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TEAC V-970X CASSETTE DECK

Manufacturer's Specifications

Frequency Response: 25 Hz to 17 kHz, to 19 kHz with Type II tape, to 20 kHz with Type IV tape.

S/N Ratio: 70 dBA with Dolby B NR, 80 dBA with Dolby C NR, 92 dBA with dbx NR.

Input Sensitivity: Line, 60 mV.

Output Level: Line, 300 mV.

Flutter: 0.025% wtd. rms.

Fast-Wind Time: 100 S for C-60 cassette.

Dimensions: 17 $\frac{1}{8}$ in. W x 4 $\frac{7}{8}$ in. H x 11 in. D (43.5 cm x 12.4 cm x 28 cm).

Weight: 13 lbs. (5.9 kg).

Price: \$799.95.

Company Address: 7733 Telegraph Rd., Montebello, Cal. 90640.

For literature, circle No. 94



The V-970X is TEAC's best-performing deck, though not its most expensive (an auto-reverse model is available at a higher price). The V-970X offers the considerable convenience of Dolby B and C NR as well as dbx NR. It has three heads, facilitating better magnetic design and allowing playback monitoring during taping. The record and playback heads, although mounted right next to each other, are separate structures. The tape transport utilizes a dual-capstan drive for controlled tape tension and lower flutter.

The built-in calibration system has individual channel pots for both level and bias. This design approach aims for the

best record/playback responses with good Dolby NR tracking. The V-970X includes Dolby HX Pro for better recording of high-frequency energy at high level. The owner's manual does not mention punch-in (flying-start) recording, but this deck has it, and it can be a great convenience for the serious recordist.

"Auto Monitor" automatically switches between source and tape, depending on the deck's operating mode. Manual monitor selection can be made at any time. There is a headphone level control, which can be so helpful in setting a good monitoring level without affecting the line output

level. Left and right "Preset" controls and a master control set the input levels.

"CD Level Check," an unusual and interesting feature, helps the recordist preset input levels when recording from CDs. With it, you can read a CD's maximum level while manually fast-scanning the disc. The deck's meter levels are boosted automatically to compensate for the fact that CD players normally reduce their output levels during fast scan. The level meters are peak-responding, which is essential for good level setting. The auto-mute function is flexible, spacing longer or shorter mutes, as desired.

Finding something on a cassette is easy with "Intro Check," which fast winds to play the first 10 S of each selection. Two program search modes, "CPS" and "CDS," allow fast winds to the start of a selected tune anywhere on the tape. "CDS" counts from the beginning of the tape, and "CPS" counts in either direction from the current position. "Block Repeat" plays a specified section over and over until the deck is stopped. The counter has a time mode (minutes and seconds) as well as the normal turns counter. A very flexible remote control, which I'll describe later, is supplied.

Control Layout

At the far left of the front panel, from top to bottom, are the power switch, the large eject button, the "Timer (Play/Out/Rec)" slide switch, and the infrared remote sensor. The cassette compartment, to the right, moves out smartly but smoothly with a push of the eject button. When the door was open, access to the tape path for cleaning and demagnetizing was fairly good. Access was somewhat better with the door's window removed, but I still needed some dexterity. While making these observations, I noticed that the deck's capstan shafts have matte finishes. This would reduce any possible tape slippage at the pinch rollers.

To the right of the tape compartment, the large display panel shows much helpful information, mostly in a clear, bright, bluish white. The four-digit counter display, at the upper left, shows either turns or play/record time in minutes and seconds. Fast winding the deck or removing the tape does not change the time display, which will continue adding time if play or record is resumed. Just to the right of the counter display is the monitor status display, which shows either tape or source. Next on the right, from the top down, are annunciators for "Start Memo," "Stop Memo," and Dolby HX Pro.

To the right of the status indicators are horizontal bar-graphs for the peak-responding channel meters, with six bluish-white indicators from -20 to -2 and six red indicators from 0 to +12. The scale calibrations between the two bars have matching colors, and the combination is very easy to read in any light. Above the meters, indicators for "Norm," "CrO₂," or "Metal" (each with a red underline) illuminate as the deck senses the tape type inserted. "Metal" remains on if no tape is in place, and the "NR System" legend, under the bar-graphs, is always on. Depending on the choices made, "MPX Filter" (to the left) and/or Dolby "B," "Dolby C," or "dbx" noise reduction (to the right) will illuminate. Having the NR status displayed next to the meters certainly helps the recordist. In this respect, the V-970X's layout is quite superior to many other decks.



Under the display panel is the "Counter" switch, with "Clear" and "Mode" pushbuttons just below. To the right is "Block Repeat," with its associated "Start M" and "Stop M" buttons below. In block operation, these switches set the point where play starts and the point where play stops; the tape then rewinds to the first point. Stop memory is set automatically at the start of calibration mode so that rewind will end at the original start point. Start and stop memories work with either direction of fast wind, but they must be set with the deck in play, play/pause, record, record/pause, or record/mute mode. Unfortunately, they cannot be set with the deck in stop mode, which can be the most convenient time. Stop memory does not work in record but does work in play, where it is really needed. These memories can be set at any counter number; it is not necessary to return to zero.

Further to the right is the "CPS/CDS" program search button. A push while in stop, play, or record gets "CPS" mode and changes the counter display to "CP 1"; successive pushes will increase the number to the maximum of 15. A push of fast forward or rewind will then cause a fast wind to the beginning of the tune which is that number of selections away from the present position, and then play starts. Blank spaces of 4 S or more are needed between selections for proper counting. One push of "CPS/CDS," and then rewind, is a fast and convenient way to get back to the beginning of a recording that somehow went awry.

If the user wants to find a selection that is a certain number of tunes away from the beginning of the tape, a push of "CPS/CDS" while in rewind gets "CDS" mode and a "PL 1" in place of the normal counter display. Successive pushes will increase the number—to a maximum of 15—until the desired tune number is reached. After rewind to the start of the tape, the deck fast forwards to the beginning of the selected tune, and play commences.

The "Intro Check" button is next on the right. Pushing it in any transport mode gets an immediate fast forward that allows you to sample, in succession, the first 10 S of all tunes following on the tape. This feature is very handy for finding a tune or reviewing what's on a tape.

"CD Level Check," an unusual and interesting feature, lets you find the highest level on a CD and preset the deck's recording level accordingly.

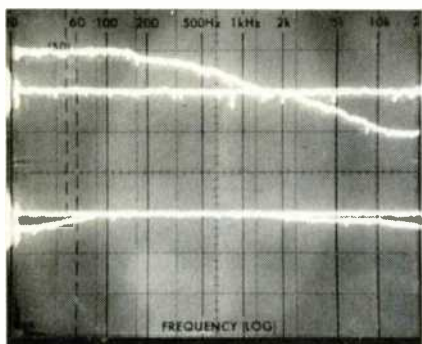


Fig. 1—Range of bias-control effects for two tapes. Straight traces show output level of 7.7-kHz test signal after using TEAC's calibration system. Curved traces show changes in 7.7-kHz output level as bias calibration pot is turned from minimum to maximum (clockwise). Test signal's output decreases smoothly with increasing bias for Maxell XLI tape (top traces) but not for Triad EM-X (bottom traces); see text. Vertical scale: 4 dB/div.

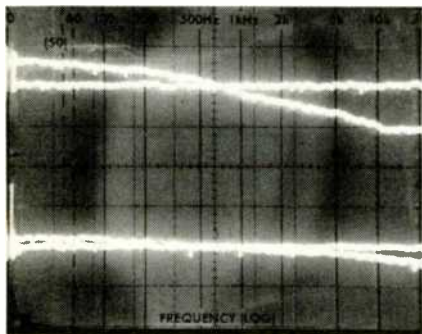


Fig. 2—Same as Fig. 1, for Fuji FR-II (top traces) and TDK MA (bottom).

The transport controls are under the switches just described. Rewind, stop, and fast forward are all of good size, and the play button is actually twice as large. All are clearly marked and angled for easy actuation. When play is pushed, a right-pointing, triangular arrow appears under the counter numbers in the display. To the right of fast forward is a horizontal bar for record, with a legend in red. Below are the pause and "Rec Mute" buttons.

In any pause mode, the word "Pause" and its double-bar symbol illuminate under the monitor status indicators. From pause mode, simultaneously pushing play and record initiates record/pause. As mentioned earlier, record can be punched in during play in the same way. When in record mode, the inside of the display-panel arrow turns red. In record/pause, the white outline goes off, and only the red arrow remains.

If "Rec Mute" is pushed, the red flashes for the duration of muting, which is normally 4 S. This period can be shortened by pushing pause or lengthened by holding in "Rec Mute." Although this description may sound a bit complicated, operation becomes quite straightforward after a little practice. The system's flexibility is excellent, and its status displays are among the best I have seen.

Below the transport and record switches are five pushbuttons for noise reduction. From left to right, they are "MPX Filter" (in/out) and the interlocked "Out," Dolby "B," Dolby "C," and "dbx" noise reduction.

At the upper right of the front panel are controls for bias and level calibration, both with left and right pots. Each pot has a small bar knob and a soft center detent. The calibration process begins in record/pause mode. A push of "Cal Start," below the bias pots, gets the deck recording a 400-Hz tone and simultaneously sets "Stop Memo." At the same time, "Level" illuminates just above the two level-calibration pots, and the left and right meters show playback with a level around zero. The left and right level pots are adjusted until the first red segments above zero turn on. Then "Cal Start" is pushed again, "Level" goes off, and "Bias" goes on. The test tone switches to a high frequency (7.7 kHz), and the meters show a level around zero. The bias pots are then adjusted as the level pots were. Clockwise rotation increases bias, which actually reduces the output signal level. This is opposite in effect to the level pots but shouldn't be confusing to those who know what changing bias does. Another push of "Cal Start" allows a rechecking of level calibration; yet another push, of course, checks bias again. Pushing rewind ends calibration and rewinds the tape to the "Stop Memo" point. This memory is retained, allowing for an easy return if something goes wrong.

Below "Cal Start" is the "Auto Monitor" button, which actually defeats the auto function by manually switching monitor mode. When the deck's operating mode changes, the monitor setting usually switches automatically to whatever monitor mode logically matches the deck's operation.

To the right of "Cal Start" are "Set" and "Reset" buttons for "CD Level Check." In "Set," a red indicator goes on, the monitor is automatically switched to source, and the meter indications are automatically increased by 12 dB. (As discussed earlier, this compensates for the way CD players reduce their output levels during fast scan. The 12-dB boost matches TEAC's CD players, but TEAC says it's a pretty close match for other makes, and I found it worked well with my own player.) After setting levels based on such scanning, "Reset" returns the metering and monitoring to normal operation. I wondered how accurate the level check would be and planned later tests to find out.

The "Master Rec Level" control, with its left and right "Preset" pots, is just below. The master knob has a bevel

The muting system, a little more elaborate than most, offers excellent flexibility, and the status displays are among the best I've seen.

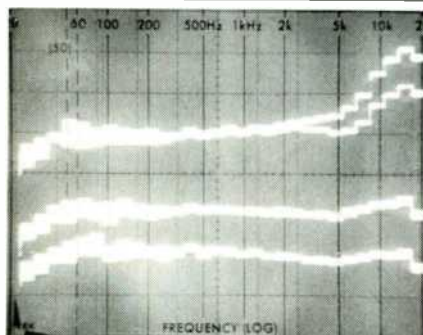


Fig. 3—Using Triad EM-X tape, the bias settings that met the deck's calibration criteria varied enough to produce this range of record/playback responses. Top: With minimum calibration bias, with and without Dolby C NR.

Middle: With Dolby C NR and maximum calibration bias. Bottom: With Dolby C NR, after using test instruments to adjust bias and level for best overall response. Vertical scale: 5 dB/div.

and an index line which aid in accurate setting. To its left, the helpful headphone level control has the same small, smooth knob and hard-to-see index used on the "Preset" controls. These are not the most important things, but a larger size or a little knurling plus a bright-line index would help in setting levels. The headphone jack at the lower right is somewhat away from the level control, but adjustments would probably be slightly more difficult if the plug were close to the control.

The back panel is very simple, having just gold-plated stereo input and output jacks and the power cord.

I removed the top and side cover to get a look at the inside. There was one large p.c. board (about two-thirds chassis size), a few small vertical cards plugged into it, and a board behind the display panel. The main board was well supported, in general, but the power supply end was springy. The function sections were labelled, and all parts and adjustments were identified. What could be seen of the soldering was excellent. Multi-pin plugs were used for the interconnections between sections.

The power transformer was mounted at an angle—to minimize hum pickup—in the left rear of the chassis. It was warm to the touch after some hours of operation. Two chassis side rails make the construction good and rigid. The transport has three motors, one for the dual-capstan drive, another for the tape-hub drive, and the third for actuation of the transport cam. Fast wind sounded a bit tonal, but with the cover replaced, it was much less distracting. The sound level of the transport was very low in play—only 45 dBA just 1 inch from the cassette compartment's door.

The remote control appears rather simple when compared to units for surround-sound systems, but the TEAC RC-311 does much more than the remotes available for

most tape decks. It controls all of the basic transport functions, of course, and has buttons for "CPS," "Auto Monitor," "Intro Check," "Start Memo," "Stop Memo," and counter "Clear," as well. The RC-311 has even more goodies: "Rec Mute," with complete duplication of the flexibility offered by the front-panel control, and two "Record" buttons that also allow flying-start recording. (The RC-311 also carries a third "Record" button and an extra playback button. They are obviously intended for use with TEAC's auto-reverse decks and have no effect on the V-970X.) The remote facilities are not just lazy-recordist conveniences. If cassette decks are physically separated, a good remote control can make dubbing and editing much easier.

Measurements

The 120- and 70- μ S playback responses of the V-970X, using TDK and BASF test tapes, ranged from very good to excellent at all points (Table I). Most deviations were within ± 0.7 dB. Tape play speed was 0.3% fast, which is very good and better than many decks.

Dolby level indicated meter zero, with the first red segment just faintly on. I tried the level and bias calibration system for about 50 tapes. The results were then evaluated, using what I call "PN/Music" as a test signal. This is pink noise, band-limited below 20 Hz and above 20 kHz, with a complex equalization designed to simulate typical music spectra. The equalization begins with a roll-off above 2 kHz that slopes down to -5 dB at 5 kHz, then slowly drops to -8 dB at 10 to 16 kHz. This decrease is followed by a sharp drop, to about -15 dB at 20 kHz. A mirror image of this equalization is applied to the deck's playback output, so flat record/playback responses will appear flat on my RTA.

The great majority of the Type I tapes calibrated easily and had good record/playback responses with and without Dolby C NR. Maxell XLI was judged to be the best overall, with Fuji FR-I Super very close.

I had more of a problem with the Type II tapes, many of which showed puzzling characteristics in calibration that I'll explain shortly. Fuji FR-II was judged the best of the Type IIs, with Maxell XLII, Memorex HBX-II, SKC QX, Sony UX-ES, and TDK SA almost as good. The responses from Fuji FR-II Super, Maxell UDS-II, and Sony UX were somewhat poorer. All other Type II tapes tried were judged to be unsatisfactory because of a peak of 4 dB or more from 12 to 16 kHz.

TEAC states that this deck cannot be calibrated for optimum response with Type IV tapes, but I found it could be properly calibrated for some metal-particle formulations. The best of these, in my view, was TDK MA; Fuji FR-Metal, Maxell MX, Nakamichi ZX, and SKC ZX were also quite good. A number of other metal tapes had the same sort of high-frequency peak as the Type IIs.

At this point, I decided to examine the calibration process more closely. I didn't have any questions about setting the Dolby reference level, but I did check the test tone used. Its frequency was 379 Hz, and it was recorded about 20 dB below Dolby reference level (200 nWb/m). The high-frequency bias test tone was 7.7 kHz at about -20 dB. The deck includes a 20-dB amplifier for these test signals, so the recording level meter will read zero for them when the deck is calibrated.

Remote control is not just a sop to the lazy recordist; it makes dubbing and editing between widely separated decks far easier to do.

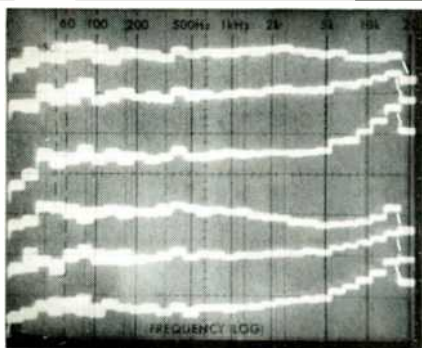


Fig. 4—Record/playback responses for PN/Music, after calibration, with Dolby C NR. Top three traces are at 0 dB for (top to bottom) Maxell XLI, Fuji FR-II, and TDK MA tapes. Bottom three traces are at -20 dB for same tapes in same order. Vertical scale: 5 dB/div.

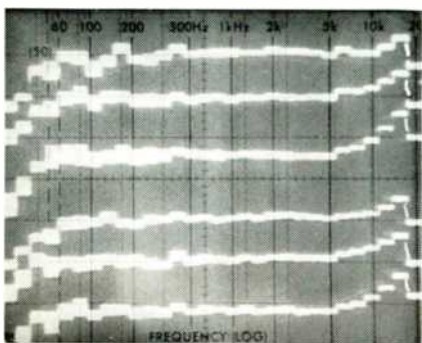


Fig. 5—Same as Fig. 4 but with dbx NR.

To see what was happening with the level of the 7.7-kHz bias test tone, I tuned my spectrum analyzer to 7.7 kHz and checked the deck's test-tone playback level over time as I changed bias settings. For each tape tried, I stored the tone level produced when the deck's bias was set according to the calibration system. I then made a second set of measurements while varying the setting of the bias pot from its minimum to its maximum. One should expect that the level would be highest with minimum bias and would drop with increasing bias.

Figure 1 shows the results from the two scans for both Maxell XLI and Triad EM-X, one of the questionable Type II tapes. With XLI, the test-tone level is higher with low bias; the level decreases smoothly as bias is increased. However, in the case of EM-X, low bias gets a low level, there is little change in tone level during a large increase in bias, and the highest bias gets a slow drop in level. Figure 2

shows the results of the same test with Fuji FR-II and TDK MA tapes. You can see a good range of 7.7-kHz level control with the Type II tape, but the total change for the metal tape is just about the same as the segment on the meter.

Using Triad EM-X tape in the V-970X, the level of the test tone changed slowly as the bias was changed, so proper calibration was indicated over a range of bias levels. Figure 3 demonstrates the different record/playback responses that are possible with EM-X, all meeting calibration criteria. The top two traces are with minimum calibration bias, with and without Dolby C NR. The higher peak is with NR. The middle trace was obtained using Dolby C NR but with bias increased to the maximum possible for a calibration indication. The bottom trace shows a slight further improvement, which was made by adjusting both bias and level for the best RTA display. Without the RTA, the top traces would be the most likely responses for EM-X. My explanation is this: Even though the test-tone level is 20 dB down, it is actually in saturation, which causes a drop in output level when the input level is increased. Because test-tone saturation is occurring, bias is actually set at a lower level than it ought to be. When recording music (or pink noise) with lower high-frequency levels which are not in saturation, the resulting record/playback will be peaked at the highest frequencies.

Figure 4 shows the record/playback responses for PN/Music, using Dolby C NR, for rms levels equivalent to meter zero (reading +6 on the deck's peak-reading meters, due to peaks in the noise signal) and at a level of -20 dB. The three tapes used were Maxell XLI, Fuji FR-II, and TDK MA. Each recording was made after following the calibration process as carefully as possible. It was easy to verify that the responses were flatter for the Type II and IV tapes if the bias was set slightly higher than was called for in calibration. Figure 5 shows the generally similar results for the same three tapes at 0 and -20 dB using dbx NR. With slightly higher bias, the high-frequency peaks would be much lower. Do note, however, the roll-off below 40 to 50 Hz, which is typical of dbx II NR.

Table I lists the -3 dB points for the three tapes without NR and with Dolby C and dbx NR, at 0 and -20 dB. The high-frequency end points could not be measured with simultaneous record/playback because of coupling between the record and playback heads, which are very close.

Table I—Record/playback responses (-3 dB limits).

Tape	With Dolby C NR				Without NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell XLI	10.6	11.6	10.0	18.5	10.5	9.8	10.5	19.9
Fuji FR-II	10.9	12.6	9.9	17.1	10.9	9.9	10.2	19.3
TDK MA	10.5	18.7	10.3	20.4	10.5	18.7	10.0	20.6

Tape	With dbx NR				Without NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell XLI	32.1	11.8	32.3	17.3	10.5	9.8	10.5	19.9
Fuji FR-II	32.3	12.3	32.0	17.2	10.9	9.9	10.2	19.3
TDK MA	32.2	18.4	31.8	21.2	10.5	18.7	10.0	20.6

The S/N with Dolby C NR was good, but with dbx NR it was outstanding—2 to 3 dB better than for any other deck I've tested with this NR system.

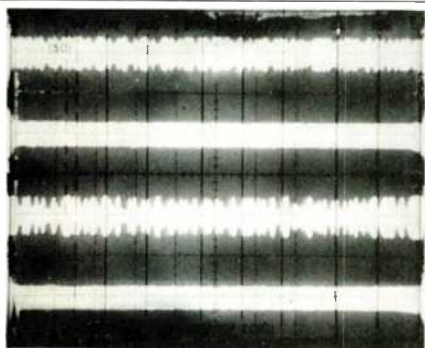


Fig. 6—Effect of coupling between record and playback heads when monitoring the playback head while recording. The upper trace of each pair shows output variations while monitoring; the lower trace shows smooth response when playing back the recorded signal. See text. Top pair of traces is for a 14.5-kHz tone; bottom pair is for 16.5 kHz.

As shown in Fig. 6, when the test tone was monitored from the playback head during recording, signal coupling from the record head made the monitor levels bounce up and down. However, when recording ceased, rewinding and playing back the tape showed excellent smoothness of output. Obviously, the bouncing level does not affect the recording. In my subsequent listening tests, using music instead of steady test tones, I did not detect any effects that I could ascribe to coupling between the heads. The lowest frequency for an observable effect was about 10 kHz. There were specific points where the bouncing was low, and 16.5 kHz was a point where it was quite high.

Table II lists a number of record/playback characteristics, all of which were excellent except for the 100-Hz erasure with Dolby C NR, which I wish were 5 dB better. Notice the improved results for erasure, separation, and crosstalk with dbx NR. I'm not certain how far down crosstalk was—I gave up at -110 dB.

Table III shows the third-harmonic distortion levels with Dolby C and dbx NR for the three tapes, from -10 dB to the level where $HDL_3 = 3\%$. All of these results are very good, especially the low distortion at low levels with dbx NR and Maxell XLI tape. The 3% limits for the Maxell and TDK tapes with dbx NR were actually the points at which the electronics clipped.

Table IV lists the MOLs for 3% distortion attained with the three tapes, using Dolby C and dbx NR. An HDL_3 limit was used for 40 Hz, 100 Hz, 400 Hz, and 1 kHz, and a TTIM limit for 2.5, 10, and 15 kHz. The Dolby C NR figures were pretty much what I expected for the Type I and II tapes, with some evidence of HX Pro at work. The results for TDK MA were very impressive, with the 15-kHz level actually higher than that for 10 kHz. This tape was also the most impressive performer with dbx NR, despite the large drop in maximum levels from 10 to 15 kHz. The XLI and FR-II tapes had very

high MOL figures from 100 Hz to 2.5 kHz with dbx NR, but a large drop in the MOLs occurred at 40 Hz and at 10 and 15 kHz. Therefore, with these tapes, the very high MOLs for dbx at 400 Hz cannot be taken advantage of when recording music with organ, obvious bass drum (40-Hz limit), or loud cymbal crashes (15-kHz limit).

Table V shows S/N ratios for the three tapes, using Dolby C and dbx NR, with both IEC A and CCIR/ARM weightings. The results for Dolby C NR are very good and somewhat better than the average for other decks. The dbx figures are outstanding—2 to 3 dB better than any previous ratios for this NR. At first, I wondered if my measurements were off, but rechecks confirmed the data shown.

Table VI lists some miscellaneous input and output characteristics. My numbers were higher than specified by TEAC for both input sensitivity and output level, but these differences are of minor importance. The right and left sections of the master input and headphone level pots tracked within 1 dB for 45-dB attenuation, which is fairly good. The level was quite high on all headphones tried, and it was very nice to have this pot to set a comfortable listening level. I confirmed that "CD Level Check" increased the displayed meter level by 12 dB. Next, I tried this feature with two CDs I knew would be challenging, Stravinsky's "The Firebird Suite" and Tchaikovsky's "1812 Overture." The "CD Level Check" provided some clues to the disc's peak levels, but the actual peak levels were 4 dB higher for the Stravinsky and 6 dB higher for the Tchaikovsky. After a little practice, the user might find that setting the level to -4 would be close for similar classical music. The level check was quite good, within 1 or 2 dB for pop/rock CDs because of their rather consistent high levels.

The bar-graph meters were 3 dB down at 4.7 Hz and 20.2 kHz—better than meters on quite a few other decks. The scale calibrations were accurate, with most segments within 0.2 dB. For example, the +8 segment turned on at +7.9 dB; +12 was the exception, turning on at +10.0 dB. The response time of the meters was very short, meeting the requirements for peak program meters, but the decay time was just 0.6 s, about one-third the recommended time. The meter was full peak responding and gave the correct in-

Table II—Miscellaneous record/playback characteristics.

NR Type	Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase		MPX Filter At 19.00 kHz
				Error	Jitter	
Dolby C	55 dB	64 dB	-100 dB	5°	15°	-37.0 dB
dbx	83 dB	68 dB	< -110 dB			

Table III—400-Hz HDL_3 (%) vs. output level (0 dB = 200 nWb/m).

Tape	NR	Output Level						$HDL_3 = 3\%$
		-10	-8	-4	0	+4	+8	
Maxell XLI	Dolby C	0.08	0.09	0.21	0.36	1.26		+6.6 dB
	dbx	0.05	0.07	0.10	0.18	0.27	0.38	+17.3 dB
Fuji FR-II	Dolby C	0.08	0.14	0.30	0.79	2.51		+4.6 dB
	dbx	0.16	0.20	0.25	0.32	0.56	0.80	+16.9 dB
TDK MA	Dolby C	0.08	0.13	0.32	0.82	1.58		+6.6 dB
	dbx	0.14	0.19	0.24	0.34	0.47	0.70	+17.5 dB

The V-970X combines excellent performance in all areas with many real conveniences. It's worth comparing to decks that sell for twice its price.

Table IV—MOL (0 dB = 200 nWb/m) for 3% distortion vs. frequency.

Tape	NR	Frequency (Hz)						
		HLD ₃ = 3% (dB)				TTIM = 3% (dB)		
		40	100	400	1k	2.5k	10k	15k
Maxell XLI	Dolby C	-3.9	-6.5	-6.6	-5.0	-3.4	-3.2	-8.4
	dbx	-0.3	+17.2	-17.3	-16.4	-9.9	-1.8	20.4
Fuji FR-II	Dolby C	-0.8	+3.9	-4.6	-4.5	-2.1	-3.7	-8.5
	dbx	-4.7	+11.6	-16.9	-15.7	-8.3	-2.3	-17.9
TDK MA	Dolby C	-2.8	-6.0	-6.6	-7.1	-7.0	-3.6	-3.9
	dbx	-8.7	-15.3	-17.5	-17.4	-15.0	-11.0	-1.6

Table V—Signal/noise ratios with IEC A and CCIR/ARM weightings.

Tape	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		W/dbx NR		W/Dolby C NR		W/dbx NR	
	α DL	HD=3%	α DL	HD=3%	α DL	HD=3%	α DL	HD=3%
Maxell XLI	68.0	74.6	81.3	98.6	68.9	75.5	77.7	95.0
Fuji FR-II	71.2	75.8	82.5	99.4	71.0	75.6	78.7	95.6
TDK MA	70.0	76.6	82.0	99.5	70.6	77.2	78.4	95.9

Table VI—Input and output characteristics at 1 kHz.

Input	Level			Imp., Kilohms	Output	Level			Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload				Open Ckt.	Loaded			
Line	99 mV	>31 V		58	Line	440 mV	345 mV	3.0k		+15.7 dB
					Hdphn.	469 mV	319 mV	22		

creases in reading when the tone burst was offset in either direction from zero voltage. Very few other cassette decks have meters that meet this criterion. In source mode, the signal polarity was the same at both the input and the output. In tape mode, polarity at the output was reversed.

Typical measured flutter was 0.032% weighted rms and ±0.046% weighted peak. The rms figure is slightly higher than specified, but it is excellent nonetheless. There was no measurable change in tape playback speed with line voltage anywhere from 110 to 130 V. There were small speed variations with time that were limited to about ±0.02%. The TEAC owner's manual specifies 100 S for fast winding a C-60 cassette, but the tested unit did it in 80 S; it even wound a C-90 in 104 S. Transport mode changes required less than 1 S.

Use and Listening Tests

The four-language owner's manual provides good detail on most things, and a fold-out page with diagrams provides a lot of helpful information. The manual has an explanation of HX Pro which most users would find of interest, although more information about setting record levels would certainly be beneficial.

Tape insertion and removal were very easy, and I did not find myself confusing the power and eject buttons, as on some decks. I did need a bit of a training period to learn all of the various functions and variations, although it all seemed very logical after some practice. I was going to list

one or two things I really liked, but there are more than a few: Complete control of auto-mute time, Dolby and dbx NR systems, an excellent remote control, three heads, head-phone level control, bias and level calibration, peak-responding meters, and the admirable display panel. The memory modes were also very useful, even if I did wish the elapsed-time counter would count time when fast winding. Other functions, such as "Intro Check," worked very well and were most convenient when used with tapes of pop/rock music. All controls and switches were completely reliable during the testing.

Timer start in play or record had about a 2-S delay before the transport was engaged. This seemed a rather short time for the transport to get up to speed, but I didn't detect any problems. Record, pause, and stop sounds with Dolby C NR were all very low in level and hard to detect by meter or ear, even when well amplified. The sounds were even lower with dbx NR.

The calibration system worked very well, but I decided to make pink-noise comparisons between source and tape while adjusting bias and listening carefully. Without NR, the change in level at the highest frequencies was obvious for small changes in bias; it was much more so with Dolby C NR. With dbx NR, bias changes had less effect on high-frequency peaking but more on overall level. I also used the RTA to recheck the peaking effect versus small changes of bias. My general conclusion was that Type II and IV tapes had the flattest responses when bias was increased enough to get a slightly lower meter indication than TEAC recommends in their calibration instructions.

I used CDs for the record/playback listening tests. During quiet passages, the noise background with dbx was slightly less noticeable than it was with Dolby C NR. With dbx NR, it was possible to record at very high levels without gross distortion. At normal recording levels, however, clarity and musical detail were better with Dolby C NR. On Stravinsky's "Firebird Suite," with Robert Shaw and the Atlanta Symphony (Telarc CD-80039), TDK MA tape showed its advantages at higher record levels with both NR systems. The bass drum beats near the end of the music were slightly subdued with dbx NR, but the cymbal crashes, at very high recording levels, were cleaner than I expected. Beethoven's "Piano Concerto No. 3" and the "Choral Fantasy" with Rudolf Serkin, Seiji Ozawa, and the Boston Symphony (Telarc CD-80063) confirmed the excellent flutter performance of the TEAC deck. The chorus was reproduced very well, and I did not detect modulation effects with soprano voices. Saint-Saëns' "Symphony No. 3," played by Michael Murray with Eugene Ormandy and the Philadelphia Orchestra (Telarc CD-80051), fared best with Dolby C NR. This noise-reduction system provided a fuller organ tone on the lower pedal notes and better articulation in the loud passages than did dbx NR.

The V-970X offers many real conveniences and delivers very good to excellent performance in all areas. Trimming bias for the best record/playback will be aided by careful listening. This deck is a potent combination for those who do lots of recording/dubbing, and it is certainly worthy of comparison to decks costing up to 50% more.

Howard A. Roberson