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tech tips

Learning To Use The PA81

The PA81 STEREO POWER AMPLIFIER ANALYZER provides the ability to analyze and isolate defective stages in audio equipment. Its three inputs provide the ability to test the output of audio equipment ranging from phono pickup cartridges to large power amplifiers. This TECH TIP will familiarize you with the PA81 and its features. It is broken into 4 major sections:

1) Inputs
2) Measurement functions
3) Using standard test signals
4) IHF Filters

Inputs

The PA81 has 3 different inputs - Dummy Load, Line, and External. Each is optimized for a specific use in a different portion of an audio system. Since the PA81 is stereo, each input has a left and right channel. Which input is connected to the measuring circuits is determined by the setting of the FUNCTION switch. This section explains the basic application of each input. The next section explains the individual measurement functions.

DUMMY LOAD Input

The IHF DUMMY LOAD inputs allow you to performance test and check the operation of power amplifiers at their rated power. The DUMMY LOAD INPUTS replace the system speakers, and provide accurate measurements and proper load impedances. The black ground banana jacks are isolated from each other, and from the other inputs, to allow testing amplifiers that do not have common grounds.

The orange color coded portion of the FUNCTION switch selects measurements through the DUMMY LOAD input. The RMS WATTS function is unique to this input. Two other features also work only in conjunction with the DUMMY LOAD input - the IHF DUMMY LOADS switch, and DC BALANCE. (Refer to figure 1)

IHF DUMMY LOADS Switch

The IHF DUMMY LOADS switch allows you to select the necessary impedance to test the amplifier under the specified load condition. The switch selects the impedance for both the left and right channel simultaneously. To connect to the amplifier, set the IHF DUMMY LOADs switch to the same impedance that is specified for the speakers and connect the PA81's DUMMY LOAD input in place of the speakers.

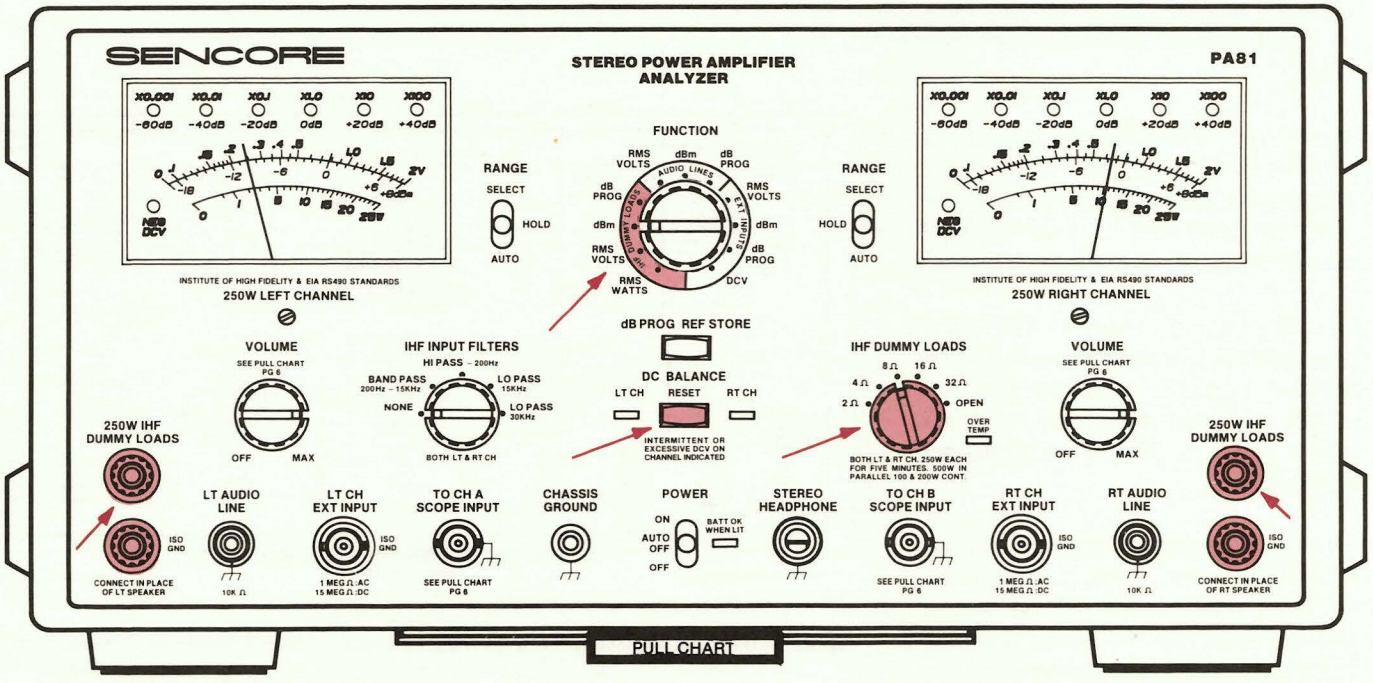


Fig. 1: DUMMY LOAD Inputs, DC BALANCE SWITCH, and IHF DUMMY LOADS work together to performance test power amplifiers.

The OVER TEMP light will come on if the dummy loads should begin to overheat. This will occur if too much power is applied to the dummy loads for too long, or if the air flow from the fans on the rear of the PA81 is restricted. If the OVER TEMP indicator comes on, remove the power amplifiers output power and allow the PA81 loads to cool for a minimum of 10 minutes after the indicator goes out. The DUMMY LOADS are rated at 250 watts per channel for 5 minutes on and 10 minutes off, or 100 watts per channel continuous .

The open position provides a quick way to test the amplifier with a no load condition, as is specified by some manufacturers. The DC BALANCE function continues to operate in the open position.

DC Balance

The PA81's DC BALANCE feature trips to remove the dummy loads from the amplifier when it senses 1 volt DC or greater across either channel DUMMY LOAD input. This protects DC coupled amplifiers from avalanching by opening the current path. When tripped, the dummy loads for both the left and right channel are interrupted. An LED illuminates to indicate on which channel the DC offset occurred. The loads remain open until you manually reset them by pushing the "Reset" button.

Occasionally, the DC BALANCE may seem to randomly trip, staying set after you reset it. Two conditions cause this to occur. In some amplifiers this is a "normal" condition and occurs when you turn the amplifier on or off. (You will likely hear a pop when the loudspeakers are connected.)

The second normal condition which may cause the PA81's DC BALANCE to trip is when music is applied to the power amplifier. Music contains low frequency beats which may instantaneously appear as DC to the fast-acting PA81 circuits.

NOTE: When testing and performance testing power amplifiers, always use a continuous tone rather than music as the input signal. A continuous tone provides a much better test of the amplifier, and is the IHF/IEEE recommended test condition.

If either of the above conditions occur, reset the DC BALANCE switch. If it trips immediately you have a DC offset problem with the channel indicated. The DC BALANCE function monitors the dummy load input for DC offset regardless of where the FUNCTION switch is set.

To use the DUMMY LOAD INPUTS:

1) Connect the PA81 DUMMY LOAD INPUTS to power amplifier in place of the loud speakers.
2) Set the PA81's IHF DUMMY LOADS switch to match the impedance of the amplifier.
3) Select the desired measurement on the orange DUMMY LOAD section of the FUNCTION switch.
4) Apply a continuous tone to the power amplifier under test.
5) Read the test results on the PA81's meter, listen to the audio using the built-in monitor or headphone, or view the signal on a scope connected to the TO SCOPE OUTPUT jacks.

AUDIO LINE INPUTS

The AUDIO LINE INPUTS are used to connect to the LINE OUT jack of audio components. RCA phono connectors provide simple connection to tuners, pre-amps, CD players, cassette decks, turntables etc. The AUDIO LINE INPUTS read and display the measurement that is selected by the yellow AUDIO LINE section of the FUNCTION switch.

The AUDIO LINE INPUT impedance is 10 kohms which closely matches the Line Out level of most audio components. (refer to figure 2)

NOTE: If you require a line impedance other than 10 kohms, follow the procedures given in the EXTERNAL INPUT section.

To use the AUDIO LINE INPUTS:

1) Connect the LINE OUT of the audio device to the PA81AUDIO LINE INPUTS.
2) Select the desired measurement on the yellow AUDIO LINE section of the FUNCTION switch.
3) Use the proper test signal for the device being tested as specified by its manufacturer to insure proper test results.
4) Read the test results on the PA81's meter, listen to the audio using the built-in monitor or headphone, or view the signal on a scope connected to the TO SCOPE INPUT jacks.

EXTERNAL INPUTS

The EXTERNAL INPUTS let you signal trace and measure DC voltages to isolate defective stages in audio equipment. Their high impedance of 1 Megohm allows you to measure signals without loading the circuit. The DC voltage measuring function is unique to the EXTERNAL INPUT. Use it as a conventional voltmeter to detect DC bias problems and make individual measurements in stages.

You can use the EXTERNAL INPUTS with an external resistor if you must match to the exact Line Out impedances of an audio component (i.e. 47 or 93 kohm). When doing so, be sure that you do not interchange the ground and signal connection between the PA81 and audio com-

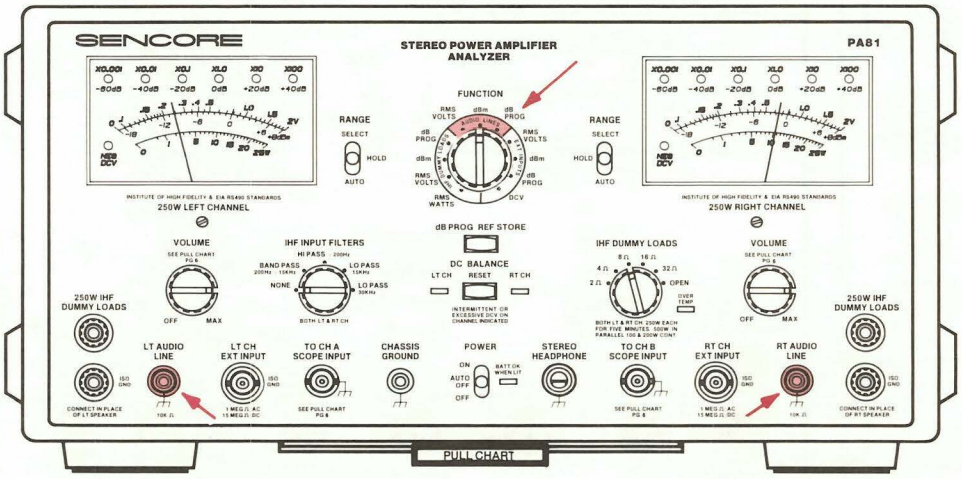


Fig. 2: AUDIO LINE INPUTS test low-level signals such as tuners, pre-amps, cassette decks, etc.

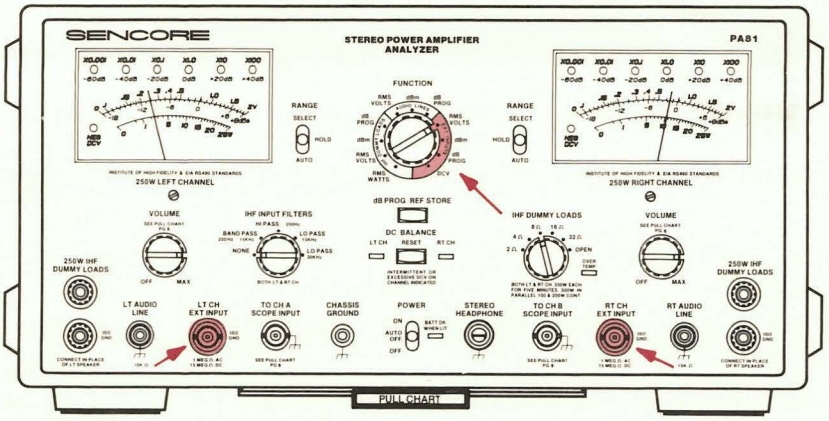


Fig. 3: EXTERNAL INPUTS are used for troubleshooting audio stages to isolate defective stages.

ponent LINE OUT. Measurements on the EXTERNAL INPUTS are made when you have selected the blue EXT. INPUT section on the FUNCTION switch. (refer to figure 3)

To use the EXTERNAL INPUTS:

1) Hook the supplied troubleshooting probes to EXTERNAL INPUTS on the PA81, or use a shielded, direct probe.
2) Select the desired measurement on the blue EXT. INPUT section of the FUNCTION switch.
3) Use the proper test signal for the device being tested as specified by its manufacturer to insure proper test results.
4) Read the test results on the PA81's meter, listen to the audio using the built-in monitor or headphone, or view the signal on a scope connected to the TO SCOPE INPUT jacks.

Measurement Functions

The FUNCTION switch determines the measurement that is displayed by the PA81's meters, and also selects which input is measured. The FUNCTION switch is divided into three color coded and labeled sections that match the inputs: IHF DUMMY LOAD INPUTS -orange; AUDIO LINES - yellow; EXT INPUTS - Blue. To make a measurement, set the FUNCTION switch to the position that matches both the input and the desired measurement. The signal selected by the FUNCTION switch is also present at the PA81's TO SCOPE INPUT jack, the built-in speakers, and the STEREO HEADPHONE output jack allowing you to view or listen to it. (Refer to figure 4)

Meters

The PA81's meters display the quantity of the signal. There are two parts to the meter reading - the numerical scale and the multiplier/range indicator. To determine the signal level, multiply the meter reading by amount shown by the illuminated range indicator. Or, when making dB or dBm measurements add the amount of dB's shown by the range indicator to the numerical meter reading. Examples of meter readings are shown in the following figures.

The meter range can be selected manually or, allowed to autorange, depending upon the setting of the RANGE switch. (Each channel has its own RANGE switch). For most measurements you will want to leave the RANGE switch set to AUTO. This will allow the meters to track the input signal. If the signal level is such that the meter reading keeps switching between ranges, or if you want to lock the meter to a specific range, set the RANGE switch to HOLD. In the HOLD position, the meter will stay locked in the current range, regardless of the signal level. To change ranges, you can allow the meter to AUTO range, or move the RANGE switch to select the desired range. The level at the TO SCOPE INPUT jacks, monitor speakers, and headphones changes along with the meter ranging.

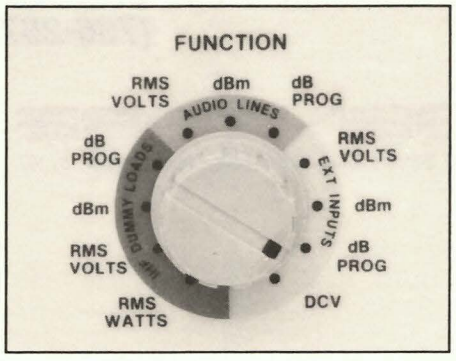


Fig. 4 The FUNCTION switch selects the desired measurement for DUMMY LOADS, AUDIO LINE and EXTERNAL INPUTS.

Following is a brief description of each measurement function:

RMS Watts

RMS WATTS (continuous average power) measurements are available only through the DUMMY LOAD INPUTS, because a load is needed for the amplifier to measure power. This function allows you to compare amplifier power ratings to manufacturer specifications. If the OPEN position of the IHF DUMMY LOADs is selected, or if the DC is tripped, the PA81 will not display a power reading because no power is dissipated across an open load. (Note: You will still be able to measure RMS VOLTS, dBm or dBp on the DUMMY LOAD INPUT).

The maximum output power of an amplifier should be measured just before the amplifier begins to clip. Use the TO SCOPE INPUT jacks, the monitor speakers or the headphones to determine when this point occurs. These features are explained later in this Tech Tip. (refer to figure 5)

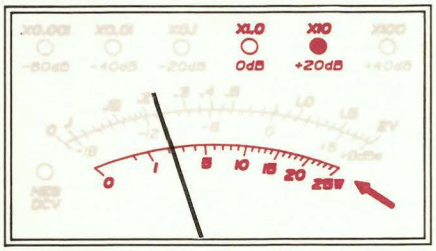


Fig. 5: Use the Watts scale to measure power. This meter reads 20W (2wx 10).

To read power:

1. Connect the PA81 to the power amplifier as explained in the DUMMY LOAD INPUT section.
2. Select the RMS Watts function.
3. Read the bottom "W" numerical meter scale.
4. Multiply the reading by the indicated range LED, (Only X1 or X10 ranges apply to RMS watts).

RMS Volts

The RMS VOLTS function allows the PA81 to operate as a dual-channel audio voltmeter. Applications of RMS volt measurements include measuring the voltage across amplifier speaker outputs as specified by some manufacturers, measuring LINE OUT and LINE IN levels, and tracing voltages within audio equipment to isolate defective stages.

RMS VOLTS can be measured through all the inputs, depending upon the setting of the FUNCTION switch. (refer to figure 6)

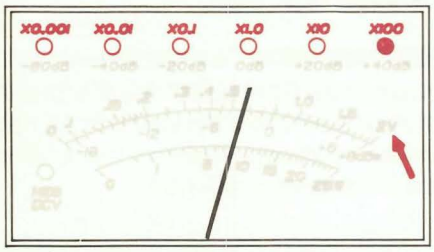


Fig. 6: Use the voltage scale to measure RMS Volts. This meter reads 60 VRMS (.6v x 100).

To read RMS VOLTS:

1. Connect the signal to be measured to the PA81 as described in the Inputs section of this Tech Tip.
2. Select the RMS VOLTS function corresponding to the desired input.
3. Read the top "V" numerical meter scale.
4. Multiply the reading by the indicated range multiplier (the X0.001 range does not function with the EXT. INPUT).

dBm

dBm is a standard signal level measurement used in all types of audio testing. Like RMS volts, dBm specifies an absolute signal level. (dBm means 0dB referenced to 1 milliwatt, which equals .7745 volts RMS). LINE IN and LINE OUT levels are often specified in dBm. dBm measurements simplify comparison measurements, such as separation, S/N and stage gain as you simply add or subtract the dBm readings to determine the dB difference.

Keep in mind that since dBm is referenced RMS voltage, the pointer location on the meter won't change when you switch between the dBm and RMS VOLTS functions - you simply refer to a different meter scale. dBm measurements can be made on all PA81's inputs. (refer to figure 7)

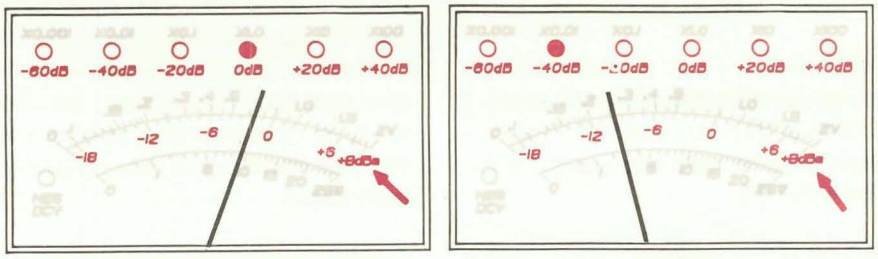


Fig. 7: Use this scale for dBM measurements. The meters read 53 dBM (-3db + - 50 db)

To read dBm signal level:

1. Connect the signal to be measured to the PA81 as described in the Inputs section of this Tech Tip.
2. Select the dBm function corresponding to the desired input.
3. Read the top dBm numerical meter scale.
4. Add or subtract the amount of dBs to the numerical reading as indicated by range adder (the -60 dB range does not function with the EXT Input).
5. To make a comparison measurement using dBms, follow steps 1-4 for each signal. Then add or subtract the readings in step 4.

dB Programmable (dbp)

The dBp function is used to make fast determinations of relative differences in signal levels - such as separation, stage gain or S/N measurements. Think of dBp as adding or subtracting dBm levels, with one level being 0dBm.

Pushing the db PROG REF STORE button takes whatever signal level is being measured on the meters and sets it to a "0" reference starting point. When the next signal is applied (such as moving the input probe to a different point, changing the RF modulation applied to a receiver, or moving from amplifier's input to output) the dB gain or loss is displayed directly on the meter.

Pushing the dB PROG REF STORE sets the meter readings on both channels to zero. The dBp function works on all the inputs. (refer to figure 8)

To measure stage or amplifier gain:

1. Connect the PA81 input to the amplifier or stage input as described in the Inputs section of this Tech Tip. (Use either the left or the right channel for mono,or both channels for stereo).
2. Select the "dBp" function corresponding to the input which you are using.
3. Push the dB PROG REF STORE button.
4. Move the PA81 input to the output of the amplifier or stage you are measuring.
5. Read the dBm numerical meter scale.
6. Add or subtract the amount of dBs to the numerical reading as indicated by range adder.
7. This is the dB gain of the stage or amplifier.

To measure stereo separation:

1. Connect the PA81 inputs to the device to be tested as described in the Inputs section of this Tech Tip.
2. Select the dBp function corresponding to the input which you are using.
3 Apply the necessary signal to the device so that both channels have the same output level.
4. Push the dB PROG REF STORE button.
5. Apply the necessary signal to the device so that only one channel has output.
6. The separation is the difference between the PA81 meter readings.

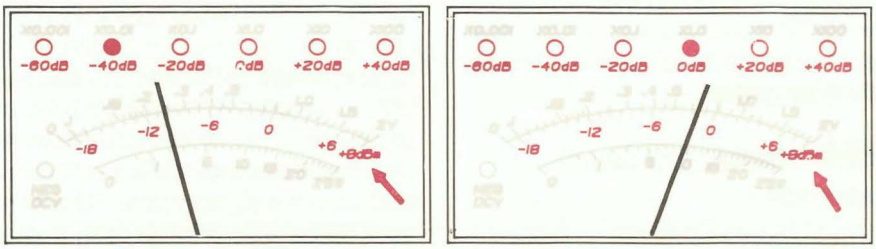


Fig. 8: Use the dBm scale fo db measurements. The meters read 50 db separation; right channel is referenced to 0 db and the left channel reads 50 db.

DC Volts (DCV)

The DCV function is used to measure DC voltages when isolating defective stages, adjusting bias levels or checking DC offsets. DCV measurements can be made only through the EXTERNAL INPUTS.

A NEG DC LED on the PA81's meters indicate when a negative DC voltage is being measured. (refer to fig. 9)

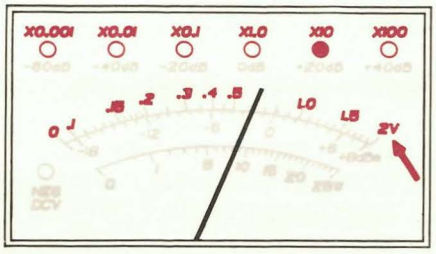


Fig. 9: Use the voltage scale to measure dc volts. This meter reads 7 vdc (.7v x 10).

To read DCV measurements:

1. Connect the supplied troubleshooting probes as referred to the Inputs section of this Tech Tip.
2. Select the DCV function on the EXT. INPUTS".
3. Read the top "V" numerical scale .
4. Multiply the reading by the indicated range multiplier (the x 0.001 range does not function with the EXT. INPUTS)

Scope Outputs

The TO SCOPE INPUTS provides a means to view the waveform which is being measured. This allows you to identify noise and distortion problems down to a level of about 2%. (For precise distortion measurements use an external distortion meter connected across the DUMMY LOAD INPUTS). Viewing the signal on an oscilloscope will also tell you when the amplifier has reached maximum power when performing the RMS power test.

Connect the TO SCOPE INPUT jacks to the input of any oscilloscope, and adjust the scope to see the waveform. The waveform at the TO SCOPE INPUT jack is relative to the signal level applied to the PA81 inputs and is not calibrated to exactly match the meter reading. The amplitude of the signal at the scope jacks will change as the meter ranges.

Monitor Speaker and Stereo Headphone

The SPEAKERS and STEREO HEADPHONE jack allow you to monitor the signal applied to the PA81 input that is selected by the FUNCTION switch. They provide a quick way to determine audio quality and distortion (as when listening for clipping to occur when measuring maximum power), and to trace signals through audio stages.

A volume control adjusts the output level of both the speakers and headphones. Separate volume controls are provided for the left and right channel. Connecting headphones to the STEREO HEADPHONE jack defeats the monitor speakers. Any stereo headphones having a standard 1/4" plug may be used.

Using Standard Test Signals

The PA81 is universal, meaning that it is compatible with any audio signal generator, test tape, test CD etc. that provides audio signals. Test tapes and CD's are available through the parts service centers of most audio manufacturers that provide signals for separation testing, frequency response testing and general system checkout.

For troubleshooting amplifiers, a sine wave signal of 400 Hz or 1 kHz works well. Be sure that the signal level is not too large as to overdrive the amplifier input, or too small as to not adequately drive the input circuits.

For performance testing, most IHF/IEEE and manufacturer test procedures specify the use of a constant frequency, constant amplitude tone. Music should not be used for final performance testing because it varies in amplitude and frequency and doesn't work the amplifier as hard as a continuous tone. Additionally, music may randomly trip the PA81's DC BALANCE circuitry. Always use the test signal that is specified by the manufacturer when doing final performance testing of audio components.

IHF Filters

The IHF FILTERS change the frequency response of the PA81 measuring circuits. They are used to identify noise and interference problems. By selecting different combinations of filters you can detect AC hum caused by defective power supplies; locate 19 kHz pilot interference when troubleshooting FM stereo receivers; and, block unwanted signals such as CD clock noise when testing CD's or when using them as a signal source.

The IHF FILTERS can be used with all inputs, and are simultaneously selected for both channel. They only change the frequency response of the meter circuits, and do not change what you hear through the speakers and headphones, or what you see at the scope jacks. Following is a brief description of each:

NONE (20 Hz to 200 kHz) - This is the frequency response of the PA81 without being limited. Use it in conjunction with the other filters to identify the presence of noise and interference.

BANDPASS (200 Hz to 15 kHz) - Most manufacturers specify this bandpass for separation and power tests.

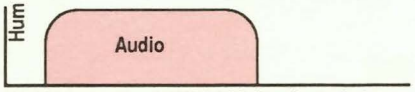
HIGH PASS 200 Hz - All frequencies below 200 Hz are blocked by this filter. Any difference in readings between this filter and the NONE filter indicate the presence of AC hum, such as 60 hz and 120 hz power supply hum.

LO PASS 15 kHz - This filter blocks all frequencies below 15 kHz. Any difference between this filter and the NONE filter indicates the presence of 19 kHz pilot or 38 kHz subcarrier leakage.

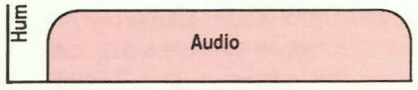
LO PASS 30 khz - Use this filter when using a CD to provide test signals. It blocks all frequencies below 30 kHz to stop the 44.1 kHz CD clock frequencies. Use it to also distinguish between 19 kHz pilot leakage and 38 kHz subcarrier leakage. (refer to fig. 10)

The IHF Input Filters Pass The Following Frequency Ranges:

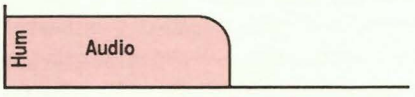
NONE: - Passes audio signals from 20Hz to 200 KHz.



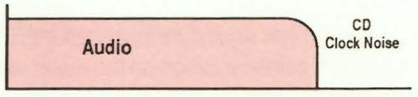
200 Hz to 15 kHz - BANDPASS filter for typical tests.



200 Hz and above - HIPASS filter rejects hum.



20 Hz to 15 KHz - LO PASS filter for hum test.



20 Hz to 30 KHz - LO PASS filter blocks clock noise for CD tests.

Fig. 10: The IHF FILTERS identify noise and interference within audio devices.

For More Information
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