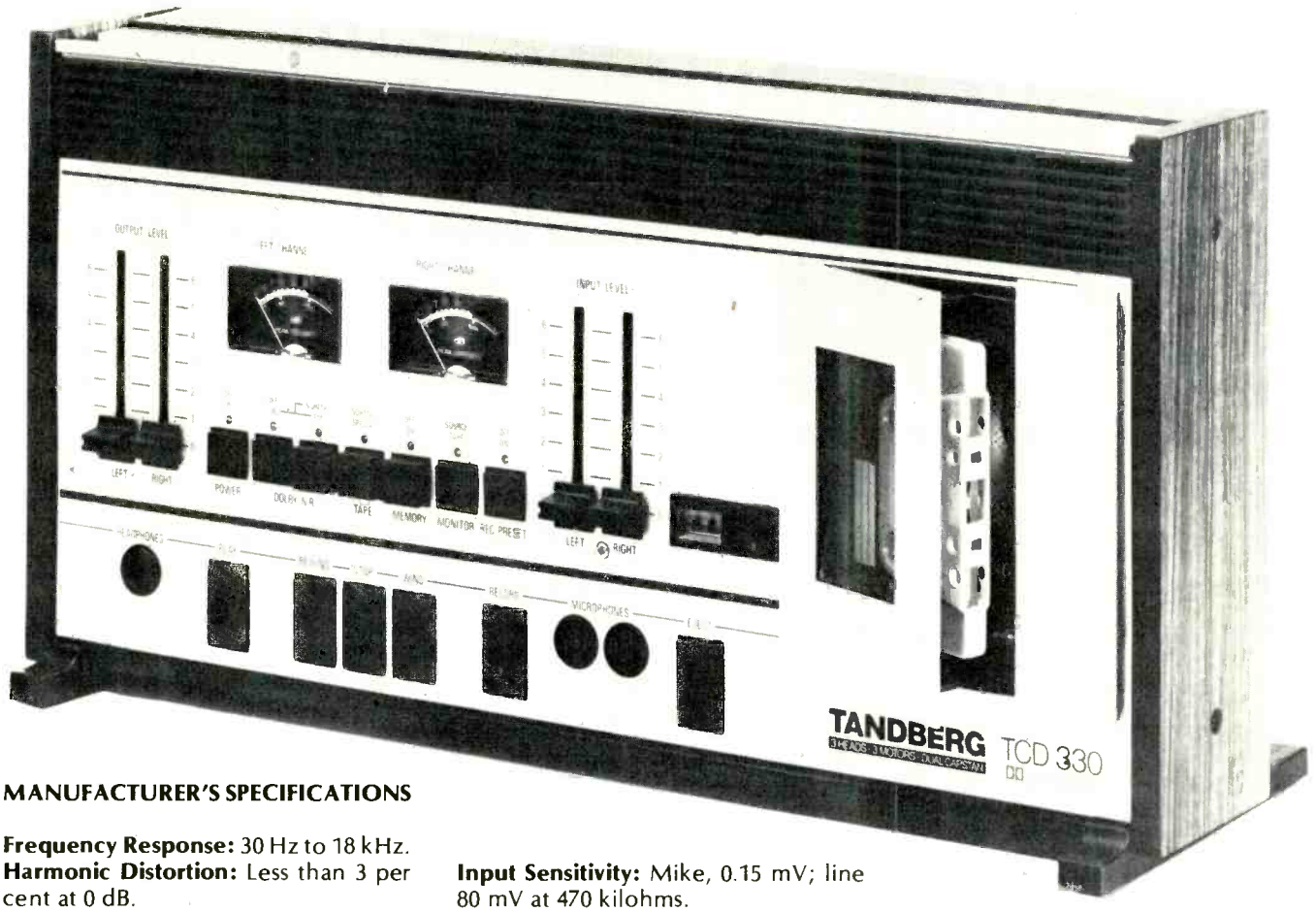
Tandberg Model TCD 330 Cassette Deck



MANUFACTURER'S SPECIFICATIONS

Frequency Response: 30 Hz to 18 kHz.
Harmonic Distortion: Less than 3 per cent at 0 dB.
S/N Ratio: 65 dB at 3 per cent THD with Dolby.
Separation: 35 dB.
Crosstalk: 60 dB.
Input Sensitivity: Mike, 0.15 mV; line 80 mV at 470 kilohms.
Output Level: Line, 1.5 V, headphones 5 mW @ 8 ohms.
Wow and Flutter: 0.18 DIN wtd. peak.
Speed Deviation: 0.5 per cent.
Dimensions: 18 ½ in. (47 cm) W x 4 1/8 in. (10.5 cm) H x 9 1/8 in. (23 cm) D.
Weight: 15 ¾ lbs (6.6 kg).
Price: $995.00.

The Tandberg TCD 330 three-head cassette deck provides excellent overall performance with a number of interesting and helpful features. Its appearance is similar to other Tandberg products, with an aluminum front panel, wooden end pieces, and the square push-button switches. The TCD 330 can be operated either horizontally or vertically, on a table or even hung on a wall. Snap-on feet are provided to ensure stability in the vertical on-table position, used for the following description. The output level slide pots are at the left, with the headphone jack below. The two peak-reading meters are scaled from -30 to +5 dB with the Dolby level reference at -2.5 dB. The white and red scale with the blue background and the good illumination combine to make for good meter legibility. Below the two meters is a rather imposing row of large push-button switches, each with its own status light. Starting from the left, the power *On/Off* switch is first, followed by the Dolby button, and then a selector for decoding FM/Dolby broadcasts. The *Normal/Special* tape switch is next, and then the *Memory* On/Off. The *Monitor* switch to the right allows selecting either *Source* or *Tape* (from the unit's playback head) to be fed to the outputs. The meters, however, always show source (or record level) except for record head alignment or when a tape is simply being played. The last button in the row is the *Rec Preset* switch. If the preset is not *On*, a recording cannot be started even if *Record* and *Play* are accidentally pushed at the same time. Once the switch is preset, however, a recording can be started just by pushing *Record*.

Below are the light-touch tape-motion switches with *Rewind*, *Stop*, and *Wind* centered between *Play* on the left and *Record* to the right. Logic control permits switching in any order with the exception that *Record* is only possible from *Stop*, or *Play* if both buttons are held in (*Rec Preset* pressed). At first the layout seemed a little odd, but in use the convenience of it seems very logical. *Play* is near the headphone jack and the output level controls: what else to play the tape for but output? *Record* is handily under the preset switch, and the mike jacks and the input pots are just to the right. Below the counter is the control button for the *Eject* solenoid. On the back of the unit is a manual release for the cassette which can be used when the power is off. The well opens up for cassette insertion from the right. Removing the snap-in cover provides easy access for all cleaning and demagnetization tasks. A window in the cover and a light in the bottom of the well facilitates observation of tape motion. All the way to the right is the access door for the 10 kHz alignment tone switch and the record-head azimuth adjustment. When the test tone is turned on with the deck in *Record*, its playback level appears on the right meter. The record-head adjust knob is turned for a maximum in-

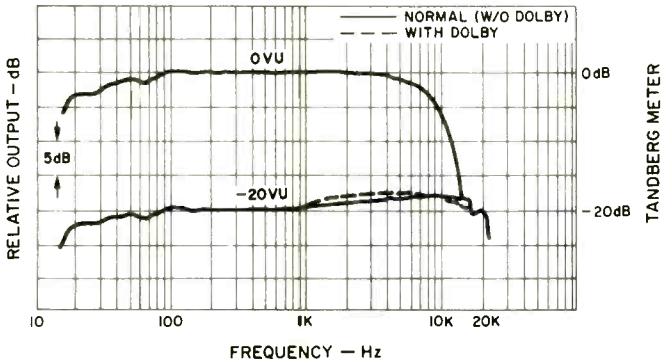


Fig. 1—Frequency response plots with Maxell UDXL tape with the *Normal* tape select.

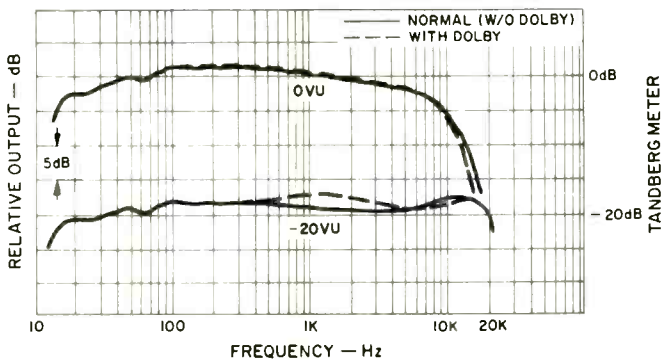


Fig. 2—Frequency response plots with the Maxell UDXL II tape with the tape select on *Special*.

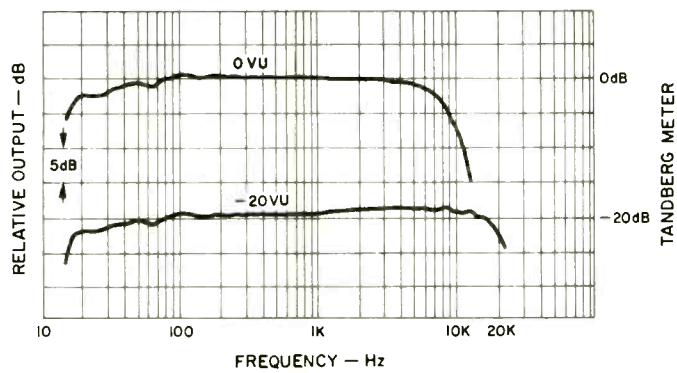


Fig. 3—Frequency response plots with the Ampex 20-20+ with the *Normal* tape select, both with and without Dolby. The Capitol Music tapes are substantially identical with the Ampex.

dication, thereby ensuring alignment with the playback head. Access is also provided for playback head adjustment by qualified personnel using an alignment tape.

On the top are the line in/out connectors, the multiplex filter switch and a remote-control socket. A snap-on cover keeps cabling snug to the unit for an extra-neat appearance. Holes in the back metal cover provide access to adjustments, but there are no labels either there or on the large circuit board revealed with the removal of the cover. Elements of the dual-capstan closed-loop drive system could be examined with this view. There was a good-sized hysteresis-synchronous motor which belt drives the flywheels of the capstans. The two direct-drive d.c. motors are servo controlled with motion sensing and pre-tensioning for fast, smooth tape handling without loops or excessive tension.

Performance

The playback responses of the Tandberg TCD 330 were within 2 dB for both the 70- and 120-microsecond equalizations at all frequencies, except for slightly greater droop at the highest frequencies with the chrome EQ. The record head was aligned for each test cassette using the built-in 10 kHz test tone. After alignment, an external 10 kHz signal was recorded on both channels, and playback was fed to a two-channel scope. The average phase discrepancy was only three degrees, with a maximum error of just eight degrees. This is excellent alignment, and it might be noted that the average phase error at 1 kHz would be 0.3 degrees. Tests with pink noise and the third-octave real-time analyzer showed that good results were obtained with Ampex 20-20+, Capitol Music, Nakamichi EXII, and TDK Audua, as well as with the Maxell UDXL and UDXLII cassettes supplied with the unit. Record/playback responses were run at *Normal* settings with Maxell UDXL, Capitol Music and Ampex 20-20+. The results were almost identical, within 3 dB at meter zero from 19 Hz to 8 kHz. At -20 dB, the responses extended from 17 Hz to over 20 kHz, notably better than the 30 Hz to 18 kHz specification. With the UDXL and *Special*, response at meter zero was from 18 Hz to 7 kHz, and from 17 Hz to 20.4 kHz with the record level 20 dB lower. The results with Dolby were very close for all tapes, with a little boost around 2 kHz at -20 dB for the Maxell tapes. A record/playback response 2.5 dB down at Dolby level, more in accordance with the zero level of other machines, showed a headroom limit of 9 kHz.

Measurements of HD_3 (third harmonic distortion) vs. level with a 1-kHz test tone were made from -15 to +6 dB. The results with Maxell UDXL and UDXLII were very similar. HD_3 was about 1.4 per cent at meter zero, much less than the specified 3 per cent. At Dolby level, HD_3 was 0.8 per cent, and at -15 dB, it was down to 0.06 per cent. Operation with Dolby reduced the distortion figures by 20 to 30 per cent. Data was also obtained on HD_3 vs. frequency from 30 Hz to 7 kHz with Maxell UDXLII at meter zero and 10 dB below that. At the lower record level, the distortion was 1.0 per cent or less from 30 Hz to over 6 kHz.

The signal-to-noise ratio was 52.2 dBA (A-weighted) at meter zero for UDXL tape and 55.3 dBA for the UDXLII tape. With a reference level where $HD_3 = 3$ per cent, the ratio was 55.3 dBA for UDXL and 58 dBA for UDXLII. With Dolby and $HD_3 = 3$ per cent, the figures were 62.9 dBA for UDXL and 65.6 dBA for UDXLII, both excellent results. Separation from one track to the other was 35 dB, exactly as specified. Crosstalk to the adjacent track of opposite play direction and erasure were both at least 75 dB down, excellent performance. Mike input sensitivity was 0.16 mV, better than most decks and substantially to specification. Line input was 77 mV, slightly better than the spec. The multiplex filter notch was

28 dB down at 19 kHz. The playback of 0 dB record was varied with the output pots with a maximum of 1.4 volts, somewhat less than the specified 1.5 volts, but still considerably higher than most decks. Headphone drive into 8 ohms was 880 mV, producing a high and easily controlled volume. The two meters tracked very closely, and the scale markings were without error from -10 to +5 dB. The TCD 330 zero level is higher than most others, actually 2.5 dB above the Dolby reference. The feed to the meters is after record EQ, rather than the more-common before-EQ connection. The response was up 4 dB at 30 Hz, 6 dB at 10 kHz, and about 12 dB at 20 kHz. With the relatively limited headroom of cassette systems, this scheme helps to ensure that high-level sounds at the frequency extremes aren't distorted or self-erased from too high a recording level. Measurements of the meter dynamics showed that the indications were down just 1 dB with a 90 millisecond 1 kHz tone burst. Additional checks proved that the response met the requirements of British Standard 4297 for peak program meters. The slower decay time was judged to be well chosen for operational use.

The lowest measured flutter was 0.02 per cent DIN weighted peak, with an average value of 0.065 per cent. These figures are outstanding for a cassette deck, and much better than the specified 0.18 per cent Wtd peak. Tape play speed was measured to be 0.6 per cent fast, slightly above the specified 0.5 per cent limit. Speed variations with time or with line voltage were negligible. Rewind time was 44 seconds, much faster than many units, and the winding was smooth throughout. The built-in slow-up near the end resulted in a low-stress non-bang stop. Cassettes were inserted with varying amounts of purposely-introduced slack and the pre-tensioning system promptly eliminated any loose loops. With the cassette well cover removed and the deck in play, a small screwdriver was used to stop rotation of one spindle and then the other. The take-up motor's brush-noise sensor detected the condition generating the loose loop, putting the deck into *Stop* before any damage had been done to the tape. When the supply hub was stalled, that motor's sensor caused a switch to *Stop* quite promptly. A small amount of curling was noted on one edge of the tape, but at worst the effect on the recorded music was minor. Such purposely generated problems might not be common, but Tandberg's sophisticated design does provide possible benefits not available in other decks.

In-Use Tests

The deck was easily operated either horizontally or vertically. The horizontal orientation facilitated cassette insertion and removal and was more suitable for on-shelf use, but the in-panel meters were harder to see. The vertical position was used most of the time for better observation and operation during the testing. All controls and switches worked smoothly without any malfunctions during these tests, including a concerted effort to defeat the tape motion controls and their associated logic. The status lights were useful, particularly with the quiet operation of the deck. The peak-reading meters were easy to read and record levels could be set more quickly than would be the case with VU-type meters. Personally I liked the TCD 330 approach for monitoring while recording. Even when switched to *Tape*, the meters continue to show the record level, and the output level pots set headphone and line levels. I've always been a little nervous when I switch to monitor on a typical unit, and then in setting a good listening volume, end up with nothing showing on the meters.

The record head was aligned for all cassettes used in the course of this evaluation with the built-in 10 kHz test tone. As the adjustment is made while monitoring playback, any

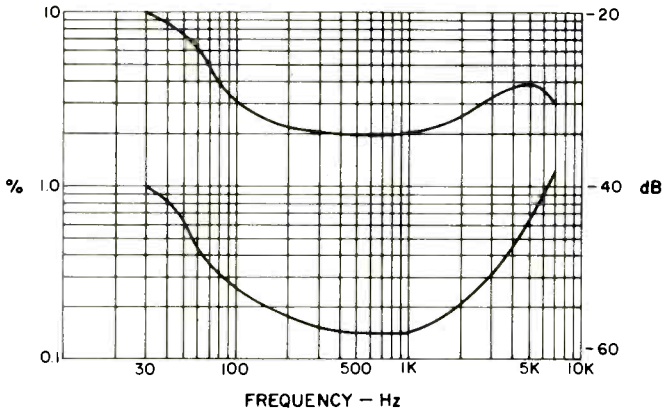


Fig. 4—Third harmonic distortion vs. frequency with the Maxell UDXL II tape and Dolby off with the meter readings at 0 and -10.

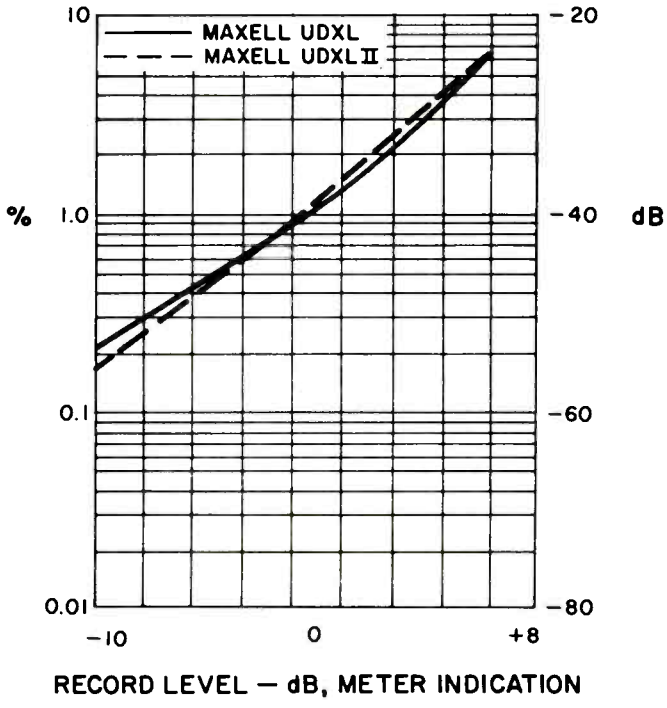


Fig. 5—Third harmonic distortion vs. record level with the Maxell UDXL and UDXL II tapes with the Dolby off (at -15 dB the THD was 0.06 per cent).

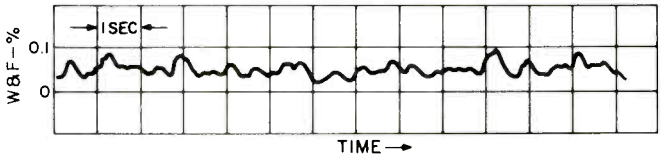


Fig. 6—The weighted peak wow and flutter at tape middle; the wow and flutter at the start and finish are substantially the same.

variations from tape record sensitivity, bias requirements or poor tape/head contact are shown at the same time.

The instruction book is not very detailed and does not include a schematic...but it is well written and includes very good illustrations. There is a limited list of recommended tapes, which is consistent with the lack of information on internal adjustments that might be required for other tape formulations. The listening tests included both FM and discs, switching back and forth from *Source* to *Tape*. This monitor switching generated no detectable clicks. Record on/off transients were substantially at tape noise level. No problem ensued from having the multiplex filter switch out of sight, but for the forgetful it would also be "out of mind." It didn't take long to conclude that playback was "as in" except when levels were set extra high. The good low-frequency response was particularly evident with one rock-band recording. Overall, the premium-priced Tandberg TCD 330 provides excellent performance, particularly in some areas, and a number of interesting and helpful features for the serious audiophile. *Howard A. Roberson*

Enter No. 71 on Reader Service Card

AKG C451E Condenser Microphone System

MANUFACTURER'S SPECIFICATIONS

CK1 Microphone Capsule

Type: Pressure Gradient.
Frequency Range: 20-20,000 Hz.
Directional Characteristic: Frequency-independent cardioid.
Sensitivity at 1000 Hz: 0.95 mV per microbar; 0.95 mV/Pa; -41 dBV/Pa; -38 dBm.
Unweighted Noise Level: 3.6 microvolts eff., -107 dBm.
Weighted Noise Level: 2.2 microvolts eff., -111 dBm, filter CCITT-c/DIN 45-405.
Equivalent Noise Level: 21 dB.
Capsule Capacity: 27 pF.
Weight: 20g; gross weight, 60g.
Temperature Range: -20°C (-4°F) to +60°C (140°F).
Humidity: 99 per cent at 20°C (68°F), 95 per cent at 60°C (140°F).
Dimensions: 18mm diameter x 26.3 mm long.
The above measured with an AKG standard measuring preamplifier with following data: no-load amplification, 0.47; input capacitance, 12 pF; polarization voltage, 62 V.

C451E Preamplifier

Type: FET preamplifier.
Frequency Range: 5-30,000 Hz.
No-load Amplification: 0.47 ±0.5 dB.
Source Impedance (20-20,000 Hz): ≦ 200 ohms.
Supply Voltage: 9 to 52 d.c. Sensitivity is proportionally reduced from 7.5 to 9 V.
Noise Level: see CK1 data.
Current Consumption: ≦ 5.5 mA (DIN 45-596).
Sensitivity to Magnetic Stray Field: At 50 Hz, 5 microvolts/50 milligauss (-138 dBm, 1 milligauss); at 100 Hz, 8 microvolts/50 milligauss; at 1000 Hz, 80 microvolts/50 milligauss.
Load Impedance: ≧500 ohms.
Harmonic Distortion at 1000 Hz (UE= 200 mV): ≦0.5 per cent.
Weight: 74g, Gross Weight, 370g.
Temperature Range: -20°C to +60°C (-4°to 140°F).
Humidity: 99 per cent at 20°C (68°F), 95 per cent at 60°C (140°F).
Dimensions: 18 mm diameter x 120 mm long.
Connector: XLR-3 pin male.
(dBm) values computed for 150 ohm impedance.
Prices: C451E combination, $229.00; complete with CK1 microphone capsule, C451E preamplifier, W3 foam windscreen, and SA15/1 stand adapter.

Optional Accessories

B46E battery supply unit (9V), $75.00; MCH-20 extension cable, XLR plugs, $13.00; H60 elastic suspension, $18.00, and H15 elastic suspension, $37.00.

The AKG CMS Series includes a large "a la carte" selection of studio-quality condenser microphone components. These include microphone capsules, preamps, power supplies, windscreens, "shotgun" pipes, and mountings. From these interchangeable modular parts, the user may assemble microphones varying from a pop-proof cardioid mike for close talking to a "shotgun" type for distant sound pickup.

We tested a cardioid system suitable for many professional or advanced audiophile applications in speech or music pickup. The CK1 capsule is a cardioid type with nominally flat frequency response. The capsule housing is an acoustically open structure enclosing the transducer element, which is similar in size to a stack of three or four nickels. The gold-film coated plastic diaphragm is stretched and cemented to the front of the transducer. The membrane has a rough surface which AKG says is a micro-

embossed pattern which controls tension. Apparently this is similar to the embossed corrugations in a ribbon which serve to increase compliance and stabilize the tuning. The exterior of the transducer is coated with an organic finish which probably keeps out moisture. The rear sound port is a sintered metal disc about ¼-inch in diameter. This disc is made to pass sound and barometric pressure, but retard moisture.

The CK-1 is advertised as stable with temperature and humidity, and we can believe this after examining the transducer. We are not equally well impressed with the electrical contact arrangement, which reminds us of a carbon microphone. The "hot" center contact is via a gold-plated spring which may have a resonance at some audible frequency. This spring also presses the gold-coated diaphragm against the case, forming the ground connection.

The C451E preamplifier is a FET-input discrete component circuit. A balanced low impedance output is provided by a transformer. The C451E "handle" also includes an integral 62-volt power supply for polarizing the capsule. A standard two-wire shielded microphone cable carries audio away from, and brings d.c. power to, the preamp. A so-called "phantom" power circuit is used. The audio signal is balanced to ground, but the d.c. is an unbalanced "common-mode signal." D.C. power, for our test, was obtained from the B46E battery supply. This contains an audio transformer with the primary center tap connected to the positive terminal of the 9-volt battery. The user may be able to provide power from the recorder or mixer and save on the cost of this accessory.

The "phantom" power arrangement is obviously compatible with either dynamic or ribbon microphones. In other words, the "common-mode" d.c. will have no effect if an electrodynamic mike is plugged into the condenser input. However, if you make a wiring error, the ribbon or voice coil could be destroyed. The output of the B46E is a balanced, low impedance line with no d.c. on it.

The application of the other accessories is obvious, but the cable deserves mention. AKG has engineered their own high quality microphone cable with long flex-life conductors and an especially tough plastic jacket. These cables are available in four colors which is a boon to multi-mike setups.

Packaged along with the microphone capsule was a frequency response graph, which showed the CK1 capsule to be +3-6 dB from 40 Hz to 15 kHz. Enclosed with the hardware was a data sheet on the preamp alone and a two-page pictorial showing the CMS line. We received separately a batch of microphone applications information intended for audiophiles and musicians, emphasizing the AKG dynamics, but not describing how the CMS studio condensers might be used in these applications. We were not supplied the usual explicit instructions (connect jack "A" and socket "B") which accompany most domestic microphones. (*Editor's Note:* We understand that AKG has a new owner's manual in progress, but was not able to complete it in time to supply one for the review.)

Laboratory Tests

The impedance curve (Fig. 1) shows that the impedance is not 200 ohms or less from 20 to 20,000 Hz, as specified, though it is within spec from 25 Hz to 8 kHz. We suspect that the transformer in the battery pack may be responsible, but AKG does not specify what effect this transformer may have. The rise at 20,000 Hz is due to the leakage inductance of preamp and battery pack transformers. It had no effect on frequency response when the mike was tested with a broadcast preamp. We recommend a load of not less than 1000 ohms,

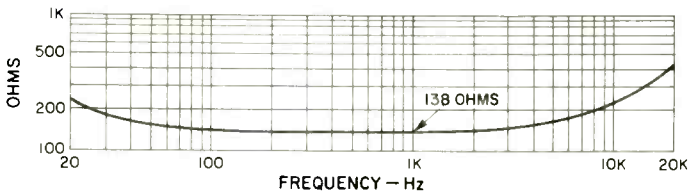


Fig. 1—Impedance of the AKG C-451E microphone.

corresponding to a high-quality 150-ohm "unloaded" input. The rise at 20 Hz is caused by the output coupling condenser in the preamp. This may indicate an undersized capacitor which could cause some loss in low frequency response if load impedance is not high enough.

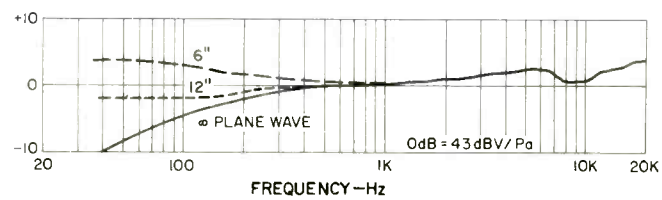
The frequency response (Fig. 2) shows a smooth and slightly rising response. From 500 to 20,000 Hz, the AKG is somewhat flatter and smoother than our RCA BK-5B reference microphone. Above 500 Hz, our curve agrees precisely with the calibration curve supplied with the microphone. Below 500 Hz, it is flat at 12 inches, but with a pronounced rolloff for plane waves or sources greater than 3 feet away. The AKG may be preferred for high fidelity reproduction of treble instruments, voice, or the close miking of bass instruments, but it's my opinion that it will not be as good as the BK-5B ribbon mike for distant miking of symphony orchestras, as mentioned later. The AKG curve shows the response of the *capsule only*, which is down 6 dB at 50 Hz. Apparently, the preamp and battery box account for an additional 2 dB loss at 50 Hz, which might be reduced with alternative powering arrangements. (*Editor's Note:* AKG confirms that statement.)

The low frequency response of the AKG is similar to the V1 (voice) response of the BK-5B. This is an excellent characteristic for distant speech pickup as it suppresses low frequency room noise. The AKG should be good for pickup of stage plays or opera.

The sensitivity of the AKG is more than 10 dB higher than the BK-5B or other electrodynamic microphones. For most applications, we recommend a 10-dB attenuator at the input of the mixer or recorder. AKG sells attenuators for use between capsule and preamp for use with high sound levels, though with normal sound levels these will degrade signal-to-noise ratio. We found the CK1/C451E will not clip on peaks up to 130 dB, so there is little need for the capsule attenuators—unless you are recording jet aircraft. In-line attenuators are available for low impedance microphones from several manufacturers. Take care that an attenuator does not interfere with d.c. powering.

The directional characteristics (Fig. 3) show a cardioid unidirectional pattern that is extremely uniform with frequency. It is superior in this respect to almost any mike we've tested. This means that undesired sounds of all frequencies will be uniformly rejected, and the sound of distant sources in reverberant rooms will be most accurately reproduced.

Fig. 2—Frequency response vs. distance.



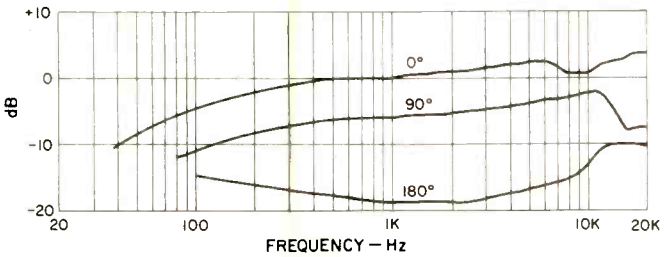


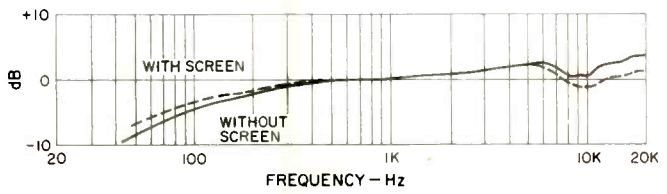
Fig. 3—Frequency response vs. angle.

While tapping the AKG microphone, we noticed a bell-like ringing sound that decayed slowly. We made a one-third-octave band spectrum analysis of the vibration noise of the AKG compared to the BK-5B (Fig. 5). Some of the higher noise of the AKG can be attributed to the higher mass of the condenser diaphragm as compared to the ribbon. The 630-Hz resonance is far more annoying than it seems on the graph, and we suspect it may be related to the contact spring. The 630-Hz resonance could also be related to the acoustical resonance of the preamp case's air space. The vibration sensitivity of the AKG is not significantly reduced by the H60 shockmount. We did not try the H15 mount which looks like a better design. If you have a vibration problem that the H15 doesn't solve, try adding some mass to the microphone.

The H60 shockmount which we tested is a small shockmount, intended for use with a floor or desk stand. It is very compliant in a direction parallel to the microphone axis, but very stiff in the perpendicular direction. The H15 mount is a larger one which could be used on a mike boom or stand, and it will probably have reasonably equal compliance in all directions. As with all low-mass mikes, the AKG is difficult to isolate and a very compliant mount is required.

Another indispensable item is the windscreen, which is supplied as part of the C451E "combo" package. The wind and "pop" sensitivity of the CK1 is very high. The integral capsule grille is formed by one piece of wire mesh which is both too open and too close to the diaphragm to offer much protection. We found that the foam windscreen offers excellent protection, virtually eliminating wind and "pop" noise. It would be a good idea to use this screen for all applications, but what effect does this use have on performance? We tested frequency response for each cardinal direction: 0°, 90°, 180°, both with and without the screen. The effect of the screen was minor, but easily measured with this high quality microphone. Only the 0° response (Fig. 4) is shown, for clarity. Significant but not objectionable changes were noted in the 90° and 180° responses. High frequency response is slightly reduced because the screen acts as a resistance in series with the acoustically capacitive diaphragm. If this were a pressure (omnidirectional) microphone, no change in low frequency response would be observed. The bass response of the AKG is improved because the screen covers the side sound entrances. You may imagine that less sound reaches the rear of the diaphragm, and since it responds to the pressure gradient (difference between front and rear pressure), the net pressure acting on the diaphragm increases. The screen has a net flattening effect on response, and we recommend it be used at all times. AKG offers an attractive metal screen with foam lining that is more durable. The frequency response must suffer a little from acoustic reflections off the metal screen, so the plain foam screen performs best.

Fig. 4—Effect of foam windscreen on the AKG C-451E Microphone.



The phasing test with the EMT Polarity Tester revealed that the red wire of the output cable from the battery box is positive with positive sound pressure. Before you conclude that this fully agrees with EIA standards, read RS-221 paragraph 3.3 again: "...in phase terminal shall be the red (or other than black) conductor, the out-of-phase terminal shall be the black conductor." Since the cable does not contain a black conductor, the AKG system does not conform to standards. We recommend that AKG follow EIA RS-215 which calls for red and black conductors in broadcast microphone cables. (*Editor's Note:* The B-46E power supply is now being supplied, says AKG, complete with a standard XLR-type connector mounted on the output cable. Both the microphone and the power supply are phased [poled] "pin 2 high," i.e. positive acoustic pressure on the microphone's diaphragm will result in a positive voltage on pin 2 with reference to pin 3. This follows IEC standard 268-12 and IEC 268-4.)

We found the MCH-20 extension cables to be of excellent quality. The Swiss-made three-pin connectors are inferior to either the Cannon XLR or Switchcraft A3 type connectors. The strain reliefs are a positive sort, in that they continue to tighten as force is applied. The ones on the set supplies needed additional tightening, as they were a bit loose when received, and the cable could be twisted inside the relief. The female connector did not mate easily with the plug on the microphone. (*Editor's Note:* These connectors were from the initial production run, and several design changes will be implemented in the final product available by the end of this year. AKG says that their original design intent was to provide a connector with a compliant insert which would be compressed during mating to prevent rattling during use.)

Subjective and Listening Tests

We recall from the classic theoretical studies that a condenser microphone with less than approximately 150 volts, polarization could be too noisy. The AKG uses 62 volts, but was quiet enough that we could not measure the noise without replacing the microphone with a capacitor. Subjectively, it seems quiet enough for most applications, but if you intend to use it for extremely low sound levels, we suggest you check the noise level first.

As previously indicated, the preamp has quite a high output capability and did not clip or distort with any sound we could generate, up to about 130 dB.

The very low magnetic hum sensitivity rating was difficult to believe, what with the unshielded transformer in the preamplifier. We found the hum to be less than our BK-5B reference microphone so we believe the specification is correct. The CK1/C451E is extremely impervious to magnetic fields. AKG transformers utilize D-U laminations and two separate coils, which is a hum-bucking design.

The mid range and high frequency sound is extremely clear and transparent, and perhaps just a little cleaner than our BK-5B. The bass response sounds a little thin compared to the BK-5B for sound sources such as a bass viol in an orchestra where just two microphones are used at a great distance. For close miking and most "pop" music, the AKG is

just about the best microphone we've heard. But for classical recordings, the BK-5B or 77-DX ribbon microphones remain our favorites, as the small orchestras we record are always weak on bass.

The quality and durability of the AKG products is excellent. Most parts are abrasive blasted and nickel plated, resulting in a very tough finish. Biomechanics are good, save for the stand adapter. It is very difficult to slide the microphone into the plastic clamp because neither microphone nor clamp have chamfered edges. These remarks apply to the clamps on the SA15/1 and H60. (*Editor's Note:* AKG says they are now changing the adapters to a less rigid material for an easier fit.)

Our conclusions from the tests: As an exdesigner of ribbons, I have to admit a built-in bias against batteries and power supplies and—in fairness—point out that this system would normally be phantom powered in the studio, though again this is another subsystem which at least potentially can break down. Be that as it may, for the devotees of "condenser sound," we can state that the AKG CK1/C451E is one of the best condensers we have tested and certainly not the most expensive. We can enthusiastically recommend the AKG to anyone wanting a condenser microphone. *Jon Sank*

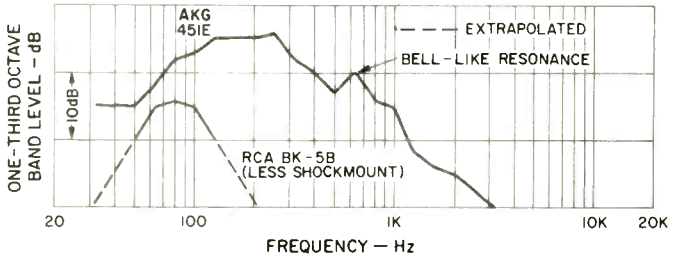


Fig. 5—Analysis of tapping noise (see text for discussion).

Enter No. 72 on Reader Service Card

Pioneer Model 510A Direct-Drive Manual Turntable

MANUFACTURER'S SPECIFICATIONS
Motor: d.c. servo.
Speeds: 33 1/3 and 45 rpm.
Wow & Flutter: 0.03 per cent W rms.
Rumble: 68 dB, DIN B.
Arm Length: 9 ¼ in. (22.1 cm).
Cue Control: Oil damped.
Dimensions: 17 in. (43.2 cm) W x 14 ¼ in. (36.2 cm) D x 6 ¼ in. (15.9 cm) H.
Power Consumption: 5 watts.
Price: $200.00.

Direct-drive turntables are becoming more and more popular with new models appearing on the scene almost every week. Most of them are fairly expensive, but there are several now available, at the $200.00 mark, which thus offer excellent value for the money. One of the best examples of these is the Pioneer 510A which compares favorably with models costing nearly twice as much — and what's more it doesn't *look* cheap! It has the same level of styling and finish

as the more expensive units, and nothing appears to have been skimped on.

The S-shaped arm is made of polished tubular aluminum, and balancing is both vertical and lateral. A weight slides on an extension rod projecting out from the left-hand side of the arm near the pivot, and the adjustment is not critical. The headshell is the low-mass type, and it is locked to the arm by the usual collar. Controls are all located to the right, on a neat satin-finished panel, with the *Off/On* switch at the front of the unit. This switch is unusual as it also controls the cueing. The *Off* position is at the rear and in moving the lever forward to the center position you start the motor, while bringing it forward again to the third position at the front lowers the tonearm onto the record. This takes a little getting used to, but it's all quite logical enough. Behind this dual-purpose switch are two pushbuttons for 33 1/3 and 45 rpm, and behind those are the variable speed adjustments. At the rear alongside the tonearm base is the anti-skating adjustment, which is calibrated from 0 to 4 grams.

At the left front is the strobe lamp, protected by a cover, with the strobe markings on the edge of the platter, which, incidentally, weighs just under 3 3/4 lbs. (1.7 kg). The motor is a d.c. servo type, and all bearings are permanently lubricated. The unit is styled in matte black and silver with a woodgrain vinyl base which stands on four acoustically damped feet. The turntable comes complete with a hinged dustcover, and the accessories include an overhang gauge and a miniature screwdriver.

Measurements

Like all Pioneer turntables, the 510A came with a generous selection of cartridge mounting hardware, and no particular difficulty was experienced in either balancing the arm or obtaining optimum alignment. The cartridge selected for testing was an Empire 2000Z, a top of the line, high compliance model which needs a good tonearm for best performance. The tracking force was set at 1¼ grams with the anti-skating dial turned to 1½ grams for optimum performance, and these were used throughout the tests, although it was found that the 2000Z could track very well at lower forces.

Checking the speed variations first, the 33 1/3 control had a range of +1.6 per cent and -4.5 per cent, while the 45 rpm speed could be varied ±4.5 per cent. Wow and flutter measured 0.05 per cent (DIN), and the rumble was -63 dB using the ARRL weighting. Tonearm resonance with the Empire cartridge was just under 8 Hz with a rise of approximately 3 dB. Both lateral and vertical arm friction was less than 10 mg, and the tracking error was within 0.5 degrees per inch, standard for this type of arm. Both the tracking force and anti-skating dial calibrations were found to be within practical tolerances for accuracy, and the position of the lateral weight was non-critical, as stated by Pioneer.

In-Use Tests

The cue lift device took longer than usual to lower the arm onto the record, but it was very gentle, with insignificant side drift. As mentioned earlier, the combination motor start and cue switch does take a little getting used to, but it really works well. And once the turntable speed has been set, the servo control holds it right on the nose.

All in all, the 510A is a first-class value for the money, and the engineers at Pioneer are to be congratulated for bringing the price down without sacrificing very much in the process.

George W. Tillett

Enter No. 73 on Reader Service Card

Optonica Model RT-3535 Cassette Deck

MANUFACTURER'S SPECIFICATIONS

Motors: 1 d.c. servo and 1 d.c. high torque.
Heads: 3, record-replay, erase, and APLD sensing.
Wow & Flutter: 0.04 per cent W rms.
Bias: 3 position switch.
Equalizing: 3 position switch.
Bias Frequency: 84 kHz.
Frequency Response: Normal tape, 30-15 kHz; CrO_2, 30-16 kHz, and FeCr, 30-17 kHz ±3 dB.
S/N Ratio: 58 dB, 64 dB with Dolby.
Output: 580 mV.
Input: Line, 70 mV; mike, 0.2 mV.
Dimensions: 18 3/4 in. (46.6 cm) W x 5 3/4 in. (13.5 cm) H x 14 in. (32.8 cm) D.
Weight: 22.4 lbs (10.2 kg).
Price: $429.95.

Sharp is an old, established Japanese electronics company known mainly in the United States for television, appliances, and medium-priced audio products. Recently, following the example of other manufacturers, they have decided to make equipment for more critical audio enthusiasts, under the name Optonica. The first model is a versatile cassette deck, designated the RT-3535, introduced recently and boasting some unusual features. It looks much like other front-load-

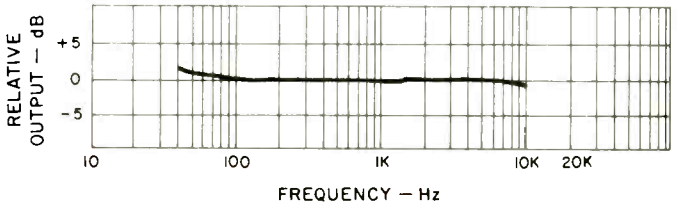


Fig. 1—Frequency response with the 40 Hz to 10 kHz test tape.

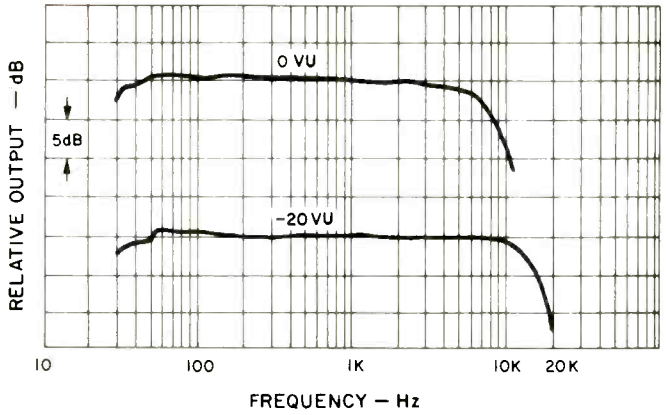


Fig. 2—Record-replay response with the Maxell UDXL tape.

ing decks, with the typical semi-professional type instrument styling, but the big difference is a row of buttons just under the two VU meters. These push-buttons are numbered from one-to-nine with one marked C and a blank one on the left which turns out to be a digital indicator. The function of these buttons is to operate the "auto program locate device" (APLD) which enables a quick selection to be made of any program on the tape. It uses a signal sensing circuit with a separate tape head, and here is how it works: assuming you want to hear the fifth selection on a cassette, all you have to do is press button number 4 and either the *Fast Forward* or *Play* button. The first four selections are automatically skipped and the tape comes to rest at the beginning of number five. At the same time, visual indication is given as the digital readout shows the numbered sections in sequence. Obviously, the user must know what order the various selections are in, but this information can be written on the cassette if it is not there already. How about making new tapes with APLD? There are no problems, provided a space is left between the selections . . . but more on this later.

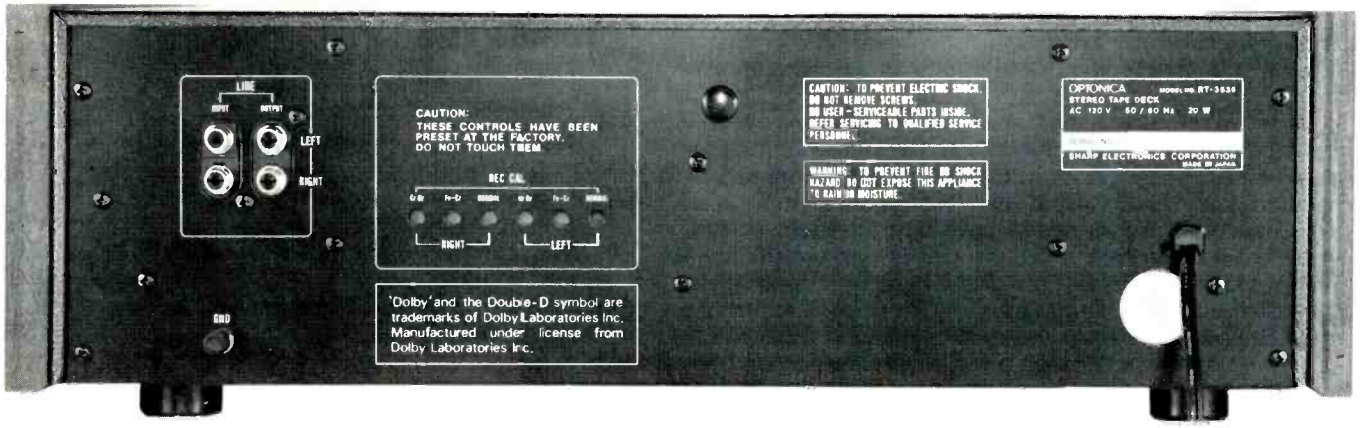
Let's take a look at some of the other features of the 3535 . . . on the left under the cassette compartment is the usual group of tape control keys; including a separate control for eject. To the right is a row of three lever switches, one is for bias with a provision for high, medium, and low; the second lever controls equalizing for CrO_2, FeCr, and Normal, while the third is the Dolby switch, which also has a position for the MPX filter. Above these three levers are the digital counter and three pushbuttons for limiter, mike line input, and auto-selection control. When the auto-selection control button is depressed a red LED indicator just above it lights up. There are two VU meters mounted at an angle for good visibility with a recording indicator light located between them. Underneath are three control knobs for output, and right and left inputs, while on the extreme left to the side of the cassette compartment is the *On/Off* switch, in addition to jack sockets for microphones and headphones . . . which completes the listing of the front panel controls. At the rear are the usual RCA-type input and output sockets, plus a group of six controls for bias and equalizing which have a cautionary note placed above them stating they have been factory set and should not be touched.

Two motors are used, one for fast winding and a d.c. servo type for the capstan drive. Eight ICs are used in the APLD gating and pulse generating circuits. There are a total of 45 transistors with 59 diodes used in the circuitry, plus two SCRs.

As mentioned earlier, the styling conforms to the modern instrument type concept with a satin-finished panel and matching knobs. The two wooden veneered sidepieces make a nice contrast, and the metal top cover has a durable "hammer" finish. Near the front is a small trap door which gives access to the tape heads for cleaning.

Measurements

Figure 1 shows the frequency response from a standard 40 Hz to 10 kHz test tape, while Fig. 2 shows the record-replay response with Maxell UDXL tape. The high frequency 3-dB point was just above 16 kHz, and the low frequency response was well maintained with a minimum of "fringing." I ought to mention that the 0 VU on the meter corresponds to a level of 200 nWb/m which is the Dolby level and 3 dB higher than the standard used by most other machines. So in order to allow for more meaningful comparisons, the 0 dB



reference on the graphs is equal to −3 dB on the meters. Results similar to the Maxell tape were obtained with Fuji FX60, TDK Audua, and Scotch Master tapes. The next tapes tested were the Sony and Advent CrO_2 variety, with the results shown in Fig. 3. The high frequency response was extended slightly to 16.5 kHz and the saturation curve is very similar. Finally a FeCr tape was tested, a Meriton, and it will be seen from Fig. 4 that the high frequency response has been increased significantly with a 3 dB point at nearly 19 kHz.

The next series of measurements were related to distortion at 1 kHz, as shown in Fig. 5. The Maxell and other low noise tapes gave almost identical results, so only one tape is shown for this group. Figure 6 indicates distortion versus frequency the three different kinds of tapes. Signal-to-noise for the Maxell was 60 dB (66 dB), Sony CrO_2 58 (65 dB), and Meriton FeCr 59 (67 dB). The Dolby figures are in parenthesis and the reference is for 3 per cent distortion with A weighting

Line input for 0 VU was 68 mV, and the output was then 700 to 900 mV, depending on the kind of tape used. Microphone input for 0 VU was 220 microvolts, and the decrease in signal/noise was 7 dB. Erase efficiency was over 67 dB. The Dolby system tracked within 1.5 dB, and the MPX filter was 3 dB down at 17 kHz, reaching −20 dB at 19 kHz. The limiter has a very fast action, keeping peaks down to the 0 VU level.

Turning now to the mechanical side, wow and flutter was a very low 0.04 per cent (DIN), exactly as claimed, and speed was right on the nose. Rewind time for a C-60 cassette was 80 seconds.

Listening Tests

Well, as you might expect, the first exercise in the listening tests was to check out the automatic program locate device (APLD). As I could not find a recorded cassette having a number of separate selections, I decided to make one. And so I recorded eight musical selections from my local FM stations. As I mentioned earlier, a space has to be left in between the items, but this was taken care of by a "delayed action" pause key. When this is depressed the tape travels for about four seconds without being recorded and then stops. Having rewound the tape, I pressed button number five so I could hear selection six on the cassette, and then I pressed the fast forward key. The digital indicator showed 5, 4, 3, 2, 1, and—bingo—there was number six! I also made recordings with longer spaces between items, but I couldn't fool the sensor—it worked every time! The button marked C clears any previous instructions from the "memory"—just like a calculator.

The tape control keys need a fair amount of pressure to operate, but they have a very positive feel to them, and it is evident that the whole mechanism is soundly constructed. The rotary controls have an unusually smooth, silky kind of feeling—almost as if they were turning in oil-damped bearings.

In terms of basic performance, the Optonica RT-3535 must be placed in the highest category—all tapes sounded very good except when overdriven. The best sounding tapes seemed to be the CrO_2 and FeCr. Precise adjustments were very easy to make with this unit. The provision for FeCr tapes is a definite plus, as are the biasing and equalizing facilities, but whether the cost of the automatic program locate device (APLD) is justified is a moot point. It is certainly ingenious and well engineered, so I suppose, it could be argued that other decks in the price range offer less for more money.

George W. Tillet

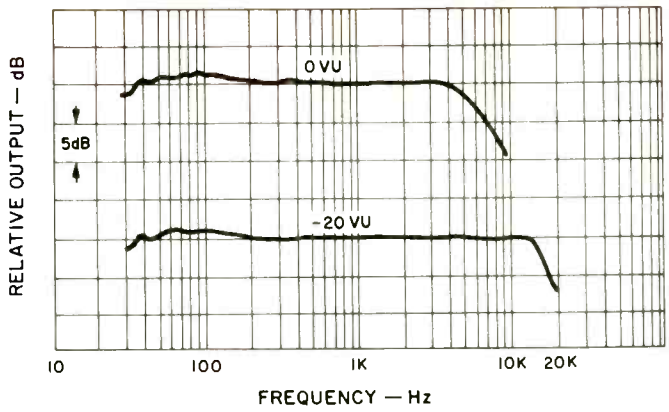


Fig. 3—Record-replay response with the Sony and Advent CrO_2 tapes.

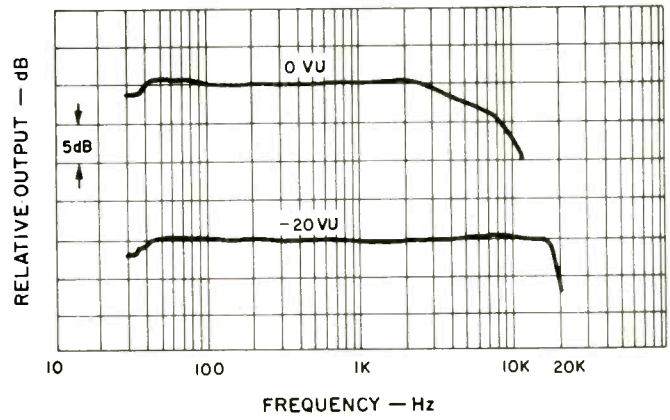


Fig. 4—Record-replay response with Meriton FeCr tape.

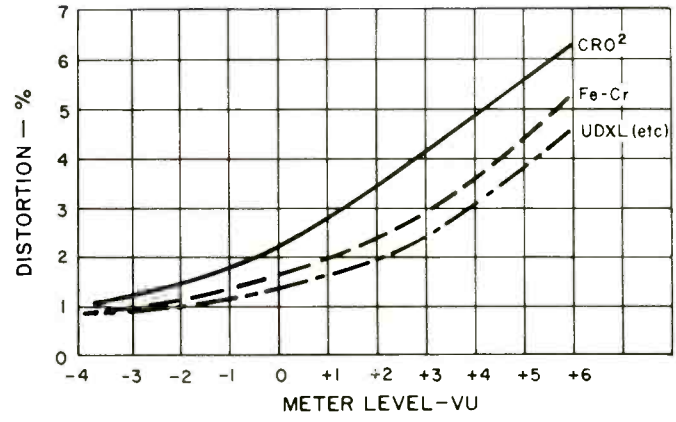


Fig. 5—THD at 1 kHz.

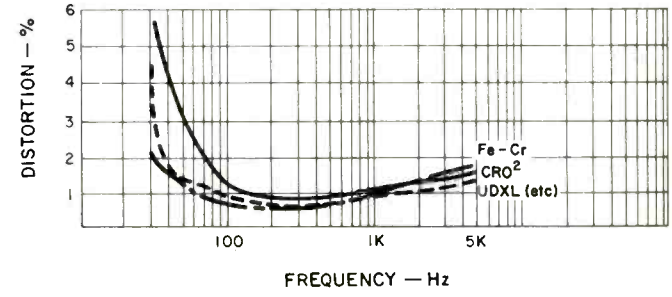


Fig. 6—Distortion vs. frequency.