# 3

# REMOTE OPERATION

## REMOTE OPERATION

# REMOTE OPERATION

## THE HEWLETT PACKARD INTERFACE BUS

### WHAT IS THE HP-IB?

The Hewlett Packard Interface Bus (HP-IB) is an easy to use, high performance bus structure that links the HP 3577A and other instruments, desktop computers and minicomputers into automated measurement systems. The HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488-1978, ANSII Standard MC 1.1 and IEC Recommendation 625-1.

### HOW DOES THE HP-IB OPERATE?

All of the active interface circuits are contained within the various HP-IB devices. The cable's role is limited to connecting all of the devices in parallel, so that data can be transferred from one device to another.

Every participating device must be able to perform at least one of the following roles: TALKER, LISTENER, or CONTROLLER. A talker transmits data to other devices called listeners. Most devices can perform both roles, but not at the same time. A controller manages the operation of the bus system by designating which device is to talk and which device(s) are to listen at any given time. The HP 3577A can be a talker or a listener. It has no controller capabilities.

The minimum HP-IB system consists of one talker and one listener without a controller. In this configuration, data transfer is limited to one direction because one device must be manually set to "TALK ONLY" and the other device must be manually set to "LISTEN ONLY". The HP 3577A can be set to talk only; it cannot be set to listen only.

The full flexibility and power of the HP-IB is realized when a controller is added to the system. An HP-IB controller participates in the measurement by being programmed to:

- schedule measurement tasks
- set up instruments
- monitor the measurement
- interpret and operate upon the results

### HP-IB SPECIFICATION SUMMARY

**Number of Interconnected Devices:**
A maximum of fifteen on one bus.

**Interconnection Path/Maximum Cable Length:**
Total cable length equal to two meters times number of devices or twenty meters, whichever is less, with a maximum of three meters seperating any two devices.

**Message Transfer Scheme:**
Byte-serial, eight bit-parallel asynchronous data transfer using a three wire handshake.

**Data Rate:**
One megabyte per second (maximum) over limited distances, actual data rate depends upon the capability of the slowest device involved in the transmission.

**Address Capability:**
Primary addresses: 31 talk, 31 listen. A maximum of one talker and fourteen listeners at one time.

**Multiple controller capability:**
In systems with more than one controller, only one can be active at a time. The active controller can pass control to another controller, but only the system controller can assume unconditional control. Only one system controller is allowed. The system controller is hard-wired to assume bus control after a power failure.

### BUS STRUCTURE

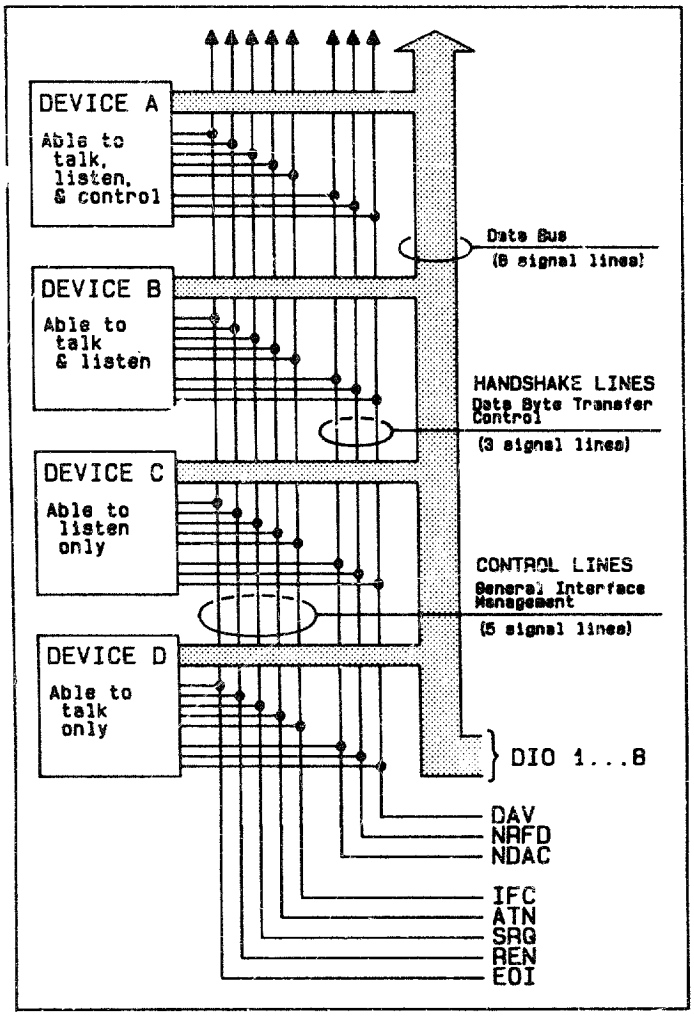


Figure 3•1

**Management (CONTROL) Lines.**

**ATN**-Attention. This line is used by the active controller to define how information on the data lines (DIO 1...8) will be interpreted by the other devices on the bus. When ATN is low (true) the HP-IB is in Command Mode and the data lines carry bus commands. When ATN is false the HP-IB is in Data Mode and the data lines carry device dependent commands. In the command mode the controller is active and all other devices are waiting for instructions.

**SRQ**-Service Request. This line is set low (true) by any instrument requesting service.

**REN**-Remote Enable. The system controller sets REN low and then addresses the devices to listen before they will operate under remote control.

**IFC**-Interface Clear. Only the system controller can activate this line. When IFC is set (true) all talkers, listeners, and active controllers go to their inactive states.

**EOI**-End Or Identify. This line is used to indicate the end of a multiple byte transfer sequence or, in conjunction with ATN, to execute a parallel polling sequence.

## THE HP 3577A AND THE HP-IB

### HP 3577A HP-IB CAPABILITY

As defined by IEEE Standard 488-1978, the HP 3577A has these characteristics:

| | |
|---|---|
| **SH1** | complete Source Handshake capability |
| **AH1** | complete Acceptor Handshake capability |
| **T5** | Basic Talker; serial poll; unaddress if MLA; Talk-Only |
| **TE0** | no Extended Talker capability |
| **L4** | Basic Listener; unaddress if MTA; no Listen Only |
| **LE0** | no Extended Listener capability |
| **SR1** | complete Service Request capability |
| **RL1** | complete Remote/Local capability |
| **PP1** | Parallel Poll; remote configuration capability |
| **DC1** | complete Device Clear capability |
| **DT1** | complete Device Trigger capability |
| **C0** | no Controller capability |
| **E1** | drivers are open-collector |

This list of capabilities is printed on the rear panel near the HP-IB connector as follows:

**SH1 AH1 T5 TE0 L4 LE0 SR1 RL1 PP1 DC1 DT1 C0 E1**

### DATA FORMAT VS TRANSFER RATE

The HP 3577A offers three data formats for transferring certain types of data on the bus. Data format may be selected for the following I/O: trace dumps, register dumps and loads, marker data dumps, and marker position dumps. A trace is made up of real numbers and is defined by the INPUT key. Trace one or trace two may be dumped (output) in any of the three data formats. A register is made up of real and imaginary numbers. There will be twice as many numbers in a register I/O as there are for a trace dump with the same sweep resolution. Registers R, A, B, D1, D2, D3, or D4 may be dumped or loaded in any of the three data formats.

As described in the previous paragraph, not all HP 3577A dump and load commands may be done in more than one type data format. It is recommended that the ASCII format (FM1) be active unless one of these

transfers is required. Each data format has a different data transfer rate. The figures listed for transfer rate are average times, shown here for comparison. They were taken such that the controller was not a limiting factor.

**FM1** — Data format one is the default data format. When FM1 is active the HP 3577A transfers data using the ASCII format. Using this format the HP 3577A can dump a trace of 401 points in approximately 1.6 seconds. This format has the slowest data transfer rate of the three.

**FM2** — Data format two is the 64 bit floating point binary specified in the IEEE draft standard P754. The data rate for this format is faster than that of FM1 but slower than that of FM3. FM2 has the advantage of being the same format used by HP Series 200 (98__6) computers. Using this format the HP 3577A can dump a trace of 401 points in approximately 0.16 seconds.

**FM3** — Data format three is the 32 bit floating point binary used by the HP 3577A fast processor. FM3 has the fastest data transfer rate of the three data formats. Using FM3 the HP 3577A can dump a trace of 401 points inapproximately 0.04 seconds. When this format is active the HP3577A does not have to convert data formats and requires half as many transfers per data value as FM2. This format may be used for data that is not processed outside the HP 3577A.

## DIRECT PLOTTING

The HP 3577A can provide a hardcopy of the CRT screen without using a computer. It does this by directly controlling a digital plotter connected to the HP 3577A's HP-IB port located on the rear panel. The plotter (such as the HP 7470A) must accept Hewlett-Packard Graphic Language (HP-GL) commands. The HP 3577A must be configured in a Talk Only mode and the plotter must be configured as a Listen Only device. Refer to SPECIAL FUNCTIONS in the REFERENCE section.

## HP-IB VERIFICATION

Refer to the computer operating manual and find the section describing the HP-IB REMOTE Message. When this message is sent to the HP 3577A, the REMOTE annunciator LED on the front panel will light. If this does not occur, recheck the cabling, the HP 3577A address, and the syntax of the computer statement. Here are some examples of the REMOTE message as implemented by HP computers:

| | |
|---|---|
| REMOTE 711 | HP Series 80, Series 200; BASIC |
| rem 711 | HP 9825, Series 200; HPL |

## HP-IB DIAGNOSTIC MODE

The Bus Diagnostic Modes (BD1 & BD2) may be used to find HP-IB program problems. When active, these modes cause the HP 3577A to display menus as though being operated from the front panel. In BD2 the programming code received by the HP 3577A over the bus will be left-shifted through the screen error block in a "ticker tape" fashion.

**BD0** is the default mode. Bus diagnostics are off; no menus appear and bus codes are not displayed. Sweep dot does not appear unless sweep time is 1 second or more. This is the fastest programming mode.

**BD1** displays all menus and updates the front panel as though the HP 3577A were being operated from the front panel. The HP-IB programming codes appear only when an error is encountered. When this occurs, processing of all bus commands will halt for three seconds to allow the programmer to read the code that caused the error before processing continues and secondary errors are generated.

**BD2** is the same as BD1 except that the HP 3577A processes bus code at a reduced rate (one command per second) and all programming code received on the bus is left-shifted through the screen error block.

***NOTE***

*The HP 3577A will interpret the carriage return (CR) as ←, linefeed as ↓, and EOI as ^. Binary loads (including the #I) and ASCII register loads are not shown on the screen.*

***NOTE***

*The HP 3577A's HP-IB buffer will hold a maximum of 100 characters. If the controller tries to send more than 100, it will have to wait for the HP 3577A to process some of the code before sending more. If the computer is waiting as just described, and the HP3577A processes a dump command, it will wait to be addressed to talk. It is possible that both controller and HP 3577A could end up waiting for each other, halting all bus activity. Care should be taken in programming such that this does not occur.*

# THE HP 3577A's HP-IB ADDRESS

## TALK/LISTEN ADDRESSES

Every HP-IB device has at least one address unless it's totally transparent or a Talk-Only or Listen-Only device. Device addresses are used by the active controller in the COMMAND MODE (ATN true) to specify who talks (via a Talk Address) and who listens (via Listen Addresses). There may be only one talker addressed (by the controller) to talk at any time. Talk and Listen addresses are the same on the HP 3577A.

## VIEWING THE HP 3577A's HP-IB ADDRESS

The HP 3577A's HP-IB address is set to eleven (11) at the factory. To display the address of the HP 3577A:

1 Press the "SPCL FCTN" hardkey
2 Press the "HP-IB ADDRESS" softkey (top item in the display menu). The address will appear in the entry block. See Figure 3•2.

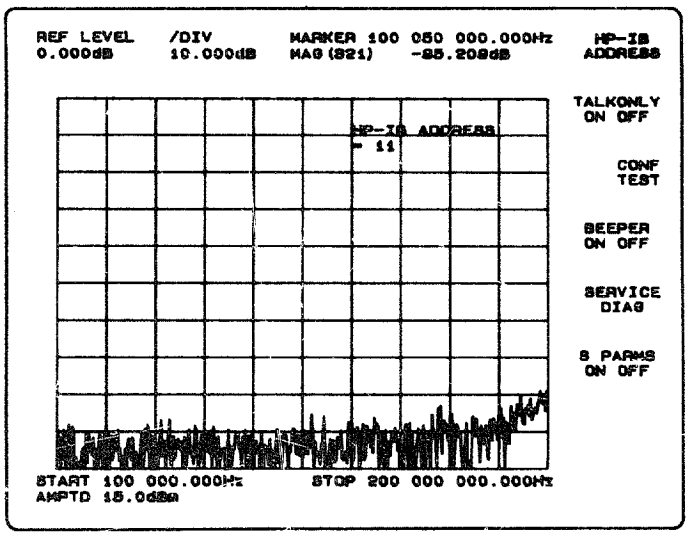


Figure 3•2

## SETTING THE HP 3577A's HP-IB ADDRESS

Every device on the HP-IB must have a unique address. The HP 3577A address can be set to any address from zero (0) to thirty (30), inclusive. When choosing an address, remember that the controller also has an address (typically 21). To change the HP-IB address:

1 Press the "SPCL FCTN" hardkey
2 Press the "HP-IB ADDRESS" softkey to display the current HP-IB address.
3 Press the appropriate keys in the numeric keypad for the new address. Note the change in the entry block.
4 Press the "ENTER" softkey.

The HP 3577A's HP-IB address is stored in a non-volatile memory; there are no address switches. If the contents of this memory are destroyed, the HP-IB address defaults to eleven (11). Under normal circumstances, the non-volatile memory should retain its data for up to five years. This time is not specified and no warranty is stated or implied.

Use the following table if you are using a controller that requires the talk and listen addresses:

**HP-IB ADDRESSES**

| DEVICE ADDRESSES | TALK | LISTEN |
|---|---|---|
| 0 | @ | SPACE ‡ |
| 1 | A | ! |
| 2 | B | " |
| 3 | C | # |
| 4 | D | $ |
| 5 | E | % |
| 6 | F | & |
| 7 | G | ' |
| 8 | H | ( |
| 9 | I | ) |
| 10 | J | * |
| 11 ‡‡ | K | + |
| 12 | L | , |
| 13 | M | - |
| 14 | N | . |
| 15 | O | / |
| 16 | P | 0 |
| 17 | Q | 1 |
| 18 | R | 2 |
| 19 | S | 3 |
| 20 | T | 4 |
| 21 ‡‡‡ | U | 5 |
| 22 | V | 6 |
| 23 | W | 7 |
| 24 | X | 8 |
| 25 | Y | 9 |
| 26 | Z | : |
| 27 | [ | ; |
| 28 | ½ | < |
| 29 | ] | = |
| 30 | ^ | > |

‡ (ASCII character)
‡‡ (HP 3577A factory setting)
‡‡‡ (usually the controller)

The Talk and Listen addresses are ASCII characters. When a device receives one of these characters while ATN is true, it will become addressed. The ASCII character ? will unaddress all devices. The Device address (set from the HP 3577A front panel) is used by most newer HP-IB computers which automatically send the Talk and Listen address characters.

## BUS MESSAGES

The interface system operates in either of two modes: COMMAND MODE (ATN true) or DATA MODE (ATN false). If an HP computer is used, the bus management lines will be configured automatically and all necessary command strings will be issued.

## BUS COMMANDS

In the Command Mode special codes known as "bus commands" may be placed on the HP-IB. These commands have the same meaning in all HP-IB systems. Each device is designed to respond to those commands that have a useful meaning to the device and ignore other bus commands. The HP 3577A will respond to the following commands as described. The three-letter command abbreviations refer to IEEE 488 nomenclature.

### ABORT I/O

Abort Input/Output (IFC; interface clear) is an unconditional assumption of control of the bus by the system controller. All bus activity halts and the HP 3577A becomes unaddressed. This does **not** clear the HP 3577A HP-IB command buffer.

Example for HP Series 200 computers, in BASIC:

ABORT 7

### CLEAR LOCKOUT/SET LOCAL

This command removes all devices from the local lockout mode and returns them to local (front panel) control. The only difference between this bus message and the LOCAL message is how it is addressed.

Example for HP Series 200 computers, in BASIC:

LOCAL 7 (Clears LOCAL LOCKOUT and enables front panel keys)

### DEVICE CLEAR

The CLEAR command may be addressed (SDC; selected device clear) or unaddressed (DCL; device clear). When this command is received by the HP 3577A it will clear the HP-IB command buffer, reset the SRQ line (if pulled low by the HP3577A), and abort any data input or output. This interrupts bus activity and gains control of the analyzer, no matter what it may be doing. It does *not* preset the 3577A. It is good practice to begin programs with this command. See the examples that follow.

Examples for HP Series 200 computers, in BASIC:

CLEAR 7 (UDC; clears all devices on computer port seven)

CLEAR 711 (SDC; clears device addressed eleven on port seven)

### LOCAL

LOCAL (GTL; go to local) returns control of the listening device to the local (front panel) state. The REMOTE LED on the front panel extinguishes if the instrument was in remote prior to the local command. The HP-IB buffer is not cleared on the HP 3577A. Also, any dump or load in progress will **not** be aborted.

Example for HP Series 200 computers, in BASIC:

LOCAL 711 (Local lockout still active if returned to REMOTE)

> ***NOTE***
>
> *This command is **not** identical to pressing the LCL front panel key on the HP 3577A. Pressing the key will clear the HP-IB buffer of all pending commands.*

### LOCAL LOCKOUT

LOCAL LOCKOUT (LLO) disables the LOCAL key of all devices on the bus to secure the system from operator interference when in remote control. After this command is issued the only way to return to front panel operation from remote control is with a LOCAL command from the controller. Local lockout will not change the local/remote status of the instrument. Local lockout is disabled by a universal (unaddressed) LOCAL command on the bus.

Example for HP Series 200 computers, in BASIC:

LOCAL LOCKOUT 7

### PARALLEL POLL

PARALLEL POLL is a command issued by the controller in response to the SRQ (service request) management line being pulled low (true). Since any instrument could have pulled SRQ the controller must poll them all to find which requested service. The parallel poll commands each device to send its Request Service bit (RQS; part of the Status Byte) on

one of the eight data lines. The Parallel Poll Configure (PPC) command determines data line and logical sense used.

Example for HP Series 200 computers, in BASIC:

Var=PPOLL(7)

## PARALLEL POLL CONFIGURE

The PARALLEL POLL CONFIGURE command (PPC) programs the logical sense and data line used by a specified device to respond to a parallel poll. The configure word is coded as shown in Figure 3•3. The three least significant bits determine the data bus line for the response. The fourth bit determines the logical sense of the response.

| Decimal | Binary |
|---|---|
| 2 | 0 010 |
| 9 | 1 001 |

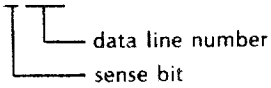


**Figure 3•3**

Example for HP Series 200 computers, in BASIC:

PPOLL CONFIGURE 711;2 (put RQS bit on DIO line 2 Sense: 0 = RQS true)
PPOLL CONFIGURE 711;9 (put RQS bit on DIO line 1 Sense: 1 = RQS true)

## PASS CONTROL

Pass Control (TCT; take control) shifts system control from one controller to another. Since the HP 3577A has no controller capability, it cannot respond.

## REMOTE

REMOTE may be used to address the HP 3577A to listen. When this command is issued, the REMOTE front panel LED illuminates and the front panel is disabled except for the LCL key. If LOCAL LOCKOUT is active the LCL front panel key is also disabled.

Examples for HP Series 200 computers, in BASIC:

REMOTE 7 (switches all devices on port seven from local to remote)
REMOTE 711 (switches device addressed eleven from local to remote)

## SERIAL POLL

SERIAL POLL is a command to dump the status byte on the bus. Encoded in the eight bits of the status byte are the states of several HP 3577A operating conditions. See "THE STATUS BYTE."

Examples for HP Series 200 computers, in BASIC:

Var=SPOLL(711)
IF Var THEN ... (Checks for the zero state)

Another example:

IF BINAND(SPOLL(711),16) THEN ... (Checks state of bit five)

## SERVICE REQUEST

The Service Request (SRQ) line is one of the five bus management lines that go to every device on the bus, along with eight data lines and three handshake lines. It may be used by one or more devices to indicate the need for attention from the controller and can act as an interruption of the current sequence of events. Typically, SRQ indicates information is ready to transmit and/or an error condition exists. When the HP 3577A issues an SRQ it also sets bit #6 of the Status Byte. Bit 6 is the RQS (Require Service) bit, sometimes referred to as the "status bit" in connection with a poll.

If properly configured, the controller will stop and poll when it senses the SRQ. A serial poll returns each device's status byte, one device at a time. A parallel poll returns all (up to eight) device's status bits simultaneously; each instrument responding on one of the eight data lines. When the HP 3577A is polled it will clear the RQS bit and the SRQ line.

Any of the bits in the Status Byte may initiate an SRQ. The Status Byte may be masked such the user may select which bits cause the HP 3577A to set the SRQ line (see the Status Byte).

## TRIGGER

The HP 3577A responds to the TRIGGER bus command (GET; group execute trigger) as it would to any other external trigger; by beginning a sweep or, in the case of CW SWEEP TYPE or MANUAL SWEEP MODE, taking a measurement. TRIGGER may be sent to a selected device or all devices addressed to listen on the HP-IB. The HP 3577A must be addressed to listen and in the "WAIT TRIG" state before the trigger message is sent. If the last statement left the HP 3577A addressed to

listen and settling is complete, it's ready for a trigger. If not, or if several devices are to be triggered simultaneously, a SEND command may be used to address the listeners. See Bit B4 of The Status Byte.

Examples for HP Series 200 computers, in BASIC:

```
SEND 7;UNL MTA LISTEN 11,17,22
TRIGGER 7
```

UNL = UNLISTEN; unaddresses all listeners
MTA = MY TALK ADDRESS; the controller addresses itself to talk
LISTEN 11,17,22; addresses devices whose addresses are 11,17, and 22 to listen

Another example:

```
ASSIGN @Listeners TO 702,707,711
TRIGGER @Listeners
```

## DEVICE DEPENDENT COMMANDS

In the Data Mode special codes known as "device dependent commands" may be placed on the HP-IB. These commands have meaning for a specific instrument. They can configure the instrument, tell it to take a measurement, dump or load data, or define error reporting conditions, and are meaningless for other instruments.

Device dependent commands and front panel key functions have a one-to-one relationship for all but the HP-IB-only commands. For example, DF5 is the remote equivalent of pressing the PHASE softkey in local. Exceptions to this rule are:

Front panel functions not allowed in remote operation:

HP-IB Address Viewing and Selection

Remote functions not allowed from the front panel:

Data Dumps
Load Data
User defined graphics
User defined annotation
User defined menus
Bus code diagnostics
Control of Settling Time value

Device dependent commands may be sent to the HP 3577A by using the BASIC command "OUTPUT" as shown in the following examples for HP Series 200 computers:

```
OUTPUT 711;"FSW;"          (Full sweep)
OUTPUT 711;"DF5;"          (Display Function 5 is PHASE)
OUTPUT 711;"FRA 2 MHZ;"    (Start Frequency = 2 MHz)
OUTPUT 711;"DRA;"          (Dump Register A)
```

```
OUTPUT 711;"DF7;FRA 1 MHZ;FRB 10 MHZ;SAM 0 DBM;TKM;DRA;"
"Display Function = Log Mag
Start Freq = 1 MHz
Stop Freq = 10 MHz
Source Amplitude = 0 dBm
Take measurement
Dump Register A
```

A delimiter should be used after all commands when there are multiple commands per line. Delimiters are semicolons (;), linefeeds (LF), and <EOI> (pulling the EOI bus management line). Separators, such as spaces and commas, may be used instead of delimiters, but using semicolons or LF characters between commands enables the HP 3577A to do a better job of error reporting. A delimiter is required to terminate a numeric entry. The HP 3577A accepts upper or lower case letters over the bus.

### DEFINITIONS

A SELECT COMMAND is a two-letter prefix followed by a qualifier digit that selects a particular state of that function.
Example: the HP-IB code for PHASE (display function 5) is DF5.

IMMEDIATE EXECUTION COMMANDS execute a given operation when issued. They require no other data.
Example: Instrument Preset is IPR.

DATA ENTRY COMMAND is a three part command that enters a value for one of the parameters. The three parts are: prefix (the parameter to be changed by the data entry), data (numbers), and suffix (units for the new value). Source amplitude (SAM) is an example of a data entry command.
Example: OUTPUT 711;"SAM 0 DBM;"

HP 3577A Program Codes have been categorized into five distinct groups to help explain them. These are:

**SOURCE**
**RECEIVER**
**DISPLAY FORMAT**
**INSTRUMENT STATE**
**HP-IB ONLY**

## DISPLAY FORMAT

| Function | HP-IB code |
|---|---|
| **TRACE 1** | **TR1** |
| **TRACE 2** | **TR2** |
| **DISPLAY FUNCTION** | **DSF** * |
| Log Magnitude | **DF7** |
| Linear Magnitude | **DF6** |
| Phase | **DF5** |
| Polar | **DF4** |
| Real | **DF3** |
| Imaginary | **DF2** |
| Delay | **DF1** |
| Trace Off | **DF0** |
| Delay Aperture menu | **DAP** * |
| Aperture .5% of span | **AP1** |
| Aperture 1% of span | **AP2** |
| Aperture 2% of span | **AP3** |
| Aperture 4% of span | **AP4** |
| Aperture 8% of span | **AP5** |
| Aperture 16% of span | **AP6** |
| Return | **RET** * |
| **INPUT** | **INP** * |
| Input = R | **INR** |
| Input = A | **INA** |
| Input = B | **INB** |
| Input = A/R | **IAR** |
| Input = B/R | **IBR** |
| Input = D1 | **ID1** |
| Input = D2 | **ID2** |
| Input = D3 | **ID3** |
| Input = D4 | **ID4** |
| Return | **RET** * |
| User Defined Input | **UDI** |
| Input = $S_{11}$ | **I11** |
| Input = $S_{21}$ | **I21** |
| Input = $S_{12}$ | **I12** |
| Input = $S_{22}$ | **I22** |
| Copy Input | **CPI** |
| Test Set Forward | **TSF** |
| Test Set Reverse | **TSR** |
| **SCALE** | **SCL** * |
| Autoscale | **ASL** |
| Reference Level (entry) | **REF** |
| Scale /DIV (entry) | **DIV** |
| Reference Position (entry) | **RPS** |
| Reference Line Off | **RL0** |
| Reference Line On | **RL1** |
| Copy Scale | **CPS** |
| Phase Slope (entry) | **PSL** |
| Phase Slope Off | **PS0** |
| Phase Slope On | **PS1** |
| Polar Full Scale (entry) | **PFS** |
| Polar Phase Ref (entry) | **PPR** |
| Smith Chart Off | **GT0** |
| Smith Chart On | **GT1** |
| **MARKER** | **MKR** * |
| Marker Position (entry) | **MKP** |
| Marker Off | **MR0** |
| Marker On | **MR1** |
| Zero Marker | **ZMK** |
| Marker Offset Off | **MO0** |
| Marker Offset On | **MO1** |
| Marker Offset (entry) | **MKO** |
| Marker Offset Freq (entry) | **MOF** |
| Marker Offset Amp (entry) | **MOA** |
| Marker Coupling Off | **CO0** |
| Marker Coupling On | **CO1** |
| Polar Mag Offset (entry) | **PMO** |
| Polar Phase Offset (entry) | **PPO** |
| Polar Real Offset (entry) | **PRO** |
| Polar Imag Offset (entry) | **PIO** |
| Polar Marker Units (Re/Im) | **MRI** |
| Polar Marker Units (Mg/Ph) | **MMP** |
| **MARKER →** | **MKG** * |
| MKR→Reference Level | **MTR** |
| MKR→Start Frequency | **MTA** |
| MKR→Stop Frequency | **MTB** |
| MKR→Center Frequency | **MTC** |
| MKR Offset→Span | **MOS** |
| MKR→Max | **MTX** |
| MKR→Min | **MTN** |
| MARKER SEARCH menu | **MSM** * |
| MKR Target Value (entry) | **MTV** |
| MKR → Right for Target | **MRT** |
| MKR → Left for Target | **MLT** |
| Return | **RET** * |
| MKR → Full Scale | **MTP** |
| MKR → Polar Phase Ref | **MPF** |
| **STORE DATA** | **STO** * |
| Store in register D1 | **SD1** |
| Store in register D2 | **SD2** |
| Store in register D3 | **SD3** |
| Store in register D4 | **SD4** |
| Store and Display | **STD** |
| User defined store | **UDS** |
| Store to D1 | **TD1** |
| Store to D2 | **TD2** |
| Store to D3 | **TD3** |
| Store to D4 | **TD4** |
| **MEASUREMENT CALIBRATION** | **CAL** * |
| Normalize | **NRM** |
| Normalize (Short) | **NRS** |
| Calibrate, Partial | **CPR** |
| Calibrate, Full | **CFL** |
| Continue Calibration | **CGO** |
| **DEFINE MATH** | **DFN** * |
| Constant K1, Real | **KR1** |
| Constant K1, Imaginary | **KI1** |
| Constant K2, Real | **KR2** |
| Constant K2, Imaginary | **KI2** |
| Constant K3, Real | **KR3** |
| Constant K3, Imaginary | **KI3** |
| Define Function | **DFC** * |
| Function F1 | **UF1** |
| Function F2 | **UF2** |
| Function F3 | **UF3** |
| Function F4 | **UF4** |
| Function F5 | **UF5** |
| Math term for input R | **R** |
| Math term for input A | **A** |
| Math term for input B | **B** |
| Math term for storage reg | **D** |

* Use not required. The only function of this code is to display a menu (if bus diagnostics are on).

| | |
|---|---|
| Math term for constant | **K** |
| Math term for function | **F** |
| Math bracket | **(** |
| Math function plus | **+** |
| Math function minus | **−** |
| Math function multiply | ***** |
| Math function divide | **/** |
| Math bracket | **)** |
| Return | **RET** * |

## DATA ENTRY SECTION COMMANDS

| | |
|---|---|
| Increment (up arrow) | **IUP** |
| Decrement (down arrow) | **IDN** |
| Continuous Entry (knob) Off | **CE0** |
| Continuous Entry (knob) On | **CE1** |
| Entry Off | **HLD** |

## DISPLAY FORMAT SUFFIX UNITS

| | |
|---|---|
| dBm | **DBM** |
| dBV (rms) | **DBV** |
| dB relative | **DBR** |
| Volt (rms) | **V** |
| milli-Volt (rms) | **MV** |
| micro-Volt (rms) | **UV** |
| nano-Volt (rms) | **NV** |
| degrees | **DEG** |
| degrees/span | **DSP** |
| radians | **RAD** |
| radians/span | **RSP** |
| seconds | **SEC** |
| milliseconds | **MSC** |
| microseconds | **USC** |
| nanoseconds | **NSC** |
| percent | **%** |
| degrees/span | **DSP** |
| radians/span | **RAP** |
| MHz | **MHZ** |
| kHz | **KHZ** |
| Hz | **HZ** |
| exponent | **E** |

**USER DEFINED INPUT (UDI)** uses the same terms and math functions as **UDF** (user defined function).

Example:

```
10 OUTPUT 711;"UDI (B/R)(K1-B/R)"
```

**COPY INPUT (CPI)** will copy the INPUT definition of the inactive trace into that of the of the active trace as follows:

1. Trace one active
2. Output CPI
3. INPUT definition of trace one is now the same as trace two

**TEST SET FORWARD AND REVERSE (TSF & TSR)** are used to configure a HP 35677A/B S-Parameter Test Set connected to the HP 3577A. The INPUT definition should be user defined (to avoid an error message). If you wish to control the test set while using one of the standard input definitions, enter it under UDI.

Example:

```
10 OUTPUT 711;"UDI R;TSR;"
```

**COPY SCALE (CPS)** will copy reference level and /DIV parameters of the inactive trace into those of the active trace *if* the DISPLAY FUNCTION units of both traces are compatible.

**MARKER POSITION (MKP)** is a prefix for a data entry. The data will be a bin number. The number of bins in a sweep depends on the sweep resolution (in a frequency sweep) or number of steps (in an amplitude sweep). The default numbers of bins in a sweep are 401 (0 through 400) for frequency sweeps and 101 (0 through 100) for amplitude sweeps. MKP is the prefix used to position the marker at a specific bin. This bin number may be calculated using the following formula:

$$\text{Bin number} = \frac{f_{bin} - f_{start}}{\text{span}} \times (\text{points per sweep})$$

Where: $f_{bin}$ is the frequency of the new marker position
$f_{start}$ is the start frequency
span is the frequency span
point_ per sweep is the sweep resolution

This number *should* be an integer $\leq$ 401. If the result is not an integer you probably picked a frequency for $f_{bin}$ that is not one of the sampled frequencies for the sweep. The HP 3577A will round any fraction received with MKP. If the number is > 401 a "NUMBER OUT OF RANGE" error message will be generated.

**USER DEFINED STORE (UDS)** and **TD1-TD4** are used together to define and store data (traces).

Example:

```
10 OUTPUT 711;"UDS D3-A/R*D4 TD3;"
```

Note that a register name may appear as part of the definition *and* as the destination register. A destination register *must* appear after the definition.

**USER DEFINED FUNCTIONS 1 THROUGH 5 (UF1-UF5)** are used to enter definitions as shown in the following:

Example:

```
10 OUTPUT 711;"UF3 D4*A/R+D3;"
20 OUTPUT 711;"UF4 (A/R-D2)/F3,"
```

Note that functions may be defined in terms of *lower* numbered functions. Thus F1 cannot be a function of another user defined function but F5 could be a function of any of the first four.

**CONTINUOUS ENTRY OFF/ON (CE0 & CE1)** corresponds to the MARKER and ENTRY modes of the knob where CE0 = MARKER and CE1 = ENTRY.

* Use not required. The only function of this code is to display a menu (if bus diagnostics are on).

## SOURCE

| Function | HP-IB code |
|---|---|
| **SWEEP TYPE** | **STY** * |
| Linear Sweep | **ST1** |
| Alternate Sweep | **ST2** |
| Log Sweep | **ST3** |
| Amplitude Sweep | **ST4** |
| CW | **ST5** |
| Sweep Direction Up | **SUP** |
| Sweep Direction Down | **SDN** |
| **SWEEP MODE** | **SMD** * |
| Continuous | **SM1** |
| Single Sweep | **SM2** |
| Manual Sweep | **SM3** |
| Manual Frequency (entry) | **MFR** |
| Manual Amplitude (entry) | **MAM** |
| Marker → Manual | **MTM** |
| **SWEEP TIME** | **STM** * |
| Sweep Time (entry) | **SWT** |
| Step Time (entry) | **SMT** |
| Sample Time (entry) | **MSR** |
| **FREQUENCY** | **FRQ** * |
| Source Frequency (entry) | **SFR** |
| Start Frequency (entry) | **FRA** |
| Stop Frequency (entry) | **FRB** |
| Center Frequency (entry) | **FRC** |
| Frequency Span (entry) | **FRS** |
| FRC Step size (entry) | **CFS** |
| Sweep Resolution menu | **SRL** * |
| Freq Swp Res 51 pts/span | **RS1** |
| Freq Swp Res 101 pts/span | **RS2** |
| Freq Swp Res 201 pts/span | **RS3** |
| Freq Swp Res 401 pts/span | **RS4** |
| Return | **RET** * |
| Full Sweep | **FSW** |
| Freq Step Size (entry) | **FST** |
| **AMPLITUDE** | **AMP** * |
| Source Amplitude (entry) | **SAM** |
| Amp Step Size (entry) | **AST** |
| Clear Trip, Source | **CTS** |
| Start Amplitude (entry) | **AMA** |
| Stop Amplitude (entry) | **AMB** |
| Steps/Sweep menu | **NST** * |
| Number of steps = 6 | **NS1** |
| Number of steps = 11 | **NS2** |
| Number of steps = 21 | **NS3** |
| Number of steps = 51 | **NS4** |
| Number of steps = 101 | **NS5** |
| Number of steps = 201 | **NS6** |
| Number of steps = 401 | **NS7** |
| Return | **RET** * |
| Full Sweep | **FSW** |
| **TRIGGER MODE** | **TRM** * |
| Free Run | **TG1** |
| Line Trigger | **TG2** |
| External Trigger | **TG3** |
| Immediate | **TG4** |
| **SWEEP TRIGGER** } TRG/ | **TRG** |
| **SWEEP RESET** } RESET | **RST** |

### SOURCE SUFFIX UNITS

| | |
|---|---|
| dBm | **DBM** |
| dBV (rms) | **DBV** |
| Volt (rms) | **V** |
| milli-Volt (rms) | **MV** |
| micro-Volt (rms) | **UV** |
| nano-Volt (rms) | **NV** |
| seconds | **SEC** |
| milliseconds | **MSC** |
| MHz | **MHZ** |
| kHz | **KHZ** |
| Hz | **HZ** |
| exponent | **E** |

**STEP TIME (SMT)** is a data entry prefix for sample time used for amplitude sweeps. The default value for this parameter is 0.05 seconds per step.

Example:

```
10 OUTPUT 711;"ST4;SMT .1 SEC;" ! ST4 is amptd sweep
```

**SAMPLE TIME (MSR)** is a data entry prefix for sample time for the manual sweep mode and CW sweep type. The default value for this parameter is 0.05 seconds per sample.

Example:

```
10 OUTPUT 711;"SM3;MSR .1 SEC;" ! SM3 = Manual sweep mode
```

**FREQUENCY STEP SIZE (FST)** is a data entry prefix used only when the source is operated at a single frequencies as with CW or amplitude sweep types or the manual frequency sweep mode.

**TRIGGER AND RESET (TRG & RST)** Where the front panel has one key, labeled TRIG/RESET, functioning as both trigger (for single sweeps) and reset, the HP-IB has separate commands for each function. Sweep control is done the same in remote as local. RST resets the sweep in all sweep modes, and TRG may be used to trigger single sweeps. RST also initiates settling even if more commands are waiting in the HP-IB buffer. Other commands do not initiate settling until the command buffer is empty. RST is useful for decreasing the time required to prepare for a sweep by overlapping settling and other HP-IB operations.



* Use not required. The only function of this code is to display a menu (if bus diagnostics are on).

Example:

```
10    !
20    ! 'RST','TRG' Use of Reset and Trigger commands
30    !
40    ! This example program will take measurements at 1, 2, 3, 4, and
50    ! 5 MHz and dump the data to the computer.
60    !
70    ! First, set up the instrument state and take a measurement
80    !
90      OUTPUT 711;"IPR;ST5;SM2;SFR 1 MHZ;TKM;"  ! Set up 1st freq
100       FOR I=2 TO 5
110         LOOP
120           EXIT IF BINAND(SPOLL(711),4)       ! 4=B2 of Status Byte
130         END LOOP                             ! Loop until Meas is
140                                              ! Complete
150   !
160     OUTPUT 711;"SFR;";I;"MHZ;RST;DM1;TRG;"   ! Start settling for
170     ENTER 711;Mkr_Mag                        ! next meas and dump
180                                              ! data for previous
190                                              ! meas. This allows
200                                              ! settling to occur
210                                              ! during the data dump
220   !
230     PRINT "MARKER MAGNITUDE AT";I-1;"MHz =";Mkr_Mag;"dB"
240   !
250       NEXT I                                 ! When this FOR/NEXT
260                                              ! loop is done 5 MHz
270                                              ! has been set up but
280                                              ! no data dumped.
290         LOOP
300           EXIT IF BINAND(SPOLL(711),4)       ! Wait for Meas
310         END LOOP                             ! Complete, again
320     OUTPUT 711;"DM1;"                        ! Dump 5 MHz data
330     ENTER 711;Mkr_Mag
340     PRINT "MARKER MAGNITUDE AT";I-1,"MHz =";Mkr_Mag;"dB"
350     END
```

## RECEIVER

| Function | HP-IB code |
|---|---|
| **RESOLUTION BW** | **RBW** * |
| Resolution BW 1 Hz | **BW1** |
| Resolution BW 10 Hz | **BW2** |
| Resolution BW 100 Hz | **BW3** |
| Resolution BW 1 kHz | **BW4** |
| Auto Bandwidth Off | **AU0** |
| Auto Bandwidth On | **AU1** |
| **AVERAGE** | **AVE** * |
| Averaging Off | **AV0** |
| N = 4 | **AV1** |
| N = 8 | **AV2** |
| N = 16 | **AV3** |
| N = 32 | **AV4** |
| N = 64 | **AV5** |
| N = 128 | **AV6** |
| N = 256 | **AV7** |
| **ATTENUATION** | **ATT** * |
| Attenuation R = 0 dB | **AR1** |
| Attenuation R = 20 dB | **AR2** |
| Attenuation A = 0 dB | **AA1** |
| Attenuation A = 20 dB | **AA2** |
| Attenuation B = 0 dB | **AB1** |
| Attenuation B = 20 dB | **AB2** |
| Impedance R = 50 Ω | **IR1** |
| Impedance R = 1 MΩ | **IR2** |
| Impedance A = 50 Ω | **IA1** |
| Impedance A = 1 MΩ | **IA2** |
| Impedance B = 50 Ω | **IB1** |
| Impedance B = 1 MΩ | **IB2** |
| Clear Trip, Receiver | **CTR** |
| **LENGTH** | **LEN** * |
| Length R (entry) | **LNR** |
| Length R Off | **LR0** |
| Length R On | **LR1** |
| Length A (entry) | **LNA** |
| Length A Off | **LA0** |
| Length A On | **LA1** |
| Length B (entry) | **LNB** |
| Length B Off | **LB0** |
| Length B On | **LB1** |
| Length Step Size (entry) | **LNS** |

### RECEIVER SUFFIX UNITS

| | |
|---|---|
| meters | **MET** |
| centimeters | **CM** |
| seconds | **SEC** |
| milliseconds | **MSC** |
| microseconds | **USC** |
| nanoseconds | **NSC** |
| exponent | **E** |

## INSTRUMENT STATE

| Function | HP-IB Code |
|---|---|
| **SPECIAL FUNCTIONS** | **SPC** * |
| Confid. (self) test menu | **SLF** * |
| Self test channel R | **STR** |
| Self test channel A | **STA** |
| Self test channel B | **STB** |
| Return | **RET** * |
| Beeper off | **BP0** |
| Beeper on | **BP1** |
| Service Diagnostics menu | **SDG** * |
| Source Leveling off | **SL0** |
| Source Leveling on | **SL1** |
| Settling Time off | **SE0** |
| Settling time on | **SE1** |
| Synthesizer Diag off | **SY0** |
| Synthesizer Diag on | **SY1** |
| Display Test Pattern | **DTP** |
| Trace Memory Test | **TMT** |
| Fast Processor Test | **FPT** |
| I/O port test | **PRT** |
| More Serv Diag menu | **MOR** * |
| Display Memory Test | **DST** |
| Software Revision message | **SRV** |
| Return | **RET** * |
| S-Parameters Off | **SP0** |
| S-Parameters On | **SP1** |
| **SAVE INSTRUMENT STATE** | **SAV** * |
| Save state in register 1 | **SV1** |
| Save state in register 2 | **SV2** |
| Save state in register 3 | **SV3** |
| Save state in register 4 | **SV4** |
| Save state in register 5 | **SV5** |
| **RECALL INSTRUMENT STATE** | **RCL** * |
| Recall old (last) state | **RLS** |
| Recall register 1 | **RC1** |
| Recall register 2 | **RC2** |
| Recall register 3 | **RC3** |
| Recall register 4 | **RC4** |
| Recall register 5 | **RC5** |
| **INSTRUMENT PRESET** | **IPR** |
| **PLOT MENU** | **PLM** * |
| Plot all | **PLA** |
| Plot trace 1 | **PL1** |
| Plot trace 2 | **PL2** |
| Plot graticule | **PLG** |
| Plot characters | **PLC** |
| Plot trace 1 marker | **PM1** |
| Plot trace 2 marker | **PM2** |
| Configure Plot menu | **CPT** * |
| Trace 1 linetype (entry) | **T1L** |
| Trace 2 linetype (entry) | **T2L** |
| Trace 1 pen number (entry) | **T1P** |
| Trace 2 pen number (entry) | **T2P** |
| Graticule pen no. (entry) | **PGP** |
| Pen speed fast (max) | **PNM** |
| Pen speed slow | **PNS** |
| Set plot config to default | **PLD** |
| Return | **RET** * |

* Use not required. The only function of this code is to display a menu (if bus diagnostics are on).

## PLOTTING VIA HP-IB

HP-IB PLOT commands are a special programming case. To control a plotter directly, the HP 3577A must become a talker. Only one talker is allowed on the bus at a time so the controller must be programmed to release the bus. The HP 3577A must be manually configured with TALK ONLY OFF, as with any remote control operation. The following examples execute a PLOT ALL command. They assume that the analyzer's address is eleven and the plotter's address is thirty.

Example for the HP Series 200 computers:

```
10  SEND 7; UNL MTA LISTEN 11 DATA "PLA" UNL MTA TALK 11
LISTEN 30 DATA
```

Example for the HP Series 80 computers:

```
10  SEND 7; UNL MTA LISTEN 11 DATA "PLA" UNL MTA TALK 11
LISTEN 30
20  RESUME 7
```

SEND 7 — selects the HP-IB interface at address seven
UNL — unlisten; unaddresses all listeners
MTA — my talk address; controller addresses itself to talk; this command will also unaddress all talkers
LISTEN 11 — addresses device at address eleven to listen
DATA "PLA" — outputs the characters in quotes on the HP-IB
UNL — unlisten
MTA — my talk address
TALK 11 — addresses device at address eleven to talk
LISTEN 30 — addresses device at address thirty to listen
DATA — releases the bus for the data transfer (Series 200)
RESUME 7 — releases the bus for the data transfer (Series 80)

If the HP 3577A is unaddressed as the talker by the bus controller during a plot, the plotting process can be resumed if the HP 3577A is readdressed to talk and was NOT addressed to listen (with a byte transmitted) in the interim. It is the responsibility of the bus controller to transmit its UNTALK command so that the handshake in progress is completed and data is not lost. Actions that will terminate a PLOT are: addressing the HP 3577A to LISTEN (and sending a data byte), sending a Universal Clear, sending a Selective Device Clear, or an invalid handshake.

If the plot is aborted via the HP-IB, the plotter pen is left in the carriage at its most recent position. If the plot is aborted from the front panel, the pen is returned to its stall and the carriage moved to the P1 position, allowing full view of the plot on plotters that roll the paper in and out for one axis of movement.

PEN SPEED. The bus code PNM (pen speed fast) allows the plotter to run at its maximum (default) velocity. This speed is dependent on the plotter used. The bus code PNS (pen speed slow) causes the plotter pen velocity to be ten centimeters per second.

## HP-IB ONLY COMMANDS

| Function | HP-IB code |
|---|---|
| Settling Time Entry | **STE** |
| Dump register A | **DRA** |
| Dump register B | **DRB** |
| Dump register R | **DRR** |
| Dump register D1 | **DD1** |
| Dump register D2 | **DD2** |
| Dump register D3 | **DD3** |
| Dump register D4 | **DD4** |
| Dump trace 1 | **DT1** |
| Dump trace 2 | **DT2** |
| Dump marker 1 | **DM1** |
| Dump marker 2 | **DM2** |
| Dump marker 1 position | **MP1** |
| Dump marker 2 position | **MP2** |
| Dump state (learn mode out) | **LMO** |
| Dump status | **DMS** |
| Dump average number | **DAN** |
| Dump key or knob | **DKY** |
| Dump characters | **DCH** |
| Dump Instrument ID | **ID?** |
| Load register A | **LRA** |
| Load register B | **LRB** |
| Load register R | **LRR** |
| Load register D1 | **LD1** |
| Load register D2 | **LD2** |
| Load register D3 | **LD3** |
| Load register D4 | **LD4** |
| Load state (learn mode in) | **LMI** |
| Graticule off | **GR0** |
| Graticule on | **GR1** |
| Characters off | **CH0** |
| Characters on | **CH1** |
| Annotation off | **AN0** |
| Annotation on | **AN1** |
| Annotation Clear | **ANC** |
| Menu off | **MN0** |
| Menu on | **MN1** |
| Menu clear | **MNC** |
| ASCII data format | **FM1** |
| 64 bit IEEE data format | **FM2** |
| 32 bit HP 3577A binary | **FM3** |
| Bus diagnostics mode off | **BD0** |
| Bus diagnostics on, fast | **BD1** |
| Bus diagnostics on, slow | **BD2** |
| Enter Menu (user defined) | **ENM** |
| Enter Annotation | **ENA** |
| Enter Graphics | **ENG** |
| Clear Keyboard Buffer | **CKB** |
| Take Measurement | **TKM** |
| Set SRQ Mask | **SQM** |
| Error Reporting mode 0 | **ER0** |
| Error Reporting mode 1 | **ER1** |
| Error Reporting mode 2 | **ER2** |
| Error Reporting mode 3 | **ER3** |
| Send SRQ | **SRQ** |

The following two example programs demonstrate methods used to recognize the end of a plot process. Either of two bits in the Status Byte are used to trigger SRQ; B0 (End Of Transfer) or B4 (Ready).

```
100   !
110   ! Controller responds to plot completion by polling the bus
120   ! CONTROL lines (SRQ=1024) pulled by the instrument's EOT
130   ! bit.
140   !
150     Adrs=711                          ! 3577A address
160     Plotter=705                       ! Plotter address
170     Done_bit=1                        ! End Of Transfer bit (B0) = 1
180   !
190     OUTPUT Adrs;"SQM ";Done_bit       ! Unmask EOT bit
200   !
210     REPEAT
220       X=SPOLL(Adrs)                   ! SPOLL to clear previous EOT bit
230     UNTIL NOT BINAND(X,Done_bit)
240   !
250   ! Next, start the plot.
260   !
270     SEND 7;UNL MTA LISTEN Adrs MOD 100 DATA "PLA" LISTEN Plotter MOD 100
TALK Adrs MOD 100 DATA
280   !
290     DISP "WAITING FOR PLOT COMPLETION"
300     LOOP
310       STATUS 7,7;X                    ! Read bus control and data lines
320       EXIT IF BINAND(X,1024)          ! Check for SRQ asserted
330     END LOOP
340   !
350     Plot_done:DISP "PLOT IS COMPLETE."
360     BEEP
370     X=SPOLL(Adrs)                     ! Clear SRQ
380     OUTPUT Adrs;"SQM 0"               ! Reset mask to default
390   !
400     END
```

---

```
100   !
110   ! Controller responds to plot completion using interrupts
120   ! and the instrument's 'Ready' bit
130   !
140     Adrs=711                          ! 3577A address
150     Plotter=705                       ! plotter address
160     Done_bit=16                       ! 'Ready'=16
170   !
180     OUTPUT Adrs;"SQM ";Done_bit       ! Unmask Ready bit
190   !
200     OUTPUT Adrs;"PLA"                 ! Get ready to plot. Plot won't start
210   !                                     until the 3577 is addressed to talk
220   !
230     REPEAT
240       X=SPOLL(Adrs)                   ! SPOLL to get rid of previous Ready
250     UNTIL NOT BINAND(X,Donebit)
260   !
```

```
270   ! Next, enable the SRQ interrupt and start the plot.
280   !
290     ENABLE INTR 7;2                          ! Allow Service Request to interrupt
300     ON INTR 7 GOTO Plot_done                 ! Turn interrupt 'ON'
310     SEND 7;UNL MTA LISTEN Plotter MOD 100 TALK Adrs MOD 100 DATA     ! Start
plotting
320   !
330   !
340     DISP "WAITING FOR PLOT COMPLETION"
350     LOOP
360   !
370   ! Wait indefinitely for plot completion
380   !
390     END LOOP
400   !
410     Plot_done:DISP "PLOT IS COMPLETE."
420     BEEP
430     X=SPOLL(Adrs)                            ! Clear the interrupt condition
440   !
450     OUTPUT Adrs;"SQM 0"                      ! Resets mask to default condition
460   !
470     END
```

**SETTLING TIME ENTRY (STE).** Settling time may be entered over the HP-IB. Each bandwidth has a settling time associated with it. When a new bandwidth is selected its associated settling time will be active. These new values for settling time are not saved with instrument state and will be cleared by a PRESET or turning off power. The default values for settling time are shown in the following table:

| | |
|---|---|
| Res BW = 1 kHz | 22 ms |
| Res BW = 100 Hz | 55 ms |
| Res BW = 10 Hz | 370 ms |
| Res BW = 1 Hz | 3.707 s |

To enter a new value for the settling time parameter, select the resolution bandwidth before entering the new settling time. Settling time values may range from one millisecond to 16.383 seconds. For zero settling time, turn settling time off (SE0). The current value of the settling time parameter will appear in the data entry block if bus diagnostics mode one is used as follows:

Example: OUTPUT 711;"BW3;BD1;STE 3 SEC;"

**DUMP/LOAD REGISTER.** The receiver input registers R, A, and B, and the storage registers D1, D2, D3, and D4 contain twice as many numbers as there are points in the active sweep resolution. Each point on the trace is derived from a register bin containing a complex number (represented by two real numbers). In the default sweep resolution of 401 points per sweep there will be 401 complex numbers. The HP 3577A will dump 401 real and 401 imaginary numbers in the form real (bin one), imaginary (bin one), real (bin two), imaginary (bin two), ... The same methods apply for the "number of steps" sweep resolution used in amplitude sweeps. Register I/O may use any of the three data formats FM1, FM2, or FM3. The example that follows shows how register data may be dumped to the computer/controller and loaded into the HP 3577A in each of the three data formats.

Example:

```
10    !
20    ! Dump and Load Registers using all 3 data transfer formats
30    !
40    REAL Real_array1(0:801),Real_array2(0:101)
50    INTEGER Integer_array(0:3,0:400)          ! array of 401x4 elements
60    ASSIGN @Na TO 711;FORMAT ON               ! Na = Network Analyzer
70    OUTPUT @Na;"IPR;SM2;TKM;"                 ! TKM = take measurement
```

```
75   !
80   ! ********************************************************************************
85   !
90   ! FM1 = the ASCII data format
100  ! Next, Dump Register R using FM1
110  !
120  OUTPUT @Na;"FM1;DRR;"                    ! DRR = Dump Register R
130  ENTER @Na;Real_array1(*)
140  !
150  ! Real_array1 now contains the real and imaginary parts of
160  ! 401 complex numbers. Next, load the data into storage
170  ! register D1.
180  !
190  OUTPUT @Na;"LD1;",Real_array1(*) ! LD1 = Load Register D1
200  !
210  ! Register D1 now contains the data held in Real_array1
220  !
230  OUTPUT @Na;"TR2;DF7;ID1;"                ! Display register D1
240  PAUSE
245  !
250  ! ********************************************************************************
255  !
260  ! FM2 = 64 bit floating point binary (HP Series 200
270  ! computer real number) data format. Next, dump register
280  ! A using FM2. Note the use of reduced sweep resolution.
290  !
300  OUTPUT @Na;"RS1;TKM;FM2;DRA;"            ! Changing sweep res
310                                           ! clears registers, so new
320                                           ! TKM is required
330  !
340  ! Enter the leading bytes (#I) into an unused string
350  !
360  ENTER @Na USING "#,2A";Junk$
370  !
380  ! Enter the register data in data format FM2:
390  !
400  ASSIGN @Na;FORMAT OFF                    ! FORMAT must be OFF to
410  ENTER @Na;Real_array2(*)                 ! use data format FM2
420  ASSIGN @Na;FORMAT ON
430  !
440  ! Real_array2 now contains the real and imaginary parts of
450  ! 51 complex numbers. Load this data into register D2:
460  !
470  OUTPUT @Na;"LD2;#I;";                    ! Last ";" prevents CR/LF
480  ASSIGN @Na;FORMAT OFF                    ! Binary data must be
490  OUTPUT @Na;Real_array2(*)                ! preceded by "#I"
500  ASSIGN @Na;FORMAT ON
510  !
520  ! Register D2 now contains the data from Real_array2
530  !
540  OUTPUT @Na;"TR2;ID2;ASL;"                ! Display data in D2
550  PAUSE
555  !
560  ! ********************************************************************************
565  !
```

```
570   ! FM3 = 32 bit floating point binary used by the HP 3577A
580   ! internal processor. There are 4 bytes per real number in
590   ! data format 3. Next, take a measurement and store to D1:
600   !
610   OUTPUT @Na;"RS4;TR1;IBR;TKM;SD1;ASL;"
620   !
630   ! Now Dump D1 in data format FM3:
640   !
650   OUTPUT @Na;"FM3;DD;"
660   !
670   ! Enter the leading bytes ("#I") into an unused string
680   ! then enter the data.
690   !
700   ENTER @Na USING "#,2A";Junk$
710   ENTER @Na USING "%,W";Integer_array(*)      ! 401x2x4 bytes
720   !
730   ! Integer_array now contains the real and imaginary parts
740   ! of 401 complex numbers, each part filling a pair of
750   ! Series 200 Integers. Load this data into register D2:
760   !
770   OUTPUT @Na;"LDI;#I;";                       ! Binary data must be preceded by
780   OUTPUT @Na USING "#,W";Integer_array        ! "#I"
790   !
800   ! Register D1 now contains the data from Integer_array
810   !
820   OUTPUT @Na;"TR2;ID1;DF5;ASL;"               ! Display D1 as phase (DF5)
830   !
840   END
```

---

**DUMP TRACE.** Traces may be dumped but not loaded. A trace is made up of real numbers as defined under the INPUT and DISPLAY FUNCTION keys and will have the same number of data points as defined in the current sweep resolution. This data is dumped using any of the three data formats with the following units:

| Display Function | Absolute Units (e.g., INPUT = R) | Relative Units (e.g., INPUT = B/R) |
|---|---|---|
| Log Mag | dBV | dB |
| Lin Mag | Volts | Units |
| Phase | Degrees | Degrees |
| Polar | Volts | Units |
| Delay | Seconds | Seconds |
| Real,Imag | Volts | Units |

Phase trace data will be offset by the active Phase Reference Level. Delay data will be meaningless in some of the beginning and end bins due to the nature of the measurement. The number of bins affected will depend on the aperture and sweep resolution. When the HP 3577A dumps a delay trace, it will output large negative numbers in those bins whose data is thus affected. The example that follows shows how a trace may be dumped to the computer/controller.

---

Example:

```
10    !
20    ! Dump Trace example demonstrating use of all three
30    ! data transfer formats.
40    !
50    REAL Real_array1(0:400),Real_array2(0:50)
60    INTEGER Integer_array(0:1,0:400)            ! array of 401x2 elements
70    ASSIGN @Na TO 711;FORMAT ON                 ! Na = Network Analyzer
80    OUTPUT @Na;IPR;SM2;TKM;"                    ! TKM = take measurement
```

```
85   !
90   ! ********************************************************************************
95   !
100  ! FM1 = the ASCII data format.
110  ! Next, dump trace one.
120  !
130  OUTPUT @Na;"FM1;DT1;"                    ! DT1 = dump trace one
140  ENTER @Na;Real_array1(*)
150  PAUSE
160  !
170  ! Real_array1 now contains 401 real numbers from trace one
180  !
190  ! ********************************************************************************
200  !
210  ! FM2 = 64 bit floating point binary (HP Series 200
220  ! computer real number) data format. Next, dump trace
230  ! two using FM2. Note the use of reduced sweep res.
240  !
250  OUTPUT @Na;"RS1;TKM;FM2;DT2;"            ! RS1 = 51 pts/span
260  !
270  ! Enter the leading bytes ("#I") into array elements 0 & 1
280  !
290  ENTER @Na USING "#,2(B)";Real_array2(0),Real_array2(1)
300  !
310  ! Prepare for a Series 200 internal real number format
320  ! data transfer and perform the entry.
330  !
340  ASSIGN @Na;FORMAT OFF                    ! FORMAT must be OFF
350  ENTER @Na;Real_array2(*)                 ! to use data format FM2
360  ASSIGN @Na;FORMAT ON                     ! Note that array elements
370  PAUSE
380  !
400  !
410  ! ********************************************************************************
420  !
430  ! FM3 = 32 bit floating point binary used by the HP 3577A
440  ! internal processor. There are 4 bytes per real number
450  ! data format 3. Next, take a measurement and dump trace 1
460  !
470  OUTPUT @Na;"RS4;TKM;FM3;DT1;"
480  !
490  ! Enter the #I as before, then the data.
500  !
510  ENTER @Na USING "#,2A";Junk$
520  ENTER @Na USING "%,W";Integer_array(*)
530  !
540  ! Integer_array now contains 401 real numbers from trace
550  ! one; each real number (32 bits) filling a pair of Series
560  ! 200 Integers (16 bits).
570  !
580  END
```

**DUMP MARKER, (DM1 & DM2)** Except for the polar display function, this is Y-axis information for one bin. The units will match those of the trace dumps shown in the table on Page 3-20. If the display function is two numbers will be output when a marker is dumped. These two numbers will be real and imaginary or magnitude and phase, respectively, depending on units selected for the marker. Any of the three data formats FM1, FM2, or FM3 may be used. The example that follows shows how a marker may be dumped and displayed.

Example: Non-polar display function

```
10      OUTPUT 711;"IPR;TKM;FM1;DM1;"          ! DM1 = Dump Marker one
20      ENTER 711;Marker_amp
30      DISP "Magnitude =";Marker_amp
40      END
```

Example: Polar display function

```
10      OUTPUT 711;"IPR;DF4;TKM;FM1;DM1;"      ! DF4 = polar
20      ENTER 711;Marker_amp,Marker_phase
30      DISP "Magnitude = ";Marker_amp
40      DISP "Phase = ";Marker_phase
50      END
```

**MARKER POSITION (MP1 & MP2)** dumps X-axis information for the appropriate trace marker. Any of the three data formats FM1, FM2, or FM3 may be used. The information units are:

```
LIN SWP  - Frequency
LOG SWP - Frequency
ALT SWP  - Frequency
AMP SWP - Source amplitude
CW       - Frequency
```

Note If the frequency span is 0 Hz and the sweep time is less than 1000 seconds, the marker position is in units of time.

Example:

```
10    OUTPUT 711;"IPR;TKM;MP1;"
20    ENTER 711;Mkr_freq
30    DISP "Marker frequency =";Mkr_freq;"Hz"
40    END
```

**DUMP AND LOAD INSTRUMENT STATE.**

**LMO** (learn mode out) dumps the instrument state out in binary to be stored by the computer. 1100 bytes will always be dumped including the first two bytes which are always #I. #I is used to indicate that binary data is to follow.

**LMI** (learn mode in) loads instrument state in binary. It is used to configure the HP 3577A to a specific instrument state. This state should be configured on the HP 3577A and dumped to the controller using LMO. Data dumped with LMO should not be changed outside the HP 3577A. It is not possible to configure the instrument state with a computer. LMI can be used to speed up reconfiguration if a large status change is necessary between tests.

It is recommended that the entire 1100 bytes (including the #I) be kept together after the dump as the same information needs to be returned to the HP 3577A when the LMI is used. The example that follows shows how to dump instrument state to a computer/controller and load instrument state back to the HP 3577A.

Example:

```
10    !
20    ! 'LMO', Learn Mode Out (dump instrument state)
30    ! 'LMI', Learn Mode In (load instrument state)
40    !
50    INTEGER Integer_array(0:549)          ! Array of 550 16 bit words
60    ASSIGN @Na TO 711;FORMAT ON
```

```
70    !
80    !  1100 bytes will be dumped, 2 bytes per element of
90    !  Integer_array. Next, configure state and dump it.
100   !
110   OUTPUT @Na;"IPR;TR2;DF5;FRA 1 MHZ;SAM 15 DBM;ST3;LMO;"
120   ENTER @Na USING "%,W";Integer_array(*)
130   PAUSE
140   !
150   !  Integer_array now contains 1100 bytes of instrument state
160   !  data. This data may be reloaded as follows:
170   !
180   OUTPUT @Na;"IPR;LMI;"
190   OUTPUT @Na USING "#,W";Integer_array(*)
200   !
210   END
```

---

**DUMP STATUS (DMS)** This command dumps the Status Byte and two more bytes of instrument status information plus a screen message (the Serial Poll dumps only the Status Byte). In the following table, B7 is the most significant bit and B0 is the least significant bit. All data is in the ASCII format.

BYTE 1 -The STATUS BYTE
- B7- Not used
- B6- RQS (require service)
- B5- Error bit
- B4- Ready for HP-IB command
- B3- Key pressed
- B2- Measurement complete
- B1- Data available
- B0- Data transfer complete

BYTE 2
- B7- Power on
- B6- Source tripped
- B5- Reference unlocked
- B4- No external reference
- B3- Input A overload
- B2- Input B overload
- B1- Input R overload
- B0- Input tripped

BYTE 3
- B7- Settling
- B6- Waiting for trigger (TRG)
- B5- Waiting for external trigger or line sync
- B4- Sweeping
- B3- End of sweep has occurred
- B2- Not used
- B1- Not used
- B0- Not used

ASCII STRING

A 26-character string containing an error, warning, or general information screen message. The error reporting mode selected will determine the level of message (none, error only, warning and error, or all) that will appear here. Refer to MASKING THE STATUS BYTE for more on error reporting modes, and to Appendix D for a complete listing of these messages.

Bits 0, 1, 2, 3, 5, and 6 of byte two will cause error messages when they become set. If the error bit is unmasked and more than one of these conditions exist, the first to occur will be the only message dumped. If the error bit is masked, DMS will dump the most recent message. The following example program was run immediately after having preset the HP 3577A and pressed a numeric key in the DATA ENTRY section:

Example:

```
10    DIM A$[100]
20    OUTPUT 711;"DMS"
30    ENTER 711;A$
40    DISP "Response to DMS command is ";A$;""""
50    END
```

Response to DMS command is

' 16, 0, 16, ENTRY UNDEFINED '

Dumping status will clear the error string to all blanks. It also clears the Power on, RQS, and (if no permanent hardware errors remain set) the error bit. Its effect on the Status Byte is the same as a serial poll.

**DUMP AVERAGE NUMBER (DAN)** dumps the number of sweeps or samples taken since averaging was turned on. This number is not the user selection, N. The ASCII equivalent of the average number is returned terminated by <CR/LF> and <EOI>. The data format for DAN is *always* ASCII. The maximum value returned is 9999.

Example:

```
10      OUTPUT 711;"IPR;AV5;"          ! AV5 = averaging on (N = 64)
20      WAIT 5
30      OUTPUT 711; "DAN;"
40      ENTER 711; Avg__no
50      DISP Avg__no
60      GOTO 20
70      END
```

---

**CLEAR KEYBOARD BUFFER & DUMP KEY (CKB & DKY)**

These allow the controller to clear the keyboard buffer (which will hold as many as ten keypresses) and monitor key presses and/or knob rotation. Note that an SRQ may be generated by front panel keys (see STATUS BYTE)

CKB clears the key buffer of key presses and the knob counter to zero. The key buffer holds a maximum of six key presses. The knob counter contains the first count, other than zero, taken by the counter since the last CKB command.

DKY dumps two numbers in ASCII format. The first number corresponds to a front panel hardkey and will range from 0 to 51 inclusive. The following table shows the keys and their corresponding number. If there has been no key pressed since the last CKB command, a −1 will be returned. The second number is the knob counter which contains a number between −15 and +15; negative numbers indicate counter-clockwise rotation and positive numbers indicate clockwise rotation. Zero indicates no rotation. The following example shows how the CKB and the DKY commands are used. Also, refer to the example for ENTER MENU and ENTER ANNOTATION.

| Number | Key Name | Number | Key Name |
|---|---|---|---|
| 0 | zero | 27 | TRACE 1 |
| 1 | one | 28 | TRACE 2 |
| 2 | two | 29 | FREQ |
| 3 | three | 30 | AMPTD |
| 4 | four | 31 | TRIG MODE |
| 5 | five | 32 | SWEEP TYPE |
| 6 | six | 33 | SWP MODE |
| 7 | seven | 34 | SWP TIME |
| 8 | eight | 35 | DEFINE MATH |
| 9 | nine | 36 | STORE DATA |
| 10 | decimal | 37 | DISPLAY FCTN |
| 11 | minus | 38 | INPUT |
| 12 | backspace | 39 | SCALE |
| 13 | softkey 1 (top) | 40 | MKR |
| 14 | softkey 2 | 41 | MEASR CAL |
| 15 | softkey 3 | 42 | (not used) |
| 16 | softkey 4 | 43 | SAVE |
| 17 | softkey 5 | 44 | RECALL |
| 18 | softkey 6 | 45 | SPCL FCTN |
| 19 | softkey 7 | 46 | RES BW |
| 20 | softkey 8 | 47 | AVG |
| 21 | TRIG/RESET | 48 | ATTEN |
| 22 | ENTRY OFF | 49 | LENGTH |
| 23 | LOCAL | 50 | PLOT |
| 24 | MARKER/ENTRY KEY | 51 | MKR → |
| 25 | INCREMENT | | |
| 26 | DECREMENT | | |

---

Example:

```
10      OUTPUT 711;"CKB;"
20      OUTPUT 711;"DKY;"
30      ENTER 711;Key,Knob             ! Enter two numbers
40      IF Key=−1 AND Knob=0 THEN 20
50      DISP "Key=";Key;" and Knob =";Knob
60      OUTPUT 711;"CKB;"
70      GOTO 20
80      END
```

**DUMP CHARACTERS (DCH)** Dumps the alphanumeric characters on the screen to determine values of certain parameters. Only information presently on the screen is returned on the bus. As soon as the instrument is addressed to talk the following ASCII information will be returned if the display is NOT in polar format:

1) Reference level for trace 1
2) Amplitude level for trace 1
3) Reference level for trace 2
4) Amplitude level for trace 2
5) Marker frequency for trace 1
6) Marker amplitude for trace 1
7) Marker frequency for trace 2
8) Marker amplitude for trace 2
9) Start frequency for trace 1
10) Stop frequency for trace 1
11) Start frequency for trace 2
12) Stop frequency for trace 2
13) Source amplitude (if not in alternate sweep)
14) Delay aperture (if DSPLY FCTN is DELAY) for the active trace
15) Entry block information (if bus diagnostics are enabled)

If the display format is POLAR, then the following ASCII information is returned:

1) Full scale level
2) Phase reference
3) Reference position
4) <null>
5) Marker frequency
6) Marker amplitude
7) Marker phase
8) <null>
9) Start frequency for trace 1
10) Stop frequency for trace 1
11) Start frequency for trace 2
12) Stop frequency for trace 2
13) Source amplitude (if not in alternate sweep)
14) <null>
15) Entry block information

Each field will be separated by a comma; the last field will be delimited by a carriage return/linefeed. If the field is not defined currently on the CRT, an empty field will be returned.

---

Example:

```
10    !
20    ! 'DCH', Dump Characters program
30    !
40      DIM Bfr$(1:15)[40],U$[300],E$[26]
50      Adrs=711
60      ASSIGN @Adrs TO 711
70    !
80    ! ---POLAR DISPLAY FUNCTION
90    !
100     OUTPUT @Adrs;"IPR;ST1;TR1;DF4;TKM;DMS;"
110     ENTER @Adrs;X,Y,Z,E$                  ! Status read to make sure all commands
120                                           ! have been processed & sweep is done
130   !
140     OUTPUT @Adrs;"ASL;"                   ! Auto scale the screen display
150     WAIT .1                               ! Allow time to update picture
160   !
170     GOSUB Get_characters
180   !
```

```
190     PRINT "Full scale: ";Bfr$(1)
200     PRINT "Phase Reference: ";Bfr$(2)
210     PRINT "Reference position: ";Bfr$(3)
220     PRINT
230     PRINT "Marker frequency: ";Bfr$(5)
240     PRINT "Marker amplitude: ";Bfr$(6)
250     PRINT "Marker phase: ";Bfr$(7)
260     PRINT
270     PRINT "Start frequency: ";Bfr$(9)
280     PRINT "Stop frequency: ";Bfr$(10)
290     PRINT "Source amplitude: ";Bfr$(13)
300     STOP
310   !
320   Get_characters: !
330     OUTPUT @Adrs;"DCH;"
340     ENTER @Adrs;U$
350       FOR I=1 TO 15
360         IF POS(U$,",") THEN
370           Bfr$(I)=U$[1,POS(U$,",")-1]
380           U$=U$[POS(U$,",")+1]
390         ELSE
400           Bfr$(I)=U$
410         END IF
420       NEXT I
430     RETURN
440   !
450     END
```

Result:

Full scale: FULL SCALE 2.5000
Phase reference: PHASE REF 0.0deg
Reference position: REF POSN 0.0deg

Marker frequency: MARKER 100 050 000.000Hz
Marker amplitude: MAG(S21) 646.58E-3
Marker phase: PHASE(S21) -45.208deg

Start frequency: START 100 000.000Hz
Stop frequency: STOP 200 000 000.000Hz
Source amplitude: AMPTD 15.0dBm

**DUMP PRODUCT IDENTIFICATION (ID?)** The HP 3577A responds with the following ASCII character string:

HP3577A, TESTSET (or <NULL>),
<Software revision>

The "TESTSET" string is present if the HP 35677A or HP 35677B S-Parameter Test Sets are connected to the HP 3577A.

**BUS DIAGNOSTIC MODES** There are three bus diagnostic modes. They are: 1) BD0 = Bus Diagnostics Off; used for best programming speed. 2) BD1 = Bus Diagnostics On, Fast; menus appear, bus codes appear on screen for three seconds after an error is detected. 3) BD2 = Bus Diagnostics On, Slow; menus appear, bus codes appear and are decoded at the rate of one per second. BD1 and BD2 are useful for debugging programs written to control the HP 3577A. When on, this mode will sequence through all menus and update the display as if the HP 3577A were being operated from the front panel.

**DATA FORMATS.** The HP 3577A offers three data formats used to transfer certain types of data on the bus. The data types that make use of all three formats are trace data, register data, marker data, and marker position.

**FM1** is the ASCII data format. The ASCII floating point format will always transfer fifteen characters in the form -12.3456789E+03 for each number (i.e., leading spaces or zeros are not suppressed). In FM1 data dumps, the HP 3577A outputs ASCII data points separated by commas and carriage return line feed (CR/LF) indicates the end of record. When transferring data, the complete set of data is referred to as a record. A record is composed of data and an end of record terminator. When loading data the HP 3577A accepts commas, CR and LF as delimiters between data points. No end of record symbol is required; the instrument will respond to EOI. No more than one delimiter is allowed between numbers; CR/LF is considered a single delimiter. Spaces between and within numbers will be ignored.

**FM2** is the 64 bit floating point binary specified by IEEE draft standard P754. This is the same data format used by the HP Series 200 computers. This format appears as follows:

---

SEEEEEEEEEEEMFFF FFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFL

where : M is the most significant bit of the fractional part
F is an intermediate fractional bit
L is the least significant fractional bit
S is the sign bit of the fractional part
E is the exponent part

and: M is a "1"
The exponent is offset by 127 (i.e., 127=0) This format represents 1.fff... All ones for f's represents ~ 2.0 (i.e., normalized to 2)

**FM3** is the 32 bit floating point binary used by the HP 3577A fast processor. This format appears as follows:

MFFFFFFFFFFFFFFF SFFFFFFLEEEEEEE

where: M is the most significant bit of the fractional part
F is an intermediate fractional bit
L is the least significant fractional bit
S is the sign of the fractional part
E is the exponent part

and: M should always be a "1"
The exponent is offset by 128 (i.e., 128=0). This format represents .1fffff... All ones represents ~ 1.0 (i.e., normalized to 1).

In either of the the binary data formats the header #I must precede a binary load so that the HP 3577A can recognize the bytes following the header as binary data.

**ABORTING A DUMP OR LOAD.** A dump or load will be aborted by any one of the following events:

1) End (EOI) sent by talker (FM2 or FM3 load only)
2) Sending non-numeric data (ASCII loads only)
3) Device Clear
4) Pressing the LOCAL front panel key
5) Addressing the HP 3577A to Listen and sending one or more bytes (dumps only).

Note that an Interface Clear (IFC) does not abort a dump or load over the bus. For unconditional control of the bus, it is recommended that Device Clear followed by Interface Clear be issued at the beginning of your program. The BASIC commands that correspond to these are CLEAR 7 and ABORT 7, respectively.

**LENGTH OF RECORD** The length of the data record (number of points transferred) will depend on the sweep type currently active. This is true for both register data and trace data. Note that in trace dumps of delay, the aperture/2 first and last bins will be undefined; the HP 3577A will output a large negative number in an attempt to protect the user from bad data. Examples of record length:

CW: 1
LIN: Sweep Resolution
LOG: 401
ALT: 401
AMP: Number of steps/sweep plus 1

**END OF INFORMATION** The bus management line EOI (end or identify) will be pulled by the HP 3577A on the last byte of any data dump whether it is a binary or ASCII dump. Once the HP 3577A has pulled its EOI line it will not transmit any more data until receiving another message. When using ENG (enter graphics) to load graphics commands, <EOI> must be pulled on the handshake of the last byte. Using BASIC on HP computers, such as the 9836, pulling the EOI line is done by putting ;END at the end of the data string as shown in the following example:

Example:

```
10 OUTPUT 711;" ENG #I ";
20 OUTPUT 711 USING "#,W";Cmnd_array(*);END
```

**ENTER MENU (ENM)** allows the user to label the eight softkeys. This feature may be used with commands that read the keyboard. It does not allow the user to redefine the key label corresponding to a HP 3577A softkey function. The user defined menu shares the same display memory with system menus. It is recommended that the bus diagnostic mode be kept off to avoid overwriting menus.

To label the softkeys use the following sequence:

| | |
|---|---|
| ENM | Enter menu bus mnemonic. |
| " | Opening quote indicates that text follows. |
| 1-8 | The softkey number on which to display the message. If the first character is not a number, 1 is assumed. |
| text | Up to 16 characters of ASCII text. If the text is 8 characters or less a single line key-label will appear centered on the key. If the text is 9 to 16 characters the text will be divided into 2 lines with 8 characters on the first line and the remainder on the second line; the 2 lines will be centered on the key. A carriage return character is not acceptable and will be translated to a left arrow. Double quote marks (") may be included as characters by sending a pair of double quotes ("") to the HP 3577A. Note that the computer may require four quote marks be entered to get two in its program line (resulting in one on the HP 3577A screen). |
| " | Closing quote mark. |
| <delim> | This delimiter may be the characters ; <CR/LF> space or the act of pulling <EOI> on the handshake of the last byte transferred. |

Whenever the instrument returns to LOCAL mode and the front panel is enabled, the user defined menu will be overwritten with the present system definition of the softkeys. For an example program using ENM, refer to ENTER ANNOTATION. Additional functions to control the menu display memory:

| | |
|---|---|
| Menu off | MN0 |
| Menu on | MN1 |
| Menu clear | MNC |

**ENTER ANNOTATION (ENA)** This command allows the user to provide text strings and to specify on which of twelve lines it will appear. These lines are located in the graticule area; four near the top, four in the middle, and four near the bottom. They are located such that there is no interference with the message block in which errors and warnings are displayed.

The format to be used is as follows:

| | |
|---|---|
| ENA | Enter annotation bus mnemonic. |
| " | Opening quote indicates that text follows. |
| 1-12 | The display line number on which the annotation is to be displayed. If the first character is not numeric, line 1 will be assumed. |
| text | Up to 40 characters of ASCII text. The carriage return character code is unacceptable and will be translated to a left arrow if used. |
| " | Closing quote marks. |
| <delim> | This delimiter may be the characters ; <CR/LF> space or the act of pulling <EOI> on the handshake of the last byte transferred. |

---

Example:

```
10    !
20    ! 'ENA','ENM' Use of Enter Annotation and Enter Menu
30    ! 'CKB','DKY' Use of Clear Keyboard and Dump Key
40    !
50      Adrs=711
60      ASSIGN @Adrs TO Adrs
70      OUTPUT @Adrs;"ANC;MNC;"                    ! Clear annotation and menu
80    !
90    ! Next, define the annotation and menu
100   !
110     OUTPUT @Adrs;"ENA;""2                Special Test"""""
120     OUTPUT @Adrs;"ENA;""4       Select appropriate MENU KEY."""""
130   !
140     OUTPUT @Adrs;"ENM;""1 CONTINUE"""""
150     OUTPUT @adrs;"ENM;""4         TEST FAILED"""""
160     OUTPUT @Adrs;"ENM;""8 ABORT"""""
170   !
180   ! Note that a pair of double quotes must be used to send
190   ! one double quote mark (") at execution time. To get a
200   ! double quote to appear in the HP 3577A screen annotation,
210   ! 4 double quotes (""""") must be written into the program.
220   !
230       LOOP
240         OUTPUT @Adrs;"MN1;AN1;"                ! Turn annotation & menu on
250         OUTPUT @Adrs;"CKB;"                    ! Clear the keyboard buffer
260           LOOP
270             OUTPUT @Adrs;"DKY;"                ! Read the keyboard
280             ENTER @Adrs;Key,Knob
290           EXIT IF Key=13 OR Key=16 OR Key=20
300             IF Key <>-1 THEN BEEP              ! -1 = no key pressed
310           END LOOP
320         OUTPUT @Adrs;"MN0;"                    ! Turn menu off
330         SELECT Key
340         CASE 13
350           OUTPUT @Adrs;"ENA;""5                CONTINUE key pressed"""""
360         CASE 16
370           OUTPUT @Adrs;"ENA;""5                TEST FAILED key pressed"""""
```

```
380         CASE 20
390           OUTPUT @Adrs;"ENA;""5                ABORT key pressed"""""
400         END SELECT
410   !
420         WAIT 2
430         OUTPUT @Adrs;"ENA;""5"""""             ! Clears the message
440         OUTPUT @Adrs;"MN1;"                    ! Turn the menu back on
450   !
460       END LOOP
470   !
480       END
```

**ENTER GRAPHICS (ENG)** The graphics mode allows the user to place alphanumeric information anywhere on the screen in different sizes, intensities and rotational positions, as well as draw vectors. Although this offers more flexibility than ENA, knowledge of the HP 1345A Digital Display command set is required. This information uses the same display memory as the ENA function, therefore the two functions cannot be used together.

The format to be used is as follows:

| | |
|---|---|
| ENG | Enter Graphics bus mnemonic. |
| #I | Indicates binary words to follow. |
| <0-923> | Starting address within annotation block where 1345A commands are to be placed. Sent as a 16 bit binary number, MSB first. |
| 1345A commands | Sent as 16 bit binary words, MSB first. The commands for the HP 1345A Digital Display are binary commands. When the ENG command is used the HP 3577A will pass these commands to the display section. Appendix B is a quick reference programming guide for the HP 1345A. The JUMP command is not allowed. The carriage return character will be translated into a left arrow. Memory capacity is 924 commands. |
| <EOI> | End Or Identify will be sent with the last data byte to indicate the end of the sequence. |

Example:

```
1000  !
1010  !    Use of Enter Graphics
1020  !
1030    COM INTEGER Cmnd__array(0:20),Array__indx,Disp__adrs,Array__ length,@Adrs
1040    INTEGER Plotx,Movey,Ploty,Set__cmnd,Text(1:5),Es
1050    INTEGER I,J,K
1060    Array__length=20
1070    Array__indx=1
1080    Disp__adrs=0
1090    Adrs=711
1100    ASSIGN @Adrs TO Adrs
1110  !
1120    OUTPUT @Adrs;"IPR;ANC;"                    ! Clear state and annotation
1130    OUTPUT @Adrs;"AN1;"                        ! Turn the display ON
1140    OUTPUT @Adrs;"TR1;DF0;GR0;CH0;"
1150  !
1160  !    Define the annotation commands
1170  !
1180  !      The PLOT command for the display: 000y pddd dddd dddd
1190  !
1200  !        Where: y = 0 for x definition; 1 for y definition
1210  !               p = 0 for 'pen up'; 1 for 'pen down'
1220  !               d = location in range 0 to 2047
```

```
1230  !
1240     Plotx=0
1250     Ploty=6144
1260     Movey=4096
1270  !
1280  !    The SET CONDITIONS command for the display:
1290  !
1300  !       011i i-l l0-w w--
1310  !
1320  !          Where: i defines the line intensity
1330  !                    00 - blank
1340  !                    01 - dim
1350  !                    10 - half bright
1360  !                    11 - full bright
1370  !                 1 defines line type
1380  !                    00 - solid line
1390  !                    01 - intensified end points
1400  !                    10 - long dashes
1410  !                    11 - short dashes
1420  !                 w defines writing speed
1430  !                    00 - 0.20 inches per microsecond
1440  !                    01 - 0.15 " " "
1450  !                    10 - 0.10 " " "
1460  !                    11 - 0.05 " " "
1470  !
1480     Set_cmnd=30744                          ! full bright, solid !ine, & .05 in/us
1490  !
1500  !    The TEXT command: 010s srre cccc cccc
1510  !
1520  !          Where: s defines character size
1530  !                    00 - 1.0X
1540  !                    01 - 1.5X
1550  !                    10 - 2.0X
1560  !                    11 - 2.5X
1570  !                 r defines rotation
1580  !                    00 - 0 degrees
1590  !                    01 - 90 degrees
1600  !                    10 - 180 degrees
1610  !                    11 - 270 degrees
1620  !                 e - establish size of character
1630  !                    0 - Use previous size and rotation
1640  !                    1 - Use new size and rotation
1650  !                 c - character code (see table in appendix)
1660  !
1670     Text(1)=16384                           ! size is 1X and rotation is 0 deg
1680     Text(2)=18944                           ! size is 1.5X and rotation is 90 deg
1690     Text(3)=21504                           ! size is 2.0X and rotation is 180 deg
1700     Text(4)=24064                           ! size is 2.5X and rotation is -90 deg
1710     Text(5)=22528                           ! size is 2.5X and rotation is 0 deg
1720     Es=256                                  ! "establish size and rotation" flag
1730  !
1740  !    Plot a square on the HP 3577A screen:
1750  !
1760     Sqr:DATA 100,100                        ! x,y coordinate for lower left corner
1770         DATA 100,1000                       ! upper left
```

```
1780        DATA 1000,1000                          ! upper right
1790        DATA 1000,100                           ! lower right
1800  !
1810  !  Since the display units are not equal (i.e., Y-axis
1820  !  units are ¾ the size of the X-axis units on the
1830  !  display), the Y-axis units should be divided by .75
1840  !  to get a true square.
1850  !
1860     Y__axis__scale=.75
1870     READ X0,Y0                              ! read the first point
1880     CALL Add__cmnd(Set__cmnd)               ! initialize SET CONDITION
1890     CALL Add__cmnd(X0+Plotx)                ! move to starting point
1900     CALL Add _cmnd(Y0/Y__axis__scale+Movey)
1910     FOR I=1 TO 3
1920       READ X,Y
1930       CALL Add__cmnd(X+Plotx)
1940       CALL Add__cmnd(Y/Y__axis__scale+Ploty)
1950     NEXT I
1960     CALL Add__cmnd(X+Plotx)
1970     CALL Add__cmnd(Y0/Y__axis__scale+Ploty)  ! plot to starting pt
1980  !
1990  !    Now display the following message in the four different
2000  !    sizes and rotations
2010  !
2020     Message$="HP3577 "
2030  !
2040     CALL Add__cmnd(550+Plotx)               ! define the start of characters
2050     CALL Add__cmnd(500+Movey)
2060     FOR I=1 TO 4
2070       CALL Add__cmnd(Text(I)+Es+NUM(Message$)) ! 1st character
2080                                               ! w/ Es asserted
2090       FOR J=2 TO LEN(Message$)
2100         CALL Add__cmnd(Text(I)+NUM(Message$[J]))
2110       NEXT J
2120     NEXT I
2130  !
2140     IF Array__indx<>1 THEN CALL Transfer__cmnd ! transfer if
2150  !                                             necessary
2160     Array__indx=1                           ! reinitialize buffer
2170     Cmnd__array(0)=100                      ! use address 100 for this buffer
2180     CALL Add__cmnd(1500+Plotx)              ! define starting position for
2190     CALL Add__cmnd(1500+Movey)              ! loop
2200     CALL Add__cmnd(Text(5)+Es+1)            ! character "1" is HP logo
2210     OUTPUT @Adrs;"ENG #I";
2220     OUTPUT @Adrs USING "W";Cmnd__array(*);END
2230  !
2240                          ! The following steps will update the two commands which
2250                          ! define the starting location of the HP logo. It
2260                          ! demonstrates changing selected commands "on the fly."
2270  !
2280     LOOP
2290       Cmnd__array(1)=INT(1500*RND)+Plotx    ! Update new starting
2300       Cmnd__array(2)=INT(1900*RND)+Movey    ! position for logo.
2310       OUTPUT @Adrs;"ENG #I";                ! Update new x,y
```

```
2320      OUTPUT @Adrs USING "#,W,W,W";Cmnd__array(0),Cmnd__array(1)
          ,Cmnd__array(2);END
2330      WAIT .1
2340      END LOOP
2350  !
2360      STOP
2370  !
2380      END
2390  !
2400  !   The following subroutine adds 1345A Display commands to
2410!     Cmnd__array until it contains 20 (Array__length) elements.
2420  !
2430      SUB Add__cmnd(INTEGER Value)
2440        COM INTEGER Cmnd__array(*),Array__indx,X,Array__length,@Adrs
2450        Cmnd__array(Array__indx)=Value
2460        Array__indx=Array__indx+1
2470        IF Array__indx>Array__length THEN
2480          CALL Transfer__cmnd
2490          Array__indx=1
2500        END IF
2510      SUBEND
2520  !
2530  !   Send Cmnd__array to HP 3577A
2540  !
2550      SUB Transfer__cmnd
2560      COM INTEGER Cmnd__array(*),Array__indx,Disp__adrs,Array__
          leng th,@Adrs
2570      Cmnd__array(0)=Disp__adrs
2580      OUTP! T @Adrs;"ENG #I";                    ! Send ENG and #I
2590      OUTPUT @Adrs USING "#,W";Cmnd__array(*);END! send array
2600      FOR K=0 TO Array__length                   ! Clear out Cmnd__array
2610      Cmnd__array(K)=0
2620      NEXT K
2630      Disp__adrs=Disp__adrs+Array__indx-1        ! Redefine display
2640                                                 ! memory address for
2650      SUBEND                                     ! next transfer.
```

**ANNOTATION OFF (AN0)** Turns off the Annotation/Graphics modes by disabling the display memory.

**ANNOTATION ON (AN1)** Enables the commands in display memory.

**ANNOTATION CLEAR (ANC)** Clear display memory back to NOP instructions.

Additional functions to control the screen are:

| | |
|---|---|
| Graticule On | **GR1** |
| Graticule Off | **GR0** |
| Characters On | **CH1** |
| Characters Off | **CH0** (screen messages will *not* be turned off) |

The character fields controlled by the CH commands are:

1) Information at the bottom of the screen.
2) The REF and /DIV messages and their values
3) The entry block
4) The marker data

The following screen features have their own on/off commands:

1) Trace data (the traces themselves; **TR1 DF0** and **TR2 DF0**)
2) Trace reference lines (**TR1 RL0** and **TR2 RL0**)
3) Annotation
4) Menu

**TAKE MEASUREMENT (TKM)** When this command is received the HP 3577A settles and takes a measurement before processing the next bus command. TKM (followed by a dump command) guarantees that the measurement will be completed before data transfer begins. For faster measurements RST and TRG may be used as shown previously.

# INSTRUMENT PRESET (DEFAULT) PARAMETER VALUES

The HP 3577A responds to the instrument preset (IPR) command configuring its parameters as defined in the following table:

| FUNCTION | PRESET CONDITION | |
|---|---|---|
| | *Without test set* | *With test set* |
| **TRACE 1** | Active | same |
| **TRACE 2** | Off | same |
| **DISPLAY FUNCTION** | Log magnitude | same |
| **INPUT** def. (both traces) | R | S21 (B/R, test set fwd) |
| user defined input | F3 | same |
| **SCALE** (log mag) | | |
| Reference level | 0.0 dBm | 0.0 dB |
| /DIV | 10.0 dB | same |
| Reference position | 100 % | same |
| Reference line | On | same |
| **SCALE** (linear mag) | | |
| Reference level | 0.0 Volts | 0.0 units |
| /DIV | 100 mV | 100E-3 units |
| Reference position | 0.0 % | same |
| Reference line | On | same |
| **SCALE** (phase) | | |
| Reference level | 0.0° | 0.0° |
| /DIV | 45 degrees | same |
| Reference position | 50 % | same |
| Reference line | On | same |
| Phase slope (Trc 1&2) | On, 0.0°/span | same |
| **SCALE** (polar) | | |
| Full scale | 1.0 Volts | 1.0 units |
| Phase reference | 0.0° | same |
| Reference position | 0.0° | same |
| Reference line | On | same |
| Phase slope (Trc 1&2) | On, 0.0°/span | same |
| **SCALE** (real & imaginary) | | |
| Reference level | 0.0 Volts | 0.0 units |
| /DIV | 200 mV | 200E-3 units |
| Reference position | 50 % | same |
| Reference line | On | same |
| Phase slope (Trc 1&2) | On, 0.0°/span | same |
| **SCALE** (delay) | | |
| Reference level | 0.0 s | same |
| /DIV | 100 ns | same |
| Reference position | 50 % | same |
| Reference line | On | same |
| Phase slope (Trc 1&2) | On, 0.0°/span | same |
| **MARKER** (Both traces) | | |
| Marker | On | same |
| Position | Bin 200 | same |
| Offset (Mag, freq swp) | Off, 13.01 dBm | Off, 0.0 dB |
| Freq Offset (X-axis) | 0.0 Hz | 0.0 Hz |
| Offset (Mag, amptd swp) Off, | 13.01 dBm | Off, 0.0 dB |
| Amptd Offset (X-axis) | 13.0 dBm | 13.0 dBm |
| Target | 10.01 dBm | -3.0dB |

| | | |
|---|---|---|
| **STORE** | | |
| User def equation | R | same |
| **DEFINE MATH** | | |
| K1 real | 1 | same |
| K1 imaginary | 0 | same |
| K2 real | 50 | same |
| K2 imaginary | 0 | same |
| K3 real | 75 | same |
| K3 imaginary | 0 | same |
| F1 | (B/R)/(K1-B/R) | same |
| F2 | A/R | same |
| F3 | (K1 + F2)/(K1-F2) | same |
| F4 | K2*F3 | same |
| F5 | K3*F3 | same |
| **SWEEP TYPE** | Linear (freq) | same |
| Sweep direction | Up (left to right) | same |
| **SWEEP MODE** | Continuous | same |
| **SWEEP TIME** (linear swp) | 1.000 s | same |
| (amplitude swp) | 0.050 s/step | same |
| (manual swp mode or CW) | 0.050 s/step | same |
| **FREQUENCY** | | |
| Start freq (linear swp) | 0.000 Hz | 100 kHz |
| Start freq (log sweep) | 50.000 Hz | 100 kHz |
| Stop frequency | 200 MHz | same |
| Center frequency | 100 MHz | 100.05 MHz |
| Frequency span | 200 MHz | 199.9 MHz |
| Center freq step size | 1.0 MHz | same |
| Freq sweep resolution | 401 points/span | same |
| **AMPLITUDE** | | |
| Source amplitude | -10.0 dBm | +15.0 dBm |
| Amplitude step size | 1.0 dBm | same |
| Start amplitude | -40.0 dBm | same |
| Stop amplitude | 0.0 dBm | +15.0 dBm |
| Steps/sweep | 100 | same |
| **TRIGGER MODE** | Free run | same |
| **RESOLUTION BANDWIDTH** | 1 kHz | same |
| Settling time for: | | |
| Res BW = 1kHz | 22 ms | same |
| Res BW = 100 Hz | 55 ms | same |
| Res BW = 10 Hz | 370 ms | same |
| Res BW = 1 Hz | 3.707 s | same |
| **AVERAGING** | Off | same |
| **INPUT ATTENUATION** | | |
| Input R | 20 dB | same |
| Input A | 20 dB | same |
| Input B | 20 dB | same |
| **INPUT IMPEDANCE** | | |
| Input R | 50Ω | same |
| Input A | 50Ω | same |
| Input B | 50Ω | same |
| **INPUT LENGTH** | | |
| Input R | On, 0.0 meters | On, 1.3 meters |
| Input A | On, 0.0 meters | same |
| Input B | On, 0.0 meters | same |
| Step size | 1.0 meter | same |

# THE STATUS BYTE

The Status Byte is an 8 bit word that the HP 3577A will dump on the HP-IB when it is serially polled. The state of each bit indicates the status of an internal HP 3577A function.

BASIC example: Var=SPOLL(711)

HPL example: rds (711)→S

## STATUS BYTE BIT NUMBERS

**B7 B6 B5 B4 B3 B2 B1 B0**

**B7:** Not used

**B6:** **REQUIRE SERVICE, RQS.** Set when the HP 3577A pulls the SRQ line. Cleared along with the SRQ line when a serial poll is performed.

**B5:** **ERROR** This bit reflects the logical OR of all error conditions in the instrument. An SRQ is generated on the rising edge of any of these error conditions. The error conditions include all HP-IB errors and all hardware error conditions. The hardware errors include input overloads, input tripped, source tripped, and reference unlocked. The error bit is cleared when the hardware error conditions have cleared and a serial poll is performed, if the error bit is unmasked. If the bit is masked it will clear whenever the error conditions clear (i.e., it won't stay set until the poll occurs). It is also cleared by a dump status command (DMS) when the user receives the error information (if all hardware error bits are clear). Four levels of masking are provided for the user to select what type of programming errors will be reported by the error bit. See MASKING THE STATUS BYTE.

**B4:** **READY** (for HP-IB commands) Set when the HP-IB input buffer is completely empty, all commands have been completely processed, and (if the last command was RST) settling is complete. If a command is issued during a sweep, the ready bit will clear until command processing is complete.

**B3:** **KEY PRESSED/SRQ** If unmasked, this bit will be set when a key is pressed or the knob is turned. Also, this bit is set when the HP 3577A receives the "SRQ" command on the bus. The set condition is cleared by a serial poll.

**B2:** **MEASUREMENT COMPLETE** Set when sweep completes. Cleared by the start of a new sweep.

**B1:** **DATA AVAILABLE** Instrument will output data when addressed to talk. Cleared by the handshake of the last byte.

**B0:** **DATA TRANSFER COMPLETE** Set after the HP 3577A handshakes the last data byte in a dump. Primarily designed for plotting. Cleared by a serial poll if it is unmasked, or upon B1 being set.

Any status bit that is unmasked will cause an SRQ (and set RQS) when the condition it represents is true. As long as the condition is true, the bit will stay set. The bit will reset when the condition has cleared and the instrument is serially polled.

Any status bit that is masked will follow the condition it represents, resetting without a serial poll whenever the condition clears.

## MASKING THE STATUS BYTE

A service request will be generated when any unmasked bit in the status byte becomes set. The SRQ mask may be loaded by sending SQM followed by the mask byte in ASCII. The mask byte definition is as follows:

| | | 0 | 1 |
|---|---|---|---|
| **B7** | (not used) | | |
| **B6** | (RQS) | | not maskable |
| **B5** | (Error) | mask B5 | enable B5 SRQ |
| **B4** | (Ready) | mask B4 | enable B4 SRQ |
| **B3** | (Key/SRQ) | mask B3 | enable B3 SRQ |
| **B2** | (MEAS DONE) | mask B2 | enable B2 SRQ |
| **B1** | (DATA AVAIL) | mask B1 | enable B1 SRQ |
| **B0** | (XFER DONE) | mask B0 | enable B0 SRQ |

In the default instrument state SQM = 0 (all bits masked). Pressing INSTR PRESET or sending IPR over the bus will set SQM = 0.

The user may choose the level of screen message that sets the SRQ line (and which level of message appears with DMS) by selecting one of the following four modes:

**ER0** Nothing will be reported
**ER1** Only errors will be reported
**ER2** Errors and warnings will be reported
**ER3** Errors, warnings, and messages will be reported

The default selection is ER1. If the error bit is unmasked, the following conditions will pull SRQ regardless of the error reporting mode selected:

Input(s) tripped
Input(s) overloaded
Reference unlocked
Source tripped

# "HOW TO GO FAST" EXAMPLE PROGRAMS

These two example programs are written for the HP Series 200 computers. The first program demonstrates the fastest measurement technique for any display function except group delay (with the appropriate changes in line 300 to change from DF7 (default) to DF__, and line 610 to print the correct units after the value of the data dumped). The second program is an example demonstrating the fastest way to make group delay measurements.

```
10    ! This program demonstrates the fastest possible single-
20    ! point (CW) measurements that the HP 3577A is capable of.
30    !
40      ASSIGN @Na TO 711
50      ASSIGN @Na__nofmt TO 711;FORMAT OFF
60      Meas__complete=4
70      Pass=0
80      CLEAR @Na                                  ! Initialize the bus
90      OUTPUT @Na;"IPR;"                          ! Preset the instrument
100   !
110   ! Turn characters and bus diagnostics off to improve speed
120   !
130     OUTPUT @Na;"CHO;BD0;"
140   !
150   ! Set the data transfer format to 64 bit binary (IEEE)
160   !
170     OUTPUT @Na;"FM2;"
180   !
190   ! Select single sweep mode to improve speed
200   !
210     OUTPUT @Na;"SM2;"
220   !
230   ! Select CW sweep type (fastest method for making single
240   ! point measurements)
250   !
260     OUTPUT @Na;"ST5;"
270   !
280   ! Set up measurement conditions
290   !
300     OUTPUT @Na;"SAM -6 DBM;TR1;BW4;UDI B/R;TSF;"
310     Freq=RND*2.00E+8                           ! Select a random frequency
320     OUTPUT @Na;"SFR";Freq;"HZ;"
330     OUTPUT @Na;"TKM;"                          ! 1st meas is done with TKM
340     LOOP
350       Starttime=TIMEDATE
360       Oldfreq=Freq
370       Freq=RND*2.00E+8                         ! Select next random frequency
380       !
390       !  Next, go to the new frequency and begin settling,
400       ! then dump the marker data from the last measurement.
410       !
420       OUTPUT @Na;"SFR";Freq;"HZ;RST;DM1;TRG;"
430       !
440       ! Note that TRG (trigger the new measurement) will not
450       ! occur until settling is complete.
460       !
470       ENTER @Na USING "%,2A";Junk$             ! gets "#I" characters
480       ENTER @Na__nofmt;Y                       ! gets marker data for Oldfreq
```

```
490         Start__meas=TIMEDATE
500         !
510         ! Next, wait for the data to be taken. Data analysis
520         ! may be performed here, while waiting.
530         !
540         REPEAT
550           Stat=SPOLL(711)
560         UNTIL BINAND(Stat,Meas__complete)
570         Stoptime=TIMEDATE
580         Measure__time=INT((Stop__time-Start__meas)*1000+.5
590         Time=INT((Stoptime-Start__time)*1000+.5
600         DISP "PASS ";Pass;", TOTAL TIME=";Time;"msec Measurement =";Measure__time;"msec"
610         PRINT "FREQ: ";Oldfreq/1.E+6;"MHz, Y: ";Y;" dB"
620         Pass=Pass+1
630       END LOOP
640       END
```

---

```
10    ! This program demonstrates the fastest possible 5-point
20    ! group delay measurements possible on the HP 3577A.
30    !
40    ! Data can be dumped by moving the marker or dumping the
50    ! trace.
60    !
70      OPTION BASE 0
80      DIM Mkr(5)                          ! Array holding the 5 marker values for the
90                                          ! filter to be tested
100     DIM Trace(100)                      ! Array holding the 100 trace data points.
110     ASSIGN @Na TO 711
120     ASSIGN @Na__nofmt TO 711; FORMAT OFF
130     Ready__bit=16
140     Meas__complete=4
150     Pass=0
160     Answer$="M"
170     INPUT "Dump Trace (T) or Dump Marker (M): ",Answer$
180     IF (Answer$[1,1]="T") OR (Answer$[1,1]="t") THEN
190       PRINT "Will use Dump Trace"
200       Dump__trace=1
210     ELSE
220       PRINT "Will use Marker Dump"
230       Dump__trace=0
240     END IF
250     Startuptime=TIMEDATE
260     CLEAR @Na
270     OUTPUT @Na;"IPR;"                   ! Preset the instrument
280   !
290   ! Turn off characters and bus diagnostics for greater speed
300   !
310     OUTPUT @Na;"CH0;BD0;"
320     IF Dump__trace THEN
330       OUTPUT @Na;"FM2;"                 ! Use 64 bit binary data format
340     ELSE
350       OUTPUT @Na;"FM1;"                 ! The marker will be dumped in ASCII
360     END IF
370   !
380   ! Select single, linear sweep and delay (display fctn. 1)
```

```
390   !
400     OUTPUT @Na;"SM2;ST1;TR1;DF1;"
410     OUTPUT @Na;"SAM 0 DBM;TR1;BW4;UDI B/R" !  Measurement set up
420     OUTPUT @Na;"RS2;"                      !  Reduced sweep res improves speed.
430                                            !  HP 3577A will change its delay
440                                            !  aperature to 2% of span and beep.
450   !
460   !  Set up the freq definition for a 10.7 MHz bandpass filter
470   !
480     OUTPUT @Na;"FRC 10.7 MHZ;FRS 45 KHZ;STM 0 1 SEC;"
490     OUTPUT @Na;"TKM;ASL;"                  !  Sweep and autoscale for onlookers
500     REPEAT                                 !  Wait for end of measurement
510       Stat=SPOLL(711)
520     UNTIL BINAND(Stat,Ready_bit)
530     OUTPUT @Na;"TKM;"
540     Starttime=TIMEDATE
550     PRINT "Initialization time: "INT((TIMEDATE-Startuptime)* 1000);"msec"
560     LOOP
570       REPEAT                               !  Wait for end of measurement
580         Stat=SPOLL(711)
590       UNTIL BINAND(Stat,Ready_bit)
600       Swptime=TIMEDATE
610       !
620       !  Now the data is taken and a new filter may be selected
630       !  for testing. This selection may occur while this data
640       !  is being dumped
650       !
660       IF Dump_trace THEN
670         !
680         !  Dump the entire trace. Assume that the program
690         !  processes the data during the Donemkr interval that
700         !  currently displays how long this took.
710         !
720         OUTPUT @Na;"DT1,TKM;"              !  dump trace & take new meas
730         ENTER @Na USING "%,2A";Junk$       !  Gets the "#I"
740         ENTER @Na_nofmt;Trace(*)           !  Gets the trace data
750         !
760         !  The "Take Measurement" command in line 720 is
770         !  executed as soon as the "Dump Trace" is complete
780         !  (when the computer has entered it; i.e., now).
790         !
800       ELSE
810         !  Send the commands to dump data at 5 marker
820         !  postions. Then enter them one at a time.
830         !
840         OUTPUT @Na;"MKP 23;DM1;MKP 33;DM1;MKP 50;DM1;MKP 67;
DM1;MKP 77;DM1;TKM;"
850         ENTER @Na;Mkr(1)
860         ENTER @Na;Mkr(2)
870         ENTER @Na;Mkr(3)
880         ENTER @Na;Mkr(4)
890         ENTER @Na;Mkr(5)
900       END IF
```

```
910       Donemkr:
920          Stoptime=TIMEDATE
930          Time__to__sweep=INT((Swptime-Starttime)*1000)
940          Time__to__dump=INT((Stoptime-Swptime)*1000)
950          Time__total=INT((Stoptime-Starttime)*1000)
960          DISP "PASS ";Pass;", SWEEP TIME=";Time__to__sweep;"msec
Dump=";Time_  o__dump;"msec TOTAL=",Time__total;"msec"
970          Pass=Pass+1
980          Starttime=Stoptime
990          END LOOP
995    END
```