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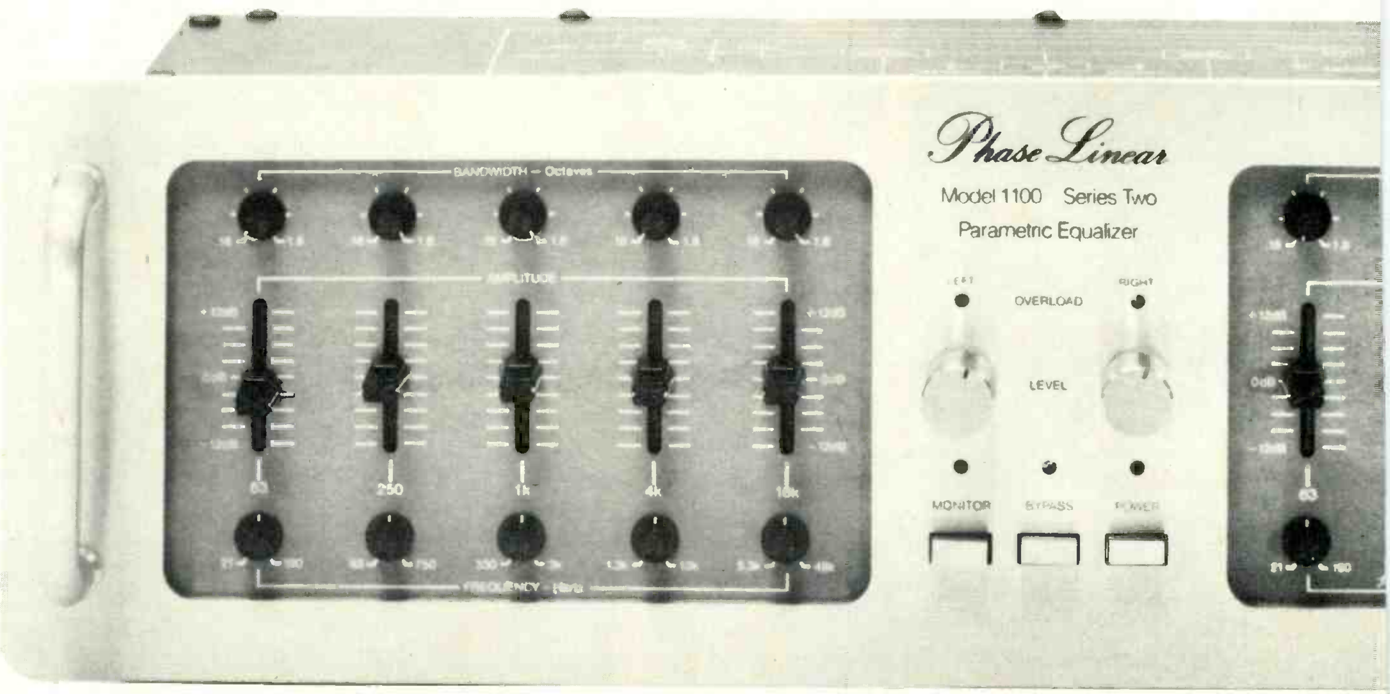
PHASE LINEAR MODEL 1100 SERIES TWO PARAMETRIC EQ

Manufacturer's Specifications
Output: 2.0 V rated, 8.0 V maximum.
THD + N: 0.02 percent.
IM Distortion: Less than 0.02 percent.
Frequency Response: 20 Hz to 20 kHz, + 0, -1 dB.
S/N: 100 dB re 2.0 V.
Amplitude Range: ±12 dB.
Bandwidth: 0.18 to 1.8 octaves, continuously adjustable.
Center Frequencies: 63 Hz, 250 Hz, 1 kHz, 4 kHz, and 16 kHz.
Center Frequency Adjustment Range: 9 to 1, from $\frac{1}{3} \times f_{ctr}$ to $3 \times f_{ctr}$.
Dimensions: 19 in. (483 mm) W x 5½ in. (140 mm) H x 8 in. (203 mm) D.
Weight: 9½ lbs. (4.3 kg).
Price: $595.00.



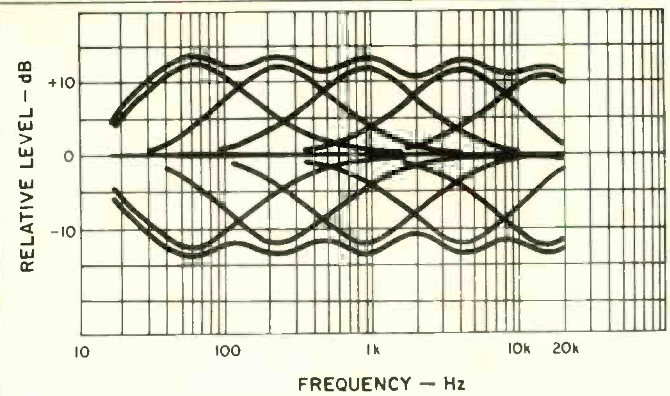


Fig. 1 — Swept-frequency responses with and without EQ; controls flat, each at maximum boost and also cut individually; all controls at maximum boost and at maximum cut. (Bandwidths set at maximum, 1.6 octaves.)

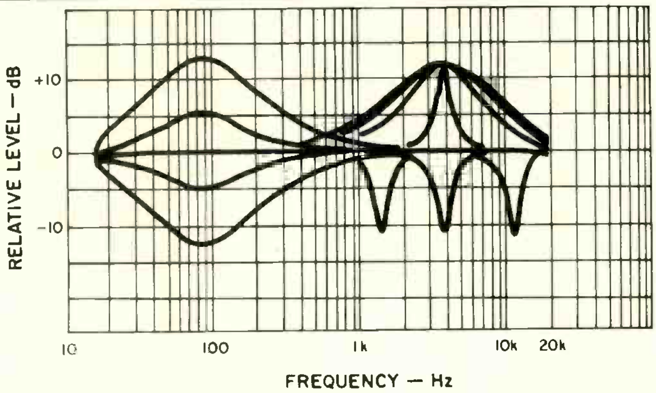
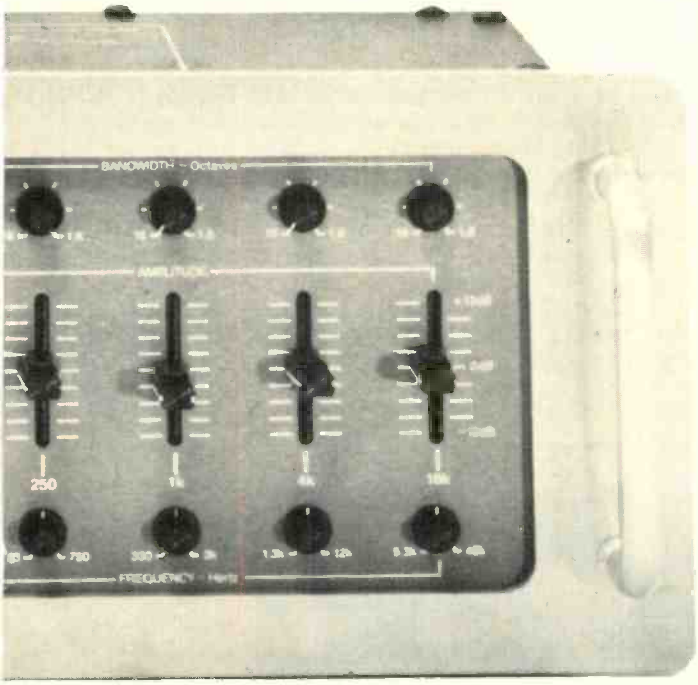


Fig. 2 — Response with lowest filter set to maximum bandwidth and 90 Hz, and gain control set to -12, -6, 0, +6, and +12, successively. Responses with 4-kHz filter at maximum boost with four bandwidth settings, and at maximum cut and minimum, center, and maximum frequency.



The Phase Linear Model 1100 Series Two parametric equalizer continues the attractive front-panel design of the Series Two units with the majority of the controls inset slightly against a sub-panel of darker tone. The 1100 gains immediate interest because it is a parametric equalizer, as opposed to the more common graphic EQ units with octave-spaced filters. The Phase Linear unit provides some graphic information by using 10 vertical sliders for boost/cut control, five for each channel, with a good range of ±12 dB and a gentle, but definite, detent at 0 dB. With the frequency adjust controls in detent at the center of their rotation, the filter center frequencies are at 63 Hz, 250 Hz, 1 kHz, 4kHz and 16 kHz, quite well chosen for covering the entire band. The frequency range of each filter from minimum to maximum is 21 to 190 Hz, 83 to 750 Hz, 330 Hz to 3 kHz, 1.3 to 12 kHz and 5.3 to 48 kHz, respectively. Thus, there is more than an octave overlap possible with adjacent filters, of definite benefit at times. Each bandwidth control has a range from 0.18 octave to 1.8 octaves, continuously adjustable. The knobs on these controls, and the frequency-adjust pots, are very small, making them hard to turn.

Between the two EQ-control sections are two pots to set channel EQ gain, from off to +6 dB. Overload lights are located above the pots, a desirable feature where EQ can cause very high levels. However, the 1100 lacks a scheme for matching EQ in/EQ out levels to prevent sudden jumps in system sound levels. There are push-button switches for *Bypass* (EQ out), *Monitor* (Tape Play fed to unit) and *Power*, each with a status light. A helpful signal-flow diagram is quite handily included on the top cover. The EQ in/out and tape record/play phono jacks are all on the rear panel.

Removal of the top cover revealed a full chassis-sized mother-board with a number of discrete components and 12 plug-in p.c. boards: Left and right sets of five filter channels and a level card. The EQ cards each had a color spot, coded to the matching spot next to the socket on the mother-board. The soldering was excellent, with very little flux residue. All ICs were in sockets, an aid to servicing; on the other hand, there was no parts identification.

There are several parametrics with three EQ sections, but the 1100 has five — a definite plus for this unit.

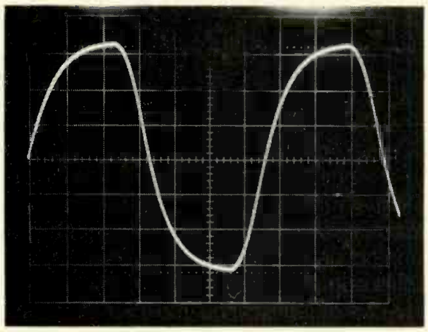


Fig. 3 — Output at maximum gain with 1.5-V 30-kHz square-wave input. (Scales: Vertical, 1V/div.; horizontal, 5 µS/div.)

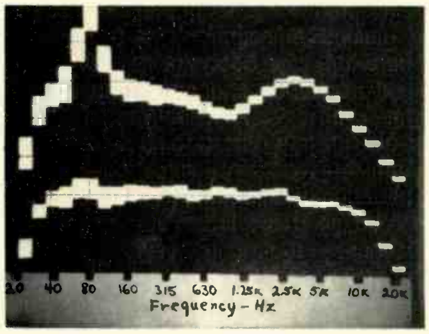


Fig. 4 — Top, response of "speaker" before EQ; bottom, response after EQ. (Scale: Vertical, 5 dB/div.)

Measurements

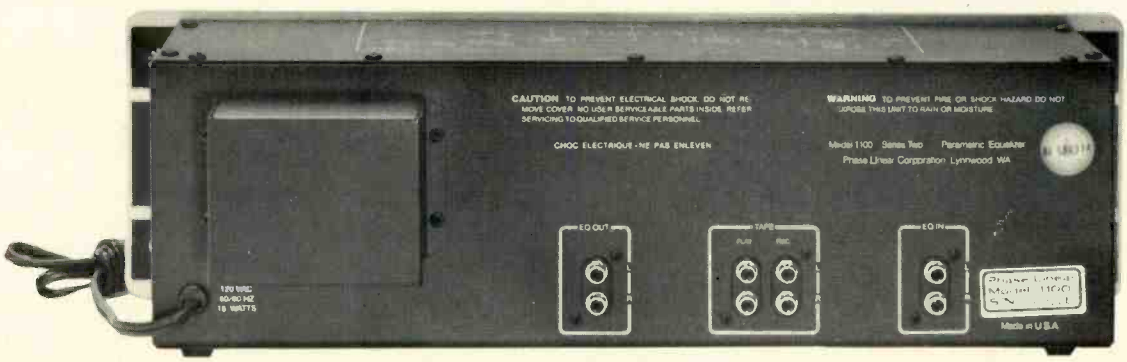
The first checks of the 1100 EQ characteristics were made with all of the frequency-adjust controls in detent. A series of swept-frequency responses were taken as shown in Fig. 1. The response with EQ but with all sliders in detent was within a small fraction of a dB from 20 Hz to 20 kHz. The 3-dB down points were at 9 Hz and at 46.9 kHz; without EQ (in *Bypass*), they were at 8 Hz and 89.3 kHz. Plots were also made of each of the filter sections at maximum boost and cut while set to maximum bandwidth. Finally, responses were run with all filters at maximum boost, and then at maximum cut. It can be seen that filter shapes are very much the same, and that all of the boost and cut maxima are very close to 12 dB from zero. The combining of the outputs is fairly good, with 2 to 3 dB ripple.

Additional tests were conducted to illustrate the versatility of the 1100 parametric EQ. The first plots made in Fig. 2 show the results of adjusting the amplitude parameter with the lowest filter, set at 90 Hz. Sweeps were made for settings from -12 to +12 dB. Next, the 4-kHz filter was set to maximum boost, and four sweeps were made with different settings of the bandwidth parameter. Finally, the 4-kHz filter was set for maximum cut and minimum bandwidth, and the frequency control parameter was varied from nominal, to minimum, and to maximum for successive sweeps. There are many other possibilities, of course, but Fig. 2 emphasizes the three basic parameters that can be varied. The reader should understand that all combinations can be used, such as moving a filter up in frequency at the same time that the response is boosted and the bandwidth made more narrow. Equalizers without facilities for adjusting these three parameters are not classified as true parametric.

With the frequency adjust pots in detent, the frequency of peak responses were generally within 3 percent of spec, very good. The 1-kHz filter peak was almost 10 percent low, but such a discrepancy is definitely *not* a problem, especially with a parametric equalizer. The frequency range was as specified, from 1.3 to 12 kHz for the 4-kHz filter, for example. The bandwidth at maximum boost agreed with the spec, but the change from 0.18 octave to 1.8 octaves occurred in less than half the rotation of the pot. A spreading out of the effective changes and a calibrated scale appeared to be in order.

The input impedance was 44 kilohms over most of the band, falling slowly at the high end to 23 kilohms at 20 kHz, plenty high enough in any normal circumstances. The output impedance was less than 8 ohms, which is very low and most unlikely to be affected by any loads that are connected. The maximum voltage, just below clipping, was 7.8 V over most of the band, falling slightly to 7.5 V at 20 kHz. The overload indicator turned on at about 0.4 V lower (7.4 V) for most of the band, but required a higher voltage (8.4 V) at 20 kHz. The input overload level was close to 30 V. The output polarity was the same as the input, with and without EQ.

The harmonic distortion with 1-V in and 2-V out was 0.0026 percent at 20 Hz, 0.0020 percent at 1 kHz, and 0.016 percent at 20 kHz — all excellent figures. The SMPTE IM distortion was about 0.005 percent up to 2-V output, rising to 0.01 percent at 3.5-V output. With all controls at +12 dB and the gain adjusted for 2.0-V output, THD plus noise was 0.002 percent, with $HDL_2 = 0.0012$ percent and $HDL_3 = 0.0015$ percent. These are certainly most excellent figures, achieved even with the maximum boost. With 1-V in and controls set flat, the distortion was just 0.12 percent at 100 kHz. Figure 3 shows the output of the



Other plus characteristics include very low distortion and noise, and excellent ranges of adjustment for handling audiophile EQ tasks.

1100 with a 2.0-V, 30-kHz square wave in. The rounding of the waveform shows the result of the small-signal high-frequency roll-off which actually prevents the unit from reaching a slew limit. The tests indicated that the slew factor is somewhat greater than 5, the specified figure. The signal-to-noise ratio was greater than 100 dBA, referred to 1 V with 1-kilohm input terminations. The noise was less than 10 µV, A-weighted, and that was the lower limit of the test equipment.

In-Use Tests

The illustrations in the 28-page owner's manual are generally very good and include filter-response curves, a schematic, and a "house curve" with a recommended high-frequency roll-off. The text discusses EQ by ear, by hand with a record and an SLM, and by eye — with particular reference to the Model 1200 Series Two RTA. There are some oddities in the text that could be confusing to the neophyte. For example, in referring to a 6-dB boost at 60 Hz, this statement is made: "The frequencies around 60 Hz are made twice as large as those around 1 kHz."

To show the versatility of the Model 1100, a speaker output was simulated using pink noise and a ⅓-octave equalizer. The top display in Fig. 4 shows the "speaker" response with a 10-dB peak around 80 Hz, falling response around 1 kHz at the crossover, a broad peak around 3.15 kHz, and a falling response above 5 kHz. What is simulated is pretty bad, and audiophile speakers should be much better than this. But what is possible with EQ? The bottom display in Fig. 4 is the result after a few minutes of adjusting the 1100. The roll-off from 1 to 10 kHz is purposeful, and the response was allowed to drop rapidly above that point. Note that variations over the rest of the band are simply gone.

The response of the 1100 with the EQ used is shown in Fig. 5. Note the narrow-bandwidth cut used to remove the 80-Hz peak, with other shaping of a rather broad nature. The actual settings used were: -11 dB at 80 Hz with narrow BW, -1.5 dB at 200 Hz with narrow BW, +3 dB at 1 kHz with medium BW, -4 dB at 4 kHz with medium BW, and +3.5 dB at about 14 kHz with medium BW. The procedure was a simple matter of adjusting all parameters necessary while watching the ⅓-octave display. Repeating the process with an octave-band RTA (Phase Linear Model 1200) gained almost exactly the same results in the final "speaker" response. The advantage gained with the parametric EQ over the octave-band type in such cases is that a fairly accurate inverse response curve can be made with the parametric, matching a peak with a notch, setting bandwidth to match shape, and sliding frequency for exact alignment. The disadvantage of any parametric equalizer is that it can generate unusual and unmusical responses, and for the best results, careful listening and good metering (such as an RTA) are required.

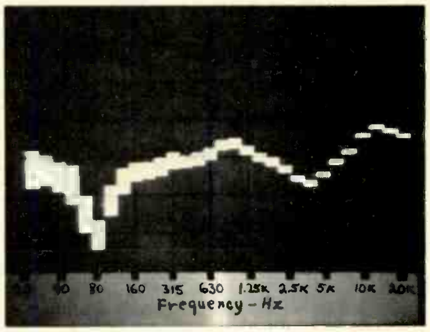


Fig. 5 — Response of EQ used to smooth "speaker" of Fig. 4. (Scale: Vertical, 5 dB/div.)

There are quite a few parametrics with three EQ sections per channel, but the 1100 has five filters, all of which aided in the smoothing discussed above. This is a definite plus for this unit, in comparison to other EQs with fewer sections. Larger knobs would be of aid in making frequency and bandwidth adjustments, and spreading bandwidth changes over the entire pot rotation would facilitate making adjustments. A gain-match scheme for EQ/bypass switching would reduce level jumping. At the least, there should be 0-dB gain index marks for the channel level pots. Other characteristics on the plus side are very low distortion and noise and excellent ranges of adjustment for handling most any audiophile EQ tasks. The Phase Linear Model 1100 parametric equalizer has a higher price than the great majority of octave-band EQs, but it can do many things none of them can.

Howard A. Roberson

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