OBJECTIVE OF THIS MANUAL

The objective of this manual is to show you how to program the HP 3562A over the Hewlett-Packard Interface Bus (HP-IB) using an external controller. This manual assumes you are familiar with operating the instrument from the front panel (refer to the HP 3562A Operating Manual for information on front panel features).

HOW THIS MANUAL IS ORGANIZED

This manual has three major parts:

1. **Programming Instructions** This section (Chapters 1—6) provides the HP-IB mnemonic commands for all front panel operations and explains how to use the bus-only features not available from the front panel.

2. **Introductory Programming Guide (IPG)** This programming note (Appendix A) shows you how to get started with HP-IB if you have never programmed an instrument over the bus.

3. **Quick Reference Guide (QRG)** This section (Appendix B) lists the front panel and bus-only commands alphabetically by command name and provides limits and syntax.

If you want an introduction to programming the HP 3562A over the HP-IB, first use the IPG. This explains how to get started and provides several example programs written for HP 9000 Series 200 computers with Basic 3.0. You may also want to use Chapter 2 of the programming instructions; this shows the keys and softkeys in the instrument and their HP-IB commands.

If you want to learn the instrument's HP-IB capabilities, its response to bus management commands, and its status byte/service request organization, use Chapter 1 of the programming instructions.

If you are familiar with the operation of the HP 3562A and the HP-IB in general, you can start programming using just the QRG to learn the syntax of individual commands.

If you want to use the bus-only commands to transfer data, perform special signal processing, program the display or utilize the special control commands, use Chapters 3 through 6 of the programming instructions.
How the Programming Instructions Are Organized

The programming instructions comprise Chapters 1 through 6 of this manual.

Chapter 1 "The HP 3562A and the HP-IB," describes the instrument's general HP-IB capabilities, including bus management commands and service requests (SRQs). For detailed information on programming SRQs, refer to Chapter 6.

Chapter 2 "The Front Panel Group," shows the key and softkey menu structure with all the HP-IB mnemonic commands for emulating front panel operation.

Chapter 3 "The Data Transfer Group," shows how to use the bus-only commands that transfer data traces, instrument states, coordinate transform blocks, and synthesis and curve fit tables.

Chapter 4 "The Signal Processing Group," shows how to use the bus-only commands that provide signal processing primitives.

Chapter 5 "The Display Control Group," shows how to create custom displays by directly programming the HP 3562A's vector display.

Chapter 6 "The Control and Command Group," primarily shows how to program the status byte, instrument status register, and activity status register to generate SRQs.

Notes On Using This Manual

In an effort to describe the syntax of the analyzer's commands, sample program lines are provided throughout this manual. While these were written in HP BASIC 3.0, their objective is to show how commands are implemented in general. If you are programming in another version of BASIC or another language, study the example lines and apply their solutions to your case.

If you would like complete example programs, rather than just sample lines, the IPG in Appendix A offers twelve programs written in BASIC 3.0. In addition, Appendix C provides a number of programs written in BASIC 2.0 and 3.0 that you may be able to adapt to your needs.
Model 3562A
Dynamic Signal Analyzer

WARNING

To prevent potential fire or shock hazard, do not expose equipment to rain or moisture.

Manual Part No. 03562-90031
Microfiche Part No. 03562-90231

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Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.
SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

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

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.
SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or 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.

⚡ Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).

-ground 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.

-ground. 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 this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.

-frame or 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 sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition 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.

NOTE The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.
PURPOSE OF THIS CHAPTER

The purpose of this chapter is to describe the HP-IB capabilities of the HP 3562A and explain how it interacts with the HP-IB in general. It assumes you are familiar with the operation of the HP 3562A and with HP-IB programming. The topics covered in this chapter are:

1. The HP-IB capabilities of the HP 3562A
   - Interface capabilities
   - Controller capabilities
   - Interrupts and instrument status

2. The HP 3562A's response to bus management commands

3. Overview of the HP 3562A's command set
   - Front panel group
   - Data transfer group
   - Signal processing group
   - Display group
   - Control and communication group

4. Programming hints

If you are new to HP-IB, use the Introductory Programming Guide in Appendix A to get started. This shows you how to connect an HP-IB system and provides example programs in BASIC 3.0 for HP 9000 Series 200 computers.

For general information on the HP-IB, contact your HP Sales Representative for copies of the following documents:

Tutorial Description of the Hewlett-Packard Interface Bus
Part Number 5952-0156

Condensed Description of the Hewlett-Packard Interface Bus
Part Number 59401-90030
HP-IB CAPABILITIES OF THE HP 3562A

The HP 3562A can be operated via HP-IB in two modes: as system controller or as an addressable-only device. When it is the system controller, the analyzer directs the flow of commands and data on the bus. When it is addressable-only, it responds to commands and data from the system controller. The HP 3562A also has the ability to interrupt the system controller and provide information about its internal status. This section starts by listing the interface capabilities of the analyzer, then describes its controller capabilities. The last part in this section describes the interrupt and instrument status features.

Interface Capabilities

The HP 3562A has the following interface capabilities, as defined by IEEE Standard 488-1978:

SH1    complete Source handshake
AH1    complete Acceptor handshake
T6     basic Talker; serial poll; unaddress if MLA; no Talk Only
TE0    no Extended Talker capability
L4     basic Listener; unaddress if MTA; no Listen Only
SR1    complete Service Request capability
RL1    complete Remote/Local capability
PP0    no Parallel Poll capability
DC1    complete Device Clear capability
DT1    complete Device Trigger capability
C1     system Controller capability
C2     send IFC and Take Charge Controller capability
C3     send REN Controller capability
C12    send IF messages; receive control; pass control capability
E1     open-collector drivers (250 kBytes/s maximum)

Refer to IEEE Standard 488-1978 if you need more detailed information.

Controller Capabilities

The HP 3562A’s system controller capability allows it to directly control digital plotters, access disc drives, and output HP-IB command strings. When it is the only controller in an HP-IB system, the analyzer is usually operated as the system controller. (The SYSTEM CNTRLR softkey in the HP-IB FCTN menu is active.)

When operated on the bus with another controller (a desktop computer, for example), the analyzer generally operates in addressable-only mode. (ADDRESS ONLY in the HP-IB FCTN menu is active.) When the HP 3562A needs to be in control of the bus, it can accept control from the system controller, then automatically pass control back when finished.

Refer to “Passing Control” in Chapter 6 for more information, including use of the Controller Address (CTAD) command.
Interrupt and Instrument Status Features

When the HP 3562A is in addressable-only mode, it can generate service requests (SRQs) to the system controller for two general reasons: it needs control of the bus to perform an operation or there is a change in its status that the controller might want to know about.

The HP 3562A communicates interrupt and status information primarily with its status byte. This 8-bit byte is sent in response to a serial poll and is encoded to provide a number of status indications. One of these indications is that there has been a change in the instrument's status. Specific information about this change is contained in the instrument status register. Finally, the system controller can monitor the analyzer's current activity by reading its activity status register. Together, these indicators can provide a great deal of information to the system controller. Table 1-1 shows all the status indications offered by the HP 3562A.

Table 1-1 Status Indications in the HP 3562A

<table>
<thead>
<tr>
<th>Indication</th>
<th>Status Byte</th>
<th>Instrument Status Register</th>
<th>Activity Status Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requested service</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error generated</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ready for HP-IB commands</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User SRQs</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of disc action</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of plot action</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power up</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key pressed</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various plotter &amp; disc requests</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument status change</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement pause</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto sequence pause</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of measurement</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweep point ready</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel 1 over range</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel 2 over range</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel 1 half scale</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel 2 half scale</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source fault</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference locked</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marker knob turned</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entry knob turned</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity status change</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System failure</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filling time record</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filters settling</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curve fit in progress</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missed external sample</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timed preview active</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data accepted</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting for trigger</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting for arm</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration in progress</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The status byte is read by performing a serial poll of the analyzer. The instrument status register is read by sending the IS? command. The activity status register is read by sending the AS? command. Complete information on using these, including masking, is provided in Chapter 6.
BUS MANAGEMENT COMMANDS

When the bus is in the command mode (the ATN line is true), bus management commands can be used to control interface hardware connected to the bus. This section describes the HP 3562A’s response to the primary bus commands. Your controller’s programming or interfacing manual should contain information on these commands from the controller’s perspective.

Abort I/O

This command instructs the HP 3562A to abort input or output. It is an unconditional assumption of control of the bus by the system controller. All bus activity halts and the HP 3562A becomes unaddressed. This does not, however, clear the analyzer’s HP-IB command buffer or clear any pending data input or output. The HP 3562A does not relinquish bus control when it receives this command.

BASIC example: ABORT 7

Clear Lockout & Set Local

This command instructs all instruments on the specified port to clear the local-lockout mode and return to local (front panel) operation. This command differs from the LOCAL command in that the LOCAL command addresses a specific device and does not clear the lockout mode.

BASIC example: LOCAL 7

Device Clear

The CLEAR command can affect a specific device (addressed clear) or all devices on a specified port (universal clear). This command causes the HP 3562A to clear its HP-IB command buffer; reset the SRQ bus management line (if it had been activated by the instrument); reset all status byte, instrument status and activity status masks; and abort any data input or output. This command unconditionally interrupts bus activity and gains control of the instrument. It does not, however, reset any HP 3562A parameters.

BASIC examples: CLEAR 720 (addressed clear)
CLEAR 7 (universal clear)

Local

The LOCAL command returns local (front panel) control to the HP 3562A. (When the instrument is under local control, the REMOTE front panel indicator is off, and the keyboard is enabled.) The HP-IB command buffer is not cleared by issuing this command. Any load operation in progress continues but the HP 3562A aborts dump operations in progress. (It does this if it receives any command over the bus.)

BASIC example: LOCAL 720
Local Lockout

This command disables the LOCAL front panel key of the HP 3562A. It does not change the remote/local status of the instrument; it does prevent the operator from using the LOCAL key to enable the front panel keyboard when the REMOTE command is in effect. When in remote control, LOCAL LOCKOUT secures the system from operator interference. While this command is in effect and the instrument is in remote control, the only way to return to front panel operation is by issuing the LOCAL command on the bus. If an unaddressed (universal) LOCAL command is used (e.g., LOCAL 7) LOCAL LOCKOUT is disabled and subsequent remote commands can be overridden from the front panel. If an addressed LOCAL command is used (e.g., LOCAL 720), local lockout will still be in effect when the device is later returned to remote control.

BASIC example: LOCAL LOCKOUT 7

Parallel Poll

This command and its accompanying PARALLEL POLL CONFIGURE are ignored by the HP 3562A. See SERIAL POLL.

Parallel Poll Configure

This command and its accompanying PARALLEL POLL are ignored by the HP 3562A. See SERIAL POLL.

Pass Control

This command shifts control of the bus from one controller to another. The Controller Address command, CTAD, (default = 21) should be sent prior to passing control. Not all controllers have the ability to pass control. Consult the operation manual of your controller to determine its capabilities in this respect.

If control is passed to the HP 3562A before it has a need for it, the analyzer immediately passes the control to the address specified by the Controller Address command. Refer to “Passing Control” in Chapter 6.

BASIC examples: PASS CONTROL 720 SEND 7; UNL UNT TALK 20 CMD 9

Remote

When this command is issued the front panel LED annunciator labeled “REMOTE” illuminates and the front panel keys are disabled (except the LOCAL key if local lockout is not active; if local lockout is active, even the LOCAL key is disabled). This command can be used to address the HP 3562A to listen.

BASIC examples: REMOTE 7 (universal) REMOTE 720 (addressed)
Serial Poll

The S POLL command instructs the HP 3562A to send its status byte to the controller. This action is usually taken in response to a service request (SRQ). Upon receiving the status byte, the controller should examine it to determine what type of service the analyzer requires. If your program sends multiple serial polls, pause for at least 5 ms between them.

BASIC example: Status—byte = S POLL(720)

Trigger

This command triggers measurements in the HP 3562A in the same manner as its other trigger modes. TRIGGER must first be enabled in the analyzer by sending the “HPT” command to select HP-IB triggering.

BASIC example: TRIGGER 7 (universal)
TRIGGER 720 (addressed)
THE HP 3562A’S HP-IB COMMAND SET

The HP 3562A’s command set includes the front panel keys and softkeys (with a few exceptions) plus a number of commands available only via HP-IB. The command set is divided into five groups:

<table>
<thead>
<tr>
<th>Front panel group</th>
<th>keys &amp; softkeys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transfer group</td>
<td></td>
</tr>
<tr>
<td>Signal processing group</td>
<td>bus-only commands</td>
</tr>
<tr>
<td>Display control group</td>
<td></td>
</tr>
<tr>
<td>Control/communication group</td>
<td></td>
</tr>
</tbody>
</table>

Front Panel Group

As its name implies, this group emulates the keys and softkeys on the analyzer’s front panel. A few are not programmable, however: the LINE key and the editing softkeys in the alpha mode (SPACE FORWRD, etc.). The alpha editing softkeys are not needed on the bus because you simply send the alpha string after entering it on your controller’s keyboard.

Chapter 2 provides mnemonics for the front panel group. It is alphabetized by key, with the softkeys associated with each key listed in order of appearance. Chapter 2 is designed to help you easily emulate front panel operation via HP-IB.

Data Transfer Group

This group allows you to transfer data traces and instrument states in and out of the instrument. Both traces and states can be transferred in ASCII, ASCII binary, and a fast binary mode used internally by the analyzer.

Chapter 3 explains how to use these commands, including interpreting data headers and converting data traces.

Signal Processing Group

This group provides access to the analyzer’s signal processing primitives. It allows you to set up data blocks in memory, operate on these blocks (using FFT, averaging, etc.), then transfer the blocks back to the controller or display them on the analyzer.

Chapter 4 explains how to set up blocks, get data into them, use the signal processing primitives, then get the processed data back out.
Display Control Group

This group provides control of the HP 3562A's vector display. The display can be controlled at three levels: using individual HP-GL (Hewlett-Packard Graphics Language) commands, loading an entire display from a controller, or defining the display as the plotter and using HP BASIC 3.0 graphics commands.

Chapter 5 shows how to program the display using these three approaches.

Command/Communication Group

This final group provides control and communications functions, including service requests, instrument and activity status, reading marker values, and communicating with the front panel.

Chapter 6 explains how to use these commands. It also describes the status byte, instrument status, and activity status parameters.

PROGRAMMING HINTS

1. See the beginning of Chapter 2 for emulating front panel commands.

2. Pause the controller for several seconds after sending resets or special presets if you want to send marker or math commands.

3. When programming anything on the display—especially markers—make sure that there is a valid data display first.

4. The HP 3562A can buffer up to 3 lines of 80 characters each.

5. If you request information from the analyzer (query, data transfer, etc.), allow for the information to be input to the controller immediately.

6. If AUTO CAL is ON, you will encounter long delays when the cal routine is run. This could affect your program if it contains time cuts. To avoid this, it is suggested that you send the following sequence of commands:

   AUTO 0
   RST
   SNGL

   This deactivates auto cal, then runs a single cal routine.

7. When activating external sampling (ESMP1), pause the program briefly to allow the HP 3562A to measure the external sample clock.
PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you the HP-IB commands for the HP 3562A's keys and softkeys. In addition, this chapter explains special considerations for some of the front panel commands. For syntax, entry ranges and suffixes, refer to the Quick Reference Guide in Appendix B. The rest of the commands—the "bus-only" commands—are covered in Chapters 3 through 6.

GETTING STARTED

A major difference between operating the instrument from the front panel and programming it over the HP-IB is that you do not always have to follow the softkey menu structure with the HP-IB. For example, to select the FFT math function from the front panel, you press MATH followed by NEXT, followed by NEXT, followed by FFT. Over the bus, however, you simply send the FFT command. In a few cases, a particular menu must be displayed before a command can be used. An example is CLEAR TABLE in synthesis. You need to first display the POLE ZERO, POLE RESIDU or POLYNOMIAL menu before telling the instrument to clear the table. These special cases are identified and explained in this chapter.

Another consideration when programming over the HP-IB: Several pairs of softkeys have the same name but different mnemonics. For example, to select the frequency response measurement and the frequency response display from the front panel, you press FREQ RESP in the SELECT MEAS menu and FREQ RESP in the MEAS DISP menu. Over the bus, however, you send FRSP and FRQR. The organization of this chapter by key avoids this problem entirely, and such cases in the QRG listing are explained as well.

Softkeys which toggle between two states (e.g., TIM AV ON OFF, AVG AU FIX) can be toggled using the basic mnemonic. However, to guarantee the resultant state, these commands allow you to send 0 or 1 after the mnemonic to explicitly choose one state or the other. Sending "TIAV" explicitly activates time averaging, while "TIAV" merely toggles the existing state. The results of sending 0 and 1 for each toggle softkey are explained in the Quick Reference Guide.

This chapter is organized alphabetically by the keys on the front panel. Under each key, the softkeys it accesses are displayed in order of appearance. The HP-IB mnemonic is shown beside every key and softkey. This organization lets you leverage your knowledge of front panel operation into writing controller programs. If you know the particular functions you want to program, use the Quick Reference Guide (QRG) in Appendix B, which lists all keys and softkeys in alphabetical order. The QRG also explains the syntax for all commands.

There are two more ways of learning HP-IB mnemonics for individual commands: the HELP display and the command echo. The mnemonic is shown at the top of all HELP displays, and the letters that make up the mnemonic are underlined in the command echo field on the display.
Parameter Queries

You can learn the current value of any variable parameter in the analyzer by sending the appropriate command followed by a question mark. For example, to learn the current frequency span, you could send the following BASIC statements:

```
OUTPUT 720; "FRS?"
ENTER 720; Freq—span
```

where 720 is the analyzer's address
FRS is the mnemonic for the FREQ SPAN softkey
Freq—span is the variable the value is entered into

The Alpha Menu

The softkeys in the alpha menu (SPACE FORWRD, SPACE BACKWD, INSERT ON OFF, DELETE CHAR, CLEAR LINE, AT POINTR, OVER WRITE, and CANCEL ALPHA) are not programmable over the HP-IB. When you need to send alpha characters, simply include them with the commands. The Quick Reference Guide (Appendix B) shows the syntax for every command requiring alpha entries.

```
A
A&B
ARM
AUTO MATH
```

```
EDIT MATH
VIEW MATH
START MATH
LABEL MATH
EDIT LINE#
DELETE LINE
CHANGE LINE
ADD LINE
CLEAR MATH
END EDIT
```

```
(EDMA)
(VWMA)
(STMA)
(LBLM)
(LINE)
(DLTL)
(CHGL)
(ADDL)
(CLMA)
(ENED)
```

1The EDIT MATH menu must be displayed before these commands can be used.

2When ADDL or CHGL is sent, the analyzer stays in the add line or change line mode, respectively. All subsequent commands until ENED (END EDIT) are added or changed.
AUTO SEQ

(ASEQ)

START ASEQ1  (ASQ1)\(^3\)
START ASEQ2  (ASQ2)\(^2\)
START ASEQ3  (ASQ3)\(^2\)
START ASEQ4  (ASQ4)\(^2\)
START ASEQ5  (ASQ5)\(^2\)
PAUSE ASEQ   (PSAS)
CONT ASEQ    (CNAS)
SELECT ASEQ# (SASQ)

EDIT       (EDIT)
VIEW       (VIEW)

LABEL ASEQ  (LBLA)\(^1\)
EDIT LINE#  (LINE)\(^1\)
DELETE LINE (DLTL)\(^1\)
CHANGE LINE (CHGL)\(^1,2\)
ADD LINE    (ADDL)\(^1,2\)
CLEAR ASEQ  (CLAS)\(^1\)
ASEQ FCTN   (ASFN)\(^1\)
END EDIT    (ENED)\(^1\)

LOOP TO    (LPTO)
GO TO      (GOTO)
ASEQ MESSGE (ASMS)
TIMED PAUSE (TIPS)
TIMED START (TIST)
DISPLAY ON OFF (DSPL)
RETURN     (RTN)

\(^1\)The EDIT menu must be displayed before these commands can be used.

\(^2\)When ADDL or CHGL is sent, the analyzer stays in the add line or change line mode, respectively. All subsequent commands until ENED (END EDIT) are added or changed.

\(^3\)The mnemonics for these are always ASQ1-5, even when the labels are replaced by user-defined labels.
### AVG

**linear res mode**

<table>
<thead>
<tr>
<th>Command</th>
<th>Abbreviation</th>
</tr>
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<tbody>
<tr>
<td>NUMBER AVGS</td>
<td>NAVG</td>
</tr>
<tr>
<td>AVG OFF</td>
<td>AVOF</td>
</tr>
<tr>
<td>STABLE (MEAN)</td>
<td>STBL</td>
</tr>
<tr>
<td>EXPON</td>
<td>EXP</td>
</tr>
<tr>
<td>PEAK HOLD</td>
<td>PHLD</td>
</tr>
<tr>
<td>CONT PEAK</td>
<td>CNPK</td>
</tr>
<tr>
<td>TIM AV ON OFF</td>
<td>TIAV</td>
</tr>
<tr>
<td>NEXT</td>
<td>NX</td>
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**log res mode**

<table>
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<th>Command</th>
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<tr>
<td>NUMBER AVGS</td>
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</tr>
<tr>
<td>AVG OFF</td>
<td>AVOF</td>
</tr>
<tr>
<td>STABLE (MEAN)</td>
<td>STBL</td>
</tr>
<tr>
<td>EXPON</td>
<td>EXP</td>
</tr>
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<td>PEAK HOLD</td>
<td>PHLD</td>
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<td>CONT PEAK</td>
<td>CNPK</td>
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<td>NEXT</td>
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**swept sine mode**

<table>
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<tr>
<td>AUTO INTGRT</td>
<td>AUINT</td>
</tr>
<tr>
<td>FIXED INTGRT</td>
<td>FXIN</td>
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<tr>
<td>INTGRT TIME</td>
<td>INTM</td>
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**time capture mode**

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<th>Abbreviation</th>
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<tbody>
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<tr>
<td>AUTO INTGRT</td>
<td>AUINT</td>
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<td>FIXED INTGRT</td>
<td>FXIN</td>
</tr>
<tr>
<td>INTGRT TIME</td>
<td>INTM</td>
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</table>

---

1Use ACPT for YES and REJT for NO when previewing over the bus.

### B

<table>
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<tbody>
<tr>
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### CAL

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### COORD

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<tr>
<td>MAG (LOG)</td>
<td>MGLG</td>
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<tr>
<td>MAG (LIN)</td>
<td>MAG</td>
</tr>
<tr>
<td>PHASE</td>
<td>PHSE</td>
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<tr>
<td>REAL</td>
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<tr>
<td>IMAG</td>
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<tr>
<td>NEXT</td>
<td>NEXT</td>
</tr>
</tbody>
</table>
NYGUST  (NYQT)
NICHOL  (NICL)
LOG X    (LOGX)
LIN X    (LINX)
RETURN   (RTN)

CURVE FIT  (CVFT)
CREATE FIT (CRFT)
STOP FIT   (SPFT)
NUMBER POLES (NPOL)
NUMBER ZEROS (NZER)
LAST MEAS  (LSMS)
A & B TRACES (ABTR)
EDIT TABLE (EDTB)
FIT FCNT   (FTFN)

EDIT POLES (EPOL)
EDIT ZEROS (EZER)
FIX LINE# (FXLN)
UNFIX LINE# (UFLN)
ADD LINE   (ADLN)
DELETE LINE# (DLLN)
TABLE FCNT (TBFN)
RETURN   (RTN)

TIME DELAY (TMDL)
SCALE FREQ (SCLF)
CLEAR TABLE (CLTA)
RETURN   (RTN)

USER WEIGHT (USWT)
AUTO WEIGHT (AUWT)
USER ORDER (USOR)
AUTO ORDER (AUOR)
FIT → SYNTH (FTSN)
SYNTH → FIT (SNFT)
EDIT WEIGHT (EDWT)
RETURN   (RTN)

VIEW WEIGHT (VWWT)
WEIGHT REGION (WTRG)
WEIGHT VALUE (WTVL)
STORE WEIGHT (STWT)
RETURN   (RTN)
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<td>RECALL FILE</td>
<td>(RCLF)</td>
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<td>DELETE FILE</td>
<td>(DLTF)</td>
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<td>VIEW CATLOG</td>
<td>(CAT)</td>
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<td>NEXT PAGE</td>
<td>(NXTP)</td>
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<tr>
<td>PREV PAGE</td>
<td>(PRVP)</td>
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<tr>
<td>CATLOG POINTR</td>
<td>(CTPT)</td>
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<td>DISC FCTN</td>
<td>(DIFn)</td>
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<td>SERVICE FCTNS</td>
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<td>DISC COPY</td>
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<td>FORMAT</td>
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<td>CREATE THRUPT</td>
<td>(CRTH)</td>
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<td>ABORT HP-IB</td>
<td>(ABIB)</td>
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<tr>
<td>RETURN</td>
<td>(RTN)</td>
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<td>FORMAT OPTION</td>
<td>(FOOP)</td>
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<td>INIT DISC</td>
<td>(INDI)</td>
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<tr>
<td>INIT CATLOG</td>
<td>(INCT)</td>
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<tr>
<td>RETURN</td>
<td>(RTN)</td>
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<td>(DEUN)</td>
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<td>COPY FILES</td>
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<td>OVERWR AU MAN</td>
<td>(OVAU)</td>
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<td>RESUME OVERWR</td>
<td>(RSOV)</td>
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<td>RESUME COPY</td>
<td>(RSCO)</td>
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<td>RETURN</td>
<td>(RTN)</td>
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<tr>
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<td>RO ERT TEST</td>
<td>(RERT)</td>
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<td>OUTPUT LOG</td>
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<td>(NXPG)</td>
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<td>CLEAR LOGS</td>
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<td>DISC STATUS</td>
<td>(DIST)</td>
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<td>SPARE BLOCK</td>
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<tr>
<td>RETURN</td>
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<td>FAULT LOG</td>
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<td>ERT LOG</td>
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<tr>
<td>RUN TM LOG</td>
<td>(RULG)</td>
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<tr>
<td>RETURN</td>
<td>(RTN)</td>
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</tbody>
</table>
ENGR UNITS

(ENGR)

EU VAL CHAN1 (EUV1)
VOLTS CHAN1 (VLT1)
EU LBL CHAN1 (EUL1)
EU VAL CHAN2 (EUV2)
VOLTS CHAN2 (VLT2)
EU LBL CHAN2 (EUL2)

FREQ

(FREQ)

(linear res & time capture modes) (log res mode)

FREQ SPAN (FRS) FREQ SPAN (FRS)
START FREQ (SF) START FREQ (SF)
CENTER FREQ (CF) MAX SPAN (MAXS)
ZERO START (ZST) TIME LENGTH (TLN)
MAX SPAN (MAXS) TIME LENGTH (TLN)
TIME LENGTH (TLN) E SMPL ON OFF (ESMP)
SAMPLE FREQ (SMPI) SAMPLE FREQ (SMPI)

(swept sine mode)

FREQ SPAN (FRS) FREQ SPAN (FRS)
CENTER FREQ (CF) CENTER FREQ (CF)
START FREQ (SF) START FREQ (SF)
STOP FREQ (SPF) STOP FREQ (SPF)
RESLTN (RES) RESLTN (RES)
RESLTN AU FIX (RSAU) RESLTN AU FIX (RSAU)
SWEEP RATE (SWRT)1 SWEEP RATE (SWRT)1

1 Same as SWEEP RATE in SOURCE menu.

FRONT BACK

(FRBK)

HP-IB FCTN

(IBFN)

SYSTEM CNTRLR (SYSC)
ADDRES ONLY (ADRS)
SELECT ADDRESS (SADR)
USER SQN (USRQ)
OUTPUT STRING (OUT)1
ABORT HP-IB (ABIB)2

1 This is programmable over the bus only when entering output strings into an auto sequence. OUTPUT STRING cannot be executed immediately because the HP 3562A must be the system controller to use this function.
2 Same as ABORT HP-IB in the USER LIMITS menu.
Chapter 2—The Front Panel Commands

INPUT COUPLE to MATH

USER SRQ1 (SRQ1)
USER SRQ2 (SRQ2)
USER SRQ3 (SRQ3)
USER SRQ4 (SRQ4)
USER SRQ5 (SRQ5)
USER SRQ6 (SRQ6)
USER SRQ7 (SRQ7)
USER SRQ8 (SRQ8)

HP-IB ADDRESS (IBAD)
PLOT ADDRESS (PLAD)
DISC ADDRESS (DIAD)
DISC UNIT (DIUN)
RETURN (RTN)

INPUT COUPLE (ICPL)

CHAN1 AC DC (C1AC)
CHAN2 AC DC (C2AC)
FLOAT CHAN1 (FLT1)
GROUND CHAN1 (GND1)
FLOAT CHAN2 (FLT2)
GROUND CHAN2 (GND2)

LOCAL (LCL)

MATH (MATH)

ADD (ADD)
SUB (SUB)
MPY (MPY)
DIV (DIV)
SQUARE ROOT (SQRT)
RECIP (RCP)
NEGATE (NEG)
NEXT (NXT)

DIFF (DIFF)
jw (JW)
INTGRT (INGR)
INTGRT INIT = 0 (INGI)
3jw (JW1)
T1—T (TT)
NEXT (NEX)
RETURN (RTN)

REAL PART (RLPT)
COMPLEX CONJ (CMPC)
LN OF DATA (LN)
LN-1 OF DATA (LN1)
FFT (FFT)
FFT-1 (FFT1)
RETURN (RTN)
### MEAS DISP

<table>
<thead>
<tr>
<th>Linear Res Mode</th>
<th>Linear Res Mode</th>
<th>Linear Res Mode</th>
<th>Linear Res Mode</th>
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</thead>
<tbody>
<tr>
<td>FREQ RESP</td>
<td>POWER SPEC1</td>
<td>AUTO MATH</td>
<td>HIST1</td>
</tr>
<tr>
<td>COHER</td>
<td>COHR</td>
<td>AUTO CORR2</td>
<td>HIST2</td>
</tr>
<tr>
<td>POWER SPEC1</td>
<td>PSP1</td>
<td>AUTO MATH</td>
<td>PDF1</td>
</tr>
<tr>
<td>POWER SPEC2</td>
<td>PSP2</td>
<td>FILTERD INPUT</td>
<td>PDF2</td>
</tr>
<tr>
<td>CROSS SPEC</td>
<td>CSPC</td>
<td>FILTERD INPUT</td>
<td>CDF1</td>
</tr>
<tr>
<td>IMPLS RESP</td>
<td>RSP</td>
<td>FILTERD INPUT</td>
<td>CDF2</td>
</tr>
<tr>
<td>AUTO MATH</td>
<td>AUMT</td>
<td>FILTERD INPUT</td>
<td>AUTO MATH</td>
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<td>FILT</td>
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### MEAS DISP

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<td>CRCR</td>
<td>FILTERD INPUT</td>
<td>TIME REC 1</td>
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<tr>
<td>AUTO CORR1</td>
<td>AUC1</td>
<td>FILTERD INPUT</td>
<td>TIME REC 2</td>
</tr>
<tr>
<td>AUTO CORR2</td>
<td>AUC2</td>
<td>FILTERD INPUT</td>
<td>LINEAR SPEC1</td>
</tr>
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<td>AUTO MATH</td>
<td>AUMT</td>
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<td>LINEAR SPEC2</td>
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<tr>
<td>FILTERD INPUT</td>
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### MEAS DISP

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<td>TIME REC 1</td>
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<tr>
<td>HIST2</td>
<td>(HIS2)</td>
<td>TIME REC 2</td>
</tr>
<tr>
<td>PDF1</td>
<td>(PDF1)</td>
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<td>PDF2</td>
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<td>LINEAR SPEC2</td>
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<td>CDF1</td>
<td>(CDF1)</td>
<td>ORBITS T1vsT2</td>
</tr>
<tr>
<td>CDF2</td>
<td>(CDF2)</td>
<td>DEMOD POLAR</td>
</tr>
<tr>
<td>AUTO MATH</td>
<td>(AUMT)</td>
<td>INST</td>
</tr>
<tr>
<td>FILTERD INPUT</td>
<td>(FILT)</td>
<td>INST WINDOWD</td>
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### MEAS DISP

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<td>INST</td>
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<td>AUTO MATH</td>
<td>(AUMT)</td>
<td>INST WINDOWD</td>
<td>AVGREG</td>
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<td>FILTERD INPUT</td>
<td>(FILT)</td>
<td>RETURN</td>
<td>(RTN)</td>
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<tr>
<td>(log res mode) freq resp measurement</td>
<td>(log res mode) power spec measurement</td>
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<td>-------------------------------------</td>
<td>--------------------------------------</td>
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<tr>
<td>FREQ RESP (FRQR)</td>
<td>POWER SPEC1 (PSP1)</td>
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<td>COHER (COHR)</td>
<td>POWER SPEC2 (PSP2)</td>
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<td>AUTO MATH (AUMT)</td>
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<tr>
<td>POWER SPEC2 (PSP2)</td>
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<td>CROSS SPEC (CSPC)</td>
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</table>

| (swept sine mode)                  |                                       |
| FREQ RESP (FRQR)                   |                                       |
| COHER (COHR)                       |                                       |
| POWER SPEC1 (PSP1)                 |                                       |
| POWER SPEC2 (PSP2)                 |                                       |
| CROSS SPEC (CSPC)                  |                                       |
| AUTO MATH (AUMT)                   |                                       |

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<th>(time capture mode) histogram measurement</th>
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<tbody>
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<td>HIST1 (HIS1)</td>
</tr>
<tr>
<td>POWER SPEC2 (PSP2)</td>
<td>HIST2 (HIS2)</td>
</tr>
<tr>
<td>FILTRD INPUT (FILT)</td>
<td>PDF1 (PDF1)</td>
</tr>
<tr>
<td></td>
<td>PDF2 (PDF2)</td>
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<tr>
<td></td>
<td>CDF1 (CDF1)</td>
</tr>
<tr>
<td></td>
<td>CDF2 (CDF2)</td>
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<td>FILTRD INPUT (FILT)</td>
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<th>(all time capture)</th>
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<td>TIME REC1 (TMR1)</td>
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<tr>
<td>AUTO CORR2 (AUC2)</td>
<td>TIME REC2 (TMR2)</td>
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<td>FILTRD INPUT (FILT)</td>
<td>LINEAR SPEC1 (LSP1)</td>
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<tr>
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<td>LINEAR SPEC2 (LSP2)</td>
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<td>INST (INST)</td>
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<td>AVRG (AVRG3)</td>
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<td>RETURN (RTN)</td>
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**MEAS MODE**

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<th>Code</th>
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<td>LOG RES</td>
<td>LGRS</td>
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<td>SSSN</td>
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<tr>
<td>TIME CAPTUR</td>
<td>CPTR</td>
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<tr>
<td>CAPTUR SELECT</td>
<td>CPSE</td>
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<tr>
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<td>THRU</td>
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<td>RFC1</td>
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<td>RFC2</td>
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<tr>
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<td>ABCP</td>
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<td>CPNT</td>
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<tr>
<td>POINTR INCRMT</td>
<td>PTIN</td>
</tr>
<tr>
<td>CAPTUR LENGTH</td>
<td>CLEN</td>
</tr>
<tr>
<td>CAPTUR HEADER</td>
<td>CHED</td>
</tr>
<tr>
<td>RETURN</td>
<td>RTN</td>
</tr>
<tr>
<td>START THRPT</td>
<td>STHR</td>
</tr>
<tr>
<td>ABORT THRPT</td>
<td>ABTH</td>
</tr>
<tr>
<td>ACTIVE FILE</td>
<td>ACFL</td>
</tr>
<tr>
<td>THRPT LENGTH</td>
<td>THLN</td>
</tr>
<tr>
<td>THRPT HEADER</td>
<td>THED</td>
</tr>
<tr>
<td>RETURN</td>
<td>RTN</td>
</tr>
<tr>
<td>DEMOD CHAN1</td>
<td>DM1</td>
</tr>
<tr>
<td>DEMOD CHAN2</td>
<td>DM2</td>
</tr>
<tr>
<td>DEMOD BOTH</td>
<td>DMB</td>
</tr>
<tr>
<td>PVVIEW ON OFF</td>
<td>PRON</td>
</tr>
<tr>
<td>PM/FM CARRIER</td>
<td>PFCR</td>
</tr>
<tr>
<td>DELETE FREQ</td>
<td>DLFR</td>
</tr>
<tr>
<td>DELETE ON OFF</td>
<td>DLON</td>
</tr>
<tr>
<td>RETURN</td>
<td>RTN</td>
</tr>
</tbody>
</table>
AM CHAN1 (AM1)
FM CHAN1 (FM1)
PM CHAN1 (PM1)
AM CHAN2 (AM2)
FM CHAN2 (FM2)
PM CHAN2 (PM2)
RETURN (RTN)

AUTO CARRIER (ACRR)
USER CARRIER (UCRR)
EDIT LINE# (EDLN)
DELET REGION (DLRG)
CHANGE REGION (CHRGL)
ADD REGION (ADRG)
CLEAR TABLE (CLRT)
RETURN (RTN)

^The DELETE FREQ menu must be displayed before this command can be used.

PAUSE CONT (PSCN)

^PSCN switches back and forth between pause and continue. PAUS explicitly pauses, and
CONT explicitly continues, regardless of the key's previous state. To be certain of the resulting
state, use PAUS or CONT over the bus.

PLOT (PLOT)

START PLOT (STPL)
SELECT DATA (SDAT)
SELECT PENS (SPEN)
SPEED FS (SPED)
LINE TYPES (LNTP)
PAGING CONTRL (PCTL)
PLOT LIMITS (PLIM)
PLOT PRESET (PLPR)

DATA ONLY (DATA)
DATA & ANNOT (DAAN)
DEFAULT GRIDS (DFGR)
SOLID GRIDS (SLGR)
TICK MARKS (TKMK)
RETURN (RTN)

GRID PEN (GRDP)
TRACE A PEN (TRAP)
TRACE B PEN (TRBP)
ANNOT A PEN (ANAP)
ANNOT B PEN (ANBP)
MARKER PEN (MKRP)
RETURN (RTN)
SOLID LINES (SLDL)
DASHED LINES (DSHL)
DOTS (DOTS)
SOLIDA DASH B (SLDA)
USER LINES (ULIN)
LINE A TYPE# (LINA)
LINE B TYPE# (LINB)
RETURN (RTN)

PAGE FORWRD (PGFW)
PAGE BACKWD (PGBK)
NO PAGING (NOPG)
CUT PG ON OFF (CTPG)
RETURN (RTN)

PLOT AREA (PLAR)
GRID AREA (GRAR)
DEFAULT LIMITS (DLIM)
USER LIMITS (ULIM)
ROT 90 ON OFF (ROT)

SET P1 LWR LF (SEP1)
SET P2 UPR RT (SEP2)
READ PEN→P1 (RDP1)
READ PEN→P2 (RDP2)
ABORT HP-IB (ABIB)¹
RETURN (RTN)

¹Same as ABORT HP-IB in the HP-IB FCTN menus.

PRESET (PRST)

F RESP LINRES (FRLN)
F RESP LOGRES (FRLG)
F RESP SWEPT (FRSW)
P SPEC LINRES (PSLN)
TIME CAPTUR (TMCP)
TIME THR UPT (THTH)
RESET (RST)

RANGE (RNG)

CHAN 1 RANGE (CIRG)
AUTO 1 RNG UP (AU1U)
AUTO 1 UP&DWN (AU1)
CHAN 2 RANGE (C2RG)
AUTO 2 RNG UP (AU2U)
AUTO 2 UP&DWN (AU2)
SAVE RECALL
(SAVR)

RECALL PWR DN   (RCLP)
RECALL STATE#   (RCLS)
SAVE STATE#     (SAVS)
RECALL DATA#    (RCLD)
SAVE DATA#      (SAVD)

SCALE
(SCAL)

X FIXD SCALE    (XSCL)
X MRKR SCALE    (XMKR)
X AUTO SCALE    (XASC)
Y FIXD SCALE    (YSCL)
Y MRKR SCALE    (YMKR)
Y AUTO SCALE    (YASC)
Y DFLT SCALE    (YDSC)

1Same as corresponding softkey in the X menu.
2Same as corresponding softkey in the Y menu.

SELECT MEAS
(SMES)

(linear res mode) (log res mode)

FREQ RESP       (FRSP)
POWER SPEC      (PSPC)
AUTO CORR       (AUCR)
CROSS CORR      (CCOR)
HIST            (HIST)
CH 1&2 ACTIVE   (CH12)
CH 1 ACTIVE     (CH1)
CH 2 ACTIVE     (CH2)

(swept sine mode) (time capture mode)

FREQ RESP       (FRSP)
POWER SPEC      (PSPC)
AUTO CORR       (AUCR)
HIST            (HIST)
CH 1 ACTIVE     (CH1)
CH 2 ACTIVE     (CH2)

SELECT TRIG
(SELT)

TRIG LEVEL      (TRLV)
ARM AU MAN      (ARMA)
FREE RUN        (FREE)
CHAN 1 INPUT    (C1IN)
CHAN 2 INPUT    (C2IN)
SOURCE TRIG     (SRTG)
EXT             (EXT)
SLOPE + -       (SLOP)
SINGLE  (SNGL)

SOURCE  (SRCE)

(linear res & time capture modes)

SOURCE LEVEL  (SRLV)
DC OFFSET  (DCOF)
SOURCE OFF  (SROF)
RANDOM NOISE  (RND)
BURST RANDOM  (BRND)
PRIODC CHIRP  (PCRP)
BURST CHIRP  (BCPR)
FIXED SINE  (FSIN)

(log res mode)  (swept sine mode)

SOURCE LEVEL  (SRLV)  SOURCE LEVEL  (SRLV)
DC OFFSET  (DCOF)  DC OFFSET  (DCOF)
SOURCE OFF  (SROF)  SOURCE ON OFF  (SRONI)
RANDOM NOISE  (RND)  SWEEP UP  (SWUP)
FIXED SINE  (FSIN)  SWEEP DOWN  (SWDN)
                     SWEEP HOLD  (SWHD)
                     MANUAL SWEEP  (MNSW)
                     SWEEP RATE  (SWRT) \(^1\)

\(^1\)Same as SWEEP RATE in the FREQ menu.

SPCL FCTN  (SPFN)

SELF TEST  (TST)
SERVIC TEST  (SVTS)
TIME H, M, S  (TIME)
DATE M, D, Y  (DATE)
BEEP ON OFF  (BEEP)
SOURCE PROTCT  (SRPT)
PwrSRQ ON OFF  (PSRQ)

PROTCT ON OFF  (PTON)
RAMP TIME  (RAMP)
RETURN  (RTN)
SPCL MARKER

<table>
<thead>
<tr>
<th>Command</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>X FCTN OFF</td>
<td>XFOF</td>
</tr>
<tr>
<td>HMNC ON</td>
<td>HMNC</td>
</tr>
<tr>
<td>SBAND ON</td>
<td>SBND</td>
</tr>
<tr>
<td>SLOPE</td>
<td>SLP</td>
</tr>
<tr>
<td>FREQ &amp; DAMP</td>
<td>FRDA</td>
</tr>
<tr>
<td>POWER</td>
<td>PWR</td>
</tr>
<tr>
<td>MRKR→PEAK</td>
<td>MKPK</td>
</tr>
<tr>
<td>AVG VALUE</td>
<td>AVGV</td>
</tr>
<tr>
<td>CARRIER FREQ</td>
<td>CRFR</td>
</tr>
<tr>
<td>SBAND INCRMT</td>
<td>SBIN</td>
</tr>
<tr>
<td>MOD INDEX</td>
<td>MIND</td>
</tr>
<tr>
<td>SBAND POWER</td>
<td>SPWR</td>
</tr>
<tr>
<td>CALC OFF</td>
<td>CLOF</td>
</tr>
<tr>
<td>RETURN</td>
<td>RTN</td>
</tr>
</tbody>
</table>

FNDMTL FREQ
HMNC POWER
THD
CALC OFF
RETURN

START

<table>
<thead>
<tr>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRT</td>
</tr>
</tbody>
</table>

STATE TRACE

<table>
<thead>
<tr>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>STTR</td>
</tr>
</tbody>
</table>

\(^1\)STTR switches back and forth between state and trace. STAT explicitly displays the state, and TRAC explicitly displays the trace(s). To be certain of the resulting condition, use STAT and TRAC over the bus.
SYNTH

POLE ZERO (PZRO)
POLE RESIDU (PRSD)
POLY NOMIAL (POLY)
CONVRT TABLE (CVTB)
CREATE CONST (CCON)
CREATE TRACE (CTRC)

TO→POL ZERO (TOPZ)
TO→POL RESIDU (TOPR)
TO→POLY (TOPY)

EDIT POLE# (EDPL)\textsuperscript{1,2}
EDIT ZERO# (EDZR)\textsuperscript{1}
EDIT RESIDU# (EDRS)\textsuperscript{2}
EDIT NUMER# (EDNM)\textsuperscript{3}
EDIT DENOM# (EDDN)\textsuperscript{3}
DELETE VALUE (DLTV)
CHANGE VALUE (CHGV)
ADD VALUE (ADDV)
SYNTH FCTN (SNFN)
CLEAR TABLE (CLTB)
RETURN (RTN)

GAIN FACTOR (GAIN)
TIME DELAY (TDLY)
SCALE FREQ (SCFR)
RETURN (RTN)

\textsuperscript{1} POLE ZERO menu must be displayed before these commands can be used.
\textsuperscript{2} POLE RESIDU menu must be displayed before these commands can be used.
\textsuperscript{3} POLY NOMIAL menu must be displayed before these commands can be used.

TRIG DELAY

CHAN1 DELAY (C1DL)
CHAN2 DELAY (C2DL)
Chapter 2 — The Front Panel Commands

UNITS to UPPER LOWER

UNITS

<table>
<thead>
<tr>
<th>Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>L SPEC UNITS</td>
<td>(LSUN)</td>
</tr>
<tr>
<td>P SPEC UNITS</td>
<td>(PSUN)</td>
</tr>
<tr>
<td>SWEPT UNITS</td>
<td>(SWUN)</td>
</tr>
<tr>
<td>Hz (Sec)</td>
<td>(HZS)</td>
</tr>
<tr>
<td>RPM (Sec)</td>
<td>(RPMS)</td>
</tr>
<tr>
<td>Orders (Revs)</td>
<td>(ORDR)</td>
</tr>
<tr>
<td>Orders CAL</td>
<td>(ORCL)</td>
</tr>
<tr>
<td>TRACE TITLE</td>
<td>(TITL)</td>
</tr>
</tbody>
</table>

VOLTS PEAK    (VTPK)
VOLTS RMS    (VTRM)
VOLTS        (VLTS)
VOLTS²       (VT2)
RETURN       (RTN)

VOLTS PEAK    (VTPK)
VOLTS RMS    (VTRM)
VOLTS        (VLTS)
VOLTS²       (VT2)
V/√Hz (√PSD) (VHZ)
V²/Hz (PSD)  (V2HZ)
V²/s/Hz (ESD) (V2SH)
RETURN       (RTN)

VOLTS PEAK    (VTPK)
VOLTS RMS    (VTRM)
RETURN       (RTN)

¹Appropriate menu (L SPEC UNITS, P SPEC UNITS or SWEPT UNITS) must be displayed before these commands can be used. It is recommended that you always send the first level menu command before the second level command. For example, PSUN; VTPK for VOLTS PEAK in the P SPEC UNITS menu.

UPPER LOWER (UPLO)
VIEW INPUT

(linear res, log res
& swept sine modes)

INPUT TIME 1 (ITM1)
INPUT TIME 2 (ITM2)
INPUT SPEC 1 (ISP1)
INPUT SPEC 2 (ISP2)
VIEW OFF (VWOF)

(time capture mode)

INPUT TIME 1 (ITM1)
INPUT TIME 2 (ITM2)
INPUT SPEC 1 (ISP1)
INPUT SPEC 2 (ISP2)
TIME RECORD (TMRC)
LINEAR SPEC (LSPC)
TIME BUFFER (TMBF)
VIEW OFF (VWOF)

(time throughput active)

INPUT TIME 1 (ITM1)
INPUT TIME 2 (ITM2)
INPUT SPEC 1 (ISP1)
INPUT SPEC 2 (ISP2)
THRUPUT TIME 1 (THT1)
THRUPUT TIME 2 (THT2)
NEXT RECORD (NXRC)
VIEW OFF (VWOF)

WINDOW

HANN (HANN)
FLAT TOP (FLAT)
UNIFRM (NONE) (UNIF)
FORCE EXPON (FOXp)
USER SAVD1 (USD1)

FORCE CHAN1 (FRC1)
EXPN CHAN1 (XPN1)
FORCE CHAN2 (FRC2)
EXPN CHAN2 (XPN2)

X

X VALUE (XVAL)
X MRKR SCALE (XMKR)\(^1\)
X AUTO SCALE (XASC)\(^1\)
SCROLL ON OFF (SCRL)
HOLD X CENTER (HXCT)
HOLD X RIGHT (HXRT)
HOLD X LEFT (HXLF)
HOLD X OFF (HXOF)

\(^1\)Same as corresponding softkey in the SCALE menu.
Chapter 2—The Front Panel Commands

X OFF to Y OFF

X OFF  (XOFF)

Y  (Y)

Y VALUE  (YVAL)
Y MRKR SCALE  (YMKR)¹
Y AUTO SCALE  (YASC)¹
Y DEFAULT SCALE  (YDSC)¹
HOLD Y CENTER  (HYCT)
HOLD Y UPPER  (HYUP)
HOLD Y LOWER  (HYLW)
HOLD Y OFF  (HYOF)

¹Same as corresponding softkey in the SCALE menu.

Y OFF  (YOFF)
THE DATA TRANSFER GROUP

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you how to perform data block transfers between a controller and the HP 3562A. The following topics are addressed:

1. Data formats offered by the HP 3562A
2. Loading/dumping data traces
3. Loading/dumping instrument states
4. Dumping the coordinate transform block
5. Loading/dumping the synthesis table
6. Accessing capture and throughput files on disc

This chapter deals only with these data block transfers. For display buffer transfers, see Chapter 5. For signal processing primitive block transfers, see Chapter 4. Note: ANSI and ASCII transfers cannot be performed while the HP 3562A is in auto sequence edit.
THREE DATA FORMATS

The HP 3562A offers three data formats for transferring data via HP-IB: ASCII, ANSI floating point binary, and a non-standard binary used internally by the instrument. All three formats are provided to better address the needs of specific instrument/controller operations.

Every data transfer requires a format specifier, a length word, a header, and data. In some cases there is no header, and in others there is no data. But in general, these four items are required. The format specifier and length word depend on the data format; these are discussed separately in the following descriptions of data formats. The header and data depend on the type of data (e.g., data trace) being transferred; these are discussed throughout this chapter with each type of transfer.

NOTE

This section compares relative speeds of the three data transfer formats. This is done for comparison purposes only. No guarantees of actual transfer rates are expressed or implied. Transfer rates are highly dependent on system configuration, instrument state, controller, language, and programming.

Each data format offers unique advantages; the choice depends on speed requirements, data being transferred, and ability to handle each format. The ASCII format is the slowest of the three, but it is a commonly used standard format. The ANSI floating point format is relatively fast and is a standard format compatible with many controllers. Internal binary is the fastest data transfer format offered by the HP 3562A.

ASCII Data Format

The ASCII (American national Standard Code for Information Interchange) format is a common data communication code which uses 8-bit bytes to represent single characters. The transfer rate for this format is the slowest of the three because ASCII requires many more bytes per number, as compared to ANSI and internal binary. Also, the HP 3562A's internal processor must take the time to convert data between the binary format it uses to the ASCII data format before dumping and after loading.

The format specifier for ASCII data is #I, and the length word following this shows the number of variables to be transferred. Refer to "HP 3562A Internal Binary Format" for an explanation of the conversion of header information to ASCII.
ANSI Floating Point Format

The ANSI binary data format is the 64-bit floating point binary data format specified by IEEE draft standard P754 and used by HP Series 200 and other computer/controllers. This format is faster than the ASCII format because fewer bytes are required to specify a number to a given number of decimal places. It is a standard format used by many controllers and, therefore, saves controller time if the data block is to be processed outside the instrument. Table 3-1 shows the bit arrangement of ANSI floating point.

<table>
<thead>
<tr>
<th>Bit 15</th>
<th>Bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
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<tr>
<td>M</td>
<td>M</td>
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<td>M</td>
<td>M</td>
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<td>M</td>
<td>M</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
</tr>
</tbody>
</table>

where S is sign bit
E is biased exponent (+1023)
M is mantissa

Table 3-1 ANSI Floating Point Format

The format specifier for ANSI data is #A, and the length word following this shows the number of bytes to be transferred. Refer to "HP 3562A Internal Binary Format" for an explanation of the conversion of header information to ASCII.

HP 3562A Internal Binary Format

The internal binary format consists of several data types combined in each transfer to maximize transfer rates. This format is faster than ASCII or ANSI because no conversion is required in the analyzer and fewer bytes are transferred. The following data types are used with internal binary:

- 64-bit floating point ("long real")
- 32-bit floating point ("real")
- 32-bit integer ("long integer")
- 16-bit integer ("integer")
- String

Data transfers are always in 32-bit floating point when using internal binary format. Header information, including instrument state, is a combination of all five types. The explanations of each transfer later in this chapter list the data type for each variable. The following paragraphs describe these five internal binary data types.
64-bit Floating Point Data Type (‘Long Real’)

\[ \text{FF} \ldots \text{FF} \quad \text{FF} \ldots \text{FF} \quad \text{FF} \ldots \text{FF} \quad \text{FF} \ldots \text{EE} \]

where:  
- F is the intermediate fractional bit of the mantissa in two’s-complement form with a binary point between the most significant (sign) bit and the next bit and the mantissa is normalized.
- E is the exponent part in two’s-complement integer format.

This format does not allow the first two bits to be identical (i.e., both 0 or both 1) unless the number represented is zero. A non-zero mantissa always describes a fraction F, where \( 0.5 \leq F < 1 \) or \( -0.5 \geq F \geq -1 \).

The 64-bit floating point data type is used infrequently in headers. For ASCII and ANSI transfers, each internal 64-bit value is converted to one 64-bit ANSI value.

32-bit Floating Point Data Type (‘Real’)

\[ \text{FF} \ldots \text{FF} \quad \text{FF} \ldots \text{FF} \quad \text{FF} \ldots \text{EE} \]

Refer to the 64-bit description for explanations of E and F. The 32-bit floating point data type is used for both data and header transfers. For ASCII and ANSI transfers, each internal 32-bit value is converted to one 64-bit value in ANSI format.

32-Bit Integer Data Type (‘Long Integer’)

This data type consists of 32-bit integers in two’s complement format. This type is used infrequently in headers. For ASCII and ANSI transfers, each 32-bit internal integer is converted to two 16-bit integers (high word, low word), each of which is then converted to 64-bit ANSI floating point format.

16-Bit Integer Data Type (‘Integer’)

This data type consists of 16-bit integers in two’s complement format. This type is used extensively in headers for Boolean and enumerated values. For ASCII and ANSI transfers, each internal 16-bit integer is converted to one 64-bit ANSI floating point value.

String Data Type

The string data type consists of ASCII-encoded bytes representing alphanumeric data. Each string is preceded by one byte indicating the number of data bytes in the string. Each data byte represents one alphanumeric character. For ASCII and ANSI transfers, two string bytes are concatenated to form one 16-bit floating point element. First, two successive string bytes are concatenated to form one 16-bit integer, then that integer is floated.
LOADING/DUMPING DATA TRACES

The active trace on the display can be dumped in any of the three data formats. When a trace is dumped, the data points are preceded by the format specifier, the length word, and a group of bytes called the "header." The header defines the conditions under which the trace is being displayed. The contents of the header are described in the next section.

Trace data is dumped either in real/imaginary pairs or real numbers and represents the measured data, not what is necessarily on the screen. For example, if you attempt to dump a phase trace, you will get the entire frequency response function from which the phase trace was derived. If you want strictly what is on the display, refer to "Dumping the Coordinate Transform Block" later in this chapter. All data trace dumps are calibrated (i.e., no conversion is needed); the data points are scaled in the current units.

The Data Header

The header dumped with data traces is the same for all three data formats. The only difference is in the variable count. Table 3-2 shows the contents of the data header. For data types listed in the table as "E-type" (enumerated type) the value of that variable can be decoded by referring to table 3-3. The range of values for each E-type is shown in parentheses. The (+1) beside the byte count for strings is a reminder that each string is preceded by one length byte.

The index shown for each format indicates the position in the header that each item is located for each data format. The binary index indicates 16-bit words, and the ASCII/ANSI index indicates elements.
<table>
<thead>
<tr>
<th>Item</th>
<th>Data Type</th>
<th>Size (bytes)</th>
<th>Binary Index</th>
<th>ASCII/ANSI Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display function</td>
<td>E-type (0-49)</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Number of elements</td>
<td>Integer</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Displayed elements</td>
<td>Integer</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Number of averages</td>
<td>Integer</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Channel selection</td>
<td>E-type (0-3)</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Overflow status</td>
<td>E-type (0-3)</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Overlap percentage</td>
<td>Integer</td>
<td>2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Domain</td>
<td>Integer</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Volts peak/rms</td>
<td>E-type (0-2)</td>
<td>2</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Amplitude Units</td>
<td>E-type (0-7)</td>
<td>2</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>X Axis Units</td>
<td>E-type (0-35)</td>
<td>2</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Auto Math Label</td>
<td>String</td>
<td>13 (+1)</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Trace Label</td>
<td>String</td>
<td>21 (+1)</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>EU Label 1</td>
<td>String</td>
<td>5 (+1)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>EU Label 2</td>
<td>String</td>
<td>5 (+1)</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Float/integer</td>
<td>Boolean</td>
<td>2</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Complex/Real</td>
<td>Boolean</td>
<td>2</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Live/Recalled</td>
<td>Boolean</td>
<td>2</td>
<td>38</td>
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</tr>
<tr>
<td>Math result</td>
<td>Boolean</td>
<td>2</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>Real/Complex input</td>
<td>Boolean</td>
<td>2</td>
<td>40</td>
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</tr>
<tr>
<td>Log/Linear data</td>
<td>Boolean</td>
<td>2</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Auto math</td>
<td>Boolean</td>
<td>2</td>
<td>42</td>
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<tr>
<td>Real time status</td>
<td>Boolean</td>
<td>2</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Measurement Mode</td>
<td>E-type (0-4)</td>
<td>2</td>
<td>44</td>
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</tr>
<tr>
<td>Window</td>
<td>E-type (0-8)</td>
<td>2</td>
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<tr>
<td>Demod type chan 1</td>
<td>E-type (45-47)</td>
<td>2</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Demod type chan 2</td>
<td>E-type (45-47)</td>
<td>2</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Demod active chan 1</td>
<td>Boolean</td>
<td>2</td>
<td>48</td>
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</tr>
<tr>
<td>Demod active chan 2</td>
<td>Boolean</td>
<td>2</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Average status</td>
<td>E-type (0-2)</td>
<td>2</td>
<td>50</td>
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</tr>
<tr>
<td>Not used</td>
<td>Integers (2)</td>
<td>4</td>
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<td>51</td>
</tr>
<tr>
<td>Samp freq/2 (real)</td>
<td>Real</td>
<td>4</td>
<td>53</td>
<td>53</td>
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<tr>
<td>Samp freq/2 (imag)</td>
<td>Real</td>
<td>4</td>
<td>55</td>
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<tr>
<td>Not used</td>
<td>Real</td>
<td>4</td>
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<td>55</td>
</tr>
<tr>
<td>Delta X-axis(^2)</td>
<td>Real</td>
<td>4</td>
<td>59</td>
<td>56</td>
</tr>
<tr>
<td>Max range (for scaling)</td>
<td>Real</td>
<td>4</td>
<td>61</td>
<td>57</td>
</tr>
<tr>
<td>Start time value</td>
<td>Real</td>
<td>4</td>
<td>63</td>
<td>58</td>
</tr>
<tr>
<td>Expon wind const 1</td>
<td>Real</td>
<td>4</td>
<td>65</td>
<td>59</td>
</tr>
<tr>
<td>Expon wind const 2</td>
<td>Real</td>
<td>4</td>
<td>67</td>
<td>60</td>
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<tr>
<td>EU value chan 1</td>
<td>Real</td>
<td>4</td>
<td>69</td>
<td>61</td>
</tr>
<tr>
<td>EU value chan 2</td>
<td>Real</td>
<td>4</td>
<td>71</td>
<td>62</td>
</tr>
<tr>
<td>Trig delay chan 1</td>
<td>Real</td>
<td>4</td>
<td>73</td>
<td>63</td>
</tr>
<tr>
<td>Trig delay chan 2</td>
<td>Real</td>
<td>4</td>
<td>75</td>
<td>64</td>
</tr>
<tr>
<td>Start freq value</td>
<td>Long Real</td>
<td>8</td>
<td>77</td>
<td>65</td>
</tr>
<tr>
<td>Start data value</td>
<td>Long Real</td>
<td>8</td>
<td>81(^1)</td>
<td>66</td>
</tr>
</tbody>
</table>

\(^1\) The last word for binary is number 84.  
\(^2\) 10AX for log-x axis.
| Display Function | 46 | Preview demod record 1 |
| 0 | No data |
| 1 | Frequency response |
| 2 | Power spectrum 1 |
| 3 | Power spectrum 2 |
| 4 | Coherence |
| 5 | Cross spectrum |
| 6 | Input time 1 |
| 7 | Input time 2 |
| 8 | Input linear spectrum 1 |
| 9 | Input linear spectrum 2 |
| 10 | Impulse response |
| 11 | Cross correlation |
| 12 | Auto correlation 1 |
| 13 | Auto correlation 2 |
| 14 | Histogram 1 |
| 15 | Histogram 2 |
| 16 | Cumulative density function 1 |
| 17 | Cumulative density function 2 |
| 18 | Probability density function 1 |
| 19 | Probability density function 2 |
| 20 | Average linear spectrum 1 |
| 21 | Average linear spectrum 2 |
| 22 | Average time record 1 |
| 23 | Average time record 2 |
| 24 | Synthesis pole-zero |
| 25 | Synthesis pole-residue |
| 26 | Synthesis polynomial |
| 27 | Synthesis constant |
| 28 | Windowed time record 1 |
| 29 | Windowed time record 2 |
| 30 | Windowed linear spectrum 1 |
| 31 | Windowed linear spectrum 2 |
| 32 | Filtered time record 1 |
| 33 | Filtered time record 2 |
| 34 | Filtered linear spectrum 1 |
| 35 | Filtered linear spectrum 2 |
| 36 | Time capture buffer |
| 37 | Captured linear spectrum |
| 38 | Captured time record |
| 39 | Throughput time record 1 |
| 40 | Throughput time record 2 |
| 41 | Curve fit |
| 42 | Weighting function |
| 43 | Not used |
| 44 | Orbits |
| 45 | Demodulation polar |
| 46 | Preview demod record 1 |
| 47 | Preview demod record 2 |
| 48 | Preview demod linear spectrum 1 |
| 49 | Preview demod linear spectrum 2 |
| 50 | Channel Selection |
| 0 | Channel 1 |
| 1 | Channel 2 |
| 2 | Channels 1 & 2 |
| 3 | No channel |
| 51 | Overload Status |
| 0 | Channel 1 |
| 1 | Channel 2 |
| 2 | Channels 1 & 2 |
| 3 | No channel |
| 52 | Domain Type |
| 0 | Time |
| 1 | Frequency |
| 2 | Voltage (amplitude) |
| 53 | Volts peak/rms |
| 0 | Peak |
| 1 | RMS |
| 2 | Volts (indicates peak only) |
| 54 | Amplitude Units |
| 0 | Volts |
| 1 | Volts squared |
| 2 | PSD (V^2/Hz) |
| 3 | ESD (V^2s/Hz) |
| 4 | √PSD (V/√Hz) |
| 5 | No amplitude units |
| 6 | Unit volts |
| 7 | Unit volts^2 |
| 55 | X Axis Units |
| 0 | No units |
| 1 | Hertz |
| 2 | RPM |
| 3 | Orders |
| 4 | Seconds |
| 5 | Revs |
| 6 | Degrees |
| 7 | dB |
| 8 | dBV |
| 9 | Volts |
| 10 | V/√Hz (√PSD) |
| 11 | Hertz/second |
| 12 | Volts/EU |
| 13 | Vrms |
| 14 | V^2/Hz (PSD) |
| 15 | Percent |
| 16 | Points |
| 17 | Records |
| 18 | Ohms |
| 19 | Hertz/Octave |
| 20 | Pulse/Rev |
| 21 | Decades |
| 22 | Minutes |
| 23 | V^2s/Hz (ESD) |
| 24 | Octave |
| 25 | Seconds/Decade |
| 26 | Seconds/Octave |
| 27 | Hz/Point |
| 28 | Points/Sweep |
| 29 | Points/Decade |
| 30 | Points/Octave |
| 31 | Vrms |
| 32 | V |
| 33 | EU referenced to Chan 1 |
| 34 | EU referenced to Chan 2 |
| 35 | EU value |
| 36 | Measurement Mode |
| 0 | Linear resolution |
| 1 | Log resolution |
| 2 | Swept sine |
| 3 | Time capture |
| 4 | Linear resolution throughput |
| 37 | Demod Type Chan 1 |
| 45 | AM |
| 46 | FM |
| 47 | PM |
| 38 | Demod Type Chan 2 |
| 45 | AM |
| 46 | FM |
| 47 | PM |
| 39 | Average Status |
| 0 | No data (any data received are invalid) |
| 1 | Not averaged |
| 2 | Averaged |
| 40 | Window |
| 0 | Window not applicable |
| 1 | Hann |
| 2 | Flat top |
| 3 | Uniform |
| 4 | Exponential |
| 5 | Force |
| 6 | Force chan 1/expon chan 2 |
| 7 | Expon chan 1/force chan 2 |
| 8 | User |
ASCII Format

To dump the active trace in ASCII, use the DDAS (Dump Data in ASCII) command; to load data in ASCII, use LDAS (Load Data in ASCII). The format specifier is #I, and the two bytes (one word) following that indicate the number of variables to be transferred. For example, the following BASIC statements dump then load a frequency response trace:

```
OPTION BASE 1
DIM Data__buffer (1668) ! Set array base to 1
OUTPUT @Dsa; "DDAS" ! Create array for data
ENTER @Dsa USING "2A,K"; F$L
PRINT F$L
ENTER @Dsa; Data__buffer(*) ! Dump ASCII command
PRINT F$L
ENTER @Dsa; Data__buffer(*) ! Read format & length
PRINT F$L
ENTER @Dsa; Data__buffer(*) ! Verify format & length
PRINT F$L
ENTER @Dsa; Data__buffer(*) ! Read header & trace data
PRINT F$L
OUTPUT @Dsa; "LDAS" ! Load ASCII command
OUTPUT @Dsa USING "2A,K"; F$L
OUTPUT @Dsa; Data__buffer(*) ! Output format & length
OUTPUT @Dsa; Data__buffer(*) ! Output header & trace data
```

Because this is an ASCII transfer, the format specifier read into F$ is #I. For the specific case of a frequency response trace, the length word read into L indicates 1668 variables (1601 data points (801 real/imaginary pairs) plus the 66-element header). To make this a general program, you should redimension the array Data__buffer to L after reading L.

ANSI Format

To dump the active trace in ANSI floating point, use the DDAN (Dump Data in ANSi) command; to load data in ANSI, use LDAN (Load Data in ANSi). The format specifier is #A, and the two bytes (one word) following that indicate the number of bytes to be transferred. For example, the following BASIC statements dump then load a frequency response trace:

```
OPTION BASE 1
DIM Data__buffer (1668) ! Set array base to 1
OUTPUT @Dsa; "DDAN" ! Create array for data
ENTER @Dsa USING "%2A,W"; F$L
PRINT F$L
ASSIGN @Dsa; FORMAT OFF
ENTER @Dsa; Data__buffer(*) ! Dump ANSI command
PRINT F$L
ASSIGN @Dsa; FORMAT ON ! Read format & length
PRINT F$L
ASSIGN @Dsa; FORMAT OFF ! Verify format & length
ENTER @Dsa; Data__buffer(*) ! Allow binary data
PRINT F$L
ENTER @Dsa; Data__buffer(*) ! Read header & trace data
PRINT F$L
OUTPUT @Dsa; "LDAN" ! Allow ASCII data
OUTPUT @Dsa USING "#.2A,W"; F$L
OUTPUT @Dsa; Data__buffer(*) ! Load ANSI command
OUTPUT @Dsa; Data__buffer(*) ! Output format & length
ASSIGN @Dsa; FORMAT OFF ! Allow binary data
OUTPUT @Dsa; Data__buffer(*) ! Output header & trace data
ASSIGN @Dsa; FORMAT ON ! Allow ASCII data
```

Notice that Data__buffer is dimensioned to the number of bytes divided by 8 (13344/8 = 1668); this is a 64-bit floating point transfer wherein every 8 bytes coming from the analyzer represent one element of data. Because this is an ANSI transfer, the format specifier read into F$ is #A. For the specific case of a frequency response trace, the length word read into L indicates 13344 bytes. To make this a general program, you should redimension the array Data__buffer after reading L. Remember to divide the length word value by 8 for all ANSI transfers.
Internal Binary Format

To dump the active trace in internal binary, use the DDBN (Dump Data in internal BiNary) command; to load data in internal binary use LDBN (Load Data in internal BiNary). The format specifier is #A, and the two bytes (one word) following that indicate the number of bytes to be transferred. For example, the following BASIC statements dump then load a frequency response trace:

```
OPTION BASE 1
INTEGER Data__buffer (3288)
 OUTPUT @Dsa; “DDBN”
 ENTER @Dsa USING “%,2A,W”: F$L
 PRINT F$L
 ASSIGN @Dsa; FORMAT OFF
 ENTER @Dsa; Data__buffer(*)
 ASSIGN @Dsa; FORMAT ON
```

Notice that Data__buffer is dimensioned to the number of bytes divided by 2 (6576 ÷ 2 = 3288). The header contains 168 bytes (84 16-bit integers), and the data trace contains 6408 bytes (1602 32-bit floating point values).

Because this is a binary transfer, the format specifier read into F$ is #A. For the specific case of a frequency response trace, the length word read into L indicates 6576 bytes. To make this a general program, you should redimension the array Data__buffer after reading L.

LOADING/DUMPING THE INSTRUMENT STATE

The instrument state can be dumped and loaded in any of the three data formats. When you dump the instrument state, you get what is shown in the state display (you don’t need to display the state to dump it, however).

Contents of the Instrument State

Table 3-4 shows the contents of the instrument state. For those data types listed as “E-type” (enumerated type), refer to table 3-5 to decode the value. The range of values for each E-type is shown in parentheses. The (+1) beside the byte count for strings is a reminder that each string is preceded by one length byte.

The index shown for each format indicates the position in the header that each item is located for each data format. The binary index indicates 16-bit words, and the ASCII/ANSI index indicates elements.
<table>
<thead>
<tr>
<th>Item</th>
<th>Data Type</th>
<th>Size (bytes)</th>
<th>Binary Index</th>
<th>ASCII/ANSI Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement mode</td>
<td>E-type (0-3)</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Measurement 1</td>
<td>E-type (0-5)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Measurement 2</td>
<td>E-type (0-5)</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Window type</td>
<td>E-type (11-15)</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Force/Expon window 1</td>
<td>E-type (0-1)</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Force/Expon window 2</td>
<td>E-type (0-1)</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Average type</td>
<td>E-type (6-10)</td>
<td>2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Overlap percentage</td>
<td>Integer</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Number of averages</td>
<td>Integer</td>
<td>2</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Sweep # of averages</td>
<td>Integer</td>
<td>2</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Trigger type</td>
<td>E-type (18-23)</td>
<td>2</td>
<td>11</td>
<td>11</td>
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<tr>
<td>Trigger slope</td>
<td>E-type (16-17)</td>
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</tr>
<tr>
<td>Preview type</td>
<td>E-type (0-2)</td>
<td>2</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Sample type</td>
<td>E-type (24-25)</td>
<td>2</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Range units chan 1</td>
<td>E-type (8-35)</td>
<td>2</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Range units chan 2</td>
<td>E-type (8-35)</td>
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<td>Range type 1</td>
<td>E-type (26-28)</td>
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</tr>
<tr>
<td>Range type 2</td>
<td>E-type (26-28)</td>
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</tr>
<tr>
<td>Input coupling 1</td>
<td>E-type (29-30)</td>
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<tr>
<td>Input coupling 2</td>
<td>E-type (29-30)</td>
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<td>20</td>
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<tr>
<td>Source type</td>
<td>E-Type (31-36)</td>
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<td>21</td>
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</tr>
<tr>
<td>Chirp percent</td>
<td>Integer</td>
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<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Burst percent</td>
<td>Integer</td>
<td>2</td>
<td>23</td>
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</tr>
<tr>
<td>Sweep direction</td>
<td>E-type (0-1)</td>
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<td>24</td>
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<tr>
<td>Sweep mode</td>
<td>E-Type (38-39)</td>
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</tr>
<tr>
<td>Ext sample freq units</td>
<td>E-Type (1-20)</td>
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<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Bandwidth units</td>
<td>E-Type (1-3)</td>
<td>2</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Log span index</td>
<td>Integer</td>
<td>2</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Log start index</td>
<td>Integer</td>
<td>2</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Sweep rate units</td>
<td>E-Type (11-26)</td>
<td>2</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Auto gain ref chan</td>
<td>E-Type (0-3)</td>
<td>2</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Demod channels</td>
<td>E-type (0-3)</td>
<td>2</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Demod type chan 1</td>
<td>E-type (45-47)</td>
<td>2</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Demod type chan 2</td>
<td>E-type (45-47)</td>
<td>2</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Source level units</td>
<td>E-type (8-13)</td>
<td>2</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Source offset units</td>
<td>E-type (9)</td>
<td>2</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Trigger level units</td>
<td>E-type (9-34)</td>
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<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Capt/thru length units</td>
<td>E-type (4-17)</td>
<td>2</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>EU label 1</td>
<td>String</td>
<td>5(+1)</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>EU Label 2</td>
<td>String</td>
<td>5(+1)</td>
<td>42</td>
<td>42</td>
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<tr>
<td>Auto carrier on/off</td>
<td>Boolean</td>
<td>2</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Time average on/off</td>
<td>Boolean</td>
<td>2</td>
<td>46</td>
<td>46</td>
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<tr>
<td>Autofixed resolution</td>
<td>Boolean</td>
<td>2</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Auto gain on/off</td>
<td>Boolean</td>
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<td>48</td>
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<td>Autofixed integrate</td>
<td>Boolean</td>
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<td>49</td>
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</tr>
</tbody>
</table>
### Contents of the Instrument State cont.

<table>
<thead>
<tr>
<th>Item</th>
<th>Data Type</th>
<th>Size (bytes)</th>
<th>Binary Index</th>
<th>ASCII/ANSI Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast average on/off</td>
<td>Boolean</td>
<td>2</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Overload reject on/off</td>
<td>Boolean</td>
<td>2</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Chan 1 float/ground</td>
<td>Boolean</td>
<td>2</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>Chan 2 float/ground</td>
<td>Boolean</td>
<td>2</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>Time throughput on/off</td>
<td>Boolean</td>
<td>2</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Demodulation on/off</td>
<td>Boolean</td>
<td>2</td>
<td>55</td>
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</tr>
<tr>
<td>EU or volts chan 1</td>
<td>Boolean</td>
<td>2</td>
<td>56</td>
<td>56</td>
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<tr>
<td>EU or volts chan 2</td>
<td>Boolean</td>
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</tr>
<tr>
<td>Manual/auto arm</td>
<td>Boolean</td>
<td>2</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>Demod preview on/off</td>
<td>Boolean</td>
<td>2</td>
<td>59</td>
<td>59</td>
</tr>
<tr>
<td>Delete freq on/off</td>
<td>Boolean</td>
<td>2</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Lin res Fstart pegged</td>
<td>Boolean</td>
<td>2</td>
<td>61</td>
<td>61</td>
</tr>
<tr>
<td>Swept Fstart pegged</td>
<td>Boolean</td>
<td>2</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>Force length chan 1</td>
<td>Real</td>
<td>4</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>Force length chan 2</td>
<td>Real</td>
<td>4</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Expo time constant 1</td>
<td>Real</td>
<td>4</td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td>Expo time constant 2</td>
<td>Real</td>
<td>4</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Sweep time</td>
<td>Real</td>
<td>4</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>Sweep rate</td>
<td>Real</td>
<td>4</td>
<td>73</td>
<td>73</td>
</tr>
<tr>
<td>Sweep resolution</td>
<td>Real</td>
<td>4</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Sweep integrate time</td>
<td>Real</td>
<td>4</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Auto gain level</td>
<td>Real</td>
<td>4</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>Auto gain limit</td>
<td>Real</td>
<td>4</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Source level</td>
<td>Real</td>
<td>4</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>EU value chan 1</td>
<td>Real</td>
<td>4</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>EU value chan 2</td>
<td>Real</td>
<td>4</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>Trigger delay chan 1</td>
<td>Real</td>
<td>4</td>
<td>89</td>
<td>89</td>
</tr>
<tr>
<td>Trigger delay chan 2</td>
<td>Real</td>
<td>4</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Integrate var thresh</td>
<td>Real</td>
<td>4</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td>Capt/thru length</td>
<td>Real</td>
<td>4</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Frequency span</td>
<td>Real</td>
<td>4</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td>Time record length</td>
<td>Real</td>
<td>4</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>Frequency resolution</td>
<td>Real</td>
<td>4</td>
<td>101</td>
<td>101</td>
</tr>
<tr>
<td>Time resolution</td>
<td>Real</td>
<td>4</td>
<td>103</td>
<td>103</td>
</tr>
<tr>
<td>External sample rate</td>
<td>Real</td>
<td>4</td>
<td>105</td>
<td>105</td>
</tr>
<tr>
<td>Sample rate (actual)</td>
<td>Real</td>
<td>4</td>
<td>107</td>
<td>107</td>
</tr>
<tr>
<td>Range channel 1</td>
<td>Real</td>
<td>4</td>
<td>109</td>
<td>109</td>
</tr>
<tr>
<td>Range channel 2</td>
<td>Real</td>
<td>4</td>
<td>111</td>
<td>111</td>
</tr>
<tr>
<td>Preview time</td>
<td>Real</td>
<td>4</td>
<td>113</td>
<td>113</td>
</tr>
<tr>
<td>Trigger level</td>
<td>Real</td>
<td>4</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>Source dc offset</td>
<td>Real</td>
<td>4</td>
<td>117</td>
<td>117</td>
</tr>
<tr>
<td>Fixed sine frequency</td>
<td>Long Real</td>
<td>8</td>
<td>119</td>
<td>119</td>
</tr>
<tr>
<td>Start frequency</td>
<td>Long Real</td>
<td>8</td>
<td>123</td>
<td>123</td>
</tr>
<tr>
<td>Center frequency</td>
<td>Long Real</td>
<td>8</td>
<td>127</td>
<td>127</td>
</tr>
<tr>
<td>Sweep start</td>
<td>Long Real</td>
<td>8</td>
<td>131</td>
<td>131</td>
</tr>
<tr>
<td>Sweep end</td>
<td>Long Real</td>
<td>8</td>
<td>135</td>
<td>135</td>
</tr>
<tr>
<td>Carrier frequency</td>
<td>Long Real</td>
<td>8</td>
<td>139</td>
<td>139</td>
</tr>
</tbody>
</table>

*Last word for binary is number 142.
Table 3-5  Enumerated Types for Instrument State Values

<table>
<thead>
<tr>
<th>Measurement Mode</th>
<th>Sample Type</th>
<th>Bandwidth Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Linear resolution</td>
<td>24 Internal Sample</td>
<td>1 Hertz</td>
</tr>
<tr>
<td>1 Log resolution</td>
<td>25 External Sample</td>
<td>2 RPM</td>
</tr>
<tr>
<td>2 Swept sine</td>
<td></td>
<td>3 Orders</td>
</tr>
<tr>
<td>3 Time capture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 dBV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Vrms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 EU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto Range Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 Auto Range On</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 Auto Range Off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 Auto Range Set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Coupling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 DC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 Source off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 Random noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 Burst random</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34 Periodic chirp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 Burst chirp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36 Swept sine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 Fixed sine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweep Direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41 Up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42 Sweep hold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43 Manual sweep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44 Down</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweep Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39 Linear sweep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 Log sweep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Sample Frequency Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Hertz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 RPM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Pulses/rev</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demod Channel Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 Channel 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Channel 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Both channels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 No channels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demod Type 1/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46 FM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47 PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source Level Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 dBV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Vrms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source DC Offset Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trigger level units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 EU channel 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34 EU channel 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capt/Thru Session Length Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Revs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Records</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ASCII Format

To dump the state in ASCII, use the DSAS (Dump State in Ascii) command; to load the state in ASCII, use LSAS (Load State in Ascii). The format specifier is #1, and the two bytes (one word) following that indicate the number of variables to be transferred. For example, the following BASIC statements dump then load the instrument state:

```
OPTION BASE 1
DIM State___buf (96)
OUTPUT @Dsa; "DSAS"
ENTER @Dsa USING "2A,K"; F$,L
PRINT F$,L
ENTER @Dsa; State___buf(*)
OUTPUT @Dsa; "LSAS"
OUTPUT @Dsa USING "2A,K"; F$,L
OUTPUT @Dsa; State___buf(*)
```

Because this is an ASCII transfer, the format specifier read into F$ is #1. The length word for dumping the state always indicates 96 elements in ASCII format.

ANSI Format

To dump the state in ANSI, use the DSAN (Dump State in ANS) command; to load the state in ANSI, use LSAN (Load State in ANS). The format specifier is #A, and the two bytes (one word) following that indicate the number of bytes to be transferred. For example, the following BASIC statements dump then load the instrument state:

```
OPTION BASE 1
DIM State___buf (96)
OUTPUT @Dsa; "DSAN"
ENTER @Dsa USING "%2A,W"; F$,L
PRINT F$,L
ASSIGN @Dsa; FORMAT OFF
ENTER @Dsa; State___buf(*)
ASSIGN @Dsa; FORMAT ON
OUTPUT @Dsa; "LSAN"
OUTPUT @Dsa USING "#,2A,W"; F$,L
ASSIGN @Dsa; FORMAT OFF
OUTPUT @Dsa; State___buf(*)
ASSIGN @Dsa; FORMAT ON
```

Because this is an ANSI transfer, the format specifier read into F$ is #A. The length word always indicates 768 bytes for dumping the state in ANSI format, but the array was dimensioned for 96 values (768 + 8).
Internal Binary Format

To dump the state in binary, use the DSBN (Dump State in Internal Binary) command; to load the state in binary, use LSBN (Load State in Internal Binary). The format specifier is #A, and the two bytes (one word) following that indicate the number of bytes to be transferred. For example, the following BASIC statements dump then load the instrument state:

```
OPTION BASE 1
INTEGER State___buf (142)
OUTPUT @Dsa; "DSBN"
ENTER @Dsa USING "%,2A,W"; FS,L
PRINT FS,L
ASSIGN @Dsa; FORMAT OFF
ENTER @Dsa; State___buf(*)
ASSIGN @Dsa; FORMAT ON

OUTPUT @Dsa; "LSBN"
OUTPUT @Dsa USING "#,2A,W"; FS,L
ASSIGN @Dsa; FORMAT OFF
OUTPUT @Dsa; State___buf(*)
ASSIGN @Dsa; FORMAT ON
```

Because this is a binary transfer, the format specifier read into FS is #A. The length word always indicates 284 bytes for dumping the state in binary format, but the array was dimensioned for 142 values (284 ÷ 2).
DUMPING THE COORDINATE TRANSFORM BLOCK

The coordinate transform block contains three groups of data: the display parameters, the data header for the active trace, and the displayed data in the active trace. As with other block transfers, this can be dumped in any of the three data formats. Note, however, the coordinate transform block can be dumped only; it has no load command. The coordinate transform data block contains exactly what you see on the display; if you have a phase trace active, the coordinate block contains phase data. The coordinate block is not as accurate as the data trace.

This section describes the contents of the coordinate transform block and the coordinate transform header. The last three parts in this section explain how to dump it in each of the three data formats.

Contents of the Coordinate Transform Block

Table 3-6 shows the organization of the data received after dumping the coordinate transform block:

<table>
<thead>
<tr>
<th>Table 3-6</th>
<th>The Coordinate Transform Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1:</td>
<td>Coordinate transform header</td>
</tr>
<tr>
<td>Part 2:</td>
<td>Data header for active trace</td>
</tr>
<tr>
<td>Part 3:</td>
<td>Displayed trace data</td>
</tr>
</tbody>
</table>

Table 3-7 shows the contents of the coordinate transform header. For data types listed in the table as "E-type" (enumerated type) the value of that variable can be decoded by referring to table 3-8. The range of values for each E-type is shown in parentheses. The (+ 1) beside the byte count for strings is a reminder that each string is preceded by one length byte.

The index shown for each format indicates the position in the header that each item is located for each data format. The binary index indicates 16-bit words, and the ASCII/ANSI index indicates elements.
## Table 3-7 The Coordinate Transform Header

<table>
<thead>
<tr>
<th>Item</th>
<th>Data Type</th>
<th>Size (bytes)</th>
<th>Binary Index</th>
<th>ASCII/ANSI Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y coordinates</td>
<td>E-type (0-10)</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td># of disp elements</td>
<td>Integer</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>First element</td>
<td>Integer</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total elements</td>
<td>Integer</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Display sampling</td>
<td>E-type (0-2)</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Scaling</td>
<td>E-type (0-3)</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Data Pointer</td>
<td>Long integer</td>
<td>4</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>In Data</td>
<td>Long integer</td>
<td>4</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Log/Linear x-axis</td>
<td>Boolean</td>
<td>2</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Sampled display data</td>
<td>Boolean</td>
<td>2</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Plot/Graph mode</td>
<td>Boolean</td>
<td>2</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Phase wrap</td>
<td>Boolean</td>
<td>2</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Not used</td>
<td>Integers (18)</td>
<td>36</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>X scale factor</td>
<td>Real</td>
<td>4</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>Grid min Y scale</td>
<td>Real</td>
<td>4</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>Grid max Y scale</td>
<td>Real</td>
<td>4</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>/Div</td>
<td>Real</td>
<td>4</td>
<td>37</td>
<td>36</td>
</tr>
<tr>
<td>Min value of data</td>
<td>Real</td>
<td>4</td>
<td>39</td>
<td>37</td>
</tr>
<tr>
<td>Max value of data</td>
<td>Real</td>
<td>4</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>Y cumulative Min</td>
<td>Real</td>
<td>4</td>
<td>43</td>
<td>39</td>
</tr>
<tr>
<td>Y cumulative Max</td>
<td>Real</td>
<td>4</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>Y scale factor&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Real</td>
<td>4</td>
<td>47</td>
<td>41</td>
</tr>
<tr>
<td>Not used</td>
<td>Real (4)</td>
<td>16</td>
<td>49</td>
<td>42</td>
</tr>
<tr>
<td>Stop value</td>
<td>Long Real</td>
<td>8</td>
<td>57</td>
<td>46</td>
</tr>
<tr>
<td>Left grid</td>
<td>Long Real</td>
<td>8</td>
<td>63</td>
<td>47</td>
</tr>
<tr>
<td>Right grid</td>
<td>Long Real</td>
<td>8</td>
<td>67</td>
<td>48</td>
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<tr>
<td>Left data</td>
<td>Long Real</td>
<td>8</td>
<td>71</td>
<td>49</td>
</tr>
<tr>
<td>Right data</td>
<td>Long Real</td>
<td>8</td>
<td>75&lt;sup&gt;2&lt;/sup&gt;</td>
<td>50</td>
</tr>
</tbody>
</table>

<sup>1</sup>Multiply by data to calibrate trace data  
<sup>2</sup>Last word for binary is number 78.
Table 3-8  Enumerated (E-type) Values for Coordinate Transform Block

<table>
<thead>
<tr>
<th>Y Coordinate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Real</td>
<td></td>
</tr>
<tr>
<td>2 Imaginary</td>
<td></td>
</tr>
<tr>
<td>3 Linear magnitude</td>
<td></td>
</tr>
<tr>
<td>4 Log magnitude</td>
<td></td>
</tr>
<tr>
<td>5 dB</td>
<td></td>
</tr>
<tr>
<td>6 Nyquist</td>
<td></td>
</tr>
<tr>
<td>7 Not used</td>
<td></td>
</tr>
<tr>
<td>8 Phase</td>
<td></td>
</tr>
<tr>
<td>9 Nichols</td>
<td></td>
</tr>
<tr>
<td>10 dBm</td>
<td></td>
</tr>
</tbody>
</table>

Display Sampling

- 0 not sampled (# of displayed elements = total elements)
- 1 half sampled (# of displayed elements = total elements/2)
- 2 sampled (# of displayed elements < total elements)

Scaling

- 0 X and Y auto scale
- 1 X fixed scale, Y auto scale
- 2 X auto scale, Y fixed scale
- 3 X and Y fixed scale
ASCII Format

To dump the coordinate transform block in ASCII, use the DCAS (Dump Coordinate block in ASCII) command. The format specifier is #i, and the two bytes (one word) following that indicate the number of variables to be transferred. For example, the following BASIC statements dump the coordinate transform block when a frequency response is displayed:

```
OPTION BASE 1
DIM Coord__buf(917) ! Create array for data
OUTPUT @Dsa; "DCAS" ! Dump ASCII command
ENTER @Dsa USING "2A,K"; F$$_L
PRINT F$$_L
ENTER @Dsa; Coord__buf("
```

Because this is an ASCII transfer, the format specifier read into F$ is #i. For the specific case of a frequency response trace with full X scale, the length word read into L indicates 917 elements (50 in coordinate transform header, 66 in the data header, and 801 from the display). To make this a general program, you should redimension the array Coord__buf to L after reading L.

ANSI Format

To dump the coordinate transform block in ANSI, use the DCAN (Dump Coordinate block in ANSI) command. The format specifier is #A, and the two bytes (one word) following that indicate the number of bytes to be transferred. For example, the following BASIC statements dump the coordinate transform block when a frequency response is displayed:

```
OPTION BASE 1
DIM Coord__buf(917) ! Create array for data
OUTPUT @Dsa; "DCAN" ! Dump ANSI command
ENTER @Dsa USING "#2A,W"; F$$_L
PRINT F$$_L
ASSIGN @Dsa; FORMAT OFF
ENTER @Dsa; Coord__buf("
ASSIGN @Dsa; FORMAT ON ! Allow ASCII data
```

Because this is a binary transfer, the format specifier read into F$ is #A. For the specific case of a frequency response trace with full X scale, the length word read into L indicates 7336 bytes. This makes the element count equal 917 (7336 ÷ 8), with 50 elements in the coordinate transform header, 66 in the data header, and 801 from the display. To make this a general program, you should redimension the array Coord__buf after reading L.
Internal Binary Format

To dump the coordinate transform block in internal binary, use the DCBN (Dump Coordinate block in Binary) command. The format specifier is #A, and the two bytes (one word) following that indicate the number of bytes to be transferred. For example, the following BASIC statements dump the coordinate transform block when a frequency response is displayed:

```
OPTION BASE 1
INTEGER C___hdr (78) ! Array for coord header
INTEGER D___hdr (84) ! Array for data header
INTEGER T___data (1602) ! Array for trace data
OUTPUT @Dsa; ""DCBN"
ENTER @Dsa USING ""#,2A,W""; F$,L
PRINT F$,L
ASSIGN @Dsa; FORMAT OFF
ENTER @Dsa; C___hdr(*),D___hdr(*),T___data(*) ! Read 3 parts of transfer
ASSIGN @Dsa; FORMAT ON ! Allow ASCII data
```

Because this is an binary transfer, the format specifier read into F$ is #A. For the specific case of a frequency response trace with full X scale, the length word read into L indicates 3528 bytes: 156 in the coordinate header, 168 in the data header, and 3204 from the display. (Trace data are dumped in 32-bit floating point, so 4 bytes are required for each of the 801 displayed points.) To make this a general program, you should redimension the array T___data after reading L.
DUMPING/LOADING THE SYNTHESIS AND CURVE FIT TABLES

The synthesis and curve fit tables can be dumped and loaded in each of the three data formats. Transfer the table to pole-zero synth format first. For descriptions of these formats, please refer to “Three Data Formats” earlier in this chapter. The commands used are:

- DTAN: Dump Table in ANsi
- DTBN: Dump Table in internal BiNary
- DTAS: Dump Table in ASCii
- LTAN: Load Table in ANsi
- LTBN: Load Table in internal BiNary
- LTAS: Load Table in ASCii

Contents of the Synthesis and Curve Fit Tables

Table 3-9 shows the contents of the synthesis and curve fit tables dumped via HP-IB. For enumerated (E-type) values, refer to table 3-10.

<table>
<thead>
<tr>
<th>Item</th>
<th>Data Type</th>
<th>Size (bytes)</th>
<th>Binary Index</th>
<th>ASCII/ANSI Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table type</td>
<td>E-type (0-4)</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Number in left side</td>
<td>Integer</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Number in right side</td>
<td>Integer</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Left side values¹</td>
<td>Complex [1:22]</td>
<td>176</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Right side values¹</td>
<td>Complex [1:22]</td>
<td>176</td>
<td>92</td>
<td>48</td>
</tr>
<tr>
<td>Left constraints²</td>
<td>Boolean [1:22]</td>
<td>22</td>
<td>180</td>
<td>92</td>
</tr>
<tr>
<td>Right constraints²</td>
<td>Boolean [1:22]</td>
<td>22</td>
<td>202</td>
<td>114</td>
</tr>
<tr>
<td>Time delay</td>
<td>Real</td>
<td>4</td>
<td>224</td>
<td>136</td>
</tr>
<tr>
<td>Gain factor</td>
<td>Real</td>
<td>4</td>
<td>228</td>
<td>137</td>
</tr>
<tr>
<td>Scale frequency</td>
<td>Real</td>
<td>4</td>
<td>228</td>
<td>138</td>
</tr>
<tr>
<td>Current line</td>
<td>Integer</td>
<td>2</td>
<td>230</td>
<td>139</td>
</tr>
<tr>
<td>Current half</td>
<td>E-type (0-1)</td>
<td>2</td>
<td>231</td>
<td>140</td>
</tr>
<tr>
<td>Zero total</td>
<td>Integer</td>
<td>2</td>
<td>232</td>
<td>141</td>
</tr>
<tr>
<td>Pole total</td>
<td>Integer</td>
<td>2</td>
<td>233</td>
<td>142</td>
</tr>
</tbody>
</table>

¹ Each complex value is a pair of 32-bit floating point values representing a complex conjugate pair. These arrays are arranged as line 1 real, line 1 imaginary, line 2 real, etc. If a value is real-only, the imaginary part is zero.

² This is an array of 22 boolean elements, one flag for each line in the table. A 1 indicates that value in the table is constrained (user-created or fixed), and a 0 indicates that value is unconstrained.
Table 3-10  E-types in Synthesis & Curve Fit Tables

<table>
<thead>
<tr>
<th>Table Type</th>
<th>Current Half</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Pole zero synth</td>
</tr>
<tr>
<td>1</td>
<td>Pole residue synth</td>
</tr>
<tr>
<td>2</td>
<td>Polynomial synth</td>
</tr>
<tr>
<td>3</td>
<td>Constant trace</td>
</tr>
<tr>
<td>4</td>
<td>Curve fit</td>
</tr>
</tbody>
</table>

ACCESSING DISC FILES

This section explains the arrangement of HP 3562A disc files. These files may be stored data traces, time throughput sessions, and time capture buffers. The next section explains how to read trace files, and then throughput and capture files are discussed. All files on disc are stored in internal binary format.

Accessing Data Trace Files

Reading data trace disc files is very similar to dumping traces directly out of the analyzer. The only difference is that the data portion of the file (following the header) always starts on a sector boundary. Since the HP 3562A uses only 256-byte sectors, you simply need to ignore the bytes between the end of the header and byte #256, the beginning of the data.

The data header is 168 bytes long, so ignore bytes 169 through 255 (words 85 through 127). Please refer to “Dumping/Loading Data Traces” earlier in this chapter for the rest of the information you need. Note that data trace files are scaled and do not need to be multiplied by a calibration factor when read off disc.

Accessing Throughput and Capture Files

There are three types of disc storage for throughput and capture files: one-channel, two-channel without delay, and two-channel with delay. Capture files are treated as one-channel throughput files. “Delay” in this case indicates differential delay between the two channels, not the delay at the beginning of the session. The following sections explain:

1. How data records are arranged for each of the three storage types
2. How to handle skipped tracks
3. How to scale data
4. How to use the calibration table
5. How to interpret the throughput/capture header.
Data Record Arrangement

Throughput/capture files are composed of the throughput/capture header followed by data. The header is composed of one BDAT file sector followed by three sectors of HP 3562A header information. Throughput and capture data are arranged by time record. Records are composed of 2048 16-bit integer words (4096 bytes).

Record arrangement depends on the number of channels and whether any cross-channel trigger delay was used to start the session (throughput only). In capture and single-channel throughput files, records are arranged sequentially started with the first record stored, as shown in figure 3-1. The header contains one BDAT file sector and three sectors of header information. Because these three sectors contain 768 bytes (256 x 3) and the header is only 648 bytes long, there are 120 unused bytes at the end of the third sector (the fourth sector counting the BDAT sector).

Always starts on sector boundary

| Header | Rec 1 | Rec 2 | Rec 3 | --- | --- | Rec N |

Header contains 648 bytes (324 16-bit integers) of information, but the header always resides in 3 sectors after the 1 BDAT file sector

Figure 3-1 Disc Storage of One-Channel Files

For two-channel throughput with no trigger delay, records alternate for each channel (1st record on Channel 1, 1st record on Channel 2, 2nd record on Channel 1, etc.). Figures 3-3a, b and c show an example of a throughput with 5 records on each channel and a 2.5 record delay on Channel 2. Once again, the header contains one BDAT file sector and three sectors of header information. Because these three sectors contain 768 bytes (256 x 3) and the header is only 648 bytes long, there are 120 unused bytes at the end of the third sector (the fourth sector counting the BDAT sector).
Always starts on sector boundary

<table>
<thead>
<tr>
<th>Header</th>
<th>Chan 1</th>
<th>Chan 2</th>
<th>Chan 1</th>
<th>Chan 2</th>
<th>Chan 1</th>
<th>Chan 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rec 1</td>
<td>Rec 1</td>
<td>Rec 2</td>
<td>Rec</td>
<td>Rec N</td>
<td>Rec N</td>
<td></td>
</tr>
</tbody>
</table>

Header contains 648 bytes (324 16-bit integers) of information, but the header always resides in 3 sectors after one BDAT file sector.

**Figure 3-2 Disc Storage of Two-Channel Files without Delay**

For two-channel throughputs with trigger delay, records are interleaved according to the amount of differential delay between the two channels, as shown in figure 3-3. Once again, the header contains one BDAT file sector and three sectors of header information. Because these three sectors contain 768 bytes (256 x 3) and the header is only 648 bytes long, there are 120 unused bytes at the end of the third sector (the fourth sector if you count the BDAT sector).

Figure 3-3a shows how what the interleave, delay count and delay channel indicator in the throughput capture header mean. Interleave is the number of pairs of Channel 1/Channel 2 records between the Channel 1 records and the Channel 2 records. Delay count is the number of whole records of delay between the two channels. In this example, the delay is 2.5 records, but just the 2 records are indicated by the delay count variable. (The remaining partial record is explained in figure 3-3b.) The delay channel just indicates which channel is delayed past the other, Channel 2 in this example.

Figure 3-3b shows how the remaining 1/2 record delay is handled. The partial record count shows the number of data points in the remaining partial delay record. If the data are real-only (baseband), the number of data points equals the number of words in the record. If the data are complex (zoom), the number of data points is 1/2 the number of words. Figure 3-3b also shows where the valid data records actually reside in relation to the records created by the disc. Remember that in this example, the delay is 2.5 records, and interpret your data file according to the delay you actually have.

Figure 3-3c shows how the records are actually arranged on the disc and how you need to re-assemble them to get valid records for the delayed channel. In this example, the first half of Chan 2 Rec 1 and the last half of Chan 2 Rec 6 contains irrelevant data. Note that the partial record count shows both the number of invalid data points at the beginning of Rec 1 and the number of valid data points at the beginning of Rec 6.
Figure 3-3 Disc Storage of Two-Channel Files with Delay
Skipped Tracks

When the HP 3562A throughputs to Hewlett-Packard Command Set/80 (CS/80) disc drives, it skips over tracks which have been previously spared. (Refer to Chapter 11 in the HP 3562A Operating Manual for information on sparing tracks.) Before reading data from a CS/80 disc file, you should read the number of skipped tracks indicator in the header and see if there are any spared tracks in the file area. If there are, you need to pass over these areas as you read the data.

The skipped track offset table shows the location of up to 9 spared tracks. These are address offsets from the beginning of the entire file, not absolute addresses. You can use the sectors/track indicator to determine where in the data file the good disc area resumes. Remember that the HP 3562A always uses 256 byte sectors and there are 2048 data points per record (each point is one word, so there are 4096 bytes required to store one record). Consequently, each record requires 16 sectors (4096/256) of disc area.

Data Scaling

Data points read out of a disc file must be scaled to obtain calibrated values. Here is the formula to scale data:

$$\text{Scaled data} = \left( -\frac{4}{3}\right)(\text{disc data})(\text{range})(32,768)/26028.55$$

where: disc data is the data portion of the file range is the range setting for that channel
Calibration Tables

Two calibration tables are stored in the header. Cal table #1 is used for Channel 1, and table #2 is used for Channel 2/Channel 1. The curves should be reconstructed over the desired frequency range using linear interpolation.

Each table is composed of 56 complex values. Each complex value is composed of two 16-bit integers representing a real/imaginary pair. The span from 0 to 90 kHz is covered in 2 kHz steps; the span from 91 to 100 kHz is covered in 1 kHz steps. The two cal tables are scaled by the "Mag cal scale factors" 1 and 2, respectively.

The Throughput/Capture Header

Table 3-11 shows the throughput/capture header. Refer to table 3-12 for enumerated (E-type) values.

<table>
<thead>
<tr>
<th>Item</th>
<th>Data Type</th>
<th>Size (bytes)</th>
<th>Binary Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex data flag</td>
<td>Boolean (1 = yes)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Bytes per point</td>
<td>Integer</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Points per record</td>
<td>Integer</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Channel type</td>
<td>E-type (0-1)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Bandwidth units</td>
<td>E-type (1-3)</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>X units</td>
<td>E-type (0-35)</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Delay channel¹</td>
<td>E-type (0-3)</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Delay count¹</td>
<td>Integer</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Partial record¹</td>
<td>Integer</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Interleave¹</td>
<td>Integer</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td># of realtime records</td>
<td>Integer</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Sectors/track</td>
<td>Integer</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Skip track offsets²</td>
<td>Long integers (9)</td>
<td>36</td>
<td>13</td>
</tr>
<tr>
<td>Digit Revision</td>
<td>Integer</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>Not used</td>
<td>Integer</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td># of skip tracks</td>
<td>Integer</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>Cal failure</td>
<td>Boolean (1 = yes)</td>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td>Start frequency</td>
<td>Long Real</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>Center frequency</td>
<td>Long Real</td>
<td>8</td>
<td>39</td>
</tr>
<tr>
<td>Frequency span</td>
<td>Real</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>∆t</td>
<td>Real</td>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td>Mag cal cspr scale factor</td>
<td>Real</td>
<td>4</td>
<td>47</td>
</tr>
<tr>
<td>Mag cal fr sp scale factor</td>
<td>Real</td>
<td>4</td>
<td>49</td>
</tr>
<tr>
<td>Digitized pt len 1</td>
<td>Long Integer</td>
<td>4</td>
<td>51</td>
</tr>
<tr>
<td>Range units 1</td>
<td>E-type (0-35)</td>
<td>2</td>
<td>53</td>
</tr>
<tr>
<td>Tng delay 1</td>
<td>Long Integer</td>
<td>4</td>
<td>54</td>
</tr>
<tr>
<td>Coupling 1</td>
<td>E-type (29-30)</td>
<td>2</td>
<td>56</td>
</tr>
<tr>
<td>Input float 1</td>
<td>Boolean (1 = float)</td>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>Overflow status 1</td>
<td>Boolean (1 = overrange)</td>
<td>2</td>
<td>58</td>
</tr>
<tr>
<td>EU Label 1</td>
<td>String</td>
<td>5 (+1)</td>
<td>59</td>
</tr>
<tr>
<td>Range 1</td>
<td>Real</td>
<td>4</td>
<td>62</td>
</tr>
<tr>
<td>Delay 1</td>
<td>Real</td>
<td>4</td>
<td>64</td>
</tr>
</tbody>
</table>
Table 3-11 Throughput/Capture Header cont.

<table>
<thead>
<tr>
<th>Item</th>
<th>Data Type</th>
<th>Size (bytes)</th>
<th>Binary Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU value 1</td>
<td>Real</td>
<td>4</td>
<td>66</td>
</tr>
<tr>
<td>Digitized pt len 2</td>
<td>Long Integer</td>
<td>4</td>
<td>68</td>
</tr>
<tr>
<td>Range units 2</td>
<td>E-type (0-35)</td>
<td>2</td>
<td>70</td>
</tr>
<tr>
<td>Trig delay 2</td>
<td>Long Integer</td>
<td>4</td>
<td>71</td>
</tr>
<tr>
<td>Coupling 2</td>
<td>E-type (29-30)</td>
<td>2</td>
<td>73</td>
</tr>
<tr>
<td>Input float 2</td>
<td>Boolean (1 = float)</td>
<td>2</td>
<td>74</td>
</tr>
<tr>
<td>Overflow status 2</td>
<td>Boolean (1 = overrange)</td>
<td>2</td>
<td>75</td>
</tr>
<tr>
<td>EU Label 2</td>
<td>String</td>
<td>5</td>
<td>76</td>
</tr>
<tr>
<td>Range 2</td>
<td>Real</td>
<td>4</td>
<td>79</td>
</tr>
<tr>
<td>Delay 2</td>
<td>Real</td>
<td>4</td>
<td>81</td>
</tr>
<tr>
<td>EU value 2</td>
<td>Real</td>
<td>4</td>
<td>83</td>
</tr>
<tr>
<td>Cal table 1</td>
<td>Int array [2,56]</td>
<td>224</td>
<td>85</td>
</tr>
<tr>
<td>Cal table 2</td>
<td>Int array [2,56]</td>
<td>224</td>
<td>197</td>
</tr>
<tr>
<td>Sec att corr 1&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Complex (2 reals)</td>
<td>8</td>
<td>309</td>
</tr>
<tr>
<td>Sec att corr 2&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Complex (2 reals)</td>
<td>8</td>
<td>313</td>
</tr>
<tr>
<td>Trigger phase corr&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Long Integer</td>
<td>4</td>
<td>317</td>
</tr>
<tr>
<td>Trigger path delay&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Real</td>
<td>4</td>
<td>319</td>
</tr>
<tr>
<td>Dig filter word 1</td>
<td>Integer</td>
<td>2</td>
<td>321&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Dig filter word 2</td>
<td>Integer</td>
<td>2</td>
<td>323&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Not used</td>
<td>Integers (2)</td>
<td>4</td>
<td>323&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>Relevant only in two channel throughputs; refer to “Data Record Arrangement” earlier in this chapter.
<sup>2</sup>Table contains 10 address offsets.
<sup>3</sup>This is the correction factor at 100 kHz for the secondary attenuators.
<sup>4</sup>Last word in header is 324.
<sup>5</sup>These two variables are not used to calibrate throughput data, but they are available for your information.
<sup>6</sup>Valid only if Digit Revision ≥ 1.
### Table 3-12  E-types in Throughput/Capture Header

<table>
<thead>
<tr>
<th>Channel Type and Delay Channel</th>
<th>21 Decades</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Channel 1</td>
<td>22 Minutes</td>
</tr>
<tr>
<td>1 Channel 2</td>
<td>23 Oct/minute</td>
</tr>
<tr>
<td>2 Both channels</td>
<td>24 Octaves</td>
</tr>
<tr>
<td>3 No channels</td>
<td>25 Sec/decade</td>
</tr>
<tr>
<td></td>
<td>26 Sec/octave</td>
</tr>
<tr>
<td><strong>Bandwidth Units and X Units</strong></td>
<td>27 Hz/point</td>
</tr>
<tr>
<td>0 Null</td>
<td>28 Points/sweep</td>
</tr>
<tr>
<td>1 Hz</td>
<td>29 Points/decade</td>
</tr>
<tr>
<td>2 RPM</td>
<td>30 Points/octave</td>
</tr>
<tr>
<td>3 Orders</td>
<td></td>
</tr>
<tr>
<td>4 Seconds</td>
<td></td>
</tr>
<tr>
<td>5 Revs</td>
<td>31 V/Vrms</td>
</tr>
<tr>
<td>6 Degrees</td>
<td>32 Volts²</td>
</tr>
<tr>
<td>7 dB</td>
<td></td>
</tr>
<tr>
<td>8 dBV</td>
<td>33 Channel 1 EU</td>
</tr>
<tr>
<td>9 Volts</td>
<td>34 Channel 2 EU</td>
</tr>
<tr>
<td>10 Volts/Hz</td>
<td>35 EU</td>
</tr>
<tr>
<td>11 Hz/second</td>
<td></td>
</tr>
<tr>
<td>12 Volts/EU</td>
<td></td>
</tr>
<tr>
<td>13 Volts rms</td>
<td></td>
</tr>
<tr>
<td>14 Volts²/Hz</td>
<td></td>
</tr>
<tr>
<td>15 Percent</td>
<td></td>
</tr>
<tr>
<td>16 Points</td>
<td></td>
</tr>
<tr>
<td>17 Records</td>
<td></td>
</tr>
<tr>
<td>18 Ohms</td>
<td></td>
</tr>
<tr>
<td>19 Hz/octave</td>
<td>29 AC</td>
</tr>
<tr>
<td>20 Pulses/rev</td>
<td>30 DC</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PURPOSE OF THIS CHAPTER

The purpose of this chapter is to explain the use of the signal processing command group. These commands allow you to set up data blocks in the HP 3562A's memory then perform a number of signal processing operations on these blocks. The topics covered here are:

1. Overview of signal processing steps
2. General block operations
3. Transferring blocks
4. Math operations
5. Averaging operations
6. Measurement operations
7. Plotting and graphing results

NOTE 1

Most of the signal processing operations described in this chapter can be performed using waveform math. Please refer to chapter 9 in the operating manual, which describes the math operations, before using the primitives in this chapter. If waveform math can meet your needs, it presents a much simpler programming task than the signal processing primitives.

NOTE 2

The HP 3562A must be paused before you use signal processing primitives (the data blocks will be erased otherwise).
OVERVIEW OF SIGNAL PROCESSING STEPS

There are five general steps to perform signal processing primitive operations in the HP 3562A:

1. Set up primitive blocks
2. Input data
3. Perform operations
4. Output results
5. Display results

The first step, setting up the blocks you need, is covered in the next section, “General Block Operations.” For step two, you have two choices for input data: digital input via HP-IB or analog signals from the input channels. Transferring primitive data blocks via HP-IB is covered in “Transferring Blocks” later in this chapter, and analog input is covered in “General Block Operations” (the ANIN command). For step three, choose the desired operation from “Math Operations,” “Averaging Operations” or “Measurement Operations” later in this chapter. To output results via HP-IB, refer to “Transferring Blocks.” Finally, if you want to display result on the analyzer’s screen, refer to “Plotting and Graphing Results” at the end of this chapter.

PARTIAL MEMORY MAP

The following memory map shows the location of important data blocks. Signal processing blocks start overlaying RAM at “TRACE A DATA.”

<table>
<thead>
<tr>
<th>Partial Memory Map</th>
<th>(Typical linear resolution state)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACE A DATA</td>
<td>(4k)</td>
</tr>
<tr>
<td>TRACE B DATA</td>
<td>(4k)</td>
</tr>
<tr>
<td>DATA ON CHANNEL 1</td>
<td>(4k)</td>
</tr>
<tr>
<td>(integer)</td>
<td></td>
</tr>
<tr>
<td>DATA ON CHANNEL 2</td>
<td>(4k)</td>
</tr>
<tr>
<td>(integer)</td>
<td></td>
</tr>
<tr>
<td>FFT OUTPUT—CHANNEL 1</td>
<td>(2k)</td>
</tr>
<tr>
<td>(integer)</td>
<td></td>
</tr>
<tr>
<td>FFT OUTPUT—CHANNEL 2</td>
<td>(2k)</td>
</tr>
<tr>
<td>(integer)</td>
<td></td>
</tr>
<tr>
<td>MEASUREMENT WORKING BLOCK—CHANNEL 1</td>
<td>(4k)</td>
</tr>
<tr>
<td>MEASUREMENT WORKING BLOCK—CHANNEL 2</td>
<td>(4k)</td>
</tr>
<tr>
<td>MEASUREMENT AVERAGING BLOCKS</td>
<td>(8k)</td>
</tr>
</tbody>
</table>
GENERAL BLOCK OPERATIONS

This section describes the commands used to create and handle data blocks. You should familiarize yourself with the commands in this section before attempting to use the other commands in this chapter. The commands covered in this section are:

- Block size (BLSZ)
- Point count (PTCT)
- Float block (FLTB)
- Unfloat block (UFLB)
- Move block (MOVBL)
- Move complex constant (MOVX)
- Move real constant (MOVCR)
- Partial block clear (PCLR)
- Analog input (ANIN)

Block Size (BLSZ)

The block size command (BLSZ) allocates memory for signal processing operations by creating individual blocks. When creating blocks, you specify the size of the block(s), the number of the first block, and how many blocks you want to create. The syntax of BLSZ is:

\[ \text{BLSZ} \text{s}, \text{n1}, [\text{n}] \]

where
- s is the size of the block(s) in words
- n1 is the number of the first block
- n is the number of blocks to be created (optional)

There are approximately 37.9 kwords of RAM reserved for signal processing blocks. Individual block size is limited to 32 kwords. If you want to create multiple blocks, make sure that their combined size does not exceed 37.9 kwords. The number of the first block, n1, must be between 0 and 15, inclusive. The number of blocks to be created, n, can be from 1 to 16, provided that the combination of n1 and n used does not attempt to create a block numbered higher than 15. Note that n is optional; if you do not specify it, one block is created.

As an example, the BASIC statement:

\[ \text{OUTPUT} 720; \text{"BLSZ100,0,2"} \]

creates 2 100-word blocks, numbered 0 and 1.

If more than one block exists in memory, changing the of lower-numbered blocks affects higher-numbered blocks. For example, if you have 10 500-word blocks, then recreate block 1 only at 400 words, blocks 2 through 10 will be shifted down 100 words. This can effectively erase data, so recreate blocks carefully.

If you intend to use the FFT operations, some constraints apply to primitive blocks. First, all blocks used in FFT operations must be 2048 words long (2 kwords). Second all blocks used for FFTs must reside on 2 kwords boundaries (i.e., the size of all lower-numbered blocks must be a multiple of 2 kwords).
Point Count (PTCT)

The point count command (PTCT) allows you to specify a portion of an existing block for use in subsequent operations. Its syntax is:

\[ \text{PTCT} n, p \]

where \( n \) is the block

\( p \) is the number of points

The block number, \( n \), must be between 0 and 15 and must represent an active block. The number of points, \( p \), specifies that the first \( p \) points (words) in block \( n \) will be used. Of course, \( p \) cannot be greater than the size of the block. As an example, the BASIC statement:

\[ \text{OUTPUT 720; ","PTCT1,50"} \]

specifies that the first 50 points in block 1 will be used any time in the future that block is used. To respecify the point count for a block, send PTCT again.

Float Block (FLTB)

The float block command (FLTB) is used to convert integer data to floating point format. Its syntax is:

\[ \text{FLTB} n1, n2 [,count] \]

where \( n1 \) is the integer block (source)

\( n2 \) is the destination block

\( \text{count} \) is point count (optional)

FLTB floats \( n1 \) and puts the result in \( n2 \). Of course, \( n1 \) and \( n2 \) must be valid block numbers.

Unfloat Block (UFLB)

The unfloat block command (UFLB) is used to convert floating point data to integer format. Its syntax is:

\[ \text{UFLB} n1, n2 [,count] \]

where \( n1 \) is the floating point block (source)

\( n2 \) is the destination

\( \text{count} \) is point count (optional)

UFLB unfloats \( n1 \) and puts the result in \( n2 \). Of course, \( n1 \) and \( n2 \) must be valid block numbers.
Move Block (MOVB)

The move block command (MOVB) is used to move the contents of one block into another block. Its syntax is:

```
MOVBn1,n2,p [,count]
```

where n1 is the source block
n2 is the destination block
count is the number of points to be moved (optional)

The block numbers n1 and n2 specify the source and destination, respectively. The point count, p, specifies how many points (words) from n1 are to be moved into n2. If p is not specified, all of n1 is moved. As an example, the BASIC statement:

```
OUTPUT 720; ‘MOV B9,3,50
```

moves the first 50 points of block 9 into block 3.

Move Complex Constant (MOVX)

The move complex constant command (MOVX) moves a complex constant into a complex block. Its syntax is:

```
MOVXn1,n2,n3 [,count]
```

where n1 is the real part of source constant
n2 is the imaginary part of source constant
n3 is the complex destination block
count is destination point count (optional)

The block number n3 must represent a valid block. As an example, the BASIC statement:

```
OUTPUT 720; ‘MOV X1,2,3
```

moves blocks 1 and 2 into block 3. Block 3 now = (4, 7, 5, 8, 6, 9).

Move Real Constant (MOV C)

Moves a real constant into a block. Its syntax is as follows:

```
MOV Cn1,n2 [,count]
```

where n1 is real source constant
n2 is real destination block
count is destination point count (optional)
Partial Block Clear (PCLR)

The partial block clear command (PCLR) allows you to clear points at the beginning of a block. Its syntax is:

\[
PCLRn1,p
\]

where \(n1\) is the block to be partially cleared
\(p\) is the number of points to be cleared

For example, the BASIC statement:

\[
OUTPUT 720; "PCLR1,5"
\]

clears the first 5 points in block 1.

Analog Input (ANIN)

The analog input command (ANIN) allows you to take data from the input channels for use in signal processing primitives. Its syntax is:

\[
ANINn1,n2,c1,c2
\]

where \(n1\) is the destination block for Channel 1
\(n2\) is the destination block for Channel 2
\(c1\) is the number of points to take on Ch 1
\(c2\) is the number of points to take on Ch 2

For example, the BASIC statement:

\[
OUTPUT 720; "ANIN1,2,1024,1024"
\]

inputs 1024-point blocks on both channels into primitive blocks 1 (Channel 1) and 2 (Channel 2). If no data is wanted on a channel, set the number of points for that channel to zero. This command was the current triggering setup. See "Accessing Throughput and Capture Files" in Chapter 3 for information on scaling the data.
TRANSFERRING BLOCKS

This section explains how to transfer signal processing between the controller and the HP 3562A. Each dump or load requires two steps: first identify the block to be transferred, then send the dump or load command specifying the data format. The topics covered in this section are:

1. The primitive block header
2. The block pointer (PBLK)
3. Dumping blocks in ASCII (DBAS)
   - in ANSI (DBAN)
   - in internal binary (DBBN)
4. Loading blocks in ASCII (LBAS)
   - in ANSI (LBAN)
   - in internal binary (LBBN)

The Primitive Block Header

Every primitive block has a 3-word header located at the beginning of the block. These 3 word are transparent to any size specifications. If you dump a block, make sure to allow for the 3 non-data words at the beginning.

Table 4-1 shows the primitive block header. Note that the header has this format regardless of the data format of the block.

<table>
<thead>
<tr>
<th>Word</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Block type</td>
<td>0 = real floating point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = complex floating point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = real integer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = complex integer</td>
</tr>
<tr>
<td>2</td>
<td>Block exponent</td>
<td>see text</td>
</tr>
<tr>
<td>3</td>
<td>Point count</td>
<td>equal to PTCT value</td>
</tr>
</tbody>
</table>

The value of word 1 depends on the data format in which the block was filled and any subsequent operations performed on it. The block exponent value in word 2 is used to calculate amplitude values for real integer and complex integer data blocks (types 2 and 3). The equation is:

\[
\text{amplitude} = \text{value}(2^{\text{block exponent}})
\]

Finally, the value of word 3, the point count, is equal to point count specified for the block. If you have previously specified this with the PTCT command, word 3 will be equal to the value of PTCT. If you have not used PTCT on this block, word 3 is equal to the dynamic length of the block in points.
**Primitive Block Pointer (PBLK)**

The primitive block pointer command (PBLK) specifies the active block for dumping and loading. Its syntax is:

\[ \text{PBLK}n \]

where \( n \) is the number of the block

The number of the block, \( n \), must be between 0 and 15 and must represent an existing block.

**Dumping Blocks**

Primitive data blocks can be dumped in each of the three data formats (refer to Chapter 3 for descriptions of data types). When the HP 3562A receives the dump command, it outputs six elements:

- elements 1-2: \#1 or \#A (to specify format)
- element 3: length variable
- elements 4-6: header (described earlier in this section)

The length variable differs from the point count in the header in that the length variable includes the three header elements, while the point count does not.
Dump Block in ASCII (DBAS)

The dump block in ASCII command (DBAS) dumps a block (specified by the block pointer) in ASCII format. (For a description of the ASCII format, please refer to Chapter 3.) The format specifier is #I, and the length word specifies the number of elements to be transferred.

Dump Block in ANSI (DBAN)

The dump block in ANSI format (DBAN) dumps a block (specified by the block pointer) in ANSI floating point format. (For a description of this format, please refer to Chapter 3.) The format specifier is #A, and the length word specifies the number of bytes to be transferred. Only blocks shorter than 32,768 bytes (including header) can be transferred this way.

When using the ANSI transfer, remember that these are 8-byte floating point values. Also, if your computer has an ASCII formatter, you need to disable it for ANSI transfers.

Dump Block in Internal Binary (DBBN)

The dump block in internal binary (DBBN) dumps a block (specified by the block pointer) in the internal 32-bit floating point format. (For a description of this format, please refer to Chapter 3.) The format specifier is #A, and the length word specifies the number of bytes to be transferred. Only blocks shorter than 32,768 bytes (including header) can be transferred this way.

When using the binary transfer, remember that these are 32-bit floating point values. Also, if your computer has an ASCII formatter, you need to disable it for binary transfers.
Loading Blocks

When primitive data blocks are loaded into the HP 3562A, it expects the following six elements:

- elements 1-2: #I or #A to specify format
- elements 3: length variable
- elements 4-6: header (described earlier in this section)

Load Block in ASCII (LBAS)

The load block in ASCII command (LBAS) loads a block (specified by the block pointer) in ASCII format. (For a description of the ASCII format, please refer to Chapter 3.) The format specifier is #I, and the length word specifies the number of elements to be transferred.
Load Block in ANSI (LBAN)

The load block in ANSI format (LBAN) loads a block (specified by the block pointer) in ANSI floating point format. (For a description of this format, please refer to Chapter 3.) The format specifier is #A, and the length word specifies the number of bytes to be transferred. Only blocks shorter than 32,768 bytes (including header) can be transferred this way.

When using the ANSI transfer, remember that these are 8-byte floating point values. Also, if your computer has an ASCII formatter, you need to disable it for ANSI transfers.

Load Block in Internal Binary (LBBN)

The load block in internal binary (LBBN) loads a block (specified by the block pointer) in the internal 32-bit floating point format. (For a description of this format, please refer to Chapter 3.) The format specifier is #A, and the length word specifies the number of bytes to be transferred. Only blocks shorter than 32,768 bytes (including header) can be transferred this way.

When using the binary transfer, remember that these are 32-bit floating point values. Also, if your computer has an ASCII formatter, you need to disable it for binary transfers.
MATH OPERATIONS

The commands in this section perform math operations on data blocks. If you have not yet created and filled the blocks needed for your math operation, refer to the previous section, "General Block Operations." The commands covered in this section are:

- Add blocks (ADDB)
- Add complex constant (ADDC)
- Subtract blocks (SUBB)
- Subtract complex constant (SUBX)
- Subtract real constant (SUBC)
- Multiply blocks (MPYB)
- Multiply by complex constant (MPYX)
- Multiply by real constant (MPYC)
- Multiply by \( j \) (MPJW)
- Multiply by self conjugate (MPSC)
- Multiply by magnitude squared (MPMG)
- Divide by block (DIVB)
- Divide by complex constant (DIVX)
- Divide by real constant (DIVC)
- Divide by \( j \) (DIVJW)
- Divide imaginary part (DIVI)
- Divide real part (DIVR)
- Divide into real constant (DIVR)
- Negate block (NEG)
- Conjugate block (CNJB)
- Differentiate block (DIFB)
- Integrate block (INGB)
- Power spectrum summation (PSPS)
- Cross spectrum summation (CSPS)
Add Blocks (ADDB)

The add blocks command (ADDB) allows you to add two data blocks. Its syntax is:

\[ \text{ADDB} n1, n2[, n3] \]

where:
- \( n1 \) is the first addend
- \( n2 \) is the second addend
- \( n3 \) is the destination of the result (optional)

ADDB adds \( n1 \) to \( n2 \) and puts the result in \( n3 \). If \( n3 \) is not specified, the result is put in \( n2 \).

Add Complex Constant to Block (ADDX)

The add complex constant command (ADDX) allows you to add a complex constant to a complex block. Its syntax is:

\[ \text{ADDX} n1, n2, n3[, n4] \]

where:
- \( n1 \) is the real part of the source constant
- \( n2 \) is the imaginary part of the source constant
- \( n3 \) is the complex second addend block
- \( n4 \) is the optional destination for the result

If \( n4 \) is not specified, the result is put in \( n3 \). As an example, the BASIC statement:

\[ \text{OUTPUT 720: "ADDX1,2,3,4"} \]

adds 1 + , 2 to 3 and puts the result in block 4.

Add Real Constant to Block (ADDC)

The add real constant to block command (ADDC) adds a real constant to the contents of a second block. Its syntax is:

\[ \text{ADDC} n1, n2[, n3] \]

where:
- \( n1 \) is the source constant
- \( n2 \) is the real second addend block
- \( n3 \) is the optional destination for the result

If \( n3 \) is not specified, the result is put in \( n2 \).
Subtract Blocks (SUBB)

The subtract block command (SUBB) allows you to subtract one block from another. Its syntax is:

\[ \text{SUBB} n1, n2[, n3] \]

where:
- \( n1 \) is the minuend
- \( n2 \) is the subtrahend
- \( n3 \) is the optional destination block

SUBB subtracts \( n2 \) from \( n1 \) and puts the result in \( n3 \). If \( n3 \) is not specified, the result is put in \( n2 \).

Subtract Complex Block From Complex Constant (SUBX)

The subtract complex constant command (SUBX) allows you to subtract a complex block from a complex constant. Its syntax is:

\[ \text{SUBX} n1, n2, n3[, n4] \]

where:
- \( n1 \) is the real part of the minuend
- \( n2 \) is the imaginary part of the minuend
- \( n3 \) is the complex subtrahend
- \( n4 \) is the optional destination for the result

If \( n4 \) is not specified, the result is put in \( n3 \). As an example, the BASIC statement:

\[ \text{OUTPUT} 720; "\"\text{SUBX}1,2,3,4"\]  

subtracts block 3 from \( 1 + , 2 \) and puts the result in 4.

Subtract Real Constant from Block (SUBC)

The subtract real constant from block command (SUBC) subtracts a block from a real constant. Its syntax is:

\[ \text{SUBC} n1, n2[, n3] \]

where:
- \( n1 \) is the constant minuend
- \( n2 \) is the subtrahend block
- \( n3 \) is the optional destination for the result

If \( n3 \) is not specified, the result is put in \( n2 \).
Multiply Blocks (MPYB)

The multiply blocks command (MPYB) allows you to multiply two blocks. Its syntax is:

\[ \text{MPYB} n1, n2[, n3] \]

where
- \( n1 \) is the first factor
- \( n2 \) is the second factor
- \( n3 \) is the optional destination for the result

MPYB multiplies \( n1 \) by \( n2 \) and puts the result in \( n3 \). If \( n3 \) is not specified, the result is put in \( n2 \).

Multiply Block by Complex Constant (MPYX)

The multiply complex constant command (MPYX) allows you to multiply a complex constant by a complex block. Its syntax is:

\[ \text{MPYX} n1, n2, n3[, n4] \]

where
- \( n1 \) is the real part of the source constant
- \( n2 \) is the imaginary part of the source constant
- \( n3 \) is the complex block
- \( n4 \) is the optional destination for the result

If \( n4 \) is not specified, the result is put in \( n3 \). As an example, assume block \( 1 = (1,3,5) \), block \( 2 = (2,4,6) \) and block \( 3 = (1,2,3,4,5,6) \). The BASIC statement:

\[ \text{OUTPUT} 720; "\text{MPYX}1,2,3,4" \]

multiplies 1 and 2 by 3 and puts the result in block 4.

Multiply Block by Real Constant (MPYC)

The multiply real constant block command (MPYC) multiplies a real constant by a real block. Its syntax is:

\[ \text{MPYC} n1, n2[, n3] \]

where
- \( n1 \) is the source constant
- \( n2 \) is the real block
- \( n3 \) is the optional destination for the result

If \( n3 \) is not specified, the result is put in \( n2 \).
Multiply Block by \( j\omega \) (MPJW)

The multiply by \( j\omega \) command (MPJW) command allows you to multiply a block by \( j\omega \) to perform artificial differentiation. Its syntax is:

\[
\text{MPJW} \omega_{\text{start}}, \Delta \omega, n1[, n2]
\]

where \( \omega_{\text{start}} \) is the starting value of \( \omega \)
\( \Delta \omega \) is the \( \omega \) increment
\( n1 \) is the block to be differentiated
\( n2 \) is the optional destination block for the result

Multiply Block by Self Conjugate (MPSC)

The multiply by self-conjugate command (MPSC) allows you to multiply a complex block by its complex conjugate. Its syntax is:

\[
\text{MPSC} n1[, n2]
\]

where \( n1 \) is the complex block
\( n2 \) is the optional destination for the result

Multiply Block by Magnitude Squared (MPMG)

The multiply by magnitude squared command allows you to multiply a real block by the magnitude squared of a complex block. Its syntax is:

\[
\text{MPMG} n1, n2[, n3]
\]

where \( n1 \) is the real block
\( n2 \) is the complex block
\( n3 \) is the optional destination of the result

If \( n3 \) is not specified, the result is put in \( n1 \).

Divide Block by Block (DIVB)

The divide block command (DIVB) allows you to divide one block by another. Its syntax is:

\[
\text{DIVB} n1, n2[, n3]
\]

where \( n1 \) is the dividend
\( n2 \) is the divisor
\( n3 \) is the optional destination for the result

DIVB divides \( n1 \) by \( n2 \) and puts the result in \( n3 \). \( n3 \) is an optional parameter; if it is not specified, the result is put in \( n2 \).
**Divide Block by Complex Constant (DIVX)**

The divide block by complex constant command (DIVX) allows you to divide a block by a complex constant. Its syntax is:

```
DIVX n1,n2,n3[,n4]
```

- `n1`: is the real part of the divisor
- `n2`: is the imaginary part of the divisor
- `n3`: is the complex dividend block
- `n4`: is the optional destination for the result

If `n4` is not specified, the result is put in `n3`. As an example, the BASIC statement:

```
OUTPUT 720; "DIVX1,2,3,4"
```

divides block 3 by 1+, 2 and puts the result in block 4.

**Divide Block by Real Constant (DIVC)**

The divide block by real constant command (DIVC) divides a block by a real constant. Its syntax is:

```
DIVC n1,n2[,n3]
```

- `n1`: is the constant divisor
- `n2`: is the dividend block
- `n3`: is the optional destination for the result

If `n3` is not specified, the result is put in `n2`.

**Divide Block by jω (DVJW)**

The divide by jω command (DVJW) command allows you to divide a block by jω to perform artificial integration. Its syntax is:

```
DVJW ωstart, Δω, n1[,n2]
```

- `ωstart`: is the starting value of ω
- `Δω`: is the ω increment
- `n1`: is the block to be integrated
- `n2`: is the optional destination block for the result

If `n2` is not specified, the result is put in `n1`. 
Divide Imaginary Part of Block (DIVI)

The divide imaginary part of block command (DIVI) allows you to divide the imaginary part of a complex block by a real constant. Its syntax is:

```
DIVIn1,n2[,n3]
```

where:
- `n1` is the complex block
- `n2` contains the real value
- `n3` is the optional destination for the result

If `n3` is not specified, the result is put in `n1`.

Divide Real Part of Block (DIVR)

The divide real part of block command (DIVR) allows you to divide the real part of a complex block by a real constant. Its syntax is:

```
DIVRn1,n2[,n3]
```

where:
- `n1` is the complex block
- `n2` contains the real value
- `n3` is the optional destination for the result

If `n3` is not specified, the result is put in `n1`. 
**Divide Block into Real Constant (DVIC)**

The divide block into real constant command (DVIC) allows you to divide a real block into a real constant. Its syntax is:

```
DVIC n1.n2,[n3]
```

- *n1* is the real divisor block
- *n2* is the real dividend constant
- *n3* is the optional destination for the result

If *n3* is not specified, the result is put in *n1*.

**Negate Block (NEGB)**

The negate block allows you to negate the contents of a block. Its syntax is:

```
NEGB n1[,n2]
```

- *n1* is the block to be negated
- *n2* is the optional destination for the result

If *n2* is not specified, the result is put in *n1*.

**Conjugate Block (CNJB)**

The conjugate block command (CNJB) computes the complex conjugate of a data block. Its syntax is:

```
CNJB n1[,n2]
```

- *n1* is the block to be conjugated
- *n2* is the optional destination of the result

If *n2* is not specified, the result is put in *n1*.

**Differentiate Block (DIFB)**

The differentiate block command (DIFB) computes the differential of a data block. Its syntax is:

```
DIFB n1[,n2]
```

- *n1* is the block to be differentiated
- *n2* is the optional destination for the result

If *n2* is not specified, the result is put in *n1*.
Integrate Block (INGB)

The integrate block command (INGB) computes the integral of a data block. Its syntax is:

\[ \text{INGB} n1[n2] \]

where \( n1 \) is the block to be integrated
\( n2 \) is the optional destination for the result

If \( n2 \) is not specified, the result is put in \( n1 \).

Power Spectrum Summation (PSPS)

The power spectrum summation command (PSPS) computes the power spectrum of a complex floating point block and sums it with the contents of a second block. Its syntax is:

\[ \text{PSPS} n1,n2 \]

where \( n1 \) is the block to be summed
\( n2 \) contains the cumulative result
Cross Spectrum Summation (CSPS)

The cross spectrum summation command (CSPS) computes the cross spectrum of two complex floating point blocks and sums the result with the contents of a third block. Its syntax is:

\[
\text{CSPS} n1, n2, n3
\]

where 
- \( n1 \) is the first complex block
- \( n2 \) is the second complex block
- \( n3 \) contains the cumulative result
AVERAGING OPERATIONS

The HP 3562A offers the following averaging primitives:

- Exponential averaging (XAVG)
- Power spectrum exponential averaging (PXAV)
- Cross spectrum exponential averaging (CXAV)
- Peak hold (PKHD)
- Power spectrum peak hold (PPEK)
- Cross spectrum peak hold (CPEK)

Exponential Averaging (XAVG)

The exponential average command (XAVG) averages data blocks using an exponentially
weighted averaging formula. Its syntax is:

\[ XAVGn1, n2, awf \]

where:
- \( n1 \) is the block to be averaged
- \( n2 \) is the cumulative average
- \( awf \) is the exponential weighting factor

The weighting factor, \( awf \), is interpreted as a power of 2. The formula used in exponential
averaging is:

\[ A_n = (1 - 2^{-awf})a_n + 2^{-awf}D_n \]

where:
- \( A_n \) is the cumulative average (in \( n2 \))
- \( D_n \) is the new block (in \( n1 \))
- \( awf \) is the exponential weighting factor

Power Spectrum Exponential Averaging (PXAV)

The power spectrum exponential averaging command (PXAV) computes the power spectrum
from a complex block then exponentially averages that with a cumulative average in another
block. Its syntax is:

\[ PXAVn1, n2, awf \]

where:
- \( n1 \) is the complex data block to be averaged
- \( n2 \) is the cumulative average
- \( awf \) is the exponential weighting factor

Refer to the exponential averaging command (XAVG) for the formula used.
Cross Spectrum Exponential Averaging (CXAV)

The cross spectrum exponential averaging command (CXAV) computes the cross spectrum of two complex blocks then exponentially averages that with a cumulative average in another block. Its syntax is:

```
CXAV/n1,n2,n3,awf
```

where:
- n1 is the first complex block
- n2 is the second complex block
- n3 is the cumulative average
- awf is the exponential weighting factor

Refer to the exponential averaging command (XAVG) for the formula used.

Peak Hold (PKHD)

The peak hold command (PKHD) compares the magnitudes of two blocks on a point-to-point basis and holds the larger values. Its syntax is:

```
PXHDn1,n2
```

where:
- n1 is the new block
- n2 contains the peak values

Power Spectrum Peak Hold (PPEK)

The power spectrum peak hold command (PPEK) computes the power spectrum of a complex block then compares its magnitudes to a second power spectrum block and holds the larger values. Its syntax is:

```
PPEKn1,n2
```

where:
- n1 is the new complex block
- n2 contains the peak values

Cross Spectrum Peak Hold (CPEK)

The cross spectrum peak hold command (CPEK) computes the cross spectrum of two complex blocks then compares those magnitudes to a third cross spectrum block and holds the larger values. Its syntax is:

```
CPEKn1,n2,n3
```

where:
- n1 is the first complex block
- n2 is the second complex block
- n3 contains the peak values
MEASUREMENT OPERATIONS

The HP 3562A offers the following measurement primitives:

- Histogram (HST)
- Real FFT (RFFT)
- Complex FFT (CFFT)
- Real inverse FFT (RFTI)
- Complex inverse FFT (CFTI)

**Histogram (HST)**

The histogram command (HST) computes the histogram of a block and records the histogram count in a second block. Its syntax is as follows:

```
HSTn1,n2,vmax
```

where:
- `n1` is the block to be computed (cannot be complex)
- `n2` is the destination block
- `vmax` is the maximum absolute amplitude range for block `n1`

The number of histogram bins equals the number of points in the destination block (must be greater than zero). `vmax` should be greater than the magnitude of any element in `n1` to allow for rounding.

**Real FFT (RFFT)**

The real FFT command (RFFT) computes the FFT of a real integer data block and stores the result in a second block. Its syntax is as follows:

```
RFTFn1,n2
```

where:
- `n1` is the block to be transformed
- `n2` is the destination for the result

The result is a 1k complex block. RFFT can be performed only on block sizes of 2048 that reside on 2k boundaries in memory. The imaginary part of the DC bin contains the Fs/2 point (used by the inverse FFT). To place a block on a 2k boundary, make sure that all data blocks up to the block to be transformed are multiples of 2kwords long. Also, blocks for FFT and inverse FFT operations must reside in the first 32 kwords of the 37.9 kwords available for signal processing primitives. The FFT commands use the window currently selected, unless the force or exponential is active, in which case the uniform window is used.

**NOTE 1**

To obtain the correct 2-sided linear spectra from the FFT commands, multiply by the appropriate window correction factor:

- Uniform — 1.414242555
- Hann — 2.828465107
- Flat top — 7.403524615

**NOTE 2**

Forward FFTs use a coefficient of \( \frac{1}{\sqrt{2N}} \).
Complex FFT (CFFT)

The complex FFT command (CFFT) computes the FFT of a complex integer data block and stores the result in a second block. Its syntax is as follows:

```
CFFT n1, n2
```

where `n1` is the block to be transformed

`n2` is the destination for the result

The result is a 1k complex block. CFFT can be performed only on block sizes of 1024 complex points that reside on 2k boundaries in memory. To place a block on a 2k boundary, make sure that all data blocks up to the block to be transformed are multiples of 2 kwords long. Also, blocks for FFT and inverse FFT operations must reside in the first 32 kwords of the 37.9 kwords available for signal processing primitives. The FFT commands use the window currently selected, unless the force or exponential is active, in which case the uniform window is used.

Real Inverse FFT (RFT1)

The real inverse FFT command (RFT1) computes the inverse FFT of a complex integer data block and stores the result in a second block. Its syntax is as follows:

```
RFT1 n1, n2
```

where `n1` is the block to be transformed

`n2` is the destination for the result

The result is a 2k real block. RFT1 can be performed only on block sizes of 1024 complex points that reside on 2k boundaries in memory. To place a block on a 2k boundary, make sure that all data blocks up to the block to be transformed are multiples of 2 kwords long. Also, blocks for FFT and inverse FFT operations must reside in the first 32 kwords of the 37.9 kwords available for signal processing primitives. The FFT commands use the window currently selected, unless the force or exponential is active, in which case the uniform window is used. `n1` is destroyed by the inverse FFT.

Complex Inverse FFT (CFT1)

The complex inverse FFT command (CFT1) computes the inverse FFT of a complex integer data block and stores the result in a second block. Its syntax is as follows:

```
CFT1 n1, n2
```

where `n1` is the block to be transformed

`n2` is the destination for the result

The result is a 1k complex block. CFT1 can be performed only on block sizes of 1024 complex points that reside on 2k boundaries in memory. To place a block on a 2k boundary, make sure that all data blocks up to the block to be transformed are multiples of 2 kwords long. Also, blocks for FFT and inverse FFT operations must reside in the first 32 kwords of the 37.9 kwords available for signal processing primitives. The FFT commands use the window currently selected.
PLOTTING AND GRAPHING DATA BLOCKS

The HP 3562A's plotting and graphing primitives allow you to display data blocks on the analyzer's screen. The plotting operations plot data versus data to create traces. The graphing operations create displays given a data block and an X-axis increment. The commands covered in this section are:

- Plot complex block (PCBL)
- Plot real block (PRBL)
- Graph block (GRBL)
- Graph imaginary part (GRIM)
- Graph real part (GRRE)

Plotting Complex Blocks (PCBL)

The plot complex block command (PCBL) plots the real part of a complex block versus the imaginary part of that block. Its syntax is:

```
PCBLn1
```

where n1 is the complex block to be plotted.

Plotting Real Blocks (PRBL)

The plot real block command (PRBL) allows you to create a display by plotting one real floating point data block against another. Its syntax is:

```
PRBLn1,n2
```

where n1 is the first real block
n2 is the second real block

Both blocks must be real and their point counts must be set the same.
Graphing Real Blocks (GRBL)

The graph real block command (GRBL) creates a trace from a real block and an X-axis increment. Its syntax is:

\[ \text{GRBL}n1,x,\Delta x \]

where \( n1 \) is the block to be graphed
\( x \) is the X-axis starting point
\( \Delta \) is the X-axis increment

Before using this command, you need to create and activate a display buffer that is at least as big as the primitive block you want to graph. Refer to Chapter 5 for handling display buffers. The primitive block \( n1 \) is transferred to the active display buffer when GRBL is executed.

Graphing Imaginary Part of Blocks (GRIM)

The graph imaginary part command (GRIM) is similar to the graph block (GRBL), except that GRIM uses just the imaginary part of a complex block to create the trace. Its syntax is:

\[ \text{GRIM}n1,x,\Delta x \]

where \( n1 \) is the block to be graphed
\( x \) is the X-axis starting point
\( \Delta \) is the X-axis increment

Refer to GRBL if you need more information.

Graphing Real Parts of Blocks (GRRE)

The graph real part command (GRRE) operates in the same manner as GRIM, except that GRRE graphs the real part of a complex block. Its syntax is:

\[ \text{GRRE}n1,x,\Delta x \]

where \( n1 \) is the block to be graphed
\( x \) is the X-axis starting point
\( \Delta \) is the X-axis increment

Refer to GRIM and GRBL if you need more information.
Chapter 5

DISPLAY CONTROL GROUP

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to explain the use of the display control group of bus-only commands. There are three approaches to programming the display: the Hewlett Packard Graphics Language (HP-GL), the binary language used by the display, or defining the display as a plotter for HP BASIC 3.0 graphics commands. This chapter addresses the following topics:

1. Description of the vector display
   — methods of display programming

2. Handling buffers

3. Programming with HP-GL
   — moving the pen
   — writing into buffers
   — drawing into buffers

4. Direct binary programming
   — the 1345A programming language
   — loading binary display buffers

5. Defining the display as a BASIC 3.0 plotter

6. Dumping display buffers

To get started, read the description of the display and the instructions on handling buffers, then select the method best suited to your application.

DESCRIPTION OF THE VECTOR DISPLAY

The HP 3562A's display produces images by combining vectors and text characters. There are 2048 points on each axis, for a total of over 4 million addressable points on the display. The lower left corner of the display is address 0,0 and the upper right corner is 2047,2047. The display's aspect ratio is 4.7:3.9 (X,Y).
Methods of Programming the Display

As stated at the beginning of the chapter, there are three methods you can use to program images on the display:

1. HP-GL commands
2. Direct binary programming
3. Defining the display as a BASIC 3.0 plotter

HP-GL is the language used by Hewlett-Packard plotters, and the HP 3562A implements a subset of that language. Using HP-GL is a simple way to create custom graphics. You can create up to 16 display buffers, which you then fill with commands and put on the display as needed. The commands are straightforward; each performs just one function. For example, to select line type 1 (solid line), you simply send the Line Type command “LT1” to the appropriate buffer. The Introductory Programming Guide in Appendix A provides an example of HP-GL programming.

Direct binary programming is one level closer to the display hardware and software. Instead of many simple commands, this method has just four commands, each of which can perform multiple tasks. Each command is a 16-bit word, and you configure each bit in the command. For example, the Set Conditions command selects line types as well, but it can also select brightness and writing speed. While the direct binary commands are more complicated, they provide faster display control because fewer individual commands are required. (In fact, the HP-GL commands are used internally to select the binary commands; HP-GL isolates you from the bit-by-bit programming.)

Identifying the display as a plotter for BASIC 3.0 graphics commands allows you to program the display in a high level language. This method is the easiest for BASIC 3.0 users, but it the slowest.

In summary, use the display as a BASIC 3.0 plotter when you want programming that is easy to learn and easy to use, and when speed is not a concern. Use the direct binary method for more serious graphics work when both program size and execution time are critical. Finally, use HP-GL when you need faster execution than BASIC 3.0 and friendlier programming than direct binary.

A two-step procedure that gives you the ease of HP-GL and the speed of direct binary is to load a buffer with HP-GL commands, dump it back to the analyzer, then reload it as a binary command buffer. Once you convert a set of HP-GL commands to binary, which is done automatically as you fill the buffer, you can then take advantage of direct binary’s speed. “Dumping Display Buffers,” later in this chapter, explains how to do this.
Overview of Display Programming Steps

Regardless of the method you use, there are four general steps to programming user displays:

1. Create display buffers in the analyzer’s memory
2. Activate a particular buffer
3. Load the buffer (with HP-GL, binary or BASIC 3.0)
4. Display the buffer

You must follow this sequence to get anything on the display. Steps 1, 2 and 4 are independent of the method used and are covered in the next section, “Handling Display Buffers.” Step 3 is dependent on the method used; the three methods are discussed individually later in this chapter.

HANDLING DISPLAY BUFFERS

A display buffer is simply an area you reserve in the HP 3562A’s memory for display programming. You can create up to sixteen display buffers. There are six commands for handling buffers:

**DBSZ (display buffer size)**—creates and sizes buffers

**DBAC (display buffer activate & clear)**—clears and activates a particular buffer

**DBAA (display buffer activate & append)**—activates a buffer and allows commands to be added to it

**DBUP (display buffer up)**—puts a buffer up on the display

**DBDN (display buffer down)**—takes a buffer down off the display

**DBSW (display buffer switch)**—replaces the buffer on the display with another buffer.

These commands are discussed in the following paragraphs. Keep in mind that the general sequence used with buffers is to create a buffer, activate it, fill it with commands, then put it up on the display.
Creating Buffers

Buffers are created with the DBSZ (display buffer size) command. This sets the size, identifies each buffer with a unique number, and determines how many buffers are created. Its syntax is:

\[ \text{DBSZ} s, n1, n \]

where \( s \) is size of buffer in words
\( n1 \) is number of first buffer
\( n \) is number of buffers created

For example, the BASIC statement:

\[ \text{OUTPUT 720; "DBSZ100,0,4"} \]

creates 4 buffers, numbered 0, 1, 2 and 3, each 100 words long. There are approximately 11 kwords of memory available for all display buffers, and the combined size of all buffers you create cannot exceed this. The number of the first buffer, \( n1 \), must be between 0 and 15, inclusive. The number of buffers, \( n \), cannot cause buffers numbered higher than 15. For example, if \( n1 \) is 10, \( n \) cannot be greater than 6.

Clearing and Activating a Buffer

Before a buffer can be filled, it must be activated. You have two choices: clear and activate or append and activate (discussed next). One buffer can be active at any time; it is the active buffer that receives the graphics commands sent to the analyzer. The syntax for clearing and activating is:

\[ \text{DBAC} n \]

where \( n \) is the number of the buffer

The buffer specified must already exist, and \( n \) must be between 0 and 15, inclusive. For example, the command:

\[ \text{DBAC1} \]

clears buffer number 1 and then activates it. If the specified buffer is already on the display, DBAC takes it down and clears it.

Clearing Buffers

To clear a buffer without activating it, use the clear buffer command (CLBFn, where \( n \) is the buffer to be cleared).
Appending and Activating a Buffer

If you need to add commands to a buffer that has some commands already in it but is not currently active, you need to append and activate, rather than clear and activate. The syntax is:

\[ DBAA n \]

where \( n \) is the buffer to be activated

For example, the BASIC statement:

\[ OUTPUT 720; "DBAA5" \]

activates buffer number 5 without clearing it. As with DBAC, the buffer must already exist, and \( n \) must be between 0 and 15, inclusive. If the \( n \) is already on the display, it is taken down and activated.

Putting Buffers Up and Down

After you have filled a buffer with the desired commands, the next step is to put it up on the display. This is done with DBUP\( n \), where \( n \) is the buffer to be displayed. The command is ignored if \( n \) is already up.

To take a buffer down, use DBD\( n \), where \( n \) is the buffer to be taken down. For both DBUP and DBD\( n \), the buffer must already exist, and \( n \) must be between 0 and 15, inclusive.

Display Buffer Switch

For fast buffer switching, the DBSW (display buffer switch) command is provided. Its syntax is:

\[ DBSW n1, n2 \]

where \( n1 \) is the buffer to go up

\( n2 \) is the buffer to come down

If \( n1 \) is already on the display, the command has no effect. Both buffers must already exist, and \( n1 \) and \( n2 \) must be between 0 and 15, inclusive.
PROGRAMMING WITH HP-GL

The Hewlett Packard Graphics Language (HP-GL) provides a simple method of programming the analyzer's display. Here is the general sequence of steps used with HP-GL:

1. Set up necessary buffer(s)
2. Activate one buffer
3. Move pen to desired location
4. Write text or draw vector
5. Repeat steps 3 and 4 as needed
6. Put the buffer up on the display

Modify this sequence as needed to produce your display. Steps 1, 2 and 6 are discussed earlier in this chapter under "Handling Display Buffers." Remember that the screen does not change until the buffer is put up on the display. The following sections shows you how to move the pen, write text, and draw vectors.

MOVING THE PEN

The "pen" is the beam used to produce images on the display. The nomenclature is carried over from the original use of HP-GL, where the pen is an actual pen in a plotter. This section explains how to control and move the pen. This is needed in two areas: positioning the pen to start writing or drawing, and to actually draw vectors.

Turning the "Pen" On and Off

Two commands determine whether the pen is up or down. PU (pen up) lifts the pen (turns the beam off). PD (pen down) sets the pen down (turns the beam on). To move from one point to another without drawing on the display, as when positioning the pen to start drawing, turn the beam off. To move while drawing, as when drawing a vector or writing text, turn the beam back on. In many cases you cannot be certain of the beam’s current status, so it is a good idea to explicitly turn it on or off before moving it. Note that, unlike a plotter, dropping the pen on a display does not produce a dot; you need to move it a short distance to produce a mark.
Absolute and Relative Plotting

There are two ways of moving the pen: absolute plotting and relative plotting. Absolute plotting moves to an address relative to the origin (0,0—the lower left corner). The command is PA (Plot Absolute). For example, the BASIC statement:

```
OUTPUT 720; "PA1000,1000"
```

moves the beam to approximately the center of the display. The first number if the X-axis location, and the second is the Y-axis location. Remember this will draw or not draw to address, depending on whether the beam is on or off.

Relative plotting moves to an address relative to the current position of the beam. The command is PR (Plot Relative). For example, if the pen had not been moved since the PA1000,1000 command, sending the basic statement:

```
OUTPUT 720; "PR0,-500"
```

moves the beam 500 Y-axis units down from the center of the display. The X-axis location is not changed because its relative address was specified as 0. Note that negative X values move the beam to the left, and negative Y values move the beam down.

WRITING INTO BUFFERS

Once you have the pen positioned, you can write text into the buffer. You can control character size, brightness, and rotation when writing text.

Setting Character Size

Character size is set with CHSZn, where n is 0-3:

<table>
<thead>
<tr>
<th>n</th>
<th>Character Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>24 x 36 points (default)</td>
</tr>
<tr>
<td>1</td>
<td>36 x 54 points</td>
</tr>
<tr>
<td>2</td>
<td>48 x 72 points</td>
</tr>
<tr>
<td>3</td>
<td>60 x 90 points</td>
</tr>
</tbody>
</table>
Setting Brightness

There are four levels of brightness you can select, using BRITn, where n is 0-3:

0 = off
1 = dim
2 = half bright
3 = full bright (default)

Rotating Characters

Characters can be rotated at four angles, using CHROn, where n is 0-3:

0 = 0° (default)
1 = 90°
2 = 180°
3 = 270°

Writing on the Display

When you have positioned the beam and set size, brightness and rotation, you are ready to write text. The command is WRIT, and the alpha string must be enclosed either in single quote marks or a pair of double quote marks. For example, the BASIC statements:

```
OUTPUT 720; “WRIT”’”MESSAGE”’”
```

and

```
OUTPUT 720; “WRIT”’”MESSAGE”’”
```

both write MESSAGE at the current beam position. Because of the obvious complexity of the second format, the first is recommended.

As an example of combining the four text commands, the BASIC statements:

```
OUTPUT 720; “CHSZ2”
OUTPUT 720; “BRIT3”
OUTPUT 720; “CHRO1”
OUTPUT 720; “WRIT”’”XX”’”’”
```

write XXXXXXXXXX on the display at a 90 degree angle, with character size 2 and brightness 3.
DRAWING INTO BUFFERS

Drawing vectors is merely a special application of moving the beam. Send the PD command to turn the beam on, then PA (Plot Absolute) and PR (Plot Relative) can draw vectors for you. For example, the BASIC statements:

```
OUTPUT 720;"PU"
OUTPUT 720;"PA1000,1000"
OUTPUT 720;"PD"
OUTPUT 720;"PR0,-800"
```

draw a vector from the center of the screen to 800 units down the Y-axis to 1000,200. The brightness selection (BRITn) explained in the last section applies to vectors as well. There is one more selection for vectors only, selecting the line type.

Selecting Line Types

Lines types can be selected with LTn, where n is 0-4:

0 = solid lines (default)
1 = solid lines with intensified endpoints
2 = long dashed lines
3 = short dashed lines
4 = endpoints only

If an optional second parameter is sent, it is ignored (for HP-GL compatibility).

Figure 5-1 shows the five line types available.

---

(End points intensified on display only)

---

0

1

2

3

4

---

Figure 5-1 Display Line Types
DIRECT BINARY PROGRAMMING

This is the fastest method of programming user displays. As explained earlier, it uses the commands that the display processor itself uses. This saves time by bypassing the conversion from HP-GL to the display’s binary language.

The overall programming sequence is the same: create a buffer, activate it, load it, then display it. This method provides commands to dump and load the user display buffers in ANSI floating point, ASCII, or internal binary format. (See Chapter 3 for descriptions of these data formats.)

The Display’s Binary Language

The HP 3562A uses the HP 1345A Digital Display. The 1345A receives 16-bit words that are decoded into its four commands:

- PLOT—moves the beam on the screen
- GRAPH—creates a graph given a set of data
- SET CONDITION—defines vector attributes (brightness, etc.)
- TEXT—writes alphanumeric text

Section V of the 1345A Designer’s Manual and the 1345A Quick Reference Guide have been included at the end this chapter to give you all the details of direct binary programming.

When you want to fill the active buffer, you send a data array with the load user display commands: LUAS (ASCII), LUAN (ANSI), or LUBN (internal binary). The following sections explain how to transfer binary display data to the analyzer. Please refer to Chapter 3 for descriptions of the three data formats.

Loading User Buffers in ASCII (LUAS)

The LUAS command loads the active display buffer with ASCII integer values. Here is a sample listing:

```plaintext
OUTPUT @Dsa; "DBSZ100,1"
OUTPUT @Dsa; "DBAC1"
OUTPUT @Dsa; "LUAS"
OUTPUT @Dsa USING "2A,K";"#1",5
OUTPUT @Dsa; Array(*)
OUTPUT @Dsa; "DBUP!"
```

After receiving LUAS, the analyzer expects #1 to specify ASCII data, then a variable containing the number of ASCII variables to be sent (5 in this example). After receiving these first four bytes, the analyzer is ready for data, which is in “Array” in this example. After the active buffer (#1) is filled with the contents of “Array,” the buffer is put up on the display with DBUP.
Loading User Buffers in ANSI Floating Point (LUAN)

The LUAN command loads the active display buffer with 64-bit ANSI floating point values, which are converted to integers. Here is a sample listing:

```
OUTPUT @Dsa; "DBSZ100,1"
OUTPUT @Dsa; "DBAC1"
OUTPUT @Dsa; "LUAN"
OUTPUT @Dsa USING ",","#.A",",","A",40
OUTPUT @Dsa; FORMAT OFF
OUTPUT @Dsa; Array(*)
OUTPUT @Dsa; FORMAT ON
OUTPUT @Dsa; "DBUP1"
```

After receiving LUAN, the analyzer expects to receive #A to specify ANSI data followed by the length word specifying the number of bytes to be output (40 in this example). After receiving these first four bytes, the analyzer is ready for data, which is in "Array" in this example. (The ASCII formatter was deactivated for this computer to prevent it from converting ANSI to ASCII. Your computer/language may handle this differently; if it automatically formats output data to ASCII, you need to disable this feature before sending ANSI data.) Finally, buffer #1 is put up on the display.

Loading User Buffers in Internal Binary (LUBN)

The LUBN command loads the active display buffer in the HP 3562A's internal binary format. This load command can be used only with data that have been dumped from the analyzer in (or externally converted to) the internal binary format. Here is a sample listing:

```
OUTPUT @Dsa; "DBSZ100,1"
OUTPUT @Dsa; "DBAC1"
OUTPUT @Dsa; "LUBN"
OUTPUT @Dsa USING ",","#.A",",","A",10
OUTPUT @Dsa; FORMAT OFF
OUTPUT @Dsa; Array(*)
OUTPUT @Dsa; FORMAT ON
OUTPUT @Dsa; "DBUP1"
```

After receiving LUBN, the analyzer expects to receive #A to specify binary data followed by the length word specifying the number of bytes to be output (10 in this example). After receiving these first four bytes, the analyzer is ready for data, which is in "Array" in this example. (The ASCII formatter was deactivated for this computer to prevent it from converting binary to ASCII. Your computer/language may handle this differently; if it automatically formats output data to ASCII, you need to disable this feature before sending binary data.) Finally, buffer #1 is put up on the display.
DISPLAY PROGRAMMING WITH BASIC 3.0

As explained at the beginning of this chapter, the third method of display programming is defining the analyzer’s display as the plotter for BASIC 3.0 graphics. The use of this technique is described in BASIC 3.0 Graphics Techniques. The command used to specify the display is:

```
PLOTTER IS 720, "HPGL"
```

where 720 is the analyzer’s address

For example, the following BASIC 3.0 statements plot a box and some large text on the display:

```
PLOTTER IS 720, "HPGL"
OUTPUT 720, "DBSZ250,1"
OUTPUT 720, "DBAC1"
VIEWPORT 0,88,5,99
WINDOW -130,130,-100,100
FRAME
LORG 5
C SIZE 17
MOVE 0,0
LABEL "BIG TEXT"
OUTPUT 720, "DBUP1"
```

This example also demonstrates the ability of this technique to draw larger text than is possible with the HP-GL technique.

DUMPING DISPLAY BUFFERS

Every display buffer in the HP 3562A, both user buffers and the analyzer’s own internal buffers, can be dumped via HP-IB. The internal buffers hold data traces, marker readouts, etc. This section shows you how to select the buffer to be dumped, describes the internal display buffers, and shows how to dump the selected buffer.

Dumping buffers takes two steps: first, use the vector block pointer (VBLK) to identify the buffer to be dumped. Second, select the data format in which you want the data dumped; then send the appropriate command. Buffers can be dumped in ASCII, ANSI floating point, and the internal binary formats. (For general information on these formats, please refer to Chapter 3.)

Display buffers contain 1345A binary commands (see “Direct Binary Programming” earlier in this chapter). When HP-GL or BASIC 3.0 commands are loaded, they are converted to 1345A commands by the analyzer. Because of this conversion, you can program a display initially with HP-GL or BASIC 3.0, load it into the analyzer, then dump the direct binary equivalent. If you then store these binary commands, you can have the speed advantage of direct binary any time in the future that this display is needed.
The Vector Display Buffer Pointer (VBLK)

The buffer to be dumped is selected with the vector buffer pointer command (VBLK). Its syntax is:

\[
\text{VBLKn}
\]

where \( n \) is the buffer number

The number you specify with \( n \) depends on whether or not user buffers are being used. Table 5-1 shows the value of \( n \) to be used for dumping all user and internal display buffers. Note that to dump user buffers, their numbers are offset by +4 from the number used to identify them for other graphics commands.

<table>
<thead>
<tr>
<th>Value of ( n ) (VBLKn)</th>
<th>User buffer</th>
<th>Internal buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>—</td>
<td>Softkey underlining</td>
</tr>
<tr>
<td>1</td>
<td>—</td>
<td>Softkey menu</td>
</tr>
<tr>
<td>2</td>
<td>—</td>
<td>Command echo</td>
</tr>
<tr>
<td>3</td>
<td>—</td>
<td>Message</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>Special markers, trace A</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Special markers, trace B</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>X marker readout</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>Y marker readout</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>Trace A</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>Trace B</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>Grid</td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>12</td>
<td>8</td>
<td>Y_a readout</td>
</tr>
<tr>
<td>13</td>
<td>9</td>
<td>Y_b readout</td>
</tr>
<tr>
<td>14</td>
<td>10</td>
<td>X_a readout</td>
</tr>
<tr>
<td>15</td>
<td>11</td>
<td>X_b readout</td>
</tr>
<tr>
<td>16</td>
<td>12</td>
<td>A label</td>
</tr>
<tr>
<td>17</td>
<td>13</td>
<td>B label</td>
</tr>
<tr>
<td>18</td>
<td>14</td>
<td>—</td>
</tr>
<tr>
<td>19</td>
<td>15</td>
<td>—</td>
</tr>
</tbody>
</table>

If any user buffer has been created, the user buffer corresponding to \( n \) is dumped. Otherwise, the internal buffer corresponding to \( n \) is dumped. For example, if you set up a user buffer with the DBSZ command and then send VBLK10, you will get user buffer 6 if you send a dump command. However, if you had not created a user buffer and you sent VBLK10, you would get the internal grid buffer in response to a dump command.
Dumping Buffers in ASCII (DVAS)

The display buffer identified with the vector buffer pointer (VBLK) can be dumped in ASCII format with the DVAS command. There is no header with this transfer, just #I and the length variable. The following BASIC statements dump the internal buffer that contains the softkey labels:

```basic
OPTION BASE 1
OUTPUT 720; "DVAS"
Enter 720 USING "2A,K";A$,Length
REDIM Buffer(Length)
Enter 720 Buffer(*)
```

This dumps the #I format specifier into A$, the length variable into "Length," and the ASCII variables into integer array "Buffer."

Dumping Buffers in ANSI Floating Point (DVAN)

The display buffer identified with the vector buffer pointer (VBLK) can be dumped in ANSI floating point format with the DVAN command. There is no header with this transfer, just #A and the length word indicating the number of bytes to be transferred. The following BASIC statements dump the internal buffer that contains the softkey labels:

```basic
OPTION BASE 1
ASSIGN @Dsa to 720
OUTPUT @Dsa; "DVAN"
Enter @Dsa USING "%2A,W";A$,Length
REDIM Buffer (Length DIV 8)
ASSIGN @; Dsa FORMAT OFF
ENTER @Dsa Buffer(*)
```

This dumps the #A format specifier into A$, the length word into "Length," then redimensions the array to Length/8 (8-byte floating point values).

Dumping Buffers in Internal Binary (DVBN)

The display buffer identified with the vector buffer pointer (VBLK) can be dumped in the analyzer's internal binary format with the DVBN command. There is no header with this transfer, just #A and the length word indicating the number of bytes to be transferred. The following BASIC statements dump the internal buffer that contains the softkey labels:

```basic
OPTION BASE 1
ASSIGN @Dsa to 720
OUTPUT @Dsa; "DVBN"
Enter @Dsa USING "%2A,W";A$,Length
REDIM Buffer (Length DIV 8)
ASSIGN @Dsa; FORMAT OFF
ENTER @Dsa Buffer(*)
```

This dumps the #A format specifier into A$, the length word into "Length," then redimensions the array to Length/2 (2-byte values).
1345A Quick Reference Guide

1345A COMMANDS.
NOTE: Bit D15 is used only for vector memory board commands. For standard 1345A commands, D15 should be 0.

1345A 16 Bit Data Word.

<table>
<thead>
<tr>
<th>MSB</th>
<th>D14</th>
<th>D13</th>
<th>D12</th>
<th>D11</th>
<th>D10</th>
<th>D9</th>
<th>D8</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>LSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMAND</td>
<td>COMMAND MODIFIERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set Condition</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plot Command</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graph Command</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Command</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Programming Command Ranges.

<p>| PROGRAMMING COMMAND RANGES OF THE 1345A |</p>
<table>
<thead>
<tr>
<th>1345A Command</th>
<th>Decimal Range</th>
<th>Hexadecimal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Plot</td>
<td>0000-07777</td>
<td>0000-FFFF</td>
</tr>
<tr>
<td>y (y increment)</td>
<td>1000-13777</td>
<td>1000-17F</td>
</tr>
<tr>
<td>b. Graph</td>
<td>2000-27777</td>
<td>2000-FFFF</td>
</tr>
<tr>
<td>y (y increment)</td>
<td>3000-37777</td>
<td>3000-3FFF</td>
</tr>
<tr>
<td>c. Test</td>
<td>4000-47777</td>
<td>4000-4FFF</td>
</tr>
<tr>
<td>d. Set Condition</td>
<td>6000-77777</td>
<td>6000-FFFF</td>
</tr>
</tbody>
</table>

Graph Command.

<table>
<thead>
<tr>
<th>Graph Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSB</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

Command Modifiers:
- XY Information (D12)
  - 0 = Set Delx X increment specified by D8,D9
  - 1 = Set Y coordinate, specified by Delx X increment
- PC Beam Control Information (D11)
  - 0 = Beam OFF move
  - 1 = Beam ON draw

MEMORY BOARD COMMANDS.

Vector Memory Word.

<table>
<thead>
<tr>
<th>M15</th>
<th>M14</th>
<th>M13</th>
<th>M12</th>
<th>M11</th>
<th>M10</th>
<th>M9</th>
<th>M8</th>
<th>M7</th>
<th>M6</th>
<th>M5</th>
<th>M4</th>
<th>M3</th>
<th>M2</th>
<th>M1</th>
<th>M0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(SEE DATA BIT DEFINITIONS FOR 1345A COMMANDS)

Internal Jump.

An internal jump does not affect the Vector Memory address pointer.

Y = DON'T CARE
M15 = 1, M14 = 0 Internal jump to Vector Memory address specified by A3 thru A0 during refresh.

Address Pointer.

<table>
<thead>
<tr>
<th>M15</th>
<th>M14</th>
<th>M13</th>
<th>M12</th>
<th>M11</th>
<th>M10</th>
<th>M9</th>
<th>M8</th>
<th>M7</th>
<th>M6</th>
<th>M5</th>
<th>M4</th>
<th>M3</th>
<th>M2</th>
<th>M1</th>
<th>M0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### 1345A Modified ASCII Character Set.

#### Conversion Table

<table>
<thead>
<tr>
<th>Character Code</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter Case</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
</tr>
<tr>
<td>Numbers</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Punctuation</td>
<td>.</td>
<td>,</td>
<td>'</td>
<td>''</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Examples
- "HP logo" = 01
- "a" = 61
- "1" = 30
- "\" = 16
- "1" = 31
- "I" = 51

### Capabilities for Character and Vector Combinations

#### Conditions
- Average character drawing time: 16 ms
- Average vector drawing time: 1 ms
- Total character to vector conversion time: 16 ms
- Vector drawing time: 16 ms
- Total frame time (ms): 16.67
- Character draw time: 1.67 ms
- Average vector length: 1.67 ms
- Time to draw vectors: 16.67 ms
- Average vector length: 16.67 ms
- Number of characters to draw:
  - 0: 0
  - 100: 100
  - 200: 200
  - 300: 300

#### Vector Drawing Time Calculations

- Vector Drawing Time = \( \frac{\text{Vector Length}}{\text{Writing Speed}} \) + \( \frac{1}{\mu s} \)
- Picture Drawing Time = \( \frac{N \times \text{Vector Length}}{T \times \text{Writing Speed}} \) + \( \frac{1}{\mu s} \)

#### Vector Length vs. Writing Speed for 60 Hz Refresh Rate

![Vector Length Graph](image)

#### Character Rotation

![Character Rotation Diagram](image)

### Text Command

**Text Command:**

- **Command:** MSB D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0
- **CHARACTER:**

**Command Modifiers:**

For CO-CR, see modified ASCII conversion table

- a = Establish size of character
  - A = Use previous size and rotation
  - 1 = Establish new line and rotation according to Sr, Sr, Rh, and Re
- b = Rotate Character CCW

<table>
<thead>
<tr>
<th>Rh</th>
<th>Re</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0 degrees</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>90 degrees</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>180 degrees</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>270 degrees</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sr</th>
<th>Sr</th>
<th>Size</th>
<th>W x H (in addressable points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1&quot; x 1&quot;</td>
<td>24 x 24</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1.5&quot; x 1.4&quot;</td>
<td>36 x 34</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2&quot; x 1.5&quot;</td>
<td>48 x 36</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2.5&quot; x 1.8&quot;</td>
<td>60 x 50</td>
</tr>
</tbody>
</table>

### 4 Programmable Character Sizes:

- 1.0 x 56 characters per line, 20 horizontal lines possible
- 1.5 x 27 characters per line, 19 horizontal lines possible
- 2.0 x 28 characters per line, 14 horizontal lines possible
- 2.5 x 22 characters per line, 11 horizontal lines possible
SECTION V
1345A PROGRAMMING

INTRODUCTION.

This section of the DESIGNERS MANUAL will describe the programmable functions of the 1345A Digital Display Module. Proper understanding of the capabilities and limitations of the 1345A will enable the user to obtain optimum performance. This section of the manual will be divided into three parts. These three parts will address the areas of 1345A Programming Commands, 1345A Display Requirements, and Performance Optimization. It is recommended that the user read through Section 4, Interfacing the 1345A, prior to reading this section. Please read the complete text once to gain a firm foundation of the total 1345A operating environment.

The 1345A Digital Display has 4 commands. These are PLOT, GRAPH, SET CONDITION, and TEXT. These four commands provide complete programmable vector and text generation with a minimum of command overhead. Most vector and text operations can be handled with only one 16 bit command word.

The 1345A receives 16 bit data words over the 26 pin interface connector. These 16 bit data words are decoded by the 1345A into one of four distinct commands. Each 16 bit data word sent to the 1345A can be separated into two distinct data fields. The 1345A 16 bit data word is shown in figure 5-1.

Each of the commands that the 1345A can recognize is selected by the state of data bits D14 and D13. Data bit D15 is used only for memory board operations and is discussed later. The 1345A without memory uses only data bits D0-D14. The lower 13 data bits D0-D12 are used as command modifiers.

<table>
<thead>
<tr>
<th>Command</th>
<th>Bit 14</th>
<th>Bit 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Condition</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Plot Command</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Graph Command</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Text Command</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

*Figure 5-1. 1345A 16 Bit Data Word*
These modifiers allow each command to have several selectable attributes. Vector drawing operations are directly dependent on the status of these data bits in every 1345A command. Each of these commands and their modifiers will be discussed using programming examples. The 16 bit data for the examples will be in HEXADECIMAL or HEX format. This format is easier to follow than 16 bit binary data words. Each HEX data word sent to the 1345A will be equivalent to a 16 bit binary word.

**HEX Format Generation.** Each 16 bit data word can be separated into four, four bit binary numbers. This allows each four bit binary number to have sixteen distinct combinations. Each of these combinations is assigned a HEX equivalence. The conversion from binary to HEX is contained in figure 5-2.

Each data word in the following command examples will use this HEX format. These HEX representations will correspond to the required bit patterns recognized by the 1345A.

<table>
<thead>
<tr>
<th>Hexadecimal Code</th>
<th>Binary Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b4 b3 b2 b1</td>
</tr>
<tr>
<td>0</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>1</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td>2</td>
<td>0 0 1 0</td>
</tr>
<tr>
<td>3</td>
<td>0 0 1 1</td>
</tr>
<tr>
<td>4</td>
<td>0 1 0 0</td>
</tr>
<tr>
<td>5</td>
<td>0 1 0 1</td>
</tr>
<tr>
<td>6</td>
<td>0 1 1 0</td>
</tr>
<tr>
<td>7</td>
<td>0 1 1 1</td>
</tr>
<tr>
<td>8</td>
<td>1 0 0 0</td>
</tr>
<tr>
<td>9</td>
<td>1 0 0 1</td>
</tr>
<tr>
<td>A</td>
<td>1 0 1 0</td>
</tr>
<tr>
<td>B</td>
<td>1 0 1 1</td>
</tr>
<tr>
<td>C</td>
<td>1 1 0 0</td>
</tr>
<tr>
<td>D</td>
<td>1 1 0 1</td>
</tr>
<tr>
<td>E</td>
<td>1 1 1 0</td>
</tr>
<tr>
<td>F</td>
<td>1 1 1 1</td>
</tr>
</tbody>
</table>

**Figure 5-2. Binary to HEX Conversion**

**PROGRAMMING EXAMPLES.**

**Vector Plotting.**

An explanation of vector drawing will help clarify the process. In figure 5-3, there are three vectors defined by four endpoints. Each vector requires two endpoints. The vector from point 1 to point 2 requires two endpoint declarations. The vector from point 2 to point 3 requires only point 3 be declared as an endpoint, because point 2 is already established. The vector drawn from point 2 to point 3 is a vector with the beam off. This allows the beam to be moved to new vector starting points without affecting existing displayed vectors. The vector from point 3 to point 4 is drawn with the beam on. The
correct sequence for constructing vectors in PLOT mode is ALWAYS X first, Y next, X, Y, X, ..., Y, until
the vector sequence is complete. A vector is plotted according to the last SET CONDITION command
sent to the 1345A.

The “BEAM ON” bit in the PLOT command is ignored if the coordinate being specified is an X value.
The beam status only has effect if the Y coordinate is being entered. The CRT beam will move to the
location specified by the last X and Y coordinate values specified in the PLOT commands.

Graph Plotting.

An example of the graph command is contained in figure 5-4. In this example 15 vectors are drawn
with only 20 commands. The sequence is described below:

Step 1 — Set Condition to define line type.

Step 2 — Plot command to set X location at lower left corner of graph.

Step 3 — Plot command to set Y location at lower left corner of graph.

Step 4 — Graph command to set X increment value. This value is referenced to the X axis of the
graph.

Step 5 — Graph command with beam off and Y value set to 0. This will not plot anything, but is
used to initiate the X increment to point 1.

Step 6 — Graph command with beam on and Y value set to point 1.

Step 7 — Graph command with beam on and Y value set to point 2.

(send only Y values of points 3 through 14)

Step 20 — Graph command with beam on and Y value set to point 15.
Normal XY plot mode would require 33 commands to construct the same graph. Note that the above command sequence does not include generation of the graph axis, only construction of the graph itself.

The construction of a graph can have two forms. The vectors may start at either the origin or somewhere along the Y axis of the graph. If the origin is the starting point, then the user needs to set the first Y value to zero. This will not plot anything but will start the graph at the origin and increment the X value by one. When the next Y value is sent, a vector will be drawn from the origin to the new Y value. If the Y axis is the starting point then the user needs to send the first Y value with the beam off. This will insure that the axis of the graph is not altered by the line type set for the graph trace. For the next Y value the beam should be turned on.

![Graph Mode Example](image)

**Figure 5-4. Graph Mode Example**

### 1345A COMMANDS.

#### Set Condition Command.

When D14 and D13 are both in the High TTL state, the 1345A will interpret the data word as a SET CONDITION command. This command is used to set vector attributes. The attributes affected are line type, speed, and intensity. The required bit patterns for this command and its command modifiers are contained in figure 5-5.

By combining line intensity and writing speed parameters, up to twelve levels of discernible intensities can be generated. Figure 5-6 contains several example combinations. This allows the user to create displays with background graticules and intensity important trace data. The beam will be brightest with the intensity set at full bright at the slowest writing speed. The beam will be dimmest with the intensity set at dim at the fastest writing speed. The SET CONDITION command may be executed at any time and the vector attributes will remain in effect until another SET CONDITION command is executed. Data bit 6 in this command is defined to be TTL low. This MUST occur when the Set Condition command is executed or the display may respond in an undefined fashion.
### Set Condition Command:

<table>
<thead>
<tr>
<th>MSB</th>
<th>D14</th>
<th>D13</th>
<th>D12</th>
<th>D11</th>
<th>D10</th>
<th>D9</th>
<th>D8</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>LSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>D</td>
<td>X</td>
<td>X</td>
<td>L1</td>
<td>L0</td>
<td>0</td>
<td>X</td>
<td>W1</td>
<td>W0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Note: Bit 6 (D6) must be zero.

### Command Modifiers:

a. To Set Line Intensity:

<table>
<thead>
<tr>
<th>L1</th>
<th>L0</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Blank</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Dim</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Half Brightness</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Full Brightness</td>
</tr>
</tbody>
</table>

b. To Set Line Type:

<table>
<thead>
<tr>
<th>L1</th>
<th>L0</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Solid Line</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Intensified End Points on Solid Line</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Long Dashes</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Short Dashes</td>
</tr>
</tbody>
</table>

c. To Set Writing Speed:

<table>
<thead>
<tr>
<th>W1</th>
<th>W0</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0.05 in. per μs</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0.10 in. per μs</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0.15 in. per μs</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0.20 in. per μs</td>
</tr>
</tbody>
</table>

---

**Figure 5-5. Set Condition Command**

<table>
<thead>
<tr>
<th>Hex Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6998h</td>
<td>Dim, Short Dash, Speed 0.05</td>
</tr>
<tr>
<td>7800h</td>
<td>Bright, Solid, Speed 0.2</td>
</tr>
<tr>
<td>7000h</td>
<td>Half Bright, Solid, Speed 0.2</td>
</tr>
<tr>
<td>7100h</td>
<td>Half Bright, Long Dash, Speed 0.2</td>
</tr>
</tbody>
</table>

**Figure 5-6. Set Condition Examples In Hex**
Plot Command.

When the two most significant bits of the data word, D14 and D13, are in a low TTL state, the 1345A will recognize the data word to be a PLOT command. Figure 5-7 contains the correct bit pattern for this command.

<table>
<thead>
<tr>
<th>Plot Command:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MSB</td>
<td>LSB</td>
</tr>
<tr>
<td>D14 D13 D12 D11 D10</td>
<td>D8 D7 D6 D5 D4 D3 D2 D1 D0</td>
</tr>
<tr>
<td>0 0 XY PC</td>
<td>D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0</td>
</tr>
<tr>
<td>DATA</td>
<td></td>
</tr>
</tbody>
</table>

Command Modifiers:

a. XY Information (D12)

0 = X coordinate (0-2047), specified by D8-D10
1 = Y coordinate (0-2047), specified by D8-D10

b. PC Beam Control Information (D11)

0 = Beam OFF (move)
1 = Beam ON (draw)

Figure 5-7. Plot Command Bit Pattern

This command moves the beam to a specific X-Y location in the defined cartesian coordinate plane each time an X-Y coordinate pair is received. The values of the X and Y coordinates range from 0 to 2047. The origin of the cartesian plane is located in the lower left corner and has an X-Y value of (0,0). This command also turns the beam on or off for each vector. The beam may be moved in either mode. The vector is drawn from the previous beam location to the current location specified by the last two X,Y coordinate values in the PLOT commands. The vector is drawn in accordance with the last SET CONDITION command received by the 1345A.

The diagram in figure 5-8 is a single vector defined by its endpoints in the vector drawing area. To draw this line the 1345A would need to receive two sets of X and Y coordinates. The 1345A receives the coordinates in the specified order X1,Y1,X2,Y2. The beam is moved only when the Y coordinate is received. The status of the beam is only affected by the beam status bit in the Y coordinate command.
Figure 5-8. Vector Defined By Endpoints

An example of vector plotting is contained in figure 5-9. This example contains vectors drawn with the beam on and with the beam off. The steps to draw these figures are given in the required sequence with equivalent HEX code for the 16 bit data words.

Figure 5-9. Plot Vector Example
To draw the figures, send the following 16 bit data words in sequence to the 1345A.

<table>
<thead>
<tr>
<th>Command Step</th>
<th>Box 1 data</th>
<th>Box 2 data</th>
<th>1345A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Set Condition</td>
<td>7818h</td>
<td>7818h</td>
<td>Sets Vector type (Solid Full Bright .05) X1=512</td>
</tr>
<tr>
<td>2. Plot X1</td>
<td>0200h</td>
<td>0200h</td>
<td>move to Y1=512</td>
</tr>
<tr>
<td>3. Plot Y1 (beam off)</td>
<td>1200h</td>
<td>1200h</td>
<td>move to Y2=1792</td>
</tr>
<tr>
<td>4. Plot Y2 (beam on)</td>
<td>1F00h</td>
<td>(beam off) 1700h</td>
<td>move to Y3=1792</td>
</tr>
<tr>
<td>5. Plot X3</td>
<td>8F00h</td>
<td>8F00h</td>
<td>move to Y4=512</td>
</tr>
<tr>
<td>6. Plot Y3 (beam on)</td>
<td>1F00h</td>
<td>1F00h</td>
<td>X3=1792</td>
</tr>
<tr>
<td>7. Plot Y4 (beam on)</td>
<td>1A00h</td>
<td>(beam off) 1200h</td>
<td>move to Y3=1792</td>
</tr>
<tr>
<td>8. Plot X1</td>
<td>0200h</td>
<td>0200h</td>
<td>X1=512</td>
</tr>
<tr>
<td>9. Plot Y1 (beam on)</td>
<td>1A00h</td>
<td>1A00h</td>
<td>move to Y1=512</td>
</tr>
</tbody>
</table>

A description of these two examples will help the user understand the vector plotting process. Step 1 defines the vector attributes for the vectors to be plotted by the 1345A. Definition of a starting point is crucial when plotting vectors. Steps 2 and 3 initialize the starting point of the box. Next a new Y value is received indicating that the beam be turned on. Since the X value didn’t change, only a new Y value need be sent. The beam will move to the location specified by the X-Y location when the Y value is received. The vector is drawn according to the status of the last SET CONDITION command.

When a new horizontal location is required, both the X and Y coordinates need to be sent to the 1345A. The beam is only moved and the vector drawn when a Y coordinate is received. The Y value doesn’t change going from step 4 to step 5, but the X value does. This requires that a new X-Y coordinate pair be sent to the 1345A as in steps 5 and 6. In step 7, the X value doesn’t require a change so only a new Y value is sent in step 7. The beam is turned on to draw the vector. In steps 8 and 9 a new X-Y pair is required so both values must be sent. To draw box 2, only steps 5 and 7 need to be changed. The beam status bit tells the 1345A to turn the beam off during the movement. A vector is still drawn, but with the beam turned off.

The user should notice that when a vector is to be drawn vertically, only a Y value is sent for the second vector endpoint. The 1345A has a “last X” register that stores the value of the last X location. This feature allows vertical vectors with the same X values to be drawn with one less endpoint requirement.

When plotting vectors in the vector drawing area, the user should take into account the difference in CRT screen height and width. The 1345A vector drawing area is 9.5 cm high by 12.5 cm wide and has 2048 addressable points in either direction. If this difference is not taken into account, boxes will appear as rectangles. To plot vectors correctly, the user may need to apply a scaling factor to vector endpoint calculations. The scaling factors for the 1345A are approximately 215.58 addressable points/cm in the Y direction and 163.84 addressable points/cm in the X direction. These figures are used when calculating the actual length of vectors in cm.
Graph Command.

The GRAPH command is very similar to the PLOT command. The purpose of the GRAPH command is to allow plotting of vectors that have equal incremental X coordinates. When data word bits D14 and D13 are TTL low and TTL high respectively the 1345A will interpret the data word to be a GRAPH command as shown in figure 5-10. In the GRAPH mode, the 1345A will automatically increment the X coordinate after each Y-coordinate is received. This allows single valued functions to be plotted in graph form with fewer endpoints than would be possible using X,Y coordinates for each data point.

<table>
<thead>
<tr>
<th>MSB</th>
<th>D14</th>
<th>D13</th>
<th>D12</th>
<th>D11</th>
<th>D10</th>
<th>D9</th>
<th>D8</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>LSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>XY</td>
<td>PC</td>
<td></td>
<td>D10</td>
<td>D9</td>
<td>D8</td>
<td>D7</td>
<td>D6</td>
<td>D5</td>
<td>D4</td>
<td>D3</td>
<td>D2</td>
<td>D1</td>
<td>D0</td>
<td></td>
</tr>
</tbody>
</table>

Command Modifiers:

a. XY Information (D12)

0 = Set Delta-X increment, specified by D8-D10 for all subsequent Y coordinates
1 = Set Y coordinate, specified by D8-D10. The beam is to be moved to this Y in conjunction with the Delta X increment.

b. PC Beam Control Information (D11)

0 = Beam OFF (move)
1 = Beam ON (draw)

Figure 5-10. Bit Definition For Graph Command

There are three command modifiers in the GRAPH command. These modifiers control the X increment, Y coordinate data value, and the beam status. When D12 is 0, the data in bits D0-D10 define the value of the X increment. This is the amount the X coordinate will increase after each Y coordinate is plotted. The range of the X increment is 0 to 2047. It should be noted that X increases relative to present X,Y coordinate values on the screen. Figure 5-11 contains an example of the graph mode commands. The beam moves when the Y coordinate value is received.

Figure 5-11. Graph Mode Example
To create the output in figure 5-10 the following steps were executed with the given 16 bit HEX data.

<table>
<thead>
<tr>
<th>Command Step</th>
<th>16 Bit Data</th>
<th>1345A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Set Condition</td>
<td>7818h</td>
<td>Set Vector Attributes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Solid Full Bright, .05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X=512</td>
</tr>
<tr>
<td>2. Plot X1</td>
<td>0200h</td>
<td></td>
</tr>
<tr>
<td>3. Plot Y1 (beam off)</td>
<td>1200h</td>
<td>move to Y=512</td>
</tr>
<tr>
<td>4. Graph command Set Delta X</td>
<td>2040h</td>
<td>set X increment to 64</td>
</tr>
<tr>
<td>5. Graph command Y1</td>
<td>3280h</td>
<td>Y=640</td>
</tr>
<tr>
<td>6. Graph command Y2</td>
<td>3280h</td>
<td>Y=640</td>
</tr>
<tr>
<td>7. Graph command Y3</td>
<td>3300h</td>
<td>Y=768</td>
</tr>
<tr>
<td>8. Graph command Y4</td>
<td>3280h</td>
<td>Y=640</td>
</tr>
</tbody>
</table>

Step 1 defines the line type, speed, and intensity. Steps 2 and 3 determine the starting point of the graph. The delta X increment is established in step 4. The (4) Y values are sent in steps 5-8. The value of X is incremented AFTER each Y value is received.

If the graph is to start at the axis origin, then execute a graph command with a first Y value set to zero. This will not plot anything, but will increment the X value by delta X. The next vector will be drawn from the origin to the Y value for the first X increment. If the graph is to start at the Y axis, then execute a Y value command. The next vector will be drawn from the Y value on the Y axis to the Y value of the first X increment.

Text.

The 1345A comes complete with an internal character generator. This internal character data is a modified ASCII character set for graphics use. The data for commanding the 1345A to enter the text mode is in figure 5-12. Data bits D14 must be TTL high and D13 must be TTL low. When this command is executed the 1345A will interpret the lower eight data bits, D0-D7 as an equivalence for an ASCII or special character. Each vector of the character is drawn on the CRT screen according to the vector characteristics of the last SET CONDITION command. The characters are always drawn at the slowest writing speed. The line type has no visible effect except on the largest character size, (2.5X). The position is defined by the last X and Y coordinates received by the 1345A.

When generating characters, the 1345A automatically provides character spacing to the right of each character. The TEXT command has command modifiers for size and rotation information. New size and rotation information is controlled by the status of data word bit D8. To initiate new character attributes, bit D8 must be set high as a new information indicator. If this data bit is "0", the size and rotation bits are ignored.

The 1345A has 4 character sizes. These 4 sizes are defined by the status of bits D11 and D12. The amount of space needed to draw the characters is contained in figure 5-12. This is the required space needed out of 2048 X 2048 possible points. The number of characters that can be drawn across the screen at the different sizes is in figure 5-13. An example of 1x character spacing is contained in figure 5-14.
Text Command:

<table>
<thead>
<tr>
<th>MSB</th>
<th>LSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0</td>
<td>C7 C6 C5 C4 C3 C2 C1 C0</td>
</tr>
<tr>
<td>1   0 S1 S0 R1 R0 ES C7 C6 C5 C4 C3 C2 C1 C0</td>
<td></td>
</tr>
</tbody>
</table>

Command Modifiers:

For C0-C7, see figure 5-14

a. ES Establish Size of Character

φ = Use previous size and rotation
1 = Establish new size and rotation according to S1, S0, R1 and R0

b. Rotate Character CCW

<table>
<thead>
<tr>
<th>R1</th>
<th>R0</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ</td>
<td>φ</td>
<td>0 degrees</td>
</tr>
<tr>
<td>φ</td>
<td>1</td>
<td>90 degrees</td>
</tr>
<tr>
<td>1</td>
<td>φ</td>
<td>180 degrees</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>270 degrees</td>
</tr>
</tbody>
</table>

c. Character Size

<table>
<thead>
<tr>
<th>S1</th>
<th>S0</th>
<th>Size</th>
<th>W × H (in addressable points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ</td>
<td>φ</td>
<td>1X</td>
<td>24 × 36</td>
</tr>
<tr>
<td>φ</td>
<td>1</td>
<td>1.5X</td>
<td>36 × 54</td>
</tr>
<tr>
<td>1</td>
<td>φ</td>
<td>2X</td>
<td>48 × 72</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2.5X</td>
<td>60 × 90</td>
</tr>
</tbody>
</table>

Figure 5-12. Text Command Bit Pattern

4 PROGRAMMABLE CHARACTER SIZES:

1.0 × 56 characters per line, 29 horizontal lines possible.
1.5 × 37 characters per line, 19 horizontal lines possible.
2.0 × 28 characters per line, 14 horizontal lines possible.
2.5 × 22 characters per line, 11 horizontal lines possible.

Figure 5-13. 1345A Character Display Capabilities
The starting position of each character is the lower left corner of the defined character cell. After drawing a character, the 1345A advances to the starting point of the next character much like a typewriter would operate. The 1345A also contains many special characters that facilitate graphics and display annotation. Figure 5-15 contains the modified 1345A ASCII character set in HEX format. This HEX code is sent to the 1345A in the lower 8 bits of each text command.

### 1345A MODIFIED ASCII CODE CONVERSION TABLE

<table>
<thead>
<tr>
<th>LEAST SIGNIFICANT CHARACTER</th>
<th>MOST SIGNIFICANT CHARACTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/2 shift down</td>
<td>\μ (degree)</td>
</tr>
<tr>
<td>horizontal tic</td>
<td>\theta</td>
</tr>
<tr>
<td>vertical tic</td>
<td>\lambda</td>
</tr>
<tr>
<td>carriage return</td>
<td>\Gamma</td>
</tr>
<tr>
<td>1/2 shift up</td>
<td>\rho</td>
</tr>
<tr>
<td>inv. line feed</td>
<td>\Omega</td>
</tr>
<tr>
<td>line feed</td>
<td>°</td>
</tr>
<tr>
<td>back space</td>
<td>\Delta</td>
</tr>
<tr>
<td>right-half tic</td>
<td>π</td>
</tr>
<tr>
<td>left-half tic</td>
<td>\sqrt</td>
</tr>
<tr>
<td>lower-half tic</td>
<td>%</td>
</tr>
<tr>
<td>upper-half tic</td>
<td>$</td>
</tr>
<tr>
<td>1/2 shift down</td>
<td>_</td>
</tr>
<tr>
<td>back space</td>
<td>μ</td>
</tr>
<tr>
<td>right-half tic</td>
<td>\pi</td>
</tr>
<tr>
<td>left-half tic</td>
<td>\sqrt</td>
</tr>
<tr>
<td>lower-half tic</td>
<td>%</td>
</tr>
<tr>
<td>upper-half tic</td>
<td>$</td>
</tr>
<tr>
<td>1/2 shift down</td>
<td>_</td>
</tr>
<tr>
<td>back space</td>
<td>μ</td>
</tr>
<tr>
<td>right-half tic</td>
<td>\pi</td>
</tr>
<tr>
<td>left-half tic</td>
<td>\sqrt</td>
</tr>
<tr>
<td>lower-half tic</td>
<td>%</td>
</tr>
<tr>
<td>upper-half tic</td>
<td>$</td>
</tr>
<tr>
<td>1/2 shift down</td>
<td>_</td>
</tr>
</tbody>
</table>

### EXAMPLES:

- HP logo = 01
- A = 41
- i = 69
- \sqrt = 16
- \rightarrow = 7F
- line feed = 09

*Figure 5-15. 1345A Modified ASCII Character Set*
Character rotation is an additional feature of the 1345A. The 1345A can be programmed to rotate any character at 0, 90, 180, or 270 degrees rotation measured counter clockwise from horizontal. This can be done for any character at any size. The starting point of the character is always the lower left corner relative to any rotation. For character rotation, the entire character area is rotated the specified number of degrees and the starting point moves around in a counter clockwise fashion. For example the starting point of a character rotated 180 degrees would be the upper right corner. This technique is illustrated in figure 5-16.

Since the starting point of the character changes with rotation, so does the direction of character spacing. If the rotation is 180 degrees, the characters will be written upside down from right to left. If the rotation mode is 270 degrees, the characters will advance from top to bottom. Rotation spacing examples are contained in figure 5-17.
Character generation on the 1345A has several capabilities that the user need be aware of. Certain characters that the 1345A is capable of drawing CANNOT be written within a certain distances of certain CRT screen boundaries. These characters are listed in Figure 5-18. The characters are referenced to the to the screen boundary at which the limitation occurs.

It is important to observe the recommended character boundary specifications, to avoid problems which might be encountered by writing at the screen edges. Figure 5-19 contains recommended limits for each character size at each screen edge. Failure to observe these limits may result in undefined results particularly when writing characters listed in figure 5-18. The user should plot all characters within these specified borders.

The user should not attempt to write any character along a screen edge. The character spacing guidelines in figure 5-19 allow ample spacing for characters of all specified sizes. Characters NOT specified in figure 5-18 may be written closer to the screen borders but it is not recommended.

**BOUNDARY CHARACTERS**

<table>
<thead>
<tr>
<th>Left Boundary:</th>
<th>07 &quot;right-half tic&quot;; 08 &quot;back space&quot;; 0E &quot;horizontal tic&quot;; 0F &quot;vertical tic&quot;; 10 &quot;centered *&quot;; 11 &quot;centered o&quot;; 41 &quot;A&quot;; 57 &quot;W&quot;; 5F &quot;_&quot;; 77 &quot;w&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom Boundary:</td>
<td>02 &quot;β&quot;; 05 &quot;lower-half tic&quot;; 09 &quot;1/2 shift down&quot;; 0A &quot;line feed&quot;; 0F &quot;vertical tic&quot;; 10 &quot;centered *&quot;; 11 &quot;centered o&quot;; 19 &quot;μ&quot;; 1C &quot;ρ&quot;; 24 &quot;$&quot;; 28 &quot;(&quot;; 29 &quot;);&quot;; 2C &quot;&quot;,; 3B &quot;&quot;,; 51 &quot;Q&quot;; 5B &quot;&quot;; 5D &quot;;&quot;; 5F &quot;_&quot;; 67 &quot;g&quot;; 6A &quot;]&quot;; 70 &quot;p&quot;; 71 &quot;q&quot;; 79 &quot;γ&quot;; 7B &quot;{&quot;; 7D &quot;}&quot;</td>
</tr>
<tr>
<td>Top Boundary:</td>
<td>01 &quot;HP logo&quot;; 0B &quot;inv. line feed&quot;; 0C &quot;1/2 shift up&quot;; 16 &quot;√&quot;; 11 &quot;A&quot;; 8 (degree); 24 &quot;$&quot;; 28 &quot;(&quot;; 29 &quot;);&quot;; 38 &quot;8&quot;; 5B &quot;&quot;; 5D &quot;&quot;; 7B &quot;{&quot;; 7D &quot;}&quot;; 7E &quot;□&quot;</td>
</tr>
<tr>
<td>Right Boundary:</td>
<td>01 &quot;HP logo&quot;; 16 &quot;√&quot;; 41 &quot;A&quot;; 51 &quot;Q&quot;; 57 &quot;W&quot;; 61 &quot;a&quot;; 71 &quot;q&quot;; 77 &quot;w&quot;; 7E &quot;□&quot;</td>
</tr>
</tbody>
</table>

**NOTE:** HEX character equivalents appear in quotation marks.

*Figure 5-18. Boundary Characters*

**Wrap Around.** The user needs to be aware of a phenomenon called "wrap around". If one or more vectors are drawn outside the vector drawing area, the display will draw vectors on opposite sides of the CRT. One part of the vector will be at one side of the screen while the other part of the vector will be drawn on the opposite side of the CRT. The picture will appear distorted with visible vectors connecting ends of the vectors. This can be corrected by plotting inside the 1345A vector drawing area.
PROGRAMMING THE MEMORY OPTION (704).

The 1345A Memory Option stores up to 4k, 16 bit commands and refreshes the CRT thus relieving the user processor of data storage and CRT refresh requirements. The vector memory will appear to the user processor as a single memory location. The memory option recognizes two commands for programming. These commands are for data transfer and memory address pointer manipulation. A data transfer is either a read from or a write to the vector memory. Address pointer operations are used for positioning the data in the vector memory list and selecting a desired memory read address.

The vector memory contains a 4k by 16 bit memory, a 60 hz refresh timer, and two address pointers for accessing the memory. The timer is used to generate a refresh cycle of approximately 60 hz. This timer, when enabled will display the contents of the vector memory approximately once every 16.67 ms. There is a jumper on the memory board that allows the user to initiate the refresh cycle from an external source. This would be used to synchronize the refresh cycle with the user instrument data transfers or to refresh the display at a frequency other than 60 hz.

There are two pointers used to control access of data to and from the vector memory. One of these pointers is called the refresh pointer. It is enabled at the start of a refresh cycle and starts sequencing through vector memory until the end of memory is reached or an internal jump to 4095 is encountered. This is an internal memory address pointer that the user cannot access. The other pointer is called the Vector Memory Address pointer. This pointer is used to control data access to the vector memory. This pointer may be positioned by user commands for data transfer into and out of the vector memory list. In either case, an important fact is, that after a read or write operation the address of this pointer will increment by one.
## PURPOSE OF THIS CHAPTER

The purpose of this chapter is to explain the bus-only control and communication group of commands. The topics covered here are:

| Service Requests & Instrument Status | The status byte  
The instrument status register  
The activity status register  
Labeling user SRQs  
Power-on SRQ  
Reading sweep points  
Ready status  
Source fault status  
Reference locked status  
Measurement done status  
Missed sample status  
Overflow status  
Identify query  
Revision query  
Serial number query  
Setup state transfer  
HP-IB trigger enable  
Passing control  
Error code query |
|-------------------------------------|-------------------------------------------------|
| Reading Marker Values               | X marker  
Individual special markers  
Grouped special markers |
| Communicating with the Front Panel  | Key presses  
Reading Entry knob movement  
Reading Markers knob movement  
Writing to the message field  
Controlling display updating  
Reading auto carrier values  
Controlling HP logo for plotting |

Most of the topics in this chapter are also discussed in condensed format in Appendix B, "Quick Reference Guide."
SERVICE REQUESTS AND INSTRUMENT STATUS

The service request (SRQ) is sent by the HP 3562A to gain the attention of the system controller. The SRQ is generated by conditions in the status byte (see the next section). When the HP 3562A issues an SRQ (activates the SRQ line), it also sets bit #6 in the status byte. This is the Require Service (RQS) bit, sometimes referred to as the "status bit" in connection with a poll.

An SRQ is sent for two general reasons: either the analyzer needs control of the bus, or there is some change in its internal status that the controller may be interested in.

The HP 3562A generates SRQs at three levels. First, true conditions in the status byte directly send the SRQ. Second, true conditions in the instrument status register (IS) indirectly generate SRQs through the status byte. Third, conditions in the activity status (AS) register indirectly generate SRQs through the IS then through the status byte.

Your controller’s program doesn’t necessarily have to be interrupt-driven. Any status condition or event capable of sending an SRQ can also be read directly. Table 6-1 summarizes the available status checks and how you can read them with a controller. The “Command” column shows the checks that have dedicated HP-IB commands.

Programming for Service Requests

In many applications, the controller program will be written so that it stops execution and polls all instruments on the bus when it receives an SRQ. A program written to perform serial polls dumps an entire status byte from each instrument and checks the status bit to detect which instrument requires service. When the instrument requesting service is identified, the reason for the SRQ can be found by decoding the status byte. Any unmasked status bits and conditions can initiate an SRQ. RESET and DEVICE CLEAR reset all masks in the status byte, instrument status and activity status registers.

As mentioned earlier, your program does not have to be interrupt-driven: every condition/event listed in Table 6-1 can be read without waiting for an SRQ. The scheme you should take, waiting for interrupts or reading status checks, depends on your application.
### Table 6-1 Summary of Status Checks in the HP 3562A

<table>
<thead>
<tr>
<th>Condition/Event</th>
<th>Status Byte</th>
<th>IS</th>
<th>AS</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requested service</td>
<td>*</td>
<td>IS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error generated</td>
<td>*</td>
<td></td>
<td>AS</td>
<td>ERR?</td>
</tr>
<tr>
<td>Ready for HP-IB commands</td>
<td></td>
<td></td>
<td></td>
<td>RDY?</td>
</tr>
<tr>
<td>User SRGs</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of disc action</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of plot action</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power up</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key pressed</td>
<td>*</td>
<td></td>
<td></td>
<td>KEY?</td>
</tr>
<tr>
<td>Various plotter &amp; disc requests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument status change</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement pause</td>
<td>*</td>
<td></td>
<td></td>
<td>IS?</td>
</tr>
<tr>
<td>Auto sequence pause</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of measurement, capture or throughput</td>
<td>*</td>
<td></td>
<td></td>
<td>SMSD</td>
</tr>
<tr>
<td>Sweep point ready</td>
<td>*</td>
<td></td>
<td></td>
<td>SSWP</td>
</tr>
<tr>
<td>Channel 1 over range</td>
<td>*</td>
<td></td>
<td></td>
<td>SCV1</td>
</tr>
<tr>
<td>Channel 2 over range</td>
<td>*</td>
<td></td>
<td></td>
<td>SCV2</td>
</tr>
<tr>
<td>Channel 1 half scale</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel 2 half scale</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source fault</td>
<td>*</td>
<td></td>
<td></td>
<td>SPLT</td>
</tr>
<tr>
<td>Reference locked</td>
<td>*</td>
<td></td>
<td></td>
<td>RLOCK</td>
</tr>
<tr>
<td>Marker knob turned</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entry knob turned</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity status change</td>
<td>*</td>
<td></td>
<td></td>
<td>AS?</td>
</tr>
<tr>
<td>System failure</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filling time record</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filters setting</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curve fit in progress</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missed external sample</td>
<td>*</td>
<td></td>
<td></td>
<td>SMSP</td>
</tr>
<tr>
<td>Timed preview active</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data accepted</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting for trigger</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting for arm</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramping source</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnostic in progress</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marker calc in progress</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify</td>
<td>*</td>
<td></td>
<td></td>
<td>ID?</td>
</tr>
<tr>
<td>Revision</td>
<td>*</td>
<td></td>
<td></td>
<td>REV?</td>
</tr>
<tr>
<td>Send setup state</td>
<td>*</td>
<td></td>
<td></td>
<td>SET?</td>
</tr>
</tbody>
</table>


The Status Byte

The status byte is an 8-bit byte that provides information about the analyzer’s current interaction with the bus. It provides 35 conditions, each with a unique code. All conditions are capable of generating SRQs. Some of the conditions can be masked, which prevents them from sending an SRQ, regardless of their current state. For example, if the "key pressed" condition is enabled (unmasked) and a key is pressed on the front panel, reading the status byte indicates that it was indeed the key pressed condition that generated the SRQ.

Table 6-2 shows the eight bits in the HP 3562A’s status byte. The status byte is read by serial polling the analyzer (which also clears the status byte). Five of these bits are encoded; refer to table 6-3 for the condition codes.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>128</td>
<td>see table 6-3</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>RQS (HP 3562A requested service)</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>ERR (HP-IB error)</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>RDY (ready to accept HP-IB commands)</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>see table 6-3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>see table 6-3</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>see table 6-3</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>see table 6-3</td>
</tr>
</tbody>
</table>

RDY (bit 4) is set when the instrument is ready to receive commands over the bus. This occurs when the command buffer is empty. The HP-IB command buffer has a capacity of three 80-byte command lines where a byte represents one character, and a line is defined to be terminated by a line-feed or activation of the EOI (End Of Identify) bus management line (carriage returns are ignored).

ERR (bit 5) is set when the instrument encounters an error condition and is cleared when the error register is read by the controller with the ERR? query command. Refer to "Error Codes" later in this section to decode the number returned with ERR?.

RQS (bit 6) is set when the analyzer activates the SRQ bus management line and is cleared when the controller serial polls the HP 3562A for its status byte.
Table 6-3 shows the condition codes represented by bits 7, 3, 2, 1 and 0 in the status byte.

<table>
<thead>
<tr>
<th>Status bit Numbers 7 3 2 1 0</th>
<th>Status Byte Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0 0</td>
<td>0</td>
<td>No service requested</td>
</tr>
<tr>
<td>0 0 0 0 1</td>
<td>1</td>
<td>User SRQ #1</td>
</tr>
<tr>
<td>0 0 0 1 0</td>
<td>2</td>
<td>User SRQ #2</td>
</tr>
<tr>
<td>0 0 0 1 1</td>
<td>3</td>
<td>User SRQ #3</td>
</tr>
<tr>
<td>0 0 1 0 0</td>
<td>4</td>
<td>User SRQ #4</td>
</tr>
<tr>
<td>0 0 1 0 1</td>
<td>5</td>
<td>User SRQ #5</td>
</tr>
<tr>
<td>0 0 1 1 0</td>
<td>6</td>
<td>User SRQ #6</td>
</tr>
<tr>
<td>0 0 1 1 1</td>
<td>7</td>
<td>User SRQ #7</td>
</tr>
<tr>
<td>0 1 0 0 0</td>
<td>8</td>
<td>User SRQ #8</td>
</tr>
<tr>
<td>0 1 0 0 1</td>
<td>9</td>
<td>End of disc action</td>
</tr>
<tr>
<td>0 1 0 1 0</td>
<td>10</td>
<td>End of plot action</td>
</tr>
<tr>
<td>0 1 0 1 1</td>
<td>11</td>
<td>Instrument status change</td>
</tr>
<tr>
<td>0 1 1 0 0</td>
<td>12</td>
<td>Power up</td>
</tr>
<tr>
<td>0 1 1 0 1</td>
<td>13</td>
<td>Key pressed</td>
</tr>
<tr>
<td>0 1 1 1 0</td>
<td>14</td>
<td>Device Clear Plotter, Listen HP 3562A</td>
</tr>
<tr>
<td>0 1 1 1 1</td>
<td>15</td>
<td>Unaddress Bus, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 0 0 0</td>
<td>128</td>
<td>Talk plotter, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 0 0 1</td>
<td>129</td>
<td>Talk disc execution, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 0 1 0</td>
<td>130</td>
<td>Talk disc report, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 0 1 1</td>
<td>131</td>
<td>Talk Amigo disc command, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 1 0 0</td>
<td>132</td>
<td>Talk Amigo disc data, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 1 0 1</td>
<td>133</td>
<td>Talk Amigo short status, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 1 1 0</td>
<td>134</td>
<td>Talk disc identify, Listen HP 3562A</td>
</tr>
<tr>
<td>1 0 1 1 1</td>
<td>135</td>
<td>Talk Amigo parallel poll, Listen HP 3562A</td>
</tr>
<tr>
<td>1 1 0 0 0</td>
<td>136</td>
<td>Listen Plotter, Talk HP 3562A</td>
</tr>
<tr>
<td>1 1 0 0 1</td>
<td>137</td>
<td>Listen disc command, Talk HP 3562A</td>
</tr>
<tr>
<td>1 1 0 1 0</td>
<td>138</td>
<td>Listen disc execution, Talk HP 3562A</td>
</tr>
<tr>
<td>1 1 0 1 1</td>
<td>139</td>
<td>Listen Amigo disc command, Talk HP 3562A</td>
</tr>
<tr>
<td>1 1 1 0 0</td>
<td>140</td>
<td>Listen Amigo disc data, Talk HP 3562A</td>
</tr>
<tr>
<td>1 1 1 0 1</td>
<td>141</td>
<td>Listen Amigo disc read, Talk HP 3562A</td>
</tr>
<tr>
<td>1 1 1 1 0</td>
<td>142</td>
<td>Listen Amigo disc write, Talk HP 3562A</td>
</tr>
<tr>
<td>1 1 1 1 1</td>
<td>143</td>
<td>Listen Amigo disc format, Talk HP 3562A</td>
</tr>
</tbody>
</table>
Condition 0 indicates that no service was requested and it was not the HP 3562A that sent the SRQ. Conditions 1—8 are the eight USER SRQ softkeys (see “Labeling User SRQs” later in this section). Condition 9 indicates that disc action under the analyzer's control is finished; 10 shows the same thing for a plotter. Condition 11 is the "window" into the instrument status (IS) register; any change in the IS register sets this condition. Condition 12 is set if the PwrSRQ ON OFF softkey (in the SPCL PCTN menu) is ON and power is applied to the analyzer. Condition 13 is set if key code monitoring is enabled and a key on the analyzer's front panel is pressed. Conditions 14, 15 and 128-143 are provided for controllers incapable of passing control; refer to "Passing Control" later in this chapter.

The status byte can indicate up to three conditions simultaneously:

1. Occurrence of an error with ERR (bit 5)
2. Readiness to accept more commands with RDY (bit 4)
3. One of the 32 other conditions (bits 7,3,2,1,0)

The analyzer remembers one status condition beyond the one shown in the status byte. For example, assume the power-on and key pressed conditions are both enabled, and you power on and press a key. If you then read the status byte, it indicates the power-on SRQ (which occurred first). Since reading the status byte this time clears it, reading it again shows the key pressed condition. This queuing applies only to conditions 1-12. When conditions 13-143 are set, they must be serviced and cleared before the analyzer can continue.
Masking the Status Byte

When a condition is “masked,” it is prevented from generating an SRQ when it becomes true. At power-on, all conditions except the power-on SRQ are masked (disabled), but it is a good idea to explicitly mask and unmask conditions as needed. Masking a condition does not prevent it from occurring, nor does it prevent the condition code from being set. Table 6-4 summarizes status byte masking.

<table>
<thead>
<tr>
<th>Condition</th>
<th>How to Mask</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>not maskable (never generates an SRQ)</td>
</tr>
<tr>
<td>1-8</td>
<td>not maskable</td>
</tr>
<tr>
<td>9-10</td>
<td>masked with SRQD; unmasked with SRQE</td>
</tr>
<tr>
<td>11</td>
<td>masked with ISMn, where n is decimal equivalent of the bits in the IS register to be unmasked. This bit is completely masked by sending ISM0.</td>
</tr>
<tr>
<td>12</td>
<td>masked with PSRQ0; unmasked with PSRQ1</td>
</tr>
<tr>
<td>13</td>
<td>masked with KEYD; unmasked with KEYE</td>
</tr>
<tr>
<td>14-15</td>
<td>not maskable</td>
</tr>
<tr>
<td>16 (RDY)</td>
<td>masked with RDYD; unmasked with RDYE</td>
</tr>
<tr>
<td>32 (ERR)</td>
<td>masked with ERRD; unmasked with ERRE</td>
</tr>
<tr>
<td>64 (RQS)</td>
<td>not maskable (never generates an SRQ)</td>
</tr>
<tr>
<td>128-143</td>
<td>not maskable</td>
</tr>
</tbody>
</table>

Conditions 9 and 10 are unmasked with SRQE (optional service request enable) and masked with SRQD (optional service request disable). Condition 11 is masked/unmasked indirectly with ISMn (instrument status mask). Refer to “Masking the IS Register” later in this section for details. The point here is that unmasking at least one bit in the IS register automatically unmasks condition 11 in the status byte. Condition 12 is masked by pressing PwrSRQ ON OFF to OFF (or sending PSRQ0 over the bus) and unmasked by pressing it ON (or sending PSRQ1 over the bus). Condition 13 is masked with KEYD (key code disable) and unmasked with KEYE (key code enable). Condition 16 (the RDY bit) is masked with RDYD (ready SRQ disable) and unmasked with RDYE (ready SRQ enable). Condition 32 is masked with ERRD (error SRQ disable) and unmasked with ERRE (error SRQ enable). Remember, to enable a condition, unmask it. To disable it and prevent it from sending an SRQ, mask it.

SRQs are generated only by the status byte; the instrument status (IS) and activity status (AS) registers must generate SRQs indirectly through the status byte. The IS register can generate an SRQ if condition 11 in the status byte is enabled. The AS register is twice removed: bit 13 of the IS register and condition 11 of the status byte must be enabled for the AS to generate an SRQ.
The Instrument Status Register

Unlike the status byte, which shows the analyzer's current interaction with the bus, the instrument status (IS) register shows various conditions of the analyzer's internal status. The IS register does not generate SRQs (at least not directly). True conditions in the IS set condition 11 in the status byte, which in turn sends the SRQ.

Table 6-5 shows the instrument status (IS) register. The contents of the IS are read by sending the IS? command (which also clears the register). Unlike the status byte, the IS is not encoded: each bit represents a single condition/event. Remember that condition 11 in the status byte must be enabled (unmasked) before the IS can indirectly generate an SRQ.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Condition/Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Measurement pause</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Auto sequence pause</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>End of measurement, capture or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>throughput</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>End of auto sequence</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Sweep point ready</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Channel 1 over range</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Channel 2 over range</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Channel 1 half range</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Channel 2 half range</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>Source fault</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>Reference unlocked</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>Remote marker knob turn</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>Remote entry knob turn</td>
</tr>
<tr>
<td>13</td>
<td>8192</td>
<td>activity status register change</td>
</tr>
<tr>
<td>14</td>
<td>16384</td>
<td>Power-on test failed</td>
</tr>
</tbody>
</table>

Bit 0 is set when the measurement has been paused, either from the front panel or via HP-IB. Bit 1 is set when an auto sequence has been paused. Bit 2 is set when a measurement, capture, or throughput ends. For averaged measurements, this is at the completion of the last average. When averaging is off, it is set after each measurement. Bit 3 is set when an auto sequence is finished. Bit 4 is set when the analyzer is in the swept sine mode and a sweep point is ready. Bits 5—6 can be set only when a measurement, capture, or throughput is in progress. Bits 7—8 are set if the signal reaches half-range at least once during the measurement. Bit 9 indicates when a source fault occurs that causes the source to supply more than 12 volts. Bit 10 indicates whether the analyzer is locked to the external reference signal (at the EXT REF IN rear panel connector). Bits 11 and 12 indicate that the Markers and Entry knobs, respectively, have been moved. Bit 13 indicates a change in the activity status register. Bit 14 is set if the power-on self test fails.
Most of these bits have corresponding HP-IB commands. Bits 0 and 2 work with SMSD; refer to "Measurement Done Status" later in this section. Bit 4 works with SSWP; refer to "Sending Sweep Points" later in this section. Bits 5—6 work with SOV1 and SOV2; refer to "Overflow Status" later in this section. Bit 9 works with SFLT; refer to "Source Fault Status" later in this chapter. Bit 10 works with RLOC; refer to "Reference Lock Status" later in this section. Bits 11 and 12 work with the remote knob commands; refer to "Communicating with the Front Panel" later in this chapter.

Masking the Instrument Status Register

Bits in the IS are masked with the ISMn command, where n is the decimal equivalent of the sum of the values of the bits to be unmasked. For example, the BASIC statement

```
OUTPUT 720;"ISM20"
```

unmasks bit 2 (value = 4) and bit 4 (value = 16), and masks all other bits. Remember that at least one bit in the IS must be unmasked to unmask condition 11 in the status byte. At power-on, the IS mask defaults to all bits masked. You can read the current masking of the IS register with the IS? query:

```
OUTPUT 720;"ISM?"
ENTER 720;IS_.mask
PRINT IS_.mask
```

Bit 4 (sweep point ready) can also be masked with DSWQ (disable sweep SRQ) and unmasked with ESWQ (enable sweep SRQ). Bit 11 (remote marker knob turn) can be masked with RMKD (remote marker knob disable) and unmasked with RMKE (remote marker knob enable). Bit 12 can be masked with REND (remote entry knob disable) and unmasked with remote RENE (remote entry knob enable).
The Status Query (STA?)

The status query command (STA?) provides some information from both the status byte and the instrument status register. Sending STA? causes the HP 3562A to return the 16-bit word shown in table 6-6. Note that STA? does not clear the information shown in these bits.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Condition/Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Not used</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Not used</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Key pressed</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Not used</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>RDY</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>ERR</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>RCS</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Message on screen</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Measurement pause</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>Auto sequence pause</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>End of measurement</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>End of auto sequence</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>Sweep point ready</td>
</tr>
<tr>
<td>13</td>
<td>8192</td>
<td>Channel 1 over range</td>
</tr>
<tr>
<td>14</td>
<td>16384</td>
<td>Channel 2 over range</td>
</tr>
<tr>
<td>15</td>
<td>32768</td>
<td>Math overflow</td>
</tr>
</tbody>
</table>

The only unique information provided by STA? is the message on screen indicator (bit 7). This is set when a message is displayed in the message field on the screen. This field is the second line from the bottom on the right side. Messages appear in half-bright upper and lower case. To read the message, send the display message query command (DSP?), which returns up to 24 characters. See page 6-23. Here is a sample listing:

```
OUTPUT 720,"STA?"
ENTER 720,Status
```
The Activity Status Register

The activity status (AS) register indicates several aspects of the HP 3562A's current activity. It generates SRQs through the IS register, then through the the status byte. Unlike the status byte and IS, reading the AS register with AS? does not erase it. The AS register indicates events, as opposed to conditions. Consequently, it is possible to receive an SRQ caused by the AS, then find the register empty when you read it with AS?. Keep this in mind when programming for AS-based interrupts.

Table 6-7 shows the activity status (AS) register. The contents of the AS are read by sending the AS? command (which also clears the register). Unlike the status byte and like the IS, the AS is not encoded: each bit represents a single condition. Remember that both bit 13 of the IS and condition 11 of the status byte must be enabled before the AS can indirectly generate an SRQ.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Check fault log</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Filling time record</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Filters settling</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Curve fit in progress</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Missed sample (when in external sample)</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Timed preview</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Accept data</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Waiting for trigger</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Waiting for arm</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>not used</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>Ramping source</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>Diagnostic in progress</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>Marker calc in progress</td>
</tr>
</tbody>
</table>

Use these event indicators to monitor the analyzer's activity after assigning tasks to it. Bit 0 indicates that a system error inside the HP 3562A has been entered into the fault log. The fault log is intended for use by trained service people only; refer to the HP 3562A Service Manual for details. Bit 1 indicates that the time record is being filled, which becomes more noticeable as the frequency span decreases (increasing the time record length). Bit 3 indicates that a curve fit is in progress. Bit 4 indicates that a sample was missed while in external sampling because the external sampling frequency is too high. Bits 5 and 6 are used with previewing in the linear resolution mode. Bit 5 indicates that the analyzer is paused for a time preview, and bit 6 tells whether or not the last time record was accepted. Bits 7 and 8 indicate that the analyzer is waiting for the trigger signal or manual arming, respectively. Bit 9 indicates that the calibration routine is in progress. Bit 10 indicates that the source is being ramped. Bit 11 indicates that a service diagnostic is in progress. Finally, bit 12 indicates that a special marker calculation is in progress.
Masking the AS Register

Because it monitors events, the AS must be masked for the positive-going or the negative-going transition of each bit. Two commands are used to mask the AS register. ASMH:n unmask the bits equal to n as they change from low to high (0 to 1). ASML:n unmask the bits as they change from high to low (1 to 0). The current masking of the AS can be read with the ASML? and ASMH? queries:

```
OUTPUT 720;"ASML?"
ENTER 720;ASML—low
OUTPUT 720;"ASMH?"
ENTER 720;ASMH—high
PRINT ASM—low,ASM—high
```

As an example of AS masking, the BASIC statements

```
OUTPUT 720;"ISM8192"
OUTPUT 720;"ASML8"
```

detect when a curve fit currently in progress finishes. The ISM8192 unmask two conditions simultaneously: by unmasking at least one bit in the IS, it unmask condition 11 in the status byte (instrument status change); and by unmasking bit 13 in the IS, it allows changes in the AS register to be communicated to the IS register. The second statement, ASML8, unmask bit 8 in the AS (curve fit in progress) for its transition from high to low. While the curve fit is in progress, bit 8 is high; as soon as the fit ends, bit 8 drops low. This in turn sets bit 13 in the IS, which then sets condition 11 in the status byte and send the SRQ. The flowchart in figure 6-1 summarizes these actions.

```
Figure 6-1 Example of Activity Status Masking

6-12
```
Labeling User SRQs

The HP 3562A offers a special class of interrupts called user SRQs. These allow you to initiate the SRQ whenever you want to, rather than depending on the device to issue one when it needs to. Under the HP-IB FCTN key, there is a softkey labeled USER SRQ. This softkey displays a menu containing the USER SRQ1 through USER SRQ8 softkeys. You can label each of these softkeys and individually detect the eight user SRQs. This feature has extensive implications: by utilizing the user SRQ softkeys, you can run the controller in the "background" while operating the analyzer from its front panel softkeys. You can create an entire menu structure by redefining the USER SRQ menu with the controller program. Labels are saved in nonvolatile memory and are not affected by power-down or reset.

To label the USER SRQ softkeys, use the LBS1—LBS8 commands. Labels can be one or two lines, with a maximum of six characters per line. The label must be enclosed in single or double quote marks, and if two lines are labeled, they must be separated by a comma. For example, the BASIC statement:

```
OUTPUT 720,"LBS4'TWO,LINES'
```

labels the USER SRQ4 softkey as

```
    TWO
    LINES
```

Labels can contain letters, numbers, and any punctuation that does not affect command syntax. Lines with fewer than six characters are automatically centered. Refer to “The Status Byte” earlier in this chapter for handling the SRQs generated by user SRQs. An example program written in BASIC 3.0 that labels and handles all eight user SRQs is provided in the Introductory Programming Guide in Appendix A.

The Power-On SRQ

By setting the PwrSRQ ON OFF softkey in the SPCL FCTN menu to ON, you can command the HP 3562A to send an SRQ when it is powered on. The state of PwrSRQ ON OFF is saved in nonvolatile memory in the analyzer, so it is not affected by power-down or reset. The power-on SRQ is detected as condition 12 in the status byte; see “The Status Byte” earlier in the chapter for information on decoding the status byte.
Reading Sweep Points (SSWP)

When the HP 3562A is measuring in the swept sine mode, you can read each sweep point via HP-IB. This allows you to write your own auto adjustments programs, for example. The send sweep point command (SSWP) is used in conjunction with the sweep point ready condition (bit 4) in the instrument status register.

The general procedure for reading the sweep points is:

1. Enable the sweep point ready bit in the instrument status register using ESWQ or enable the sweep point ready SRQ with ISM.
2. Start the sweep.
3. Wait for the SRQ interrupt.
4. Decode the status byte and instrument status register to verify that the sweep is indeed ready.
5. Tell the analyzer to send the sweep point using SSWG.
6. Go back to step 3 and wait for the next point.
7. Disable sweep point with DSWG when finished.

An alternative to the interrupt-driven method is reading the IS register in a loop, which would replace steps 3 and 4. SSWG returns five variables, in the following order:

Input power
Output Power
Cross spectrum real part
Cross spectrum imaginary part
Frequency

The first four are floating point real variables, and frequency is long floating point. An example program written in HP BASIC 3.0 that reads sweep points and displays them on the controller’s CRT is provided in the Introductory Programming Guide in Appendix A.
Ready Status Query (RDY?)

The ready status query (RDY?) indicates whether or not the analyzer's HP-IB command buffer is full. It returns either a 1 (buffer is empty) or a 0 (buffer has some commands). The HP 3562A always returns a 1 in response to the RDY? query. Use the RDY bit in the status byte if you need to monitor the command buffer.

The HP-IB command buffer can store three lines of 60 bytes each. A line is defined to be terminated by a line feed command or activation of the EOI bus management line. Commands can be queued in the buffer, and they are processed as soon as they are received. When the buffer is full, the HP-IB handshaking sequence forces the controller to wait.

Source Fault Status (SFLT)

The source fault status query (SFLT) returns a 1 if a failure in the source is causing it to supply over 12 volts. A 0 is returned when the source level is in its normal operating range.

Reference Locked Status (RLOK)

The reference locked status command (RLOK) indicates whether or not the analyzer is locked to an external reference signal (applied to the EXT REF IN rear panel connector). A 1 is returned if it is locked, a 0 if not. This command provides the same information as bit 10 in the instrument status register.

Measurement Done Status (SMRD)

The measurement done status command (SMRD) indicates if a measurement, capture or throughput is in progress. SMRD returns a 1 if the measurement, capture or throughput is done and a 0 if it is still in progress.

Missed Sample Status (SMSP)

The missed sample status command (SMSP) indicates if the analyzer missed a sample while in external sampling. This is caused by an external sample rate greater than 256 kHz.
Overflow Status (SOV1, SOV2)

The send overflow status commands (SOV1 and SOV2) return a 1 if an overrange occurred in the last measurement, and a 0 if not. These flags are set only during a measurement and are cleared only by reading.

Identify Query (ID?)

This query (ID?) is used to identify devices on the bus. The HP 3562A responds to ID? by returning the 7-character string "HP3562A."

Revision Query (REV?)

This query (REV?) identifies the revision code of the software contained and the instrument and code and format convention revision to which the software is written. For example, the BASIC statements:

```
OUTPUT 720; "REV?"
ENTER 720; Software, Format
PRINT Software, Format
```

Provide the software and format codes.

Serial Number Query (SER?)

This command is a partial implementation of the serial number query. The HP 3562A responds to it returning a 10-character string: prefix (4 numbers indicating the date of the analyzer's introduction), country of manufacture (A for USA), and 5 zeros. Individual instrument serial numbers are not provided (the 5 zeros are returned instead).
**Setup State Transfer (SET, SET?)**

The SET? command dumps the current instrument state in the ANSI floating point format. The SET command loads a state that has been previously dumped with SET? back into the analyzer. SET? is interchangeable with the DSAN (Dump State in ANsi) command, and SET is interchangeable with the LSAN (Load State in ANsi) command. Please refer to Chapter 3 for information on using DSAN and LSAN.

**HP-IB Trigger Enable (HPT)**

In addition to the triggering modes selectable from the front panel, the analyzer can also be triggered via HP-IB. To do this, you first need to select HP-IB triggering by sending the HPT command. Once HPT is sent, the analyzer can respond to the HP-IB bus management command "TRIGGER."
Passing Control

The HP 3562A is capable of controlling the bus so that it can control plotters, access disc drives and output command strings. When it needs control of the bus, the most efficient method is to:

1. Send the CTAD command (controller address) to the HP 3562A telling it where to pass control back when it is finished.

2. Send the command that requires the analyzer to have control of the bus; STPL (START PLOT), for example.

3. Wait for the analyzer to issue an SRQ saying its needs control of the bus.

4. Pass control to the analyzer. This is a controller-dependent operation; HP BASIC 3.0 provides the PASS CONTROL command for this purpose.

5. Wait for the HP 3562A to send a second SRQ saying it is finished with the bus. You can, of course, have the controller continue its program without waiting for the analyzer to release control of the bus if regaining control, is not important. In any case, the HP 3562A automatically passes control back to the controller specified by CTAD when it no longer needs it.

The Introductory Programming Guide in Appendix A provides two examples of passing control, one for plotter control and one for sharing a disc drive with a controller.

If your controller is incapable of passing control, use status byte conditions 14, 15 and 128-143 to detect when each device on the bus needs to talk and listen. Then explicitly address and unaddress each device as needed to complete the data transfer. Your controller’s HP-IB documentation should explain its use of the HP-IB secondary commands needed to do this.

A troubleshooting hint: if your controller grabs control of the bus before the HP 3562A is finished, see if some other device on the bus is sending an inadvertent SRQ. Such an SRQ causes the controller to immediately retake control of the bus.

Time-Out Control

To enable time-out control, send TMOE. This causes the HP 3562A to abort bus activity if it has control and a device under its control does not respond to a command after ~5s. To disable time-out, send TMOD. TMOE is the default.

Error Codes

The Error query (ERR?) returns the error code of the last HP-IB error. Each error code has a corresponding description in table 6-9. Note that these are the same errors as those encountered in front panel operation. For complete descriptions, with suggested corrective actions, refer to Appendix B of the HP 3562A Operating Manual.
### Table 6-9 Error Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Error</th>
<th>Code</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>No Peak Avg in HIST Meas</td>
<td>200</td>
<td>Not Active Softkey</td>
</tr>
<tr>
<td>101</td>
<td>No Peak Avg in CORR Meas</td>
<td>201</td>
<td>Unknown Mnemonic</td>
</tr>
<tr>
<td>102</td>
<td>Freq Resp, No 1 Ch Demod</td>
<td>202</td>
<td>Line Too Long</td>
</tr>
<tr>
<td>103</td>
<td>Cross Corr, No 1 Ch Demod</td>
<td>203</td>
<td>Command Too Long</td>
</tr>
<tr>
<td>104</td>
<td>No fundamental</td>
<td>204</td>
<td>Alpha Delimiter Expected</td>
</tr>
<tr>
<td>105</td>
<td>X Marker Must Be Active</td>
<td>205</td>
<td>Not A Valid Terminator</td>
</tr>
<tr>
<td>106</td>
<td>Buffer Overflow</td>
<td>206</td>
<td>Extra Chars In Command</td>
</tr>
<tr>
<td>107</td>
<td>No Coord Change Allowed</td>
<td>207</td>
<td>Function Inactive</td>
</tr>
<tr>
<td>108</td>
<td>Not In Frequency Domain</td>
<td>300</td>
<td>Missing input</td>
</tr>
<tr>
<td>109</td>
<td>No Data</td>
<td>301</td>
<td>Not Valid Units</td>
</tr>
<tr>
<td>110</td>
<td>Measurement In Progress</td>
<td>302</td>
<td>Not A Valid Number</td>
</tr>
<tr>
<td>111</td>
<td>Trace Not Compatible</td>
<td>303</td>
<td>Alpha Too Long</td>
</tr>
<tr>
<td>112</td>
<td>Data Type Incompatible</td>
<td>304</td>
<td>Number Too Long</td>
</tr>
<tr>
<td>113</td>
<td>Data Blocks Incompatible</td>
<td>305</td>
<td>Out Of Range</td>
</tr>
<tr>
<td>114</td>
<td>Source Block Empty</td>
<td>306</td>
<td>Unable To Curve Fit</td>
</tr>
<tr>
<td>115</td>
<td>User Display Not Enabled</td>
<td>307</td>
<td>Bad # Of Parameters</td>
</tr>
<tr>
<td>116</td>
<td>No Active Display Buffer</td>
<td>308</td>
<td>Auto Carrier Selected</td>
</tr>
<tr>
<td>117</td>
<td>Recursive Call</td>
<td>309</td>
<td>ENTRY Not Enabled</td>
</tr>
<tr>
<td>118</td>
<td>Not A Valid Auto Math</td>
<td>400</td>
<td>Not A Valid Block Length</td>
</tr>
<tr>
<td>119</td>
<td>Bad Setup State</td>
<td>401</td>
<td>Not A Valid Block Mode</td>
</tr>
<tr>
<td>120</td>
<td>Bad Auto Sequence Table</td>
<td>402</td>
<td>Not HP-IB Controller</td>
</tr>
<tr>
<td>121</td>
<td>Bad Synth Table</td>
<td>403</td>
<td>HP-IB Time Out</td>
</tr>
<tr>
<td>122</td>
<td>Bad Non-Volatile State</td>
<td>500</td>
<td>Bad Plotter Data Read</td>
</tr>
<tr>
<td>123</td>
<td>Bad Data Block</td>
<td>600</td>
<td>Cannot Recall Throughput</td>
</tr>
<tr>
<td>124</td>
<td>Bad Data Header</td>
<td>601</td>
<td>Not A Valid Catalog</td>
</tr>
<tr>
<td>125</td>
<td>Marker Not On</td>
<td>602</td>
<td>Unformatted Disc</td>
</tr>
<tr>
<td>126</td>
<td>No Valid Marker Units</td>
<td>603</td>
<td>Catalog Full</td>
</tr>
<tr>
<td>127</td>
<td>No Capture Data</td>
<td>604</td>
<td>Not A Valid Name</td>
</tr>
<tr>
<td>128</td>
<td>No Thruput Data</td>
<td>605</td>
<td>Not A Valid Display</td>
</tr>
<tr>
<td>129</td>
<td>Thruput Data Too Long</td>
<td>606</td>
<td>File Not Found</td>
</tr>
<tr>
<td>130</td>
<td>Bad Curve Fit Table</td>
<td>607</td>
<td>Disc Full</td>
</tr>
<tr>
<td>131</td>
<td>Bad Capture</td>
<td>608</td>
<td>Disc Reject</td>
</tr>
<tr>
<td>132</td>
<td>Bad Thruput</td>
<td>609</td>
<td>Recall Active Auto Seq</td>
</tr>
<tr>
<td>133</td>
<td>Not A Valid User Window</td>
<td>610</td>
<td>Unknown Disc Command Set</td>
</tr>
<tr>
<td>134</td>
<td>Bad Primitive Block</td>
<td>611</td>
<td>No Disc In Drive</td>
</tr>
<tr>
<td>135</td>
<td>View input Disabled</td>
<td>612</td>
<td>Disc Write Protected</td>
</tr>
<tr>
<td>136</td>
<td>Cannot Use Zoom Data</td>
<td>613</td>
<td>Disc Fault</td>
</tr>
<tr>
<td>137</td>
<td>Already Running</td>
<td>614</td>
<td>Disc Transfer Error</td>
</tr>
<tr>
<td>138</td>
<td>May Be inaccurate</td>
<td>615</td>
<td>No Spares Or Fault Areas</td>
</tr>
<tr>
<td>139</td>
<td>Cannot Be Complex</td>
<td>616</td>
<td>No Thruput File</td>
</tr>
<tr>
<td>140</td>
<td>Bad Delete Freq Table</td>
<td>617</td>
<td>Catalog Not In Memory</td>
</tr>
<tr>
<td>141</td>
<td>Loops Nested Too Deep</td>
<td>618</td>
<td>File Size Not Specified</td>
</tr>
<tr>
<td>142</td>
<td>Demod In Zoom Only</td>
<td>619</td>
<td>Select Capture To Recall</td>
</tr>
<tr>
<td>143</td>
<td>Numeric Overflow</td>
<td>620</td>
<td>Source ≠ Destination</td>
</tr>
<tr>
<td>144</td>
<td>Invalid: Nyquist/Nichols</td>
<td>621</td>
<td>Sector Size ≤ 256 Bytes</td>
</tr>
<tr>
<td>145</td>
<td>Invalid: Log Data</td>
<td>622</td>
<td>Not Valid Format Option</td>
</tr>
<tr>
<td>146</td>
<td>No Carrier</td>
<td>623</td>
<td>Not Valid For This Disc</td>
</tr>
<tr>
<td>147</td>
<td>No Peak Hold In Time Avg</td>
<td>624</td>
<td>Destination Too Small</td>
</tr>
<tr>
<td>148</td>
<td>Calibration In Progress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>149</td>
<td>No Avg in Demod Hist</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
READING MARKER VALUES

The HP 3562A allows you to read the X marker and the slope and power special marker functions via HP-IB. (The Y marker is not tied to display data, so there is little value in reading it over the bus.) This section explains the commands used for these functions and the data they provide. The Introductory Programming Guide in Appendix A has a example program in HP BASIC 3.0 that reads all three marker values. Note that before reading marker values, you should explicitly set the units and coordinates in which you want the trace to be calculated.

Reading the X Marker (RDMK)

The read marker command (RDMK) returns two long floating-point numbers: the x-axis ("X = ") and y-axis ("Ya = " or "Yb = ") values of the X marker. The following BASIC statements read the X marker:

```
OUTPUT 720; "RDMK"
ENTER 720; X,Ya
PRINT "X = ";X,"Ya = ";Ya
```

Reading the Special Marker Once (RSMO)

The read special marker once command (RSMO) returns the value of the POWER, FREQ & DAMP or AVG VALUE special marker function, whichever one was pressed last for each trace. This is a long floating point value and is scaled in the current display coordinates and units. The following BASIC statements read whichever of these marker functions is active:

```
OUTPUT 720; "RSMO"
ENTER 720; Marker__Vala, Marker__Valb
PRINT Marker__Val
```

Reading the Special Marker Group (RSMG)

The read special marker group command (RSMG) returns the value of the SLOPE, HMNC POWER, THD or SBAND POWER special marker function, whichever one is active for each trace. This is a long floating point value and is scaled in the current units and coordinates. The following BASIC statements read the SLOPE marker:

```
OUTPUT 720; "RSMG"
ENTER 720; Slope a, Slope b
PRINT Slope
```
COMMUNICATING WITH THE FRONT PANEL

The rest of this chapter shows you how to communicate with the analyzer’s front panel: keys, eight softkeys, and two knobs. The end of this section shows you how to write messages to the message field and control display updating.

Key Codes

Each key and the eight generic softkeys are assigned key code. You can use these codes in two ways: monitor key presses by interpreting key codes, and simulate key presses by sending key codes to the analyzer.

There are four commands used with this feature. KEY? is a query that returns the key code of the last key pressed since power-up or reset (if KEYE has been sent previously). KEYn sends a key code, where n is the code from 1 to 70, to the analyzer. And there are two commands used for masking/unmasking the key pressed condition in the status byte. KEYD masks (disables) the condition, and KEYE unmasks it.

Table 6-10 lists the HP 3562A’s key codes. Note that the eight softkey buttons have unique codes, but individual softkey labels do not. The code of the last key pressed (since power-up or reset) is returned by the KEY? command. Key presses are simulated by sending the analyzer the KEYn command, where n is the code of the key to be simulated. The key buffer holds the last three key presses. COM? returns the HP-IB command of the last key pressed (this is useful for detecting softkeys).

<table>
<thead>
<tr>
<th>Key Name</th>
<th>Code</th>
<th>Key Name</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Key Pressed</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR UNITS</td>
<td>1</td>
<td>Softkey 4</td>
<td>36</td>
</tr>
<tr>
<td>INPUT COUPLE</td>
<td>2</td>
<td>Softkey 5</td>
<td>37</td>
</tr>
<tr>
<td>TRIG DELAY</td>
<td>3</td>
<td>Softkey 2</td>
<td>38</td>
</tr>
<tr>
<td>HP-IB FCTN</td>
<td>4</td>
<td>Softkey 1 (top)</td>
<td>39</td>
</tr>
<tr>
<td>DISC</td>
<td>5</td>
<td>Softkey 3</td>
<td>40</td>
</tr>
<tr>
<td>SELECT TRIG</td>
<td>6</td>
<td>5</td>
<td>41</td>
</tr>
<tr>
<td>CAL</td>
<td>7</td>
<td>4</td>
<td>42</td>
</tr>
<tr>
<td>RANGE</td>
<td>8</td>
<td>3</td>
<td>43</td>
</tr>
<tr>
<td>AVG</td>
<td>9</td>
<td>Softkey 7</td>
<td>44</td>
</tr>
<tr>
<td>SELECT MEAS</td>
<td>10</td>
<td>Softkey 6</td>
<td>45</td>
</tr>
<tr>
<td>WINDOW</td>
<td>11</td>
<td>1</td>
<td>46</td>
</tr>
<tr>
<td>LOCAL</td>
<td>12</td>
<td>2</td>
<td>47</td>
</tr>
<tr>
<td>PLOT</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOURCE</td>
<td>14</td>
<td>MARKER VALUE</td>
<td>49</td>
</tr>
<tr>
<td>FREQ</td>
<td>15</td>
<td>(negative sign)</td>
<td>50</td>
</tr>
<tr>
<td>MEAS MODE</td>
<td>16</td>
<td>BACKSPACE</td>
<td>51</td>
</tr>
<tr>
<td>START</td>
<td>17</td>
<td>Softkey 8 (bottom)</td>
<td>52</td>
</tr>
<tr>
<td>SPCL FCTN</td>
<td>18</td>
<td>VIEW INPUT</td>
<td>53</td>
</tr>
<tr>
<td>PRESET</td>
<td>19</td>
<td>0</td>
<td>54</td>
</tr>
<tr>
<td>MATH</td>
<td>20</td>
<td>(comma)</td>
<td>55</td>
</tr>
<tr>
<td>SYNTH</td>
<td>21</td>
<td>(decimal point)</td>
<td>56</td>
</tr>
<tr>
<td>AUTO SEQ</td>
<td>22</td>
<td>A</td>
<td>57</td>
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Table 6-10 (Continued)

<table>
<thead>
<tr>
<th>Command</th>
<th>Value</th>
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<tbody>
<tr>
<td>PAUSE CONT</td>
<td>23</td>
</tr>
<tr>
<td>SAVE RECALL</td>
<td>24</td>
</tr>
<tr>
<td>Y</td>
<td>25</td>
</tr>
<tr>
<td>SPCL MARKER</td>
<td>26</td>
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<tr>
<td>HELP</td>
<td>27</td>
</tr>
<tr>
<td>AUTO MATH</td>
<td>28</td>
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<tr>
<td>CURVE FIT</td>
<td>29</td>
</tr>
<tr>
<td>X OFF</td>
<td>30</td>
</tr>
<tr>
<td>X</td>
<td>31</td>
</tr>
<tr>
<td>Y OFF</td>
<td>32</td>
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<td>8</td>
<td>33</td>
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<tr>
<td>9</td>
<td>34</td>
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<tr>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>B</td>
<td>58</td>
</tr>
<tr>
<td>A&amp;B</td>
<td>59</td>
</tr>
<tr>
<td>COORD</td>
<td>60</td>
</tr>
<tr>
<td>MEAS DISP</td>
<td>61</td>
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<tr>
<td>ARM</td>
<td>62</td>
</tr>
<tr>
<td>SINGLE</td>
<td>63</td>
</tr>
<tr>
<td>UPPER LOWER</td>
<td>64</td>
</tr>
<tr>
<td>STATE TRACE</td>
<td>65</td>
</tr>
<tr>
<td>UNITS</td>
<td>66</td>
</tr>
<tr>
<td>FRONT BACK</td>
<td>67</td>
</tr>
<tr>
<td>SCALE</td>
<td>68</td>
</tr>
<tr>
<td>UP arrow</td>
<td>69</td>
</tr>
<tr>
<td>DOWN arrow</td>
<td>70</td>
</tr>
</tbody>
</table>

Reading Entry Knob Movement

The rotary pulse generator (RPG) knob in the Entry group can be addressed via HP-IB. You can use the knob to generate SRQs or use it to send numeric values to the controller.

To set up the knob in the Entry group to generate SRQs as it is rotated, you need use the instrument status register. Bit 12 in this register is used to indirectly generate the SRQ; refer to “The Instrument Status Register” earlier in this chapter.

The knot has a numeric range of -32 766 to +32 767. To program its value, use the RENV command (remote entry knob value). To read its current value, use the RENV? query. The Entry knob has variable acceleration, which you set with the RENS (Remote Entry Knob Speed) command. RENS0, 32767 specifies fixed acceleration, and RENS1, 32767 specifies variable acceleration. Use RENE to enable remote entry, or REND to disable it.

Reading Markers Knob Movement

The Markers group knob can also be addressed via HP-IB. This knob uses bit 11 in the instrument status register. Addressing the Markers knob is similar to addressing the Entry knob; the difference is that the acceleration of the Markers knob is fixed. To program its value, use the RMKV command (remote markers knob value). To read its current value, use the RMKV? query. Send RMKE to enable remote markers, RMKD to disable. When remote markers are enabled, the X and Y marker values should not be set.
Writing to the Message Field

You can write messages up to 24 characters long to the displays message field. Use the DSP command and put the message string in single quotes. For example, the BASIC statement:

```
OUTPUT 720;"DSP'Hi Mom'."'
```

Display “Hi Mom” (without quotes) in the message field. To read the message currently in the field, use the DSP? query, which returns an alphanumeric string up to 24 characters long. For example:

```
OUTPUT 720; "DSP?"
ENTER 720; Message$ 
PRINT Message$
```

Reads and prints the current message. When a measurement is started a “blank” message is displayed, which sets bit 7 of the STA? word.

Controlling Display Updating

Two commands are provided to enable/disable updating on the display. To disable updating, send the DSPD (display disable) command. To enable it, send DSPE (display enable). Note that once you send DSPD, updating is disabled until you re-enable it by sending DSPE or resetting the analyzer.
Reading Auto Carrier Values

The values calculated by the demodulation algorithm's auto carrier feature can be read via HP:IB. The command SACR (Send Auto Carrier) returns four values:

- Auto carrier calculated for Channel 1
- Auto carrier calculated for Channel 2
- Phase offset removed from Channel 1
- Phase offset removed from Channel 2

For example, the BASIC statements:

```basic
OUTPUT 720; "SACR"
ENTER 720; Car1, Car2, Phase1, Phase2
```

return the four values. These values are in floating point format.

Controlling the HP Logo for Plotting

The HP logo that appears at the top of table displays is not normally plotted, but you can specify it to be plotted if desired. Send the command "LOGO0" to disable it or "LOGO1" to enable it.
INTRODUCTORY PROGRAMMING GUIDE
for the HP 3562A Dynamic Signal Analyzer
with the HP 9000 Series 200 Desktop Computer (Basic)

INTRODUCTION

This is an introductory guide to programming the HP 3562A Dynamic Signal Analyzer using an HP 9000 Series 200 Computer with BASIC 3.0. This note has two purposes: showing you how to start programming the HP 3562A over the Hewlett-Packard Interface Bus (HP-IB) and providing simple example programs. It assumes you are familiar with the general features of the HP 3562A and some version of the BASIC language.

The topics discussed in this guide are:

The HP-IB concept—explains the advantages of remotely programming your analyzer with a computer

Reference information—where to turn for more information

Connecting the HP-IB system—how to get the computer and the analyzer to work together

The HP 3562A’s command set—an overview of the analyzer’s flexibility and power when programmed via HP-IB

Example programs—provides twelve short example programs to help you get started with programs of your own
THE HP-IB CONCEPT

In a general sense, programming an instrument via HP-IB simply replaces the instrument’s front panel with commands sent by a computer or calculator. For example, instead of pressing the START key on the analyzer’s front panel, you send the STRT mnemonic command via HP-IB. The immediate advantage is automation: your computer now controls the analyzer.

In most cases, HP-IB programmed operation emulates front panel operation. However, the HP 3562A provides additional functions available only over the bus. These allow you to transfer data in and out of the analyzer, write custom signal processing routines, control the vector display and communicate with various parts of the instrument.

This programming note shows you both aspects, front panel emulation and the special bus-only commands. Each step in the example programs is documented and explained, so use these programs to help understand the concept of HP-IB programming. And then try modifying the programs and view the results. All the HP-IB command mnemonics, with limits, terminators and syntax, are provided in the HP-IB Quick Reference Guide in Appendix B of the HP 3562A Programming Manual.

Reference Information

Complete operating and programming information for the HP 3562A is offered in these documents:

- HP 3562A Operating Manual (P/N 03562-90000)
- HP 3562A Programming Manual (P/N 03562-90030) This includes the HP-IB Quick Reference Guide for the HP 3562A.

The Hewlett-Packard BASIC 3.0 programming language for HP 9000 Series 200 Computers is covered in these documents:

- BASIC 3.0 User’s Guide (P/N 98613-90040)
- BASIC 3.0 Programming Techniques (P/N 98613-90010)
- BASIC 3.0 Language Reference (P/N 98613-90050)
- BASIC 3.0 Interfacing Techniques (P/N 98613-90020)
- BASIC 3.0 Graphics Techniques (P/N 98613-90030)

The entire documentation package (consisting of eleven manuals) for BASIC 3.0 has the following part number:

- Manual Kit for BASIC 3.0 (P/N 98613-87901)

The HP 9000 Series 200 Computers have individual operating manuals.
CONNECTING THE HP-IB SYSTEM

This section shows you to connect the HP 3562A to the computer and verify that the system works.

Equipment Required

To run the example programs in this note, you need the following equipment:

- HP 3562A Dynamic Signal Analyzer
- HP 9000 Series 200 Computer
- HP 10833A/B/C/D HP-IB Cable

Setup

Begin by removing power from the HP 3562A and the computer.

1. As shown in figure 1, connect the HP 3562A to the computer using the HP-IB cable.

---

Figure 1  HP-IB System Connection
CAUTION

The HP 3562A has metric threaded HP-IB cable mounting studs, as opposed to English threads. Metric threaded HP 10833A/B/C/D cables must be used. Metric fasteners are colored black, while English fasteners are colored silver. DO NOT attempt to connect black and silver fasteners, or damage to cable and instrument will result.

2. Apply power to the computer. If required, load the BASIC language operating system, following the instructions in the computer's operating manual. Note: with BASIC 3.0, you need to load at least the "HPIB" driver BIN and the "IO" language extensions BIN. You may also need the "DISC" and "FHPIB" drivers; consult the BASIC 3.0 User's Guide to see what your system needs. Note that you will probably need more language extensions as your programs get more complex than these simple examples.

3. Apply power to the HP 3562A.

4. The HP-IB address of the 3562A is stored in nonvolatile memory. It is a good idea to view the address after you power-up to see its current value. Press the HP-IB FCTN key in the HP 3562A's HP-IB group. When its softkey menu appears, press the SELECT ADDRES softkey. This displays a menu containing the HP-IB ADDRSET softkey. Press this softkey to display the analyzer's current address in the lower left corner of the display. If you want to enter a new address, use the 0-9 numeric keypad and the ENTER softkey. The examples in this note use address 20 for the HP 3562A.

Check-Out

To verify proper system connection, type in the following command on the computer:

REMOTE 720

and press the computer's [Return], [EXECUTE], or [EXEC] key (depending on the type of keyboard you have). After you have issued the remote command, the green REMOTE indicator LED on the HP 3562A's front panel should light up. This indicates that the analyzer is now under the remote control of the computer. Try pressing some keys on the HP 3562A to verify that the keyboard is disabled. If you want to return local (front panel) control to the analyzer, press the LOCAL key in the HP-IB group. You can also issue the "LOCAL 7" command from the computer.

If the REMOTE indicator does not light up, recheck the system connection as explained earlier in "Setup." If this does not solve the problem, the computer, the analyzer or the cable may be at fault. Once you have successfully verified the system connection, you are ready to run some example programs.
THE HP 3562A'S HP-IB COMMAND SET

The HP 3562A provides HP-IB codes to emulate front panel operation, as well as a number of "bus-only" commands to perform special operations via HP-IB. The HP-IB command set is divided into five groups:

1. **Front panel**—provides HP-IB commands for the keys and softkeys.

2. **Data Transfer**—allows you to dump and load data traces and instrument states.

3. **Signal Processing**—provides signal processing primitives that allow you to operate on the blocks of data inside the analyzer.

4. **Display Control**—gives you complete access to the vector display for programming custom text and graphics displays.

5. **Command/Communication**—provides service requests, instrument status, special queries and communication with the front panel.

In addition to front panel emulation examples, this programming note provides examples from the data transfer, display control, and command/communication groups. Instructions for using all the commands in these groups are provided in the *HP 3562A Programming Manual*. 
PROGRAMMING EXAMPLES

This section provides twelve example programs that show you the power and flexibility provided by the HP 3562A combined with an external controller. These programs are written in BASIC 3.0 for HP 9000 Series 200 computers.

Example #1: Setting Up a Measurement

This program shows you how to set up several basic measurement parameters. It sets up and starts a frequency response measurement in the linear resolution mode using commands accessible from the front panel. This is the type of programming used to emulate front panel operation.

```
10 ! Example 1
20 ! Setting up a linear resolution measurement
30 !
40 Dsa=720 ! Address of 3562A
50 !
60 OUTPUT Dsa:"RST" ! Reset 3562A
70 OUTPUT Dsa:"LNRS" ! Linear resolution mode
80 OUTPUT Dsa:"FRSP" ! Frequency response meas
90 OUTPUT Dsa:"FRS10KHZ" ! Span at 0-10 kHz
100 OUTPUT Dsa:"RND" ! Random noise source
110 OUTPUT Dsa:"SRLSV" ! Source level at 5V
120 OUTPUT Dsa:"HANN" ! Hanning window
130 OUTPUT Dsa:"NAVG10ENT" ! 10 averages
140 OUTPUT Dsa:"STBL" ! Stable averaging
150 OUTPUT Dsa:"RNG5V" ! Range 5V both channels
160 !
170 ! Measurement is set up and ready to start
180 !
190 OUTPUT Dsa:"STRT" ! Start the measurement
200 OUTPUT Dsa:"FRQR" ! Frequency response display
210 END
```

Line 40 sets the analyzer's HP-IB address (700 for the HP-IB interface plus 20 for the HP 3562A) equal to the variable "Dsa." Lines 60 through 150 set up individual parameters: reset, mode, measurement, frequency span, noise source, source level, number of averages, stable averaging and input range. (To set up any measurement over the HP-IB, you merely program each variable, just as you do from the front panel.) When the setup is ready, line 190 starts the measurement. Note that this program could have been compressed to a few lines, but it was written this way to illustrate each step.
Example #2: Interactive Swept Sine

This program makes a swept sine measurement that sends each measurement point to the computer. The HP 3562A sends five variables at each sweep point: frequency, input power, output power, cross spectrum real, and cross spectrum imaginary. You could use a program like this one to monitor a sweep and operate on each point as it becomes available. This program merely displays the result at each point, but you could use it for the data collection portion of another program. (You may need to modify the data display portion to use this with small screens.)

10 ! Example 2
20 ! Setting up a swept sine measurement and
30 ! sending each sweep point to the controller
40  !
50 Dsa=720 ! Address of 3562A
60  !
70 OUTPUT Dsa;"ESWQ" ! Enable sweep SRQ
80 OUTPUT Dsa;"FRSW" ! Swept sine preset
90 OUTPUT Dsa;"SRLOW" ! Source level at 1V
100 OUTPUT Dsa;"SRON" ! Source on
110 OUTPUT Dsa;"RNG1V" ! Range 1V: both channels
120 OUTPUT Dsa;"RES25P/DC" ! Resolution 25 pts/dec
130  !
140 ! Sweep is set up; ready to start
150  !
160 PRINT USING "5X,4A,12X,5A,5X,6A,4X,6A,4X,6A,4X,"F,",PurIn","PurOut","CrSpRe","CrSpIm"
170 OUTPUT Dsa;"STRT" ! Set up table on CRT
180  !
190  !
200 OUTPUT Dsa;"IS?" ! Read IS register
210 ENTER Dsa;I,byte!
220 IF BIT(Is_byte,2) THEN 390
230  ! Quit if sweep done
240 IF BIT(Is_byte,4) THEN 310
250 GOTO 200 !
260  !
270  !
280  !
290  !
300 !
310 OUTPUT Dsa;"SSWP" ! Send each sweep point
320 ENTER Dsa;I,0,R,Im,F ! I = input power
330  ! O = output power
340  ! R = cross spec real
350  ! Im = cross spec imag
360  ! F = frequency
370 PRINT F,I,0,R,Im
380 GOTO 200
390 END
Lines 10 through 190 set up and start the sweep. Line 50 sets the HP 3562A's address to "Dsa." Line 70 enables the sweep service request (SRQ). This allows the analyzer to request service from the controller when each point is ready. Line 80 sends the F RESP SWEPT command to activate the swept sine preset. Lines 90 through 120 set up several sweep variables. Line 160 displays the table heading on the CRT. The analyzer and the computer are now ready to start, and line 180 sends the start command (equivalent to pressing the yellow START key.)

Lines 200 through 250 monitor the analyzer's instrument status register to detect when sweep points are ready. Line 200 requests the value of the HP 3562A's instrument status (IS) register (the contents of this register are fully described in programming manual). Line 210 enters the IS contents into the variable "is_byte." Line 220 checks to see if bit 2 in the IS is set, indicating that the measurement is over; if yes, the program ends. If no, line 240 checks to see if bit 4 of the IS is set. This bit indicates when the sweep point is ready. If a point is ready, program control moves to line 310. If neither bit 2 nor bit 4 is set, line 250 loops the program back to line 200 to read the IS again. The program stays in the 200-250 loop until the sweep is finished or a point is ready.

Line 310 commands the analyzer to send the sweep point. One sweep point (consisting of five values) is sent each time bit 4 in the IS register indicates a point is ready. Line 320 enters the five variables passed at each point: input power (I), output power (O), cross spectrum real part (R), cross spectrum imaginary part (Im), and frequency (F). These values are printed by line 370. Line 380 then sends the program back to line 200 to wait for the next point. The END statement in line 390 is reached whenever bit 2 of the IS is set, indicating the measurement is finished (detected in line 220).
Example #3: User Service Requests (SRQs)

Service requests (SRQs) allow a device on the bus to request service from the system controller. When the controller receives an SRQ, it can then "poll" each device on the bus to see which one requested service. After identifying the device, the controller can then read the device’s status byte to determine why it requested service. Reasons for requesting service can be anything from a printer being out of paper to an analyzer ending a measurement.

The HP 3562A offers a special class of interrupts called user SRQs. These allow you to initiate the SRQ whenever you want to, rather than depending on the device to issue one when it needs to. Under the HP-IB FCTN key, there is a softkey labeled USER SRQ. This softkey displays a menu containing the USER SRQ through USER SRQ8 softkeys. You can label each of these softkeys and individually detect the eight user SRQs. This feature has extensive implications: by utilizing the user SRQ softkeys, you can run the controller in the "background" while operating the analyzer from its front panel softkeys. You can create an entire menu structure by redefining the USER SRQ menu with the controller program.

This program shows you how to label the user SRQ softkeys and handle the SRQ interrupts. In a real program, you would direct the SRQ from a softkey press to perform a particular action. In this program, each softkey merely displays a CRT message.

```
10 ! Example 3
20 ! Labeling and handling user SRQs
30 !
40 Dsa=720 ! Address of 3562A
50 !
60 OUTPUT Dsa="LBS1""SOFT,KEY 1"
70 OUTPUT Dsa="LBS2""SOFT,KEY 2"
80 OUTPUT Dsa="LBS3""SOFT,KEY 3"
90 OUTPUT Dsa="LBS4""SOFT,KEY 4"
100 OUTPUT Dsa="LBS5""SOFT,KEY 5"
110 OUTPUT Dsa="LBS6""SOFT,KEY 6"
120 OUTPUT Dsa="LBS7""SOFT,KEY 7"
130 OUTPUT Dsa="LBS8""SOFT,KEY 8"
140 !
150 ! The user SRQ softkeys are labeled
160 !
170 OUTPUT Dsa="USRQsLCL" ! Display USER SRQ menu
180 ON INTR 7 GOTO 220 ! Look for interrupt
190 ENABLE INTR 7:2 ! Enable SRQ interrupts
200 Idle: GOTO Idle ! Wait for interrupt
210 !
220 Status_byte=SPOLL(Dsa) ! Serial poll the 3562A &
230 ! read its status byte
240 Status_byte=BINAND(Status_byte,15)
250 ! Delete bits 4 - 7
260 !
270 ! Following lines identify the softkey pressed
280 !
290 IF Status_byte=1 THEN PRINT "SOFT KEY 1"
300 IF Status_byte=2 THEN PRINT "SOFT KEY 2"
310 IF Status_byte=3 THEN PRINT "SOFT KEY 3"
320 IF Status_byte=4 THEN PRINT "SOFT KEY 4"
330 IF Status_byte=5 THEN PRINT "SOFT KEY 5"
340 IF Status_byte=6 THEN PRINT "SOFT KEY 6"
350 IF Status_byte=7 THEN PRINT "SOFT KEY 7"
360 IF Status_byte=8 THEN PRINT "SOFT KEY 8"
370 GOTO 180 ! Go back and wait
380 ! for next interrupt
390 END
```
Lines 10 through 160 write custom labels in the eight USER SRQ softkeys. Line 40 sets the analyzer’s address to the variable “Drn.” Lines 60 through 130 label the eight softkeys (SOFT KEY 1 through 8 in this case; you can use any combination of two six-character lines, upper or lower case).

Lines 170 through 210 display the USER SRQ menu and wait for you to press one of the eight softkeys. Line 170 tells the HP 3562A to display the USER SRQ menu then return local control. Line 180 instructs the computer to go to line 220 if it receives an interrupt over the HP-IB (interface 7). Line 190 enables SRQ interrupts, and line 200 forces the program to wait until it receives an interrupt. The BASIC statements ON INTR and ENABLE INTR simply tell the computer what kind of interrupts to accept and where to go if it receives them.

When the interrupt occurs, the program goes to line 220. This line serial polls the HP 3562A, requesting its status byte so the computer can determine why the analyzer requested service. The status byte is read into the variable “Status_byte.” To make decoding easier, line 240 erases the bits in Status_byte that don’t concern us here. (For user SRQs, we are interested only in the lower four bits of the status byte.) Lines 290 through 360 determine which softkey was pressed and displays an appropriate message. (At this point, you can replace the individual messages with program routines that perform appropriate action for each softkey.) Line 370 sends the program back to line 180 to wait for the next softkey press. In this program, the END statement in line 390 is never reached.
Example #4: Reading Marker Values

The HP 3562A allows an external computer to query many aspects of its operation and status. One of these capabilities is sending current marker values (X- and Y-axis values of the X marker and the special marker values). This program shows how to read these values and enter them into the controller.

```
10 | Example 4
20 | Reading marker values and printing them
30 | on the computer CRT
40 |
50 Dsa=720                      | Address of 3562A
60 |
70 OUTPUT Dsa:"X"               | Activate X marker
80 OUTPUT Dsa:"RDMK"           | Read marker command
90 ENTER Dsa:X,Y               | Read X- & Y-axis values
100 PRINT "X =";X,"Y =";Y      | Display X and Y
110 |
120 OUTPUT Dsa:"PWR"           | Special power marker
130 OUTPUT Dsa:"RSMO"          | Read special marker once
140 ENTER Dsa;Power            | Read power
150 PRINT "Power =";Power      | Print power value
160 |
170 OUTPUT Dsa:"SLP"           | Special slope marker
180 OUTPUT Dsa:"RSMG"          | Read slope command
190 ENTER Dsa;Slope            | Read slope
200 PRINT "Slope =";Slope      | Print slope value
210 END
```

Lines 50 sets the analyzer's address equal to the variable "Dsa." Lines 70 through 110 read the X- and Y-axis marker values. Both these values are transmitted when the analyzer receives the Read Marker command (RDMK). Line 70 activates the X marker, then line 80 sends the RDMK command. Line 90 tells the computer to input two variables; the first is the X-axis value, and the second is the Y-axis value. Line 100 prints the two values.

Lines 120 through 160 read the power value. This function shows the total power in the active trace. Line 120 activates the function, then line 130 sends the read special marker once command (RSMO). This command reads the value of the last softkey pressed in the group of FREQ & DAMP, POWER and AVG VALUE. The value enters the computer at line 140 and is printed by line 150.

Lines 170 through 200 read the slope value. This function shows the slope at the marker position. This segment operates in the same manner as lines 120 through 160, except it uses the read special marker group command (RSMG). This command reads the value of the active softkey in the group of SLOPE, HMONC POWER, THD, MOD INDEX and SBAND POWER. Finally, line 200 ends the program.

This program shows marker reading in general. For your applications, you should explicitly set the display units before reading markers so that you know the units in which the marker values will be transmitted.
Example #5: Custom Graphics

The display group of bus-only commands allows you to write and draw on the analyzer's vector display. This is basically a three-step process: create and activate a display buffer, fill the buffer, then put the buffer on the display. A display "buffer" is simply an area in memory reserved for your display commands. Uses of custom graphics include providing operator messages and showing equipment connections.

This program shows two simple steps: first writing a message on the display, then drawing some simple boxes. You can expand these techniques to create almost any display.

```
10   ! Example 5
20   ! Drawing and writing on the 3562A display
30   !
40   Dsa=720   ! Address of 3562A
50   !
60   OUTPUT Dsa:"COMD"  ! Disable command echo
70   OUTPUT Dsa:"DBS?500,1,2"  ! Set up 2 S00-word display buffers.
80   ! #1 and #2
90   !
100  OUTPUT Dsa:"DBAC1"  ! Activate buffer #1
110  OUTPUT Dsa:"CHSZ2"  ! Character size=2
120  OUTPUT Dsa:"PU"    ! Lift pen
130  OUTPUT Dsa:"PA100,1000"  ! Move pen to left center of display
140  OUTPUT Dsa:"PD"    ! Put pen down
150  OUTPUT Dsa:"WRIT"Custom Graphics Display"  
160  ! Write text into buffer
170  !
180  !
190  OUTPUT Dsa:"DBUP1"  ! Put up buffer #1
200  WAIT !  ! Pause for 1 second
210  !
220  ! Rest of this program draws on the display
230  !
240  OUTPUT Dsa:"DBAC2"  ! Activate buffer #2
250  !
260  T=1900  ! Top of box
270  B=300   ! Bottom
280  L=100   ! Left side
290  R=1700  ! Right side
300  !
310  FOR Box=1 TO 15  ! Draw 15 boxes
320    OUTPUT Dsa:"PU"  ! Move pen to
330    OUTPUT Dsa:"PA";L,B ! bottom
340    OUTPUT Dsa:"PD"  ! left corner
350  !
360  OUTPUT Dsa:"PA";L,T ! These 4 lines
370  OUTPUT Dsa:"PA";R,T ! draw the box
380  OUTPUT Dsa:"PA";R,B !
390  OUTPUT Dsa:"PA";L,B !
400  !
410  OUTPUT Dsa:"DBSW2,1"  ! Switch buffers
420  OUTPUT Dsa:"DBAC2"  ! Lets us add #2
430  !
440  T=T-50  ! These four lines
450  B=B+50  ! decrease size for
460  L=L+50  ! the next box
470  R=R-50  !
480  !
490  NEXT Box  ! Draw next box
500  END
```
Line 40 sets the analyzer's address equal to the variable "Dsa." Line 60 disables command echoing, which significantly increases program speed. Line 70 creates two display buffers, #1 and #2, each 500 words long. Line 100 clears and activates buffer #1, which will be used to write the message. (Buffer #2 will be used to draw the boxes.) Line 110 sets the character size to 2 (your choices are 0 to 3). Line 120 lifts the "pen," allowing us to move the beam without drawing anything. (These commands—PU, PD, etc.—are the ones used by Hewlett-Packard plotters, hence the pen analogies.) Line 130 moves the pen (using the Plot Absolute command) to location 100,1000. The lower left corner is 0,0; the upper right corner is 2048,2048. Line 150 puts the pen back down so that line 160 can write the message "Custom Graphics Display ."

We have now written the message we want into display buffer #1; the next step is to put the buffer up on the display. This is accomplished with line 190. Line 200 waits for a second before going on to the second part of the program. To review the steps in this segment: create buffers, activate a buffer, fill it with graphics commands, then put it on the display. Figure 2 shows the display after the first segment is finished.

---

**Custom Graphics Display**

---

**Figure 2  Message Display**

Line 240 starts the drawing segment of the program by clearing and activating buffer #2. Buffer #1 is still displayed, however, because we haven't yet pulled it down from the display. Lines 260 through 290 initialize the four variables that define the top (T), bottom (B), left side (L), and right side (R) of the box. This is roughly the size of a single measurement display.
The FOR/NEXT loop from line 310 to line 490 draws fifteen boxes, each slightly smaller than the last. Lines 320 through 340 move the pen to the lower left corner of the box. Lines 360 through 390 draw the four sides of the box. After the box is complete, line 410 switches buffer #1 for #2. This takes buffer #1 (the message) down from the display and puts buffer #2 (the box) up on the display. Line 420 allows us to add more commands to buffer #2 without taking it down from the display. Lines 440 through 470 decrease the size of the box to draw another one inside the last one. Line 490 sends the program back to draw the next box.

Each time the program makes one loop a box is drawn, slightly smaller than the last box. The buffer switch command (DBSW(2,1)) in line 410 tells the analyzer to put buffer #2 back up on the display after each new box is drawn. Figure 3 shows the display after the fifteen boxes are drawn.

Figure 3  The Graphics Display

To get a good feel for graphics on the HP 3562A’s display, try modifying lines in this program. For example, deleting the Pen Up command in line 120 causes the screen to draw a vector from the current position to 100,1000 when the Plot Absolute command in line 130 is executed. In the drawing segment, try changing such variables as the decrease factors in lines 440 through 470.
Example #6: Plotting with a Controller on the Bus

This program shows you how to pass control from the computer to the analyzer so it can plot the display. Because only one device can be in control of the bus at a time, you need to pass control to the HP 3562A when you want to plot. After the plot is finished, control is passed back to the computer. A program of this type is necessary when a controller is on the bus, and the HP 3562A needs to be the active controller: plotting, accessing a disc drive, or outputting command strings. This program uses service request (SRQ) interrupts to pass control back and forth.

```plaintext
10 ! Example 6
20 ! Plotting with a controller on the bus
30 !
40 Dsa=720 ! Address of 3562A
50 OUTPUT Dsa:"CTAD21" ! Controller address
60 ON INTR 7 GOTO Got_sq; ! When SRQ received,
70 ENABLE INTR 7:12 ! go to 'Got_sq;'
75 OUTPUT Dsa:"SRQE" ! Enables SRQs
80 OUTPUT Dsa:"STPL" ! START PLOT command
90 Idle1: GOTO Idle1 ! Wait for SRQ
120 !
130 Got_sq;: ! Plotting has started
130 Erase=SPOLL(Dsa) ! Erase SRQ flag
130 PRINT "Control passed to HP 3562A" !
140 PASS CONTROL Dsa ! Pass control to 3562A
150 !
160 ON INTR 7 GOTO Plot_done; ! Wait for plot to finish
170 ENABLE INTR 7:12 ! Enable SRQ interrupts
180 Idle2: GOTO Idle2 ! Wait for interrupt
190 !
200 Plot_done: ! Plot is finished
210 Erase=SPOLL(Dsa) ! Erase SRQ flag
220 PRINT "Control passed back to computer" !
230 REMOTE Dsa ! Put 3562A in remote
240 END
```

Line 40 sets the analyzer's address to the variable “Dsa.” Line 50 sends the computer's address [21] to the HP 3562A so it knows where to pass control back to when it is finished plotting. If you want to pass control to another device, simply modify line 50 accordingly.

Lines 60 through 100 monitor for SRQ interrupts and tell the HP 3562A to start plotting. When the analyzer receives the START PLOT command from the computer, it generates an SRQ telling the computer it needs control of the bus before it can plot. Line 60 sends the program to “Got_sq;” if an interrupt is detected on the bus. Line 70 enables only SRQ interrupts. Line 80 sends the START PLOT (STPL) command. Line 90 forces the program to wait until the SRQ is received. In this case, the wait is very short because the SRQ is received as soon as the HP 3562A reacts to the STPL command in line 80.

Lines 110 through 150 pass control to the analyzer after it tells the computer it needs control of the bus. Line 120 serial polls the HP 3562A to clear the SRQ. This is the only function of the serial poll in this example (the analyzer can't receive control until its SRQ is serviced). In a real program, however, you should interpret the status byte (which is read into the variable “Erase” here) to make sure that it was actually plotting that sent the SRQ. To keep this example simple, we assume it was. Line 130 displays a message on the CRT, and line 140 uses the BASIC 3.0 command PASS CONTROL to pass control to the analyzer.
In order to know when the analyzer is through with the bus, the computer must monitor for
the "end of plot SRQ." The HP 3562A automatically passes control when it no longer needs it.
This is done in lines 160 through 190. Line 160 sends the program to "Plot_done" when
the plot done SRQ is received. Line 170 enables only SRQ interrupts (they must be re-enabled
each time they are anticipated). Line 180 forces the program to wait until the SRQ is received.
If the program wasn't forced to wait here, it would continue on without the computer having
control of the system (which may or may not be desirable).

Lines 200 through 240 are optional but allow the program to exit with both the computer and
the analyzer ready for more action. Line 210 clears the SRQ, as explained earlier. Line 220 lets
you know that the computer is back in control of the bus. Line 230 puts the HP 3562A back
into the remote mode.

This program can be modified to fit your particular application. For example, you can delete
lines 50 and 80, and the computer will idle until you manually press the START PLOT softkey.
This allows you to use the front panel and plot without physically removing the controller from
the bus. Similarly, if you end the program at line 200, the HP 3562A stays in local mode after
it is finished plotting. Complete information on using SRQ and the status byte is provided in
Chapter 6 of the HP 3562A Programming Manual. In addition, the CTAD command (controller
address) should be sent to specify the address to which the analyzer should pass control when
it is finished. This is also explained in Chapter 6.

Example #7: Sharing a Disc Drive with a Controller

This program is a modified version of example #6 that allows you to share a disc drive with the
system controller. The program passes control to the analyzer, has it save the display to disc,
then passes control back to the computer.

```
10    ! Example 7
20    ! Disc accessing with a controller
30    !
40    ! Dsa=728       ! Address of 3562A
50    !
60    ! ON INTR 7 GOTO Got_src       ! When SRQ received.
70    ! ENABLE INTR 7\12        ! go to 'Got_src'
75    ! OUTPUT Dsa:"SRQE"     ! Enables SRQs
80    ! INPUT 'File name?\n\"\n\"\n90    ! OUTPUT Dsa:"SAVF\"\"N\#:\"\"      !
100   ! SAVE FILE command
110   ! Idle1: GOTO Idle1       ! Wait for SRQ
120   !
130   ! Got_src:            ! Disc access has started
140   ! Erase=SPOLL(1Dsa)          ! Erase SRQ flag
150   ! PRINT "Control passed to HP 3562A"
160   ! PASS CONTROL Dsa       ! Pass control to 3562A
170   !
180   ! ON INTR 7 GOTO Disc_done! Wait for disc to finish
190   ! ENABLE INTR 7\12  ! Enable SRQ interrupts
200   ! Idle2: GOTO Idle2     ! Wait for interrupt
210   !
220   ! Disc_done:           ! Disc is finished
230   ! Erase=SPOLL(1Dsa)          ! Erase SRQ flag
240   ! PRINT "Control passed back to computer"
250   ! PRINT
260   ! PRINT "File \"\"N\#:\"\" saved"
270   ! REMOTE Dsa       ! Put 3562A in remote
280   ! END
```
The only differences between this program and example #6 are the commands needed to save files on disc. Line 80 asks you to enter the desired file name. Line 90 combines the SAVE FILE (SAVF) command with the file name you enter and sends this to the analyzer. Note the syntax of this command: it is necessary to combine the mnemonic (SAVF), the opening single quote ('), the alpha name (NS), and the closing single quote (') in exactly this arrangement. The semicolons (;) must be used to concatenate the various pieces of the command. The other difference is in the message displayed on the CRT by lines 240 through 260, which confirms that the file was saved under the name you entered.

Example #8: Dumping/Loading Data Traces

This program shows you how to dump a data trace from the analyzer. This dump is done in ANSI floating point format. Detailed instructions on all the HP 3562A’s data transfer capabilities are provided into Chapter 3 of the HP 3562A Programming Manual. The last part of the program loads the data trace back into the analyzer so that you can verify both transfers.

```
10  ! Example 8
20  ! Dumping/loading the active trace
30  !
40  OPTION BASE 1                          ! Set array base to 1
50  ASSIGN @Dsa TO 720                     ! Address of 3562A
60  DIM Block(2500)                       ! Set initial array
70  !
80  OUTPUT @Dsa:"DDAN";                 ! Dump data command
90  ENTER @Dsa USING ":,.2A,W";A#,Length  ! Determine length
100 ENDIM Block(Float)                   ! Floating point data
110 RESIZE Block(Float)                  ! Resize array
120 !
130 ASSIGN @Dsa;FORMAT OFF              ! Disable ASCII format
140 ENTER @Dsa;Block(*)                  ! Enter data
150 ASSIGN @Dsa;FORMAT ON               ! Enable ASCII format
160 !
170 PRINT "Data trace dumped to controller"
180 PRINT 'Elements received:':;Float   ! Change trace now
190 PAUSE                                 ! to verify transfer
200 !
210 OUTPUT @Dsa:"LDAN";                 ! Load data command
220 OUTPUT @Dsa USING ":,.2A,W";A#,Length  ! Data format & length
230 ASSIGN @Dsa;FORMAT OFF              ! Disable ASCII format
240 OUTPUT @Dsa;Block(*)                 ! Output data
250 ASSIGN @Dsa;FORMAT ON               ! Enable ASCII format
260 !
270 PRINT "Data trace loaded back to 3562A"
280 ENO
```
Line 40 sets the option base for the array at 1. This was done to make the number of variables in the array more obvious. Line 50 assigns an I/O path to the analyzer at address 720. Line 60 dimensions a real array with a maximum size of 2500 values. (The number of variables dumped by the program varies according to the type of trace dumped; the program redimensions the array later.) Line 80 outputs the dump data command (DDAN = Dump Data in ANsi binary.) You can also dump data in ASCII and a special binary format; the programming manual has the details.

The data are dumped in two stages. The first stage consists of four bytes: two byte specifying the data format and two bytes specifying the amount of data that will be transferred. The format specifier (#A for ANSI data) is ignored in this case, and the length word is read into "Length." This stage is accomplished by lines 80 and 90.

The second stage starts with line 110. Since this transfer is in floating point format, eight bytes will be coming over for each value. We want each value in the array to represent one complete value from the analyzer, so line 110 divides "Length" by 8 to produce "Float." (Floating point values are 8 bytes long.) The value of "Float" is then used to redimension (line 120) the array "Block" into which the data will be read.

Line 140 disables the ASCII formatter in the computer. If this is not done, the computer takes every two byte and converts them to one ASCII character, rather than waiting for eight bytes. Line 150 completes the second stage of the data transfer. The (*) after the array name simply tells the computer to use the entire array; remember we just resized the array (line 120) to fit our data length. Line 160 re-enables the ASCII formatter.

The PAUSE in line 200 was inserted so you can change the trace on the display and then load the trace just dumped back into the analyzer. This is quick indication that both transfers worked.

The load section of the program starts at line 230, which outputs the load data command. Line 240 then outputs the #A and the length word. Lines 260 through 280 output the data stored in the array "Block."
Example #9: Dumping/Loading Instrument States

This program is similar in concept to example #8: it dumps the instrument state to the controller and allows you to load it back into the analyzer later. The "instrument state" is the collection of setup parameters that define the analyzer's current operating state. If you want to view the instrument state display, press the STATE TRACE key until the state is displayed.

The method in this program is the same as that in example #8. The differences are in the dump and load commands used and the size of the array. Note that the array size is fixed for the instrument state.

```
10  | Example 9
20  | Dumping/loading the instrument state
30  |
40  | OPTION BASE 1 | Set array base to 1
50  | ASSIGN @Dsa TO 720 | Address of 3562A
60  | DIM Block(100) | Set initial array
70  |
80  | OUTPUT @Dsa:"DSAN" | Dump data command
90  | ENTER @Dsa USING "#,.2A,W";#A;Length
100 | Determine length
110 | Float=Length DIV 8 | Floating point data
120 | REDIM Block(Float) | Resize array
130 |
140 | ASSIGN @Dsa:FORMAT OFF | Disable ASCII format
150 | ENTER @Dsa:Block(*) | Enter state
160 | ASSIGN @Dsa:FORMAT ON | Enable ASCII format
170 |
180 | PRINT "Instrument state dumped to controller"
190 | PRINT "Elements received:";Float
200 | PAUSE | Change state now
210 | | to verify transfer
220 |
230 | OUTPUT @Dsa:"LSAN" | Load state command
240 | OUTPUT @Dsa USING ";,.2A,W";#A;Length
250 | | Data format & length
260 | ASSIGN @Dsa:FORMAT OFF | Disable ASCII format
270 | OUTPUT @Dsa:Block(*) | Output state
280 | ASSIGN @Dsa:FORMAT ON | Enable ASCII format
290 |
300 | PRINT "Instrument state loaded back to 3562A"
310 | END
```
Example #10: Power-on Service Requests

As explained in example #3, instruments (and sometimes operators) can send service requests (SRQs) to the system controller. One of the SRQs provided by the HP 3562A is the power-on SRQ. As its name implies, this request service when the analyzer is powered on.

This program forces the computer to wait until the analyzer is turned on, then displays a message indicating so. In a real program, you would substitute the message with the appropriate service routine.

```
10  ! Example 10
20  ! Handling a power-on SRQ
30  !
40  Dsa=720   ! Address of 3562A
50  !
60  DISABLE 7 GOTO Got_srq  ! Look for interrupts
70  ENABLE 7:2      ! Enable SRQ interrupts
80  PRINT "Waiting for power-on ..."
90  Idle:  GOTO Idle  ! Wait for interrupt
100  !
110  Got_srq:  ! Received SRQ
120  Status_byte=SPOLL(Dsa)  ! Serial poll 3562A and
130  ! read its status byte
140  Status_byte=BNAND(Status_byte,15)  ! Mask bits 4-7
150  !
160  IF Status_byte=12 THEN Go_on  ! Continue if power-on
170  !
180  ! SRQ flag is set
190  GOTO 60  ! Interrupt was not
200  !
210  Go_on:  PRINT "HARK! The HP 3562A is awake!"
220  END
```

Lines 60 through 100 enables the interrupt then wait for the SRQ to occur. Line 60 tells the program to go to "Got_srq" when it receives the SRQ. Line 70 enables the SRQ interrupt. Line 80 displays a message, and line 90 forces the program to wait until the SRQ is received.

After the SRQ is received, lines 110 through 190 determine if it was actually the HP 3562A's power-up that generated the SRQ. (In contrast to examples 6 and 7, which did not verify the cause of the interrupt. The reason it was done here is that the time between when the computer starts looking for an interrupt and when it actually receives one is indeterminate. Another device could generate an SRQ in the meantime, and we need away to separate the interrupts.) Line 120 serial polls the HP 3562A and reads its status byte. Line 140 masks out bits 4—7 of the status byte (the power-on SRQ is encoded in bits 0—3, so erasing the other bits make decoding easier). Line 160 checks to see if the variable "Status_byte" equals 12. If yes, the SRQ was caused by the analyzer's power-up, and the program prints a message with line 210 then ends. If not, the SRQ had another cause, and line 190 sends the program back to line 60 to wait for the next interrupt.

To demonstrate this program, turn the HP 3562A off then run the program. When the message "Waiting for power-on..." is displayed, turn the analyzer back on. This generates the power-on SRQ and causes the program to continue with line 110.
Example #11: External Control without the Controller

This example shows a very powerful HP-IB feature of the HP 3562A: providing "external" control without the controller. The analyzer's system controller capability allows it to output HP-IB command strings. These commands can be used to program other devices on the bus. When combined with the auto sequence feature, command strings allow you to create entire programs in the HP 3562A that control other devices.

```
Display ON
Label: EXAMPLE 11
1 HP-IB FCTN: OUTPUT STRING --OB62SO.1
2 HP-IB FCTN: OUTPUT STRING --OBAC1.PU
3 IBPN: OUTPUT STRING --PA6CO.1000; PD
4 HP-IB FCTN: OUTPUT STRING --CMC23
5 IBPN: OUTPUT STRING --WAIT"CONTROL\'
6 HP-IB FCTN: OUTPUT STRING --DBUP1
```

Let's start with a one-line example. Press the HP-IB FCTN key (the one used earlier to set addresses). One of the softkeys in its menu is OUTPUT STRING. After pressing this, you can enter an HP-IB address followed by a comma, then the desired command string. Here is an example that resets a device at address 7:

```
OUTPUT STRING 7,RST
```

Assume that the device at address 7 is a synthesizer you are using to stimulate a device the HP 3562A is testing. You could program the synthesizer's setup state in an auto sequence, then with one key press set up the synthesizer under HP-IB control.

To make the OUTPUT STRING feature even more useful, the analyzer allows you to send HP-IB commands back to itself. Just replace the address and comma with two dashes (---). Let's modify the last example to reset the HP 3562A:
OUTPUT STRING—RST

Try this one and verify that the analyzer is indeed reset. Obviously, we haven't accomplished much if we merely emulate front panel commands. However, the real power of the OUTPUT STRING — is using the bus-only commands. (Remember these are the commands available only via HP-IB and not from the front panel.) The following example uses an auto sequence programmed with some of the graphics commands used in example #5:

Line 1 sets up one 50-character display buffer. Line 2 activates this buffer (#1) then lifts the "pen." Line 3 move the pen to left center of the screen then puts the pen back down. Line 4 sets the character size to 3 (the largest size available). Line 5 writes the message "CONTROL..." Line 6 puts buffer #1 up on the display. Figure 4 shows the result of running this auto sequence.

---

CONTROL

---

Figure 4  The Result of Example #11

By combining auto sequences with graphics commands, you can display operator messages and simple diagrams without using a computer. (Chapter 10 in the HP 3562A Operating Manual explains the use of auto sequences.)
Example #12: User-Defined Windows

This program shows you how to load a user-defined window into the HP 3562A. This feature allows you to create a function in your computer then have the analyzer use that function as its window. Creating a function in a controller and transferring to the analyzer presents a special problem: you need to construct a header to go along with the data you want to send. To provide a simple example, this program modifies example #8, which dumped a trace and its header then turned around and loaded them back into the analyzer. To avoid the problem of creating a header, we will use the header dumped from the analyzer and simply replace the original data with our created windowing function.

```
10 | Example 12
20 | Loading a user-defined window
30 |
40 | OPTION BASE 1  | Set array base to 1
50 | ASSIGN @Os;i TO 720  | Address of 3562A
60 | OUTPUT @Os;i;"FRLN"  | Freq resp preset
70 | WAIT 3  | Pause to allow preset
80 | OUTPUT @Os;i;"LSP1"  | Select linear spectrum
90 | DIM Header(66)  | Create header array
90 | DIM Trace(1602)  | Create trace array
100 |
110 | OUTPUT @Os;i;"DDAN"  | Dump data command
120 | ENTER @Os;i USING ";,2A,WM#,%#\r\n\n130 |
140 | ASSIGN @Os;i;FORMAT OFF  | Disable ASCII format
150 | ENTER @Os;i;Header(*),Trace(*)  |
160 | ENTER header and trace
170 | ASSIGN @Os;i;FORMAT ON  | Enable ASCII format
180 |
190 | MAT Trace= ();  | Erase trace data
200 | Trace(1)=.999028  |
210 | Trace(3)=.957252  | Enter window data
220 | Trace(5)=.351960  |
230 |
240 | OUTPUT @Os;"LDAN"  | Load data command
250 | OUTPUT @Os; USING "#,2A,WM#,%#\r\n\n260 | Data format and length
270 | ASSIGN @Os;i;FORMAT OFF  | Disable ASCII format
280 | OUTPUT @Os;i;Header(*),Trace(*)  |
290 | Output header and trace
300 | ASSIGN @Os;i;FORMAT ON  | Enable ASCII format
310 |
320 | OUTPUT @Os;i;"FFT1"  | Inverse FFT
330 | OUTPUT @Os;i;"SAV01"  | Save function
340 | OUTPUT @Os;i;"USD1"  | Select user window
350 | END
```
Most of this program was taken from example #8, so this explanation covers only those lines unique to this example. Lines 60 and 70 select the frequency response preset and the linear spectrum display. This causes the analyzer to expect a linear spectrum in return when the window function is loaded. Lines 80 and 90 create separate arrays for the header and data that will be dumped from the analyzer. They are put into separate arrays to make replacing the data while keeping the header easier.

Lines 110 through 170 are similar to the dump commands used in example #8, with the exception of using two arrays. Line 190 is a BASIC function to set the Trace array to zero; this erases the trace data just dumped from the analyzer. Lines 200 through 220 insert several values into the beginning of the trace array, while leaving the rest equal to zero. Note that this example is not intended to produce a usable window, but only to demonstrate how a window can be created. After the trace data have been replaced by the window function, the header can be combined with the new trace data and sent back to the analyzer. This is accomplished by lines 240 through 300.

The user-defined window must be a time domain function, so line 320 performs an inverse FFT on the trace jump loaded into the analyzer. Line 330 then saves the result in the saved data #1 memory location. Finally, line 340 selects the user-defined window.
INTRODUCTION

This appendix provides condensed HP-I B programming information for the HP 3562A Dynamic Signal Analyzer. It contains the following information in quick reference format:

- General command syntax
- Response to bus management commands
- Command mnemonics, including syntax, limits & terminators
- Service requests
- Status byte description, including masking
- Instrument status register description
- Activity status register description
- Error codes
- Key codes

For complete information, please refer to Chapters 1 through 6. This appendix is intended for reference use by programmers familiar with both the HP 3562A and the computer/controller being used.

The mnemonic list is divided in two parts. The first part contains the front panel (key and softkey) mnemonics listed alphabetically. The second part contains the bus-only commands listed alphabetically.
GENERAL COMMAND SYNTAX

The general syntax for sending commands to the HP 3562A is:

<mnem> <opt sp> <para> <sep> <para> <opt sp> <suff> <term>

where  <mnem> is the command mnemonic
       <opt sp> is ignored optional space
       <para> is first command-dependent parameter
       <sep> is required comma (,) for multi-parameter commands
       <para> is second command-dependent parameter
       <opt sp> is ignored optional space
       <suff> is command-dependent suffix
       <term> is command terminator (semicolon)

For example, to set up a frequency span from 10 to 60 kHz, you would send the command:

FRS 10,60 KHZ;

where: FRS is the mnemonic
       10 is the first command-dependent parameter
       , is the parameter separator
       60 is the second command-dependent parameter
       KHZ is the command-dependent suffix
       ; is the command terminator

Note that the front panel mnemonics usually emulate the respective key or softkey. In some cases, suffixes (terminators, delimiters) are not required. The syntax required for every command is described in the mnemonic table. You should consult this whenever there is a question about a particular command's syntax.

Parameter Queries

To query the current value of any variable parameter, send the appropriate mnemonic followed by a question mark. For example, to learn the current frequency span, send FRS?.

# RESPONSE TO BUS MANAGEMENT COMMANDS

Table 1 summarizes the HP 3562A's response to the HP-IB primary bus management commands.

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABORT I/O</td>
<td>Aborts data input or output and unaddresses the analyzer. Does not clear the HP-IB command buffer.</td>
</tr>
<tr>
<td>CLEAR LOCKOUT &amp; SET LOCAL</td>
<td>Clears local lockout and returns to local control.</td>
</tr>
<tr>
<td>DEVICE CLEAR</td>
<td>Unconditionally interrupts bus activity; clears the HP-IB command buffer, resets the SRQ line, aborts data input/output, and enters REMOTE mode.</td>
</tr>
<tr>
<td>LOCAL</td>
<td>Returns to local (front panel) control and aborts load operations in progress, but does not abort dump operations or clear the HP-IB command buffer.</td>
</tr>
<tr>
<td>LOCAL LOCKOUT</td>
<td>Disables the front panel LOCAL key, but does affect local/remote status.</td>
</tr>
<tr>
<td>PARALLEL POLL</td>
<td>Does not respond.</td>
</tr>
<tr>
<td>PARALLEL POLL CONFIGURE</td>
<td>Does not respond.</td>
</tr>
<tr>
<td>PASS CONTROL</td>
<td>Accepts control if needed; passes control back when finished to address specified by the CTAD command. Immediately passes control back if it receives control when it does not need it.</td>
</tr>
<tr>
<td>REMOTE</td>
<td>Forces the HP 3562A into the REMOTE mode.</td>
</tr>
<tr>
<td>SERIAL POLL</td>
<td>Responds by sending its status byte, a 8-bit integer.</td>
</tr>
<tr>
<td>TRIGGER</td>
<td>Accepts HP-IB triggering if it is first enabled by sending the analyzer the HPT command.</td>
</tr>
</tbody>
</table>
# FRONT PANEL COMMANDS

<table>
<thead>
<tr>
<th>NAME</th>
<th>MNEM</th>
<th>RANGE</th>
<th>SUFFIXES</th>
<th>SYNTAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>A &amp; B TRACES</td>
<td>ABTR</td>
<td></td>
<td></td>
<td>ABTR</td>
</tr>
<tr>
<td>A&amp;B</td>
<td>AB</td>
<td></td>
<td></td>
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<td>AGON0 = off</td>
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<td>ADD</td>
<td>10 ± 38</td>
<td>TRACE A (TRCA)</td>
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<td>TRACE B (TRCB)</td>
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r = value within the range specified in the RANGE column  
s = one of the suffixes from the SUFFIX column  
a = alphanumeric character
# Front Panel Commands (cont)

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### Front Panel Commands (cont)

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<td>CALC OFF (SBAND)</td>
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<td>USEC, MSEC, SEC</td>
<td>CLENrrss (range depends on suffix; 10 records or equivalent limits)</td>
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<td>MIN, REVS, PNTS REC</td>
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<td>CPNT</td>
<td>(same as CAPTUR LENGTH)</td>
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<td>CPNTrss</td>
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<td>CPSE</td>
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<td>CFrrss (range limited to 100 kHz – (10.24 mHz/2)</td>
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<td>MIN, REVS, REC</td>
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<td>CHAN 1 INPUT</td>
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<td>C1IN</td>
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<tr>
<td>CHAN 1 RANGE</td>
<td>C1RG</td>
<td>15-27</td>
<td>V, MV, VRMS, MVRM, DBV, EU</td>
<td>C1RGrrss (range depends on suffix; absolute limit is -51 to +27 dBV)</td>
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<td>CHAN 2 AC DC</td>
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<td>0 or 1</td>
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<td>C2AC 0 = dc C2AC 1 = ac</td>
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<td>see comment</td>
<td>USEC, MSEC, SEC</td>
<td>C2DLrrss (range depends on suffix; -4095 points and +50 records are absolute limits)</td>
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<td></td>
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<td>MIN, REVS, REC</td>
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<tr>
<td>CHAN 2 INPUT</td>
<td>C2IN</td>
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### Front Panel Commands (cont)

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<th>SYNTAX</th>
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<td>51-27</td>
<td>V, MV, VRMS, MVRM, DBV, EU</td>
<td>C2RGrrss (range depends on suffix; absolute limit is (-51) to (+27) dBV)</td>
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<td>CHANGE LINE</td>
<td>CHGL</td>
<td>see comment</td>
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<td>CHGL (for auto sequences and auto math; entry is any valid command)</td>
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<tr>
<td>CHANGE REGION</td>
<td>CHRG</td>
<td>0-100 kHz</td>
<td>MHz, Hz, KHz</td>
<td>CHRGrrr,rrss</td>
</tr>
<tr>
<td>CHANGE VALUE</td>
<td>CHGV</td>
<td>10(^{+38})</td>
<td>MHz, Hz, KHz</td>
<td>CHGVrrr,rrss</td>
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<td>CLAS (auto sequence must be displayed first)</td>
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<tr>
<td>CROSS CORR</td>
<td>CCOR</td>
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<td>CCOR (measurement)</td>
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<td>DMOD1 = on</td>
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- r = value within the range specified in the **RANGE** column
- s = one of the suffixes from the **SUFFIX** column
- a = alphanumeric character
Front Panel Commands (cont)

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<td>TRACE B (TRCB)</td>
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r = value within the range specified in the RANGE column
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a = alphanumeric character

B-9
## Front Panel Commands (cont)

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<td>ENGR</td>
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<tr>
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<td>ENT</td>
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<td>ENT (terminator only)</td>
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<td>EU</td>
<td>EU</td>
<td></td>
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<td>EU (terminator only)</td>
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<td>EUL1'aaa'</td>
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<tr>
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<td>±1 nV to ±1000 V</td>
<td>VEU, MVEU, DB</td>
<td>EUV1rrs</td>
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<td>±1 nV to ±1000 V</td>
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<td>nErr (exponential notation; example: 10E4 = 100 000. D or L can be used in place of E.)</td>
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<td>USEC, MSEC, SEC, MIN, REV</td>
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<td></td>
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<td>FTLG (disc service functions)</td>
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<td>FIT FCTN</td>
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### Front Panel Commands (cont)

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<td>FSINrrss (range is 64</td>
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<td>μHz to 100 kHz; entry</td>
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<td>limits depend on suffix)</td>
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<td>FNFrrrssss</td>
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<td>SEC, MIN, REV</td>
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<td>Hz (Sec)</td>
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\( r = \) value within the range specified in the **RANGE** column

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<td>HZ/S (terminator only)</td>
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<td>INCT'aaaaaa'</td>
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<tr>
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| PROTCT ON OFF      | PTON  | 0 or 1  |                           | PTON0 = off  
|                    |       |         |                           | PTON1 = on                                   |
| PRVIEW OFF         | PROF  |         |                           | PROF                                        |
| PRVIEW ON OFF      | PRON  |         |                           | PRON0 = off  
|                    |       |         |                           | PRON1 = on                                   |
| Pulse/Rev          | P/RV  |         |                           | P/RV (terminator only)                      |
| PwrSRQ ON OFF      | PSRQ  | 0 or 1  |                           | PSRQ0 = off  
|                    |       |         |                           | PSRQ1 = on                                   |
| RAMP TIME          | RAMP  | 10⁻³⁸   | USEC, MSEC, SEC, MIN, REC | RAMPrrrrssss (limit is 10⁻³⁸s; entry range depends on suffix) |
| RANDOM NOISE       | RND   |         |                           | RND                                         |
| RANGE              | RNG   | -51 to  | V, MV, VRMS, MVRM, DBVR, | RANGrrrrssss (entry is EU optional; range depends on suffix) |
| READ PEN→P1        | RDP1  |         |                           | RDP1                                        |
| READ PEN→P2        | RDP2  |         |                           | RDP2                                        |
| REAL               | REAL  |         |                           | REAL                                        |
| REAL PART          | RLPT  |         |                           | RLPT                                        |
| RECALL DATA#       | RCLD  | 1 or 2  |                           | RCLDr                                       |
| RECALL FILE        | RCFL  | alpha   |                           | RCFL’a’aaaaaa’                              |
| RECALL PWR DN      | RCLP  |         |                           | RCLP                                        |
| RECALL STATE#      | RCLS  | 1—5     |                           | RCLSr                                       |
| RECIPI             | RCIP  |         |                           | RECIPI                                       |
| Record             | REC   |         |                           | REC (terminator only)                        |
| REF CHAN 1         | RFC1  |         |                           | RFC1                                        |
| REF CHAN 2         | RFC2  |         |                           | RFC2                                        |
| REF LEVEL          | RFLV  | 5 mV to | V, MV, VRMS, MVRM, DBVR, | RFLVrrrrsss                                  |
|                    |       | 31.5 Vpk|                           |                                              |
| RESLTN             | RES   | 64 μHz— | HZ/P, P/SW                | RESrrrrssss                                  |
|                    |       | 99.99994 kHz |                  |                                              |

r = value within the range specified in the RANGE column  
s = one of the suffixes from the SUFFIXES column  
a = alphanumeric character
### Front Panel Commands (cont)

<table>
<thead>
<tr>
<th>NAME</th>
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<th>RANGE</th>
<th>SUFFIXES</th>
<th>SYNTAX</th>
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<tr>
<td>RESLTN AU FIX</td>
<td>RSAU</td>
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<td></td>
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<td></td>
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<td>RSAU1 = au</td>
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<tr>
<td>RESTOR CATLOG</td>
<td>RSCT</td>
<td>alpha</td>
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<td>RSCT'aaaaa'</td>
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<tr>
<td>RETURN</td>
<td>RTN</td>
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<td>REVS</td>
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<td>ROT 90 ON OFF</td>
<td>ROT</td>
<td>0 or 1</td>
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<td>ROT0 = off</td>
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<td>ROT1 = on</td>
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<tr>
<td>RPM</td>
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<td>SMPF</td>
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<td>SAVSr</td>
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<td>SBIN</td>
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<td>SCFR</td>
<td>10^-6</td>
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<td>10^-6</td>
<td>KHZ, HZ, MHZ</td>
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<td>SCRL1 = on</td>
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<td>Sec</td>
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<tr>
<td>Sec/Dec</td>
<td>S/DC</td>
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<td>Sec/Oct</td>
<td>S/OC</td>
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<td>SDAT</td>
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<tr>
<td>SELECT MEAS</td>
<td>SMES</td>
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<th>MNEM</th>
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<tr>
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<td>SVFN</td>
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<td>SET P1 LWR LF</td>
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<td>±32767</td>
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<td>SEP1,rrr,rrr</td>
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<tr>
<td>SET P2 UPR RT</td>
<td>SEP2</td>
<td>±32767</td>
<td></td>
<td>SEP2,rrr,rrr</td>
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<tr>
<td>SINGLE CAL</td>
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<td>SLOPE</td>
<td>SLP</td>
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<td>SLP</td>
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<td>SLOPE + -</td>
<td>SLOP</td>
<td>0 or 1</td>
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<td>SLOPO = off, SLOP1 = on</td>
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<td>SRLV</td>
<td>0—5V</td>
<td>V, MV, VRMS, MVRM, DBV</td>
<td>SRLV,rrrrrrr</td>
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<td>5 mV—5V</td>
<td>V, MV, VRMS, MVRM, DBV</td>
<td>SRLM,rrrrrrr</td>
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<td>SPFNR</td>
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<td><strong>SPCL MARKER</strong></td>
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<td>SPMKR</td>
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<td>SPEED FS</td>
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<td>SPED0 = slow, SPED1 = fast</td>
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<td>SQUARE ROOT</td>
<td>SQRT</td>
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<td>STABLE (MEAN)</td>
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<tr>
<td><strong>START</strong></td>
<td>STRT</td>
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</tbody>
</table>

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<th>MNEM</th>
<th>RANGE</th>
<th>SUFFIXES</th>
<th>SYNTAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>START ASEQ 1</td>
<td>ASQ1</td>
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<td>ASQ1</td>
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<tr>
<td>START ASEQ 2</td>
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<td>START ASEQ 3</td>
<td>ASQ3</td>
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<td>ASQ3</td>
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<td>START ASEQ 4</td>
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<td>START ASEQ 5</td>
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<td>START CAPTUR</td>
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<td>STCP</td>
</tr>
<tr>
<td>START FREQ</td>
<td>SF</td>
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<td>KHZ, Hz, MHZ, RPM, ORD</td>
<td>SFrrss (linear res, capture)</td>
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<td></td>
<td></td>
<td>0.1 Hz—100 kHz</td>
<td>KHZ, HZ, MHZ</td>
<td>SFrrss (log res)</td>
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<td></td>
<td></td>
<td>64 μHz—99999.99986 Hz</td>
<td>KHZ, HZ, MHZ, RPM, ORD</td>
<td>SFrrsss (swept sine)</td>
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<td>START PLOT</td>
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<tr>
<td>START THRUIT</td>
<td>STHR</td>
<td></td>
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<td>STHR</td>
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</table>
| STATE TRACE  | STTR |                   |                           | STTR
|              |      | STAT = state      |                           | TRAC = trace                |
| STOP FIT     | SPFT |                   |                           | SPFT                        |
| STOP FREQ    | SPF  | 120 μHz—100 kHz  | KHZ, HZ, MHZ, RPM, ORD   | SPFrrss (swept sine)        |
| STORE WEIGHT | STWT |                   |                           | STWT                        |
| SUB          | SUB  | 10⁻³⁵              | TRACE A (TRCA)            | SUBrrr                      |
|              |      |                   | TRACE B (TRCB)            | SUBsrrs                     |
|              |      |                   | SAVED 1 (SAV1)           |                             |
|              |      |                   | SAVED 2 (SAV2)           |                             |
| SWEEP DOWN   | SWDN |                   |                           | SWDN                        |
| SWEEP HOLD   | SWHD |                   |                           | holds the sweep             |
| SWEEP RATE   | SWRT | 10⁻³⁵              | S/DC, M/DC, S/OC, M/OC, H/M/S, HZ/S, HZ/M | SWRTrrss (limit depends on suffix) |

\( \text{r} = \text{value within the range specified in the RANGE column} \\
\text{s} = \text{one of the suffixes from the SUFFIXES column} \\
\text{a} = \text{alphanumeric character} \)
## Front Panel Commands (cont)

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<td>SYSTEM CNTLR</td>
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<td>SYSC</td>
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<td>GAIN</td>
<td>10 ± 38</td>
<td>USEC, MSEC, SEC, MIN, REV3, REC</td>
<td>GAINr</td>
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<td>USEC, MSEC, SEC, MIN, REV3, REC</td>
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<td>THRU0 = off, THRU1 = on</td>
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<td>CPTR (MEAS MODE)</td>
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<td>TIME CAPTUR</td>
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<td>TMCP (PRESET)</td>
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<tr>
<td>TIME DELAY</td>
<td>TMDL</td>
<td>10 ± 38</td>
<td>USEC, MSEC, SEC,</td>
<td>TMDLrrrrssss (CURVE FIT)</td>
</tr>
</tbody>
</table>

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* a = alphanumeric character
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<td>USEC, MSEC, SEC</td>
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<td>0—32767 sec</td>
<td>SEC</td>
<td>TIPSrrrSEC</td>
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<td>SEC</td>
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<td>TISTrrrrr (24 hour deactivate timed start)</td>
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</table>

| TO→POL RESIDU | TCPR |             |                | TOPR                           |
| TO→POL       | TCPY |             |                | TOPY                           |
| TO→POL ZERO  | TOPZ |             |                | TOPZ                           |
| TRACE A      | TRCA |             |                | TRCA                           |
| TRACE A PEN  | TRAP | 0—max       |                | TRAPrrr (max is number of pens in plotter) |
| TRACE B      | TRCB |             |                | TRCB                           |
| TRACE B PEN  | TRBP | 0—max       |                | TRBPrrr (max is number of pens in plotter) |
| TRACE TITLE  | TITL | alpha        |                | TITL 'aaaaaa'                  |

**TRIG DELAY**

| TRIG DELAY | TRGD |             |                | TRGD                           |
| TRIG LEVEL | TRLV | 10 ± 38 V, MV, EUC1, EUC2 | TRLVrrrssss (max is 10V for ext trigger) |

| UNFIX LINE# | UFLN | 1—20 |                | UFLNrr                        |
| UNIFRM (NONE) | UNIF |       |                | UNIF                          |
| UNITS        | UNIT |       |                | UNIT                          |
| UP ARROW     | UP   |       |                | UP                            |
| UPPER LOWER  | UPLO |       |                | UPLO                          |

r = value within the range specified in the RANGE column  
s = one of the suffixes from the SUFFIX column  
a = alphanumeric character
### Front Panel Commands (cont)

<table>
<thead>
<tr>
<th>NAME</th>
<th>MNEM</th>
<th>RANGE</th>
<th>SUFFIXES</th>
<th>SYNTAX</th>
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<tbody>
<tr>
<td>USER ORDER</td>
<td>USOR</td>
<td></td>
<td></td>
<td>USOR</td>
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<tr>
<td>USER LIMITS</td>
<td>ULIM</td>
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<tr>
<td>USER LINES</td>
<td>ULIN</td>
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<td>ULIN</td>
</tr>
<tr>
<td>USER CARRIER</td>
<td>UCRR</td>
<td>current span</td>
<td>MHZ, HZ, KHZ, RPM, ORD</td>
<td>UCRRr0rrrrrrss</td>
</tr>
<tr>
<td>USER SAVD1</td>
<td>USD1</td>
<td></td>
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<td>USD1</td>
</tr>
<tr>
<td>USER SRQ</td>
<td>USRQ</td>
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<td>USRQ</td>
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<tr>
<td>USER SRQ1</td>
<td>SRQ1</td>
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<tr>
<td>USER SRQ2</td>
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<td>USER SRQ3</td>
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<td>USER SRQ4</td>
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<td>USER SRQ6</td>
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<tr>
<td>USER SRQ7</td>
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<td>SRQ7</td>
</tr>
<tr>
<td>USER SRQ8</td>
<td>SRQ8</td>
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<td>SRQ8</td>
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<tr>
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<td>USWT</td>
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<td>USWT</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
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<td>V</td>
<td>V (terminator only)</td>
</tr>
<tr>
<td>VIEW</td>
<td>VEU</td>
<td></td>
<td>VEU</td>
<td>VEU (terminator only)</td>
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<tr>
<td>V/√Hz (√ PSD)</td>
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<tr>
<td>VOLTS²</td>
<td>VT2</td>
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<tr>
<td>V²/Hz (PSD)</td>
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<tr>
<td>V²/s/HZ (ESD)</td>
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<tr>
<td>VIEW</td>
<td>VIEW</td>
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<tr>
<td>VIEW CATLOG</td>
<td>CAT</td>
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<td>VIEW INPUT</td>
<td>VWIN</td>
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<td>VIEW MATH</td>
<td>VWMA</td>
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<tr>
<td>VIEW OFF</td>
<td>VWOF</td>
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<td>VWOF</td>
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</tr>
<tr>
<td>VIEW WEIGHT</td>
<td>VWWT</td>
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</tbody>
</table>

- r = value within the range specified in the RANGE column
- s = one of the suffixes from the SUFFIX column
- a = alphanumeric character
### Front Panel Commands (cont)

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<th>MNEM</th>
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<th>SUFFIXES</th>
<th>SYNTAX</th>
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<tbody>
<tr>
<td>VRms</td>
<td>VRMS</td>
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<td></td>
<td>VRMS (terminator only)</td>
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<tr>
<td>VOLTS</td>
<td>VLTS</td>
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<td>VLTS</td>
</tr>
<tr>
<td>VOLTS CHAN 1</td>
<td>VLT1</td>
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<td>VLT1</td>
</tr>
<tr>
<td>VOLTS CHAN 2</td>
<td>VLT2</td>
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<tr>
<td>VOLTS PEAK</td>
<td>VTPK</td>
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<td>VTPK</td>
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<tr>
<td>VOLTS RMS</td>
<td>VTRM</td>
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<td>VTRM</td>
</tr>
<tr>
<td>WEIGHT REGION</td>
<td>WTRG</td>
<td>0—100 kHz</td>
<td>KHZ, HZ, MHZ</td>
<td>WTRGRrrrrrrs</td>
</tr>
<tr>
<td>WEIGHT VALUE</td>
<td>WTVL</td>
<td>10±.06</td>
<td></td>
<td>WTVLrrr</td>
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<tr>
<td>WINDOW</td>
<td>WND0</td>
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<td>WND0</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>see comment</td>
<td></td>
<td>Xrrrrss (entry optional; range and suffix depend on current display)</td>
</tr>
<tr>
<td>X AUTO SCALE</td>
<td>XASC</td>
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<td>XASC</td>
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<tr>
<td>X FCTN OFF</td>
<td>XFOF</td>
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<td>XFOF</td>
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<tr>
<td>X FIXD SCALE</td>
<td>XSCL</td>
<td>see comment</td>
<td></td>
<td>XSCLrrrrss (range and suffix depend on current display)</td>
</tr>
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<td>XSCLrrrrr,rrrrss (range and suffix depend on current display)</td>
</tr>
<tr>
<td>X MRKR SCALE</td>
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<td>XMKR</td>
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<tr>
<td>X VALUE</td>
<td>XVAL</td>
<td>see comment</td>
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<td>XVALrrrrss (range and suffix depend on current display)</td>
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<td>XVALrrrrrr,rrrrss (range and suffix depend on current display)</td>
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<tr>
<td>Y</td>
<td>Y</td>
<td>see comment</td>
<td></td>
<td>Yrrrrss (entry optional; range and suffix depend on current display)</td>
</tr>
<tr>
<td>Y AUTO SCALE</td>
<td>YASC</td>
<td></td>
<td></td>
<td>YASC</td>
</tr>
<tr>
<td>Y DFLT SCALE</td>
<td>YDSC</td>
<td></td>
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<td>YDSC</td>
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<td>Y FIXD SCALE</td>
<td>YSCL</td>
<td>see comment</td>
<td></td>
<td>YSCLrrrrss (range and suffix depend on current display)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>YSCLrrrrrr,rrrrss (range and suffix depend on current display)</td>
</tr>
</tbody>
</table>

\[ r = \text{value within the range specified in the RANGE column} \]
\[ s = \text{one of the suffixes from the SUFFIX column} \]
\[ a = \text{alphanumeric character} \]
<table>
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<th>RANGE</th>
<th>SUFFIXES</th>
<th>SYNTAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y MRKR SCALE</td>
<td>YMKR</td>
<td></td>
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<td>YMKR</td>
</tr>
<tr>
<td>Y OFF</td>
<td>YOFF</td>
<td></td>
<td></td>
<td>YOFF</td>
</tr>
<tr>
<td>Y VALUE</td>
<td>YVAL</td>
<td>see comment</td>
<td></td>
<td>YVALrrrssss</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>YVALrrrrrrssss</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(range and suffix</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>depend on current</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>display)</td>
</tr>
</tbody>
</table>

**YES**

Use ACPT in place of YES when previewing over the bus.

**ZERO START**

ZST

---

r = value within the range specified in the **RANGE** column
s = one of the suffixes from the **SUFFIX** column
a = alphanumeric character
# BUS-ONLY COMMANDS

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>MNEM</th>
<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add Block</td>
<td>ADDB</td>
<td>ADDB:n1,,n2[,,n3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adds block n1 to n2 and puts the result in n3. If n3 is not specified the result is put in n2.</td>
</tr>
<tr>
<td>Add Complex Constant to Block</td>
<td>ADDX</td>
<td>ADDX:n1,,n2[,,n3[,,n4]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adds complex constant n1, n2 to block n3 (n1 is the real part and n2 is the imaginary part). The result is put in n4 if specified, n3 if not.</td>
</tr>
<tr>
<td>Add Real Constant to Block</td>
<td>ADDC</td>
<td>ADDC:n1,,n2[,,n3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adds constant n1 to real block n2 and puts the result in n3. If n3 is not specified the result put in n2.</td>
</tr>
<tr>
<td>Activity Status Query</td>
<td>AS?</td>
<td>AS?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns contents of activity status register</td>
</tr>
<tr>
<td>Activity Status Mask High</td>
<td>ASMH</td>
<td>ASMH:n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where n = decimal equivalent of sum of bits to be unmasked. See table 7.</td>
</tr>
<tr>
<td>Activity Status Mask Low</td>
<td>ASML</td>
<td>ASML:n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where n = decimal equivalent of sum of bits to be unmasked. See table 7.</td>
</tr>
<tr>
<td>Brightness</td>
<td>BRiT</td>
<td>BRiT:n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where values for n are: 0 = trace off 1 = dim 2 = half bright 3 = full bright (default)</td>
</tr>
<tr>
<td>Block Size</td>
<td>BLSZ</td>
<td>BLSZ:size,,n1[,,count]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Size is limited to 37 900 words n1 is first buffer (0 to 15) count is number of buffers; if not specified, count = 1</td>
</tr>
<tr>
<td>Character Rotation</td>
<td>CHRO</td>
<td>CHRO:n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where values of n are: 0 = 0° (default) 1 = 90° 2 = 180° 3 = 270°</td>
</tr>
<tr>
<td>Character Size</td>
<td>CHSZ</td>
<td>CHSZ:n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where values of n are: 0 = 24 × 36 points (default) 1 = 36 × 54 2 = 48 × 72 3 = 60 × 90</td>
</tr>
<tr>
<td>Clear Buffer</td>
<td>CLBF</td>
<td>CLBF:n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where n = −4 to 15</td>
</tr>
</tbody>
</table>

[ ] indicates optional parameter
### Bus Only Commands (cont)

<table>
<thead>
<tr>
<th>COMMAND</th>
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<th>SYNTAX/DATA FORMAT</th>
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</thead>
<tbody>
<tr>
<td>Command Echo Disable</td>
<td>COMD</td>
<td>COMD</td>
</tr>
<tr>
<td>Command Echo Enable</td>
<td>COME</td>
<td>COME</td>
</tr>
<tr>
<td>Complex Fast Fourier Transform</td>
<td>CFFT</td>
<td>CFFT n1, n2&lt;br&gt;Performs FFT on complex block n1 and puts results in n2.</td>
</tr>
<tr>
<td>Complex Inverse Fast Fourier Transform</td>
<td>CFT1</td>
<td>CFT1 n1, n2&lt;br&gt;Performs inverse FFT on complex block n1 and puts results in n2.</td>
</tr>
<tr>
<td>Conjugate Block</td>
<td>CNJB</td>
<td>CNJB n1, n2&lt;br&gt;Computes the complex conjugate of complex block n1 and puts results in n2. If n2 is not specified, the results are put in n1.</td>
</tr>
<tr>
<td>Controller Address</td>
<td>CTAD</td>
<td>CTAD n&lt;br&gt;Where n = 0 to 31</td>
</tr>
<tr>
<td>Cross Spectrum Exponential Average</td>
<td>CXAV</td>
<td>CXAV n1, n2, n3, awf&lt;br&gt;Computes cross spectrum of complex floating point blocks n1 and n2 and exponentially averages it with complex floating point block n3. awf is the average weighting factor (a power of two). Result is put in block n3.</td>
</tr>
<tr>
<td>Cross Spectrum Peak Hold</td>
<td>CPEK</td>
<td>CPEK n1, n2, n3&lt;br&gt;Computes cross spectrum of complex floating point blocks n1 and n2 and compares magnitudes of result with complex block n3. The larger values are put in n3.</td>
</tr>
<tr>
<td>Cross Spectrum Summation</td>
<td>CSPS</td>
<td>CSPS n1, n2, n3&lt;br&gt;Computes cross spectrum of complex floating point blocks n1 and n2 and adds it to complex floating point block n3, puts results in n3.</td>
</tr>
<tr>
<td>D (exponent image specifier)</td>
<td>D</td>
<td>Used as an exponent indicator in scientific notation, as is &quot;E&quot; and &quot;L&quot;.</td>
</tr>
<tr>
<td>Differentiate Block</td>
<td>DIFB</td>
<td>DIFB n1, n2&lt;br&gt;Computes differential of block n1 and puts result in n2. If n2 is not specified, result is put in n1.</td>
</tr>
<tr>
<td>Disable Sweep SRQ</td>
<td>DSWQ</td>
<td>DSWQ</td>
</tr>
<tr>
<td>Display</td>
<td>DSP</td>
<td>DSP 'aaa...aaa'&lt;br&gt;(max 24 characters)</td>
</tr>
<tr>
<td>Display Buffer Size</td>
<td>DBSZ</td>
<td>DBSZ size, n1, [count]&lt;br&gt;Size is number of words in each buffer; n1 is the first buffer; count is the number buffers. If count is not specified, one block is configured.</td>
</tr>
<tr>
<td>Display Query</td>
<td>DSP?</td>
<td>DSP?&lt;br&gt;Returns display message, up to 24 characters</td>
</tr>
</tbody>
</table>

[ ] indicates optional parameter
<table>
<thead>
<tr>
<th>COMMAND</th>
<th>MNEM</th>
<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
</table>
| Display Buffer Active Append  | DBAA  | DBAAn
Where n is the buffer to be activated                                           |
| Display Buffer Active Clear   | DBAC  | DBAC n
Where n is the buffer to be cleared and activated                                 |
| Display Buffer Switch         | DBSW  | DBSWn1, n2
Where n1 is the currently displayed buffer, and n2 is the buffer to be displayed   |
| Display Buffer Down           | DBDN  | DBDNn
Where n is the buffer to be taken down                                              |
| Display Buffer Up             | DBUP  | DBUPn
Where n is the buffer to be put up                                                 |
| Display Disable               | DSPD  | DSPD                                                                              |
| Display Enable                | DSPE  | DSPE                                                                              |
| Divide Block                  | DIVB  | DIVBn1, n2 [n3]
Divides block n2 by n1 and puts results in n3. If n3 is not specified, result is put in n2. |
| Divide Block into Real Constant | DIVC  | DIVCn1, n2 [n3]
Divides block n2 by constant n1 and puts results in n3. If n3 is not specified, results are put in n2. |
| Divide Block by jω             | DVJW  | DVJWω,ω₂, Δω, n2 [n3]
Divides complex block n1 by jω and puts results in n2. If n2 is not specified, results are put into n1. ω₂, Δω is the floating point starting value of ω and Δω is the incremental value of ω. |
| Divide Imaginary Part         | DIVI  | DIVI n1, n2 [n3]
Divides the imaginary part of complex floating point block n1 by real constant n2 and puts result in n3. If n3 is not specified, result is put in n1. |
| Divide By Complex Constant    | DIVX  | DIVXn1, n2, n3 [n4];
Divides block n1 by complex constant n2, n3 and puts the results in n4. If n4 is not specified the results are put in n1. n1 may be a real or complex block. Dividing a real block by a complex number requires a destination block twice the size of the real (source) block. |
| Divide By Constant            | DIVC  | DIVCn1, n2 [n3]
Divides block n1 by constant n2 and puts results in n3. If n3 is not specified, results are put in n1. |
| Divide Real Part              | DIVR  | DIVRn1, n2 [n3]
Divides real part of complex floating point block n1 by real constant n2 and puts result in n3. If n3 is not specified, result is put in n1. |

[ ] indicates optional parameter
### Bus Only Commands (cont)

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<tr>
<th>COMMAND</th>
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<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dump Block in ANSI Binary</td>
<td>DBAN</td>
<td>DBAN Dump primitive block PBLK&lt;sub&gt;n&lt;/sub&gt; in ANSI format.</td>
</tr>
<tr>
<td>Dump Block in ASCII</td>
<td>DBAS</td>
<td>DBAS Dump primitive block PBLK&lt;sub&gt;n&lt;/sub&gt; in ASCII format.</td>
</tr>
<tr>
<td>Dump Block in Internal Binary</td>
<td>DBBN</td>
<td>DBBN Dump primitive block PBLK&lt;sub&gt;n&lt;/sub&gt; in internal binary format.</td>
</tr>
<tr>
<td>Dump Coordinate Transform Block in ANSI Binary</td>
<td>DCAN</td>
<td>DCAN Dumps coordinate transform block in ANSI format.</td>
</tr>
<tr>
<td>Dump Coordinate Transform Block in ASCII</td>
<td>DCAS</td>
<td>DCAS Dumps coordinate transform block in ASCII format.</td>
</tr>
<tr>
<td>Dump Coordinate Transform Block in Internal Binary</td>
<td>DCBN</td>
<td>DCBN Dumps coordinate transform block in internal binary format.</td>
</tr>
<tr>
<td>Dump Data in ANSI Binary</td>
<td>DDAN</td>
<td>DDAN Dumps active trace in ANSI format.</td>
</tr>
<tr>
<td>Dump Data in ASCII</td>
<td>DDAS</td>
<td>DDAS Dumps active trace in ASCII format.</td>
</tr>
<tr>
<td>Dump Data in Internal Binary</td>
<td>DDBN</td>
<td>DDBN Dumps active trace in internal binary format.</td>
</tr>
<tr>
<td>Dump State in ANSI Binary</td>
<td>DSAN</td>
<td>DSAN Dumps state in ANSI format.</td>
</tr>
<tr>
<td>Dump State in ASCII</td>
<td>DSAS</td>
<td>DSAS Dumps state in ASCII format.</td>
</tr>
<tr>
<td>Dump State in Internal Binary</td>
<td>DSBN</td>
<td>DSBN Dumps state in internal binary format.</td>
</tr>
<tr>
<td>Dump Table in ANSI Binary</td>
<td>DTAN</td>
<td>DTAN Dumps synth/curve fit table in ANSI.</td>
</tr>
<tr>
<td>Dump Table in ASCII</td>
<td>DTAS</td>
<td>DTAS Dumps synth/curve fit table in ASCII.</td>
</tr>
<tr>
<td>Dump Table in Internal Binary</td>
<td>DTBN</td>
<td>DTBN Dumps synth/curve fit table in internal binary.</td>
</tr>
<tr>
<td>Dump Vector Display Buffer in ANSI Binary</td>
<td>DVAN</td>
<td>DVAN Dumps vector display buffer VBLK&lt;sub&gt;n&lt;/sub&gt; in ANSI format.</td>
</tr>
<tr>
<td>Dump Vector Display Buffer in ASCII</td>
<td>DVAS</td>
<td>DVAS Dumps vector display buffer VBLK&lt;sub&gt;n&lt;/sub&gt; in ASCII format.</td>
</tr>
<tr>
<td>Dump Vector Display Buffer in Internal Binary</td>
<td>DVBN</td>
<td>DVBN Dumps vector display buffer VBLK&lt;sub&gt;n&lt;/sub&gt; in internal binary format.</td>
</tr>
</tbody>
</table>

[] indicates optional parameter
## Bus Only Commands (cont)

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>MNEM</th>
<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable Sweep SRQ</td>
<td>ESWQ</td>
<td>ESWQ</td>
</tr>
<tr>
<td>Error Code Query</td>
<td>ERR?</td>
<td>ERR?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns error code; refer to table 8 for description.</td>
</tr>
<tr>
<td>Error SRQ Disable</td>
<td>ERRD</td>
<td>ERRD</td>
</tr>
<tr>
<td>Error SRQ Enable</td>
<td>ERRE</td>
<td>ERRE</td>
</tr>
<tr>
<td>Exponential Average</td>
<td>XAVG</td>
<td>XAVGn1,n2.awf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exponentially averages n1 with n2 and puts the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>results in n2. awf is the average weighting factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a power of two).</td>
</tr>
<tr>
<td>Float Block</td>
<td>FLTB</td>
<td>FLTBn1,n2 [ , count]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Converts integers in block n1 to floating point (real)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and puts results in n2. Count is optional point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>count.</td>
</tr>
<tr>
<td>Graph Real Block</td>
<td>GRBL</td>
<td>GRBLn,x,Δx</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where n is active buffer x is starting location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Δx is increment.</td>
</tr>
<tr>
<td>Graph Imaginary Part of</td>
<td>GRIM</td>
<td>GRIMn,x,Δx</td>
</tr>
<tr>
<td>Complex Block</td>
<td></td>
<td>Where n is active buffer x is starting location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Δx is increment.</td>
</tr>
<tr>
<td>Graph Real Part of Complex</td>
<td>GRRE</td>
<td>GRREn,x,Δx</td>
</tr>
<tr>
<td>Block</td>
<td></td>
<td>Where n is active buffer x is starting location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Δx is increment.</td>
</tr>
<tr>
<td>Histogram</td>
<td>HST</td>
<td>HSTn1,n2,vmax</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n1 contains the new input data, n2 is the histogram</td>
</tr>
<tr>
<td></td>
<td></td>
<td>count block, and vmax in the maximum absolute</td>
</tr>
<tr>
<td></td>
<td></td>
<td>amplitude range for n1.</td>
</tr>
<tr>
<td>HP Logo</td>
<td>LOGO</td>
<td>LOGO0 = logo off for plots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LOGO1 = logo on for plots</td>
</tr>
<tr>
<td>HP-IB Trigger</td>
<td>HPT</td>
<td>HPT</td>
</tr>
<tr>
<td>Identify</td>
<td>ID?</td>
<td>ID?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outputs 7-character string &quot;HP3562A&quot;</td>
</tr>
<tr>
<td>Instrument Status</td>
<td>IS?</td>
<td>IS?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns instrument status register contents.</td>
</tr>
<tr>
<td>Instrument Status Mask</td>
<td>ISM</td>
<td>ISMn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where n is decimal equivalent of sum of bits to be</td>
</tr>
<tr>
<td></td>
<td></td>
<td>unmasked.</td>
</tr>
<tr>
<td>Integrate Block</td>
<td>INGB</td>
<td>INGBn1[,n2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrates n1 and puts result in n2. If n2 is not</td>
</tr>
<tr>
<td></td>
<td></td>
<td>specified, result is put in n1.</td>
</tr>
<tr>
<td>Key Press Simulation</td>
<td>KEY</td>
<td>KEYnn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where nn is key code from 0 to 70.</td>
</tr>
</tbody>
</table>

[ ] indicates optional parameter
### Bus Only Commands (cont)

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>MNEM</th>
<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Press Query</td>
<td>KEY?</td>
<td>KEY?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns key code of last key pressed.</td>
</tr>
<tr>
<td>Key Press SRQ Disable</td>
<td>KEYD</td>
<td>KEYD</td>
</tr>
<tr>
<td>Key Press SRQ Enable</td>
<td>KEYE</td>
<td>KEYE</td>
</tr>
<tr>
<td>L (long exponent imag specifier)</td>
<td>L</td>
<td>Used in scientific notation as an exponent indicator, as is “E” and “D”.</td>
</tr>
<tr>
<td>Label User SRQs One through Eight</td>
<td>LBS1</td>
<td>LBSn: aaaaaa[.bbbbbb]</td>
</tr>
<tr>
<td>LBS2</td>
<td></td>
<td>Where n is softkey number, aaaaaa is top line, bbbbb is bottom line LBS8</td>
</tr>
<tr>
<td>LBS3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBS8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line Type</td>
<td>LT</td>
<td>LTn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where values for n are:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = solid lines (default)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = solid lines with endpoints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = long dashes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = short dashes</td>
</tr>
<tr>
<td>Load Block in ANSI Binary</td>
<td>LBAN</td>
<td>LBAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads primitive block PBLKn in ANSI format.</td>
</tr>
<tr>
<td>Load Block in ASCII</td>
<td>LBAS</td>
<td>LBAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads primitive block PBLKn in ASCII format.</td>
</tr>
<tr>
<td>Load Block in Internal Binary</td>
<td>LBBN</td>
<td>LBBN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads primitive block PBLKn in internal binary format.</td>
</tr>
<tr>
<td>Load Data in ANSI Binary</td>
<td>LDAN</td>
<td>LDAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads active trace in ANSI format.</td>
</tr>
<tr>
<td>Load Data in ASCII</td>
<td>LDAS</td>
<td>LDAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads active trace in ASCII format.</td>
</tr>
<tr>
<td>Load Data in Internal Binary</td>
<td>LDBN</td>
<td>LDBN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads active trace in internal binary format.</td>
</tr>
<tr>
<td>Load State in ANSI Binary</td>
<td>LSAN</td>
<td>LSAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads state in ANSI format.</td>
</tr>
<tr>
<td>Load State in ASCII</td>
<td>LSAS</td>
<td>LSAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads state in ASCII format.</td>
</tr>
<tr>
<td>Load State in Internal Binary</td>
<td>LSBN</td>
<td>LSBN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads state in internal binary format.</td>
</tr>
<tr>
<td>Load Table in ANSI Binary</td>
<td>LTAN</td>
<td>LTAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads synth/curve fit table in ANSI format.</td>
</tr>
<tr>
<td>Load Table in ASCII</td>
<td>LTAS</td>
<td>LTAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads synth/curve fit table in ASCII format.</td>
</tr>
</tbody>
</table>
## Bus Only Commands (cont)

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>MNEM</th>
<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Table in Internal Binary</td>
<td>LTBN</td>
<td>LTBN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads synth/curve fit table in internal binary format.</td>
</tr>
<tr>
<td>Load User Display in ANSI Binary</td>
<td>LUAN</td>
<td>LUAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads active user display buffer in ANSI format.</td>
</tr>
<tr>
<td>Load User Display in ASCII</td>
<td>LUAS</td>
<td>LUAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads active user display buffer in ASCII format.</td>
</tr>
<tr>
<td>Load User Display in Internal Binary</td>
<td>LUBN</td>
<td>LUBN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads active user display buffer in internal binary format.</td>
</tr>
<tr>
<td>Move Block</td>
<td>MOVB</td>
<td>MOVBn1,n2,count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moves n1 to n2. Optional count is used to move partial blocks.</td>
</tr>
<tr>
<td>Move Complex</td>
<td>MOVX</td>
<td>MOVXn1,n2,n3,[,count]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moves complex number n1,n2 (real,imag) into complex block n3.</td>
</tr>
<tr>
<td>Move Constant</td>
<td>MOVC</td>
<td>MOVCn1,n2,[count]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moves real constant n1 into n2. Optional count moves partial blocks.</td>
</tr>
<tr>
<td>Multiply Blocks</td>
<td>MPYB</td>
<td>MPYBn1,n2,[n3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiplies n1 by n2 and puts results in n3. If n3 is not specified, results are put in n2.</td>
</tr>
<tr>
<td>Multiply Block by Complex Constant</td>
<td>MPYX</td>
<td>MPYXn1,n2,n3,[n4]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiplies complex block n3 by complex constant n1,n2 (real,imag). Result is put in n4 if specified, n3 otherwise.</td>
</tr>
<tr>
<td>Multiply Block by Real Constant</td>
<td>MPYC</td>
<td>MPYCn1,n2,[n3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiplies n2 by constant n1 and puts result in n3 specified, n2 otherwise.</td>
</tr>
<tr>
<td>Multiply Block by joω</td>
<td>MPJW</td>
<td>MPJWωstart,Δω,n1,[n2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiplies n1 by joω and puts result in n2 if specified. n1 if not. ωstart is the floating point starting value and Δω is the incremental value of ω.</td>
</tr>
<tr>
<td>Multiply Block by Magnitude Squared</td>
<td>MPMG</td>
<td>MPMGn1,n2,[n3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiplies real floating point block n1 by the magnitude squared of the complex floating point block n2 and puts the result in n3 if specified, n1 if not.</td>
</tr>
<tr>
<td>Multiply Block by Self Conjugate</td>
<td>MPSC</td>
<td>MPSCn1,[n2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiplies n1 by complex conjugate of n1 and puts the result in n2 if specified, n1 if not.</td>
</tr>
<tr>
<td>Negate Block</td>
<td>NEGB</td>
<td>NEGBn1,[n2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negates n1 and puts result in n2 if specified, n1 if not.</td>
</tr>
<tr>
<td>Partial Block Clear</td>
<td>PCLR</td>
<td>PCLRn1,n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clears the first n points in n.</td>
</tr>
</tbody>
</table>

[ ] indicates optional parameter.
## Bus Only Commands (cont)

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<tr>
<th>COMMAND</th>
<th>MNEM</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Pause</td>
<td>PAUS</td>
<td>PAUS</td>
</tr>
<tr>
<td>Peak Hold</td>
<td>PKHD</td>
<td>PKHDn1,n2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compares values in blocks n1 and n2 and puts larger values in n2.</td>
</tr>
<tr>
<td>Pen Down</td>
<td>PD</td>
<td>PD</td>
</tr>
<tr>
<td>Pen Up</td>
<td>PU</td>
<td>PU</td>
</tr>
<tr>
<td>Plot Absolute</td>
<td>PA</td>
<td>PAx,y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where x is X-axis location; y is Y-axis location.</td>
</tr>
<tr>
<td>Plot Complex Block</td>
<td>PCBL</td>
<td>PCBLn1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Converts complex floating point block n1 to display format and puts it in the active display buffer.</td>
</tr>
<tr>
<td>Plot Real Block</td>
<td>PRBL</td>
<td>PRBLn1,n2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Converts real floating point block n1 vs. n2 to display format and puts it in the active buffer.</td>
</tr>
<tr>
<td>Plot Relative</td>
<td>PR</td>
<td>PRx,y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where x is relative X-axis location, y is relative Y-axis location.</td>
</tr>
<tr>
<td>Point Count</td>
<td>PTCT</td>
<td>PTCTn1,n2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where n1 is block number, n2 is number of points.</td>
</tr>
<tr>
<td>Power Spectrum Exponential Average</td>
<td>PXAV</td>
<td>PXAVn1,n2,awf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computes power spectrum of the complex floating point block n1 and exponentially averages it with real floating point block n2. awf is the average weighting factor (a power of two).</td>
</tr>
<tr>
<td>Power Spectrum Peak Hold</td>
<td>PPEK</td>
<td>PPEKn1,n2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computes power spectrum of n1 and compares the magnitudes of the result with real block n2, putting the larger values in n2.</td>
</tr>
<tr>
<td>Power Spectrum Summation</td>
<td>PSPS</td>
<td>PSPSn1,n2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computes power spectrum of complex floating point block n1 and adds it to the real floating point block n2. The result is put into n2.</td>
</tr>
<tr>
<td>Primitive Block Number</td>
<td>PBLK</td>
<td>PBLKn1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where n1 is the primitive block number, 0 to 31.</td>
</tr>
<tr>
<td>Read Marker</td>
<td>RDMK</td>
<td>RDMK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outputs 2 ASCII values, X-axis value then Y-axis value.</td>
</tr>
<tr>
<td>Read Special Marker Once</td>
<td>RSMO</td>
<td>RSMO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See Chapter 6</td>
</tr>
<tr>
<td>Read Special Marker Group</td>
<td>RSMG</td>
<td>RSMG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See Chapter 6</td>
</tr>
</tbody>
</table>

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<tr>
<th>COMMAND</th>
<th>MNEM</th>
<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready Query</td>
<td>RDY?</td>
<td>RDY? Always returns &quot;1&quot;</td>
</tr>
<tr>
<td>Ready Bit Disable</td>
<td>RDYD</td>
<td>RDYD</td>
</tr>
<tr>
<td>Ready Bit Enable</td>
<td>RDYE</td>
<td>RDYE</td>
</tr>
<tr>
<td>Real Fast Fourier Transform</td>
<td>RFFT</td>
<td>RFFTn1, n2 Performs real FFT on n1 and puts result in n2.</td>
</tr>
<tr>
<td>Real Inverse Fast Fourier Transform</td>
<td>RFT1</td>
<td>RFT1n1, n2 Performs real inverse FFT on n1 and puts result in n2.</td>
</tr>
<tr>
<td>Reject</td>
<td>REJT</td>
<td>REJT</td>
</tr>
<tr>
<td>Remote Entry Disable</td>
<td>REND</td>
<td>REND</td>
</tr>
<tr>
<td>Remote Entry Enable</td>
<td>RENE</td>
<td>RENE</td>
</tr>
<tr>
<td>Remote Entry Speed</td>
<td>RENS</td>
<td>RENSn, max where n is 0 for constant acceleration, &gt; 1 for variable acceleration. Max is maximum entry velocity.</td>
</tr>
<tr>
<td>Remote Entry Value</td>
<td>RENV</td>
<td>RENVn where n is value</td>
</tr>
<tr>
<td>Remote Marker Disable</td>
<td>RMKD</td>
<td>RMKD</td>
</tr>
<tr>
<td>Remote Marker Enable</td>
<td>RMKE</td>
<td>RMKE</td>
</tr>
<tr>
<td>Remote Marker Value</td>
<td>RMKV</td>
<td>RMKVn where n is value</td>
</tr>
<tr>
<td>Reset</td>
<td>RST</td>
<td>RST</td>
</tr>
<tr>
<td>Revision</td>
<td>REV?</td>
<td>REV? Outputs software revision date code and the revision date of the applicable codes and format document to which the software was designed.</td>
</tr>
<tr>
<td>Send Auto Carrier</td>
<td>SACR</td>
<td>SACR Returns 4 values: Auto carrier 1 Auto carrier 2 Phase offset 1 Phase offset 2</td>
</tr>
<tr>
<td>Send Measurement Done</td>
<td>SMSD</td>
<td>SMSD Returns a &quot;1&quot; if measurement is done, &quot;0&quot; if not</td>
</tr>
<tr>
<td>Send Missed Sample</td>
<td>SMSP</td>
<td>SMSP Returns a &quot;1&quot; if sample was missed, &quot;0&quot; if not</td>
</tr>
<tr>
<td>Send Overflow Status Channel 1</td>
<td>SOV1</td>
<td>SOV1 Returns 1 if over range, 0 if not</td>
</tr>
<tr>
<td>Send Overflow Status Channel 2</td>
<td>SOV2</td>
<td>SOV2 Returns 1 if over range, 0 if not</td>
</tr>
</tbody>
</table>

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### Bus Only Commands (cont)

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<tr>
<th>COMMAND</th>
<th>MNEM</th>
<th>SYNTAX/DATA FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send Reference Locked</td>
<td>RLOK</td>
<td>RLOK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns a &quot;1&quot; if locked; &quot;0&quot; if trying to lock externally.</td>
</tr>
<tr>
<td>Send Source Fault</td>
<td>SFLT</td>
<td>SFLT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns 1 if source fault.</td>
</tr>
<tr>
<td>Send Sweep Point</td>
<td>SSWP</td>
<td>SSWP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns five values:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input power</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output power</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cross spectrum real</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cross spectrum imaginary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First 4 are real; frequency is long real</td>
</tr>
<tr>
<td>Serial Number Query</td>
<td>SER?</td>
<td>SER?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outputs a 10-character string: serial number prefix (4 integers), country of origin (1 letter) and 5 zeros.</td>
</tr>
<tr>
<td>Setup State</td>
<td>SET</td>
<td>SET</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loads instrument state; interchangeable with LSAN.</td>
</tr>
<tr>
<td>Setup State Query</td>
<td>SET?</td>
<td>SET?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dumps instrument state; interchangeable with DSAN.</td>
</tr>
<tr>
<td>SRQ Disable</td>
<td>SROE</td>
<td>SRQD</td>
</tr>
<tr>
<td>SRQ Enable</td>
<td>SROD</td>
<td>SRQE</td>
</tr>
<tr>
<td>State</td>
<td>STAT</td>
<td>STAT</td>
</tr>
<tr>
<td>Status/Event Query</td>
<td>STA?</td>
<td>STA?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See Chapter 6</td>
</tr>
<tr>
<td>Subtract Block</td>
<td>SUBB</td>
<td>SUBBn1,n2,[n3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtracts n2 from n1 and puts result in n3 if specified, n2 otherwise.</td>
</tr>
<tr>
<td>Subtract Complex Constant</td>
<td>SUBX</td>
<td>SUBXn1,n2,n3,[n4]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtracts complex constant n1, n2 (real, imag) from n3 and stores it in n4 if specified, n3 otherwise.</td>
</tr>
<tr>
<td>Subtract Real Constant</td>
<td>SUBC</td>
<td>SUBCn1,n2,[n3]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtracts n1 from n2 and stores result in n3 if specified, n2 otherwise.</td>
</tr>
<tr>
<td>Time-out enable</td>
<td>TMOE</td>
<td>TMOE</td>
</tr>
<tr>
<td>Time-out disable</td>
<td>TMOD</td>
<td>TMOD</td>
</tr>
<tr>
<td>Unifloat Block</td>
<td>UFLB</td>
<td>UFLBn1,n2,[count]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Converts floating point block n1 to integers and puts result in n2. Optional count partially unfloats n1.</td>
</tr>
<tr>
<td>Vector Display Buffer</td>
<td>VBLK</td>
<td>Points to vector display buffer to be dumped with DWAN, DVAS, DVBN.</td>
</tr>
<tr>
<td>Write Text</td>
<td>WRIT</td>
<td>WRIT 'aaaaaa' where aaaaaa are alphanumeric characters.</td>
</tr>
<tr>
<td>Exponential averaging</td>
<td>XAVG</td>
<td>XAVG n1, n2, awf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See Chapter 6.</td>
</tr>
</tbody>
</table>
STATUS BYTE

Table 2 shows the eight bits in the HP 3562A’s status byte. The status byte is read by serial polling the analyzer (which also clears the status byte). Five of these bits are encoded; refer to table 3 for the condition codes. Chapter 6 provides complete explanations of the status byte conditions.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>128</td>
<td>see table 3</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>RQS (HP 3562A requested service)</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>ERR (HP-IB error)</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>RDY (ready to accept HP-IB commands)</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>see table 3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>see table 3</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>see table 3</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>see table 3</td>
</tr>
</tbody>
</table>

Bit 6 (RQS) is set when the HP 3562A sends an SRQ. Bit 5 (ERR) is set when an HP-IB error has been made. Bit 4 (RDY) is set when the analyzer is ready to receive HP-IB commands.
Table 3 shows the condition codes represented by bits 7, 3, 2, 1 and 0 in the status byte.

<table>
<thead>
<tr>
<th>Status bit Numbers</th>
<th>Status Byte Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000</td>
<td>0</td>
<td>No service requested</td>
</tr>
<tr>
<td>00001</td>
<td>1</td>
<td>User SRQ #1</td>
</tr>
<tr>
<td>00010</td>
<td>2</td>
<td>User SRQ #2</td>
</tr>
<tr>
<td>00011</td>
<td>3</td>
<td>User SRQ #3</td>
</tr>
<tr>
<td>00100</td>
<td>4</td>
<td>User SRQ #4</td>
</tr>
<tr>
<td>00101</td>
<td>5</td>
<td>User SRQ #5</td>
</tr>
<tr>
<td>00110</td>
<td>6</td>
<td>User SRQ #6</td>
</tr>
<tr>
<td>00111</td>
<td>7</td>
<td>User SRQ #7</td>
</tr>
<tr>
<td>01000</td>
<td>8</td>
<td>User SRQ #8</td>
</tr>
<tr>
<td>01001</td>
<td>9</td>
<td>End of disc action</td>
</tr>
<tr>
<td>01010</td>
<td>10</td>
<td>End of plot action</td>
</tr>
<tr>
<td>01011</td>
<td>11</td>
<td>Instrument status change</td>
</tr>
<tr>
<td>01100</td>
<td>12</td>
<td>Power up</td>
</tr>
<tr>
<td>01101</td>
<td>13</td>
<td>Key pressed</td>
</tr>
<tr>
<td>01110</td>
<td>14</td>
<td>Device Clear Plotter, Listen HP 3562A</td>
</tr>
<tr>
<td>01111</td>
<td>15</td>
<td>Unaddress Bus, Listen HP 3562A</td>
</tr>
<tr>
<td>10000</td>
<td>128</td>
<td>Talk plotter, Listen HP 3562A</td>
</tr>
<tr>
<td>10001</td>
<td>129</td>
<td>Talk disc execution, Listen HP 3562A</td>
</tr>
<tr>
<td>10010</td>
<td>130</td>
<td>Talk disc report, Listen HP 3562A</td>
</tr>
<tr>
<td>10011</td>
<td>131</td>
<td>Talk Amigo disc command, Listen HP 3562A</td>
</tr>
<tr>
<td>10100</td>
<td>132</td>
<td>Talk Amigo disc data, Listen HP 3562A</td>
</tr>
<tr>
<td>10101</td>
<td>133</td>
<td>Talk Amigo short status, Listen HP 3562A</td>
</tr>
<tr>
<td>10110</td>
<td>134</td>
<td>Talk disc identify, Listen HP 3562A</td>
</tr>
<tr>
<td>10111</td>
<td>135</td>
<td>Talk Amigo parallel poll, Listen HP 3562A</td>
</tr>
<tr>
<td>11000</td>
<td>136</td>
<td>Listen Plotter, Talk HP 3562A</td>
</tr>
<tr>
<td>11001</td>
<td>137</td>
<td>Listen disc command, Talk HP 3562A</td>
</tr>
<tr>
<td>11010</td>
<td>138</td>
<td>Listen disc execution, Talk HP 3562A</td>
</tr>
<tr>
<td>11011</td>
<td>139</td>
<td>Listen Amigo disc command, Talk HP 3562A</td>
</tr>
<tr>
<td>11100</td>
<td>140</td>
<td>Listen Amigo disc data, Talk HP 3562A</td>
</tr>
<tr>
<td>11101</td>
<td>141</td>
<td>Listen Amigo disc read, Talk HP 3562A</td>
</tr>
<tr>
<td>11110</td>
<td>142</td>
<td>Listen Amigo disc write, Talk HP 3562A</td>
</tr>
<tr>
<td>11111</td>
<td>143</td>
<td>Listen Amigo disc format, Talk HP 3562A</td>
</tr>
</tbody>
</table>
Masking SRQ Conditions in the Status Byte

When a condition is "masked," it is prevented from generating an SRQ when it becomes true. Table 4 shows how to mask the status byte conditions that can be masked. Conditions that cannot be masked are noted as well.

<table>
<thead>
<tr>
<th>Condition</th>
<th>How to Mask</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>not maskable (never generates an SRQ)</td>
</tr>
<tr>
<td>1 - 8</td>
<td>not maskable</td>
</tr>
<tr>
<td>9 - 10</td>
<td>unmasked with SRQE; masked with SRQD</td>
</tr>
<tr>
<td>11</td>
<td>unmasked with ISMn, where n is decimal equivalent of the bits in the IS register to be unmasked. This bit is completely masked by sending ISM0.</td>
</tr>
<tr>
<td>12</td>
<td>masked with PSQ0; unmasked with PSQ1</td>
</tr>
<tr>
<td>13</td>
<td>masked with KEYD; unmasked with KEYE</td>
</tr>
<tr>
<td>14 - 143</td>
<td>not maskable.</td>
</tr>
</tbody>
</table>

SRQs are generated only by the status byte; the instrument status (IS) and activity status (AS) registers must generate SRQs indirectly through the status byte. The IS register can generate an SRQ if condition 11 in the status byte is enabled. The AS register is twice removed: bit 13 of the IS register and condition 11 of the status byte must be enabled for the AS to generate an SRQ. Chapter 6 has all the details.
THE INSTRUMENT STATUS REGISTER

Table 5 shows the instrument status (IS) register. The contents of the IS are read by sending the IS? command (which also clears the register). Unlike the status byte, the IS is not encoded: each bit represents a single condition. Complete information on the IS register is provided in Chapter 6. Remember that bit 11 in the status byte must be enabled (unmasked) before the IS can indirectly generate an SRQ.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Measurement pause</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Autosequence pause</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>End of measurement</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>End of autosequence</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Sweep point ready</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Channel 1 over range</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Channel 2 over range</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Channel 1 half range</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Channel 2 half range</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>Source fault</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>Reference unlocked</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>Remote marker knob turn</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>Remote entry knob turn</td>
</tr>
<tr>
<td>13</td>
<td>8192</td>
<td>Activity status register change</td>
</tr>
<tr>
<td>14</td>
<td>16384</td>
<td>Power-on test failed</td>
</tr>
</tbody>
</table>

Bits in the IS are masked with the ISMn command, where n is the decimal equivalent of the sum of the values of the bits to be unmasked. For example, ISM20 enables (unmasks) bit 2 (value = 4) and bit 4 (value = 16). All other bits are masked.
The Status Query (STA?)

The status query command (STA?) provides some information from both the status byte and the instrument status register. Sending STA? causes the HP 3562A to return the 16-bit word shown in Table 6.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Condition/Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Not used</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Not used</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Key pressed</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Not used</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>RDY</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>ERR</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>ROS</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Message on screen</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Measurement pause</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>Auto sequence pause</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>End of measurement</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>End of auto sequence</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>Sweep point ready</td>
</tr>
<tr>
<td>13</td>
<td>8192</td>
<td>Channel 1 over range</td>
</tr>
<tr>
<td>14</td>
<td>16384</td>
<td>Channel 2 over range</td>
</tr>
<tr>
<td>15</td>
<td>32768</td>
<td>Not used</td>
</tr>
</tbody>
</table>
THE ACTIVITY STATUS REGISTER

Table 7 shows the activity status (AS) register. The contents of the AS are read by sending the AS? command (which does not clear the register). Unlike the status byte and like the IS, the AS is not encoded: each bit represents a single condition. Complete information on the AS register is provided in Chapter 6. Remember that both bit 13 of the IS and condition 11 of the status byte must be enabled before the AS can indirectly generate an SRQ.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Check fault log</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Filling time record</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Filters setting</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Curve fit in progress</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Missed sample</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Time preview</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Accept data</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Waiting for trigger</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Waiting for arm</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>Not used</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>Ramping Source</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>Diagnostic in Progress</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>Marker Calc in Progress</td>
</tr>
</tbody>
</table>

Bits in the AS are masked with the ASMLn and ASMHn commands, where n is the decimal equivalent of the sum of the values of the bits to be unmasked. ASML unmask for the negative-going transition; ASMH unmask for the positive-going transition.
**ERROR CODES**

The Error query (ERR?) causes the analyzer to return the error code of the last HP-IB error. Each error code has a corresponding description in Table 8. Note that these are the same errors as those encountered in front panel operation. For complete descriptions, with suggested corrective actions, refer to Appendix B of the HP 3562A Operating Manual.

<table>
<thead>
<tr>
<th>Code Error</th>
<th>Code Error</th>
<th>Code Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 No Peak Avg in HIST Meas</td>
<td>135 View Input Disabled</td>
<td>400 Not A Valid Block Length</td>
</tr>
<tr>
<td>101 No Peak Avg in CORR Meas</td>
<td>136 Cannot Use Zoom Data</td>
<td>401 Not A Valid Block Mode</td>
</tr>
<tr>
<td>102 Freq Resp, No 1 Ch Demod</td>
<td>137 Already Running</td>
<td>402 Not HP-IB Controller</td>
</tr>
<tr>
<td>103 Cross Corr, No 1 Ch Demod</td>
<td>138 May Be Inaccurate</td>
<td>403 HP-IB Time Out</td>
</tr>
<tr>
<td>104 No Fundamental</td>
<td>139 Cannot Be Complex</td>
<td>500 Bad Plotter Data Read</td>
</tr>
<tr>
<td>105 X Marker Must Be Active</td>
<td>140 Bad Delete Freq Table</td>
<td>600 Cannot Recall Throughput</td>
</tr>
<tr>
<td>106 Buffer Overflow</td>
<td>141 Loops Nested Too Deep</td>
<td>601 Not A Valid Catalog</td>
</tr>
<tr>
<td>107 No Coord Change Allowed</td>
<td>142 Demod In Zoom Only</td>
<td>602 Unformatted Disc</td>
</tr>
<tr>
<td>108 Not In Frequency Domain</td>
<td>143 Numeric Overflow</td>
<td>603 Catalog Full</td>
</tr>
<tr>
<td>109 No Data</td>
<td>144 Invalid: Nyquist/Nichols</td>
<td>604 Not A Valid Name</td>
</tr>
<tr>
<td>110 Measurement In Progress</td>
<td>145 Invalid: Log Data</td>
<td>605 Not A Valid Display</td>
</tr>
<tr>
<td>111 Trace Not Compatible</td>
<td>146 No Carrier</td>
<td>606 File Not Found</td>
</tr>
<tr>
<td>112 Data Type Incompatible</td>
<td>147 No Peak Hold in Time Avg</td>
<td>607 Disc Full</td>
</tr>
<tr>
<td>113 Data Blocks Incompatible</td>
<td>148 Calibration in Progress</td>
<td>608 Disc Reject</td>
</tr>
<tr>
<td>114 Source Block Empty</td>
<td>149 No Avg For Demod Hist</td>
<td>609 Recall Active Auto Seq</td>
</tr>
<tr>
<td>115 User Display Not Enabled</td>
<td>200 Not Active Softkey</td>
<td>610 Unknown Disc Command Set</td>
</tr>
<tr>
<td>116 No Active Display Buffer</td>
<td>201 Unknown Mnemonic</td>
<td>611 No Disc In Drive</td>
</tr>
<tr>
<td>117 Recursive Call</td>
<td>202 Line Too Long</td>
<td>612 Disc Write Protected</td>
</tr>
<tr>
<td>118 Not A Valid Auto Math</td>
<td>203 Command Too Long</td>
<td>613 Disc Fault</td>
</tr>
<tr>
<td>119 Bad Setup State</td>
<td>204 Alpha Delimiter Expected</td>
<td>614 Disc Transfer Error</td>
</tr>
<tr>
<td>120 Bad Auto Sequence Table</td>
<td>205 Not A Valid Terminator</td>
<td>615 No Spares Or Fault Areas</td>
</tr>
<tr>
<td>121 Bad Synth Table</td>
<td>206 Extra Chars In Command</td>
<td>616 No Thruput File</td>
</tr>
<tr>
<td>122 Bad Non-Volatile State</td>
<td>207 Function Inactive</td>
<td>617 Catalog Not In Memory</td>
</tr>
<tr>
<td>123 Bad Data Block</td>
<td>300 Missing Input</td>
<td>618 File Size Not Specified</td>
</tr>
<tr>
<td>124 Bad Data Header</td>
<td>301 Not Valid Units</td>
<td>619 Select Capture To Recall</td>
</tr>
<tr>
<td>125 Marker Not On</td>
<td>302 Not A Valid Number</td>
<td>620 Source = Destination</td>
</tr>
<tr>
<td>126 No Valid Marker Units</td>
<td>303 Alpha Too Long</td>
<td>621 Sector Size &lt; &gt; 256 Bytes</td>
</tr>
<tr>
<td>127 No Capture Data</td>
<td>304 Number Too Long</td>
<td>622 Not Valid Format Option</td>
</tr>
<tr>
<td>128 No Thruput Data</td>
<td>305 Out Of Range</td>
<td>623 Not Valid For This Disc</td>
</tr>
<tr>
<td>129 Thruput Data Too Long</td>
<td>306 Unable To Curve Fit</td>
<td>624 Destination Too Small</td>
</tr>
<tr>
<td>130 Bad Curve Fit Table</td>
<td>307 Bad # Of Parameters</td>
<td></td>
</tr>
<tr>
<td>131 Bad Capture</td>
<td>308 Auto Carrier Selected</td>
<td></td>
</tr>
<tr>
<td>132 Bad Thruput</td>
<td>309 ENTRY Not Enabled</td>
<td></td>
</tr>
<tr>
<td>133 Not A Valid User Window</td>
<td></td>
<td></td>
</tr>
<tr>
<td>134 Bad Primitive Block</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KEY CODES

Table 8 lists the HP 3562A’s key codes. Note that the eight softkey buttons have unique codes, but individual softkey labels do not. The code of the last key pressed (since power-up or reset) is returned by the KEY? command. Key presses are simulated by sending the analyzer the KEYn command, where n is the code of the key to be simulated.

<table>
<thead>
<tr>
<th>Key Name</th>
<th>Code</th>
<th>Key Name</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Key Pressed</td>
<td>0</td>
<td>Softkey 4</td>
<td>36</td>
</tr>
<tr>
<td>ENGR UNITS</td>
<td>1</td>
<td>Softkey 5</td>
<td>37</td>
</tr>
<tr>
<td>INPUT COUPLE</td>
<td>2</td>
<td>Softkey 2</td>
<td>38</td>
</tr>
<tr>
<td>TRIG DELAY</td>
<td>3</td>
<td>Softkey 1 (top)</td>
<td>39</td>
</tr>
<tr>
<td>HP-IB FCTN</td>
<td>4</td>
<td>Softkey 3</td>
<td>40</td>
</tr>
<tr>
<td>DISC</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELECT TRIG</td>
<td>6</td>
<td>5</td>
<td>41</td>
</tr>
<tr>
<td>CAL</td>
<td>7</td>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td>RANGE</td>
<td>8</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>AVG</td>
<td>9</td>
<td>Softkey 7</td>
<td>44</td>
</tr>
<tr>
<td>SELECT MEAS</td>
<td>10</td>
<td>Softkey 6</td>
<td>45</td>
</tr>
<tr>
<td>WINDOW</td>
<td>11</td>
<td>1</td>
<td>46</td>
</tr>
<tr>
<td>LOCAL</td>
<td>12</td>
<td>3</td>
<td>47</td>
</tr>
<tr>
<td>PLOT</td>
<td>13</td>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>SOURCE</td>
<td>14</td>
<td>MARKER VALUE</td>
<td>49</td>
</tr>
<tr>
<td>FREQ</td>
<td>15</td>
<td>- (negative sign)</td>
<td>50</td>
</tr>
<tr>
<td>MEAS MODE</td>
<td>16</td>
<td>BACKSPACE</td>
<td>51</td>
</tr>
<tr>
<td>START</td>
<td>17</td>
<td>Softkey 8 (bottom)</td>
<td>52</td>
</tr>
<tr>
<td>SPCL FCTN</td>
<td>18</td>
<td>VIEW INPUT</td>
<td>53</td>
</tr>
<tr>
<td>PRESET</td>
<td>19</td>
<td>0</td>
<td>54</td>
</tr>
<tr>
<td>MATH</td>
<td>20</td>
<td>, (comma)</td>
<td>55</td>
</tr>
<tr>
<td>SYNTH</td>
<td>21</td>
<td>. (decimal point)</td>
<td>56</td>
</tr>
<tr>
<td>AUTO SEQ</td>
<td>22</td>
<td>A</td>
<td>57</td>
</tr>
<tr>
<td>PAUSE CONT</td>
<td>23</td>
<td>B</td>
<td>58</td>
</tr>
<tr>
<td>SAVE RECALL</td>
<td>24</td>
<td>A&amp;B</td>
<td>59</td>
</tr>
<tr>
<td>Y &lt; marker &gt;</td>
<td>25</td>
<td>COORD</td>
<td>60</td>
</tr>
<tr>
<td>SPCL MARKER</td>
<td>26</td>
<td>MEAS DISP</td>
<td>61</td>
</tr>
<tr>
<td>HELP</td>
<td>27</td>
<td>ARM</td>
<td>62</td>
</tr>
<tr>
<td>AUTO MATH</td>
<td>28</td>
<td>SINGLE</td>
<td>63</td>
</tr>
<tr>
<td>CURVE FIT</td>
<td>29</td>
<td>UPPER LOWER</td>
<td>64</td>
</tr>
<tr>
<td>X OFF</td>
<td>30</td>
<td>STATE TRACE</td>
<td>65</td>
</tr>
<tr>
<td>X</td>
<td>31</td>
<td>UNITS</td>
<td>66</td>
</tr>
<tr>
<td>Y OFF</td>
<td>32</td>
<td>FRONT BACK</td>
<td>67</td>
</tr>
<tr>
<td>8</td>
<td>33</td>
<td>SCALE</td>
<td>68</td>
</tr>
<tr>
<td>9</td>
<td>34</td>
<td>UP arrow</td>
<td>69</td>
</tr>
<tr>
<td>7</td>
<td>35</td>
<td>DOWN arrow</td>
<td>70</td>
</tr>
</tbody>
</table>
PURPOSE OF THIS APPENDIX

This appendix contains example HP BASIC 3.0 programs written for the HP 3562A. These programs were written to provide you with ideas for controlling the HP 3562A via HP-IB. They are not intended to be final solutions to any particular programming problems, but rather to demonstrate the analyzer's power and flexibility.

NOTE

These programs are not warranted, guaranteed, or supported by Hewlett-Packard or any of its representatives in any manner whatsoever.
APPENDIX C — EXAMPLE PROGRAM 1

DEMO PROGRAM PASS CONTROL

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last update 4-23-85

BASIC 3.0

PURPOSE:

This program responds to a request for service by
the HP3552A so that it can make direct digital
plots, etc., while attached to a Series 200
controller by passing control to the analyzer.

DATA DICTIONARY:

Spoll_byte Masked serial poll byte
@Io HP-IB code assignment of the 3552
Hpb_intr HPIB interrupt service routine

ASSIGN @Io TO 720
LOCAL @Io
ON INTR 7 GOSUB Hpb_intr
ENABLE INTR 7;2

W_loop:GOTO W_loop  ; Wait for interrupt

Hpb_intr:  ; Pass control interrupt service routine
Spoll_byte=BINAND(SPOll(@Io),143)! MASK OUT BITS 4,5,6
IF Spoll_byte>=14 AND Spoll_byte<=143 THEN
SEND ?;UNL UNT TALK 20 CMD 9
GOTO End_intr
END IF

End_intr:ENABLE INTR 7
RETURN
END
APPENDIX C - EXAMPLE PROGRAM 2

// DEMO PROGRAM DUMP DATA TRACE

(c) COPYRIGHT 1985, Hewlett-Packard Co.
last updated 4-23-85
BASIC 3.0

PURPOSE:
This program will read data directly from a HP3562A analyzer over the HP-IB bus using the capability of the series 200. The data is assumed to be linear in real and imag formats. resolution data and is plotted; if complex,

DATA DICTIONARY:

Max_val(*) The data array max and/or min value used in determining the plotting limit.

Header_len Data header length (constant)

Data_len Data buffer length (bytes)

N_points Number of data points

Start_f Start frequency

Delta_f Frequency or time spacing

Hbuf(*) Real buffer containing data header

Fbuf(*) Real buffer containing data trace

INTEGER I,Real,Imag,Mag,Phase
DIM A$(2),Max_val(1:2),Min_val(1:2)

Real=1
Imag=2
GINGIT

Header_len=66 ! Data header length
ASSIGN @Io TO 720
REMOTE @Io

GET DATA
540 DISP "DUMP DATA"
550 OUTPUT @1o:"DDAN" ! Dump data ANSI format
560 ENTER @1o USING ",.2A,\"\"@A\"\"\",Data_len
570 ASSIGN @1o:FORMAT OFF ! Turn ASCII formatter off
580 ALLOCATE REAL Hbuf(1:Header_len)
590 ENTER @1o:Hbuf(*) ! Read data header
600 |
610 ! EXTRACT HEADER INFORMATION
620 |
630 N_points=Hbuf(2) ! Number of data points
640 Cmplx_f1g=Hbuf(37) ! Complex data flag
650 Start_f=Hbuf(66) ! Data start frequency
660 Delta_f=Hbuf(56) ! Delta frequency or time
670 IF Cmplx_f1g=1 THEN
680 LESS ALLOCATE Fbuf(1:N_points,1:2)
690 ELSE
700 ALLOCATE Fbuf(1:N_points,1:1)
710 END IF
720 ENTER @1o:Fbuf(*) ! Read data trace
730 ASSIGN @1o:FORMAT ON
740 DISP "DATA TRANSFER COMPLETE"
750 |
760 ! FIND MAX VALUE
770 |
780 DISP "FINDING MAX MIN FOR PLOT"
790 Max_min: ! Calculates the MAX and MIN for plotting
800 ! Initialize Variables
810 Max_val(Real)=0 ! Real trace Max
820 Max_val(Imag)=0 ! Imag trace Max
830 Min_val(Real)=0 ! Real trace Min
840 Min_val(Imag)=0 ! Imag trace Min
850 FOR I=1 TO N_points ! Find Max's and Min's
860 FOR J=1 TO Cmplx_f1g+1
870 IF Fbuf(I,J)>Max_val(J) THEN Max_val(J)=Fbuf(I,J)
880 IF Fbuf(I,J)<Min_val(J) THEN Min_val(J)=Fbuf(I,J)
890 NEXT J
900 NEXT I
910 Plot_out: ! Plots data
920 GCLEAR
930 GRAPHICS ON
940 X_min=Start_f
950 X_max=((N_points-1)*Delta_f+Start_f
960 ALPHA OFF
970 FOR K_funct=1 TO Cmplx_f1g+1
980 IF Cmplx_f1g=0 THEN
990 VIEWPORT 10,110,15,85
1000 ELSE
1010 VIEWPORT 10,110,15,48
1020 END IF
1030 IF K_funct=2 THEN VIEWPORT 10,110,53,85
1040 WINDOW X_min,X_max,Min_val(K_funct),Max_val(K_funct))!
1050  MOVE Start_f,Fbuf(I,K_funct)
1060  FOR I=2 TO N_points
1070   PLOT Start_f+(I*Delta_f),Fbuf(I,K_funct)
1080  NEXT I
1090  NEXT K_funct

! Border: ! Plots border around data
1120  VIEWPORT 10,110,10,90
1130  WINDOW 0,1000,0,1000
1140  MOVE 0,500
1150  DRAW 0,1000
1160  PLOT 1000,1000
1170  PLOT 1000,500
1180  PLOT 0,500
1190  PLOT 0,0
1200  PLOT 1000,0
1210  PLOT 1000,500
1220  !
1230  DISP **
1240  LOCAL @Io
1250  END
APPENDIX C — EXAMPLE PROGRAM 3

DEMO PROGRAM 1/3 RD OCTAVE

(c) COPYRIGHT 1985, Hewlett-Packard Co.

last update 4-23-85

BASIC 3.0

PURPOSE:

This program will read data directly from a HP3562A analyzer over the HP-IB of the HP9000 Series 200 controller.
The data is assumed to be in Log res mod and amplitude units of \( \text{vit}^2 \) it is converted to a pseud 1/3 octave format and dumped back to the HP3562A analyzer.

SUB PROGRAMS REQUIRED:

F_shape  Computes the ANSI class III filter shape

DATA DICTIONARY:

Header_len  Data header length (constant)

Data_len  Data buffer length (bytes)

N_points  Number of data points

Start_f  Start frequency

Delta_f  Frequency spacing in dec/pt

Pt_dec  Points per decade

Hbuf(*)  Real buffer containing data header

Fbuf(*)  Real buffer containing log res data

Oct_buf(*)  Buffer with synthesized 1/3 oct data

INTEGER I,N_points,Header_len,Pt_dec,N_fact,Flag

N_fact=32

ALLOCATE Trans(-N_fact:N_fact)  ! OCT FILTER
Header_len=66

GOSUB Get_data ! Gets data from the HP3S62A
PRINT "GOT DATA"
GOSUB Get_pwr ! Reads total power using markers
GOSUB Oct_1_3 ! Calculates 1/3d Octave Spec
GOSUB Restore_dat ! Restores data to Analyzer
LOCAL @IO
GOTO W_loop
GET_pwr: ! Reads power using power marker
OUTPUT @IO;"XOFF;PWR;RSMO"
ENTER @IO;Pwr_a,Pwr_b
RETURN
GET_data: ! Reads data block
ASSIGN @IO TO 720
ASSIGN @IO;FORMAT ON
REMOTE 720
OUTPUT @IO;"COME"
OUTPUT @IO;"DDAN"
PRINT "DUMP DATA"
ENTER @IO USING ";A\$;W\$;A\$;Data_len
ASSIGN @IO;FORMAT OFF
ALLOCATE REAL Hbuf(1:Header_len)
ENTER @IO;Hbuf(*)
CALL Fshape(Trans(*),N_fact) ! Calculates 1/3d Oct filter
!
! EXTRACT HEADER INFORMATION
N_points=Hbuf(2)
Cmplx_flg=Hbuf(37)
Log_data=Hbuf(41)
IF Log_data=0 THEN GOTO Fmt_error ! Data not log res
Amp_units=Hbuf(10)
IF Amp_units<>1 THEN GOTO Fmt_error ! Units not V/\$^2
Hbuf(10)=0.
Start_f=Hbuf(66)
Pt_dec=1/Hbuf(56) ! pts per decade
Delta_f=1/Pt_dec ! in decades
ALLOCATE Fbuf(1:N_points)
ALLOCATE Oct_buf(1:N_points)
ENTER @IO;Fbuf(*)
ASSIGN @IO;FORMAT ON
PRINT "DATA TRANSFER COMPLETE"
RETURN
!
Oct_1_3: ! Reformate data in 1/3 Octaves
FOR I=1 TO N_points STEP 8
Oct_buf(I)=0
FOR J=-(N_fact-1) TO (N_fact-1)
IF (I-J)<1 OR (I-J)>N_points THEN
IF (I-J)<1 THEN Oct_dum=Fbuf(1)
IF (I-J)>N_points THEN Oct_dum=Fbuf(N_points)
ELSE
!

1050     Oct_dum=Fbuf(I-J)
1060     END IF
1070     Oct_buf(I)=Oct_dum*Trans(J)+Oct_buf(I)
1080     NEXT J
1090     Oct_dum=Oct_buf(I)
1100     FOR J=-3 TO 4
1110     IF (I+J)>=1 AND (I+J)<=N_points THEN
1120     Oct_buf(I+J)=SQR(Oct_dum)
1130     END IF
1140     NEXT J
1150     NEXT I
1160     !
1170     PRINT " Total Power is = ";Pwr_a;" dB"
1180     RETURN
1190     !
1200     Restore_dat: !
1210     PRINT " RE-STORING DATA"
1220     OUTPUT @Io;"LDAN"
1230     OUTPUT @Io USING ";.2A,W:";"A",Data_len
1240     ASSIGN @Io;FORMAT OFF
1250     OUTPUT @Io;Hbuf(*);Oct_buf(*);END
1260     RETURN
1270     !
1280     W_loop: !
1290     LOCAL @Io
1300     STOP
1310     Fmt_error: !
1320     BEEP
1330     PRINT " DATA NOT IN PROPER MEAS MODE FOR"
1340     PRINT ";1/3rd OCTAVE. MEASUREMENT MUST "
1350     PRINT " BE MADE IN LOG RESOLUTION MODE"
1360     PRINT " AND IN AMP UNITS OF VLT^2"
1370     CLEAR @Io
1380     LOCAL @Io
1390     END
1400     SUB Fshape(Trans(*),INTEGER N_fact)
1410     !
1420     ! SUB PROGRAM TO CALCULATE THE
1430     ! FILTER SHAPE OF A 1/3 RD OCT
1440     ! CLASS III FILTER
1450     !
1460     INTEGER N
1470     FOR N=-N_fact TO N_fact
1480     IF N<4 AND N>=-4 THEN
1490     Attan=1
1500     ELSE
1510     Attan=(8/13+2500*(10^(N/60)-10^(-N/80)))*6
1520     END IF
1530     Trans(N)=1/Attan
1540     NEXT N
1550     SUBEND
APPENDIX C - EXAMPLE PROGRAM 4

DEMO PROGRAM DUMP COORDINATE TRANSFORM BLOCK

(c) COPYRIGHT 1985, Hewlett-Packard Co.

last update 3-14-85

BASIC 3.0

PURPOSE:

This program will read coord transform block from HP3562A analyzer over the HP-IB bus using the capability of the Series 200.
The data is assumed to be dB magnitude data and Hz frequency domain power spectrum data.
The data is repeatedly read and displayed in a spectral map format. Only the data actual displayed is read and plotted.

DATA DICTIONARY:

Header_len  Data header length (constant)
Chead_len  Coordinate transform header length
Data_len  Data buffer length (bytes)
N_points  Number of data points
Cbuf(*)  Real buffer for coord transform header
Hbuf(*)  Real buffer containing data header
Buff(*)  Real buffer containing coord trans data
Mask(*)  Data buffer containing max values; used for hidden line calculations
Penc(*)  Pen control buffer for hidden lines

INTEGER I,Real,Img,Mag,Phase,Done_flg
DIM #[3]
Real=1
Img=2

Header_len=66  ! Data header length
Chead_len=50   ! Coord transform header length
Done_flg=0     ! Measurement done flag
550  ASSIGN @Io TO 720
560  REMOTE @Io
570  ALLOCATE REAL Hbuf(1:Header_len),Cbuf(1:Chhead_len)
580  Control: !
590  N_spect=25
600  GOSUB Dsa_setup
610  GOSUB Get_head
620  GOSUB Plot_init
630  GOSUB Hpie_init
640  FOR K=0 TO N_spect-1
650  !
660  ! Wait for End of Measurement
670  W_data:IF Done_flg=0 THEN GOTO W_data
680  !
690  GOSUB Get_data
700  GOSUB Meas_start
710  GOSUB Plot_out
720  NEXT K
730  LOCAL @Io
740  W_loop:GOTO W_loop ! Wait (suppress softkey menu)
750  !
760  Get_data: ! Gets data and calculates hidden lines
770  GOSUB Mask_update
780  OUTPUT @Io:"DCAN" !Dump Coord trans ANSI
790  ENTER @Io USING ",",2A,"","A",Data_len
800  ASSIGN @Io;FORMAT OFF
810  ENTER @Io;Cbuf(*);Hbuf(*)
820  ENTER @Io;Buff(*)
830  ASSIGN @Io;FORMAT ON
840  FOR I=0 TO N_points-1 ! Set clipping boundary
850  IF Buff(I)<Y_min THEN Buff(I)=Y_min
860  IF Buff(I)>Y_max THEN Buff(I)=Y_max
870  NEXT I
880  !
890  ! Set pen control for plotting
900  MAT Penc= Buff-Mask
910  FOR I=0 TO N_points-1
920  Penc(I)=SGN(Penc(I))
930  NEXT I
940  Done_flg=1
950  RETURN
960  !
970  Mask_update: ! Does X & Y axis shifting and mask update
980  FOR I=N_points-N_delta_x TO N_points-1
990  Mask(I)=(Y_min-Delta_y)
1000 NEXT I
1010 Xshift:FOR I=N_delta_x TO N_points-1
1020  Buff(I)=Buff(I)-Delta_y
1030  Mask(I-N_delta_x)=MAX(Mask(I-Delta_y,Buff(I))
1040 NEXT I
1050 RETURN
1060 !
1070 Get_head: !
1080 OUTPUT @Io:"DCAN"
1090 ENTER @Io USING ",",2A,W",A",Data_len
1100 ASSIGN @Io:FORMAT OFF
1110 ENTER @Io:Cbuf(*);Hbuf(*): !Read Coord Trans and Data header
1120 N_points=Cbuf(2): !Number of points
1130 ALLOCATE Buff(0:N_points-1)
1140 ENTER @Io:Buff(*)
1150 ASSIGN @Io:FORMAT ON
1160 CLEAR @Io
1170 RETURN
1180 !
1190 Plot_out: !
1200 !Set viewport boundaries to match spec'd min/max's
1210 X1=X_min_view+X_inc*K
1220 X2=X_min_view+X_delta_view+X_inc*K
1230 Y1=Y_min_view+Y_inc*K
1240 Y2=Y_min_view+Y_delta_view+Y_inc*K
1250 VIEWPORT X1,X2,Y1,Y2
1260 WINDOW 0,N_points-1,Y_min,Y_max ! Set window
1270 MOVE 0,Buff(0)
1280 FOR I=1 TO N_points-1
1290 !Put Pen control in proper format
1300 Pnt_cnt=Penc(I)-1
1310 IF Pnt_cnt=0 THEN Pnt_cnt=1
1320 PLOT I,Buff(I),Pnt_cnt
1330 NEXT I
1340 RETURN
1350 !
1360 !
1370 Plot_init: ! Initialize plot
1380 PLOTTER IS CRT,"INTERNAL"
1390 GINIT
1400 GCLEAR
1410 GRAPHICS ON
1420 !
1430 ! FOLLOWING PARAMETERS IN ENGINEERING UNITS
1440 !
1450 Y_min=Cbuf(34) ! Read Y min from header
1460 Y_max=Cbuf(35) ! Read Y max from header
1470 Y_scale=Cbuf(41) ! Amplitude scale factor
1480 X_min=Cbuf(49) ! Read X min from header
1490 X_max=Cbuf(50) ! Read X max from header
1500 Y_off=ABS(.05*(Y_min-Y_max)) ! Cal offset= 5% full scale
1510 Y_min=Y_min-Y_off ! Adjust Y min
1520 Y_max=Y_max+Y_off ! and Y max
1530 Y_delta=Y_max-Y_min ! Calculate Y span
1540 !
1550 ! VIEWPORT VALUES FOR INDIVIDUAL SPECTRA
1560 ! IN % OF FULL SCALE
1570 !
1580 INTEGER N_delta_x !
1590 Y_min_view=10 ! Y min for single spectrum (in %)  
1600 X_min_view=10 ! X min for single spectrum (in %)  
1610 Y_delta_view=45 ! Single spectrum height (in %)  
1620 X_delta_view=80 ! Single spectrum width (in %)  
1630 Y_delta_bound=85 ! Entire map height (in %)  
1640 X_delta_bound=100 ! Entire map width (in %)  
1650 Y_inc=(Y_delta_bound-Y_delta_view)/(N_spect-1)  
1660 ! Y_inc is incremental vertical movement (in %)  
1670 X_inc=(X_delta_bound-X_delta_view)/(N_spect-1)  
1680 ! X_inc is incremental horizontal movement (in %)  
1690 Delta_y=Y_inc*(Y_max-Y_min)/Y_delta_view  
1700 ! Delta_y is incremental vertical movement in plot units  
1710 N_delta_x=X_inc*(N_points-1)/X_delta_view  
1720 ! N_delta_x is incremental horizontal movement in number  
1730 ! of data points (rounded integer)  
1740  
1750 ! RECALCULATE X_INC FOR INTEGER N_DELTA  
1760  
1770 X_inc=N_delta_x/(N_points-1)*X_delta_view  
1780 X_delta_bound=X_inc*(N_spect-1)+X_delta_view  
1790  
1800 Init_hidden: ! Initial for hidden lines  
1810 ALLOCATE Penc(0:N_points-1),Mask(0:N_points-1)  
1820 MAT Buf=(Y_min)! Set to Min Y value  
1830 MAT Mask=(Y_min)  
1840 ALPHA OFF  
1850 60SUB Plot_axis  
1860 RETURN  
1870  
1880 Plot_axis: ! DRAW THE AXIS AND BOUNDARIES OF THE PLOT  
1890 X1=X_min_view  
1900 X2=X_min_view+X_delta_bound  
1910 Y1=Y_min_view  
1920 Y2=Y_min_view+Y_delta_bound  
1930 VIEWPORT X1,X2,Y1,Y2  
1940 WINDOW X1,X2,Y1,Y2  
1950 Offset_y=.05*Y_delta_view  
1960 MOVE X1,Y1+Offset_y  
1970 DRAW X1,Y1  
1980 DRAW X1+X_delta_view,Y1  
1990 DRAW X1+X_delta_view,Y1+Offset_y  
2000 DRAW X2,Y2-Y_delta_view+Offset_y  
2010 DRAW X2,Y2  
2020 DRAW X2-X_delta_view,Y2  
2030 DRAW X2-X_delta_view,Y2-Y_delta_view+Offset_y  
2040 DRAW X1,Y1+Offset_y  
2050  
2060 Right_tics: ! DOES VERTICAL TICK MARKS  
2070 ! Reset viewport and window  
2080 X1=X_min_view+X_inc*(N_spect-1)  
2090 X2=X_min_view+X_delta_view+1.2*X_inc*(N_spect-1)  
2100 Y1=Y_min_view+Y_inc*(N_spect-1)  
2110 Y2=Y_min_view+Y_delta_view+Y_inc*(N_spect-1)  
2120 VIEWPORT X1,X2,Y1,Y2  
2130 WINDOW 0,(N_points-1)*1.20,Y_min,Y_max !
MOVE N_points-1,Y_min!
DRAW (N_points-1)*1.03,Y_min! !Draw lower tick mark
CSIZE (3)
LOR6 (2)
Y_label$="dB"
Y_fmt$="X,5DDD.D"
LABEL USING Y_fmt$;(Y_min1*Y_scale_f)
MOVE N_points-1,Y_max1
DRAW (N_points-1)*1.03,Y_max1 !Draw upper tick mark
LABEL USING Y_fmt$;(Y_max1*Y_scale_f)
MOVE (N_points-1)*1.05,Y_min1+(Y_max1-Y_min1)*.5
LABEL Y_label$
!
Lower_tics: ! DOES FREQUENCY AXIS
! Reset viewport and window
X1=X_min_view-X_delta_view*.10
X2=X_min_view+X_delta_view*.15
Y1=Y_min_view-Y_delta_view*.15
Y2=Y_min_view+Y_delta_view
VIEWPORT X1,X2,Y1,Y2
!
X1=0-(N_points-1)*.10
X2=(N_points-1)*.15
Y1=Y_min-Y_delta*.15+1.1
Y2=Y_max
WINDOW X1,X2,Y1,Y2
MOVE 0,Y_min
DRAW 0,Y_min-Y_off
LOR6 (6)
X_fmt$="SDD.D"
X_label$="Hz"
LABEL (X_min)
MOVE N_points-1,Y_min
DRAW N_points-1,Y_min-Y_off
LABEL (X_max)
MOVE (N_points-1)*.5,Y_min-Y_off
LABEL X_label$
RETURN
!
Dsa_setup:!! SETS UP ANALYZER TO INTERRUPT ON EOM
OUTPUT @Io:"COMD" ! Disable command echo
OUTPUT @Io:"UNIT: HZS" ! Sets X axis units to Hertz
OUTPUT @Io:"HGD" ! Sets Y axis to Mag dB
!
Hpih_init: !
OUTPUT @Io:"SRQE " ! Enable SRQ's
OUTPUT @Io:"ISM 4" ! End of Measurement status mask
ON INTR 7 GOSUB Hpih_intr
ENABLE INTR 72
!
Meas_start: !
Done_flg=0
OUTPUT @Io:"STRT" ! Start measurement
RETURN !
2680 !
2690 Hpi2_intr: ! Processes End of Measurement and Request for
2700 ! Control interrupts
2710 Spoll_byte=SPOLL(@Io)
2720 Stest_byte=BINAND(Spoll_byte,143) ! MASK OUT BITS 4,5,6
2730 IF Stest_byte=14 AND Stest_byte<=143 THEN
2740 PASS CONTROL @Io
2750 END IF
2760 IF Stest_byte=11 THEN
2770 ASSIGN @Io:FORMAT ON
2780 OUTPUT @Io:"IS?"
2790 ENTER @Io:Stat
2800 IF BINAND(Stat,4)=4 THEN Done_flg=1
2810 END IF
2820 End_intr: ENABLE INTR 7
2830 RETURN
2840 END
APPENDIX C - EXAMPLE PROGRAM 5

DEMO PROGRAM THRUPUT SPECTRAL MAP

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last updated 4-23-85

BASIC 3.0

SUBPROGRAMS REQUIRED

Int_real(INTEGER I1,I2,REAL Real)

converts data in HP3562A internal
real format to BASIC real format

L_int_real(INTEGER I1,I2,I3,I4,REAL Real)

converts data in HP3562A internal
long real format to BASIC real format

PURPOSE:

This program will read coord transform block from
the HP3562A analyzer over the HP-IB bus using
capabilities of the HP9000 Series 200 computer.
The data is assumed to be dB magnitude and
Hz frequency domain power spectrum data.
The data is assumed to reside on an auxillary
disc having been created by a thru put session.
The data is displayed in a spectral map format
and only the data ranges displayed are read
and plotted

DATA DICTIONARY:

Chad_len Coordinate transform header length

Header_len Data header length (constant)

Data_len Data buffer length (bytes)

N_points Number of data points

N_spec Number of spectra in map(constant)

Start_f Start frequency

Delta_f Linear res frequency spacing

Th_head(#) Integer buffer for thruput header

Cbuf(#) Real buffer for coord transform header
550 !
560 ! Hbuf(*) Real buffer containing data header
570 !
580 ! Buff(*) Real buffer containing coord trans data
590 !
600 ! Mask(*) Data buffer contains max values used for
610 ! hidden line calculations.
620 !
630 ! Penc(*) Pen control buffer for hidden lines
640 !
650 !
660 !%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
670 !
680 OPTION BASE 1
690 INTEGER I,Real,Imag,Mag,Phase,N_avgs,Done_f1g
700 INTEGER Th_head(1:512)
710 REAL Per_o1r1p,Delay
720 DIM A$(3),Max_val(1:2),Min_val(1:2)
730 Real=1
740 Imag=2
750 !
760 Header_len=66 ! Data header length
770 Chead_len=50 ! Coord transform header length
780 ASSIGN @Io TO 720
790 ASSIGN @Io;FORMAT ON
800 CLEAR 7
810 REMOTE @Io
820 ALLOCATE REAL Hbuf(1:Header_len),Cbuf(1:Chead_len)
830 !
840 Thru_name$="THRU" ! Thru put file name
850 ! MUST ALREADY EXIST
860 GOSUB Read_header ! Reads thru put header and
870 ! extract parameters
880 GOSUB Osa_set ! Sets up the analyzer
890 Intr_on: ! ENABLE INTERRUPTS FOR PASS CONTROL ETC
900 GOSUB Hpi1b_init
910 ON INTR 7 GOSUB Hpi1b_intr
920 ENABLE INTR 7;2
930 !
940 Control: ! Loops to preform the desire number of spectrum
950 N_spect=20 ! Constant for number of spectrum
960 FOR K=0 TO N_spect-1
970 Done_f1g=0
980 OUTPUT @Io;"TRG0:Delay+K*Inc_delay:"REC"
990 OUTPUT @Io;"STRT" ! Start measurement
1000 ENABLE INTR 7;2
1010 Meas_wait: ! Wait for measurement to be done
1020 IF Done_f1g=0 THEN GOTO Meas_wait
1030 GOSUB Plot_out ! Plot out data
1040 NEXT K
1050 !
1060  W_loop: GOTO W_loop        ! Wait (suppresses softkey menu)
1070  
1080  Get_data: ! Gets data and calculates hidden lines
1090  OUTPUT @Io:"DCAN"        ! Dump Coordinate Transform Block
1100  ! in ANSI floating point format
1110  ENTER @Io USING ",#A,W;#A$#,Data_len
1120  ASSIGN @Io:FORMT OFF
1130  ENTER @Io;Cbuf(*);Hbuf(*) ! Read Coord Trans & Data headers
1140  IF K=0 THEN                ! For first spectrum initialize
1150      N_points=Cbuf(2)       ! Read number of points from header
1160      ALLOCATE Buff(0:N_points-1) ! Allocate buffer
1170      GOSUB Plot_init       ! Initialize Plotting
1180  END IF
1190  
1200  Mask_update: ! Update hidden line mask
1210  Yshift:FOR I=N_points-N_delta_x TO N_points-1
1220      Mask(I)=(Y_min-Delta_y)
1230  NEXT I
1240  Xshift:FOR I=N_delta_x TO N_points-1 ! Horizontal shift of mask
1250      Buff(I)=Buff(I)-Delta_y
1260      Mask(I-N_delta_x)=MAX(Mask(I)-Delta_y,Buff(I))
1270  NEXT I
1280  
1290  ASSIGN @Io:FORMAT OFF
1300  ENTER @Io;Buff(*)          ! Read Coord Trans Block
1310  ASSIGN @Io:FORMAT ON
1320  FOR I=0 TO N_points-1      ! Set lower clipping value
1330      IF Buff(I)<Y_min THEN Buff(I)=Y_min
1340  NEXT I
1350  MAT Penc= Buff-Mask       ! Calc pen control for plotting
1360  FOR I=0 TO N_points-1
1370      Penc(I)=SGN(Penc(I))
1380  NEXT I
1390  Done_flg=1
1400  RETURN
1410  !
1420  Plot_out: !
1430  ! Set viewport boundaries to match specified min's & max's
1440  X1=X_min_view+X_inc*K
1450  X2=X_min_view+X_delta_view+X_inc*K
1460  Y1=Y_min_view+Y_inc*K
1470  Y2=Y_min_view+Y_delta_view+Y_inc*K
1480  VIEWPORT X1,X2,Y1,Y2
1490  WINDOW 0,N_points-1,Y_min,Y_max
1500  MOVE 0,Buff(0)
1510  FOR I=1 TO N_points-1
1520      Pnt_cnt=Penc(I)-1
1530      IF Pnt_cnt=0 THEN Pnt_cnt=1
1540      PLOT I,Buff(I),Pnt_cnt
1550  NEXT I
1560  !
1570  RETURN
1580  !
1590 Plot_init: ! Initialize plot
1600 PLOTTER IS CRT,"INTERNAL"
1610 GINIT
1620 GCLEAR
1630 GRAPHICS ON
1640 |
1650 ! FOLLOWING PARAMETER IN PHYSICAL UNITS
1660 |
1670 Y_min=Cbuf(34) ! Read Y min from header
1680 Y_max=Cbuf(35) ! Read Y max from header
1690 Y_scale_f=Cbuf(41) ! Amp scale factor
1700 X_min=Cbuf(43) ! Read X min from header
1710 X_max=Cbuf(50) ! Read X max from header
1720 Y_off=ABS(.05*(Y_min-Y_max)) ! Calc offset=5% f.s.
1730 Y_min=Y_min-Y_off ! Adjust Y min and
1740 Y_max=Y_max+Y_off ! Y max by calculated offset
1750 Y_delta=Y_max-Y_min ! Calculate Y span
1760 |
1770 ! VIEWPORT VALUES FOR INDIVIDUAL SPECTRA
1780 ! IN % OF FULL SCALE
1790 |
1800 INTEGER N_delta_x ! Horizontal offset of spectrum
1810 ! in units of # of Delta_x
1820 Y_min_view=10 ! Y min for single spectrum (in %)
1830 X_min_view=10 ! X min for single spectrum (in %)
1840 Y_delta_view=45 ! Single spectrum height (in %)
1850 X_delta_view=80 ! Single spectrum width (in %)
1860 Y_delta_bound=85 ! Entire map height (in %)
1870 X_delta_bound=100 ! Entire map width (in %)
1880 Y_inc=(Y_delta_bound-Y_delta_view)/(N_spect-1)
1890 ! Y_inc is incremental vertical movement between
1900 ! spectrum (in %)
1910 X_inc=(X_delta_bound-X_delta_view)/(N_spect-1)
1920 ! X_inc is incremental horizontal movement between
1930 ! spectrum (in %)
1940 Delta_y=Y_inc*(Y_max-Y_min)/Y_delta_view
1950 ! Delta_y is incremental vertical movement in plot units
1960 N_delta_x=X_inc*(N_points-1)/X_delta_view
1970 ! N_delta_x is incremental vertical movement in
1980 ! number of data points (rounded integer)
1990 ! only even number of data point shift allowed
2000 ! RECALCULATE X_INC FOR INTEGER N_DELTA
2010 X_inc=N_delta_x/(N_points-1)*X_delta_view
2020 X_delta_bound=X_inc*(N_spect-1)+X_delta_view
2030 |
2040 Init_hidden: ! Initialize hidden lines
2050 ALLOCATE Penc(0:N_points-1),Mask(0:N_points-1)
2060 MAT Buff= (Y_min)
2070 MAT Mask= (Y_min)
2080 ALPHA OFF
2090 GOSUB Plot_axis ! Draw plot axis
2100 RETURN
2110 !
2120 Plot_axis!: DRAW THE AXIS AND BOUNDARIES OF THE PLOT
2130 X1=X_min_view
2140 X2=X_min_view+X_delta_bound
2150 Y1=Y_min_view
2160 Y2=Y_min_view+Y_delta_bound
2170 VIEWPORT X1,X2,Y1,Y2
2180 WINDOW X1,X2,Y1,Y2
2190 Offset_y=.05*Y_delta_view
2200 MOVE X1,Y1+Offset_y
2210 DRAW X1,Y1
2220 DRAW X1+X_delta_view,Y1
2230 DRAW X1+X_delta_view,Y1+Offset_y
2240 DRAW X2,Y2-Y_delta_view+Offset_y
2250 DRAW X2,Y2
2260 DRAW X2-X_delta_view,Y2
2270 DRAW X2-X_delta_view,Y2-Y_delta_view+Offset_y
2280 DRAW X1,Y1+Offset_y
2290 !
2300 Right_tics: ! DOES VERTICAL TICK MARKS
2310 ! Reset viewport and window
2320 K1=N_spect-1
2330 X1=X_min_view+N*inc*(N_spect-1)
2340 X2=X_min_view+1.2*X_delta_view+N*inc*(N_spect-1)
2350 Y1=Y_min_view+N*inc*(N_spect-1)
2360 Y2=Y_min_view+N*inc*(N_spect-1)
2370 VIEWPORT X1,X2,Y1,Y2
2380 WINDOW 0,(N_points-1)*1.20,Y_min,Y_max
2390 MOVE N_points-1,Y_min1 ! Lower tic
2400 DRAW (N_points-1)*1.03,Y_min1
2410 CSIZE (3)
2420 LOR6 (2)
2430 Y_label$="dB"
2440 Y_fmt$="X,S,D.D"
2450 LABEL USING Y_fmt$,(Y_min1*Y_scale_f)
2460 MOVE N_points-1,Y_max1 ! Upper tic
2470 DRAW (N_points-1)*1.03,Y_max1
2480 LABEL USING Y_fmt$,(Y_max1*Y_scale_f)
2490 MOVE (N_points-1)*1.05,Y_min1+(Y_max1-Y_min1)*.5
2500 LABEL Y_label$
2510 !
2520 Lower_tics: ! DOES FREQUENCY AXIS
2530 X1=X_min_view+X_delta_view*.10
2540 X2=X_min_view+X_delta_view*.15
2550 Y1=Y_min_view-Y_delta_view*.15
2560 Y2=Y_min_view+Y_delta_view
2570 VIEWPORT X1,X2,Y1,Y2
2580 X1=0-(N_points-1)*.10
2590 X2=(N_points-1)*1.15
2600 Y1=Y_min-Y_delta_view*.15*1.1
2610 Y2=Y_max
2620 WINDOW X1,X2,Y1,Y2
2630 MOVE 0,Y_min ! Left tic
2640 DRAW 0,Y_min-Y_off
2650 LOR6 (6)
Appendix C—Example 5

2660 X_fmt$="SOD.0"
2670 X_label$="HZ"
2680 LABEL (X_min)
2690 MOVE N_points-1,Y_min ! Right tic
2700 DRAW N_points-1,Y_min-Y_off
2710 LABEL (X_max)
2720 MOVE (N_points-1)*.5,Y_min-Y_off
2730 LABEL X_label$
2740 RETURN
2750 !
2760 Daa_set: ! SUBROUTINE TO SETUP DATA AQUISITION
2770 N_avg=2 ! Number of averages per spectrum
2780 Per_ovlp=50 ! % overlap
2790 Delay=.5 ! Delay in records for first spectrum
2800 Inc_delay=(N_avg)*Per_ovlp/100 ! Calculates the delay between
2810 ! spectrum in records
2820 CALL Int_real(Th_head(43),Th_head(44),Fmax) ! Converts thruput
2830 ! header values into max frequency
2840 CALL L_int_real(Th_head(39),Th_head(40),Th_head(41),Th_head(42),Fcent)
2850 ! Converts thruput header values into center
2860 ! frequency
2870 !
2880 ! SET ANALYSER STATE
2890 OUTPUT @Io:"TMT"
2900 OUTPUT @Io:"PSPC;CH1;STBL:NAVG ";N_avg;"ENT;OVL";Per_ovlp
2910 OUTPUT @Io:"C1GR;AUTO 0"
2920 OUTPUT @Io:"C1IN;TRGD;Delay;"REC"
2930 OUTPUT @Io:"ACFL ";Thru_name$;"
2940 OUTPUT @Io:"FRS ";Fmax;"HZ"
2950 OUTPUT @Io:"SF 0 HZ"
2960 RETURN
2970 Hpib_init: !
2980 ! SETUP End of Measurement Mask
2990 OUTPUT @Io:"SRQ"
3000 OUTPUT @Io:"ISM 4"
3010 RETURN
3020 !
3030 Hpib_intr: ! Handles end of measurement and request
3040 ! for control interrupts
3050 Spoll_byte=SPOLL(@Io)
3060 PRINT "SPOLL=";Spoll_byte
3070 Spoll_test=BINAND(Spoll_byte,143) ! MASK OUT BITS 4,5,6
3080 IF Spoll_test=14 AND Spoll_test<143 THEN
3090 ! Request for control of bus
3100 PASS CONTROL @Io
3110 END IF
3120 IF Spoll_test=11 THEN ! End of Measurement
3130 ASSIGN @Io;FORMAT ON
3140 OUTPUT @Io:"IS?"
3150 ENTER @Io;Stat
3160 IF BINAND(Stat,4)=4 THEN GOSUB Get_data
3170 END IF
3180 End_intr:ENABLE INTR 7
3190 RETURN !
3200 !
3210 Read_header:  ! READS THRUPUT HEADER
3220  ASSIGN @Disc TO "TS"&Thru_name$&":,700,0"
3230  ENTER @Disc,Th_head(*)
3240  ASSIGN @Disc TO *
3250  RETURN
3260 !
3270 END
3279 !SUB Int_real(INTEGER I1,I2,REAL Real)
3280 !SUB L_int_real(INTEGER I1,I2,I3,I4,REAL Real)

SAMPLE PLOT FROM EXAMPLE PROGRAMS 4 & 5
APPENDIX C – EXAMPLE PROGRAM 6

 DEMO PROGRAM TSUNAMI PLOT

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last update 4-04-85

BASIC 3.0

w/GROUPH

PURPOSE:

This program will dump the display buffers from
the display of the HP3562 using the DUMP VECTOR BINARY cmd.
The program decodes the HP1345 display commands and
translates them to HP-GL then plots it on the CRT

SUB PROGRAMS USED:

Gplot

Reed_binary

DATA DICTIONARY:

Ibuf(*) Integer buffer for storing the dumped
data prior to plotting

Ix,Iy,Idx Integer in range 0 to 2048 corresponding
to the current value of the increment for
use with the graph command

Chr_buf Common arrays containing the definition of
character set not standard to HP-GL

First_dsdbuf First display buffer

Num_dsdbuf Number of display buffers used

Data_len Length of buffer in bytes

@1o HP-IB code assignment of the 3562

----------------------------------------------------------------------------------

PROGRAM TO PLOT TSUNAMI GRAPHICS BUFFER

OPTION BASE 1

DIM A$(11)

INTEGER Ibuf(4096),Ix,Iy,Idx

INTEGER Data_len
550 ! THE FOLLOWING ARE USED TO DESCRIBE NONE HPGL
570 ! STANDARD CHARACTERS USED IN HP1745 DISPLAY
580 !
580 COM /Char_buf/ Triangle(6.3),Tri_2(5.3),Sqr_rt(5.3)
590 COM /Char_buf/ Rgt_arrow(6.3),Hp_log(20.3)
610 READ Triangle(*),Tri_2(*),Sqr_rt(*),Rgt_arrow(*),Hp_log(*)
620 !
630 Triangle:DATA 0,0,6, 0,0,-2, 9,4,-1
640 DATA 0,8,-1, 0,0,-1, 0,0,7
650 Tri_2:DATA 1,0,-2, 8,0,-1, 5,8,-1
660 DATA 1,0,-1, 0,0,-2
670 Sqr_rt:DATA 0,3,-2, 1,4,-1, 3,0,-1
680 DATA 6,8,-1, 0,0,-2
690 Rgt_arrow:DATA 0,4,-2, 8,4,-1, 5,6,-1
700 DATA 6,2,-2, 8,4,-1, 0,0,-2
710 Hp_log:DATA 6,4,-2, 6,12,-1, 6,8,-2
720 DATA 9,8,-1, 9,4,-1, 11,0,-2
730 DATA 11,8,-1, 14,8,-1, 14,4,-1
740 DATA 11,4,-1
750 DATA 0,2,-2, 0,10,-1, 2,12,-1
760 DATA 18,12,-1, 20,10,-1, 20,2,-1
770 DATA 18,0,-1, 2,0,-1, 0,2,-1
780 DATA 20,0,-2
790 !
800 ASSIGN @Io TO 720
810 CREATE BOAT "PLOTFILE:700",200 ! Creates plotfile
820 PLOTTER IS "PLOTFILE:700","HPGL" ! Assigns plotfile
830 LORG 1
840 CSIZE 3.4,.57 ! Set character size
850 WINDOW 0,2100,0,2100 ! Set window in HP1345 units
860 DEG ! Default to degrees
870 OUTPUT @Io:"COMD" ! Disable command echo
880 First_dsdbuf=4 ! Start with buffer 4 (ie. ignore
890 ! menu and command fields)
900 FOR J=First_dsdbuf TO 17 ! 17 is last buffer
910 OUTPUT @Io:"VBLK ",J ! Output buffer 'J'
920 CALL Read_binary(@Io,"DVBN",Data_len,Ibuf(*))
930 IF Data_len=0 THEN End_j ! Ignore if buffer empty
940 FOR I=1 TO Data_len DIV 2
950 CALL Ggplot(Ibuf(I),Ix,Iy,Idx)
960 NEXT I
970 End_j:NEXT J
980 PLOTTER IS 3,"INTERNAL" ! This closes the plotfile out
990 END
1000 !
1010 SUB Ggplot(INTEGER Coordt,Xcoord,Ycoord,Delta_x)
1020 !
1030 ! This subprogram translate the HP1745 commands
1040 ! to HPGL commands.
1050 !
1060 OPTION BASE 1
1070 COM /Char_buf/ Triangle(6,3),Tri_2(5,3),Sqr_rt(5,3)
1080 COM /Char_buf/ Rgt_arrow(6,3),Hp_log(20,3)
1090 INTEGER Op_code
1100 DIM A$(11)
1110 Decode_instr:   ! Mask out opcode
1120 Op_code=(BINAND(Coordt,24576))  ! Set condition
1130 IF Op_code=24576 THEN GOSUB Set_cond   ! Set condition
1140 IF Op_code=0 THEN GOSUB Plot   ! Plot vector
1150 IF Op_code=8192 THEN GOSUB Graph   ! Graph vector
1160 IF Op_code=16384 THEN GOSUB Text   ! Write text
1170 SUBEXIT
1180   !
1190 Set_cond:   ! Sets Linetype
1200 IF BIT(Coordt,8)=1 AND BIT(Coordt,7)=0 THEN LINE TYPE 4
1210 IF BIT(Coordt,8)=1 AND BIT(Coordt,7)=1 THEN LINE TYPE 4
1220 IF BIT(Coordt,8)=0 AND BIT(Coordt,7)=1 THEN LINE TYPE 1
1230 IF BIT(Coordt,8)=0 AND BIT(Coordt,7)=0 THEN LINE TYPE 1
1240 RETURN
1250 Plot:       ! Plots/move pen
1260 IF BIT(Coordt,12)=0 THEN Xplot
1270 Ycoord=BINAND(Coordt,2047)
1280 IF BIT(Coordt,11)=0 THEN
1290   Pflag=-2
1300   ELSE
1310   Pflag=-1
1320 END IF
1330 PLOT Xcoord,Ycoord,Pflag
1340 RETURN
1350 Xplot:Xcoord=BINAND(Coordt,2047)
1360 RETURN
1370 Graph:   ! Graph data
1380 IF BIT(Coordt,12)=0 THEN Set_deltax
1390 Ycoord=BINAND(Coordt,2047)
1400 Xcoord=Xcoord+Delta_x
1410 IF BIT(Coordt,11)=0 THEN
1420   Pflag=-2
1430   ELSE
1440   Pflag=-1
1450 END IF
1460 PLOT Xcoord,Ycoord,Pflag
1470 RETURN
1480 Set_deltax:Delta_x=BINAND(Coordt,2047)
1490 RETURN
1500 Text:   ! Text control and output
1510 LINE TYPE 1
1520 A$=CHR$(BINAND(Coordt,255))
1530 IF BIT(Coordt,8)=0 THEN GOTO Type
1540 IF BIT(Coordt,10)=0 AND BIT(Coordt,9)=0 THEN LDIR 0
1550 IF BIT(Coordt,10)=0 AND BIT(Coordt,9)=1 THEN LDIR 90
1560 IF BIT(Coordt,10)=1 AND BIT(Coordt,9)=0 THEN LDIR 180
1570 IF BIT(Coordt,10)=1 AND BIT(Coordt,9)=1 THEN LDIR 270
1580 IF BIT(Coordt,12)=0 AND BIT(Coordt,11)=0 THEN CSIZE 3,4,.67

C-24
1590 IF BIT(Coordt,12)=0 AND BIT(Coordt,11)=1 THEN CSIZE 5.1,.67
1600 IF BIT(Coordt,12)=1 AND BIT(Coordt,11)=0 THEN CSIZE 6.8,.67
1610 IF BIT(Coordt,12)=1 AND BIT(Coordt,11)=1 THEN CSIZE 8.5,.67
1620 Type: ! Special characters
1630 IF A$=CHR$(95) THEN LABEL USING ",,A",CHR$(8)
1640 IF A$=CHR$(17) THEN GOTO Marker
1650 IF A$=CHR$(127) THEN GOTO Chr_tri
1660 IF A$=CHR$(24) THEN GOTO Chr_tri2
1670 IF A$=CHR$(22) THEN GOTO Chr_sqr
1680 IF A$=CHR$(21) THEN GOTO Chr_rarw
1690 IF A$=CHR$(9) THEN GOTO Half_dn
1700 IF A$=CHR$(12) THEN GOTO Half_up
1710 IF A$=CHR$(1) THEN GOTO Chr_hp
1720 IMOVE 0,-20
1730 LABEL USING ",,A",A$
1740 IMOVE 0,20
1750 RETURN
1760 Marker:
1770 IMOVE -13,-28
1780 LABEL USING ",,A",CHR$(111)
1790 RETURN
1800 Half_up:
1810 IMOVE 0,18
1820 RETURN
1830 Half_dn:
1840 IMOVE 0,-18
1850 RETURN
1860 Chr_tri:
1870 SYMBOL Triangle(*)
1880 LABEL USING ",,A",CHR$(32)
1890 RETURN
1900 Chr_tri2:
1910 SYMBOL Tri_2(*)
1920 LABEL USING ",,A",CHR$(32)
1930 RETURN
1940 Chr_sqr:
1950 SYMBOL Sqr_rt(*)
1960 LABEL USING ",,A",CHR$(32)
1970 RETURN
1980 Chr_rarw:
1990 SYMBOL Rgt_arrow(*)
2000 LABEL USING ",,A",CHR$(32)
2010 RETURN
2020 Chr_hp:
2030 SYMBOL Hp_log(*)
2040 RETURN
2050 SUBEND
2060 !
2070 SUB Read_binary(@Io,Com$,INTEGER Data_len,INTEGER Buf(*))
2080 !
2090 ! This routine performs a "generic" read binary
2100 ! from the HP3562A
2110 !
2120  OPTION BASE 1
2130  ASSIGN @Io;FORMAT ON
2140  OUTPUT @Io;Com$          ! Output command
2150  ENTER @Io USING "%2A,%";A$;Data_len
2160  IF A$<>"#A" THEN          ! Check for correct response
2170     DISP "NOT CORRECT BLOCK MODE"
2180     CLEAR @Io
2190 ELSE
2200     IF Data_len=0 THEN SUBEXIT
2210     REDIM Buf(Data_len DIV 2) ! Set buffer to proper length
2220     ASSIGN @Io;FORMAT OFF
2230     ENTER @Io;Buf(*)        ! Read data into buffer
2240     ASSIGN @Io;FORMAT ON
2250 END IF
2260 LOCAL @Io
2270 SUBEND
APPENDIX C — DEMO PROGRAM 7

DEMO PROGRAM CONVERSION SUBPROGRAMS

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last updated 3-1-85
Basic 3.0

PURPOSE:
These subprograms are used to convert data from the internal format of the HP3562A to standard ANSI floating point representation used by the HP Series 200 computer. The internal real and long real data is stored as integers (2 & 4 respectively) and passed to the programs and converted.

SUBPROGRAMS:

Int_real Converts two integers to the corresponding ANSI real value

L_int_real Converts four integers to the corresponding ANSI real value

SUB Int_real(INTEGER I1, I2, REAL Real)
CONVERTS DATA IN HP3562A INTERNAL REAL FORMAT TO BASIC REAL FORMAT

INTEGER I2_low
I2_low=BINAND(I2,255) IEXTRACT EXPONENT
I2_hi=SHIFT(I2,8)*2^(-23)
Real=(I1/32768.+I2_hi)*2^I2_low

SUB L_int_real(INTEGER I1, I2, I3, I4, REAL Real)
CONVERTS DATA IN HP3562A INTERNAL LONG REAL FORMAT TO BASIC REAL FORMAT

INTEGER I4_low LEAST SIG BYTE
R1=I1
IF I2<0 THEN
R2=(I2+32768.)*2^(-15)
ELSE
R2=(I2)*2^(-15)
END IF
IF I3<0 THEN
R3=(I3+32768.)*2^(-30)
ELSE

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550         R3=(I3)*2.^(30)
560         END IF
570         I4_low=BINAND(I4,255)  !EXTRACT EXPONENT
580         R4=SHIFT(I4,8)*2^(-30-8)
590         Real=(R1+R2+R3+R4)*2^(I4_low-15)
600         SUBEND
610         !
APPENDIX C - EXAMPLE PROGRAM 8

10 REM STORE "COMMAND"
20 REM THIS PROGRAM SENDS COMMANDS TO HP-IB
30 OPTION BASE 1
40 DIM A$(80), B$(100), Buf(2200)
50 INTEGER lbuf(4400)
60 INTEGER Data_len
70 True=1
80 Report=16
90 Command=5
100 Xexecute=14
110 A_command=8
120 A_data=0
130 A_dsj=16
140 A_format=12
150 A_read=10
160 A_write=9
170 Italk=128
180 Ilisten=136
190 Isdc=14
200 Iskey=13
210 Ischange=11
220 Daddr=1
230 Paddr=5
240 Haddr=20
250 ASSIGN @Io TO 700+Haddr
260 Rep_flg=True
270 End_flg=False
280 Iplot=0
290 Ignore=False
300 Idisk=1
310 Tct_flg=False
320 DISP ""
330 REMOTE 7
340 GOSUB Label1
350 .DISP "HP-IB address = ", Haddr
355 GOTO Com_loop
370 Label1: ON INTR 7, 15 GOSUB Hpib_intr
390 ON KEY 0 LABEL "", 14 GOSUB Nothing
390 ON KEY 1 LABEL "Command", 14 GOSUB Com_intr
400 ON KEY 2 LABEL "Address", 14 GOSUB Labeladdr
410 ON KEY 3 LABEL "Ser Poll", 14 GOSUB Ser_poll
420 ON KEY 4 LABEL "Xfer", 14 GOSUB Label2
430 ON KEY 5 LABEL "Clear", 14 GOSUB Device_clear
440 ON KEY 6 LABEL "Read", 14 GOSUB Read_intr
450 ON KEY 7 LABEL "Demo", 14 GOSUB Labeldemo
460 ON KEY 8 LABEL "EXIT", 15 GOSUB Exit_intr
470 ON KEY 9 LABEL "EXIT", 15 GOSUB Exit_intr
480 ENABLE INTR 7: 2
490 RETURN
500 Com_loop: IF NOT End_flg THEN Com_loop
510 WAIT .5 I MAKE SURE COMMAND FINISHED
520 LOCAL 7
530 DISP "End of Commands"
540 STOP
550 Labeladdr: !
560 ON KEY 0 LABEL "",14 GOSUB Nothing
570 ON KEY 1 LABEL "HP 14 Addr",14 GOSUB Hpio_addr
580 ON KEY 2 LABEL "Disk Addr",14 GOSUB Disk_addr
590 ON KEY 3 LABEL "TCT Flag",14 GOSUB Set_tct
600 ON KEY 4 LABEL "",14 GOSUB Nothing
610 ON KEY 5 LABEL "",14 GOSUB Nothing
620 ON KEY 6 LABEL "",14 GOSUB Nothing
630 ON KEY 7 LABEL "",14 GOSUB Nothing
640 ON KEY 8 LABEL "EXIT",14 GOSUB Label1
650 ON KEY 9 LABEL "EXIT",14 GOSUB Label1
660 RETURN
670 Labeldemo: !
680 ON KEY 0 LABEL "",14 GOSUB Nothing
690 ON KEY 1 LABEL "Help",14 GOSUB Help_list
700 ON KEY 2 LABEL "Help Plot",14 GOSUB Help_plot
710 ON KEY 3 LABEL "Ignore",14 GOSUB Ignore_intr
720 ON KEY 4 LABEL "Rpg Demo",14 GOSUB Rpg_demo
730 ON KEY 5 LABEL "Demo 1",14 GOSUB Demo
740 ON KEY 6 LABEL "Demo 2",14 GOSUB Demo2
750 ON KEY 7 LABEL "Control",14 GOSUB Canned
760 ON KEY 8 LABEL "EXIT Demo",15 GOSUB End_demo
770 ON KEY 9 LABEL "EXIT Demo",15 GOSUB End_demo
780 RETURN
790 End_demo: Demo_flg=False
800 GOSUB Label1
810 RETURN
820 Set_tct: Tct_flg=NOT Tct_flg
830 DISP 'TCT flag = ";Tct_flg
840 RETURN
850 Help_list: OUTPUT @Io:"BEEP -85;ERRE;ERR?"
860 ENTER @Io:x
870 Err_flag=False
880 Demo_flg=True
890 Loop_send: OUTPUT @Io:"BEEP -86"
900 IF (Err_flag=False) AND (Demo_flg=True) THEN Loop_send
910 RETURN
920 Help_plot: OUTPUT @Io:"BEEP -85;ERRE;SRQE;ERR?"
930 ENTER @Io:x
940 OUTPUT @Io:"ROF 1"
950 Demo_flg=True
960 Err_flag=False
970 Loop_plot: OUTPUT @Io:"BEEP -86"
980 IF Err_flag OR (Demo_flg=False) THEN RETURN
990 End_plot=False
1000 OUTPUT @Io:"STPL"
1010 Wait_plot:IF End_plot=False THEN Wait_plot
1020 OUTPUT 700+Paddr:"EC;AH"
1030 GOTO Loop_plot
1040 RETURN
1050 Canned:BS="HP-IB control program"
1060 GOSUB Out_hpio
1070 B$="Change Setup State"
1080 GOSUB Out_hpib
1090 OUTPUT @Io;"SRQ;STAT"
1100 WAIT 2
1110 OUTPUT @Io;"SMES;TRGD;FREQ"
1120 OUTPUT @Io;"RNG"
1130 WAIT 2
1140 B$="Synthesize Data"
1150 GOSUB Out_hpib
1160 Disk_flg=False
1170 OUTPUT @Io;"CTRC"
1180 WAIT 5
1190 B$="Display LOG MAG data"
1200 GOSUB Out_hpib
1210 OUTPUT @Io;"CORD;MGLG"
1220 WAIT 5
1230 B$="Display REAL data"
1240 GOSUB Out_hpib
1250 OUTPUT @Io;"CORD;REAL"
1260 WAIT 5
1270 B$="Display IMAGINARY data"
1280 GOSUB Out_hpib
1290 OUTPUT @Io;"CORD;IMAG"
1300 WAIT 5
1310 B$="End of HP-IB test"
1320 GOSUB Out_hpib
1330 OUTPUT @Io;"STAT;COME"
1340 WAIT 1
1350 LOCAL @Io
1360 RETURN
1370 Out_hpib: OUTPUT @Io;"COMD;DBSZ 100,0"
1380 OUTPUT @Io;"DBAC @i;PU;PA 20,1000"
1390 OUTPUT @Io;"CHSZ 2"
1400 OUTPUT @Io;"WRIT ";B$i;""
1410 OUTPUT @Io;"CHSZ @i;DBUP 0"
1420 WAIT 3
1430 RETURN
1440 Ser_poll: Poll_byte=SPOLL(@Io)
1450 DISP "Ser Poll = ";Poll_byte
1460 RETURN
1470 Hpb_intr: Poll_byte=SPOLL(@Io)
1480 PRINT "SRQ = ";Poll_byte
1490 ! MASK OUT RQS, ERR, RDY
1500 IF BIT(Poll_byte,5) THEN Err_flag=True
1510 Poll_byte=BINAND(Poll_byte,143)
1520 IF Ignore THEN End_intr
1530 !
1540 ! PASS CONTROL
1550 !
1560 IF Tct_flg AND Poll_byte>=14 AND Poll_byte<=143 THEN
1570 DISP "PASS CONTROL"
1580 SEND ?;UNL UNT TALK Haddr CMD 9
1590 GOTO End_intr
1600  END IF
1610  !
1620  ! END OF DISK ACTION
1630  !
1640  IF Poll_byte=9 THEN
1650  Disk_flg=True
1660  GOTO End_intr
1670  END IF.
1680  !
1690  ! END OF PLOT ACTION
1700  !
1710  IF Poll_byte=10 THEN
1720  End_plot=True
1730  GOTO End_intr
1740  END IF
1750  !
1760  ! TALK PLOTTER
1770  !
1780  IF Poll_byte=Italk+Iplot THEN
1790  SEND 7;UNL UNT LISTEN Haddr CMD 1 TALK Paddr DATA
1800  GOTO End_intr
1810  END IF
1820  !
1830  ! LISTEN PLOTTER
1840  !
1850  IF Poll_byte=Ilisten+Iplot THEN
1860  SEND 7;UNL UNT LISTEN Paddr TALK Haddr DATA
1870  GOTO End_intr
1880  END IF
1890  !
1900  ! LISTEN DISK COMMAND
1910  !
1920  IF Poll_byte=Ilisten+Idisk THEN
1930  SEND 7;UNL UNT LISTEN Daddr SEC Command TALK Haddr DATA
1940  Rep_flg=False
1950  GOTO End_intr
1960  END IF
1970  !
1980  ! LISTEN DISK EXECUTION
1990  !
2000  IF Poll_byte=Ilisten+Idisk+1 THEN
2010  GOSUB Parallel_poll
2020  SEND 7;UNL UNT LISTEN Daddr SEC Execute TALK Haddr DATA
2030  Rep_flg=False
2040  GOTO End_intr
2050  END IF
2060  !
2070  ! LISTEN AMI<00 COMMAND
2080  !
2090  IF Poll_byte=Ilisten+Idisk+2 THEN
2100  SEND 7;UNL UNL TALK Haddr LISTEN Daddr
2110  WAIT .001
2120  SEND 7;SEC A_command
2130  WAIT .001
2140  SEND 7;DATA
2150  GOTO End_intr
2160  END IF
2170  !
2180  ! LISTEN AMIGO DATA
2190  !
2200  IF Poll_byte=Ilisten+Idisk+3 THEN
2210  SEND 7;UNT UNL TALK Haddr LISTEN Daddr
2220  WAIT .001
2230  SEND 7;SEC A_data
2240  WAIT .001
2250  SEND 7;DATA
2260  GOTO End_intr
2270  END IF
2280  !
2290  ! LISTEN AMIGO READ COMMAND
2300  !
2310  IF Poll_byte=Ilisten+Idisk+4 THEN
2320  SEND 7;UNT UNL TALK Haddr LISTEN Daddr
2330  WAIT .001
2340  SEND 7;SEC A_read
2350  WAIT .001
2360  SEND 7;DATA
2370  GOTO End_intr
2380  END IF
2390  !
2400  ! LISTEN AMIGO WRITE COMMAND
2410  !
2420  IF Poll_byte=Ilisten+Idisk+5 THEN
2430  SEND 7;UNT UNL TALK Haddr LISTEN Daddr
2440  WAIT .001
2450  SEND 7;SEC A_write
2460  WAIT .001
2470  SEND 7;DATA
2480  GOTO End_intr
2490  END IF
2500  !
2510  ! LISTEN AMIGO FORMAT
2520  !
2530  IF Poll_byte=Ilisten+Idisk+6 THEN
2540  SEND 7;UNT UNL TALK Haddr LISTEN Daddr
2550  WAIT .001
2560  SEND 7;SEC A_format
2570  WAIT .001
2580  SEND 7;DATA
2590  GOTO End_intr
2600  END IF
2610  !
2620  ! TALK DISK EXECUTION
2630  !
2640  IF Poll_byte=Italk+Idisk THEN
2650  GOSUB Parallel_poll
2660  SEND 7:UNL UNT LISTEN Haddr CMD 1 TALK Daddr SEC Xecute DATA
2670  Rep_fig=False
2680  GOTO End_intr
2690  END IF
2700  |
2710  | TALK DISK REPORT
2720  |
2730  IF Poll_byte=Italk+Idisk+1 THEN
2740  IF NOT Rep_fig THEN GOSUB Parallel_poll
2750  SEND 7:UNL UNT LISTEN Haddr CMD 1 TALK Daddr
2760  WAIT .001
2770  SEND 7:SEC Report DATA
2780  Rep_fig=True
2790  GOTO End_intr
2800  END IF
2810  |
2820  | TALK AMIGO STATUS / COMMAND
2830  |
2840  IF Poll_byte=Italk+Idisk+2 THEN
2850  SEND 7:UNT UNT LISTEN Haddr CMD 1 TALK Daddr
2860  WAIT .001
2870  SEND 7:SEC A_command DATA
2880  GOTO End_intr
2890  END IF
2900  |
2910  | TALK AMIGO DATA
2920  |
2930  IF Poll_byte=Italk+Idisk+3 THEN
2940  SEND 7:UNT UNT LISTEN Haddr CMD 1 TALK Daddr
2950  WAIT .001
2960  SEND 7:SEC A_data DATA
2970  GOTO End_intr
2980  END IF
2990  |
3000  | TALK AMIGO DSJ
3010  |
3020  IF Poll_byte=Italk+Idisk+4 THEN
3030  SEND 7:UNT UNT LISTEN Haddr CMD 1 TALK Daddr
3040  WAIT .001
3050  SEND 7:SEC A_dsj DATA
3060  GOTO End_intr
3070  END IF
3080  |
3090  | TALK DISK IDENT
3100  |
3110  IF Poll_byte=Italk+Idisk+5 THEN
3120  SEND 7:UNT UNT LISTEN Haddr CMD 1 UNT
3130  WAIT .001
3140  SEND 7:SEC Daddr DATA
3150  GOTO End_intr
3150  END IF
3170  |

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! TALK AMIGO PARALLEL POLL

IF Poll_byte=Italk+Idisk+6 THEN
  SEND 7;UNT UNL DATA
  GOSUB Parallel_poll
  GOTO End_intr
END IF

! CLEAR PLOTTER
IF Poll_byte=Isdc THEN
  CLEAR 700+Paddr
  SEND 7;UNT UNL LISTEN Haddr CMD 1 DATA
  GOTO End_intr
END IF

! UNADDRESS BUS
IF Poll_byte=Isdc+1 THEN
  SEND 7;UNT UNL LISTEN Haddr CMD 1 UNL DATA
  GOTO End_intr
END IF

! REDIRECTED KEY HIT
IF Poll_byte=Iskey THEN
  OUTPUT @Io;"COM?"
  ENTER @Io;Keycode,Keystr$
  DISP "KEY CODE = ",Keycode,"STR->";Keystr$;"<-"
  IF Keycode>0 THEN OUTPUT @Io;"KEY ";Keycode
  GOTO End_intr
END IF

! INSTRUMENT STATUS CHANGE
IF Poll_byte=11 THEN
  OUTPUT @Io;"IS?"
  ENTER @Io;Stat_word
  PRINT "IS = ",Stat_word
  IF BINAND(Stat_word,4096) THEN Entry_changed=True
  IF BINAND(Stat_word,8192) THEN
    OUTPUT @Io;"AS?"
    ENTER @Io;As_word
    PRINT "AS = ",As_word
  END IF
END IF
LOCAL @Io
END IF

! UNKNOWN SRQ
END Intr:   ENABLE INTR 7
RETURN
3700 !
3710 !
3720 Parallel_poll: Ppoll_byte=PPOLL(7)
3730 IF BIT(Ppoll_byte,7-Daddr)=0 THEN Parallel_poll
3740 RETURN
3750 !
3760 Exit_intr:End_flg=True
3770 RETURN
3780 !
3790 !
3800 Com_intr:DISP "Enter Command"
3810 ENTER 2;A$
3820 IF A$<"=" THEN
3830 OUTPUT @Io;A$
3840 LOCAL @Io
3850 END IF
3860 DISP
3870 RETURN
3880 Demo: I=0
3890 Demo_flg=True
3900 P1x=0
3910 P1y=250
3920 P1dir=1
3930 P2x=1750
3940 P2y=2000
3950 P2dir=3
3960 OUTPUT @Io;"COMD:DBSZ 200,0,2"
3970 Demo_loop: OUTPUT @Io;"DBAC ";I
3980 OUTPUT @Io;"PU;PA ";P1x,P1y
3990 OUTPUT @Io;"PD;PA ";P2x,P2y
4000 OUTPUT @Io;"LT 0"
4010 OUTPUT @Io;"DBSW ";I,1-1
4020 I=1-1
4030 CALL Nextpoint(P1x,P1y,P1dir)
4040 CALL Nextpoint(P2x,P2y,P2dir)
4050 IF Demo_flg THEN Demo_loop
4060 RETURN
4070 !
4080 Demo2: P1x=0
4090 P1y=250
4100 P2x=1750
4110 P2y=2000
4120 Demo_flg=True
4130 Incr=50
4140 OUTPUT @Io;"COMD:DBSZ 300,0;DBAC 0;PU"
4150 OUTPUT @Io;"PA ";P1x,P1y
4160 OUTPUT @Io;"PD;DBUP 0"
4170 Demo2_loop: IF End_flg THEN Demo2_end
4180 OUTPUT @Io;"DBAA 0;PA ";P2x,P2y
4190 OUTPUT @Io;"DBUP 0"
4200 P2y=P2y+Incr
4210 IF P2y<P1y THEN Demo2_end
4220  OUTPUT @Io:"DBAA 0;PA ";P2x,P2y
4230  OUTPUT @Io:"DBUP 0"
4240  P1x=P1x+Incr
4250  IF P1x>P2x THEN Demo2_end
4260  OUTPUT @Io:"DBAA 0;PA ";P1x,P2y
4270  OUTPUT @Io:"DBUP 0"
4280  P1y=P1y+Incr
4290  IF P1y>P2y THEN Demo2_end
4300  OUTPUT @Io:"DBAA 0;PA ";P1x,P1y
4310  OUTPUT @Io:"DBUP 0"
4320  P2x=P2x-1Incr
4330  IF P2x<P1x THEN Demo2_end
4340  GOTO Demo2_loop
4350  Demo2_end: IF Demo_flg THEN Demo2
4360  RETURN
4370  !
4380  Rpg_demo: OUTPUT @Io:"COMDG:ISM 4095;RENE"
4390  Demo_flg=True
4400  Entry_changed=True
4410  Rpg_loop: IF Entry_changed THEN
4420  Entry_changed=False
4430  OUTPUT @Io:"RENU?"
4440  ENTER @Io:Entry_value
4450  DISP "Entry = ";Entry_value
4460  END IF
4470  IF Demo_flg THEN Rpg_loop
4480  OUTPUT @Io:"REND:ISM 0;COME"
4490  RETURN
4500  Ignore_intr:Ignore=NOT Ignore
4510  DISP "Ignore = ";Ignore
4520  GOTO End_intr
4530  Device_clear:CLEAR 700+Haddr
4540  DISP "Device clear sent"
4550  GOTO End_intr
4560  Read_intr:ENTER 700+Haddr;AS
4570  DISP "String ->";AS;"<-
4580  RETURN
4590  Hpi8_addr:DISP USING "3(K)";'Enter HP-IB address (',Haddr,')"
4600  ENTER 2;Haddr
4610  ASSIGN @Io TO 700+Haddr
4620  DISP
4630  RETURN
4640  Disk_addr:DISP USING "3(K)";'Enter Disk address (',Daddr,')"
4650  ENTER 2;Daddr
4660  DISP
4670  RETURN
4680  !
4690  LABEL2: !
4700  ON KEY 0 LABEL "",14 GOSUB Nothing
4710  ON KEY 1 LABEL "Display",14 GOSUB Labeldsp
4720  ON KEY 2 LABEL "Synth",14 GOSUB Labelss
t
4730  ON KEY 3 LABEL "Memory",14 GOSUB Labelmem
4740  ON KEY 4 LABEL "Setup",14 GOSUB Labels
4750 ON KEY 5 LABEL "Data",14 GOSUB Labeld
4760 ON KEY 5 LABEL "Coord",14 GOSUB Labelc
4770 ON KEY 7 LABEL "Vector",14 GOSUB Labelf
4780 ON KEY 8 LABEL "EXIT",14 GOSUB Labell
4790 ON KEY 9 LABEL "EXIT",14 GOSUB Labell
4800 |
4810 Nothing: RETURN
4820 |
4830 Labels:
4840 ON KEY 0 LABEL "",14 GOSUB Nothing
4850 ON KEY 1 LABEL "LSAS",14 GOSUB Lsas
4860 ON KEY 2 LABEL "LSBN",14 GOSUB Lsbn
4870 ON KEY 3 LABEL "LSAN",14 GOSUB Lsan
4880 ON KEY 4 LABEL "EXIT",14 GOSUB Labell2
4890 ON KEY 5 LABEL "",14 GOSUB Nothing
4900 ON KEY 6 LABEL "DSAS",14 GOSUB Dsas
4910 ON KEY 7 LABEL "DSBN",14 GOSUB Dsbn
4920 ON KEY 8 LABEL "DSAN",14 GOSUB Dsan
4930 ON KEY 9 LABEL "EXIT",14 GOSUB Labell2
4940 RETURN
4950 |
4960 LABELdsp:
4970 ON KEY 0 LABEL "",14 GOSUB Nothing
4980 ON KEY 1 LABEL "",14 GOSUB Nothing
4990 ON KEY 2 LABEL "",14 GOSUB Nothing
5000 ON KEY 3 LABEL "",14 GOSUB Nothing
5010 ON KEY 4 LABEL "",14 GOSUB Nothing
5020 ON KEY 5 LABEL "Asci",14 GOSUB Disp_asc
5030 ON KEY 6 LABEL "Binary",14 GOSUB Disp_bin
5040 ON KEY 7 LABEL "Ansi",14 GOSUB Disp_ans
5050 ON KEY 8 LABEL "EXIT",14 GOSUB Labell2
5060 ON KEY 9 LABEL "EXIT" GOSUB Labell2
5070 RETURN
5080 |
5090 Labels:
5100 ON KEY 0 LABEL "",14 GOSUB Nothing
5110 ON KEY 1 LABEL "LDAS",14 GOSUB Ldas
5120 ON KEY 2 LABEL "LDBN",14 GOSUB Ldbn
5130 ON KEY 3 LABEL "LDAN",14 GOSUB Ldan
5140 ON KEY 4 LABEL "EXIT",14 GOSUB Labell2
5150 ON KEY 5 LABEL "",14 GOSUB Nothing
5160 ON KEY 6 LABEL "DDAS",14 GOSUB Ddas
5170 ON KEY 7 LABEL "DDBN",14 GOSUB Ddbn
5180 ON KEY 8 LABEL "DDAN",14 GOSUB Ddan
5190 ON KEY 9 LABEL "EXIT" GOSUB Labell2
5200 RETURN
5210 |
5220 Labels:
5230 ON KEY 0 LABEL "",14 GOSUB Nothing
5240 ON KEY 1 LABEL "LTAS",14 GOSUB Ltas
5250 ON KEY 2 LABEL "LTBN",14 GOSUB Ltbm
5260 ON KEY 3 LABEL "LTAN",14 GOSUB Ltan
5270 ON KEY 4 LABEL "EXIT",14 GOSUB Labell2
5280 ON KEY 5 LABEL "",14 GOSUB Nothing
5250 ON KEY 6 LABEL "DTAS",14 GOSUB Utas
5300 ON KEY 7 LABEL "DTBN",14 GOSUB Dtbn
5310 ON KEY 8 LABEL "DTAN",14 GOSUB Dtan
5320 ON KEY 9 LABEL "EXIT",14 GOSUB Label12
5330 RETURN
5340 |
5350 Labelc: !
5360 ON KEY 0 LABEL "",14 GOSUB Nothing
5370 ON KEY 1 LABEL "",14 GOSUB Nothing
5380 ON KEY 2 LABEL "",14 GOSUB Nothing
5390 ON KEY 3 LABEL "",14 GOSUB Nothing
5400 ON KEY 4 LABEL "",14 GOSUB Nothing
5410 ON KEY 5 LABEL "DCAS",14 GOSUB Dcas
5420 ON KEY 6 LABEL "DCBN",14 GOSUB Dcbn
5430 ON KEY 7 LABEL "DCAN",14 GOSUB Dcan
5440 ON KEY 8 LABEL "EXIT",14 GOSUB Label12
5450 ON KEY 9 LABEL "EXIT",14 GOSUB Label12
5460 RETURN
5470 |
5480 Labelv: !
5490 ON KEY 0 LABEL "",14 GOSUB Nothing
5500 ON KEY 1 LABEL "",14 GOSUB Nothing
5510 ON KEY 2 LABEL "",14 GOSUB Nothing
5520 ON KEY 3 LABEL "",14 GOSUB Nothing
5530 ON KEY 4 LABEL "",14 GOSUB Nothing
5540 ON KEY 5 LABEL "DVAS",14 GOSUB Dvas
5550 ON KEY 6 LABEL "DVBN",14 GOSUB Dvbn
5560 ON KEY 7 LABEL "DVAN",14 GOSUB Dvan
5570 ON KEY 8 LABEL "EXIT",14 GOSUB Label12
5580 ON KEY 9 LABEL "EXIT",14 GOSUB Label12
5590 RETURN
5600 |
5610 Labeln: !
5620 ON KEY 0 LABEL "",14 GOSUB Nothing
5630 ON KEY 1 LABEL "DISP Memory",14 GOSUB Display_mem
5640 ON KEY 2 LABEL "Load FIt Ansi",14 GOSUB Load_fit
5650 ON KEY 3 LABEL "Dump FIt Ansi",14 GOSUB Dump_fit
5660 ON KEY 4 LABEL "Mem Addr",14 GOSUB Mem_addr
5670 ON KEY 5 LABEL "Dump Ascii",14 GOSUB Dump_asc
5680 ON KEY 6 LABEL "Dump Binary",14 GOSUB Dump_bin
5690 ON KEY 7 LABEL "Dump Ansi",14 GOSUB Dump_ans
5700 ON KEY 8 LABEL "EXIT",14 GOSUB Label12
5710 ON KEY 9 LABEL "EXIT",14 GOSUB Label12
5720 RETURN
5730 |
5740 Display_mem: CALL Disp_mem(@Io,Ibuf(*))
5750 RETURN
5760 Lsas: CALL Write_ascii(@Io,"LSAS",Data_len,Buf(*))
5770 RETURN
5780 Dsas: CALL Read_ascii(@Io,"DSAS",Data_len,Buf(*))
5790 RETURN
5800 Lebn: CALL Write_binary(@Io,"LSBN",Data_len,Ibuf(*))
5810 RETURN
5820 Dsbn: CALL Read_binary(@Io,"DSBN",Data_len,Ibuf(*))
5830    RETURN
5840 Lsan: CALL Write_float(@Io,"LSAN",Data_len,Buf(*))
5850    RETURN
5860 Dsan: CALL Read_float(@Io,"DSAN",Data_len,Buf(*))
5870    RETURN
5880    |
5890 Ldas: CALL Write_ascii(@Io,"LDAS",Data_len,Buf(*))
5900    RETURN
5910 Ddas: CALL Read_ascii(@Io,"DDAS",Data_len,Buf(*))
5920    RETURN
5930 Ldbn: CALL Write_binary(@Io,"LDBN",Data_len,Ibuf(*))
5940    RETURN
5950 Ddbn: CALL Read_binary(@Io,"DDBN",Data_len,Ibuf(*))
5960    RETURN
5970 Ldsn: CALL Write_float(@Io,"LDSN",Data_len,Buf(*))
5980    RETURN
5990 Ddsn: CALL Read_float(@Io,"DDSN",Data_len,Buf(*))
6000    RETURN
6010 |
6020 Ltas: CALL Write_ascii(@Io,"LTAS",Data_len,Buf(*))
6030    RETURN
6040 Dtas: CALL Read_ascii(@Io,"DTAS",Data_len,Buf(*))
6050    RETURN
6060 Ltbn: CALL Write_binary(@Io,"LTBN",Data_len,Ibuf(*))
6070    RETURN
6080 Dtbn: CALL Read_binary(@Io,"DTBN",Data_len,Ibuf(*))
6090    RETURN
6100 Ltan: CALL Write_float(@Io,"LTAN",Data_len,Buf(*))
6110    RETURN
6120 Dtan: CALL Read_float(@Io,"DTAN",Data_len,Buf(*))
6130    RETURN
6140 |
6150 Dcas: CALL Read_ascii(@Io,"DCA",Data_len,Buf(*))
6160    RETURN
6170 Dcbn: CALL Read_binary(@Io,"DCBN",Data_len,Ibuf(*))
6180    RETURN
6190 Docn: CALL Read_float(@Io,"DCAN",Data_len,Buf(*))
6200    RETURN
6210 |
6220 Dvas: CALL Read_ascii(@Io,"DVA",Data_len,Buf(*))
6230    RETURN
6240 Dvbn: CALL Read_binary(@Io,"DVBN",Data_len,Ibuf(*))
6250    RETURN
6260 Dvbn: CALL Read_float(@Io,"DVAN",Data_len,Buf(*))
6270    RETURN
6280 |
6290 Dump_asc: CALL Read_ascii(@Io,"DMAS",Data_len,Buf(*))
6300    RETURN
6310 Dump_bin: CALL Read_binary(@Io,"DMBN",Data_len,Ibuf(*))
6320    RETURN
6330 Load_bin: CALL Write_binary(@Io,"LMEN",Data_len,Ibuf(*))
6340    RETURN
6350 Dump_ans: CALL Read_float(@Io,"DMAN",Data_len,Buf(*)
6360 RETURN
6370 Dump_fit: CALL Read_float(@Io,"DFAN",Data_len,Buf(*))
6380 RETURN
6390 Load_fit: CALL Write_float(@Io,"LFAN",Data_len,Buf(*))
6400 RETURN
6410 Memo_addr: DISP "Enter High word, Low word, Mem size"
6420 ENTER 2;iHigh,illow,Isize
6430 OUTPUT @Io:"MEMA ";iHigh";";iLow";";MEMS ";iSize
6440 LOCAL @Io
6450 RETURN
6460 !
6470 Disp_asc: !
6480 Disp_ans: DISP "Enter Start, Count"
6490 ENTER 2;iStart,icount
6500 FOR I=iStart TO iStart+icount-1
6510 PRINT I:" = ";iBuF(I)
6520 NEXT I
6530 RETURN
6540 !
6550 Disp_bin: DISP "Enter Start, Count"
6560 ENTER 2;iStart,icount
6570 FOR I=iStart TO iStart+icount-1
6580 PRINT I:" = ";iBuF(I)
6590 NEXT I
6600 RETURN
6610 !
6620 END
6630 !
6640 !
6650 SUB Nextpoint(X,Y,Dir)
6660 Incr=100
6670 ON Dir 60SUB Dright,Dup,DleFT,Down
6680 SUBEXIT
6690 Dright: X=X+Incr
6700 Y=250
6710 IF X+Incr>1750 THEN Dir=2
6720 RETURN
6730 Dup: Y=Y+Incr
6740 X=1750
6750 IF Y+Incr>2000 THEN Dir=3
6760 RETURN
6770 Dleft: X=X-Incr
6780 Y=2000
6790 IF X-Incr<0 THEN Dir=4
6800 RETURN
6810 Down: Y=Y-Incr
6820 X=0
6830 IF Y-Incr<250 THEN Dir=1
6840 RETURN
6850 SUBEND
6860 !
6870 !
6880   SUB Read_ascii(@Io,Com$),INTEGER Data_len,REAL Buf(*)
6890   OPTION BASE 1
6900   ASSIGN @Io:FORMAT ON
6910   DISP "Start Read Ascii"
6920   OUTPUT @Io;Com$
6930   ENTER @Io USING "2A,K";A$;Float_len
6940   Data_len=INT(Float_len+.5)
6950   REDIM Buf(Data_len)
6960   IF A$<>"#I" THEN
6970       DISP "NOT CORRECT BLOCK MODE"
6980       CLEAR @Io
6990   ELSE
7000       FOR I=1 TO Data_len
7010           ENTER @Io;Buf(I)
7020       NEXT I
7030       DISP "End Read, Data length = ";Data_len
7040   END IF
7050   LOCAL @Io
7060   SUBEND
7070   !
7080   !
7090   SUB Write_ascii(@Io,Com$),INTEGER Data_len,REAL Buf(*)
7100   OPTION BASE 1
7110   ASSIGN @Io:FORMAT ON
7120   DISP "Start Write Ascii, Data_len = ";Data_len
7130   OUTPUT @Io;Com$
7140   OUTPUT @Io:"#I";Data_len
7150   FOR I=1 TO Data_len-1
7160       OUTPUT @Io;Buf(I)
7170   NEXT I
7180   OUTPUT @Io;Buf(I),END
7190   DISP "End Write"
7200   LOCAL @Io
7210   SUBEND
7220   !
7230   !
7240   SUB Read_binary(@Io,Com$),INTEGER Data_len,INTEGER Buf(*)
7250   OPTION BASE 1
7260   ASSIGN @Io:FORMAT ON
7270   DISP "Read Binary"
7280   OUTPUT @Io;Com$
7290   ENTER @Io USING "%,2A,W";A$;Data_len
7300   IF A$<>"#A" THEN
7310       DISP "NOT CORRECT BLOCK MODE"
7320       CLEAR @Io
7330   ELSE
7340       REDIM Buf(Data_len DIV 2)
7350       ASSIGN @Io:FORMAT OFF
7360       ENTER @Io;Buf(*)
7370       ASSIGN @Io:FORMAT ON
7380   END IF
7390   END FOR
7400   CLEAR @Io
7390 END IF
7400 LOCAL @Io
7410 SUBEND
7420 !
7430 !
7440 SUB Write_binary(@Io,Com$,INTEGER Data_len,INTEGER Buf(*))
7450 OPTION BASE 1
7460 ASSIGN @Io;FORMAT ON
7470 DISP "Start Write Binary, Data_len = ", Data_len
7480 OUTPUT @Io;Com$
7490 REDIM Buf(Data_len DIV 2)
7500 OUTPUT @Io USING ",2A, W","A",Data_len
7510 ASSIGN @Io;FORMAT OFF
7520 OUTPUT @Io;Buf(*)
7530 ASSIGN @Io;FORMAT ON
7540 DISP "End Write"
7550 LOCAL @Io
7560 SUBEND
7570 !
7580 !
7590 SUB Read_float(@Io,Com$,INTEGER Data_len,REAL Buf(*))
7600 OPTION BASE 1
7610 ASSIGN @Io;FORMAT ON
7620 DISP "Start Read float"
7630 OUTPUT @Io;Com$
7640 ENTER @Io USING ",2A, W","A",Data_len
7650 IF (A$<>"A") OR (Data_len MOD 8<>0) THEN
7660 DISP "NOT CORRECT BLOCK MODE"
7670 CLEAR @Io
7680 ELSE
7690 ASSIGN @Io;FORMAT OFF
7700 REDIM Buf(Data_len DIV 8)
7710 ENTER @Io;Buf(*)
7720 DISP "End Read, Data_len = ", Data_len
7730 ASSIGN @Io;FORMAT ON
7740 END IF
7750 LOCAL @Io
7760 SUBEND
7770 !
7780 !
7790 SUB Write_float(@Io,Com$,INTEGER Data_len,REAL Buf(*))
7800 OPTION BASE 1
7810 ASSIGN @Io;FORMAT ON
7820 DISP "Start Write Float, Data_len = ", Data_len
7830 OUTPUT @Io;Com$
7840 OUTPUT @Io USING "",2A, W","A",Data_len
7850 ASSIGN @Io;FORMAT OFF
7860 REDIM Buf(Data_len DIV 8)
7870 OUTPUT @Io;Buf(*)
7880 ASSIGN @Io;FORMAT ON
7890 DISP "End Write"
7900 LOCAL @Io
7910 SUBEND
7920 !
7930 !
7940 Disp_mem: SUB Disp_mem(@Io,INTEGER Buf(*))
7950 OPTION BASE 1
7960 INTEGER Byte_len
7970 DIM R$[10]
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SALES & SUPPORT OFFICES
Arranged alphabetically by country

Product Line Sales/Support Key

Key Product Line
A Analytical
CM Components
C Computer Systems Sales only
CH Computer Systems Hardware Sales and Services
CS Computer Systems Software Sales and Services
E Electronic Instruments & Measurement Systems
M Medical Products
MP Medical Products Primary SRO
MS Medical Products Secondary SRO
P Personal Computation Products
Sales only for specified product line
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Wing On Centre, 28th Floor
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ICELAND
Elding Trading Company Inc.
Halfragnar-tryggavogu
P.O. Box 895
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Computer products are sold through
Blue Star Ltd. All computer repairs and
maintenance service is done through
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Sabri Complex II Floor
24 Residency Rd.
BANGALORE 560 025
Tel: 55880
Telex: 0845 490
Cable: BLUESTAR
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Telex: 0155-459
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A.E

Blue Star Ltd.
T.C. 7/903 Poonamila
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TRIVANDRUM 695 013
Tel: 65798
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Antara Bldg., 17th Floor
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G.M. Dholmedian
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Mishuk & Company Ltd.
Osman Chambers
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PERU
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Telex: 140073 PUSCHEF

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Cubao, QUEZON CITY
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Telex: 40018, 42000 ITT GLOBE
MACKAY BOOTH

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Intercambio Mundial de Comercio S.A.R.L.
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LISBON
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Telex: 16691 inutil p
M

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1298 LISBOA Codex
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Telex: 13316 SABASA
P.
Telecom-Empresa Técnica de Equipamentos Eléctricos S.A.R.L.
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