dynakit

HIGH FIDELITY PREAMPLIFIER KIT

A LOW NOISE, LOW DISTORTION CONTROL UNIT

FOR THE

AUDIO PERFECTIONIST

DYNACO INC. 617 N. 41st STREET, PHILADELPHIA 4, PA.

DYNAKIT PREAMPLIFIER KIT

The Dynakit preamplifier is a flexible high gain control unit of unique design and performance. For the first time, a preamplifier is available which has such superior performance that its effect on the listening quality of the associated high fidelity system is completely inaudible. Except for deliberately imposed changes in frequency response by use of the tone control networks or the phono equalization circuits, the addition of the Dynakit preamplifier to a fine quality system makes no perceptible change in performance to the discriminating listener. Further, the outstanding quality of this unit is completely unaffected by the setting of the volume control—in sharp contrast to other preamplifiers whose performance may be satisfactory when the volume is wide open but is seriously deteriorated at normal volume settings.

The excellent attributes of the Dynakit result from its all feedback circuitry (both current and voltage feedback loops include all four stages of gain), its superior quality components, and its factory wired printed circuit module which insures accuracy of construction without possibility of harming the critical parts which control noise and performance. The constructor of the Dynakit, even though a novice at kit construction, has assurance of a successfully operating unit which will maintain its high level of performance for many years to come.

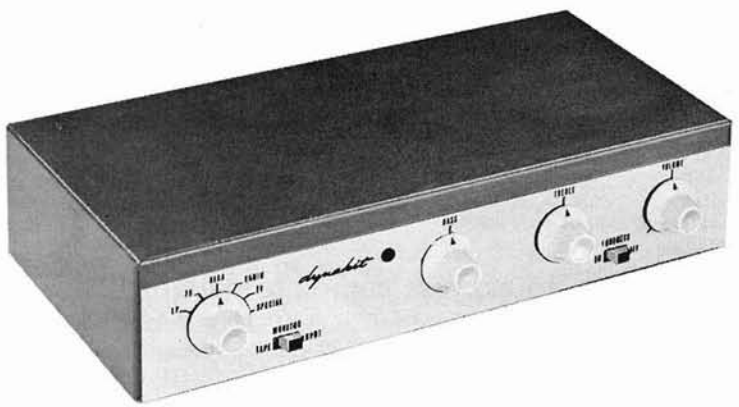
Controlled listening tests as well as stringent measurements of transient performance affirm the success of this new design. The benefits of large proportions of negative feedback carefully applied are lowered distortion and noise, wider frequency response, reduced output impedance, greater stability of characteristics and improved transient response. All of these features give a clarity and naturalness of reproduction which indicates that the gap between original and transcribed sound has been significantly narrowed by the introduction of the Dynakit.

SPECIFICATIONS

Inputs:	Low level magnetic cartridge, high level magnetic, radio, TV, tape, "special" low level (permits option of extra RIAA phono input, tape head, or microphone).
Outputs:	Tape, audio output.
Controls:	Selector and equalization, bass, treble, volume, tape monitor, loudness, and hum balance.
Tone Control Range:	±14 db at 20,000 cps. ±20 db at 20 cps.
Phono Equalization:	RIAA, 78 rpm, original LP. Equalization accurately controlled by use of 1% components.
Distortion:	Less than .05% intermodulation at sufficient output to drive all power amplifiers. This figure unchanged at any setting of volume control.
Response:	±.5 db 6 cps to 60 kc. Response not affected by position of volume control.
Transient Performance:	Passes square waves without deformation or ringing from 20 cps to 20 kc at any volume control setting. No overshoot or bounce on pulse type signals. Instantaneous recovery from overload.
Noise:	Less than 3 microvolt equivalent noise input on RIAA. Less than 1.5 microvolt equivalent on mike connection. Between 70 and 74 db below level of 10 millivolt magnetic cartridge.
Gain:	54 db at 1000 cps on RIAA input. 20 db 20 cps to 20 kc on high level inputs.
Impedances:	Output impedance 1000 ohms. Terminating impedance 500,000 ohms or higher (provision for 250,000 ohms).
Tubes:	2 12AX7 (ECC-83), 1 selenium stack.
Power Requirements:	200 to 400 volts dc at 3 to 4 ma, 6 volts ac at .75 amps.
Special Features:	4 ac convenience outlets. Integral dc heater supply. Choice of bone white or charcoal brown maple finish.
Size:	12" by 6" by 2¾" high. Shipping weight 7 pounds.
Price:	$34.95 net. (Slightly higher in the West).

THE quality of a superb amplifier is to a large extent wasted if it is preceded by a preamplifier-control unit whose performance is much poorer than that of the amplifier. Until a short time ago, the design of control units did not keep step with the improvements in power amplifiers, particularly in respect to transient response and low distortion, with the result that most of the electrical distortion in hi-fi systems originated *before* the amplifier.

Recently, however, preamp-control units have been receiving more attention from designers. The Dynakit preamplifier comes astonishingly close to the ideal of hi-fi performance — that is, to control the signal without leaving any degrading evidence, either measurable or audible, of its work. Distortion of all types is so low that for any practical purpose, even for laboratory service, the Dynakit preamp can be called distortionless. This performance is all the more astonishing in view of the price: $35.



A preamp with unmeasurable distortion? Once only a fantastic dream, the idea's here to stay, in

The Dynakit Preamplifier

An **audiocraft** *kit report* *by Joseph Marshall*

The Circuit

A quick and nonanalytical glance may give the impression that the Dynakit circuit, Fig. 1, is a fairly conventional one. Analysis will reveal several differences from standard circuitry far more important in effect than they might seem on paper. For one thing, every stage has at least two feedback circuits; the first two actually benefit from three.

The first 12AX7 supplies amplification and equalization for the phono and tape-head or mike channels. Equalizing networks are in the feedback loop from the plate of the second tube to the cathode of the first. But there is one very significant difference from the usual feedback-pair equalizer. Note the 100-K resistor that joins the two cathodes. This provides *positive* feedback which increases the gain of the pair very markedly. The increased gain yields two benefits: 1) it permits complete boost at the bass end for the phono equalizers, and yet 2) leaves enough additional gain to provide an appreciable amount of feedback even at the bass frequencies which, in other circuits, receive little benefit from feedback. In addition to the positive and negative voltage feedback, each tube has an unbypassed cathode resistor to supply current feedback. This combination provides an unusually high feedback factor which is reflected in the extraordinarily low distortion.

Three equalization curves are provided for the phono channel: RIAA, LP, and 78. The 78-rpm curve provides a 6-db-per-octave boost below 500 cps, and a 6-db rolloff at 10,000 cps. The input resistance of the phono channel is 50,000 ohms — a good compromise value that will work well with most pickups. Lower values can be obtained simply by inserting a resistor across the output of the pickup at the turntable. For example, a 56-K resistor will give a total resistance of 27,000 ohms, for Pickering cartridges.

There are two phono inputs, one for low-level and another for high-level cartridges (only one can be used at a time). There is another input marked SPECIAL which can be wired to provide still another switched phono input with RIAA equalization, a mike input, or an NARTB-equalized input for a tape head. Instructions are provided for all three possibilities; the extra parts required (a 33 $\mu\mu$fd capacitor and an 18-K resistor) are now supplied with the kit. There is a low-pass RF filter provided by the 10-K series resistor and the input capacitance of the input tube, to bypass strong local radio signals picked up by the cartridge, which might otherwise overload the circuit and might be rectified to produce audible interference.

The LOUDNESS control is a very simple tapped-control type, with compensation furnished only when the VOLUME control is below half rotation. It provides both bass and treble compensation, quite satisfactorily. It can be completely disabled, however, by a front-panel switch.

High-level inputs are provided for RADIO, TAPE and TV sources (Fig. 2). There are no input level controls because they aren't needed; no amplification is supplied before the main VOLUME control. All inputs not in use are grounded to eliminate crosstalk.

The tone-control circuits are new, although they have superficial resemblance to the Baxendall type. Another 12AX7 is used, with the tone-shaping network in the two-stage feedback loop. More than 20 db of cut or boost at 20 cps is furnished by the BASS channel; the TREBLE channel provides some 14 db of boost and (in our specimen) 20 db of cut at 20,000 cps (only 14 db is specified). Most of the bass boost is applied below 100 cps where it is most needed by good speaker systems and doesn't muddy up the lower middle range. The high-frequency boost also

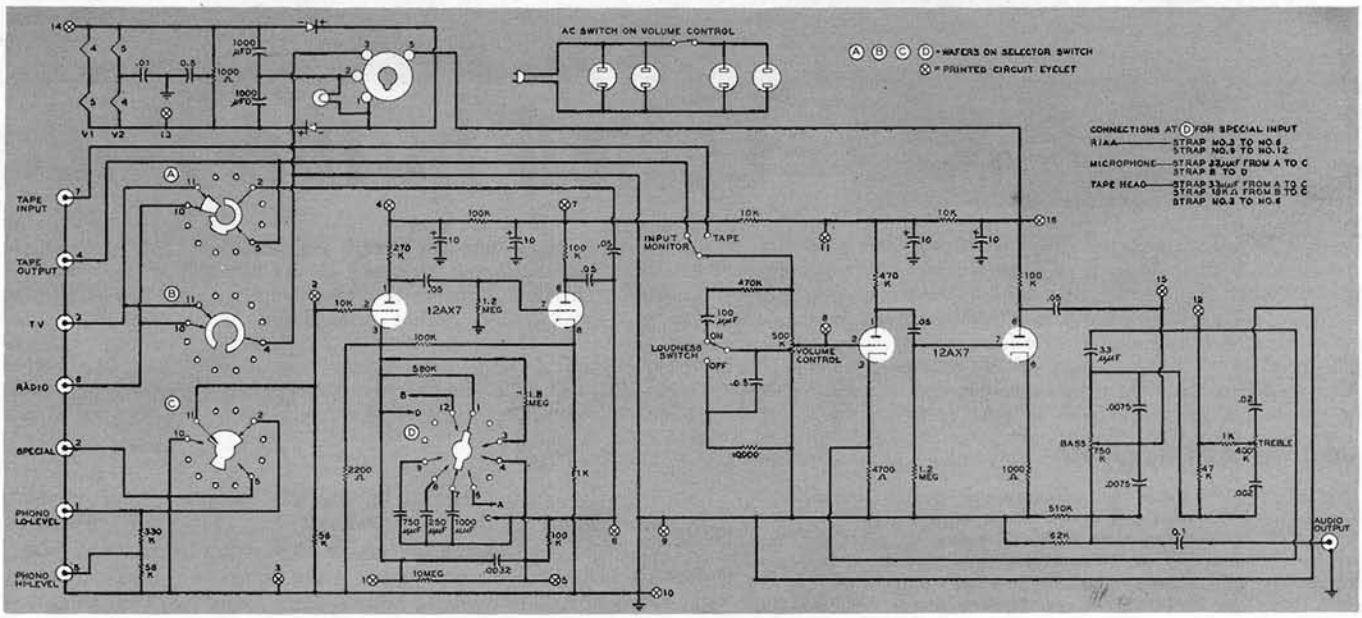


Fig. 1. Schematic diagram of the Dynakit Preamplifier.
Note the multiple feedback loops, and unique rectifying circuit which provides DC voltage to the tube filaments.

is most effective at the extreme end where tweeters begin to falter.

It will be noted that, as in the Baxendall, the bass crossover moves downward as the boost is reduced. The result is a very smooth and inconspicuous tone control which (as the curves show) gives far more boost than one might think when twirling the knob. The two tube sections have gain enough for wide tone-control operating ranges and enough to spare for reduction of distortion by feedback.

Provision of a self-contained rectifier to convert 6-v AC from the companion amplifier to 12-v DC for the filaments of the tubes is a welcome novelty. The hum-balancing pot is unusual in a DC filament supply, but it does produce additional reduction of hum. The capacitor in the center of the filament chain is an RF filter to clear up line hash which can be quite a problem in sensitive preamps. Decoupling is elaborate and, for extra safety, a long-life electrolytic unit is used. Operating voltages of 6 v AC and 200 to 350 v DC must be obtained from an outside source — such as the power amplifier.

No cathode-follower output circuit is provided, but the output impedance is very low because of the feedback loop from the final stage. There is one disadvantage to this: the input impedance of the following amplifier affects the feedback loop and, therefore, the frequency response. The Dynakit preamp is designed to feed a 470-K input. Higher input resistances will not be any problem; lower ones will require snipping off (or leaving out) a 510-K output resistor.

Construction Notes

In the Dynakit amplifier, a new standard for simplicity of kit construction was established. This is continued in the Dynaco preamplifier, although it will take considerably longer to do the job (six to eight hours) than building the amplifier. The most critical portion of the work is eliminated because the tube circuits are already wired on a printed-circuit board. But there are still 100 different steps in assembling and wiring.

The steps have been figured out very thoughtfully in four stages. Wiring and assembly are done in layers, as it were, so that even at the end, when almost everything is done, the wiring is straightforward and there is no necessity for trying to reach into a corner already too full, and little danger of burning one part while soldering another.

In the first stage, Fig. 3, the power supply and tone-control components are mounted and partially wired. Then the printed-circuit board is added and connected to the work done previously. The equalizer switch is assembled and wired before mounting in the chassis, for the third stage. Finally, when the switch is mounted, the remaining interconnections are made.

It is a good idea to use the scale marked on the pictorial diagrams to cut the leads to the size specified. And, if you like to make strong mechanical joints at terminals, allow an extra quarter inch in length for each piece. Also, as you do each step, check it against the big pictorial diagram.

The steps in construction have been especially well worked out to make wiring to the printed-circuit board as simple and orderly as possible (Fig. 4). To minimize any possibility of damage to the etched foil, the board has tinned eyelets where the wires are to be soldered. We suggest that the soldering iron be applied from the front (the side on which the components and tubes are mounted) while the wire is pushed in from the back. In this way you are far less likely to damage the printed circuit. The completely wired chassis is shown in Fig. 5.

Adjustments are very minor and simply made. We found that the tone controls centered in the flat spot within less than 1/16 inch when we simply set the knobs as suggested at the 7-o'clock position. Setting the hum balance is also not critical. It can be done perfectly well by ear. Instructions for connecting the power cable are based on the idea that the preamp will be used with a Dynakit or Heathkit amplifier, and an octal plug is provided so that after wiring it can be plugged directly into such amplifiers. The voltages can be supplied by any amplifier or other gadget which will yield between 200 and 350 v DC and 6 v AC. But note below that 350 v B+ yields the optimum performance; lower voltages result in somewhat higher distortion. (The red wire in the cable is for the positive high voltage; the black is for the ground. Green and white leads are for the 6 v AC.)

The source of 6 v AC must be "floating" — that is, not grounded at any point. In some amplifiers, the filament chain is grounded at the center point of the filament winding on the transformer

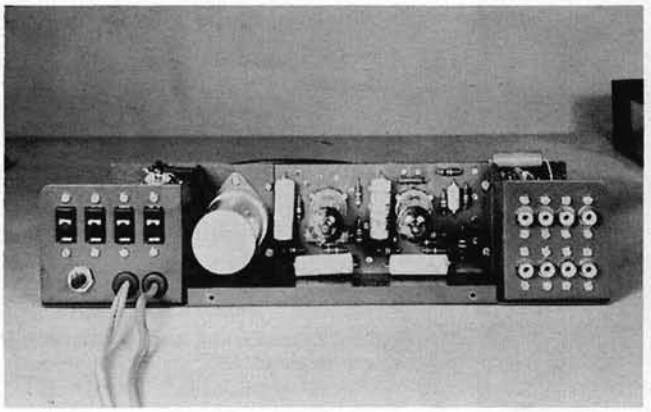


Fig. 2. Rear view of the chassis shows inputs and AC outlets.

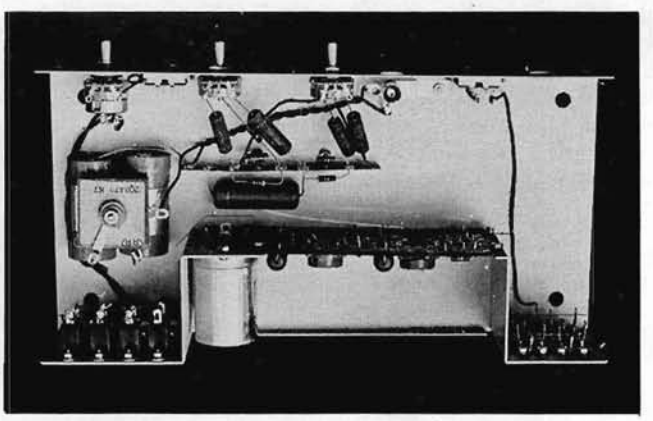


Fig. 3. Power supply and tone controls are partially wired.

or through a built-in hum control. This can be made to work by simply disconnecting the ground from the center tap on the hum balance control entirely. Then the balance pot in the preamp will provide an AC ground for both amplifier and preamp.

AUDIOCRAFT Test Results

It is seldom that a piece of equipment amazes us, but the Dynakit preamp certainly did. Fig. 6 shows the frequency response at various levels of output with and without the LOUDNESS-control compensation. Note that our measured response with the VOLUME control at maximum is absolutely flat from 10 to 40,000 cps, and slopes to only 3 db down at 100,000 cps. Note also that the response below 10 cps is within ½ db to 6 cps, down 1½ db at 5 cps, and 4 db down at 4 cps. The low-end response remains absolutely flat whatever the position of the VOLUME control (with LOUDNESS off). The high end slopes as the VOLUME control is moved down, but the slope always begins beyond 20,000 cps.

The LOUDNESS-control compensation comes in at half rotation. We liked its effect because the largest part of the boost was below 100 cps, just as with the BASS control, so that it did not result in the boomy, muddy sound some loudness controls produce. It also provided some boost at the high end: 5 db maximum at 20,000 cps. All these curves were taken with a constant 0.25-volt input, which produced an output of about 2.5 v with the VOLUME control at maximum.

Because the high-level inputs go directly into the VOLUME control it is virtually impossible to overload the Dynakit preamp, although the loudness contour will vary with the input voltage. It is suggested that the volume controls on radio and TV be adjusted with the preamp VOLUME control just past the middle point (where the LOUDNESS control is inoperative) to produce a rather loud "concert-hall" loudness which requires no compensation. Then, as the volume is reduced to a more comfortable level, loudness compensation will come in.

Fig. 7 shows the tone-control contours, and Fig. 8 the phono equalization curves. Because precision capacitors are used, these curves follow the specs very closely. The RIAA and LP curves depart from the theoretical by less than ½ db. The 78 curve is similarly close to that specified and, you will note, delivers some 27 db of boost as 20 cps.

Distortion curves in Figs. 9 and 10 are really extraordinary. We must note to begin with that, although the kit will operate with any B+ voltage between 150 and 350 v, and with very little difference in gain as the voltage is changed, the distortion *will* vary with applied voltage. The curves shown were taken with 350 v. Whereas with 350 v B+ the IM at 2 volts (equivalent sine-wave voltage) was less than 0.1%, with 200 v B+ the IM went up to 0.3% at 2 volts output. Harmonic distortion also increases at the bass end with lower voltages, as the following brief table shows:

Harmonic Distortion

	200 v	*250 v*	*350 v*
50 cps	0.5%	0.1%	.05%
500 cps	.01%	0	0
5,000 cps	0	0	0

This is presumably a result of the fact that feedback is reduced as the B+ voltage is reduced.

We do not claim the figures and curves to be absolutely accurate. It is extremely difficult even with the finest laboratory equipment to measure such low levels of distortion accurately. Wherever we indicate zero distortion, we recorded no reading whatever; it is

Fig. 4. Rear of PC board shows how connections are made.

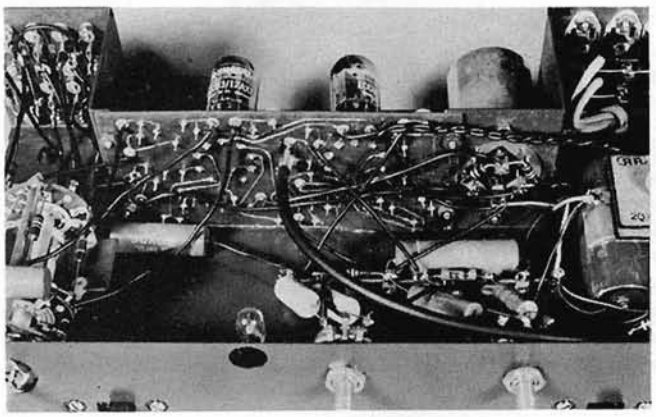
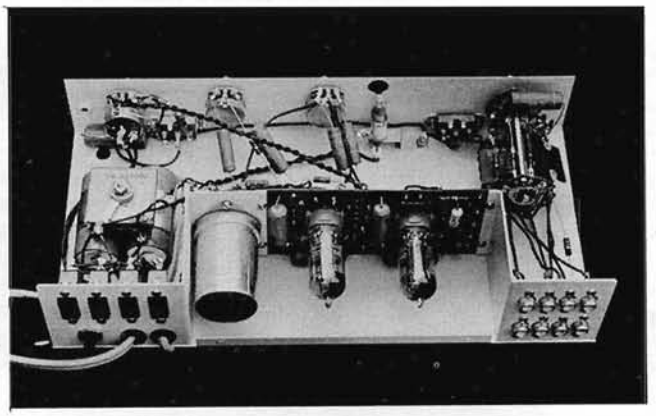


Fig. 5. Completed preamp testifies to simplicity of wiring.



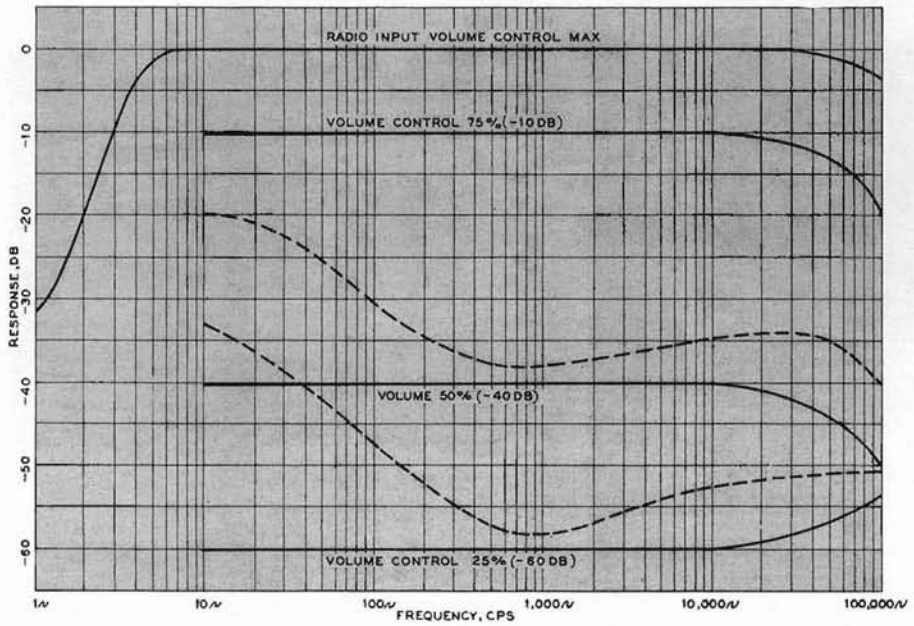


Fig. 6. Frequency response of the Dynakit preamplifier at several settings of the volume control. The dotted line shows response with loudness compensation added.

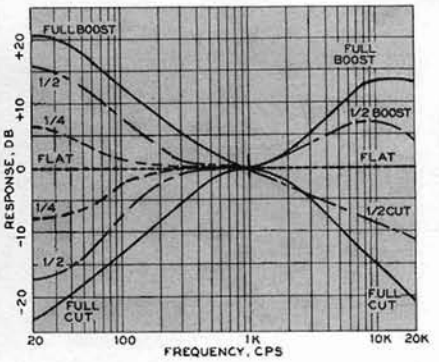


Fig. 7. Contours of the tone controls.

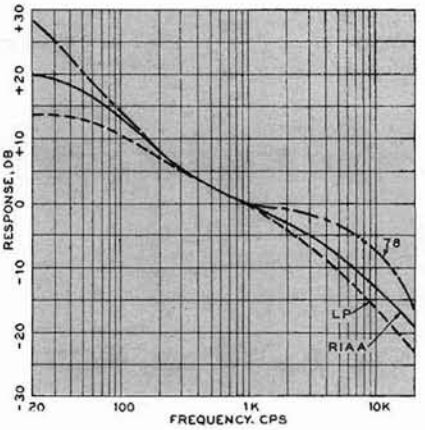


Fig. 8. Equalization of phono channel.

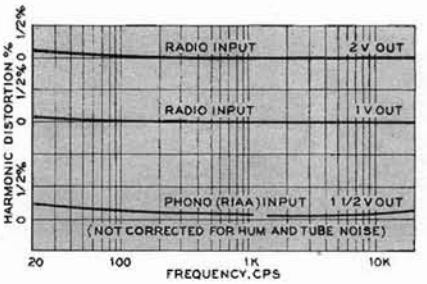


Fig. 9. Harmonic-distortion percentage.

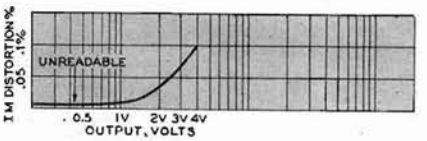


Fig. 10. Curve indicates IM distortion.

Fig. 11. 10 KC square wave from Dynakit (below) is much like original (above).

quite possible that there may nevertheless be distortion on the order of one hundredth of one percent. Incidentally, the distortion does not increase as the VOLUME control is turned down, so long as the output voltage is kept below 2 or 3 volts.

Even more extraordinary and satisfying is the harmonic distortion curve which includes the *entire* preamp — from the phono input (with RIAA equalization) to the output. Input voltage was adjusted at various frequencies to produce an output of 1½ v — enough to drive most modern amplifiers to full output. Obviously, it took a great deal less input at 20 cps than at 20,000 but the method approximates an absolutely flat recording without recorded distortion. It will be noted that the distortion is 0.2% or less throughout the audio range. Actually, the distortion itself is considerably lower than the curves indicate because the readings include hum and tube noise which of course are much higher in the phono channel. This noise may well account for as much as 50% of the total reading.

It is difficult to do the same sort of test for IM distortion. The regular 4-to-1 ratio of 60 to 6,000 cps gave a figure too low to read — well below 0.1%. To come closer to the real situation existing in an RIAA-equalized record, the proportion was varied to ratios of 1 to 2 and 1 to 4, but the reading was still under 0.1%.

Square-wave response in the flat tone-control positions, with the VOLUME control at maximum, is so good in our model that the preamp can be used to increase the sensitivity of a scope at audio frequencies. Even the 10,000 (Fig. 11) and 20-cps square waves were very close to the original; there was no sign of ringing. The transient response of the preamp alone, with an independent power supply, was better than any test we could devise to try it. Transient performance of a combination of the preamp and a power amplifier sharing the same power supply would depend a great deal on the stability of the power amplifier. With the Dynakit amplifiers for which, presumably, the preamp was tailored, it remains excellent indeed.

Hum and noise are completely insignificant and will be inaudible even with low-level cartridges at any level anybody could possibly tolerate in the home. The gain is sufficient to operate a Fairchild pickup without a transformer, for example, although the loudness compensation is then not of much use.

The preamp's heavy-gauge cabinet provides very good shielding against stray magnetic fields. Since there is little heat to dissipate, the unit can safely be installed in closed spaces such as a turntable base or cabinet.

There can be differences of opinion on such matters as whether three phono equalization curves are sufficient, whether there ought to be input level controls or more and different main controls, and so on. It seems to us that Dynaco has worked out a preamp-control combination that will suit the great majority of people: simple and inexpensive, yet flexible enough to take care of most contingencies and tastes.

But even the most demanding of hi-fi perfectionists could not ask for more performance in terms of the high-fidelity essentials — wide-band response, almost complete freedom from distortion, faithful equalization of modern recordings, and superb transient response.