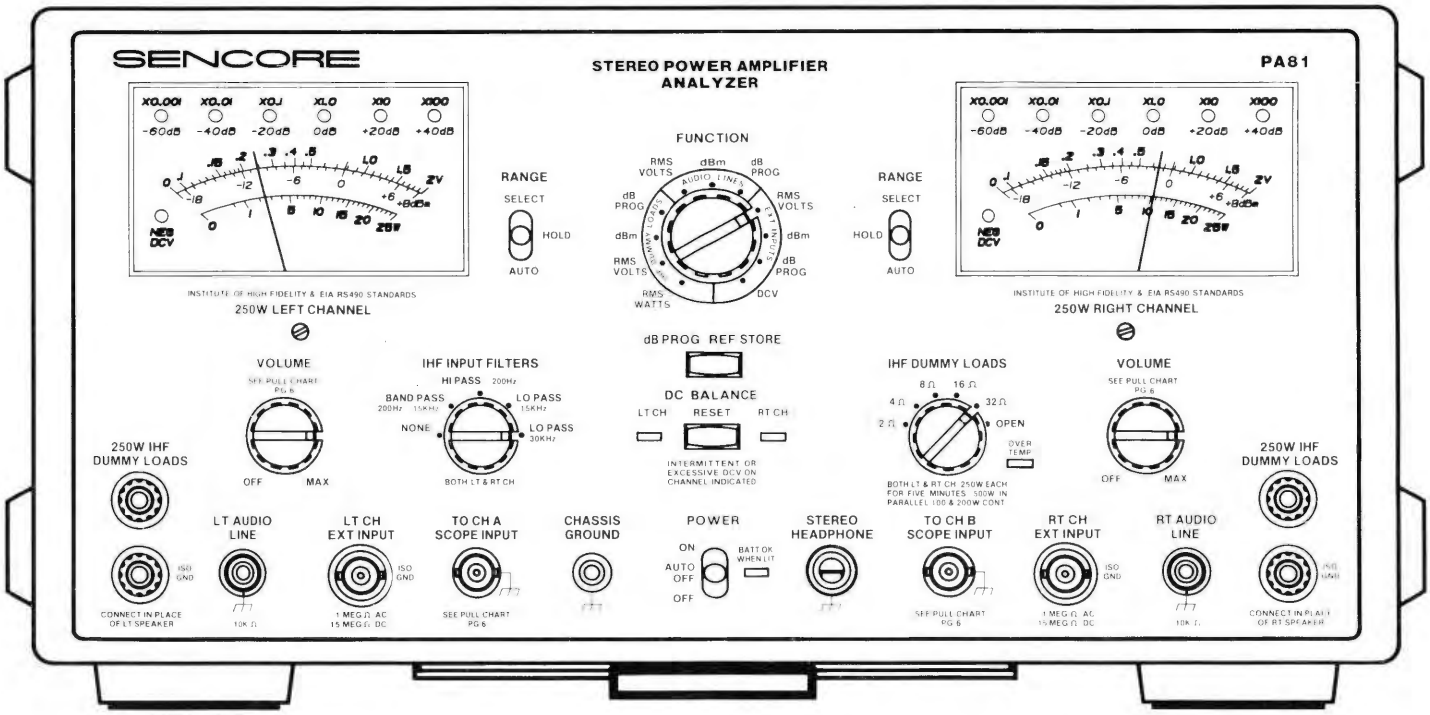
PA81

STEREO POWER AMPLIFIER ANALYZER

Operation, Application, and Maintenance Manual



SENCORE
3200 Sencore Drive, Sioux Falls, SD 57107

WARNING

PLEASE OBSERVE THESE SAFETY PRECAUTIONS

There is always a danger present when testing electronic equipment. Unexpected high voltages can be present at unusual locations in defective equipment. Every precaution has been taken in the design of your instrument to insure that it is as safe as possible. However, safe operation depends on you, the operator. Become familiar with the equipment you're working with, and observe the following safety precautions:

1. Never exceed the limits of this instrument as given in the specifications section and the additional special warnings in this manual.

2. A severe shock hazard can result if the chassis of the equipment being serviced is tied to the "hot" side of the AC line. An isolation transformer should always be used with hot-chassis equipment. Also, be sure that the top of your workbench and the floor underneath it are dry and made of non-conductive materials.

3. Remove the circuit power before making connections to high voltage points. If this cannot be done, be sure to avoid contact with other equipment or metal objects. Place one hand in your pocket and stand on an insulated floor to reduce the possibility of shock.

4. Discharge filter capacitors (after removing power) before connecting to any part of the circuit requiring power to be removed.

5. Be sure your equipment is in good order. Broken or frayed test leads can be extremely dangerous and can expose you to dangerous voltages.

6. Remove the test lead immediately after the test has been completed to reduce the possibility of shock.

7. Do not work alone when working on hazardous circuits. Always have another person close by in case of an accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment, or coming in contact with high voltages.

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DESCRIPTION

Introduction

The PA81 Stereo Power Amplifier Analyzer is a complete audio troubleshooter that allows you to totally analyze and isolate trouble in power amplifier stages or the signal sources that feed the amplifier.

The PA81 Stereo Power Amplifier Analyzer has the measuring capabilities you need to effectively service modern stereo equipment. It is a stand alone instrument that is enhanced when used with a signal generator or test tape, disk, or record. By injecting signals into the stereo under test and using the PA81 to analyze output signals, you can performance test, troubleshoot, and align modern stereos with complete confidence.

Features

The PA81's built-in low reactance dummy loads substitute for the normal amplifier loads at standard impedances from 2 to 32 ohms to allow you to test with known good loads. These loads handle up to 250 watts intermittent or 100 watts continuous per channel. The direct reading power meters are microprocessor controlled for accurate power readings at any dummy load impedance. An internal, thermally activated fan cycles automatically to cool the internal loads during high power operation. The OVER TEMP indicator alerts you if the input power exceeds the limits of the PA81. Plus, the open loads condition allows you to perform manufacturer recommended tests for amplifier stability.

There are three sets of inputs, controlled by the FUNCTION switch, for signal connection to the PA81:

1. 250 W IHF DUMMY LOADS inputs connect stereo power amplifier outputs to the PA81 monitor circuits to measure RMS WATTS, dBm, dB PROG and RMS VOLTS.

2. AUDIO LINE inputs connect pre-amplifiers and low signal level stereo components to the PA81 to measure dBm, dB PROG, and RMS VOLTS.

3. EXT INPUTs connect to external probes to measure RMS Volts, dBm, dB PROG and DC Volts.

The left and right channels have individual matched inputs. Individual TO SCOPE output jacks are provided to use an oscilloscope with the PA81 for waveform monitoring.

You can filter each input using the IHF INPUT FILTERS switch to select specific frequencies to be passed:

1. The BANDPASS filter passes frequencies from 200 Hz to 15 kHz.

2. The HI PASS filter passes frequencies above 200 Hz.

3. The LO PASS filters pass frequencies below either to 15 kHz or 30 kHz.

With the dB PROG function, you can program any 0 dB reference that is required in your testing. You simply use the dB PROG REF STORE button to store the level you wish to use as a 0 dB reference for comparison to other voltage levels.

The PA81 protects an amplifier's output stages from further damage due to high current when amplifier DC balance problems cause DC voltage to appear on the speaker outputs. The PA81 has a DC triggered breaker that opens when 1 volt DC or more is present at either of the 250 W IHF DUMMY LOADS inputs. Individual indicators show you which channel has the DC balance problem.

The PA81 meters can be automatically ranged for accurate readings. The range is automatically selected when the RANGE switch is in the AUTO position, or you can select and lock on the range you desire. In either position, indicator lights show you which meter range to read.

Audio monitors are mounted inside the PA81 to let you quickly judge the quality of the audio for both channels. A headphone jack is mounted on the front panel for connecting stereo headphones to the monitoring circuits. Using the headphone jack disables the audio monitors. Independent left and right volume controls change the audio level at the audio monitors and at the headphones.

You can take the PA81 with you for monitoring away from the bench. With the optional battery pack, you can work over 5 hours without having to recharge the battery. To conserve battery life, the PA81 shuts off automatically after 30 minutes of battery operation.

For automotive applications, the PA81 comes with a set of fused DC leads to plug into any 12 VDC negative ground auto accessory jack. Using this DC power adapter or the supplied AC power adapter disables the AUTO-OFF feature since the battery pack is not in use.

Specifications

All specifications allow for twenty minutes warmup and are guaranteed over the temperature range of 0 to 40 degrees C (32 to 104 degrees F).

SEPARATION BETWEEN CHANNELS:
Greater than 100 dB at 1 kHz.

RMS VOLTS (any input)

DYNAMIC RANGE: 0.2 mV to 200 volts RMS in six autoranged or manually selected ranges for Audio Line and Dummy Load inputs. 2 mV to 200 Volts in five autoranged or manually selected ranges for Ext Inputs.

RANGES:
0.2 mV to 2 mV except Ext Input
2 mV to 20 mV
20 mV to 200 mV
200 mV to 2 V
2 V to 20 V
20 V to 200 V

ACCURACY: ±2% of range full scale at 1 kHz.

FREQUENCY RESPONSE (1 kHz Reference)
20 Hz to 20 kHz = ±2%
15 Hz to 100 kHz = ±10%
10 Hz to 200 kHz =±5 dB

dBm (any input)

DYNAMIC RANGE: 120 dB total dynamic range from −72 dBm to +48 dBm in six autoranged or manually selected ranges for Audio Line and Dummy Load inputs. 100 dB total dynamic range from −52 dBm to +48 dBm in five autoranged or manually selected ranges for Ext Inputs.

RANGES:
−72 dBm to −52 dBm except Ext Input
−52 dBm to −32 dBm
−32 dBm to −12 dBm
−12 dBm to +8 dBm
+8 dBm to +28 dBm
+28 dBm to +48 dBm

ACCURACY: ±0.5 dBm at 1 kHz

FREQUENCY RESPONSE (1 kHz Reference)
20 Hz to 20 kHz = ±.2 dB
15 Hz to 100 kHz = ±1 dB
10 Hz to 200 kHz = ± 5 dB

dB PROG (any input)

DYNAMIC RANGE:
Same as dBm for reference and subsequent inputs.

RANGES:
Same as dBm.

ACCURACY:
±1 dB at 1 kHz

FREQUENCY RESPONSE:
Same as dBm.

RMS WATTS (Dummy Load Input Only)

DYNAMIC RANGE: 0 to 250 watts in two autoranged or manually selected ranges.

RANGES:
0 to 25 watts
0 to 250 watts

ACCURACY: ±3% of range full scale at 1 kHz, 8 ohm load.

DC VOLTS (External Input Only)

DYNAMIC RANGE: 0 to ±200 VDC in four autoranged or manually selected ranges.

RANGES:
0 to ±0.2 VDC
±0.2 to ±2 VDC
±2 to ±20 VDC
±20 to ±200 VDC

ACCURACY: ±3% of range full scale.

250 W IHF DUMMY LOADS INPUTS

LOADS: Front panel selectable 2, 4, 8, 16, 32 ohms, or open.

TOLERANCE: ±1% any load.

REACTANCE: less than 10% reactive at any frequency less than 200 kHz.

POWER HANDLING: Up to 250 watts intermittent or up to 100 watts continuous power per channel. See graph on page 16 for time that power above 100 watts can be applied.

EXTERNAL INPUTS

IMPEDANCE:
1 Megohm for AC tests.
15 Megohm for DC tests.

AUTO LINE INPUTS

IMPEDANCE: 10 Kohms, shunted by 100 pf.

TOLERANCE: ±10%

IHF INPUT FILTERS

FILTERS:
NONE: 20 Hz to 200 kHz
BAND PASS: 200 Hz to 15 kHz
HI PASS: Above 200 Hz
LO PASS: Below 15 kHz
LO PASS: Below 30 kHz

ATTENUATION AT CUTOFF: Less than 3 dB.

ROLL-OFF: At least 18 dB per octave.

19kHz ATTENUATION: At least 30 dB on Bandpass and 15 kHz Lo Pass filters.

SCOPE OUTPUTS

OUTPUT LEVEL: 2 volts ±5% RMS out at full scale meter indication.

DC TRIP PROTECTION

LEVEL: 1 VDC or greater will cause the relays to trip open and remain open until manually reset.

RESPONSE TIME: 50 milliseconds typical.

IEEE-488 BUS

TALKER: Full talker for all functions and inputs.

LISTENER: Partial listener; accepts commands to change all controls except the IHF DUMMY LOADS switch and VOLUME controls.

GENERAL

TEMPERATURE: Operating range −20 to +50 degrees C (−4 to 122 degrees F). Specified accuracy range 0 to 40 degrees C (32 to 104 degrees F).

HUMIDITY: Up to 90% RH, no condensation.

DISPLAY: Two analog meters with LED range, scale, and negative DCV indicators.

POWER: 105-130 VAC, 60 Hz with supplied PA241 power adapter, or 12 VDC with supplied 39G176 fused DC leads or with optional BY234 rechargeable battery pack. Battery life greater than 5 hours typical. Auto-off after 30 minutes of use during battery operation. Auto-off overridden when using external power.

SIZE: 7" x 14" x 16.7" (17.9 x 35.8 x 42.5 cm) HWD.

WEIGHT: Without Battery: 15.8 lbs. (7.18 kg)
With Battery: 17.2 lbs. (7.8 kg)

SUPPLIED ACCESSORIES: PA241 Power Adapter (1), 39G176 Fused DC Leads (1), 39G216 Cable Pair (1), 39G212 Test Lead (1), 39G213 Test Lead (1), 39G211 Ground Lead (1), 39G214 Test Lead (1), 39G215 Test Lead (1).

OPTIONAL ACCESSORIES: BY234 12V 2.0 AH Lead-Acid Battery Pack, IB72 IEEE 488 Bus Interface Accessory, PC259 Protective Cover/Lead Storage.

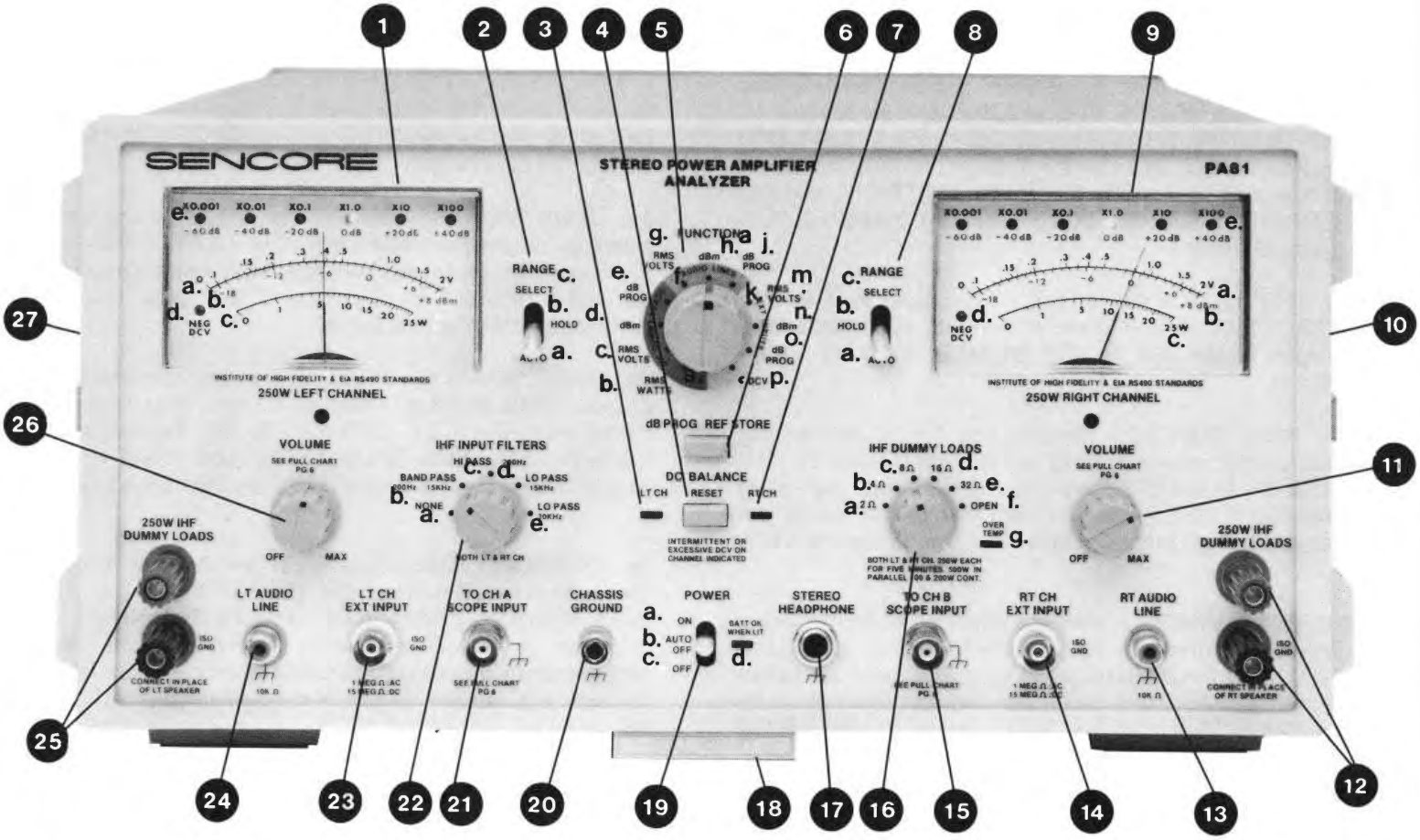


Fig. 1: Location for PA81 controls and features. (For details, see pages following.)

Controls

1. LEFT CHANNEL Output Meter - Displays level of signal present at the 250 W IHF DUMMY LOADS input (25), LT AUDIO LINE input (24) or LT CH EXT INPUT (23). The scales are marked for reading volts, dBm, or RMS watts.

1a. Volts Scale - Used to read RMS voltage when RMS VOLTS (5c, 5g, 5m) is selected on FUNCTION switch (5) and used to read DC voltage when DCV (5p) is selected on the FUNCTION switch (5).

1b. dBm Scale - Used to read dBm when dBm (5d, 5h, 5n) or dB PROG (5e, 5j, 5o) is selected on the FUNCTION switch (5).

1c. WATTS Scale - Used to read power in RMS Watts when RMS WATTS (5b) is selected on the FUNCTION switch (5).

1d. NEG DCV LED - When lit, indicates that DCV being measured is of negative polarity.

1e. RANGE Multiplier LEDs - Used with meter scales to determine level of signal applied at the 250 W IHF DUMMY LOADS input (25), LT AUDIO LINE input (24) and LT CH EXT INPUT (23).

2. Left Channel RANGE switch - Three position rocker switch selects AUTO (2a), HOLD (2b) or SELECT (2c) for range selection of the LEFT CHANNEL output meter (1).

2a. AUTO - Automatically changes the range for the LEFT CHANNEL output meter (1) according to the level of the input to the PA81 for the most accurate meter readings.

2b. HOLD - Overrides left channel autorange circuits and locks into range indicated by Range Multipliers (1e).

2c. SELECT - Manually selects LEFT CHANNEL output meter (1) range. Range Multipliers (1e) indicate the range.

3. LT CH DC BALANCE Indicator - Lights when a stereo amplifier defect causes DCV to exceed one volt across the left channel speaker output.

4. DC BALANCE RESET pushbutton - Used to reset the protection relays that open when the receiver under test has a DC voltage level of one volt or greater across either channel. One or both of the DC

BALANCE indicators (3,7) light and the protection relay opens when 1 volt DC or greater is present at the 250 W IHF DUMMY LOADS inputs (12, 25).

5. FUNCTION Switch - Eleven position switch that selects RMS VOLTS, dBm or dB PROG for the 250 W IHF DUMMY LOADS inputs (12, 25), AUDIO LINE inputs (13, 24), and the EXT INPUTs (14, 23). Also, DCV can be selected for the EXT INPUTs (14, 23), and RMS WATTS for the 250 W IHF DUMMY LOADS inputs (12, 25).

5a. IHF DUMMY LOADS - Four positions on the FUNCTION switch (5) that connect the monitoring circuits to the 250 W IHF DUMMY LOADS inputs (12, 25).

5b. RMS WATTS - Selects the PA81 monitoring circuits that measure RMS watts from the 250 W IHF DUMMY LOADS inputs (12, 25). Readings are taken from the WATTS Scale (1d, 9d) and multiplied by the Range Multiplier (1e, 9e) indicated by the lighted LED.

5c. RMS VOLTS - Selects the PA81 monitoring circuits that measure RMS volts from the 250 W IHF DUMMY LOADS inputs (12, 25). Readings are taken from the RMS Volts Scale (1a, 9a) and multiplied by the Range Multiplier (1e, 9e) indicated by the lighted LED.

5d. dBm - Selects the PA81 monitoring circuits that measure dBm (0 dB referenced at 1 milliwatt into 600 ohms) from the 250 W IHF DUMMY LOADS inputs (12, 25). Readings are taken from the dBm Scale (1b, 9b) and added to the Range Multiplier (1e, 9e) indicated by the lighted LED.

5e. dB PROG - Selects the PA81 monitoring circuits that measure dBm from the 250 W IHF DUMMY LOADS inputs (12, 25). Used with dB PROG REF STORE button (5n) to program a 0 dB reference depending on test requirements. Readings are taken from the dBm Scale (1b, 9b) and added to the Range Multiplier (1e, 9e) indicated by the lighted LED.

5f. AUDIO LINES - Three positions on the FUNCTION switch (5) that connect the monitoring circuits to the AUDIO LINE inputs (13, 24).

5g. RMS VOLTS - Selects the PA81 monitoring circuits that measure RMS volts from the AUDIO LINE inputs (13, 24). Readings are taken from the RMS Volts Scale (1a, 9a) and multiplied by the Range Multiplier (1e, 9e) indicated by the lighted LED.

5h. dBm - Selects the PA81 monitoring circuits that measures dBm (0 dB referenced at 1 milliwatt into 600 ohms) from the AUDIO LINE inputs (13, 24). Readings are taken from the dBm Scale (1b, 9b) and added to the Range Multiplier (1e, 9e) indicated by the lighted LED.

5j. dB PROG - Selects the PA81 monitoring circuits that measure dBm from the AUDIO LINE inputs (13, 24). Used with dB PROG REF STORE button (6) to program a 0 dB reference depending on test requirements. Readings are taken from the dBm Scale (1b, 9b) and added to the Range Multiplier (1e, 9e) indicated by the lighted LED.

5k. EXT INPUTS - Four positions on the FUNCTION switch (5) that connect the monitoring circuits to the EXT INPUTs (14, 23).

5m. RMS VOLTS - Selects the PA81 monitoring circuits that measure RMS from the EXT INPUTs (14, 23). Readings are taken from the RMS Volts Scale (1a, 9a) and multiplied by the Range Multiplier (1e, 9e) indicated by the lighted LED.

5n. dBm - Selects the PA81 monitoring circuits that measure dBm (0 dB referenced at 1 milliwatt into 600 ohms) from the EXT INPUTs (14, 23). Readings are taken from the dBm Scale (1b, 9b) and added to the Range Multiplier (1e, 9e) indicated by the lighted LED.

5o. dB PROG - Selects the PA81 monitoring circuits that measure dBm from the EXT INPUTs (14, 23). Used with dB PROG REF STORE button (6) to program a 0 dB reference depending on test requirements. Readings are taken from the dBm Scale (1b, 9b) and added to the Range Multiplier (1e, 9e) indicated by the lighted LED.

5p. DCV - Selects the PA81 monitoring circuits that measure DC Volts from the EXT INPUTs (14, 23). Readings are taken from the DCV Scale (1c, 9c) and multiplied by the Range Multiplier (1e, 9e) indicated by the lighted LED.

6. dB PROG REF STORE Pushbutton - Used to program a 0 dB reference level when FUNCTION switch is in a dB PROG position.

7. RT CH DC BALANCE Indicator - Lights when a stereo amplifier defect causes DCV to exceed one volt across the right channel speaker output.

8. Right Channel RANGE Switch - Three position rocker switch selects AUTO (8a), HOLD (8b) or SELECT (8c) for range selection of the RIGHT CHANNEL output meter (9).

8a. AUTO - Automatically changes the range for the RIGHT CHANNEL output meter (9) according to the level of the input of the PA81 for the most accurate meter readings.

8b. HOLD - Overrides right channel autorange circuits and locks into range indicated by Range Multipliers (9e).

8c. SELECT - Manually selects RIGHT CHANNEL output meter (9) range. Range Multipliers (9e) indicate the range.

9. RIGHT CHANNEL Output Meter - Displays level of signal present at the 250 W IHF DUMMY LOADS input (12), RT AUDIO LINE input (13) or RT CH EXT

INPUT (14). The scales are marked for reading volts, dBm, or RMS watts.

9a. Volts Scale - Used to read RMS voltage when RMS VOLTS (5c, 5g, 5m) is selected on FUNCTION switch (5) and used to read DC voltage when DCV (5p) is selected on the FUNCTION switch (5).

9b. dBm Scale - Used to read dBm when dBm (5c, 5h, 5n) or dB PROG (5e, 5j, 5o) is selected on the FUNCTION switch (5).

9c. WATTS Scale - Used to read power in RMS Watts when RMS WATTS (5b) is selected on the FUNCTION switch (5).

9d. NEG DCV LED - When lit, indicates that DCV being measured is of negative polarity.

9e. RANGE Multipliers - Used with meter scales to determine level of signal applied at the 250 W IHF DUMMY LOADS input (12), RT AUDIO LINE input (13) and RT CH EXT INPUT (14).

10. Right Channel Audio Monitor - Used to produce sound for the right channel. An independent amplifier in the PA81 provides the signal to the audio monitor. The amplified signal originates at the 250 W IHF DUMMY LOADS input (12), RT AUDIO LINE input (13) or the RT CH EXT INPUT (14) depending on the setting of the FUNCTION switch. The output level is controlled by the VOLUME control (11).

11. Right Channel VOLUME Control And On/Off Switch - Controls the PA81 amplifier for the right channel. Adjusts the volume for the right channel audio monitor or the headphones.

12. Right Channel 250 W IHF DUMMY LOADS input - Connects the stereo's right channel speaker outputs to the PA81 monitoring circuits for testing of RMS WATTS (5b), RMS VOLTS (5c), dBm (5d), and dB PROG (5e).

13. RT AUDIO LINE Input - Connects the stereo's right channel low level output to the PA81 monitoring circuits for testing of RMS VOLTS (5g), dBm (5h), and dB PROG (5j).

14. RT CH EXT INPUT - Connects to the PA81 monitoring circuits for testing of RMS VOLTS (5m), dBm (5n), dB PROG (5o) and DCV (5p) for troubleshooting.

15. TO CH B SCOPE INPUT - Connects oscilloscope to the PA81 monitoring circuits for analyzing the right channel waveform.

16. IHF DUMMY LOADS Switch - Six position switch that selects a dummy load of 2, 4, 8, 16 or 32 ohms, or an open load condition for the 250 W IHF DUMMY LOADS inputs (12, 25).

16a. 2 OHMS - Selects a 2 ohm load for the 250 W IHF DUMMY LOADS inputs (12, 25).

16b. 4 OHMS - Selects a 4 ohm load for the 250 W IHF DUMMY LOADS inputs (12, 25).

16c. 8 OHMS - Selects an 8 ohm load for the 250 W IHF DUMMY LOADS inputs (12, 25).

16d. 16 OHMS - Selects a 16 ohm load for the 250 W IHF DUMMY LOADS inputs (12, 25).

16e. 32 OHMS - Selects a 32 ohm load for the 250 W IHF DUMMY LOADS inputs (12, 25).

16f. OPEN - Selects an open load condition for the 250 W IHF DUMMY LOADS inputs (12, 25).

16g. OVER TEMP Indicator - Alerts you when the dummy loads are too hot. This is caused when power above 100 watts is applied to the loads for too long a period of time. See the graph on page 16 for the power versus time ratings.

17. STEREO HEADPHONE Jack - Connects a set of optional stereo headphones with a 1/4 inch, three conductor plug to the PA81 amplifiers. The amplified signal originates at the 250 W IHF DUMMY LOADS input (12, 25), AUDIO LINE input (13, 24) or the EXTERNAL METER INPUT (14, 23) depending on the setting of the FUNCTION switch. The output level is controlled by the VOLUME controls 11, 26).

18. PULL CHART - Provides a quick reference for simplified operation.

19. POWER Switch - Controls the operating voltage to the PA81.

19a. OFF - Removes power from PA81 meters and monitor circuits.

19b. AUTO-OFF - During battery operation, removes power 30 minutes after auto-off circuitry is reset. This conserves battery life when the PA81 is in battery operation.

19c. ON - Applies power to PA81. When in battery operation, resets auto-off circuit to apply power to PA81. Use with BATT OK WHEN LIT (19d) indicator to determine if battery charge is adequate.

19d. BATT OK WHEN LIT - Indicates the PA81 is on and that the battery has enough charge to power the PA81.

20. CHASSIS GROUND JACK - Provides an external chassis ground connection from the PA81.

21. TO CH A SCOPE INPUT - Connects oscilloscope to the PA81 monitoring circuits for analyzing the left channel waveform.

22. IHF INPUT FILTERS Switch - This five-position switch selects no filter (22a), BAND PASS (22b), HI PASS (22c) or LO PASS (22d, 22e) filters. Each filter is used to pass specific frequencies to the monitoring circuits of the PA81.

22a. NONE - Passes signal frequencies up to 200 kHz from the 250 W IHF DUMMY LOADS inputs (12,25), AUDIO LINE inputs(13,24) and EXT INPUTs(14,23).

22b. 200 Hz-15 kHz BAND PASS - Selects filters that pass frequencies of 200 Hz to 15 kHz from the 250 W IHF DUMMY LOADS inputs (12, 25), AUDIO LINE inputs (13, 24) and EXT INPUTs (14, 23).

22c. 200 Hz HI PASS - Selects filters that pass frequencies above 200 Hz from the 250 W IHF DUMMY LOADS inputs (12, 25), AUDIO LINE inputs (13, 24) and EXT INPUTs (14, 23).

22d. 15 kHz LO PASS - Selects filters that pass frequencies below 15 kHz from the 250 W IHF DUMMY LOADS inputs (12, 25), AUDIO LINE inputs (13, 24) and EXT INPUTs (14, 23).

22e. 30 kHz LO PASS - Selects filters that pass frequencies below 30 kHz from the 250 W IHF DUMMY LOADS inputs (12, 25), AUDIO LINE inputs (13, 24) and EXT INPUTs (14, 23).

23. LT CH EXT INPUT - Connects to the PA81 monitoring circuits for testing of RMS VOLTS (5m), dBm (5n), and dB PROG (5o) and DCV (5p) for trouble-shooting.

24. LT AUDIO LINE INPUT - Connects the stereo's left channel low level output to the PA81 monitoring circuits for testing of RMS VOLTS (5g), dBm (5h), and dB PROG (5j).

25. LEFT CHANNEL 250 W IHF DUMMY LOADS INPUT - Connects the stereo's left channel speaker outputs to the PA81 monitoring circuits for testing of RMS WATTS (5b), RMS VOLTS (5c), dBm (5d), and dB PROG (5e).

26. LEFT CHANNEL VOLUME CONTROL AND ON/OFF SWITCH - Controls the PA81 amplifier for the left channel. Adjusts the volume for the left channel audio monitor or the headphones.

27. LEFT CHANNEL AUDIO MONITOR - Used to produce sound for the left channel. An independent amplifier in the PA81 provides the signal to the audio monitor. The amplified signal originates at the 250 W IHF DUMMY LOADS input (25), LT AUDIO LINE input (24) or the LT CH EXT INPUT (23). The output level is controlled by the VOLUME Control and ON/OFF switch (26).

Rear Panel Features

28. INTERFACE ACCESSORY JACK - Connects the optional IB72 IEEE 488 Bus Interface Accessory (39) to the PA81 for automated testing.

29. BATTERY COMPARTMENT COVER - Provides access to the optional rechargeable BY234 Lead-Acid Battery Pack (38).

30. POWER ADAPTER/EXT. DC INPUT JACK - Connects to the supplied PA241 Power Adapter (31) for AC operation.

Supplied Accessories

31. PA241 POWER ADAPTER - Plugs into POWER ADAPTER/EXT. DC INPUT Jack (30) to power unit from 105-130 VAC 60 Hz line. Also charges the optional BY234 (39) rechargeable Lead-Acid Battery Pack.

32. 39G212 TEST LEAD - Test lead pair terminated at one end with insulated alligator clips and the other with banana plugs. These leads provide connection from the left stereo speaker outputs to the left 250 W IHF DUMMY LOADS input (25).

33. 39G213 TEST LEAD - Test lead pair terminated at one end with insulated alligator clips and the other with banana plugs. These leads provide connection from the right stereo speaker outputs to the right 250 W IHF DUMMY LOADS input (12).

34. 39G211 GROUND LEAD - A grey lead terminated at one end with an insulated alligator clip and the other with a banana plug. This lead provides connection from the stereo chassis ground to the PA81 chassis ground (20).

35. 39G214 LEFT TEST LEAD - A test lead terminated at one end with a BNC plug and the other with EZ Hooks. This lead provides connection from various test points within the stereo under test to the PA81 LT CH EXT INPUT (23).

36. 39G215 RIGHT TEST LEAD - A test lead terminated at one end with a BNC plug and the other with EZ Hooks. This lead provides connection from various test points within the stereo under test to the PA81 RT CH EXT INPUT (14).

37. 39G216 CABLE - A 75 ohm cable pair terminated at both ends with RCA phono plugs. These leads provide connection from stereo line level outputs to PA81 AUDIO LINE inputs (13, 24).

38. 39G176 FUSED DC LEADS - Plugs into the POWER ADAPTER/EXT. DC INPUT Jack (30) to power the PA81 from any 12 VDC negative ground automotive cigarette lighter jack.

Optional Accessories

39. BY234 12V LEAD-ACID BATTERY PACK - Lead-acid battery pack rated at 12 VDC, 2.0 Amp Hour. Provides portable operation of PA81 for over 5 hours under normal operation.

40. IB72 IEEE 488 BUS INTERFACE ACCESSORY - Connects between the INTERFACE ACCESSORY JACK (28) and IEEE 488 port of a bus controller to allow the PA81 to be used on an IEEE 488 bus system.

41. PC259 PROTECTIVE COVER/LEAD STORAGE - Snap on cover to protect the front panel of the PA81 and to provide a storage space for the leads during transportation.

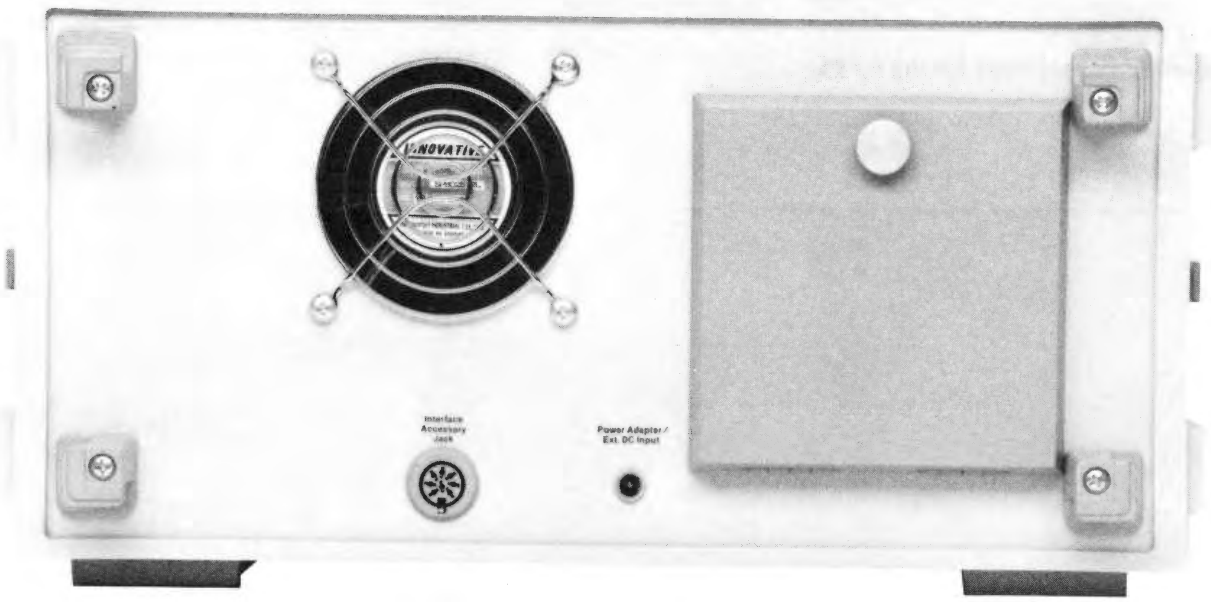


Fig. 2: Location of rear panel features.

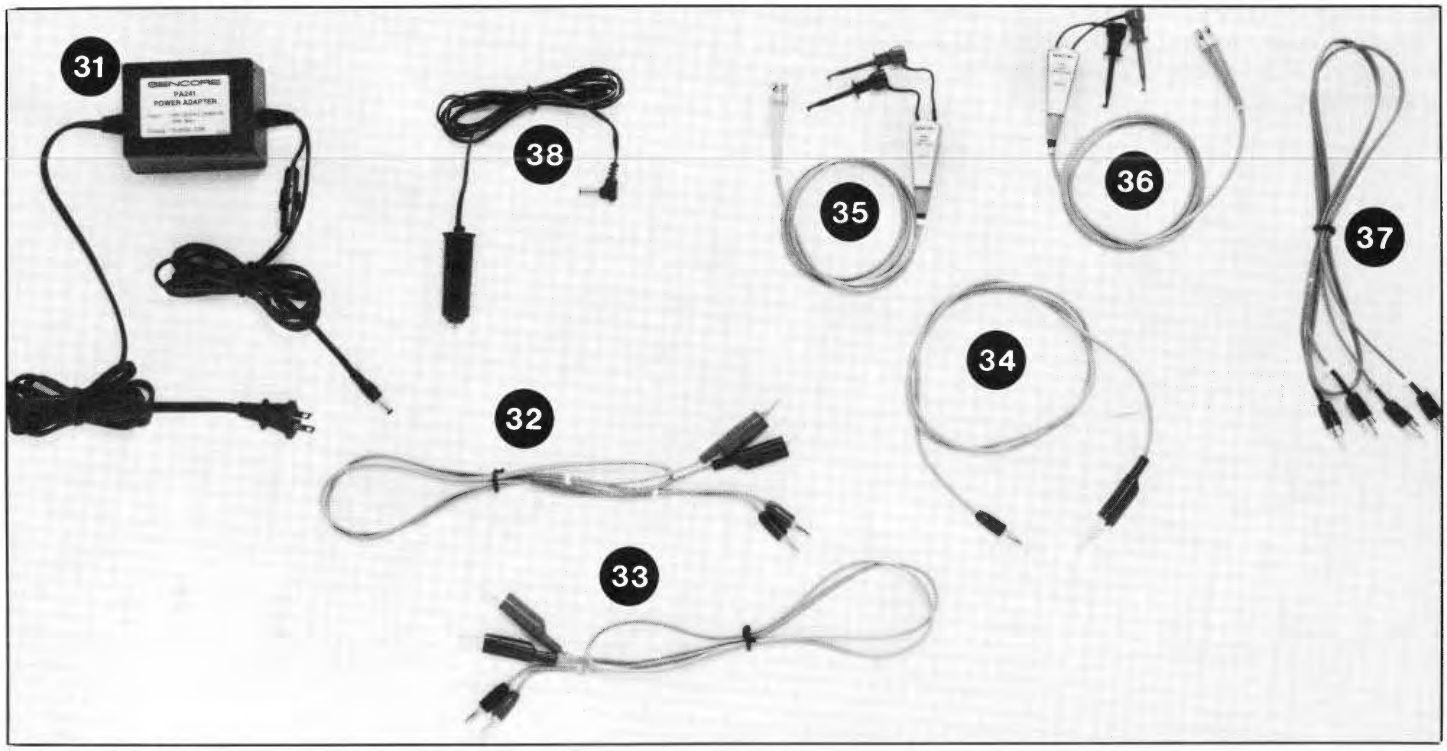


Fig. 3: Supplied accessories for the PA81.

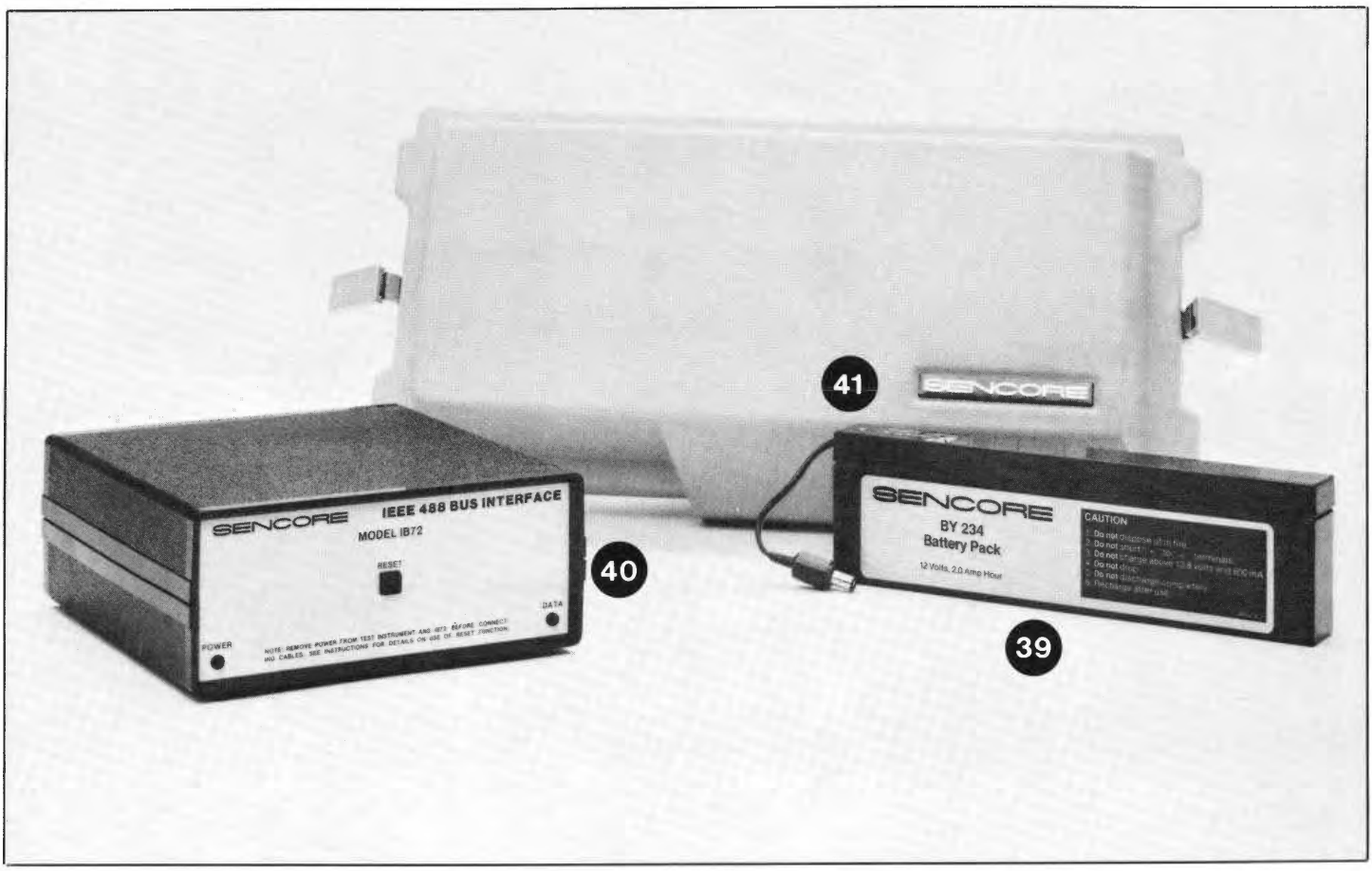


Fig. 4: Optional accessories for the PA81.

OPERATION

Introduction

This section will help you to understand the operation of the PA81. For details on specific uses, refer to the "APPLICATIONS" section.

Before using your PA81 Stereo Power Amplifier Analyzer for the first time, take a few minutes to read the operation section of this manual to acquaint yourself with its features. Once you are familiar with its operation, you can perform most tests from the information on the front panel. The pull chart attached to the bottom of the PA81 gives you simplified operating instructions and quick reference information.

AC Operation

For bench operation, the PA81 is powered from any 105-130 VAC 60 Hz outlet with the supplied PA241 Power Adapter. The PA241 overrides the auto-off feature allowing continuous operation of the PA81. The PA241 also recharges the optional BY234 Lead Acid Battery Pack when properly installed in the unit.

To operate the PA81 from an AC line:

1. Connect the PA241 Power Adapter to an AC outlet (105-130 VAC, 60 Hz).

2. Insert the adapter plug of the power adapter into the POWER ADAPTER/EXT. DC INPUT jack on the back of the PA81.

3. Push the POWER switch to the "ON" position.

External DC Operation

The PA81 may be powered from the 12 volt, negative ground accessory jack (cigarette lighter) in a vehicle or other source of DC capable of supplying 12 VDC at 500 mA. If the DC supply has enough voltage and current, the optional BY234 battery pack can be recharged. The external source of DC must be at least 13.8 volts at 800 mA to charge the battery. The auto-off feature is overridden when using the DC leads.

WARNING

Do not apply more than 20 VDC to the POWER ADAPTER/EXT. DC INPUT Jack. Damage to the PA81 or the battery pack may result.

External DC is applied to the POWER ADAPTER/EXT. DC INPUT Jack on the rear of the PA81 using the supplied 39G176 Fused DC Leads. The fuse is inside the positive lead and is a one amp fast-blow fuse. It protects the PA81 from drawing excessive current should the PA81 develop an internal failure.

To operate the PA81 from an external DC source:

1. Connect the adapter plug of the 39G176 Fused DC Leads to the POWER ADAPTER/EXT. DC INPUT Jack on the rear of the PA81.

2. Connect the automotive accessory plug of the 39G176 Fused DC Leads to the source of DC. The outer ground terminal must be connected to the negative side of the DC source and the center terminal to the positive side.

3. Turn the PA81 on using the POWER switch.

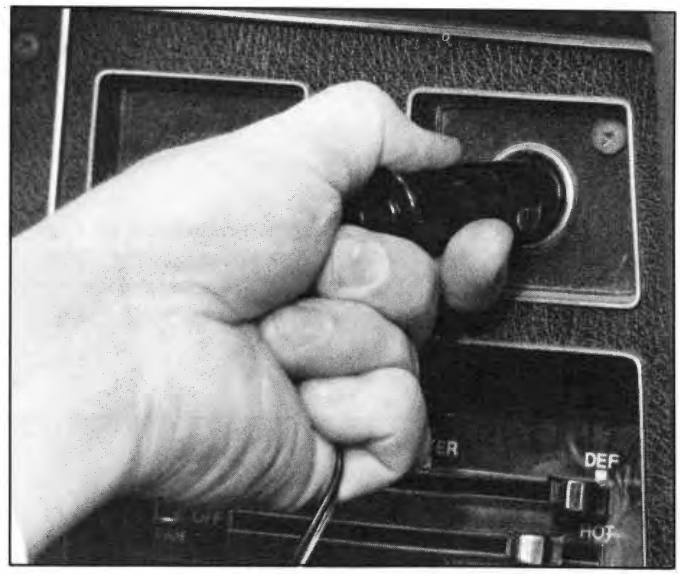


Fig. 5: The PA81 may be powered from an automotive accessory jack by using the supplied 39G176 Fused DC Leads.

Battery Operation

The PA81 Universal Stereo Monitor operates as a portable unit when the optional BY234 Lead-Acid Battery Pack is properly installed.

A full battery charge typically lasts over 5 hours. The amount of time the battery holds its charge gradually decreases with age. You will get several years of service from one BY234 before needing to replace it.

No maintenance is required for the BY234. It is a sealed lead-acid battery that only requires charging. To maximize the life of the battery, charge the battery after each use and do not allow it to become fully discharged, or partially discharged for a long period of time.

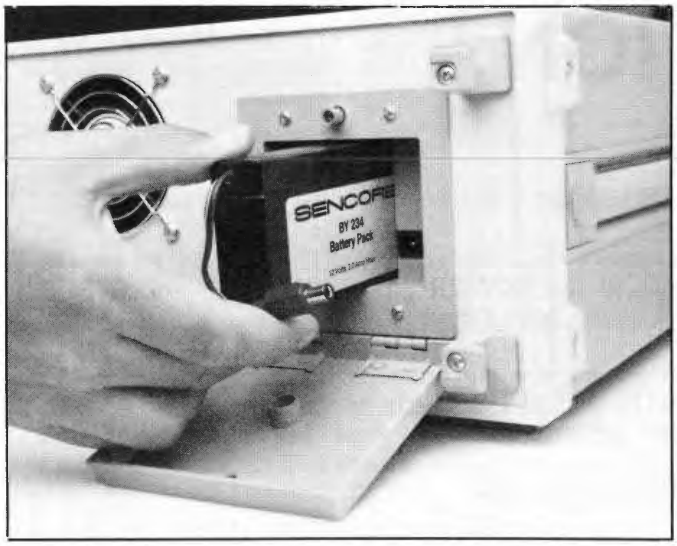


Fig. 6: The optional BY234 Lead-Acid Battery Pack fits inside the PA81 for portability.

The auto-off feature of the PA81 saves on battery life by turning the unit off after 30 minutes of battery operation.

To install the battery:

1. Open the battery compartment cover located on the rear of the unit by unscrewing the thumbscrew. The door is hinged to fold out and the thumbscrew is secured to the cover by a captive nut to secure it to the battery compartment.

2. Slide the battery end without the connector attached into the battery compartment. (The connector plug should be facing out after the battery is in place.) Carefully slide the battery all the way into the compartment.

3. Connect the plug from the battery pack to the jack inside the battery compartment.

4. Close the battery compartment making sure that the battery cord is not pinched or crimped.

5. Replace the cover and tighten the thumbscrew to secure the door and battery in place.

6. Set the POWER switch to the "ON" position.

Signal Connections

Dummy load Inputs

The 250 W IHF DUMMY LOADS terminals, figure 7, provide left and right channel inputs to the PA81 from the stereo under test. The loads selected by the IHF DUMMY LOADS selector switch are connected to the 250 W IHF DUMMY LOADS input terminals at all times, except when the trip circuit senses voltage exceeding one volt DC at the input terminals. When monitoring an input to the 250 W IHF DUMMY LOADS terminals, the FUNCTION switch should be in one of the IHF DUMMY LOADS positions(Figure 8).

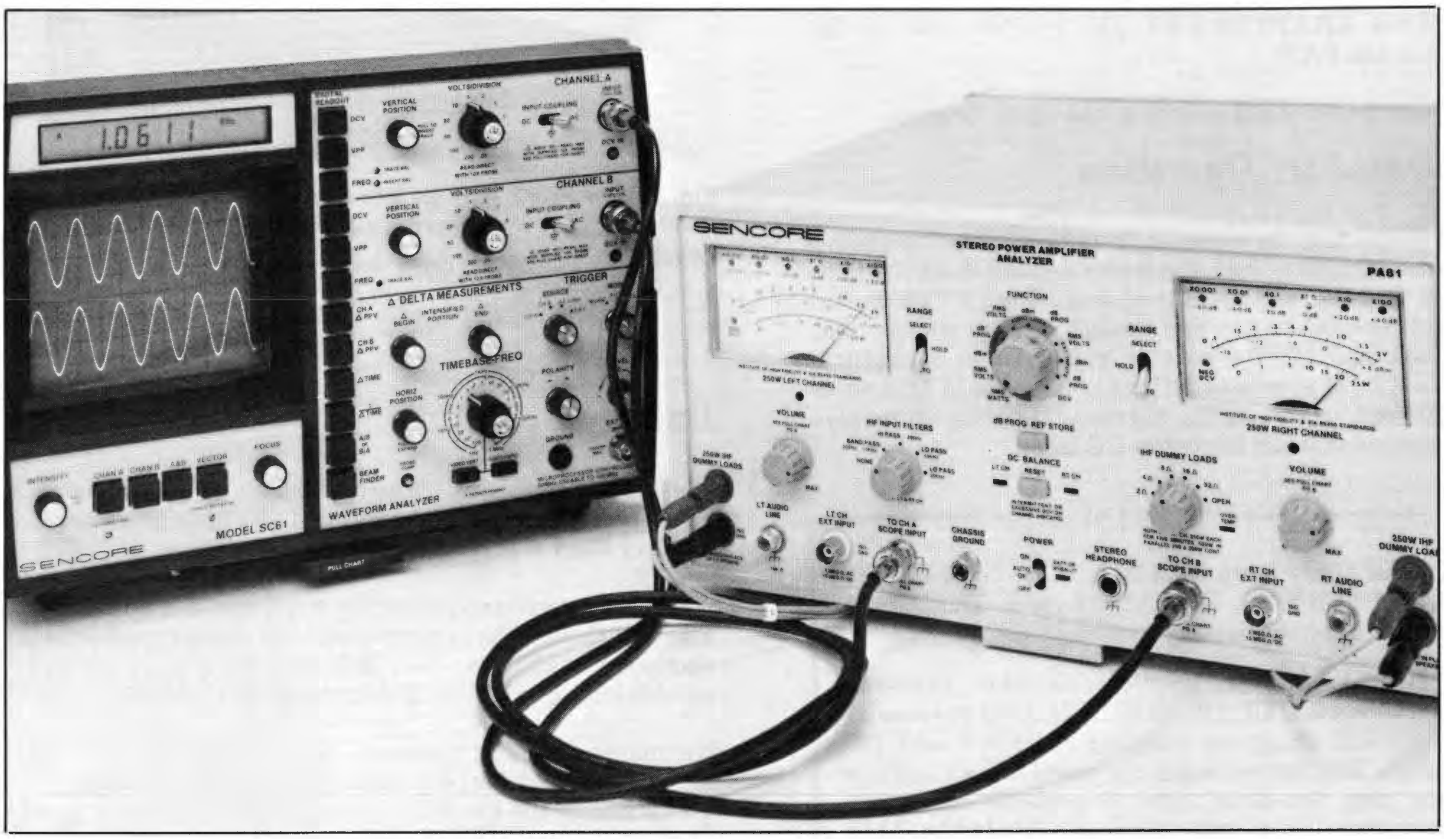


Fig. 7: The PA81 monitoring circuits can be accessed for testing through the three inputs. The TO SCOPE jacks connect the PA81 monitoring circuits to an oscilloscope for signal analysis.

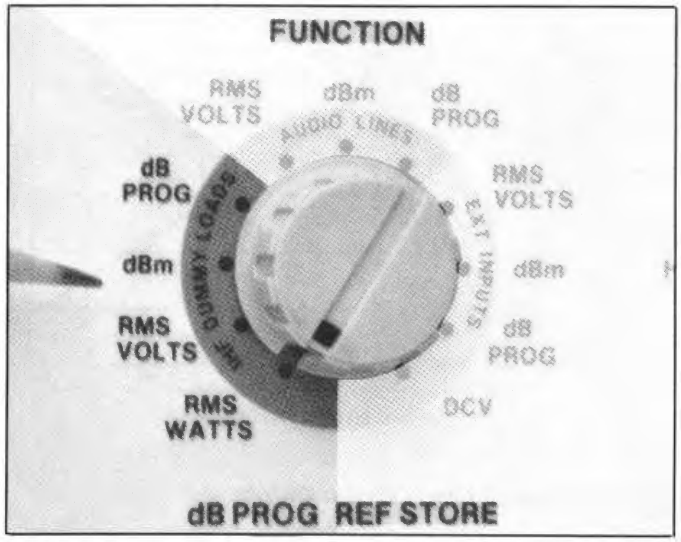


Fig. 8: Signals applied to the 250 W IHF DUMMY LOADS inputs are tested with the FUNCTION switch in one of the IHF DUMMY LOADS positions.

Audio Line Inputs

The AUDIO LINE inputs, Figure 7, accept two-conductor RCA phono plugs. These phono jacks provide input for low-level signals from stereos and stereo components. For testing of signals applied to the AUDIO LINE inputs, place the FUNCTION switch in one of the AUDIO LINES positions (Figure 9).

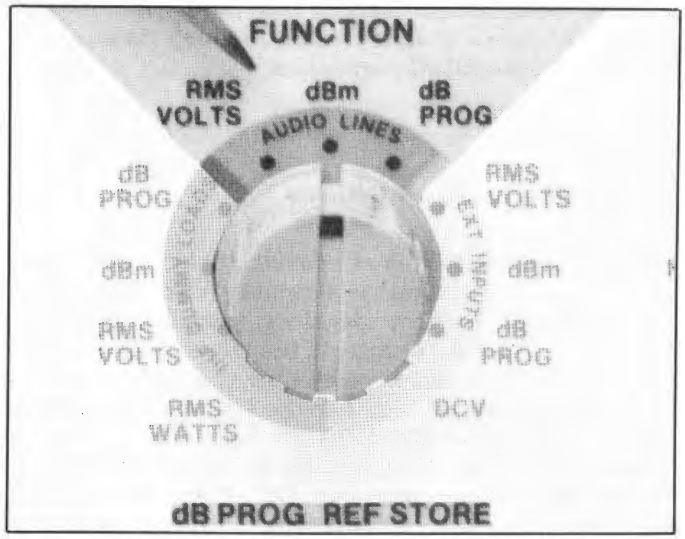


Fig. 9: Signals applied to the AUDIO LINE inputs are tested with the FUNCTION switch in one of the AUDIO LINES positions.

External Inputs

The EXT INPUTs, Figure 7, provide left and right channel inputs from the stereo under test. You will normally use the EXT INPUTs with the supplied probes for troubleshooting to check signal levels and DC voltages in individual stages. When you are using these inputs to the PA81, use the EXT INPUTs section of the FUNCTION switch (Figure 10).

Grounding The PA81

A chassis ground jack is included on the front panel of the PA81 for use when measuring low level signals such as magnetic phono cartridge outputs. Grounding the PA81 to the chassis of the equipment being tested minimizes the noise that would otherwise be picked up with low level signals.

Oscilloscope Connections To The PA81

For waveform analysis of the right and the left channel signals of the stereo under test, the TO SCOPE outputs connect the PA81 monitoring circuits to an oscilloscope. The FUNCTION switch controls which input signal is applied to the scope outputs. This enables you to observe the audio waveforms to test for noise and distortion.

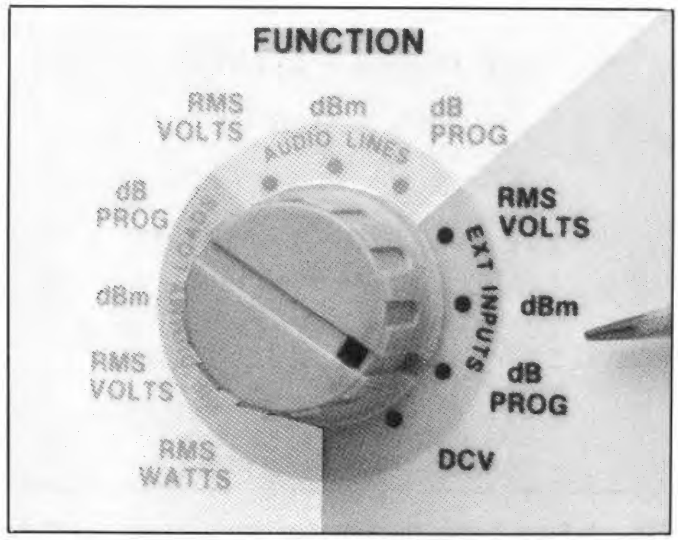


Fig. 10: Signals applied to the EXT INPUTs are tested with the FUNCTION switch in one of the EXT INPUTS positions.

Selecting The Dummy Load Impedance

Stereos use speakers with various impedances. The speakers that the stereo uses during its normal operation have an impedance of 2, 4, 8, 16, or 32 ohms. The PA81 provides these impedances to give you proper loading to protect the stereo. The PA81 also provides an OPEN load condition for checking the stereo amplifiers for possible oscillation. Selection is made for both left and right channels together using the IHF DUMMY LOADS switch (Figure 11).

NOTE: Always reduce power to 25 Watts or less before switching the IHF DUMMY LOADS switch per manufacturers' recommendations to reduce switching transients.

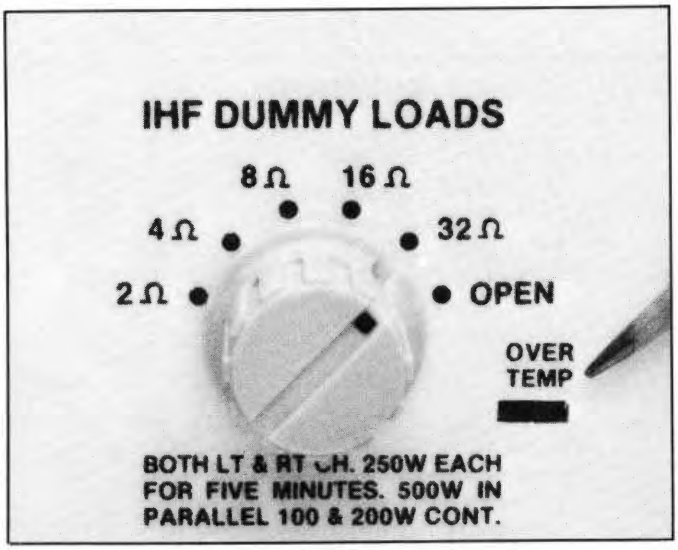


Fig. 11: Selection of the speaker load is made using the IHF DUMMY LOADS switch. The OVER TEMP indicator lights if the dummy loads are overheated from excessive power input.

The PA81 measures 250 watts of RMS power intermittantly, or 100 watts continuously. When monitoring receivers or amplifiers with more than 100 watts of output power, use the chart in figure 12 to determine the amount of time you can apply power to the loads. The maximum power capability of the PA81 is 250 watts RMS per channel. If you exceed the rated power, or apply more than 100 watts for longer than the specified time, the speaker loads will overheat and the OVER TEMP indicator will light and stay lit until the loads cool to a safe level.

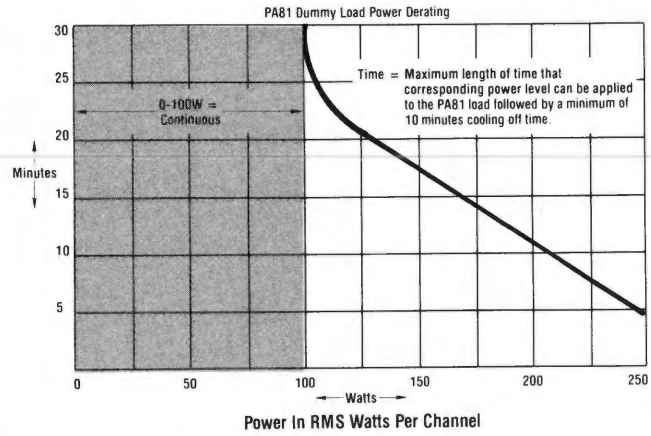


Fig. 12: Dummy Loads Power Graph.

CAUTION: The PA81 is a high-power monitor capable of handling 100 Watts per channel continuously. More power may be applied to the PA81, but care must be taken when doing so. When applying 100 to 250 Watts per channel, refer to the graph in figure 12 for the acceptable time for that applied power. Exceeding this time overheats the dummy loads causing the OVER TEMP indicator to come on. If this should happen, reduce the stereo's volume to 0 Watts until the OVER TEMP indicator goes off to allow cooling of the dummy loads. Do not exceed 250 Watts per channel. Failure to follow these instructions may damage the PA81 and will void all warranties.

Protection for Amplifiers

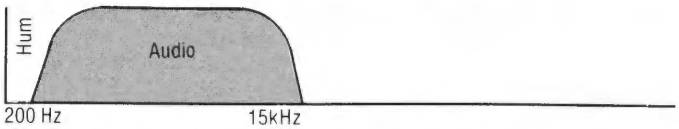
Stereo amplifier circuits can develop defects that cause DC voltage at the speaker outputs. With the speaker load connected current increases, possibly damaging the stereo. The PA81 protects the stereo under test by providing a DCV sensitive breaker that automatically trips when the level at either the left or right channel 250 W IHF DUMMY LOADS inputs is 1 VDC or greater. The DC BALANCE indicators show you which channel has excessive DC. Refer to the DCV function in this section for testing amplifiers with this problem. Pressing the reset button connects the loads back into the monitoring circuits.

Selecting The Input Filter

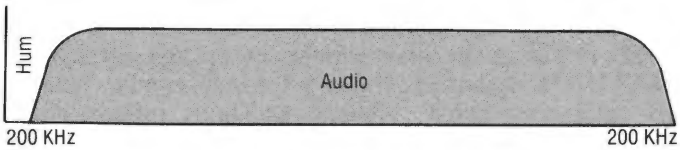
Testing stereos requires the use of filtering for detection of amplifier hum, filtering out amplifier hum, eliminating clock noise in compact disc players, or testing of typical audio amps and FM receivers. The IHF INPUT FILTERS switch provides selection of five filters for monitoring receivers within these frequencies:

The IHF INPUT FILTERS pass the following frequency ranges:

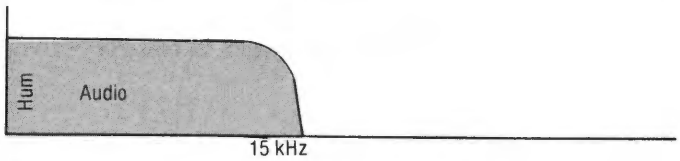
NONE - passes audio signals from 0 to 200 kHz.



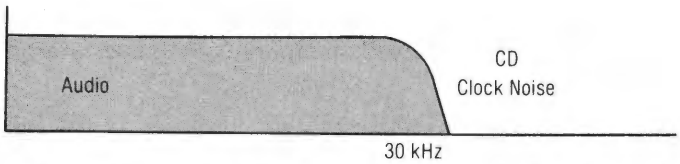
200 Hz to 15 kHz - BANDPASS filter for typical stereo tests.



200 Hz and above - HI PASS filter rejects hum.



15 kHz and below - LO PASS filter for hum test.



30 kHz and below - LO PASS filter blocks clock noise for CD tests.

Fig. 13: The PA81 Input Filters filter out various parts of the audio spectrum to aid in audio testing.

a. 0 Hz to 200 kHz - filter out to pass all audio signals.
b. 200 Hz to 15 kHz - BANDPASS filter for typical tests.
c. 200 Hz and above - HI PASS filter rejects hum.
d. 15 kHz and below - LO PASS filter checks for hum presence.
e. 30 kHz and below - LO PASS filter for Compact Disc players.

Selecting Functions

RMS WATTS

A stereo receiver or amplifier has a rated output power measurable in watts. The PA81 tests the output power of the stereo using the 250 W IHF DUMMY LOADS inputs for connection from the receiver's or amplifier's speaker terminals.

Measuring Power

To test for output power:

1. Set the PA81 FUNCTION switch to the RMS WATTS position, and select the IHF DUMMY LOADS impedance to match the output impedance of the stereo under test.

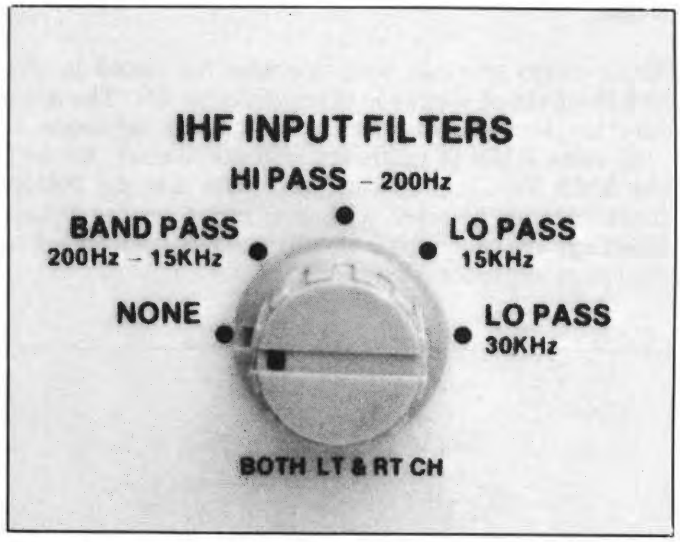


Fig.14: Selection of the input filters is made using the IHF INPUT FILTERS switch.

2. Set the IHF INPUT FILTERS switch to the NONE position.

3. Set the RANGE switches to the AUTO position.

4. Connect the stereo's speaker outputs to the PA81 250 W IHF DUMMY LOADS terminals.

5. Using a signal generator, inject a signal into the stereo under test. (Refer to the signal generator's instruction manual for correct signal injection.)

6. Adjust the stereo's volume control to maximum and the balance control for equal left/right power.

7. Use the scale and multiplier indicators to read the output power for right and left channels.

CAUTION: The PA81 is a high-power monitor capable of measuring 250 watts intermittent or 100 watts continuous per channel. When applying 100 to 250 watts per channel, refer to the graph on page 16 for the acceptable time for that applied power.

Exceeding this time overheats the dummy loads causing the OVER TEMP indicator to light. If this should happen, reduce the stereo's volume to 0 watts until the OVER TEMP indicator goes off to allow cooling of the dummy loads. Do not exceed 250 watts per channel. Failure to follow these instructions may damage the PA81 and will void all warranties.

RMS VOLTS

When troubleshooting audio products, it is important to be able to measure signal voltages to isolate defective stages. The PA81 measures RMS VOLTS using the 250 W IHF DUMMY LOADS inputs, the AUDIO LINE inputs or the EXT INPUTs. You can accurately measure from 0.2 mV to 200 volts RMS. The reading is taken from the RMS scale and multiplied by the indicated multiplier.

dBm

Many audio product specifications are listed in dB, and the gain of stages is often given in dB. The dBm function lets you measure with a 0 dB reference at .775 volts RMS (1 milliwatt into 600 ohms). As with the RMS VOLTS function, the dBm and dB PROG functions can be used with any input on the PA81. Readings are taken from the dBm scale, then added to the range indicator. For example:

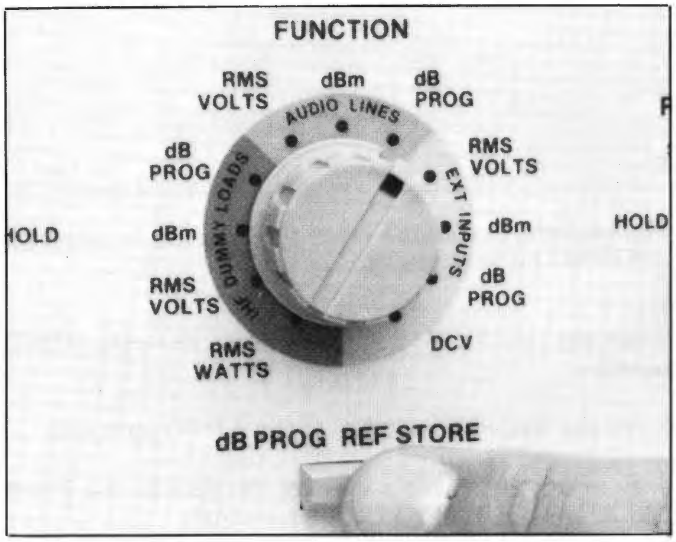


Fig. 15: The dB PROG function can be programmed to different 0 dB reference levels for testing the gain of amplifier stages.

If a -6 dBm is read on the meter, and the -20 dBm range is indicated, the result is -26 dBm.

If a -6 dBm is read on the meter, and the +20 dBm range is indicated, the result is +14 dBm.

dB PROG

The dB PROG function is calibrated to the dBm reference when the PA81 is first turned on. The dB PROG and dBm readings will be the same until a new 0 dB reference is programmed using the dB PROG REF STORE button. The new 0 dB reference remains in memory until either another reference is programmed or power is removed from the PA81.

To use the dB PROG function:

1. Set the PA81 FUNCTION switch to the dB PROG position.

2. Measure the signal level at the point you want for a reference and press the dB PROG REF STORE pushbutton.

3. Measure the signal level at any other point and read the signal level in dB compared to your stored reference level.

DCV

Stereo defects can often be caused by improper biasing of amplifier stages. Using the EXT INPUTs gives you

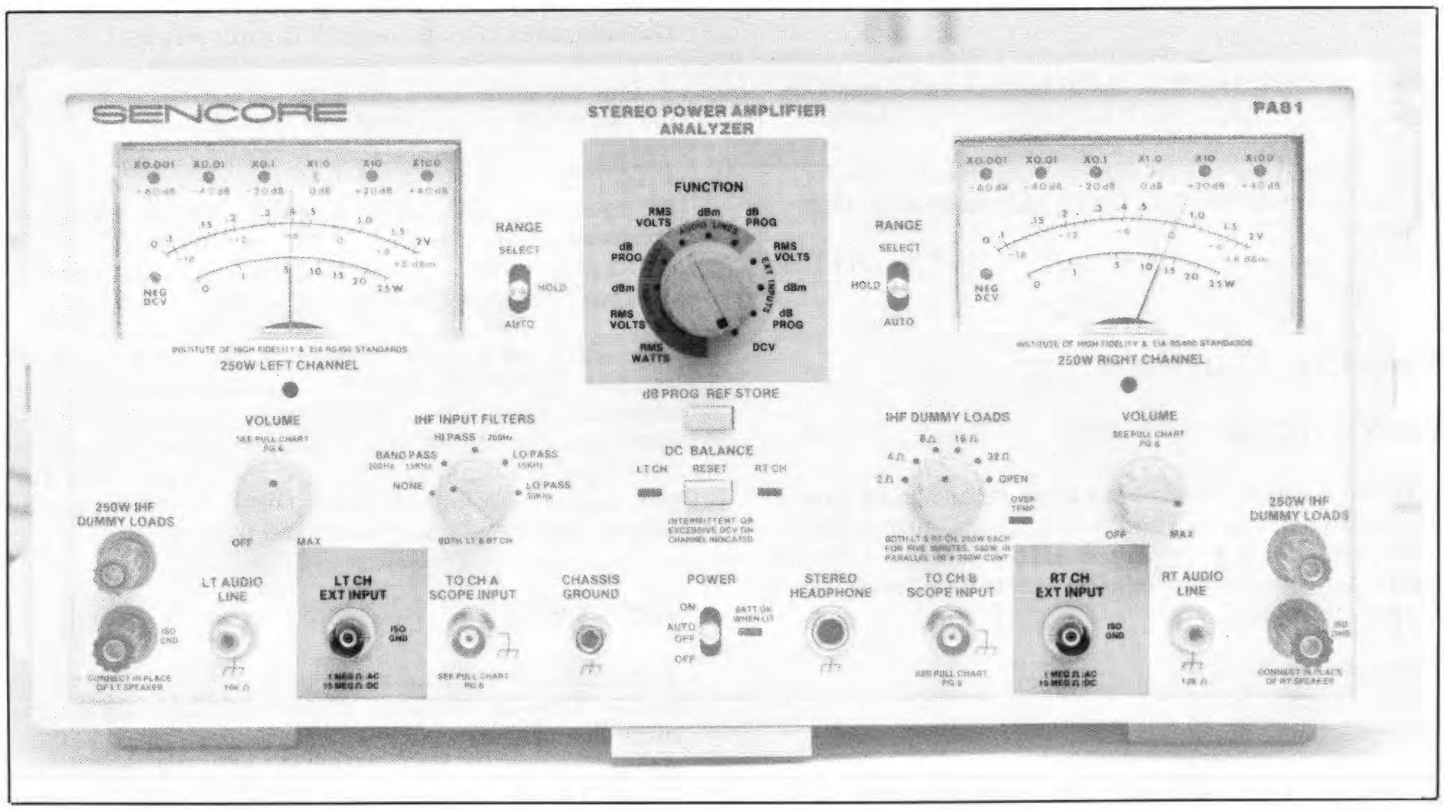


Fig. 16: DC voltage can be measured from 0 to 200 volts when connected to the EXT INPUTs and the FUNCTION switch is set to the DCV position.

the capability of measuring DCV from 0 to 200 volts so you can check the DC operation of the stereo.

Simply hook up the test leads to the EXTERNAL METER INPUT and set the FUNCTION switch to the DCV position. Apply the test lead to the desired test point, read the meter scale marked DCV, and use the multiplier indicated by the LED to get the value. Always set the RANGE switch to AUTO for initial readings since DC values may unexpectedly exceed the manually selected range.

Reading The Meters

The PA81 has separate meters for the left and the right channels. Analog meters are used to show you the quick changes in audio signals that can occur in both good and defective stereos. There are six LED range indicators above the scales on each meter to indicate which multiplier or adder to use (Figure 17).

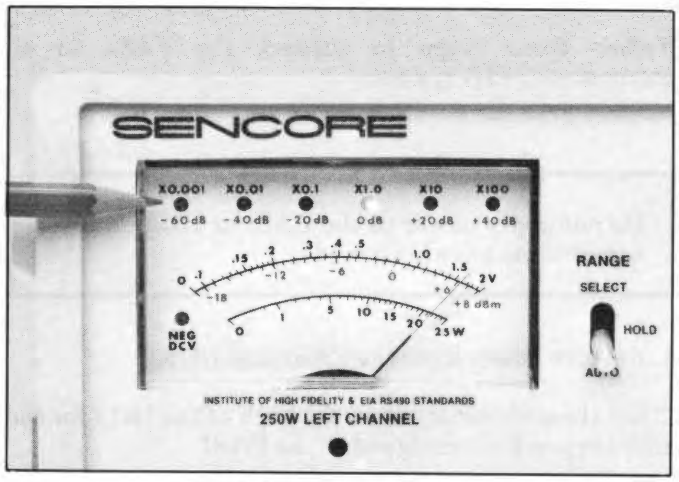


Fig. 17: Both meters have indicators for multipliers for RMS VOLTS, WATTS, DCV and adders for dBm.

Range Selection For The Meters

The meters have range switches for getting the most accurate reading from the scales. You can choose between automatic or manual ranging. When in the AUTO position, the meter automatically ranges with the level of the input. The range is locked in by setting the RANGE switch to the HOLD position. The SELECT position is a momentary switch that selects the range manually.

Listening To The Audio Signal

Audio monitors for the left and right channels are mounted inside the PA81 on each side. These internal monitors allow you to monitor the tests being done and are amplified by the PA81. The audio monitors are disconnected from the amplifiers when the optional stereo headphones are plugged into the jack labeled STEREO HEADPHONE. The audio level is controlled by the VOLUME controls on the PA81 and by the stereo. The reference level for the volume control is set by the RANGE switch, so full scale on the meter will give you the greatest volume potential.

IEEE-488 BUS OPERATION

Introduction

The PA81 Stereo Power Amplifier Analyzer tests may be totally automated or incorporated into an automated test system through the use of the IEEE 488 General Purpose Interface Bus (GPIB). The PA81 is interfaced to any IEEE system or controller using the optional IB72 IEEE 488 Bus Interface Accessory. The IB72 makes the PA81 a fully compatible IEEE instrument.

As an IEEE compatible instrument, the PA81 may have either of two functions:

As a "talker", the PA81 sends readings to the IEEE 488 bus controller. The PA81 talker function can provide a single measurement or a series of repeated readings.

As a "listener", the PA81 receives instructions from the IEEE 488 bus controller to change functions or ranges. The PA81 listener function provides complete automation, as the controller is able to automatically step the PA81 through all its tests just as you would manually.

Connecting The PA81 For IEEE Operation

The PA81 must be used with the IB72 IEEE 488 Bus Interface accessory for IEEE automation. The IB72 acts as a translator between the IEEE signals and the microprocessor inside the PA81. The IB72 connects to the "Interface Accessory" connector on the back of the PA81. The standard GPIB cable from the IB72 then connects to your IEEE controller (or IEEE controller card in your PC).

WARNING

Connect only the matching IB72 connector to the INTERFACE ACCESSORY JACK on the rear of the PA81. Do not connect any other communications or interface bus equipment to the PA81, even though the connectors may fit.

Operate the PA81 only from its AC power adapter, not battery, when using it in automated systems. The power adapter prevents the battery-saving auto-off circuit from removing power from the PA81 during automated testing. If the auto-off circuit shuts down the PA81, it can cause the controller to become hung up (stuck) in the middle of its program.

Each instrument in an automated bus system must be assigned its own address in order for the controller to send instructions to or receive readings from one instrument at a time. This address is set with a group of miniature slide switches on the back of the IB72. See the IB72 instruction manual for details about addresses and setting these switches.

The address assigned to the IB72 that is used to control the PA81 must be different than the address for any other instrument connected to the IEEE controller. Some controllers have their own internal address, which no instrument connected to the controller may use.

The special connectors on GPIB cables have both male and female contacts at each end, allowing the connectors to be stacked on top of each other. Simply connect one end of a cable to the controller (either directly or with other instruments) and the other end to the IB72. Consult the instructions for your controller concerning maximum cable lengths and the maximum number of instruments that can be connected to the controller at the same time.

Follow these steps to connect the PA81 to an automated GPIB system:

WARNING

Do not apply power to the PA81 or IB72 until all connections have been made.

1. Remove power from the PA81 and IB72.

2. Set the slide switches on the back of the IB72 for the address you have assigned to the PA81.

3. Connect the IB72's male DIN connector to the Interface Accessory jack on the back of the PA81.

4. Connect the GPIB cable from your controller or computer controller card to the IB72.

5. Connect the AC power adapters to the PA81 and to the IB72 and connect them to AC outlets.

6. Confirm that power has reached the units by checking the power LEDs on the IB72 and the PA81.

7. Follow the instructions for your controller to load and run your test software.

Using The PA81 As A Talker Only

The simplest mode of PA81 IEEE operation is as a talker only. As a talker, you manually select all PA81 functions using the front panel controls. The PA81 then sends readings over the bus corresponding to the measurements on the analog meters. The talk mode of IEEE operation is useful for guided probe operations or where only a limited number of readings need to be taken. Only a very simple control program is needed to obtain readings from the PA81 in the talk only mode.

To use the Stereo Power Amplifier Analyzer as a talker, simply make the proper connections between the controller, the IB72, and the PA81 as explained in the preceeding section entitled "Connecting The PA81 For IEEE Operation".

The PA81 sends data to the controller through the IB72 IEEE Bus Interface accessory whenever the controller sends the correct talk address and a "Talk" command. The data returned over the bus will be the same as the readings on the PA81 meters.

NOTE: Most controllers automatically combine the "Talk" command with the instruction containing the address, so there isn't a separate step required in the program. Consult the manual for the controller you are using for information on its operation.

Once addressed, the PA81 continuously sends readings over the bus. The software in the controller determines how many readings are recorded. Some applications only require a single reading, while other applications may require collecting several readings in a row. If only one reading is desired, the controller triggers the talk function and waits until one reading is received. The controller can then send a bus instruction to cause the PA81 to stop sending readings, or simply disregard the returning data.

To stop the PA81 from sending readings, simply have the controller address a different instrument on the bus. The PA81 remains in the last test function selected, but no readings are sent to the controller until the PA81's talk address is selected again by the controller.

NOTE: The PA81 does not need (nor does it respond to) the special "GET" (group-execute-trigger) command used by some controllers. It begins sending readings as soon as the talk command is given.

Data Returned By The PA81

All data returned from the PA81 is in a standard data format. Each string of data is the same length and contains information in six data fields. Your controller software can keep the entire string of characters together, or it can separate the fields for calculations or processing.

Each data string is 27 characters long. The six data string fields are: 1. Header, 2. Left Indicator, 3. Left Numerical Data Field, 4. Right Indicator, 5. Right Numerical Data, and 6. End Terminator. Each field has the same number of characters for any function, allowing you to use the same subroutines to process any returned data. Here are the details for each field of data.

Header: The first three characters identify the function which produced the reading. The three characters sent back from the instrument are the same ones used to select a function when the PA81 acts as a listener (Figure 19). These codes let the software identify the source of the data or confirm that the correct function is producing readings.

In certain cases, the Header identifies some special conditions, such as errors. The controller software should test for these conditions before processing readings for accurate test results.

Left Indicator: The fifth character, which is an "L", identifies the data field that follows as being data from the left channel.

Left Numerical Data Field: The nine spaces following the Left Indicator (characters 6 through 14) contain the value of the reading on the left meter. The data returned over the bus has the range scaling factor already added to it. You do not need to add or subtract the dB multiplier to determine the correct reading.

The values returning from test functions are in scientific notation, allowing any value to be represented with the same number of characters. Error codes appear as a single digit (from 1 to 3) without the scientific notation. Most controllers, however, treat either scientific or non-scientific values the same, so no special programming is needed to isolate one type of reading from the other.

Right Indicator: The sixteenth character, which is an "R", identifies the data field that follows as being data from the right channel.

Right Numerical Data Field: The nine spaces following the Right Indicator (characters 17 through 25) contain the value of the reading on the right meter. The right numerical data is in the same format as the left numerical data.

End Terminator: All data ends with both a carriage-return (ASCII decimal 13) and a linefeed (ASCII decimal 10) character (characters 26 and 27), as recommended by the IEEE data standards. Many controllers respond to either character, while others respond if only the linefeed is present. A few controllers may stop accepting data when the carriage-return character is sent, leaving the PA81 hung up, waiting to send its last (linefeed) character. If this happens, you may need to put an extra GET or INPUT statement into your control program to let the PA81 send its last character into an unused variable.

Fig. 19: PA81 IEEE talker data format.

Separating Data Fields

The BASIC commands needed to separate the four fields of information into separate variables are LEFT$, MID$, and VAL. The LEFT$ command can collect the three characters of the Header if they need to be compared to information within the program. The MID$ command is used to separate the Numerical Data Fields and the VAL command is used to convert from the string-variable MID$ to the numerical-variable RDATA.

For example, the controller could place a reading from the PA81 into a string-variable called called RESULT$. The following subroutine can then separate the Header into the string-variable HEAD$, the Left Numerical Data into the numerical-variable LDATA, and the Right Numerical Data into the numerical-variable RDATA.

```
200  REM SUBROUTINE TO SEPARATE PA81
     DATA INTO 3 PARTS
2010 HEAD$=LEFT$(RESULT$,3): REM FIND
     HEADER
2020 LDATA=VAL(MID$(RESULT$, 6,9): REM
     LEFT DATA
2040 RETURN: REM JUMP BACK TO MAIN
     PROGRAM
```

Line 2010 collects the first 3 characters into the header variable HEAD$. Line 2020 selects the 9 characters, starting at the sixth position, and converts the result to a value (with the VAL statement) before placing it into LDATA. Line 2030 selects the 9 characters, starting at the 17th position, and converts the result to a value (with the VAL statement) before placing it into RDATA. This subroutine can be used to separate data from any reading into the three main parts.

Error Messages

Certain commands cause error conditions during PA81 bus operation. An error code is returned over the bus in the form "ERR XX" whenever the controller requests a reading and an error condition exists. The error codes follow:

ERR 1: Bad command
ERR 2: Attempted REF store while not in dB Prog function
ERR 3: DC Trip

Data Updates

The PA81 returns a reading over the bus as soon as requested by the controller. No "trigger" command is required. The PA81 continues to send updated readings until another bus command is issued or until another instrument on the bus is addressed.

Using The PA81 As A Talker/Listener

The PA81's most versatile mode of IEEE operation is as a talker/listener. As a talker/listener the Stereo Power Amplifier Analyzer not only sends readings back to the controller, it also responds to commands from the controller. All of the PA81 functions, except IHF DUMMY LOADS select and VOLUME control, may be controlled via the bus.

In the talker/listener mode, the settings of front panel controls are automatically disregarded and the PA81 responds only to commands sent over the IEEE bus. The first valid bus command received by the PA81 "locks out" the front panel controls, preventing them from being accidentally misadjusted during an IEEE controlled test. The front panel controls remain locked out until the PA81 receives a "CPO" (control panel on) command from the controller. This command returns the PA81 to manual non-bus operation until another valid IEEE bus command is received by the PA81.

The PA81 meters continue to display readings during bus operation. The data returned on the bus will be the same as the readings on the PA81 meters. The same steps are required to use the PA81 via the IEEE bus as are required for manual operation. Complete setup information and programming instructions are included in the following sections.

PA81 IEEE Control Codes

The PA81 responds to three-letter control codes representing the desired function or operation. The three-letter control codes must be uppercase characters (capital letters). Lowercase characters are ignored by the PA81. The control code must terminate in a line feed to be recognized by the PA81. Figure 20 lists the PA81 control codes.

Most controllers require you to place the control code into a string variable, which in turn becomes part of a "Print" statement, a "Write" statement, or a subroutine call. Refer to the instructions for your specific IEEE controller or computer for details on the proper way to send alpha-numeric data over the IEEE bus.

Unless noted, all IEEE selected functions operate exactly the same as during manual front panel control. To program the PA81 for bus operation, follow the same control setup sequence as for manual operation.

Command Descriptions

BPF - 200 Hz to 15 kHz Band Pass Filter - Selects the band pass filter for the audio inputs.

CPO - Control Panel On - Allows the PA81 to respond to front panel control. The first valid 3-letter command code received by the PA81 automatically disables the front panel controls. This prevents the PA81 from

Command	Control Code
Function Commands	
Dummy Load Watts	DLW
Dummy Load RMS Volts	DLV
Dummy Load dBm	DLD
Dummy Load dB Prog	DLP
Line RMS Volts	LNV
Line dBm	LND
Line dB Prog	LNP
EXT RMS Volts	EXV
EXT dBm	EXD
EXT dB Prog	EXP
EXT DCV	DCV
Meter Commands	
Left Meter Select	LMS
Left Meter Hold	LMH
Left Meter Auto	LMA
Right Meter Select	RMS
Right Meter Hold	RMH
Right Meter Auto	RMA
Filter	
NONE	OUT
200 Hz - 15 kHz BP	BPF
200 Hz HP	HPF
15 kHz LP	LPL
30 kHz LP	LPH
General Commands	
Control Panel On	CPO
Control Panel Settings	CPS
Reference Store	REF
Reset DC Trip	RST

Fig. 20: PA81 IEEE Control Codes

jumping between front panel switch settings and IEEE commands. The Control Panel On (CPO) command returns the PA81 to manual front panel operation.

CPS - Control Panel Settings - Returns the present status of control panel settings and meter ranges.

Example: "CPS" returns the following:
FNC ..... LNV
LMT M2
RMT A6
FLT ..... BPF
(determined by panel settings)

(FNC = Function; LMT = Left Meter; RMT = Right Meter; FLT = Filters) (M2 = Manual Range 2; A6 = Auto Range 6)

DCV - Ext Input DC Volts - Selects the Ext Input DC Volts function.

DLD - Dummy Load dBm - Selects the Dummy Load dBm voltmeter function. The 0 dB reference is .775 volts RMS, equivalent to 1 milliwatt across 600 ohms.

DLP - Dummy Load dB Prog - Selects the Dummy Load programmable dB reference voltmeter function. Until a new 0 dB reference is set, either manually or via the IEEE bus with the "REF" code, the programmable dB reference is the same as the dBm reference; .775 volts RMS, equivalent to 1 milliwatt across 600 ohms.

DLV - Dummy Load RMS Volts - Selects the Dummy Load RMS Volts function.

DLW - Dummy Load RMS Watts - Selects the Dummy Load RMS Watts function.

EXD - Ext Input dBm - Selects the Ext Input dBm function. The 0 dB reference is .775 volts RMS, equivalent to 1 milliwatt across 600 ohms.

EXP - Ext Input dB Prog - Selects the Ext Input programmable dB reference voltmeter function. Until a new 0 dB reference is set, either manually or via the IEEE bus with the "REF" code, the programmable dB reference is the same as the dBm reference; .775 volts RMS, equivalent to 1 milliwatt across 600 ohms.

EXV - Ext Input RMS Volts - Selects the Ext Input RMS Volts function.

HPF - 200 Hz High Pass Filter - Selects the high pass filter for the audio inputs.

LMA - Left Meter Auto - Allows left PA81 meter to autorange.

LMH - Left Meter Hold - Places the left meter in the manual ranging mode. Holds the meter in the range it is in when the command is issued. This command must be issued before selecting a new range with the LMS command.

LMS - Left Meter Select - Selects the next higher range on the left meter. Before the LMS command is issued, the meter must first be placed in the manual ranging mode by issuing the Left Meter Hold (LMH) command. When the meter is in its highest range for a particular function (Figure 21) and the Select command is issued, the meter wraps around to its lowest range for that function, just as it does in manual operation.

LND - Audio Line dBm - Selects the Audio Line dBm function. The 0 dB reference is .775 volts RMS, equivalent to 1 milliwatt across 600 ohms.

LNP - Audio Line dB Prog - Selects the Audio Line programmable dB reference voltmeter function. Until a new 0 dB reference is set, either manually or via the IEEE bus with the "REF" code, the programmable dB reference is the same as the dBm reference; .775 volts RMS, equivalent to 1 milliwatt across 600 ohms.

LNV - Audio Line RMS Volts - Selects the Audio Line RMS Volts function.

LPL - 15 kHz Low Pass Filter - Selects the 15 kHz low pass filter for the audio inputs.

LPH - 30 kHz Low Pass Filter - Selects the 30 kHz low pass filter for the audio inputs.

OUT - Removes input filters - Removes all filters from the audio inputs.

REF - Reference Store - Sets 0 dB reference level for dB Prog - When in one of the dB Prog functions, the level currently indicated on the PA81 meters is programed as the 0 dB reference. The meters reset to indicate 0 dB. The DUMMY LOADS, AUDIO LINES, and EXT INPUTS dB PROG functions can each have a different 0 dB reference level programmed.

Example: "LNP": "REF" programs the current audio line input levels as the 0 dB references for AUDIO LINES dB PROG.

RMA - Right Meter Auto - Allows right PA81 meter to autorange.

RMH - Right Meter Hold - Places the right meter in the manual ranging mode. Holds the meter in the range it is in when the command is issued. This command must be issued before selecting a new range with the RMS command.

RMS - Right Meter Select - Selects the next higher range on the left meter. Before the RMS command is issued, the meter must first be placed in the manual ranging mode by issuing the Right Meter Hold (RMH) command. When the meter is in its highest range for a particular function (Figure 21) and the Select command is issued, the meter wraps around to its lowest range for that function, just as it does in manual operation.

RST - Reset DC Trip - Reconnects the internal PA81 dummy loads to the DUMMY LOADS inputs. Unless the reset tripped because of a transient DC voltage, the cause of the DC voltage being present on the speaker output leads will need to be corrected before the trip circuit will stay set.

Ranging The Meters

To range the meters under IEEE control, switch the meters to manual ranging (LMH & RMH), check the control panel settings to determine which range the meter is in (CPS), and range up enough times to bring the meter to the desired range (LMS & RMS). The meter ranging has "wraparound", so when it reaches the top meter range for that particular function, it wraps around to the lowest range for that function (Figure 21).

Example: "RMH": "CPS": "RMS": "RMS" sets the right meter to range hold, determines which range the meter is in, and steps the right meter up two ranges.

	Range 1 x0.0001 −60 dB	Range 2 x0.01 −40 dB	Range 3 x0.1 −20 dB	Range 4 x1.0 0 dB	Range 5 x10 +20 dB	Range 6 x100 +40 dB
Dummy Load Watts				x	x	
Dummy Load RMS Volts	x	x	x	x	x	x
Dummy Load dBm	x	x	x	x	x	x
Dummy Load dB Prog	x	x	x	x	x	x
Line RMS Volts	x	x	x	x	x	x
Line dBm	x	x	x	x	x	x
Line dB Prog	x	x	x	x	x	x
EXT RMS Volts		x	x	x	x	x
EXT dBm		x	x	x	x	x
EXT dB Prog		x	x	x	x	x
EXT DCV			x	x	x	x

Fig. 21: Ranging up from the highest range for a function wraps around to the lowest range for that function.

APPLICATIONS

Introduction

The procedures explained in the Operation section of this manual provide information on how to use the Stereo Power Amplifier Analyzer. As you become familiar with the PA81, you will find numerous applications for its use in audio system performance testing and troubleshooting. This section provides you with a better understanding of how to use the PA81 to its fullest capability.

Performance Testing Audio Amplifiers

An important application of the Stereo Power Amplifier Analyzer is performance testing audio amplifiers, to know whether they are operating to their original capabilities. Performance tests are a useful troubleshooting tool that help you determine the extent of amplifier problems. Performance testing is also a valuable quality check to determine whether an amplifier is working properly after a repair, before it goes back to your customer.

Audio Amp Preliminary Test Setup

Before proceeding with the audio amplifier performance tests, make the following setups:

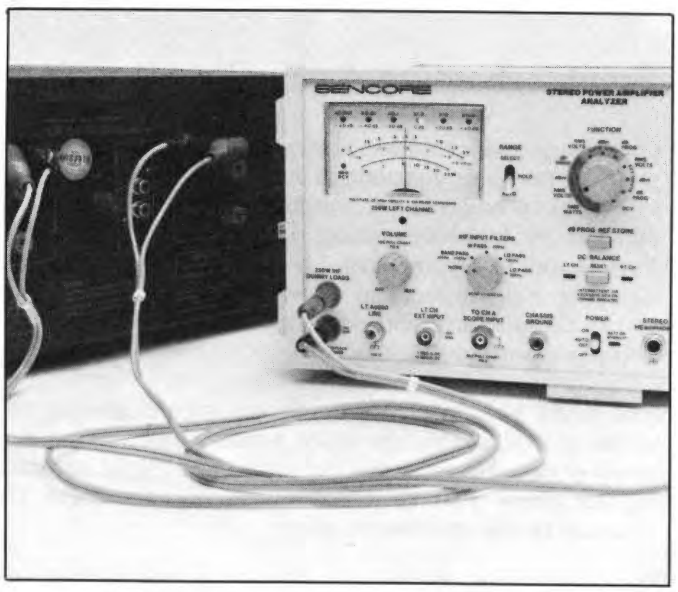


Fig. 22: For audio amp testing, connect the PA81 Dummy Loads in place of the left and right speakers.

A. Connect the power amp speaker outputs to the PA81's IHF DUMMY LOADS inputs.

B. Set the PA81's IHF DUMMY LOADS selector switch to match the amplifier's output impedance.

C. Connect the PA81's scope outputs to a dual channel scope's inputs.

D. Set the PA81's FUNCTION switch to RMS WATTS.

E. Set the IHF INPUT FILTERS switch to BANDPASS 200 Hz - 15 kHz.

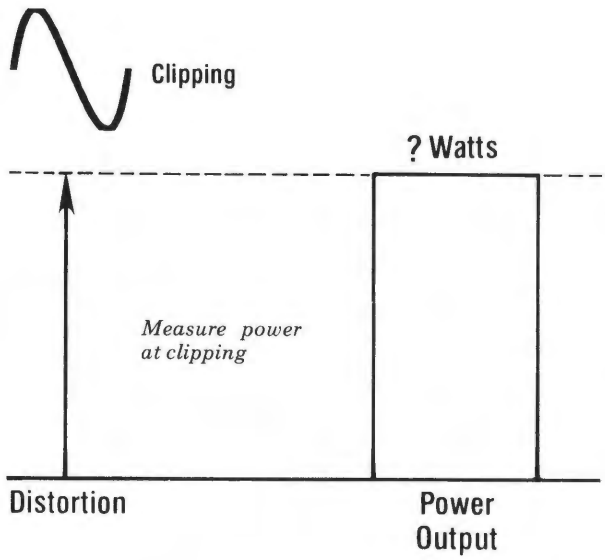
F. When testing the audio amps of an integrated power amp or receiver, set the tone controls to their flat (center) position.

Open Load Test

Many manufacturers recommend checking their audio amplifiers for proper operation with open loads before applying normal loads. This allows serious amplifier problems to be detected before a normal load compounds the problem by drawing high current, damaging additional components, and blowing fuses.

A general recommended procedure is to supply a 1 kHz signal to the amplifier input with open loads. Monitor the amplifier's audio output waveform on an oscilloscope connected to the PA81 scope output connectors as you increase the input level. The waveform should be free of distortion up to normal clipping levels. When normal clipping occurs at high input levels, the waveform should be clean, with no oscillation or ringing.

Power Output



This test measures the amplifier's maximum undistorted RMS power output.

To measure the amplifier's power output:

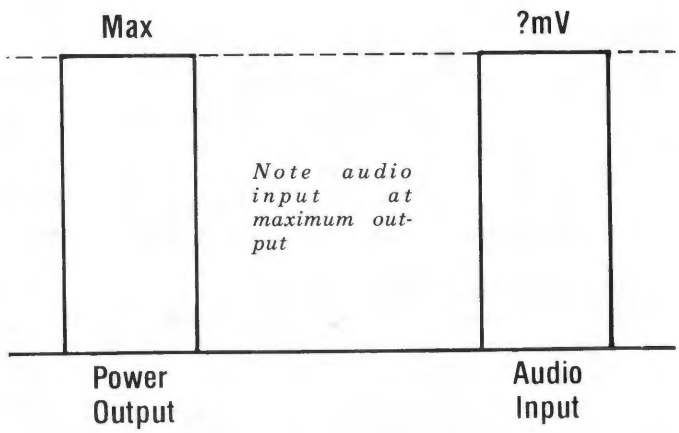
A. Supply a 400 Hz sinewave to the amplifier through its tuner or line inputs.

B. Increase the input signal level to the amplifier (or turn up volume control on receiver or integrated amplifier) to just below the point of visible clipping or distortion, as seen on the oscilloscope.

C. Read the RMS Watts output power on the PA81 meters.

D. If the amplifier is rated for more than one load impedance, reset the PA81 IHF DUMMY LOADS switch and repeat steps B and C for each rated impedance.

Sensitivity



This test measures the audio input level that the amplifier requires to produce its maximum undistorted power output. This is the level required from a preamp or from a tuner, turntable, tape deck, or CD player.

To measure the amplifier's sensitivity:

A. Supply 1 kHz sinewave to the power amplifier inputs (set volume control to maximum if testing an integrated amplifier).

B. Increase the amplifier's input signal level to just below the point of visible clipping or distortion on the output, as seen on the oscilloscope.

C. Disconnect the audio signal leads from the power amp inputs and connect the leads to the PA81 AUDIO LINE inputs.

D. Switch the PA81 FUNCTION switch to the AUDIO LINES RMS VOLTS position and read the audio amp input level (sensitivity) in RMS Volts.

Separation (Crosstalk)

This test measures how well the amplifier circuits keep one channel's audio input signal isolated from the other channel's output.

To measure the amplifier's separation:

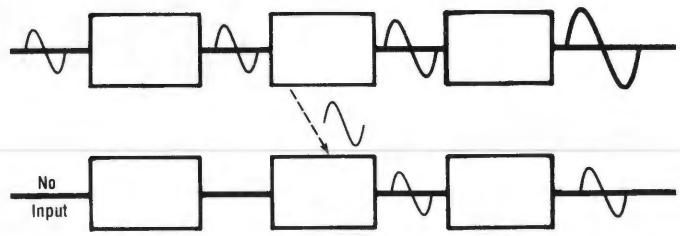


Fig. 23: Block diagram showing crosstalk path.

A. Supply a 1 kHz sinewave to one channel input only. Terminate the other input in its characteristic impedance (typically 47 Kohms).

B. Switch the PA81 FUNCTION switch to the IHF DUMMY LOADS dBm position.

C. Increase the input signal level to the amplifier to just below the point of visible clipping or distortion on the output, as seen on the oscilloscope.

D. Read the dBm level on both channels.

E. Figure the difference in levels (the figures are normally of opposite sign, so simply ignore the signs and add the numbers; +32 and −61 give 93 dB difference).

F. Reverse the input and termination to the two channels and repeat steps A thru E. The power amplifier separation is the lower of the two results.

Troubleshooting Audio Circuits

Once your performance testing has identified that a piece of audio equipment is not performing properly, you need to begin troubleshooting. The most efficient method of troubleshooting is functional analyzing. Functional analyzing combines signal injection and signal tracing to localize a problem to a small portion of the circuit, and component testing to identify the defective component.

The PA81 is helpful when you are signal tracing any audio circuits. This includes audio power amps and receiver circuits after the detector. The PA81 external inputs allow you to trace audio signals from the detector to the speaker outputs.

You can use the PA81 programmable dB readings for stage gain measurements; the dual inputs for quick comparison between channels; the speakers for audio monitoring; and the scope connections for simultaneous waveform monitoring.

Amplifier Stage Gain Measurements

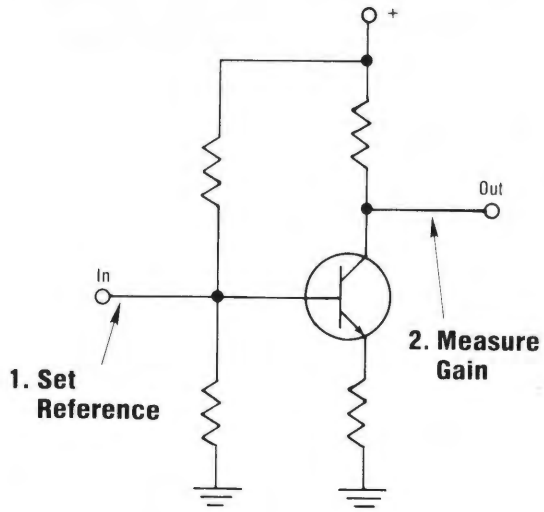
To measure an amplifier stage's gain:

A. Apply a standard signal to the input and switch the PA81 to EXT INPUTS dB PROG.

B. Connect the external PA81 probe to the input of the stage under test.

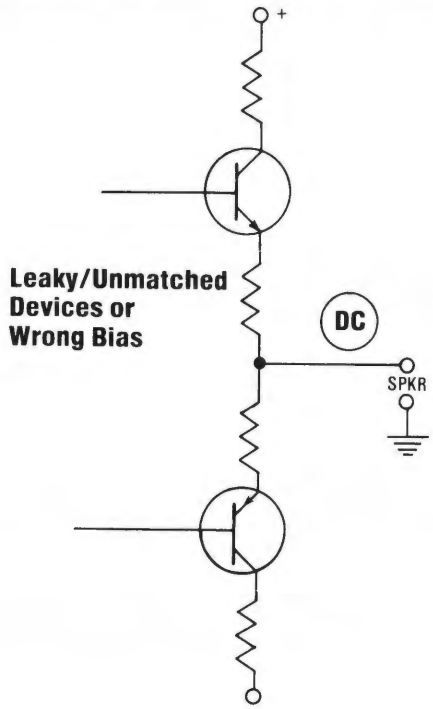
C. Set a 0 dB reference at this level by pushing the dB PROG REF STORE button.

D. Move the external probe to the output of the stage under test and read the stage gain directly in dB on the PA81 meter.



Amplifier DC Balance

Amplifier output stage problems that upset the output stage's DC balance, such as leaky or shorted output devices, often cause a DC voltage to appear at the speaker output leads. This DC voltage is usually a symptom of an amplifier problem that, if left uncorrected, will cause additional damage to the amplifier output stages. Also, if a speaker is connected to the output, the DC voltage causes DC current flow in the speaker that degrades performance and often damages the speaker.



The PA81 automatically senses DC balance problems during testing, trips open the affected load, and lights the appropriate left or right channel light to indicate the problem and minimize further damage to the amplifier.

Amplifier Feedback Problems

Manufacturers use negative feedback to stabilize audio amplifiers, reduce audio distortion, and increase amplifier bandwidth. This negative feedback reduces the gain of the amplifier.

Occasionally a defective feedback loop in one channel of an audio amplifier can mislead you when you are troubleshooting the amplifier. Insufficient feedback in one of the channels causes the output level of that channel to increase, but it also increases the distortion and reduces the bandwidth of that channel.

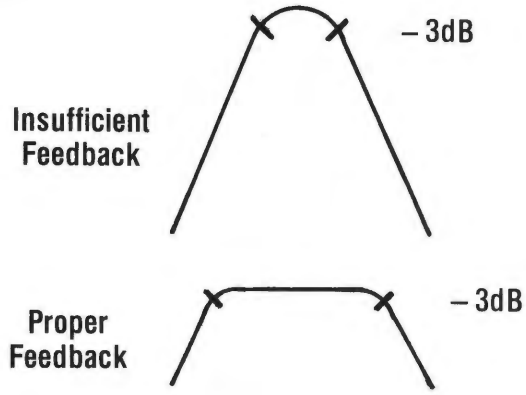


Fig. 24: Insufficient feedback causes increased gain, but reduced bandwidth.

When you test the two channel outputs and find that one channel has a lower output level than the other channel, you may mistakenly assume that the channel with the lower level is defective. You may spend hours troubleshooting the channel with the lower output and not find anything wrong. The problem may actually be a defective feedback loop in the channel with the higher output.

To detect the true problem, check the bandwidth of both channels. If the output of the higher channel drops off at high and low frequencies (poor bandwidth), the feedback circuit in the higher output channel is likely at fault.

Performance Testing FM Tuners

Another important application of the Stereo Power Amplifier Analyzer is performance testing FM tuners, or the tuner sections of stereo receivers.

FM Tuner Preliminary Test Setup

Before proceeding with the FM tuner performance tests, make the following setups:

A. Connect the tuner's line outputs to the PA81's AUDIO LINE inputs.

B. Connect the PA81's scope outputs to a dual channel scope's inputs.

Fig. 25: For testing tuners, connect the tuner line outputs to the PA81 line inputs.

C. Set the PA81's FUNCTION switch to AUDIO LINES dB PROG.

D. Set the PA81's IHF INPUT FILTERS switch to BANDPASS 200 Hz - 15 kHz.

E. Set the PA81's RANGE SELECT switches to their AUTO position.

F. When testing the tuner section of a receiver, set the receiver's tone controls to their flat (center) position.

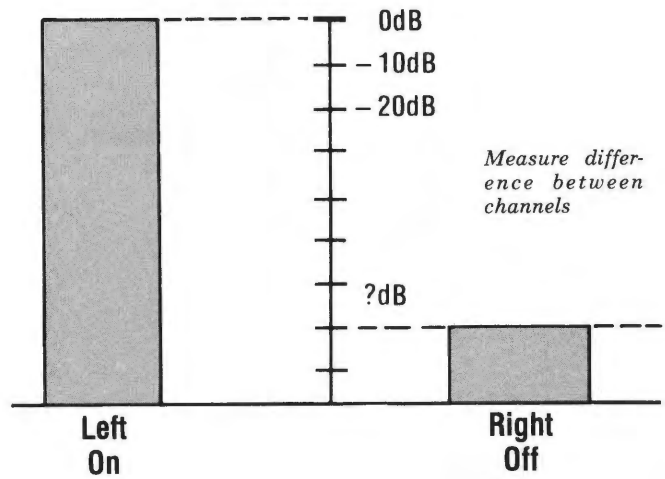
G. When performing a test that calls for standard mono signal, supply 98.1 MHz at 65 dBf with monaural 1 kHz audio at 100% modulation (no pilot).

H. When performing a test that calls for standard stereo signal, supply 98.1 MHz at 65 dBf with 1 kHz L−R audio (left signal is equal in amplitude but 180 degrees out of phase with the right signal) at 100% modulation. Stereo pilot should be at normal level (9% of total modulation).

J. When testing an analog tuner (continuous, rather than step tuning), accurately fine tune the tuner to center channel (standard mono signal) by turning off the tuner's muting and temporarily reducing the input signal level until noise appears on the oscilloscope display. Fine tune the tuner for equal noise on positive and negative peaks of the audio signal. Then restore the signal to its standard level (65 dBf).

K. When using an analog RF generator follow the above procedure, except, fine tune the generator rather than the tuner for equal noise.

Stereo Separation



This test measures how well the tuner circuits keep left channel audio isolated from the right channel output and vice versa.

Separation is measured in dB; the higher the figure the better. Typical stereo separation for modern tuners ranges from 30 dB to 60 dB or better.

To measure the tuner's stereo separation:

A. Supply a standard stereo signal to the tuner's antenna input.

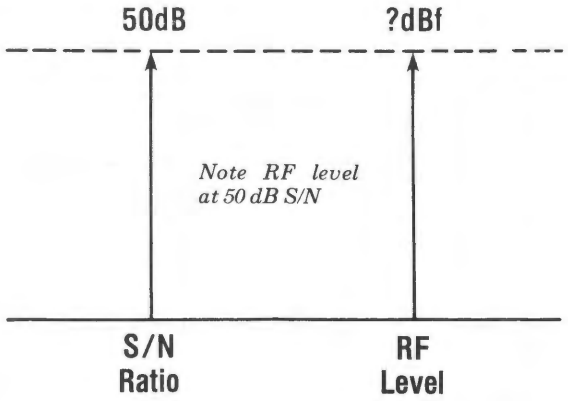
B. Push the PA81's dB PROG REF STORE button to set a 0 dB reference at the standard audio modulation level.

C. Switch modulation to left channel only and read the level on the PA81's right channel meter.

NOTE: If the left channel meter instead of the right channel meter dropped when you switched to left channel modulation, check for reversed left and right channel inputs to the PA81.

D. Switch modulation to right channel only and read the level on the PA81's left channel meter. The smaller dB number for the two tests is the tuner's Stereo Separation.

50 dB Quieting Sensitivity (Mono & Stereo)



This test measures how much input signal the tuner requires to suppress noise by 50 dB compared to the desired signal.

The lower the test result, the less signal the tuner requires to produce an acceptably quiet output, and the more sensitive the tuner. Typical 50 dB Quieting Sensitivity for modern tuners ranges from 30 dBf to 10 dBf or less for mono and 50 dBf to 20 dBf or less for stereo.

To measure the tuner's 50 dB quieting sensitivity:

A. Supply a standard mono signal to the tuner's antenna input (tuner muting switch off).

B. Push the PA81's dB PROG REF STORE button to set a 0 dB reference at the audio modulation level.

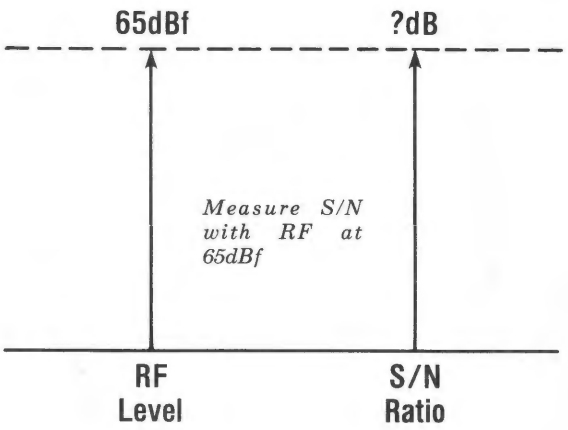
C. Turn off the audio modulation.

D. Reduce the RF signal level to obtain a −50 dB reading on the PA81. (If the noise level won't drop by 50 dB, check to be sure the PA81 INPUT FILTERS switch is in the BANDPASS position.)

E. Read the generator RF output level for the tuner's Mono 50 dB Quieting Sensitivity.

F. Supply a standard stereo signal to the tuner and repeat steps B thru E for the tuner's Stereo 50 dB Quieting Sensitivity.

65 dBf S/N Ratio (Mono & Stereo)



At low RF signal input levels, both natural and man-made noise are present at the tuner output, along with the desired signal. As the input signal is increased, the desired signal tends to "capture" the FM detector and block the noise, resulting in a quieting effect. This quieting effect levels off at some medium level of RF input.

This test measures the signal-to-noise ratio attained for relatively strong input signals (65 dBf). The higher the dB ratio, the less noise at the tuner output. Typical S/N ratios for modern tuners range from 70 dB to 95 dB or better for mono and from 60 dB to 85 dB or better for stereo.

To measure the tuner's 65 dBf S/N ratio:

A. Supply a standard mono signal to the tuner's antenna input.

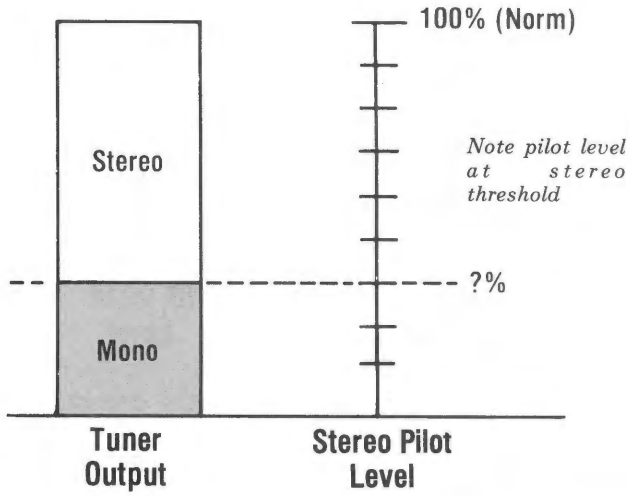
B. Push the PA81's dB PROG REF STORE button to set a 0 dB reference at the audio modulation level.

C. Turn off the audio modulation.

D. Read the higher of the two noise levels on the PA81 meters for the tuner's Mono 65 dBf S/N Ratio.

E. Supply a standard stereo signal to the tuner and repeat steps B thru D for the tuner's Stereo 65 dBf S/N Ratio.

Stereo Pilot Threshold



The transmitted FM stereo signal contains a 19 kHz pilot signal to turn on the receiver's stereo circuitry and provide a phase reference for the stereo decoder. The stereo decoder has a pilot detect circuit to detect the presence of the stereo pilot and turn the stereo circuits on. If the pilot detect circuit doesn't perform properly, a number of problems can occur:

1. If the pilot detect threshold is too high, or never switches, a stereo signal may not trigger the pilot detect circuit and the tuner will remain in the mono mode.

2. If the pilot detect threshold is too low, noise may trigger the tuner into the stereo mode even when receiving a mono signal, resulting in noisy operation.

To measure the tuner's stereo pilot threshold:

A. Supply a standard stereo signal to the tuner's antenna input.

B. Set the PA81's RANGE SELECT switches to the RANGE HOLD position.

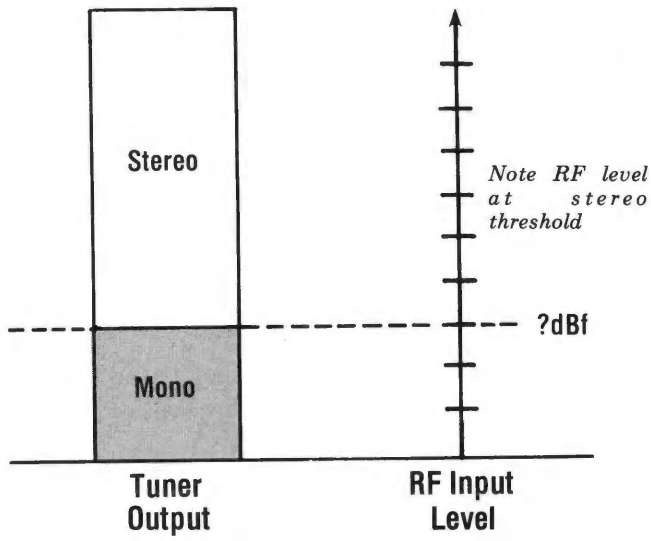
C. Reduce the generator's pilot level until the PA81 meters drop sharply (stereo light also switches off).

D. Read the generator pilot level for the tuner's Stereo Pilot Turn-Off Threshold. (Should be less than 50% of normal pilot level.)

E. Increase the pilot level until the stereo light switches back on and the PA81 meters rise sharply.

F. Read the generator pilot level for the tuner's Stereo Pilot Turn-On Threshold. (Should be a slightly higher level than step D.)

Stereo Switching Threshold



This test measures the automatic stereo switch response to RF signal level changes. The switching threshold level will typically be lower than the Stereo 50 dB Quieting level.

To measure the tuner's stereo switching threshold:

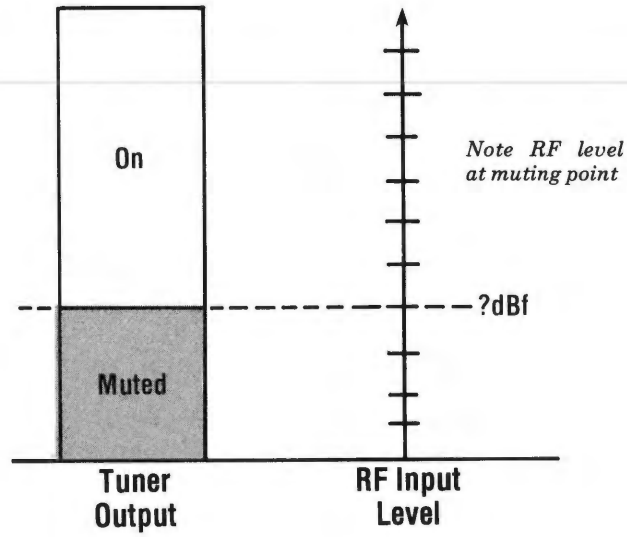
A. Supply a standard stereo signal to the tuner's antenna input.

B. Set the PA81's RANGE SELECT switches to the RANGE HOLD position.

C. Reduce the RF generator's level until the PA81 meters drop sharply (stereo light also switches off).

D. Read the generator RF level for the tuner's Stereo Switching Threshold.

Muting Threshold



FM tuners often have a muting circuit that turns off the tuner's audio output when no signal or only a very weak, noisy signal is present at the tuner input. The muting threshold will typically be about equal to the stereo switching threshold.

This test measures the muting circuit's response to RF signal level changes.

To measure the tuner's muting threshold:

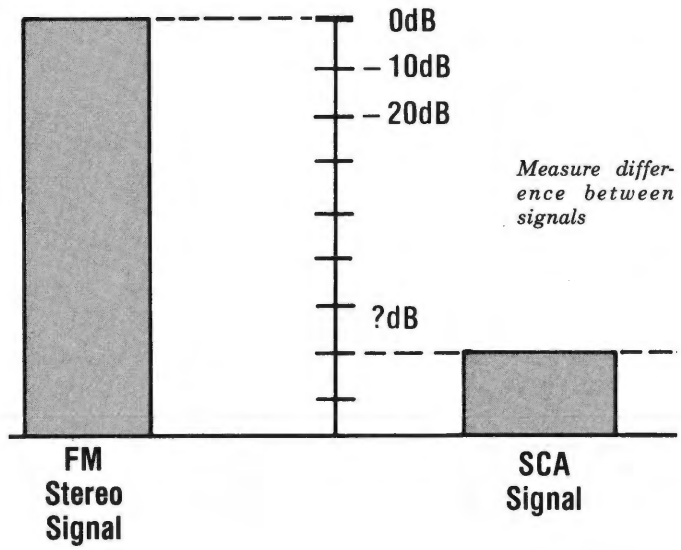
A. Supply a standard mono signal to the tuner's antenna input (tuner muting switch on).

B. Set the PA81's RANGE SELECT switches to the RANGE HOLD position.

C. Reduce the RF generator's level until the PA81 meters drop sharply.

D. Read the generator RF level for the tuner's Muting Threshold.

SCA Rejection



Many FM stations transmit an additional audio subcarrier signal (SCA) with their standard FM stereo signal. The SCA signal is used to carry background music, data, or paging signals.

A standard FM receiver doesn't use these signals and should not allow them to mix with the desired audio output. A filter circuit is included in standard FM receivers to reject the 67 kHz subcarrier signal. The SCA rejection level should equal or exceed the manufacturer's specifications.

To measure the tuner's SCA rejection:

A. Supply a standard mono signal to the tuner's antenna input (reduce the audio modulation to 90%).

B. Push the PA81's dB PROG REF STORE button to set a 0 dB reference at the standard audio modulation level.

C. Turn off the audio modulation.

D. Turn on the SCA subcarrier (2.5 kHz SCA audio at ±6 kHz deviation).

E. Read the levels on the PA81 meters. The higher of the two meter levels is the tuner's SCA Rejection level.

Performance Testing Line Output Audio Decks

Audio decks (turntables, cassettes, CDs, reel-to-reels, Hi-Fi VCRs, etc.) are tested by monitoring the audio line outputs of the deck with the PA81 while playing back the appropriate test signal source (record, tape, disk). Records, tapes, and disks made for alignment and testing are available from recording companies and stereo manufacturers as well as from third-party sources.

Separation

Test an audio deck's separation the same way you test tuner separation.

A. Play back the test section with reference level audio (1 kHz) on both left and right channels.

B. Set a 0 dB reference with the dB PROG REF STORE button (using the AUDIO LINES dB PROG function).

C. Play back the test sections with left channel only and right channel only audio.

D. In each case, note the separation level on the appropriate meter (i.e. read the right meter during left channel only audio).

When performing this test on CDs, use the 30 kHz LO PASS filter to eliminate digital clock noise above 30 kHz from the measurement.

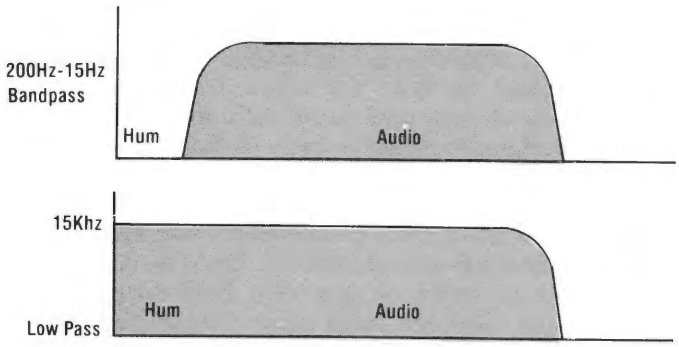
Frequency Response

Test an audio deck's frequency response by playing back the test section containing audio sweep. With the PA81 0 dB reference previously set to the 1 kHz reference level, the meters will indicate low frequency and high frequency rolloff directly in dB.

Line output levels

Test an audio deck's line output levels by playing back the 1 kHz reference test section. Use the AUDIO LINES RMS VOLTS or dBM function to measure the output levels.

Testing For Hum



To test a receiver or audio amp for hum, first remove the input signal (terminate the input) and measure the speaker or audio line output level with the 200 Hz to 15 kHz BANDPASS filter. Then, measure the output level with the 15 kHz LOWPASS filter. The difference between the two is the hum level.

Using A Scope For Waveform Monitoring

You can use a dual trace oscilloscope to monitor the waveform of an audio signal for noise or distortion at the same time you are using your PA81 to monitor the signal's power or voltage. The isolated-ground PA81 inputs allow you to monitor the waveform at points such as the isolated speaker outputs of auto radios without upsetting the circuit by connecting the scope common grounds to the circuit.

To use your dual trace scope with the PA81, connect the PA81's TO CH A SCOPE INPUT and TO CH B SCOPE INPUT jacks to the respective vertical input jacks of your dual trace scope. Set the scope's vertical attenuators for .5V/division.

NOTE: When increasing input signal to the meter circuits causes one of the meters to reach full scale deflection, the autorange circuit switches to the next higher meter range. This causes the needle on the meter to register at a lower level on the meter face. The waveforms on the screen of an oscilloscope connected to the PA81 scope output jacks react in a similar manner. As the PA81 meters reach maximum deflection and then drop after autoranging, the scope waveform also reaches maximum amplitude and then automatically decreases. This eliminates the need for continually readjusting the scope's vertical attenuators as the signal changes amplitude. If the range change occurs at a critical point in an adjustment procedure, range hold on the higher range.

Testing Four-Speaker Stereo Systems

Both home and auto stereo systems often provide the capability of attaching more than one set of speakers. Auto radios often include a fader to provide left and right speakers for both the front and the rear of the auto. Home stereos include an A/B speaker switch to allow switching in either or both of two different pairs of speakers.

Testing a stereo's multiple speaker outputs involves checking first one set of outputs (front or A) then the other (rear or B) to be sure that both outputs have equal levels. Also, the fader control should be checked for smooth operation.

To check an auto stereo's multiple speaker outputs:

1. Attach the PA81 DUMMY LOADS inputs to the stereo's front speaker outputs and set the FUNCTION switch to RMS WATTS. Turn the fader control to "front" and the left/right balance control to center.

2. Feed a 1 kHz modulated signal to the stereo from an RF signal generator and adjust the stereo's volume control for about two watts of power output.

3. Reset the FUNCTION switch to IHF DUMMY LOADS dB PROG and push the dB PROG REF STORE button; the meters will reset to the 0 dB position.

4. Slowly turn the fader control to "rear", watching the PA81 meters for a smooth decrease; a dirty or defective control will cause erratic or intermittant readings.

5. Turn the stereo off, disconnect the PA81 DUMMY LOADS inputs from the front speaker outputs, reconnect to the rear speaker outputs, and turn the stereo back on.

6. With the fader control set to "rear", check to see that both left and right rear output levels are very close to the previously stored front levels (0 dB ±1 dB).

To check a home stereo's multiple speaker outputs:

1. Attach the PA81 DUMMY LOADS inputs to the stereo's "A" outputs and set the FUNCTION switch to RMS WATTS. Set the A/B speaker switch to "A" and the left/right balance control to center.

2. Feed a 1 kHz signal to the stereo (either from the tuner or from the audio line inputs) and adjust the stereo's volume control for about two watts of power output.

3. Reset the FUNCTION switch to IHF DUMMY LOADS dB PROG and push the dB PROG REF STORE button; the meters will reset to the 0 dB position.

4. Turn the stereo off, disconnect the PA81 DUMMY LOADS inputs from the "A" speaker outputs, reconnect to the "B" speaker outputs, and turn the stereo back on.

5. With the A/B speaker switch set to "B", check to see that both left and right "B" output levels are very close to the previously stored "A" levels (0 dB± 1 dB). dB).

MAINTENANCE

Introduction

The PA81 is designed to provide reliable service with very little maintenance. A fully equipped Factory Service Department is ready to back the PA81 should any problems develop. A schematic, parts list, and circuit board layouts are included along with this manual on separate sheets.

Recalibration And Service

Recalibration of the PA81 is recommended on a yearly basis, or whenever the performance of the unit is noticeably affected. Since precise standards are required to insure accurate calibration traceable to the National Bureau of Standards (NBS), it is recommended that the PA81 be returned to the Sencore Factory Service Department for recalibration. The address of the Service Department is listed below. No return authorization is required to return the PA81 for recalibration or service. In most cases, the unit will be on its way back to you within 72 hours after it is received by the Service Department.

Service Department Address:

Sencore Factory Service
3200 Sencore Drive
Sioux Falls, SD 57107
1-800-843-3338
In SD (605) 339-0100

Replacement Leads

Should you ever need a set of replacement leads or need a replacement part, they are available through the Sencore Service Parts Department.

Service Parts Department Address:

Sencore Service Parts Dep't
3200 Sencore Drive
Sioux Falls, SD 57107
1-800-843-3338
In SD (605) 339-0100

Replacing The DC Power Lead Fuse

The DC Power Lead supplied with the PA81 is fused for protection against shorts or reversed polarities. The fuse is located in the very end of the cigarette plug end of the lead. To replace the fuse, simply unscrew the end of the cigarette plug body by turning it counter-clockwise. Replace the fuse with a 3 amp, fast blow type.

Mechanical Meter Zero

To provide the most accurate measurements, the indicator needle on the analog meters must be properly zeroed. With the PA81 Power switch OFF, insert a small screwdriver into the mechanical zero adjust screw, centered just below the bottom of the meter. Turn this screw to align the needle over the "0" on the bottom WATTS scale.

NOTES

APPENDIX

What Is A Decibel (dB)?

In measuring and analyzing audio signals, it is useful to measure the relative intensity of sound in terms similar to the response of the human ear. The human ear responds to variations in loudness in a logarithmic manner. In other words, if the transmitted power output of a signal is increased from 10 watts to 100 watts, the human ear will perceive this as a doubling in the amplitude of the sound. The decibel (dB) is a unit of measurement that closely follows the response of the human ear.

The basic formula for the decibel, using power ratios, is:

$$dB = 10 \log \frac{\text{power 1}}{\text{power 2}}$$

As can be seen from the formula, the decibel is based on ratios of power. In other words, it compares the power level of one signal to another. Oftentimes, audio measurements are made in terms of voltages, such as when measuring audio level with an oscilloscope or RMS voltmeter.

The basic formula for the decibel, using voltage ratios, is:

$$dB = 20 \log \frac{\text{voltage 1}}{\text{voltage 2}}$$

This formula is correct only if the impedances that the two voltages are measured across are the same. This generally is the case when the outputs of stereo amplifiers are measured and compared to each other.

The dB table in this appendix gives the decibel (dB) equivalent for various voltage ratios. Voltage ratios are used so that different output levels can be more easily compared. For instance the voltage ratio of two signals, one at 2 volts and the other at 1 volt, is 2.0:1. The voltage ratio of two other signals, one at 5 volts and the other at 2.5 volts, is also 2.0:1. The perceived difference in audio level, and thus the difference in dB, is the same for both signals.

dB Table

Voltage Ratio	dB Equivalent	Voltage Ratio	dB Equivalent
1.0:1	0.0	20:1	26.0
1.5:1	3.5	30:1	30.9
2.0:1	6.0	50:1	34.0
2.5:1	8.0	75:1	37.5
3.0:1	9.5	100:1	40.0
3.5:1	10.9	150:1	43.5
4:1	12.0	200:1	46.0
5:1	14.0	500:1	54.0
6:1	15.6	1,000:1	60.0
8:1	18.0	5,000:1	74.0
10:1	20.0	10,000:1	80.0
15:1	23.5	50,000:1	94.0

NOTES

SERVICE & WARRANTY

Warranty

Your Sencore instrument has been built to the highest quality standards in the industry. Each unit has been tested, aged under power for at least 24 hours, and then retested on every function and range to insure it met all published specifications after aging. Your instrument is fully protected with a 1 year warranty and Sencore's exclusive 100% Made Right Lifetime Guarantee in the unlikely event a manufacturing defect is missed by these tests. Details are covered in the separate document included with your instrument. Read this document thoroughly, and keep it in a safe place so you can review it it questions arise later.

Service

The Sencore Factory Service Department provides all in- or out-of-warranty service and complete recalibration services for Sencore instruments. NO LOCAL SERVICE CENTERS ARE AUTHORIZED TO REPAIR SENCORE INSTRUMENTS. Factory service assures you of the highest quality work, the latest circuit improvements, and the fastest turnaround time possible because every technician specializes in Sencore instruments. Sencore's Service Department can usually repair your instrument and return it to you faster than could a local facility servicing many brands of instruments, even when shipping time is included.

YOU DO NOT NEED AUTHORIZATION TO RETURN AN INSTRUMENT TO SENCORE FOR SERVICE. Be sure you include your name and address along with a description of the symptoms if it should ever be necessary to return your instrument. Ship your instrument by United Parcel Service or air freight if possible. Use parcel post only when absolutely necessary.

BE SURE THE INSTRUMENT IS PROPERLY PACKED. Use the original shipping carton and all packing inserts whenever possible. If the original packing material is not available, make certain the unit is properly packed in a sturdy box with shock-absorbing material on all sides. Sencore suggests insuring the instrument for its full value in case it is lost or damaged in shipment.

A separate schematic and parts list is included if you wish to repair your own instrument. Parts may be ordered directly from the Factory Service Department. Any parts not shown in the parts list may be ordered by description.

We reserve the right to examine defective components before an in-warranty replacement is issued.

SENCORE FACTORY SERVICE
3200 Sencore Drive
Sioux Falls, SD 57107
1-800-843-3338
Canada 1-800-851-8866
SD (605) 339-0100

Fill in for your records:

Date Purchased: _____

Serial Number: _____

Run Number: _____

(NOTE: Please refer to the run number if it is necessary to call the Service Department. The run number may be updated when the unit has been returned for service.)

WATS Free 1-800-843-3338 In Canada 1-800-851-8866

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Sioux Falls, SD 57107
Call Collect 605-339-0100 In SD

Form 4056

Printed In U.S.A.

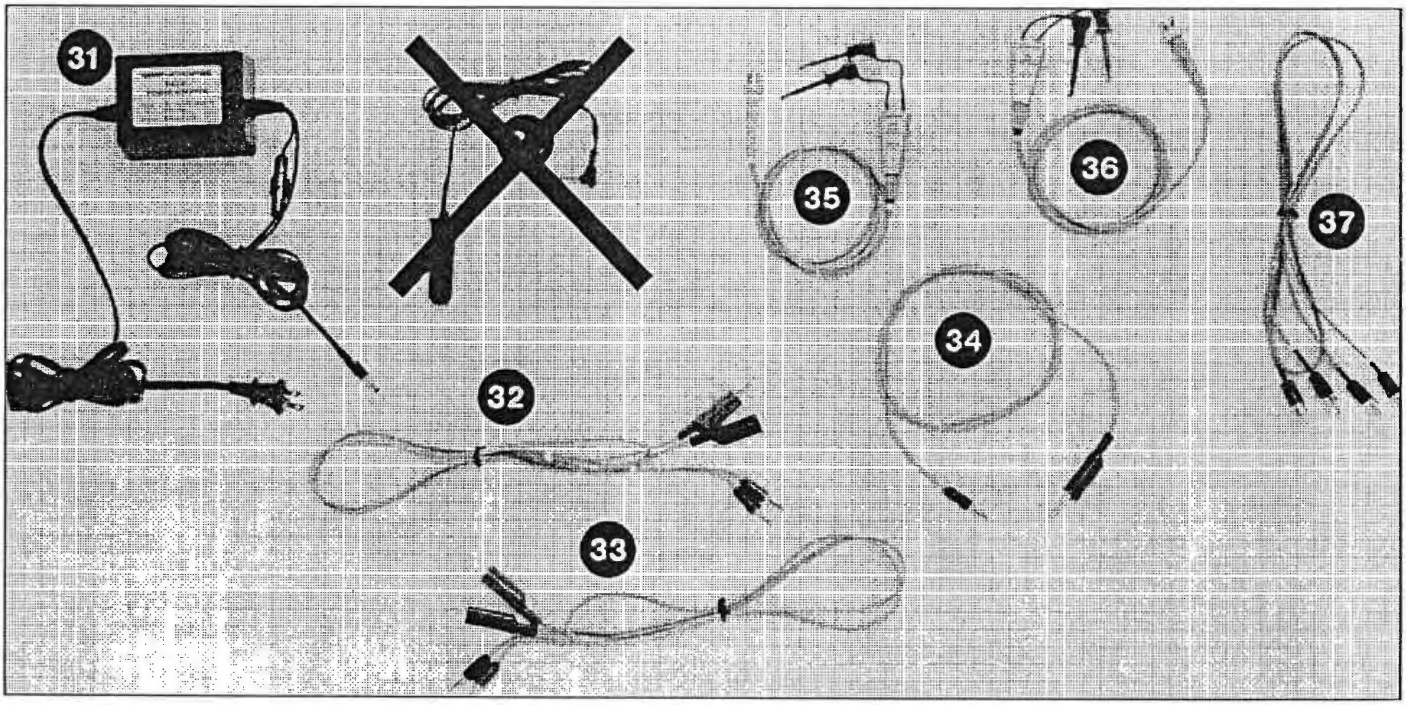
PA81 Manual Addendum

39G176 Fused DC Leads Incorrectly Added To PA81 Manual

The PA81 Stereo Power Amplifier Analyzer's Operation, Application, and Maintenance manual incorrectly included the 39G176 Fused DC Leads as a supplied accessory. The 39G176 leads are not an accessory of the PA81 and should not have been included.

The external DC input of the PA81 requires 18 volts (for the battery charging circuit) for proper operation. The 39G176 plugs into the cigarette lighter jacks in automobiles which can only supply 12 volts; this voltage is not high enough to operate the PA81 reliably.

Although the supplied PA241 Power Adapter lists its output at 13.8 VDC under a 2 amp load, the voltage rises as the load decreases. However, since the PA81 is such a low current drawing device, the voltage of the PA241 increases to 18 VDC.



Cross out the 39G176 Fused DC Leads shown in Figure 3 on page 12 of the PA81 manual.