Chapter 2
Remote Operation

This chapter contains two sections:

1. General information concerning the operation of the selected interface (either HP-IB or RS-232)
2. Interface commands specific to the HP 3325B.

The first is an overview of the Hewlett-Packard Interface Bus (HP-IB) and its relationship to the HP 3325B as well as a general description of the RS-232 interface. Both contain information that is general interface information, only; i.e., commands that might be used with any instrument.

The second section contains descriptions of commands used specifically for the HP 3325B.

Remote Operation via HP-IB

Description of the HP-IB

The HP-IB is a bus structure that links the HP 3325B to desktop computers, minicomputers, and other HP-IB controlled instruments to form automated measurement systems. The HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488-1978 and ANSI Standard MC 1.1.

All of the active HP-IB interface circuits are contained within the various HP-IB controlled devices. The interconnecting cable is entirely passive and its role is limited to connecting 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 be both a talker and listener, but not at the same time. A controller manages the operation of the bus system by designating which device is to talk and which devices are to listen at any given time. The HP 3325B can be either a talker or a listener.

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 automate, monitor, and coordinate instrument operation as well as process the measurement results. There may be more than one controller on the bus but only one can be active at a time. (Changing the active controller is accomplished with the *pass control* bus message.) One (and only one) of the controllers should be hard-wired as the *system controller*.

Capabilities of the HP-IB

Number of Interconnected Devices

Up to 15 devices, maximum, may be on one contiguous bus.

Interconnection Path/Maximum Cable Length

Star or linear bus network. Total transmission path length = 2 meters times number of devices, or 20 meters, whichever is less, with a maximum of 3 meters separating any two devices.

Message Transfer Method

Byte-serial, 8 bit-parallel, asynchronous data transfer using a 3-wire handshake.

Data Transfer 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; secondary (2-byte) addresses: 961 talk, 961 listen. 1 talker and 14 listeners, maximum, at one time. The HP 3325B has only primary address capability. Table 2-2 lists the talk and listen HP-IB addresses.

Multiple Controller Capability

In systems with more than one controller, only one controller 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 per system.

Interface Circuits

Driver and receiver circuits are TTL compatible.

Bus Structure

The HP-IB signal lines consist of eight data lines (DIO1–DIO8), five bus management lines, (explained in following text), and three handshake lines. This is shown in figure 2-1.

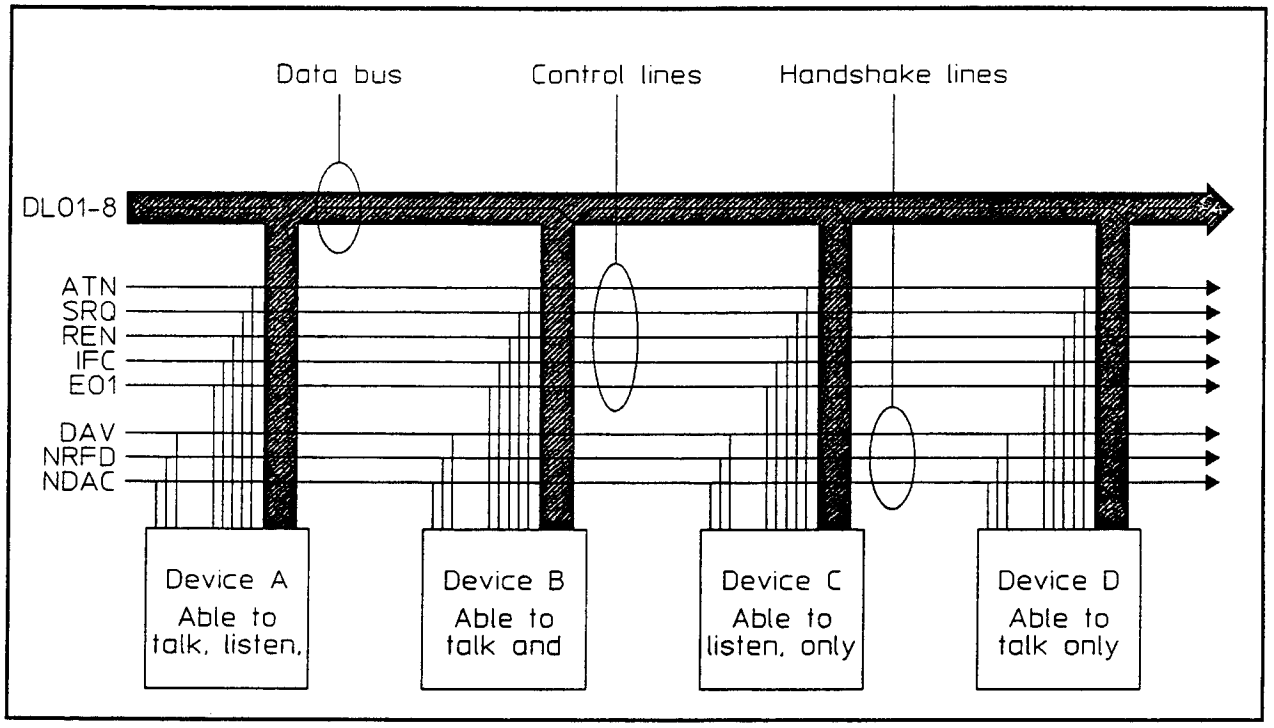


Figure 2-1. HP-IB Structure

HP-IB Management (Control) Lines

ATN — Attention. This line is used by the active controller to define how information on the data lines should be interpreted by other devices on the bus.

When ATN is low (true) the HP-IB is in the *command mode* and the data lines should be interpreted as *bus commands* (see "Bus Commands" later in this chapter). In the command mode the controller is active and all other devices are waiting for instructions. Also, devices on the HP-IB are addressed or unaddressed as listeners or talkers while the bus is in command mode.

When ATN is false the HP-IB is in *data mode* and the data lines should be interpreted as device-dependent commands. In the *data mode*, data and instructions are transferred between devices on the HP-IB. Instructions transferred to the instrument are called *device-dependent commands*. All the commands specifically for the HP 3325B fall into this category. The HP 3325B device-dependent commands configure the HP 3325B, initiate measurements, initiate data transfers, or define error-reporting conditions. These device-dependent commands are meaningless for other instruments. The HP 3325B device-dependent commands are listed later in this chapter under the heading "HP 3325B Remote Operation Command Set."

SRQ — Service Request. This line is set low (true) by any instrument requiring service. The controller should be programmed to respond to most service requests by polling the devices on the bus to determine which one initiated the request. The HP 3325B responds to a serial poll by putting its status byte on the data lines.

REN — Remote Enable. The system controller must set REN low and then address specific device(s) to listen before they can operate under remote control.

IFC — Interface Clear. Only the *system controller* can activate the IFC line. When IFC is set true (low), all devices on the bus become inactive.

EOI — End Or Identify. This line is used to indicate the end of a multiple-byte transfer sequence (in the *data mode*) or by the controller, in conjunction with ATN, to execute a parallel poll.

HP 3325B HP-IB Capability

The HP 3325B interfaces to the HP-IB as defined by IEEE Standard 488-1978. The interface functional subset which the HP 3325B implements is specified in table 2-1.

Table 2-1. HP 3325B HP-IB Capability

Code	Function
SH1	Complete source handshake capability
AH1	Complete acceptor handshake capability
T6	Basic talker; serial poll; unaddressed to talk if addressed to listen; no talk-only
L3	Basic listener; unaddressed to listen if addressed to talk; listen-only
SR1	Complete service request capability
RL1	Complete remote/local capability
PP0	No parallel poll capability
DC1	Device clear capability
DT1	Device trigger capability
C0	No controller capability
E1	Driver electronics – open collector

Talk/Listen Addresses

Each HP-IB device has at least one talk and one listen address unless the device is either totally transparent or is a talk-only or listen-only device. Device addresses are used by the active controller in the *command mode* (ATN true) to specify the talker (via a talk address) and the listener(s) (via listen addresses). Only one device may be addressed to talk at a time.

The address of a device is usually preset at the factory but may be set to another value during system configuration. In the binary representation of the address, the device address is the decimal equivalent of the five least-significant bits of the address. (On HP-IB devices with selector switches, these are the five address switches.) The address can be from 0 to 31, inclusive. The sixth and seventh bits determine if the address is a talk or listen address, respectively. High-level HP-IB controllers typically configure these two bits automatically. Table 2-2 lists the HP-IB addresses if a controller requires the talk and listen addresses.

Table 2-2. HP-IB Addresses

Device Address	Binary Address	Address Characters Talk	Listen	
0	0000 0000	@	Space	
1	0000 0001	A	!	
2	0000 0010	B	"	
3	0000 0011	C	#	
4	0000 0100	D	$	
5	0000 0101	E	%	
6	0000 0110	F	&	
7	0000 0111	G	'	
8	0000 1000	H	(	
9	0000 1001	I	)	
10	0000 1010	J	*	
11	0000 1011	K	+	
12	0000 1100	L	,	
13	0000 1101	M	-	
14	0000 1110	N	.	
15	0000 1111	O	/	
16	0001 0000	P	0	
17	0001 0001	Q	1	(HP 3325B default address)
18	0001 0010	R	2	
19	0001 0011	S	3	
20	0001 0100	T	4	
21	0001 0101	U	5	(typically the controller)
22	0001 0110	V	6	
23	0001 0111	W	7	
24	0001 1000	X	8	
25	0001 1001	Y	9	
26	0001 1010	Z	:	
27	0001 1011	[	;	
28	0001 1100	\	<	
29	0001 1101	]	=	
30	0001 1110	^	>	

The talk and listen addresses fall within the printable ASCII character set. When a device receives one of these characters while ATN is true, it becomes addressed. The ASCII character "?" (ASCII 31) unaddresses all devices while ATN is true. The device address (set from the HP 3325B front panel) is used by HP-IB controllers, most of which automatically send the talk and listen address characters.

Viewing the HP 3325B HP-IB Address

The HP-IB address is stored in a nonvolatile memory location(there are no address switches). The address appears in the display when you press [Bus Adrs] key ([Shift] [Local]). The address message is removed from the display by pressing another key that requires the display.

Changing the HP-IB Address

Every device on the HP-IB must have a unique address. The HP 3325B address can be set at any address between 0 and 31, inclusive, and is stored in internal nonvolatile memory. When selecting an address, remember that the controller also has an address (usually 21).
To change the HP-IB address:

1. Press the blue [Shift] key followed by the [Local] key in the HP-IB Status block to display the HP-IB address.
2. Enter the address with the data entry keys or change it with the arrow keys.
3. Press any units key to enter the new address.

Notes

An address entry of 31 sets the HP 3325B to *listen only* and the message "Addr. = LO" appears in the display.

If you enter an address greater than 31, the message "Error 100" appears in the display (entry parameter out of range).

The HP-IB address is reset to 17 after a memory clear operation (hold down the Preset key and cycle power).

Bus Commands

The HP-IB interface system operates in one of two modes, controlled by the ATN bus management line: *command mode* (ATN true) or data mode (ATN false). (If an HP controller is used, the bus management lines are configured automatically and all necessary command strings are issued.)

Bus commands are issued while the HP-IB is in the command mode. These commands may instruct the instrument's HP-IB interface to control the instrument (like Clear or Trigger) but are more often used for bus management (Remote, Local, Polls, Service Request, Abort interface activity, or Pass Control). Bus commands are issued through the use of one of the five bus management lines or through the eight-bit data bus. The bus commands and the HP 3325B responses to them are described in the following:

Abort

The *abort* command (interface clear – IFC true) halts all HP-IB activity. The system controller assumes unconditional control of the bus. The HP 3325B responds by becoming unaddressed.

Clear

The clear command causes all devices addressed to listen to reconfigure themselves to a predefined device-dependent condition. The HP 3325B responds to the clear command (both the device clear, DCL, and selective device clear, SDC) by clearing the interface command buffer of any pending commands, clearing the error register, and resetting the instrument to the Preset state.

Clear Lockout/Set Local

The clear lockout/set local command removes all devices from the local lockout mode and returns the HP 3325B to local (front panel) control. The HP-IB is in the local mode because the REN bus management line is set false.

Local

The *local* command clears the remote command from the listening device and returns the listening device to local (front panel) control. If local lockout is not in effect, the HP 3325B responds by returning to front panel control. The Remote indicator on the front panel extinguishes if the HP 3325B is in Remote prior to the Local command.

Local Lockout

The *local lockout* command disables the Local front panel key to avoid operator interference. The HP 3325B front panel is locked out.

Parallel Poll

The *parallel poll* command is a controller operation used to obtain information from the devices under its control. The HP 3325B does not respond to this bus command.

Pass Control

The *pass control* command shifts system control from one controller to another. The HP 3325B does not respond to this command.

Remote

The *remote* command directs an instrument to take instructions from the HP-IB instead of the instrument's front panel. To implement the remote command, the controller must set the REN bus management line true. When the HP 3325B accepts the remote command, the Remote front panel indicator illuminates and the front panel is disabled except for the Local key which can return control of the instrument to the front panel if pressed. If the *local lockout* message is also issued, the mode cannot be changed from remote to local via the front panel [Local] key.

Serial Poll

The *serial poll* is issued by the active controller along with a specific address. If the address matches the address setting of the HP 3325B, it responds by putting its status byte on the data lines for the controller to read. The HP 3325B status byte consists of eight bits indicating the states of several operating parameters (refer to "The Status Byte").

Service Request

The *service request* (SRQ) bus management line is used by a device to indicate a need for attention from the controller. When the HP 3325B requires service (as is determined by the setting of the status byte mask) it issues an SRQ (pulls the SRQ line low), sets bit 6 of the status byte (see the "Status Byte"), and illuminates the front panel SRQ indicator. The SRQ is cleared by executing a serial poll of the HP 3325B. Bit 6, the require-service bit, is sometimes referred to as the status bit in connection with a poll. Bits 0, 1, 2, and 3 in the status byte may initiate an SRQ, depending on the setting of the status byte mask. The status byte may be masked to select which of the four bits cause the HP 3325B to issue the SRQ.

Trigger

The *group execute trigger* (GET) or *selective device trigger* (SDT) command causes all addressed instruments with HP-IB trigger capability to execute a predefined function simultaneously. The HP 3325B responds to the HP-IB trigger command by starting a single sweep, providing the HP 3325B is in the enhancements mode and the sweep was reset using the RSW command.

Masking The Status Byte

The HP 3325B MS and ESTB commands specify which bits in the status byte are enabled (to generate an SRQ). These commands are described under the HP 3325B Remote Control Command Set. Table 2-3 describes the HP 3325B status byte and lists the decimal value of each bit position.

The Status Byte

The status byte is an eight-bit word transmitted by the HP 3325B in response to a serial poll. The state of each bit indicates the status of an internal HP 3325B function. Table 2-3 describes the HP 3325B status byte bit positions and the events and conditions that set and reset each bit. A status bit is enabled (set) when the condition it represents changes from false to true. When a bit is enabled, bit 6 is also set and an SRQ is generated if the Boolean AND of the status byte and the status byte mask is not equal to zero. See the MS command and table 2-3 for more information on masking the status byte.

Table 2-3. HP 3325B Status Byte

Bit	Value	Description
B0	1	**ERR.** Program or front panel entry error. Use IER or ERR? to query for error number. Set when an error occurs. Cleared by a serial poll, QSTB?, or power on. Not cleared by HP-IB clear, *RST, ERR?, or IER commands.
B1	2	**STOP.** Sweep stopped; set by completion of a single sweep or by and command that stops a single sweep. Cleared by a serial poll, QSTB?, or starting a sweep. Not cleared by the HP-IB clear command, *RST command, or a single sweep reset.
B2	4	**START.** Sweep started. Set when a dingle or continuous sweep starts. Cleared by serial poll, QSTB?, completion of a single sweep, or any command that stops a sweep.
B3	8	**FAIL.** Hardware failure. Set by Self Test failure, Calibration failure, External Reference Unlock, Oscillator Unlocked, or Memory Lost conditions. Cleared by power-on, serial poll, and QSTB?. Not cleared by HP-IB clear or *RST.
B4	16	**Bit 4.** Always zero.
B5	32	**SWEEP.** Set when a sweep is in progress, clear when a sweep is not in progress. Cannot be configured to cause SRQ.
B6	64	**Require Service.** Set when the HP 3325B requires service (sent an SRQ). Its main function is to identify the instrument as having requested service when it is polled by the controller. It is set by the occurrence of an event which sets the ERR, STOP, START, or FAIL bits (if they are not masked; see the MS command and table 2-34). Cleared by a serial poll or QSTB? command, an HP-IB clear command, a *RST (reset) command, when the HP 3325B is preset (front panel), or when power is cycled. NOTE: this status bit is not set if one of the bits which sets it is set but masked, and is then unmasked. Recommend you poll after changing the mask.
B7	128	**BUSY.** Set while a command is being executed, clear when instrument is not busy. Cannot be configured to enable SRQ.

Remote Operation via RS-232 Interface

Description of the RS-232 Interface

The RS-232 interface provides a serial data communications link between the HP 3325B and controllers such as desktop computers.

Note The RS-232C interface can be used when it is not possible or feasible to use the HP-IB. Never try to use both the RS-232 interface and HP-IB at the same time.

Serial data communication differs from the HP-IB in that serial data is transmitted one bit at a time while the HP-IB moves a byte (eight bits) at a time. The serial data format is shown in figure 2-2.

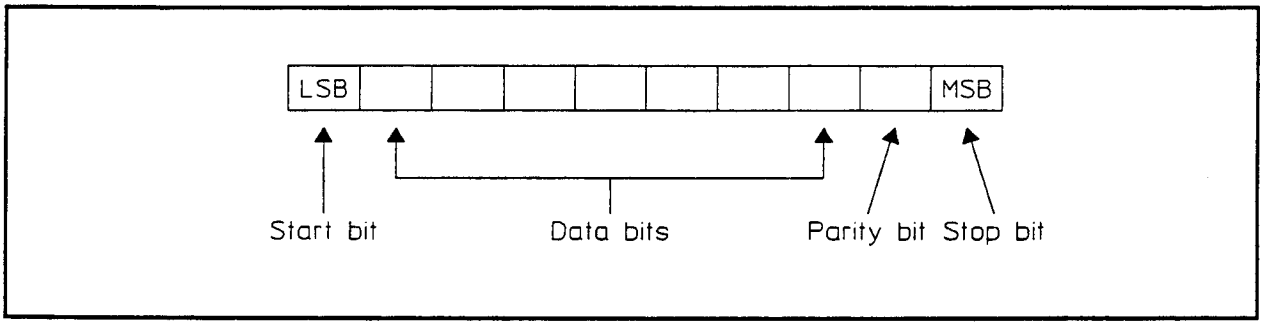


Figure 2-2. Serial Word Conifiguration

The HP 3325B RS-232 interface implements a subset of the signals defined in ANSI/EIA-232-D-1986 and CCITT V.24. The connector is a standard 25-pin female connector configured as Data Terminal Equipment (DTE). The HP 3325B sends and receives ASCII characters using an asynchronous format.

Table 2-4. RS-232 Connector Pin Assignments

Pin No.	Signal Name and Description
1	**Shield:** Connected to the HP 3325B chassis.
2	**BA or TXD (transmit data):** Bit-serial data transmitted from the HP 3325B.
3	**BB or RXD (receive data):** Bit-serial data received by the HP 3325B.
4	**CA or RTS (request to send):** An output from the HP 3325B that is usually +10V. If **hardware handshaking** is enabled, this signal changes to −10V when the HP 3325B buffer has room for less than 128 characters.
7	**AB or Signal Ground:** The reference potential for other signals. Note: *to prevent ground loops, the HP 3325B RS-232 interface circuits are isolated from earth ground and from signal ground.*
20	**CD or DTR (data terminal ready):** An output from the HP 3325B that is usually +10V. If **hardware handshaking** is enabled, this signal changes to −10V when the HP 3325B buffer has room for less than 128 characters.
	No other pins are connected.

The Cable

A standard printer cable should be used to connect the HP 3325B to another DTE device such as a computer or terminal. The printer cable switches the receive and send connections, as is necessary when a DTE device is connected to another DTE device. Use an HP 13242G to connect the HP 3325B to a controller with a 25-pin connector. Use an HP 24542G to connect to a 9-pin male connector as may be found on a serial interface in a desktop computer. Use an HP 92221P to connect to a 9-pin female connector as may be found on HP Series 9000/300 computers.

A standard modem cable should be used to connect the HP 3325B to a modem (HP 13242N).

Setting The Switches

Seven switches on the RS-232C rear panel determine the interface's baud rate, active handshake, and parity. All switches are set to the up position at the factory. New settings are recognized immediately displayed on the front panel when a switch setting is changed. The switch settings are defined in the following pages.

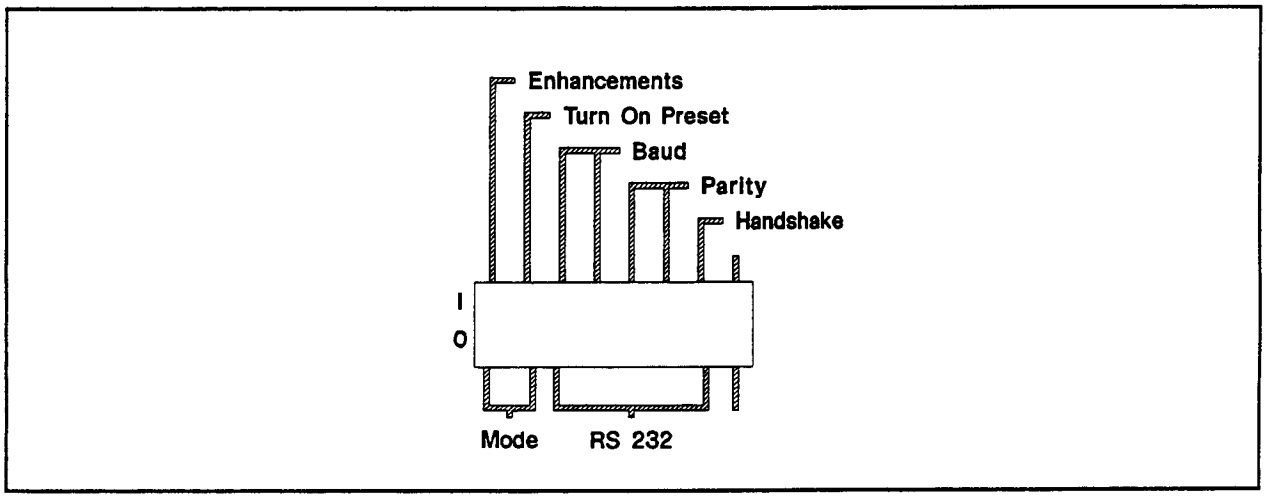


Figure 2-3. Rear-panel RS-232 switches

Mode Settings

Switches 1 and 2 select the enhancements/compatibility setting and the power-on state of the HP 3325B. These two switches are not directly tied to remote operation of the HP 3325B. They are explained here, in the remote control chapter, for the sake of completeness. They are explained again in Chapter 3, General Information.

Enhancements – Switch 1 determines the enhancement setting. Enhancements refers to capabilities that are improved on or added to those of the HP 3325A. When the enhancement mode is off, the HP 3325B is in the compatible mode. The enhancements mode may also be controlled with the ENH command as described later in this chapter.

Turn-On Preset – Switch 2 determines the turn-on settings. The choice is between the instrument preset state or the state of the instrument when it was last turned off.

Table 2-5. Mode Settings: switches 1 and 2

	Up	Down
Switch 1 – Enhancements	on	off
Switch 2 – Turn-on state	Preset	Turn-off state*

* *Requires that enhancements be on*

Baud Rate

Four different baud rates are available. These are selected by changing rear panel switches numbers three and four as shown in table 2-6. When a switch is changed the new baud rate is displayed on the front panel.

Table 2-6. Baud Rate Selection: switches 3 and 4

Baud Rate	Switch 3	Switch 4
300	up	up
1200	up	down
2400	down	up
4800	down	down

Word Length and Parity

Word length and parity are selected by setting switches five and six as shown in table 2-7.

Table 2-7. Switch settings for word length and parity: switches 5 and 6

Description	Switch 5	Switch 6
7 data bits, 1 parity bit, even parity	up	up
7 data bits, 1 parity bit, odd parity	up	down
8 data bits, no parity	down	up
7 data bits, 1 parity bit, parity bit always 0 (zero)	down	down

Handshake Selection

Handshaking, or receive pacing, is performed by the HP 3325B to prevent its character buffer from overflowing. Data is lost if it is sent to the HP 3325B when its data buffer is full. The data buffer can hold 256 characters. The handshaking may be accomplished with one of two different methods, selected with switch 7: *software handshake* or the *hardware handshake*.

When *software handshaking* is selected, the HP 3325B sends the Xoff character (decimal 19 or DC3) when there is room for less than 128 characters in its buffer. After sending Xoff the HP 3325B processes characters until there is room for 256 characters, when it sends the Xon character (decimal 17 or DC1) to indicate that it is ready for more characters.

The *hardware handshake* performs the same function using hardware connections to signal its readiness for data. Both the RTS (request to send) and DTR (data terminal ready) lines become false (−10V) when there is room for less than 128 characters in the character buffer. This handshake is not recommended when the HP 3325B is connected to a modem since dropping the DTR line may cause the modem to disconnect.

The HP 3325B uses receive handshaking, only. It does not respond when it receives the Xoff character and no hardware connection is made which would signal it to stop sending data. All data sequences sent by the HP 3325B are short enough that transmit pacing should not be necessary.

Table 2-8. Setting the Handshake: switch 7

Handshake description	Switch 7
Software (Xon/Xoff)	up
Hardware (DTR/RTS)	down

Remote and Local Functions

The first character of a remote command puts the HP 3325B in *Remote Mode* which causes the Remote LED to illuminate. The Talk and Listen LEDs are not used when using the RS-232 interface for remote control. When the HP 3325B receives the "LCL" command or the [Local] front-panel key is pressed, the HP 3325B returns to front-panel control.

Other remote-control commands that are useful for RS-232 operation are ECHO, RMT, *RST, and QSTB. These are described in more detail later in the chapter.

Note The RS-232 interface does not alert the controlling computer when the instrument issues a service request (SRQ), as the HP-IB does. We recommend checking the status byte periodically with the QSTB? command when the RS-232 interface is used for remote control.

HP 3325B Remote Operation Command Set

The commands for operating the HP 3325B with a computer controller are listed here. Some of these commands correspond to front-panel keystrokes; the rest are remote-only commands. Remote commands corresponding to front panel keys are described in Chapter 1.

The HP-IB Remote status light, located in the HP-IB Status block on the left side of the front panel, indicates whether the instrument is currently operating under *local* (front panel control) or *remote* control. Remote operation is accomplished only via commands transmitted through one of the two interface connectors located on the rear panel.

Note The Remote indicator on the HP 3325B can be used for a quick operational check of the remote interface. If you are using the HP-IB interface, refer to the controller operating manual for a description of the HP-IB Remote message. If you are using the RS-232 interface, send the RMT command. When this message is sent to the HP 3325B, the Remote indicator should illuminate. If this does not occur, check the cabling, the HP 3325B HP-IB address and the syntax of the controller statement (for HP-IB), or the baud rate, word length and parity settings (for RS-232).

Changing from local control to remote control does not alter the current operating state. Changing from local to remote control may be accomplished by issuing a remote command such as REMOTE (HP-IB) or RMT (RS-232).

Changing the HP 3325B from remote control to local control causes the HP 3325B to return to front panel control without changing the operating state. This may be accomplished by either pressing the [Local] key (if local lockout is not in effect), or by issuing a command remote command such as LOCAL (an HP-IB bus message) or LCL (an RS-232 command).

Command Syntax

The following conventions apply to the HP 3325B HP-IB commands:

- The HP 3325B accepts data in 7-bit ASCII code and ignores the 8th (parity) bit.
- All spaces and lower case alphabetic characters are ignored by the HP 3325B; they may be used to improve program readability.
- Under HP-IB control, two data transfer modes are available. Refer to the MD command for more detail. An asterisk or line feed is required to terminate a command string in data transfer mode 2.
- A semicolon can be used to separate commands (recommended but not required).
- Range values may be in integer, real, or exponential form. For positive values, only the first eleven digits of the mantissa are used. For negative values, only the first ten digits of the mantissa are used. Leading zeros before the decimal point are ignored.

The HP 3325B uses the following forms for remote commands:

Command Form	Example	Example Description
<mnemonic>	AC	Amplitude Calibrate
<mnemonic> <data>	FU2	Square wave function select
<mnemonic> <rangedata> <suffix>	AM1.2VO	Amplitude of 1.2 V_{pp}
<mnemonic>?	FR?	Interrogate frequency
<mnemonic>	IFR	Interrogate frequency

where:

- **<mnemonic>** is the HP-IB mnemonic
- **<suffix>** is an alphabetic code for units, function, or mode
- **<data>** is a numeric code for a function or mode
- **<range data>** is the value for an entry parameter
- **?** is used to interrogate the HP 3325B.

A program string for the HP 3325B may contain multiple HP-IB commands such as

"FU2 FR 1 MH AM 2 VO FR?"

Interrogating The HP 3325B For Setup Parameters

The value of a setup parameter is read over the HP-IB by sending the parameter HP-IB mnemonic followed by a question mark (?). For example, sending the mnemonic FR? sets up the HP 3325B to respond with the frequency value. HP-IB data is transmitted when the HP 3325B is addressed to talk. RS-232 data is transmitted 100 ms after the interrogation. Each interrogation response ends with the carriage return (ASCII 13) and line feed (ASCII 10) characters. Each interrogation may include command mnemonic and suffix, depending on the setting of the HEAD command.

Remote Operation via RS-232 Interface

Setup parameters include frequency, amplitude, offset, phase, sweep start frequency, sweep stop frequency, sweep marker frequency, sweep time, modulation source frequency, and modulation source amplitude.The current value for a setup parameter is displayed on the HP 3325B front panel if the corresponding HP-IB mnemonic is sent without data and a suffix. For example, sending the mnemonic AM displays the amplitude value but does not change the amplitude value.

The units for the displayed value of a setup parameter change to new units if the corresponding command mnemonic and new suffix are sent without data. For example, sending the mnemonic AM DB displays the current amplitude value in dBm. Sending the AM DB command does not change the amplitude value.

Note If the display is disabled with the DSP0 command, the requested value is not displayed.

Command Reference

Syntax Drawing Rules

All characters in circles or ovals are terminal symbols and must be sent exactly as shown. Items in boxes are *non-terminal* symbols; descriptions of these items are given following the syntax drawings. Spaces and lower case letters are ignored; they can be inserted to improve readability.

The *Response Format* tables specify what is returned by the instrument in response to a

query. All responses are terminated with <carriage return> and <line feed> with the HP-IB EOI (bus management line) active. The "#" symbol represents one digit.

Definitions

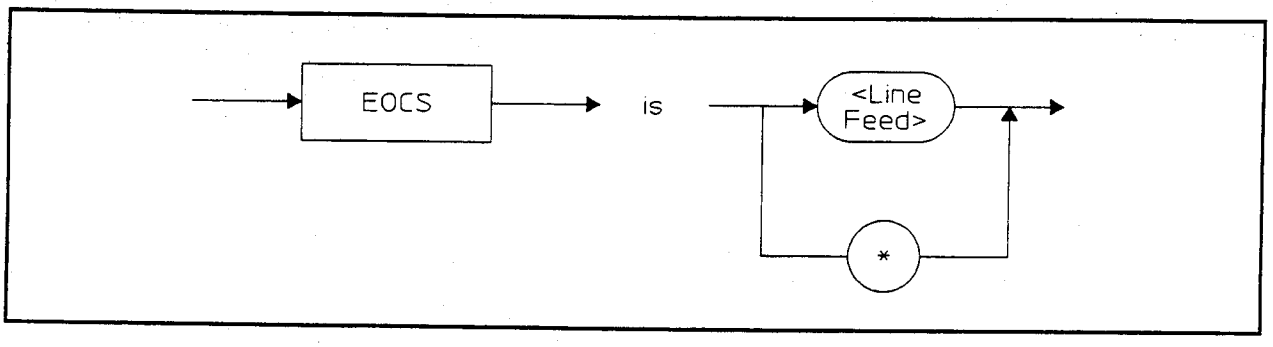


Figure 2-4. Definition of EOCS

The End-Of-Command-String character is used in Data Transfer Mode 2 (see the MD command). In data transfer mode 2, device-dependent commands are accepted and stored in an internal buffer and are not processed until the End-Of-Command-String (EOCS) character is received or the buffer is filled (48 bytes).

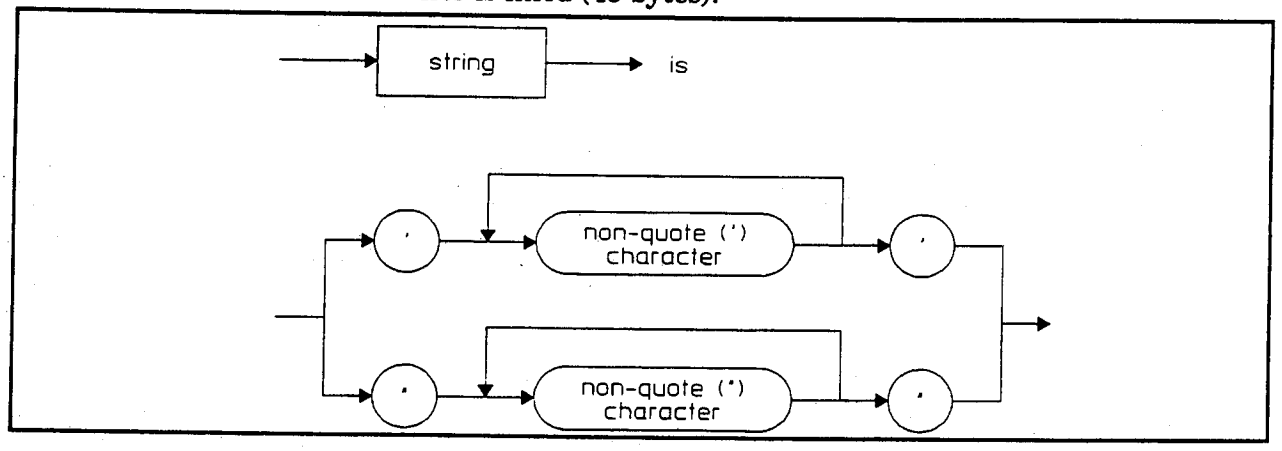


Figure 2-5. Definition of "String"

Strings can not include the End-Of-Command-String characters (* or <line feed>).

AC; Amplitude Calibration Command

The AC command performs an amplitude calibration. If calibration is not successful, the FAIL bit of the status register is set.

Command Availability

	AC
HP 3325B	Yes
HP 3325A	Yes

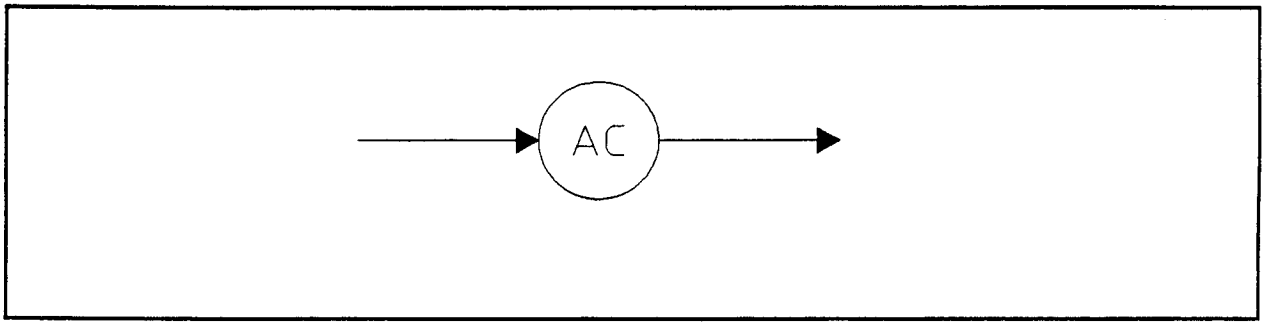


Figure 2-6. AC Syntax Diagram

AM; Amplitude Command

The AM command sets the amplitude of the main signal. Sending AM with no value or units displays the current amplitude. Sending AM and units without any value causes the current amplitude to be displayed in the new units. Issuing IAM or AM? causes the instrument to output its current amplitude. See MOAM to set the amplitude of the modulation source.

Instrument Preset value: 1.0 mV_{pp}

Command Availability

	AM	IAM	AM?	DV
HP 3325B	Yes	Yes	Yes	Yes
HP 3325A	Yes	Yes	No	No

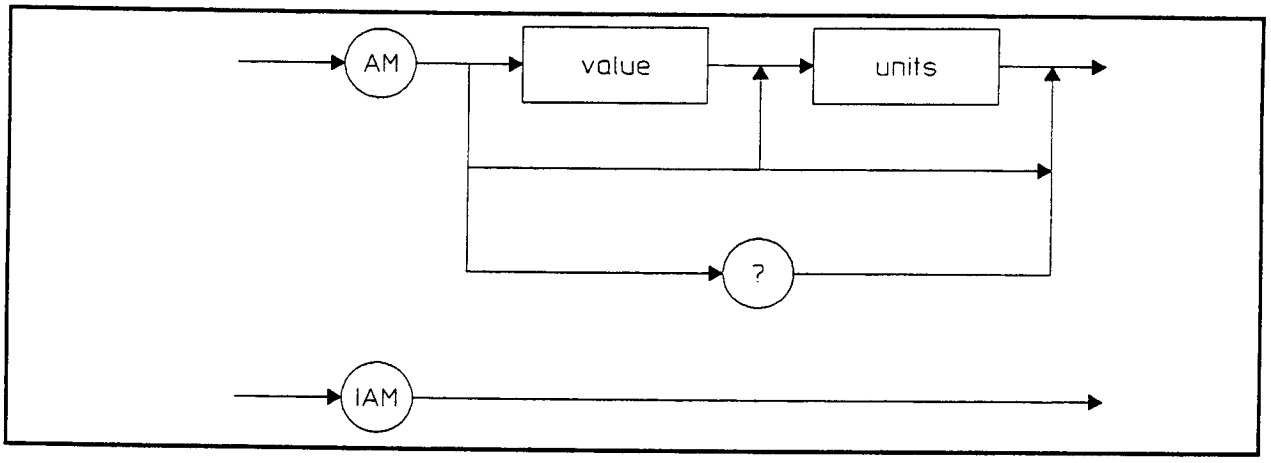


Figure 2-7. AM Syntax Diagram

Table 2-9. AM "value" Restrictions Given "units"

Value range	Units	Description	High Voltage"
0.001 →10.0 0.004 → 40.0	VO	V_{pp} On	Off
1.0 → 10000.0 4.0 → 40000.0	MV	mV_{pp} On	Off
0.000354 →3.53 0.00142 → 14.1	VR	V_{rms} On	Off
0.354 → 3530.0 1.42 → 14100.0	MR	mV_{rms} On	Off
−56.02 → 23.98 Illegal	DB	dBm	Off
−69.01 →10.97 −56.97 → 23.01	DV	dBV_{rms} On	Off

Table 2-10. AM? and IAM Response Format

Current Units	HEAD-on response	HEAD-off response
VO or MV	AM#####.######VO	#####.######
VR or MR	AM#####.######VR	#####.######
DB or DV	AM−#######.###DB	−#######.###
DB or DV (special)	AM−#######.###DV	−#######.###

AP; Assign Zero Phase Command

The AP command assigns the current phase value to zero; subsequent changes in phase are referenced to that point.

Command Availability

	AP
HP 3325B	Yes
HP 3325A	Yes

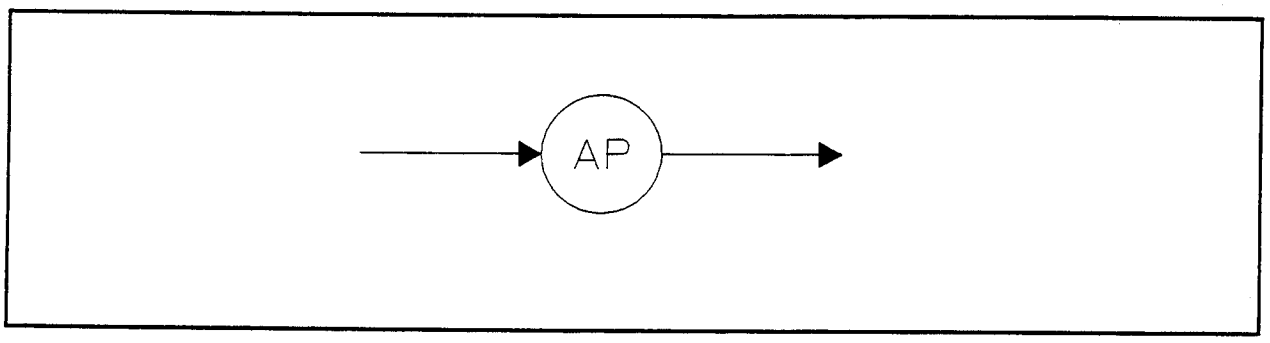


Figure 2-8. AP Syntax Diagram

CALM; Calibration Mode Command

The CALM command allows all functions to be calibrated once. In this mode, function changes are faster.

Instrument Power-on value: 0

Instrument Preset, HP-IB clear value: not changed.

Command Availability

	CALM
HP 3325B	Yes
HP 3325A	No

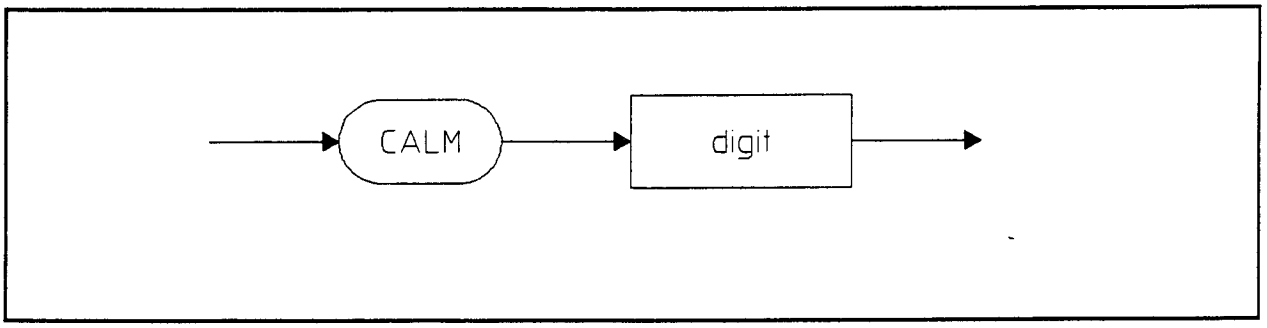


Figure 2-9. CALM Syntax Diagram

Digit	Meaning
0	Perform an Amplitude Calibration whenever the waveform function is changed.
1	Perform an Amplitude Calibration on all functions immediately, do not re-calibrate when waveform function is changed.

DCLR; Discrete Sweep Table Clear Command

The DCLR command clears all previously stored discrete sweep vectors.

Command Availability

	DCLR
HP 3325B	Yes
HP 3325A	No

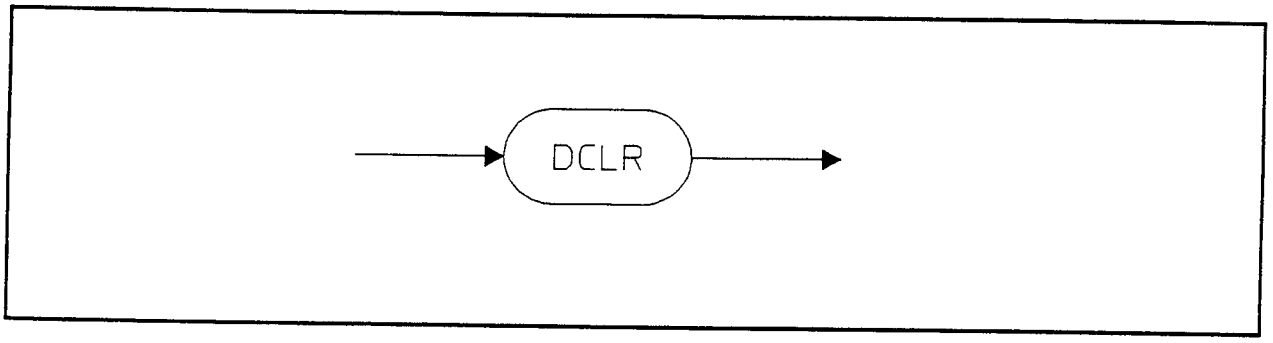


Figure 2-10. DCLR Syntax Diagram

DISP; Display On/Off Command

The DISP command and allows the display to be turned off. "DISP OFF" is displayed until the display is turned back on.

Instrument Power-on value: On

Instrument Preset, HP-IB clear value: not changed.

Command Availability

	DISP
HP 3325B	Yes
HP 3325A	No

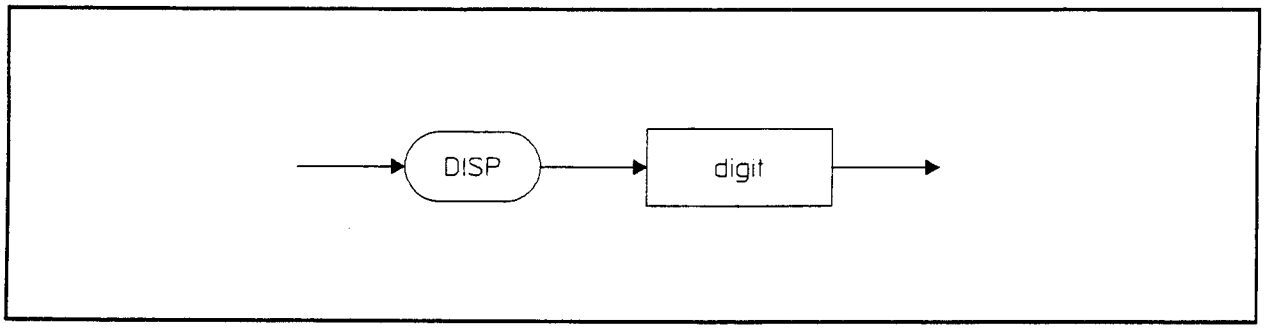


Figure 2-11. DISP Syntax Diagram

digit	Meaning
0	Display off.
1	Display on.

DRCL and DSTO; Discrete Sweep Store and Recall Commands

DRCL recalls the discrete sweep vector number specified by the two digits. Start frequency, stop frequency, marker frequency, and sweep time values are overwritten with the recalled values.

DSTO saves the current start frequency, stop frequency, marker frequency, and sweep time values in the discrete sweep vector number specified by the two digits.

Command Availability

	DRCL	DSTO
HP 3325B	Yes	Yes
HP 3325A	No	No

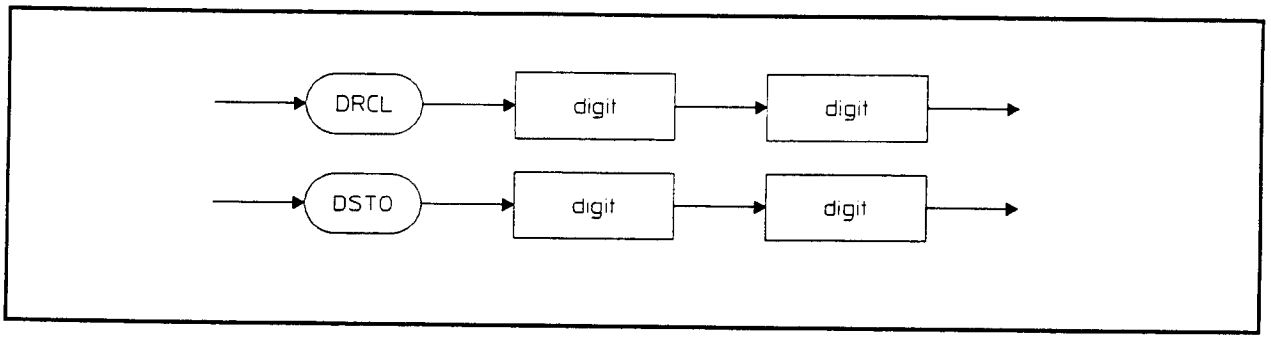


Figure 2-12. DRCL and DSTO Syntax Diagrams

DSP; Display String Command

The DSP command allows a message to be put in the instrument's display. Some alphabetic characters may be hard to distinguish when displayed in the 7-segment numeric displays.

Command Availability

	DSP
HP 3325B	Yes
HP 3325A	No

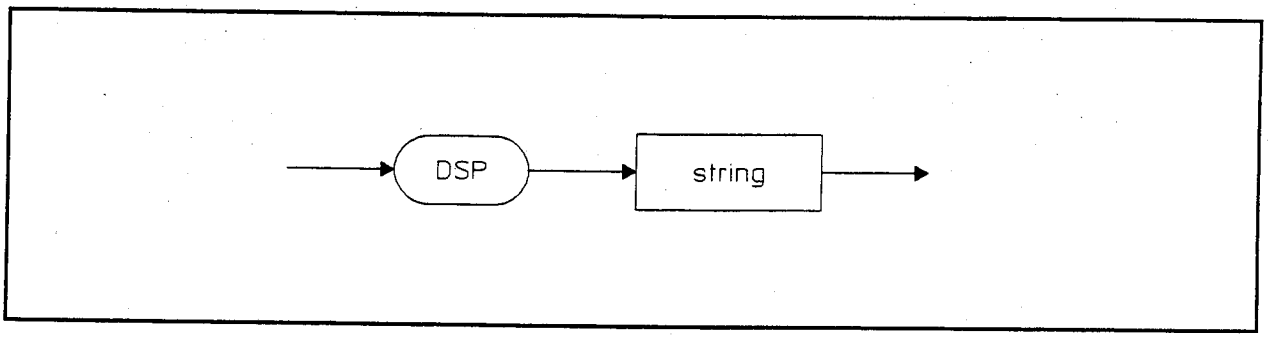


Figure 2-13. DSP Syntax Diagram

ECHO; RS-232 Echo-Control Command

The ECHO command enables echoing of in-bound RS-232 characters. This is useful when using a full-duplex terminal to program the HP 3325B. The carriage return character is

echoed as <carriage return> and <line feed>.

Instrument Preset, HP-IB clear value: not changed

Instrument Power-on value: 0

Command Availability

	ECHO
HP 3325B	Yes
HP 3325A	No

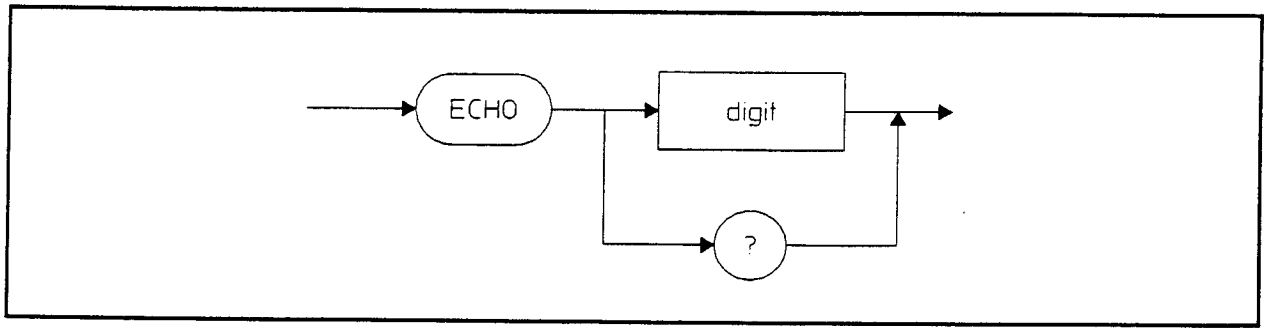


Figure 2-14. ECHO Syntax Diagram

digit	Meaning
0	Do not echo characters.
1	Echo characters.

Table 2-11. ECHO? Response Format

HEAD-on response	HEAD-off response
ECHO#	#

ENH; Enhancements Control Command

The ENH command selects between the *enhancements* mode and the *compatibility* mode. In the *enhancements* mode, new features of the HP 3325B are enabled. In the *compatibility* mode, some new features are disabled, but only those which may cause compatibility problems. Refer to Chapter 3, General Information, for a description of the differences in the two settings.

Instrument Preset, HP-IB clear value: not changed

Instrument Power-on value: rear-panel switch setting

Command Availability

	ENH
HP 3325B	Yes
HP 3325A	No

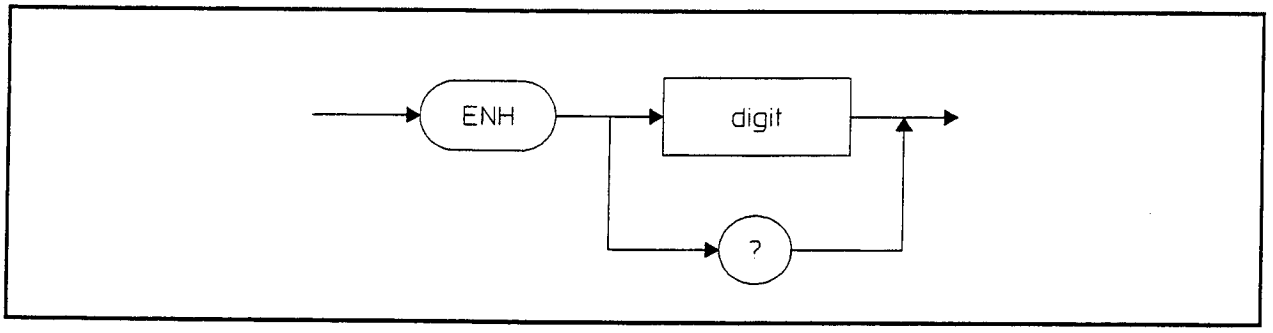


Figure 2-15. ENH Syntax Diagram

digit	Meaning
0	Select the compatibility mode.
1	Select the Enhancements mode.

Table 2-12. ENH? Response Format

HEAD-on response	HEAD-off response
ENH#	#

ERR? and IER; Error Query

These commands query the instrument for the most recent error code. The IER query returns a one-digit code. The ERR? query returns a three-digit code, the first digit of which is the same as the IER query; the other two digits provide more detail as described in table 2-51 later in this chapter. If no error occurred, 0 is returned. Issuing either command clears both error codes to 0.

Instrument Power-on: Clears any errors.

Instrument Preset, HP-IB Clear: Clears any errors.

Command Availability

	ERR?	IER
HP 3325B	Yes	Yes
HP 3325A	No	Yes

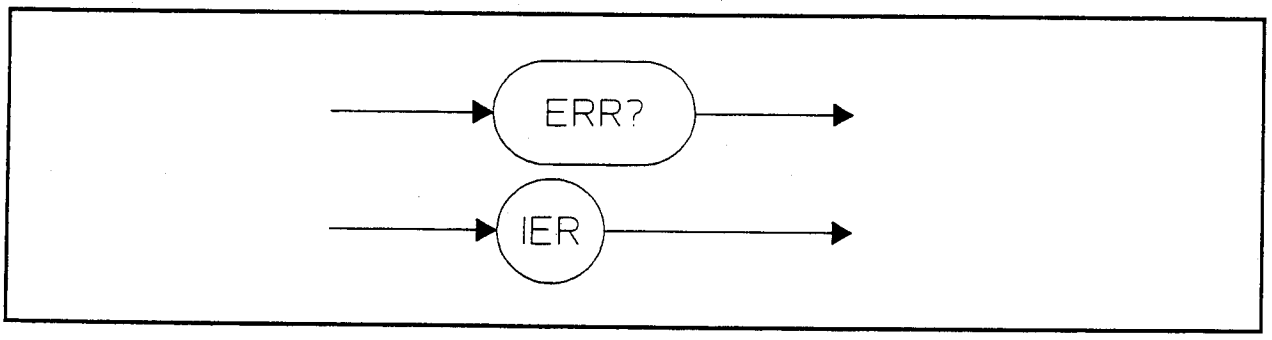


Figure 2-16. ERR Syntax Diagram

Table 2-13. ERR? and IER Response Formats

Command	HEAD-on response	HEAD-off response
ERR?	ERR###	###
IER	ER#	#

ESTB; Service Request Enable Command

The ESTB command is used to set the status byte mask. Four lists in the status byte are capable of causing a service request (SRQ). When they are enabled (unmasked). They may be enabled or masked in any combination as defined in the table 2-34. The MS Command accomplishes the same thing using alpha characters instead of decimal characters.

In the syntax diagram of Figure 2-17, **value** is a decimal number whose binary (base 2) equivalent represents the bits of the Status Register. The range of **value** is 0 thru 15.

Instrument Power-on value: 0 (all masked)

Instrument Preset, HP-IB-clear value: not changed

Command Availability

	ESTB	ESTB?
HP 3325B	Yes	Yes
HP 3325A	No	No

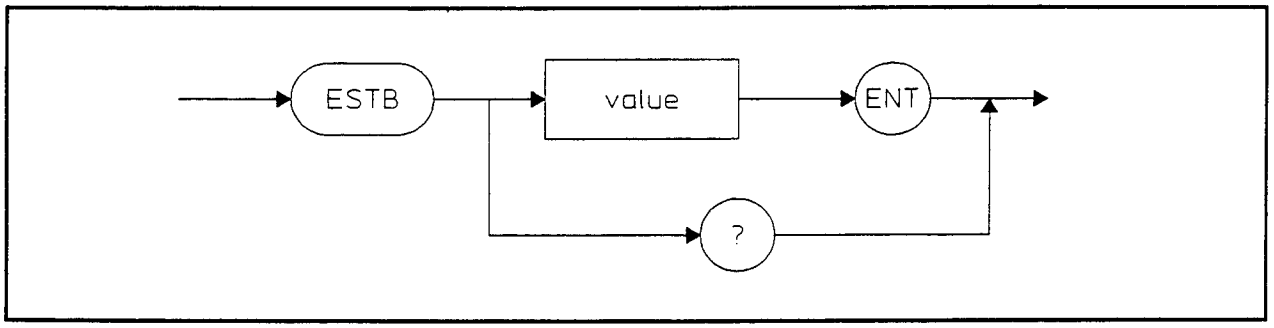


Figure 2-17. ESTB Syntax Diagram

Table 2-14. Status-Register Bits that can be enabled to cause SRQ

Bit	Value	Name	Description
0	1	ERR	Program or keyboard entry error.
1	2	STOP	Sweep stopped.
2	4	START	Sweep started.
3	8	FAIL	Hardware failure.

Table 2-15. ESTB? Response Format

HEAD-on response	HEAD-off response
ESTB###ENT	###

EXTR?; External Reference Locked Query

The EXTR? query returns 1 if the reference oscillator is locked to an external input, 0 if not.

Command Availability

	EXTR
HP 3325B	Yes
HP 3325A	No

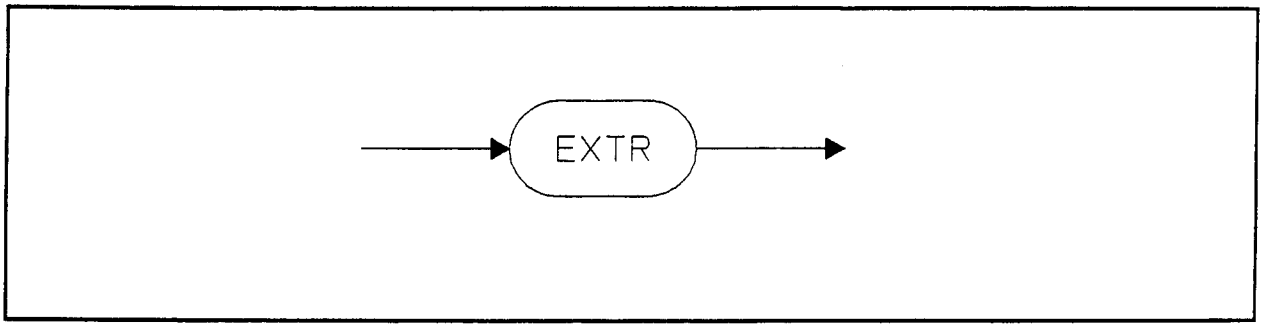


Figure 2-18. EXTR? Syntax Diagram

Table 2-16. EXTR? Response Format

HEAD-on response	HEAD-off response
EXTR#	#

FR; Frequency Command

The FR command sets the frequency. Sending FR with no value or units displays the current frequency. IFR and FR? cause the instrument to output its current frequency. See MOFR to set the frequency of the modulation source.

Instrument Preset value: 1000.0 Hz

Command Availability:

	FR	IFR	FR?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

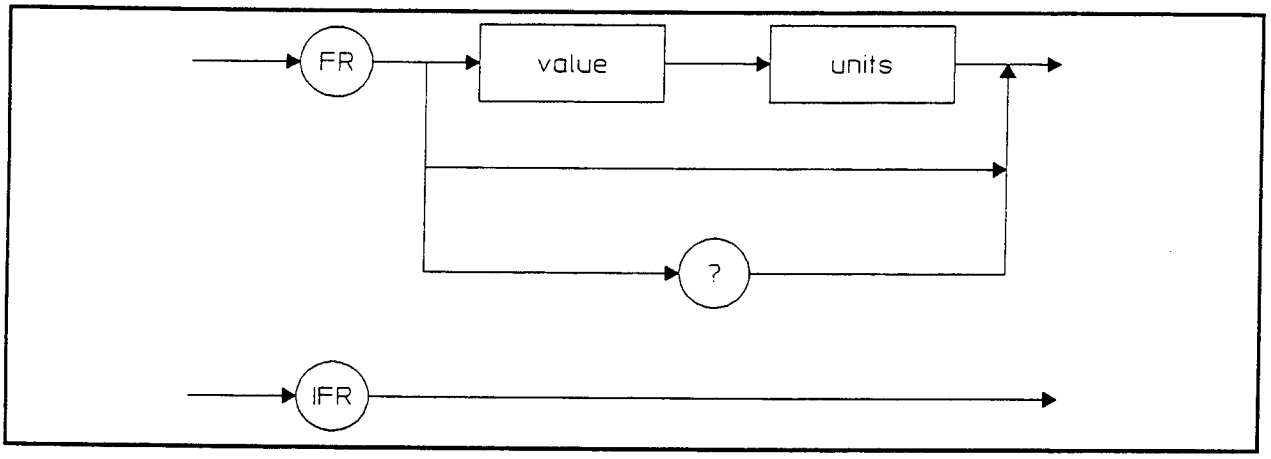


Figure 2-19. FR Syntax Diagram

Table 2-17. FR "value" Restrictions Given "units"

Units	Description	Range Restrictions for "value" (sine)
HZ	Hertz	0.0 → 60999999.999
KH	kHz	0.0 → 60999.999999
MH	MHz	0.0 → 60.999999

Table 2-18. FR? and IFR Response Format

µHz programmed	HEAD-on response	HEAD-off response
No	FR########.###HZ	########.###
Yes	FR#####.######HZ	#####.######

FU; Waveform Function Command

The FU command selects the waveform function for the main signal output.

Instrument Preset value: 1

Command Availability

	FU	IFU	FU?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

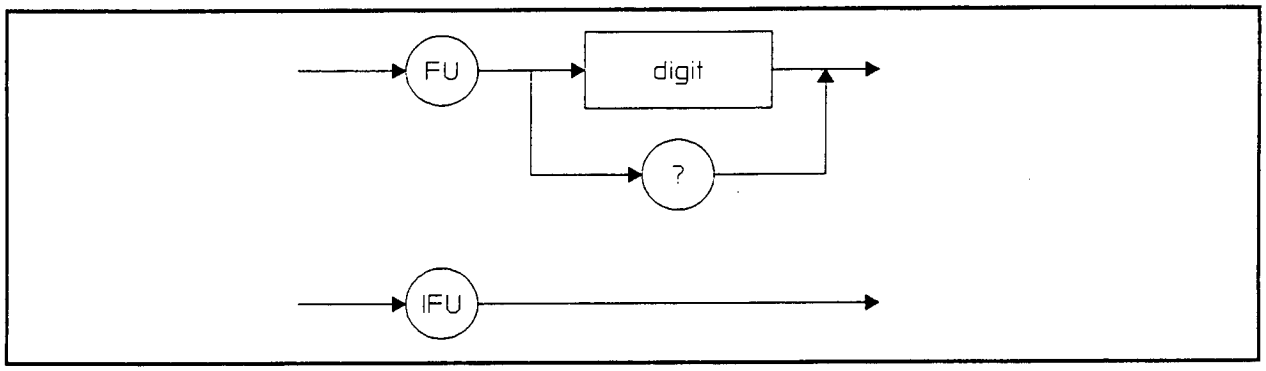


Figure 2-20. FU Syntax Diagram

Table 2-19. Waveform Selections for "digit"

digit	Waveform
0	Selects DC only.
1	Selects Sine wave
2	Selects Square wave.
3	Selects Triangle wave.
4	Selects Positive ramp.
5	Selects Negative ramp.

Table 2-20. FU? and IFU Response Format

HEAD-on response	HEAD-off response
FU#	#

HEAD; Response Header Control Command

The HEAD command enables or disables the alpha header (and units suffix) for query responses. With HEAD on, the response can be used to re-program the item. With HEAD off, only the numerics are sent which can make it easier to read into a numeric variable in a program.

Instrument Power-on value: 1.

Instrument Preset, HP-IB clear value: not changed.

Command Availability:

	HEAD
HP 3325B	Yes
HP 3325A	No

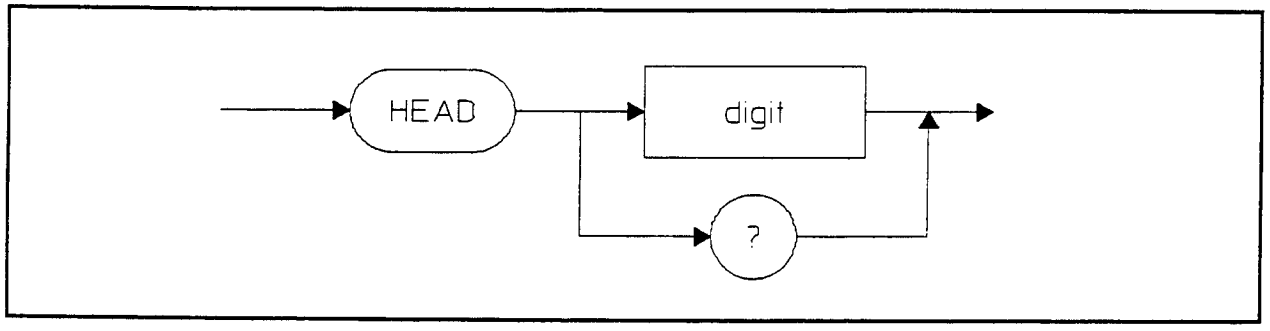


Figure 2-21. HEAD Syntax Diagram

"Digit"	Mode
0	Selects header OFF mode.
1	Selects header ON mode.

Table 2-21. HEAD? Response Format

HEAD-on response	HEAD-off response
HEAD#	#

HV; High Voltage Output Command

The HV command controls the High Voltage amplifier option for the main signal output.

Instrument Preset value: 1.

Command Availability

	HV	IHV	HV?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

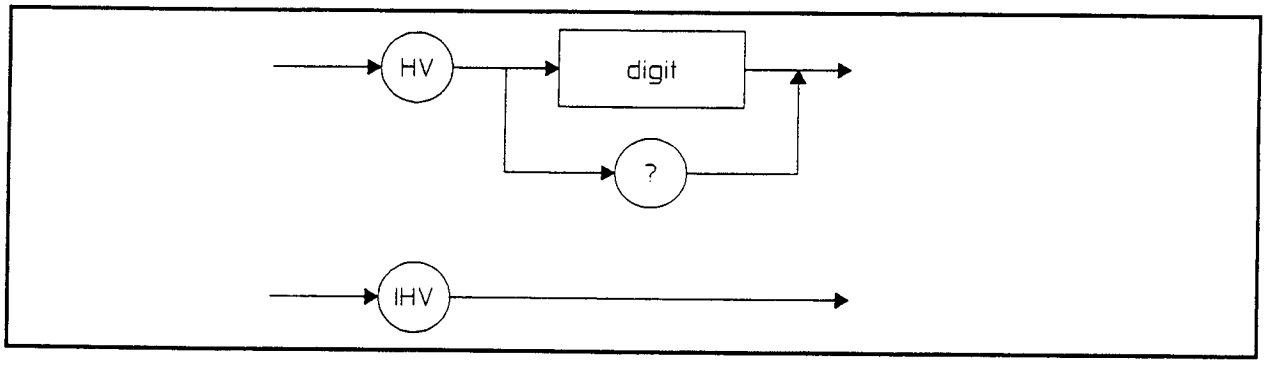


Figure 2-22. HV Syntax Diagram

digit	Meaning
0	Disable the high voltage amplifier.
1	Enable the high voltage amplifier.

Table 2-22. HV? and IHV Response Format

Option installed	HEAD-on response	HEAD-off response
Yes	HV#	#
No	RF#	#

ID?, *IDN?; Identification Query

This query returns the instrument manufacturer, model number, serial number, and firmware revision code.

Note In data transfer mode 2, an asterisk terminates a command string. Therefore use IDN?, without an asterisk, in data transfer mode 2.

Command Availability

	*IDN?	ID?
HP 3325B	Yes	Yes
HP 3325A	No	No

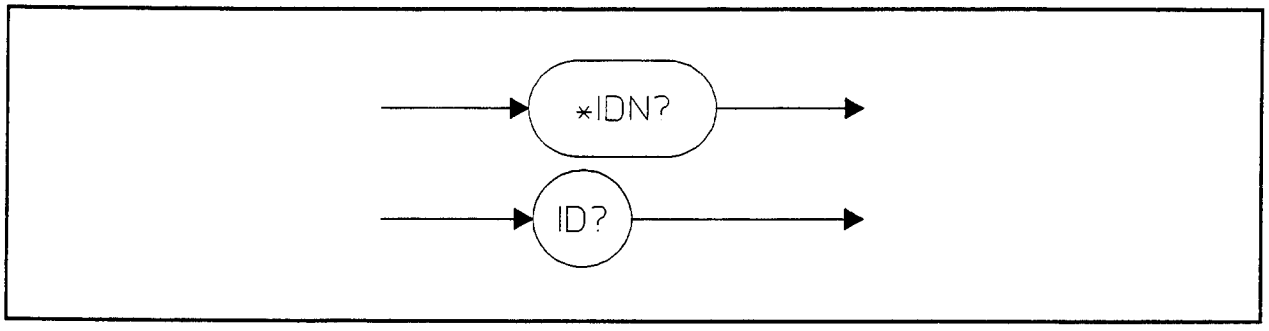


Figure 2-23. ID? and *IDN? Syntax Diagrams

Table 2-23. ID? and *IDN? Response Format

ID? response	*IDN? response
HP3325B	HEWLETT-PACKARD,3325B,2800A00000,2800

LCL; Local Command

The LCL command places the instrument in *local mode* and clears any local lockout. This command has the same effect as the HP-IB *local* bus command but can be issued when using the RS-232 interface.

Command Availability

	LCL
HP 3325B	Yes
HP 3325A	No

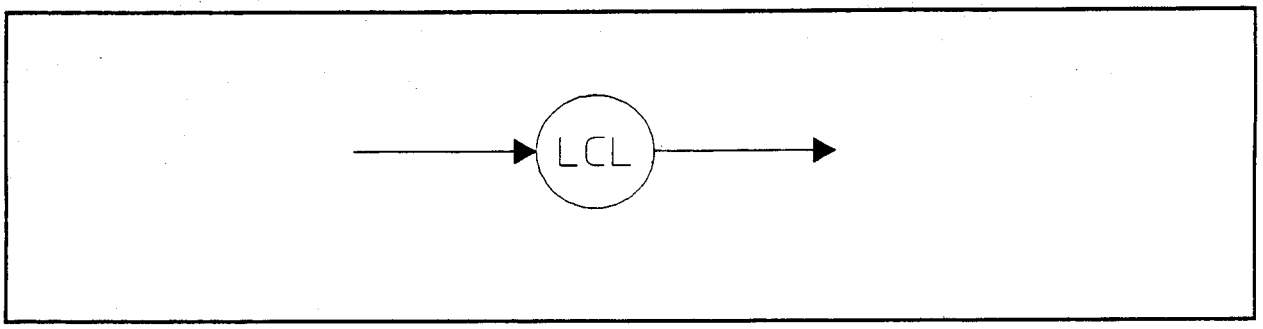


Figure 2-24. LCL Syntax Diagram

MA; Amplitude Modulation Command

The MA command enables and disables amplitude modulation of the main signal output. Amplitude modulation is only valid for sine waves.

Note If MA is enabled and no signal is applied to the AMPTD MOD input, the main signal amplitude is one half of its programmed value since 0 Volts corresponds to 50% modulation.

Instrument Preset value: 0.

Command Availability

	MA	IMA	MA?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

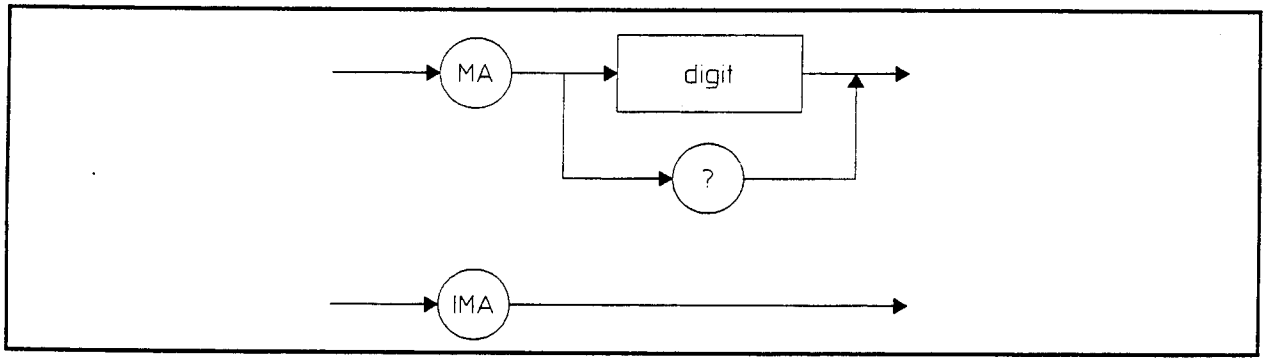


Figure 2-25. MA Syntax Diagram

"Digit	Meaning
0	Disable amplitude modulation.
1	Enable amplitude modulation.

Table 2-24. MA? and IMA Response Format

HEAD-on response	HEAD-off response
MA#	#

MD; Data Transfer Mode Command

The MD command selects the HP-IB data transfer mode. (This command has no effect when the RS-232 interface is used.) In mode 1, each device-dependent character is processed when received. No other communications are permitted on the bus until the entire HP 3325B program string has been accepted and all but the last character processed. In mode 2, device-dependent characters are accepted and stored in an internal buffer; they are not processed until the End-Of-Command-String (EOCS) character is received or the buffer is

filled (48 bytes). Valid EOCS characters are the <line feed> character (ASCII decimal 10) or the asterisk (*) character (ASCII decimal 42).

Instrument Power-on, HP-IB Clear value: 1.

Instrument Preset value: not changed.

Command Availability

	MD	MD?
HP 3325B	Yes	Yes
HP 3325A	Yes	No

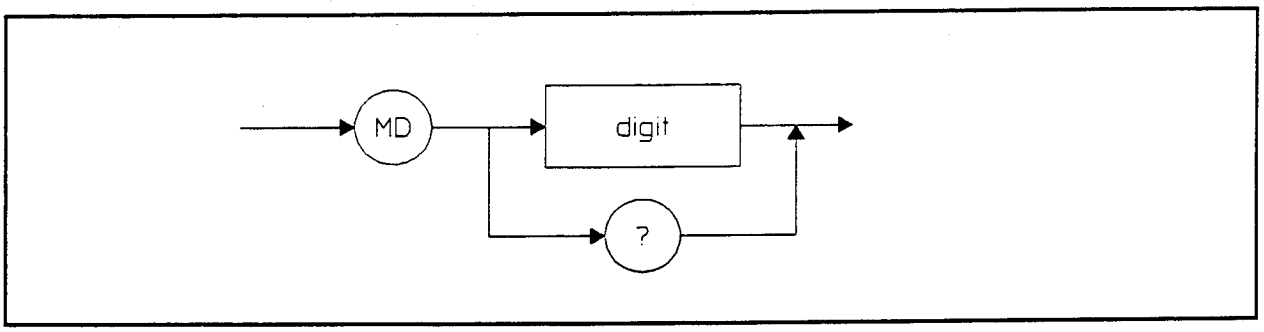


Figure 2-26. MD Syntax Diagram

Digit"	Meaning
1	Each character processed when received.
2	Characters buffered, EOCS starts processing.

Table 2-25. MD? and IMD Response Format

HEAD-on response	HEAD-off response
MD#	#

MF; Marker Frequency Command

The MF command sets the marker frequency. Sending MF with no value or units displays the current frequency. IMF and MF? cause the instrument to output its current frequency.

Instrument Preset value: 5.0 MHz

Command Availability

	MF	IMF	MF?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

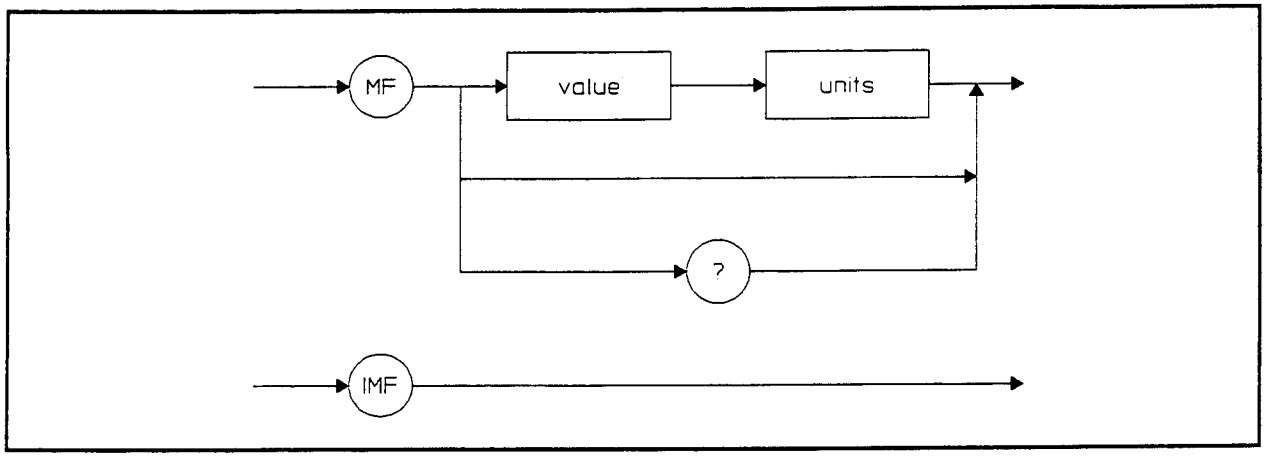


Figure 2-27. MF Syntax Diagram

Table 2-26. MF "value" Restrictions Given "units"

"Units"	Description	Range Restrictions for "value"
HZ	Hertz	0.0 → 20999999.999
KH	kilo-Hz	0.0 → 20999.999999
MH	mega-Hz	0.0 → 20.999999999

Table 2-27. MF? and IMF Response Format

μ Hz programmed	HEAD-on response	HEAD-off response
No	MF########.###HZ	########.###
Yes	MF#####.######HZ	#####.######

MOAM; Modulation Source Amplitude Command

The MOAM command sets the amplitude of the modulation signal. Sending MOAM with no value or units displays the current amplitude. Sending MOAM and units without any value displays the current amplitude in the new units. MOAM? causes the instrument to output the current amplitude.

Instrument Preset value: 0.1 Vpp

Command Availability

	MOAM	MOAM?
HP 3325B	Yes	Yes
HP 3325A	No	No

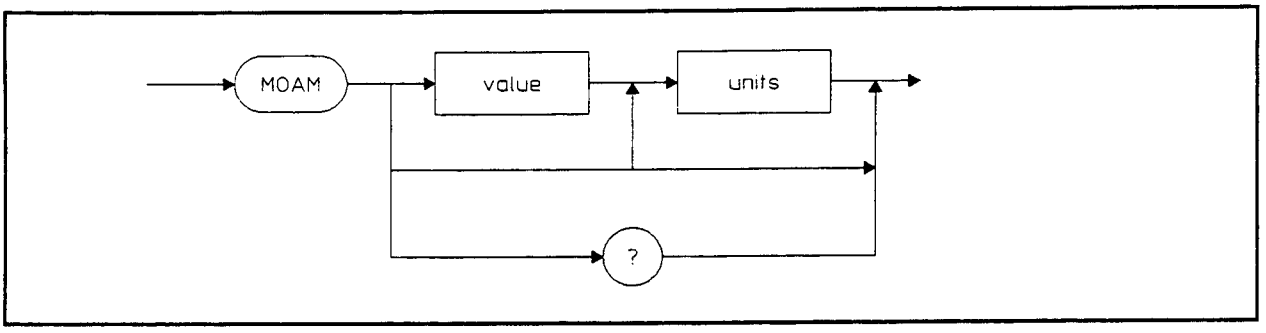


Figure 2-28. MOAM Syntax Diagram

Table 2-28. MOAM "value" Restrictions Given "units"

value range	units	Description
VO	V_{pp}	0.0 → 12.0
MV	mV_{pp}	0.0 → 12000.0
VR	V_{rms}	0.0 → 4.2
MR	mV_{rms}	0.0 → 4200.0

Table 2-29. MOAM? Response Format

Current Units	HEAD-on response	HEAD-off response
VO or MV	MOAM#####.######VO	#####.######
VR or MR	MOAM#####.######VR	#####.######

MOAR; Write Modulation Source Arbitrary Waveform Data

The MOAR command defines an arbitrary waveform for the modulation source. From 1 to 4096 waveform sample points can be programmed. A value of 0 corresponds to 0.0 volts, and +1.0 corresponds to full scale which is half the MOAM voltage (since MOAM is in peak-to-peak). Issuing this command turns the modulation source off, so it should be followed with a MOFU3 command.

When using arbitrary waveforms, the MOFR command sets the frequency at which the entire waveform block is repeated. Only certain discrete frequencies are available and these depend on the number of entries in the waveform. The HP 3325B selects a frequency as near as possible to the value entered with the MOFR command.

Command Availability

	MOAR
HP 3325B	Yes
HP 3325A	No

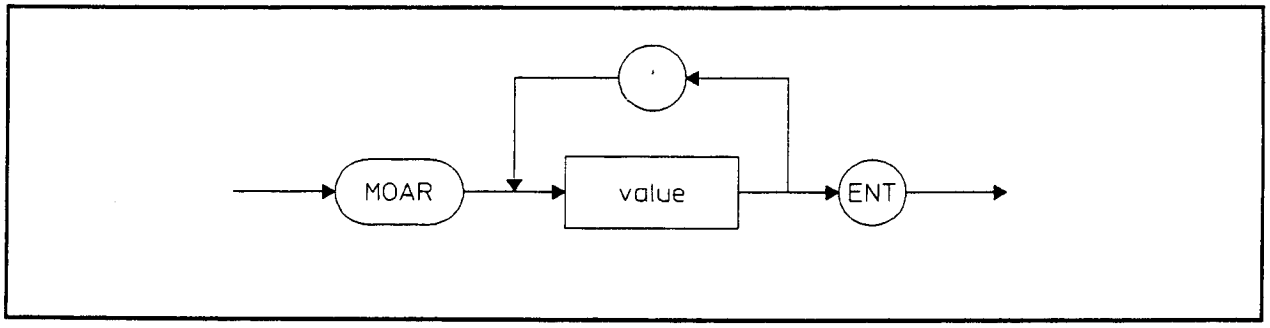
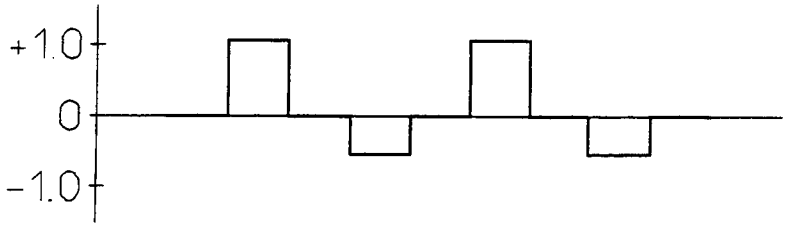


Figure 2-29. MOAR Syntax Diagram

Where *value* is a waveform sample whose value ranges from −1.0 to +1.0.

Example:

MOAR 1,0,- 0.4,0 ENT results in the following waveform:



MOFR; Modulation Source Frequency Command

The MOFR command sets the modulation source frequency. Sending MOFR with no value or units displays the current frequency. Issuing MOFR? causes the instrument to output its current frequency.

Notes

Only two digits of frequency resolution are available.

The timebase is not locked to the main signal or an external reference input.

Programming the frequency causes the signal to turn off momentarily.

Instrument Preset value: 1000.0 Hz

Command Availability

	MOFR	MOFR?
HP 3325B	Yes	Yes
HP 3325A	No	No

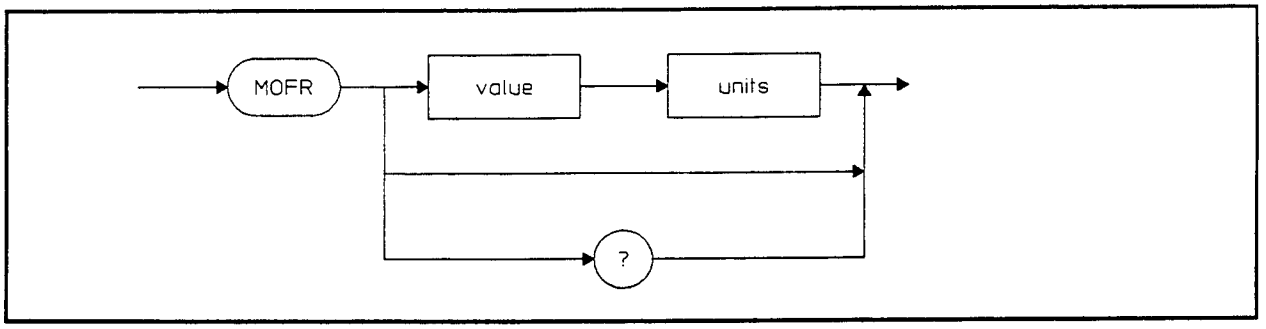


Figure 2-30. MOFR Syntax Diagram

Table 2-30. MOFR "value" Restrictions Given "units"

Value Range	Units	Description
0.0 → 10000.0	HZ	Hertz
0.0 → 10.0	KH	kilo-Hz
0.0 → 0.01	MH	mega-Hz

Table 2-31. MOFR? Response Format

HEAD-on response	HEAD-off response
MOFR########.###HZ	########.###

MOFU; Modulation Source Waveform Function Command

The MOFU command selects the waveform function for the modulation source output.

Instrument Preset value: 0.

Command Availability

	MOFR	MOFR?
HP 3325B	Yes	Yes
HP 3325A	No	No

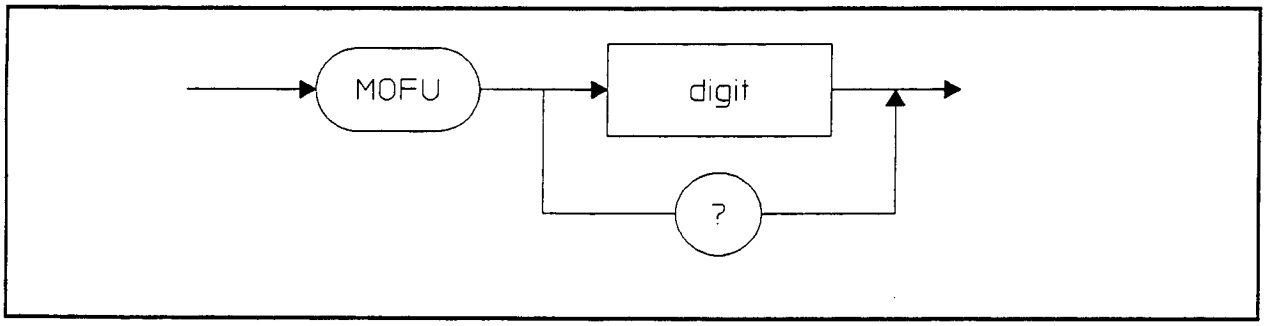


Figure 2-31. MORU Syntax Diagram

"Digit"	Waveform
0	All functions off.
1	Selects Sine wave.
2	Selects Square wave.
3	Selects Arbitrary wave.

Table 2-32. MOFU? Response Format

HEAD-on response	HEAD-off response
MOFU#	#

MP; Phase Modulation Command

The MP command enables and disables phase modulation of the main signal output.

Instrument Preset value: 0.

Command Availability

	MP	IMP	MP?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

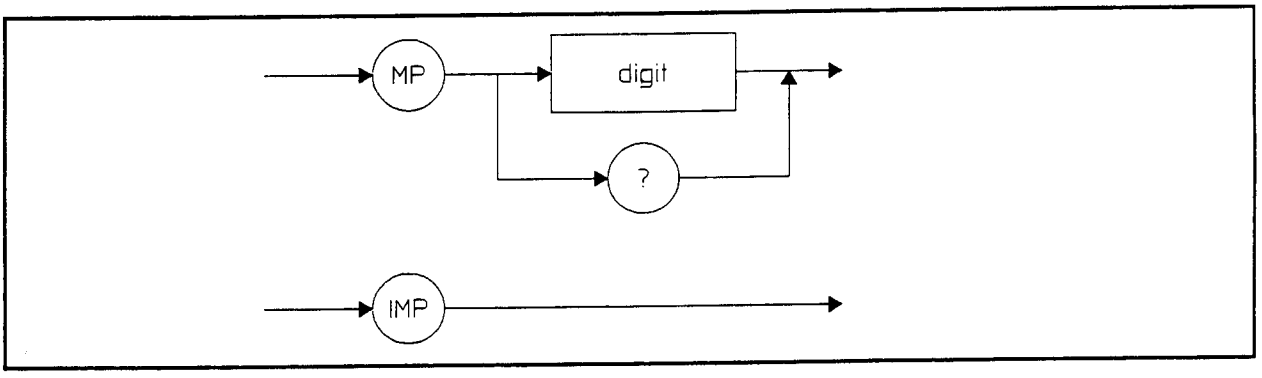


Figure 2-32. MP Syntax Diagram

"Digit"	Meaning
0	Disable phase modulation.
1	Enable phase modulation.

Table 2-33. MP? and IMP Response Format

HEAD-on response	HEAD-off response
MP#	#

MS; Status Byte Mask Command

The MS command is used to set the status byte mask. Four lists in the status byte are capable of causing a service request (SRQ) when they are enabled (unmasked). They may be enabled or masked in any combination as defined in table 2-34. The ESTB command accomplishes the same thing using decimal numbers instead of alphabetic characters.

Instrument Power-on value: @ (no bits enabled).

Instrument Preset, HP-IB Clear value: not changed.

Command Availability

	MS
HP 3325B	Yes
HP 3325A	Yes

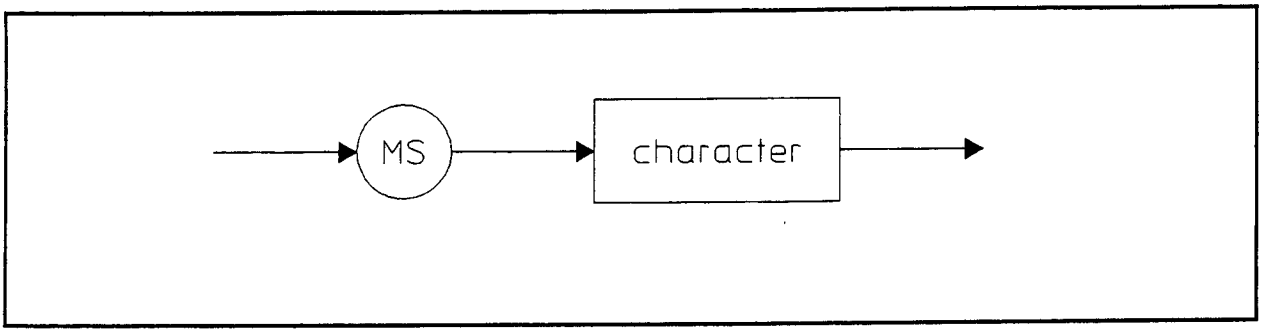


Figure 2-33. MS Syntax Diagram

Table 2-34. Status Byte Mask Characters

"character"	Status Bits FAIL	START	STOP	ERR
@	Mask	Mask	Mask	Mask
A	Mask	Mask	Mask	ENABLE
B	Mask	Mask	ENABLE	Mask
C	Mask	Mask	ENABLE	ENABLE
D	Mask	ENABLE	Mask	Mask
E	Mask	ENABLE	Mask	ENABLE
F	Mask	ENABLE	ENABLE	Mask
G	Mask	ENABLE	ENABLE	ENABLE
H	ENABLE	Mask	Mask	Mask
I	ENABLE	Mask	Mask	ENABLE
J	ENABLE	Mask	ENABLE	Mask
K	ENABLE	Mask	ENABLE	ENABLE
L	ENABLE	ENABLE	Mask	Mask
M	ENABLE	ENABLE	Mask	ENABLE
N	ENABLE	ENABLE	ENABLE	Mask
O	ENABLE	ENABLE	ENABLE	ENABLE

OF; DC Offset Command

The OF command sets the DC offset of the main signal. Sending OF with no value or units displays the current offset. When programming DC offset with an AC function, the DC offset range is further restricted by the AM setting and the resulting attenuator range. See the discussion in Chapter 1 under the heading "AC with DC Offset."

Instrument Preset value: 0.0 V_{pp}

Command Availability

	OF	IOF	OF?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

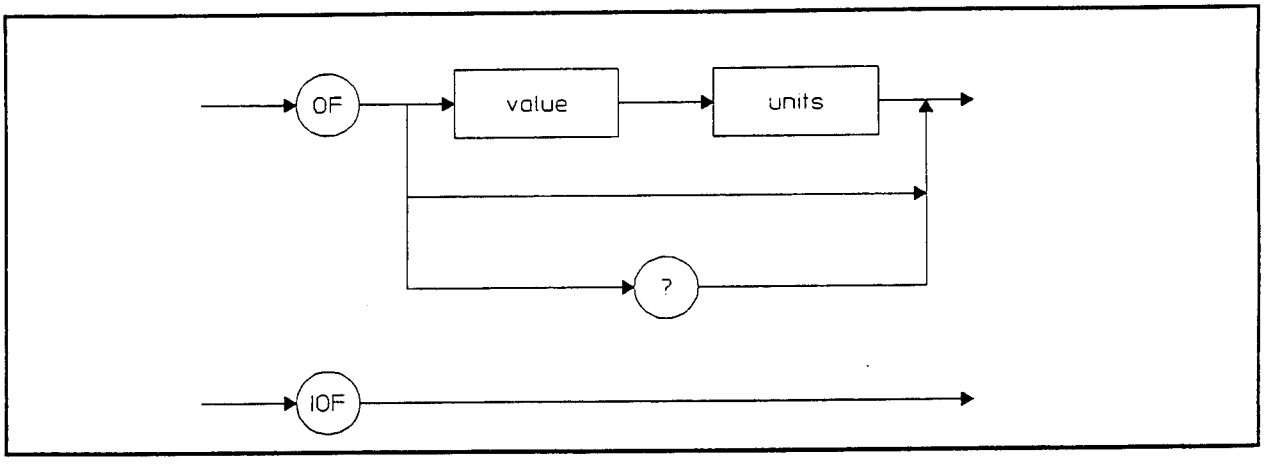


Figure 2-34. OF Syntax Diagram

Table 2-35. OF "value" Restrictions Given "units"

Units	Description	High Voltage	Value Range(DC only)
VO	Volts	Off	−5.0 → 5.0
		On	−20.0 → 20.0
MV	mVolts	Off	−5000.0 → 5000.0
		On	−20000.0 → 20000.0

Table 2-36. OF? and IOF Response Format

Current Units	HEAD-on response	HEAD-off response
VO or MV	OF#####.######VO	#####.######

OPT?; Option Query Command

The OPT? query returns a list of the options installed in the instrument.

Command Availability

	OPT?
HP 3325B	Yes
HP 3325A	No

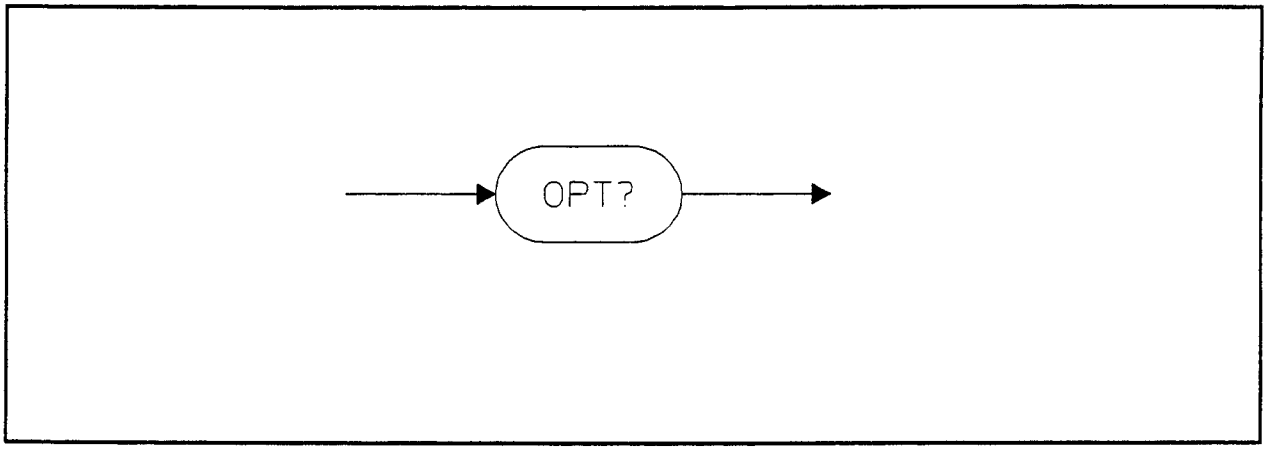


Figure 2-35. OPT? Syntax Diagram

Table 2-37. OPT? Response Format

Options Installed	HEAD-on response	HEAD-off response
none	OPT0,0	0,0
Oven	OPT1,0	1,0
High Voltage	OPT0,2	0,2
Oven and High V.	OPT1,2	1,2

PH; Phase Command

The PH command sets the phase of the main signal. Sending PH with no value or units displays the current phase. Values outside the −720 to +720 range are treated as (value modulus 720).

Instrument Preset value: 0.0 Degrees

Command Availability

	PH	IPH	PH?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

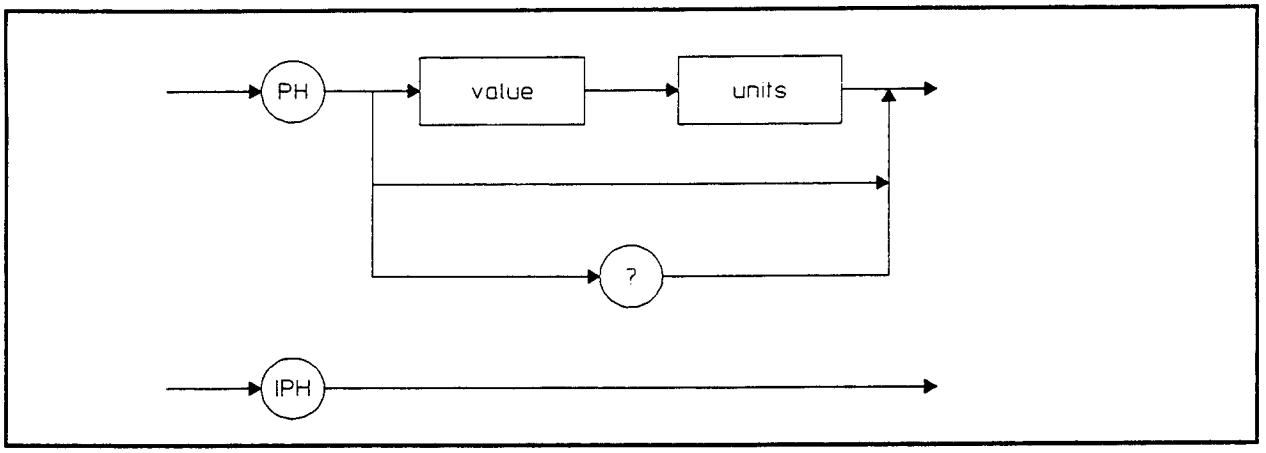


Figure 2-36. PH Syntax Diagram

Table 2-38. PH "value" Restrictions Given "units"

"Units"	Description	Range Restrictions for "value"
DE	Degrees	−720.0 → 720.0

Table 2-39. IPH and PH? Response Format

HEAD-on response	HEAD-off response
PH########.###DE	########.###

QSTB; Query Status Byte (RS-232)

The QSTB? query command is used to upload the *status byte* over the RS-232 interface. The HP 3325B responds to this command by returning the contents of the status register in the form of an integer value ranging from 0 to 255. This integer, when converted to binary (base 2), represents the bits of the Status Register. This command reads the same register as the HP-IB *serial poll* and clears the ERR, STOP, START, FAIL and RQS bits of the status byte.

Command Availability

	QSTB?
HP 3325B	Yes
HP 3325A	No

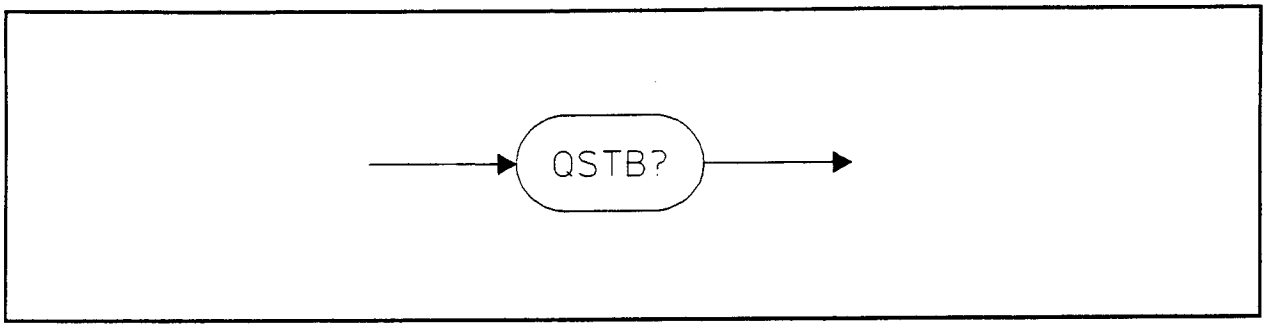


Figure 2-37. QSTB? Syntax Diagram

Table 2-40. Status Register Bit Coding

Bit	Value	Name	Description
0	1	ERR	Program or keyboard entry error.
1	2	STOP	Sweep stopped.
2	4	START	Sweep started.
3	8	FAIL	Hardware failure.
4	16	BIT4	Always zero.
5	32	SWEEP	Sweep in progress.
6	64	RQS	This corresponds to the HP-IB SRQ signal.
7	128	BUSY	Set while a command is being executed.

Table 2-41. QSTB? Response Format

HEAD-on response	HEAD-off response
QSTB###	###

RE; Recall State Command

The RE command recalls an instrument setup state from 1 of 11 memory locations. Locations 0 through 9 are programmed with the SR command. Location "–" is always the state when power is turned off.

Command Availability

	RE0 thru RE9	RE–
HP 3325B	Yes	Yes
HP 3325A	Yes	No

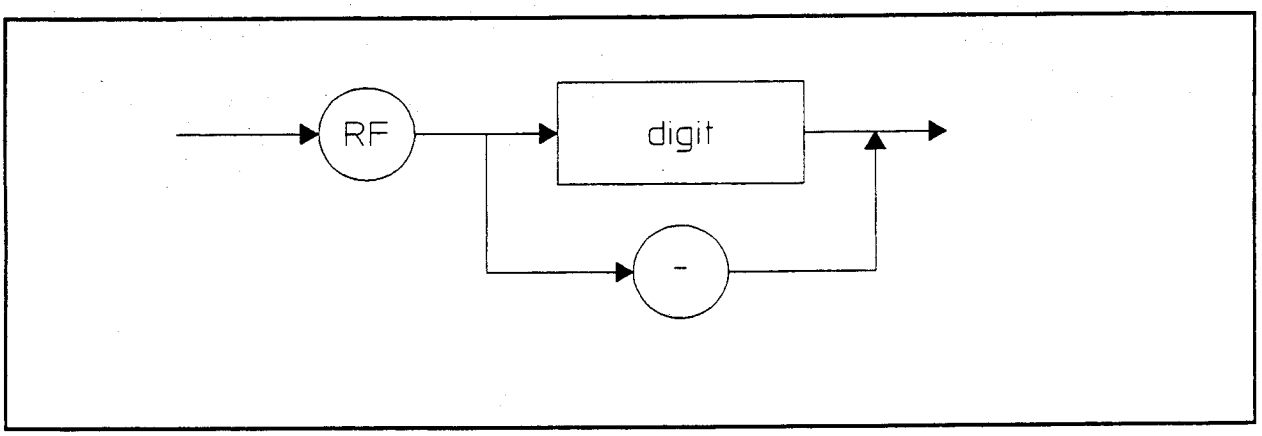


Figure 2-38. RE Syntax Diagram

"Digit"	Meaning
0 → 9	Recalls state in location 0 thru 9.
– (minus sign)	Recalls state at power-down.–

RF; Rear or Front Signal Output Command

The RF command determines whether the main signal is present at the rear or front BNC connector.

Instrument Preset value: 1 (front).

Command Availability

	RF	IRF	RF?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

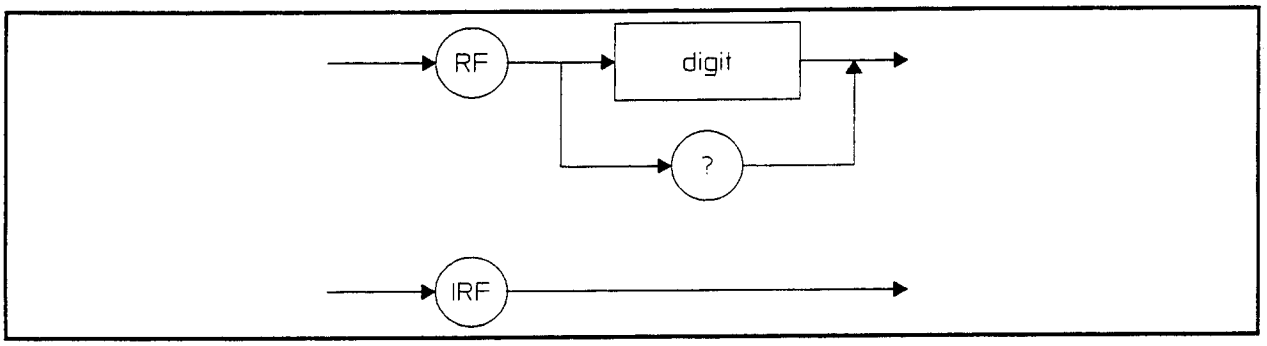


Figure 2-39. RF Syntax Diagram

"Digit"	Meaning
1	Front panel output.
2	Rear panel output.

Table 2-42. RF? and IRF Response Format

HV option	HEAD-on response	HEAD-off response
no	RF#	#
yes	HV#	#

RMT; Remote (with Local-Lockout) Command

The RMT command places the instrument in *remote* with *local lockout* mode. This command has the same effect as the HP-IB Local Lockout bus command but can be programmed using the RS-232 interface.

Command Availability

	RMT
HP 3325B	Yes
HP 3325A	No

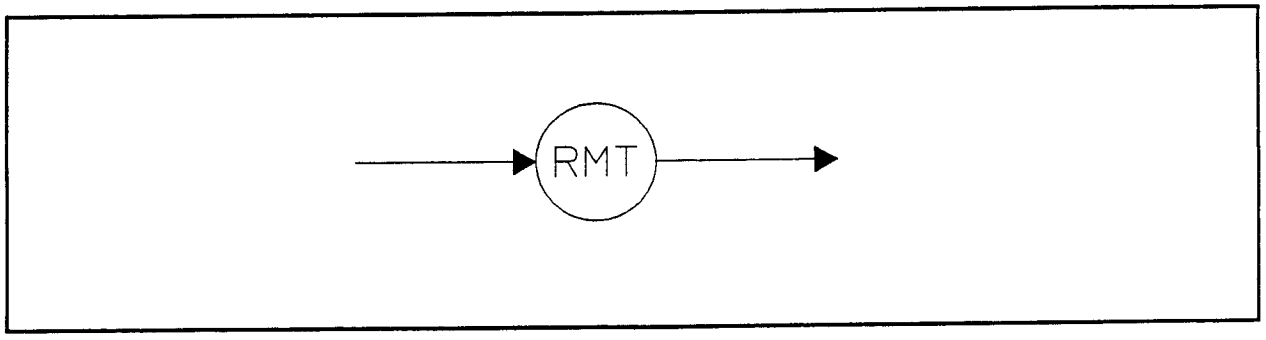


Figure 2-40. RMT Syntax Diagram

*RST; Reset Command

The *RST command resets the HP 3325B to the state in table 2-43. This command has the same effect as pressing the Instrument Preset key on the front panel and is similar to the HP-IB Device Clear command. *RST does not change the data transfer mode as does the Device Clear command.

Note In data transfer mode 2, an asterisk terminates a command string. Therefore use RST, without an asterisk, in data transfer mode 2.

Command Availability

	*RST
HP 3325B	Yes
HP 3325A	No

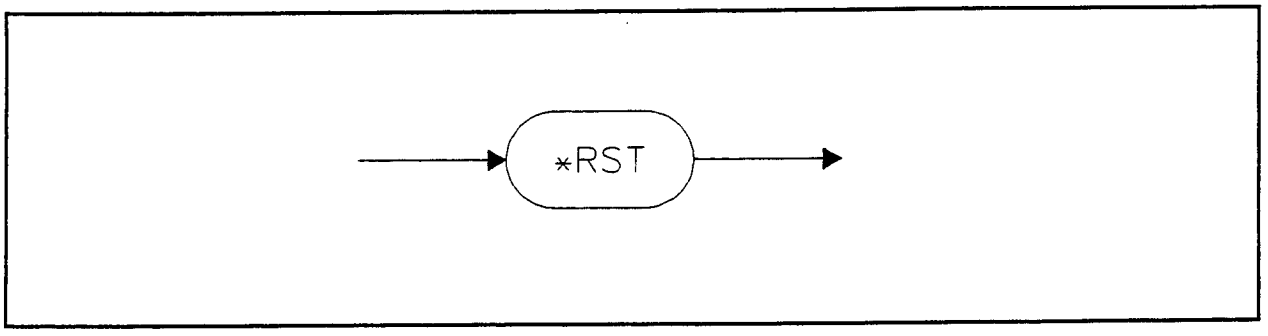


Figure 2-41. *RST Syntax Diagram

Table 2-43. Reset State

Item	Reset Value
Function	Sine
Frequency	1000.0 Hz
Amplitude	1.0 mV_{pp}
Offset	0.0 V
Phase	0.0°
Mod Source Function	Off
Mod Source Frequency	1000.0 Hz
Mod Source Amplitude	0.1 V_{pp}
Start Frequency	1.0 MHz
Stop Frequency	10.0 MHz
Marker Frequency	5 MHz
Sweep Time	1.0 Sec
High voltage	Off
Front/Rear output	Front
Amplitude Modulation	Off
Phase Modulation	Off
Sweep Mode	Linear
Status Byte (bits cleared)	0, 1, 2, 3, & 6

The *RST command does not alter:

- The 10 state storage registers
- HP-IB address
- HP-IB data transfer mode
- Status byte mask
- Enhancement/compatibility mode
- Calibration mode
- Head on/off
- Display on/off
- Echo on/off
- Discrete sweep table
- Modulation source arbitrary waveform data
- Serial number and elapsed time clock

RSW; Reset Single Sweep Command

The RSW command places the instrument in the sweep reset state. The output frequency returns to the Start Frequency and the next SS command starts a single sweep.

Command Availability

	RSW
HP 3325B	Yes
HP 3325A	No

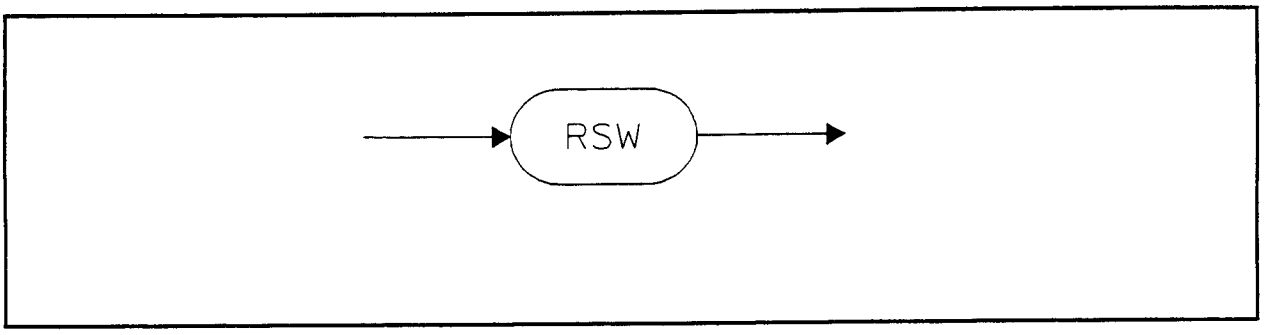


Figure 2-42. RSW Syntax Diagram

SC; Start Continuous Sweep Command

The SC command starts a continuous sweep. If the instrument is already sweeping, this command stops the sweep and does not restart it. FR can be used to stop a sweep.

Command Availability

	SC
HP 3325B	Yes
HP 3325A	Yes

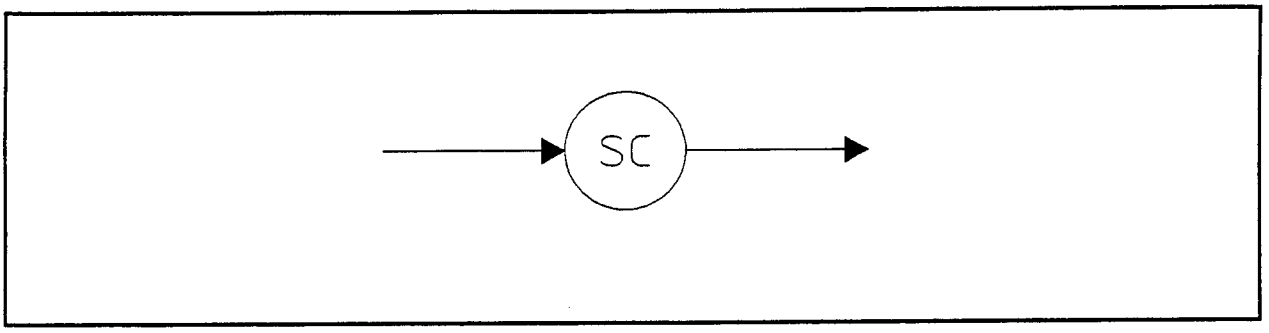


Figure 2-43. SC Syntax Diagram

SM; Sweep Mode Command

The SM command selects the sweep mode.

Instrument Preset value: 1.

Command Availability

	SM	ISM	SM?	SM3
HP 3325B	Yes	Yes	Yes	Yes
HP 3325A	Yes	Yes	No	No

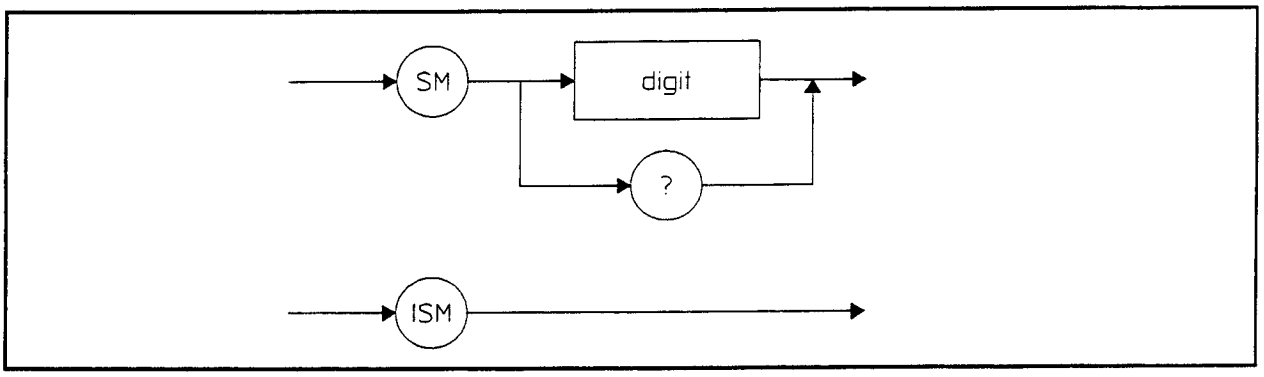


Figure 2-44. SM Syntax Diagram

"Digit"	Waveform
1	Selects Linear sweep mode.
2	Selects Logarithmic sweep mode.
3	Selects Discrete sweep mode.

Table 2-44. SM? and ISM Response Format

HEAD-on response	HEAD-off response
SM#	#

SP; Sweep Stop Frequency Command

The SP command sets the sweep stop frequency.

Instrument Preset value: 10.0 MHz

Command Availability

	SP	ISP	SP?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

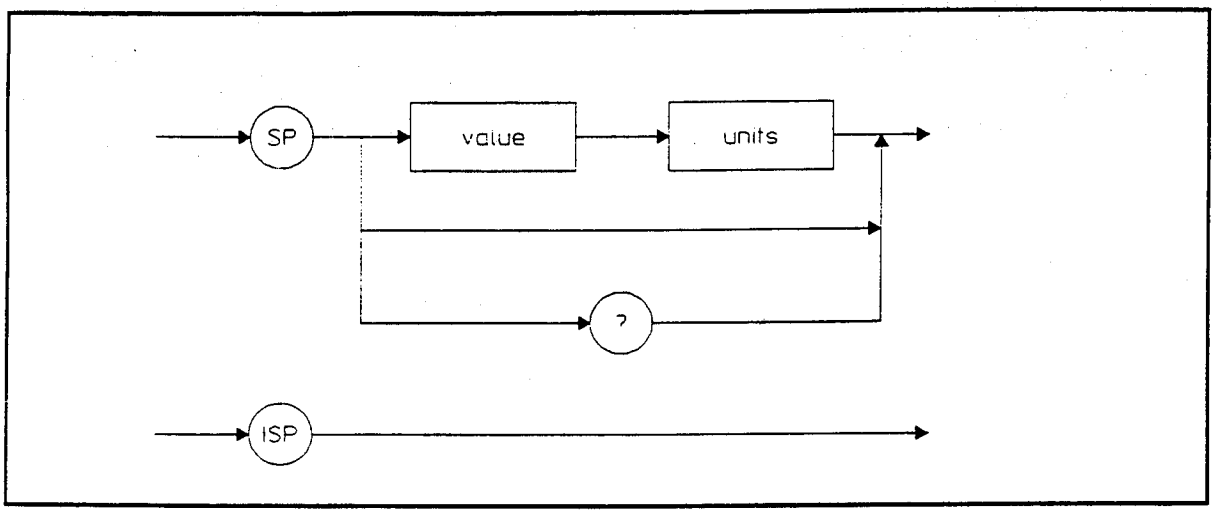


Figure 2-45. SP Syntax Diagram

Table 2-45. SP "value" Restrictions Given "units"

Value Range	Units	Description
0.0 → 20999999.999	HZ	Hertz
0.0 → 20999.9999990	KH	kilo-Hz
0.0 → 20.999999999	MH	mega-Hz

Table 2-46. SP? and ISP Response Format

μ Hz programmed	HEAD-on response	HEAD-off response
no	SP########.###HZ	########.###
yes	SP#####.######HZ	#####.######

SR; Store State Command

The SR command stores the current instrument setup state in one of 10 memory locations.

Command Availability

	SR
HP 3325B	Yes
HP 3325A	Yes

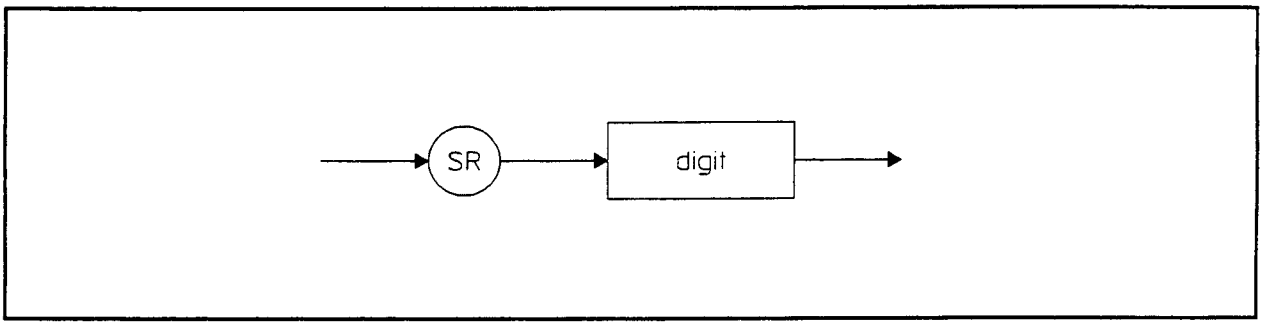


Figure 2-46. SR Syntax Diagram

"Digit"	Meaning
0 → 9	Stores state in location 0 thru 9.

SS; Start Single Sweep Command

The effect of the SS command depends on the state of the instrument. If the instrument is not sweeping and not in the sweep-reset state, then the SS command puts the instrument in the sweep-reset state at the sweep Start Frequency. If the instrument is already in the sweep-reset state, this command starts a single sweep. If the instrument is sweeping, this command stops the sweep and does not restart it.

Single sweeps can be started using the HP-IB Group Execute Trigger command. Before using the GET command, the HP 3325B must be in the enhancements mode and the sweep must be reset using the RSW command.

Command Availability

	SS
HP 3325B	Yes
HP 3325A	Yes

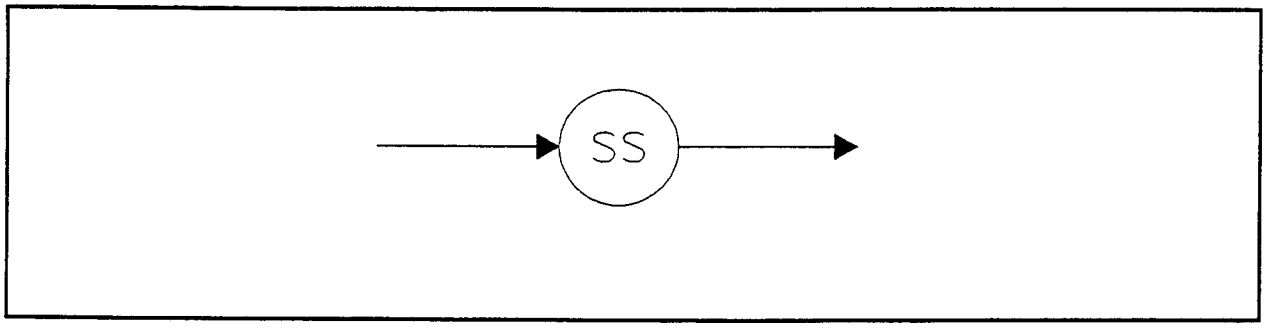


Figure 2-47. SS Syntax Diagram

ST; Sweep Start Frequency Command

The ST command sets the sweep start frequency.

Start Frequency Preset value: 1.0 MHz

Command Availability

	ST	IST	ST?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

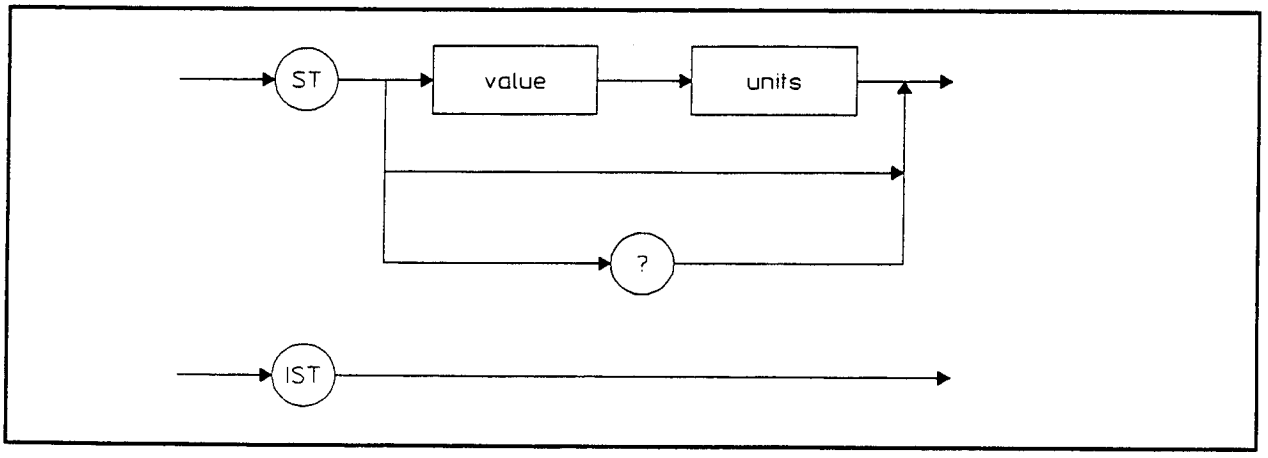


Figure 2-48. ST Syntax Diagram

Table 2-47. ST "value" Restrictions Given "units"

value range	units	Description
0.0 → 20999999.999	HZ	Hertz
0.0 → 20999.999999	KH	kilo-Hz
0.0 → 20.999999999	MH	mega-Hz

Table 2-48. ST? and IST Response Format

μHz programmed	HEAD-on response	HEAD-off response
no	ST########.###HZ	########.###
yes	ST#####.######HZ	#####.######

TI; Sweep Time Command

The TI command sets the sweep time. Sending TI with no value or units displays the current sweep time. ITI and TI? cause the instrument to output its current sweep time.

Instrument Preset value: 1.0 Sec

Command Availability

	TI	ITI	TI?
HP 3325B	Yes	Yes	Yes
HP 3325A	Yes	Yes	No

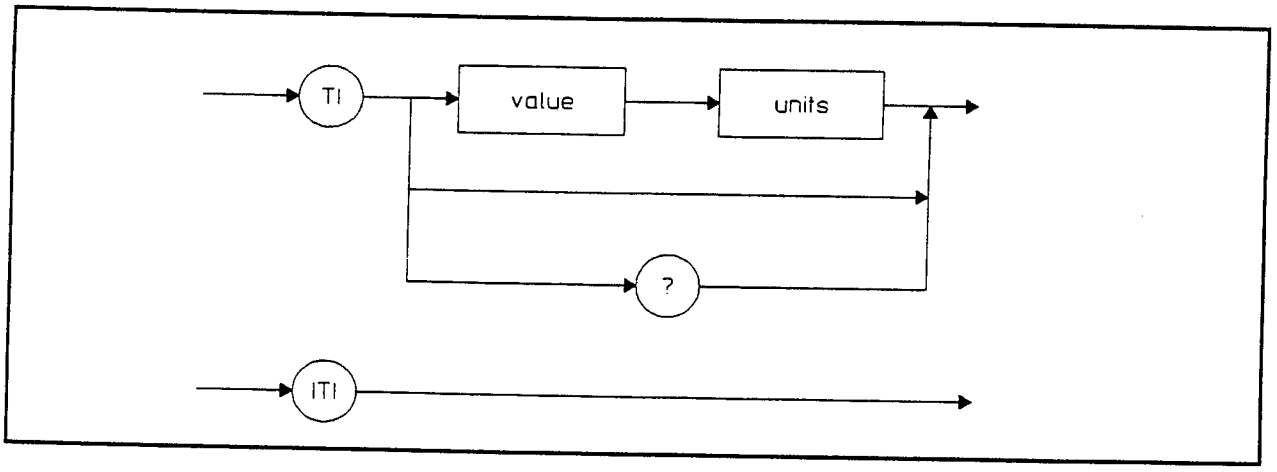


Figure 2-49. TI Syntax Diagram

Table 2-49. TI "value" Restrictions Given "units"

"Units"	Description	Range Restrictions for "value"
SE	Seconds	0.0 → 1000

Table 2-50. TI? and ITI Response Format

HEAD-on response	HEAD-off response
TI########.###SE	########.###

Table 2-51. Error Messages

Code	Description
FAIL 010	Hardware failure, DAC range
FAIL 011	Bad checksum, low byte of ROM
FAIL 012	Bad checksum, high byte of ROM
FAIL 013	Machine data bus line stuck low
FAIL 014	Keyboard shift register test failed
FAIL 021	Signal too big during calibration
FAIL 022	Signal too small during calibration
FAIL 023	DC offset too positive during cal
FAIL 024	DC offset too negative during cal
FAIL 025	Unstable/ noisy calibration
FAIL 026	Calibration factor out of range: AC gain offset
FAIL 027	Calibration factor out of range: AC gain slope
FAIL 028	Calibration factor out of range: DC offset
FAIL 029	Calibration factor out of range: DC slope
FAIL 030	External ref unlocked
FAIL 031	Oscillator unlocked, VCO voltage too low
FAIL 032	Oscillator unlocked, VCO voltage too high
FAIL 033	HP-IB isolation circuits test failed self test
FAIL 034	HP-IB IC failed self test
FAIL 035	RS-232 test failed loop-back test
FAIL 036	Memory lost (battery dead)
FAIL 037	Unexpected interrupt
FAIL 038	Sweep-limit-flag signal failed self test
FAIL 039	Fractional-N IC failed self test
FAIL 040	Modulation Source failed self test
FAIL 041	Function-integrity-flag flip-flop always set
Error 100	Entry parameter out of bounds
Error 200	Invalid units suffix for entry
Error 201	Invalid units suffix with high voltage
Error 300	Frequency too large for function
Error 400	Sweep time too large (same as sweep rate too small)
Error 401	Sweep time too small
Error 500	Amplitude/offset incompatible
Error 501	Offset too big for amplitude
Error 502	Amplitude too big for offset
Error 503	Amplitude too small

Table 2-51. Error Messages (con't)

Code	Description
Error 600	Sweep frequency improper
Error 601	Sweep frequency too large for function
Error 602	Sweep bandwidth too small
Error 603	Log sweep start freq too small
Error 604	Log sweep stop frequency less than start frequency
Error 605	Discrete sweep element is empty
Error 700	Unknown command
Error 701	Illegal query
Error 751	Key ignored – in remote (press LOCAL)*
Error 752	Key ignored – local lockout*
Error 753	Feature disabled in compatibility mode
Error 754	Attempt to recall a register that has not been stored since power up. (Use enhancements mode)*
Error 755	Amplitude modulation not allowed on selected function (warning only)*
Error 756	Modulation source arbitrary waveform is empty
Error 757	Too many modulation source arbitrary waveform points
Error 758	Firmware failure
Error 759	Error while running XRUN routine
Error 800	Illegal character received
Error 801	Illegal digit for selection item
Error 802	Illegal binary data block header
Error 803	Illegal string, string overflow
Error 810	RS-232 overrun – characters lost
Error 811	RS-232 parity error
Error 812	RS-232 frame error
Error 900	Option not installed

** These errors do not set the ERR bit in the status byte.*

HP 3325A Compatibility

For compatibility with existing programs, the HP 3325B supports all of the HP 3325A Synthesizer/Function Generator remote commands. Table 2-52 lists the HP 3325B mnemonics alphabetically and shows compatibility of each with the HP 3325A.

Table 2-52. Remote Command Compatibility

HP 3325B Command	HP 3325A Compatible?	Description
*	yes	End-of-string character
AC	yes	Amplitude Calibrate
AM	yes	Amplitude
AP	yes	Assign zero phase
CALM	no	Calibration mode
DB	yes	dBm (suffix)
DCLR	no	Discrete sweep clear
DE	yes	Degrees (suffix)
DISP	no	Display on/off
DRCL	no	Discrete sweep recall
DSP	no	Display string
DSTO	no	Discrete sweep store
DV	no	dBV_{rms} (suffix)
E	no	Exponent character
ECHO	no	Echo; for RS-232
ENH	no	Enhancements on
ENT	no	Enter, no units (suffix)
ER	yes	Error query, 1-digit code
ERR	no	Error query, 3-digit code
ESTB	no	Stat register mask (same as MS)
EXTR	no	Ext Ref query
FR	yes	Frequency
FU	yes	Function select
HEAD	no	Header on/off
HV	yes	High voltage
HZ	yes	Hertz (suffix)
ID	no	Identify, short
*IDN	no	Identify, long
KH	yes	Kilohertz (suffix)
LCL	no	Local, clear lockout (RS-232)
MA	yes	Amplitude modulation
MD	yes	Data transfer mode
MF	yes	Sweep marker frequency
MH	yes	Megahertz (suffix)
MOAM	no	Mod S amp
MOAR	no	Write arbitrary waveform

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Table 2-52. Remote Command Compatibility (con't)

HP 3325B Command	HP 3325A Compatible?	Description
MOFR	no	Mod S frequency
MOFU	no	Mod S function
MP	yes	Phase modulation
MR	yes	mV_{rms} (suffix)
MS	yes	Status register mask (same as ESTB)
MV	yes	mV_{pp} (suffix)
OF	yes	DC offset entry
OPT	no	Option query
PH	yes	Phase entry
QSTB	no	Status register query
RE	yes	Recall state
RF	yes	Rear or front output selection
RMT	no	Remote with lockout (RS-232)
*RST	no	Reset (preset)
RSW	no	Reset single sweep
SC	yes	Start continuous sweep
SE	yes	Seconds (suffix)
SM	yes	Sweep mode selection
SP	yes	Sweep stop frequency entry
SR	yes	Store state selection
SS	yes	Start a single sweep
ST	yes	Sweep start frequency
TI	yes	Sweep time
VO	yes	V_{pp} (suffix)
VR	yes	V_{rms} (suffix)

Writing Compatible Programs

Backward Compatible with the HP 3325A

- Use only the two-letter HP 3325B command mnemonics such as FR. The three and four-letter mnemonics such as MOFR are not available on the HP 3325A.
- Do not separate commands with a semicolon.
- Use a leading **I** to interrogate setup parameters instead of a trailing **?**.
- Do not send values in scientific notation.

Programming Practices Compatible with IEEE 488.2

- Separate commands with a semicolon or line feed
- Use a trailing **?** to interrogate setup parameters instead of a leading **I**.
- Do not use data transfer mode 2.

Example Programs

HP-IB Interface Example Program

```
30  !
40  ! HP-BASIC Program to control the HP 3325B synthesizer.
50  !
60    ASSIGN @Hp3325 to 717          ! Select code and bus address
70                                   ! usually 7 and 17
80    !
90    OUTPUT @Hp3325;"RST"           !  reset the HP 3325B
100   !
110   Stat-SPOLL (@Hp3325)           ! read status register
120   IF BIT(Stat,0) or BIT(Stat,3) then print "3325B has an error"
130   !
140   OUTPUT @Hp3325;"FR 123 KH; AM 1 V0"  ! program freq and amptd
150   OUTPUT @Hp3325;"FR?"           ! ask for frequency
160   ENTER @Hp3325;Freq             ! read it back
170   PRINT "Frequency in Hz = ";Freq
180   !
190   LOCAL @Hp3325                  ! return front panel to local control
200   !
210   PRINT "Program done."
220 END
```

RS-232 Interface Example Program for HP-Vectra or IBM/PC

```
10    'HP Vectra BASIC program to control the HP 3325B Synthesizer
20    '
30    'First open a communications file to the HP 3325B
40    'change COM1 to COM2 if needed.
50    OPEN "COM1:" AS #1
60    'OPEN defaults to 300 baud, 7 bits, parity EVEN
70    '
80    PRINT #1, "RST"                ' send reset
90    PRINT #1, "HEAD 0"             ' turn off heading in HP 3325B responses
100   '
110   PRINT #1,"QSTB?"               ' ask for status register
120   INPUT #1, STAT                 ' read response from HP 3325B
130   IF (STAT and (1+8)0) then print "3325B has an error"
140   '
150   PRINT "Programming frequency and amplitude"
160   PRINT #1, "FR 123.4 KH; AM 1 VO"
170   PRINT #1, "FR?"                ' ask for frequency
180   INPUT #1, FREQ                 ' read it back
190   PRINT "Frequency in Hz = ";FREQ
200   '
210   PRINT #!, "LCL"                ' return front panel to local control
220   '
230   PRINT "Program done"
240   END
```

RS-232 Interface Example Program for HP Series 300

```
30  !
40  ! HP-BASIC Program to control the HP 3325B synthesizer using either
50  ! a HP98644, HP98626, or the build-in serial interface in
60  ! a Series-200 or Series-300 computer.
70  !
80  ! The connecting cable depends on the RS232 interface:
90  !    HP98644A interface:    use 13242G cable (25 pin M to 25 pin M).
100 !    Built-in interface: use 92221P cable (9 pin M to 25 pin M).
110 !
120 ASSIGN @Hp3325 to 9              ! Select code for the serial interface,
130                                  ! usually 9 or 10
140 !
160 GOSUB Initialize_card
170 !
190 OUTPUT @Hp3325;"RST"            ! reset the HP 3325B
200 !
210 OUTPUT @Hp3325;"QSTB?"          ! ask for status register
220 ENTER @Hp3325;Stat              ! read status from HP 3325B
240 IF Bit(Stat,0) OR BIT(Stat,3) then print "3325B has an error"
250 !
260 OUTPUT @Hp3325;"FR 123 KH; AM 1 V0"        ! program freq and amptd
270 OUTPUT @Hp3325;"FR?"            ! ask for frequency
280 ENTER @Hp3325;Freq              ! read it back
290 PRINT "Frequency in Hz = ";Freq
300 !
310 OUTPUT @Hp3325;"LCL"            ! retrun front panel to local control
320 !
330 PRINT "Program done."
340 STOP
350 !
360 ! ------------------------------------------------------------------------
370 Initialize_card:    !
380 !
390 Isc=SC(@Hp3325)                 ! Get Interface select code
400 !
410 Reset_=0
420 Baud=3
430 Parity_=4
440 !
450 ! ALL the RS232 switches on the HP 3325B rear panel should be
460 ! up. This sets baud=300, parity ON, parity EVEN
470 !
480 CONTROL Isc,Reset_;1             ! reset the card
490 CONTROL Isc,Baud;300             ! set baud rate
500 CONTROL Isc,Parity_;16+8+0+2 ! set parity
510 RETURN
520 END
```

HP 3325B HP-IB and RS-232 Programming Codes:

Commands:

Code	Function	Code	Function
AC	Amplitude Cal	MF	Sweep marker frequency
AM	Amplitude	MOAM	Modulation Source amplitude
AP	Assign zero phase	MOAR	Write arb waveform
CALM	Calibration mode (0-1)	MOFR	Modulation Source frequency
DCLR	Discrete sweep clear	MOFU	Modulation Source function (0-3)
DISP	Display (0-1)	MP	Phase modulation (0-1)
DRCL	Discrete sweep recall (00-99)	MS	Status reg. mask (also ESTB) (@,A-0)
DSP	Display a string (' ')	OF	DC Offset
DSTO	Discrete sweep store (00-99)	OPT?	Option query
ECHO	Echo for RS-232 (0-1)	PH	Phase
ENH	Enhancements mode (0-1)	QSTB?	Status register query
IER	Error query (1 digit)	RE	Recallstate (−, 0-9)
ERR?	Error query (3 digit)	RF	Rear or front output (2-1)
ESTB	Status reg. mask (also MS) (0-15)	RMT	Remote with lockout
EXTR?	Ext Ref query	*RST	Reset (Preset)
FR	Frequency	RSW	Reset single sweep
FU	Function Select (0-5)	SC	Start continuous sweep
HEAD	Query Header Enabled (0-1)	SM	Sweep mode (1-3)
HV	High voltage (0-1)	SP	Sweep stop frequency
ID?	Model Identify (short)	SR	Store state (0-9)
*IDN?	Model Identify (long)	SS	Reset or Start single sweep
LCL	Local, clear lockout	ST	Sweep start frequency
MA	Amplitude modulation (0-1)	TE	Self Test
MD	Data transfer mode (1-2)	TI	Sweep time

Note that most commands may be followed by a question mark (?) to interrogate the related parameter.

* Only bits 0 to 3 may enable an SRQ.

Commands, Continued

Data		Suffix			
0 to 9	Digits	Hz	Hertz	dB	dBm
E	Exponent character	KH	KHz	DV	dBvrms
'xyz'	Alpha-numeric string	MH	MHz	DE	Degrees
–	minus sign	MR	milli-Volts RMS	SE	Seconds
.	Decimal point	MV	milli-Volts p-p	ENT	Enter, no units
		VO	Volts p-p	*	EOS character
		VR	Volts RMS		

Status Byte			
Bit	**Value**	**Name**	**Description**
0	1	ERR*	Program or keyboard entry error
1	2	STOP*	Sweep stopped
2	4	START*	Sweep started
3	8	FAIL*	Hardware failure
5	32	SWEEP	Sweeping
6	64	RQS	Requested service
7	128	BUSY	HP 3325 is busy

* Only bits 0 to 3 may enable an SRQ.

Bits which can be enabled to generate an SRQ and the arguments for MS and ESTB:

Arguments	Fail	Start	Stop	ERR
@, 0	Mask	Mask	Mask	Mask
A, 1	Mask	Mask	Mask	ENABLE
B, 2	Mask	Mask	ENABLE	Mask
C, 3	Mask	Mask	ENABLE	ENABLE
D, 4	Mask	ENABLE	Mask	Mask
E, 5	Mask	ENABLE	Mask	ENABLE
F, 6	Mask	ENABLE	ENABLE	Mask
G, 7	Mask	ENABLE	ENABLE	ENABLE
H, 8	ENABLE	Mask	Mask	Mask
I, 9	ENABLE	Mask	Mask	ENABLE
J, 10	ENABLE	Mask	ENABLE	Mask
K, 11	ENABLE	Mask	ENABLE	ENABLE
L, 12	ENABLE	Enable	Mask	Mask
M, 13	ENABLE	Enable	Mask	ENABLE
N, 14	ENABLE	Enable	ENABLE	Mask
O, 15	ENABLE	Enable	ENABLE	ENABLE

(Example: MSI or ESTB9ENT cause an SRQ to be generated when an Error of Failure occurs. ESTB? returns the byte value of the mask.)

Hardware Failure Codes

Fail	010	DAC range error
Fail	011	bad checksum, low byte of ROM
Fail	012	bad checksum, high byte of ROM
Fail	013	machine data bus line stuck low
Fail	014	keyboard shift register test failed
Fail	021	signal too big during calibration
Fail	022	signal too small during calibration
Fail	023	DC offset too positive during cal
Fail	024	DC offset too negative during cal
Fail	025	unstable/noisy calibration
Fail	026	calibration factor out of range: AC gain offset
Fail	027	calibration factor out of range: AC gain slope
Fail	028	calibration factor out of range: DC offset
Fail	029	calibration factor out of range: DC slope
Fail	030	external ref unlocked
Fail	031	oscillator unlocked, VCO voltage too low
Fail	032	oscillator unlocked, VCO voltage too high
Fail	033	HP-IB isolation circuits failed self test
Fail	034	HP-IB IC failed self test
Fail	035	RS232 test failed loop-back test
Fail	036	memory lost (battery dead)
Fail	037	unexpected interrupt
Fail	038	sweep-limit-flag signal failed self test
Fail	039	Fractional-N IC failed self test
Fail	040	Modulation Source failed self test
Fail	041	function-integrity-flag flip-flop always set

Programming Error Codes

Error	100	entry parameter out of bounds
Error	200	invalid units delimiter for entry
Error	201	invalid units delimiter with high voltage
Error	300	frequency too large for function
Error	400	sweep time too large, sweep rate too small
Error	401	sweep time too small
Error	500	amplitude/offset incompatible
Error	501	offset too big for amplitude
Error	502	amplitude too big for offset
Error	503	amplitude too small for offset
Error	600	sweep frequency
Error	601	sweep frequency too large for function
Error	602	sweep bandwidth too small
Error	603	log sweep start freq too small
Error	604	log sweep stop < start freq
Error	605	discrete sweep element is empty
Error	700	unknown command
Error	701	illegal query
Error	751	key ignored -- in remote (press LOCAL)
Error	752	key ignored -- local lockout
Error	753	feature disable in compatibility mode
Error	754	attempt to recall a register that has not been stored since power up (use enhancements mode)
Error	755	amplitude modulation not allowed on selected function (warning only)
Error	756	modulation source arbitrary wave form is empty
Error	757	too many modulation source arbitrary waveform points
Error	758	firmware failure
Error	800	illegal character received
Error	801	illegal digit for selection item
Error	802	illegal binary data block header
Error	803	illegal string, string overflow
Error	810	RS232 overrun -- characters lost
Error	811	RS232 parity error
Error	812	RS232 frame error
Error	900	option not installed