George Massenburg Labs

GML 8200 Parametric Equalizer Series II

The GML 8200 Parametric Equalizer is the reference standard parametric equalizer, from the engineer who invented the concept. Its revolutionary circuitry was first envisioned by George Massenburg and is now embodied in this fifth-generation progressive design.

Owner's Manual

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INTRODUCTION

The GML 8200 Parametric Equalizer is the reference standard parametric equalizer, from the engineer who invented the concept. Indeed, the revolutionary circuitry first envisioned by George Massenburg and embodied in this fifth-generation progressive design affects audio signals in a most musical fashion. The Model 8200 benefits from nearly twenty years of limited manufacturing, precise listening analysis, widespread usage by demanding industry professionals, and continuous evaluation by the GML Engineering Department.

FEATURES

The GML Model 8200 Parametric Equalizer has become the reference standard due in large part to its features:

- All-discrete, Class-A design; no integrated circuits to compromise the audio path
- No interstage or coupling capacitors to add distortion or degrade over time
- Transformerless; precision electronically balanced input buffer and DC-servo stabilized direct-coupled output
- Carbon-film precision potentiometers, manufactured to GML exacting standards
- Designed with GML 9202 low-noise, low-distortion, wide dynamic range, wide bandwidth precision discrete opamp
- No tantalum, ceramic, or electrolytic capacitors in the signal path
- Precious-metal interconnects
- High-quality XLR interconnects, Au over Ag
- Illuminated push-button switches for "EQ In" and "EQ Out"
- LED power indicator
- Multi-colored knobs, GML standard
- Rugged and stylish black-anodized aluminum chassis
- Reverse-anodized lettering, much more permanent than ink or paint processes
- Quality PCB manufacturing, assembly, and chassis construction

OPERATION

The GML Model 8200 Series II Parametric Equalizer offers astonishing precision and sonic accuracy when sculpting the response of any source. Its operational characteristics have been honed through many years of use in the most critical recording and mixing situations and have proven both reliable and amazingly accommodating.

The basis of the parametric design topology, in general, specifies control over not only gain or attenuation, but also over both frequency and “Q” factor in multiple user-defined bands. In the case of parametric equalization, “Q” is defined as the center frequency of the alteration (whether gain or attenuation) divided by the bandwidth of that alteration. It follows, then, that low values of “Q” affect a wide range of frequencies around the cut or boost, while high values of “Q” specify a narrow slope around the center frequency.

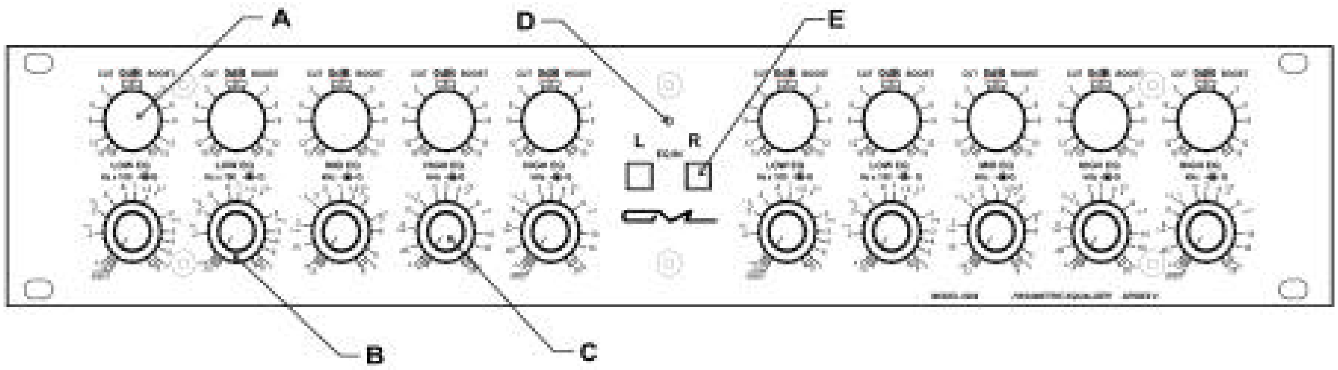
Another important aspect of true parametric equalization, as embodied in the Model 8200, is the existence of overlapping frequency bands, which provide great precision and flexibility.

Specifically, the 8200 provides complete control over a wide frequency range and “Q” setting, along with 15 dB of cut or boost on five individual bands, with the front panel controls for frequency and “Q” mounted concentrically. The addition of the “Q” characteristic represents the foremost advance in equalizer technology since the invention of the transistor as a replacement for bulky and noisy vacuum tubes, and empowers the user to maintain precise and musical control over the tonal attributes of the spectrally processed signal. *(Graphical representation of the Q characteristic and gain steps may be found in Appendix A of this manual.).*

The availability of up to 15 dB of gain or attenuation is significant in the audio world, since most contemporary equalizers offer at most 12 dB of cut or boost, and usually not over such flexible overlapping multiple bands. Thus, it is possible to achieve any particular “sound” that is desired, no matter if the goal is a subtle alteration or an audible coloration effect.

Front panel controls on the Model 8200 Series II Parametric Equalizer include an illuminated in/out pushbutton switch for each channel, five color-coded bands per channel with amplitude and dual-concentric frequency and "Q" potentiometers, plus a power indication LED. The amplitude pots are continuously variable between +15 dB and -15 dB, with highly accurate 0 dB settings. Each band offers a wide array of frequencies to select on the outer knob of the dual-concentric potentiometer, with a good deal of overlap between bands to accommodate almost any combination of cuts and boosts. The Low and High bands offer counter-clockwise detents for shelving curves in addition to the variable "Q" values from 0.4 to 4 found in the other three bands--all on the central knobs of the dual-concentric potentiometers. Frequency markings can be found along the inner, larger ring of numbers, while the outer, smaller numbers encircling the dual-concentric potentiometer denotes "Q" value.

MODEL 8200 PARAMETRIC EQUALIZER SERIES II
FRONT PANEL



A. The Cut/Boost potentiometer controls the amount of gain or attenuation for each band. Maximum level of cut or boost is 15 dB, continuously variable, with a highly accurate 0 dB setting (no detent). The element of the potentiometer is precision-trimmed carbon film, for the highest signal integrity and longest life.

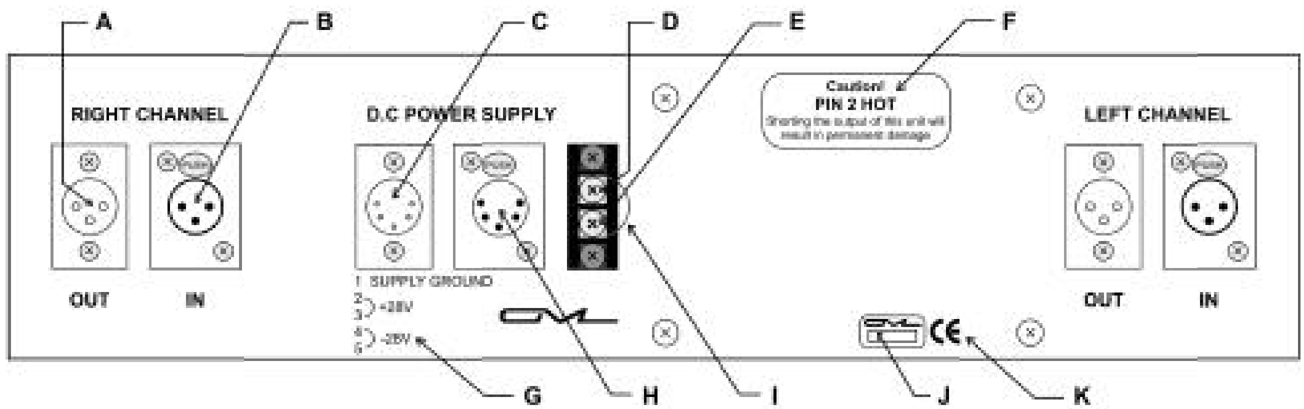
B. The Frequency potentiometer determines the center frequency for each band. Frequency ranges differ for the bands to accommodate maximum flexibility, and are continuously variable. The inner ring of numerical markings denote center frequency in concert with the pointer; these markings are estimations and will vary slightly from unit to unit due to component tolerances. Carbon film is the element of this potentiometer.

C. The Q potentiometer is mounted concentrically with the Frequency potentiometer but rotates independently. This controls the sharpness of the peak or dip for each band, with a counter-clockwise detent for shelving on the LOW and HIGH bands. The outer ring of small numerical markings denote Q value, which is continuously variable from 0.4 (widest Q) to 4.0 (sharpest Q). This is a carbon-film potentiometer.

D. The Power Indication LED allows visual confirmation of the presence of appropriate power supply voltages, +/- 28 V.

E. The EQ IN switch toggles between the active (switch in, lamp ON) and bypassed (switch out, lamp OFF) modes of operation. No signal is present at the switch itself; this is merely a latching DC voltage switch to control a high quality signal relay located near the back of the unit.

MODEL 8200 PARAMETRIC EQUALIZER SERIES II
BACK PANEL



A. The Output connector provides a professional interconnect to external devices. Precious metal, durable XLR connectors are provided for each channel. Outputs are D.C. servo corrected, direct-coupled to preserve signal integrity.

B. The Input connector features durable precious metal construction. This female XLR feeds the precision electronically balanced input stage.

C. The 5-pin D.C. Power Supply Input allows interconnection of the external supply required for the unit to operate. A 6 ft. 5-pin power supply cable ships standard with new units.

D. The Electronics Ground terminal connects to circuit ground in the unit.

E. The Chassis Ground terminal gives a common point of continuity for the chassis. This terminal is normally tied to the Electronics Ground terminal (D); however, in certain situations it may be advantageous and/or necessary to keep these ground references independent (to eliminate ground loops in some installations, for instance).

F. The Output Warning sticker reminds users of the inherent danger and imminent damage associated with shorting the output. Normally, this denotes that pin 2 is wired as the hot output pin; however, older units and custom-order units may be wired pin 3 hot.

G. The D.C. Power Supply Pin-Out Legend reveals the appropriate voltages from the external power supply.

H. The D.C. Power Supply Throughput is a 5-pin XLR connector that allows a second unit to be connected to the same external power supply without the need for a "Y" cable.

I. The Ground Strap normally connects electronics ground and chassis ground; however, it may be removed by the user if it is thought to be beneficial for a particular installation.

J. The GML Serial Number Tag contains a permanent imprint of the unit's assigned serial number.

K. The CE (European Electromagnetic Compatibility) marking indicates full compliance with EN 55013:1990 (Electromagnetic Disturbance, Sects. 3.2, 3.5) and EN 55020:1988 (Electromagnetic Compatibility, Sects. 4.3, 5.4, 6.2, 7.0, 8.0).

DESIGN

Though the front panel controls seem very intuitive to the initiated and experienced audio engineer, the circuit design behind these controls is anything but simple and straightforward. The GML 8200 features exemplary input and output buffering circuits in addition to the actual equalization circuits. It is important to keep in mind that all circuits in any device necessarily alter the sonic character of any complex signal, though these colorations have been meticulously minimized in the design of the 8200. Many contemporary equalizer designs are not sensitive or wary of this aspect of audio electronics and thus require some amount of alteration to compensate for this additional spectral signature induced by the unit itself.

Interestingly, care has also been taken--as in all aspects of the GML 8200--to select the highest quality components, from the potentiometers on the front panel to the smallest passive elements. This attention to detail partially elucidates the quality found in the GML 8200 Parametric Equalizer. These component choices, coupled with superior design and a proclivity towards innovation, combine to make the GML 8200 Parametric Equalizer the most powerful, flexible, and transparent equalizer ever designed.

Another feature that distinguishes the GML 8200 from the myriad of other commercially available equalizers is its inherent dynamic range, which allows for the addition of 15 dB of gain in multiple frequency bands simultaneously without even a hint of distortion or loss of detail and authority. This amazing power is due in large part to the GML propensity to design all audio circuits from discrete components. Discrete designs, when executed properly, help to preserve not only sonic integrity and musicality, but also to allow for the widest dynamic range through the entire signal path, thus eliminating many sonic compromises and limitations. Not only do these discrete structures--and the GML 9202 discrete opamp in particular--sound better than their integrated counterparts, they also offer the ability to design for higher signal levels internally, while also optimizing dynamic range by providing a low noise floor.

An additional benefit of the discrete circuit topology used in the GML 8200 Parametric Equalizer is increased bandwidth. Not only does this significant extension--of both high and low frequencies--provide for more detail and realism; it also ensures a greater degree of linearity in the traditional audio spectrum (20 Hz to 20 kHz) by locating bandwidth poles superceding these commonly-accepted limits. Indeed, the frequency response of the Model 8200 is well within +/- 0.1 dB from below 10 Hz to well above 80 kHz, while the +/- 3.0 dB response exceeds the ability of most audio test apparatus to measure.

POWER SUPPLY

Integral to the superb quality of all GML products is the external power supply. No piece of electronic equipment can operate as designed without an adequate power supply; however, most contemporary spectral processing devices do not feature a supply which can provide clean, quiet power without unduly heating the device. The GML 8355 excels in this respect, providing clean, quiet power for the many complex and sensitive circuits of the GML 8200, while remaining cool and efficient. Internal supply topologies are generally limited by board real-estate and thermal considerations and thus are almost always exclusively of one or another of the switching topologies, which results in more mains-induced noise and less ability to react to highly transient signal content or extreme circuit actions. The internal power distribution scheme employed by the GML 8200 is also responsible--in concert with the external supply itself--for preserving the highest audio quality throughout the many circuits of the Parametric Equalizer.

A NOTE REGARDING NOISE

It is important to keep in mind that the noise performance of the Model 8200 varies with operational settings, with an increase in noise to be expected when switching from the 'EQ Out' state to the 'EQ In' state. The reason for this characteristic is inherent to our proprietary design, which places the control before all of the processing bands. This gives our parametric equalizers two distinct advantages: first, potentiometer noise is attenuated; second, the likelihood of internal overload is extremely remote, if not impossible, even with 15 dB of gain available in each band. Interestingly, the most dangerous condition for internal overload is experienced when using just a bit of EQ with very high-level input signals. The big difference comes not only in our design topology, but also in our component choices. In fact, our topology is not really feasible with IC op-amps--they're always noisier than discretes--and only works with our quiet, transparent discrete op-amps, which can cleanly handle output signals up to +26.8 dBu. One should expect the noise floor to increase proportionally with gain, frequency, and "Q", in accordance with the laws of physics. For further information about the noise characteristic of the Model 8200, examine the Specifications page of this manual and the Noise plot located in Appendix A.

SPECIFICATIONS[1]

INPUT

20 kΩ balanced bridging
52 dB common mode rejection, averaged spot measurements 20 Hz to 20 kHz[2]
60 dB common mode rejection, broadband 20 Hz to 20 kHz[3]
+26.8 dBu maximum before clipping[4]

THROUGHPUT

+/- 0.1 dB, 10 Hz to 80 kHz[5]
+/- 0.01 dB, 20 Hz to 20 kHz
-3.0 dB at 260 kHz and <<10 Hz
<0.001% Harmonic distortion, 20 Hz to 20 kHz, EQ Out[6]
0.0015% Harmonic distortion, 20 Hz to 20 kHz, EQ In
0.0015% SMPTE Intermodulation distortion, 20 Hz to 20 kHz, EQ In or Out[7]
30 V/µsec slew rate, discrete low-noise high performance amplifiers[8]
noise, EQ Out: -118 dBu spot, -98 dBu broadband[9]
noise, EQ In: -100 dBu spot, -80 dBu broadband
-132 dBu crosstalk, EQ Out[10]
-118 dBu crosstalk, EQ In

FORM FACTOR – 2 CHANNELS, 5 BANDS: FULLY PARAMETRIC

1. 15 Hz – 800 Hz, Q of 0.4 – 4.0 or shelving, 15 dB boost/cut
2. 15 Hz – 800 Hz, Q of 0.4 – 4.0, 15 dB boost/cut
3. 120 Hz – 8 kHz, Q of 0.4 – 4.0, 15 dB boost/cut
4. 400 Hz – 26 kHz, Q of 0.4 – 4.0, 15 dB boost/cut
5. 400 Hz – 26 kHz, Q of 0.4 – 4.0 or shelving, 15 dB boost/cut

OUTPUT

+26.8 dBu clipping
< 3 mV output offset, stabilized by D.C. servo correction, direct coupled
normally wired pin 2 hot

POWER CONSUMPTION

18.2 W (650 mA at +/- 28 V D.C.), under +20 dBu signal conditions
requires GML Model 8355
5-pin XLR input and throughput
additional board-level regulation, +/- 18 V D.C.

MECHANICAL

separate ground and chassis connections at rear
input and output on precious metal XLR
19” x 3.5” x 8.5” rack mount chassis, black anodized aluminum, silver legend
weight: 6 lbs.[11]

Specification Notes

[1] All tests conducted using the Audio Precision System Two Cascade Dual Domain (AP S2C), unless otherwise noted. Individual unit performance may vary due to environmental influences, manufacturing variations, and component tolerances.
[2] CMRR determined by calculating the average of 500 individual spot measurements generated by a logarithmic frequency sweep from 20 kHz to 20 Hz.
[3] CMRR determined by AP S2C analyzer reading, including bandpass filter from <10 Hz to >500 kHz.
[4] As determined by THD+N in excess of 0.1%.
[5] All bandwidth tests were conducted at 0 dBu, EQ In, all bands flat.
[6] Includes AP S2C residual THD of 0.0007%. Test conducted with 1.0 kHz sine at +20 dBu.
[7] Includes AP S2C residual IMD of 0.0015%. Test conducted with 1.0 kHz SMPTE/DIN 4:1 at +20 dBu.
[8] GML 9202
[9] Spot noise measurements were determined in 500-point logarithmic frequency sweeps, including bandpass filter (<10 Hz to >500 kHz) to measure the individual noise contributions of those frequencies to the broadband figure. The spot noise specification noted is an average of these individual contributions from 20 Hz to 20 kHz.
Broadband measurements were determined by the AP S2C analyzer, full bandwidth.
[10] Includes AP S2C residual crosstalk of -140 dBu. Test conducted at +20 dBu, 20 Hz to 20 kHz.
[11] Actual weight. Shipping weight is approximately 8 lbs.

TROUBLESHOOTING

Note: *This unit is a highly sensitive device that includes many complex circuits.*
THIS UNIT CONTAINS NO USER-SERVICEABLE PARTS.
Warning: Risk of electric shock if top cover is removed.

In the event of unit operational failure, contact the GML repair department. Refer to the "contacts" page of this manual, or for more current contact info, check our web site. Please be prepared to describe in detail the exact problem that the unit is experiencing, including: failure conditions, system signal flow, exact failure manifestation, events and actions leading to the failure, etc. Also, be able to quickly provide your contact information and the unit's GML Serial Number.

It is highly recommended that customers do not attempt to troubleshoot their own units or have them repaired at unauthorized repair centers. Opening the case of the unit will break several manufacturing seals and void the GML warranty--these security measures cannot be readily detected nor easily thwarted, and should be respected wholeheartedly. These measures also act to protect the intellectual property of GML so that we may continue to design the best high-end professional analog audio peripherals.

CONTACTS

General Information:

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Diagrams: Jeffrey Warren
Edited by: Jeffrey Warren and George Massenburg
Additional editing: Jenny Rosato, Frank Wire
Technical assistance: Frank Wire, Adrian Nastase, Alan Meyer

ADDITIONAL GML PERIPHERALS

GML 2020 High Resolution Discrete Input Channel

GML 8300 Transformerless Microphone Preamplifier

GML 8355 Power Supply

GML 8900 Dynamic Gain Control, Series III

GML 9015 Power Supply

GML 9500 Parametric Mastering Equalizer

GML 9100 HRT Mixer

GML HRT 9145 Multi-Output Power Supply

GML 9550 Two Channel Digital Noise Filter

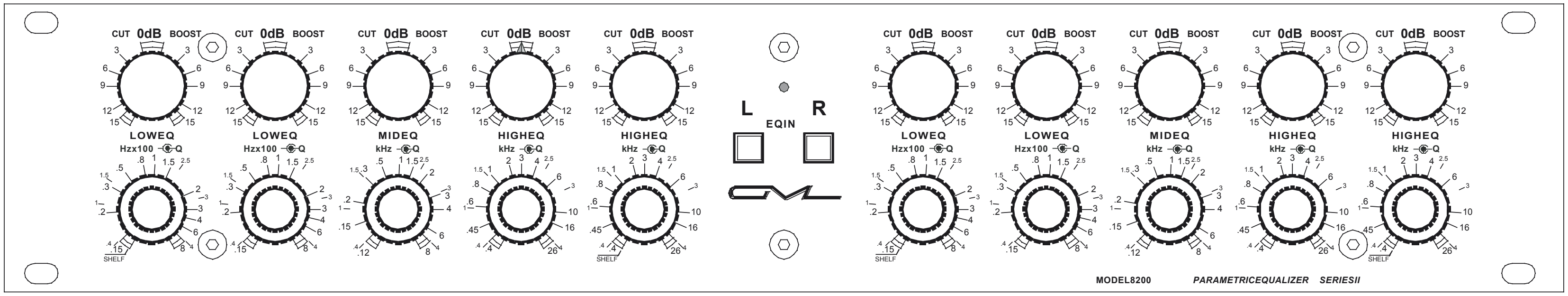
GML 9560 Digital Noise Filter w/ Macintosh Controller

For ordering information, contact:

Frank Wire
Thousand Oaks, CA
805.492.8175 (ph)
email: tgs.group@verizon.net

Or check our web site:

www.massenburg.com



ARTIST PROJECT DATE

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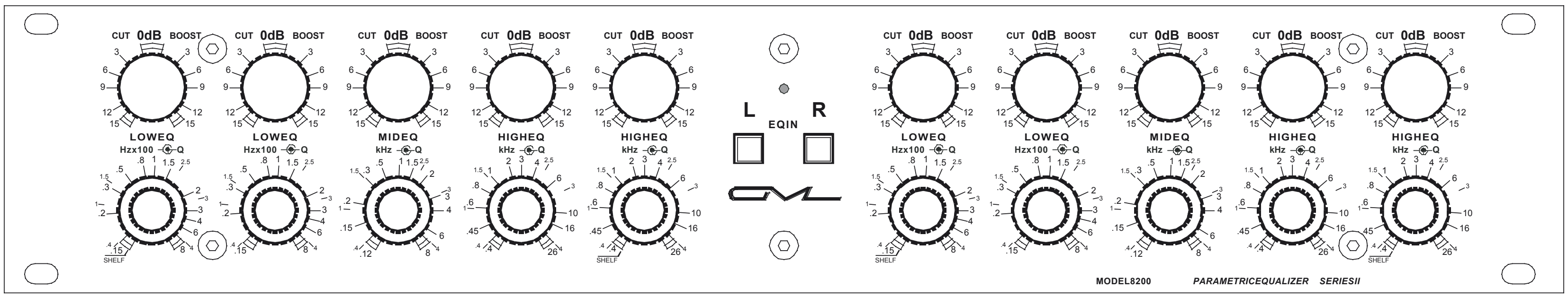
INSTRUMENT(L) ASSISTANT INSTRUMENT(R)



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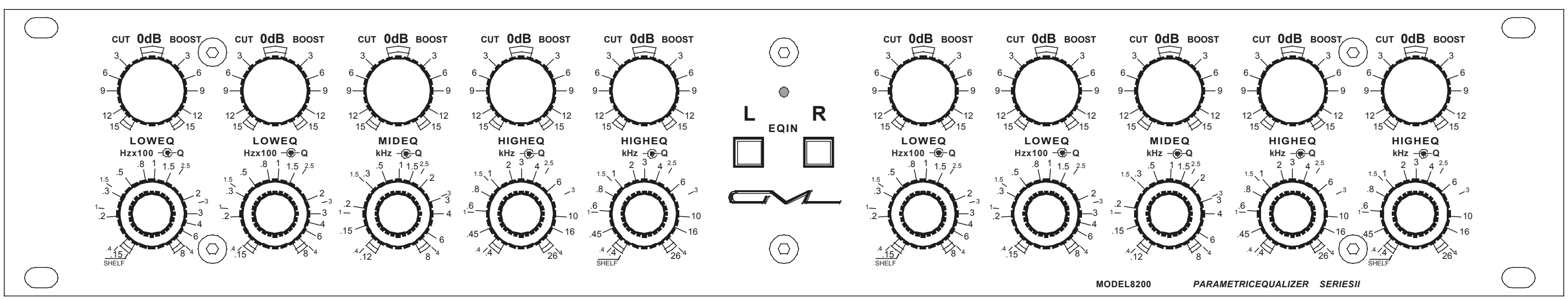

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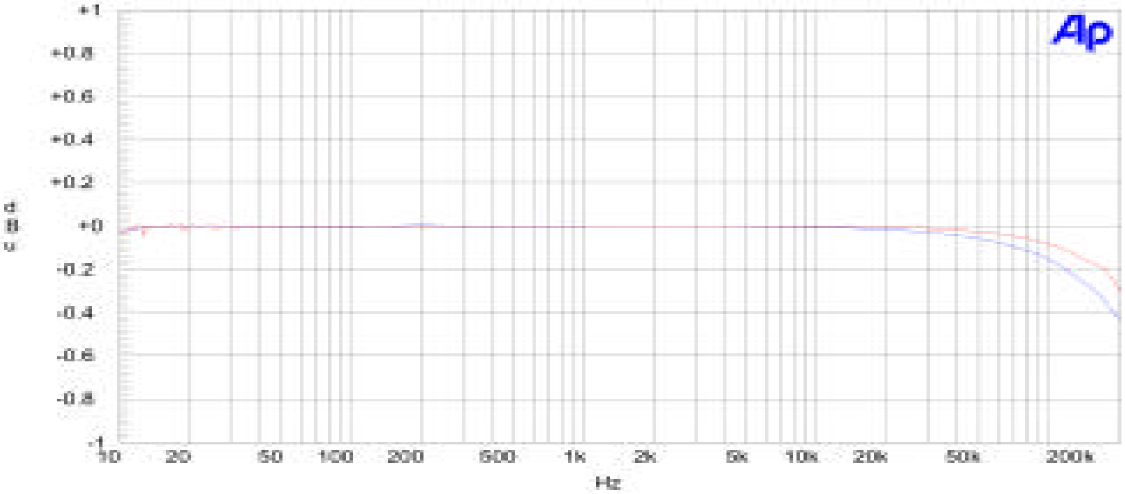
APPENDIX A:
AUDIO PRECISION PLOTS

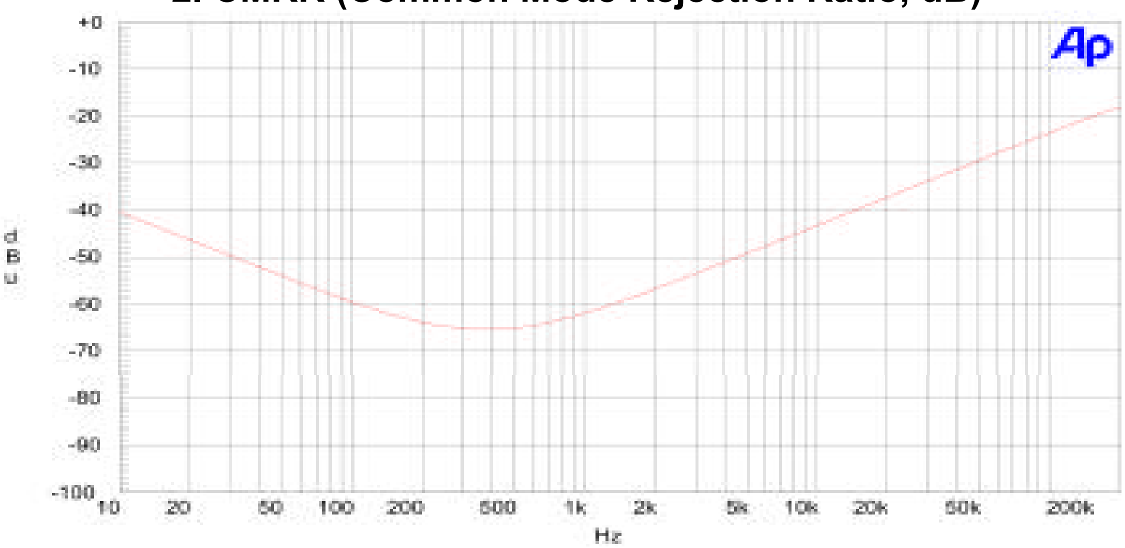
***Note**: All tests were conducted using the Audio Precision System 2 Cascade Dual Domain (AP S2C). Test results are typical of Model 8200 Parametric Equalizers; however, individual unit performance may vary due to component tolerances and environmental conditions.*

1. BANDWIDTH



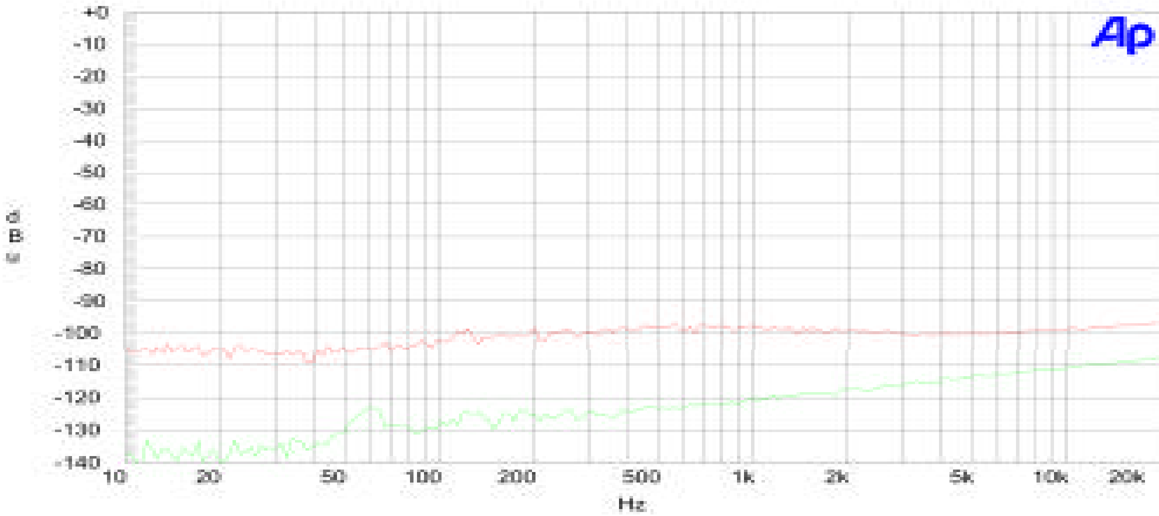
As can be seen in this plot, the bandwidth of the Model 8200 is quite extended and extremely flat. Notice that the limits of the plot along the left axis are +/- 1.0 dBu. The blue line represents the 'EQ Out' state, while the red line graphs the 'EQ In' state. Refer to the Specifications page of the Model 8200 User's Manual for more detailed bandwidth measurements.

2. CMRR (Common Mode Rejection Ratio, dB)



This plot depicts the relationship between CMRR level (dB, along the left axis) and frequency (Hz, along the bottom axis). In this test, a +20 dBu sine signal was swept from 200 kHz to 10 Hz in 500 steps.

3. NOISE

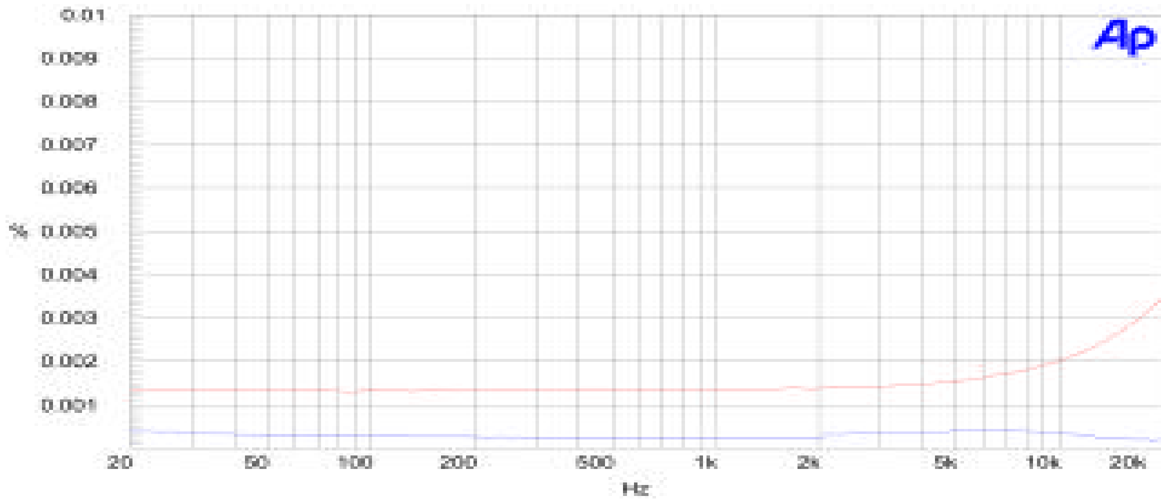


The noise floor characteristic of the Model 8200 is shown in this particular plot. Both states of operation are shown: green is the baseline noise response with the EQ 'Out' and red is the noise characteristic with the EQ 'In'. This test was conducted with a 500-point precision sweep from 20 kHz to 10 Hz, including a swept bandpass filter (<10 Hz to >500 kHz) to determine the residual noise level at each frequency. The small rises at 60 Hz and its low-order multiples are residual power supply hum, while the transients at 200 Hz are AP S2C switching noise generated during the sweep.

It is important to keep in mind that the noise performance of the Model 8200 varies with operational settings, with an increase in noise to be expected when switching from the 'EQ Out' state to the 'EQ In' state. The reason for this characteristic is inherent to our proprietary design, which places the control before all of the processing bands. This gives our parametric equalizers two distinct advantages: first, potentiometer noise is attenuated; second, the likelihood of internal overload is extremely remote, if not impossible, even with 15 dB of gain available in each band. The big difference comes not only in our design topology, but also in our component choices. In fact, our topology is not really feasible with IC opamps--they're always noisier than discretes--and only works with our quiet, transparent discrete opamps, which can cleanly handle output signals up to +26.8 dBu. One should expect the noise floor to increase proportionally with gain, frequency, and "Q", in accordance with the laws of physics.

The headroom uniquely available from our proprietary discrete opamps is appropriate to the discussion regarding noise, since the performance parameter to which noise analysis really points is the dynamic range of the device. Indeed, though the Model 8200 may have a slightly higher residual noise floor than some other units, it far surpasses most peripheral devices in terms of its extraordinary dynamic range, due in large part to the extended headroom engendered by the GML 9202 discrete opamp.

4. THD+N

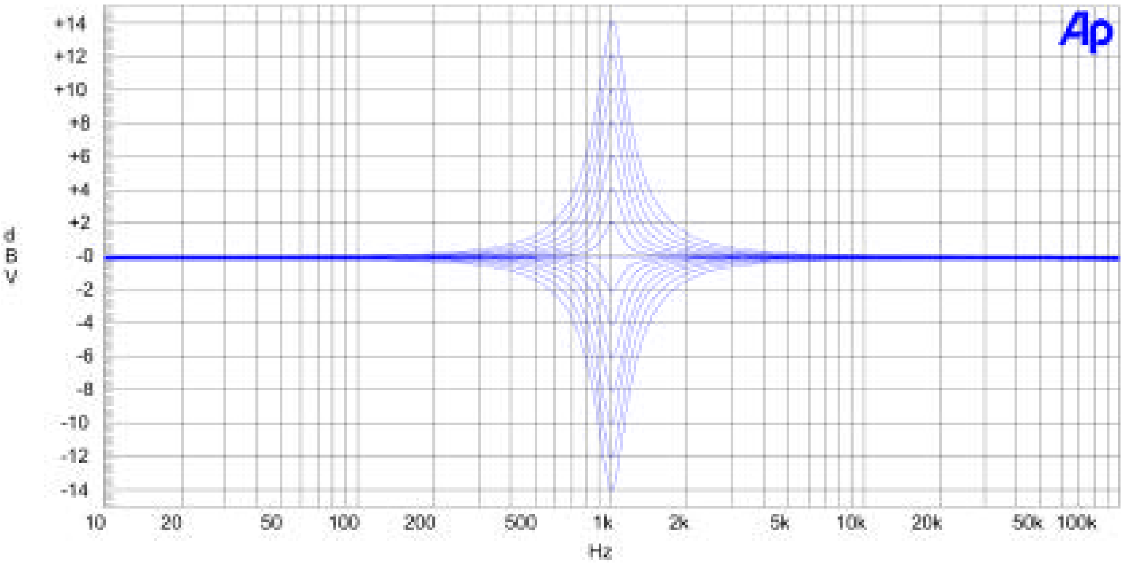


Total Harmonic Distortion (plus noise) is examined in this plot, in both the 'EQ Out' (blue) and 'EQ In' (red) states of operation. This test was conducted with a +20 dBu swept sine waveform from 20 kHz to 20 Hz. It can clearly be seen that the distortion content is very low in both states--this quantitative analysis is indicative of the widely touted qualitative conclusion regarding the transparency of the Model 8200.

5. CROSSTALK

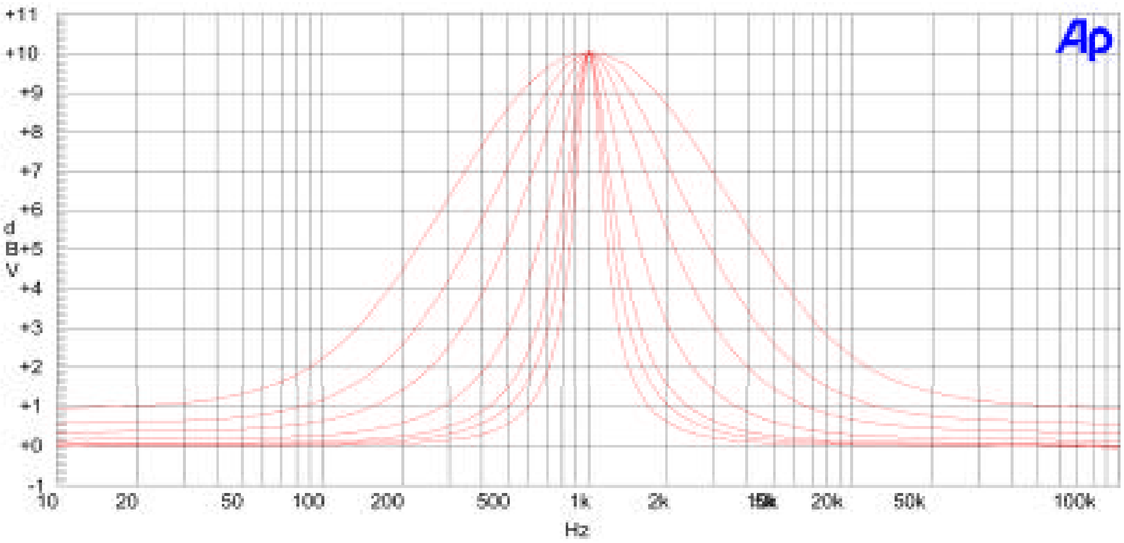
This plot illustrates the inter-channel crosstalk specification of the Model 8200. The blue line represents the 'EQ Out' state, while the red line represents the 'EQ In' state. A +20 dBu swept sine test signal was used to generate these results. Measurement was taken from the output of the right channel, with the left channel receiving the signal and the right input grounded.

6. GAIN STEPS



This plot elucidates the range of gain and attenuation available on each band of the Model 8200. Although the graphic depicts gain steps, the actual gain characteristic offered by the Model 8200 is continuously variable from -15 dB to +15 dB, with a highly accurate 0 dB position (no detent).

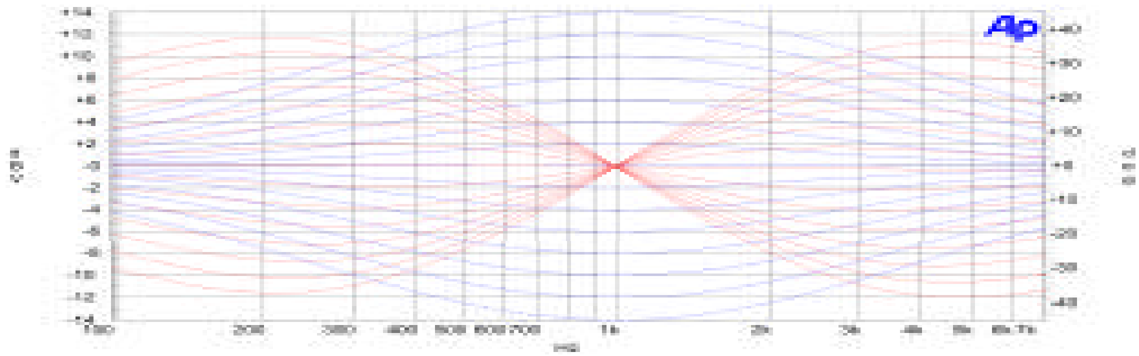
7. Q STEPS



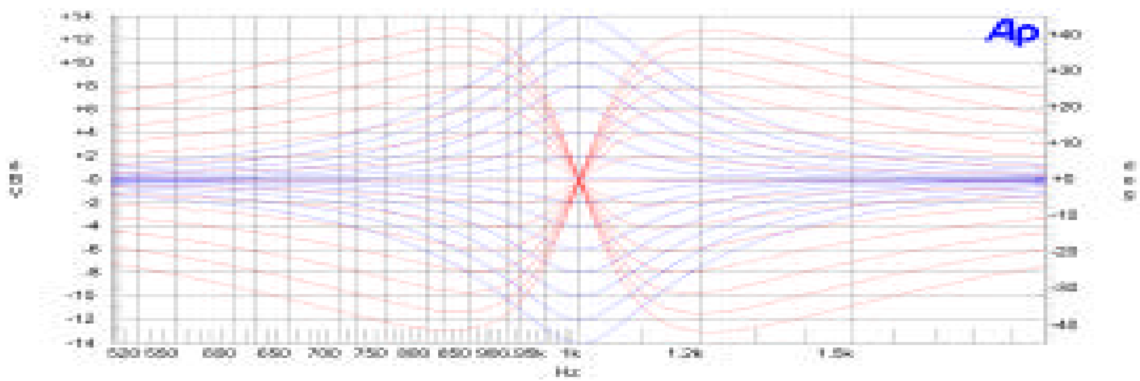
A range of Q values and its graphical representation are illustrated in this plot. The actual Q characteristic supported by the Model 8200 is continuously variable, though this plot merely represents a few stepped increments. Q values are variable from 0.4 (broad Q) to 4.0 (sharp Q) on each band, with the addition of counter-clockwise detents for shelving characteristics on both the Low and High bands of each channel.

8. AMPLITUDE AND PHASE

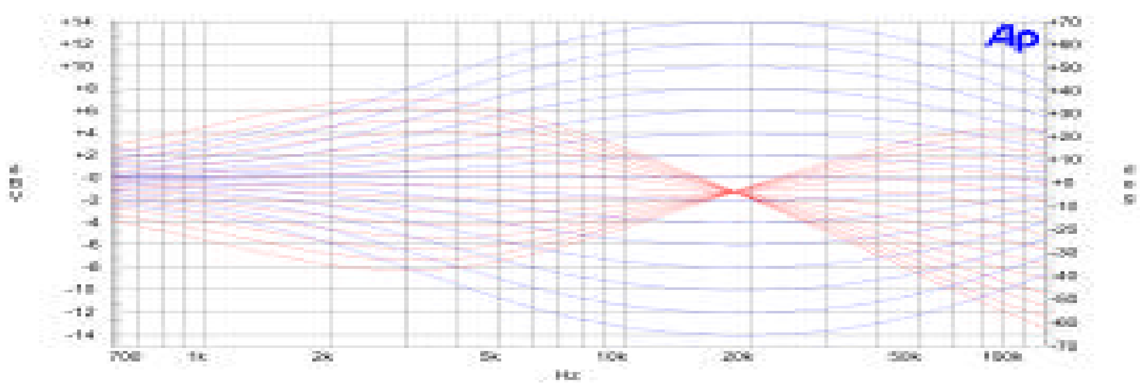
The subsequent plots depict the interrelationship of amplitude and phase in the Model 8200 under a variety of signal and operational conditions. In each instance, the blue traces depict gain or attenuation at several incremental values and the red traces reveal the relative phase shift caused in correlation with the amplitude adjustments.



This plot examines the phase shift caused by broad amplitude adjustments (Q equals approximately 0.4).



The phase shift due to amplitude adjustments with high Q value is shown here (Q equals approximately 4.0).



Relative phase shifts for amplitude adjustments with a shelving characteristic are depicted in this plot (High band shelving detent).