3-5. BASIC FUNCTIONAL CHECKS

Description

Using only an oscilloscope, the overall operation of the Audio Analyzer is verified.

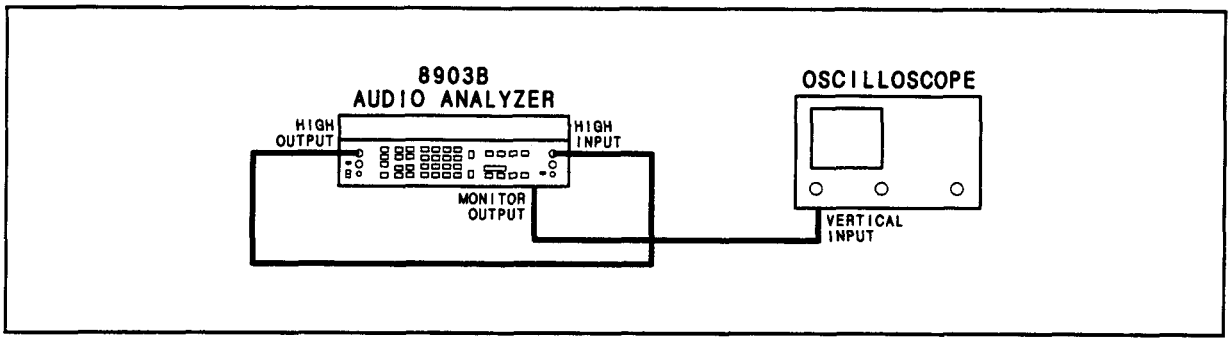


Figure 3-3. *Basic Functional Checks Setup*

Equipment

Oscilloscope ..... HP 1740A

PROCEDURE

Preliminary Check

1. Remove any cables from the Audio Analyzer's INPUT or OUTPUT. Set the LINE switch to OFF, then back to ON and note that the front-panel LED annunciators, display segments and decimal points, and key lights turn on. All LEDs should light for approximately three seconds.
2. After the turn-on sequence, the left display should show 0.000 kHz and the right display should show a low flickering value in mV. In addition, the measurement cycle annunciator in the upper left-hand corner of the right display should be blinking and the AC LEVEL and LOW PASS 80 kHz key lights should light.
3. Connect a BNC-to-BNC cable between the HIGH OUTPUT and the HIGH INPUT. See Figure 3-3. Set both FLOAT switches to the grounded position. Set impedance to 50Ω by keying in 47.1 then pressing the SPCL button. The SPCL key light should be lit.
4. Connect the oscilloscope to the MONITOR output on the rear panel. See Figure 3-3.

AC Level and Output Level Check

5. Press AMPTD. While the key is pressed, 0.00 mV should show in the right display.
6. Press 1 and V to set the amplitude to 1 Vrms. The left display should show between 960 and 1040 Hz (the frequency the source is set to during power up). The right display should show between 0.960 and 1.040V. The oscilloscope should show a 1 kHz (1 ms period) sine wave of approximately 7 Vpp.
7. Press RATIO. The RATIO key light should light. The right display should show 100%.

NOTE

In this and the following steps, the displays may vary a few least-significant digits.

8. Key in 5.2 SPCL to measure ac level with the average-responding detector. The SPCL key light should remain lit. The right display should remain at approximately 100%.
9. Key in 5.0 SPCL to measure ac level again with the rms-responding detector. Set impedance by 600Ω by keying in 47.0 then pressing the SPCL button. The SPCL key light should extinguish. The right display should drop by approximately 0.6% (down to approximately 99.4%).
10. Set the impedance back to 50Ωby keying in 47.1 then pressing the SPCL button. Set the OUTPUT FLOAT switch to FLOAT. Move the cable from the HIGH OUTPUT to the LOW OUTPUT. Short out the HIGH OUTPUT connector (inner conductor to outer conductor). The right display should show approximately 95%.
11. Remove the short from the HIGH OUTPUT, reconnect the HIGH INPUT to the HIGH OUTPUT, and set the OUTPUT switch to the ground position.
12. Move the cable from the HIGH INPUT to the LOW INPUT. Set the INPUT switch to FLOAT. The right display should show 100%.
13. Reconnect the HIGH OUTPUT to the HIGH INPUT and set the INPUT switch to the ground position. Press LOW PASS 80 kHz. Verify that the LOW PASS 80 kHz key light goes off.
14. Press the STOP FREQ key. While the key is pressed, the left display should show 20.000 kHz (the stop frequency setting at power up).
15. Press 100 kHz. The left display should show between 99.70 and 100.30 kHz.
16. Press SWEEP. During the sweep, the SWEEP key light should light. The source frequency sweeps, starting from approximately 20 Hz and stopping at approximately 100 kHz. The right display should show between 96 and 104% throughout the entire sweep.

Filter Check

17. Press the LOG/LIN key. The right display should read approximately 0.00 dB.
18. Press LOW PASS 80 kHz.
19. Use the numeric data and units keys to set frequency (but not the level) of the source (to approximately 80 kHz) until the right display reads −3 dB. The left display should show between 72 and 88 kHz.
20. Press LOW PASS 30 kHz. The 30 kHz key light should light. Adjust the frequency (but not the level) of the source (to approximately 30 kHz) until the right display reads −3 dB. The left display should show between 26 and 34 kHz.
21. Press LOW PASS 30 kHz again to turn it off.
22. If the instrument has Option 010 or 050 installed, press the 400 Hz HIGH PASS key. The 400 Hz HIGH-PASS key light should light. Adjust the frequency of the source (to approximately 400 Hz) until the right display reads −3 dB. The left display should show between 360 and 440 Hz.
23. Press the filter key listed in the following tables for the filter options installed in the instrument. The respective key light should light. For each filter, set the source frequency as shown in the table. Verify that the level ratio shown in the right display is within the limits shown for each frequency.

Table for CCITT Weighting Filter (Option 011 or 051)

Oscillator Frequency (Hz)	RATIO Limits (dB)
300	−12.1 to −9.1
800	−0.4 to +0.4
3 000	−7.1 to −4.1
3 500	−11.5 to −5.5
5 000	−40.0 to −32.0

Table for CCIR Weighting Filter (Option 012 or 052)

Oscillator Frequency (Hz)	RATIO Limits (dB)
31.5	−31.4 to −28.4
200	−14.5 to −13.1
6 300	+12.0 to +12.4
7 100	+11.7 to +12.3
10 000	+7.5 to +8.7
20 000	−23.7 to −20.7

Table for C-Message Weighting Filter (Option 013 or 053)

Oscillator Frequency (Hz)	RATIO Limits (dB)
100	−44.0 to −41.0
500	−9.0 to −6.0
1 000	−0.2 to +0.2
3 000	−4.0 to −1.0
5 000	−30.0 to −27.0

Table for CCIR/ARM Weighting Filter (Option 014 or 054)

Oscillator Frequency (Hz)	RATIO Limits (dB)
31.5	−37.0 to −34.0
200	−20.1 to −18.7
6 300	+6.4 to +6.8
7 100	+6.1 to +6.7
10 000	+1.9 to +3.1
20 000	−29.3 to −26.3

Table for "A" Weighting Filter (Option 015 or 055)

Oscillator Frequency (Hz)	RATIO Limits (dB)
50	−30.9 to −29.5
200	−11.7 to −10.3
1 000	−0.2 to +0.2
2 000	+0.5 to +1.9
10 000	−3.2 to −1.8
20 000	−10.8 to −7.8

Distortion Check

24. Set all filters on the Audio Analyzer off. Press LOW PASS 80 kHz. Press DISTN. The DISTN key light should light.
25. Set the source frequency to 1 kHz. The right display should show 0.01% or less.

SINAD Check

26. Press SINAD. The SINAD key light should light. The right display should show 80 dB or more.
27. Key in 6.1 SPCL to hold the notch filter. Set the source frequency to 890 Hz. The right display should show between 12 and 19 dB. The SINAD meter should read within ±1 dB of the right display.

Signal-to-Noise Ratio Check

28. Press AUTOMATIC OPERATION. Press S (Shift) SIG/NOISE. The right display should show 85 dB or more.

Sweep, X Axis, Y Axis, Pen Lift, and DC Level Check

29. Disconnect the cable from the OUTPUT and reconnect it to the X AXIS connector on the rear panel.
30. Press S (Shift) DC LEVEL.
31. Press SWEEP. The right display should show a voltage rising from approximately 0 to 10V in uniform steps.
32. Move the cable from the X AXIS connector to the Y AXIS connector.
33. Press START FREQ. The right display should show between −0.01 and 0.01V.
34. Press STOP FREQ. The right display should show between 9.6 and 10.4V.
35. Disconnect the cable and reconnect it to the PEN LIFT connector.
36. Press SWEEP. The right display should momentarily show a TTL high level (greater than 2.4V), then drop to a TTL low level (less than 0.4V) and remain there until the sweep is complete. The display should then show a TTL high level.

3-6. HP-IB FUNCTIONAL CHECKS

Description

The following ten procedures check the Audio Analyzer's ability to process or send all of the applicable HP-IB messages described in Table 3-3. In addition, the Audio Analyzer's ability to recognize its HP-IB address is checked and all of the bus data, handshake, and control lines except DIO8 (the most significant data line which is not used by the Audio Analyzer) are set to both their true and false states. These procedures do not check whether or not all Audio Analyzer program codes are being properly interpreted and executed by the instrument, however, if the front-panel operation is good, the program codes, in all likelihood will be correctly implemented.

The validity of these checks is based on the following assumptions:

- The Audio Analyzer performs properly when operated via the front-panel keys (that is, in local mode). This can be verified with the Basic Functional Checks.
- The bus controller properly executes HP-IB operations.
- The bus controller's HP-IB interface properly executes the HP-IB operations.

If the Audio Analyzer appears to fail any of these HP-IB checks, the validity of the above assumptions should be confirmed before attempting to service the instrument.

The select code of the controller's HP-IB interface is assumed to be 7. The address of the Audio Analyzer is assumed to be 28 (its address as set at the factory). This select code-address combination (that is, 728) is not necessary for these checks to be valid. However, the program lines presented here would have to be modified for any other combination.

These checks are intended to be as independent of each other as possible. Nevertheless, the first four checks should be performed in order before other checks are selected. Any special initialization or requirements for a check are described at its beginning.

Initial Setup

The test setup is the same for all of the checks. Connect the Audio Analyzer to the bus controller via the HP-IB interface. Do not connect any equipment to the Audio Analyzer's INPUT.

Equipment

HP-IB Controller ..... HP 9825A/98213A (General and Extended I/O ROM)
-or- ..... HP 85B Option 007
-or- ..... HP 9000 Model 226 or any HP 9000 series 200 Computer

Address Recognition

Description: This check determines whether or not the Audio Analyzer recognizes when it is being addressed and when it is not. This check assumes only that the Audio Analyzer can properly handshake on the bus. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON.

Description	HPL	BASIC
Set the Remote Enable (REN) bus control line false. Send the Audio Analyzer's listen address.	lcl 7 wrt 728	LOCAL 7 OUTPUT 728

Check that the Audio Analyzer's REMOTE annunciator is off but its ADDRESSED annunciator is on.

Description	HPL	BASIC
Unaddress the Audio Analyzer by sending a different address.	wrt 729	OUTPUT 729

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are off.

Remote and Local Messages and the LCL Key

Description: This check determines whether the Audio Analyzer properly switches from local to remote control, from remote to local control, and whether the LCL key returns the instrument to local control. This check assumes that the Audio Analyzer is able to both handshake and recognize its own address. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON.

Description	HPL	BASIC
Send the Remote message (by setting Remote Enable, REN, true and addressing the Audio Analyzer to listen).	rem728	REMOTE 728

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on.

Send the Local message to the Audio Analyzer.	lcl 728	LOCAL

Check that the Audio Analyzer's REMOTE annunciator is off but its ADDRESSED annunciator is on.

Send the Remote message to the Audio Analyzer.	rem 728	REMOTE 728

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on. Press the LCL key on the Audio Analyzer. Check that the Audio Analyzer's REMOTE annunciator is now off, but that its ADDRESSED annunciator remains on.

Sending the Data Message

Description: This check determines whether or not the Audio Analyzer properly issues Data messages when addressed to talk. This check assumes that the Audio Analyzer is able to handshake and recognize its own address. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON, then after the power-up sequence is complete, press the DISTN key.

Description	HPL	BASIC
Address the Audio Analyzer to talk and store its output data in variable V. (The output is E96 since there is no signal at its INPUT.)	red 728,V	ENTER 728;V
Display the value of V.	dsp V	PRINT V

Check that the Audio Analyzer's REMOTE annunciator is off but that its ADDRESSED annunciator is on. The controller's display should read 9009600000.00 (HPL) or 9009600000 (BASIC).

Receiving the Data Message

Description: This check determines whether or not the Audio Analyzer properly receives Data messages. The Data messages sent also cause the 7 least significant HP-IB data lines to be placed in both their true and false states. This check assumes the Audio Analyzer is able to handshake, recognize its own address and properly make the remote/local transitions. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON.

Description	HPL	BASIC
Send the first part of the Remote message (enabling the Audio Analyzer to remote).	rem 7	REMOTE 7
Address the Audio Analyzer to listen (completing the Remote message), then send a Data message (selecting the SINAD measurement).	wrt 728,"M2"	OUTPUT 728;"M2"

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on. Check also that its SINAD key light is on.

Local Lockout and Clear Lockout/Set Local Messages

Description: This check determines whether or not the Audio Analyzer properly receives the Local Lockout message, disabling all front-panel keys. The check also determines whether or not the Clear Lockout/Set Local message is properly received and executed by the Audio Analyzer. This check assumes that the Audio Analyzer is able to handshake, recognize its own address, and properly make the remote/local transitions. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON.

Description	HPL	BASIC
Send the first part of the Remote message (enabling the Audio Analyzer to remote).	rem 7	REMOTE 7
Send the Local Lockout message.	llo 7	LOCAL LOCKOUT 7
Address the Audio Analyzer to listen (completing the Remote message).	wrt 728	OUTPUT 728

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on. Press the Audio Analyzer's LCL key. Both its REMOTE and ADDRESSED annunciators should remain on.

Send the Clear Lockout/Set Local message.	lcl 7	LOCAL 7

Check that the Audio Analyzer's REMOTE annunciator is off but its ADDRESSED annunciator is on.

Clear Message

Description: This check determines whether or not the Audio Analyzer properly responds to the Clear message. This check assumes that the Audio Analyzer is able to handshake, recognize its own address, make the remote/local changes and receive Data messages. Before beginning this check set the Audio Analyzer's LINE switch to OFF, then to ON.

Description	HPL	BASIC
Send the first part of the Remote message (enabling the Audio Analyzer to remote).	rem 7	REMOTE 7
Address the Audio Analyzer to listen (completing the Remote message), then send a Data message that selects the SINAD measurement.	wrt 728,"M2"	OUTPUT 728;"M2"

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on and that the SINAD key light is also on.

Send the Clear message (setting the Audio Analyzer's measurement to AC LEVEL).	clr 728	RESET 728

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on and that the AC LEVEL key light is on.

Abort Message

Description: This check determines whether or not the Audio Analyzer becomes unaddressed when it receives the Abort message. This check assumes that the Audio Analyzer is able to handshake, recognize its own address, make the remote/local changes, and enter serial poll mode. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON.

Description	HPL	BASIC
Send the Remote message to the Audio Analyzer.	rem 728	REMOTE 728

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on.

Send the Abort message, unaddressing the Audio Analyzer to listen.	cli 7	ABORTIO 7

Check that the Audio Analyzer's ADDRESSED annunciator is off. Note that the BASIC "ABORTIO" statement sends both the Abort message and the Local message. Thus if HPL is being used, the Audio Analyzer's REMOTE annunciator should remain on. If BASIC is being used, the Audio Analyzer's REMOTE annunciator should turn off.

Send the Local message	lcl 7	ABORTIO 7 (HPL only). (The Local message was already sent with the ABORTIO 7 statement above.)
Address the Audio Analyzer to talk and store its output data in variable V.	red 728,V	ENTER 728;V

Check that the Audio Analyzer's REMOTE annunciator is off but its ADDRESSED annunciator is on.

Description	HPL	BASIC
Send the Abort message, unaddressing the Audio Analyzer to talk.	cli 7	ABORTIO 7

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are off.

Send the serial poll-enable bus command (SPE) through the interface to place the Audio Analyzer in serial poll mode.	wti 0,7; wti 6, 24	(Series 80 Controllers) SENDBUS 728; 1, 24 (Series 200/300 Controllers) SEND 7; CMD 1, 24

On the Audio Analyzer, key in 61.3 SPCL. The right display should show 1.0. This indicates the Audio Analyzer is in serial poll mode (indicated by the "1").

Send the Abort message, removing the Audio Analyzer from serial poll mode.	cli 7	ABORTIO 7

Check that the Audio Analyzer's right display shows 0.0. This indicates the Audio Analyzer properly left serial-poll mode upon receiving the Abort message.

Status Byte Message

Description: This check determines whether or not the Audio Analyzer sends the Status Byte message in both the local and remote modes. This check assumes that the Audio Analyzer is able to handshake, recognize its own address, and make the remote/local changes. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON.

Description	HPL	BASIC
Place the Audio analyzer in serial poll mode and address it to talk (causing it to send the Status Byte message).	rds (728)→V	(Series 80 Controllers) STATUS 728;V
Series 200/300 controllers: Define V with the program instruction: 10 V = 0 20 END.	rds (728)→V	(Series 200/300 Controllers) V = SPOLL (728)
Display the Value of V.	dsp V	PRINT V

Check that Audio Analyzer's REMOTE annunciator is off. Depending upon the vintage of the HP-IB interface (HP HPL) used, the Audio Analyzer's ADDRESSED annunciator may be either on or off. The controller's display should read 0.00 (HPL) or 0 (BASIC).

Description	HPL	BASIC
Send the Remote message.	rem 728	REMOTE 728 (Series 80 Controllers)
Place the Audio Analyzer in serial poll mode and address it to talk (causing it to send the Status Byte message).	rds (728)→V	STATUS 728;V (Series 200/300 Controllers) V = SPOLL (728)
Display the value of V.	dsp V	PRINT V

Check that the Audio Analyzer's REMOTE annunciator is on. Depending upon the vintage of the HP-IB interface (HP HPL) used, the Audio Analyzer's ADDRESSED annunciator may be either on or off. The controller's display should read 0.00 (HPL) or 0 (BASIC).

Require Service Message

Description: This check determines whether or not the Audio Analyzer can issue the Require Service message (set the SRQ bus control line true). This check assumes that the Audio Analyzer is able to handshake, recognize its own address, make the remote/local changes, and receive Data messages. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON, then after the power-up sequence is complete, press the DISTN key.

Description	HPL	BASIC
Send the first part of the Remote message (enabling the Audio Analyzer to remote).	rem 7	(Series 80 Controllers) REMOTE 7 (Series 200/300 Controllers) REMOTE 728
Address the Audio Analyzer to listen (completing the Remote message) then send a Data message (enabling a Require Service message to be sent upon Instrument Error).	wrt 728,"22.4SP"	OUTPUT 728;"22.4SP"
Make the controller wait 2 seconds to allow time for the Audio Analyzer to send the Require Service message. (This step is not necessary if sufficient time is allowed.)	wait 2000	WAIT 2000
Read the binary status of the controller's HP-IB interface and store the data in variable V (in this step, 7 is the interface's select code).	rds (7) →V	(Series 80 Controllers) STATUS 7; V (Series 200/300 Controllers) V = SPOLL (728)
Display the value of the SRQ bit (in this step, 6 is the SRQ bit, numbered from 0).	dsp"SRQ =",bit (6,V)	(Series 80 Controllers) PRINT "SRQ ="; BIT (V,7) (Series 200/300 Controllers) "PRINT/SRQ="BIT(V,6)

Check that the SRQ value is 1, indicating the Audio Analyzer issued the Require Service message.

Trigger Message and Clear Key Triggering

Description: This check determines whether or not the Audio Analyzer responds to the Trigger message and whether the CLEAR key serves as a manual trigger in remote. This check assumes that the Audio Analyzer is able to handshake, recognize its own address, make the remote/local changes, and send and receive Data messages. Before beginning this check, set the Audio Analyzer's LINE switch to OFF, then to ON, then, when the power-up sequence is complete, press the DISTN key.

Description	HPL	BASIC
Send the first part of the Remote message (enabling the Audio Analyzer to remote).	rem 7	(Series 80 Controllers) REMOTE 7 (Series 200/300 Controllers) REMOTE 728
Address the Audio Analyzer to listen (completing the Remote message), then send a Data message (placing the Audio Analyzer in Hold mode).	wrt 728, "T1"	OUTPUT 728; "T1"
Send the Trigger message.	trg 728	TRIGGER 728
Address the Audio Analyzer to talk and store the data in variable V.	red 728, V	ENTER 728; V
Display the value of V.	dsp V	PRINT V

Check that both the Audio Analyzer's REMOTE and ADDRESSED annunciators are on. The controller's display should read 9009600000.00 (HPL) or 9009600000 (BASIC).

Address the Audio Analyzer to talk and store the data in variable V.	red 728, V	ENTER 728;V

Check that the controller's "run" indicator is still on indicating that it has not received data from the Audio Analyzer. Press the Audio Analyzer's CLEAR key. The controller's "run" indicator should turn off.

3-7. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS

The Audio Analyzer can be operated through the Hewlett-Packard Interface Bus (HP-IB). Bus compatibility, programming, and data formats are described in the following paragraphs.

Except for the LINE switch, the ÷10 and ×10 keys, the low terminal ground/FLOAT switches, and the Controller Reset Service Special Function, all Audio Analyzer operations (including service-related functions) are fully programmable via HP-IB. In addition, rapid-source tuning and rapid-frequency count capabilities (not available from the front panel) are provided in remote operation.

A quick test of HP-IB is described under *HP-IB Functional Checks.* These checks verify that the Audio Analyzer can respond to or send each of the applicable bus messages described in Table 3-3.

For more information about HP-IB, refer to IEEE Standard 488, ANSI Standard MC1.1, the *Hewlett-Packard Electronic Systems and Instruments* catalog, and the booklet, *"Tutorial Description of the Hewlett-Packard Interface Bus"* (HP part number 5952-0156).

HP-IB Compatibility

The Audio Analyzer's complete bus compatibility (as defined by IEEE Standard 488, and the identical ANSI Standard MC1.1) is described at the end of Table 3-3. Table 3-3 also summarizes the Audio Analyzer's HP-IB capabilities in terms of the twelve bus messages in the left-hand column.

Remote Mode

Remote Capability. In remote, most of the Audio Analyzer's front-panel controls are disabled (exceptions are the LCL and CLEAR keys). However, front-panel displays and the signal at various outputs remain active and valid. In remote, the Audio Analyzer may be addressed to talk or listen. When addressed to listen, the Audio Analyzer will respond to the Data, Trigger, Clear (SDC), and Local messages. When addressed to talk, the Audio Analyzer can issue the Data and Status Byte messages. Whether addressed or not, the Audio Analyzer will respond to the Clear (DCL), Local Lockout, Clear Lockout/Set Local, and Abort messages, and in addition, the Audio Analyzer may issue the Require Service message.

Local-to-Remote Mode Changes. The Audio Analyzer switches to remote operation upon receipt of the Remote message. The Remote message has two parts. They are:

- Remote enable bus control line (REN) set true.
- Device listen address received *once* (while REN is true).

When the Audio Analyzer switches to remote, both the REMOTE and ADDRESSED annunciators on its front panel will turn on.

Local Mode

Local Capability. In local, the Audio Analyzer's front-panel controls are fully operational and the instrument will respond to the Remote message. Whether addressed or not, it will also respond to the Clear, Local Lockout, Clear Lockout/Set Local, and the Abort messages. When addressed to talk, the instrument can issue Data messages and the Status Byte message, and whether addressed or not, it can issue the Require Service message.

Remote-to-Local Mode Changes. The Audio Analyzer always switches to local from remote whenever it receives the Local message (GTL) or the Clear Lockout/Set Local message. (The Clear Lockout/Set Local message sets the Remote Enable control line [REN] false.) If it is not in Local Lockout mode, the Audio Analyzer switches to local from remote whenever its front panel LCL key is pressed.

Addressing

The Audio Analyzer interprets the byte on the bus' eight data lines as an address or a bus command if the bus is in the command mode: attention control line (ATN) true and interface clear control line (IFC) false. Whenever the Audio Analyzer is being addressed (whether in local or remote), the ADDRESSED annunciator on the front panel will turn on.

The Audio Analyzer talk and listen addresses are switch selectable as described in Section 2. Refer to Table 2-1 for a comprehensive listing of all valid HP-IB address codes. To determine the present address setting, refer to the discussion titled *HP-IB Address* in the *Detailed Operating Instructions* near the end of this section.

Table 3–3. *Message Reference Table (1 of 2)*

HP-IB Message	Applicable	Response	Related Commands and Controls	Interface Functions*
Data	Yes	All Audio Analyzer operations except the LINE switch, FLOAT switch, and the ÷10 and ×10 functions are bus-programmable. All measurement results, special displays, and error outputs except the " -- " display are available to the bus.		AH1 SH1 T5, TE0, L3, LE0
Trigger	Yes	If in remote and addressed to listen, the Audio Analyzer makes a settled measurement according to previously programmed setup. It responds equally to bus command GET and program code T3, Trigger with Settling (a Data message).	GET	DT1
Clear	Yes	Sets SOURCE to 1 kHz and 0 mV, MEASUREMENT to AC LEVEL with the 80 kHz LP FILTER on, and sets the trigger mode to free run. Resets many additional parameters as shown in Table 3–5. Clears Status Byte, RQS bit, Require Service message (if issued) and Local Lockout. Sets the Service Request Condition to the 22.2 state. Responds equally to Device Clear (DCL) and Selected Device Clear (SDC) bus commands.	DCL SDC	DC1
Remote	Yes	Remote mode is enabled when the REN bus control line is true. However, remote mode is not entered until the first time the Audio Analyzer is addressed to listen. The front-panel REMOTE annunciator lights when the instrument is actually in the remote mode. When entering remote mode, no instrument settings or functions are changed, but all front-panel keys except LCL and CLEAR are disabled, and entries in progress are cleared.	REN	RL1
Local	Yes	The Audio Analyzer returns to local mode (front-panel control). Responds equally to the GTL bus command and the front-panel LCL key. When entering local mode, no instrument settings or functions are changed but entries in progress are cleared. In local, triggering is free run only.	GTL	RL1
Local Lockout	Yes	Disables all front-panel keys including LCL and CLEAR. Only the controller can return the Audio Analyzer to local (front-panel control).	LLO	RL1
Clear Lockout/ Set Local	Yes	The Audio Analyzer returns to local (front-panel control) and local lockout is cleared when the REN bus control line goes false. When entering local mode, no instrument settings or functions are changed, but entries in progress are cleared. In local, triggering is free run only.	REN	RL1
Pass Control/ Take Control	No	The Audio Analyzer has no control capability.		C0

* Commands, Control lines, and Interface Functions are defined in IEEE Std. 488. Knowledge of these might not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

Table 3–3. *Message Reference Table (2 of 2)*

HP-IB Message	Applicable	Response	Related Commands and Controls	Interface Functions*
Require Service	Yes	The Audio Analyzer sets the SRQ bus control line true if an invalid program code is received. The Audio Analyzer will also set SRQ true, if enabled by the operator to do so, when measurement data is ready or when an instrument error occurs.	SRQ	SR1
Status Byte	Yes	The Audio Analyzer responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing the Require Service message) bit 7 (RQS bit) in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched but can be cleared by: 1) removing the causing condition, and 2) reading the Status Byte.	SPE SPD	T5, TEO
Status Bit	No	The Audio Analyzer does not respond to a parallel poll.		PPO
Abort	Yes	The Audio Analyzer stops talking and listening.	IFC	T5, TE0, L3, LE0

* Commands, Control lines, and Interface Functions are defined in IEEE Std. 488. Knowledge of these might not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

Complete HP-IB capability as defined in IEEE Std. 488 and ANSI Std. MC1.1 is: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

Local Lockout. When a data transmission is interrupted, which can happen by returning the Audio Analyzer to local mode by pressing the LCL key, the data could be lost. This would leave the Audio Analyzer in an unknown state. To prevent this, a local lockout is recommended. Local lockout disables the LCL key (and the CLEAR key) and allows return-to-local only under program control.

NOTE

Return-to-local can also be accomplished by turning the Audio Analyzer's LINE switch to OFF, then back to ON. However, this technique has several disadvantages:

- *It defeats the purpose and advantages of local lockout (that is, the system controller will lose control of a system element).*
- *There are several HP-IB conditions that reset to default states at turn-on.*

Data Messages

The Audio Analyzer communicates on the interface bus primarily with data messages. Data messages consist of one or more bytes sent over the 8 data bus lines, when the bus is in the data mode (attention control line [ATN] false). Unless it is set to Talk Only, the Audio Analyzer receives data messages when addressed to listen. Unless it is set to Listen Only, the Audio Analyzer sends data messages or the Status Byte message (if enabled) when addressed to talk. Virtually all instrument operations available in local mode may be performed in remote mode via data messages. The only exceptions are changing the LINE switch, FLOAT switches, the ÷10 or ×10 keys, and the Controller Reset Service Special Function. In addition, the Audio Analyzer may be triggered via data messages to make measurements at a particular time.

Receiving the Data Message

Depending on how the internal address switches are set, the Audio Analyzer can either talk only, talk status only, listen only, or talk and listen both (normal operation). The instrument responds to Data messages when it is enabled to remote (REN control line true) and it is addressed to listen or set to Listen Only. If not set to Listen Only, the instrument remains addressed to listen until it receives an Abort message or until its talk address or a universal unlisten command is sent by the controller.

Listen Only. If the internal LON (Listen Only) switch is set to "1", the Audio Analyzer is placed in the Listen Only mode when the remote enable bus control line (REN) is set true. The instrument then responds to all Data messages, and the Trigger, Clear, and Local Lockout messages. However, it is inhibited from responding to the Local or Abort messages and from responding to a serial poll with the Status Byte message.

Listen Only mode is provided to allow the Audio Analyzer to accept programming from devices other than controllers (for example, card readers).

Data Input Format. The Data message string, or program string, consists of a series of ASCII codes. With the exception of the Rapid Source mode, each code is typically equivalent to a front-panel keystroke in local mode. Thus, for a given operation, the program string syntax in remote mode is the same as the keystroke sequence in local mode. (For information about RS, Rapid Source, refer to *Rapid Source* in the *Detailed Operating Instructions.*) Example 1 shows the general-case programming order for selecting Audio Analyzer functions. Specific program order considerations are discussed in the following paragraphs under *"Program Order Considerations."* All functions can be programmed together as a continuous string as typified in Example 2. The string in Example 2 clears most Special Functions (with Automatic Operation), programs the source to 440 Hz at 1V, selects a distortion measurement with 30 kHz low-pass filtering and log units, then triggers a settled measurement.

Program Codes. Most all of the valid HP-IB codes for controlling Audio Analyzer functions are summarized in Table 3-6. All front-panel keys except the LCL key and the ÷10 and ×10 keys have corresponding program codes (exception: Service Special Functions).

Table 3-4 shows the Audio Analyzer's response to various ASCII characters not used in its code set. The characters in the top column will be ignored unless they appear between two characters of a program code. The characters in the bottom column, if received by the Audio Analyzer, will always cause Error 24 (invalid HP-IB code) to be displayed and a Require Service message to be generated. The controller recognizes the invalid code entry and clears the Require Service condition. Thereafter, the invalid code entry is ignored, and subsequent valid entries are processed in normal fashion. As a convenience, all lower case alpha characters are treated as upper case.

Table 3–4. *Audio Analyzer Response to Unused ASCII Codes*

Ignored†				
!	#	(	'	
"	%	)	/	
"	&	*		
Generate Error 24				
@	I	Z	⌒	}
B	J	[	—	~
E	Q	\	¦	DEL
G	Y	]	¦	

†Except when inserted between two characters of a program code.

EXAMPLE 1: General Program Syntax and Protocol*

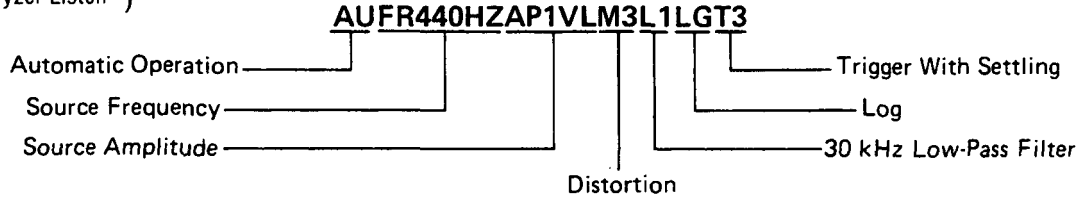
{ Controller Talk / Audio Analyzer Listen }

[Automatic Operation] [Source Frequency] [Source Amplitude] [Measurement] [Filters] [Special Functions] [Log/Lin] [Ratio] [Start Frequency] . . . [Stop Frequency] [Plot Limit] [Sweep] [Trigger]

*Excluding Rapid Source or Rapid Frequency Count Modes.

EXAMPLE 2: Typical Program String

{ Controller Talk / Audio Analyzer Listen }



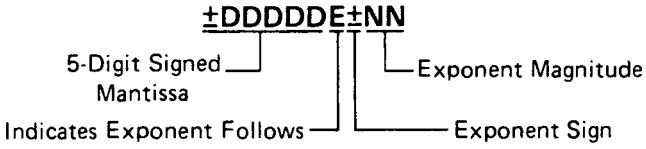
Turning off Functions. When operating in local mode, the High-Pass/Bandpass (optional plug-in filters), and Low-Pass Filters, and Ratio functions toggle on and off with successive keystrokes. In remote mode, these functions do not toggle on and off. Instead, each of the above groups has a specific code which turns off all the keys in the group. The HP-IB codes for turning off these functions are given in the following table.

Function	HP-IB Code
HP/BP FILTERS all off	H0
LP FILTERS all off	L0
RATIO off	R0
SWEEP off	W0

Programming Numeric Data. When programming source amplitude or frequency, entering ratio references, plot limits, or issuing any numeric data (other than specific HP-IB codes) to the Audio Analyzer, certain precautions should be observed. Numeric data may be entered in fixed, floating

point, or exponential formats. Usually, numeric data consists of a signed mantissa of up to five digits (including leading zeros), one decimal point, and one- or two-digit signed exponent. The decimal point may fall between any two digits of the mantissa but should not appear ahead of the first digit. If it does, a leading zero will be automatically inserted by the Audio Analyzer. Any digit beyond the five allowed for the mantissa will be received as zero. The general format for numeric data entry is given below, followed by several examples illustrating various entries and the resulting data as received by the Audio Analyzer.

General Numeric Data Input Format:



Example: + .12345E+01 issued
0.12340E+01 received by
Audio Analyzer

Example: +123456E+01 issued
123450E+01 received by
Audio Analyzer

Example: +00012345 issued
12000 received by
Audio Analyzer

In general, do not issue numeric data with more significant digits than can be displayed on the Audio Analyzer's left five-digit display.

NOTE

The above numeric data input format information does not apply to the Rapid Source mode. Refer to Rapid Source in the Detailed Operating Instructions.

Triggering Measurements with the Data Message. A feature that is only available via remote programming is the selection of free run, standby, or triggered operation of the Audio Analyzer. During local operation, the Audio Analyzer is allowed to free run outputting data to the display as each measurement is completed. In remote (except in sweep), three additional operating modes are allowed: Hold, Trigger Immediate, and Trigger with Settling. In addition, the CLEAR key can act as a manual trigger while the instrument is in remote. The trigger modes and use of the Clear key are described below.

Free Run (T0). This mode is identical to local operation and is the mode of operation in effect when no other trigger mode has been selected. The measurement result data available to the bus are constantly being updated as rapidly as the Audio Analyzer can make measurements. A Device Clear message or entry into remote from local sets the Audio Analyzer to the Free Run mode.

NOTE

Free Run triggering (code T0) is the only trigger mode allowed when using the sweep function (code W1). Any other triggering (codes T1, T2, or T3) or use of CLEAR key triggering will cause only the start frequency point to be displayed, plotted, and read to the HP-IB. Both the rear-panel X AXIS and Y AXIS outputs will be inhibited from continuing beyond the start frequency point.

Hold (T1). This mode is used to set up triggered measurements (initiated by program codes T2 or T3, the Trigger message, or the CLEAR key). In Hold mode, internal settings can be altered by the instrument itself or by the user via the bus. Thus, the signal at the MONITOR output *can change.* However, the instrument is inhibited from outputting any data to the front-panel key lights and display, to the rear-panel X AXIS or Y AXIS outputs, or to the HP-IB except as follows. The instrument will issue the Require Service message if an HP-IB code error occurs. The instrument will issue the Status Byte message if serial polled. (A serial poll, however, will trigger a new measurement, update displays and return the instrument to Hold.)

Upon leaving Hold, the front-panel indications are updated as the new measurement cycle begins. The Status Byte will be affected (and the Require Service message issued) by the events that occur during the new measurement cycle. The Audio Analyzer leaves Hold when it receives either the Free Run, Trigger Immediate, Trigger with Settling codes, or the Trigger Message, when the CLEAR key is pressed (if not in Local Lockout), or when it returns to local operation.

Trigger Immediate (T2). When the Audio Analyzer receives the Trigger Immediate code, it makes one measurement in the shortest possible time. The instrument then waits for the measurement results to be read. While waiting, the instrument can process most bus commands without losing the measurement results. However, if the instrument receives GTL (Go To Local), GET (Group Execute Trigger), its listen address, or if it is triggered by the CLEAR key, a new measurement cycle will be executed. Once the data (measurement results) are read onto the bus, the Audio Analyzer reverts to the Hold mode. Measurement results obtained via Trigger Immediate are normally valid only when the instrument is in a steady, settled state.

Trigger with Settling (T3). Trigger with Settling is identical to Trigger Immediate except the Audio Analyzer inserts a settling-time delay before taking the requested measurement. This settling time is sufficient to produce valid, accurate measurement results. Trigger with Settling is the trigger type executed when a Trigger message is received via the bus.

Triggering Measurements with the CLEAR Key. When the Audio Analyzer is in remote Hold mode and not in Local Lockout, the front-panel CLEAR key may be used to issue a Trigger with Settling instruction. Place the instrument in Hold mode (code T1). Each time the CLEAR key is pressed, the Audio Analyzer performs one Trigger with Settling measurement cycle, then waits for the data to be read. Once the data is read out to the bus, the instrument returns to Hold mode. If data is not read between trigger cycles, it will be replaced with data acquired from subsequent measurements.

Special Considerations for Triggered Operation. When in free-run mode, the Audio Analyzer must pay attention to all universal bus commands, for example, "serial poll enable (SPE)" , "local lockout (LLO)" , etc. In addition, if it is addressed to listen, it must pay attention to all addressed bus commands, such as, "go to local (GTL)", "group execute trigger (GET)", etc. As a consequence of this, the Audio Analyzer must interrupt the current measurement cycle to determine whether any action in response to these commands is necessary. Since many elements of the measurements are transitory, the measurement must be reinitiated following each interruption. Thus, if much bus activity occurs while the Audio Analyzer is trying to take a measurement, that measurement may never be completed.

Trigger Immediate and Trigger with Settling provide a way to avoid this problem. When the Trigger Immediate (T2) and Trigger with Settling (T3) codes are received, the Audio Analyzer will not allow its measurement to be interrupted; **indeed, even handshake of bus commands are inhibited until the measurement is complete.** Once the measurement is complete, bus commands will be processed, as discussed under Trigger Immediate above, with no loss of data. Thus, in an HP-IB environment where many bus commands are present, Trigger Immediate or Trigger with Settling should be used for failsafe operation.

NOTE

Free Run triggering (code T0) is the only trigger mode allowed when using the sweep function (code W1). Any other triggering (codes T1, T2, or T3) or use of CLEAR key triggering will cause only the start frequency point to be displayed, plotted, and read to the HP-IB. Both the rear-panel X AXIS and Y AXIS outputs will be inhibited from continuing beyond the start frequency point.

Reading Data from the Right or Left Display. The Audio Analyzer can only read data to the HP-IB once for each measurement made. Only the information on one display can be read each time. Use the codes RR (read right display) or RL (read left display) to control which information is read. The display will remain selected until the opposing display is specified (or until a clear message is received or power-up occurs). Errors (which occupy two displays) are output as described above, and DC LEVEL measurement results (always occupying the right display only) are placed on the bus (when requested) regardless of which display is enabled.

Program Order Considerations. Although program string syntax is virtually identical to keystroke order, some program order considerations need highlighting.

Automatic Operation (AU). As in local mode, when AUTOMATIC OPERATION is executed in remote it sets all Special Functions prefixed 1 through 8 to their zero-suffix mode, and also affects many other Special Functions. Thus when AUTOMATIC OPERATION is used, it should appear at the beginning of a program string.

Frequency or Amplitude Increment Step Up or Step Down (UP or DN). When a Step Up (UP) or Step Down (DN) is executed, the frequency or the amplitude is modified as determined by the established increment. The parameter changed is dependent upon which increment command was executed last. To insure the correct modification, program either Frequency Increment (FN) or Amplitude Increment (AN) immediately before the UP or DN command.

Trigger Immediate and Trigger with Settling (T2 and T3). When either of the trigger codes T2 or T3 is received by the Audio Analyzer, a measurement is immediately initiated. Once the measurement is complete, some bus commands can be processed without losing the measurement results. However, any HP-IB program code sent to the Audio Analyzer before the triggered measurement results have been output will initiate a new measurement. Thus, trigger codes should always appear at the end of a program string, and the triggered measurement results must be read before any additional program codes are sent.

Sending the Data Message

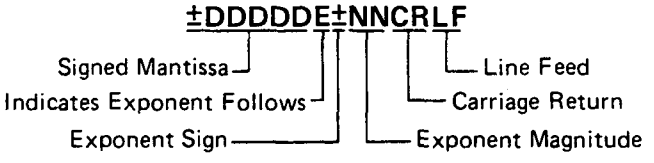
Depending on how the internal address switches are set, the Audio Analyzer can either talk only, talk status only, listen only, or talk and listen both (normal operation). If set to both talk and listen, the instrument sends Data messages when addressed to talk. The instrument then remains configured to talk until it is unaddressed to talk by the controller. To unaddress the Audio Analyzer, the controller must send either an Abort message, a new talk address, or a universal untalk command.

Talk Only Mode. If the internal address switches are set to a valid Talk address and the TON (Talk Only) switch is set to "1", the Audio Analyzer is placed in the Talk Only mode. In this mode instrument is configured to send Data messages whenever the bus is in the data mode. Each time the measurement is completed, the measurement result will be output to the bus unless the listening device is not ready for data. If the listener is not ready and the Audio Analyzer is not in a trigger mode, another measurement cycle is executed.

Talk Status Only Mode. If all the internal address switches and the TON (Talk Only) switch are set to "1", but the LON (Listen Only) switch is set to "0", the Audio Analyzer is placed in the Talk Status Only mode. In this mode the instrument is configured to send a one-byte data message whenever the bus is in the data mode. The byte sent is an exact copy of the Status Byte. Each time this byte is successfully sent on the bus, the internal Status Byte is cleared. The Data Valid (DAV) handshake line is pulsed each time the one-byte Data message is sent.

Data Output Format. As shown below, the output data is usually formatted as a real constant in exponential form: first the sign, then five digits (leading zeros not suppressed) followed by the letter E and a signed power-of-ten multiplier. (Refer to *Rapid Frequency Count* in the *Detailed Operation Instructions* for the only exceptions to this format.) The string is terminated by a carriage return (CR) and a line feed (LF), string positions 11 and 12. Data is always output in fundamental units (for example, Hz, volts, dB, %, etc.), and the decimal point (not sent) is assumed to be to the right of the fifth digit of the mantissa. Data values never exceed 4 000 000 000.

Data Output Format:

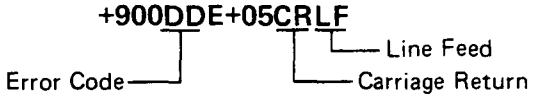


NOTE

For the only exception to the above format, refer to Rapid Frequency Count *in the* Detailed Operating Instructions.

When an error is output to the bus, it follows the same twelve-byte format described above except most of the numeric digits have predetermined values as shown below. Error outputs always exceed 9 000 000 000. The two-digit error code is represented by the last two digits of the five-digit mantissa. The error code can be derived from the string by subtracting 9×10^9, then dividing the results by 100 000.

Error Output Format:



Receiving the Clear Message

The Audio Analyzer responds to the Clear message by assuming the settings detailed in Table 3-5. The Audio Analyzer responds equally to the Selected Device Clear (SDC) bus command when addressed to listen, and the Device Clear (DCL) bus command whether addressed or not. The Clear message clears any pending Require Service message and resets the Service Request Condition (Special Function 22) such that the Require Service message will be issued on HP-IB code errors only (22.2 SPCL).

Receiving the Trigger Message

When in remote and addressed to listen, the Audio Analyzer responds to a Trigger message by executing one settled-measurement cycle. The Audio Analyzer responds equally to a Trigger message (the Group Execute Trigger bus command [GET]) and a Data message, program code T3 (Trigger with Settling).

Refer to the paragraph "*Triggering Measurements with the Data Message*" under *Receiving the Data Message.*

Receiving the Remote Message

The Remote message has two parts. First, the remote enable bus control line (REN) is held true, then the device listen address is sent by the controller. These two actions combine to place the Audio Analyzer in remote mode. Thus, the Audio Analyzer is enabled to go into remote when the controller begins the Remote message, but it does not actually switch to remote until addressed to listen the first time. No instrument settings are changed by the transition from local to remote, but the Trigger mode is set to Free Run (code T0). When actually in remote, the Audio Analyzer lights its front-panel REMOTE annunciator. When the Audio Analyzer is being addressed (whether in remote or local), its front-panel ADDRESSED annunciator turns on.

Table 3–5. *Response to a Clear Message*

Parameter	Setting
Start Frequency	20 Hz
Stop Frequency	20 kHz
Plot Limits	
Lower	−100.0
Upper	+100.0
X-Y Recorder	Enabled
Frequency	1000.0 Hz
Frequency Increment	1000.0 Hz
Amplitude	0.00 mV
Amplitude Increment	0.100V
Measurement	AC Level
Detection	RMS
Low-Pass (LP) Filter	80 kHz Low-Pass On
High-Pass (HP)/ Bandpass (BP) Filter	All off
SPCL	All Special Functions off or set to their zero-suffix mode except Service Request Condition set to 22.2 (HP-IB code error).
Ratio	Off
Log/Lin	Linear (refer to RATIO and LOG/LIN Detailed Operating Instructions.)
Right Display Read	Enabled
Service Request Condition	HP-IB Code Error Only
Status Byte	Cleared
Trigger Mode	Free Run (Code T0)
Local Lockout	Cleared

Receiving the Local Message

The Local message is the means by which the controller sends the Go To Local (GTL) bus command. If addressed to listen, the Audio Analyzer returns to front-panel control when it receives the Local message. If the instrument was in local lockout when the Local message was received, front-panel control is returned, but lockout is not cleared. Unless it receives the Clear Lockout/Set Local message, the Audio Analyzer will return to local lockout the next time it goes to remote. No instrument settings are changed by the transition from remote to local, but all measurements are made in a free run mode.

When the Audio Analyzer goes to local mode, the front-panel REMOTE annunciator turns off. However, when the Audio Analyzer is being addressed (whether in remote or local), its front-panel ADDRESSED annunciator lights.

If the Audio Analyzer is not in local lockout mode, pressing the front-panel LCL (local) key might interrupt a Data message being sent to the instrument, leaving the instrument in a state unknown to the controller. This can be prevented by disabling the Audio Analyzer's front-panel keys entirely using the Local Lockout message.

Receiving the Local Lockout Message

The Local Lockout message is the means by which the controller sends the Local Lockout (LLO) bus command. If in remote, the Audio Analyzer responds to the Local Lockout Message by disabling the front-panel LCL (local) and CLEAR keys. (In remote, CLEAR initiates a Trigger with Settling cycle.) The local lockout mode prevents loss of data or system control due to someone accidentally pressing front-panel keys. If, while in local, the Audio Analyzer is enabled to remote (that is, REN is set true) and it receives the Local Lockout Message, it will switch to remote mode with local lockout the first time it is addressed to listen. When in local lockout, the Audio Analyzer can be returned to local only by the controller (using the Local or Clear Lockout/Set Local messages), by setting the LINE switch to OFF and back to ON, or by removing the bus cable.

Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The Audio Analyzer returns to local mode (full front-panel control) when it receives the Clear Lockout/Set Local message. No instrument settings are changed by the transition from remote with local lockout to local. When the Audio Analyzer goes to local mode, the front-panel REMOTE annunciator turns off.

Receiving the Pass Control Message

The Audio Analyzer does not respond to the Pass Control message because it cannot act as a controller.

Sending the Require Service Message

The Audio Analyzer sends the Require Service message by setting the Service Request (SRQ) bus control line true. The instrument can send the Require Service message in either local or remote mode. The Require Service message is cleared when a serial poll is executed by the controller or if a Clear message is received by the Audio Analyzer. (During serial poll, the Require Service message is cleared immediately before the Audio Analyzer places the Status Byte message on the bus.) An HP-IB code error will always cause a Require Service message to be issued. In addition, there are two other conditions which can be enabled to cause the Require Service message to be sent when they occur. All three conditions are described below:

- Data Ready: When the Audio Analyzer is ready to send any information except error codes or the Status Byte.
- HP-IB Code Error: When the Audio Analyzer receives an invalid Data message. (This condition always causes a Require Service message to be sent.)

NOTE

The "- - - -" display indicates a transient condition. After nine attempts to make a measurement, it is replaced by Error 31 which causes the Require Service message to be sent.

- Instrument Error: When any Error is being displayed by the Audio Analyzer, including the HP-IB Code error (Error 24).

Selecting the Service Request Condition

Use Special Function 22, Service Request Condition, to enable the Audio Analyzer to issue the Require Service message on any of the above conditions (except HP-IB code errors which always cause the Require Service message to be sent). The Service Request Condition Special Function is entered from either the front panel or via the HP-IB. The conditions enabled by Special Function 22 are always disabled by the Clear message. A description of the Service Request Condition Special Function and the procedure for enabling the various conditions are given under *Service Request Condition* in the *Detailed Operation Instructions*. Normally, device subroutines for the Audio Analyzer can be implemented simply by triggering measurements then reading the output data. In certain applications, the controller must perform other tasks while controlling the Audio Analyzer. Figure 3-7 illustrates a flow chart for developing device subroutines using the instrument's ability to issue the Require Service message when data is ready. This subroutine structure frees the controller to process other routines until the Audio Analyzer is ready with data.

Sending the Status Byte Message

The Status Byte message consists of one 8-bit byte in which 3 of the bits are set according to the enabled conditions described above under *Sending the Require Service Message*. If one or more of the three conditions previously described are both enabled and present, all the bits corresponding to the conditions (and also bit 7 the RQS bit) will be set true, and the Require Service message is sent. If one of the above conditions occurs but has not been enabled by Special Function 22, neither the bit corresponding to the condition nor the RQS bit will be set (and the Require Service message will not be sent). The bit pattern of the Status Byte is shown in the table labeled "STATUS Byte:," under paragraph 3-7, *HP-IB Syntax and Characteristics Summary* on the following pages.

Once the Audio Analyzer receives the serial poll enable bus command (SPE), it is no longer allowed to alter the Status Byte. When addressed to talk (following SPE), the Audio Analyzer sends the Status Byte message.

NOTE

Since the Audio Analyzer cannot alter the Status Byte while in serial poll mode, it is not possible to continually request the Status Byte while waiting for a condition to cause a bit to be set.

After the Status Byte message has been sent it will be cleared if the Serial Poll Disable (SPD) bus command is received, if the Abort message is received, or if the Audio Analyzer is unaddressed to talk. Regardless of whether or not the Status Byte message has been sent, the Status Byte and any Require Service message pending will be cleared if a Clear message is received. If the instrument is set to Talk Only, the Status Byte is cleared each time the one-byte Data message is issued to the bus.

Sending the Status Bit Message

The Audio Analyzer does not respond to a Parallel Poll Enable (PPE) bus command and thus cannot send the Status Bit Message.

Receiving the Abort Message

The Abort Message is the means by which the controller sets the Interface Clear (IFC) bus control line true. When the Abort message is received, the Audio Analyzer becomes unaddressed and stops talking or listening.

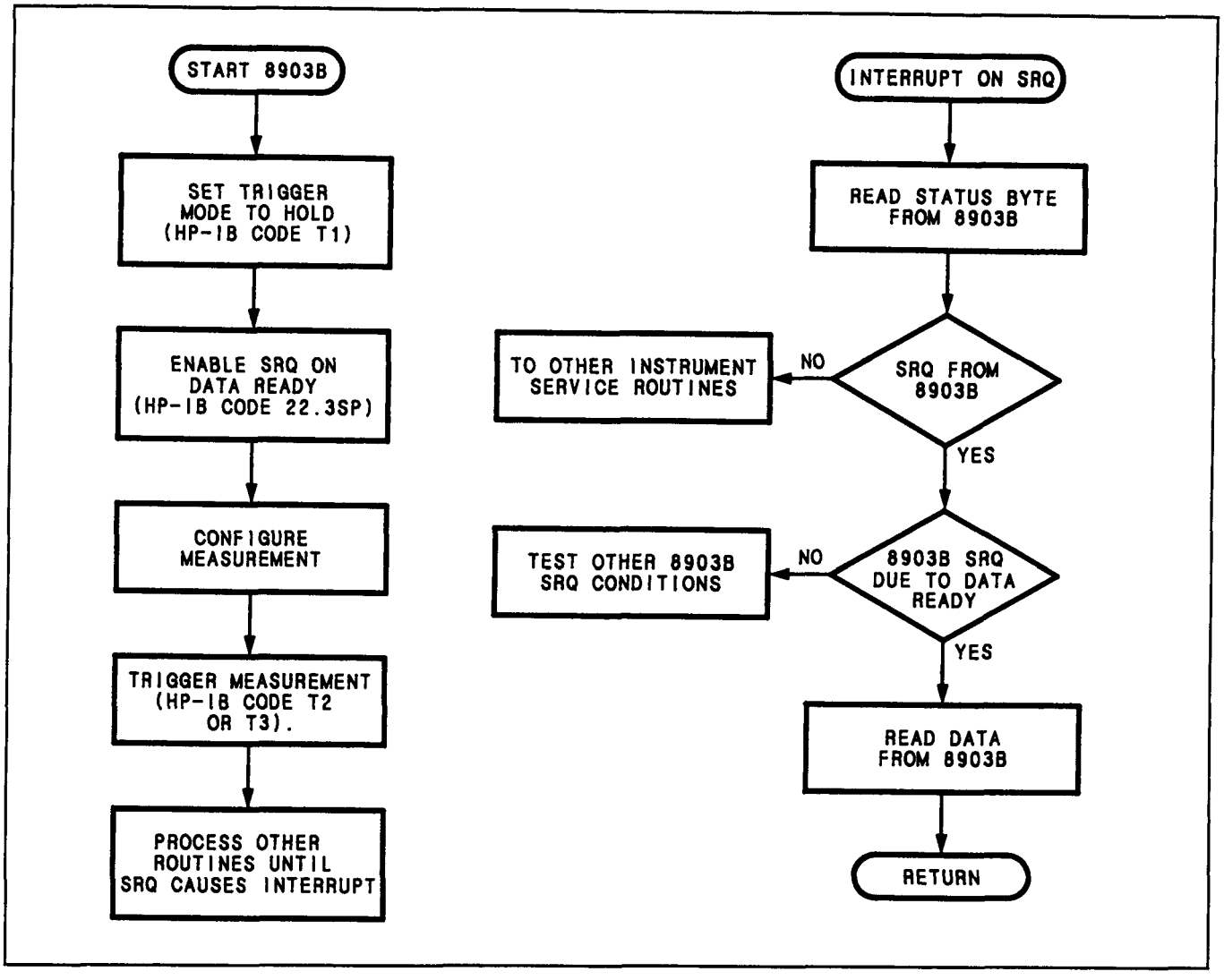


Figure 3–4. Example Flow Chart for Driving the Audio Analyzer Using the Require Service Message (SRQ)

3–7. HP-IB SYNTAX AND CHARACTERISTICS SUMMARY

Address: Set in binary by internal switches — may be displayed on front panel using Special Function 21, HP-IB Address. (Factory set to 28 decimal; 11100 binary.)

General Operating Syntax: (Excluding Rapid Frequency Count and Rapid Source modes.)* [Automatic Operation] [Source Frequency] [Source Amplitude] [Measurement] [Filters] [Special Functions] [Log/Lin] [Ratio] ... ...[Start Frequency] [Stop Frequency] [Plot Limit] [Sweep] [Trigger]

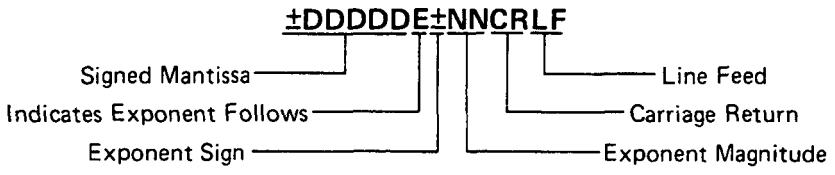
Numeric Data Input Format: (Except in Rapid Source mode.)*

±DDDDDE±NN

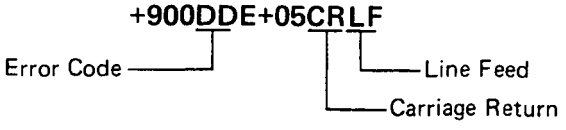
- 5-Digit Signed Mantissa (leading decimal not allowed)
- Exponent Magnitude
- Exponent Sign
- Indicates Exponent Follows

*For information on Rapid Frequency Count or Rapid Source modes refer to them by name in the Detailed Operating Instructions.

Output Formats: (Except in Rapid Frequency Count mode.)* Data (valid data output value always $<9 \times 10^9$ and in fundamental units):



Errors:



Return to Local:
Front panel LCL key if not locked out.

Manual Trigger:
Front panel CLEAR key initiates Trigger with Settling measurement.

Status Byte:

Bit	8	7	6	5	4	3	2	1
Weight	128	64	32	16	8	4	2	1
Service Request Condition	0 (always)	RQS Bit Require Service	0 (always)	0 (always)	0 (always)	Instru-ment Error	HP-IB Code Error	Data Ready

Notes:
1. The condition indicated in bits 1 and 3 must be enabled to cause a Service Request by Special Function 22, Service Request Condition.
2. The RQS bit (bit 7) is set true whenever an HP-IB code error occurs or when any of the conditions of bits 1 and 3 are enabled and occur.
3. Bits set remain set until the Status Byte is cleared.

Complete HP-IB Capability (as described in IEEE Std 488, and ANSI Std MC1.1): SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

*For information on Rapid Frequency Count or Rapid Source modes refer to them by name in the Detailed Operating Instructions.

Table 3–6. *Audio Analyzer Parameter to HP-IB Code Summary*

Parameter	Program Code	Parameter	Program Code
Source		Internal Plug-in HP/BP Filters	
Function		Left Plug-in Filter on	H1
Start Frequency	FA	Right Plug-in Filter on	H2
Stop Frequency	FB	All Plug-in HP/BP Filters off	H0
Plot Limit	PL		
Frequency Increment	FN	LP Filters	
Amplitude	AP	30 kHz LP Filter on	L1
Amplitude Increment	AN	80 Khz LP Filter on	L2
		All LP Filters off	L0
Data			
– (minus)	-	Ratio	
Clear*	CL	On	R1
0–9	0–9	Off	R0
.(decimal point)	.		
Units		Log/Lin	
kHz	KZ	Log	LG
V	VL	Lin	LN
Upper Limit	UL		
Hz	HZ	Trigger Modes	
mV	MV	Free Run	T0
Lower Limit	LL	Hold	T1
dB	DB	Trigger Immediate	T2
dBm into 600Ω (dBre.775V)	DV	Trigger with Settling	T3
Sweep on	W1	Miscellaneous	
Sweep off	W0	Read Left Display	RL
↑ (step up)	UP	Read Right Display	RR
↓ (step down)	DN	Rapid Frequency Count	RF
		Rapid Source	RS
Automatic Operation	AU		
SPCL	SP		
SPCL SPCL	SS		
Measurements			
AC Level	M1		
SINAD	M2		
Distortion	M3		
DC Level	S1		
Signal-to-Noise	S2		
Distortion Level	S3		
RMS Detector	A0		
AVG Detector	A1		
Automatic Notch Tuning	N0		
Notch Hold	N1		

* Not to be confused with Clear message which is defined in Table 3-3.

Table 3–7. *Audio Analyzer HP-IB Code to Parameter Summary*

Program Code	Parameter	Program Code	Parameter
A0	RMS Detector	N0	Automatic Notch Tuning
A1	AVG Detector	N1	Notch Hold
AN	Amplitude Increment		
AP	Amplitude	PL	
AU	Automatic Operation		
		RF	Rapid Frequency Count
*CL	Clear	RL	Read Left Display
		RR	Read Right Display
DV	dBm into 600Ω (dBre.775V)	RS	Rapid Source
DB	dB	R1	Ratio On
DN	↓ (stepdown)	R0	Ratio Off
FA	Start Frequency	SP	SPCL
FB	Stop Frequency	SS	SPCL SPCL
FN	Frequency Increment	S1	DCLevel
FR	Frequency	S2	Signal-to-Noise
		S3	Distortion Level
HZ	Hz		
H0	All Internal Plug-in HP/BP Filters off	T0	Free Run
H1	Left Plug-in Filter on	T1	Hold
H2	Right Plug-in Filter on	T2	Trigger immediate
		T3	Trigger with Setting
KZ	kHz		
		UP	↑(step-up)
		UL	Upper Limit
LG	Log		
LN	Linear		
LL	Lower Limit	VL	V
L0	All LP Filters off		
L1	30 kHz LP Filter on	W0	Sweep off
L2	80 kHz LP Filter on	W1	Sweep on
MV	mV	–	–(minus)
M1	AC Level	0–9	0–9
M2	SINAD	.	.(decimal point)
M3	Distortion		

3–8. Audio Analyzer Special Function to HP-IB Code Summary (1 of 2)

Special Function	Program Code
Input Level Range (except DC Level)	
Automatic Selection	1.0SP
300V range	1.1SP
189V range	1.2SP
119V range	1.3SP
7.54V range	1.4SP
47.6V range	1.5SP
30.0V range	1.6SP
18.9V range	1.7SP
11.9V range	1.8SP
7.54V range	1.9SP
4.76V range	1.10SP
3.00V range	1.11SP
1.89V range	1.12SP
1.19V range	1.13SP
0.754V range	1.14SP
0.476V range	1.15SP
0.300V range	1.16SP
0.189V range	1.17SP
0.119VV range	1.18SP
0.0754V range	1.19SP
Input Level Range (DC Level only)	
Automatic Selection	2.0SP
300V range	2.1SP
64V range	2.2SP
16V range	2.3SP
4V range	2.4SP
Post Notch Gain	
Automatic Selection	3.0SP
0 dB gain	3.1SP
20 dB gain	3.2SP
40 dB gain	3.3SP
60 dB gain	3.4SP
Hold Decimal Point	
Automatic Selection	4.0SP
DDDD. range	4.1SP
DDD.D range	4.2SP
DD.DD range	4.3SP
D.DDD range	4.4SP
0.DDDD range	4.5SP
DD.DD mV range	4.6SP
D.DDD mV range	4.7SP
0.DDDD mV range	4.8SP

Special Function	Program Code
Notch Tune	
Automatic notch tuning	6.0SP
Hold notch tuning	61SP
SINAD Meter Range	
0 to ≈ 18 dB range	7.0SP
0 to ≈ 24 dB range	7.1SP
Error Disable	
All errors enabled	8.0SP
Disabled Analyzers errors (Errors 12–17, 31, and 96)	8.1SP
Disable source errors (Errors 18 and 19)	8.2SP
Disable both Analyzer and Source errors	8.3SP
Hold Settings	
Hold input level ranges, post-notch gain, decimal point and notch tuning at present settings.	9.0SP
Display Source Settings	
Display source settings as entered. Frequency in left display; amplitude in right display.	10.0SP
Re-enter Ratio Mode	
Restore last RATIO reference and enter RATIO mode if allowed.	11.0SP
Display RATIO reference	11.1SP
Signal-to-Noise Measurements Delay	
Automatic Selection	12.0SP
200 ms delay	12.1SP
400 ms delay	12.2SP
600 ms delay	12.3SP
800 ms delay	12.4SP
1.0s delay	12.5SP
1.2s delay	12.6SP
1.4s delay	12.7SP
1.6s delay	12.8SP
1.8s delay	12.9SP
X-Y Recorder	
Enable plot	13.0SP
Disable plot	13.1SP

Table 3-8. *Audio Analyzer Special Function to HP-IB Code Summary (2 of 2)*

Special Function	Program Code	Special Function	Program Code
Post Notch Detector Response (except in SINAD)		Time Between Measurements	
Fast RMS Detector	5.0SP	Minimum time between measurements	14.0SP
Slow RMS Detector	5.1SP	Add 1s between measurements	14.1SP
Fast AVG Detector	5.2SP		
Slow AVG Detector	5.3SP	Read Display to HP-IB	
Quasi-peak Detector	5.7SP	Read right display	20.0SP
		Read left display	
SINAD and Signal-to-Noise Display Resolution		HP-IB Address	
0.01 dB above 25 dB; 0.5 dB below 25 dB	16.0SP	Displays HP-IB address (in binary)in left display; right display in form TLS where T=1 means talk only; L=1 means listen only; S =1 means SRQ	21.0SP
0.01 dB all ranges	16.1SP		
Sweep Resolution (maximum 255 points/sweep)		Displays HP-IB address in decimal	21.1SP
10 points/decade	17.0SP		
1 point/decade	17.1SP	HP-IB Service Request Condition	22.NSP
2 points/decade	17.2SP	Enable a Condition to to cause a service request, N is the sum of any combination of of the weighted conditions below:	
5 points/decade	17.3SP		
10 points/decade	17.4SP		
20 points/decade	17.5SP		
50 points/decade	17.6SP		
100 points/decade	17.7SP		
200 points/decade	17.8SP		
500 points/decade	17.9SP		
		1-Data Ready	
Display Level in Watts		2-HP-IB error	
Display level as watts into 8Ω	19.0SP	4-Instrument error	
Display level as watts into NNNΩ	19.NNNSP	The instrument powers up in the 22.2 state (HP-IB error).	
		Source Output Impedance (Instrument powers up at 600Ω)	
		600Ω	47.0SP
		50Ω	47.1SP

Table 3–9. *Commonly-Used Code Conversions*

ASCII	Binary	Octal	Decimal	Hexa-decimal
NUL	00 000 000	000	0	00
SOH	00 000 001	001	1	01
STX	00 000 010	002	2	02
ETX	00 000 011	003	3	03
EOT	00 000 100	004	4	04
ENQ	00 000 101	005	5	05
ACK	00 000 110	006	6	06
BEL	00 000 111	007	7	07
BS	00 001 000	010	8	08
HT	00 001 001	011	9	09
LF	00 001 010	012	10	0A
VT	00 001 011	013	11	0B
FF	00 001 100	014	12	0C
CR	00 001 101	015	13	0D
SO	00 001 110	016	14	0E
SI	00 001 111	017	15	0F
DLE	00 010 000	020	16	10
DC1	00 010 001	021	17	11
DC2	00 010 010	022	18	12
DC3	00 010 011	023	19	13
DC4	00 010 100	024	20	14
NAK	00 010 101	025	21	15
SYN	00 010 110	026	22	16
ETB	00 010 111	027	23	17
CAN	00 011 000	030	24	18
EM	00 011 001	031	25	19
SUB	00 011 010	032	26	1A
ESC	00 011 011	033	27	1B
FS	00 011 100	034	28	1C
GS	00 011 101	035	29	1D
RS	00 011 110	036	30	1E
US	00 011 111	037	31	1F
SP	00 100 000	040	32	20
!	00 100 001	041	33	21
"	00 100 010	042	34	22
#	00 100 011	043	35	23
$	00 100 100	044	36	24
%	00 100 101	045	37	25
&	00 100 110	046	38	26
'	00 100 111	047	39	27
(	00 101 000	050	40	28
)	00 101 001	051	41	29
*	00 101 010	052	42	2A
+	00 101 011	053	43	2B
,	00 101 100	054	44	2C
—	00 101 101	055	45	2D
.	00 101 110	056	46	2E
/	00 101 111	057	47	2F
0	00 110 000	060	48	30
1	00 110 001	061	49	31
2	00 110 010	062	50	32
3	00 110 011	063	51	33
4	00 110 100	064	52	34
5	00 110 101	065	53	35
6	00 110 110	066	54	36
7	00 110 111	067	55	37
8	00 111 000	070	56	38
9	00 111 001	071	57	39
:	00 111 010	072	58	3A
;	00 111 011	073	59	3B
<	00 111 100	074	60	3C
=	00 111 101	075	61	3D
>	00 111 110	076	62	3E
?	00 111 111	077	63	3F

ASCII	Binary	Octal	Decimal	Hexa-decimal
@	01 000 000	100	64	40
A	01 000 001	101	65	41
B	01 000 010	102	66	42
C	01 000 011	103	67	43
D	01 000 100	104	68	44
E	01 000 101	105	69	45
F	01 000 110	106	70	46
G	01 000 111	107	71	47
H	01 001 000	110	72	48
I	01 001 001	111	73	49
J	01 001 010	112	74	4A
K	01 001 011	113	75	4B
L	01 001 100	114	76	4C
M	01 001 101	115	77	4D
N	01 001 110	116	78	4E
O	01 001 111	117	79	4F
P	01 010 000	120	80	50
Q	01 010 001	121	81	51
R	01 010 010	122	82	52
S	01 010 011	123	83	53
T	01 010 100	124	84	54
U	01 010 101	125	85	55
V	01 010 110	126	86	56
W	01 010 111	127	87	57
X	01 011 000	130	88	58
Y	01 011 001	131	89	59
Z	01 011 010	132	90	5A
[	01 011 011	133	91	5B
\	01 011 100	134	92	5C
]	01 011 101	135	93	5D
^	01 011 110	136	94	5E
_	01 011 111	137	95	5F
`	01 100 000	140	96	60
a	01 100 001	141	97	61
b	01 100 010	142	98	62
c	01 100 011	143	99	63
d	01 100 100	144	100	64
e	01 100 101	145	101	65
f	01 100 110	146	102	66
g	01 100 111	147	103	67
h	01 101 000	150	104	68
i	01 101 001	151	105	69
j	01 101 010	152	106	6A
k	01 101 011	153	107	6B
l	01 101 100	154	108	6C
m	01 101 101	155	109	6D
n	01 101 110	156	110	6E
o	01 101 111	157	111	6F
p	01 110 000	160	112	70
q	01 110 001	161	113	71
r	01 110 010	162	114	72
s	01 110 011	163	115	73
t	01 110 100	164	116	74
u	01 110 101	165	117	75
v	01 110 110	166	118	76
w	01 110 111	167	119	77
x	01 111 000	170	120	78
y	01 111 001	171	121	79
z	01 111 010	172	122	7A
{	01 111 011	173	123	7B
|	01 111 100	174	124	7C
}	01 111 101	175	125	7D
~	01 111 110	176	126	7E
DEL	01 111 111	177	127	7F

AC Level

DESCRIPTION

The Audio Analyzer contains a wideband, true rms, and average-responding voltmeter with high accuracy and sensitivity. The AC LEVEL key causes the Audio Analyzer to measure the differential ac voltage between its HIGH and LOW INPUT connectors. Signals that are common to both the HIGH and LOW connectors are rejected.

PROCEDURE

To make an ac level measurement, press the AC LEVEL key. AC level results can be displayed in V, mV, dBm into 600Ω, watts, or as the ratio to an entered or measured value. The Audio Analyzer powers up displaying ac level in linear units (mV or V). To obtain a display in dBm (that is, dB relative to 1 milliwatt into a 600Ω load, equivalent to dBre 0.775V), press the LOG/LIN key. To return to linear, simply press the LOG/LIN key again. If the ac level is to be displayed relative to a reference, refer to *RATIO and LOG/LIN* .

EXAMPLE

To measure the ac level of a signal at the INPUT jacks:

LOCAL (keystrokes)	Measurement AC LEVEL
HP-IB **(program codes)**	M1 Measurement

PROGRAM CODE

HP-IB M1 is the program code for AC LEVEL.

INDICATIONS

When ac level is selected, the LED within the AC LEVEL key will light. The right display shows the ac level with the appropriate units. The Audio Analyzer automatically ranges for maximum resolution and accuracy. The left display shows the input signal frequency. If the input level to the frequency counter is too small, the left display will show 0.000 kHz. (This will often occur when the signal is in the stop band of the optional high-pass or weighting bandpass filters, but not the low-pass filters.)

MEASUREMENT TECHNIQUE

In ac level the Audio Analyzer acts as an ac voltmeter. The Audio Analyzer automatically sets the input attenuation and the gain settings of the various amplifiers so that the input signal amplitude lies within the range of the output detector. The output detector converts the ac level to a dc voltage which is then measured by the dc voltmeter. After correcting input gain and attenuation, the signal level is displayed in appropriate units. The frequency of the input signal level is also measured and displayed.