Equipment Profiles

Crown IC-150 Integrated Circuit Stereo Console

Crown D-150 Dual Channel Power Amplifier

MANUFACTURER'S SPECIFICATIONS
IC-150:
Frequency Response, High Level: ±0.6 dB, 3 Hz to 100kHz with High Impedance Load. ±0.1 dB, 10 Hz to 20 kHz with IHF load (100 KOhm in Parallel with 1000 pF). **Phono:** ±0.5 dB from standard RIAA response curve. **Phase Response, High Level:** typically +1° to −7°, 20 Hz to 20 kHz with high impedance load; +1° to −12°, 20 Hz to 20 kHz with IHF load; **Phono:** typically ±5° additional phase shift, 20 Hz to 20 kHz. **Total Harmonic Distortion:** Essentially too low to measure. **Intermodulation Distortion:** Less than 0.01% at 2.5 volts out; typically less than 0.002% at 2.5 volts out and less than 0.004% at 10.0 volts output. **Hum and Noise, High Level Inputs:** 90 dB below rated output of 2.5 volts. (Typically, 100 dB below rated output with IHF "A" weighted measurement). **Phono Inputs:** 80 dB below 10 mV input (typically 0.5 µV). **Gain, Hi Level Inputs:** 20.8 dB ±0.2 dB. **Phono Inputs:** Adjustable between 50 and 70 dB by means of input level controls. **Rated Output:** 2.5 volts. **Maximum Output:** 10 volts.
D-150:
Frequency Response: ±0.1 dB 20 Hz to 20 kHz at 1 watt into 8 ohm load; ±1 dB 4 Hz to 100 kHz. **Power Output at Clipping:** Typically 100 watts rms per channel into 8 ohms, 180 watts rms per channel into 4 ohms. **IHF Power Output:** Typically 210 watts rms into 8 ohm loads; 400 watts rms into 4 ohm loads. **IM Distortion:** Less than 0.01% at 75W. THD: Less than 0.05% from 20 to 20,000 Hz, 75W. **Damping Factor:** Greater than 200 up to 1 kHz, 8 ohm load. **Hum and Noise:** 110 dB below 75 watts rms (unweighted band limited from 20 Hz to 20 kHz typically measures 119 dB). **Load Impedance:** 4 ohms or greater. Stable with all speaker loads. **Input sensitivity:** 1.19 volts ±2% for 75 watts into 8 ohm load. **Input Impedance:** 25 Kohms. **Power Response:** ±1 dB, 5 Hz to 20 KHz at 75 watts rms into 8 ohm load.
General Specifications
D-150:
Dimensions: 17 in. W. x 5¼ in. H. x 8¾ in. D., 19-in. rack mounting hardware available. **Weight:** 24 lbs. with front panel. **Price:** $429.00: less front panel $399.00: optional cabinet available.
Dimensions: 17 in. W. x 8⅝ in. D x 6½ in. H. **Price:** $269.00; optional walnut cabinet, $33.00.

It is rare that the editors of AUDIO will review two important pieces of equipment produced by the same manufacturer in one issue. In the case of Crown's IC-150 stereo console and the matching D-150 power amplifier, the two units are so ideally suited to each other that to discuss one without fully evaluating its companion would be to do both an injustice. One of the few other stereo power amplifiers we have ever measured that could justifiably be used with the IC-150 control unit is Crown's higher powered DC-300, and since not everyone will even consider a 400 watt rms amplifier (or a price tag of $685.00, found on the DC-300) the D-150, at $429.00 plus the IC-150 at $269.00 form a combination at just under $700.00 that will appeal to the serious audio enthusiast who, very simply, wants the *best* specifications that have ever been incorporated in a preamplifier/amplifier component pair.

The IC-150 stereo console is shown in its optional walnut cabinet (Model 5-D), but it can be shelf mounted nearly as attractively without this optional extra. The brushed anodized aluminum and black front panel is relatively simple in layout, when you consider the flexibility of control functions afforded by the thoughtful layout. The top portion of the panel contains six knobs, two of which are really dual concentric types, and two push-push buttons. The rotary knobs include a seven position selector switch (two phono inputs, tuner, two auxiliary inputs and two tape inputs), a volume control, a balance control, a continuous control labelled PANORAMA and dual concentric BASS and TREBLE controls. The PANORAMA control acts somewhat like a MODE selector, except that its action is continuous. When rotated fully counterclockwise, normal stereo reproduction is afforded, with full separation. As you rotate the knob towards its mid-position, left-right blending takes place until a monophonic mix is achieved. Clockwise rotation of this control beyond the center point begins to restore stereo separation, this time in a reverse sense (that is, left and right channels become reversed) until, at the extreme clockwise position, full separation is restored. Thus, this one cleverly conceived control offers the advantages of a true BLEND control (a much needed feature which was popular on some equipment in the early days of stereo but which for some obscure reason was dropped from components more recently) plus the needed features of a conventional MODE switch. The two push-push buttons introduce loudness-compensation and serve to by-pass the tone controls when absolutely flat response is desired. The lower portion of the panel contains five rectangular push buttons which are also of the "push-to-make, push-to-break" variety and control such functions as TAPE 1 and TAPE 2 monitoring, low frequency filtering, high frequency filtering, and power on/off.

Fig. 1—Rear panel of the Crown IC-150.

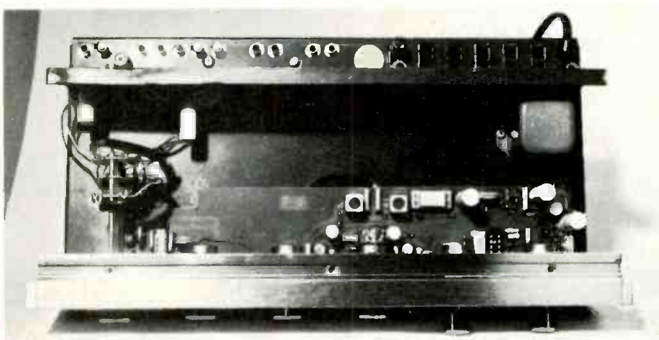


Fig. 2—View from above the Crown IC-150

As can be seen in Fig. 1, all rear panel connections are made in a horizontal plane, but the designations are printed on the vertical back wall, making them easy to read. This arrangement has the additional advantage of avoiding any protrusions from the back of the unit. Starting at the left of the rear panel, we see an a.c. line fuse followed by five convenience a.c. outlets (of which four are switched and one, intended for your phono turntable or changer, is unswitched). A pair of terminal posts come next, and these are for the optional connection of a remote electronic muting switch, which will be described later. There follow pairs of main and tape output jacks, pairs of tape input jacks and the necessary auxiliary, tuner and phono input jacks. The latter are associated with screwdriver-type level adjustments, which are to be set according upon your cartridge output.

Figure 2 shows the deceptively simple looking innards of the IC-150. All major components of small dimensions are mounted on glass (G-10) printed circuit board which is firmly supported mechanically. The magnetically shielded power transformer can also be seen over to the extreme right of the photo. Figure 3, taken from Crown's instruction manual, is a signal flow diagram showing the sequence of events that an input signal undergoes from the input jacks to the outputs. It should be noted, by the way, that the output impedance of the IC-150 is 600 ohms and, if terminated in that impedance (as would be the case in professional use), it will deliver a maximum output of 5 volts. With high impedance terminations (as, for example, when used with the matching D-150 power amplifier) maximum output will be as high as 10 volts rms. The phono preamp circuit board contains a total of nine

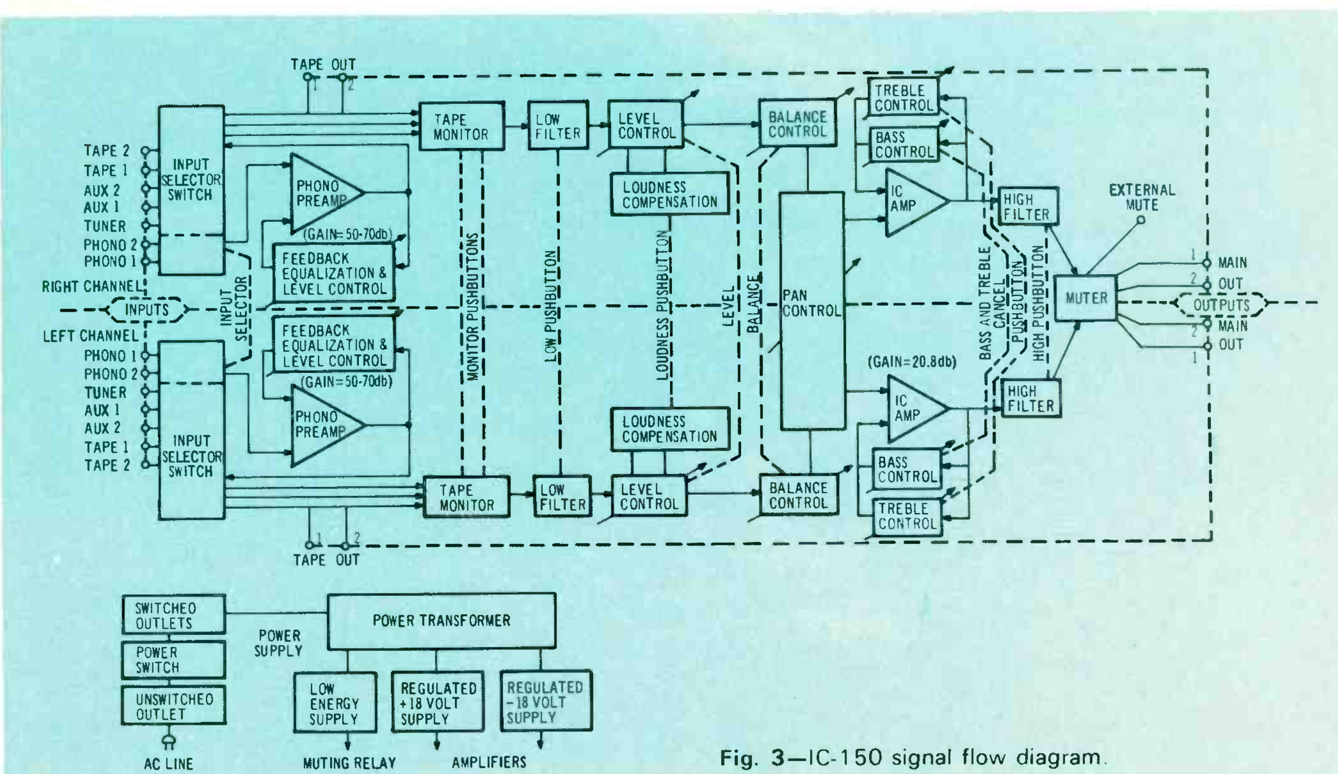


Fig. 3—IC-150 signal flow diagram.

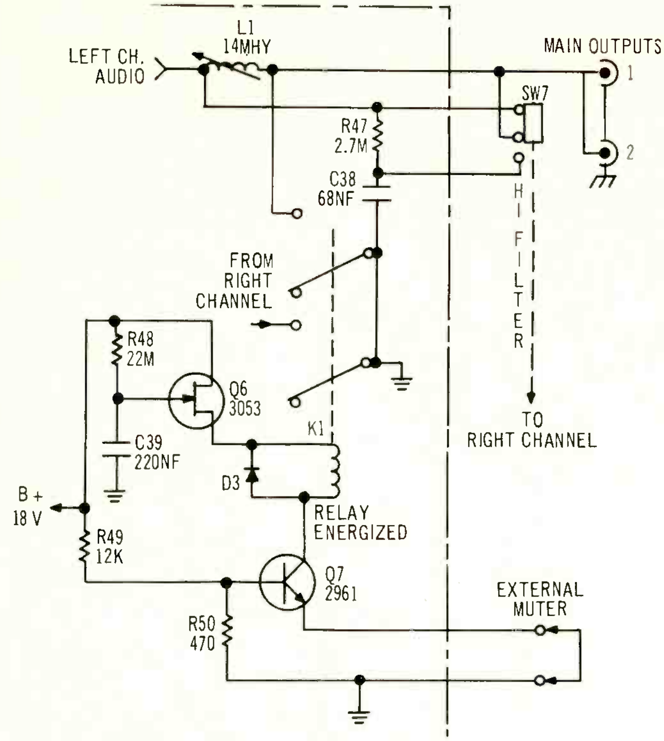


Fig. 4—Partial schematic of the muting circuit in the Crown IC-150.

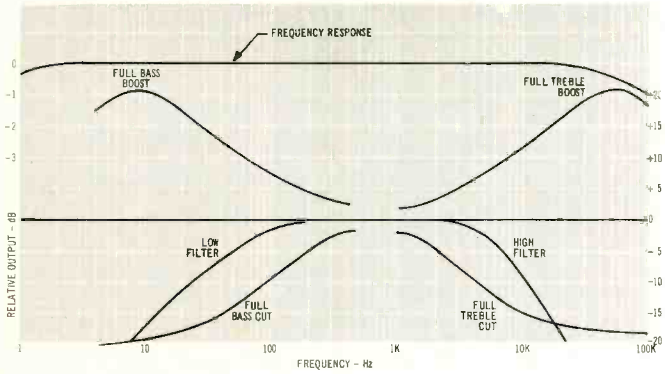


Fig. 5—Frequency response, tone control range, and filter characteristics of the Crown IC-150.

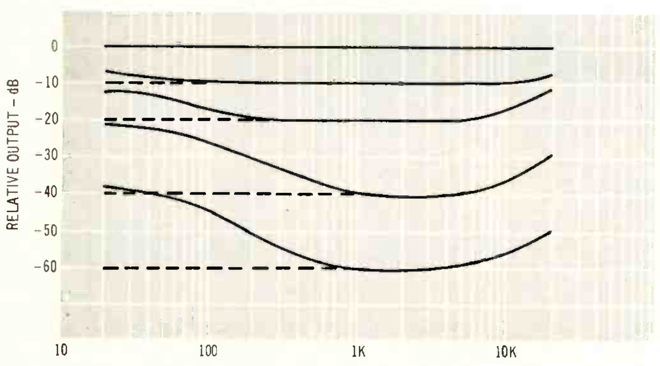


Fig. 6—Loudness-contour characteristics of the IC-150 at various settings of the volume control with loudness circuits ON.

transistors (four per channel plus one voltage regulating transistor) and all resitors involved in the equalization feedback circuits are 1% tolerance components while critical capacitors have a tolerance of 2½%! The electronics of the high-level input amplification circuits is built around two IC's, each of which contains the equivalent of 22 transistors and 14 diodes. In addition, there are 13 more bipolar transistors (nine of which are used in the phono preamp stages), one FET (field effect transistor), two zener diodes and eight diodes.

A partial schematic of the external muting circuit is shown in Fig. 4. When power is initially applied to the IC-150, the muting relay contacts tie the output to "ground." The muting relay remains unenergized until an R-C circuit charges and turns on the FET, which in turn energizes the relay and removes the short from the output. This process takes about five seconds, during which any turn-on transients are permitted to die out before the speakers are connected to the circuit. As can be seen in Fig. 4, removal of the "short" across the external mute terminals opens the emitter circuit of Q7 and prevents the relay from ever becoming energized. Thus, a remote simple SPST switch can serve to mute the system at any time from the comfort of your easy chair.

Electrical Measurements

We had no trouble plotting frequency response and tone control action (shown in Fig. 5), nor was filter response a problem (see same Fig. 5). Loudness contours are shown for various settings of the volume control when the "loudness" switch is depressed (see Fig. 6). We were able to measure hum and noise levels of approximately -93 dB below 2.5 volts output and equivalent phono noise (phono inputs shorted) at about .50 *microvolts* and to confirm RIAA equalization as being as close to perfect as our interpolation of fractions of a dB on our expanded scale a.c. VTVM would permit. However, when it came time to measure IM and THD, our test setup proved to be completely useless. As stated in previous reviews, we are rather proud of our new test equipment lower limits of 0.03% THD and 0.05% IM, but of what use are these new pieces of equipment when we are confronted with an IM figure (for 10 volts output) of 0.002%? In the interest of a complete report, however, we present Fig. 7, which is nothing more than a plot of the IM figures which appeared on the individual test sheet that accompanied our Model IC-150. Please read the scales *carefully*, as they are deliberately expanded beyond anything we normally show and, above all, feel free to take Crown's word for it, as we humbly do.

We shall reserve comment on our listening tests until after the discussion of the D-150 companion amplifier, since, as

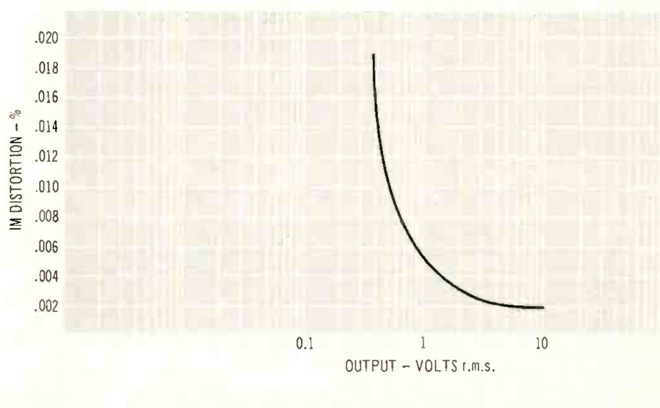


Fig. 7—IM distortion of the IC-150 as measured by the manufacturer. (Note the expanded scale of percentages.)

stated, all listening tests were done using both products hooked up together.

D-150 Power Amplifier

The D-150 dual power amplifier's optional front panel and walnut enclosure, again, need not be used except as dress items, since the power amplifier is fully enclosed as it comes and, in our view, somewhat more awe inspiring at that, as shown in Fig. 8. The major cover shown in the photo (which contains the serial identification label, etc.) is removable and, when removed, discloses the massive power transformer, as seen in Fig. 9. The photo also shows the pair of input jacks (phone jack type), above which are located a pair of screwdriver input level adjustments, and the speaker output terminals which utilize standard ¾-in. center-to-center MDP terminals intended for the dual banana plugs normally associated with test equipment interconnecting cables. These are supplied in the accessory bag with each unit. Also included in the accessory bag are in-line fuse receptacles and cables which are strongly recommended as the right way to connect from amplifier output terminals to speaker systems, in the interest of speaker protection. A handy nomograph in the very complete instruction manual helps you to select the proper fuse size for your speakers based upon their impedance and their peak music power rating.

An "underneath the chassis" view of the D-150 is shown in Fig. 10 which discloses the driver and output transistors. Input stages and associated components are located on a p.c. board which cannot be seen in this view. The D-150 has two direct coupled amplifier circuits which employ a dual IC amp and silicon transistors in all amplifier stages. As Crown explains in their instruction booklet, the dual IC op-amp used is of extremely low noise type and has a large gain-bandwidth. As a result of its use as an input voltage amplifier, a maximum amount of feedback can be applied with resultant reduction of distortion to previously unattainable low values. At a typical full output of 75 watts (8 ohms), IM has been measured by Crown as 0.002%. By implication, THD might be expected to be approximately 0.0005% which *neither* Crown nor we could legitimately measure.

The output stages are essentially in a quasi-complimentary format. In this version of an output circuit, however, the driver transistors carry the bias current, while the output transistors serve only as boosters. The output transistors "sense" when the driver transistors are delivering significant current to the direct coupled loads and then take over and deliver the required large load currents.

The output circuit is protected by a V-I (volt-ampere) limiter which limits the drive to the output configuration whenever the output transistors are overloaded and acts instantly to relieve the overload, acting only so long as the overload exists. In addition, a thermal switch is mounted on the chassis surface which protects the amplifier against insufficient ventilation. If it becomes too hot, a.c. power to the amplifier will be interrupted until the temperature falls back to a safe level, at which time power is automatically restored. The excellently written and organized instruction manual details additional protection schemes which the user might incorporate external to the amplifier but these are primarily directed at speaker protection, since the amplifier itself is deemed "fail safe" under any conditions. Positive and negative power supplies ($\pm$45 volts) permit direct coupling to the loudspeaker and the voltage offset at the point of connection is guaranteed to be less than 10 mV. Filtering of each of the supplies is by means of a 9400 μF, 50 volt capacitor of massive proportions. The power transformer, incidentally, is suitable for 240 volt or 120 volt applications and is safe at any power line frequency from 50 Hz to 400 Hz.

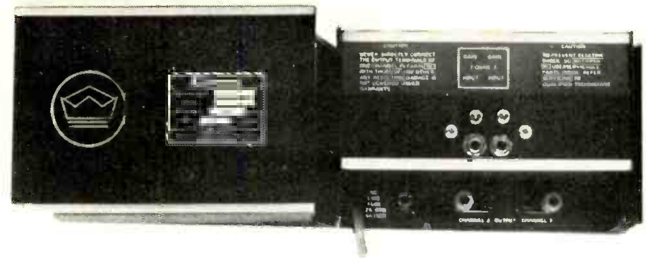


Fig. 8—D-150 amplifier with decorative panel and walnut enclosure removed.

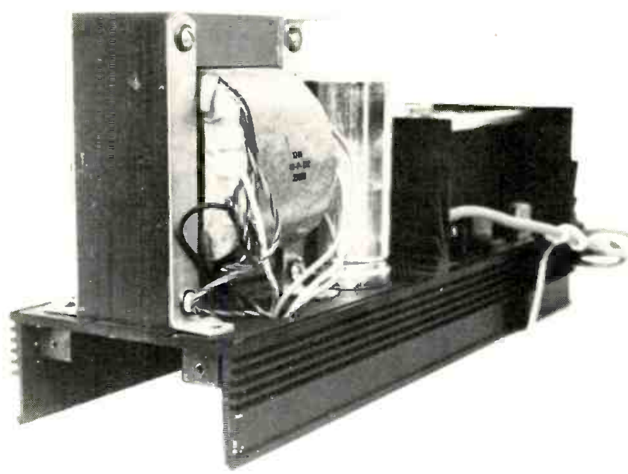


Fig. 9—Close up of the D-150's power transformer and one filter capacitor.

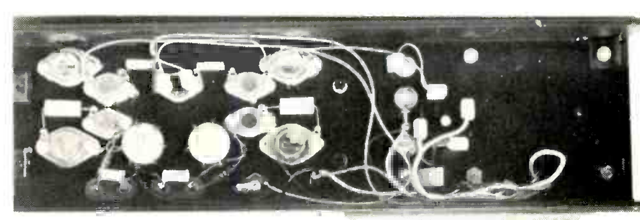


Fig. 10—The D-150's entire chassis acts as a heat sink for the driver and output transistors.

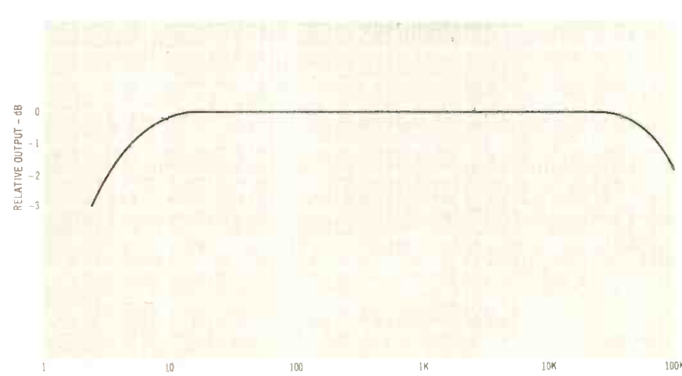


Fig. 11—Frequency response at 1 watt rms, 8-ohm load of the D-150.

Fig. 12—Power response, D-150.

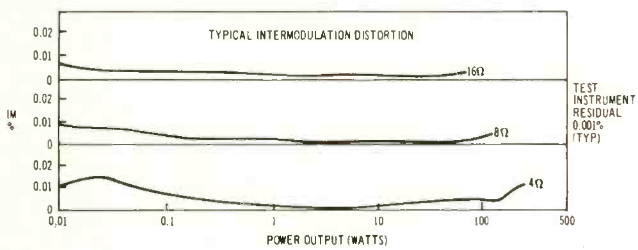


Fig. 13—IM distortion characteristics, D-150. (Supplied by the manufacturer.)

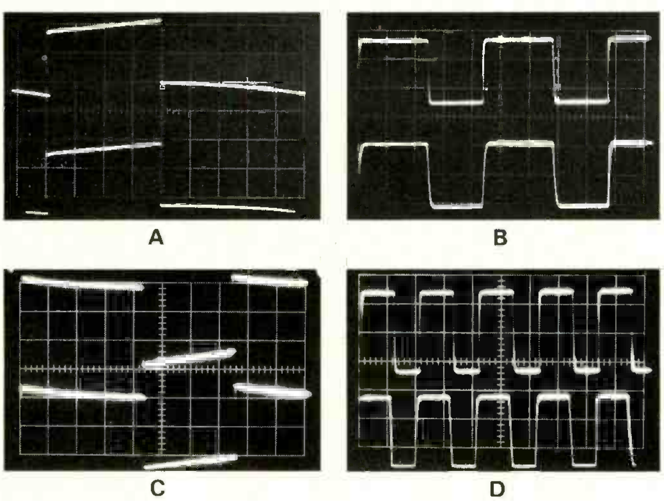


Fig. 14—Square wave presentations, **A**, output of IC-150 with 20 Hz applied; **B**, output of IC-150 with 20 KHz applied; **C**, output of IC-150 and D-150 with 20 Hz applied, and **D**, output of IC-150 and D-150 with 20 KHz applied. (Note that in all cases upper trace is signal source for comparison purposes to output waveform in lower trace.)

D-150 Measurements

Frequency response of the D-150 amplifier is plotted in Fig. 11. The –1 dB point (reference 1 watt, 8 ohm loads) was reached at 5 Hz on the low end and at 75 kHz at the high end. Power response based upon 75 watts output per channel (clipping actually occurred at about 103 watts per channel, both channels driven, 8 ohm loads) extended to below any frequency we could measure (at 5 Hz, full power output was still obtained) and up to at least 30 KHz. A graph of this "straight line" is shown in Fig. 12. Hum and noise were measured at –120 dB with reference to 75 watts rms output, 8 ohm loads and is an unweighted reading (full 20 Hz to 20 kHz bandwidth). For those interested in startlingly small numbers, this means that the hum and noise power contribution to the loudspeakers is 75 x 10^{-10} watts! (You may prefer to call this 75 pico-watts, or 0.000000000075 watts!) The real point is, YOU CAN'T HEAR IT—even with your ear glued to an *efficient* speaker system.

As for THD and IM measurements, we were again faced with the problem of test equipment. If Crown's claim of a theoretical THD of 0.0005% is correct (and we have no reason to doubt it), then we, along with Crown, have no way to measure it with presently available equipment. Evidently Crown does have an IM Meter capable of reading down to 0.001% and therefore presents a graph of IM versus power output which is reproduced in Fig. 13. Note that at 100 watts per channel into 8 ohm loads, IM distortion is approximately 0.005% and at 10 milliwatts power output (where any cross-over distortion would certainly show up if it were present), IM measured by Crown is just about 0.01%!

A series of square wave photos were taken for both the IC-150 and the D-150 plus the IC-150 (operating together). These are presented in Fig. 14 with explanatory captions for each condition of measurement. The important thing to remember here is that the *upper* trace in each photo is our signal source while the lower trace is, in all cases, the output as observed from the IC-150 or the D-150. Thus, while not all the observed waveforms are perfectly "square," this arises from the fact that our *source* waveform is not always square either. Notice, therefore, how closely the output always resembles the input waveform at all frequencies and conditions shown. Fig. 15 simply represents the condition observed when the amplifiers are driven to clipping levels. At the moment the photo was taken, total power output was approximately 110 watts rms per channel and since both channels were being driven, the amplifier was pumping out about 220 watts of power into our purely resistive loads. Since our resistive loads used in all testing are rated at 100 watts each, we did not keep this up for more than the time required to set up the camera and take the 'scope photo.

Listening Tests

All our listening tests were done using the IC-150 and D-150 as an operating pair of components. Obviously, our speakers (which are low efficiency types selling at around $150.00 apiece) are the limiting factor in any listening tests using equipment such as this, but somehow, a new sense of transparency seemed evident. We *know* that this was not psychological projection because we brought in several experienced listeners who were not told the make or model of amplifier and preamplifier being used. Without exception, all these observers told us that these particular speakers (with which all were familiar) had "never sounded that good before." Now, we sincerely doubt if the IM figures of under .01% could be audibly interpreted as sounding better than, say 0.1% (which competitive equipment often achieves). Perhaps the unusually high damping factor (over 200 at all frequencies below 1000 Hz) was responsible for the audible difference. We're really not sure. This much we do know, however: We monitored the signal delivered to our speakers and there were times when peaks of 90 watts were repeatedly delivered to the voice coil terminals. At all times the music was *absolutely devoid* of any audible distortion. We also discovered how important choice of source material becomes when you're dealing with equipment that is so perfectly "clean" in its reproduction capabilities. Evidently, less perfect amplifiers can often "mask" the deficiencies of certain types of poorly recorded material (we're speaking primarily of discs). There was, unfortunately, no single source of program that could fully utilize the dynamic range inherent in the IC-150/D-150 combination. That is, any signal source (FM, phono, tape) we tried invariably resulted in reproduced noise and/or hum that was greater than the inherent noise and/or hum which we didn't hear when listening to the equipment alone, with similar gain settings. If that sounds discouraging or suggests the question, "why buy something this good?", bear in mind that over the last decade, tape dynamic range, for example, has been improved by at least 10 dB or more. If such trends continue, it may not be long before you'll be able to feed a signal source to this superb preamplifier and amplifier that is as good as they are. If *you* want the very best control chassis and power amplifier we've ever tested in this power class and can afford the price, our endorsement of the Crown IC-150 and D-150 is completely given without *any* reservations (unless, of course, you feel you need MORE power, in which case there's always the Crown 300!) *Leonard Feldman*

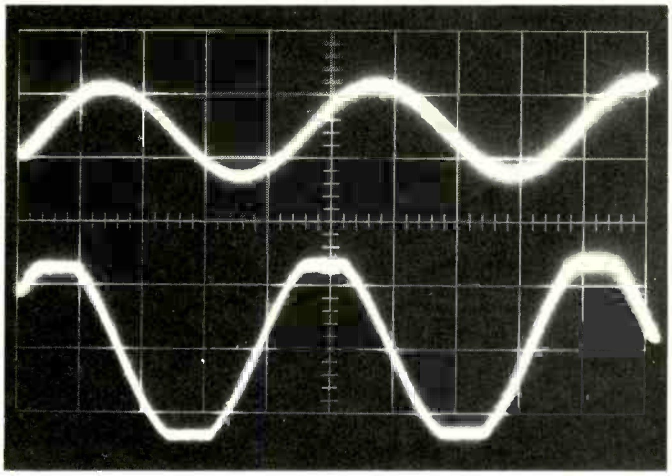


Fig. 15—Scope photo of clipped 110 watt rms signal (per channel) from the D-150 shows perfect symmetry of clipping and no evidence of "power supply collapse."

Check No. 57 on Reader Service Card

Fig. 1

Telex-Viking Quad/Sonic 2 + 2

MANUFACTURER'S SPECIFICATIONS

Speeds: 7½, 3¾, 1⅞ ips. **Motors**: Three, induction type. **Controls**: Directional levers for OFF, STANDBY, and PLAY, and for REWIND, STOP, and FAST FORWARD. Speed selector. **Playback Frequency Response**: 40 to 18,000 Hz ± 3 dB at 7½ ips. **S/N Ratio**: 50 dB. **Crosstalk**: 55 dB at 1000 Hz. **Head**: Four-channel, in line, compatible for two or four channel play. **Wow and Flutter**: Less than 0.2% at 7½, 0.25% at 3¾. **Output**: 1.4 mV at 1000 Hz. **Counter**: Four digit, push-button reset. **Brakes**: Electro-dynamic. **Finish**: Black and silver trim in walnut base. **Size**: 11 by 16½ by 6¼ inches. **Price**: $249.95, with take-up reel, four patch cords, and ground cable.

The Telex Quad/Sonic 2 + 2 is a quadraphonic tape deck intended for use with an amplifier which can also provide the necessary equalization—in other words, output is taken directly from the heads. No recording facilities are provided but the 2 + 2 can also play two-channel stereo as the heads are in-line quarter track. Three motors are used, all induction types, and there is a choice of three speeds, 1⅞, 3¾, and 7½ips.

Looking at Fig. 1, we see a digital counter on the left and just under this is the speed change lever. On the right is the ON-OFF, STANDBY, and PLAY switch, and under that is a similar switch controlling rewind direction. In the center is a pilot light which indicates whether power is on. Figure 2 shows the tape head and capstan, and Figure 3 shows the view from underneath. Note the large, dynamically balanced flywheel which weighs two pounds!

Measurements

The frequency response curves are shown in Fig. 4. Ampex standard tapes were used for the 3¾ and 7½ ips speeds but the response at 1⅞ ips was made with a tape made on a Tandberg recorder. It will be noted that very little, if any, treble boost is necessary for playback compensation and a response up to 20 kHz at 3¾ and 7½ ips should be easily realized with low distortion. It must be remembered that almost unlimited treble boost can be used to compensate for poor heads—at the expense of high distortion and poor signal/noise ratio. This is why (in terms of frequency response) a $99.95 deck can have the same specifications as one costing over $1000.00! The head in the Telex 2 + 2 is a professional-grade type made by Nortronics, which of course is not cheap. Output from the 7½ ips standard tape was 1.1 mV at 1000 Hz (10 dB below operating level). No signal/noise measurements were taken by us, as these will depend on the amplifier, matching, equalization, and so on. Wow and flutter came out at 0.11% at 7½, 0.2% at 3¾, and just under 0.25% at 1⅞ ips—better than the rather conservative specifications.

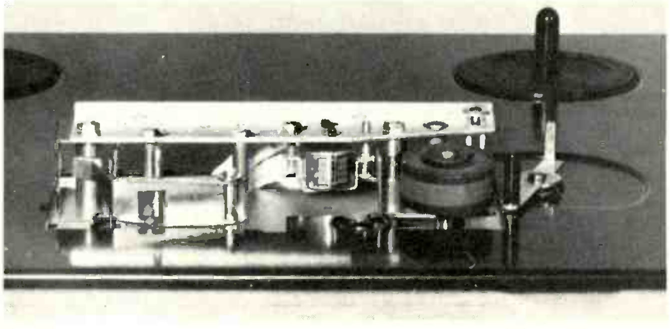


Fig. 2—Showing the tape head and capstan.

Performance

On test, the 2 + 2 came well up to expectations. The controls, which are simple but functional, worked smoothly and were extremely easy to use. Mechanical noise was low and the electro-dynamic brakes were really positive. No four-channel receiver or amplifier with tape head inputs was available so two Fisher 700 receivers were pressed into service, and it was found that equalization was not far out. No actual measurements were made but the standard Vanguard VSS-1 quadraphonic demonstration tape certainly sounded well-balanced with solid bass and silky-smooth treble. The Vanguard recording of the Mahler 9th was also most impressive. Some conventional two-channel tapes were played, with every satisfaction. Summing up, the Telex 2 + 2 can be recommended for the attention of those who want a relatively inexpensive deck for playback only. *T.A.*

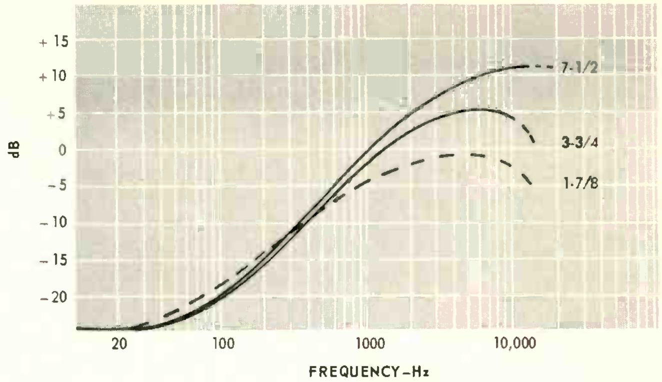


Fig. 4—Frequency response at the three speeds.

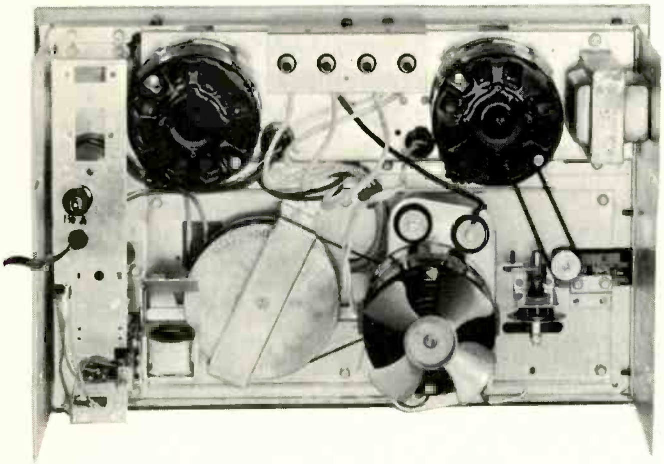


Fig. 3—Underneath view.

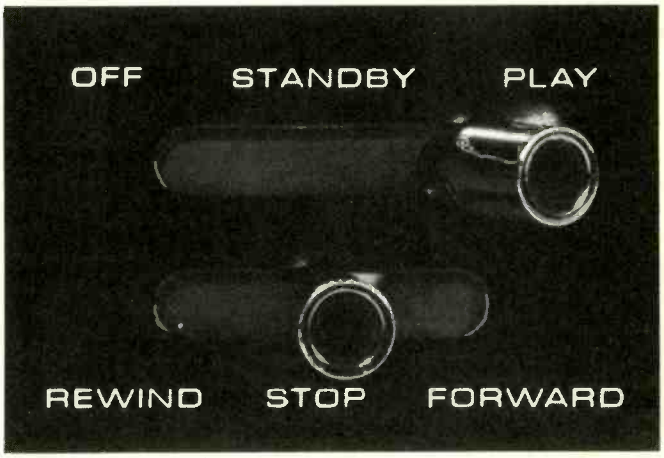


Fig. 5—Close up view of some of the controls.

Dual Model 1218 Automatic Turntable

MANUFACTURER'S SPECIFICATIONS

Speeds: 33⅓, 45, and 78 rpm; adjustable ±3%. **Platter Diameter**: 10⅝ in. **Maximum Tracking Error**: 0.5 deg. **Wow and Flutter at 33⅓ rpm**: 0.80%. **Pivot-to-stylus Distance**: 8¼ in. **Dimensions**: 13 x 10¾ in., 2⅝ in. below motor board, 5 in. above. **Weight**: 10 lbs. **Price**: $139.50.

There are many locations for automatic record changers that will not accommodate the larger units, such as the Dual 1219, but the user still wants the same performance obtainable with the top-of-the-line model, or as near that performance as possible. And therein lies the advantage of the 1218, which is very similar in performance, yet just a little smaller, and therefore can often be utilized in locations which preclude the use of the larger model.

The 1219 was profiled in these pages in December, 1969, and most of what was said in that profile could apply to the 1218. The newer—and smaller—unit still uses the two-ring gimbel mounting for the tonearm, with the elastically damped counterbalance which rotates on fine threads for fine balance, once the coarse balance is set by positioning the counterbalance shaft for approximate balance and tightening the thumb screw which keeps it in place. Stylus force is then set by a calibrated dial which applies the desired force through a long spiral spring which acts directly around the pivot of the tonearm.

Adjacent to the arm mounting is a knob which controls the amount of anti-skating force applied to the arm. The scale associated with this knob is calibrated for both conical and elliptical styli, with the graduations in black for elliptical styli, and in red for conical ones—indicative of the almost unanimous acceptance of the elliptical in high-quality installations. A hole in the chassis just in front of the arm mounting gives access to an adjustment for varying the tonearm cueing height over a range of ¼ inch. The bearings for the two degrees of motion of the turntable are of the low-friction pivot type,

Fig. 1—Most adjustments are found near the arm mounting—coarse and fine counterbalance, stylus force, anti-skating, and tonearm cueing height. Note record spindle for single-play use—it rotates with the platter to avoid wearing the center hole and to ensure concentricity.

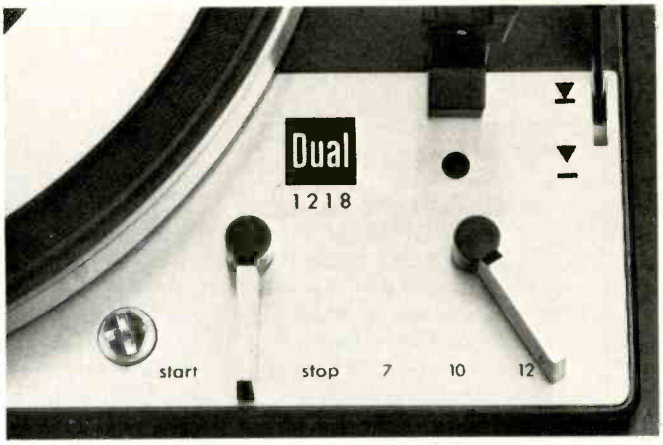


Fig. 3—The right front of the chassis accomodates the three most-used operating controls—the cueing lever, which extends out of the photo at the upper right, the record-size selector with positions for 7-, 10-, and 12-in. records, and the start-stop lever. The hole above the record-size lever gives access to an adjustment for the set-down position for 12-in. records.

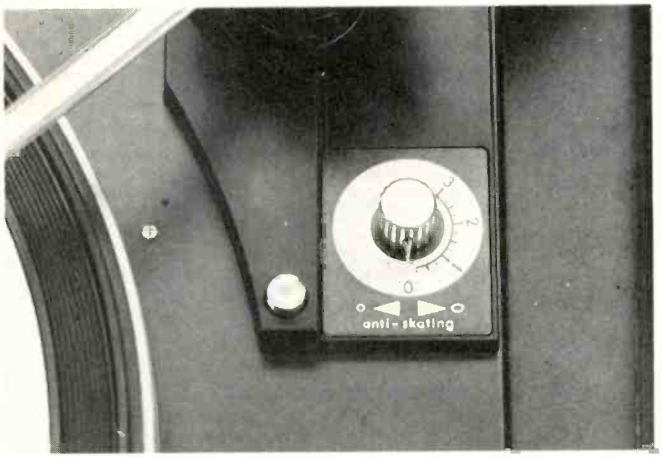


Fig. 2—Anti-skating adjustment knob, with its two scales—the one for conical styli adjusts for as much as five grams, while the one for elliptical styli adjusts only to three grams, which is, of course, about as high a force as should ever be used for these popular styli. The slotted screw head to the left of the knob adjusts the tonearm cueing height.

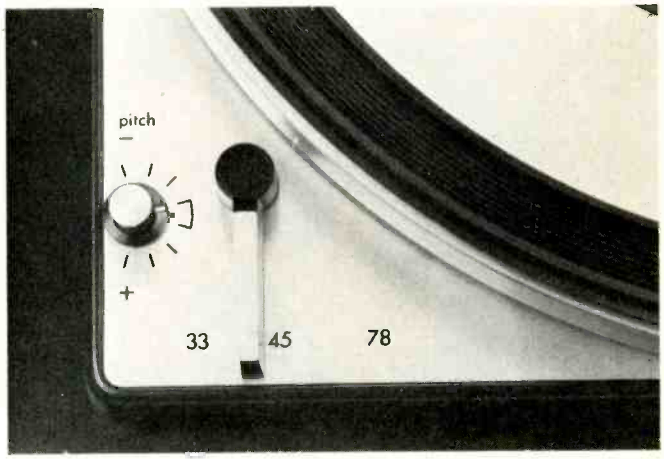
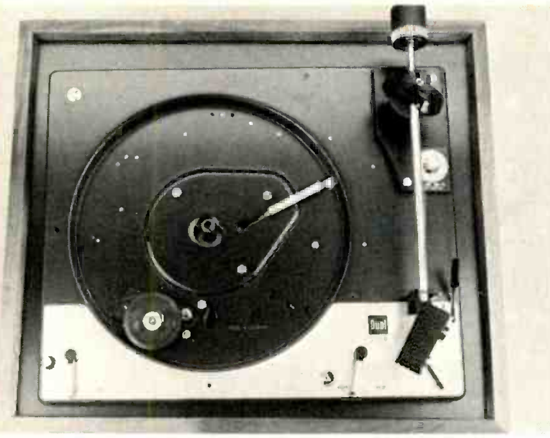


Fig. 4—The left-front corner accommodates the speed controls—the lever for the three nominal speeds, and the knob for vernier adjustment of turntable speed over a range of $\pm 3\%$.

and the manufacturer claims bearing frictions of less than one-hundredth of a gram in the vertical direction, and less than two-hundredths in the horizontal.

The cartridge mounts on a holder which is locked to the tonearm head by a single lever. One advantage of this cartridge holder is that the screw head fits into slots in the holder and the cartridge is held by nuts on the cartridge end of the screws, so it is not necessary to choose the exact length of mounting screw to avoid excessive length which would inhibit the proper seating of the holder in the head. In some cartridge mounts, the screw threads directly into the plastic mount, and again the exact length must be selected to avoid interference with the placement of the holder into the head. Furthermore, threads into the plastic often wear with several changes—as some of us are wont to make in the search for the best cartridge for our systems. In the 1218, the vertical tracking adjustment is built into the head, with a small knob extending to the right to permit setting for single- or multiple-record use. This knob turns 90 deg. to either the "S" position for single-play use, and to the "M" position when several records are stacked on the spindle. This control adjusts for 15-deg. tracking for either one record, or for the middle records of a stack of six.

The arm rest is fitted with a lock which secures the arm to the post and should normally be released before starting to play. However, if you should fail to release the lock, you have



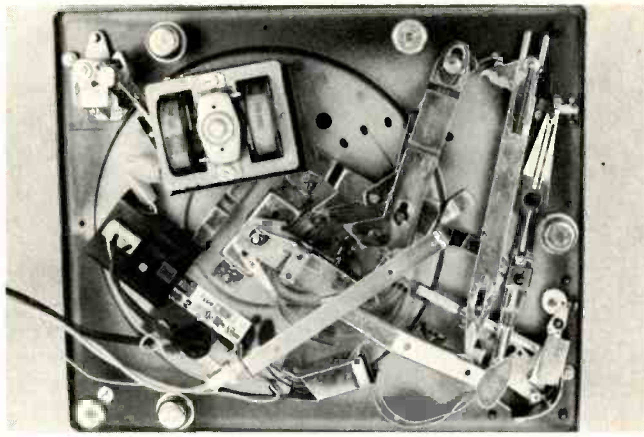


Fig. 5—Top view of the unit with the platter removed, showing the simplicity of *this* side of the chassis. The idler wheel, shown at the lower left of the turntable well, retracts from the stepped and tapered motor shaft when the STOP position.

Fig. 6—The underside of the chassis is where the complexity is—and it is remarkably similar to the top-of-the-line 1219.

only to wait until the unit goes through its cycle and the operating lever returns to the center position. No harm will occur. You simply release the lock and start again.

The right front corner of the chassis is where the action is—the lever to the right controls the point at which the arm sets down—for 7-, 10-, or 12-inch records. The other lever has a rest position at the center, and start and stop positions. To initiate playing, you press the lever to the left, and the mechanism takes over: starting the motor, raising the arm from the rest and positioning it over the lead-in groove of which record size you have selected, lowering the arm gently to the record, and returning the lever to the center position. If you prefer, you simply lift the arm from the rest and position it over the record anywhere you like—the motor starts and you can either place the stylus on the record by hand or you may use the cue-control lever to lower the arm automatically. You can interrupt the play at any time by moving the cue lever forward—the arm will lift up, but the motor continues running, and you can continue playing from the same place by moving the cue lever back.

If you are playing a stack of records, you operate the start lever and let the mechanism take over—the entire stack will be played through the unit will stop, returning the arm to the rest and shutting off the motor. To reject a record and change to the next one on the spindle, you move the lever to the start position. You can even play one record continuously by using the automatic spindle and placing the 45-rpm adapter disc on the spindle platform.

over at the other corner of the chassis are the speed controls—a lever to select the nominal speed of either 33⅓, 45, or 78 rpm—and a knob which varies the speed up or down by three per cent as desired to match the pitch to an instrument, for example.

Performance

The 1218 is an especially easy turntable to use. The controls are foolproof, and no harm results from changing a control setting during a change cycle, for instance, or for forgetting to release the arm lock before starting the playing. It has all the features needed for controlling its action, and appears to be well constructed. It is, of course, the most recent of a long line of changers and record players which have been improved continuously since the introduction of the first Dual in 1927, when the name came from a combination of both spring drive and an electric motor in the same turntable.

The platter is die cast of non-ferrous material and weighs four pounds—always a desirable feature to ensure constancy of speed. The black and chrome appearance of the unit is attractive, simple, and functional.

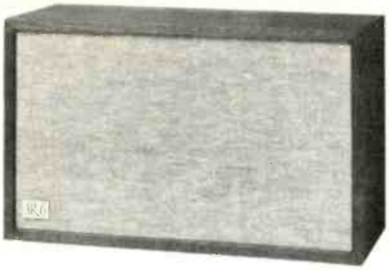
We measured its performance characteristics and found a signal-to-noise figure of 44 dB, using the old NAB method. With a standard "A" weighting network, this figure increases to 62 dB—in itself considerably better than the average "hi-fi" single-play turntable of a decade ago. Wow—the speed variation below 6 Hz—was measured at 0.1 percent—while flutter was 0.05 percent measured from 5 to 250 Hz. Cycling time was measured at 13 seconds when operating at 33⅓ rpm, 11 seconds at 45, and 8 seconds at 78. Well do we remember when a changer that cycled in 25 seconds was considered acceptable—as, of course, it was if you compared it to the early models of the Capehart, for instance.

The synchronous motor showed no speed variation whatever over a voltage range from 85 to 135 volts, but being synchronous, it was susceptible to frequency variations in the supply. This is of little concern to anyone in this country, since electric companies must maintain a close tolerance over frequency to make interconnections between areas possible. If the unit were to be used in other countries, it would require a change of the motor pulley, since the United States and Canada are just about the only places where 60 Hz is the prevailing frequency of power lines. However, this problem would arise with any synchronously driven equipment, and it can be cured, fortunately.

For those who long for a fine turntable but who cannot get up the scratch for the 1219, the 1218 is a logical choice, and it will certainly give long and satisfactory service for the average user. *C. G. McProud*

Check No. 61 on Reader Service Card

Acoustic Research AR-6 Loudspeaker System



MANUFACTURER'S SPECIFICATIONS

Speakers: Two; 8-in. woofer, with 56 Hz resonance in system, and 1½-in. diameter cone tweeter. **Enclosure Type**: Acoustic Suspension. **Crossover Frequency**: 1,500 Hz. **Impedance**: 8 ohms. **Size**: 19½ in. W. x 12 in. D. x 7 in. H. **Weight**: 20 lbs. **Price**: $81.00.

Acoustic Research's Model AR-6 has deceptively similar specifications to the AR-4x. Both are two-way systems, having 8-in. woofers, crossover between 1 and 2 KHz, and their enclosures have virtually the same volume.

Dimensions of the AR-6 are 19½ by 12 by 7 in., and thus it is one of the few bookshelf loudspeakers truly deserving the name. These proportions, besides being practical, are aesthetically more pleasing as well. It is supplied with instructions for hanging and fusing, as well as hook eyes and feet pads.

The tweeter uses the magnet structure of the AR-4x but it has a cone diameter of 1.5-in. instead of 2.5 in. A ⅝-in. dome is in its center with a viscous damped voice coil behind. See Fig. 1.

We compared the AR-6 and the AR-4x speakers with a variety of program material and the AR-6 quickly established itself as the superior speaker. This is not to say that the AR-4x is not any less of a bargain at $63.00, but to our ears, the additional $18.00 that the AR-6 costs is clearly audible.

The greatest improvement is in the performance of the 1.5 in. tweeter. Better dispersion, coupled with smoother and wider response, are responsible for the spacious stereo image. Woofer response is good down to 40 or 50 Hz with very little harmonic distortion, a hallmark of all AR speakers.

After our listening tests, we went to the more objective measurement procedure. System input consisted of ⅓ octave pink noise at 1.6 volt. This gave 84 dB S.P.L. at 40 in. on-axis, high frequency control set at maximum.

Figure 2 shows the system's frequency response. The dotted line is speaker response minus room interference. The most notable feature of Fig. 2C, which incidentally is most representative of what a listener will hear, is its unusual smoothness and excellent high frequency power response.

The lack of harmonic distortion, even at levels in excess of 100 dB, was equally gratifying. See Fig. 3.

Impedance stayed close to its rated 8 ohm value, and with the high frequency control at normal, never went below 6.75 ohms, as shown in Fig. 4. At maximum setting of the high frequency control, the impedance dipped briefly to 5 ohms at 8,000 Hz—still quite safe for any decent amplifier, but an unlikely balance setting for all but a Victorian living room.

Tone burst response, as shown in Fig. 5, reveals excellent transient response at all test frequencies. Efficiency was what one would expect from an acoustic suspension loudspeaker, medium to low. Twenty to 40 watts is sufficient power to drive this speaker system, depending on one's musical taste.

After listening to the AR-6 on and off during a three-week period and comparing it with its biggest brother, the AR-3a, we had no reason to change our initial high opinion of it. We predict that the AR-6 will supplant the AR-4x on the best seller list and probably establish itself as the standard for other loudspeakers in the under-$100.00 class. *Alex Rosner*

Check No. 62 on Reader Service Card

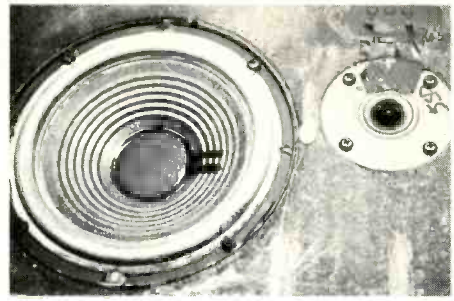


Fig. 1—Front view of the speaker elements, with the grille removed. Note the relative sizes of the drivers.

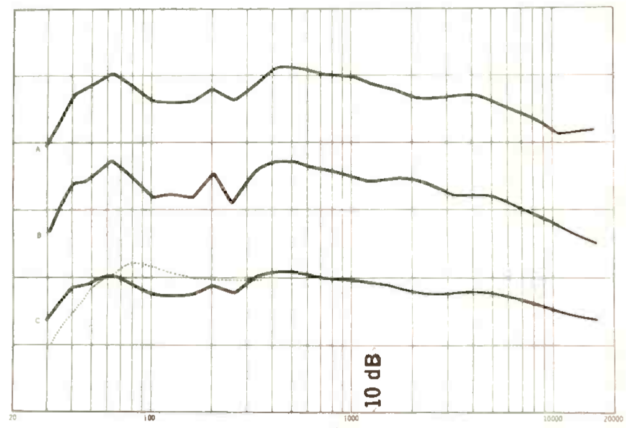


Fig. 2—Frequency response of the AR-6 loudspeaker to ⅓-octave pink noise, **A**, on-axis; **B**, 45 degrees off axis, and **C**, average of five readings. The dotted line compensates for room interferences.

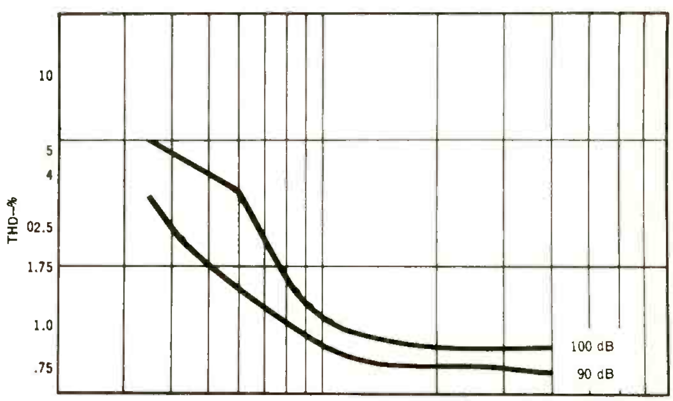


Fig. 3—Harmonic distortion at 90 and 100 dB S.P.L.

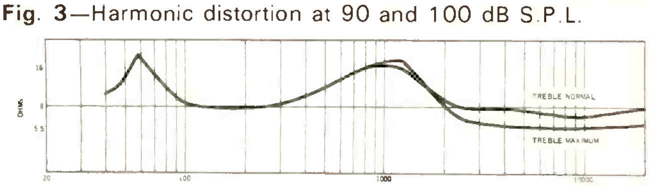


Fig. 4—Impedance curves at two settings of the unit's treble control.

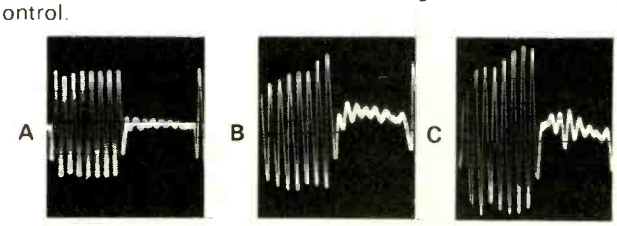


Fig. 5—Tone burst response at **A**, 500 Hz; **B**, 8000 Hz, and **C**, 10,000 Hz.