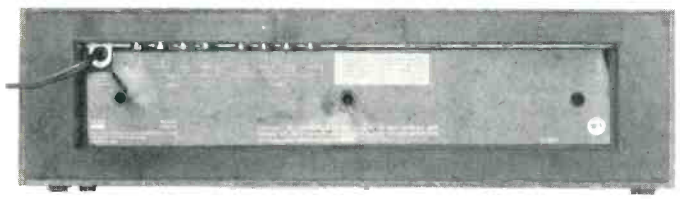
BSR Model FEW-3 Graphic Equalizer

MANUFACTURER'S SPECIFICATIONS

Number of Channels: 2.
Number of Bands per Channel: 12.
Bandwidth per Band: 1 octave.
Adjustment Range per Band: ±12 dB.
Maximum Output Voltage: 10 V rms.
THD: 0.05 per cent.
S/N: 80 dB.
Rated Output: 2.0 V rms.
Dimensions: 17 ¾ in. (45 cm) W x 7 in. (17.8 cm) D x 5 ¼ in. (13.3 cm) H.
Weight: 10 lb. (4.54 kg).
Available Accessories: SLM-1 Sound Level Meter and test record.
Price: $199.95.

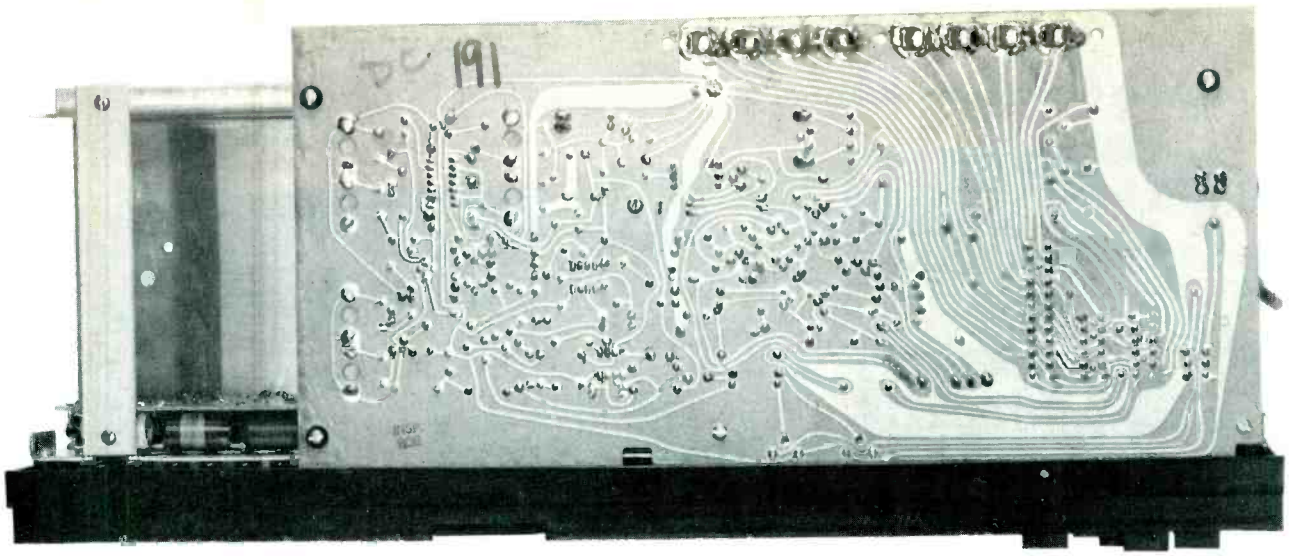
Readers of *Audio* Magazine need no lengthy explanation regarding the usefulness of a graphic equalizer. The use of these separate add-on boxes (first popularized by Altec with their professional acousta-voicing filters, and later reduced to consumer product level with the introduction of their still available Acousta-Voicette) in home hi-fi systems is increasing at a fairly rapid rate. Most readers will agree that, used in moderation, a graphic equalizer, which simply alters overall frequency response of a sound system to compensate for response variations in equipment or room acoustics, can be a worthwhile addition to any good system *providing* that the equalizer itself introduces no new distortion of its own.

One may, of course, argue about the number of separate frequency bands or segments required to do a good, smooth job of equalizing, but this, too, depends upon the degree to which you want to "trim" overall response and the amount of money you have available for this type of accessory product. There are equalizers which have as few as five bands and some (like the Altec unit) which divide the audio spectrum into 24 third-octave segments. The BSR Model FEW-3 falls mid-way between those two extremes. It has divided the audio range into 12 bands, some of which are a bit more than one-half octave apart, others spanning nearly a full octave. Center frequencies listed are 30, 50, 90, 160, 300, 500, and 900 Hz, and 1.6, 3.0, 5.0, 9.0, and 16.0 kHz. Pairs of vertically movable slide controls are neatly arranged across most of the plastic molded front panel, recessed behind a hinged transparent plastic door which can be shut after equalization has been accomplished to prevent inquisitive fingers from arbitrarily upsetting the carefully chosen settings of each of the 24 controls (12 per channel). Also contained in the recessed area of the panel are a pair of meter sensitivity controls which can be varied to insure mid-band (0 dB) readings of the twin meters at the right of the panel, regardless of the actual input level fed into the FEW-3. The twin meter movements are calibrated from −12 dB to +12 dB, the approximate adjustment range of each of the equalizer's separate-band controls and a power on/off light is positioned between these two meter pointers. The power on/off switch of the unit is located below the meter area, while directly above it are four push-to-make/push-to-release buttons. One of these buttons activates the meter circuits (which users may not want fluctuating at all times), another bypasses signals around the equalization circuitry for instant A-B comparisons of sound with and without EQ applied, the third activates a tape monitor circuit (the presumption being that the user will have used up the normal tape monitor circuit on the amplifier or receiver with which the equalizer is used), while the final button, identified as *Eq-Rec* permits the user to record a pre-equalized signal onto tape. This last feature is quite useful, particularly since the tape-out jacks of most preamps and receivers usually come ahead of any tone control circuits, thus preventing tonal coloring of signals to be recorded onto tape.



The rear panel of the BSR FEW-3 also features a fully recessed area which contains input, output, tape-out and tape-in (monitor) jacks mounted so that audio cables drape downward from the underside of the cabinet top. The shallow mounting space required for the FEW-3 is therefore not increased by any projecting pin plugs behind the unit.

No schematic diagram was supplied with the FEW-3, but a view of the inside of the unit shows that construction is on two major p.c. boards mounted at right angles to each other. One of the boards contains all the slide controls, meter adjustment pots, and push-button switches, while the second board contains the active-filter circuit components. ICs are used extensively in the circuitry, which requires no mas-



sive inductances thanks to the use of active solid-state filter circuitry. Extensive metal shielding is used to prevent extraneous hum pickup in the main circuit board, and the small power transformer is mounted as far away from critical low-level input stages as possible.

Tests and Measurements

The first test one would wish to perform with any graphic equalizer is to determine how accurately the center points of each band are set and whether the "plus and minus" range claimed is accurately maintained for each of those bands. With 24 separate knobs available, individual hand or point-by-point frequency response plotting of the entire system could take many hours, if not days. Thanks to our Tektronix 5L4N low-frequency spectrum analyzer, this odious job is reduced to a matter of a few minutes. Successive sweeps (from 20 Hz to 20 kHz) are made with each "band slide" first adjusted for maximum boost, then for maximum cut. That slider is then returned to its mid or flat position, and the procedure is repeated until all 12 "boost" and "cut" response curves have been traced and stored on the face of the analyzer's storage scope face. Results are pictured in the final composite photo of Fig. 1. Vertical sensitivity was adjusted so that one division on the scope face equals exactly 10 dB and, as can be seen, overall amplitude from any given "peak" to its corresponding "dip" is almost precisely 24 dB (the ±12 dB adjustment range claimed by the manufacturer). Center frequencies of each band corresponded closely to the frequencies enumerated earlier (sweep is logarithmic in frequency from left to right, with key frequencies labelled on the scope face at the top). Before the avalanche of letters comes pouring into the editorial offices of *Audio* pointing out the fact that there are only 11 sets of band curves in Fig. 1 instead of 12, let me hasten to explain that when we attempted to reproduce the 30 Hz band action, much of the resulting curve fell "off-screen" because of the slight frequency inaccuracy of the analyzer at its extreme low end. Plotting response of the 30-Hz band (in its extreme positions) the "hard way" confirmed that it behaves pretty much like the other 11 displayed.

With so many separate filter circuits all lined up in "series," we were curious to see just how "flat" response of the system would be if all the levers or slides were carefully set *mechanically* to their "zero" points on the front panel. To accentuate any deviation from flat response, we changed the sensitivity of the analyzer so that in the sweep response photo of Fig. 2, each vertical division corresponds to a change of only 2 dB. Aside from the very slight roll-off observed at 20 Hz (less than 1 dB), response was flat to within 0.25 dB all the way up to 20 kHz.

With the analyzer still set for this more sensitive vertical indication, we wanted to see how complex (if arbitrary) a response curve we could "tailor" with the FEW-3. Results, pictured in Fig. 3, show a response curve that, while admittedly a bit unusual, could never have been achieved using conventional treble and bass (or even treble, bass, and midrange) controls which graphic equalizers are intended to replace. While the curve seems a bit odd, remember that vertical sensitivity is only 2 dB per box, so that actually we applied no more than 4 dB of boost or cut at any frequency over the entire audio range—a not unlikely requirement in many electronic/acoustic sound reproducing situations.

Other Measurements

As we said earlier, graphic equalizers are fine if they don't introduce new distortion components of their own. With all controls set flat, and with 3 volt input and output, THD measured 0.022 per cent at 1 kHz, 0.023 per cent at 100 Hz and 0.019 per cent at 10 kHz. With 1 volt input and appropriate slide controls boosted to provide 12 dB of gain at 100 Hz, 1 kHz, and 10 kHz, distortion increased to 0.6 per cent, 0.2 per cent, and 0.14 per cent respectively. Considering the fact that the equalizer will ordinarily be connected at that tape monitor circuit (where voltage levels are usually well under 0.5 volts), harmonic distortion contributed by the FEW-3 is obviously not going to be a problem.

As for the meters, we found that an input of 50 millivolts was required (with meter sensitivity controls set fully clockwise) to obtain a "0 dB" reading. With higher input levels, meter pots are simply turned down to position the meter pointers for average readings of 0 dB.

With a signal input of 1 volt and all controls set flat, signal-to-noise ratio measured 78 dB.

Using The FEW-3

We found the FEW-3 easy to use and install, but felt that a couple minor points of human engineering might have made it even more convenient to use. It is quite difficult to set each slider for exact "0" and a mechanical detent or "stop" would have been a very useful addition. Some slide potentiometers have such a mechanical "click stop" notch in their center positions of travel. Finally, we feel that the "pairing" of left and right controls for each frequency band was not an ideal physical arrangement. More often than not, one wants equalization of the left channel to be different from equalization of the right channel, but the sets of band

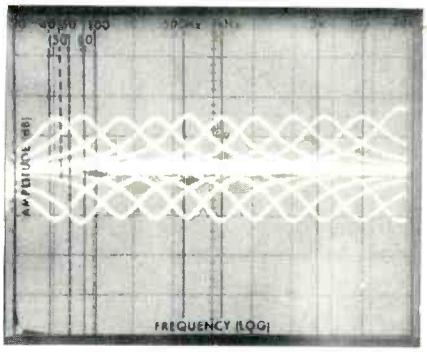


Fig. 1—Boost and cut range for each band of the BSR FEW-3 Equalizer.

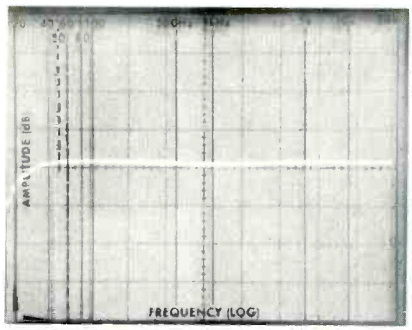


Fig. 2—With equalizer controls set to *Flat* position, response is within 0.25 dB of uniform to 20 kHz.

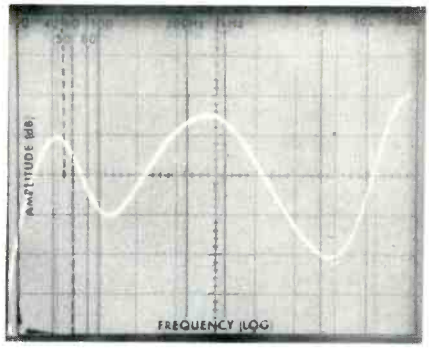


Fig. 3—Complex response curve achieved with the FEW-3 Equalizer; each vertical division on scope equals 2 dB.

controls are arranged so that they can easily be moved together (with one fingertip), but they are not so easy to move separately. Other manufacturers of equalizers of this type have generally mounted the slide controls as two separate banks—one for each channel—instead of side by side as in the case of the FEW-3.

Perhaps we are being a bit overly critical of these physical layout considerations because in testing the unit we did an inordinate amount of fiddling with each of the 24 controls. A typical user is much more likely to set up the controls once, for best results, and leave them there (hence the plastic cover door). Under those circumstances, the difficulty in handling the closely spaced left and right controls becomes minor.

With most of the slide controls adjusted to the "plus" side, overall gain of the FEW-3 becomes greater than unity, making it difficult to perform the desirable A-B test which the *EQ Bypass* switch encourages (one has to manually compensate for overall level change by means of the amplifier's volume control), a problem which some more expensive equalizers overcome by providing overall gain controls in the equalizer circuitry. In terms of its very reasonable price, however, the FEW-3 offers more frequency bands than similarly priced competitive units and certainly introduces no audible distortion or noise of its own. What more could one ask of a frequency response tailoring device that is so neatly crafted and does its intended task so well? *Leonard Feldman*

Technics Model RS-630US Stereo Cassette Deck

MANUFACTURER'S SPECIFICATIONS
Frequency Response: 30 Hz to 14 kHz, 30 Hz to 16 kHz with CrO_2 tape.
S/N Ratio: 50 dB, 63 dB with Dolby and CrO_2 tape.
Input Sensitivity: Mike, 0.25 mV; Line, 60 mV @ 47 kOhms.
Output Level: Line, 420 mV; Headphone, 60 mV @ 8 ohms.
Wow and Flutter: 0.09 per cent weighted rms.
Fast Forward & Rewind Time: 90 seconds with C-60 tape.
Dimensions: 17 1/8 in. (43.5 cm) W x 5 5/8 in. (14.29 cm) H x 12 5/8 in. (32.1 cm) D.
Weight: 17.5 lb. (7.9 kg).
Price: $249.95.

The Technics RS-630US front-loading cassette deck presents an attractive appearance and provides good performance. The compartment for the cassette is one of the better designs, as the cassette can be observed directly from the front, or from above by means of two chrome-strip mirrors. Illumination is well placed for either checking tape motion or maintenance tasks. The dust-cover door slides along the front of the unit, with the bottom lip of the compartment serving as both the lower track for the door and a stop for the ejected cassette. The tape-motion controls, immediately below the compartment, have limited interlocking, permitting going from *Play* to other modes including *Record*. There are both visual and tactile clues to proper operation with colored pads on *Eject* and *Record*, and with greater widths for both *Play* and *Stop*..

To the right of the cassette compartment are the function switches and the time counter with its reset button. Selection can be made of Dolby in-out, CrO_2 or normal tape, mike or line input, and meter mode, either normal VU or peak check. The large, well-illuminated level meters domi-

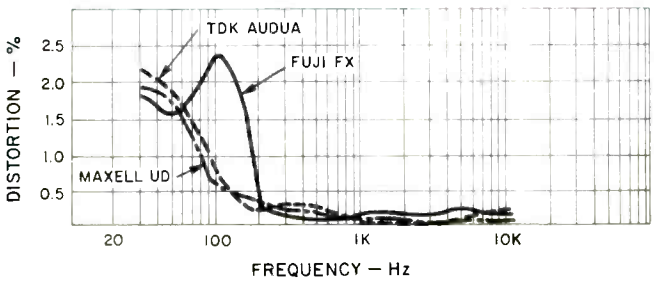


Fig. 1—Distortion vs. frequency at −10 VU showing the Fuji FX, Maxell UD, and TDK Audua tapes.

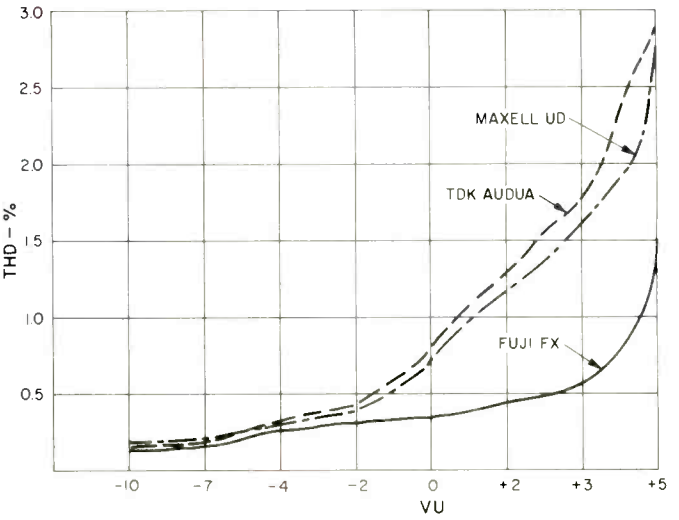


Fig. 2—THD vs. recording level with three tapes.

nate the right side of the front panel. These meters provide a most useful feature in being capable of working as either regular VU-type or peak-reading meters. The peak scale on top is offset 3 dB relative to the normal scale, but the actual difference in the reading is dependent on the dynamic character of the source. The record indicator is between and below the two meters.

Input and output levels are controlled by dual-section pots which are friction clutched to permit channel level adjustments individually or simultaneously as desired, a worthwhile feature. To the left are the phono jacks for stereo headphones and microphone inputs. To the right is the power *On-Off* switch. The clear-plastic compartment cover and the front panel elements are so proportioned that the door covers the meters, but not any of the switches, when pushed to the right. A minor point perhaps, but it is good human engineering, aiding in the practical operation of the unit. The attractive appearance of the front panel is continued with the wood end pieces and the simulated wood top cover.

Input and output line connections are made with phono jacks on the back of the unit. Removal of the metal bottom cover revealed that one large circuit board contained the great majority of the circuitry. Soldering on the board was very good, and there were limited external connections, mostly to the tape-drive control and the various function switches. Adjustments are accessible from the bottom of the board, but are not identified.

Performance

Playback responses for both equalizations were within 3 dB, with the exception of the lowest frequency. The DIN standard 0 VU level produced +4 dB meter responses. A pink-noise source and a 1/3-octave real-time analyzer were used to check the record/playback responses for 20 different tape formulations. The best tapes in this regard were then used for these and all following tests. Fuji FX had generally flat responses at −20 dB (relative to meter zero) from 40 Hz to 15.1 kHz, with a +2 dB rise from 1.2 to 11 kHz and a 14.1 kHz limit when in Dolby. Headroom was 6.8 kHz, 6.2 kHz with Dolby. TDK Audua and Maxell UD had wider frequency response, but also a greater rise in the higher frequencies. The 3-dB down low-frequency limits measured were not as low as the specified 30 Hz, but response curves

Fig. 3—Record-replay response with the Fuji tape with Dolby and without Dolby.

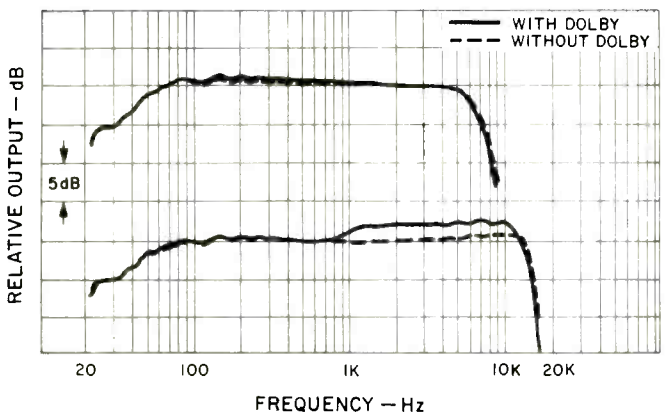
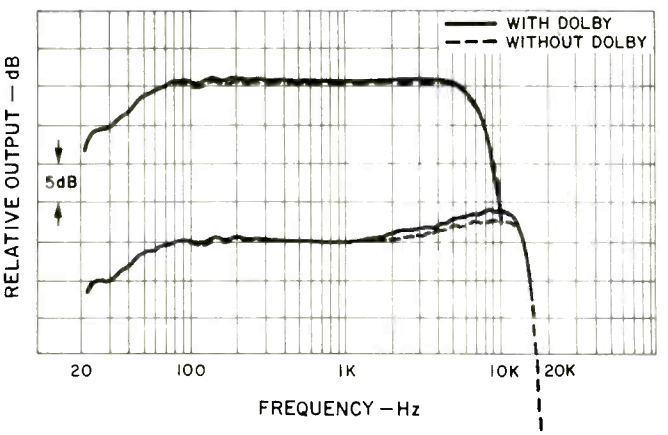


Fig. 4—Record-replay response with the Maxell UD tape with Dolby and without Dolby.



presented by Panasonic showed that they used a 5-dB down reference, a confusing practice. The best of the chrome-type tapes was actually the TDK SA, with a 15.0 kHz limit, 13.0 kHz with Dolby, both at −20 dB. The response of the two channels was substantially the same under all conditions.

Measurements were made of harmonic distortion with a 1 kHz test signal when recorded over a range from −10 to +10 dB. Attention was directed at the levels of the third harmonic normally predominant, but examination was made of the spectrum-analyzer display for other components. Distortion levels were low with Fuji FX tape with just 0.28 per cent at 0 dB. The three per cent point was more than 7 dB above meter zero. With TDK SA, the distortion was generally higher than the Fuji tape, with 1.3 per cent third harmonic at 0 dB. Distortion was measured in similar fashion with test frequencies from 30 Hz to 10 kHz with record levels of zero and −10 dB. No readings were possible at 10 kHz and 0 dB, and just 2nd harmonic was in evidence with the 7 kHz test frequency. Distortion was noticeably less at the lower record level.

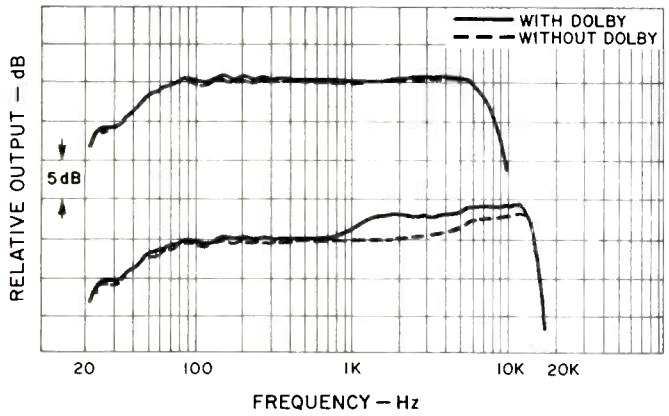


Fig. 5—Record-replay response with the TDK Audua tape with Dolby and without Dolby.

The A weighted signal-to-noise ratio was an average of 51.7 dBA for the three low-noise tapes with a meter zero reference, and 60.6 dBA with Dolby. With a three per cent distortion reference, the average ratios were 57.3 dBA, and 66.9 dBA with Dolby. The TDK SA had ratios of 59.5 dBA and 68.6 dBA, with Dolby, both referenced to the three per cent distortion level. Separation between tracks was 39 dB, which is quite good. Crosstalk between adjacent tracks of opposite play direction and erase were both more than 80 dB down, an excellent performance. Input sensitivities were 0.27 mV for mike, substantially as specified, and 60 mV for line, exactly as specified. The Technics 630 does not have a switchable multiplex filter, but a response notch at 19 kHz provides 36 dB rejection. The line output with a 0 dB record level was 420 mV, exactly as specified. The playback level, however, was dependent on the tape used, but the output was easily set with the control. The level at the headphone jack across 8 ohms was 69 mV, above that specified. The large, legible meters of this unit provide the desirable and useful feature of selectable meter response. In regular *VU* mode, the response to the standard 300 mS burst was well within limits. In the *Peak Check* mode, response to the 300 mS burst was to +2 dB on the peak scale. Response to a 10 mS burst was to 0 dB and to −3 dB for a 1 mS burst. Although the decay was judged to be somewhat fast, the deck does provide true peak-reading meters. Scale markings were accurate, and tracking in conjunction with the record level pot was excellent.

The lowest measured flutter was 0.07 per cent DIN weighted peak, with an average of 0.18 per cent, roughly approximate to the manufacturer's specified 0.09 per cent weighted rms. The deck was one per cent fast at the standard test 120 V a.c., 0.6 per cent fast at 100 V and 1.3 per cent fast at 130 V. Rewind time was 88 seconds, within the specified 90 seconds.

In-Use Tests

Insertion and removal of cassettes was easily accomplished, and ejection gave the cassette a gentle slide to the front retaining lip. The dust cover door was easily positioned over the compartment or the meters as preferred. Cleaning and demagnetization was better than many front-loading machines. Examination of the faces of the head required a dental mirror, and head alignment did not appear possible from the outside. Interlocking of the tape motion controls is limited, as mentioned before. Being able to go from *Play* directly to *Record* was helpful in using the deck for some recopying, but unwanted mistakes could occur. Auto-stop worked on *Play/Record,* but not on the fast winds, a minor limitation for most. The mike or line input is selected by switch, without the usual change from plugging in a mike. The accompanying brochure makes the valid point that separate circuits can obtain improved signal-to-noise ratios. The drive to the headphones was determined by the record/playback level. The output pot had no control of headphone drive as would be desired in some cases.

Listening tests utilized **The Sound of Musical Instruments** from the Acoustic Research demonstration record series. Levels were easily adjusted with the dual-section record pot. Good friction coupling allowed adjusting either channel when desired and then using the control as the master gain for both channels. The readability of the meters was excellent, and the normal VU and peak-check modes were both used to advantage. The display facilitated setting levels well up-scale with checks on the peaks to prevent noticeable distortion. This particular capability would be immediately instructive to the user on the dynamic character of various types of music. With the low-noise tapes, the sound on playback was very good, with the cello sounding slightly bright and some presence added to the voice. Some deficiencies in the playback of the TDK SA tape were loss of some of the transient sound of the guitar and constriction in the sound of the flute. With the low distortion and the good signal-to-noise ratio of the deck, the dynamic range of the music was preserved and the listening experience was most satisfactory.

My own judgment gave the deck a much higher price than $249.95, particularly with some of its advantages such as the meters. Within that framework, though, the absence of the automatic shut-off at the end of the fast wind, and other limitations seemed odd. But in summation, this reviewer found the modest price somewhat of a pleasant surprise considering the features and the overall performance.

Howard A. Roberson

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