Amplifier Performance Report

Report Date December 16, 2016
Manufacturer: Fisher
Model: 800-B Receiver

Special Notes:

Full Gold Level Restoration service completed. Chassis ultrasonically cleaned. All coupling and bypass caps upgraded to polypropylene types. Inrush current limiter and transformer blow out protection circuitry installed. Custom phono preamp mod installed. Regulated power supply upgraded with 300% increase in capacity. A Matched Quad of new 7591A output tubes installed. Individual output tube bias installed. Bias critically adjusted using a spectrum analyzer to minimize odd-order harmonic content, especially minimizing the 5^{th}, 7^{th}, and 9^{th} harmonics. Both AM and FM receivers restored and critically aligned, along with NOS RF and IF Amplifier tubes in the FM/AM receivers.

The purpose of this Amplifier Performance Report is twofold:

First, the report will precisely quantify your amp's current performance in relation to its original manufacturer's specifications. To do this in an accurate and reliable way, AEA uses only calibrated lab-quality instruments.

Secondly, the report will provide diagnostics. Our experienced engineering team turns the measurement information into insights that can be used to trouble shoot problems, as well as provide preventative maintenance for your amplifier.

Think of this report as the equivalent of a "full body scan" to assess your amplifier's heath and provide expert advice on solving any problems found.

Understanding Amplifier Specs

The 5 key specs for power amplifiers are output power, frequency response, distortion, crosstalk and noise. Below are the manufacture's published specifications for each of these, along with the actual amounts we measured for each channel. AEA uses calibrated lab-quality instruments to ensure accurate and reliable information.

Note: In all graphs the **Left Channel** is shown in **Yellow** and the **Right Channel** is shown in **Blue**.

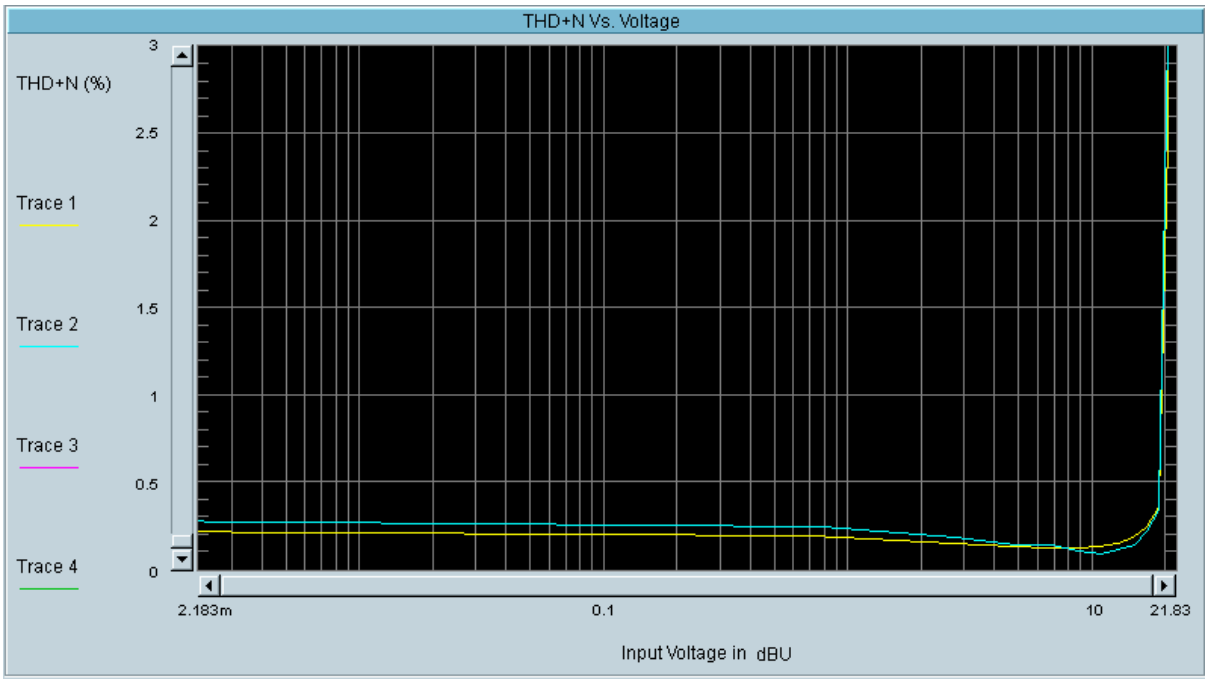
*An additional section on receiver performance specifications and alignment has been added

Maximum Power Output (RMS watts per channel into 8Ω)

Power output is roughly equivalent to how loud you can pump out music. Maximum power output is the amount of power the amp can put out while remaining within its specified maximum distortion spec.

Channel A (Left)	Manufacturer's Spec: 24 Watts	Actual Measurement: 24 Watts
Channel B (Right)	Manufacturer's Spec: 24 Watts	Actual Measurement: 24 Watts

The graph below shows your amplifier's distortion percentage at various output power levels. The vertical scale is increasing % distortion and the horizontal scale is increasing power (watts into 8 ohms).



How to read the graph:

THD vs Power is shown over an increasing range of power levels with both channels driven. The point at which distortion suddenly increases is the amplifier's maximum output, or clipping point. The distortion should remain well below the manufacturer's % distortion specification until after maximum rated power is reached.

Diagnostic Comments:

NOS output tubes and proper tube biasing results in reduced distortion across all power levels right up to the clipping point. Lower bias current also optimizes the amp's performance and tube life, with only 3 watts (less than 0.5 dB) reduction in maximum rating.

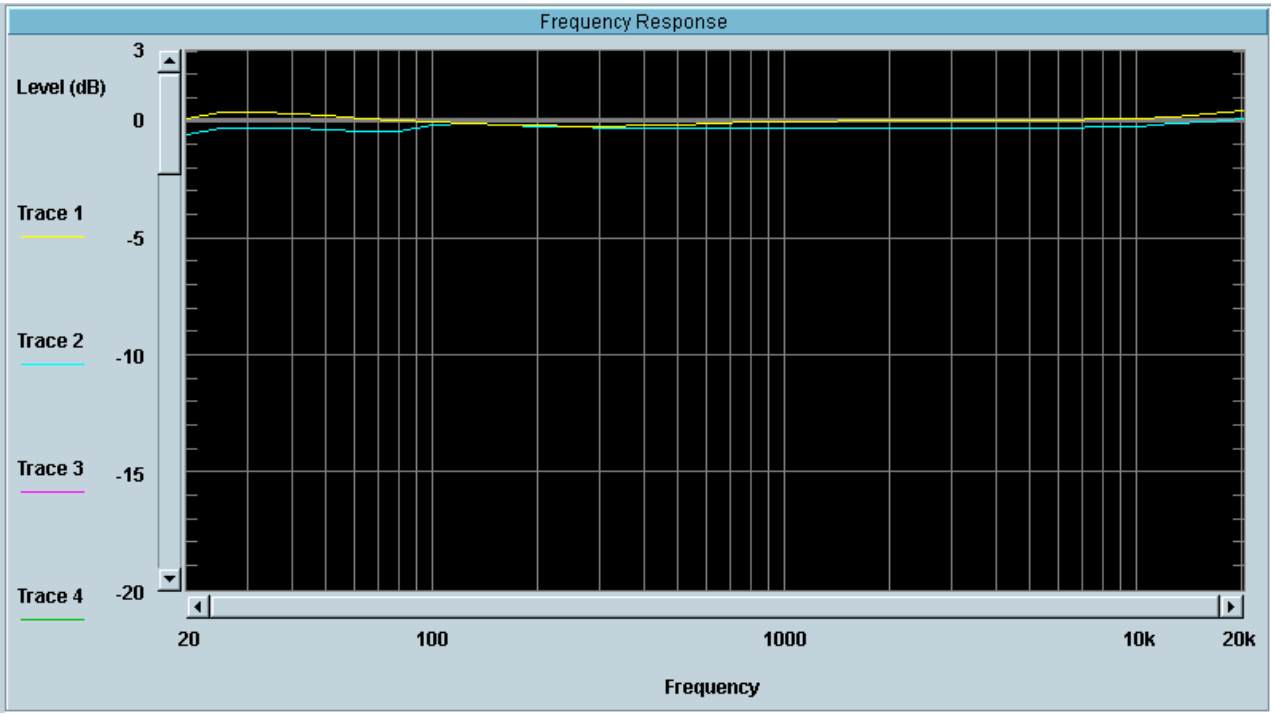
Frequency Response (at max power 20Hz to 20kHz)

Frequency response is a measure of how well your amplifier "responds" to different frequencies in the input signal. It's measured in plus or minus dB over a fixed frequency range. The smaller the variation the better. Since the human ear can only hear frequencies between 20 cycles per second (20 Hz) twenty thousand cycles per second (20 KHz), the specification is often given only for this range of frequencies.

Channel A (Left)	Manufacturer's Spec: +- 1.0 dB	Actual Measurement: +- 0.6 dB
Channel B (Right)	Manufacturer's Spec: +- 1.0 dB	Actual Measurement: +- 0.4 dB

Frequency Response Graph

To help evaluate how well your amp responds to a range of frequencies, we have recorded its response to different sound frequencies in the graph below.



How to read the graph:

Reading the graph is actually pretty simple: It shows the range of frequencies (from low to high) horizontally and the amplifier output in Decibels (dB) vertically. The frequency range represented on this graph is 20Hz to 20,000Hz (20kHz), which is the maximum range of human hearing. The frequency response should be nearly flat — the less variation the better.

Diagnostic Comments:

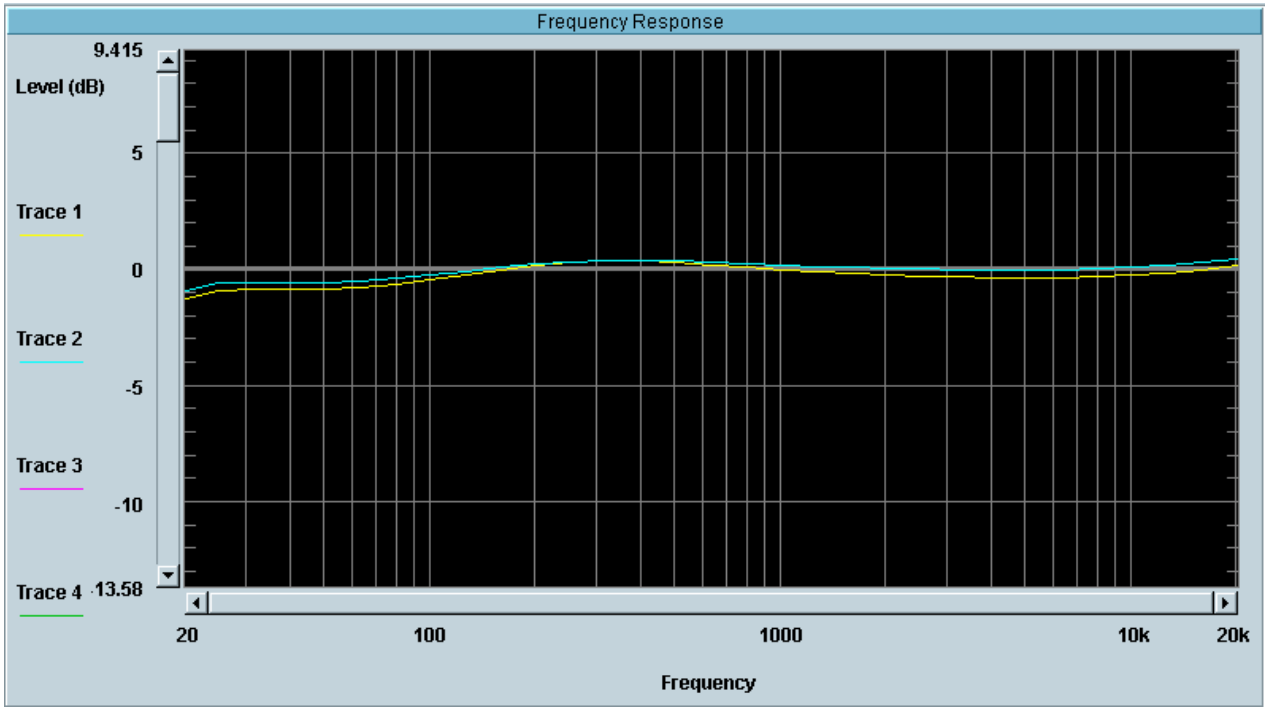
Frequency response is within specifications, and especially flat from 22Hz to 20KHz.

Phono Preamp Stage RIAA Equalization Frequency Response

RIAA equalization is an industry standard specification for the recording and playback of phonograph records. It is a form of pre-emphasis used when the record is made (cut) combined with an equal and opposite de-emphasis on playback. Accurate RIAA equalization is critical to phono preamp performance.

RIAA Equalization Graph

As components such as resistor and capacitors age, their values often change. Even small changes can cause the phono stage to apply incorrect RIAA equalization, resulting in 'tonal coloration' and phase distortion. The chart below shows how well each channel of your phono preamp stage follows the precise RIAA standard over the range of 20Hz to 20 KHz.



How to read the graph:

The graph is made by applying precision RIAA pre-emphasis to the test signal input to the phono preamp stage. If the phono input stages de-emphasis equalization is in perfect compliance with the RIAA standard there should be a flat line at zero deviation. The flatter this line is the better. Any deviation present should be below the manufacturer's specification over the entire frequency range.

Diagnostic Comments:

Individual resistors and capacitors were replaced/upgraded to allow the phono preamp to operate within 1dB of specified RIAA equalization compliance. Both channels are well balanced with less than .5dB difference across the entire frequency range.

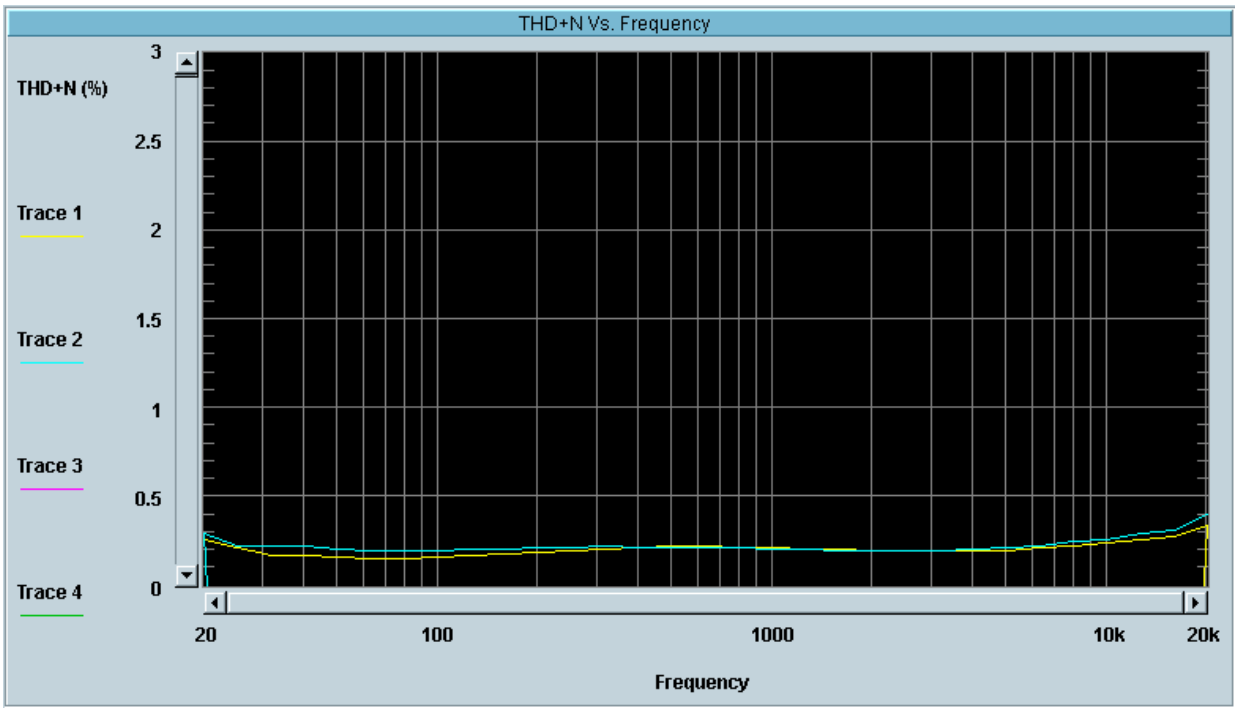
Total Harmonic Distortion + Noise (THD + N)

Total Harmonic Distortion + Noise (THD + N) is a measure of the effect the amplifier has on the sound output (distortion) as a percent of the total output. A completely transparent amplifier would have zero percent distortion. The lower this figure, the closer the output of the amplifier will be to the original recording.

Channel A (Left)	Manufacturer's Spec: <1%	Actual Measurement: .4%
Channel B (Right)	Manufacturer's Spec: <1%	Actual Measurement: .3%

THD+N Graph

To help evaluate the distortion of your amplifier over a range of frequencies, we have recorded its percentage of distortion at different sound frequencies in the graph below.



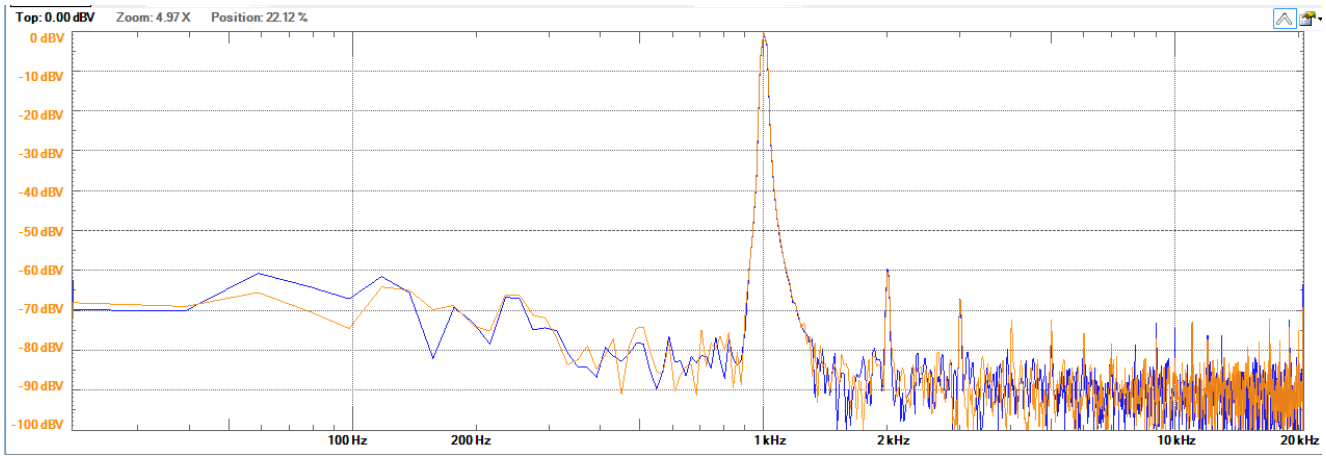
Ideally the percentage of distortion should be well below the manufacturer's specification over the entire frequency range.

Diagnostic Comments:

With an improved output tube biasing circuit added, the amp now maintains very low distortion across its entire frequency range.

Spectral Analysis of Distortion Products at full power

In order to analyze the harmonic content in your amp's distortion we have measured the distortion products produced by a pure 1 KHz tone at maximum power. Each harmonic is plotted by their frequency in the "Spectrum Analysis" graph below. While the total amount of distortion (THD) is important, it's actually the types of harmonics contained in the distortion that determine how an amplifier sounds. Odd order harmonics, especially the 5^{th}, 7^{th} and 9^{th} harmonic, are the ones that cause the most unpleasant sounding types of distortion.



How to read the graph:

The distortion of a waveform relative to a pure sinewave can be measured by separating its constituent harmonics. This allows measurement of each harmonic's amplitude relative to the reference sine wave (fundamental). Each harmonic is a multiple of the test tone's frequency of 1 kHz. They can be seen as individual blips trailing off to the left of the test tone in the center of the graph.

Diagnostic Comments:

Low distortion with excellent harmonic content of its components. Predominately second harmonic, with higher order harmonics more than 76dB down. Channel match is good, with only 3db difference in high order harmonics. This is a very good example of the clean tube amp distortion spectrum with predominate second harmonics and suppression of high order harmonics.

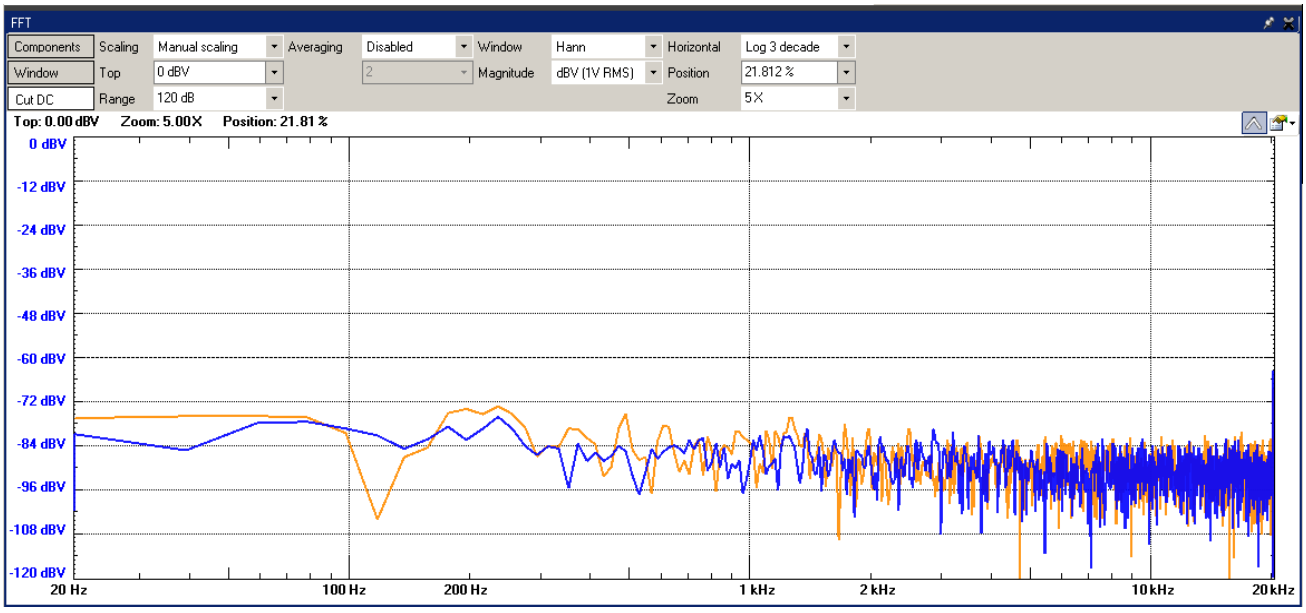
Signal to Noise Ratio (SNR)

Signal to Noise Ratio is the amount of noise contained in the amplifier's output compared the music. In all amplifiers there is always a very small amount of noise from the electrons whizzing around, bumping into things. The goal is to make this background noise imperceptible, meaning a very high signal to noise ratio is a good thing.

Channel A (Left) Manufacturer's Spec: -65 dB Actual Measurement: -74dB
Channel B (Right) Manufacturer's Spec: -65 dB Actual Measurement: -74dB

Spectral Graph of Noise:

In order to analyze and help diagnose noise and hum in your amplifier we have recorded the spectrum of each channel's noise in the graph below.



How to read the graph:

The graph shows the amplitude in of each channel's noise components with the volume control set to maximum. The vertical scale is the amplitude in reference to the amplifier's Maximum Power Output in dBm over the range of 20 Hz to 20 KHz. Ideally all noise components should be well below the manufacturer's specifications.

The noise spectrum is an important diagnosis tool when evaluating vintage amplifiers. Especially important is noise in the low frequency range of 60 and 120 Hz. Excessive noise in these frequencies indicated "hum" caused by faults in the amp's powers supply. An increase in high frequency noise can be a sign of bad component such as resistors, or instability in the amplifier's output stage.

Diagnostic Comments:

This amplifier has extremely low noise and hum due to the improved power supply. All noise components are more than 74dB below 0dB V, which is more than 87dB below full output. Both channels have very similar noise spectrum, indicating matched gain, frequency response, as well as matching low tube noise.

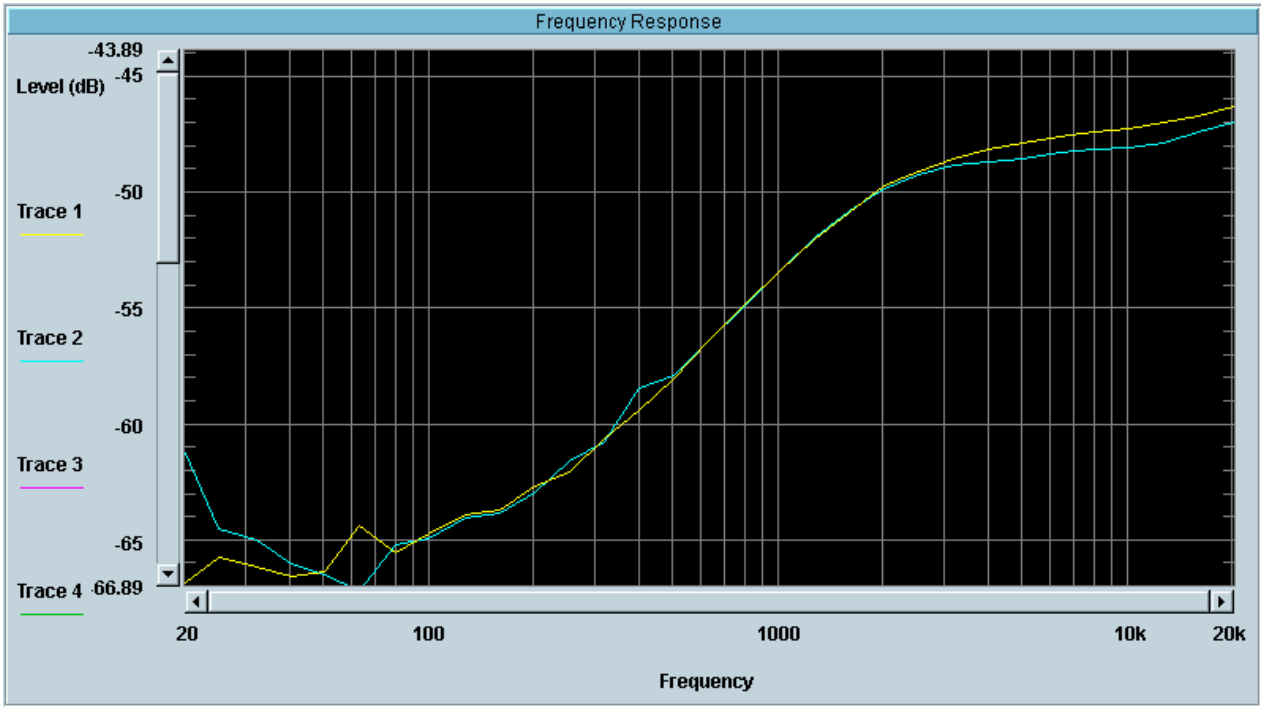
Crosstalk

We all know the left and right channels are supposed to be separate, and drive separate speakers on separate sides of the room. Crosstalk is a measure of how much undesirable left input signal is mixed with right output signal (or vise-versa). With low crosstalk it's easy to hear that the singer is a little left of center stage and the violins are towards the right. The more crosstalk there is, the harder it is to pick out the positions of the instruments within the stereo image, or "soundstage."

Channel A (Left)	Manufacturer's Spec: N/A	Actual Measurement: -26dB
Channel B (Right)	Manufacturer's Spec: N/A	Actual Measurement: -27dB

Cross Talk Graph:

Cross talk is not always specified in the manufacturer's specifications, but must be greater than -25 dB to preserve proper soundstage imaging. Due to the fact that the amount of crosstalk varies with frequency, we have plotted each channel's crosstalk by frequency in the graph below.



Crosstalk is measured in negative dB (-dB). The more negative the better.

Diagnostic Comments:

Cross talk is well below -30dB up to 15 KHz. Stereo imaging and sound stage detail are excellent.

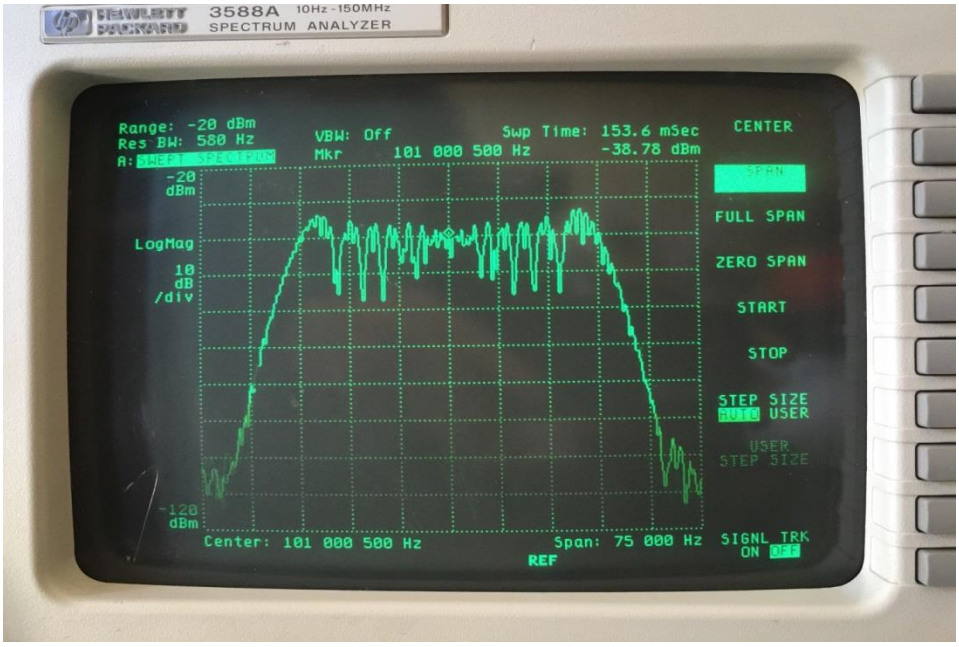
FM Receiver Section Performance and Alignment

At AEA we have extensive experience in radio circuitry design and maintenance, along with the necessary equipment to perform alignments as well as to precisely measure receiver performance against factory specifications.

Receiver Sensitivity	Manufacturer's Spec: .9 uV	Actual Measurement: .65 uV
Selectivity	Manufacturer's Spec: 52 dB	Actual Measurement: 55 dB
IF Rejection	Manufacturer's Spec: 72 dB	Actual Measurement: 72 dB

IF Selectivity Graph

To help evaluate the overall alignment of the FM receiver we perform a spectral analysis of the IF amplifier's band pass. The results are shown in the graph below.

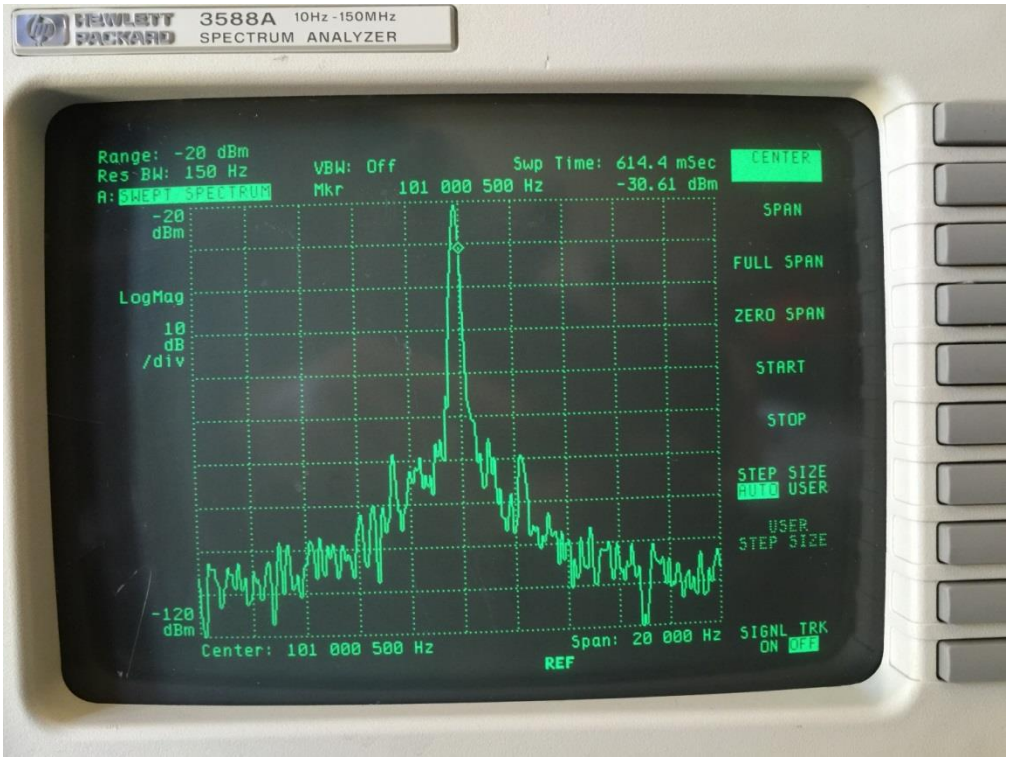


Ideally the receiver's IF amplifier selectivity should be sharply tuned to maximize sensitivity and reduce adjacent station interference, while allowing the full FM audio signal to be captured. Critically adjusting each stage of the IF allows the width and slope of the band pass filters to capture the full frequency response of the broadcast signal while limiting noise and multi-path distortion.

Diagnostic Comments:

The receiver's operating specifications exceed the factory original specs.

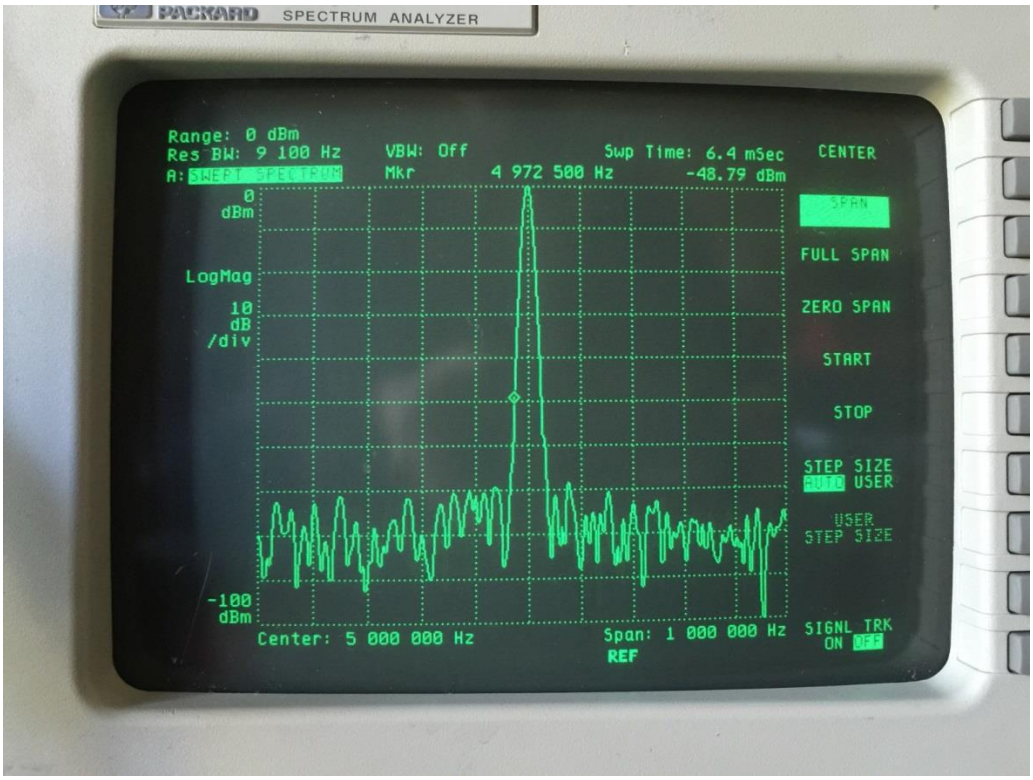
FM Receiver IF Gain and Signal to Noise Ratio



How to read the graph:

The difference between the peak amplitude of the IF signal and the noise floor on either side determines the receiver's IF signal to noise ratio. This difference should be grater that 60 db. (The graph is measuring 10 db per each vertical division)

FM Receiver IF Image Rejection

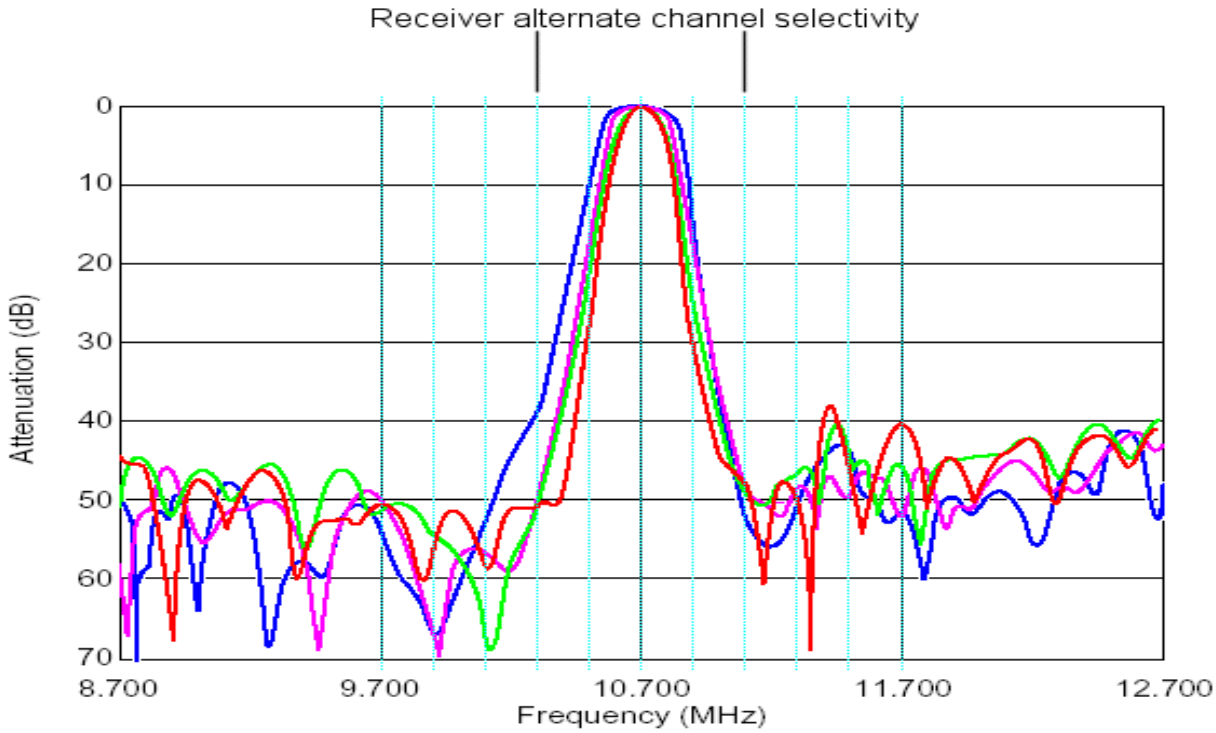


How to read the graph:

The difference between the peak amplitude of the IF signal and the noise floor on either side determines the receiver's IF signal to noise ratio. This difference should be grater that 60 db. (The graph is measuring 10 db per each vertical division). The small peaks to either side of the main signal are "image artifacts" created by the IF mixer stage and should be more than 60 db below the peak measurement level.

FM RECEIVER IF Selectivity Graph

To help evaluate the overall alignment of the FM receiver we perform a spectral analysis of the IF amplifier's band pass. The results are shown in the graph below.



Ideally the receiver's IF amplifier selectivity should be sharply tuned to maximize sensitivity and reduce adjacent station interference, while allowing the full FM audio signal to be captured. Critically adjusting each stage of the IF allows the width and slope of the band pass filters to capture the full frequency response of the broadcast signal while limiting noise and multi-path distortion.

About the Fisher 800B Receiver

As a top performing receiver in Fisher's famous vintage tube line, the 800-B is one of the most collectible receivers available.

The 800's high-performance design makes it an excellent FM receiver even by today's standards, with exceptional sensitivity and accurate stereo multiplex demodulation. It is also an outstanding integrated amplifier with 24 watts (RMS) per channel. Added to this is a robust design, using some of the highest quality materials available in the early 1960's.

Manufactured for only a few years, the 800-B was among the last designs in Fisher's long line of tube receivers that included the 400 and 500 series. Fisher receivers contain some of the finest in AM/FM tube technology ever made, and are some of the first receivers to support true multiplex FM stereo (the system is still in use today). The 800-B also supports the now obsolete "FM-AM stereo" system used briefly during the late 1950's and early 60's.

The integrated amplifier section of the 800 series is basically an update of the well regarded 500 series, with superb audio quality perfected over Fisher's 30 years of leading tube technology design. It employs 22 tubes, the most of any Fisher. The 800's controls are also arranged in the classic Fisher appealing symmetry, filling its expansive brushed faceplate.

All Fisher faceplates of this era show a highly refined quality appearance, but the 800-B's is one of the most appealing. With its separate FM and AM tuning dials on each side, and a magic eye for each tuner, it is also the largest faceplate layout in the Fisher line. As Fisher's flagship receiver, the 800-B is considered by many as the pinnacle of tube technology.

Prices of the 800 series has steadily risen over the past 10 years, increased by more than 500% during that time. As interest in vintage tube equipment increases, the 800's value has accelerated considerably over the past few years, due to its place at the top of Fisher's long line of receivers, and its rarity. Its classic look, with two retro 'magic eye' tuning indicators often make the B model more desirable than the later 800-C.

The value appreciation rate of the 800-B is greater than 25% per year and growing. It is anticipated that this trend will continue as demand increases to out-strip supply in the coming ye