



**The World Wide Leader
In State Of The Art
High Fidelity Technology**

**Engineered and Manufactured
in the United States of America**

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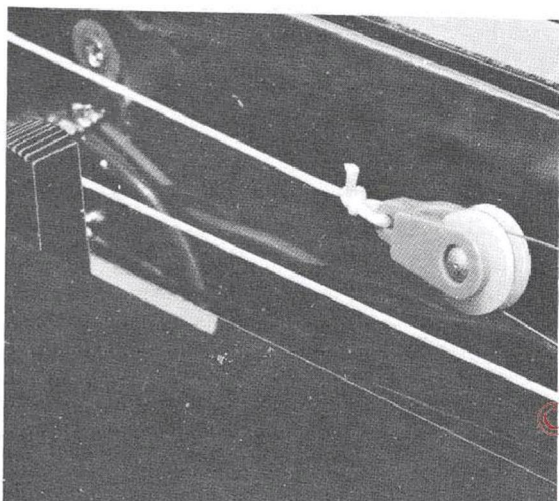
McIntosh

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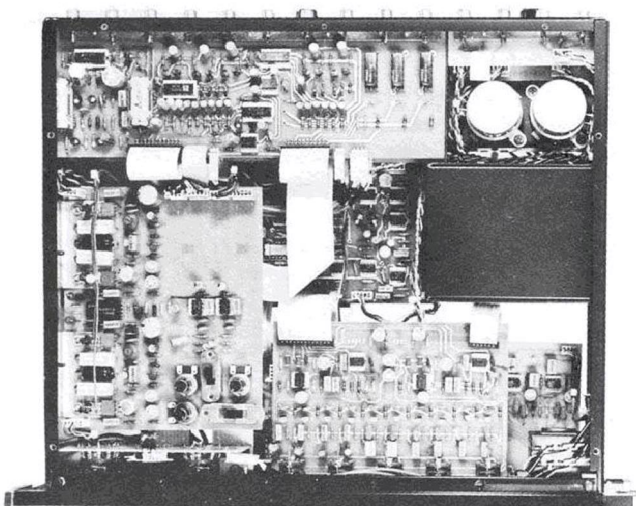
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THE McIntosh TOUCH

In a world of mass produced merchandise McIntosh is a welcome relief. McIntosh instruments are still hand made, one by one, with as much care and dedication as if each one was the only one. McIntosh instruments are made with the best materials. For example here is a dial string pulley. Before this particular type of pulley was chosen it was

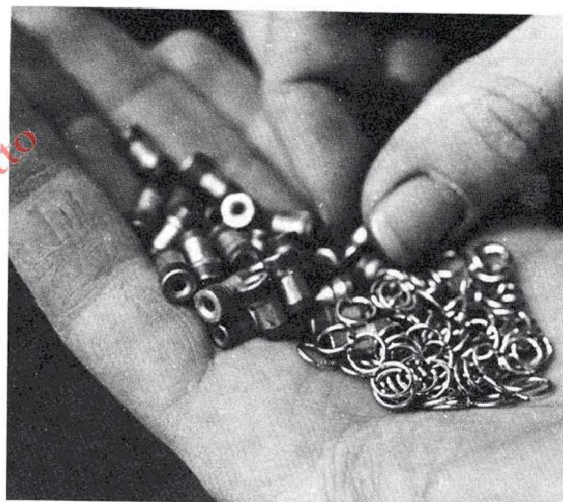


checked, re-checked, tested, re-tested, to make sure that you are getting the best. The manufacture, alignment and testing of all McIntosh instruments reflect this care. Try tuning a McIntosh instrument. Then you will know why one of the foremost technical journals of sound reproduction said: "The tuning feel...is the most perfect we have experienced."



Each McIntosh is handcrafted. Every connection, solder joint, and wire is handcrafted. Handcrafting gives you more performance and more value. Note the neat placement of each part. This means longer trouble-free performance. As more parts go into a chassis, craftsmanship becomes more apparent. Each operator is highly trained. Trained in the McIntosh way. Training is continuous. Each instrument is checked from one station to the next. Your instrument is checked again and again. This gives you the best possible performance. McIntosh instruments continue to sound good year after year after year. If you were going to build stereo components, isn't this the way you would build them? Every mechanical part used in the assembly of instruments is checked.

Here feed-through capacitors and pre-formed solder rings are checked. Nothing is

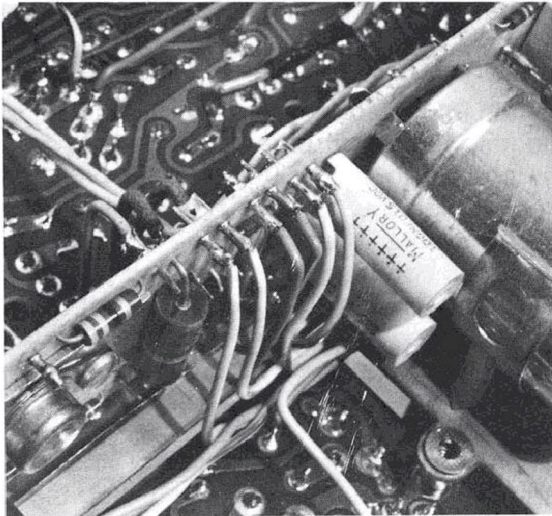


left to chance. Every part must be top quality. Each instrument passes hundreds of tests designed to prove it is a McIntosh. Handcrafting makes this high quality possible. There is no assembly line rush. There is no demanding production schedule rush. There is a "demanding product quality" pressure. That requirement takes time. Time makes a McIntosh what it is. To make a good product takes time. To make a McIntosh takes even longer.

Each instrument is rigorously tested. Each test is designed to give you the best performance. So much testing makes sure each part, each circuit, each detail meets McIntosh quality. Every instrument is tested. Every instrument must meet exacting critical, precision standards. At any point, if something does not meet its performance guarantee, all testing stops. The reason for failure is found, corrected and then the testing starts over again. This is why only

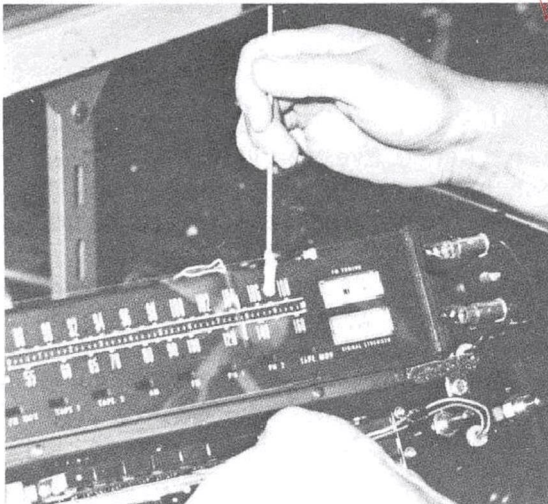
© beim Hersteller
Archiv Michael Otto

McIntosh offers you a money back guarantee if your McIntosh is not capable of meeting or exceeding its published specifications. Each finished instrument is an exact duplicate of a precision laboratory model. Each wire, each



resistor, each capacitor, each solid state device is carefully wired into its specific place. Laboratory care and precision are built into each McIntosh instrument. Each employee is responsible. Each one knows that McIntosh is the leader. Each one knows that one of the prices of leadership is the *constant struggle for superiority*. Each employee is dedicated to giving you the performance you expect and the value you deserve.

No word describes how immaculate a dial glass must be to pass the critical eye. It is



checked for dust, fingerprints, smudges, or anything that is distracting. From here the instrument gets its front panel. The front panel is checked and rechecked, just like everything in a McIntosh. After a final cleaning and visual inspection the instrument is put into a plastic bag to keep it spotless. Next it is packed in a scientifically designed shipping carton and then on to you. All these things are done to protect your investment.

YOU SHOULD OWN McIntosh BECAUSE

- McIntosh instruments are designed and manufactured for long life.
- McIntosh instruments have always been designed for long life with low maintenance costs and high quality performance. McIntosh instruments have been and are the **LABORATORY STANDARD** for the world.

Until 1949 the performance requirements for a McIntosh had long been an engineering dream. They became a reality with the introduction of the first McIntosh amplifier. Through all these years McIntosh has produced instruments that have exceptionally long life. Amplifier clinics held all over North America have shown that most of the McIntosh instruments ever manufactured still meet or exceed their original exacting specifications.

- Used McIntosh instruments have the highest resale value. Retailers report that customers are constantly searching for used McIntosh instruments. A McIntosh does not remain on the "Used" display long. You'll get more when you trade-in your McIntosh assuring you of maximum return on your investment.
- McIntosh dedication, not only to improvements, but also to fundamentals, has justified many patents on refinements as well as basic circuit structures.
- Doesn't it make good sense to deal with a company that wants to do as much for you as it possibly can?

THE NEW McINTOSH AMPLIFIERS

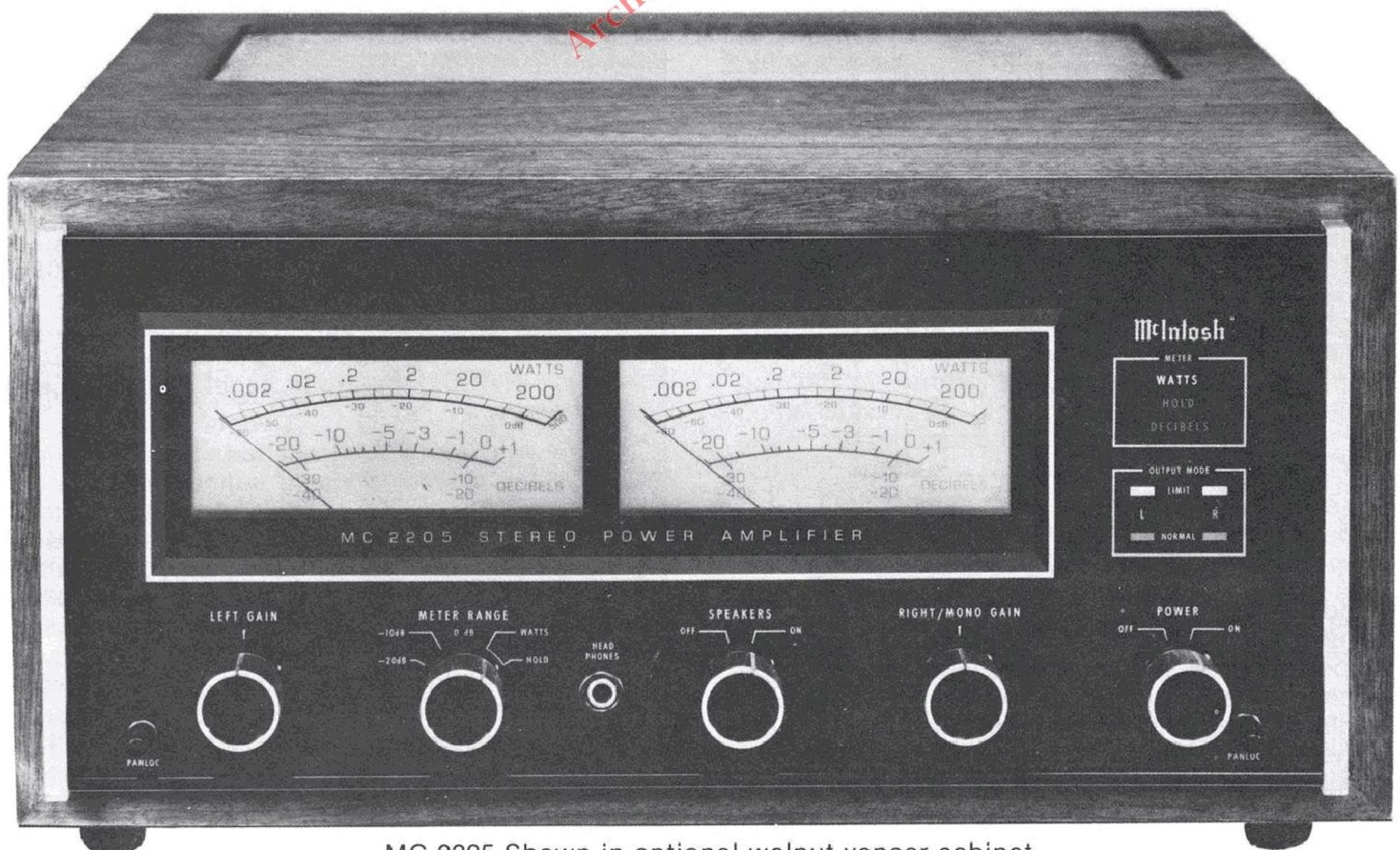
McIntosh research and bipolar epitaxial transistor technology has produced startling new advances in safe, cool, superior performance.

McIntosh engineering has advanced power amplifier technology and performance five times since 1949. Experience and knowledge are the foundation on which the engineering superstructure is built that supports the fact that McIntosh is recognized as *Laboratory Standard* for the world. A new level of technology and a higher level of amplifier performance is realized in the NEW MC 2205 Power Amplifier, the 2125, the 2120 and the 2200 Power Amplifiers.

- McIntosh POWER GUARD assures maximum amplifier power without clipping distortion.
- McIntosh Output Autotransformers deliver full power output and multiple feedback loops assure

lowest distortion at all power levels and all speaker impedances.

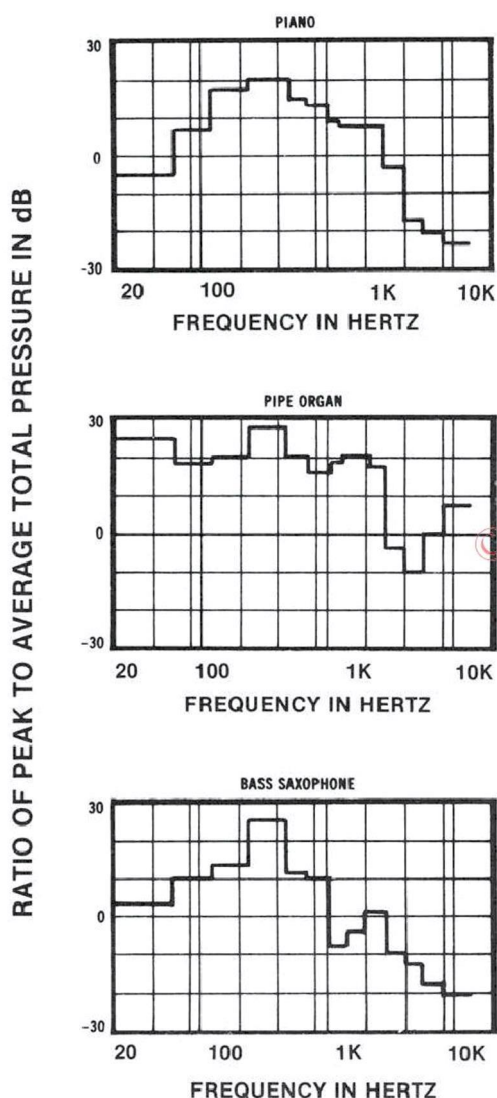
- McIntosh engineers developed a unique output circuit configuration that is temperature stable and that delivers clean output power at any level without a trace of crossover distortion.
- McIntosh life testing selects only components that give the most trouble free performance. Added care in engineering, design and manufacturing produces long product life at the peak of performance.
- McIntosh designed turn on, turn off, mute circuits give positive protection from transients due to turn on, turn off power supply voltage changes.



MC 2205 Shown in optional walnut veneer cabinet

From Conventional Amplifiers higher power demands cause overload or clipping. Clipping is caused when the amplifier is asked to produce more power output than it can deliver. Clipped waves look like square waves. Clipping is largely composed of odd order harmonics. Odd order harmonics and intermodulation components are heard as great and disappointing discordance and distortion.

In most acoustical events we may listen to surprisingly low average power output but the peak power requirements can be very high. Consider these graphs of the power demanded of an amplifier reproducing the piano, the pipe organ, and the bass saxophone. The charts show that the peak power de-



mand is almost 1000 times (30 dB) the average power demand. Since it is necessary that these short interval power spikes be reproduced with low distortion, it means the average power output of the power amplifier must be limited to 1/1000th of its capability or the listener must accept the discordant distortion of clipping.

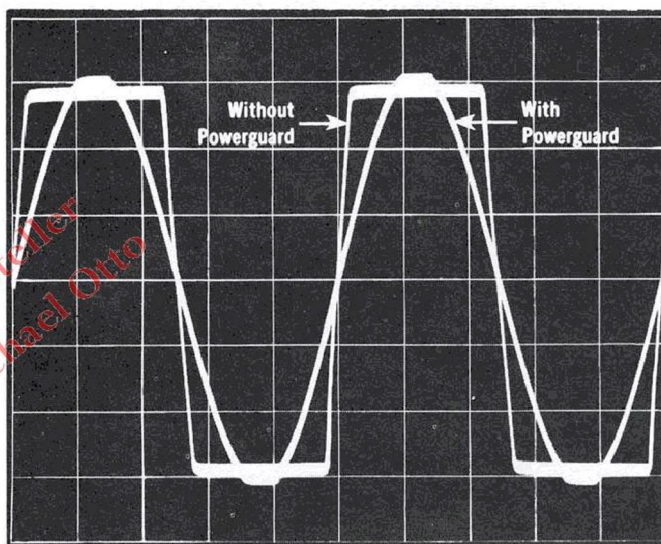
Amplifiers when driven to clipping are capable of delivering up to twice their rated power but they can

have more than 40% harmonic distortion. The extra energy content of the clipped signal will damage most speakers. McIntosh leadership in engineering has developed a new circuit that...

1. Dynamically prevents power amplifiers from being overdriven into hard clipping.
2. Protects speakers by preventing clipping.
3. Assures that the amplifier will produce its maximum output without increased distortion. That new circuit we call "POWER GUARD."

THE McINTOSH POWER GUARD

The Power Guard waveform comparison circuit detects minute amounts of waveform difference between the output signal and the input signal. A sampling of the program material at the output of the amplifier is constantly compared with the program material at the amplifier input. Should the differences reach 1%, Power Guard goes to work.



Oscillogram of output waveform with and without Power Guard. Input overdriven for each trace 20 dB.

In only a fraction of a millisecond Power Guard dynamically reduces input level to prevent amplifier overload yet permits the amplifier to deliver its absolute maximum power output without extra distortion. In addition, the output of the "waveform comparator" activates the front panel NORMAL and LIMIT indicators.

The Power Guard circuit operates a red limit light that provides a precise visual indication when the amplifier has reached full power output. Any time that the input circuit is fed excessive amounts of signal causing waveform differences of 0.5% in the output the indicators change from green NORMAL to red LIMIT automatically and instantaneously. This warning persists long enough for positive visual indication of clipping for a pulse that is so infrequent or short that it would be impossible to be seen even on an oscilloscope. The indicators will illuminate on clipping for a pulse as short in time as 100 microseconds. You are always assured that the power of your amplifier is as clean and distortion free as it can be.

THE McIntOSH POWER METERS

McIntosh developed output monitoring meters add to your operating ability. The meters are unusually flexible in that they read directly in watts, can be made to hold the highest reading and continuously update on higher power or can be switched to be peak reading — peak locking decibel meters.

When used as a watt indicating meter all the information is direct reading, without conversions or complicated mathematics. In addition, as direct reading meters they are calibrated in average watts for a sine wave signal but respond to signal peaks.

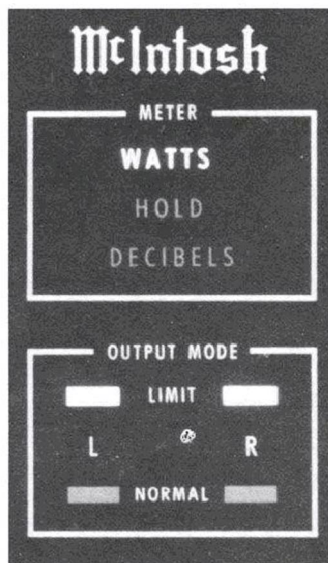
Ordinary meters are incapable of indicating the short interval information in a sound wave. The mass of the meter movement is too great to respond to the instantaneous changes in music program material. That short interval information can have a duration as brief as one-half of one thousandth of a second. Even should the meter be capable of the high velocity movement the human eye could not perceive the information.

McIntosh engineering pursued both problems electrically. By developing new electronic circuits the meters are made to respond to short intervals with an accuracy of 98%! To permit the eye to see such high speed motion the electronic circuits that drive the meter pointer are time stretched so the meter pointer position can register in the persistence of vision characteristics of the human eye.

The meters indicate direct power in watts. They are calibrated in average watts for a sine wave signal but respond to signal peaks. So a 200 average watt indication also means 400 instantaneous peak watts. The meters are voltage actuated and indicate power accurately when the amplifier is operated into rated output load impedances.

In WATTS HOLD, the meter locks to the highest power peak in a sequence of peaks. The meter will be driven to maximum power and electronically held there until a higher peak passes through the amplifier. If no further peaks are reached the meter needle will very slowly return to a lower peak or to its rest position at a decay rate of 10 dB per minute.

The meters have extremely fast rise time, about 500 microseconds for 90% accuracy. A tone burst of 500 microseconds is almost inaudible even at full power.

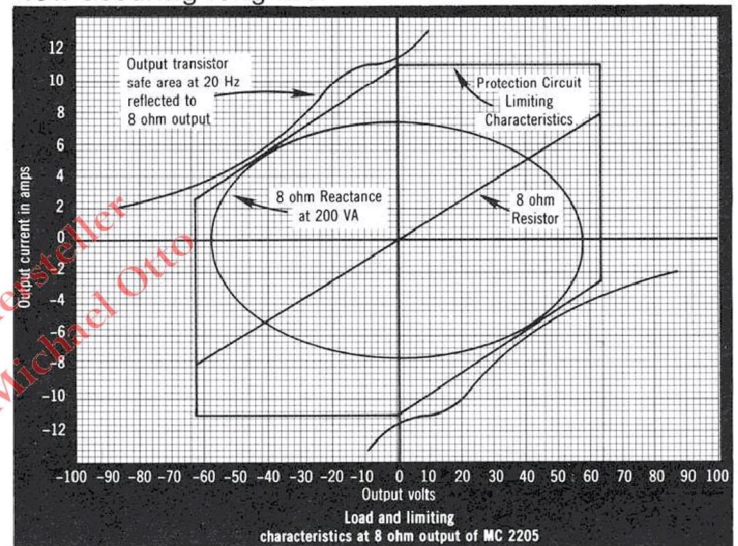


The meters cannot be damaged in the event of overloading in the wrong meter range.

THE McIntOSH OUTPUT CIRCUIT DESIGN

To achieve long trouble free life in an amplifier it is essential to have cool operation. Cool operation results from the careful design of the output circuit, matching of the output circuit to the loudspeakers with an autotransformer and a mechanical design that permits the use of generous sized heat sinks providing adequate ventilation without the use of fans.

The bipolar epitaxial output transistors and the McIntosh output circuit allows the amplifier to operate as cool as possible. When there is limited program demand on the amplifier only the optimum number of output devices operate. When there is no signal no output device is conducting. Conservative McIntosh engineering keeps operating temperatures low assuring long life.



Load and limiting characteristics at 8Ω output of MC 2205

The interleaved multifilar wound McIntosh designed autotransformer transfers all the power you paid for to all impedance taps. You are not power penalized for operating at an output impedance of less than 8 ohms. The McIntosh autotransformer does its outstanding job without adding phase shift, limiting frequency response or power output. The distortion added by the autotransformer is .003% at 20 Hz and is unmeasurable at higher frequencies. In short, the McIntosh autotransformer is the ideal answer to a difficult problem.

Heat sinks must be large and they must have adequate ventilation for effective cooling. For example the MC 2205 has 1100 square inches (7.64 square feet) of radiating surface. In addition, the chassis has been designed to permit the maximum amount of air to flow over the heat sinks to conduct away the life limiting heat.

The amplifiers provide the correct connection impedance to drive numbers of speakers simultaneously. For instance the 1 ohm output will drive eight 8 ohm speakers and deliver full power without overheating.

POWER AMPLIFIER

SPECIFICATIONS	MC 2300	MC 2205	MC 2200
POWER OUTPUT STEREO Minimum Watts, Both Channels Operating	300 Watts Per Channel	200 Watts Per Channel	200 Watts Per Channel
POWER OUTPUT MONO Minimum Watts	600 Watts	400 Watts	400 Watts
POWER BAND WIDTH	20 Hz to 20 kHz	20 Hz to 20 kHz	20 Hz to 20 kHz
TOTAL HARMONIC DISTORTION Maximum, 250 mW to Rated Power, 20 Hz to 20 kHz	0.15%	0.1%	0.1%
OUTPUT LOAD IMPEDANCE Stereo Mono	1/2, 1, 2, 4, 8, 16, Ω 1/4, 1/2, 1, 2, 4, 8 Ω	1, 2, 4, 8 Ω 1/2, 1, 2, 4 Ω	1, 2, 4, 8 Ω 1/2, 1, 2, 4 Ω
INTERMODULATION DISTORTION Maximum, 250 mW to Rated Power	0.15%	0.1%	0.1%
FREQUENCY RESPONSE 20 Hz to 20 kHz (at 1 Watt)	+ 0, - 0.5 dB (1, 4, 8 or 16 Ω) + 0, - 1.0 dB (1/2 or 2 Ω)	+ 0, - 0.25 dB	+ 0, - 0.25 dB
NOISE AND HUM Below Rated Output	- 90 dB	- 95 dB	- 95 dB
OUTPUT VOLTAGES FOR DISTRIBUTION SYSTEMS	25 and 70 Volts	25 Volts	25 Volts
DAMPING FACTOR	18 to 50	16 to 50	16 to 50
INPUT IMPEDANCE	200,000 Ω	100,000 Ω	100,000 Ω
INPUT SENSITIVITY	0.5 Volt	0.75 or 2.5 Volts	0.75 or 2.5 Volts
POWER REQUIREMENT Volts - Frequency Watts at Idle Watts at Rated Output	120V, 50-60 Hz 160 Watts 1400 Watts	120V, 50-60 Hz 70 Watts 550 Watts	120V, 50-60 Hz 70 Watts 550 Watts
SEMICONDUCTOR COMPLEMENT Transistors Diodes Integrated Circuits Others	46 17 0 0	49 45 8 2	43 24 2 2
SIZE Panel Height Panel Width Depth	10-1/2" (26.7cm) 19" (48.3cm) 17" (43.2cm)	7-1/8" (18.1cm) 16-3/16" (41.1cm) 14-1/2" (36.8cm)	6-31/32" (17.7cm) 16" (40.6cm) 14-1/2" (36.8cm)
FINISH	Gold and Black Panel, Black Knobs	Black Glass Panel, Gold/Teal Nomen- clature, Gold and Black Knobs	Gold Panel Gold and Black Knobs
WEIGHT Net In Carton	128# (58kg) 143# (65kg)	84# (38kg) 98# (45kg)	73# (33kg) 87# (39kg)
HEAT SINK AREA	1990 sq. in.	1080 sq. in.	1080 sq. in.
SPECIAL FEATURES			
Power Guard	-	✓	✓
Output Autoformers	✓	✓	✓
Output Meters: Calibrated in Watts	-	✓	-
Output Meters: Calibrated in dB	✓	✓	-
Thermal Turn-Off	✓	✓	✓
Sentry Monitor	✓	✓	✓
D.C. Speaker Protection	✓	✓	✓
Output Limit Indicator	-	✓	✓
Panloc Mounting	-	✓	-
Cooling: Fans (2)	✓	-	-
Cooling: Convection	-	✓	✓

SPECIFICATIONS

SPECIFICATONS	MC 2125	MC 2120	MC 502
POWER OUTPUT STEREO Minimum Watts, Both Channels Operating	120 Watts Per Channel	120 Watts Per Channel	75 W/Chan. 2.7 to 4 Ω 50W/Chan. 8 Ω
POWER OUTPUT MONO Minimum Watts	240 Watts	240 Watts	150 Watts into 8 Ohms
POWER BAND WIDTH	20 Hz to 20 kHz	20 Hz to 20 kHz	20 Hz to 20 kHz
TOTAL HARMONIC DISTORTION Maximum, 250 mW to Rated Power, 20 Hz to 20 kHz	0.1%	0.1%	0.02%
OUTPUT LOAD IMPEDANCE Stereo Mono	2, 4, 8, 16 Ω 1, 2, 4, 8 Ω	2, 4, 8, 16 Ω 1, 2, 4, 8 Ω	2.7 to 8 Ω 8 Ω
INTERMODULATION DISTORTION Maximum, 250 mW to Rated Power	0.1%	0.1%	0.02%
FREQUENCY RESPONSE 20 Hz to 20 kHz (at 1 Watt)	+ 0, - 0.25 dB	+ 0, - 0.25 dB	+ 0, - 0.25 dB
NOISE AND HUM Below Rated Output	- 95 dB	- 95 dB	- 95 dB
OUTPUT VOLTAGES FOR DISTRIBUTION SYSTEMS	25 Volts	25 Volts	25 Volts (Stereo Only)
DAMPING FACTOR	14 to 50	14 to 50	> 50
INPUT IMPEDANCE	100,000 Ω	100,000 Ω	75,000 Ω
INPUT SENSITIVITY	0.75 or 2.5 Volts	0.75 or 2.5 Volts	0.75 or 2.5 Volts
POWER REQUIREMENT Volts - Frequency Watts at Idle Watts at Rated Output	120V, 50-60 Hz 50 Watts 460 Watts	120V, 50-60 Hz 50 Watts 460 Watts	120, 50-60 Hz 20 Watts 400 Watts
SEMICONDUCTOR COMPLEMENT Transistors Diodes Integrated Circuits Others	45 24 8 2	39 24 2 2	39 20 4 2
SIZE Panel Height Panel Width Depth	5-7/16" (13.8cm) 16" (40.6cm) 14-1/2" (36.8cm)	5-7/32" (13.3cm) 16" (40.6cm) 14-1/2" (36.8cm)	3-5/8" (9.2cm) 16" (40.6cm) 14-1/2" (36.8cm)
FINISH	Black Glass Panel, Gold/Teal Nomen- clature, Gold and Black Knobs	Gold Panel, Gold and Black Knobs	Black Glass Panel, Gold/Teal Nomen- clature, Gold and Black Knobs
WEIGHT Net In Carton	64# (29kg) 77# (35kg)	57# (26kg) 70# (32kg)	27# (12kg) 38# (17kg)
HEAT SINK AREA	772 sq. in.	772 sq. in.	513 sq. in.
SPECIAL FEATURES			
Power Guard	✓	✓	✓
Output Autoformers	✓	✓	-
Output Meters: Calibrated in Watts	✓	-	-
Output Meters: Calibrated in dB	✓	-	-
Thermal Turn-Off	✓	✓	✓
Sentry Monitor	✓	✓	✓
D.C. Speaker Protection	✓	✓	✓
Output Limit Indicator	✓	✓	✓
Panloc Mounting	✓	-	✓
Cooling: Fans (2)	-	-	-
Cooling: Convection	✓	✓	✓

With the New McIntosh power amplifier you are McIntosh protected in five ways

1. The patented McIntosh Sentry Monitoring circuit constantly monitors the output signal. At signal levels up to rated output this circuit has high impedance and has no effect upon the output. If the power output exceeds design maximum, the Sentry Monitoring circuit operates to limit the signal to the output transistors. In the event of a short circuit across the amplifier output or severe impedance mismatch the Sentry Monitoring circuit will protect the output transistors from failure. Both positive and negative halves of the output signal are monitored independently.
2. Should the temperature of the heat sinks rise above normal through restricted ventilation or other causes, the AC Power Primary is disconnected by an automatic heat sensing relay. The AC power will be restored when the temperature returns to normal.
3. Any DC component in the output circuit from

whatever cause is shunted to ground through the McIntosh autotransformer. You and your speakers are protected completely from this kind of amplifier failure.

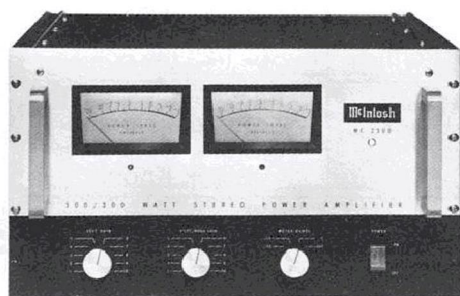
4. McIntosh gives you a money back guarantee of performance. Your McIntosh instrument must be capable of meeting its published performance limits or you get your money back. No other manufacturer offers you this money back guarantee of performance.

5. The McIntosh 3 Year Service Contract protects you from the cost of repair for three full years because McIntosh will provide the service materials and labor needed to return the measured performance to the original performance limits. The SERVICE CONTRACT does not cover any shipping costs to and from the authorized service agency or the factory.

McIntosh audio power ratings are stated in accordance with the Federal Trade Commission Regulation of November 4, 1974 concerning power output claims for amplifiers used in home entertainment products.

PERFORMANCE GUARANTEE—

Performance limits are the maximum deviation from perfection permitted for a McIntosh instrument. We promise you that the instrument you buy, at the time of your purchase, is capable of performance at or exceeding these limits or you get your money back.



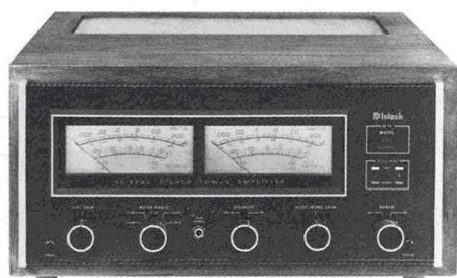
MC 2300



MC 2125



MC 2120



MC 2205



MC 2200



MC 502

THE C 32

STEREO PREAMPLIFIER

The Most Significant Breakthrough in
Electronic State of the Art Technology for this Decade!



C 32 Shown in optional walnut veneer cabinet

**FOUR HIGH QUALITY PRODUCTS IN ONE:
A STATE OF THE ART PREAMP-CONTROL CENTER,
A LINEAR DYNAMIC RANGE EXPANDER,
A WELL DESIGNED FIVE-BAND GRAPHIC EQUALIZER,
A STEREO MONITOR LOW-DISTORTION POWER AMPLIFIER.**

The McIntosh C 32 provides the most comprehensive range of functions and control options in a stereo preamplifier. The C 32 is a "dual" stereo preamplifier with a built-in monitor power amplifier. There are two totally independent left and right stereo program lines running through the preamplifier. One program line is the listen program, the other is the record program line. Each program line can select its own program source from any connected input signal without interference with the other program line. The listen and record input selectors are single wafer switches that send direct current signals to FET analog program input switches, located immediately adjacent to the program input jacks. This design frees the C 32 from input switching clicks and minimizes the effects of unwanted magnetic hum and radio interference signals.

The dual program line control begins at two stereo selector switches feeding from a common group of input sources to two separate stereo high level amplifiers. One of these is the listen amplifier, the

other is the record amplifier. The listen amplifier provides signal processing by high and low pass filters, five equalizers, loudness compensation and a logarithmic expander. The other, the record amplifier, feeds the selected signal to the tape record output connections.

The precision tracking volume control is designed and manufactured for McIntosh Laboratory. It is a stepped attenuator which has left to right tracking accuracy within 1 dB throughout its entire range. Such extremely accurate matching is achieved through electronically controlled trimming of the resistance material deposited on pairs of printed circuits. The switch tracking accuracy is not degraded with use as in ordinary volume controls.

The C 32 is designed to permit simultaneous recording on up to three tape recorders of any program input selected on the record switch regardless of what is being heard on the listen program line. The record switch selects its input from the same inputs, but entirely independently from the listen

switch. As this selection is by means of high impedance FET Analog switches, switching to or over an input in use on the listen program line does not cause any audio interference.

Output from the record switch is fed through tape interlock switches to the three pairs of tape recorder output jacks. In the event that one of the tape recorders is chosen as an input signal to the record program line, its associated tape interlock is opened to prevent feedback through that tape recorder back into the C 32 input.

The C 32 has a newly engineered logarithmic expander that overcomes the compression imposed on radio broadcasting and recording. This program expander has been designed to reduce hum, scratch and hiss. The expander affects both channels of the listen program line only. The circuit enables you to correct for the compression that is imposed on most of the program material available - records, tapes, and FM. Compression is used for many practical reason but limits the dynamic range - and, therefore, the realism of the music. Programs vary in their need for expansion. Live recordings may not need any at all. Rotation of the expander causes the loudness of the program to be affected logarithmically. The point at which operation of the expander starts is selected by the rotary level match control. The attack speed of the expander is set with the speed switch on the top panel. Settings of FAST, NORM and SLOW change the attack time of the expander.

As the expander control is rotated clockwise the circuit acts in two ways:

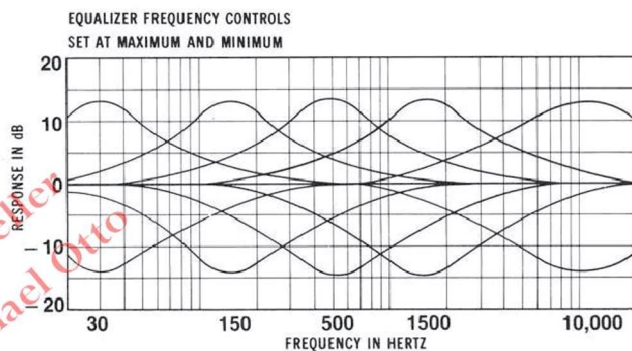
1. Loudness is reduced for signals below a predetermined set level. The further the program is below the set level the more the loudness is reduced.
2. Loudness is increased for signals above set level. The greater the program is above set level, the more the loudness is increased.

The amount of loudness expansion imposed on incoming signals is determined by the position of the expander control. Clockwise rotation increases the effect. As the expander knob is rotated clockwise, undesirable noises such as hum, scratch and hiss

are reduced. The charts A and B show the action of the expander circuit. When rotated fully counter-clockwise, the front panel expander knob activates a switch which completely by-passes all expander circuitry.

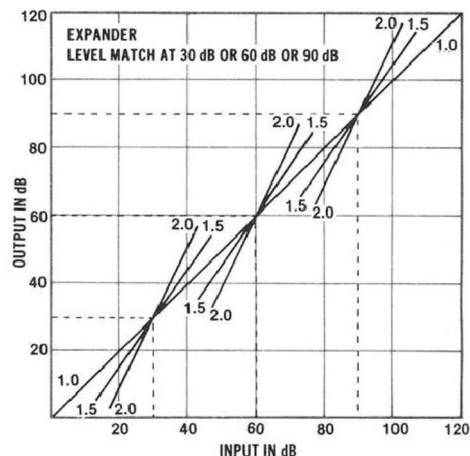
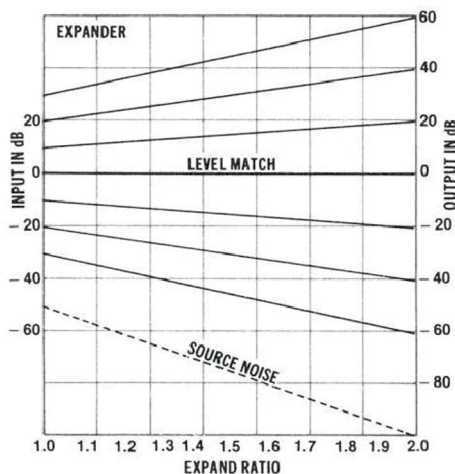
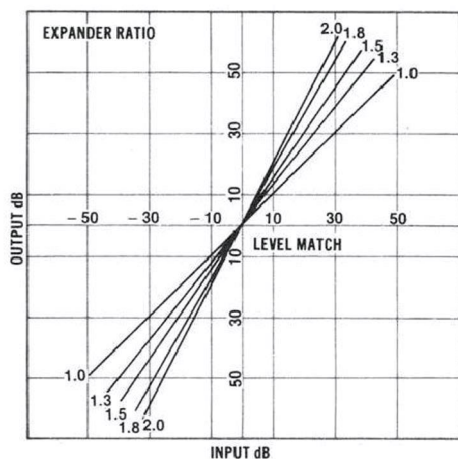
The level match control of the C 32 adjusts the set level. This is the point above and below which expansion is introduced when the expander knob is turned see chart C. By using the expander controls in conjunction with the equalizer frequency controls, the C 32 may be used to decompress disc and tape program material.

The C 32 incorporates a five band equalizer that effectively corrects for most of the frequency imbalance in commercial recordings. Each of the five equalizer frequency controls raises or lowers a frequency band centered on frequencies of 30, 150, 500, 1500, and 10,000 Hz.



A stereo monitor amplifier in the C 32 feeds head-phone, monitor and line output. The input to the monitor amplifier can be selected from either listen or record program lines. The monitor amplifier program may be selected from either the listen or record program lines. The monitor amplifier has an adequate power capacity to directly drive rear loudspeakers in a delayed sound four speaker system.

Performance graphs of the logarithmic expander:



THE C 32 IS A PREAMP CONTROL CENTER DESIGNED TO OFFER PURE SIGNAL AMPLIFICATION, PLUS . . .

• PRECISION TRACKING VOLUME CONTROL

The volume control, manufactured for McIntosh Laboratory, is a step attenuator which has tracking accuracy within 1 dB throughout its entire range. Such extremely accurate matching is achieved through electronically controlled trimming of the resistance material deposited on pairs of printed circuits. Tracking accuracy and quiet performance are permanently maintained. Use does not affect performance as in ordinary volume controls.

• FIVE BAND PROGRAM EQUALIZER

Five separate controls permit individual musical spectra shaping in two octave segments to satisfy personal preference or program limitations. There is 12 dB plus or minus control at center frequency of the individual segments. The center frequencies are 30, 150, 500, 1500 and 10,000 Hz. The program equalizer and filters can be switched out expanding the frequency response to 10 Hz to 100,000 Hz.

• ELECTRONIC INPUT SELECTION

Both LISTEN and RECORD input selectors control low DC voltages that electronically control Field Effect Analog switches. Because the FET analog switches are located near the input jacks, the length of leads are very much reduced. Noise, switch clicks and pops are eliminated while the potential for hum pickup is substantially reduced.

• EXPANDER

Recording imposes dynamic range limitations on most program sources, causing unwanted noise or hum to be heard during quiet passages. The McIntosh logarithmic expander restores the dynamic range and reduces the unwanted noise. Controls are provided that adjust the expansion ratio, the attack time and level matching.

• SEPARATE LISTEN/RECORD PROGRAM LINES

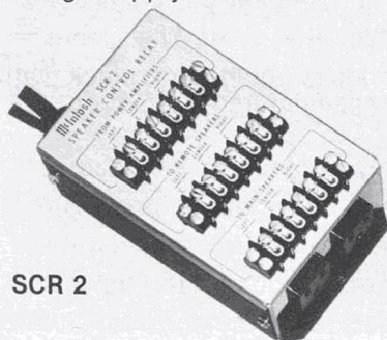
Record on up to 3 tape recorders from any connected source or copy from one tape recorder to another with complete independence from the program being listened to. The RECORD and LISTEN input selector switches operate without any interaction. The program being recorded can be monitored easily by pushing the appropriate monitor pushbutton.

• TRUE LOUDNESS COMPENSATION

In the past, loudness controls have typically used simple passive circuits connected to a portion of the rotation range of the volume control. As a consequence, loudness compensation accuracy was dependent on many variables such as speaker efficiency, amplifier gain and differences in input level. The C 32 loudness control is continuously variable, operates independently of the volume control, and its contour is accurately modeled after the Fletcher Munson family of "Equal Loudness" curves.

SPEAKER CONTROL RELAY

The McIntosh Speaker Control Relay is designed for use with the McIntosh C 32 Stereo Preamplifier. The SCR 2 provides for remote control of both the AC power to a remote amplifier and the on/off control of the Main and Remote loudspeakers. Control for the SCR 2 is provided by pushbuttons and a low voltage supply in the C 32.



SCR 2

SIZE: Chassis measures 6-3/4 inches wide (17.15 cm) by 2-1/2 inches high (6.35 cm) by 4-1/8 inches deep (10.48 cm). Terminal clearance required is 1-1/2 inches (3.81 cm).

PERFORMANCE LIMITS

FREQUENCY RESPONSE: +0, -0.5 dB 20 Hz to 20,000 Hz. (With equalizer out: +1, -1 dB from 10 Hz to 100,000 Hz).

DISTORTION: .05% maximum, at rated output level, 20 Hz to 20,000 Hz.

INPUT SENSITIVITY AND IMPEDANCE:

Phono 1 and 2: 2 millivolts at 47,000 ohms 65 pF; Auxiliary, Tuner, Tape 1, 2 and 3: 250 millivolts at 50,000 ohms.

HUM AND NOISE:

Auxiliary, tuner, tape 1, 2 and 3: IHFA 100 dB; unweighted 90 dB. Phono 1 and 2: IHFA 90 dB; unweighted 80 dB below 10 millivolt input or equivalent to less than 1 microvolt at the input terminals.

OUTPUT LEVEL AND IMPEDANCE:

Main Output: 2.5 volts with rated input, 220 ohms source impedance, to operate into 5,000 ohms or greater. Tape Output: 250 millivolts with rated input to operate into 5,000 ohms or greater.

MONITOR, HEADPHONE, LINE OUTPUT:

12 watts per channel, continuous, into 8 ohms at 0.1% harmonic distortion 20 Hz to 20,000 Hz or 5 volts RMS into 600 ohm line—level controls provided.

SEMICONDUCTOR COMPLEMENT:

67 transistors, 35 integrated circuits, 62 diodes, 2 field effect transistors, 1 silicon controlled rectifier (SCR).

AC POWER OUTLETS:

2 automatic current sensing (green), 4 switched (black).

POWER REQUIREMENTS:

120 volts, 50/60 Hz, 25 to 85 watts.

FACILITIES AND FEATURES

PROGRAM EQUALIZER:

Five, 2 octave frequency bands, each band has 12 dB of boost or cut at 30, 150, 500, 1500 and 10,000 Hz.

LF FILTER:

Flat or roll-off at 12 dB per octave below 50 Hz.

HF FILTER:

Flat or roll-off at 12 dB per octave above 7000 Hz.

VOLTAGE AMPLIFICATION in Decibels

(all equalizers and filters flat).

Auxiliary, Tuner, Tape 1, 2, and 3 to Main Output: 20 dB; to Tape Outputs: 0 dB; from Monitor Amplifier: 30 dB. Phono 1 and Phono 2 to Main Output 62 dB; to Tape Output 42 dB; to Monitor Amplifier 72 dB.

MECHANICAL INFORMATION

SIZE: Front panel measures 16 inches wide (40.64 cm) by 5-7/16 inches deep (13.81 cm). Chassis measures 15 inches wide (38.1 cm) by 5 inches high (12.7 cm) by 13 inches deep (33.02 cm), including PANLOC shelf and back panel connectors. Knob clearance required is 1-1/2 inches (3.81 cm) in front of the mounting panel.

FINISH: Front panel is anodized gold and black with special gold/teal nomenclature illumination.

CHASSIS: black.

MOUNTING: Exclusive McIntosh developed professional PANLOC.

WEIGHT: 27 pounds (12.2 kg) net, 39 pounds (17.7 kg) in shipping carton.

McINTOSH C 29 PROFESSIONAL SOLID STATE STEREO PREAMPLIFIER

PERFORMANCE LIMITS

FREQUENCY RESPONSE:

+0 -0.5 dB 20 Hz to 20,000 Hz.

DISTORTION:

.02% maximum at rated output level. 20 Hz to 20,000 Hz.

INPUT SENSITIVITY AND IMPEDANCE:

Auxiliary, Tuner, Tape 1, Tape 2, 0.25 volts at 250,000 ohms: Phono 1 and Phono 2, 2 millivolts (1,000 Hz) at 47,000 ohms and 65 pF; Microphone, 2.5 millivolts at 500,000 ohms.

HUM AND NOISE:

Auxiliary, Tuner, Tape 1, Tape 2, IHFA 100 dB; unweighted 90 dB below rated output. Phono 1, Phono 2 IHFA 90 dB; unweighted 80 dB below 10 millivolts input, equivalent to less than 1.0 microvolt at the input terminals. Microphone, 1.5 microvolts at the input terminals.

OUTPUT LEVEL:

Main Output: 2.5 volts with rated input, less than 100 ohms source impedance, to operate into 10,000 ohms or greater. Tape Output: 0.25 volts with rated input, less than 200 ohms source impedance, to operate into 10,000 ohms or greater. Headphone/Line: 0.75 volts into 8 ohm load or 2.5 volts into 600 ohm line. 47 ohms source impedance, level controls provided.

VOLTAGE AMPLIFICATION:

Phono 1, Phono 2 at 1 kHz to Main Output 62 dB, to Tape Output 42 dB, to Headphone/Line Output 72 dB. Auxiliary, Tuner, Tape 1 and Tape 2 to Main Output 20 dB, to Tape Output 0 dB, to Headphone/Line Output 30 dB. Microphone to Main Output 60 dB, to Tape Output 40 dB, to Headphone/Line Output 70 dB.

SEMICONDUCTOR COMPLEMENT:

9 Integrated Circuits, 2 Transistors, 11 Silicon Diodes, 8 Light Emitting Diodes (LED), 1 Silicon Controlled Rectifier (SCR), 1 Dual Light Dependent Resistor Network (LDR).

AC POWER OUTLETS:

2 automatic current sensing (green), 4 switched (black)

POWER REQUIREMENT:

120 volts, 50/60 Hz, 45 watts.

FACILITIES AND FEATURES

BASS:

Separate 11 position rotary switches for each channel, +20 dB to -20 dB at 20 Hz.

TREBLE:

Separate 11 position rotary switches for each channel. +18 dB to -18 dB at 20,000 Hz.

LOUDNESS:

Flat response, or continuously variable loudness equalization as volume level is reduced.

BALANCE:

Natural balance at center position, attenuation of



C 29 Shown in optional walnut veneer cabinet

left or right channel by rotating control.

VOLUME:

Precision step volume control with left to right tracking accuracy within 1 dB through its entire range.

INPUT:

Six positions—Auxiliary 1 and 2, Tuner, Phono 1 and 2, Microphone.

MODE:

Seven positions—Left channel only to both speakers. Right channel only to both speakers. Stereo Reverse, Stereo, Mono L + R to left speaker only, and L + R to right speaker only.

TAPE MONITOR:

Two pushbutton switches. Either of two tape recorders can be monitored by selecting the Tape 1 pushbutton or Tape 2 pushbutton.

TAPE COPY SWITCH:

Two pushbutton switches. Either of two tape recorders can be connected to copy from tape recorder 1 to tape recorder 2 or vice versa.

LF - HF FILTERS:

Reduce unwanted high frequency noise (above 7 kHz) and low frequency rumble etc. (below 50 Hz) at 12 dB per octave rate.

FRONT PANEL TAPE JACKS:

Allows connection to input and output of a tape recorder from the front panel.

HEADPHONE JACK:

For listening with either low or high impedance dynamic stereo headphones. Power to this jack is supplied by an amplifier in the C 29.

SPEAKER SWITCHES:

Turn Two sets of speakers on or off when properly interconnected with the accessory Speaker Control Relay. Model SCR-2 (see page 11).

MECHANICAL

SIZE:

Front panel measures 16 inches wide (40.6 cm) by 5-7/16 inches high (13.8 cm). Chassis measures 14-3/4 inches wide (37.5 cm) by 4-13/16 inches high (12.2 cm) by 13 inches deep (33.0 cm), including PANLOC shelf and back panel connectors. Knob clearance required is 1-1/4 inches (3.2 cm) in front of the mounting panel.

FINISH:

Front panel is anodized gold and black with special gold/teal nomenclature illumination.

CHASSIS:

Black

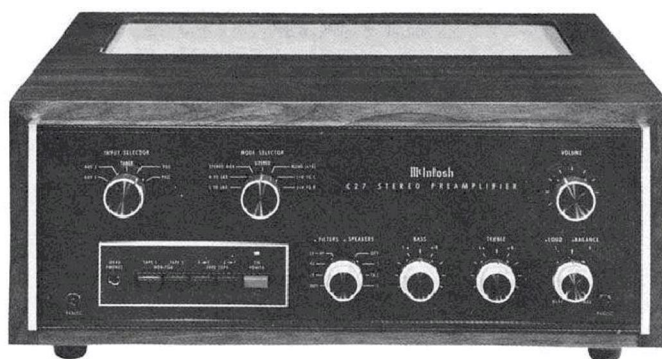
MOUNTING:

Exclusive McIntosh developed professional PANLOC.

WEIGHT:

19 pounds (8.6 kg) net, 31 pounds (14.1 kg) in shipping carton.

THE McIntOSH C 27 STEREO PREAMPLIFIER



C 27 Shown in optional walnut veneer cabinet

STATE OF THE ART PERFORMANCE WITH FLEXIBILITY • ACCURACY • NOISE FREE STEPPED VOLUME CONTROL

PERFORMANCE LIMITS

FREQUENCY RESPONSE:

+0, -0.5 dB 20 Hz to 20,000 Hz.

DISTORTION:

Will not exceed 0.05% at rated output level, 20 Hz to 20,000 Hz.

INPUT SENSITIVITY AND IMPEDANCE:

Auxiliary 1 and 2, Tuner, Tape 1 and 2: 250 millivolts at 100,000 ohms. Phono 1 and 2: 2 millivolts at 47,000 ohms and 100 pF.

HUM AND NOISE:

Auxiliary 1 and 2, Tuner, Tape 1 and 2: IHFA 90 dB, unweighted 85 dB below rated output. Phono 1 and 2 IHFA 85 dB; unweighted 80 dB below 10 millivolts input.

OUTPUT LEVEL:

Main Output: 2.5 volts with rated input. Maximum output is greater than 10 volts. Tape Output: 0.25 volts with rated input. Maximum output is greater than 10 volts. Center Channel Output: (L + R) 2.5 volts with rated input.

SEMICONDUCTOR COMPLEMENT:

18 silicon-planar transistors, 4 silicon diodes, 5 light emitting diodes.

AC POWER OUTLETS:

1 unswitched (red), 4 switched (black).

POWER REQUIREMENT:

120 volts, 50/60 Hz, 15 watts.

FACILITIES AND FEATURES

BASS:

Separate 11 position rotary switches for each channel. -17 dB to +16 dB at 20 Hz.

TREBLE:

Separate 11 position rotary switches for each channel -20 dB to +20 dB at 20kHz.

LOUDNESS:

Flat response, or continuously variable loudness equalization as volume level is reduced.

BALANCE:

Natural balance at center position, attenuation of left or right channel by rotating control.

VOLUME:

Precision step attenuator for precision tracking at

all listening levels. Does not change stereo balance as volume is changed.

INPUT:

Five positions—Auxiliary 1 and 2, Tuner, Phono 1 and 2.

MODE:

Seven positions—Left channel only to both speakers. Right channel only to both speakers, Stereo Reverse, Stereo, Mono (L + R), L + R to Left speaker only, and L + R to Right speaker only.

TAPE MONITOR:

Two pushbutton switches. Either of two tape recorders may be monitored.

TAPE COPY SWITCH:

Two pushbutton switches. Either of two tape recorders may be connected to copy from one to the other in either direction.

LF FILTER (Rumble Filter):

Flat or roll-off 6 dB per octave below 50 Hz, down 12 dB at 20 Hz.

HF FILTER (Scratch Filter):

Flat or roll-off 6 dB per octave above 5kHz, down 12 dB at 20k Hz.

MECHANICAL

SIZE:

Front panel measures 16 inches wide (40.64 cm) by 5-7/16 inches high (13.81 cm). Chassis measures 15 inches wide (38.1 cm) by 5 inches high (12.7 cm) by 13 inches deep (33.02 cm), including PANLOC shelf and back panel connectors. Knob clearance required is 1-1/2 inches (3.81 cm) in front of the mounting panel.

FINISH:

Front panel is anodized gold and black with special McIntosh gold/teal panel nomenclature illumination.

CHASSIS:

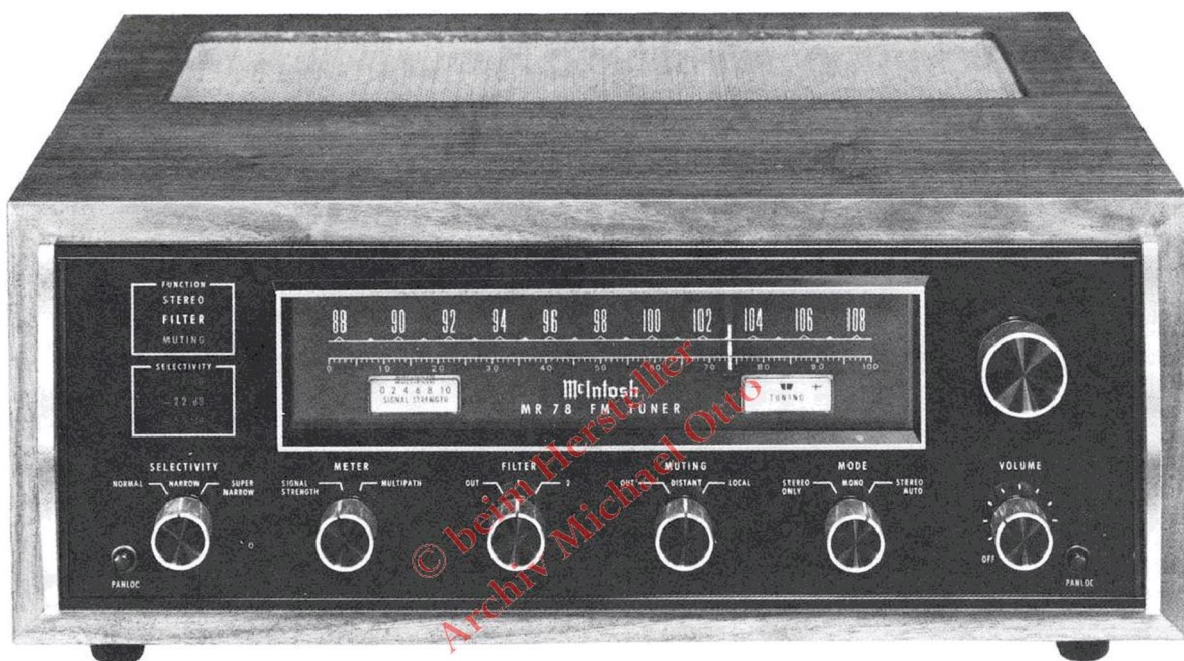
Black

WEIGHT:

20 pounds (9.1 kg) net, 32 pounds (14.5 kg) in shipping carton.

**15 YEARS OF BASIC CIRCUIT AND CONCEPT RESEARCH
HAS DEVELOPED THE NEW TECHNOLOGY
NECESSARY FOR A TRULY LOW DISTORTION
FM TUNER WITH VARIABLE SELECTIVITY . . .**

THE McINTOSH MR 78!



MR 78 Shown in optional walnut veneer cabinet

McIntosh research is a continuous program of exploration for new technology that permits performance improvement and greater value for you. This unrestricted research program developed the new technology necessary for the realization of these new design concepts for the MR 78.

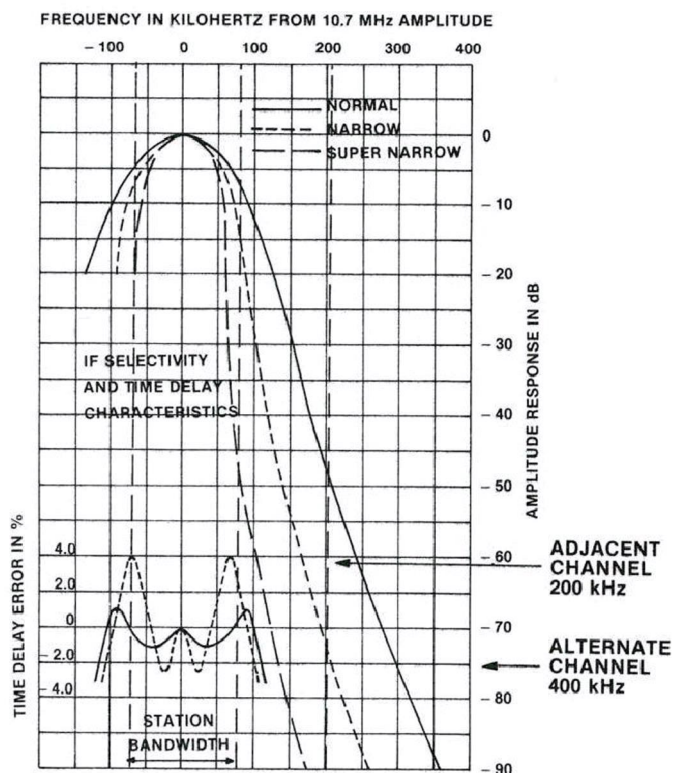
THE DISTORTIONLESS IF FILTER

Ever since the beginning of FM, research engineers have realized that constant delay IF filters equivalent to linear-phase were necessary for low distortion reception. Crude approximations to constant delay have always been used in FM tuners - with disappointing results. So-called "Butterworth" or "Legendre" filters offer only a fair compromise with respect to delay error. Crystal and ceramic filters, usually based on the "Chebychev" model, work fairly well and give good selectivity, but none of these are constant delay linear-phase, filters. Commercial tuners using these filters can show 5% stereo IM distortion at 100 % modulation. The filters used in

most of today's tuners can have delay errors up to 100%! The IF filter in the MR 78 has a delay error of less than 1% from antenna input to discriminator output! In its useful bandpass, it is a true mathematical approximation to linear-phase. It is the world's finest selective, linear-phase, minimum-phase shift filter.

A FORTRAN computer program using an algorithm that took six years to develop was used in its design. The mathematical complexity of the filter design procedure is almost beyond belief. Using a process called "numerical integration in the complex S-plane," a high speed IBM 1130 computer spent eighteen minutes on the design of the IF filter. A human engineer, working twenty-four hours a day and seven days a week, would have taken 300 years to finish this work . . . assuming he made no mistakes!

The MR 78 tuner uses linear phase filters at the NORMAL and the NARROW positions of the SELECTIVITY switch settings.



LINEAR PHASE BRIDGE DISCRIMINATOR

The excellence of the IF filter would be useless if it had to work into an ordinary FM detector. Thus a new detector with suitably low distortion had to be developed. A search of the available literature revealed a little-known bridge circuit with a theoretical distortion of zero! However, designing a practical working circuit for a commercially feasible stereo tuner took some doing. A U.S. patent is pending on this circuit.

Distortion performance of the new McIntosh bridge detector is close to the theoretical zero. In addition to its excellent distortion performance, the bridge detector also exhibits a capture ratio close to 0 dB.

Tuned circuits are not used in the MR 78 detector. They are difficult to manufacture and align accurately, and ordinary tuned-circuit discriminators go out of adjustment. There has been much talk about "permanently aligned" IF filters, but much silence concerning the most important source of misalignment in these same tuners - the discriminator. The two simple variable resistor adjustments in the MR 78 detector merely center the tuning meter and set the transistor bias. Complex tuning for minimum distortion is not needed.

NEW VARIABLE SELECTIVITY

The MR 78 has variable selectivity. In SUPER-NARROW the IF bandwidth is 210 kHz wide at 60 dB down and permits tuning stations that are impossible on ordinary tuners. Even though the MR 78 has the narrowest IF bandwidth ever used in a stereo tuner, it is the correct width to let just one FM station through. The great number of stations crowding the FM band requires a tuner with variable selectivity.

In the NORMAL position, a very low distortion 8-pole filter is used in the IF circuit for listening to local broadcasts.

The NARROW position adds a sharp 8-pole filter to the NORMAL IF filter to yield a low distortion (less than 0.2%), highly selective 16-pole composite IF filter. In the NARROW position interference is reduced while receiving distant stations.

SUPER-NARROW position adds a 4-pole 4-zero crystal filter to the two other IF filters. SUPER NARROW permits receiving distant stations which are on channels adjacent to local stations. With an adequate FM antenna there are usable signals never heard before with ordinary FM tuners.

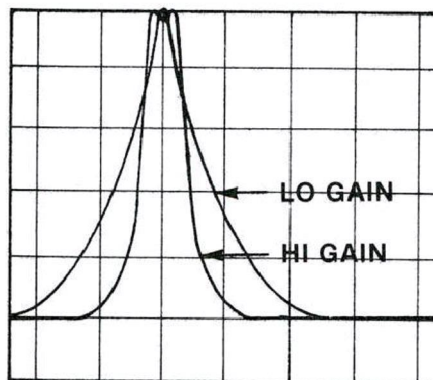
Beautiful styling, extended control flexibility and meaningful illuminated operational indicators bring the McIntosh MR 78 to a new high level of professionalism.

ANTENNA MATCHING

The MR 78 has an antenna matching circuit in the RF input. In fringe areas a broad low-loss RF circuit provides maximum sensitivity for a low-gain antenna. In metropolitan areas crowded with many strong signals a sharp RF input circuit greatly reduces spurious responses and achieves maximum sensitivity when connected to a high-gain antenna.

The RF bandpass of the antenna matching circuit can be modified by switching a resonator in or out of the circuit. Broad bandpass is obtained by setting the ANTENNA MATCHING switch to the LOW GAIN ANTENNA position.

Sharp bandpass is obtained by setting the ANTENNA MATCHING switch to the HIGH GAIN ANTENNA position. The RF input circuit becomes a double tuned filter with high Q in both resonators, which provides sharp bandpass. The graph shows the two bandpass curves of the RF input circuit.



FRONT END

FM signals enter the tuner through the antenna terminals. A coaxial cable conducts the signal to the RF amplifier. In the amplifier the stations are separated, amplified, and converted to a common 10.7 MHz IF frequency. Instead of using a conven-

tional, easily overloaded transistor or FET as a straight RF amplifier, the MR 78 uses a rugged Junction Field Effect Transistor as an impedance converter to drive a 5-watt power transistor. This combination, a cascode circuit, makes the RF amplifier virtually impossible to overload or cross-modulate. As an example, if you are tuned to a 3 microvolt signal at 96.3 MHz; the MR 78 will reject signals elsewhere on the dial which are at least, 4,000,000 times stronger. Thus, a 12 volt signal received at 104.3 MHz would not interfere with the signal at 96.3 MHz. When tuned to 104.3 MHz, the tuner will not overload. Every MR 78 tuner must pass the 12 volt overload test.

Completing the MR 78 front end is the oscillator. It uses a high-Q ceramic form tank coil. The oscillator is free from spurious radiation, and operates at high efficiency. Due to its high stability, the use of AFC and its attendant limitations are avoided.

Another new design in the MR 78 front end is the integrated circuit balanced mixer. This mixer is practically impossible to overload. Oscillator pulling, cross modulation, and other types of distortion so common in ordinary transistor or FET mixers is minimized. A balanced bifilar transformer couples the 10.7 MHz output to the IF amplifier.

THE MR 78 PERFORMANCE LIMITS

TUNING RANGE:

88 to 108 MHz.

ANTENNA INPUTS:

300 ohms balanced; 75 ohms unbalanced.

INTERMEDIATE FREQUENCY:

10.7 MHz.

SENSITIVITY:

2 μ V for 35 dB quieting; 2.5 μ V at 100% modulation ($\pm$ 75 kHz deviation) for 3% total noise and harmonic distortion.

SIGNAL TO NOISE RATIO:

75 dB below 100% modulation.

HARMONIC DISTORTION:

0.2% mono or stereo at 100% modulation, 20 Hz to 15,000 Hz. Typically, 0.05% at 1,000 Hz.

DRIFT:

25,000 Hz for the first two minutes; thereafter 5,000 Hz at 25° C in 24 hours.

FREQUENCY RESPONSE:

Mono: $\pm$ 1 dB 20 Hz to 20,000 Hz with standard de-emphasis, (75 μ S); Stereo: $\pm$ 1 dB 20 Hz to 15,000 Hz with standard de-emphasis (75 μ S).

CAPTURE RATIO:

0.25 dB detector only; 2.5 dB complete tuner.

SELECTIVITY: Switch Setting:

	NORMAL	NARROW	SUPER NARROW
Adjacent Channel	7 dB	22 dB	55 dB
Alternate Channel	55 dB	90 dB	90 dB

SPURIOUS REJECTION:

100 dB IHF.

IMAGE REJECTION:

100 dB at 88 to 108 MHz (IHF).

INTERMODULATION DISTORTION:

0.2% mono or stereo for any combination of frequencies from 20 Hz to 15,000 Hz with peak modulation equal to 100% or less. Typically 0.1%.

MAXIMUM SIGNAL INPUT:

12 volts across 300 ohm antenna terminals will not increase harmonic or intermodulation distortion.

AUDIO HUM

75 dB down from 100% modulation..

MUTING:

70 dB noise reduction between stations.

MUTING THRESHOLD (Typical):

DISTANT position 5 μ V; LOCAL position 20 μ V

SCA FILTER:

50 dB down from 67 kHz to 74 kHz; 275 dB per octave slope.

STEREO SEPARATION:

40 dB at 1,000 Hz.

STEREO FILTER (Typical):

10 dB noise reduction in Position 1.

20 dB noise reduction in Position 2.

AUDIO OUTPUT:

Front Panel Controlled: 2.5 volts into 47,000 ohms; Fixed Output: 2.5 volts into 47,000 ohms, 1.0 volts into 600 ohms. All tuner performance limits were measured with SELECTIVITY switch set at NORMAL, unless otherwise stated.

GENERAL

POWER REQUIREMENT:

120 volts, 50/60 Hz 35 watts.

SEMICONDUCTOR COMPLEMENT:

3 JFET, 2 MOSFET, 17 Bipolar Transistors, 43 Diodes, 4 Integrated Circuits.

MECHANICAL

SIZE:

Front panel: 16 inches wide (40.64 cm) by 5-7/16 inches high (13.81 cm); Chassis: 15 inches wide (38.1 cm) by 13 inches deep (33.02 cm), including PANLOC shelf and back panel connectors; Knob Clearance: 1-1/2 inches (3.81 cm) in front of mounting panel.

FINISH:

Front panel: Anodized gold and black with special gold/teal panel nomenclature illumination; Chassis: Chrome and black.

MOUNTING:

McIntosh developed professional PANLOC.

WEIGHT:

27 pounds (12.25 kg) net, 39 pounds (17.69 kg) in shipping carton.



MR 74 Shown in optional walnut veneer cabinet

THE McINTOSH MR 74 AM FM/FM STEREO TUNER

The McIntosh MR 74 AM-FM/FM Stereo Tuner is a superb instrument with unusual performance characteristics. A unique front end IF filter mixer provides for two position selectivity. When you connect this fine instrument you will discover more FM stations with good quality than you have ever heard before. The AM portion represents the most advanced techniques that promise a rediscovery of AM. The McIntosh MR 74 is used with other McIntosh products such as a preamp-power amplifier or with a separate preamplifier and power amplifier.

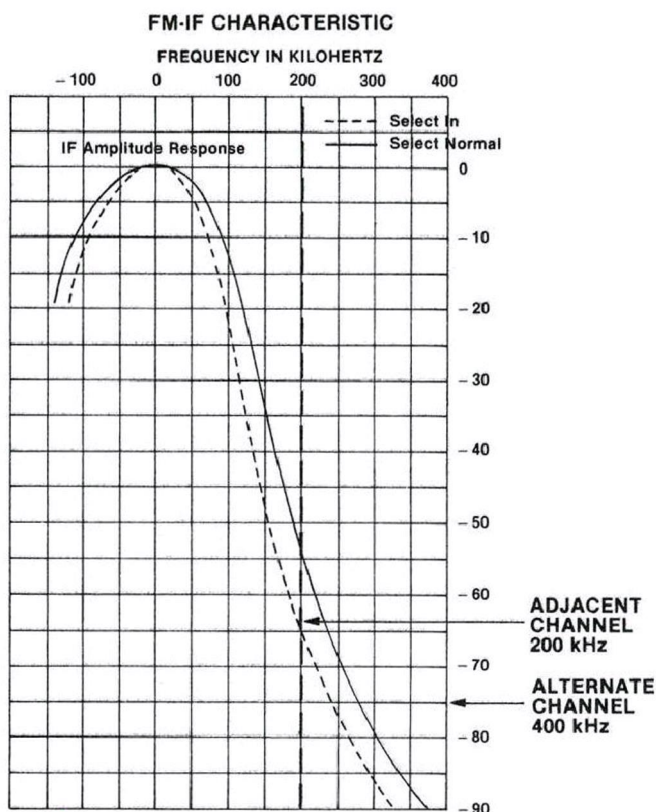
- Staggered tuning condenser elements to improve RF front end performance, less interstage coupling, lower spurious effects, higher Q circuits.
- Tremendous accommodation of strong input signals - up to 10 volts - overcoming one of the most aggravating limitations of tuners that occurs when very strong signals are present.
- Highest spurious rejection 90dB (IHF) and highest image rejection 95dB (88 to 108MHz). This means you receive the stations at the right place on the dial only. You don't receive the same stations or some mixture of stations as you tune across the dial.
- For greater spurious rejection the AM-RF amplifier circuit includes a three section variable tuning capacitor in the metal enclosed RF module which also houses the FM-RF front end. The AM

circuit has constant sensitivity, constant selectivity, and high image rejection across the complete AM band. This circuit design achieves equal sensitivity even down at the low end of the band with constant audio frequency response to the top end of the AM band. The McIntosh circuit is unique in a superheterodyne AM receiver.

- A high-quality loopstick antenna is provided. It can be rotated for maximum performance, optimum signal rejection or minimum interference. Each loopstick is individually tuned for optimum performance. After tuning, the loopstick is then sealed. Custom matching of the loopstick to the AM-RF front end maximizes the performance of the loopstick antenna.
- Ultra Sonic 'muting' provides smooth inter channel FM noise suppression.
- Connection to a McIntosh Maximum Performance Indicator is available from two rear panel jacks.
- McIntosh developed a special detecting circuit used in the multiplex section. An advantage of this circuit is the elimination of the critical adjustments necessary with commonly used matrixing circuits. The circuit detects the L - R sidebands, then automatically matrixes the recovered information with the L + R carrier signal. This yields the left and right program output with maximum separation.
- See the performance limits on the following page for many other outstanding characteristics of this remarkable instrument.

The MR 74 has a switch to change the selectivity of either the FM or AM intermediate frequency circuits. In AM, with the selectivity switch in the narrow position, excellent distant "weak" station performance occurs. In FM with the switch in the narrow selectivity position remarkable selectivity occurs. The response to a carrier 200 kHz removed from the "tuned-in" channel is 65 dB down. This means that a carrier on the adjacent frequency would have to have 3.16 million times the effective power of the wanted station to equal it. Even in the normal position there would have to be 55 dB or 316,000 times the effective power of the tuned signal to equal it.

THE MR 74 STEREO TUNER PERFORMANCE LIMITS



FM

SENSITIVITY:

2.5 μ V at 100% modulation ($\pm$ 75kHz deviation) for 3% total noise and harmonic distortion

SIGNAL TO NOISE RATIO:

70dB below 100% modulation

HARMONIC DISTORTION:

MONO - 0.3% at 100% modulation $\pm$ 75kHz deviation; STEREO - 0.5% at 100% modulation

DRIFT:

25,000Hz for the first two minutes; thereafter 5,000Hz at ambient temperatures

FREQUENCY RESPONSE:

$\pm$ 1dB 20Hz to 15,000Hz with standard de-emphasis (75 μ S) and 19,000Hz pilot filter

CAPTURE RATIO:

1.5dB minimum

SELECTIVITY:

Switch setting:	NORMAL	NARROW
Adjacent Channel:	6dB	15dB
Alternate Channel:	58dB	88dB

SPURIOUS REJECTION:

90dB

IMAGE REJECTION:

95dB, 88 to 108MHz (IHF)

SCA FILTER:

50dB down from 67kHz to 75kHz; 275dB per octave slope

STEREO SEPARATION:

35dB at 1,000Hz

STEREO FILTER:

10dB noise reduction in Position 1; 20dB noise reduction in Position 2

AM

SENSITIVITY:

75 μ V (external ant.)

SIGNAL TO NOISE RATIO:

55dB at 100% modulation; 45dB minimum

HARMONIC DISTORTION:

Does not exceed 1% at 30% modulation

SELECTIVITY:

Switch setting:	NORMAL	NARROW
Adjacent Channel:	35dB	45dB

IMAGE REJECTION:

65dB minimum 540kHz - 1600kHz

FREQUENCY RESPONSE:

3500Hz - 6dB down; NARROW: 2100Hz - 6dB

All tuner performance limits were measured with SELECTIVITY at NORMAL, unless otherwise stated.

GENERAL

POWER REQUIREMENTS:

120 volts, 50/60Hz; 30 watts

SEMICONDUCTOR COMPLEMENT:

5 FET, 17 transistors, 2 IC, 28 diodes, 1 indicator tube

MECHANICAL

SIZE:

Front panel: 16 inches wide (40.64cm) by 5-7/16 inches high (13.81cm); Chassis: 15 inches wide (38.1cm) by 13 inches deep (33.02cm), including PANLOC shelf and back panel connectors; Knob Clearance: 1-1/2 inches (3.81cm) in front of mounting panel

FINISH:

Front Panel: Anodized gold and black with special gold/teal panel nomenclature illumination; Chassis: Chrome and black

MOUNTING:

McIntosh developed professional PANLOC

WEIGHT:

25 pounds (11.34kg) net; 37 pounds (16.78kg) in shipping carton

HIGH PERFORMANCE, SOLID STATE RELIABILITY AND IDEAL FLEXIBILITY... ALL IN A COMPACT, BEAUTIFUL STEREO CONTROL CENTER

MX 113 AM-FM/FM STEREO TUNER PREAMPLIFIER

OUTSTANDING NEW DESIGN AND PERFORMANCE

The IF amplifier in the FM section consists of two integrated circuits and two *QUAD-TUNED* filters. They combine to give a total gain of over 120dB (the signal is amplified to over 1,000,000 times its original level.) The IF filter has equal time delay in its pass band region. Any error in time delay causes FM distortion. All other IF filters have delay distortion, some as much as 100% of the 10.7 MHz transit delay. The MX 113 has less than 1.0% delay distortion from antenna input to discriminator output! This makes possible the overall low distortion performance limit for the FM tuner and multiplex section of the MX 113.

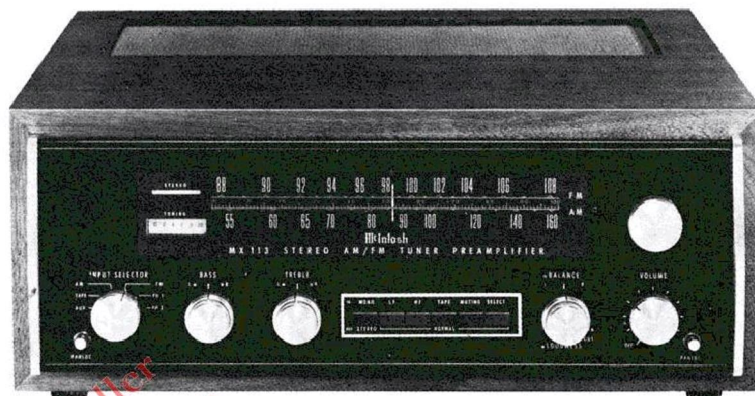
The response curve of the IF has a nearly linear phase characteristic. The skirts of the response curve are very steep. The maximum width is 170kHz at -3.0dB and 500 kHz at -60dB. The response curve is symmetrical each side of the center frequency. The filters are permanently sealed and do not require adjusting. The IF cannot drift nor vibrate out of adjustment. The exceptionally high gain of the two integrated circuits assures "hard limiting" at very low levels of input signals. Each integrated circuit contains 16 transistors, 3 zener diodes, 5 diodes and 23 resistors, all on a single monolithic silicon chip.

VARIABLE SELECTIVITY

A new addition to the front panel is the **SELECT** pushbutton. It controls the selectivity of the IF characteristics. It allows stereo reception even under severe receiving conditions. In the *NORMAL* position a very low distortion dual *QUAD-TUNED* IF filter is used. This filter has unusual adjacent channel selectivity and low distortion. The *QUAD-TUNED* IF filter has equal time delay in its pass band region.

Activating the **SELECT** pushbutton routes the signal to two double-tuned transformers, a ceramic filter network, a single-gate MOS-FET, and the dual *QUAD-TUNED* IF filters. The sides of the IF curves are compressed, narrowing the IF bandpass. In this mode weak stations adjacent to strong stations can be tuned with surprising clarity.

McIntosh has developed a special detecting circuit used in the multiplex section. A particular advantage of this circuit is the elimination of the critical adjustments necessary with commonly used matrixing circuits. The circuit detects the L - R sidebands, then automatically matrixes the recovered information with the L + R carrier signal. This yields the left and right program output with maximum separation.



MX 113 Shown in optional walnut veneer cabinet

AM-FM/FM STEREO

For greater spurious rejection the AM-RF amplifier circuit includes a three section variable tuning capacitor in the metal enclosed shielded RF module which also houses the FM-RF front end. The AM circuit has constant sensitivity, constant selectivity, high image rejection across the complete AM band. This circuit design achieves equal sensitivity even down at the low end of the band. But, it also achieves equal selectivity from low to high end of the AM band. There is no loss of treble to 1600kHz from that at 550kHz. Spurious, image, and intermediate frequency rejection are all superior. The McIntosh circuit is unique in a superheterodyne AM receiver.

A high-quality loopstick antenna is provided. It can be rotated for maximum performance, optimum signal reception or minimum interference. Each loopstick is individually tuned for optimum performance. After tuning, the loopstick is then sealed. Custom matching of the loopstick to the AM-RF front end maximizes the performance of the loopstick antenna.

PERFORMANCE LIMITS

FM

USABLE SENSITIVITY:

2.5 microvolts at 100% modulation (± 75 kHz deviation) for less than 3% total noise and harmonic distortion.

SIGNAL TO NOISE RATIO:

70dB at 100% modulation.

HARMONIC DISTORTION:

Mono: Will not exceed 0.3% at 100% modulation ± 75 kHz deviation. Stereo: Will not exceed 0.5% at 100% modulation ± 75 kHz deviation.

FREQUENCY RESPONSE:

± 1 dB from 20 Hz to 15,000 Hz with standard de-emphasis (75 μ S) and 19,000 Hz pilot filter.

CAPTURE RATIO:

1.5 dB

SPURIOUS REJECTION:

90 dB

IMAGE REJECTION:

95 dB at 88 to 108 MHz (IHF)

STEREO SEPARATION:

Exceeds 35 dB at 1,000 Hz.

SELECTIVITY:

Switch Setting:	Out	In
Adjacent Channel:	6 dB	15 dB
Alternate Channel:	58 dB	88 dB

TUNING INDICATOR:

D'Arsonval movement meter with increased sensitivity.

STEREO INDICATOR:

Stereo light activated by 19,000 Hz pilot signal only.

AM**SENSITIVITY:**

75 microvolts at 1,000 kHz (using external antenna input).

SIGNAL TO NOISE RATIO:

45 dB

HARMONIC DISTORTION:

1% at 30% modulation.

FREQUENCY RESPONSE:

Down 6 dB at 3,500 Hz.

SELECTIVITY:

Switch Setting:	Out	In
Adjacent Channel:	35 dB	45 dB

IMAGE REJECTION:

65 dB; 540 kHz to 1600 kHz

PREAMPLIFIER**FREQUENCY RESPONSE:**

± 0.5 dB, 20 to 20,000 Hz.

DISTORTION:

Will not exceed 0.1% at 2.5 volts output, 20 to 20,000 Hz.

INPUT SENSITIVITY AND IMPEDANCE:

Phono 1 Phono 2: 2 millivolts for 2.5 volts output at 1,000 Hz, 47,000 ohms; Auxiliary and Tape: 0.25 volts for 2.5 volts output; 250,000 ohms.

VOLTAGE AMPLIFICATION:

Phono 1, Phono 2 to Main output 62 dB, to Tape output 42 dB. Auxiliary, Tape to Main output 20 dB to Tape output 0 dB.

OUTPUT:

Main: 2.5 volts with rated input. Up to 10 volts can be developed without increase in distortion. FM will produce 10 volts output at 100% modulation. Tape: 0.25 volts with rated input. Phono signal of 10 millivolts produces 1.2 volts output. FM will produce 1 volt output at 100% modulation. L + R 2 volts with rated input.

HUM AND NOISE:

Phono 1 and Phono 2: 72 dB below 10 millivolt input; equivalent to less than 3 microvolts at the input terminals. Aux-Tape: 85 dB below 2.5 volts output, unweighted.

BASE CONTROL:

- 18 dB + 16 dB at 20 Hz.

TREBLE CONTROL:

± 20 dB at 20,000 Hz.

LF FILTER:

Flat or roll off below 50 Hz, down 12 dB at 20 Hz.

HF FILTER:

Flat or roll off above 5,000 Hz, down 12 dB at 20,000 Hz.

FACILITIES AND FEATURES**VOLUME CONTROL:**

Precision "tracked" at all listening levels, (0 to -65 dB). Does not change stereo balance as loudness is changed. The AC power ON/OFF switch is coupled with this control.

BALANCE CONTROL:

Natural balance at center position, attenuation of left or right channel by rotating control.

LOUDNESS:

Loudness position boosts low frequencies for low level listening. Operates as a function of volume control position. Full compensation is obtained at lower volume levels and flat response is obtained at full volume.

SELECTIVITY PUSHBUTTON:

Increases the ability of the tuner to separate a weak (distant) station from a strong (local) station on adjacent channels.

MODE PUSHBUTTON:

Select either stereo or mono operation.

PHASE CONTROL (located on top of unit):

Electronically reverses phase in the left channel to correct "out of phase" program sources.

MUTING PUSHBUTTON:

Suppresses the background noise and hiss normally heard between FM stations.

TAPE MONITOR:

Pushbutton; compares recorded tape with program source while recording.

MUTING ADJUST:

Modifies the noise rejection threshold between stations on FM.

DIAL SCALE INTENSITY:

Modifies the brightness of the illumination of the front panel.

POWER REQUIREMENTS:

120 volts, 50/60 Hz, 30 watts

TRANSISTOR COMPLEMENT:

2 JFET, 3 MOSFET, 30 Silicon Planar, 31 Diodes, 2 Integrated Circuits (each contains the equivalent of 16 transistors and 8 diodes).

MECHANICAL**SIZE:**

Front panel: 16 inches wide (40.64 cm) by 5-7/16 inches high (13.81 cm); Chassis: 15 inches wide (38.1 cm) by 13 inches deep (33.02 cm), including PANLOC shelf and back panel connectors, Knob Clearance: 1-1/2 inches (3.81 cm) in front of mounting panel.

FINISH:

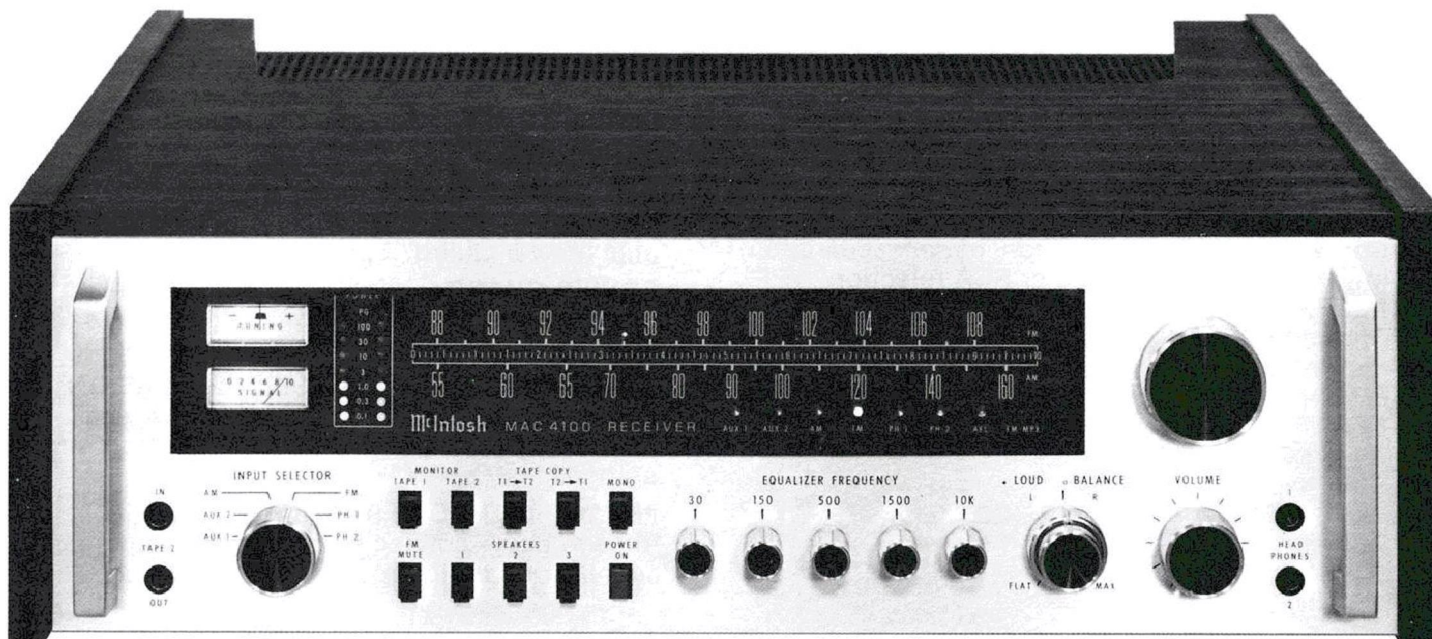
Front panel: Anodized gold and black with special gold/teal panel nomenclature illumination; Chassis: Chrome and black.

MOUNTING:

McIntosh developed professional PANLOC.

WEIGHT:

26 pounds (11.79 kg) net, 38 pounds (17.24 kg) in shipping carton.



The MAC 4100 comes with walnut grained vinyl cabinet

THE NEW MAC 4100

A HIGH QUALITY, HIGH POWER

AM/FM STEREO RECEIVER

A BREAKTHROUGH IN STATE OF THE ART TECHNOLOGY - the McIntosh 4100's design has been governed by insistence on great flexibility, sensitivity, and high performance with long life.

FM STEREO MULTIPLEX, A REAL DESIGN BREAKTHROUGH

The heart of the multiplex section is a new third generation phase locked loop multiplex integrated circuit with tri-phase logic. The phase lock loop stereo decoder integrated circuit incorporates a variable separation control in which sensitivity to the third harmonics of both the pilot and sub carrier frequencies has been eliminated by the use of appropriate digitally generated waveforms in the phase lock loop and decoder sections.

The elimination of sensitivity to the third harmonic of the sub carrier, 114kHz, excludes interference from side bands of adjacent transmitters. The elimination of sensitivity to the third harmonic of the pilot tone, 57kHz, excludes interference from SCA. In the phase lock loop, the internal RC oscillator operates at 228kHz and feeds a three-stage Johnson counter via a binary divider to generate a series of

19kHz square waves. Suitably connected NAND gates and exclusive OR gates generate the waveforms used to drive the various modulators in the circuit. The usual square waveforms have been replaced by three level, or tri-phase waveforms which eliminate third harmonics. Harmonics which are multiples of two or three are not present, eliminating interference from side bands into the audible region.

Additional advantages of the phase locked loop stereo demodulation are the elimination of inductors to minimize drift, integral lamp driving capability to indicate presence of 19kHz pilot carrier, excellent channel separation over the entire audio frequency range, extremely low distortion, low output impedance, and transient-free mono/stereo switching.

After multiplex detection, 19kHz pilot and 38kHz carrier suppression circuits are used to prevent tape recorder interference. The FM muting circuit is unusual. It operates both by detecting ultrasonic noise and by sensing correct tuning of the detector circuit. To "un-mute" it is necessary for the signal to have an adequate signal-to-noise ratio and to be turned to the center of the FM carrier. The MUTING circuit can be activated or defeated by the front panel muting pushbutton. The switching on and off of the audio signal is done with FET analog switches. This is an outstanding receiver with many features designed for your listening pleasure.

MAC 4100 FEATURES

- **SUPER TRACKING VOLUME CONTROL**
Channel to channel tracking of better than 1 dB throughout the control range
- **THIRD GENERATION PHASE LOCKED LOOP MULTIPLEX**
Contains tri-level logic for better separation, lower distortion and greater SCA rejection
- **PENTA FREQUENCY PROGRAM EQUALIZER**
Allows for more flexibility than old fashioned tone controls when compensating for program deficiencies
- **TRIPLE SPEAKER SWITCHING**
Allows for the use of three pairs of speakers, independently or simultaneously
- **TAPE MONITOR AND TAPE COPY PUSHBUTTONS**
Either of two tape recorders can be monitored and

either can copy one to the other. A third recorder can be connected by means of the front panel TAPE jacks.

- **LED OUTPUT POWER INDICATORS**
Instantaneous indication of power output level and "Power Guard" operation
- **POWER GUARD**
Protects your tweeters from clipped or square waves and prevents harsh sounding clipping
- **AUTOMATIC STEREO NOISE SUPPRESSION**
On only when the FM stereo signal is weak. Adjusts itself to the signal and turns off on strong stations
- **PREAMP OUT POWER AMP IN**
Allows easy connection of an environmental equalizer or audio processor

MAC 4100 PERFORMANCE LIMITS

PERFORMANCE

POWER OUTPUT:

100 watts minimum sine wave continuous average power output, per channel, both channels operating into 4ohms 20Hz to 20kHz, with no more than .05% total harmonic distortion

75 watts minimum sine wave continuous average power output, per channel, both channels operating into 8 ohms 20Hz to 20kHz, with no more than .05% total harmonic distortion.

OUTPUT LOAD IMPEDANCE:

4 ohms, 8 ohms

RATED POWER BAND:

20Hz to 20kHz

TOTAL HARMONIC DISTORTION:

.05% maximum at any power level from 250 milliwatts to rated power per channel, 20Hz to 20,000Hz, both channels operating

FREQUENCY RESPONSE:

20Hz to 20kHz +0, -0.5dB at rated power

INTERMODULATION DISTORTION:

.05% maximum at any power level from 250 milliwatts to rated power per channel both channels operating for any combination of frequencies 20Hz to 20,000Hz

NOISE AND HUM:

Power Amplifier: 100dB IHFA, 95dB unweighted, below rated output. Tape and Aux Input: 95dB IHFA, 90dB unweighted below rated output. Phono Input: 90dB IHFA, 80dB unweighted, below 10mV input

DAMPING FACTOR:

Greater than 30

INPUT SENSITIVITY AND IMPEDANCE:

Power Amplifier: 2.5 volts, 22,000ohms; Tape, Auxiliary: 250 millivolts, 100,000ohms; Phono: 2 millivolts, 47,000ohms, 87pF

TAPE OUTPUT LEVEL:

Tuner: 1.0 volts at 100% modulation [FM]; Tape: 250 millivolts with rated input; Phono: 250 millivolts with rated input

PROGRAM EQUALIZER:

± 12dB at 30,150,500,1500, and 10,000Hz

FM

SENSITIVITY:

2.5µV [13dB] IHF minimum

SIGNAL TO NOISE RATIO:

70dB IHF minimum

HARMONIC DISTORTION:

Mono: 0.18% IHF maximum Stereo: 0.38% IHF Maximum

FREQUENCY RESPONSE:

20Hz to 15kHz +0, -1dB

CAPTURE RATIO:

1.8dB

SELECTIVITY:

75dB IHF minimum

SPURIOUS REJECTION:

90dB IHF minimum

IMAGE REJECTION:

80dB IHF minimum

STEREO SEPARATION:

45dB minimum at 1kHz

SCA REJECTION:

60dB minimum

AM

SENSITIVITY:

75mV IHF [External antenna]

SIGNAL TO NOISE RATIO:

45dB minimum IHF, 55dB at 100% modulation

HARMONIC DISTORTION:

0.8% maximum at 30% modulation

FREQUENCY RESPONSE:

6 dB down at 3500 Hz

ADJACENT CHANNEL SELECTIVITY:

30dB minimum IHF

IMAGE REJECTION:

65dB minimum, 540kHz to 1600kHz

GENERAL

SEMICONDUCTOR COMPLEMENT:

45 Transistors, 31 Integrated Circuits, 62 Diodes, 1 Silicon Controlled Rectifier

POWER REQUIREMENTS:

120 Volts, 50/60 Hz, 0.6 to 4 amperes (72 to 480 watts)

MECHANICAL

SIZE:

IN CABINET: 18-5/8 inches (47.3cm) wide, 6-1/2 inches (16.5cm) high, 15-1/2 inches (39.4cm) deep.

WITHOUT CABINET: Front panel measures 17-9/16 inches (44.6cm) wide by 5-1/4 inches (13.3cm) high. Chassis measures 17-1/8 inches (43.5cm) wide by 4-15/16 inches (12.5cm) high by 13-1/2 inches (34.3cm) deep. Knob and handle clearance required is 1-1/4 inches (3.2cm) in front of the mounting surface.

FINISH:

Front panel is clear anodized to produce a brushed satin -silver finish with black and anodized trim. Cabinet is walnut grained vinyl

WEIGHT:

40 pounds (18.1 kg) net, 54 pounds (24.5 kg) in shipping carton

The NEW McIntosh MA 6200 Stereo Preamp-Amplifier

Here is performance once only obtained
with separate preamps and power amps

The MA 6200 delivers McIntosh performance and quality in a combination solid state preamplifier and solid state power amplifier. The MA 6200 reproduces music accurately with real life definition. Here is the power you need to give you the sound of live music in your home.

MA 6200 FEATURES

- Super Tracking Volume Control
- Penta Frequency Program Equalizer
- Power Guard with Indicators
- Current Sensing AC Outlets for "Auto Turn-On"
- Switching for Three Pairs of Speakers - all three can be on at once
- Tape Monitor - Tape Copy, for two recorders
- Continuously Variable Loudness Compensation
- Front Panel Tape Jacks
- Preamp Out - Power Amp In Connections for Environmental Equalizers or Audio Processors
- Speaker Protection Circuits
- LED Function Indicators
- Two Headphone Jacks
- Turn-On Transient Elimination Circuits
- Less than .05% THD, phono input to speaker output
- Active Filter Elements
- Triple Shielded Power Transformer
- Electronically Regulated Power Supply
- Modular Construction
- Switched AC Outlets

McIntosh audio power ratings are stated in accordance with the Federal Trade Commission Regulation of November 4, 1974 concerning power output claims for amplifiers used in home entertainment products.

PERFORMANCE LIMITS

POWER OUTPUT:

100 Watts minimum sine wave continuous average power output per channel, both channels operating into 4 ohms, 20 Hz to 20 kHz, with no more than .05% total Harmonic Distortion

75 Watts minimum sine wave continuous average power output per channel, both channels operating into 8 ohms, 20 Hz to 20 kHz, with no more than .05% total Harmonic Distortion

OUTPUT LOAD IMPEDANCE:

4 ohms, 8 ohms

RATED POWER BAND:

20 Hz to 20 kHz

TOTAL HARMONIC DISTORTION:

.05% maximum at any power level from 250 milliwatts to rated power per channel. 20 Hz to 20 kHz, both channels operating

INTERMODULATION DISTORTION:

.05% maximum at any power level from 250 milliwatts to rated power per channel with both channels operating for any combination of frequencies 20 Hz to 20 kHz

FREQUENCY RESPONSE:

20 Hz to 20 kHz +0, -0.5 dB at rated power

NOISE AND HUM:

Power Amplifier: 105 dBA, 100 dB unweighted,



MA 6200 Shown in optional walnut veneer cabinet

below rated output; Auxiliary, Tape Input: 100 dBA, 95 dB unweighted, below rated output; Phono Input: 85 dBA, 80 dB unweighted, below 10 millivolts input

DAMPING FACTOR:

Greater than 30

INPUT SENSITIVITY AND IMPEDANCE:

Power Amplifier: 2.5 volts, 22,000 ohms; Tape, Auxiliary: 250 millivolts, 100,000 ohms; Phono: 2 millivolts, 47,000 ohms, 100 pF

TAPE OUTPUT LEVEL:

Auxiliary, Tape: 250 millivolts with rated input; Phono: 250 millivolts with rated input

PROGRAM EQUALIZER:

± 12 dB at 30, 150, 500, 1,500, and 10,000 Hz

GENERAL

SEMICONDUCTOR COMPLEMENT:

42 Transistors; 13 Integrated Circuits; 25 Diodes; 1 Silicon Controlled Rectifier

POWER REQUIREMENTS:

120 Volts, 50/60 Hz, 0.5 to 5 amperes (60 to 480 watts)

MECHANICAL

SIZE:

Front Panel measures 16 inches wide (40.6cm) by 5-7/16 inches high (13.8cm). Chassis measures 14-3/4 inches wide (37.5cm) by 4-13/16 inches high (12.2cm) by 13 inches deep (33.0cm) including PANLOC shelf and back panel connectors. Knob clearance required is 1-1/4 inches (3.2cm) in front of the mounting panel

FINISH:

Front panel is anodized gold and black with special gold/teal nomenclature illumination. Chassis is black

MOUNTING:

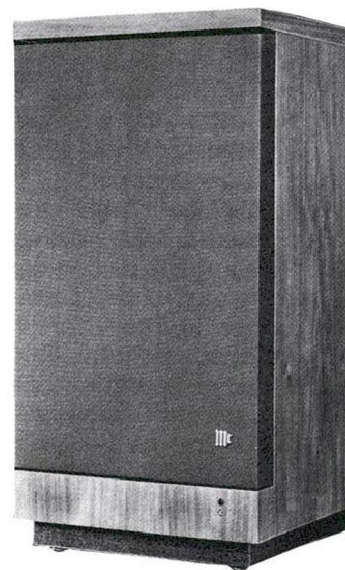
Exclusive McIntosh developed professional PANLOC

WEIGHT:

30 pounds (13.6kg) net. 42 pounds (19.1kg) in shipping carton

McIntosh

XR ISOPLANAR RADIATOR LOUDSPEAKER SYSTEMS



McIntosh loudspeakers will always sound better than any other loudspeakers simply because McIntosh has lower intermodulation distortion, better balance, better dispersion and broader frequency response than any other speaker.

- **Lower intermodulation distortion** means clearer sound, cleaner sound, better definition, better recognition, more life-like sound.
- **Better balance** means that McIntosh speakers are more musical, more natural, more like real, live music in your room.
- **Better dispersion** means more accurate stereo imaging and better stereo imaging wherever you sit or stand in your room.
- **Broader frequency response** means easier recognition of every instrument in the orchestra whether it is producing Sub Contra A at 27.5 hertz or whether it requires full reproduction at 20,000 hertz.

McIntosh loudspeakers have these superior qualities simply and precisely because they are the product of a total concept. They have been researched more thoroughly. They have been designed more

carefully with a truer application of real scientific knowledge. The individual mechanisms are better designed and better built. The cabinets that enclose the mechanisms are far superior in their construction integrity, rigidity and utility than any other.

McIntosh Loudspeakers started in concept 30 years ago. Thirty years of working to the ultimate goal of the perfect loudspeaker has led to the new XR Isoplanar Radiators. Isoplanar loudspeakers radiate equal amounts of energy at all horizontal angles from the plane of the loudspeaker mechanism. McIntosh Isoplanar Radiators combine this broad dispersion pattern with the lowest intermodulation distortion and most accurate transient response. Here is the step by step story of the last decade of innovative, dedicated, research and development that led to the most perfect loudspeakers known today.

WHAT IS A LOUDSPEAKER?

A loudspeaker is a "sound imaging" device much the same as a photograph is a "visual imaging" device. You measure the excellence of a photograph by judging the coincidence of the visual image with reality. You measure the excellence of a loudspeaker by judging the coincidence of the sound image with reality. After considering both the reality and the sound image you make the ultimate judgement based on what you hear. The most important thing a loudspeaker can do for you is to sound right the *first time* you listen to it, the *next time* you listen to it and *every time* you listen to it.

THE MCINTOSH PROMISE

A McIntosh Loudspeaker is a promise of a new psycho-acoustic experience - - - the experience of reality in your listening room - - - the experience of listening to an almost perfect sound image. From many man years of research McIntosh promises you that nearly perfect sound images will occur in your listening room - - - whatever the room is like! To say it differently - - - if the actual live or real sound would please you in your listening room then the McIntosh loudspeaker in your listening room will equally please you.

HOW IMPORTANT ARE LOUDSPEAKER SPECIFICATIONS?

To a research scientist who strives for perfection, specifications are the raw material of his trade. Through the analytical use of measurements a scientist sets his objectives, goals and direction. Specifications give him the ability to chart his progress, and most importantly tell him when his objectives have been achieved. But what do specifications mean to you? Specifications must be understood and interpreted correctly. Many loudspeakers are sold with no meaningful specifications and only a claim for perfection. Perhaps the most important single specification for a loudspeaker is its intermodulation distortion versus sound pressure level. Since most manufacturers do not give this information it is possible to judge their speakers only by listening to them. So to evaluate such speakers you must listen carefully to many types of music for some time and if possible right in your own home. The Total Listening Impression is most often the final criterion of value - - - the final judgment of reality. The massive investment and many man years of research at McIntosh were constantly directed to the one goal of Total Listening Impression. For though specifications may guide you, in the final analysis, the Total Listening Impression when correctly and carefully formed is the basis for the judgement of value.

MAKING A REAL SOUND IMAGE

When you look in a perfectly flat mirror you will see an accurate image of yourself. If the mirror is bent then the accuracy of the image is altered. Mirrors can have other accuracy problems. They can be tinted so that the color coincidence of the object and the image is altered. In addition, the image may correspond in shape and size for one color but be out of shape or size for another color. Optical and sound imaging devices have analogous problems. Considering these facts it is possible to state the

concept of image fidelity: the *image should coincide with the object in every detail. It should be no more nor no less.*

Applying the image fidelity concept to a sound system requires a statement like this: We should hear the original sound from the loudspeaker - nothing subtracted - nothing added!

There are many links in the sound imaging chain. The microphone, the tape recorder, the disc recording, the many amplifiers and the loudspeaker all present possibilities for altering the sound image.

It's somewhat like the old parlor game of "gossip." That's the game where a group of people sit in a circle. One person whispers the details of a story to the person next to him. The story is whispered from person to person. As you would expect the story will not take many tellings and remain intact. In fact, the more details in the story the greater the likelihood that the story will be modified.

In the same way the more detail in the music, the richer the orchestration, the greater the range of contrast in tone, color and loudness, the greater is the demand on fidelity in the sound system chain.

Most of the links in the sound imaging chain have reached a high level of perfection. The loudspeaker has been the last link in need of a breakthrough to fidelity.

DESIGNING FOR LOUDSPEAKER FIDELITY

The reflection in a perfect mirror is a straight line relationship between the object and the image. Standing in front of the perfect mirror you will see yourself as you are. If your shoes are brown the mirror will reflect them as brown. Any change in color or

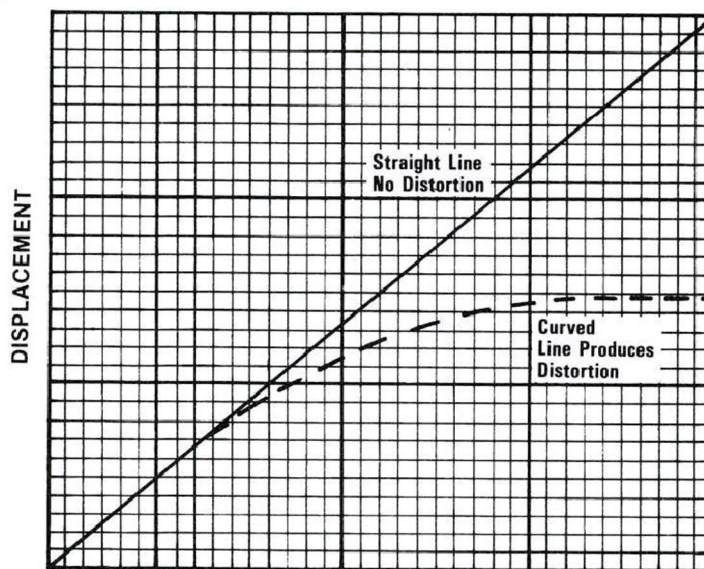


Figure 1 DRIVING FORCE

shape is a departure from a straight-line relationship. The sound image must, like the perfect mirror, be a faithful reflection of the original. Each link in the sound imaging chain must be capable of the same straight line relationship.

In loudspeakers, the relationship between the displacement of the cone and the driving force that moves the cone, must be a straight line to be able to produce a natural sound. For example - - - if 1 volt

across the voice coil moves the cone one tenth of an inch, then 2 volts should move the cone 2 tenths, 3 volts, 3 tenths and so on to the limits of its travel (Figure 1). The graph of this action relating volts and displacement is a straight line.

However, if the line relating volts and displacement departs from a straight line the sound image will depart from reality. The greater the departure from a straight line relationship the less and less accurate the sound image. Then to make matters worse, if two sound images are reconstructed at the same time from the same cone - - not only is each altered - - but each image also blurs the other. The

name of this action is intermodulation distortion. Speakers developed from older technology have intermodulation distortion that can measure from 5 to 15 percent. The new technology that permitted the development of McIntosh speakers brought measured intermodulation distortion down to only 1/3 of 1 percent (Figure 2). That difference is a dramatic contrast! You hear reeds and strings as sharp, clear, well defined sounds with only 1/3 of 1 percent intermodulation distortion. On loudspeakers designed from older technology with 5 percent intermodulation distortion (Figure 3), these sounds are indistinct and unpleasant.

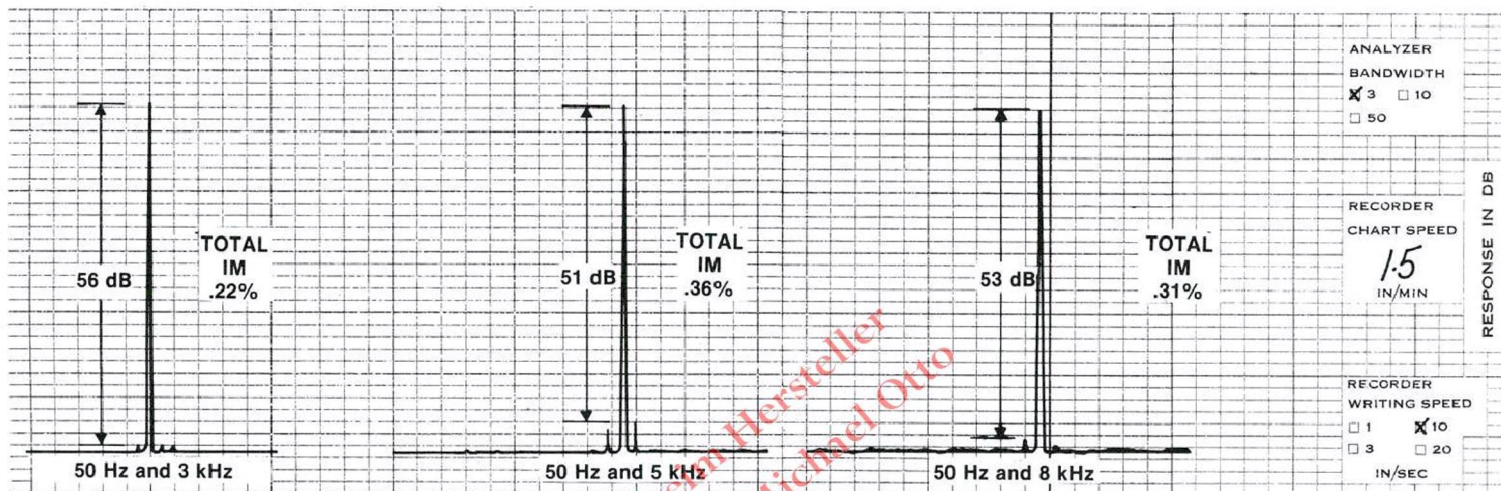


Figure 2
INTERMODULATION DISTORTION GRAPH
for 3 pairs of tones measured on McIntosh XR 5
MEASURED AT 100 dB SOUND PRESSURE LEVEL

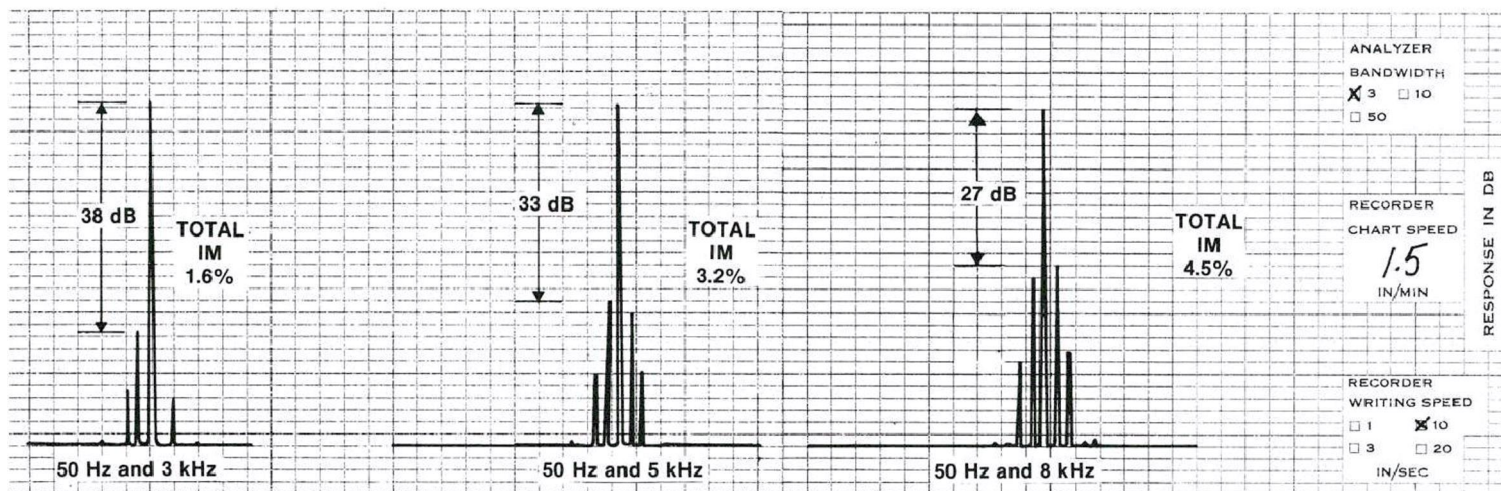


Figure 3
INTERMODULATION DISTORTION GRAPH
for 3 pairs of tones measured on a popular
loudspeaker design using older technology
MEASURED AT 100 dB SOUND PRESSURE LEVEL

To achieve the performance, needed to recreate reality, loudspeaker cones must move as perfect pistons. The entire surface of the cone must move the same distance at the same time. If part of the cone should flex and so fail to move the same amount at the same time then an imperfect sound image occurs.

This condition is called "break-up" (Figure 4). It can be seen that when the cone breaks up, its motion no longer has a straight-line relation to the cone driving force. Again, any departure from a straight-line relationship is an increase in distortion.

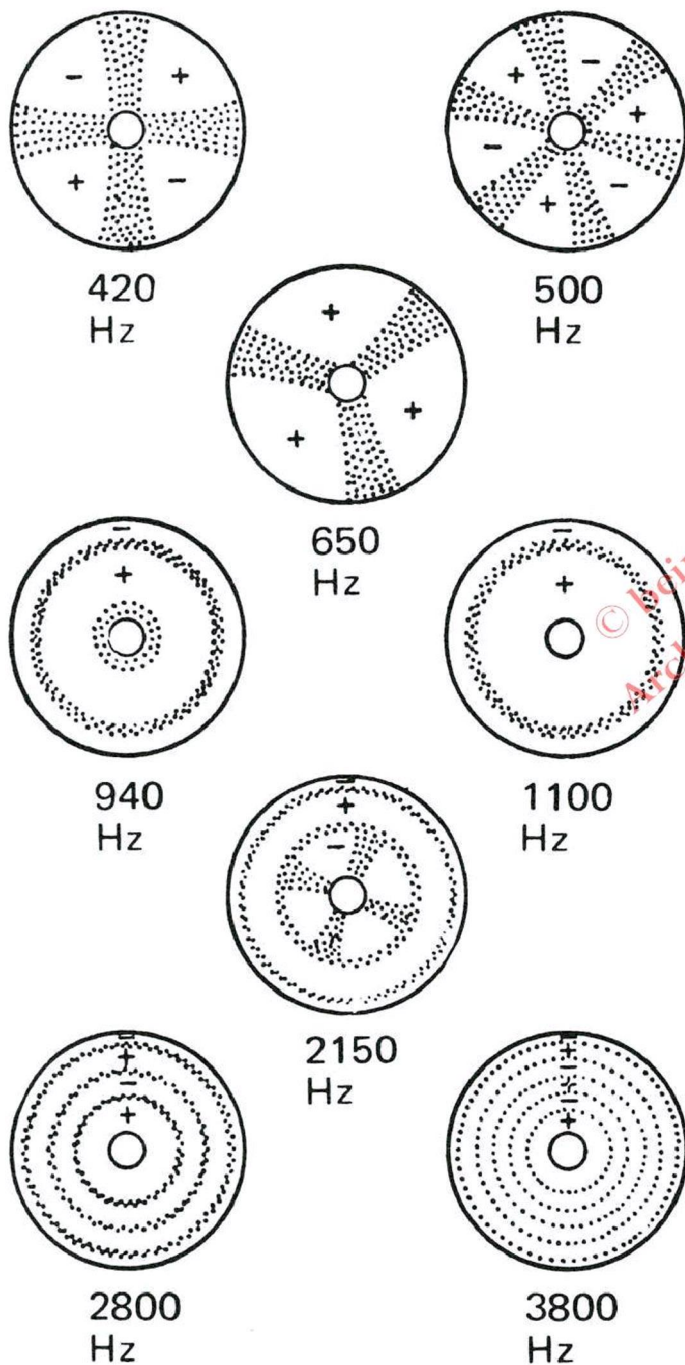


Figure 4

The (+) and (-) signs indicate regions where the cone is flexing in opposite directions, *i. e.*, opposite phases.

Loudspeaker scientists have not been free to use the perfect piston cone because of its limitations. The perfect piston must be stiff to prevent cone break-up. Increase in stiffness usually requires increased cone weight. The two characteristics, cone stiffness and cone weight, dictate the frequency range over which the cone can operate. As cone weight goes up usually cone stiffness increases, but at the expense of frequency range and efficiency. Hence the design of a loudspeaker system using a perfect piston cone is more elaborate and usually more expensive.

The cone of a loudspeaker is driven by a linear, as opposed to a rotary, electrical motor. The linear motor supplies the driving force that causes the cone to move. The motor consists of the voice coil and the magnet assembly. In the McIntosh low frequency speaker this assembly weighs 15 pounds. As frequency is increased from 20 hertz to 250 hertz the acceleration of the cone is increased. Obviously the driving force must also increase. The laws of physics state that as mass is accelerated the driving force required increases one unit for each unit of acceleration. An acceleration of 10 "g's," for example, requires a driving force 10 times that for a single "g." It can be shown that at 60 hertz, with the loudspeaker producing one acoustic watt, the maximum acceleration experienced is equivalent to 93 "g's." You can imagine that the loudspeaker scientists must consider any increase in weight (mass) very carefully. It becomes obvious that at high frequencies the driving force required is excessive. The McIntosh perfect piston low frequency speaker begins to require excessive driving force at 250 hertz. The driving force required continues to increase as frequency is increased, but since the increase in force is not available to be supplied, the frequency of the speaker is likewise limited.

The acceptance of these frequency limitations and the use of many more specialized radiators gives the loudspeaker scientist the key to low distortion and perfect sound image performance. The price paid for excellence is always totalled in terms of singleness of purpose, effort, care and attention to detail. Each of the loudspeaker elements used in a McIntosh loudspeaker system have been researched and designed with the same exhaustive, extensive, thorough care. The meticulous attention to minute detail is the McIntosh way to design for the nearly perfect sound imaging of a McIntosh loudspeaker.

MAKING A STEREO IMAGE

The human brain forms a stereo sound image based on information gathered by the ears. In the case of your listening room, the sound information is usually supplied by two loudspeakers. Differences in loudness intensity and differences in the time occurrence of sounds are recognized by the brain. These differences allow the brain to position the source of the sound. The intensity information, is greatly dependent on the directional radiation characteristics of each loudspeaker system.

Loudspeaker radiation patterns have been measured and plotted by several authorities. The means of designing for non-directional sound and widely dispersed sound are well known. It has been established, for example, that if the wavelength to be radiated is long in relation to the loudspeaker diameter then the intensity of sound tends to be the same on either side of the speaker, above it and below it, in front of it and behind it. With the knowledge that wavelength decreases from 56 feet at 20 hertz to about a half inch at 20,000 hertz the loudspeaker scientist can describe the dimensions of the reproducer to be used in the loudspeaker system. He can also describe the band of frequencies to which each loudspeaker must be limited to achieve widely dispersed radiation.

to the loudspeaker diameter. Then he must exercise great care in mounting the speakers, in the design of crossover networks, the selection of grille structures and cloths as well as the actual construction of the basic loudspeaker mechanisms.

DIRECTIVITY vs. WAVELENGTH

To focus in a little more on this problem consider the chart of radiation patterns for a 12 inch diameter loudspeaker (Figure 5). Notice that as wavelength shortens the speaker becomes progressively more directional until it breaks up into major and minor lobes. The octave from 1500 hertz to 3000 hertz is particularly interesting. If an instrument were to increase pitch by this octave a listener 30 degrees off axis would hear a greatly reduced intensity. As we

Measured directivity patterns for a typical 12-in. direct-radiator loudspeaker in a 27 - by 20 - by 12-in. rectangular box.

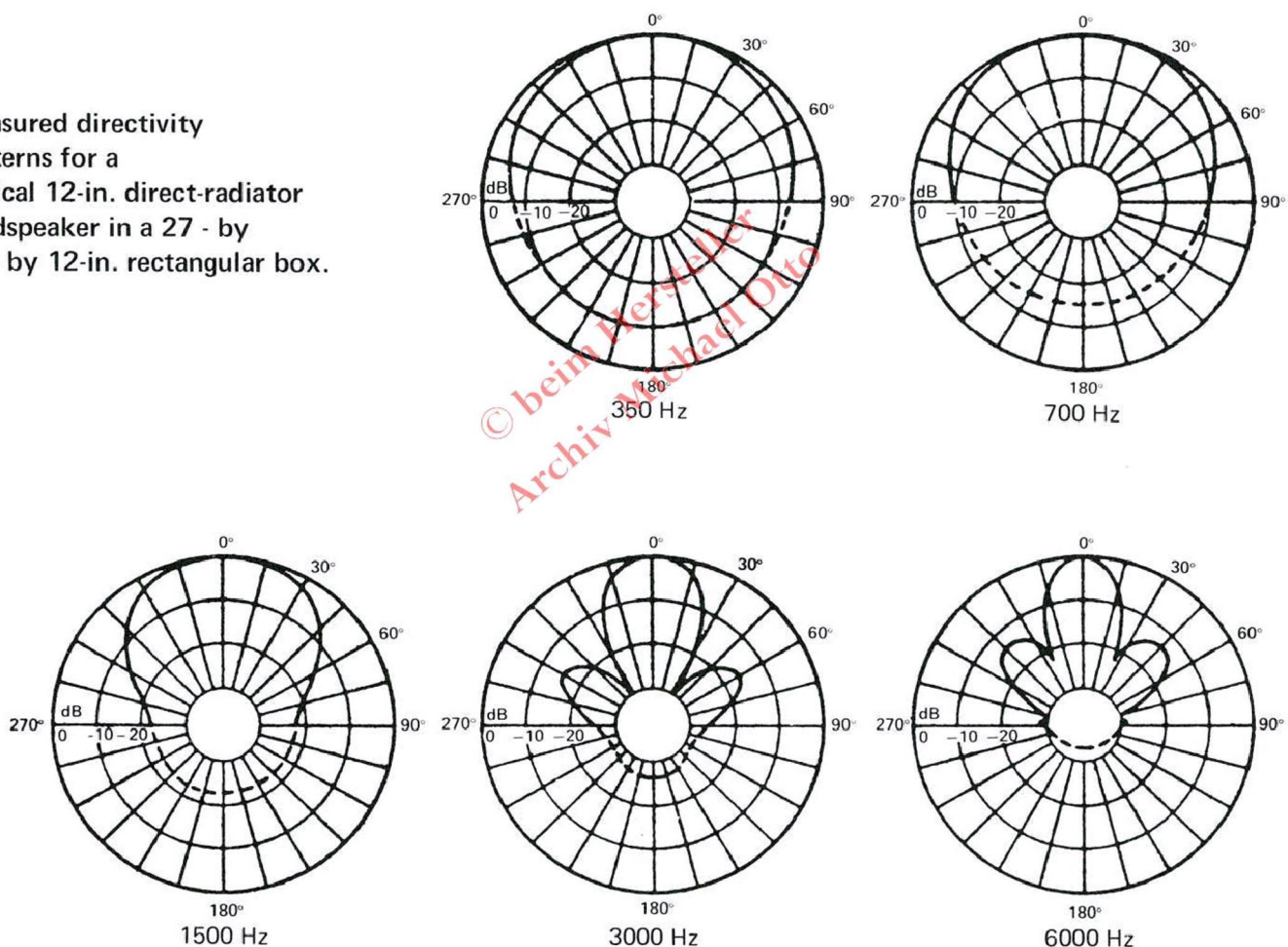


Figure 5

Widely dispersed radiation over the whole ten octaves of music makes for a well defined, stable stereo image. But the widely dispersed loudspeaker will not sound as loud as the highly directional loudspeaker. The designer must compensate by using expensive and heavy magnet structures to obtain equivalent loudness. He must limit the frequency bandwidth which the loudspeakers radiate so that the shortest wavelength is at least comparable

have seen, one of the prime pieces of information used by the brain to localize the stereo image is the intensity of the sound. If the intensity is changed merely by the pitch change radiated from the loudspeaker then the listener will be subjected to the incongruous image of the musician moving about as he plays different notes (Figure 6A and 6B). That's not an image of reality.

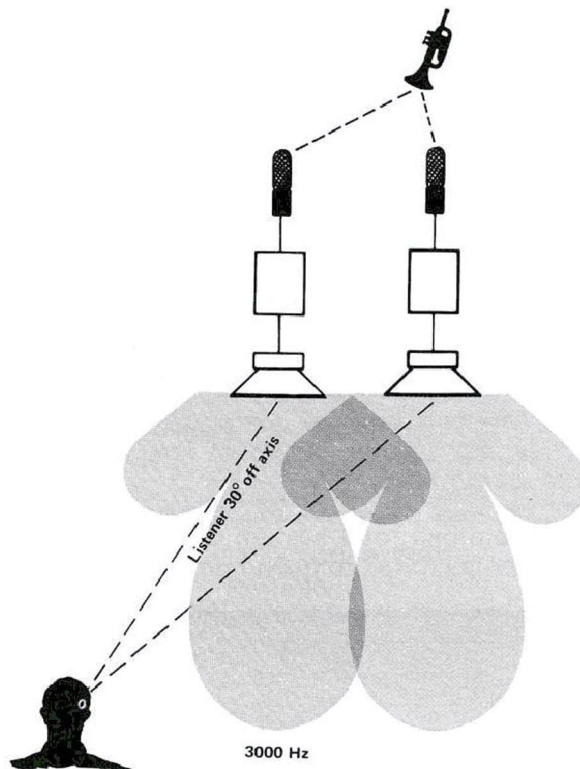
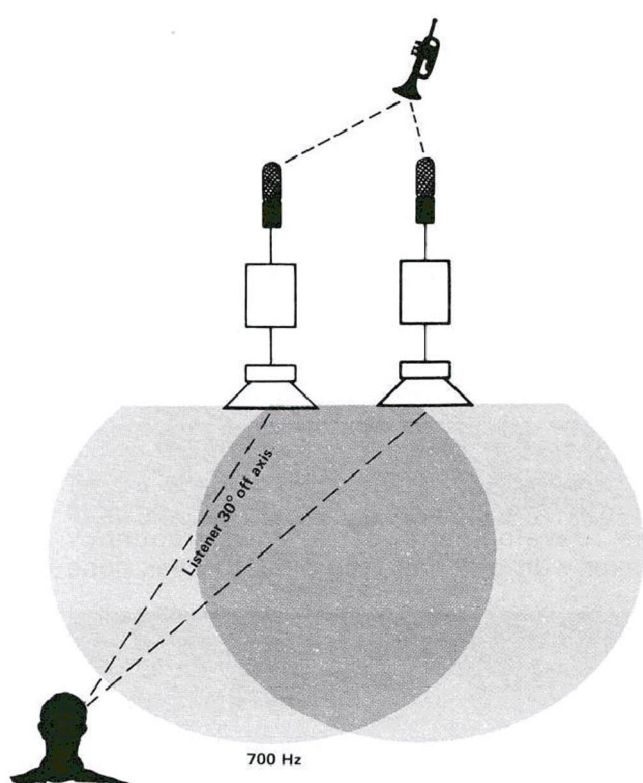


Figure 6A

Radiation patterns above typical of loudspeakers designed from older technology. Note the change in pattern from 700 Hz to 3000 Hz.

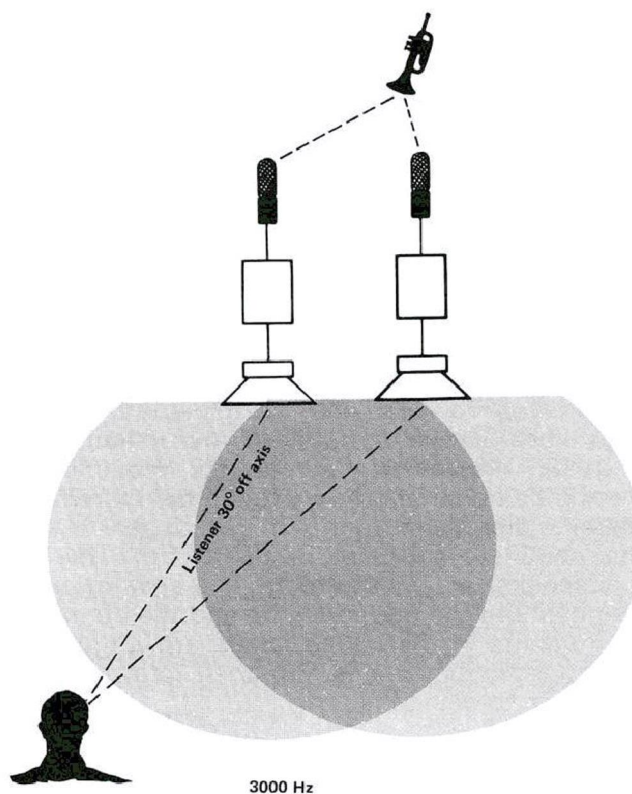
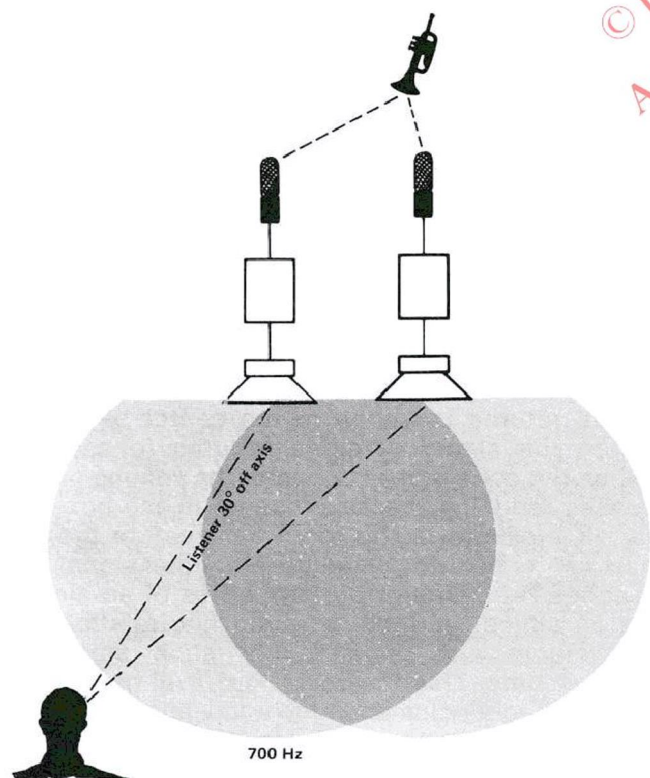


Figure 6B

Radiation pattern from McIntosh loudspeakers designed from new technology. Note the similarity from 700 Hz to 3000 Hz.

To avoid this problem right from the beginning our loudspeaker scientists used many loudspeakers with different diameters. We limited the 12 inch loudspeaker to an upper frequency of 250 hertz, used a smaller diameter speaker to radiate to 1400 hertz, and then a still smaller speaker to radiate to 7000 hertz, and then an even smaller speaker to radiate to 20,000 hertz. By this means the system dispersion was preserved and hence the stereo imaging preserved for all listening positions.

Limiting the frequency spectrum of each driver also allows perfect piston designing with its advantage of low intermodulation distortion. *It is interesting that both of these design objectives, better sound imaging and better stereo imaging, lead to similar construction.*

In the McIntosh total system design the 12 inch loudspeaker is limited to maximum power up to 250

contributions. Most of these opportunities were discovered just where lesser men saw only problems. One of the great opportunities that the McIntosh acoustics research team uncovered was a new design for natural sound of bass instruments.

To understand more of this design consider what happens when a bass drum is struck, and the motion of the diaphragm pumps a large volume of air. The reproduction of such a sound image requires the motion of the same volume of air or, at least, a significant fraction of it. Because the other design objectives of low intermodulation distortion and widely dispersed radiation dictated a maximum cone diameter of 10 inches the low frequency loudspeaker had to be designed with large excursion, back and forth movement, to achieve the air volume movement necessary. Our design objective was the development of a low frequency loudspeaker with one half inch peak to peak cone

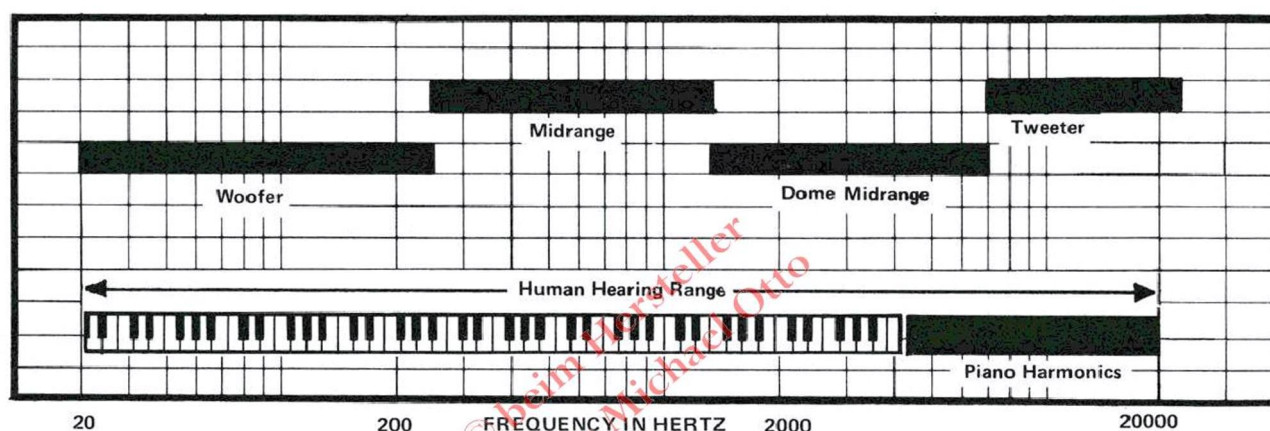


Figure 7

hertz. At this point an 8 inch loudspeaker takes over and continues the widely dispersed pattern to 1500 hertz. Then a 1½ inch dome mid range loudspeaker carries the radiation pattern to 7000 hertz. At 7000 hertz, a compound coaxial loudspeaker continues to 14000 hertz on the outer diaphragm and to above 20000 hertz on the inner half inch-diameter diaphragm (Figure 7).

The dispersion of McIntosh loudspeaker systems allows you to hear the complete stereo image regardless of where you sit in your listening room. With 180° dispersion the complete frequency spectrum is heard in all areas. Even in the extreme case of being directly in front of one loudspeaker system the complete program is heard from the other loudspeaker across the room. The *separation* of instruments in the *stereo image* and the *definition* of instruments in the *sound image* are a unique and valuable product of the McIntosh total technology approach to design.

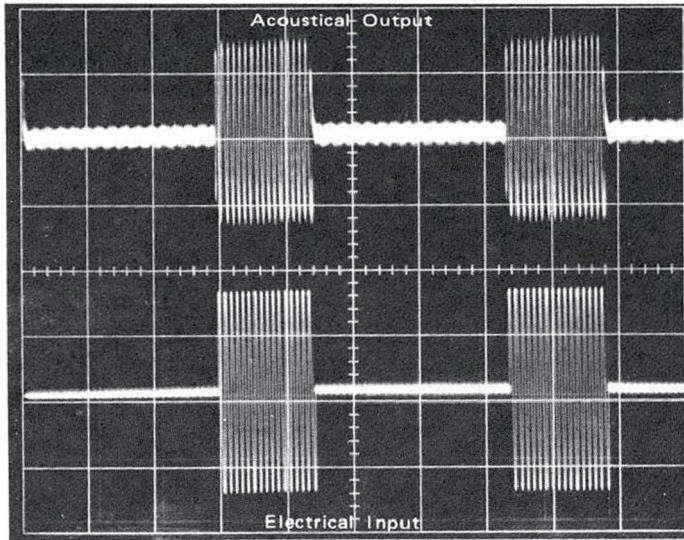
DESIGNING FOR NATURAL BASS

Research programs have one common advantage for the alert scientist and engineer. The thousands of hours of effort, analysis, conjecture, and synthesis uncover opportunities to make meaningful

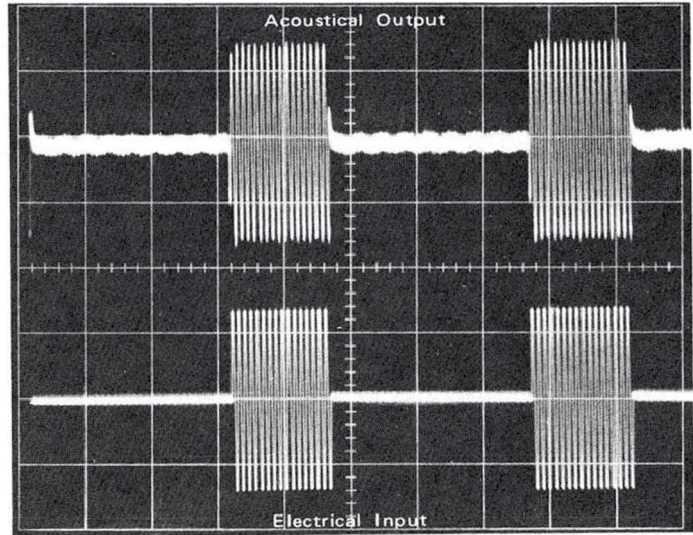
excursion. Remember that, even with this large excursion, the straight line relationship between driving force and movement had to be maintained.

To achieve this linear relationship our engineers employed a long voice coil winding, a very light edge and centering suspension and an air spring. The air spring is the natural result of mounting the speaker in a relatively small air tight extremely rigid box. When the cone moves inward, it reduces the volume of air thereby increasing its pressure. The increased air pressure returns the cone to the center of its travel when the electrical signal returns to zero value. When the cone moves outward, the volume of air increases reducing the air pressure in the box. Now the air pressure in the room can restore the cone to its center position when the electrical signal again reaches zero. One of the properties of an air spring is an almost perfectly straight line relation between volume and pressure for such small changes in volume. This insures a low level of distortion at low frequencies and also a low level of intermodulation distortion.

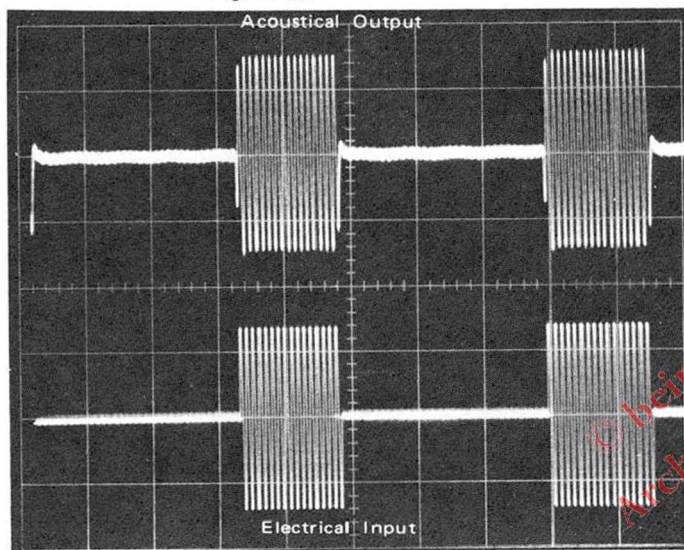
It was at this point that a really new and patented development occurred. We found that if we combined the linear air spring with a stiff cone, long voice coil and a very large and massive magnet structure



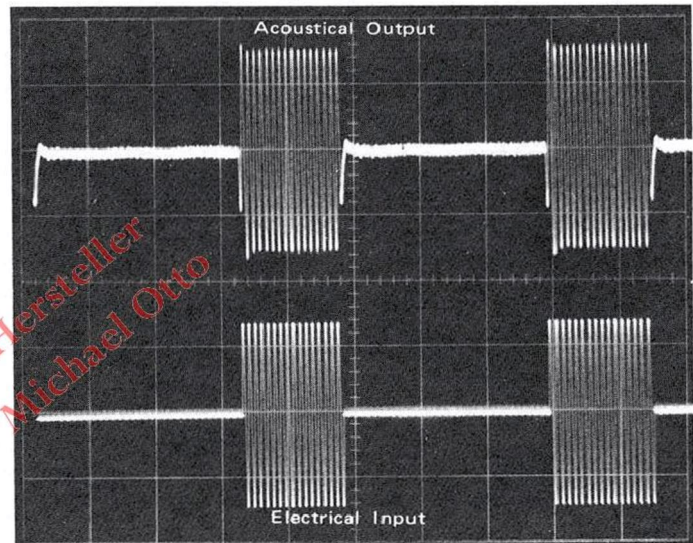
20 HERTZ TONEBURST
Figure 8A



50 HERTZ TONEBURST
Figure 8B



100 HERTZ TONEBURST
Figure 8C



150 HERTZ TONEBURST
Figure 8D

we could achieve the most accurate transient response for bass frequencies.

The above oscillograms show the degree of accuracy with which the system reproduces tone bursts at 20 hertz (Figure 8A), 50 hertz (Figure 8B), 100 hertz (Figure 8C), and 150 hertz (Figure 8D).

The use of a massive magnet structure to obtain this degree of transient accuracy produces what is called an over damped speaker. Such a speaker produces the most accurate transient response, but it has another characteristic that has bothered designers for many years. The response of the speaker

rises as frequency increases from 20 hertz to about 160 hertz. The rise in response is on the order of 17 decibels, a power ratio of 50 to 1. See Figure 9.

There are two ways to obtain a flat response over this frequency range. In the older technological approach to loudspeaker system design, flat frequency response was obtained by using mechanical resonances in the speaker and its enclosure but this compromised the transient response. This has been the traditional solution with its emphasis on cost reduction rather than reproduction accuracy.

Then there is the new approach. To restore the system to a flat frequency response while preserving the most accurate transient response, an electrical signal is supplied having an exactly opposite curve to the curve of the rising speaker response. (Figure 9) Supplying this electrical signal introduces an equalizer into the system. The combination of the loudspeaker system and equalizer produces both a flat response and an excellent transient characteristic, free of ringing, down to 20 Hz. This is the subject of three patents #3,715,501, 3,721,861, and 3,803,359 all assigned to McIntosh Laboratory, Inc.

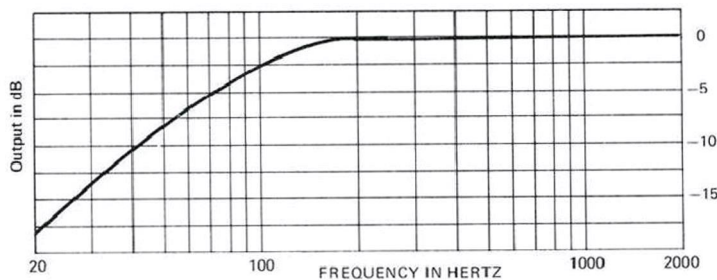


Figure 9

This advantage brings another potential improvement to the system. The room in which the loudspeaker is placed can substantially alter its sound balance. The equalizer can be designed to compensate for different rooms and for different positions of the loudspeakers in any room.

DESIGNING FOR DIFFERENT SPEAKER POSITIONS

The intensity of sound delivered to the room from a bass speaker at very low frequencies varies over an 8 to 1 range (9 decibels) depending on where the speaker is positioned in the room.

For example if the loudspeaker enclosure is suspended in the center of a large, sound absorbing room, a 20 hertz signal will radiate equally in all directions from the loudspeaker. It will be radiating into a sphere.

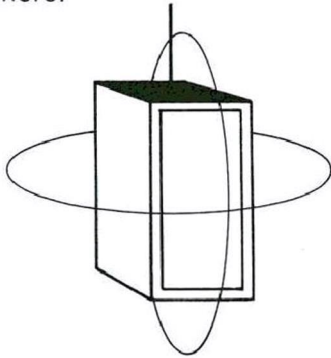


Figure 10

If the loudspeaker enclosure is then lowered to the floor in the center of the room it would be radiating into a hemisphere. The signal striking the floor would be reflected upward and in effect double the intensity delivered to the room.

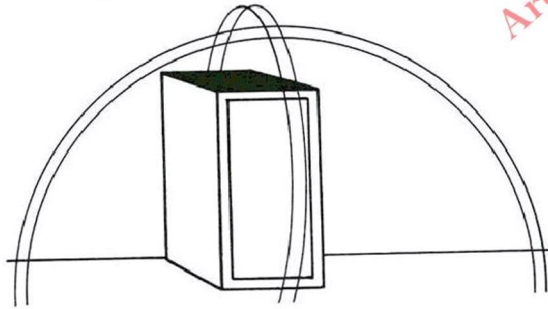


Figure 11

If the loudspeaker is then moved along the floor to the center of the wall the intensity will double again. The loudspeaker is then radiating into one quarter of a sphere.

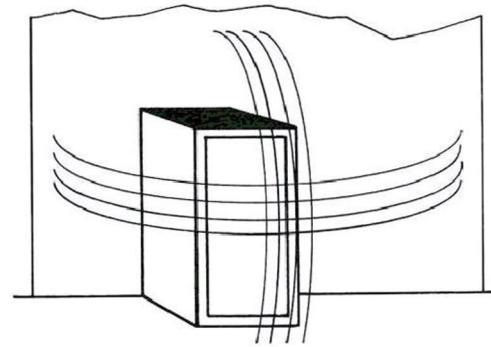


Figure 12

Then by moving the loudspeaker into a corner of the room the radiation is concentrated into one eighth sphere with another apparent doubling in intensity.

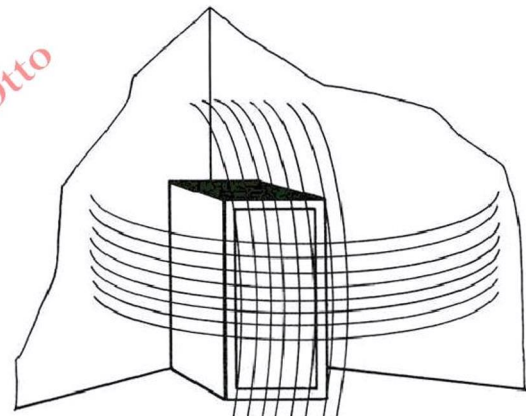


Figure 13

The effect of the position of a loudspeaker system in a room can be summarized graphically as in Fig. 14.

Comparative Effect of Room Gain with Changes in Loudspeaker Placement.

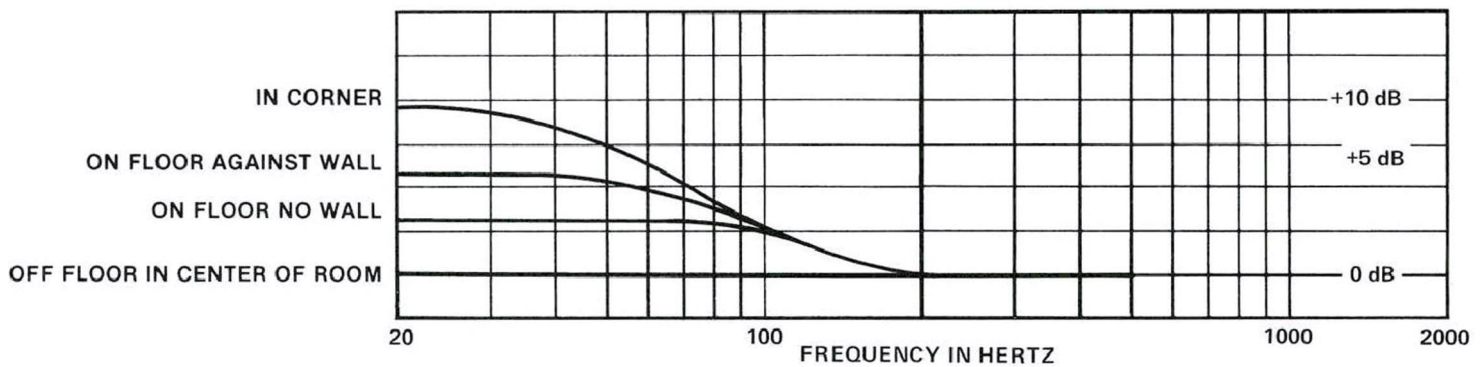


Figure 14

The equalizer that was required for natural bass reproduction with accurate transient response can now provide an additional advantage. The electrical correction supplied by the equalizer can be varied in accordance with the upper curves shown in Figure 15. The lower group of curves show the net acoustic effect of the environmental equalizer.

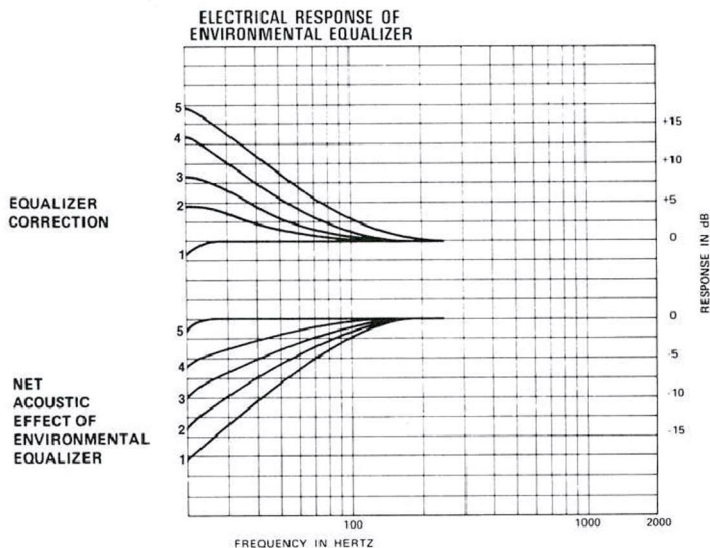


Figure 15

By selecting one of five curvature rates in the environmental equalizer it is possible to make a speaker sound as it would in a corner when it's mounted on a wall or vice versa. For stereo individual left and right controls are provided to correct for different placement of the loudspeakers in the room.

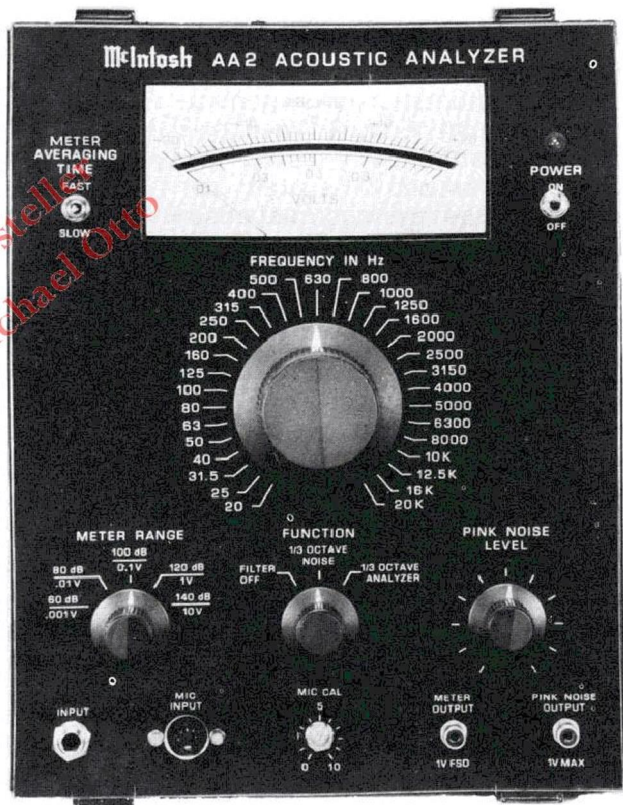
OBTAINING MAXIMUM VALUE FROM THE WORLDS BEST LOUDSPEAKER

Regardless of what room you use them in McIntosh speakers will always sound better than any other speaker. Whether they are used with an equalizer or not the superiority of the McIntosh speaker is always apparent. The clarity, the naturalness of sound, the balance, the accurate transient response are all superior qualities that are always with you.

Every room affects the balance of the sound in that room. Millions of dollars have been spent trying to establish correct balance for symphony orchestras in concert halls. As live music is affected by a room so is the sound of a speaker. There are several ways in which this happens.

- The position of the speakers in the room.
- The dimensions of the room.
- The wall, floor and ceiling covering.
- The stiffness or flexibility of the room surfaces.
- Radiation from furnishings or substructures in the room.

Any or all of these factors can alter the sound balance. What you can do about this depends of course on what you want to do. Some people simply live with incorrect musical balance because it's not important enough to them. Sometimes very simple measures, such as changing the location of speakers, will produce adequate musical balance. After going to over 100 rooms where people live and listen we have found that most systems can be dramatically improved by acoustically analyzing the room and then from this position of knowledge specific remedial action is easy to apply. Whether it is a simple action such as relocation of speakers or whether it involves electrical compensation for otherwise unavoidable imbalance, simply knowing at what frequency to apply correction and how much correction is valuable in itself. When each speaker's response to the listeners ears is smooth and uniform and in balance the sudden A/B comparison of improved clarity, stereo imaging and overall listening impression is dramatically satisfactory.



McIntosh has developed an acoustical analyzer which your franchised dealer can bring to your home. In a matter of one to three hours you can have an accurate point by point 1/3 octave analysis of your speakers in your home. You can experience the A/B comparison of correct balance and smooth uniform sound from each loudspeaker. You can know that your system is right for your home and for your own ears. Even if you should need to move your home, or only move your speakers in your home, correct balance can be restored in a short time.

An investment in McIntosh sound is truly one of the safest investments you can make.

To protect your investment each McIntosh Isoplanar Radiator System is given a wide variety of tests.

Tests range from intermodulation distortion to power response. These tests require the purchase of some very expensive and sophisticated test equipment and facilities. Too often manufacturers bypass the expense and time required to perform this important research.

Response measurements are made in a matter of seconds with a Bruel & Kjaer Real Time Analyzer, (fig. 1). We can see the output of all the 1/3 octave bands simultaneously. This screen display shows the output of a pink noise generator that is used to make response measurements. By driving a speaker system with pink noise and automatically switching the output of many Bruel & Kjaer condenser microphones located at various points around the system, we quickly find the average response radiated over various solid angles. This way we can design with a degree of confidence not only in the measurements, but also in the loud-

speaker system performance. To do the same test by measuring each of 30 individual frequency bands at each of many points in space and then calculating the average response would literally take days. If improvements were then to be made in developing the system, these tests would have to be done over again many times.

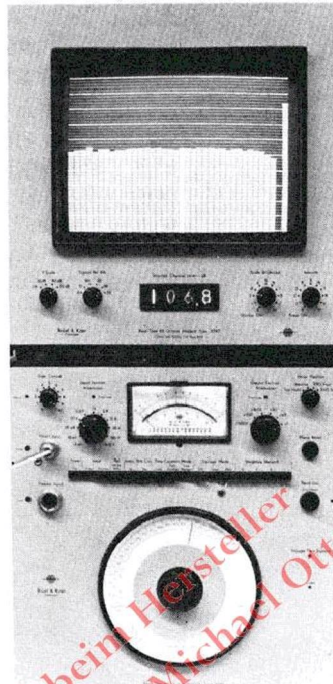


FIG. 1 REAL TIME ANALYZER

The anechoic chamber (fig. 2) is used for some of our tests where a controlled acoustic environment is essential. The surfaces of this chamber reflect only .1% of the sound striking them. Distortion and response can be easily and repeatedly measured under these conditions without any false readings caused by reflecting surfaces.

The reverberant room tests (fig. 3) are equivalent to measuring and averaging an infinite number of points around the speaker system. This enables us to rapidly find the total acoustic power radiated from the speaker in all directions. Smooth acoustic power is essential in good speaker design. Calibration and environmental control devices are shown as well as Bruel & Kjaer condenser microphone and McIntosh XR Isoplanar Radiator system.

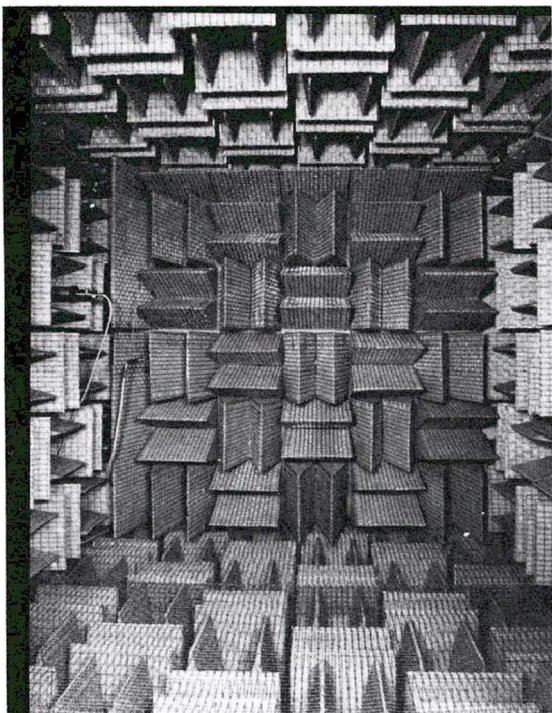


FIG. 2 ANECHOIC CHAMBER

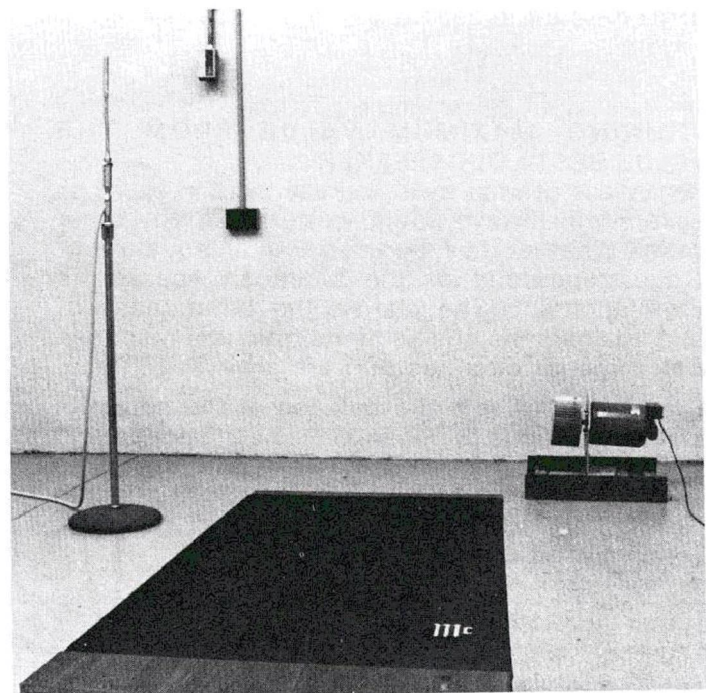


FIG. 3 REVERBERANT ROOM

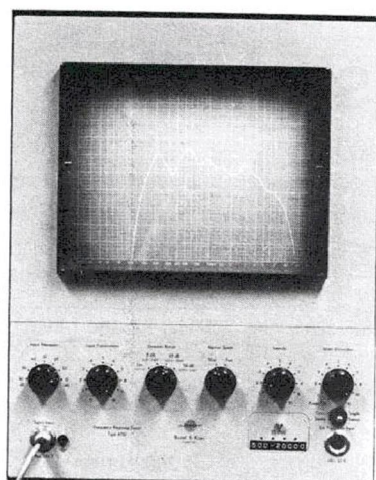


FIG. 4 RESPONSE TRACER

This Bruel & Kjaer Response Tracer (fig. 4) is used to test speaker elements in production before they are used in the system. This insures maximum quality control and uniformity between systems.

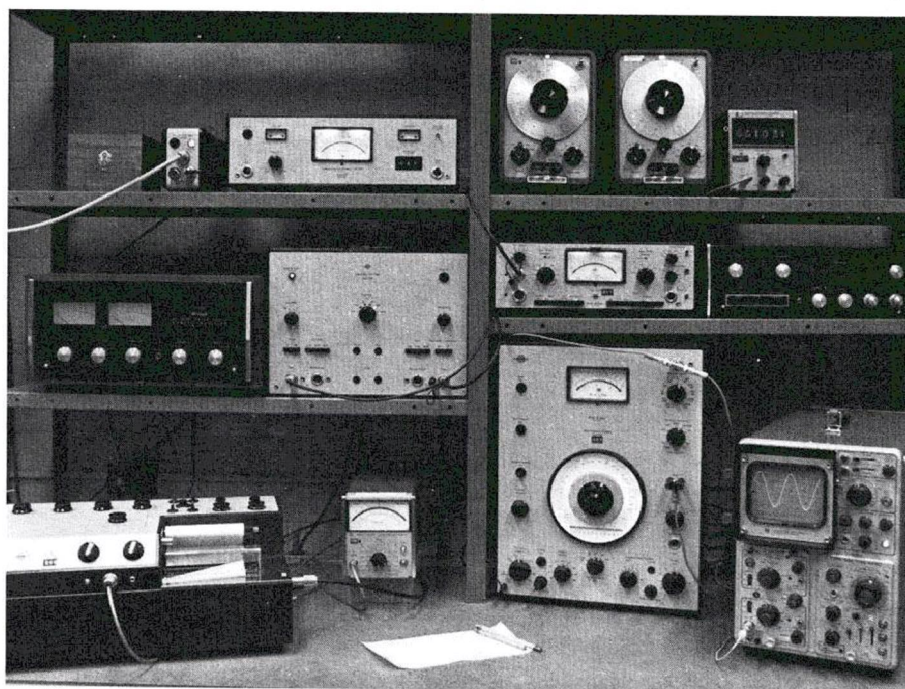


FIG. 5 TEST BENCH

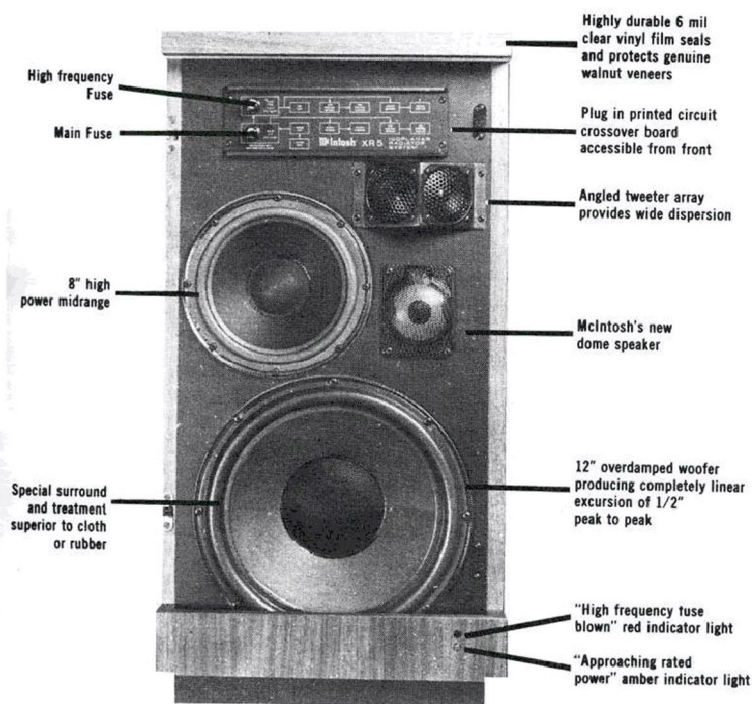
This Bruel & Kjaer test equipment (fig. 5) is used for measuring response and impedance as well as harmonic and IM distortion. This equipment automatically plots a continuous curve of total harmonic distortion or resolves individual curves for 2nd, 3rd, 4th, and higher components. Higher harmonics are more easily heard than lower ones. If you were to measure a power amplifier for distortion you might measure at 20 Hz, 1 kHz, and 20 kHz. If it is low at these frequencies, you could infer all other frequen-

cies are as low and you probably would be right. With loudspeakers, however, any frequency could be bad and not show up at other frequencies. A continuous measurement is the only way to be sure.

The XR Isoplanar Radiator loudspeaker systems are the result of extensive and thorough research and development. We make the XR systems to give you the best performance and best value.

Special attention is paid to the crossover network. Low loss metalized capacitors are used in all critical mid and high frequency circuits. Selected low loss electrolytics are used in less critical areas. Both air core and iron core inductors are used. The iron cores operate in the completely linear region even at the maximum recommended power levels for the system. The circuits and components in the network of each speaker element are carefully adjusted for optimum system performance with maximum phase continuity which presents an improved coherent sound source to the listener over a wide listening area. This causes the stereo image between the speakers to remain steady without changing apparent location with various frequencies.

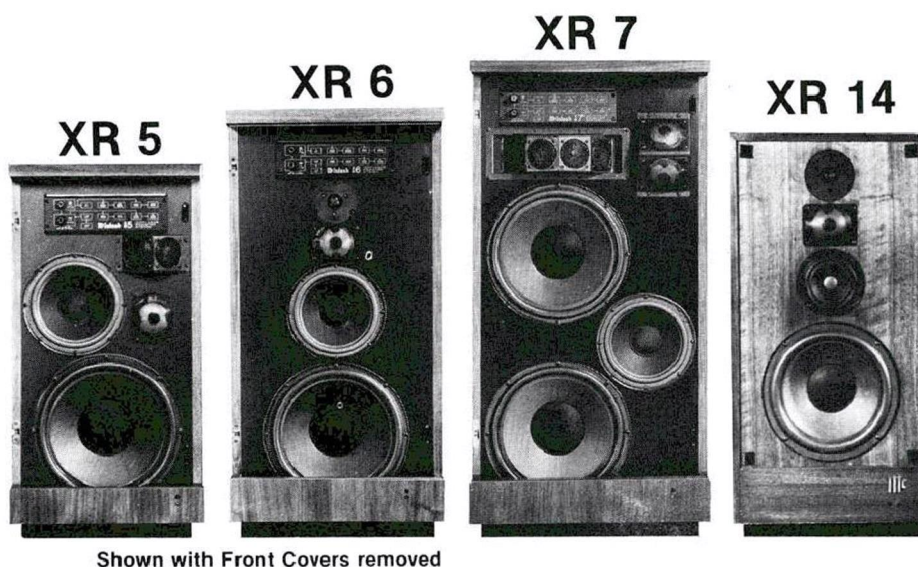
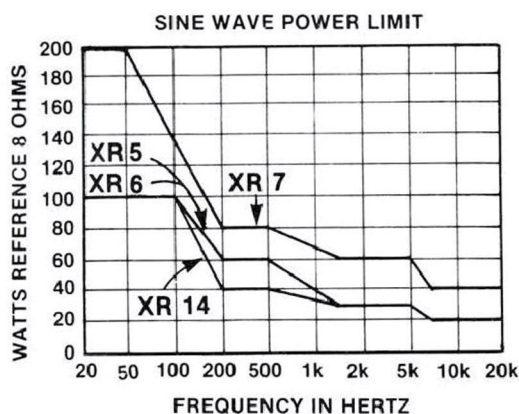
Finally we listen to our loudspeakers. We listen over a wide range of program material and in a variety of rooms. When we listen to a speaker that appears to sound smooth, we need to know why it sounds smooth. We need to measure it to know how smooth, in what frequency range, and where it might need improvement. Achieving the design goals of low distortion, smooth power response, wide frequency range, minimum phase interference, wide dispersion, high power handling, etc., is a challenge that can only be met by extensive use of adequate test equipment coupled with years of listening, designing and manufacturing experience.



XR 5

ISOPLANAR RADIATOR LOUDSPEAKER SPECIFICATIONS

SPECIFICATIONS	XR 5	XR 6	XR 7	XR 14
Impedance	All Systems: 8 Ohms Nominal			
Crossover Frequencies	250 Hz, 1.4 and 7 kHz	250 Hz, 1.4 and 7 kHz	250 Hz, 1.4 and 7 kHz	250 Hz, 1.4 and 7 kHz
Program Power Rating (Maximum Power Provided Amplifier Is Not Driven Into Clipping)	200 Watts	200 Watts	300 Watts	200 Watts
Sine Wave Power Rating	See Graph Below			
Speaker Sizes (Diameter) Woofer, Frame Size Radiator Size Low Mid-Range, Frame Size Radiator Size Upper Mid-Range, Radiator Tweeters, Radiator	12" (30.5 cm) 9 1/2" (24.1 cm) 8" (20.3 cm) 6" (15.2 cm) 1 1/2" (3.8 cm) Dome Two 2" 5/8" (5.1/1.6 cm) Coaxial Super Radiators	12" (30.5 cm) 9 1/2" (24.1 cm) 8" (20.3 cm) 6" (15.2 cm) 1 1/2" (3.8 cm) Dome 1" (2.54 cm) Super Radiator	Two 12" (30.5 cm) Two 9 1/2" (24.1 cm) 8" (20.3 cm) 6" (15.2 cm) Two 1 1/2" (3.8 cm) Domes Four 2" 5/8" (5.1/1.6 cm) Coaxial Super Radiators	10" (25.4 cm) 7 3/4" (19.7 cm) 5" (12.7 cm) 3 1/8" (7.9 cm) 1 1/2" (3.8 cm) Dome 1" (2.54 cm) Dome Super Radiator
Burn-Out Protection	All models have individual system and high frequency fuses with warning and blown fuse indicator lights			
Cabinet Size Height Width Depth	29 15/16" (76 cm) 15 (38.1 cm) 12" (30.5 cm)	35 13/16" (90 cm) 17 1/2" (44.5 cm) 13" (33 cm)	40 3/16" (102 cm) 19 1/2" (49.5 cm) 14 3/8" (36.5 cm)	30 3/16" (76.6 cm) 14 3/4" (37.5 cm) 9 15/16" (25.1 cm)
Construction	All models constructed of 3/4" thick 45 pound density particle board covered with genuine walnut veneer. Hardwood internal bracing and airtight glueing of all seams and joints assures a strong and rigid enclosure. The walnut has been protected by a low sheen, clear, highly durable .006" clear film.			
Weight Net Shipping	69 lbs. (31.3 kg) 76 lbs. (34.5 kg)	81 lbs. (36.7 kg) 100 lbs. (45.4 kg)	118 lbs. (53.5 kg) 128 lbs. (58.1 kg)	52 lbs. (23.6 kg) 72 lbs. (32.7 kg)



THE McIntOSH MQ 104



FOR THE SOUND OF REALITY IN YOUR LISTENING ROOM

- To ensure musical balance in your listening room tailored to your personal needs -
- To restore your musical balance when you move your speakers -
- To restore your musical balance if you move to a new room -
- To protect your investment in your stereo system -

McIntosh has developed the

MQ 104

CUSTOM ENVIRONMENTAL EQUALIZER.

The McIntosh MQ 104 equalizer is really two stereo equalizers in one. The MQ 104 has one set of equalizer filters designed especially to correct for musical imbalance caused by: room resonances, placement of the speakers in the room, stiffness or flexibility of room surfaces and some other types of room problems. There are eight programmable filter bands, four

in each stereo channel. Each filter can be set for frequency and bandwidth and is adjustable for amplitude boost or cut.

Extensive testing of home living rooms and dealer listening rooms indicates that room dimensions influence the performance of loudspeakers below 1000 Hz. The most pronounced effects are measured below 250 Hz. Speakers which appear to have no highs and sound "boomy" usually are the victims of a poor listening environment. By eliminating the low frequency peaks caused by room resonances, the highs will appear to be restored and the "boomy" sound will be gone. In many "problem" rooms, the difference with and without the correction is literally night and day.

The MQ 104 has a second equalizer circuit that can be used with McIntosh loudspeakers for low frequency compensation.

McIntosh loudspeaker systems have a unique combination of moving or sound producing parts, cabinet, and acoustic damping material. The design relationship of these many elements produces the most accurate control of the woofer cone motion. Motional control is particularly important at system resonance where other types of designs lose control and cause "ringing." Control is achieved in a low frequency radiator by increasing the size and effectiveness of the magnetic structure. This causes the radiator to have a rising response with frequency. Compensation is pro-



PROGRAMMABLE FILTER SECTION



LOW FREQUENCY COMPENSATION SECTION

vided by the MQ 104 and is used to extend bass response to 20 Hz.

In some homes acoustical response of the room, when measured with a $\frac{1}{3}$ octave analyzer, will occasionally not require use of compensation. In such a room where resonance or room gain compensates for much of the rising response of the McIntosh woofer, the programmable filter sections can be used to make any further improvements. In this case, the compensation controls of the MQ 104 would not be needed.

In other rooms, when needed, the compensation controls are really useful since they have been designed with five positions of compensation. The design allows correction for different room gains that occur when the speaker is placed on the floor in a corner, against a wall on the floor away from the corner, or off the floor and away from the corners of the room. The low frequency compensation controls can select one of five curves to correct for these different locations.

The MQ 104 is designed to be used with accurate acoustic test equipment. Response measurements in the normal listening area are essential to correct equalization with the MQ 104. In addition, the MQ 104 can be most effectively adjusted by persons having knowledge, experience and expertise in making acoustic measurements.

With suitable test equipment and qualified personnel, the McIntosh MQ 104 allows complete control of the listening room environment at low frequencies.

The MQ 104 is designed to be used between the input of the power amplifier and the output of the preamplifier. Its noise output is so low that it will not degrade the signal to noise ratio of the system by any appreciable amount. Its distortion components are similarly insignificant.

MQ 104 PERFORMANCE LIMITS

FREQUENCY RESPONSE

± 0.5 dB from 20 Hz to 20,000 Hz (with equalization set flat)

HUM AND NOISE

Flat Response, 90 dB (79 μ V) below rated output (2.5 V). Worst case setting, 85 dB (140 μ V) below rated output (2.5 V)

HARMONIC AND INTERMODULATION DISTORTION

Will not exceed 0.1% at rated output level (2.5 V) 20 Hz to 20,000 Hz

INPUT SENSITIVITY AND IMPEDANCE

2.5 volts into 27,000 ohms for rated output with controls set for flat response

OUTPUT LEVEL AND IMPEDANCE

2.5 volts into 27,000 ohms or more with controls set for flat response. Output source impedance is 600 ohms.

PROGRAMMABLE FILTERS

8 sections (4 per channel) each of which can be programmed for $\frac{1}{3}$ octave center frequencies

from 20 Hz to 3150 Hz. Filter bandwidth is programmable for narrow (approx. $\frac{1}{3}$ octave) or wide (approx. 1 octave). Amplitude is continuously adjustable ± 12 dB for narrow and ± 15 dB for wide. A detented control is used to position for flat response. Programming is achieved by means of plug-in capacitors provided with the MQ 104.

LOW FREQUENCY COMPENSATION

Five steps of low frequency compensation are included for McIntosh speakers, allowing 0 to +17 dB at 20 Hz

MECHANICAL INFORMATION

SIZE

Measures overall: length 9 $\frac{1}{4}$ inches (23.5 cm) by width 5 $\frac{1}{2}$ inches (14.0 cm) by height 3 $\frac{5}{8}$ inches (9.2 cm)

FINISH

Chrome and Black

WEIGHT

4 $\frac{3}{4}$ pounds (2.15 kg) net, 6 $\frac{1}{4}$ pounds (2.83 kg) in shipping carton

Output Transformers in Transistor Power Amplifiers

by Sidney Corderman*

Output transformers can make transistor power amplifiers more reliable, more flexible, and more powerful. At the same time output transformers offer the best continuous protection to loudspeakers against the hazards of avalanche failure of output transistor devices.

Time has shown that output transformers make transistor amplifiers operate cool and safe. The output transformerless amplifier (OTL) becomes less exciting when amplifiers must give long, consistent and predictable operation.

Let's take a look at transformers in general - - at their past and present use in amplifiers - - and at why McIntosh Laboratory continues to be the leader in the amplifier field with the use of transformers.

Remember Vacuum Tube Amplifiers?

Until the early 1960's, McIntosh and just about everyone else in the high fidelity component manufacturing business produced vacuum tube power amplifiers exclusively. The familiar push-pull circuit of Fig. 1 reigned supreme. In that circuit we had a pair of tetrode or pentode tubes with their high output impedance trying to deliver power to low impedance loudspeaker systems. A transformer was needed to provide the necessary impedance match between them. But there were problems in trying to achieve an optimum transfer of power between tubes and speakers. Typically, using a pair of 6L6 output tubes in

push pull, we had a tube load impedance of 4000 ohms trying to deliver

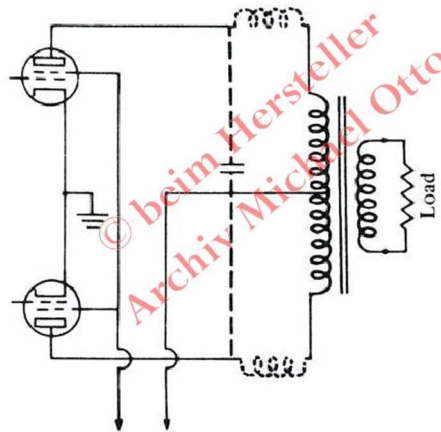


Fig. 1 - Typical push - pull output circuit (see story for dashed line information)

power to, say, an 8 ohm speaker load. The impedance ratio was 500 to 1, and the necessary transformer had to have a turns ratio of around 23 to 1 (turns ratio varies as the square root of the impedance ratio). The required turns ratio created problems at both ends of the audio frequency spectrum. Leakage inductance and shunt capacitance (represented as dashed lines in Fig. 1) caused high frequency roll-off. The primary inductance of the transformer together with its inherent non-linear characteristics placed limits on low-frequency response. And the energy stored in the unwanted leakage inductance caused notch distortion, as illustrated in Fig. 2.

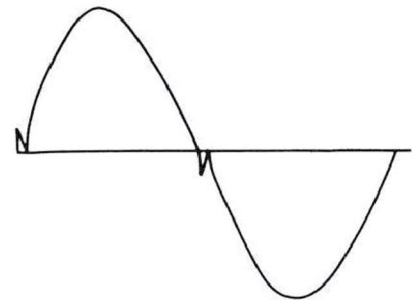


Fig. 2 - Notch distortion in a typical Class B output circuit

The McIntosh Unity Coupled Circuit

Long before the advent of transistorized power amplifiers, McIntosh found an effective way to solve these problems. We called it the Unity Coupled Circuit. The basic configuration is illustrated in the diagram of Fig. 3.

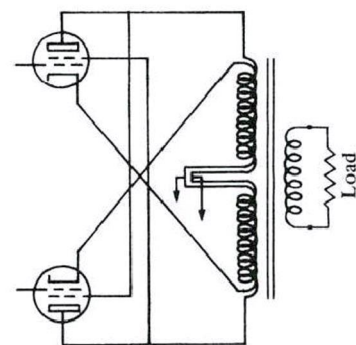


Fig. 3 - McIntosh "notch free" low distortion Unity Coupled Circuit

*Vice President of Research and Development, McIntosh Laboratory Inc.

The impedance ratio required between primary and secondary has been reduced by a factor of four-to-one compared with the conventional arrangement. It is now 125 to 1 (1000/8). The turns ratio is therefore only half of what it was before. Leakage inductance is therefore much lower, and so is the shunt capacitance across the windings. The use of a bifilar winding technique completely eliminates the leakage inductance problem of coupling between the sections of the primary windings. It was the development of the Unity Coupled Circuit by McIntosh (the circuit is patented) way back in 1947 that enabled us to produce amplifiers which were a whole order of magnitude lower in distortion than the competition of those days. Typically, we were able to produce power output circuits with total harmonic distortion of under 1.0% even before the distortion-reducing negative feedback loop was added. With just 20 dB of feedback applied, the THD was further reduced to under 0.1%!

What About Transistor Amplifiers

The audio industry welcomed the power output transistor as the solution to all its problems. After a few faltering starts (early germanium power output transistors were notoriously unreliable and easily destroyed by high operating temperatures), silicon power transistors became the standard power device in power amplifiers.

Since power output transistors exhibit a low output impedance, it was possible to design output circuits to match 8-ohm loads directly—without the need for a matching audio output transformer. Indeed, most OTL amplifiers, when coupled to 8-ohm resistive loads for test purposes, can deliver full rated power to those loads for long periods of time without overheating or exceeding safe thermal dissipation limits. The trouble is that we don't listen to resistors—we listen to loudspeakers. It will come as no surprise to you to learn that speakers having a "nominal" impedance of 8 ohms often measure lower and higher impedance values at different audio frequencies. Then, too, consider the fact that many popular speaker systems have nominal impedances of 4 ohms, and the impedance of 4 ohm speakers can easily dip down to as low as 2 ohms at certain

frequencies. What happens to an OTL amplifier with such low impedances connected to it? In theory, if an output stage is designed to match an 8 ohm impedance, its power output capability should double when it's connected to a 4 ohm impedance. But as this mismatch occurs, thermal dissipation increases rapidly. In fact, operating into a 4 ohm load, heat dissipation is double what it would be when operating at 8 ohms, as illustrated in Fig. 4. Unfortunately, if the amplifier was designed for 8-ohm operation, its thermal dissipation limits were designed with some safety factor

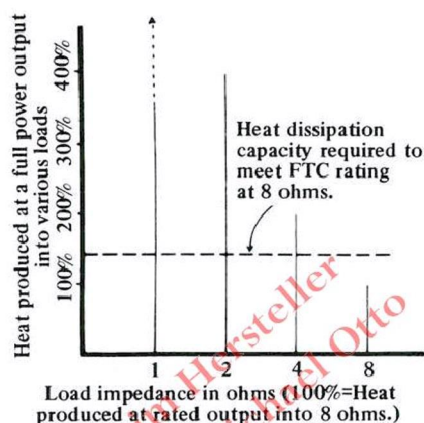


Fig. 4—Heat produced by transformerless amplifier at various load impedance

for 8 ohm operation, so as to meet the new FTC preconditioning requirements. These call for the amplifier to be able to deliver one-third rated power at rated impedance for one hour. But, as you can see from Fig. 4, the safety margin is not nearly great enough to permit operation at 4-ohms—or 2-ohms—or 1-ohm impedances. Remember, too, that many amplifiers and receivers have provisions for connection of more than one pair of speakers for use in different listening rooms, so that even if 8-ohm speakers are selected, using double pairs of them results in a 4-ohm net nominal impedance even before allowing for downward variations in impedance at specific frequencies in the audio spectrum. So, unless manufacturers are willing to resort to disproportionately massive heat sinks, cooling fans or combinations of both, designing power amplifiers that can deliver their maximum powers at both 8 ohms and im-

pedances of 4 ohms and lower becomes physically impractical in the case of the OTL amplifiers.

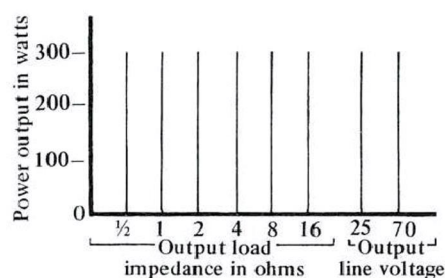


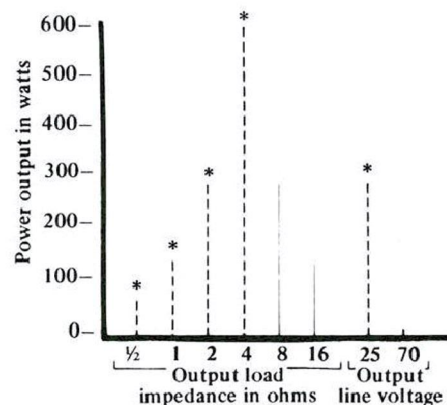
Fig. 6—Performance of MC 2300

The Answer—Output Transformers!

If a transistorized amplifier were equipped with an output transformer, you could move up or down in load impedance and maintain full power ratings without over-dissipating anything, since the amplifier's output stages would always be working into an ideal load.

To many hi-fi enthusiasts, output transformers tend to create visions of compromised design. That is just not the case today. Technology in materials and transformer design methods have advanced significantly in recent years and, remember, we're dealing with low impedance devices—not tubes.

It's no longer necessary to translate impedances from a "plate circuit" to a speaker—a step down of several hun-



(* - - - Continuous operation not possible due to overheating. Protection circuit is assumed to current limit when load falls below 4 ohms, in actuality the output into 4 ohms and lower impedances will fall below the values shown.)

Fig. 7—Performance of non McIntosh transformerless amplifier rated for 300 watts in 8 ohm load

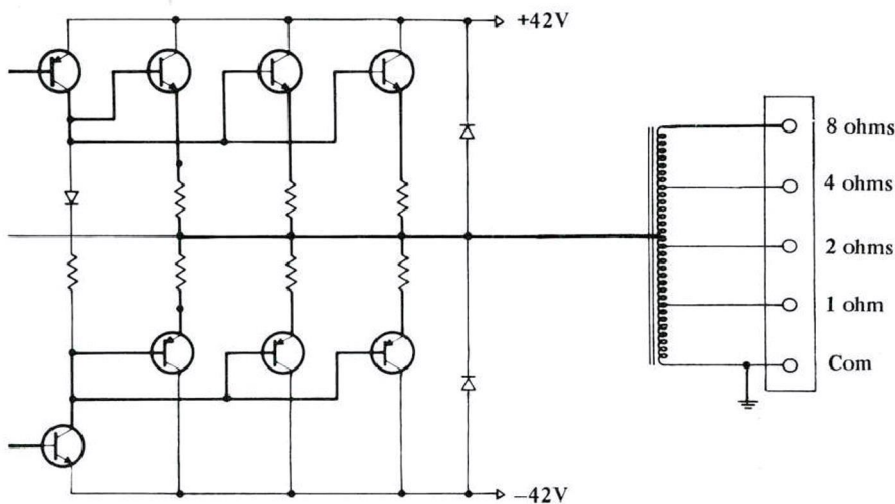


Fig. 5 – McIntosh MC 2205 output stage and transformer

dred to one. With transistor output stages, a ratio of only about 4 to 1 is required. In tube amplifiers, extremely good balance in the push-pull primary was required if notch distortion was to be avoided. Now, using a single ended push-pull transistor output stage the transformer can be driven in a single ended fashion. One end of the winding is returned to ground potential. With the transformer at ground, no isolation is required between the input and output and therefore a simple auto-transformer can be used.

Fig. 5 shows a typical arrangement used in our new MC 2205 amplifier. The output stages are designed to work optimally into a load impedance of 2.1 ohms and it becomes a simple matter to “tap into” the auto-transformer for that precise impedance match. Taps for 1 ohm, 2 ohm, 4 ohm and 8 ohm operation are arranged so that the output transistors continue to work into their optimum impedance. The result: full power output at any of these impedances, with no possibility of thermal over-dissipation.

Our popular MC 2300 amplifier also uses an auto-transformer and Fig. 6 shows how that amplifier is able to deliver its full rated power (300 watts RMS per channel) into any impedance from 0.5 ohms to 16 ohms, as well as to 25 volt and 70 volt multi-speaker system taps on the transformer. If we compare these results with those obtained with a similarly rated

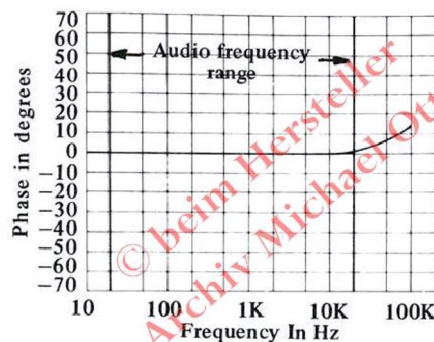


Fig. 8A – Typical of phase shift in McIntosh auto-transformer at 8 ohms

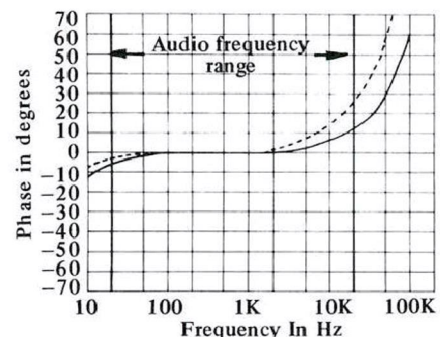
OTL amplifier (Fig. 7) we see that at all but 8 and 16 ohms, continuous operation at theoretical maximum power is impossible because of overheating and protection circuit limiting. Operation at 16 ohms, though possible, is limited to a maximum power output of 150 watts, in this case, while operation into a 70-volt line is impossible because of limitations in power supply voltages.

What About Phase Shift?

Critics opposed to the use of transformers in output circuits of audio amplifiers are quick to point out that “transformers introduce phase shift” at the low and high frequency extremes. As a matter of fact, a properly designed transformer (and we’ll get into some of the factors that are involved in designing McIntosh output

transformers in a moment) can introduce about 3 degrees of phase shift at 20 kHz (Fig. 8A), which is certainly insignificant. The typical volume control used on amplifiers (both those that are OTL and those equipped with transformers) introduce more shift than that—about 20 degrees in fact (Fig. 8B). Since an output transformer is driven from an extremely low impedance, there is actually more low-frequency phase shift caused by the usual input coupling capacitor at these low frequencies than by the transformer.

So, why haven’t more manufacturers used output transformers on solid-state amplifiers? Possibly they are not aware of the technology, but more likely they don’t want to spend the extra cost. A good transformer is an expensive component. It is heavy, takes up a fair amount of space and contradicts the audiophile’s notion that transistorized equipment must be small and lightweight. Be that as it may, the FTC regulations suggest that output transformers are the only logical solution to rating audio amplifiers honestly at 4, 8, 16 or any other impedance required.



1 watt, 8 ohms
— Volume Control Clockwise
- - - Volume Control 12 o'clock

Fig. 8B – Typical phase shift in a complete McIntosh amplifier

Not Just Any Transformer!

At McIntosh, we wind all our own output auto-transformers. Of course, we could purchase them from any one of a number of transformer companies who do nothing but wind transformers (our power transformers are, in fact, purchased from other suppliers), but we have long since found that transformers can’t always be made successfully “according to the book”. A great deal of experimentation is required before a new design of a transformer can

be mated to a specific amplifier circuit. We went through dozens of developmental samples in the case of our new MC 2205 amplifier. What we ended up with is shown schematically in the diagram of Fig. 9. The transformer is trifilar wound to provide coupling between sections. It takes 23 individual windings to make this output transformer. There are five different winding sections, all five of which are connected in parallel. We use grain oriented silicon steel core laminations because that kind of core means less iron—and less iron in turn means tighter coupling. It also means lower winding resistance for a given size wire. The grain oriented silicon steel means that it has a higher magnetic saturation point—about 17 kilogauss versus 12 to 13 kilogausses for the non-oriented variety. There is therefore less core loss, or, to put it simply, we end up with a more efficient transformer—one which couples more of the available amplifier power to the speaker loads. To further improve coupling, we don't use any interlayer insulating paper in a power transformer that might pose a breakdown problem. But since our polyurethane insulated

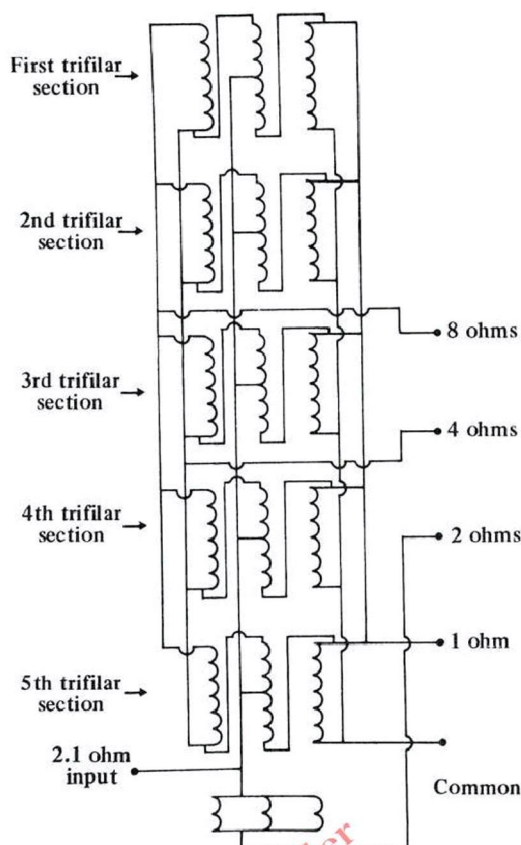


Fig. 9 - Mc 2205 output auto-transformer schematic diagram

wire is rated at 4000 volts per mil (and since the highest voltage we're talking about for an audio transformer is about 56 volts), this really is no problem at all. All of our output transformers are potted with material which has especially high thermal conductivity. Besides helping to keep operating temperatures within the transformer down, this compound reduces lamination buzz to inaudible levels. We figure you'd rather listen to your speakers than to our transformers!

Our Transformers Are Only Part of The Story

Whether an amplifier uses an output transformer or not, its output devices must be designed to work into an optimum load so that maximum current delivered by the output transistors never exceeds the safe operating area specified for the transistor. Fig. 11 shows current versus voltage limitations for the epibase type of output transistor used in our MC 2205 amplifier. If all amplifier loads were purely resistive, staying within the safe operating area would be relatively simple, but the fact is that speakers often present highly reactive loads to ampli-

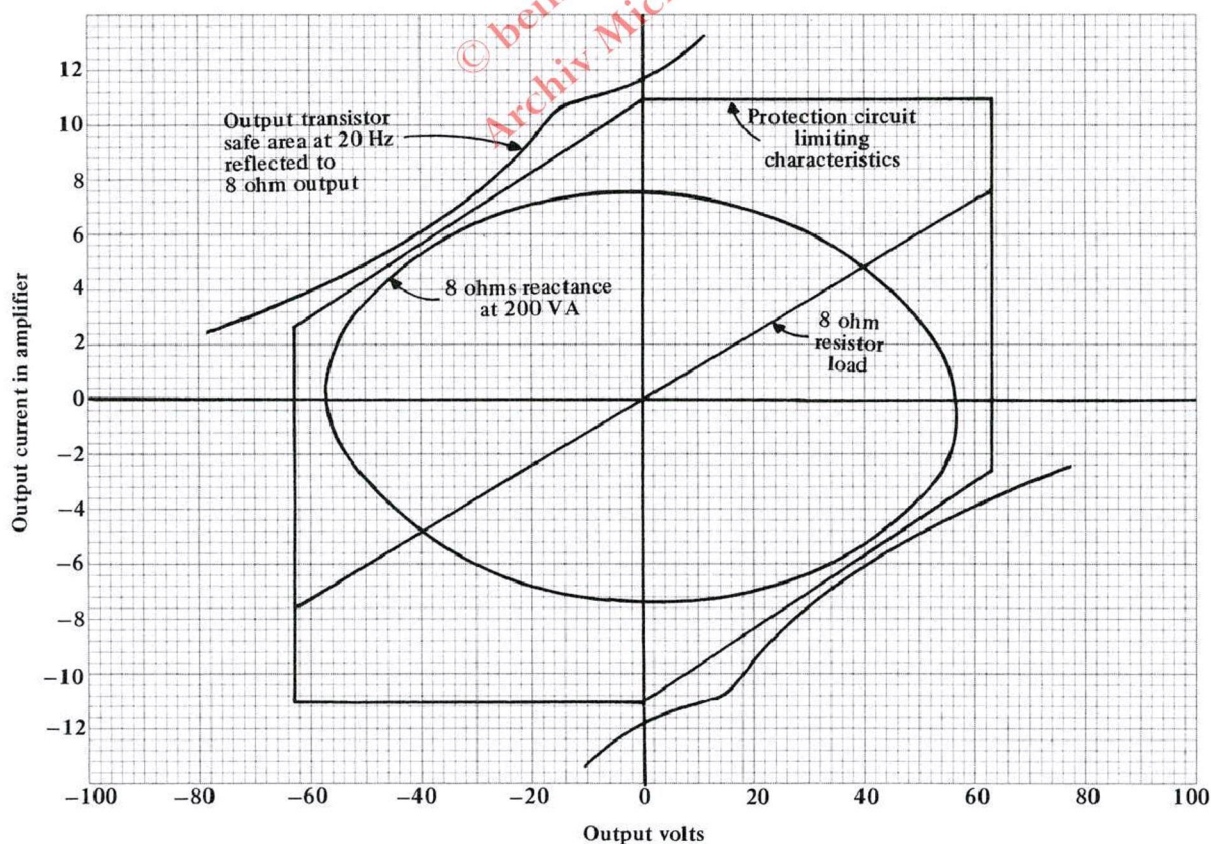


Fig. 10—Load and limiting data of the McIntosh MC 2205 measured at 8 ohm output.

provided for reactive loads.

To Sum It All Up

The points we've tried to make are relatively few, but they spell the difference between a McIntosh output-transformer equipped amplifier and every other kind of amplifier around.

1. A transformer equipped amplifier will deliver rated power at any impedance for which a transformer tap is provided.

2. An OTL amplifier designed for 8-ohm operation cannot operate safely (according to the FTC rules) when driving lower impedances (4 ohms, 2 ohms, etc.), yet such loads commonly occur either because of speaker impedance variations with frequency or because of paralleling of multiple speaker systems across one channel of an amplifier.

3. The new FTC power rule regarding audio amplifiers has forced many manufacturers to omit 4-ohm ratings—even though 4-ohm speakers are in common use. McIntosh transformer-equipped audio amplifiers deliver full power at any impedance for which a transformer output tap is provided.

4. Because of their design, McIntosh

transformers introduce less series leakage inductance than is commonly encountered with OTL amplifiers which require a series inductance between the output circuit and the speaker connection for amplifier stability. At the 8 ohm tap of our MC 2205, leakage inductance is a low 3.5 microhenries. This represents an impedance of only 2.2 ohms at a frequency of 100 kHz.

5. Properly designed output transformers impose no limitations on frequency response. At the 8-ohm tap of the MC 2205, response is down 0.3 dB at 50 kHz. With a 4-ohm load connected, response is down 0.1 dB at 50 kHz.

6. Phase response of the MC 2205 amplifier, using its specially designed output transformer, is accurate to within 9 degrees at the 8 ohm tap at a frequency of 50 kHz and undergoes zero degrees of phase shift at 20 Hz. At the 4-ohm tap, phase shift at 50 kHz is only 7.2 degrees.

Next time anyone gets into an argument with you concerning the attributes of an OTL amplifier versus a McIntosh transformer-equipped amplifier, you might let your adversary read this story.

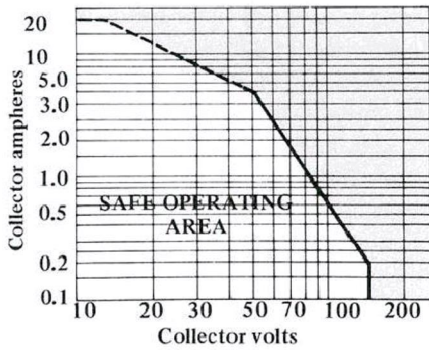


Fig. 11 - Current versus voltage limitation epibase type output transistor

fiers. In Fig. 10 we have combined the safe operating diagram of Fig. 10 with load and limiting characteristics at the 8-ohm tap of our MC 2205. As you can see, even when the load is totally reactive, every possible voltage and current condition falls within the safe operating area of the output devices used. Compare this diagram with Fig. 12 derived from data concerning the output transistors used in a currently available high-powered amplifier. Note that inadequate protection is

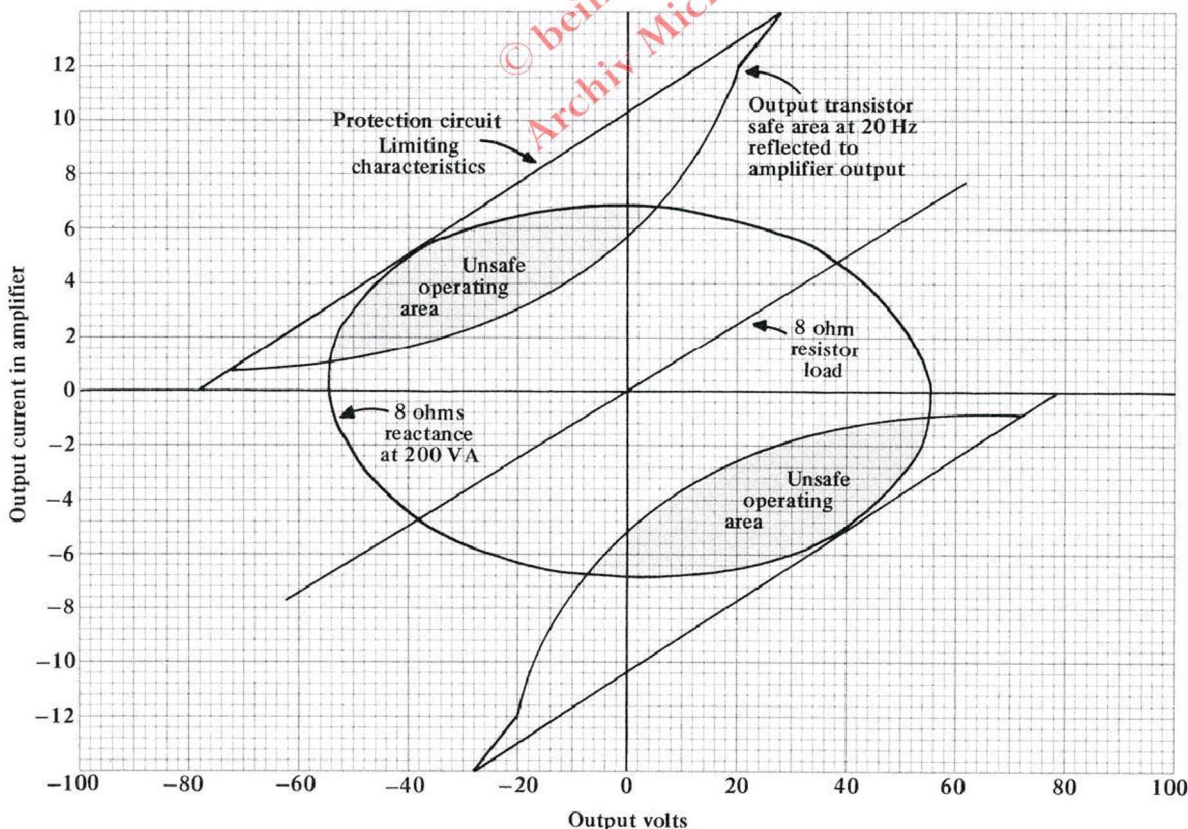


Fig. 12 - Load and limiting data of a non McIntosh high-powered transformerless amplifier measured at 8 ohms output.

Electronic Laboratories'

PRODUCT ANALYSIS

THE McIntOSH C 27 STEREO PREAMPLIFIER

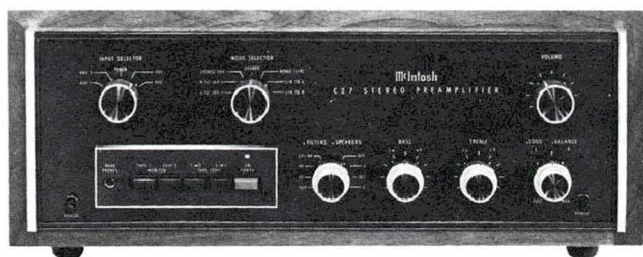


Fig.1 - Front view

MANUFACTURER'S PUBLISHED PERFORMANCE LIMITS (SPECIFICATIONS):

Rated Outputs: Main, 2.5 volts (Maximum greater than 10 volts) into 22k ohm load or greater; Tape, 0.25 volts (Maximum greater than 10 volts) into 22k ohm load or greater; Center Channel (L + R), 2.5 volts into 22k ohm load or greater. **Input Sensitivities:** High Level, 250 millivolts at 100k ohms; Low Level (Phono 1 & 2), 2 millivolts at 47k ohms and 100 pF. **Frequency Response:** (any input): 20 Hz to 20 kHz, +0, -0.5 dB. **Hum and Noise:** (Phono): 80 dB below 10 mV input, unweighted, 85 dB IHF "A" weighted; (High Level): 85 dB unweighted; 90 dB IHF "A" weighted.

GENERAL SPECIFICATIONS:

Dimensions: Front Panel: 16" W x 5-7/16" H. **Chassis:** 15" W x 5" H x 13" D including PANLOC shelf and back panel connectors. Required knob clearance in front of mounting panel: 1 1/2". **Net Weight:** 20 lbs. **Power Requirements:** 120 V, 50/60 Hz. **Suggested Retail Price:** \$749.00.

Serious devotees of the audio art may be somewhat surprised to find that McIntosh Laboratory Inc. has introduced yet another top performing preamplifier/control unit, less than one year after the introduction of their all-out C 32 preamplifier. In previous times, McIntosh was never noted as a company that subscribed to the annual cosmetic "model changes" so often seen from other high fidelity component

manufacturers. Well, for all those thousands of dedicated Mac fans let us preface this report by stating emphatically that the newly designed C 27 is much more than a cosmetic face-lift of older models. In fact, the highly acclaimed "McIntosh look" of the front panel has been retained, while new internal circuitry, from stem to stern, makes this new entry a state-of-the-art design that should enjoy the same sort of longevity typical of other McIntosh products. The earlier-introduced C 32 was, as we said, a multiple featured product, with such built-in accessory features as a full five-control graphic equalizer and an adjustable linear expander, not to mention its fully separate monitoring/headphone amplifier output facilities.

The C 27 takes a more restrained approach in which those features that are deemed important to most preamplifier/control users are retained but other accessory facilities are omitted in favor of a suggested retail price that will be affordable to a greater number of potential purchasers. Think of the C 27 as a "middle of the road" unit in terms of its control facilities and flexibility. It is not a unit that subscribes to the "straight wire with gain" approach -- an approach which we, at least, have always felt is a bit unrealistic. After all, how many of us are blessed with companion components, speakers, or even room acoustics that require absolutely no control "tweaking"? Rather than do away with such control features as tone controls or filters, it seems to us that it is far more useful for the consumer to have these facilities providing that their presence in the signal path does not introduce any form of distortion. Evidently McIntosh felt the same way and, as we learned during our lab testing of the C 27, these features, when deactivated or, in the case of the tone controls, when placed in their nominal flat positions, do not in any way negate the "straight wire with gain" concept which some purists espouse.

The front panel of the C 27, pictured in Fig. 1, is anodized gold and black with McIntosh's familiar gold-teal panel nomenclature illumination which magically appears when power is applied. Rotary controls along the top of the panel include a five-position program input selector (aux 1, aux 2, tuner, phono 1 and phono 2), a mode selector (left or right to both outputs, stereo reverse, stereo, L + R mono, left plus right to left or right outputs) and, at the extreme right, the master volume control. The four rotary control sets at the lower right of the panel are dual concentric types. The first of these introduces, singly or in combination, the high and low cut filters and selects either or both sets of loudspeakers which can be switched via the front panel providing that the power amplifier's outputs are connected to the rear of the C 27 instead of directly to the speakers. Bass and treble tone controls permit tonal tailoring of each channel separately while the right-most control in this group is a combination balance and loudness control. The loudness control of the C 27

works a bit differently from that contained in the C 32. The user is instructed to set the volume control for maximum (lifelike) listening levels while the loudness knob is set to its "flat" (counterclockwise) position. Then, for lower listening levels, the **loudness** control is rotated (rather than the volume control) and proper Fletcher-Munson compensation is introduced as listening levels are lowered.

Completing the panel layout is a group of push-buttons and a headphone jack at the lower left. The buttons, five in all, take care of the two tape monitor circuits and provide tape dubbing from either of two connected tape decks to the other.

The final button turns on power to the unit and has an illuminated rectangle just above it to indicate that power is on.



Fig. 2 - View of back panel

The rear panel of the C 27 is shown in Fig. 2. Adjacent to the four switched and one unswitched convenience AC receptacles are three sets of spring-loaded terminals which require only that the stripped ends of power amplifier and speaker connecting cables be inserted in small holes that are exposed when the terminal keys are depressed. It is this arrangement which brings speaker switching capability to the front panel of the C 27, and a handy feature it is, too, since most high quality basic power amplifiers are normally equipped with only one set of speaker terminals. The right portion of the rear panel is equipped with the necessary phono-tip jacks for signal inputs, tape in and tape out circuits, two pairs of main output jacks (in case you want to feed two separate power amplifiers) and a "center channel" output for feeding the sum (L+R) of both channels to a separate monophonic power amplifier for background music in an alternate location or for powering a center-channel speaker system in the main listening area. A 0.5 ampere line fuse holder completes the rear panel layout.

Circuit Highlights

Internally, the C 27 major circuit board contains all of the audio signal handling active circuitry, including the preamplifier-equalizer low level stages. Smaller p.c. modules include the pushbutton switch circuits, input

terminal boards, a switch indicator circuit board (for illuminating the front panel LED's that light up when tape monitoring or tape copying is employed) and a power supply module. Signal paths can be traced by consulting the block diagram of Fig. 3. The input selector routes the different input signals within the C 27. Isolating networks are present at each high level input and shorting switch contacts ground unused inputs. The isolating networks also block any DC voltages that might be present, preventing pops or clicks when changing inputs. The phono preamp section uses three selected transistors per channel. Low impedance components are used in the RIAA equalization network, drive for which is provided by the final stage which operates at an adequate current level to drive the low impedance without slew rate limiting. Isolating networks are included at each tape output and input. The volume control is a step attenuator type having 32 steps and 70 dB of range plus a total attenuation position. A voltage gain stage follows the volume control and provides 14 dB of gain. High and low cut filters follow, with the signals then passed along to the loudness and balance control and thence to another gain stage for an additional 6 dB of amplification. This last gain section is used for the bass and treble control circuits and consists of a three-stage linear amplifier with tone controls included in a negative feedback circuit using precision capacitors and resistors for shaping the desired frequency response characteristics depending upon the setting of the tone controls. The output of this amplifier is fed to the two pairs of main output jacks.

The C 27 power transformer uses a grain oriented silicon steel core plus copper and magnetic steel shields to eliminate radiated magnetic hum fields. The power supply uses zener diode reference voltage regulation and electronic filtering. Turn-on and turn-off time characteristics of the power supply are controlled to prevent switching transients. Total semiconductor complement of the C 27 includes 18 silicon planar transistors, 4 silicon diodes and five light emitting diodes.

Laboratory Test Measurements

All of our measurements were made with respect to rated output (2.0 volts from the main output terminals) unless otherwise stated. We first studied the performance of the phono-equalizer section. Input sensitivity for rated output measured 2.3 millivolts for both phono inputs. Though McIntosh does not provide a "limit spec" for phono overload, we consider this to be an important specification. The phono inputs were able to handle signal levels of 135 millivolts at 1 kHz before noticeable first-stage distortion occurred – considerably more than is likely to be delivered even by a high output cartridge tracing the most heavily modulated record grooves. Signal to noise in phono, referred to a 10 mV input measured 82 dB unweighted, increasing to 89 dB when an "A" weighting network was inserted in the patch between the output and the measuring instruments. A word is called for regarding the play-

back curve measured via the phono inputs and shown as photographed from the face of our spectrum analyzer's CRT tube. McIntosh has wisely elected to adopt the new IEC standards for playback which call for an additional roll-off time constant of 7960 microseconds in addition to the three time constants normally prescribed for RIAA equalization. This final low-end roll-off makes a great deal of sense, since it reduces needless amplification of turntable rumble components which serve no purpose other than to overload the bass power output capabilities of modern power amplifiers (especially those that have response down to "DC") and to cause speaker cones to fluctuate wildly sending the voice coils into non-linear regions of operation. The final low-end roll-off or turnaround of the new curve is clearly visible in our 'scope photo of Fig. 4 and, al-

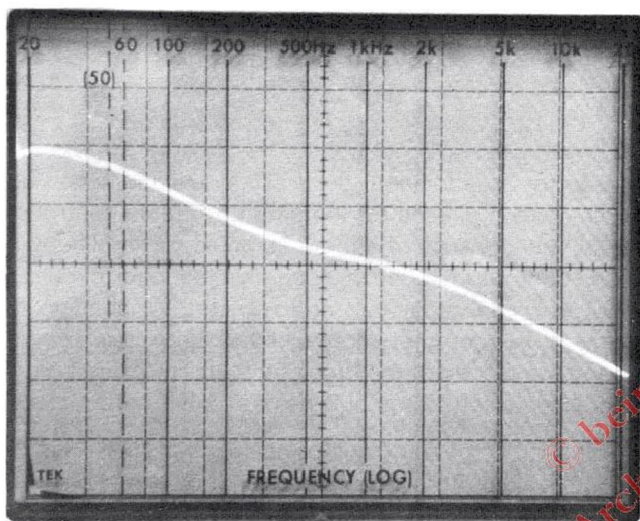


Fig. 4 - Playback response of phono preamp-equalizer section

though our frequency sweep extends only down to 20 Hz, the response continues to roll off below that frequency at a 6 dB per octave rate, exactly as prescribed by the new IEC standards. If you try to measure the phono response against the "old" RIAA curve, however, you will find that at 30 Hz it differs from the old prescribed point-by-point plot by approximately 1.3 dB. In terms of the new and preferred playback curve, the equalization of the C 27 was so accurate that it varied by no more than 0.1 dB at any of the remaining test points measured.

Fig. 5 is a plot of distortion versus frequency (at rated output) via the high-level inputs, as observed at the main output terminals. Over the entire spectrum from 20 Hz to 20 kHz, harmonic distortion never exceeded 0.025% and at mid frequencies it measured an extremely low 0.009%. Since the distortion measured from the phono inputs to the tape outputs was even lower, we did not bother to plot these results since the high-level section would govern actual distortion of the output signals under actual use condition. Though

McIntosh does not quote IM distortion figures for the C 27, we nevertheless measured this important parameter as well and, for rated equivalent output from the main output terminals obtained a reading of just

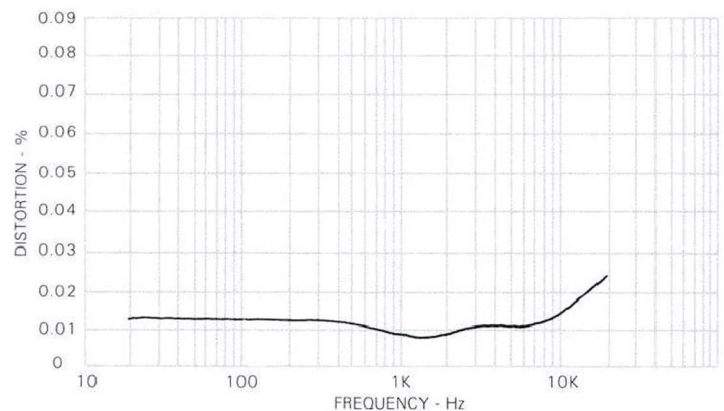


Fig. 5 - Distortion versus frequency, for rated output (2.0 volts) aux input to main outputs

under 0.04%. Maximum output obtained from the main output terminals was 10.0 volts for a rated distortion figure of 0.05% harmonic.

Tone control action of both the bass and treble controls is so precise and well calibrated that we decided to trace overall response for each of the ten possible settings of each of those controls. The results are displayed in the 'scope photo of Fig. 6. Flat response is re-

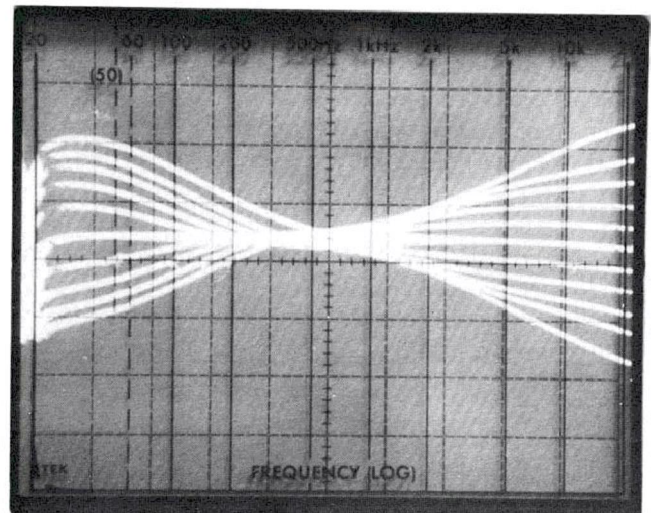


Fig. 6 - Step-by-step tone control response characteristics

presented by the center curve of this series and was measured as flat within 0.5 dB from 10 Hz to 23 kHz. The -3 dB points in response occurred at 4 Hz and 60 kHz. Signal to noise ratio in the high level settings measured 86 dB below rated output, unweighted, and

92 dB with an "A" weighting network inserted, both figures exceeding published limits of McIntosh. Volume control tracking was found to be accurate from left to right channels within 0.2 dB from maximum settings down to a -70 dB level.

The action of the high and low cut filters is illustrated in the 'scope photos of Fig. 7. While the slope rates are clearly only 6 dB per octave (we prefer steeper slopes ourselves), McIntosh wisely set the cut-off points at sufficiently high and low frequencies (50 Hz for the low-cut and 5 kHz for the high-cut) so that their intro-

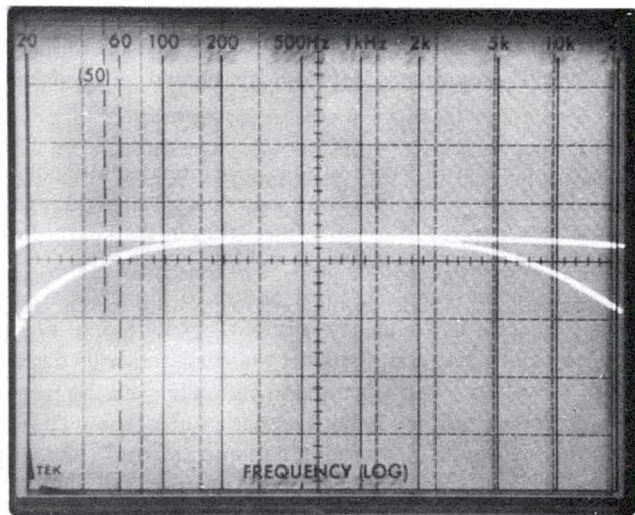


Fig. 7 - Low-cut and high-cut filter response

duction into the signal path would not take too big a "bite" out of musical content or program sources that require "cleaning up" because of background hiss or low frequency noise and rumble.

The action of the previously described loudness control is clearly illustrated in the three response plots

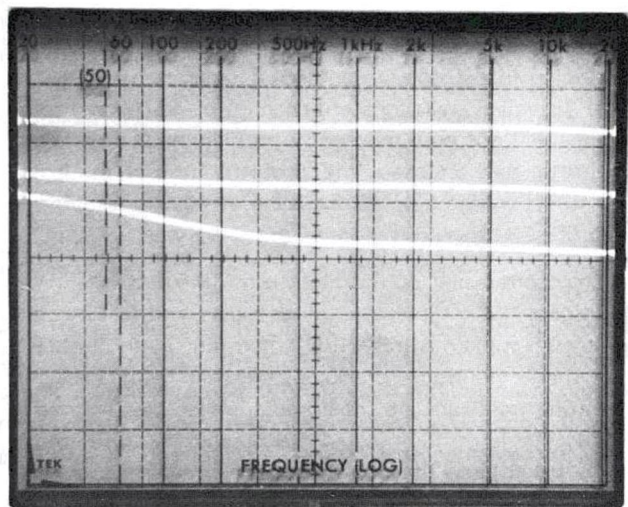


Fig. 8 - Action of separate loudness control at "flat" (upper trace), "mid" and "max" (lower trace) settings

shown in Fig. 8. Note that these curves were achieved with a **constant** setting of the master volume control and only the loudness control setting itself was varied, from one extreme to the other. Total level variation afforded by this control amounted to approximately 22 dB (each vertical division in this Figure as well as in Figs. 4, 6 and 7 represents an amplitude difference of 10 dB).

Use and Listening Tests

As is true of other McIntosh components we have tested in the past, one immediately senses that the C 27 is, first and foremost, a reliably built product and one that is likely to last for a very long time and require a minimum of servicing. Controls have a positive and rugged feel about them and tend to be manipulated with confidence even by an inexperienced user encountering the product for the first time. We played a variety of discs through the phono section of the C 27, using our recently acquired Shure V15 Type IV cartridge for that purpose. Our record library now contains a good selection of direct-to-disc records which were reproduced flawlessly through the C 27 and a high quality 110-watt per channel power amplifier plus our reference loudspeakers. Transient response was superb and bass passages were tight and totally unmuddled. Attempting to use the phone jack we discovered that it must be powered from the interconnections of the associated power amplifier. In other words, the C 27, unlike the C 32, does not contain its own built-in headphone amplifier but rather derives phone power from the amp-speaker connections which are brought over to the unit for the switching capability incorporated in the C 27. A user of the C 27 would want to utilize this feature in any case, and there is an "off" position on the C 27's speaker switch for headphone-only listening once these connections are made.

All in all, McIntosh seems to have come up with a brand new preamplifier which should fit nicely into those systems which are comprised of the finest power amplifiers, speakers and program source components and whose owners either prefer to do without such extras as graphic equalizers or expanders or who would rather add such devices as separate accessories when and if the need arises. In our opinion, the suggested price of the new C 27 is not at all inconsistent with the level of performance achieved by the C 27 or with its excellent design, construction and control features.

Electronic Laboratories'

PRODUCT ANALYSIS

THE McIntOSH MR78 FM/FM STEREO TUNER

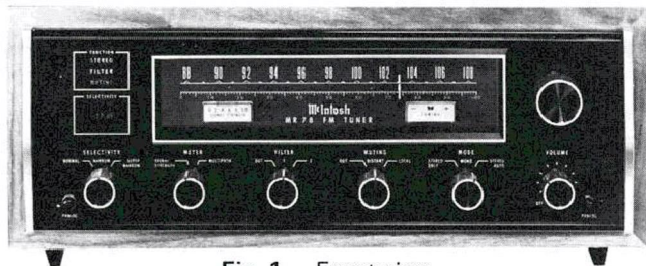


Fig. 1 — Front view

MANUFACTURER'S PUBLISHED PERFORMANCE LIMITS (SPECIFICATIONS):

Tuning Range: 88 to 108 MHz. **Antenna Inputs:** 300 ohms balanced; 75 ohms unbalanced. **Intermediate Frequency (IF):** 10.7 MHz. **Sensitivity:** $2 \mu\text{V}$ for 35 dB of quieting; $2.5 \mu\text{V}$ at 100% modulation (± 75 kHz deviation) for 3% total noise and harmonic distortion. **Signal to Noise Ratio:** 75 dB below 100% modulation. **Harmonic Distortion:** 0.2% 20 Hz to 15,000 Hz, mono or stereo at 100% modulation. Typically, 0.05% at 1000 Hz. **Drift:** 25,000 Hz for the first two minutes; thereafter 5,000 Hz at 25°C in 24 hours. **Frequency Response:** MONO ± 1 dB 20 Hz to 20,000 Hz with standard deemphasis, (75 μs). STEREO ± 1 dB 20 Hz to 15,000 Hz with standard deemphasis, (75 μs). **Capture Ratio:** 0.25 dB detector only; 2.5 dB complete tuner. **Selectivity (IHF):** Adjacent Channel: set switch to: normal, 7 dB; narrow, 22 dB; super narrow, 55 dB. Alternate Channel: set switch to: normal, 55 dB; narrow, 90 dB; super narrow, 90 dB; super narrow, 90 dB. **Spurious Rejection:** 100 dB IHF. **Image Rejection:** 100 dB, 88 to 100 MHz, (IHF). **Intermodulation Distortion:** 0.2% mono or stereo for any combination of frequencies from 20 Hz to 15,000 Hz with peak modulation equal to 100% or less. Typically 0.1%. **Maximum Signal Input:** 12 volts across 300 ohms antenna terminals will not increase harmonic or intermodulation distortion. **Audio Hum:** 75 dB down from 100% modulation. **Muting:** 70 dB noise reduction between stations. **Muting Threshold:** (Typical): Distant position $5 \mu\text{V}$; Local position $20 \mu\text{V}$. **SCA Filter:** 50 dB down from 67 kHz to 74 kHz; 275 dB per octave slope. **Stereo Separation:** 40 dB at 1,000 Hz. **Stereo Filter:** (Typical): 10 dB noise reduction in Position 1; 20 dB noise reduction in Position 2. **Audio Output:** Front panel controlled: 2.5 volts into 47,000 ohms. Fixed output: 2.5 volts into 47,000 ohms; 1.0 volt into 600 ohms. (All tuner performance limits were

measured with SELECTIVITY switch set at NORMAL, unless otherwise stated.)

GENERAL SPECIFICATIONS:

Power Requirements: 120 volts, 50/60 Hz, 35 watts. **Semiconductor Complement:** 3 J FET's, 2 MOS FET's, 17 Bipolar Transistors, 43 Diodes, 4 Integrated Circuits.

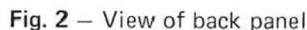
MECHANICAL SPECIFICATIONS:

Size: Front Panel: 16 inches wide (40.64 cm) by 5-7/16 inches high (13.81 cm); Chassis: 15 inches wide (38.1 cm) by 13 inches deep (33.02 cm), including PANLOC shelf and back panel connectors; Knob clearance 1-1/2 inches (3.81 cm) in front of mounting panel. **Weight:** 27 pounds (12.25 kg) net, 39 pounds (17.69 kg) in shipping carton. **Finish:** Front panel; Anodized gold and black with special gold/teal panel nomenclature illumination; Chassis: Chrome and black. **Mounting:** McIntosh developed professional PANLOC.

Most of the semi-technical literature intended for audio-ophile-consumer education deals with the specifications of an FM or a stereo FM tuner as though each were mutually independent of the others. For example, we are at once told that "good selectivity" (the ability to tune to stations closely spaced in frequency without encountering interference from nearby stations on the dial) and wide bandwidth as well as low distortion are mutually exclusive parameters. We are also led to believe that a tuner "should have ultra low harmonic or intermodulation distortion", but we are hardly ever told that such low distortion can only be achieved if the IF bandwidth of the tuner is sufficiently broad (and linear in phase) to accommodate the upper modulation sidebands of the incoming signal which may well extend well beyond the nominal 150 kHz which is supposed to represent the "maximum bandwidth" of a given FM channel. But if bandwidth is broadened to accommodate such extreme sidebands (which occur particularly during stereo FM transmissions), how is it possible to achieve high orders adjacent channel (or even alternate channel) selectivity? Excellent stereo separation at high audio frequencies is also dependent upon adequate bandwidth, so that again, such high orders of separation are in conflict with high orders of selectivity. What's to be done? Most tuner manufacturer's content themselves with a series of trade-offs. Selectivity figures are made high enough (without sacrificing low distortion and good separation) so that in **most** listening areas adjacent-channel or co-channel interference will not pose much of a problem **most** of the time. McIntosh has attacked the problem in a more logical and direct method — by providing variable selectivity on their MR 78 tuner. But more of this shortly.

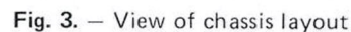
The front panel of the McIntosh MR 78 maintains the traditional "Mac" look of "black glass" and features that company's well known PANLOC mounting method (shelves and shelf mounting brackets, together with necessary mounting hardware are, as usual, supplied) as pictured in Fig. 1. The large, illuminated dial area at the upper center of the panel has a linear dial scale, calibrated at every half MHz, as well as a 0-100 logging scale for easy referencing of favorite stations. The smooth traveling dial pointer is

The rear panel of the MR 78 has a pair of test points, as illustrated in Fig. 2., which are intended for use with the McIntosh Maximum Performance Indicator, an accessory product marketed by that company. A fuseholder cap is also accessible from the rear for replacement, if necessary, of the tuner's 0.5 ampere slo-blow line fuse. Push-type



Internal Construction and Circuit Highlights

positions are labelled "Lo Gain" and "Hi Gain", a bit confusing unless the user reads the manual carefully and discovers that the gain references refer to the **antennas** which might be used with the tuner. Thus, the Lo Gain position is intended for use in seeking out distant or weak signals



A block diagram of the Multiplex and Audio Sections is illustrated in Fig. 5. An IC audio amplifier with over 120 dB of negative feedback in two feedback loops is used to drive the stereo demodulator. Muting, "stereo only" tuning and automatic mono/stereo switching are all functions which are performed within the stereo decoder circuitry. A stereo filter circuit follows the matrix decoder and de-emphasis networks to reduce noise when tuning to weak stereo stations. This filter employs a twin-T bandpass filter design to suppress noise while only minimally affecting stereo separation and imaging. The audio amplifier section consists of a pair of two-transistor amplifiers, one for each channel. Each amplifier delivers 2.5 volts to the fixed output jacks and to the volume control sections which feed the

variable output jacks. The power supply section consists of a 24-volt regulated supply which uses electronic filtering and supplies power to all signal stages, while a second, half-wave rectifier supply also equipped with electronic filter circuits feeds the necessary DC voltages to the multiplex decoder section.

Laboratory Measurements

Although most listening situations require selectivity settings of NORMAL on the MR 78, we decided to measure performance in this setting as well as the NARROW selectivity setting. In the NORMAL setting, IHF sensitivity measured $2.0 \mu\text{V}$ (11.2 dBf) and 50 dB quieting was reached with an input signal strength of $3.0 \mu\text{V}$ (14.7 dBf) in mono. Referring back to the published specifications, readers will note that McIntosh has not as yet seen fit to bring their specs into line with the newly adopted IHF/IEEE/EIA FM Tuner Measurement standards. Thus, no claim is made for the 50 dB quieting sensitivity, for example, and Mac offers us a 35 dB quieting point instead. While we recognize that McIntosh has, in the past, differed with the rest of the industry in the matter of publishing specifications, we do feel that the new tuner standards are worth following and would hope that if they have not already done so, McIntosh would bring their published specs into line so that they might be easily compared with those of other companies. Be that as it may, $3.0 \mu\text{V}$ (14.7 dBf) is a very respectable figure for 50 dB quieting. Stereo sensitivity was $4.5 \mu\text{V}$ (18.3 dBf), at which signal strength in stereo was sufficient to cause nearly 35 dB of quieting. 50 dB of quieting in stereo was attained with an input signal of $32 \mu\text{V}$ (35.3 dBf). Ultimate S/N in mono was an incredibly high 81 dB (we never thought our signal generator could read that low — now we know it can), while in stereo, best quieting for strong signals was 73 dB. Total harmonic distortion in mono was a low 0.06%, while in stereo, for the same strong signals used, THD read 0.1% at 1 kHz. Curves of results obtained in the Normal selectivity setting are plotted in Fig. 6.

Switching to the NARROW selectivity setting, S/N readings in both mono and stereo remained virtually the same, but, as was to be expected, THD readings increased slightly, to 0.08% for mono and 0.35% for stereo. These results are shown in Fig. 7.

Returning to the NORMAL selectivity setting, we measured a capture ratio of 1.8 dB. Alternate channel selectivity was 57 dB for this setting, while image and spurious rejection were both in excess of 100 dB (the limits of our test equipment). Maximum deviation from ideally flat frequency response, for both mono and stereo, was less than 1.0 dB, with the deviation approaching that number at 15 kHz but remaining within 0.2 dB at frequencies from 10 kHz down to 50 Hz. Muting threshold occurred at $7.0 \mu\text{V}$ for the "distant" position, $30 \mu\text{V}$ for the "local" position. Stereo switching occurred at around $4.0 \mu\text{V}$ (17.2 dBf).

Stereo separation measured 52 dB at mid frequencies for the normal selectivity position, decreasing to 43 dB at 100 Hz and 36 dB at 10 kHz, as plotted in Fig. 8. In order to properly ascertain the THD produced by the tuner at high modulating frequencies it was necessary for us to employ our spectrum analyzer and to "sum" the harmonic products mathematically to arrive at the 0.14% THD figure shown

for a 10 kHz modulating frequency. If this is not done, super-audible products (not properly identifiable as harmonic distortion) "cloud" the single-reading measurement that is obtained on a conventional meter-type distortion analyzer.

Fig. 9 is a plot of separation versus frequency with the selectivity control set to the NARROW position. Separation naturally suffers somewhat when this narrow setting is used, but remains well above 30 dB for most frequencies tested. Distortion in stereo also rose somewhat in the narrow setting, as shown in the curves of Fig. 9. While in mono, THD remained incredibly low at mid-frequencies even when the narrow setting of the selectivity switch was used. Sub-carrier product rejection was so good that it was not even necessary to use the recommended 15 kHz low-pass filters for all of our high-frequency noise and distortion measurements, except as already noted for the 10 kHz readings. Audio output level was exactly 2.5 volts, as claimed, for a 100% modulation signal at the fixed output terminals. Since our own signal generating equipment is limited to 0.2 volts output, there was no way for us to verify McIntosh claims regarding 12 volt antenna input overload capability, though we have no reason to doubt the claim, based on subsequent strong-signal listening tests. We purposely carted the tuner over to a mid-city location where we have access to a listening room that is just a few blocks away from several high-powered FM transmitters.

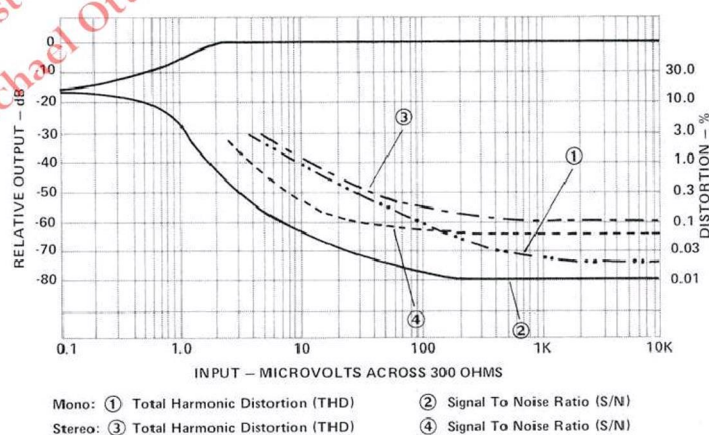


Fig. 6 — FM quieting and distortion characteristics (with selectivity switch set to "NORMAL")

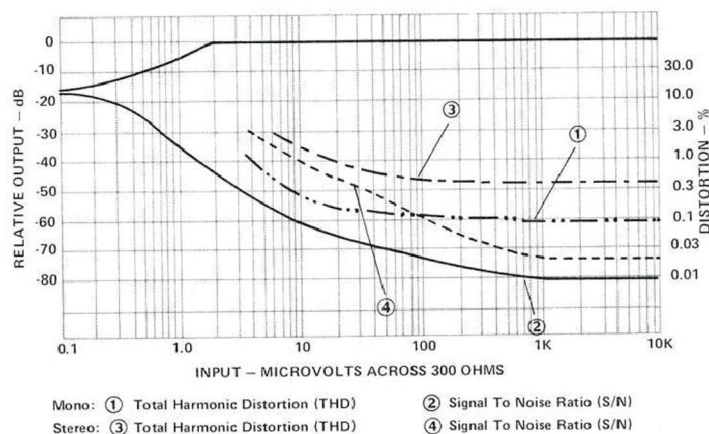


Fig. 7 — FM quieting and distortion characteristics (with selectivity switch set to "NARROW")

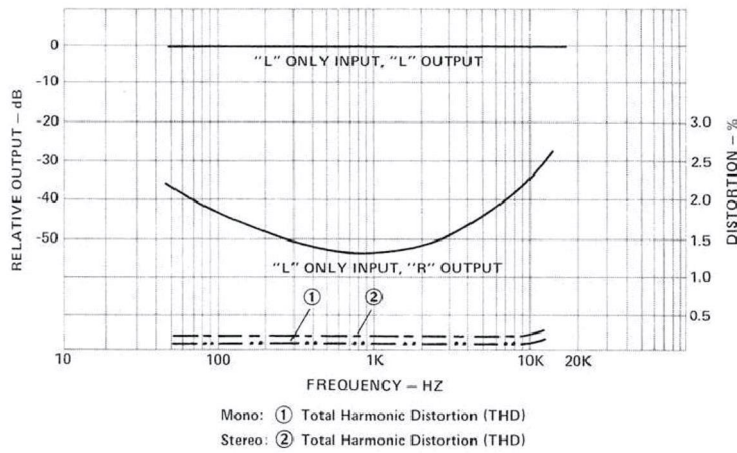


Fig. 8 — Separation and distortion versus frequency (with selectivity switch set to "NORMAL")

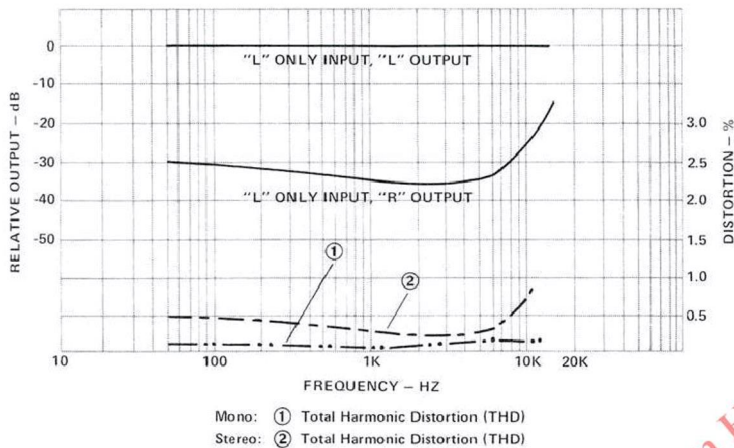


Fig. 9 — Separation and distortion versus frequency (with selectivity switch set to "NARROW")

Previously, we had measured signal voltages of 2 to 3 volts at that location and found that most tuners did exhibit cross-modulation and other overload effects. With the "Mac" tuner, we were able to clearly separate closely spaced high-signal stations on the dial with nary a trace of interference from other strong-signal stations in the same vicinity.

Other Use and Listening Tests

Back in our lab (some 20 miles from the city), we began to appreciate the importance of that selectivity switch on the front panel. If you are an inveterate FM DX-er, you will be amazed (as we were) at how many signals you can separate and receive clearly by using the narrow (and at times even the super-narrow) selectivity switch positions on the MR 78. Here is a tuner that doesn't compromise between low distortion and wide bandwidth. 55 dB of selectivity (that claimed in the NORMAL setting) is no problem if you are not plagued by adjacent and alternate channel signals. In fact, the normal setting, coupled with those linear phase filters in the IF section, rendered the kind of reception from the few good quality stations that we have in our listening area that we had often dreamed about. Program quality varied, of course, but when we were fortunate enough to tune to a live concert (yes, we still do have some live FM programming in this area, albeit at midnight each night), the results were truly astounding. We had the feeling that the late Major Armstrong, too, would have smiled

if he could have heard FM the way we heard it over the Mac MR 78.

There was only one instance where we found it necessary to use the SUPER-NARROW position of the selector switch, and that was when we were trying to listen to a weak signal originating some 120 miles from our listening location — one nestled between a stronger signal 200 kHz below it, and a much stronger local station, 200 kHz on the higher side of the dial. If you've ever tried to receive that kind of signal on a lesser tuner, you'll know what we mean. In any case, when we did switch to the SUPER-NARROW position, we actually were able to listen to the desired distant station and distortion, though audibly higher, was still at tolerable levels.

Naturally, one would think twice before spending close to \$900.00 for an FM tuner, but if you are confronted with the same sorts of signal conditions as exist in our test location and have been repeatedly frustrated in your attempts to zero in on desired stations, only to be annoyed by rasps, buzzes and spiked sounds "spilling in" as interference, the McIntosh MR 78, with its three positions of selectivity, may well be one of the only, if not the only high quality tuner that will do the job.

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Archiv Michael Otto

Electronic Laboratories'

PRODUCT ANALYSIS

THE McIntOSH MC 2205 SOLID STATE POWER AMPLIFIER



Fig. 1 — Front view

MANUFACTURER'S PUBLISHED PERFORMANCE LIMITS (SPECIFICATIONS):

Power Output: (Stereo): 200 watts per channel, 1, 2, 4 or 8 ohms, 20 Hz to 20 kHz; (Mono): 400 watts per channel, 0.5, 1.0, 2.0 or 4 ohms, 20 Hz to 20 kHz. **Harmonic Distortion:** 0.1% maximum from 0.25 watts to rated output. **Intermodulation Distortion:** 0.1% maximum, any combination of frequencies from 20 Hz to 20 kHz up to instantaneous peak power of 400 watts (stereo) or 800 watts (mono). **Frequency Response** (at 1 watt): 20 Hz to 20,000 Hz, +0, -0.25 dB; 10 Hz to 100 kHz, +0, -3 dB. **Hum and Noise:** 95 dB below rated output. **Damping Factor** (Stereo): 16 at 1 ohm, 50 at 2 ohms, 30 at 4 ohms, 16 at 8 ohms; (Mono): 16 at 0.5 ohms, 50 at 1 ohm, 30 at 2 ohms, 16 at 4 ohms. **Input Impedance:** 100,000 ohms. **Input Sensitivity:** 0.75 volts or 2.5 volts, level adjustable.

GENERAL SPECIFICATIONS:

Power Requirements: 120 volts 50/60 Hz, 70 to 550 watts.

MECHANICAL SPECIFICATIONS:

Size: Front Panel: 16-3/16" wide by 7-1/8" high. **Chassis:** 15" wide by 6-9/16" high by 14-1/2" deep, including connectors. 1-1/2" clearance required in front of panel for knobs. **Weight:** 85 lbs. net.

McIntosh Laboratory's new model MC 2205 power amplifier is one of several recently introduced products from the company that traditionally has refrained from annual or even bi-annual product "face lifting" and model number changing. As such, the MC 2205 is a totally new design incorporating new and innovative circuitry and features which seem to have been thoroughly pre-tested for their sonic excellence and long-term reliability. Retaining the "Mac" look, overall, a detailed examination of the front

panel (see photo) this impressive looking anodized gold and black panel tells us much (though by no means all) about some of the new features incorporated in this amp. Dominantly featured are a pair of large, illuminated power meters - - one for each channel. Calibrated in watts as well as in decibels, the meters can be set to operate in several modes. When the meter switch is set to WATTS, the upper scale is read and is calibrated to beyond 200 watts (the rated output of each channel of the amplifier when it is used in the stereo mode). When the 0 dB, -10 dB or -20 dB scales are selected, the meters read in decibels, relative to a 0 dB = 200 watts reference, while in the HOLD position of the meter switch, the meter once more indicates watts and locks to the highest power peak delivered during playing. If signals are removed while the meters are set to the HOLD position, the meter pointers will slowly decay (at a rate of about 10 dB per minute). Lighted words to the right of the meter area indicate which meter mode has been selected. Below these illuminated words is another area containing four indicator lights - - a pair of green lights for "normal" and red indicators for "limit". The limit lights are also associated with McIntosh's new POWER GUARD circuit about which we shall have much more to say presently. In addition to the meter range switch, the front panel also contains left and right/mono gain controls (when used as a mono amplifier, only the right channel input is active on the rear panel), a speaker off/on switch (which can be set to off to permit private headphone listening via the adjacent phone jack provided) and an AC power on/off switch.

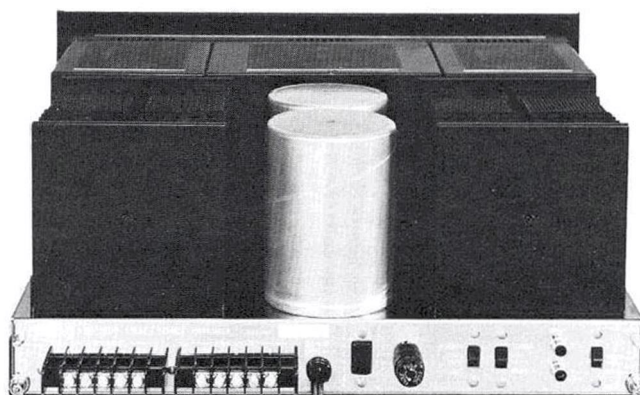


Fig. 2 — View of back panel

The rear panel, see Fig. 2, is equipped with barrier-strip speaker terminal blocks for left and right speaker connection. Since the McIntosh MC 2205 employs output transformers, a variety of impedance taps are available (1, 2, 4 or 8 ohms for stereo connection, 0.5, 1.0, 2.0 and 4.0 ohms for mono use) and, of course, full rated power is available regardless of the impedance chosen - - an advantage inherent in the use of matching output transformers. An unswitched convenience AC receptacle is located adjacent to the line fuse-holder, near which are the POWER GUARD switch (ordinarily set to the NORMAL or "on" position) and a mono/stereo switch. Left and right input jacks come next, and next to them is the input sensitivity switch which selects 0.75 or 2.5 volt sensitivity for rated output.

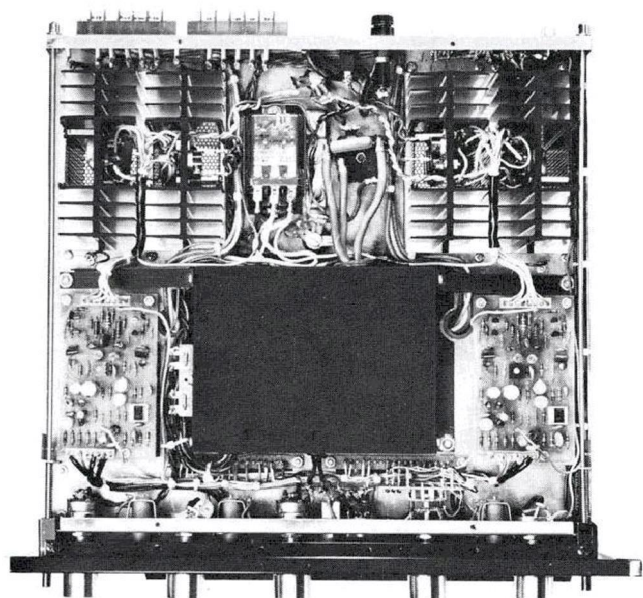


Fig. 3 — View of chassis layout

Internal Construction and Circuit Highlights

As can be seen from the chassis view (Fig. 3) of the MC 2205, the amplifier is as ruggedly constructed as most McIntosh products. The unusual weight of the amplifier is, in part, due to the use of those famous McIntosh auto-transformers. While some may argue that the interjection of autoformers in the output circuitry of a solid-state amplifier poses performance problems, McIntosh stoutly maintains that the use of such transformers offers more advantages than disadvantages. While we will certainly not get involved in that old argument (the proof is, after all, in the listening), we should point out that, indeed, transformers used at the low impedance levels required by solid state output devices behave quite differently from "old fashioned" step-down output transformers which were required to translate high-impedance tube output circuits to low-impedance levels required by loudspeaker loads.

A block diagram of the MC 2205 is reproduced in Fig. 5. Each input amplifier is a two transistor feedback amp with unity gain. At the input to each power amplifier section is a monolithic differential transistor. Input and feedback signals are applied to this amp. The second stage is a class A voltage amplifier with applied feedback. The predriver, driver and output sections are fully complementary. The output stage consists of six complementary power transistors connected in a single-ended push pull parallel arrangement. The bias network for the output stage is temperature compensated assuring class B operation at any temperature or power level. Output transistors are mounted on large black anodized aluminum heat sinks. The output of the amplifier is switched by a heavy duty relay to the output auto-transformers. The relay is driven by a transistor switch and also provides transient-free turn-on and turn-off. Relay turn-on takes place approximately two seconds after power is applied to the amplifier. A short turn-off time constant opens the relay's contacts when power is turned off before the main power supply voltage drops. A patented "Sentry

Monitoring" circuit monitors output signals. At signal levels up to rated output, this circuit has a high impedance and does not affect the output. If power outputs exceed design maximum, the circuit limits signals to the output transistors. Both positive and negative halves of the output signal are monitored independently.

Limit Indicator and Power Guard Circuits

The MC 2205 has a waveform comparator circuit which compares output and input waveforms. If waveform differences reach 0.5%, the red LIMIT indicator on the front panel illuminates while a distortion content of 1.0% causes the POWER GUARD circuit to act. Differences in waveform are first converted to a control voltage which is applied differentially to a high gain op-amp where it is amplified 100 times and detected by a full-wave bridge rectifier and applied to a Schmidt trigger programmed to sequence the front panel indicators. The same control voltage actuates the POWER GUARD system by operating a light emitting diode/light dependent resistor network. The LDR is part of an attenuator between the volume control and the input amplifier. Both the LIMIT indicator and POWER GUARD circuits are operated separately for each channel.

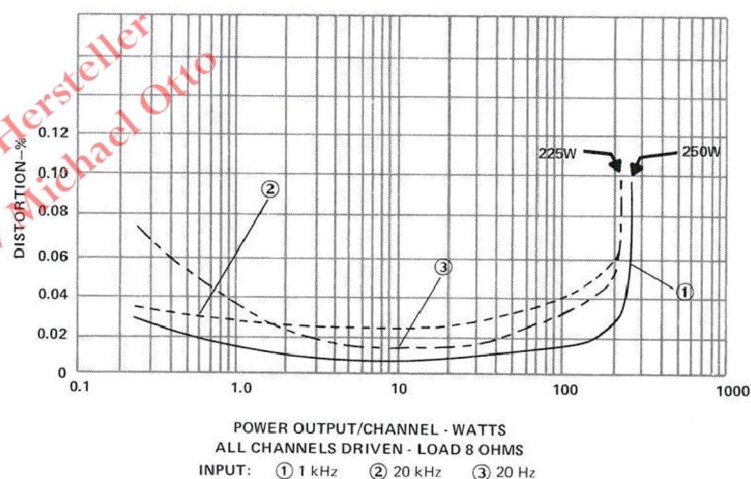


Fig. 4 — Harmonic distortion

Laboratory Measurements

The graphs of Fig. 4 show harmonic distortion as a function of power output for the MC 2205 at three frequencies: 1 kHz, 20 Hz and 20 kHz. Nominal rated harmonic distortion (0.1%) was reached at an output level of 250 watts per channel at 1 kHz and approximately 225 watts per channel at the two frequency extremes. Note that the vertical axis of this graph has been greatly expanded to better illustrate the extremely low levels of distortion measured. McIntosh's traditionally conservative ratings are such that this amplifier might well have been "FTC rated" at 225 watts per channel in stereo. Full rated power (200 watts per channel) is, in fact, obtainable with no more than 0.1% total harmonic distortion from 17 Hz to 34 kHz, well beyond the 20 Hz to 20 kHz limits stated by the manufacturer.

Intermodulation distortion is plotted as a function of

power output in Fig. 6, using the standard SMPTE frequencies of 60 Hz and 7,000 Hz in a 4:1 ratio.

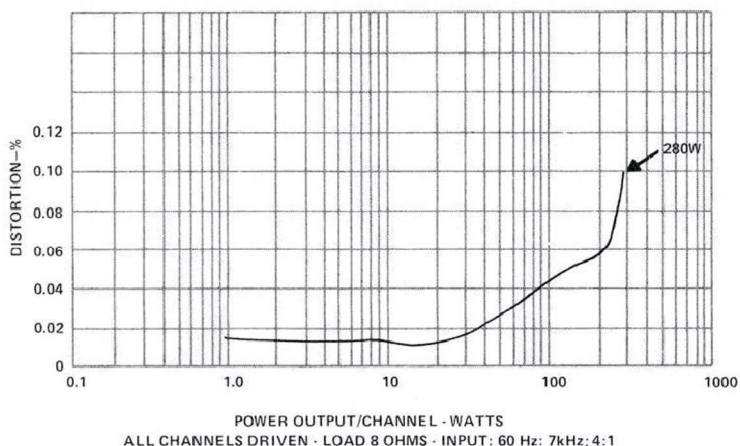


Fig. 6 - Intermodulation distortion

Rated IM distortion (0.1%) was reached at an output level of 280 watts per channel with both channels driven. (Note that our wattage measurements are "equivalent watts". Translated to McIntosh's "peak wattage" specification statement, output would have been in excess of 500 watts per channel, rather than the 400 watts claimed in their published specifications!). Residual noise and hum measured 100 dB below full rated output, while damping factors corresponded almost exactly to those stated for the various impedance connections. In case you are wondering why the damping factors vary the way they do depending upon auto-transformer output taps connected to the load, bear in mind that the "looking back" impedance used in calculating damping factor includes the impedance of that portion of the auto-transformer winding which is in series with the output stage take-off point. Thus, the highest damping factor is observed at the 2 ohm tap, since that tap is closest to the input tap to the transformer, to which the output stages are connected. Although the 8 ohm damping factor may seem low (16) compared to some of the astronomical damping factor figures quoted for solid-state amp-

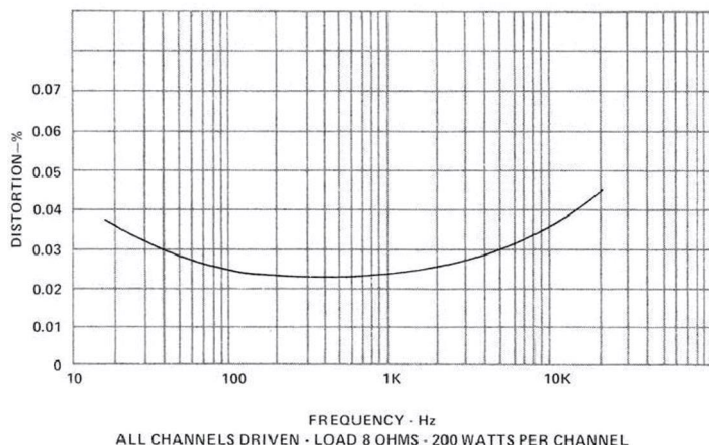


Fig. 7 - Harmonic distortion versus frequency

lifiers that do not employ output transformers, we could not attribute any sound quality deficiencies in our subsequent listening tests to this factor. Distortion vs. frequency at rated output is plotted in Fig. 7 and reached a maximum of 0.045% at 20 kHz.

Tests of The Power Guard Feature

One of the most intriguing aspects of this new amplifier from McIntosh is the novel Power Guard circuit which has already been described. In order to test its effectiveness, we applied a 1 kHz test signal to the amplifier, increasing it's amplitude until obvious output clipping was taking place with the POWER GUARD switch turned off. The resulting output waveform is displayed in the 'scope photo of Fig. 8.

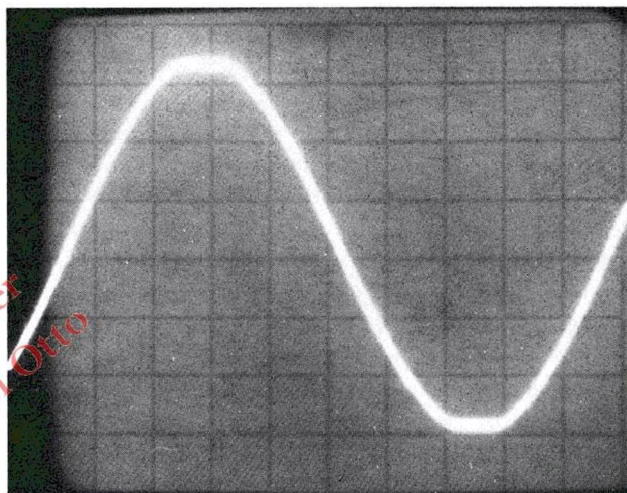


Fig. 8 - Clipped 1 kHz signal with, POWER GUARD "OFF"

With the identical signal applied, we flipped the switch to NORMAL, and observed a significant diminution in output signal clipping, as illustrated in Fig. 9.

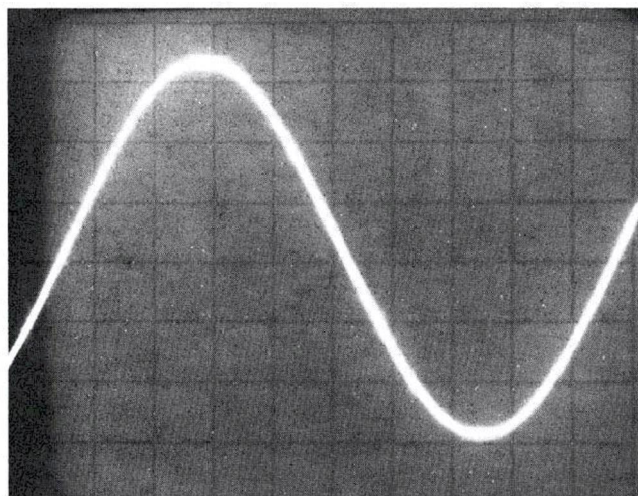


Fig. 9 - Signal input as in Fig. 11, with POWER GUARD "ON" results in output waveform shown above

With the same overdriving signal applied to the amplifier, we analyzed signal output by means of our spectrum analyzer. With power guard "off", higher level harmonics (third and fifth) were approximately 44 and 48 dB below the reference 1 kHz spike as shown in the 'scope photo of Fig. 10.

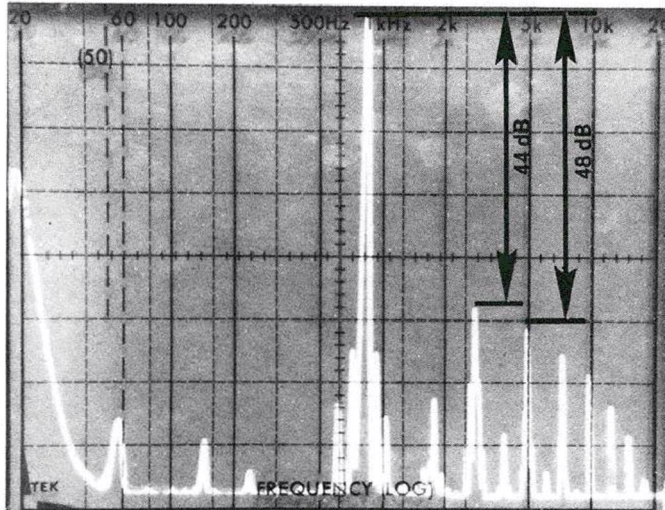


Fig. 10 — Harmonic distortion components of output signal shown in Fig. 8

A second analysis of the output signal was made after the Power Guard switch was once again set to NORMAL and, this time, the third harmonic contribution was instantly reduced to some 57 dB below rated output reference, while the fifth harmonic distortion component was reduced to some 63 dB below rated output (see Fig. 11).

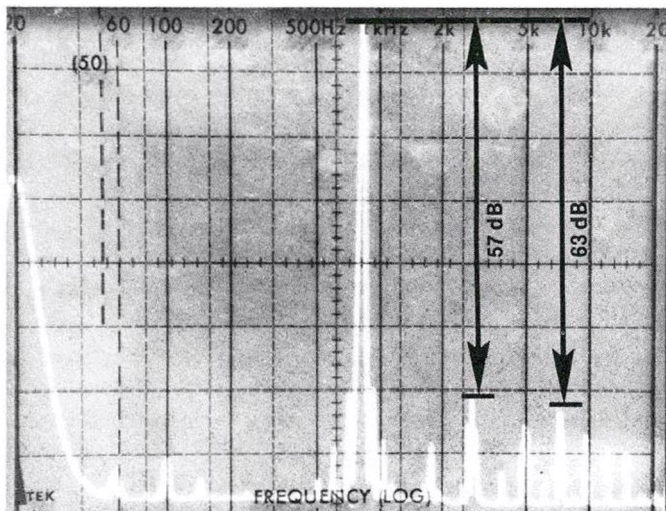


Fig. 11 — Reduced harmonic distortion components when POWER GUARD circuit is activated

Impressive as these results are, we recognized, of course, that people don't generally listen to continuous sine-waves and were curious to find out what the POWER GUARD circuit could do when subjected to more complex signals.

Accordingly, we next applied an IM test signal to the amplifier, driving it well beyond clipping, as shown in Fig. 12.

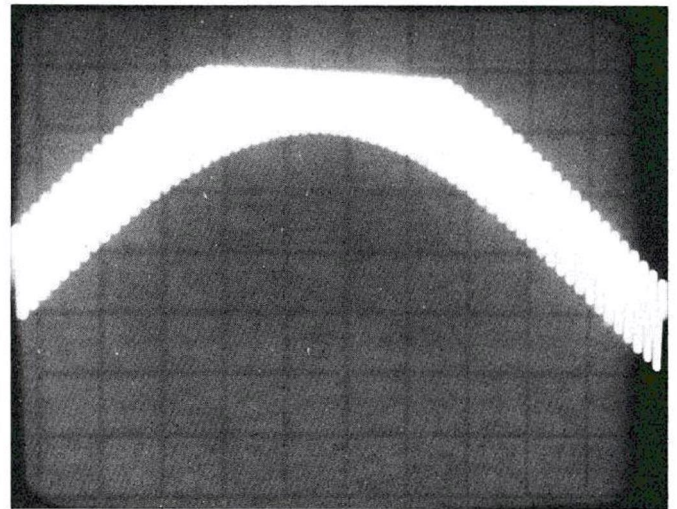


Fig. 12 — "IM" test signal drives MC 2205 beyond clipping without POWER GUARD

Turning on the Power Guard circuit once more the waveform was instantly restored to its almost totally undistorted shape, as illustrated in the 'scope photo of Fig. 13.

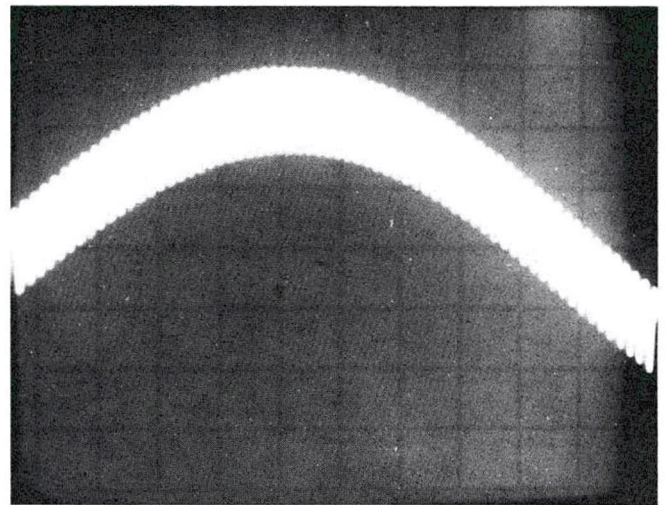


Fig. 13 — Same input as in Fig. 12 results in output waveform shown above when POWER GUARD circuit is activated

In fact, we discovered that the power guard circuit is fast enough to diminish the amplitude of even a single cycle of a 20,000 Hz tone burst. Further, the power guard circuit is able to reduce or attenuate input signals to as little as one-tenth their actual amplitudes, if necessary, in order to maintain low distortion in the event of inadvertently excessive input signals.

Performance Evaluation and Listening Tests

Following the laboratory measurements described, we subjected the MC 2205 to extensive listening tests and con-

tinuous power output life and heat tests. Relatively low efficiency loudspeakers were used throughout our listening tests so that desired loud listening levels might require the amplifier to produce and deliver a substantial percentage of its rated power output during musical peaks. On more than one occasion, we drove the amplifier to the point where the LIMIT indicators became illuminated and, during those listening sequences we operated the amplifier both with and without the POWER GUARD circuitry turned on and observed output waveforms on a permanently connected oscilloscope. Clearly, the attenuating circuit was effective in eliminating all visible or audible evidence of amplifier clipping even during severe overdrive conditions. Combined use of the power meters and LIMIT indicators really told us just what level of power was being delivered to the loads at every instant.

The amplifier delivered clean, tight sound with no evidence of audible coloration and sharp transients were reproduced effortlessly. The power reserve of this amplifier is more than adequate when it is used with even the least efficient loudspeaker systems currently available for home high fidelity reproduction. With so much available power, in fact, one needs to be careful in selecting appropriate speaker systems, especially if one of the new accessory expansion devices is used in conjunction with the system. We did use an expander in some of our listening tests, and the audible merits of the expander can only be appreciated when an associated amplifier can provide the needed "headroom" required by such devices.

In actual use for music reproduction, the heat developed by the output stages was surprisingly low, even after extended listening at levels which repeatedly drove the meters above mid-scale and, on occasion, to the 200 watt calibration point and beyond.

One cannot honestly equate dollars and watts when considering the true worth of an amplifier such as the McIntosh MC 2205. Long-term reliability, McIntosh's unqualified performance guarantees and their willingness to stand behind all of their products must all enter into the "price/performance" equation. In the case of our sample unit, we did just about everything we could to tax the capabilities of the amplifier (including momentary output short circuits, extended operation at overload and severe clipping, and repeated on/off cycling with high level signals applied). There was no "tricking" the amplifier into any form of failure or faulty operation. It literally defied our attempts to "blow it up". The McIntosh MC 2205 is likely to become as much of a "classic" in its own time as have other fine products from this highly reputed company in the past.

Electronic Laboratories'

PRODUCT ANALYSIS

THE McINTOSH LABORATORY MODEL C 32 SOLID STATE STEREO PREAMPLIFIER



Fig. 1 — Front view

MANUFACTURER'S PUBLISHED PERFORMANCE LIMITS (SPECIFICATIONS):

Rated Output: 2.5 V (Main); 250 mV (Tape). **Output Impedance:** 220 ohms (designed to operate into 5000 ohm load or higher). **Frequency Response:** 20 Hz to 20,000 Hz, +0, -0.5 dB; with equalizer out: 10 Hz to 100,000 Hz, +0, -0.1 dB. **Total Harmonic Distortion:** 0.05% maximum, at rated output level, 20 Hz to 20 kHz. **Hum and Noise (Phono 1 & 2)** 80 dB below 10 mV input, unweighted; 90 dB IHF "A" weighted; (AUX, Tuner, Tape 1, 2 & 3): 90 dB unweighted; 100 dB IHF "A" weighted. **Input Sensitivity:** (Phono 1 & 2): 2.0 mV into 47,000 ohms, 65 pF; (Aux, Tuner, Tape 1, 2 & 3): 250 mV into 50,000 ohms. **Equalizer Center Frequencies:** 30 Hz, 150 Hz, 500 Hz, 1.5 kHz, 10 kHz. **Equalizer Control Range:** ± 12 dB at each center frequency. **High and Low Cut Filters:** 12 dB/octave above 7 kHz and below 50 Hz. **Voltage Gain (controls flat):** 62 dB (Phono input to main outputs); 42 dB (Phono input to tape output); 20 dB (high level inputs to main outputs). **Power Output:** (Monitor, Headphone or Line Out): 12 watts per channel, 8 ohm loads, 20 Hz to 20 kHz, 0.1% total harmonic distortion, or 5.0 V RMS into 600 ohm line.

MECHANICAL SPECIFICATIONS:

Front Panel Dimensions: 16" w. x 5-7/16" h. **Chassis Dimensions:** 15" w. x 5" h. x 13" d. Knob clearance required in front of mounting panel surface: 1 1/2". **Weight:** 26 lbs. net. **Semiconductor Complement:** 67 transistors, 35 IC's, 62 diodes, 2 FET's, 1-SCR. **Power Requirements:** 120 V, 50/60 Hz, 25 to 85 watts. **Suggested Retail Price:** \$1500.00.

McIntosh Laboratory Inc. is not the sort of company that introduces new products simply for the sake of annual cosmetic changes and price adjustments. So, when that Binghamton, New York based high fidelity equipment manufacturer announced availability of a newly designed preamplifier/control unit we were particularly anxious to obtain a sample and put it through its paces -- both on the lab bench and as a control center in our reference listening system. After carefully unpacking what seemed like an inordinately large and heavy carton for a preamp, we began a month-long testing and listening experience with the new C 32, pictured in Fig. 1. The C 32 is such a flexible control center that even after that long period of use we are still discovering features and interconnection possibilities which were not immediately apparent. While some devotees of so-called esoteric equipment maintain that a preamplifier should be almost totally devoid of tone-tailoring and signal processing circuits (they speak of straight wires "with gain" and such), our brief experience with the C 32 suggests that it is possible to design a preamp control center that offers pure signal amplification plus, if the need arises, all the signal processing circuitry one might ever desire or require. In short, the C 32 is loaded with welcome surprises.

The front panel is similar in appearance to those of other familiar McIntosh products, with its black glass face, gold nomenclature (much of which illuminates in a soft green color when power is applied) and heavy gold colored end-caps. Mac's popular PANLOC installation system, along with all necessary hardware and slides has been retained and the front panel is made larger than the chassis dimensions to facilitate mounting behind a furniture panel. Optional wood-cabinet mounting is also possible. Two selector controls, identified as LISTEN and RECORD permit listening to any program source while recording any other (or the same) program. A mode selector affects only those programs selected by the LISTEN switch and has positions for L to L&R, R to L&R, Stereo, Reverse, Mono (L&R), L+R to L and L+R to R.

The First Surprise

The C 32 is equipped with a 5-band equalizer (two octaves per band) with five separate controls for adjusting overall response. To their right is the master volume control while just below are dual concentrically mounted balance and loudness-compensation controls. The loudness control operates independently of the volume control and can be set to provide Fletcher-Munson "equal loudness" contours at any volume level. This preferred arrangement allows the user to introduce correct loudness compensation regardless of such variables as program source level, speaker efficiencies, room dimensions or personal listening preferences.

The Second Surprise

Adjacent to the balance and loudness controls is an expander control. The C 32 includes a linear expander circuit with adjustable expansion ratios from 1.0 to 2.0. McIntosh advises that with expansion set to 2.0, the C 32 can playback dbx encoded programs with almost perfect compatibility. Eight pushbuttons, including a red-colored on/off power switch are grouped along the bottom of the panel along with Tape 3 in and out jacks and two headphone

jacks. The upper phone jack is fed directly from a full-range 12 watt per channel monitor amplifier through an appropriate matching network.

The monitor amplifier can also be used to drive a pair of speakers directly and program sources applied to the monitor amp may be selected from either the LISTEN buss or the RECORD buss by means of a switch located on the top surface of the preamp. Beside the input switch are separate gain controls which adjust monitor amplifier output level. Additional controls located in this area determine the level at which the expander makes its transition from "downward" to "upward" expansion and the attack time constant associated with the expansion circuit. Certain types of program material are reproduced more effectively with a slower attack time than others, and three speeds of expansion (slow, normal and fast) are provided by means of a three position slide switch.

Since the LISTEN and RECORD selectors have only a single Phono setting, the first of the remaining push-buttons is used to switch from Phono 1 to Phono 2. The next button is a record monitor switch (which tape monitor circuit is monitored depends upon the setting of the LISTEN or RECORD selectors). This is followed by an Equalization switch (which bypasses or introduces the five band equalizer and the low and high cut filters), low and high cut filter buttons, and two output selectors which connect the LISTEN program to either or both pairs of additional output jacks (over and above the main output jacks) and can be used to feed program material to additional power amplifiers feeding remote speaker installations. These buttons also serve to turn remote speakers on and off if an optional remote control SCR relay is connected to an appropriate socket on the rear panel of the C 32.



Fig. 2 — View of back panel

As for the rear panel, (shown pictorially in Fig. 2) there are a few surprises to be found here as well. There are, for example, those familiar spring-loaded speaker terminals at the lower right which are used for connecting a pair of speakers directly to this unit. If you think about the LISTEN and RECORD buss arrangement for a moment, you will realize that these speakers could serve as the "rear channels" in a quadraphonic system, or even to provide "ambience" channels when using an audio time delay unit, since the feed to such a time delay unit could come from one of the TAPE OUT circuits and the return could be fed to the alternate buss and extracted via the monitor

amplifier. In that way, a second stereo power amp would not be required for these arrangements.

All of the program source input jacks, the three sets of tape out jacks and the main and extra sets of output jacks are neatly arranged along the top of the rear panel while below are four sets of switched AC receptacles plus an additional pair identified as "turntable power" and colored green. Associated with these latter receptacles is a slide switch which, when placed in the "auto" position permits your entire system to be turned off and on whenever your turntable is activated. A sensing system associated with these receptacles detects the fact that current is being drawn by the turntable and turns on the C 32 (as well as anything else connected to its other switched receptacles). A separate fuse protects these receptacles (which can supply no more than 100 watts) while a main line fuse is located near the power cord at the lower left of the rear panel. A ground terminal, located near the phono inputs and the speaker control relay socket at the lower right completes the rear panel layout.

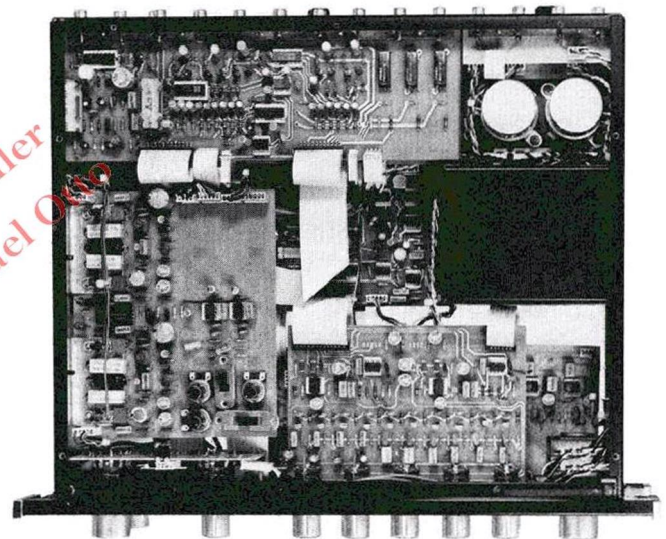


Fig. 3A — Top view of chassis

Internal Construction and Circuit Highlights

The views of the underside and top side of the C 32 chassis clearly disclose the flawless workmanship and layout for which McIntosh products have become famous (See Fig. 3A and Fig. 3B). Flat-ribbon multiple conductor cables can be seen used as interconnecting cables between the various p.c. board assemblies while all conventional point-to-point wiring is carefully harnessed and methodically routed. A block diagram of the C 32 circuitry is reproduced in Fig. 4. Each phono preamp circuit used four low-noise transistors arranged in a low-impedance configuration. To achieve low noise a 68 ohm feedback termination is used. All program source input switching is done electronically, using FET analog switches. The mechanical LISTEN and RECORD front panel switches are single-deck units that simply switch low DC voltages which turn the FET analog switches on or off. The master volume control (picture in Fig. 5) is a step attenuator and since the switch commutator touches

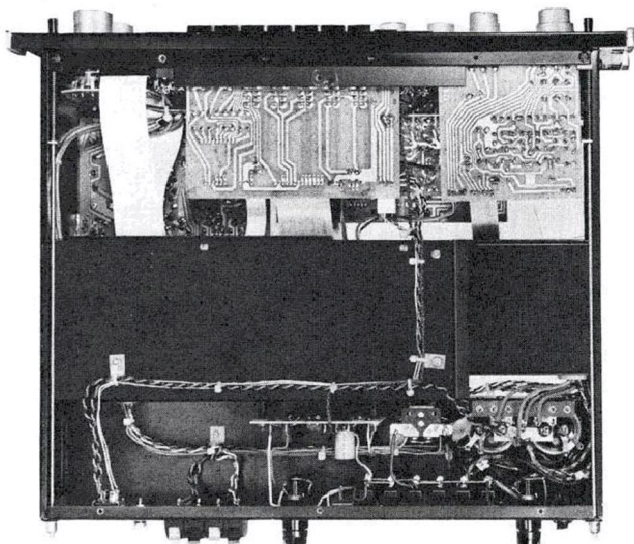


Fig. 3B — Bottom view of chassis

only contact pads rather than the actual resistance elements, tracking accuracy (spec'd at within 1 dB over its entire range) is not degraded with continued use. Loudness, equalizer and band pass filters are all constructed using ion implanted junction field effect op-amps. The logarithmic expander is capable of being switched only into the LISTEN program line. Signals from the equalizer circuit are applied to a voltage controlled amplifier which operates as a variable gain block. Control voltages for this VCA are developed from a sample taken from the output of the equalizer. Electronic processing of this sample includes band shaping, logarithmic amplification, full wave rectification, level setting, expansion ratio regulation, attack timing, level setting and DC amplification. The resulting voltage controls the gain of the VCA to cause logarithmic gain reduction below set level and logarithmic expansion

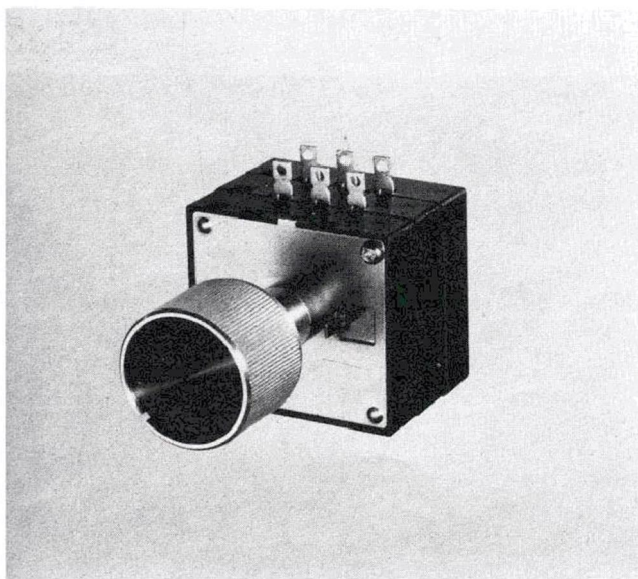


Fig. 5 — Precision master volume control

above that level. A switched bypass link provides a program path around the expander, maintaining a constant signal level regardless of whether the expander is in or out of the circuit.

To minimize hum pickup, the C 32 power transformer is triple shielded (copper strap, silicon steel strap and steel outer shell). Transformer output voltage is fed to a full wave bridge with 5000 mfd filter capacitors to provide plus and minus 24 volts DC for powering the monitor amplifier. The plus and minus 18 volts needed for low level and op amp stages is derived from the 24 volt supply and controlled with integrated circuit voltage regulators. A relay, time controlled by a transistor switch, connects the output of the preamplifier to the output jacks. Transistor switch control is derived from a long time constant capacitor charging network which turns on the relay approximately two seconds after the unit is turned on. The same circuit has a short turn-off time constant which turns off the relay before the preamplifier's main power supply has had a chance to discharge.

Phono Equalizer Section Measurements

Phono equalization was accurate to within 0.2 dB from 30 Hz to 20,000 Hz. Below 15 Hz, a sub-sonic filter rolls off all program sources and is independent of the RIAA equalization. This additional roll-off, though not part of the phono circuitry, tends to reduce response at sub-sonic frequencies somewhat in the manner required by the newly adopted revised RIAA response curve which calls for a roll-off beginning at around 30 Hz. We measured an input sensitivity for phono, for 2.5 volts rated output from the main outputs, of 2.3 mV and phono overload (at 1 kHz occurred with a 100 mV input signal -- adequate for just about any cartridge tracking any disc we know of. Harmonic distortion in phono (measured at the output) was well below 0.02% for any frequency from 20 Hz to 10 kHz, rising slightly to 0.03% at 20 kHz. Signal-to-hum and noise in phono measured 78 dB referred to actual input sensitivity (nearly 91 dB referred to 10 mV as compared with McIntosh's limit spec of 80 dB) and 82 dB when using an "A" weighting network but still referred to actual 2.3 mV input. Translated to a 10 mV reference, the weighted S/N becomes nearly 95 dB as opposed to the 90 dB limit specified by the manufacturer. No matter what reference level you choose to use, these are excellent S/N figures for any phono preamp.

Frequency response using the high level inputs was within 0.25 dB from 20 Hz to 20 kHz and within 1 dB from 10 Hz to 100 kHz.

Figure 6 is a plot of output voltage versus harmonic and IM distortion, measured at the MAIN output terminals. Maximum output before clipping measured between 10 and 12 volts depending upon frequency used and, at rated output (with equalization and expander circuits bypassed), THD measured 0.007% at 1 kHz, 0.01% at 20 Hz and 0.012% at 20 kHz. IM distortion measured a very low 0.003% at any output voltage (equivalent) level up to 10 volts.

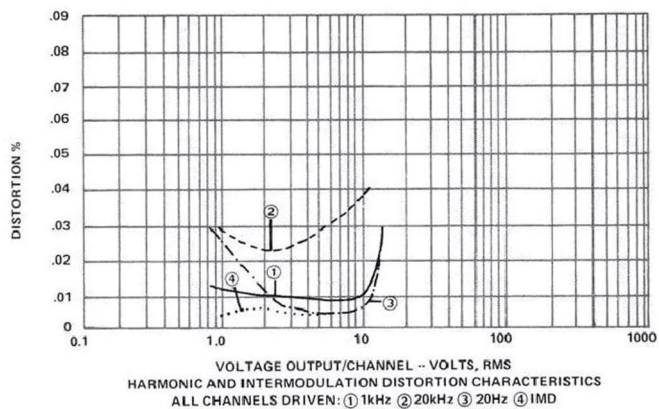


Fig. 6 - Harmonic and intermodulation distortion main output

Measurements were repeated using the speaker output terminals to include the monitor power amplifier in the signal path. At 12 watts output per channel (both channels driven, 8 ohm loads), with a 1 kHz test signal, THD measured 0.0075% while IM distortion was 0.01%. These results as well as those obtained at lower and higher power output levels are plotted in Fig. 7. Rated (limit) distortion of 0.1% was reached when the amplifier delivered 16 watts per channel under the same driving and test signal conditions.

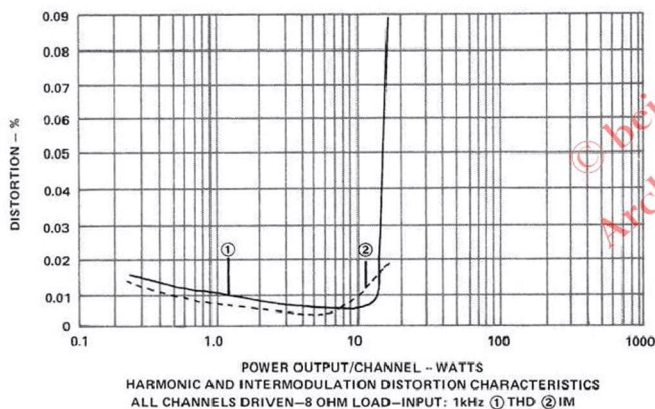


Fig. 7 - Harmonic and intermodulation distortion line/monitor output

Introducing the expander into the circuit tended to increase THD slightly, but even then harmonic distortion remained well below McIntosh's published limit, with typical readings of 0.018% at the 12 watt output level from the monitor amplifier. Figure 8 is a plot of harmonic distortion versus frequency at the 12 watt per channel output level as measured at the speaker terminals of the C 32, with 8 ohm resistive loads connected. Distortion remained below 0.01% up to around 5 kHz, increasing gradually to a maximum of 0.023% at 20 kHz. In terms of FTC power disclosure requirements, the power amplifier section of this unit might well have carried a power rating of 14 watts per channel, while power band might have been specified as extending all the way from below 10 Hz to 55 kHz for the existing power rating of 12 watts and the rated THD level of 0.1%! If anyone ever doubted the

conservatism of McIntosh Specifications (or, as they prefer to call them, "performance limits") these reported readings and measurements should certainly dispel those doubts.

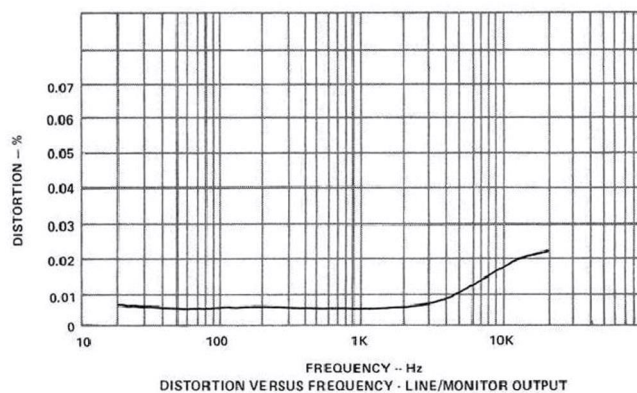


Fig. 8 - Distortion versus frequency - line/monitor output

Turning our attention to some of the front panel control features, we next examined the way in which the equalizer controls performed. The sequential stored 'scope sweeps of Fig. 9 were made by running ten separate traces or sweeps, from 20 Hz to 20 kHz, each sweep made with either maximum attenuation of maximum boost of a single one of the five available band controls of the equalizer section. Center frequencies of each control corresponded very closely with specified frequencies and maximum boost or cut in each case was almost precisely the 12 dB specified. Needless to say, with overall response adjustment capability such as this, there is no need for conventional bass, treble or even mid-range tone controls on this unit.

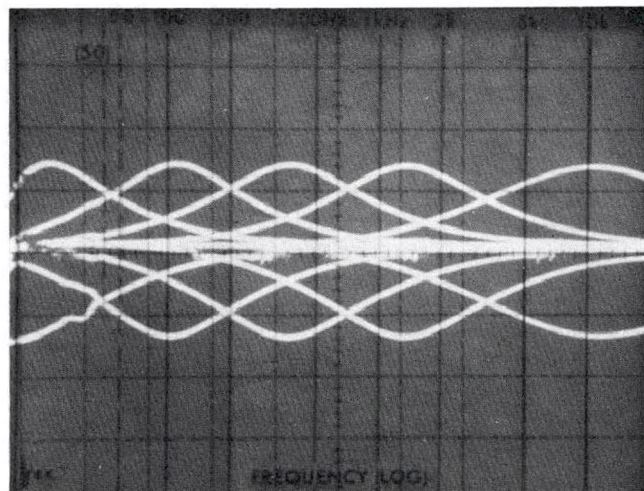


Fig. 9 - Range of control provided by the five equalizer controls

The response of the high and low cut filters was plotted using our spectrum analyzer/storage scope combination and it is interesting to note that the action of the permanent sub-sonic filter is clearly discernible even in the "flat response" position with the low-cut filter out of the circuit. To illustrate this action, the 20 Hz low limit of our sweep was deliberately offset slightly, since at 20 Hz the sub-sonic filter has no effect. (See Fig. 10).

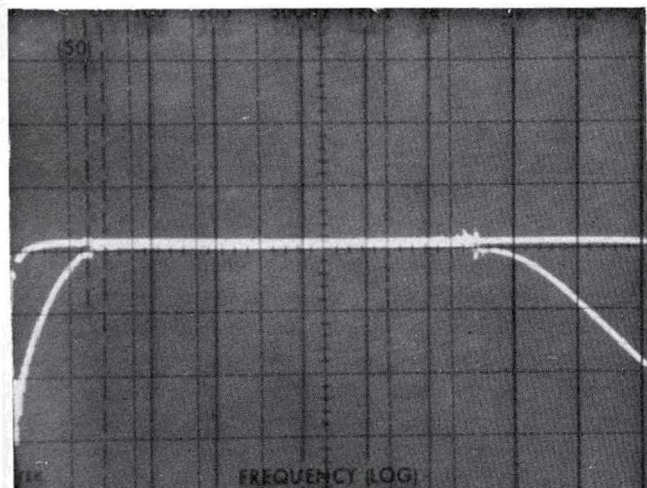


Fig. 10 — High-cut and low cut filter response compared "flat" response

Examples of the loudness compensation curves available through the use of the separate loudness control were plotted for the 'scope photo of Fig. 11. All of these curves were made for an arbitrary setting of the volume control which, as we mentioned earlier, is totally unrelated to the loudness-contour control. While this arrangement permits the user to properly utilize loudness compensation at any listening level, the method of use is somewhat different from that which most audio equipment users are accustomed to and a bit of explanatory material in the owner's manual might prove helpful. As matters stand, the user is left pretty much on his own when it comes to setting up this control.

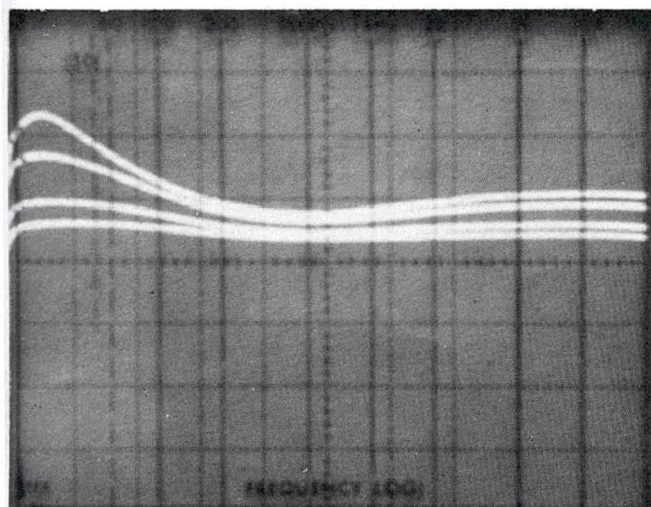


Fig. 11 — Typical loudness - compensation response curves obtained at various settings of the loudness control (volume control setting remained fixed)

While the action of a linear expander is probably familiar to most readers and has been verbally explained earlier, we sought nevertheless to present the action of the C 32 expander in a more graphic way. After some experimentation (and thanks to the flexibility of our Tektronix 5L4N spectrum analyzer) we devised a technique which resulted in the 'scope displays shown in Fig. 12. The 5L4N analyzer

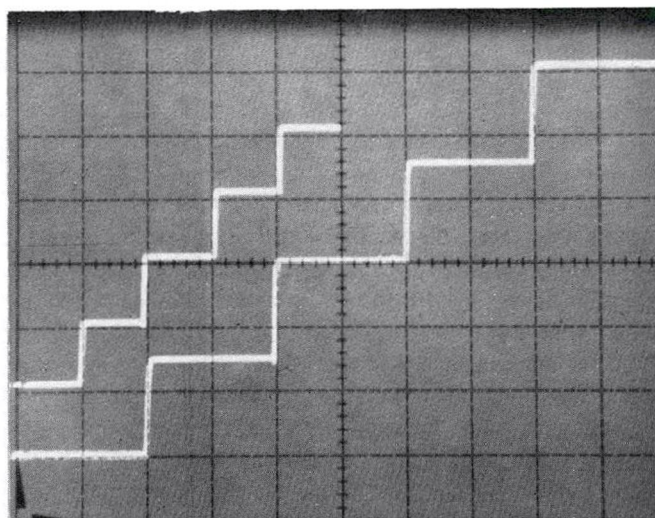


Fig. 12 — Display at left illustrates 40 dB of input amplitude change, in ten dB steps, with no expansion, as observed at output. The same change of input signal amplitude with expander set to 1.5 results in 60 dB change (trace at right.)

can be set so that it is responsive only to a single frequency (in this case, 1 kHz) even though the horizontal sweep on the scope display moves across the screen. Having tuned the analyzer to 1 kHz, we fed a signal of that frequency into one of the high level inputs of the C 32 and applied the output to the vertical input of the analyzer. A very slow sweep was initiated, and after each horizontal division was traversed, we increased the signal input level by 10 dB for a total of 40 dB of amplitude change. The "steps" formed by the leftmost trace shows this 10 dB progression, since during this first pass the expander control was in the off position and the preamplifier operated in a perfectly linear fashion. Next, we turned on the expander control and set it to 1.5 linear expansion. Starting at the same signal input level as before, we once again began a "scope sweep, only this time we allowed each level to remain constant for two horizontal divisions, so that the second display would not overlap and confuse the first one. As you can see, each 10 dB of amplitude increase now resulted in a 15 dB increase, as seen at the output of the C 32 (each vertical division on the analyzer's scope face equals 10 dB of amplitude change). Thus, at low signal levels, the output has been "downward" expanded (it is lower in amplitude than it would have been with the expander out of the circuit), while at levels above the "level match" setting (mid-screen, vertically), outputs become progressively greater than those in the earlier display. Note that each successive increase of 10 dB in input level resulted in almost precisely 15 dB of increase in output level. ($15 \text{ dB}/10 \text{ dB} = 1.5$, the ratio of expansion selected by means of the front panel control.) Putting it another way, a "program" having only 40 dB

or dynamic range has been expanded to 60 dB of audible dynamic range.

The attack time selected for this display was "normal". Had we chosen the "slow" attack time available, we would have observed a slight rounding of the rising or leading edge of each "step", indicating a slight time lag in the action of the expander. Using the "fast" setting would have resulted in even sharper "corners" for each of the expanded steps than those recorded.

Speaking of attack time of expanders, should you ever have occasion to measure the C 32, you will find that with the expander "in circuit" any attempts to measure IM distortion will be rather meaningless and readings are likely to be higher than you would expect. Such readings are not to be interpreted as actual intermodulation distortion, which is normally defined as sum and difference products which arise from non-linear combining of the 60 Hz and 7000 Hz test tones used in the IM test. Observation of the "distortion" output components when making the IM measurement with the expander circuit in the signal path showed that, in fact, the residual products consisted primarily of 60 Hz components rather than high frequency sum-and-differences. The response time of the expander to these low frequencies is such that a finite delay is introduced between the input 60 Hz and the output at that frequency which shows up on an IM analyzer as if it were actually IM distortion. In actual listening tests these effects were not audible as IM distortion, despite the somewhat higher "meter" readings with the expander in-circuit.

Use Tests and Listening Tests

Our listening tests using the McIntosh C 32 were really divided into two parts. First, we wanted to judge the unit as a no-frills preamplifier, and so much of our initial listening was done with the equalizer and expander circuits bypassed. Sound quality when playing a variety of disc recordings was as good as anything we have heard to date -- regardless of price. In fact, at one point in our tests we decided to do away with our high-powered basic amplifier entirely and simply hooked up the speaker terminals of the C 32 directly to a pair of high-efficiency vented-enclosure speaker systems in the lab. You would be amazed at how much sound power can be achieved with just 12 watts per channel driving reasonable high efficiency speakers. Happily, the monitor amplifier included in the C 32 is of as high a quality as the rest of the unit and at levels below power amp overload, sound was tight and clean. As suggested by McIntosh, this built in amplifier, in addition to its head-phone driving function, would make an idea "second power amp" for driving rear ambience channels (which seldom require anywhere near the loudness levels of the main, front speakers) or for rear channels in a 4-channel system. Where a remote pair of stereo speakers are called for (as, for example, in a bedroom or den), one could also forego turning on any associated main power amplifier during such remote listening and operate the second set of speakers directly from the monitor amplifier of the C 32.

As for the action of the expander, it compared very favorably with results obtained using such one-sided ex-

panders as the dbx 117 or 119. We also played two dbx encoded discs using the expander set to 2.0 linear expansion and agree that results were compatible with those heard when playing back the same material using a dbx 120 series compander, though there seemed to be some slight differences in overall balance at the high end when using the expander of the C 32. A bit of maneuvering with the highest band control of the equalizer section made these differences even less apparent. Breathing or pumping is minimal, but depends in part upon the setting of the expansion speed control. Here, we feel, the Mac unit offers a definite plus for it is indeed true that certain program material does best with the normal speed setting while other recorded material was expanded more realistically using the fast, and in rare cases, even the "slow" expand attack time.

When you add it all up, the McIntosh C 32 is, in reality, four high quality products in one: a top performing preamp/control, a well designed five-band graphic equalizer, a linear dynamic range expander and a moderately powered low-distortion power amplifier. Based upon that analysis, and its overall performance and listenability, the suggested retail price of \$1500.00 doesn't seem all that high. In fact, it's rather quite a bargain!

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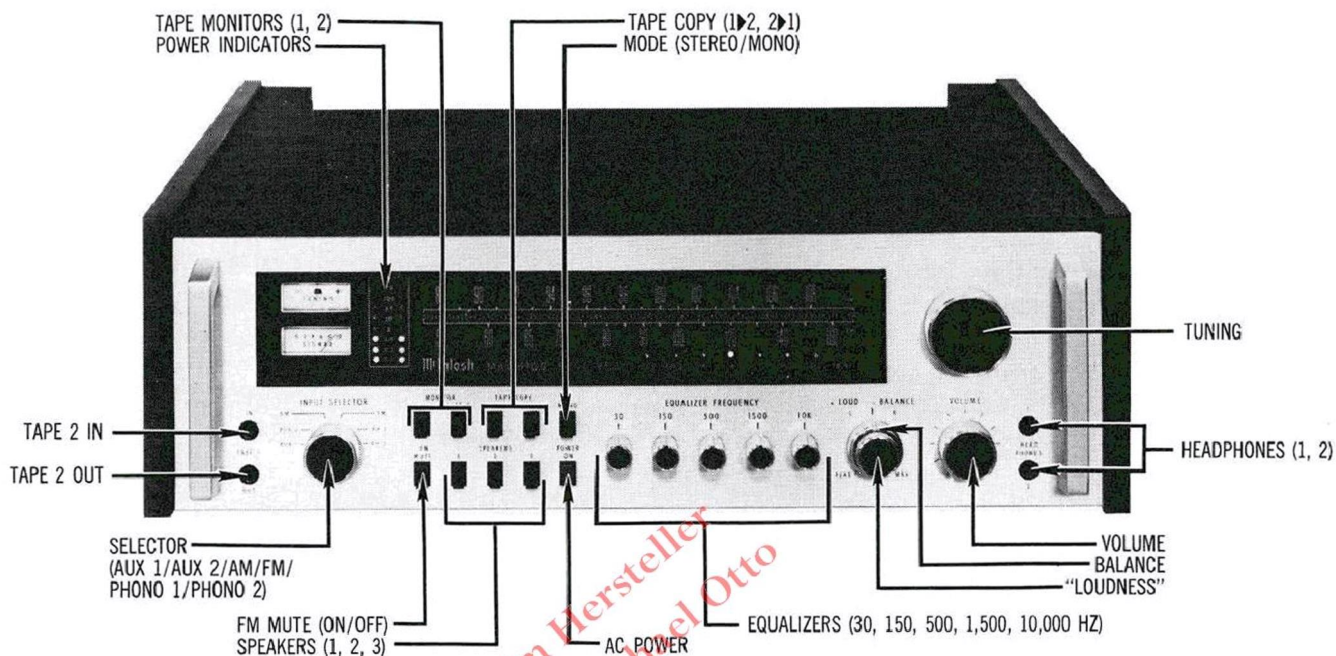
McIntosh's New Receiver • MAC 4100

February 1979

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McIntosh's New Receiver: Breeding Tells

Mac 4100 stereo FM/AM receiver, in case with simulated wood-grain finish. Dimensions: 18 $\frac{1}{2}$ by 5 $\frac{3}{4}$ inches (front), 14 inches deep plus clearance for controls and connections. AC convenience outlets: 2 switched plus 1 unswitched (600 watts total), 2 for auto-on turntable switching (100 watts total). Price: \$1,499; optional RMA-5 rack-mounting adapter, \$29. Warranty: three-year service contract, free with purchase of the receiver, has provisions comparable to typical "limited" warranties but covers normal wear and tear. Manufacturer: McIntosh Laboratory, Inc., 2 Chambers St., Binghamton, N.Y. 13903.

McIntosh has for some years kept a very low profile vis-à-vis the press. This hiatus in communications has fostered a polarization of opinion about McIntosh: Is the company still deserving of its reputation for superb engineering, or is it trading on past glories? One review can't provide a definitive answer, of course, but the Mac 4100 receiver can be taken as a positive sign of health in Binghamton.

The personality of this receiver is like that of an accomplished servant used to coping with pampered aristocrats who

demand the finest but are not always technically knowledgeable or manually dexterous. Accordingly, it takes responsibility in a manner that, paradoxically enough, is unassuming yet quite intolerant of intervention by its master. But once it has taken over, it performs virtually impeccably and can even ward off the consequences of ineptitude without noticeable fuss.

REPORT POLICY Equipment reports are based on laboratory measurements and controlled listening tests. Unless otherwise noted, test data and measurements are obtained by CBS Technology Center, Stamford, Connecticut, a division of Columbia Broadcasting System, Inc., one of the nation's leading research organizations. The choice of equipment to be tested rests with the editors of HIGH FIDELITY. Samples normally are supplied on loan from the manufacturer. Manufacturers are not permitted to read reports in advance of publication, and no report, or portion thereof, may be reproduced for any purpose or in any form without written permission of the publisher. All reports should be construed as applying to the specific samples tested; neither HIGH FIDELITY nor CBS Technology Center assumes responsibility for product performance or quality.

Very little of the receiver's special quality is immediately apparent from the outside, though in hooking it up you get a clue from the convenience outlets. In addition to the conventional switched (black) and unswitched (red) ones, there are two green ones marked TURNTABLE, plus an AUTO/MANUAL switch. If you use the AUTO setting and a turntable plugged into one of the green sockets is turned on, the receiver and any outboarded equipment run off the switched outlets will come on automatically, even when the receiver's power switch is off, and all will turn off again when the turntable shuts down. Thus an automatic model can be made to turn off the whole system unattended. Since the feature works by sensing current drain through the turntable outlets, the switch serves to override it should the turntable be one of those that draw some current even when they are off.

The receiver's switching is handled by DC control voltages, actuated by the front-panel controls and fed to FETs that actually do the signal switching. There are two fundamental advantages to this approach: Switching transients are eliminated, and the short, direct signal paths made possible minimize noise pickup, RFI, and crosstalk. In all of these re-

spects the 4100 is above reproach. We seldom have RFI problems in our area, but we do often find that, for example, some audio from an FM tuner section will "leak" into the tape-monitor signals; none was detectable in the Mac.

The FM section is unusual in that—in addition to conventional automatic stereo/mono switching—it has an automatic-blend feature that progressively reduces stereo separation (and hence out-of-phase noise) as signal strength drops. Since the full audio band is blended, the resulting stereo image may be a bit stabler than in the more usual high-blend solution, but the hiss seems a little more intrusive for a given degree of separation loss. On weak signals it does work, however—and, like so many features of the Mac, without drawing undue attention to itself. Similarly, the Automatic Frequency Lock gently holds onto an FM station that has been tuned correctly; were it not for the front-panel AFL LED, which lights when lock occurs, you would be unaware of its action. This LED acts as a tuning aid; when the muting is on, the LED announces arrival at a receivable station before the unmuting action (which is gentle and slightly delayed) allows any audio to pass. The

McIntosh Mac 4100 Receiver

Tuner Section

Capture ratio 2 dB

Alternate channel selectivity 76 dB

THD + N	L ch	R ch	mono
80 Hz	0.25%	0.25%	0.16%
1 kHz	0.17%	0.22%	0.15%
10 kHz	1.8%	1.7%	0.21%

IM distortion 0.06%

19-kHz pilot -63½ dB

38-kHz subcarrier -66½ dB

S/N ratio (at 65 dBf)
stereo 67 dB
mono 71 dB

Amplifier Section

Manufacturer's rated power 17¼ dBW (75 watts)/ch.

Power output at clipping (channels driven simultaneously)

L ch	20 dBW (98 watts)
R ch	20 dBW (98 watts)

Dynamic headroom (at 1 kHz) 1½ dB

Frequency response +½, -¼ dB, 20 Hz to 20 kHz
+½, -3 dB, 13 Hz to 35 kHz

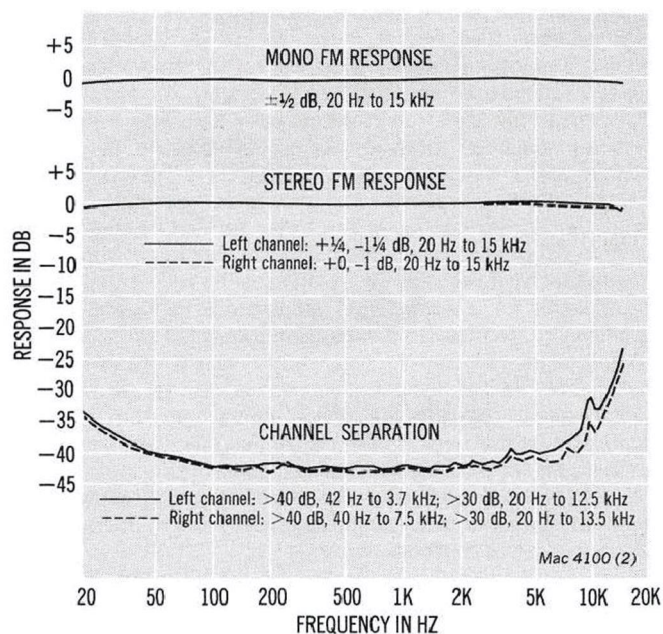
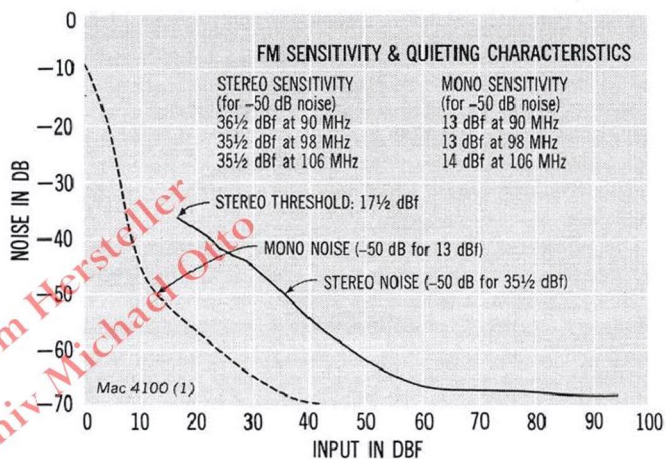
RIAA equalization ±1 dB, 20 Hz to 20 kHz

Input characteristics (re 0 dBW (1 watt); noise A-weighted)

	Sensitivity	S/N ratio
phono 1, 2	0.27 mV	76½ dB
aux 1, 2	30.0 mV	80 dB
tape 1, 2	30.0 mV	80 dB

Phono overload (clipping point) 88 mV at 1 kHz

Damping factor at 50 Hz 100



range of the signal-strength meter is well chosen as an aid in antenna orientation for best reception of problem stations.

The amplifier section, too, exemplifies the extra care that sets the receiver apart. Whether the option that enables switching in three speaker pairs simultaneously requires them or not, it has three distinct protection systems. The most conventional is triggered by a heat sensor and shuts down the output until the heat sink has cooled to within safe operating limits. The Sentry Monitor circuit reacts to abnormal current conditions by restricting the drive to the output transistors. And the Power Guard circuit responds to overdrive that normally would create hard clipping by shaving off the potentially dangerous harmonics—"softening" the clipping, so to speak. None impinges on normal operation; all minimize the effects—aural, thermal, or electrical—of abnormal operation.

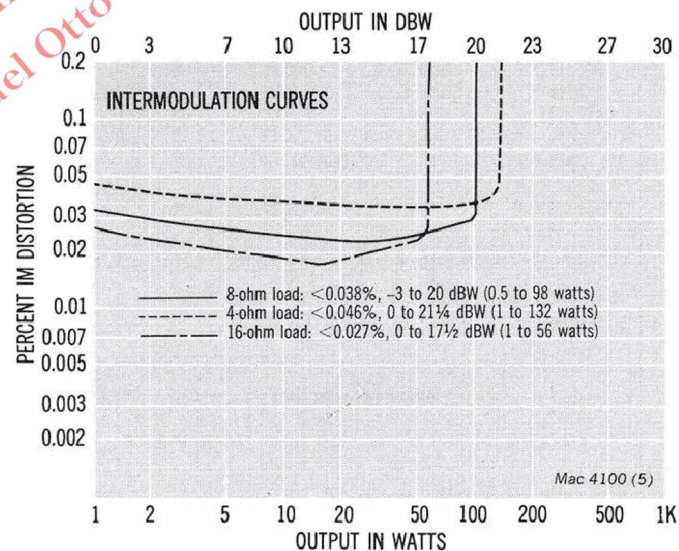
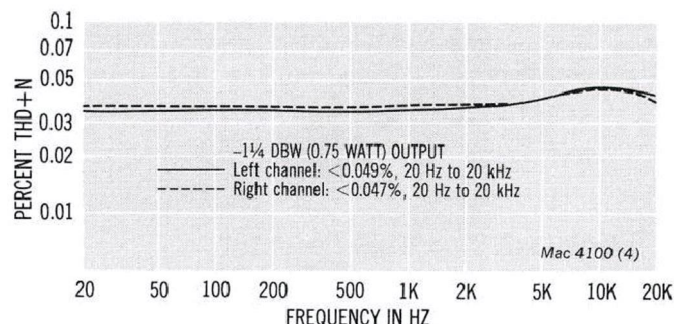
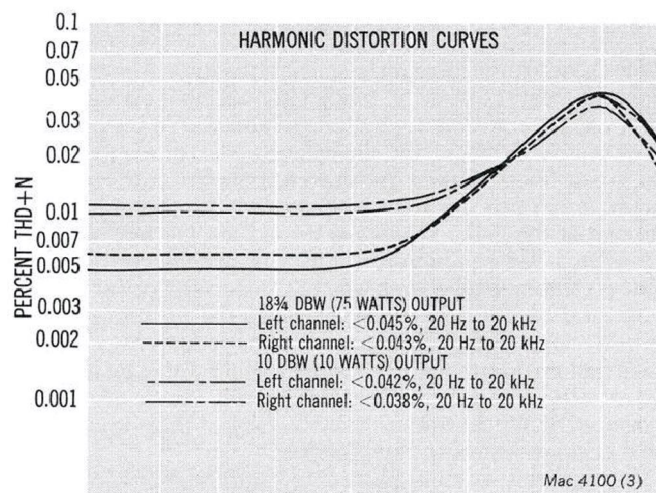
The Power Guard, for example, limits peaks so smoothly that you are unlikely ever to hear this receiver overload, as such. The top LEDs in the front-panel power display—the one possible concession to fashion in the design—are Power Guard pilots; below that, the display is calibrated from 100 watts down to 0.1 watt in 5-dB steps. As we've said before, we're not convinced of the utility of such indicators, but the calibration points do seem relatively well chosen.

Two unusual features of the front panel are the equalizer/tone controls and the "loudness" knob. The latter might better be marked "contour" since it does not adjust midband level like most loudness controls, but simply adds boost in the deep bass plus some in the upper treble to compensate for low listening levels. Like other separate-knob schemes, this frees the loudness compensation from the volume control and makes it adjustable to the actual listening levels through the system; unlike some, the appropriate setting must be determined by ear alone—which is arguably the most reasonable approach.

The equalizer's five bands have maximum ranges of approximately ± 13 dB and are marked for center frequencies of 30, 150, 500, 1,500, and 10,000 Hz—making them, respectively, controls for subbass, bass, midrange, treble, and sparkle. The 30-Hz control is most effective as a rumble-filter/boom-boost control; the top one might be used as a hiss filter, though its maximum-cut setting dulls the upper treble a good deal. As an ensemble, they offer genuinely useful flexibility; all have detented center "flat" positions.

While the lab measurements give little clue to the "extras" from which the receiver's special qualities derive, they document its very solid performance. McIntosh appears to be thinking in terms of listening quality rather than specsman-ship (an attitude we applaud), so distortion, for example, is only vanishingly low—not infinitesimally low. The frequency response has been intentionally cut off beyond the audio band to help maintain clean sound by inhibiting intermodulation with infrasonic and ultrasonic "garbage" (a design criterion that applies to the tuner section as well as the amplifier); though this, similarly, may dismay those who judge an amplifier by its square waves, the results with music seem all the better for it. Tuner data are likewise very good—even superb—with no offsetting cause for complaint of any kind.

It is obvious, too, that McIntosh has a clearly formed idea of the sort of user it is designing for: someone who, while he is uninterested in playing the "pro," cares very much about quality and craftsmanship. The cosmetics, the "feel," and the sound quality of the Mac 4100 are all superb; the controls are minimal for the degree of useful flexibility they provide, with little if any concession to users who simply like to putter. This truly is a receiver for music lovers.



NEW MEASUREMENT STANDARDS

In making comparisons between current reports and those published in the past, readers are cautioned to pay particular attention to the reference levels and similar test criteria cited. S/N ratios for electronics, in particular, are measured very differently now that we have adopted salient features of the new IHF amplifier-measurement standard. While we believe that the new technique (which also implies a saner approach to loading of all inputs and outputs) will result in measurements that more perfectly reflect audible, in-use effects, they cannot be compared directly to the numbers resulting from the former, more conventional lab measurements.

FM DIRECTORY

88.1

KGED Batesville, AR
KEGG El Cerrito, CA
KFCF Fresno, CA
KLON Long Beach, CA
KUCR Riverside, CA
KZSC Santa Cruz, CA
WESU Middletown, CT
WMNR Monroe, CT
KDPS Des Moines, IA
KDB Fort Dodge, IA
WESN Bloomington, IL
WUIC Chicago, IL
WLTL La Grange, IL
WLRA Lockport, IL
WRHS Park Forest, IL
WETN Wheaton, IL
WNTH Winnetka, IL
WVPE Elkhart, IN
WNAS New Albany, IN
KHHS Hillsboro, IN
KSDB-FM Manhattan, KS
KTJO-FM Ottawa, KS
WTBS Cambridge, MA
WSPH Baltimore, MD
WHFC Bel Air, MD
WVAC Adrian, MI
WBFH Bloomfield, MI
WTSO Dayton Plains, MI
WHPR Highland Park, MI
WEMU Ypsilanti, MI
KHRU Clayton, MO
KCOU Columbia, MO
WUNF-FM Asheville, NC
WFSS Fayetteville, NC
WKNC-FM Raleigh, NC
WKNT Hastings, NE
WMCX West Long Branch, NJ
KLMG Battle Mountain, NV
KCEP Las Vegas, NV
WCWP Brookville, NY
WECW Elmira, NY
WAUP Akron, OH
WBGU Bowling Green, OH
WGMX Dayton, OH
WLMH Morrow, OH
WWRP West Carrollton, OH
KTEC Klamath Falls, OR
WTFG Greenville, PA
WVYC York, PA
WSBF-FM Clemson, SC
WMPR Sumter, SC
KTEQ Rapid City, SD
WRFN Nashville, TN
WRSN Seawane, TN
KWCR-FM Ogden, UT
KPCR Pleasant Grove, UT
WBCR-FM Beloit, WI
WCCX Milwaukee, WI
WCCW Waukesha, WI
WVBC Bethany, WV
WMUL Huntington, WV
KCWC Riverton, WY

88.3

KUNF La Canada, CA
KEMR Loma Linda, CA
KPSH-FM Palm Springs, CA
KSDS San Diego, CA
WDAO Hamden, CT
WOTO Hartford, CT
KCKC-FM Cedar Rapids, IA
WVHV Arlington Heights, IL
WHPK-FM Chicago, IL
WZRD Chicago, IL
WDGC-FM Downers Grove, IL
WKOC Kanakakee, IL
WLHI Fort Wayne, IN
KVOC Concordia, KS
KSWC Winfield, KS
KRVS Lafayette, LA
WBMT Boxford, MA
WIOH Concord, MA
WRSB Weston, MA
WIAA Interlachen, MI
WSHJ Southfield, MI
WGWG Boiling Springs, NC
WBGD Newark, NJ
KLYT Albuquerque, NM
WVCR-FM Loudonville, NY
WSBU St. Bonaventure, NY
WAER Syracuse, NY
WKHR Bainbridge, OH
WBWC Berea, OH
WAIF Cincinnati, OH
WJVS Cincinnati, OH
WLFC Findlay, OH
WMRT Marietta, OH
WAMP-FM Toledo, OH
WGEV Beaver Falls, PA
WDCV-FM Carlisle, PA
WESD Girard, PA
WRCT Pittsburgh, PA
WJCR Washington, PA
KESD Brookings, SD
KSUC Keene, TX
WHOV Hampton, VA
WVEP East Montpelier, VT
WHWC Menomonee, WI

88.5

KAXR Flagstaff, AZ
KSBR Mission Viejo, CA
KCSN Northridge, CA
KQED-FM San Francisco, CA
KGNU Boulder, CO
WVOF Fairfield, CT
WAMU-FM Washington, DC
WMNF Tampa, FL

WRAS Atlanta, GA
WHCJ Savannah, GA
KDIC Grinnell, IA
WBPR Barrington, IL
WBHI Chicago, IL
WHFH Flossmoor, IL
WGHS Glen Ellyn, IL
WHSD Hinsdale, IL
WMTH Park Ridge, IL
WFCR Amherst, MA
WSRX Allendale, MI
KBEM-FM Minneapolis, MN
KVSC St. Cloud, MN
KLJC Kansas City, MO
KUMR Rolla, MO
WFDD-FM Greensboro, NC
WEDD-FM Winston-Salem, NC
KEYA Belmont, ND
WMBF Brentwood, NY
WPOB Plainville, NY
WRUR-FM Rochester, NY
WKWZ Syosset, NY
WARY Valhalla, NY
WWSU Dayton, OH
WMUB Oxford, OH
WYSU Youngstown, OH
KMHD Gresham, OR
WRKC Scranton, PA
WRKC Wilkes-Barre, PA
KSTI Springfield, SD
WTTU Cookeville, TN
WOOX Memphis, TN
KRSM Dallas, TX
KNTU Denton, TX
KTEP El Paso, TX
KPLU-FM Tacoma, WA
WVFN Charleston, WV

88.7

KSPC Claremont, CA
WNHU West Haven, CT
WZZE Hockessin, DE
WRMB Boynton Beach, FL
KIGC Oskaloosa, IA
WPCD Champaign, IL
WCYC Chicago, IL
WLUW Chicago, IL
WOUJ Chicago, IL
WSIE Edwardsville, IL
WRSE-FM Elmhurst, IL
WGVE Gary, IN
WICR Indianapolis, IN
KNLU Monroe, LA
WOLI Newbury, MA
WRFW Minneapolis, MN
WRRH Franklin Lakes, NJ
WRSU-FM New Brunswick, NJ
KUNR Reno, NV
WBFO Buffalo, NY
WHCL-FM Clinton, NY
WVHC Hempstead, NY
WCNE Batavia, OH
WBHR Bellaire, OH
WUJC Cleveland, OH
WCXL Dayton, OH
WDPS Dayton, OH
WCXL Kettering, OH
WBOC-FM Oberlin, OH
WUJC University Heights, OH
CJOM-FM Windsor, ON
WESS East Stroudsburg, PA
WFNM Lancaster, PA
WLIU Lincoln University, PA
WSYC-FM Shippensburg, PA
WLCH Lebanon, TN
KAZI Austin, TX
KHUF Houston, TX
WNHS Norfolk, VA
WNHS Portsmouth, VA
WVPP-FM Colchester, VT
WERN Madison, WI
WRFR River Falls, WI
WSHC Shepherdstown, WV
WBHR Wheeling, WV

88.9

KUAF Fayetteville, AR
KXLU Los Angeles, CA
KUSP Santa Cruz, CA
WJMJ Hartford, CT
WDNA Miami, FL
WPFL Winter Park, FL
WXGC Milledgeville, GA
KWMR Cedar Rapids, IA
KWDW West Des Moines, IA
WXXM Lake Forest, IL
WRRG River Grove, IL
WARG Summit, IL
WNSD-FM Notre Dame, IN
KNBU Baldwin City, KS
WEKU-FM Richmond, KY
WERS Boston, MA
WEAA Baltimore, MD
KLUU-FM Jefferson City, MO
KRER Billings, MT
WSHA Raleigh, NC
WDWN Auburn, NY
WHWJ Dix Hills, NY
WHEI Tiffin, OH
WCSU-FM Wilberforce, OH
WKPS New Wilmington, PA
WXPB Philadelphia, PA
WPRV Rock Hill, SC
WMBW Chattanooga, TN
WNAZ-FM Nashville, TN
KETR Commerce, TX
KBYU-FM Provo, UT
WVUS Putney, VT
WLSU La Crosse, WI
WYMS Milwaukee, WI
WVPW Buckhannon, WV

89.1

KHDX Conway, AR
KBOR Merced, CA
KUOR-FM Redlands, CA
KBBS Santa Rosa, CA
WBXC Gainesville, GA
KCUJ Pella, IA
KWAR Waverly, IA
KLHS-FM Lewiston, ID
WVJC Mt. Carmel, IL
WONC Naperville, IL
WDSO Chesterton, IN
WIPU Fort Wayne, IN
WHSK Kokomo, IN
KMLW Wichita, KS
KLPI Ruston, LA
WRTZ Springfield, MA
WCHC Worcester, MA
WRNE-FM Houlton, ME
WIDR Kalamazoo, MI
KSJU Collegeville, MN
KUMD-FM Duluth, MN
KSJU Minneapolis, MN
KCLC St. Charles, MO
WMSB Mississippi State, MS
KUFM Missoula, MT
WDFU Teaneck, NJ
KANW Albuquerque, NM
WKNN Keene, NV
WNYU-FM New York, NY
WPSA Paul Smith's, NY
WMHT-FM Schenectady, NY
WAPS Akron, OH
WUSS Springfield, OH
KEPO Eagle Point, OR
WERG Erie, PA
WPSI Lehman, PA
CKRL-FM Quebec, PQ
KAUR Sioux Falls, SD
KBHU-FM Spearfish, SD
WDNX Olive Hill, TN
KTCU-FM Dallas, TX
KTCU-FM Fort Worth, TX
KUIB Vernal, UT
WVWR-FM Roanoke, VA
WCWM Williamsburg, VA
WNUB-FM Northfield, VT
WBSD Burlington, VT

89.3

KPFB Berkeley, CA
KPHL Fremont, CA
KPCS Pasadena, CA
KLEL San Jose, CA
WRTC-FM Hartford, CT
WPFW Washington, DC
WVAG-FM Orlando, FL
WPCS Pensacola, FL
WRFG Atlanta, GA
WWGA Carrollton, GA
KUOI-FM Moscow, ID
WKKC Chicago, IL
WNUR Evanston, IL
WGRN Greenville, IL
WFCI Franklin, IN
WFPL Louisville, KY
WAMH Amherst, MA
WHSN Bangor, ME
WBID Orchard Lake, MI
WSDP Plymouth, MI
WOKA Royal Oak, MI
WSAE Spring Arbor, MI
WVCA-FM Northfield, MN
KCUR-FM Kansas City, MO
KOMR St. Louis, MO
WXYC Chapel Hill, NC
KFJM-FM Grand Forks, ND
WSKG-FM Binghamton, NY
WCSO Central Square, NY
WGSU Geneseo, NY
WCSB Cleveland, OH
WSMR Dayton, OH
WCMO Marietta, OH
WRJC Reading, OH
KRRJ Portland, OR
WHHS Havertown, PA
WODE-FM Pittsburgh, PA
WCSO-FM Warminster, PA
WSCI Charleston, SC
WLYX Memphis, TN
KSHU Houston, TX
KASB Bellevue, WA
KUGS Bellingham, WA
KAOS Olympia, WA
KASB Seattle, WA
WPNE-FM Green Bay, WI
KSMC Moraga, CA
KPBS-FM San Diego, CA
KPOO San Francisco, CA
KSJC-FM Stockton, CA
KTSC-FM Pueblo, CO
WPKN Bridgeport, CT
KHKE Cedar Falls, IA
KLCD Decorah, IA
KBGL Pocahontas, ID
WRTT Cahokia, IL
WNIU-FM De Kalb, IL
WBKE-FM North Manchester, IN
WVUR-FM Valparaiso, IN
WCHH Holyoke, MA
WTRB-FM Pittsfield, MA
WCBN-FM Ann Arbor, MI
WAHS Auburn Heights, MI
WEJY Monroe, MI
WCMU-FM Mount Pleasant, MI
WOVI Novi, MI
KAVS Thier River Falls, MN
KOAL Winona, MN
KOPN Columbia, MO

KCFV Ferguson, MO
KHCT Helena, MT
WDCO-FM Sanford, NC
CBYP-FM Portland Creek, NF
WSOU South Orange, NJ
WRHO Oneonta, NY
WGSJ Sodus, NY
WRDL Ashland, OH
WKET Dayton, OH
WHSS Hamilton, OH
WKET Kettering, OH
KWGS Tulsa, OK
WONR Chester, PA
WSAJ-FM Grove City, PA
WITF-FM Hershey, PA
WNTE Lykens, PA
WETS Johnson City, TN
WMDT Murfreesboro, TN
KMFA Austin, TX
KEPH Ephraim, UT
WTGM Norfolk, VA
NEW-FM Colchester, VT
WVPR Windsor, VT
KNHC Seattle, WA

89.7

KLLU Loma Linda, CA
KFJC Los Altos, CA
KLLU Riverside, CA
KNHS Torrance, CA
WNCU Miami, FL
WUSF Tampa, FL
KRNL-FM Mount Vernon, IA
WBCE Belleville, IL
WTPC Elsie, IL
WHWE Howe, IN
WISU Terre Haute, IN
WGBH Boston, MA
WCVT Towson, MD
WOCR Olivet, MI
KUMM Morris, MN
KMNR Rolla, MO
KLSR St. Louis, MO
WCPE Raleigh, NC
WGLS-FM Glassboro, NJ
WLCR Lawrence Township, NJ
WDOB Ramah, MN
WALE Andover, NY
WEDS-FM Geneva, NY
WHH Henrietta, NY
WKSU-FM Akron, OH
WDSU-FM Columbus, OH
WKSU-FM Kent, OH
KLCG Eugene, OR
WUHH Allentown, PA
WBRM Telford, PA
WRTU San Juan, PR
WMHK Columbia, SC
WVNM-FM Vermillion, SD
CJUS-FM Saskatoon, SK
WVNM-FM Chattanooga, TN
KGCC Denison, TX
WUEC Eau Claire, WI
WRET Madison, WI
WUWM Milwaukee, WI
KIEA Ethel, WY

89.9

KANG Angwin, CA
KUCI Irvine, CA
KBHI-FM Modesto, CA
KCRW Santa Monica, CA
WWEB Wallingford, CT
WJCT-FM Jacksonville, FL
WFTU-FM Orlando, FL
WPIO Titusville, FL
WJMD Decatur, IL
WLCA Godfrey, IL
WCBU Peoria, IL
WSOF-FM Madisonville, KY
WNOW New Orleans, LA
WCSB Springfield, MA
WACC Arnold, MD
WMTB-FM Emmitsburg, MD
WCHS Grand Rapids, MI
KRPR Rochester, MN
KBDY St. Louis, MO
WUAG Greensboro, NC
WJOL Fredonia, NY
WKCR-FM New York, NY
WVVO Oswego, NY
WRSF Miamisburg, OH
WLHS West Chester, OH
WVIA-FM Scranton, PA
WVSU Selinsgrove, PA
WTLR State College, PA
WUSC-FM Columbia, SC
KACV-FM Amarillo, TX
KGRG Auburn, WA
KEWC-FM Cheney, WA
WWSA Brule, WI
WMDP Milton, WI
WVSP Stevens Point, WI
WVWC Buckhannon, WV
WHPW Huntington, WV

90.1

WOCG Huntsville, AL
WTSU Troy, AL
KBKP Buena Park, CA
KSUL Long Beach, CA
KCBX San Luis Obispo, CA
KZSU Stanford, CA
KSAK Walnut, CA
KCFR Denver, CO
WVCS New Britain, CT
WGTB-FM Washington, DC
WABE Atlanta, GA
WOFI Ames, IA

KALA Davenport, IA
KBSU Boise, ID
KRIC Rexburg, ID
WMBI-FM Chicago, IL
WLXN Lincoln, IL
WIAN Indianapolis, IN
KHCC Hutchinson, KS
WRVG Georgetown, KY
WMEA Portland, ME
WNMU-FM Marquette, MI
KSJR-FM Collegeville, MN
KSJR-FM Minneapolis, MN
KTSR Kansas City, MO
KRSH Overland, MO
WNJC-FM Senatobia, MS
WCCE Buie's Creek, NC
WPGT Roanoke Rapids, NC
WSIF Wilkesboro, NC
KUNM Albuquerque, NM
WGMC Greece, NY
WRCU-FM Hamilton, NY
WUSB Stony Brook, NY
WNSD Cincinnati, OH
WMCM Paris, OH
KCSC Edmond, OK
KSOR Ashland, OR
KBVR Corvallis, OR
WRTI Philadelphia, PA
WEPR Greenville, SC
KASD Aberdeen, SD
KCSF Sioux Falls, SD
KERA-FM Dallas, TX
KPFT Houston, TX
KSAU Nacogdoches, TX
KBBD Beaver, UT
KGSU-FM Cedar City, UT
KUER Salt Lake City, UT
KDCR-FM St. George, UT
WDCE Richmond, VA
WRUW Burlington, VT
WJSC-FM Johnson, VT
KMH Mercer Island, WA
KSVR Mount Vernon, WA
KRNB Nech Bay, WA
KOLU Pasco, WA
KUPS Tacoma, WA
WGRB-FM Green Bay, WI
WRPN-FM Ripon, WI
KYDZ Cody, WY

90.3

WBHM Birmingham, AL
KNBS Manteca, CA
KAZU Pacific Grove, CA
KUSF San Francisco, CA
WVPT Westport, CT
WAFG Fort Lauderdale, FL
KCOE Cedar Rapids, IA
KWIT Sioux City, IA
WLKI Mattson, IL
WWOC-FM Quincy, IL
WBCL Fort Wayne, IN
WMKY Morehead, KY
WZCB Newton, MA
WMOS Bath, ME
WUFC Fort Kent, ME
WOPR Oak Park, MI
KRLX Northfield, MN
KBFL Buffalo, MO
KWUR Clayton, MO
KGSP Parkville, MO
WAFR Durham, NC
WWIH Greensboro, NC
WAFR Raleigh, NC
KRNH Lincoln, NE
WHPH Hanover, NJ
WVHP-FM Highland Park, NJ
WVPH Piscataway, NJ
WVPH Princeton Junction, NJ
WMSC Upper Montclair, NJ
WAMC Albany, NY
WBAU Garden City, NY
WHPC Garden City, NY
WDSO Ossining, NY
WCDR-FM Cedarville, OH
WBOE Cleveland, OH
KSLC McMinville, OR
WZBT Gettysburg, PA
WARC Meadville, PA
WUTM Martin, TN
WEVL Memphis, TN
WPLN Nashville, TN
KAMU-FM College Station, TX
KSYM-FM San Antonio, TX
KLVF Longview, WA
KWRS Spokane, WA
WHLA Holmen, WI
WHLA La Crosse, WI
WRST-FM Oshkosh, WI
WDEI Elkins, WV

90.5

KLRE-FM Little Rock, AR
KUAT-FM Tucson, AZ
KHSH-FM Arcata, AZ
KVHS Concord, CA
KBHS Modesto, CA
KSFH Mountain View, CA
KCHH Stockton, CA
KEPC Colorado Springs, CO
KCMK Glenwood Springs, CO
WVUM Coral Gables, FL
WAMF Tallahassee, FL
WUOG Athens, GA
WABR-FM Tifton, GA
KTUH Honolulu, HI
WKVC Gatesburg, IL
WPUU Rensselaer, IN
WUOL Louisville, KY
WMMC North Andover, MA
WUSM North Dartmouth, MA

WICN Worcester, MA
WKSH Worton, MD
WKAR-FM East Lansing, MI
WKAR-FM Lansing, MI
KMSU Mankato, MN
KWWC-FM Columbia, MO
KXCV Maryville, MO
WALP Corinth, MS
WASU-FM Boone, NC
WDVA Davidson, NC
WNAA Greensboro, NC
WKNS Kinston, NC
WVMH-FM Mars Hill, NC
WCWH Flemington, NJ
WBJB-FM Lincroft, NJ
WJSV Morristown, NJ
WSPS Concord, NV
WPEA Exeter, NV
WBXL Baldwinville, NY
WHRW Binghamton, NY
WBKT Brockport, NY
WRRH Henrietta, NY
WCBE Columbus, OH
KAYE-FM Tonkawa, OK
WJRH Allentown, PA
WJRH Easton, PA
WVBU-FM Lewisburg, PA
WDUO Pittsburgh, PA
WBCT Columbia, SC
WFOS Chesapeake, VA
KCMU Seattle, WA
KWCV Walla Walla, WA
WSPU Platteville, WI

90.7

WHCR Montgomery, AL
KALX Berkeley, CA
KPFL Los Angeles, CA
KERS Sacramento, CA
KSJS San Jose, CA
KCDC Longmont, CO
WKGK-FM Panama City, FL
WAGC-FM Augusta, GA
WPSR Evansville, IN
WBST Muncie, IN
KJHK Lawrence, KS
WSSC Somerset, KY
WVOZ New Orleans, LA
WMHC South Hadley, MA
WTCO Springfield, MA
KEDQ Austin, MN
KQBC Joplin, MO
KWMU St. Louis, MO
WJSU Jackson, MS
WOFB Greensboro, NC
KVNQ Omaha, NE
KRWG Las Cruces, NM
WUSC-FM Portland, NY
WVUW New York, NY
WPNR-FM Utica, NY
WMCO New Concord, OH
WKTL Struthers, OH
KALU Langston, OK
KB00 Portland, OR
WCLH Scranton, PA
WCLH Wilkes-Barre, PA
WJHD Portsmouth, RI
WSMC-FM Collegedale, TN
KUT-FM Austin, TX
KPLN-FM Plains, TX
KSME Mantli, UT
WUVT-FM Blacksburg, VA
WVTC Randolph Center, VT
WHAD Delafield, WI
WVSS Menomonee, WI
WFGH Fort Gay, WV

90.9

KRVH Rio Vista, CA
KAUG Salinas, CA
KASF Alamosa, CO
KCSU-FM Fort Collins, CO
WETA-FM Washington, DC
WVVS Valdosta, GA
KUNI Cedar Falls, IA
WEPS Elgin, IL
WILL-FM Urbana, IL
WBDG Indianapolis, IN
KSLU Hammond, LA
WBUR Boston, MA
WMEH Bangor, ME
WAUS Berrien Springs, MI
WDRR Detroit, MI
KRCU Cape Girardeau, MO
KCMW-FM Warrensburg, MO
WLNK Columbus, MS
WFAE Charlotte, NC
WVSP Warrenton, NC
KSHI Zuni, NM
KRUD Las Vegas, NV
WCDN Albany, NY
WKRBY New York, NY
WONY Oneonta, NY
WIRQ Rochester, NY
WRUC Schenectady, NY
WNWR Canal Fulton, OH
WUCG Cincinnati, OH
WDUB Granville, OH
KOKF Edmond, OK
KRBH Pendleton, OR
WUHY-FM Philadelphia, PA
KTSU Houston, TX
KPNW Parowan, UT
KUHS Roosevelt, UT
KPEC-FM Tacoma, WA

91.1

WEGL Auburn, AL
WJSR Birmingham, AL
WVSU-FM Birmingham, AL
WLJS-FM Jacksonville, AL

91.1 Continued

KSWH Arkadelphia, AR
KCHO Chico, CA
KCSM San Mateo, CA
KWBI Morrison, CO
WSHU Fairfield, CT
WFAW Jacksonville, FL
WREK Atlanta, GA
WVVK Davenport, IA
WIBI Carlisle, IL
WVVK Rock Island, IL
WDHS Gaston, IN
WGCS Goshen, IN
WEDM Indianapolis, IN
WVUB Vincennes, IN
KDSA Wichita, KS
WMUA Amherst, MA
WNRC Dudley, MA
WJWV North Adams, MA
WKLI West Barnstable, MA
WBOR Brunswick, ME
WMPG Gorham, ME
WNCY Springvale, ME
WGGL-FM Houghton, MI
KSJN Minneapolis, MN
KCCM-FM Moorhead, MN
KSJN St. Paul, MN
KSMU Springfield, MO
WMSU Hattiesburg, MS
WWCL Wesson, MS
WRSH Rockingham, NC
WNDN-FM Salisbury, NC
KDCV-FM Blair, NE
WFMU East Orange, NJ
KEDP Las Vegas, NM
WTSC-FM Potsdam, NY
WSPN Saratoga Springs, NY
WRMU Alliance, OH
WRUW-FM Cleveland, OH
WDEQ-FM De Graff, OH
WLSN Delaware, OH
CJRT-FM Toronto, ON
KWAX Eugene, OR
KEOL La Grande, OR
WDFM State College, PA
WRIU Kingston, RI
WKCS Knoxville, TN
WKNO-FM Memphis, TN
WRVU Nashville, TN
KWTS Canyon, TX
KOHM Lubbock, TX
KWCB Marshall, TX
KMTP Mount Pleasant, UT
WMRA Harrisonburg, VA
WDGR Plainfield, VT
KPBX-FM Spokane, WA
WLFM Appleton, WI
WGTG Kenosha, WI
WITB-FM Salem, WV

91.3
WHIL-FM Mobile, AL
KCPR San Luis Obispo, CA
KUOP Stockton, CA
KMSA Grand Junction, CO
KSUT Ignacio, CO
WUHU West Hartford, CT
WXDR Newark, DE
WCIE Lakeland, FL
WLRN-FM Miami, FL
WVGS Statesboro, GA
KDCR Sioux Center, IA
WIUM Macomb, IL
WHJE Carmel, IN
WBKY Lexington, KY
WKMS-FM Murray, KY
KGRM Grambling, LA
KSCS Shreveport, LA
WSHL-FM Easton, MA
WJUM-FM Framingham, MA
WGAO Franklin, MA
WCWL Stockbridge, MA
WUWV Worcester, MA
WCHW-FM Bay City, MI
WOES Elsie, MI
WCSG Grand Rapids, MI
WGRG-FM Port Huron, MI
KBIA Columbia, MO
WBUM-FM Asheville, NC
KOVF-FM Kearney, NE
KUCV Lincoln, NE
WTSR Trenton, NJ
WUNH Durham, NY
WETD Alfred, NY
WSMH-FM Lancaster, NY
WVKR-FM Poughkeepsie, NY
WCNY-FM Syracuse, NY
WUOB-FM Athens, OH
WGTE-FM Toledo, OH
WLVR-FM Allentown, PA
WLVF-FM Bethlehem, PA
WQLN-FM Erie, PA
WIUP-FM Indiana, PA
WXAC Reading, PA
WIPR-FM San Juan, PR
WDOM Providence, RI
WLTR Columbia, SC
WFMQ Lebanon, TN
KACC Alvin, TX
KVLV Beaumont, TX
KNCT-FM Killeen, TX
KOCV Odessa, TX
WTJU Charlottesville, VA
WUUV Castleton, VT
KBOS Bellevue, WA
KCED Centralia, WA
KGTS College Place, WA
KBOS Seattle, WA
WHHI Highland, WI
WSSU Superior, WI
WQAB Philippi, WV

91.5
WEXP Gadsden, AL
KUCA Conway, AR
MKCR-FM Phoenix, AZ
KAHS Arcata, CA
KKUP Cupertino, CA
KDVS Davis, CA
KUSC Los Angeles, CA
KCSB-FM Santa Barbara, CA
KRCC Colorado Springs, CO
KUNC-FM Greeley, CO
WCNI New London, CT
WFIT Melbourne, FL
WFSU-FM Tallahassee, FL
WPRK Winter Park, FL
WBEZ Chicago, IL
WMHS Morrison, IL
WUEV Evansville, IN
WGRE Greencastle, IN
WRFT Indianapolis, IN
WVHI Muncie, IN
WECI Richmond, IN
KANU Lawrence, KS
WKCC Grayson, KY
WTUL New Orleans, LA
KVFG Thibodaux, LA
WBIM-FM Bridgewater, MA
WHHB Holliston, MA
WJUL Lowell, MA
WMFO Medford, MA
WMLN-FM Milton, MA
WRPS Rockland, MA
WRSB Walpole, MA
WZLY Wellesley, MA
WSKB Westfield, MA
WBJC Baltimore, MD
WRJR Lewiston, ME
WMHB Waterville, ME
WMHW-FM Mount Pleasant, MI
WPHS-FM Warren, MI
KICC International Falls, MN
KSLH St. Louis, MO
WVLS Jackson, MS
KMSM-FM Butte, MT
WUNC Chapel Hill, NC
KIOS-FM Omaha, NE
KIPC Albuquerque, NM
WNYE New York, NY
WXXI-FM Rochester, NY
WRPI Troy, NY
WFAC Columbus, OH
WSTB Streetsboro, OH
WOBW Westerville, OH
WYSO Yellow Springs, OH
KOAP-FM Portland, OR
WYEP-FM Pittsburgh, PA
WVMM-FM Scranton, PA
WSRN-FM Swarthmore, PA
WJMF Smithfield, RI
WFHC-FM Henderson, TN
KWLD Plainville, TX
KUSU-FM Logan, UT
KOHG Orem, UT
WLUR Lexington, VA
WYCS Yorktown, VA
WMTF Stowe, VT
KUBS Newport, WA
WGBW Green Bay, WI
WKCC Huntington, WV
WJGF Romney, WV

91.7
WBOM Decatur, AL
WUAL-FM Tuscaloosa, AL
KUPR-FM Fresno, CA
KALW San Francisco, CA
KWHS West Sacramento, CA
KOTO Telluride, CO
WXCJ Danbury, CT
WHUS Storrs, CT
WMPH Wilmington, DE
WHRS Boynton Beach, FL
KSUI Iowa City, IA
KUID Moscow, ID
WGLT Normal, IL
WEEM Pendleton, IN
KNWD Natchitoches, LA
WPAA Andover, MA
WRBB Boston, MA
WAVM Maynard, MA
WMWM Salem, MA
WSDH Sandwich, MA
WBSL Sheffield, MA
WBRS Waltham, MA
WBSF Biddford, ME
WCMF-FM Alpena, MI
WUOM Ann Arbor, MI
KCUM-FM Crookston, MN
KAXE Grand Rapids, MN
KDXL Minneapolis, MN
KRSW-FM Pipestone, MN
KLSE-FM Rushford, MN
KDXL St. Cloud, MN
KNOS Marshall, MO
KSQZ Point Lookout, MO
KEMC Billings, MT
WNCU Cullowhee, NC
WNEC-FM Henniker, NV
WPCR-FM Plymouth, NV
WICB Itasca, NY
WYXU-FM Cincinnati, OH
WGVO Greenville, OH
WUHS Urbana, OH
KPSU Goodwell, OK
KOSU-FM Stillwater, OK
KCHC Central Point, OR
WUCU-FM Clifton, PA
WIOX Millersville, PA
WVVE Norristown, PA

WKDU Philadelphia, PA
WPWT Philadelphia, PA
WRLC Williamsport, PA
WARP Due West, SC
WSWM Memphis, TN
KVTT Dallas, TX
KTRU Houston, TX
KRTU San Antonio, TX
KGVH Gunnison, UT
WVHS-FM Hampden-Sydney, VA
WEMC Harrisonburg, VA
WVLR Lyndonville, VT
WVRC-FM Middlebury, VT
KTOY Tacoma, WA
WSHS Sheboygan, WI
WSUW Whitewater, WI
WVPB Beckley, WV

91.9
KASU Jonesboro, AR
KNCC Tsale, AZ
KVCR San Bernardino, CA
KCSS Turlock, CA
KOUR Durango, CO
KWSB-FM Gunnison, CO
WSLN New Canaan, CT
WGTS-FM Washington, DC
WCLK Atlanta, GA
KPGY Ames, IA
KIBO Idaho Falls, ID
WJUL Lowell, IL
WSSR Springfield, IL
WVSH Huntington, IN
WJEF Lafayette, IN
WETL South Bend, IN
KTCC Colby, KS
KBIC Great Bend, KS
WFPK Louisville, KY
WAIC Springfield, MA
WCFM Williamstown, MA
WHSR-FM Winchester, MA
WGTS-FM Takoma Park, MD
WBHS Brunswick, ME
WUMF-FM Farmington, ME
WMEB-FM Orono, ME
WORW Port Huron, MI
KBSB Bemidji, MN
KWBP Liberty, MO
KGLT Bozeman, MT
KDSU Fargo, ND
KTLX Columbus, NE
KWSC Wayne, NE
WBGD Bricktown, NJ
WNTI Hackettstown, NJ
WCEB Corning, NY
WGRF Glens Falls, NY
WSHR Lake Ronkonkoma, NY
WCWT-FM Centerville, OH
WKCO Gambier, OH
WCWS Wooster, OH
WCWS Wooster, OH
KHIB Durant, OK
CFRC-FM Kingston, ON
KRVN Eugene, OR
WVCS California, PA
WUOT Knoxville, TN
KTAI Kingsville, TX
KTXF-FM Lubbock, TX
KSCF Spokane, WA
WHRM Wausau, WI
WPHF Wheeling, WV
KUWR Laramie, WY

92.1
CJAY-FM Calgary, AB
WKLN Cullman, AL
WGOK-FM Fairhope, AL
WERH-FM Hamilton, AL
WGOK-FM Mobile, AL
KKEG Fayetteville, AR
KBAZ Bisbee, AZ
KOWN-FM Escondido, CA
KUUL Madera, CA
KOWN-FM San Diego, CA
KDFM Walnut Creek, CA
KBLJ La Junta, CO
KVRH-FM Salida, CO
WCMD-FM Hialeah, FL
WBKF MacClenny, FL
WCMD-FM Miami, FL
WNCX Naples, FL
WWRN Tallahassee, FL
WAMR-FM Venice, FL
WWRN West Palm Beach, FL
WBTP-FM Carrollton, GA
WDWD-FM Dawson, GA
WUFF-FM Eastman, GA
WWRK Elberton, GA
WJGA-FM Jackson, GA
WPEH-FM Louisville, GA
KTGA Fort Dodge, IA
KRLS Knoxville, IA
KTAV Knoxville, IA
WEIC-FM Charleston, IL
WACI Freeport, IL
WJRE Kewanee, IL
WROI Rochester, IN
WMOR-FM Morehead, KY
WDHR Pikeville, KY
WTKY-FM Tompkinsville, KY
WKVL-FM Winnfield, LA
CITI-FM Winnipeg, MB
WMSG-FM Oakland, MD
WSME-FM Sanford, ME
WLEW-FM Bad Axe, MI
WFMG Grand Haven, MI
WKKM Harrison, MI
WCSR-FM Hillsdale, MI
WRBJ-FM St. Johns, MI
WCCW-FM Traverse City, MI

WCMP-FM Pine City, MN
KODE-FM Wasco, MN
KCBW Sedalia, MO
WMRO Brookhaven, MS
WJNS-FM Yazoo City, MS
WRCM Jacksonville, NC
WOXX Morganton, NC
WJLY Moyock, NC
WRSV Rocky Mount, NC
KFAH Alliance, NJ
WDVL-FM Vineland, NJ
KBAO-FM Carlsbad, MN
WSLE Peterborough, NV
WSEN-FM Baldwinville, NY
WVNG-FM Sag Harbor, NY
WSEN-FM Syracuse, NY
WDLA-FM Walton, NY
WNRH Bellevue, OH
WMPD-FM Middleport, OH
WERM Wakarusa, OH
KRRO Ardmore, OK
KGOW Broken Arrow, OK
KGOW Tulsa, OK
CKPC-FM Brantford, ON
CFTI-FM Timmins, ON
WFEM Ellwood City, PA
WFMN Johnstown, PA
WBPF-FM Lock Haven, PA
WRCV Mercersburg, PA
WVWJ Nanticoke, PA
WCTY Palmyra, PA
WVWJ Scranton, PA
WGIT Hagerstown, PA
WZOL Luquillo, PR
WBLR-FM Batesburg, SC
WTWE Manning, SC
WMYB-FM Myrtle Beach, SC
KJLV-FM Huron, SD
CFMQ-FM Regina, SK
WBVO Hendersonville, TN
WBVO Nashville, TN
KDSO Alice, TX
WTAW-FM College Station, TX
KETX-FM Livingston, TX
KTBC Nacogdoches, TX
WNBW New Braunfels, TX
KNBT San Antonio, TX
KVRN-FM Sonora, TX
KROZ Tyler, TX
WDYL Chester, VA
WDLR-FM Haywood, VA
WYXK Madison, VA
WYXK Manitoque, WI
WJRC-FM Mauston, WI
WVFM Menomonee, WI
WVFN Racine, WI
WYXK Sun Prairie, WI

92.3
WLVI Montgomery, AL
KOTN-FM Pine Bluff, AR
KXTC Glendale, AZ
KXTC Phoenix, AZ
KPDJ Eureka, CA
KFAC-FM Los Angeles, CA
KSJO San Jose, CA
KREX-FM Grand Junction, CO
KGRE Greeley, CO
WDBO-FM Orlando, FL
KULA Honolulu, HI
KULA Waipahu, HI
KOEL-FM Oelwein, IA
KBBK-FM Boise, ID
WYCA Chicago, IL
WGTC Bloomington, IN
WYCA Hammond, IN
KOEZ Newton, KS
WCKW La Place, LA
WLPL Baltimore, MD
WCAR-FM Detroit, MI
WJPD-FM Ishpeming, MI
KMDE Butler, MO
WIL-FM St. Louis, MO
WCSE Asheboro, NC
KEZO Omaha, NE
KRST Albuquerque, NM
KEND-FM Las Vegas, NV
WFLY Albany, NY
WKTU New York, NY
WFLY Troy, NY
WLYT Cleveland, OH
WLYT Cleveland Heights, OH
WXGT Columbus, OH
KCON Portland, OR
WRRN Warren, PA
WPRO-FM Providence, RI
WDEF-FM Chattanooga, TN
WKBJ-FM Milan, TN
KFIM El Paso, TX
KNFM Midland, TX
WLRG Roanoke, VA

92.5
KFBK-FM Sacramento, CA
WVYZ Waterbury, CT
WVFN-FM Key West, FL
WPAP-FM Panama City, FL
WDEK De Kalb, IL
WBKR Owensboro, KY
WHAV-FM Haverhill, MA
KORS-FM Golden Valley, MN
KORS-FM Minneapolis, MN
KSYN Joplin, MO
WGST Forest, MS
KPDH Haver, MT
WXCN Henderson, NC
WMJQ Rochester, NY
WFAH-FM Alliance, OH
WWEZ Cincinnati, OH

WMHE Toledo, OH
KNGK Oklahoma City, OK
KJSN Klamath Falls, OR
WFI Philadelphia, PA
CFOR-FM Montreal, PQ
WORO Corvallis, OR
WESC-FM Greenville, SC
KELO-FM Sioux Falls, SD
KYND Houston, TX
KYND Pasadena, TX
KSUB-FM Cedar City, UT
WRFL Winchester, VA
KZAM-FM Bellevue, WA
KZAM-FM Seattle, WA
WBKV-FM Milwaukee, WI
WBKV-FM West Bend, WI

92.7
WCRO-FM Arab, AL
WULA-FM Eufaula, AL
WHTB Talladega, AL
KLYR-FM Clarksville, AR
KWYN-FM Wynne, AR
KZZZ Kingman, AZ
KJAZ Alameda, CA
KLPC-FM Lompoc, CA
KMFB-FM Mendocino, CA
KZIO-FM Ridgecrest, CA
KHNY-FM Riverside, CA
KHNY-FM San Bernardino, CA
KJAZ San Francisco, CA
KROG Sonoma, CA
KSUE-FM Susanville, CA
KNJO Thousand Oaks, CA
KGLS Glenwood Springs, CO
WLRB Rehoboth Beach, DE
WKUE Green Cove Springs, FL
WMFO Ocala, FL
WCCF-FM Punta Gorda, FL
WCMF Stuart, FL
WLXI-FM Dublin, GA
KLGA-FM Algona, IA
KFMA Jerome, ID
WRAJ-FM Anna, IL
WVMM Arlington Heights, IL
WVMM Chicago, IL
WEEE Taylorville, IL
WADM-FM Decatur, IN
WXUS Lafayette, IN
WCAK Catlettsburg, KY
WMIK-FM Middlesboro, KY
KJEF-FM Jennings, LA
KBED Lake Providence, LA
KJVC Mansfield, LA
KTKC Springhill, LA
WVMS Prince Frederick, MD
WODY-FM Calais, ME
WEXO Norway, ME
WCR-FM Charlotte, MI
WSMM Sault Ste. Marie, MI
KXRA-FM Alexandria, MN
KLND-FM Eldon, MO
KLRS-FM Mountain Grove, MO
WDLT Cleveland, MS
WKRA-FM Holly Springs, MS
KBRX-FM O'Neill, NE
WOBM Toms River, NJ
KLCJ Aztec, NM
KTNM-FM Tucuman, NM
WLEZ Elmira, NY
WLIR Garden City, NY
WLUF Gouverneur, NY
WALL-FM Middletown, NY
WLIR New York, NY
WBGO-FM Bucyrus, OH
CIGM-FM Sudbury, ON
WJSM-FM Martinsburg, PA
WRHY Starview, PA
WVBO-FM Bamberg, SC
KIVY-FM Crockett, TX
KINL Eagle Pass, TX
KJAK Slaton, TX
KVEL-FM Vernal, UT
WBBF-FM Abingdon, VA
WKVT-FM Brattleboro, VT
KENE-FM Toppish, WA
WAUN Keweenaw, WI
WOUX-FM Waupaca, WI
WVHF-FM Clarksburg, WV

92.9
WBLX Mobile, AL
KFLG Flagstaff, AZ
KWFM Tucson, AZ
KONG-FM Visalia, CA
KVOR-FM Colorado Springs, CO
WZGC Atlanta, GA
WGOV-FM Valdosta, GA
KFMD Dubuque, IA
WSEI Olney, IL
WVNU-FM South Bend, IN
WVLC-FM Lexington, KY
WBOS Boston, MA
WBOS Brookline, MA
WPBC Bangor, ME
WKJF Cadillac, MI
WSDC-FM Duluth, MN
KGRC Hannibal, MO
WYYY Bismarck, ND
KKDO Grand Forks, ND
KWBE-FM Beatrice, NE
KNEB-FM Scottsbluff, NE
CBTR-FM Rockdickton, NE
KSVP-FM Artesia, NM
KRWV Farmington, NM
WBUF Buffalo, NY
WJAI Dayton, OH
WJAI Eaton, OH
KBEZ Tulsa, OK
KDKA-FM Pittsburgh, PA

WYZZ Scranton, PA
WYZZ Wilkes-Barre, PA
WTPM Aguadilla, PR
WDSO-FM Dillon, SC
WZEE Nashville, TN
KITV San Antonio, TX
KBID Wichita Falls, TX
KBLW-FM Logan, UT
WFOG-FM Norfolk, VA
WFOG-FM Suffolk, VA
WEZF Burlington, VT
KISM Bellingham, WA
KREM-FM Spokane, WA

93.1
KJOK Yuma, AZ
KNX-FM Los Angeles, CA
KOSO Patterson, CA
KOIX-FM Grand Junction, CO
WTMI Miami, FL
WEAS-FM Savannah, GA
KOMQ Honolulu, HI
WXRT Chicago, IL
WNAP Indianapolis, IN
KJWS-FM Pratt, KS
WHYN-FM Springfield, MA
WPOC Baltimore, MD
WMGX Portland, ME
WDRO Detroit, MI
KNUJ-FM New Ulm, MN
WSEZ Greensboro, NC
WSEZ Winston-Salem, NC
KRVN-FM Lexington, NE
WPAT-FM Paterson, NJ
KUDO Las Vegas, NV
WPAT-FM New York, NY
WNTQ Syracuse, NY
WZAK Cleveland, OH
CHAY-FM Barrie, ON
KSDN Springfield, OR
KRCS Sturgis, SD
KQIZ-FM Amarillo, TX
KAMA-FM El Paso, TX
KTYL Tyler, TX

93.3
KDKB-FM Mesa, AZ
KDKB-FM Phoenix, AZ
KECR El Cajon, CA
KYA-FM San Francisco, CA
KZOO San Luis Obispo, CA
KTCL Fort Collins, CO
KLMM-FM Lamar, CO
WFLA-FM Tampa, FL
WDFR-FM Manchester, GA
KMGS Des Moines, IA
WKWZ Peoria, IL
WAWK-FM Kendallville, IN
WVXQ Paducah, KY
WQUE New Orleans, LA
WRLM Taunton, MA
WKVI Kansas City, MO
WGPC-FM Houston, MS
KYTA Billings, MT
KDXT Missoula, MT
WBBO-FM Forest City, NC
WITN-FM Washington, NC
KSJM Jamestown, ND
KQB-FM Albuquerque, NM
WVSE Jamestown, NY
WBEX-FM Chillicothe, OH
WAWK Cincinnati, OH
WQMD Youngstown, OH
KTEN-FM Ada, OK
KCMR-FM Hamilton, ON
WMMR Philadelphia, PA
WPAB-FM Ponce, PR
WBGY-FM Tullahoma, TN
KIXS-FM Killeen, TX
KBAT Midland, TX
KYKR-FM Port Arthur, TX
KWHQ-FM Salt Lake City, UT
WFLS-FM Fredericksburg, VA
KBLE-FM Seattle, WA
KEXI Walla Walla, WA
WIZM-FM La Crosse, WI
WQFM Milwaukee, WI

93.5
WQGL Butler, AL
WGEA-FM Geneva, AL
KBFC Forrest City, AR
KBBM-FM Monticello, AR
KWVM-FM Show Low, AZ
KXGO Arcata, CA
KHIP Hollister, CA
KKOP Los Angeles, CA
KNTF Ontario, CA
KFOK Redondo Beach, CA
KPIP Roseville, CA
KPIP Sacramento, CA
KSOM-FM San Bernardino, CA
KALO-FM Alamosa, CO
WSEA Georgetown, DE
WSWN-FM Belle Glade, FL
WRGI Naples, FL
WGVG Port St. Joe, FL
WVGL Vero Beach, FL
WVOH-FM Hazlehurst, GA
KRNA Iowa City, IA
KSKI-FM Sun Valley, ID
WJAP Joliet, IL
WITT Tuscola, IL
WZVZ Kokomo, IN
WBTO-FM Linton, IN
WVWY-FM Barbourville, KY
WMMG Brandenburg, KY
WAIN-FM Columbia, KY
KFNV-FM Ferriday, LA
KVPJ-FM Ville Platte, LA
WRKD-FM Rockland, ME

93.5 Continued

WATZ-FM Alpena, MI
WCLX Boyne City, MI
WHMI-FM Detroit, MI
WMP-LFM Hancock, MI
WHMI-FM Howell, MI
WRCI Midland, MI
KMBO-FM Benson, MN
KRFG Greenfield, MO
KRMS-FM Osage Beach, MO
KTRX Tarkio, MO
WXIY Bay Springs, MS
WHJT Clinton, MS
WDZO Charlotte, NC
KTTT-FM Columbus, NE
KICS-FM Hastings, NE
KIBC Ogallala, NE
WBNC-FM Conway, NV
WHUG-FM Hudson, NY
WVBR-FM Ithaca, NY
WRTN-FM New Rochelle, NY
WRTN New York, NY
WKIO Bowling Green, OH
KWHW-FM Altus, OK
KSIW-FM Muskogee, OK
WCPA-FM Clearfield, PA
WVPO-FM Stroudsburg, PA
CBM-FM Les-De-La-Madeleine, PQ
CBM-FM Montreal, PQ
WXXY Columbia, SC
WWVZ Summerville, SC
KLYX-FM Sioux Falls, SD
WKBL-FM Covington, TN
WLIL-FM Lenoir City, TN
WKBL-FM Memphis, TN
KIKT Greenville, TX
KDXU-FM St. George, UT
WLSD-FM Big Stone Gap, VA
WBBC Blackstone, VA
WJLM Roanoke, VA
WJLM Salem, VA
WSGM Staunton, VA
WCFF-FM Springfield, VT
WJMT-FM Merrill, WI
WLII-FM New London, WI
WCST-FM Berkeley Springs, WV
KOLL-FM Gillette, WY
KTKA Riverton, WY

93.7

CKUAFM1 Calgary, AB
WDJC Birmingham, AL
KISR Fort Smith, AR
KR00 Tucson, AZ
KFME Chico, CA
KVIM Coachella, CA
KFYE Fresno, CA
KDB-FM Santa Barbara, CA
KRAI-FM Craig, CO
WLVI Hartford, CT
WSTW Wilmington, DE
WFUZ Ocala, FL
KCM-FM Carroll, IA
KSNM-FM Pocahontas, ID
WJCD-FM Seymour, IN
KYEZ Salina, KS
WAMX Ashland, KY
KMBO Shreveport, LA
WCGY Boston, MA
WCGY Lawrence, MA
WJFM Grand Rapids, MI
WAYL-FM Minneapolis, MN
KCFM St. Louis, MO
WQID Biloxi, MS
WMYK Elizabeth City, NC
WDAY-FM Fargo, ND
KMOT-FM Minot, ND
KQNM Gallup, NM
WBLK-FM Buffalo, NY
WBLK-FM Depew, NY
WFCJ Miamisburg, OH
WMVO-FM Mount Vernon, OH
CKAT-FM North Bay, ON
KTMT Medford, OR
KPD0-FM Portland, OR
WJOI Pittsburgh, PA
WSRA San Juan, PR
WFBC-FM Greenville, SC
KWYR-FM Winner, SD
KLBJ-FM Austin, TX
KRLY Houston, TX
KSEL-FM Lubbock, TX
KSYC-FM Richfield, UT
KXXR-FM Spokane, WA
WEKZ-FM Monroe, WI
WAMX Huntington, WV

93.9

KCTB-FM Flagstaff, AZ
KPOL-FM Los Angeles, CA
KIL0 Colorado Springs, CO
WKYS Washington, DC
WWWL Miami, FL
WWWL Miami Beach, FL
WMTM-FM Moultrie, GA
KEKI Honolulu, HI
WLAK Chicago, IL
KTLT Dodge City, KS
WTKT Madisonville, KY
WCOU-FM Lewiston, ME
CKLW-FM Detroit, MI
KWPM-FM West Plains, MO
WBAG-FM Burlington, NC
CHOZ-FM St. John's, NF
WNYC-FM New York, NY
WCHN-FM Norwich, NY
KSPJ-FM Stillwater, OK
CFMO-FM Ottawa, ON
CKLW-FM Windsor, ON
KHHJ Rapid City, SD
KEXX-FM Corpus Christi, TX

KESS Dallas, TX
KPAS El Paso, TX
KESS Fort Worth, TX
KWLW San Angelo, TX
WMEV-FM Marion, VA
WDOF-FM Sturgeon Bay, WI

94.1

WAOT Carrollton, AL
KEZO Little Rock, AR
KLYD-FM Bakersfield, CA
KPFA Berkeley, CA
KFSD-FM San Diego, CA
KUBC-FM Montrose, CO
WVFM Lakeland, FL
WMEZ Pensacola, FL
WQXI-FM Atlanta, GA
WQXI-FM Savannah, GA
WQXI-FM Smyrna, GA
KBXL-FM Caldwell, ID
WMA-FM Mt. Vernon, IL
WMA-FM Waukegan, IL
KCKN-FM Kansas City, KS
WHEI Jackson, MI
KCKN-FM Kansas City, MO
WCCA McCormick, MS
KOPR Butte, MT
WLXN Greensboro, NC
WLXN Lexington, NC
KOWH-FM Omaha, NE
KRKE-FM Albuquerque, NM
KYKK Humble City, NM
KXTZ Henderson, NV
WHBC-FM Canton, OH
WSAI-FM Cincinnati, OH
CBL-FM Toronto, ON
KXIO Bend, OR
WYSP Philadelphia, PA
WKOK-FM Sunbury, PA
WQYE-FM Mayaguez, PR
WHYJ Providence, RI
KSDN-FM Aberdeen, SD
KBUV-FM Amarillo, TX
KQXY Beaumont, TX
KALL-FM Salt Lake City, UT
WYVA-FM Yorktown, VA
CKLK-FM Clarkston, WA
KMPS-FM Seattle, WA
WIAL Eau Claire, WI
WTTN-FM Watertown, WI
WKL-PM Keyser, WV
WOAY-FM Oak Hills, WV

94.3

WXLE Abbeville, AL
KAMO-FM Rogers, AR
KWTC-FM Barstow, CA
KORJ Garden Grove, CA
KNGT Jackson, CA
KGL-FM Los Angeles, CA
KORJ Los Angeles, CA
KPRA Paso Robles, CA
KGL-FM San Fernando, CA
WYBC-FM New Haven, CT
WTL0-FM Lake City, FL
WMUM Marathon, FL
WGMW Riviera Beach, FL
WIPE Americus, GA
WSNT-FM Sandersville, GA
KVDB-FM Sioux Center, IA
KADO Rexburg, ID
WRMS-FM Beardstown, IL
WCLL Chillicothe, IL
WJLK Elgin, IL
WJVM Sterling, IL
WXTA Greencastle, IN
WTCA-FM Plymouth, IN
WRCR Rushville, IN
WTCA-FM South Bend, IN
WHIC-FM Hardinsburg, KY
WREM-FM Jenkins, KY
KTRY-FM Bastrop, LA
KZZO Golden Meadow, LA
CHIQ-FM Winniepeg, MB
WICO-FM Salisbury, MD
WIDE-FM Biddford, ME
KEZZ Aitkin, MN
KMRS Sauk Centre, MN
KDOM-FM Windom, MN
KCLU-FM Rolla, MO
WKCU-FM Corinth, MS
WBAD Leland, MS
WRQR Farmville, NC
WLSE-FM Wallace, NC
WULK-FM Asbury Park, NJ
WWOC Avalon, NJ
WLVI Elmira, NY
WBPM Kingston, NY
WCT0 New York, NY
WCT0 Smithtown, NY
WKKI Celina, OH
WMOA-FM Marietta, OH
WDIF Marion, OH
KNFB Nowata, OK
KLLS Okmulgee, OK
CJSD-FM Thunder Bay, ON
WCDL-FM Caribou, PA
WKSL Greencastle, PA
WTMX-FM Ridgway, PA
CKMF-FM Montreal, PQ
WPUB-FM Camden, SC
WATP-FM Marion, SC
KBRK-FM Brookings, SD
WPTN-FM Cookeville, TN
WEFF Germantown, TN
WJUM-FM Lewisburg, TN
WTHJ Lobelville, TN
WEEF Memphis, TN
WUUU Oak Ridge, TN
WSTM Red Bank, TN
WDBL-FM Springfield, TN

KDLK-FM Del Rio, TX
KWCB Floresville, TX
KPJH Fort Stockton, TX
KPFM Kerrville, TX
KRCT Orange, TX
KLIS Palestine, TX
WHGC Bennington, VT
WERL-FM Eagle River, WI
WROE Neenah-Menasha, WI
WPRE-FM Prairie Du Chien, WI

94.5

WAPI-FM Birmingham, AL
KOOL-FM Phoenix, AZ
KLIL Ukiah, CA
WWLV Daytona Beach, FL
WCVU Naples, FL
KKEZ Fort Dodge, IA
WLRW Champaign, IL
KJCK-FM Junction City, KS
KULL Scott City, KS
WLAP-FM Lexington, KY
KSMB Lafayette, LA
KROK Shreveport, LA
WCOZ Boston, MA
WCRM Williamsport, MD
WJBL-FM Holland, MI
WCEN-FM Mount Pleasant, MI
KSTP-FM Minneapolis, MN
KSTP-FM St. Paul, MN
KRXL Kirksville, MO
KPBH-FM Poplar Bluff, MO
KNUW Great Falls, MT
WEAF Eden, NC
KODY Bismarck, ND
WCHR Trenton, NJ
KGLP Gallup, NM
WNED-FM Buffalo, NY
WSYR-FM Syracuse, NY
WRWR-FM Port Clinton, OH
CKMS-FM Waterloo, ON
KBMC Eugene, OR
WDAC Lancaster, PA
WPEZ Pittsburgh, PA
WMU0-FM Greenville, SC
KGAF-FM Gainesville, TX
KELT Harlingen, TX
KLEF Houston, TX
KLBK-FM Lubbock, TX
KVWJ Logan, UT
WRVO Richmond, VA
KIT-FM Yakima, WA
WKTI Milwaukee, WI
KAWY Casper, WY

94.7

KMET Los Angeles, CA
KBVL Boulder, CO
KBVL Denver, CO
WJMD Washington, DC
WDSO Dover, DE
KUMU-FM Honolulu, HI
WDAL Chicago, IL
WFB0 Indianapolis, IN
WXID Mayfield, KY
WMAS-FM Springfield, MA
WJMD Bethesda, MD
WMJC Birmingham, MI
WMJC Detroit, MI
KSHE Crestwood, MO
KITS-FM Springfield, MO
KSHE St. Louis, MO
WKXJ Jackson, MS
WDDR Raleigh, NC
KYTN Grand Forks, ND
WFME Newark, NJ
KNIS Carson City, NV
KNIS Reno, NV
WVVO-FM Columbus, OH
KEBC Oklahoma City, OK
WEVA Bayamon, PR
WEVA San Juan, PR
KSET-FM El Paso, TX
KIXY-FM San Angelo, TX

94.9

CKUA-FM Edmonton, AB
WKSJ-FM Mobile, AL
KADL-FM Pine Bluff, AR
KJYK Tucson, AZ
KLRO San Diego, CA
KSAN-FM San Francisco, CA
KBOS Tulare, CA
WINZ-FM Miami, FL
WINZ-FM Miami Beach, FL
WLVW Tallahassee, FL
WYNF Tampa, FL
WPCB Atlanta, GA
KGGO Des Moines, IA
KFSD-FM Nampa, ID
KSHI Pocatello, ID
WAAG Galesburg, IL
WYER-FM Mt. Carmel, IL
WOCB-FM West Yarmouth, MA
WVIC-FM East Lansing, MI
WVIC-FM Lansing, MI
KAOH-FM Duluth, MN
KCEZ Kansas City, MO
KYSS-FM Missoula, MT
KBIM-FM Roswell, NM
JCJB-FM Sydney, NS
WHOM Mt. Washington, NV
WDBN Akron, OH
WLVV Cincinnati, OH
WDBN Cleveland, OH
WLVV Fairfield, OH
WDBN Medina, OH
CKOS-FM Oshawa, ON
CIMP-FM Ottawa, ON
WMSP Harrisburg, PA
CIMP-FM Hill, PQ

KQAA Aberdeen, SD
WOFM Greenville, TN
KAMC Arlington, TX
KWSJ Dallas, TX
KQYE Laredo, TX
KBRE-FM Cedar City, UT
KRMO Provo, UT
WVPR Roanoke, VA
KUOW Seattle, WA
WLVE Madison, WI
KR0E-FM Sheridan, WY

95.1

WNDA Huntsville, AL
KAMS Mammoth Spring, AR
KALJ Yuma, AZ
KPAY-FM Chico, CA
KQLH San Bernardino, CA
KBBY Ventura, CA
KRBD-FM Colorado Springs, CO
WRKI Brookfield, CT
WJAX-FM Jacksonville, FL
KAOI Walluku, HI
WDZO Decatur, IL
WPTH Fort Wayne, IN
KICT Wichita, KS
WGGC Glasgow, KY
WRBS Baltimore, MD
WDFE Flint, MI
WK0A-FM Worthington, MN
WONZ Natchez, MS
WROQ Charlotte, NC
WRNS Kingston, NC
WAVY Atlantic City, NJ
WMIV Rochester, NY
WMIV South Bristol, NY
WEVZ Allentown, PA
WEVZ Bethlehem, PA
WIZK Chambersburg, PA
WEDA-FM Grove City, PA
WRPC San Germán, PR
WPXI Charleston, SC
KIEL Beaumont, TX
KCMW Victoria, TX
WJZO Kenosha, WI
WLST Marinette, WI
WXIL Parkersburg, WV

95.3

WOIM Prattville, AL
WELR-FM Roanoke, VA
WJDB-FM Thomasville, AL
KAPA-FM Douglas, AZ
KRVE Los Gatos, CA
KEDY Mt. Shasta, CA
KPSA Pismo Beach, CA
KRVE San Jose, CA
KUIV Vacaville, CA
WTLN-FM Apopka, FL
WVSR Fort Myers, FL
KOUR-FM Independence, IA
KIFG-FM Iowa Falls, IA
KIMI Keokuk, IA
KMAO-FM Maquoketa, IA
KCIU-FM Washington, IA
WRXX Centralia, IL
WVSIU-FM Pekin, IL
WRTL-FM Rantoul, IL
WYFE-FM Winnebago, IL
WVTL Monticello, IN
WUME-FM Paoli, IN
WMSK-FM Morganfield, KY
KQKI-FM Bayou Vista, LA
KASO-FM Minden, LA
WHRB-FM Boston, MA
WHRB Cambridge, MA
WOTE Adrian, MI
WDFP Battle Creek, MI
WRNN-FM Clare, MI
WAOR Niles, MI
WLRO Whitehall, MI
KCPJ-FM Albert Lea, MN
KVLK Detroit Lakes, MN
KLFD-FM Litchfield, MN
KNOF Minneapolis, MN
KNOF St. Paul, MN
KAGE-FM Winona, MN
KOKD-FM Clinton, MO
KNIM-FM Maryville, MO
WAFM Amory, MS
WVIM-FM Coldwater, MS
WADI Corinth, MS
WDRI Drew, MS
KRWS Hardin, MT
WOBH-FM Wanchese, NC
KBHL Lincoln, NE
KSID-FM Sidney, NE
WVRJ Southampton, NY
WBZJ Dayton, OH
WKTN-FM Kenton, OH
WLRK-FM Norwalk, OH
WBZJ Xenia, OH
KCDK-FM Hamilton, ON
KURY-FM Brookings, OR
KBOY-FM Medford, OR
WJPA-FM Pittsburgh, PA
WISL-FM Shamokin, PA
WTTT-FM Towanda, PA
WJPA-FM Washington, PA
CBV-FM Quebec, PQ
WBTG-FM Brownsville, TN
WDEH-FM Sweetwater, TN
KFNE Big Spring, TX
KMMK Dallas, TX
KMRE Dumas, TX
KMMK McKinney, TX
KYUF Uvalde, TX
WQMC Charlottesville, VA
WIXV Front Royal, VA
WVPA-FM Petersburg, VA
WNHV-FM White River Junction, VT

KXLE-FM Ellensburg, WA
WXRO Beaver Dam, WI
WGM0 Shell Lake, WI

95.5

WTVY-FM Dothan, AL
KQYT Phoenix, AZ
KYNO-FM Fresno, CA
KLOS Los Angeles, CA
WPGC-FM Washington, DC
WQVY Fort Pierce, FL
WVFK Key West, FL
WNGC Athens, GA
WSFG Savannah, GA
KAIM-FM Honolulu, HI
KBCM Sioux City, IA
WMET Chicago, IL
WFMS Indianapolis, IN
KGN0-FM Dodge City, KS
WDOC-FM Prestonburg, KY
WPGC-FM Morningside, MD
WCZY Detroit, MI
KMMX Poplar Bluff, MO
WLIN Jackson, MS
WHPE-FM Greensboro, NC
WHPE-FM High Point, NC
KSNM Santa Fe, NM
KILA Henderson, NV
KNEV Reno, NV
WROW-FM Albany, NY
WPLJ New York, NY
WCLV Cleveland, OH
WHOK-FM Lancaster, OH
KWEN Tulsa, OK
KXL-FM Portland, OR
WJAC-FM Johnstown, PA
WBRU Providence, RI
WSM-FM Nashville, TN
K0KE-FM Austin, TX
KZFM Corpus Christi, TX
KSP-LM Diboll, TX
KUOE El Paso, TX
KNFO Waco, TX
KVFM Ogden, UT
WIFC Wausau, WI

95.7

WUOA Tuscaloosa, AL
KXXA Little Rock, AR
KKHI-FM San Francisco, CA
KOYN Twentynine Palms, CA
KXXX Denver, CO
WKSS Hartford, CT
WKSS Hartford-Meriden, CT
WOKF Clearwater, FL
WOKF Tampa, FL
KEZJ Twin Falls, ID
WCRC Effingham, IL
WOHI Jeffersonville, IN
KOFO-FM Ottawa, KS
WOHI Louisville, KY
WBYU New Orleans, LA
WDEA-FM Ellsworth, ME
WZZR-FM Grand Rapids, MI
WDMJ-FM Marquette, MI
KLIZ-FM Brainerd, MN
KMRS-FM Morris, MN
KWWR-FM Mexico, MO
KCGM Scooby, MT
WXRC Hickory, NC
WTSB-FM Lumberton, NC
KROA Grand Island, NE
KSCR Hobbs, NM
WZID Manchester, NV
WEBF Olean, NY
WPTW-FM Dayton, OH
WPTW-FM Piqua, OH
KKAJ Ardmore, OK
WFLN-FM Philadelphia, PA
WFDI Rio Piedras, PR
KIKK-FM Houston, TX
WFO-FM Farmville, VA
WKEZ Norfolk, VA
KIXI-FM Seattle, WA
WZUU-FM Milwaukee, WI

95.9

CHFM-FM Calgary, AB
WKXN Greenville, AL
WTVX Guntersville, AL
WTVX Tuskegee, AL
KSAR Salem, AR
KRFM Lake Havasu City, AZ
KEZY-FM Anaheim, CA
KGAB Camarillo, CA
KKOS Carlsbad, CA
KEZY-FM Los Angeles, CA
KLBS-FM Los Banos, CA
KAVI-FM Rocky Ford, CO
WLYO Norwalk, CT
WVTR-FM Bethany Beach, DE
WLEO Bonita Springs, FL
WOXY Dublin, GA
WLGA Valdosta, GA
KILR-FM Esterville, IA
KBCT Fairfield, IA
KLNV Newton, IA
KOWC-FM Webster City, IA
WKKD-FM Aurora, IL
WHOW-FM Clinton, IL
WDOH-FM Duquoin, IL
WIFN Franklin, IN
WMCB-FM Michigan City, IN
WAVV Vevay, IN
WKUZ Wabash, IN
KDRB Derby, KS
KRSL-FM Russell, KS
WFTM-FM Maysville, KY
WRSL-FM Stanford, KY
KMAR-FM Winnsboro, LA
WUPE-FM Pittsfield, MA

WBKZ Baltimore, MD
WBKZ Glen Burnie, MD
WYII Williamsport, MO
WLKM-FM Three Rivers, MI
KDLH-FM Fairbault, MN
KETU Salem, MO
KLYQ-FM Hamilton, MT
KLCM-FM Lewistown, MT
WMBL-FM Morehead City, NC
WADB Point Pleasant, NJ
WFLR-FM Dundee, NY
WYLR-FM Glens Falls, NY
WVOS-FM Liberty, NY
WKAL-FM Rome, NY
WHFD Archbold, OH
WNPO New Philadelphia, OH
WHFD Toledo, OH
WYAN-FM Upper Sandusky, OH
KRBB-FM Oklahoma City, OK
KRBB-FM Salinas, OK
CFPL-FM London, ON
WMRF-FM Lewistown, PA
WJAR-FM Sharpshooter, PA
CJFM-FM Montreal, PQ
WLOW-FM Aiken, SC
WDXE-FM Lawrenceburg, TN
WLIV-FM Livingston, TN
WAZI Morristown, TN
KXIT-FM Daltan, TX
KKTX Kilgore, TX
KMWT Mineral Wells, TX
KNBO-FM New Boston, TX
WATW-FM Ashland, WI
WRDN-FM Durand, WI
WSP-LA Crosse, WI
WMMH Minocqua, WI
WCCW-FM Ripon, WI
WAEY-FM Princeton, WV

96.1

WLPR Mobile, AL
KHLIS Blytheville, AR
KCEE-FM Tuscon, AZ
KCTC Sacramento, CA
KUNA San Luis Obispo, CA
KFZ Greeley, CO
WKTF-FM Jacksonville, FL
WKL5-FM Atlanta, GA
KSAV Clinton, IA
KID-FM Idaho Falls, ID
WOLK Richmond, ID
WOTO Owensboro, KY
KSNS Lake Charles, LA
KSNB Worcester, MA
CJCM-FM Brandon, MB
WHNN Bay City, MI
WHNN Flint, MI
WHTC-FM Grand Rapids, MI
WHTC-FM Holland, MI
WYTO Raleigh, NC
WQHS-FM Shelby, NC
KINI Crookston, NE
KEFM-FM Omaha, NE
WBNY Buffalo, NY
KXXY Oklahoma City, OK
KZEL-FM Eugene, OR
KXBO Ontario, OR
WLEV Allentown, PA
WLEV Easton, PA
WXXK Pittsburgh, PA
WGBF-FM Red Lion, PA
WAEI-FM Maricao, PR
KIXX Watertown, SD
KMBS Harlingen, TX
KMFM San Antonio, TX
KAYK-FM Provo, UT
KAYK-FM Salt Lake City, UT
KZUN-FM Opportunity, WA
KZUN-FM Spokane, WA
WBES Charleston, WV

96.3

KFMI Eureka, CA
KFSG Los Angeles, CA
KUBB Mariposa, CA
WHUR-FM Washington, DC
WJXX Miami, FL
KKAI Kailua, HI
WBBM-FM Chicago, IL
WRUM-FM Rumford, ME
WJR-FM Detroit, MI
KADI-FM St. Louis, MO
WJFR Jackson, MS
KJIN-FM Shelby, MT
KHFM Albuquerque, NM
WQXR-FM New York, NY
WLV0 Columbus, OH
CFMK-FM Kingston, ON
WMTS-FM Murrellsboro, TN
WMTS-FM Nashville, TN
KSCS Dallas, TX
KEZB El Paso, TX
KSCS Fort Worth, TX
KLLF-FM Lubbock, TX
WVMA-FM Martinsville, VA
WJMC-FM Rice Lake, WI

96.5

WOEZ Birmingham, AL
KHIS-FM Bakersfield, CA
KYYX San Diego, CA
KOIT San Francisco, CA
KKFM Colorado Springs, CO
WTIC-FM Hartford, CT
WH00-FM Orlando, FL
WJCL-FM Savannah, GA
WMT-FM Cedar Rapids, IA
KMTW Twin Falls, ID
KEPT Shreveport, LA
KXTR Kansas City, MO

96.5 Continued

KIVE Glendive, MT
WSTS Laurinburg, NC
KRGI-FM Grand Island, NE
WCMF Rochester, NY
WKDD Akron, OH
WKZN-FM Zion, IL
KMRJ Pittsburg, KS
WPAO-FM Paducah, KY
KSLI Alexandria, LA
WJIB Boston, MA
WDHP Presque Isle, ME
WLAV-FM Grand Rapids, MI
WEOR Goldsboro, NC
W000 Statesville, NC
KSRD Seward, NE
WPGF-FM Atlantic City, NJ
KRAZ Farmington, NM
WGRQ Buffalo, NY
WOUR Utica, NY
KNID Enid, OK
WFFM Braddock, PA
WLAN-FM Lancaster, PA
WLWS Cincinnati, OH
WQMS Hamilton, OH
KRAV Tulsa, OK
WJNL-FM Johnston, PA
WPEL-FM Montrose, PA
W0DB Philadelphia, PA
WMDO-FM Fajardo, PR
KNWC-FM Sioux Falls, SD
W000-FM Chattanooga, TN
KIOU Corpus Christi, TX
KAUM Houston, TX
WBCI Williamsburg, VA
KYYX Seattle, WA
WFRM Milwaukee, WI
KQSW Rock Springs, WY
KLWD Sheridan, WY

96.7

KDEW-FM Dewitt, AR
KAWW-FM Heber Springs, AR
KSPA Hos Springs, AR
KWIZ-FM Los Angeles, CA
KNVR Paradise, CA
KCAL-FM Redlands, CA
KCAL-FM San Bernardino, CA
KWIZ-FM Santa Ana, CA
KAAP-FM Santa Paula, CA
KBRC-FM Steamboat Springs, CO
KSTC-FM Sterling, CO
WYRS Stamford, CT
WRYZ-FM Jupiter, FL
WVMG-FM Cochran, GA
WCOH-FM Newnan, GA
KOZE-FM Lewiston, ID
WLLI-FM Joliet, IL
WLUV-FM Loves Park, IL
WIHN Normal, IL
WCOE La Porte, IN
WAZY-FM Lafayette, IN
WORX-FM Madison, IN
WAOV-FM Vincennes, IN
KANS-FM Larned, KS
KNEF-FM McPherson, KS
WLBV-FM Bowling Green, KY
WBGH-FM Paris, KY
WSEK Somerset, KY
KMRC-FM Morgan City, LA
KDDI Oak Grove, LA
WEMD-FM Easton, MD
WQCM Halfway, MD
WUFN Albion, MI
WITW Cadillac, MI
WMBN-FM Petoskey, MI
KXGR Grand Rapids, MI
KWKK Rochester, MN
KTGC Columbia, MO
WFFF-FM Columbia, MS
WGUU-FM Gulfport, MS
WSEL-FM Pontotoc, MS
WONA-FM Winona, MS
KGWV-FM Belgrade, MT
WFSO-FM Franklin, NC
WKRX Roxboro, NC
KDLR-FM Devils Lake, ND
WLSU Canton, NY
WDLC-FM Port Jervis, NY
WILE-FM Cambridge, OH
WCSM-FM Celina, OH
WFOB-FM Fostoria, OH
WKOV-FM Wellston, OH
KWDG Idabel, OK
CKGL-FM Kitchener, ON
WPGM-FM Danville, PA
WQWK State College, PA
CHUT-FM Chicoutimi, PQ
WZLD Cayce, SC
WCRS-FM Greenwood, SC
WVST Boulivar, TN
WIKR Centerville, TN
KGTN-FM Georgetown, TX
KLMT Marlin, TX
KIKM-FM Sherman, TX
KQOX-FM Sweetwater, TX
WJMA-FM Orange, VA
WTSF-FM Brattleboro, VT
WNCS Montpelier, VT
KREW-FM Sunnyside, WA
WMKC Oshkosh, WI
WVLR Sauk City, WI
WRLR-FM Rainelle, WV

96.9

KDEW-FM Dewitt, AR
KAWW-FM Heber Springs, AR
KSPA Hos Springs, AR
KWIZ-FM Los Angeles, CA
KNVR Paradise, CA
KCAL-FM Redlands, CA
KCAL-FM San Bernardino, CA
KWIZ-FM Santa Ana, CA
KAAP-FM Santa Paula, CA
KBRC-FM Steamboat Springs, CO
KSTC-FM Sterling, CO
WYRS Stamford, CT
WRYZ-FM Jupiter, FL
WVMG-FM Cochran, GA
WCOH-FM Newnan, GA
KOZE-FM Lewiston, ID
WLLI-FM Joliet, IL
WLUV-FM Loves Park, IL
WIHN Normal, IL
WCOE La Porte, IN
WAZY-FM Lafayette, IN
WORX-FM Madison, IN
WAOV-FM Vincennes, IN
KANS-FM Larned, KS
KNEF-FM McPherson, KS
WLBV-FM Bowling Green, KY
WBGH-FM Paris, KY
WSEK Somerset, KY
KMRC-FM Morgan City, LA
KDDI Oak Grove, LA
WEMD-FM Easton, MD
WQCM Halfway, MD
WUFN Albion, MI
WITW Cadillac, MI
WMBN-FM Petoskey, MI
KXGR Grand Rapids, MI
KWKK Rochester, MN
KTGC Columbia, MO
WFFF-FM Columbia, MS
WGUU-FM Gulfport, MS
WSEL-FM Pontotoc, MS
WONA-FM Winona, MS
KGWV-FM Belgrade, MT
WFSO-FM Franklin, NC
WKRX Roxboro, NC
KDLR-FM Devils Lake, ND
WLSU Canton, NY
WDLC-FM Port Jervis, NY
WILE-FM Cambridge, OH
WCSM-FM Celina, OH
WFOB-FM Fostoria, OH
WKOV-FM Wellston, OH
KWDG Idabel, OK
CKGL-FM Kitchener, ON
WPGM-FM Danville, PA
WQWK State College, PA
CHUT-FM Chicoutimi, PQ
WZLD Cayce, SC
WCRS-FM Greenwood, SC
WVST Boulivar, TN
WIKR Centerville, TN
KGTN-FM Georgetown, TX
KLMT Marlin, TX
KIKM-FM Sherman, TX
KQOX-FM Sweetwater, TX
WJMA-FM Orange, VA
WTSF-FM Brattleboro, VT
WNCS Montpelier, VT
KREW-FM Sunnyside, WA
WMKC Oshkosh, WI
WVLR Sauk City, WI
WRLR-FM Rainelle, WV

WVST Boulivar, TN
WIKR Centerville, TN
KGTN-FM Georgetown, TX
KLMT Marlin, TX
KIKM-FM Sherman, TX
KQOX-FM Sweetwater, TX
WJMA-FM Orange, VA
WTSF-FM Brattleboro, VT
WNCS Montpelier, VT
KREW-FM Sunnyside, WA
WMKC Oshkosh, WI
WVLR Sauk City, WI
WRLR-FM Rainelle, WV

WVST Boulivar, TN
WIKR Centerville, TN
KGTN-FM Georgetown, TX
KLMT Marlin, TX
KIKM-FM Sherman, TX
KQOX-FM Sweetwater, TX
WJMA-FM Orange, VA
WTSF-FM Brattleboro, VT
WNCS Montpelier, VT
KREW-FM Sunnyside, WA
WMKC Oshkosh, WI
WVLR Sauk City, WI
WRLR-FM Rainelle, WV

WVST Boulivar, TN
WIKR Centerville, TN
KGTN-FM Georgetown, TX
KLMT Marlin, TX
KIKM-FM Sherman, TX
KQOX-FM Sweetwater, TX
WJMA-FM Orange, VA
WTSF-FM Brattleboro, VT
WNCS Montpelier, VT
KREW-FM Sunnyside, WA
WMKC Oshkosh, WI
WVLR Sauk City, WI
WRLR-FM Rainelle, WV

WVST Boulivar, TN
WIKR Centerville, TN
KGTN-FM Georgetown, TX
KLMT Marlin, TX
KIKM-FM Sherman, TX
KQOX-FM Sweetwater, TX
WJMA-FM Orange, VA
WTSF-FM Brattleboro, VT
WNCS Montpelier, VT
KREW-FM Sunnyside, WA
WMKC Oshkosh, WI
WVLR Sauk City, WI
WRLR-FM Rainelle, WV

WAIV Jacksonville, FL
KRIT Clarion, IA
KUJZ Nampa, ID
WLBI-FM Maltoen, IL
WHTT Moline, IL
WFFM Pittsburgh, PA
CBC-FM Charlottetown, PE
CKOI-FM Montreal, PQ
CKOI-FM Verdun, PQ
WMLD Manati, PR
WXTG Charleston, SC
KDLO-FM Watertown, SD
CBK-FM Regina, SK
WUHG-FM Bristol, TN
KULP-FM El Campo, TX
KVMV-FM McAllen, TX
KQIP Odessa, TX
KMTN Jackson, WY

97.1

KWEH Camden, AR
CKOK-FM Penticton, BC
KGBS Los Angeles, CA
WASH Washington, DC
WFOF Gainesville, GA
WNIB Chicago, IL
WVSL-FM Shelbyville, IN
WEZB New Orleans, LA
WBGW Bangor, ME
WVJ-FM Detroit, MI
WKZY Escanaba, MI
KTCR-FM Minneapolis, MN
KSCF Florissant, MO
WALT Meridian, MS
KURL-FM Billings, MT
KALS Kalispell, MT
WOMG Greensboro, NC
KJUB-FM Minot, ND
CBTB-FM Baie Verte, NF
KRSY-FM Roswell, NM
KORK-FM Las Vegas, NV
WYNY New York, NY
WRED-FM Ashtabula, OH
WBNS-FM Columbus, OH
CJBO-FM Bellevue, ON
KPAM-FM Portland, OR
WHRK Memphis, TN
KFJZ-FM Dallas, TX
KFJZ-FM Fort Worth, TX
KLUB-FM Salt Lake City, UT
WRUT Rutland, VT
KSXT Walla Walla, WA
WCOW-FM Sparta, WI

97.3

CJCA-FM Edmonton, AB
CJAFM3 Medicine Hat, AB
KSON-FM San Diego, CA
KEAR San Francisco, CA
KBGO Boulder, CO
WAIM Miami, FL
WJAD Baimbridge, GA
WXLN Savannah, GA
KDMI Des Moines, IA
WRUL Carmi, IL
WMEF Fort Wayne, IN
KBUF-FM Garden City, KS
WIBW-FM Topeka, KS
WJFD-FM New Bedford, MA
KWFC Springfield, MO
WKBC-FM North Wilkesboro, NC
WHSL Wilmington, NC
WMBV-FM Millville, NJ
KAFE-FM Sante Fe, NM
KKBC Carson City, NV
KKBC Reno, NV
WVCU-FM Ithaca, NY
WVEY-FM Weatherford, OK
WHP-FM Harrisburg, PA
KPAT Sioux Falls, SD
KATX Plainview, TX
WDAI-FM San Antonio, TX
WGH-FM Newport News, VA
WGH-FM Norfolk, VA
KNBO Tacoma, WA
WLPX Milwaukee, WI
WKWK-FM Wheeling, WV

97.5

WABB-FM Mobile, AL
KGUS Hot Springs, AR
KMYT Merced, CA
KDUO Riverside, CA
KDUO San Bernardino, CA
KTMS-FM Santa Barbara, CA
WPCW Winter Haven, FL
KHSS Honolulu, HI
WDWS-FM Champaign, IL
WZOK Rockford, IL
WAMZ Louisville, KY
CHMM-FM Winnipeg, MB
CJOB-FM Winnipeg, MB
WJIM-FM Lansing, MI
KNXR Rochester, MN
W00R Oxford, MS
WPST Trenton, NJ
WOKO Dover, NV
WALK-FM New York, NY
WALK-FM Patchogue, NY
WQCO Watertown, NY
WAEZ Akron, OH
KM0D Tulsa, OK
CKO-FM3 London, ON
WIOA Mayaguez, PR
WEZK Knoxville, TN
KAYD Beaumont, TX
KINT-FM El Paso, TX
KSJT San Angelo, TX
KWTX-FM Waco, TX
WVWV Charlottesville, VA
WJLC-FM South Boston, VA

WVWV Charlottesville, VA
WJLC-FM South Boston, VA

WVWV Charlottesville, VA
WJLC-FM South Boston, VA

WVWV Charlottesville, VA
WJLC-FM South Boston, VA

WQBE Charleston, WV
WESM Martinsburg, WV
KDLY Lander, WY

97.7

WFR1 Auburn, AL
WEZZ Clanton, AL
WKLD Oneonta, AL
WFR1 Opelika, AL
KUPO-FM Phoenix, AZ
CBUF-FM Vancouver, BC
KOEZ Bakersfield, CA
KWIN Lodi, CA
KPEN Los Altos, CA
KDOL-FM Mojave, CA
KRJB Monte Rio, CA
KOEZ Shafter, CA
KSPN Aspen, CO
WCTY Norwich, CT
WAFI Milford, DE
WFOY-FM St. Augustine, FL
WUPR Americus, GA
WKEU-FM Griffin, GA
WROM-FM Rome, GA
WTCO Vidalia, GA
KLNQ-FM Clinton, IA
KHBT Humboldt, IA
KLEE-FM Ottumwa, IA
KBLI-FM Blackfoot, ID
WDRL Monmouth, IL
WBBM-FM Pittsfield, IL
WLAX Streator, IL
WFRX-FM West Frankfort, IL
WVCM-FM Brazil, IN
WZOW Goshen, IN
WJCK Rensselaer, IN
WJUN-FM Jackson, KY
WHRZ Providence, KY
KAPB-FM Marksville, LA
KDBH Natchitoches, LA
WCAV Brockton, MA
WFST-FM Caribou, ME
WDDW-FM Dowagiac, MI
WMTF-FM Manistee, MI
WMIQ-FM Sandusky, MI
KLGR-FM Redwood Falls, MN
KOEK Doniphan, MO
KKCA Fulton, MO
KSTG Sikeston, MO
KFBD-FM Waynesville, MO
WRJB Brandon, MS
WYLI-FM Tylertown, MS
KGLM-FM Anacosta, MT
KYBS Livingston, MT
W0DW Kingston, NT
KUVF-FM Holdrege, NE
KNKY-FM Nebraska City, NE
CKWM-FM Kentville, NS
WCSF-FM Amsterdam, NY
WHVS Hyde Park, NY
WGGN Castalia, OH
WURD Georgetown, OH
WCJO Jackson, OH
WGTN Lima, OH
WOXY Oxford, OH
KWHF Edmond, OK
KWHF Oklahoma City, OK
CKTB-FM St. Catharines, ON
WBLT-FM Butler, PA
WVSC-FM Somerset, PA
CHOM-FM Montreal, PQ
WBRO Cidra, PR
WGBM Georgetown, SC
CBKF-FM Regina, SK
KPUP Kingsville, TX
WMJD Grundy, VA
WVJR Sheboygan, WI

WVJR Sheboygan, WI

WVJR Sheboygan, WI

WVJR Sheboygan, WI

WVJR Sheboygan, WI

WVJR Sheboygan, WI

WVJR Sheboygan, WI

WHKW Fayette, AL
KVIP-FM Redding, CA
KIFM San Diego, CA
KABL-FM San Francisco, CA
W0HL Live Oak, FL
KHAK-FM Cedar Rapids, IA
WRAY-FM Princeton, IN
KUUL-FM Kansas City, KS
WKQO Lexington, KY
WAFB-FM Baton Rouge, LA
WVMS New Bedford, MA
WKCO Saginaw, MI
WWJO St. Cloud, MN
KUUL Kansas City, MO
KSLQ St. Louis, MO
WQSM Fayetteville, NC
WQYT Binghamton, NY
WTOF Canton, OH
KRLG Lawton, OK
CHFI-FM Toronto, ON
WFBG-FM Altoona, PA
WCAU-FM Philadelphia, PA
CHOI-FM Quebec, PQ
WBFM Seneca, SC
KTAL-FM Texarkana, TX
WBOB-FM Galax, VA
WTVR-FM Richmond, VA
WHWB-FM Rutland, VT
KING-FM Seattle, WA
KHQ-FM Spokane, WA
WISM-FM Madison, WI

98.3

WCNA-FM Scottsboro, AL
WMLS-FM Sylacauga, AL
KTLO-FM Mountain Home, AR
KAYN Nogales, AZ
KNOT-FM Prescott, AZ
KWXC Wilcox, AZ
CFFM-FM Kamloops, BC
K0AR Oxnard, CA
KB0B West Covina, CA
WLAD-FM Danbury, CT
WXLN Willimantic, CT
W0UX-FM Seaford, DE
W0KD Arcadia, DE
WGLY Goulds, FL
WRMF-FM Titusville, FL
W0SJ-FM Jesup, GA
WJAT-FM Swainsboro, GA
KWBG-FM Boone, IA
KEMB Emmetsburg, IA
KSAX Burley, ID
WBSY-FM Canton, IL
WCCO Crest Hill, IL
WRKX Ottawa, IL
WARU-FM Peru, IN
WART Plainfield, IN
WUOC Winchester, IN
KAB-FM Abilene, KS
W0NS Bowling Green, KY
KYEA West Monroe, LA
W0AI-FM Greenfield, MA
KB0B-FM Winnipeg, MB
WTVL-FM Waterville, ME
WVMO Monroe, MI
W0XO Munising, MI
KFMZ Columbia, MO
KDBM-FM Dillon, MT
WVDR-FM Murfreesboro, NC
WNSC-FM Thomasville, NC
W0MG New Brunswick, NJ
WLNH-FM Laconia, NV
WVIN-FM Hammond, NY
W0IK Hempstead, NY
WSUL Monticello, NY
W0UJ New York, NY
W0MG New York, NY
W000-FM Bellefontaine, OH
W0GN-FM Logan, OH
CFLY-FM Kingston, ON
KLMB-FM La Grande, OR
WESA-FM Charletri, OR
WJUR-FM Milfflinburg, PA
WREI Quebradillas, PR
W0KT-FM Kingstree, SC
WRJB Camden, TN
WHUB-FM Cookeville, TN
W0GL Pulaski, TN
KHFI-FM Austin, TX
K0RA-FM Bryan, TX
KULM Columbus, TX
KMCS Gatesville, TX
KBOP-FM Pearsant, TX
KBMF-FM Spearman, TX
KWVM Stephenville, TX
KARB Price, UT
W0GL Lynchburg, VA
KYBO Yakima, WA
W0UZ-FM Green Bay, WI
WZMF Menomonee Falls, WI
WZMF Milwaukee, WI
WNB1-FM Park Falls, WI
WZFM Charles Town, WV
KERM Torrington, WY

WZFM Charles Town, WV

WZFM Charles Town, WV

WZFM Charles Town, WV

WZFM Charles Town, WV

WZFM Charles Town, WV

WACF Paris, IL
WYLD-FM New Orleans, LA
WROR Boston, MA
WMDM-FM Lexington Park, MD
W0NN Coldwater, MI
WJGS Houghton Lake, MI
KTIS-FM Minneapolis, MN
KTJJ Farmington, MO
W0LO-FM Tupelo, MS
KBMS Billings, MT
KSSR Kalispell, MT
CBHM-FM Richibucto, NB
K0KQ-FM Omaha, NE
KRSN-FM Los Alamos, NM
KLUC Las Vegas, NV
W0LD-FM Buffalo, NY
W0LD-FM Niagara Falls, NY
W0QA Cincinnati, OH
W0GL Cleveland, OH
KCFO Tulsa, OK
KAGM Klamath Falls, OR
KULP-FM Portland, OR
WYCR Hanover, PA
WRJS Oil City, PA
W0RE-FM Scranton, PA
W0RE-FM Wilkes-Barre, PA
CIEL-FM Longueuil, PQ
CIEL-FM Montreal, PQ
W0PM-FM San Juan, PR
WKPT-FM Bristol, TN
WKPT-FM Kingsport, TN
KQXX McAllen, TX
KHYS Fort Arthur, TX

98.7

KBBC Phoenix, AZ
KJ0I Los Angeles, CA
WMZO Washington, DC
W0LY-FM Fort Pierce, FL
KMGO Centerville, IA
W0MT-FM Chicago, IL
W0HP-FM Hopkinsville, KY
W0BF Detroit, MI
K0WB-FM Moorhead, MN
K0UH-FM Pipestone, MN
KWTO-FM Springfield, MO
W0MY Vicksburg, MS
W0RK Greensboro, NC
CBYM-FM Mount St. Margaret, NF
W0XO New York, NY
W0BO Utica, NY
CKWR-FM Kitchener, ON
W0BU-FM Beaufort, SC
KYTX-FM Amarillo, TX
KNUS Dallas, TX
KTXX Victoria, TX
KCPX-FM Salt Lake City, UT
WNOR-FM Norfolk, VA
W0PI Wheeling, WV

W0PI Wheeling, WV

W0PI Wheeling, WV

W0PI Wheeling, WV

W0PI Wheeling, WV

W0PI Wheeling, WV

WAAL Binghamton, NY
WHIO-FM Dayton, OH
WFR0-FM Fremont, OH
CKO-FM2 Toronto, ON
KPNW-FM Eugene, OR
W0KL Ebensburg, PA
WKJB-FM Mayaguez, PR
K0DA-FM Houston, TX
K0KK Odessa, TX
W0LQ Roanoke, VA
W0UW Milwaukee, WI

99.3

CKUA-FM2 Lethbridge, AB
WMFC-FM Monroeville, AL
WSLY York, AL
KRIL El Dorado, AR
KSER Searcy, AR
CKLG-FM Vancouver, BC
KJAX Stockton, CA
W0KX-FM Cocoa, FL
WFTW-FM Fort Walton Beach, FL
W0MT Chatsworth, GA
W0CN Cornelia, GA
KFGO Boone, IA
KWAY-FM Waverly, IA
W0UK Havana, IL
W0PO-FM La Salle, IL
WSCH Aurora, IN
WKVI-FM Knox, IN
K0YV-FM El Dorado, KS
K0YV-FM Wichita, KS
W0GO-FM Corbin, KY
W0UL-FM Fulton, KY
W0BN-FM Harrodsburg, KY
W0LK-FM Scottsville, KY
KJNA Jena, LA
WHMP-FM Northampton, MA
WHMP-FM Springfield, MA
W0KT-FM Farmington, ME
W0KN-FM Lincoln, ME
W0ZND Grand Rapids, MI
W0TR-FM Sturgis, MI
W0ZND Zealand, MI
K0SN-FM Thief River Falls, MN
K0WT-FM Boonville, MO
W0SC-FM Houston, MO
W0BP-FM Booneville, MS
W0RS-FM Ahoskie, NC
W0GR Pleasantville, NJ
CKON-FM Baker Lake, NT
KVLV-FM Fallon, NV
W0RD Hanover, NV
W0LV-FM Ellenville, NY
W0SN Potsdam, NY
W0SF-FM Seneca Falls, NY
W0TN-FM Coschocton, OH
W0XT-FM Portsmouth, OH
W0CF-FM Ponca City, OK
W0VEN Franklin, PA
W0SF Harrisburg, PA
W0MT-FM South Williamsport, PA
W0PR-FM Uniontown, PA
CINO-FM Montreal, PQ
W0NE Aiken, SC
W0CJ Chester, SC
W0AE-FM Crossville, TN
W0DD-FM Elizabethton, TN
W0SC Jefferson City, TN
W0DL-FM Lexington, TN
K0FN Abilene, TX
K0UK Atlanta, TX
K0SN Brownwood, TX
K0LD Lampasas, TX
K0CW Paris, TX
W0FFV Front Royal, VA
W0PLZ Petersburg, VA
W0MP-FM Dodgeville, WI
W0GN-FM Medford, WI
W0TH-FM Shawano, WI
W0GO Waupun, WI
W0BZ Parkersburg, WV

W0BZ Parkersburg, WV

W0BZ Parkersburg, WV

W0BZ Parkersburg, WV

W0BZ Parkersburg, WV

W0BZ Parkersburg, WV

99.5 Continued

WIVI-FM Christiansted, VI
WBKW Beckley, WV

99.7
WDOF-FM Dothan, AL
KIOO Porterville, CA
KYUU San Francisco, CA
WLTA-FM Atlanta, GA
KFHM Muscatine, IA
WILQ-FM Frankfort, IN
WCNS Louisville, KY
WIMI Ironwood, MI
WUGN Midland, MI
KMBR Kansas City, MO
WJMI Jackson, MS
WRKB-FM Kannapolis, NC
WRMZ Columbus, OH
WSHH Pittsburgh, PA
CBMI-FM Baie Comeau, PQ
WMSR-FM Manchester, TN
WMC-FM Memphis, TN
WYFI Norfolk, VA

99.9
WKRQ-FM Mobile, AL
KTCS-FM Fort Smith, AR
KRFD Marysville, CA
KOLA San Bernardino, CA
KTYD-FM Santa Barbara, CA
KPUB-FM Pueblo, CO
WEZN Bridgeport, CT
WDOG Boca Raton, FL
WIYD-FM Palatka, FL
WEBQ-FM Harrisburg, IL
WBVG-FM Kankakee, IL
WTHI-FM Terre Haute, IN
KSKG Salina, KS
KTDY Lafayette, LA
WORC Barnstable, MA
WFRE Frederick, MD
WHFB-FM Benton Harbor, MI
KAUS-FM Austin, MN
KVDX-FM Moorhead, MN
WLOS-FM Asheville, NC
WPIC Burgaw, NC
KGOR Omaha, NE
KTOM-FM Clovis, NM
WNOZ Cortland, NY
WGBF Plattsburgh, NY
WVUD-FM Dayton, OH
WVUD-FM Kettering, OH
WKLR Toledo, OH
CKFM-FM Toronto, ON
KRKT-FM Albany, NY
WQQQ Allentown, PA
WQQQ Easton, PA
WLWU Erie, PA
WIOB San Juan, PR
KTSM-FM El Paso, TX
KROB-FM Robstown, TX
KHOO Waco, TX
KLUR Wichita Falls, TX
KISW Seattle, WA
KXLY-FM Spokane, WA
WJVL Janesville, WI
WVAF Charleston, WV

100.1
KQOK Kenai, AK
KMXT Kodiak, AK
KMTE Sitka, AK
WEIZ Phenix City, AL
WTUN Selma, AL
KZST Santa Rosa, CA
KRLT South Lake Tahoe, CA
WEEJ Port Charlotte, FL
WFNE Forsyth, GA
WMCD Statesboro, GA
WLOV-FM Washington, GA
WPRC-FM Lincoln, IL
WKAI-FM Macomb, IL
WGLC-FM Mendota, IL
WJBD-FM Salem, IL
WCCI Savanna, IL
WLKI Angola, IN
WCRR Bluffton, IN
WVCM Carrollton, KY
WQXE Elizabethtown, KY
WKDJ Winchester, KY
KJBS Bastrop, LA
KCOZ Shreveport, LA
WMNB-FM North Adams, MA
WESO-FM Southbridge, MA
WWAV Auburn, ME
WHOU-FM Houlton, ME
WSHN-FM Fremont, MI
WOON Grayling, MI
WBCH-FM Hastings, MI
WUUN Marquette, MI
WVLA Eveleth, MN
KMHF-FM Marshall, MN
KELE Aurora, MO
KJMO Jefferson City, MO
WQXB Grenada, MS
KYLTFM Missoula, MT
KPWD Plentywood, MT
WBXB Edenton, NC
WJRZ Ship Bottom, NJ
WPNH-FM Plymouth, NV
WKNT-FM Akron, OH
WKNT-FM Kent, OH
KYFM Bartlesville, OK
WVAM-FM Altoona, PA
WUFM Lebanon, PA
WSCQ Columbia, SC
WSCQ West Columbia, SC
WASL Dyersburg, TN
WIZO-FM Franklin, TN
KGRI-FM Henderson, TX
WIVE-FM Ashland, VA
WVOD-FM Lynchburg, VA
WIVE-FM Richmond, VA

WTZE-FM Tazewell, VA
WGLB-FM Port Washington, WI
WDDC Portage, WI
WCLG-FM Morgantown, WV

100.3
CFRN-FM Edmonton, AB
KICY-FM Nome, AK
KJNP-FM North Pole, AK
WVNA-FM Tusculumbia, AL
KGMR-FM Jacksonville, AR
KIKO-FM Globe, AZ
KIKO-FM Miami, AZ
KYOR-FM Blythe, CA
KIOQ Los Angeles, CA
KBAY San Jose, CA
KLIR-FM Denver, CO
WDOO Washington, DC
WDIZ Orlando, FL
WXOS Plantation Key, FL
WCUP Tifton, GA
KLYF Des Moines, IA
WOKZ-FM Alton, IL
WL00 Chicago, IL
WCNB-FM Connorsville, IN
KXXX-FM Colby, KS
KDVV Topeka, KS
WKOA-FM Hopkinsville, KY
KDBS-FM Alexandria, LA
WNIC Dearborn, MI
WNIC Detroit, MI
WCTS-FM Minneapolis, MN
WNSL-FM Laurel, MS
WGLD-FM Greensboro, NC
WGLD-FM High Point, NC
WVNJ-FM Newark, NJ
KPAR-FM Albuquerque, NM
WHEB-FM Portsmouth, NV
WVNJ-FM New York, NY
WCLT-FM Newark, OH
KQFM Portland, OR
WZPR Meadville, PA
WIVA-FM Aguadilla, PR
KGGG-FM Rapid City, SD
WOKI-FM Oak Ridge, TN
KDUV Brownsville, TX
KMEZ Dallas, TX
KILT-FM Houston, TX
KZZY San Antonio, TX
KSFI Salt Lake City, UT
KWIO-FM Moses Lake, WA

100.5
WHMA-FM Annisston, AL
KEBR Sacramento, CA
KRJS Durango, CO
WRCH-FM Hartford, CT
WRCH-FM New Britain, CT
WEAI Jacksonville, IL
WWKI Kokomo, IN
WVOR Rochester, NY
WOMP-FM Bellaire, OH
WHMO Findlay, OH
KATT-FM Oklahoma City, OK
CHAS-FM Sault Ste. Marie, ON
WGLX Laurens, SC
WCMS-FM Norfolk, VA
WKEE-FM Huntington, WV
WOMP-FM Wheeling, WV

100.7
KDOT-FM Phoenix, AZ
KOPA-FM Scottsdale, AZ
KIOO-FM Bishop, CA
KWTY-FM Salinas, CA
KFMB-FM San Diego, CA
KHAY Ventura, CA
KZLO Pueblo, CO
WHYI Fort Lauderdale, FL
WHYI Miami, FL
WJLO Pensacola, FL
WJYW Tampa, FL
WSBI-FM Brunswick, GA
KICG Iowa City, IA
WYEZ Elkhart, IN
WYEZ South Bend, IN
WVTS Terre Haute, IN
WQXY-FM Baton Rouge, LA
WHUE-FM Boston, MA
WTRR-FM Westminster, MD
WITL-FM Lansing, MI
KCMT-FM Alexandria, MN
KGM0-FM Cape Girardeau, MO
KIEE Harrisonville, MO
WDMS Greenville, MS
WFMA Rocky Mount, NC
KGBI-FM Omaha, NE
WCMC-FM Wildwood, NJ
WHUD New York, NY
WHUD Peekskill, NY
WMMS Cleveland, OH
WEEC Springfield, OH
CHIN-FM Toronto, ON
KICE Bend, OR
WFMZ Allentown, PA
WNUF New Kensington, PA
WBF-FM Montreal, PQ
WXYX Bayam, PR
WOLS Cleveland, TN
KORG Abilene, TX
KASE Austin, TX
KPKI Mount Pleasant, TX
WQPO Harrisonburg, VA
KSEA Seattle, WA
WBIZ Eau Claire, WI
WRKR-FM Racine, WI

100.9
CHEC-FM Lethbridge, AB
KFSK Petersburg, AK
WALX Selma, AL

KDEL-FM Arkadelphia, AR
KXXI Fort Smith, AR
KTAA-FM Sierra Vista, AZ
KTIM-FM San Francisco, CA
KTIM-FM San Rafael, CA
KSRT Tracy, CA
WTYD New London, CT
WJQA Marianna, FL
WPGA-FM Perry, GA
WWGA Waynesboro, GA
WCJM West Point, GA
WKXX Pana, IL
WIVQ Peru, IL
WQFL Rockford, IL
WBDC Huntingburg, IN
WN0N Lebanon, IN
WPGW-FM Portland, IN
WMPI Scottsburg, IN
WHKK Erlanger, KY
WJMM Versailles, KY
KLOO Sulphur, LA
WLOB-FM Portland, ME
WR0N Westbrook, ME
WBRN-FM Big Rapids, MI
WKLK-FM Cloquet, MN
KQAD-FM Luverne, MN
KPCR-FM Bowling Green, MO
WMDC-FM Hazlehurst, MS
WKBG West Point, MS
WABZ-FM Albemarle, NC
WIFM-FM Elkin, NC
WZY2 Fairmont, NC
WMFD-FM Wilmington, NC
KFUN-FM Las Vegas, NM
CKCL-FM Truro, NS
WWOM Albany, NY
WQIX Horseheads, NY
WEZG North Syracuse, NY
WEZG Syracuse, NY
WBNO-FM Bryan, OH
WHKK Cincinnati, OH
WBO Waverly, OH
KGLC-FM Miami, OK
KXDJ-FM Sapulpa, OK
KXDJ-FM Tulsa, OK
WAKM Bedford, PA
WMLP-FM Milton, PA
WHYP-FM North East, PA
CBJ-FM Chicoutimi, PQ
WALD-FM Waterboro, SC
WVVG Huntington, TN
WIOO-FM Covington, VA
WNNT-FM Warsaw, VA
WNCM Middlebury, VT
WRCD-FM Richland Center, WI
WFMH-FM Cullman, AL
CFMI-FM New Westminster, BC
KHYL Auburn, CA
KFIG Fresno, CA
KRTH Los Angeles, CA
KOSI-FM Denver, CO
WVDC-FM Washington, DC
WCKS Cocoa Beach, FL
WAFV Valdosta, GA
KFJB-FM Marshalltown, IA
WKQX Chicago, IL
WMRY East St. Louis, IL
KSAN Oberlin, KS
WSGS Hazard, KY
WAKO Russellville, KY
WNOE-FM New Orleans, LA
KRMD-FM Shreveport, LA
WRIF Detroit, MI
KBHP Bemidji, MN
KAOL-FM Carrollton, MO
WMRY St. Louis, MO
WPCM Burlington, NC
KQXI Columbus, NE
WGIR-FM Manchester, NV
WBCS-FM New York, NY
WSDR Youngstown, OH
CBQV-FM Sandy Lake, ON
CJET-FM Smiths Falls, ON
KYTE-FM Portland, OR
WVDR Philadelphia, PA
WGMR Tyrone, PA
WCAC Anderson, SC
KWAM-FM Memphis, TN
WRR Dallas, TX
KNAF-FM Fredericksburg, TX
KL0L Houston, TX
KTEZ Lubbock, TX
K0AB Ogden, UT
WCRN Charlotte Amalie, VI
WIXX Green Bay, WI

101.3
KGOT Anchorage, AK
KIOI San Francisco, CA
WKCI Hamden, CT
WEMO Davenport, IA
WEMO East Moline, IL
WRIA Richmond, IN
KF0I-FM Wichita, KS
WFAU-FM Augusta, ME
WMLW Grand Rapids, MI
WSUE Sault Ste. Marie, MI
KDWB-FM Minneapolis, MN
KDWB-FM Richfield, MN
WDAL Meridian, MS
WEZO Rochester, NY
WNCO-FM Ashland, OH
KNED-FM McAlester, OK
CKOT-FM Tillsonburg, ON
WNCE Lancaster, PA
WGBI-FM Scranton, PA
WVDM Sumter, SC
KNCN Sinton, TX
WNCN-FM Hampton, VA
WVDE-FM Norfolk, VA

101.5
KHFP-FM Phoenix, AZ
KGFM Bakersfield, CA
KAMB Merced, CA
KGBF-FM San Diego, CA
WLYF Miami, FL
WBOP-FM Pensacola, FL
WKES St. Petersburg, FL
WYNR-FM Brunswick, GA
WBIE Marietta, GA
KAYL-FM Storm Lake, IA
WBNO Bloomington, IL
WCIL-FM Carbondale, IL
WCSI-FM Columbus, IN
WUJY South Bend, IN
WYNK-FM Baton Rouge, LA
CJUM-FM Winnipeg, MB
KTXR Springfield, MO
WRAL Raleigh, NC
WBJH Trenton, NJ
WP0H Poughkeepsie, NY
WYPC Gallipolis, OH
WLOR Toledo, OH
KLAU Lawton, OK
CFMP-FM Peterborough, ON
KFLY-FM Corvallis, OR
WPIT-FM Pittsburgh, PA
CJBR-FM Rimouski, PQ
WKSA-FM Isabela, PR
WLKW-FM Providence, RI
WQUT Bristol, TN
WQUT Johnson City, TN
K0XE Brownwood, TX
KNUU Tyler, TX
WVFA-FM Fredericksburg, VA
KVI-FM Seattle, WA
WIBA-FM Madison, WI

101.7
KSTK Wrangell, AK
WVSV Stevenson, AL
KSKR Mena, AR
KROT-FM Big Bear Lake, CA
KLBB Carmel, CA
KKIO Livermore, CA
KVRE-FM Santa Rosa, CA
KVVN St. Helena, CA
KEZC Truckee, CA
KBRU Fort Morgan, CO
WCNH-FM Quincy, FL
WVWC Albany, GA
WTHO-FM Thomson, GA
WRBL-FM Warner Robins, GA
KTR Creston, IA
KBBK-FM Fort Madison, IA
KMFE Emmett, ID
WIXN-FM Dixon, IL
WYAX-FM Robinson, IL
WBMP Elwood, IN
WCMX Fort Wayne, IN
KIND-FM Independence, KS
MKKE Manhattan, KS
WKYM Monticello, KY
WBZT Richmond, KY
KEAZ De Ridder, LA
WLYN Boston, MA
WLYN Lynn, MA
WBRK-FM Pittsfield, MA
WILS-FM Lansing, MI
WKJR-FM Muskegon Heights, MI
WDBI-FM Tawas City, MI
KRCH Rochester, MN
WMMH-FM Sauk Rapids, MN
KLPM-FM Union, MO
WVWL Canton, MS
WJBI Clarksdale, MS
WFTA Fulton, MS
KMAAF-FM Mayville, ND
WNAN Canton, NJ
KLEA-FM Lovington, NM
KXRT Taos, NM
WCNL-FM Newport, NV
WBTf Attica, NY
WEOQ Geneva, NY
WHUG Jamestown, NY
WBOO-FM Owego, NY
WNKO Columbus, OH
WJER-FM Dover-New Philadelphia, OH
WNKO Newark, OH
WCOM-FM Urbana, OH
KEOK Tahlequah, OK
KCMX-FM Ashland, OR
KCMX-FM Medford, OR
WCCS Central City, PA
WCCC Iinesville, PA
WBAW-FM Barnwell, SC
WBZD Myrtle Beach, SC
WKOM Columbia, TN
WCMT-FM Martin, TN
WORM-FM Savannah, TN
WJLE-FM Smithville, TN
KDSQ Denison-Sherman, TX
KSAM-FM Huntsville, TX
WKWI Kilmarnock, VA
WJJS-FM Lynchburg, VA
WRIQ Radford, VA
WRFB Stowe, VT
KACA Prosser, WA

101.9
WHYY-FM Montgomery, AL
KBTM-FM Jonesboro, AR
KFRY Fresno, CA
KUTE Glendale, CA
KBUE Los Angeles, CA
KINX Colorado Springs, CO
WOXO Daytona Beach, FL
WHWF Fort Myers, FL
KNWS-FM Waterloo, IA
WCLR Chicago, IL

WCLR Skokie, IL
WVEM Springfield, IL
WNES-FM Central City, KY
KNOE-FM Monroe, LA
WWL-FM New Orleans, LA
WCIB Falmouth, MA
WLIF Baltimore, MD
WPOR-FM Portland, ME
WDET-FM Detroit, MI
WLDR Traverse City, MI
WGNC-FM Charlotte, NC
WGNC-FM Gastonia, NC
WRBK New Bern, NC
KFMO Lincoln, NE
CHFX-FM Halifax, NS
KFMS Las Vegas, NV
WJIV Albany, NY
WJIV Cherry Valley, NY
WPIX-FM New York, NY
WKRO Cincinnati, OH
KFNB Oklahoma City, OK
KINK Portland, OR
WAVT Pottsville, PA
WZAR Ponce, PR
KWAS Amarillo, TX
KQXT San Antonio, TX
KOPD Ogden, UT
WDEZ Wausau, WI
WVOW-FM Logan, WV
WVAC Morgantown, WV

102.1
GBR-FM Calgary, AB
KJZZ Anchorage, AK
WDRM Decatur, AL
KJFM Oceanside, CA
KDCC San Francisco, CA
WZAT Savannah, GA
WONL Danville, IL
KSKU Hutchinson, KS
WAUQ Springfield, MA
WMUQ Kalamazoo, MI
KEEY-FM Minneapolis, MN
KEEY-FM St. Paul, MN
KYY5 Kansas City, MO
WVMO Reidsville, NC
WDOK-FM Cleveland, OH
WIMA-FM Lima, OH
CFNY-FM Brampton, ON
CFNY-FM Toronto, ON
WCED-FM Dubois, PA
WIOG Philadelphia, PA
WSEV-FM Sevierville, TN
KMJQ Clear Lake City, TX
KFWO Dallas, TX
KLOZ El Paso, TX
KFWD Fort Worth, TX
KMJQ Houston, TX
WRXL Richmond, VA
KPO-FM Wenatchee, WA
WAWA-FM Milwaukee, WI

102.3
WAMI-FM Opp, AL
KBRI-FM Brinkley, AR
KWKK Dardanelle, AR
KAVR-FM Apple Valley, CA
KJLH Compton, CA
KJLH Los Angeles, CA
KFIV-FM Modesto, CA
KITA Modesto, CA
KLGT Breckenridge, CO
KLOV-FM Loveland, CO
WHFS Washington, DC
WRTM Blountstown, FL
WTRS-FM Dunnellon, FL
WYRL Melbourne, FL
WGUS-FM Augusta, GA
WGCO Bulford, GA
WVWG-FM Milledgeville, GA
WOTU Rome, GA
KCHE-FM Cherokee, IA
WTAS Chicago, IL
WTAS Crete, IL
WKSI Eldorado, IL
WTAZ Mt. Carmel, IL
WRHL-FM Rochelle, IL
WEFA Waukegan, IL
WSAL-FM Logansport, IN
WCBK-FM Martinsville, IN
WLJC Beattyville, KY
WCLB-FM Benton, KY
WCYN-FM Cynthiana, KY
WGOH-FM Grayson, KY
WLRS Louisville, KY
WLOC-FM Munfordville, KY
WHFS Bethesda, MD
KOCA Canton, MO
KDEX-FM Dexter, MO
KYSO Waynesville, MO
WBSJ Ellisville, MS
WTAM Gulfport, MS
CBZF-FM Fredericktown, NB
WOKN Goldsboro, NC
WJSK Lumberton, NC
WPTM Roanoke Rapids, NC
WRIQ-FM Cape May, NJ
WSUS Franklin, NJ
KBOS Espanola, NM
WKXL-FM Concord, NV
WBAB-FM Babylon, NY
WFLC Canandaigua, NY
WBAB-FM New York, NY
WKAJ-FM Saratoga Springs, NY
WAVR Waverly, NY
WQLX Galion, OH
WPOS-FM Holland, OH
WDHK Wilmington, OH
KRHD-FM Duncan, OK
KCES Eufaula, OK
WHYL-FM Carlisle, PA

WMDI McKean, PA
WCPL-FM Pageland, SC
KMIT Mitchell, SD
KVRF Vermillion, SD
WRKM-FM Carthage, TN
WNTO Dickson, TN
WIRJ-FM Humboldt, TN
WZDO Saddy-Daisy, TN
KBIC Alice, TX
KLCR Center, TX
KTJX-FM Jasper, TX
KWVC-FM Vernon, TX
WOLD-FM Marion, VA
WWSR-FM St. Albans, VT
WISS-FM Berlin, WI
WQTC-FM Two Rivers, WI
WGBM Viroqua, WI
WGOH-FM Huntington, WV
WHAW-FM Weston, WV

102.5
WWWB-FM Jasper, AL
KOSY-FM Texarkana, AR
KNIX-FM Phoenix, AZ
KNIX-FM Tempe, AZ
KSFM Sacramento, CA
KDON-FM Salinas, CA
KSMA-FM Santa Maria, CA
KSFM Woodland, CA
WOSR Sarasota, FL
WQSR Tampa, FL
WLTE Waycross, GA
KRND Des Moines, IA
WMOH Des Moines, IA
WMFM Baton Rouge, LA
WCRB Boston, MA
WCRB Waltham, MA
WOLC Princess Anne, MD
WGER Bay City, MI
WGER-FM Flint, MI
KQIC William, MN
KPCG Joplin, MO
KEZK St. Louis, MO
WKIT Hendersonville, NC
WBEN-FM Buffalo, NY
WHIZ-FM Zanesville, OH
CBOF-FM Ottawa, ON
KNPT-FM Newport, OR
WDVE Pittsburgh, PA
WRFY-FM Reading, PA
WACM-FM San Juan, PR
WKTM Charleston, SC
KHBR-FM Hillsboro, TX
KOSY-FM Texarkana, TX
WEGF Winchester, VA
KZOK-FM Seattle, WA
WNWC Madison, WI

102.7
CFRO-FM Vancouver, BC
KNUU Fresno, CA
KIIS-FM Los Angeles, CA
KIOI-FM Manitou Springs, CO
WKCO Fort Lauderdale, FL
WXBK-FM Milton, FL
WMO Pompano Beach, FL
WBXM Chicago, IL
WBXM Oak Park, IL
WPRF Terre Haute, IN
WXYV Baltimore, MD
WBRB-FM Detroit, MI
WBRB-FM Mount Clemens, MI
WAAV Wilmington, NC
KFOR-FM Lincoln, NE
CBH-FM Halifax, NS
WNWF-FM New York, NY
WEBN Cincinnati, OH
WLEC-FM Sandusky, OH
WRAC-FM Williamsport, PA
CITE-FM Sherbrooke, PQ
WZXR Memphis, TN
KTFM San Antonio, TX
KORD-FM Richland, WA
WRVM Suring, WI
WTIO Charleston, WV

102.9
KHOF-FM Harrison, AR
KRE-FM Berkeley, CA
KEZL San Diego, CA
KRE-FM San Francisco, CA
WDRF-FM Hartford, CT
WVIF-FM Jacksonville, FL
WRBL-FM Columbus, GA
KQCR Cedar Rapids, IA
KWBW-FM Hutchinson, KS
KHIO Crowley, LA
WPYM Cumberland, MD
WGAN-FM Portland, ME
WQB Ann Arbor, MI
WVFR-FM Grand Rapids, MI
WCCO-FM Minneapolis, MN
KFMP Cape Girardeau, MO
KMFL-FM Marshall, MO
WZZO Jackson, MS
WHKY-FM Hickory, NC
WMHR Syracuse, NY
WBLV-FM Springfield, OH
WYFM Youngstown, OH
WMGK Philadelphia, PA
WYFM Sharon, PA
CHGB-FM La Pociatere, PQ
WCHQ-FM Camuy, PR
WTCV Shelbyville, TN
KMGC Dallas, TX
KQUE Houston, TX
WOWI Norfolk, VA
KELA-FM Centraia, WA
WBCS-FM Milwaukee, WI
KIOZ Laramie, WY

103.1

KEZU El Dorado, AR
KCRI Helena, AR
KCMS Indio, CA
KSRR Los Angeles, CA
KOCM Newport Beach, CA
KSRR Santa Monica, CA
KTHO-FM South Lake Tahoe, CA
WQUH De Funiak Springs, FL
WLMO Okeechobee, FL
WLOO Orlando, FL
WOWO Tallahassee, FL
WLOO Winter Park, FL
WZZW Augusta, GA
WVXV Chicago, IL
WVXV Highland Park, IL
WAKO-FM Lawrenceville, IL
WPOK-FM Pontiac, IL
WRWC Rockton, IL
WHLT-FM Huntington, IN
WHME South Bend, IN
KNDY-FM Marysville, KS
WECL Elkhorn City, KY
WAXU-FM Georgetown, KY
WGRK-FM Greensburg, KY
WHKC Henderson, KY
WJRS Jamestown, KY
WSTM Louisville, KY
WVXL-FM Manchester, KY
WSTM St. Matthews, KY
WTHM-FM Lapeer, MI
KFIL-FM Preston, MN
KCRV-FM Caruthersville, MO
WJWF Columbus, MS
WOSM Ocean Springs, MS
KCAP-FM Helena, MT
WQTI Dunn, NC
KASK Las Cruces, NM
WHRL Albany, NY
WWWB Newburgh, NY
WONT Oneonta, NY
WWWJ Johnstown, OH
WNHD Napoleon, OH
KRBS Roseburg, OR
WACM Freeland, PA
WQMU Indiana, PA
WXLK State College, PA
WANB-FM Waynesburg, PA
WJBW-FM Hampton, SC
WRIX Honea Path, SC
WYAK-FM Surfside Beach, SC
KJAM-FM Madison, SD
WMCC Elowah, TN
KCWB Ballinger, TX
KOOV Copperas Cove, TX
KMUL-FM Muleshoe, TX
WCUL Culpes, VA
WQAW Parkersburg, WV

103.3

WREZ Montgomery, AL
KBEE-FM Modesto, CA
KRUZ Santa Barbara, CA
KALF Ukiah, CA
WDJW Bradenton, FL
WVEE Atlanta, GA
WACL-FM Waycross, GA
KPLL Pella, IA
KTFC Sioux City, IA
WXTZ Indianapolis, IN
KJLS Hays, KS
WTGI Hammond, LA
WEEI-FM Boston, MA
WKRF-FM Battle Creek, MI
WDTH Duluth, MN
KBRF-FM Fergus Falls, MN
KPRS Kansas City, MO
KMOX-FM St. Louis, MO
WPRB Princeton, NJ
WPRB Trenton, NJ
WPRB Buffalo, NY
WCFD Cleveland, OH
KTFX Tulsa, OK
CBO-FM Ottawa, ON
WSBA-FM York, PA
WVJP-FM Caguas, PR
WKDF Nashville, TN
KWMJ Midland, TX
KJCS Nogadoches, TX
KDLU Sinton, TX
KNTQ Wichita Falls, TX
WAKG Danville, VA
WESR-FM Tasley, VA
WWRW Wisconsin Rapids, WI
WHEZ Huntington, WV

103.5

CHQM-FM Vancouver, BC
KOST Los Angeles, CA
KQAO Denver, CO
WGMS-FM Washington, DC
WSHE-FM Fort Lauderdale, FL
WSHE-FM Miami, FL
WFYR Chicago, IL
WMIU Detroit, MI
WTCM-FM Traverse City, MI
KYSM-FM Mankato, MN
WNAU-FM New Albany, MS
CBZA-FM Grand Manan, NB
WTFM Lake Success, NY
WTFM New York, NY
WOKV Hamilton, OH
WRKY Steubenville, OH
WEZL Charleston, SC
WBIR-FM Knoxville, TN
KRSP-FM Salt Lake City, UT

103.7

WQEN Gadsden, AL
KKYK Little Rock, AR

KIOY Hanford, CA
KQZN-FM San Diego, CA
KSFX San Francisco, CA
WRUF-FM Gainesville, FL
KJAN-FM Atlantic, IA
KLIK Davenport, IA
WDBR Springfield, IL
WFUI Bloomington, IL
KEYN-FM Wichita, KS
WAAW Murray, KY
KGRA Lake Charles, LA
WHOG Havre De Grace, MD
KPRM-FM Park Rapids, MN
KJEL-FM Lebanon, MO
WHER Hattiesburg, MS
WSEC-FM Charlotte, NC
WSEC Williamston, NC
WMGM Atlantic City, NJ
WIXL-FM Newton, NJ
WXLO Berlin, NV
WNBX-FM Keene, NV
WEIV Ithaca, NY
WTFE-FM Tiffin, OH
KOMS Lebanon, OR
WCKC Erie, PA
WERI-FM Westerly, RI
KVIL-FM Dallas, TX
KVIL-FM Highland Park, TX
KCSW San Marcos, TX
WEZS Richmond, VA
WWIB Ladysmith, WI
WEZW Milwaukee, WI
WEZW Wauwatosa, WI
WGR-FM Beckley, WV

103.9

KKLV Anchorage, AK
WAYD-FM Ozark, AL
KMLA Ashdown, AR
KNWA Fayetteville, AR
KPOC-FM Pocatontos, AR
KACE Inglewood, CA
KACE Los Angeles, CA
KRAY-FM Salinas, CA
KHGX Yuba City, CA
KSTX Canon City, CO
KFMU Oak Creek, CO
WRCC Cape Coral, FL
WPPL Blue Ridge, GA
WCEH-FM Hawkinsville, GA
WGLS Springfield, GA
KNEI-FM Waukon, IA
KRPL-FM Moscow, ID
WVTV Dundee, IL
WNOI Flora, IL
WTVW Urbana, IL
WRBI Batesville, IN
WLF0 Crawfordsville, IN
WFLM Crown Point, IN
WXXE Fort Wayne, IN
WRRB South Bend, IN
KNZA Hiawatha, KS
WTCO-FM Campbellsville, KY
WFTG-FM London, KY
WFIA-FM Louisville, KY
WXXO Whitesburg, KY
WZYO-FM Braddock Heights, MD
WLEN Adrian, MI
WJNR-FM Iron Mountain, MI
WOAP-FM Owosso, MI
KRAD-FM East Grand Forks, MN
KCHI-FM Chillicothe, MO
WCLD-FM Cleveland, MS
WAKS-FM Fuquay Varina, NC
WAKS-FM Raleigh, NC
KTAP Crete, NE
KRFS-FM Superior, NE
KGRD Las Cruces, NM
WOBK-FM Albany, NY
WVYD New York, NY
WSRK Oneonta, NY
WOBK-FM Rensselaer, NY
WRCN-FM Riverhead, NY
WDXK Rochester, NY
WVYD White Plains, NY
WBBY-FM Columbus, OH
WBBY-FM Westerville, OH
WHBM Xenia, OH
WWIX Youngstown, OH
WHGM Bellwood, PA
WIBF-FM Jenkintown, PA
WWIZ Mercer, PA
WIBF-FM Philadelphia, PA
WLSW Pittsburgh, PA
WLSW Scottsdale, PA
WELP-FM Easley, SC
WORG-FM Orangeburg, SC
CFMC-FM Saskatoon, SK
WXIS Erwin, TN
WDEB-FM Jamestown, TN
WBMC-FM McMinnville, TN
KMHT-FM Marshall, TX
KGHO-FM Hoquiam, WA
KBRD Tacoma, WA
WOSH Oshkosh, WI
WKGI New Martinsville, WV

104.1

WATM-FM Atmore, AL
KHOP Modesto, CA
WIOF Waterbury, CT
WXTR-FM Washington, DC
WRKT Cocoa Beach, FL
WGLF Tallahassee, FL
WWCG La Grange, GA
KLFM Ames, IA
WJBM-FM Jerseyville, IL
WIKY-FM Evansville, IN
WLBG-FM Muncie, IN
KHOM Houma, LA

KWEZ Monroe, LA
WBCN Boston, MA
WYTR-FM La Plata, MD
WVGR Grand Rapids, MI
KFMX Minneapolis, MN
KFMX St. Louis Park, MN
WTOR Greensboro, NC
WTON Winston-Salem, NC
WVOL-FM Buffalo, NY
WQAL Cleveland, OH
WPAY-FM Portsmouth, OH
KOFM Oklahoma City, OK
WXXW Allentown, PA
WTPA-FM Harrisburg, PA
WUPR-FM Utuado, PR
WLAT-FM Conway, SC
KOHU Yankton, SD
WKIR Jackson, TN
KBFM Edinburg, TX
KRBE Houston, TX
KUEZ Yakima, WA
WZEE Madison, WI

104.3

KTOO Juneau, AK
WJOF Athens, AL
KBIG Los Angeles, CA
KLMO-FM Denver, CO
KLMO-FM Longmont/Boulder, CO
WBBO-FM Augusta, GA
WJEZ Chicago, IL
KVGB-FM Great Bend, KS
WITM-FM Baltimore, MD
WABK-FM Gardiner, ME
WOMC Detroit, MI
KBEO Kansas City, MO
WKTCT Tarboro, NC
WNCN New York, NY
WKGW Utica, NY
WELA East Liverpool, OH
CKCY-FM Sault Ste. Marie, ON
CFDM-FM Drummondville, PQ
KBBB-FM Broomfield, CO
KSOP-FM Salt Lake City, UT
KERI Bellingham, WA

104.5

KIOO Atascadero, CA
KFOG San Francisco, CA
WEAT-FM West Palm Beach, FL
WGPC-FM Albany, GA
KTOF Cedar Rapids, IA
WFBM Springfield, IL
WJWC Indianapolis, IN
WFMP Fitchburg, MA
WOWG-FM Muskegon, MI
WHSY-FM Hattiesburg, MS
KOOO-FM Omaha, NE
KSRN Reno, NV
WWSST-FM Wooster, OH
KKMA Pryor, OK
CFLG-FM Cornwall, ON
CHUM-FM Toronto, ON
KCIV The Dalles, OR
WSNI Philadelphia, PA
WGRW Wellsville, PA
WHIN-FM Gallatin, TN
WUOD Memphis, TN
KKDA-FM Dallas, TX
KOBBS-FM Orange, TX
KITE-FM San Antonio, TX
WROK Norfolk, VA
WEAU-FM Eau Claire, WI
WHAS Bluefield, WV

104.7

KUAC Fairbanks, AK
WZZK Birmingham, AL
KIOG Mesa, AZ
KIOG Phoenix, AZ
KJOV-FM Kelowna, BC
KACY-FM Oxnard, CA
KDES-FM Palm Springs, CA
KMYT Vail, CO
WRBO Tampa, FL
WAGO Athens, GA
WCSJ-FM Morris, IL
WXXA Elkhart, IN
WVIZ-FM Jasper, IN
WLOM Orleans, MA
WVMD Hagerstown, MD
WBOC-FM Salisbury, MD
WENN Escanaba, MI
KCLD-FM St. Cloud, MN
KRES Moberly, MO
WEZZ Charlotte, NC
WKFM Fulton, NY
WSPK Poughkeepsie, NY
WKFM Syracuse, NY
WTOE Dayton, OH
WTOE Toledo, OH
WYDD Pittsburgh, PA
WKAQ-FM San Juan, PR
WNOK-FM Columbia, SC
KIOV Sioux Falls, SD
KCOE Lamesa, TX
KSVS-FM Crewe, VA
KDXU-FM Ocean Shores, WA

104.9

WHOD-FM Jackson, AL
WQAB Ozark, AL
KAGH-FM Crossett, AR
KHPA Hope, AR
KHIG Paragould, AR
KHFA Prescott, AR
KCIZ Springdale, AR
KFMR Fremont, CA
KOCN Pacific Grove, CA

WHS Middletown, CT
WUNJ-FM Atlantic Beach, FL
WAAZ-FM Crestview, FL
WUNJ-FM Jacksonville, FL
WFXE Columbus, GA
WHCG Metter, GA
WCHA-FM Charles City, IA
KBOE-FM Oskaloosa, IA
KDL-SFM Perry, IA
KRBU Pocahontas, ID
WPAY Belvidere, IL
WTAO Carbondale, IL
WCBW Columbia, IL
WFIW-FM Fairfield, IL
WRSO-FM Geneseo, IL
WTAO Murphysboro, IL
WZRO Pekin, IL
WSHY-FM Shelbyville, IL
WWWY Columbus, IN
WHHC Hartford City, IN
WAXI Rockville, IN
KLRB Emporia, KS
WKWV Frankfort, KY
WMTL-FM Leitchfield, KY
WPKY-FM Princeton, KY
WSKV Stanton, KY
KROF-FM Abbeville, LA
KSMI-FM Donaldsonville, LA
KTCC-FM Jonesboro, LA
KQVR Oakdale, LA
WVCA-FM Boston, MA
WVCA-FM Gloucester, MA
WFCV-FM Alma, MI
WIDL Caro, MI
WELL-FM Marshall, MI
KKWB Breckenridge, MN
KRF0-FM Owatonna, MN
KRFG Carthage, MO
WCBW St. Louis, MO
WTLB Luka, MS
WKYK Pascagoula, MS
WKVO-FM Havelock, NC
WMTD Tabor City, NC
KNDR Mandan, ND
KTGH-FM Wayne, NE
KAWL-FM York, NE
WRDR Egg Harbor, NJ
KORP Mesilla Park, NM
WIZR-FM Johnstown, NY
WXXY Montour Falls, NY
WCVG Ganana, OH
WLSR Lima, OH
WZLS Lorain, OH
KJLI Bethany, OK
KJLI Oklahoma City, OK
WHPA Hollidaysburg, PA
WVDF-FM Scranton, PA
WYSH-FM Clinton, TN
WVEM Dayton, TN
WVLR-FM Union City, TN
WVRY Waverly, TN
KCWW Beeville, TX
KFRD-FM Houston, TX
KMUZ La Grange, TX
KFRD-FM Rosenberg-Richmond, TX
KPLE Temple, TX
WVVV Blacksburg, VA
WVAT-FM Gate City, VA
KQOD Pullman, WA
KIAM-FM Wenatchee, WA
WRL0-FM Antigo, WI
WTKM-FM Hartford, WI
WKAU-FM Kaukauna, WI
WLXR La Crosse, WI
WTKM-FM Milwaukee, WI
WRDB-FM Reedsburg, WI
WPOX-FM Clarksburg, WV

105.1

WOSB Albertville, AL
KLF Conway, AR
KBKA Los Angeles, CA
KEWT Sacramento, CA
KADK Denver, CO
WAVA Washington, DC
WYOR Coral Gables, FL
WYOR Miami, FL
WBJW-FM Orlando, FL
WJOJ Chicago, IL
WJOJ Evanston, IL
WGEN-FM Quincy, IL
WTOF-FM Skowhegan, ME
WCBY-FM Cheboygan, MI
WORS-FM Detroit, MI
WGGF Duluth, MN
KSFT St. Joseph, MO
WKQZ-FM Kosciusko, MS
WDCG Durham, NC
WDCG Raleigh, NC
WVOV De Ruyter Township, NY
WRFM New York, NY
WVOV Syracuse, NY
WUBE-FM Cincinnati, OH
WSOM-FM Salem, OH
KSKD Salem, OR
WIOV Ephrata, PA
WIL0 Williamsport, PA
WIOC Ponce, PR
WVJB-FM Providence, RI
KEAN-FM Abilene, TX
KLUF-FM Lufkin, TX
WAVA Arlington, VA
WKLC-FM Charleston, WV
WKLC-FM St. Albans, WV

105.3

KITT San Diego, CA
KBRG San Francisco, CA
WDFN-FM Macon, GA
KIWI Dubuque, IA

WVHI Evansville, IN
WASK-FM Lafayette, IN
WXEL New Orleans, LA
WXEL Slidell, LA
WFRB-FM Frostburg, MD
KZNN Rolla, MO
WHHO-FM Hornell, NY
WCLW-FM Mansfield, OH
CFCA-FM Kitchener, ON
CKBY-FM Ottawa, ON
WDAS-FM Philadelphia, PA
WAGI-FM Gaffney, SC
KOAX Dallas, TX
KWED-FM Seguin, TX
WXRI Norfolk, VA
KBIQ Edmonds, WA
KONA-FM Kennewick, WA
KBIQ Seattle, WA

105.5

KNIK-FM Anchorage, AK
WWSM Bay Minette, AL
WLAY-FM Muscle Shoals, AL
WACT-FM Tuscaloosa, AL
KNAS Nashville, AR
KOKR Newport, AR
KWRP-FM Warren, AR
KBFE Casa Grande, AZ
KBFE Phoenix, AZ
KYLO Davis, CA
KHSJ-FM Hemet, CA
KNAC Long Beach, CA
KNAC Los Angeles, CA
KOVA Ojai, CA
KWYD Security, CO
WSUB-FM Grotton, CT
WGVJ Gainesville, FL
WGUL-FM New Port Richey, FL
WKZM Sarasota, FL
WSPK-FM Sebring, FL
WCHK-FM Atlanta, GA
WEBI Calhoun, GA
WCHK-FM Canton, GA
WIFO-FM Jesup, GA
WOWE Rossville, GA
KILJ Mount Pleasant, IA
KIWA-FM Sheldon, IA
KTLB Twin Lakes, IA
WVLI Monticello, IL
WXRD Woodstock, IL
WIFF-FM Auburn, IN
WBIF Bedford, IN
WLJE Valparaiso, IN
WVVR West Terre Haute, IN
KQSM-FM Chanute, KS
WSAC-FM Fort Knox, KY
WVOV Glasgow, KY
WKDO-FM Liberty, KY
WMST-FM Mt. Sterling, KY
WPRT-FM Prestonburg, KY
KFRA-FM Franklin, LA
KVVP Leesville, LA
WORB Pittsfield, MA
WWCK Flint, MI
WBMI West Branch, MI
KABG Cambridge, MN
KCUF-FM Red Wing, MN
KRBI-FM St. Peter, MN
WHAY Aberdeen, MS
WNLA-FM Indianola, MS
WABO-FM Waynesboro, MS
WXOR Jacksonville, NC
WFJA Sanford, NC
KHUB-FM Fremont, NE
WDHA-FM Dover, NJ
WSGO-FM Oswego, NY
WXT0 Athens, OH
WFIJ Conneaut, OH
WVVR-FM Sidney, OH
WXEZ Sylvania, OH
WXEZ Toledo, OH
WCHO-FM Washington Court House, OH
KXKK Chickasha, OK
KVRO Stillwater, OK
WPMF-FM Punxsutawney, PA
WZTA Tamagua, PA
WRFE Aquada, PR
WDAR-FM Darlington, SC
WTFW Moncks Corner, SC
WNMB North Myrtle Beach, SC
WOWE Chattanooga, TN
WYTM-FM Fayetteville, TN
WBNT-FM Oneida, TN
WTPR-FM Paris, TN
WSMT-FM Sparta, TN
KCGI Centerville, UT
WKDE-FM Altavista, VA
WSWV-FM Pennington Gap, VA
WGTH Richlands, VA
WSHV South Hill, VA
WRAR-FM Tappahannock, VA
KLYK Longview, WA
WCFW Chippewa Falls, WI

105.7

WRES Troy, AL
KMCK Siloam Springs, AR
CBU-FM Vancouver, BC
KARA San Jose, CA
KARA Santa Clara, CA
WAUG-FM Augusta, GA
KXEL-FM Waterloo, IA
WWCT Peoria, IL
WTLG Indianapolis, IN
WVBF Boston, MA
WVBF Framingham, MA
WTKT Baltimore, MD
WTKT Catonsville, MD
W00D-FM Grand Rapids, MI
KSGM-FM Ste. Genevieve, MO

WIXO McComb, MS
WFMX Statesville, NC
KGLR Reno, NV
WMRV Endicott, NY
WWWN Cleveland, OH
CHSC-FM St. Catharines, ON
WXXA York, PA
CFGL-FM Laval, PQ
CFGL-FM Montreal, PQ
WKVM-FM San Juan, PR
KHCB-FM Houston, TX
KYYX Longview, TX
KEZE-FM Spokane, WA
WCXR-FM Appleton, WI

105.9

CKO-FM6 Edmonton, AB
KRBD Ketchikan, AK
KKOJ Fesno, CA
KWST Los Angeles, CA
KBPI Denver, CO
WHCN Hartford, CT
WXRA Washington, DC
WELE-FM De Land, FL
WAXY Fort Lauderdale, FL
WAXY Miami, FL
WVFM Chicago, IL
WVFM Elmwood Park, IL
WVFM-FM Lawrence, KS
WIGY Bath, ME
WJZZ Detroit, MI
KKWS Wadena, MN
WHBI Newark, NJ
WHBI New York, NY
WPBF Middletown, OH
WAMO Pittsburgh, PA
CBKA-FM La Ronge, SK
WEZI Memphis, TN
WKOZ Nashville, TN
WXR4 Woodbridge, VA

106.1

KMEL San Francisco, CA
WLET-FM Toccoa, GA
KLSS Mason City, IA
WSMI-FM Litchfield, IL
WVOH-FM North Vernon, IN
KLOO Lyons, KS
KRBS Monroe, LA
WCOO-FM Hyannis, MA
WGOB Cumberland, MD
WMEM Presque Isle, ME
WJDX-FM Jackson, MI
WXXY Wilson, NC
WECM Claremont, NV
WCLF-FM Corning, NY
WBLI New York, NY
WBLI Patchogue, NY
WVNO-FM Mansfield, OH
CKLA-FM Guelph, ON
KLOO-FM Corvallis, OR
WWSH Philadelphia, PA
KDNT-FM Denton, TX
KIOG Orange, TX
WVIS Frederiksted, VI
KLAY-FM Tacoma, WA
WMIL Milwaukee, WI
WMIL Waukesha, WI

106.3

WKNU Brewton, AL
WNAM Denopolis, AL
WRCK-FM Sheffield, AL
KXOW-FM Hot Springs, AR
KCAC Walnut Ridge, AR
KWA0 San City, AZ
KOTE Lancaster, CA
KXMS Los Angeles, CA
KMMT Mammoth Lakes, CA
KXMS Santa Ana, CA
WAFK Clewiston, FL
WSPB-FM Sarasota, FL
WPKE-FM Starke, FL
WKIG-FM Glenview, GA
KANY Ankeny, IA
KSWI Clarinda, IA
WQXR Benton, IL
WLNR Chicago, IL
WLSN Lansing, IL
WVSA Sullivan, IL
WFOU Columbia City, IN
WVND Crawfordsville, IN
WANY-FM Albany, KY
WCKO-FM Cadiz, KY
WLLS-FM Hartford, KY
WKMO Hodgenville, KY
WTJM Pineville, KY
KXOR Thibodaux, LA
WESP-FM Cambridge, MD
WJBO-FM Scarborough, ME
WKLA-FM Ludington, MI
WIOG Saginaw, MI
WMFG-FM Duluth, MN
WMFG-FM Hibbing, MN
WEVR-FM Minneapolis, MN
WOPM-FM Princeton, MN
KLTB Bolivar, MO
KIRK-FM Branson, MO
KVCV-FM Cabool, MO
KBK Lexington, MO
KMIS-FM Portageville, MO
WAD Clarksdale, MS
WMOO-FM Newton, MS
WGOO Pascagoula, MS
WPEM Pascagoula, MS
WJ0J Picaune, MS
WSMU-FM Starkville, MS
KOOZ Great Falls, MT
KHAT Lincoln, NE
WFMV-FM Blairtown, NJ

106.3 Continued

WHTG-FM Eatontown, NJ
WSLT-FM Ocean City-
Somers Point, NJ
WOTW-FM Nashua, NV
WVIP-FM Mount Kisco, NY
WVIP-FM New York, NY
WMCR-FM Oneida, NY
WSYX London, OH
WPNM Ottawa, OH
KGOU Norman, OK
KGOU Oklahoma City, OK
WRLR Huntingdon, PA
WCTL Union City, PA
WWON-FM Woonsocket, RI
WSTN Florence, SC
WSHG Georgetown, SC
WSHG Greenville, SC
WHHR Hilton Head Island, SC
KTON-FM Belton, TX
KWHI-FM Brenham, TX
KPAN-FM Hereford, TX
KONI-FM Spanish Fork, UT
WBDY Bluefield, VA
WMNA-FM Gretna, VA
WLCC Luray, VA
WNVA-FM Norton, VA
WWQM-FM Madison, WI
WWOM-FM Middleton, WI
WEVR-FM River Falls, WI
KLEN-FM Cheyenne, WY

106.5

KWOD Sacramento, CA
KPRI San Diego, CA
KEZR San Jose, CA
KRVR Davenport, IA
WGNU-FM Granite City, IL
WFML Washington, IN
WMAR-FM Baltimore, MD
WOLR Kalamazoo, MI
KFMC Fairmont, MN
KFIX-FM Liberty, MO
WGNU-FM St. Louis, MO
WSFL Bridgeton, NC
WRDX Salisbury, NC
WHSB Albany, NY
WADV Buffalo, NY
WDRK Greenville, OH
WHLR-FM Bloomsburg, PA
WHLR-FM Arcadio, PR
WYNO Chattanooga, TN
KUFO Galveston, TX
KDOI Jacksonville, TX
WRFK-FM Richmond, VA
KLYN-FM Lynden, WA
WDLB-FM Marshfield, WI
WKKW Clarksburg, WV

106.7

WKMX Enterprise, AL
CUAT-FM Trail, BC
KROQ-FM Pasadena, CA
KJUG Tulare, CA
KAZY Denver, CO
WEZR Washington, DC
WGLO Fort Lauderdale, FL
WHLV Leesburg, FL
WGLO Miami, FL
WHLV Orlando, FL
WOKA-FM Douglas, GA
WWID Gainesville, GA
WYEN Chicago, IL
WYEN Des Plaines, IL
WBZ-FM Boston, MA
WWWW Detroit, MI
WWRM Gaylord, MI
WKYV-FM Vicksburg, MS
WJAG-FM Norfolk, NE
WVRV New York, NY
WSRW-FM Hillsboro, OH
WVKS Youngstown, OH
KMJK Lake Oswego, OR
KMJK Portland, OR
WVKS Beaver Falls, PA
WPDC-FM Elizabethtown, PA
WVKS Pittsburgh, PA
WVJS Orangeburg, SC
WEZR Manassas, VA

106.9

WKXX Birmingham, AL
KMPX San Francisco, CA
WCCC-FM Hartford, CT
WSWT Peoria, IL
WMRI Marion, IN
KTPK Topeka, KS
WVEX Louisville, KY
WWCS Hagerstown, MD
WUPM Ironwood, MI
WMUS-FM Muskegon, MI
KROC-FM Rochester, MN
KJFF Jefferson City, MO
WMIT Black Mountain, NC
CBN-FM St. John's, NF
WKDN-FM Camden, NJ
KRNO Reno, NV
WRLX Auburn, NY
WDOO Canton, OH
WVRN-FM Marion, OH
KWOE-FM Clinton, OK
KMMM-FM Muskogee, OK
CKO-FM1 Ottawa, ON
WKDN-FM Philadelphia, PA
WXR-FM Guayama, PR
WKTA McKenzie, TN
KMCV Conroe, TX
KBRO-FM Bremerton, WA

107.1

KSCC Berryville, AR
KADO-FM Texarkana, AR

KSTM Apache Junction, AZ
KMAX Arcadia, CA
KAVO Fallbrook, CA
KMAX Los Angeles, CA
KZEN Seaside, CA
WIS Key West, FL
WSWK-FM Lehigh Acres, FL
WTAI-FM Melbourne, FL
WCLA-FM Claxton, GA
WKOG-FM Gordon, GA
WZOT Rockmart, GA
WTUF Thomasville, GA
KCCQ Ames, IA
KOSN-FM Denison, IA
WSPY Plano, IL
WPGU Urbana, IL
WKRK Vandalia, IL
WBNL-FM Boonville, IN
WGRT Danville, IN
WGRT Indianapolis, IN
WLCL-FM Lowell, IN
WCTT-FM Corbin, KY
WMGE Danville, KY
WKCB-FM Hindman, KY
WHMD Hammond, LA
KCIL Houma, LA
KWLV Many, LA
KOGM Opelousas, LA
KXKZ Ruston, LA
WPAG-FM Ann Arbor, MI
WMQT Ishpeming, MI
WSAQ Port Huron, MI
WWWWS Saginaw, MI
WIRX St. Joseph, MI
KEHG-FM Fosston, MN
KDUZ-FM Hutchinson, MN
WIKX-FM Minneapolis, MN
WIRN Virginia, MN
KESM-FM El Dorado Springs, MO
WROA-FM Gulfport, MS
WLSM-FM Louisville, MS
WRRZ-FM Clinton, NC
WDBS Durham, NC
WDBS Raleigh, NC
WIOZ Southern Pines, NC
WLCF Southport, NC
WRLB Long Branch, NJ
WKXR-FM Exeter, NV
WRNW Briarcliff Manor, NY
WBZA-FM Glen Falls, NY
WRNW New York, NY
WLYK Cincinnati, OH
WNRE-FM Circleville, OH
WDOH Delphos, OH
WITO Ironton, OH
WLYK Milford, OH
KSEO-FM Durant, OK
CILQ-FM Toronto, ON
WOKU-FM Greensburg, PA
WGRV-FM Greenville, PA
WOKU-FM Pittsburgh, PA
WEZX Scranton, PA
WOTB Middletown, RI
WPAJ-FM Lancaster, SC
WCGI Mullins, SC
KSTA-FM Coleman, TX
KWKO Graham, TX
KADO-FM Texarkana, TX
KWBU Waco, TX
KBUH-FM Brigham City, UT
KORM Orem, UT
WTTX-FM Appomattox, VA
WPUV-FM Pulaski, VA
WORK Barre, VT
WFON Fond Du Lac, WI
WIXK-FM New Richmond, WI
WOCO-FM Oconto, WI
WSWW-FM Platteville, WI
WNNO-FM Wisconsin Dells, WI
WITO Huntington, WV

107.3

WOLT Florence, AL
KSTN-FM Stockton, CA
WROX Washington, DC
WJEE Jacksonville, FL
WAJB Pensacola, FL
WWBA-FM St. Petersburg, FL
WWBA-FM Tampa, FL
WCGO Columbus, GA
KGRS Burlington, IA
WDDD Marion, IL
WTRF-FM Greensburg, IN
WRSW-FM Warsaw, IN
KARD Wichita, KS
WAAF Worcester, MA
WPLB-FM Greenville, MI
KLIN-FM Lincoln, NE
WTLB-FM Utica, NY
WBEA Cleveland, OH
WBEA Elyria, OH
KINB Poteau, OK
WDBA Dubois, PA
WDMN-FM Arcadio, PR
WANS-FM Anderson, SC
WCOR-FM Lebanon, TN
KGOL Lake Jackson, TX
KFFM Yakima, WA
WFAW-FM Fort Atkinson, WI

107.5

KXG-FM El Centro, CA
KKYS Hanford, CA
KLVE Los Angeles, CA
KPPL Denver, CO
KPPL Lakewood, CO
WJOK Miami, FL
WGCI Chicago, IL
WBOO Terre Haute, IN
WBLM Lewiston, ME

WGPR Detroit, MI
WSJC-FM Magee, MS
WKZL Greensboro, NC
WKZL Winston-Salem, NC
WBLS New York, NY
WBVO Bovertown, PA
WPWR St. George, SC
KNOK-FM Dallas, TX
KNOK-FM Fort Worth, TX
KBUC-FM San Antonio, TX
WEXM-FM Exmore, VA
WCCN-FM Neillsville, WI
WTRF Wheeling, WV

107.7

WENN-FM Birmingham, AL
KSOL San Francisco, CA
KSOL San Mateo, CA
WORJ-FM Mount Dora, FL
WORJ-FM Orlando, FL
KICD-FM Spencer, IA
KSWT Topeka, KS
WHSB Alpena, MI
KKSS St. Louis, MO
WNCI-FM Greenville, NC
WSNJ-FM Bridgeton, NJ
WGNB Albany, NY
WBIV Buffalo, NY
WBIV Wethersfield, NY
WDAO Dayton, OH
KAEZ Oklahoma City, OK
WGET-FM Gettysburg, PA
WOLA-FM Carolina, PR
WIVK-FM Knoxville, TN
KWIC Beaumont, TX
WEER-FM Warrenton, VA
KRAB Seattle, WA
WVCY Milwaukee, WI

107.9

KFIN Jonesboro, AR
KFMV Magnolia, AR
KKXX Bakersfield, CA
KXOA Sacramento, CA
KWVE San Clemente, CA
KCOL-FM Fort Collins, CO
WDJF Westport, CT
WPFM Panama City, FL
WIRK-FM West Palm Beach, FL
WCRY-FM Macon, GA
KFMW Waterloo, IA
WAUR Aurora, IL
WIFE-FM Indianapolis, IN
WABO-FM Fort Campbell, KY
WWEL-FM Boston, MA
WWEL-FM Medford, MA
WFSI Annapolis, MD
WGMZ Flint, MI
KTWN-FM Anoka, MN
KTWN-FM Minneapolis, MN
WRPM-FM Poplarville, MS
WBT-FM Charlotte, NC
KFMG Albuquerque, NM
WONO Syracuse, NY
WDMT Cleveland, OH
CING-FM Burlington, ON
CING-FM Toronto, ON
KHPE Albany, OR
WEPP-FM Pittsburgh, PA
CBJE-FM Chicoutimi, PQ
KXCL Corsicana, TX
KESI Edinburg, TX
KMBI-FM Spokane, WA
WRHN Rhinelander, WI
WEMM Huntington, WV

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