For those of you who do not know about these amplifiers here is a short history. There are two amplifiers in this family, the home version MC3500 and the professional version the MI350. They differ in only two respects. The MC3500 has a light gold anodized face plate where the MI350 has a natural silver finish. The MI350 had the option of adding 600 ohm input transformers which accommodated a balanced source. Otherwise the two models are identical. They were built in very limited numbers (some say less than a few hundred were made) from 1968 through 1971.

Mechanical condition:
These are in superb condition based on the fact that they are 43 years old. There are no dents or dings anywhere on either the chassis or the face plates. The internal chrome plating is in good condition and all lettering is intact.

Upgrades to the Mechanicals:

The binding posts were replaced with gold plated types. The RCA and BNC connectors were replaced with Tiffany RCA sockets, front and rear. All bolts on the front were replaced with gold plated types and the black oxide bolts which hold the chassis together were replaced with new Torx head types.

Upgrades to the Electronics:

This was the main focus of the restoration. At the time that these amplifiers were built, the use of Phenolic printed circuit card material was the norm. Time took its toll and when I purchased these amplifiers the boards were cracked and burnt.

I designed new double sided boards and had them made from FR4 material. In addition I designed two extra printed circuit cards, one for the DC supply for the driver tubes' filaments and the second for the extra power supply capacitors and bootstrap capacitors which are used around the primary windings of the output transformer.

Meter drive board: This was simply a redesign of the original with no modifications to the circuit design. It fits where the original was.

Power supply rectifier board: This was a new design incorporating series connected high speed, high voltage diodes for the main bridge rectifier stack. The screen supply has been changed to a Darlington configured series pass regulator with increased capacitance multiplying properties.

Power supply upgrade board: The original design has 700mfd capacitors stacked in series either side of the main filter choke for a net total of 700mfd. I have added another 1,200mfd of capacitance after the choke which increases the post choke energy storage from 77 joules to 342 joules. These are made up of two pairs of series stacked 1,200mfd low ESR 105 degrees C capacitors. These are bypassed with high voltage polypropylene capacitors.
The bootstrap capacitors which are in the primary circuit of the output transformer were replaced with parallel stacks of electrolytic capacitors in parallel with high voltage polypropylene capacitors. All the large electrolytic capacitors in the power supply have been bypassed with high quality film types.

Driver tubes filament supply: The drive circuit which uses five dual triodes was designed to run off a 6.3 volt AC winding with a "Hum" control. This potentiometer was connected across the 6.3 volt winding with the slider connected to the +120 volt rail. By adjusting the position of the potentiometer it was supposed to reduce the hum which was introduced into the cathode circuits of these 5 triodes. It never worked that well. The solution, an extremely smooth 6.3 volt DC supply now feeds the filaments and there is ZERO hum. The signal to noise ratio was improved by almost 6dB. A total of 72,000mfd of ultra low ESR capacitance is used to ensure that a ripple free voltage is applied to these filaments. Four 15 amp high speed rectifiers convert the 6.3v AC to DC and this is followed by a C-R-C filter.

Audio Driver circuit modifications: The original McIntosh design used a low pass 6dB/octave filter right after the input sockets and this was made from a simple series capacitor with the gain control and input impedance of the first stage determining the crossover (-3dB) frequency. A slide switch on the rear panel allowed the user to bypass the capacitor. Being a cheap switch I felt this would compromise sound quality. The switch was later used to change the fan speed. This was removed and the input sockets were wired directly to the potentiometer which was changed to a conductive plastic type.

The input stage is a cathode follower of which only one half of the ECC83 tube was used. The two sections were paralleled and a temperature compensated constant current source replaces the simple cathode resistor. This alone lowered the measured THD by about 0.05%.

The -165 volt supply which supplies cathode drive to the differential amplifier, bias to the final cathode follower (which drives the output tubes) and the grid circuit of the output tubes was changed from a simple rectifier and capacitor to a fully regulated and ripple free supply.

The drive PCB being new was assembled with 1% metal film resistors and polypropylene coupling capacitors. New ceramic tube sockets were installed.

The output stage utilizes eight beam power 6LQ6 pentode tubes which were designed for transmitter use. Being a highly linear tube they are well suited for audio. The McIntosh output stage uses an output transformer with five (5) primary windings which allows local feedback to be applied around the output stage which lowers distortion. Each output tube has its own bias adjust potentiometer. I had these made by a company in Japan which specializes in very high quality potentiometers. These potentiometers are NOT adjustable from the bottom of the amplifier as the originals were but only from the top. (Cover must be removed).

The control grid, screen grid and cathode resistors were replaced with 1% metal film and wirewound types were applicable.

The fan which cools the output tubes can now run on high or normal speed. I keep the fan on high speed when the amplifiers are on but not being used (This keeps the tubes much cooler) and then switch to normal speed for listening.

The amplifiers were tested before any modifications were done even with the cracked and burnt printed circuit cards. As expected they met and beat the published specifications by a good margin. The modification process was done on one amplifier first, measurements were taken and compared to the original. The test equipment used was an Audio Precision System 22A which can measure THD down to 0.0003%.

Listening tests (Yes done in mono) revealed quite easily that the modified amplifier sounded superior to the original. This was done using a blind A-B set up. Of course after the bench and listening tests were complete, the second amplifier underwent the same modification procedure as the first.

Unfortunately I did not keep the electronically generated test results from the Audio Precision but I made hand written notes. Here they are. All measurements were done with an 8 ohm load. The amplifier can drive loads from 1, 4, 8, 16, 50 and 64 ohms.

Specification	Unmodified	Modified
Output Power	490 watts	490 watts
THD 2KHz 1w	0.044%	0.013% **
THD 2KHz 50w	0.017%	0.0072%
THD 2KHz 350w	0.03%	0.009%
THD 20KHz 1w	0.078%	0.05% **
THD 20KHz 50w	0.07%	0.023%
THD 20KHz 350w	0.11%	0.088%
THD 20Hz 1w	0.044%	0.013% **
THD 20Hz 50w	0.021%	0.008%
THD 20Hz 350w	0.1%	0.085%

** Limited by noise as the analyzer reads THD+Noise.

Frequency Response 1w	0.7Hz-76KHz	0.7Hz-76KHz
Frequency Response 50w	0.7Hz-41KHz	0.7Hz-41KHz
Frequency Response 350w	16Hz-23KHz	16Hz-23KHz

The 1w and 50w response readings are at the -3dB points, the 350w reading is at the ---0.3dB point.

Noise +	**-96dB**	**-103dB**

+ Noise is measured with a 20KHz bandwidth and is measured in dB below the rated output.

Final comments:

In my humble opinion this is still the finest tube amplifier ever designed and built. Consider that it was designed in the “1960s” and to attain this level of performance with the passive parts which were available in the day is truly astonishing.

The designers were blessed with a true genius and my hat is off to Mile Nestorovich who was truly the brains behind these works of art. Mile passed away in 2009.