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TEAC Z-7000 CASSETTE DECK

Manufacturer's Specifications

Frequency Response: 20 Hz to 20 kHz; to 21 kHz with CrO₂ tape; to 22 kHz with metal tape.

Signal/Noise Ratio: At 1 kHz, 82 dB with Dolby C NR; 92 dB with dbx NR.

Input Sensitivity: Mike, 0.25 mV; line, 60 mV.

Output Level: Line, 300 mV; head-phone, 100 mW at 8 ohms.

Flutter: 0.019% wtd. rms.

Fast-Forward and Rewind Times: 80 S with C-60 cassette.

Dimensions: 17 in. (432 mm) W × 6-7/16 in. (163 mm) H × 17-13/16 in. (437 mm) D.

Weight: 39.4 lbs. (17.9 kg).

Price: \$1,800.00.

Company Address: 7733 Telegraph Rd., Montebello, Cal. 90640.
For literature, circle No. 94



Teac calls the Z-7000 a "master cassette deck," and its size alone is impressive. Hefting its 40 pounds and contemplating all its front-panel buttons is certain to give pause to many.

As the button count implies, the deck is full of features: Three types of noise reduction (Dolby B and C and dbx), pitch control in recording and in playback, automatic fade-in and fade-out, a real-time tape counter, and automatic tape-parameter setting with a degree of manual override, to name just some of the less usual ones. As with many units full of microprocessor-controlled functions, a period of familiarization is in order, to give the user confidence and to ensure that all of the features are used as much as possible.

The center of the front panel is dominated by the cassette compartment on the left and the meter/display panel on the right. The controls are in three main areas, in a "U" surrounding these dominant features.

The cassette compartment has a carrier which moves out and tilts down for tape ejection. Loading and unloading are easy and smooth, and maintenance access is good, especially so with the clear door cover snapped off.

The main operating controls lie horizontally, slightly recessed below the tape well and display. Logically, the transport controls are just below the transport, with "Record," "Rec Mute" and "Pause" just to their right, all equipped with indicator LEDs (green for playback functions, red for the three record ones). The Z-7000's "Rec Mute" is unusual in that the period of time before the transport goes into pause mode can be set for anywhere from 2 to 10 S by using the "Auto Space" control at the upper left. Even longer mute times can be obtained by holding down "Play" while pushing "Rec Mute," then releasing "Play" at the end of the desired mute time.

Pots next to "Auto Space" control "Fade In" and "Fade Out" times, which can be independently set anywhere from 0 (normal on/off recording) to 10 S for the change between full level and off. Fading in will occur at any time that recording is started, but a fade-out requires the use of "Rec Mute." Automatic fading is a nice feature to have, particularly as record level-set controls do not have to be changed. All three pots have small-diameter, spring-loaded knobs which lock in flush with the front panel but remain operative even when pushed in.

Below the three knobs are three rows of four pushbuttons with status LEDs, plus one row of three buttons without. The top row is for monitor selection: "Source," "Cal," "Tape" and "Sync." "Cal" is the normal mode for most three-head decks where the playback level shown on the meters is *not* affected by the setting of the output-level pot. In "Tape" mode, the level on the meters does vary with the setting of the output-level control, possibly useful where level matching is needed. The "Sync" position has automatic switching, so that the meters display input levels when the transport is stopped (including record/pause) or in a wind mode and show playback level when the deck is in play or record/play mode. This feature would be a great convenience when doing a lot of copying or editing of short selections.

The four buttons in the second row are for noise-reduction control: "Out," "dbx," "Dolby B" and "Dolby C." Annunciators in the meter/display panel remind the user what has

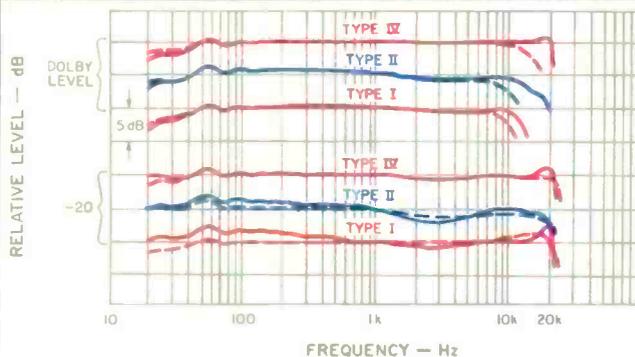


Fig. 1—Swept-frequency responses with (solid line) and without (dashed line) Dolby C NR, at Dolby level and -20 dB for Maxell MX (Type IV), UD-XL II (Type II) and UD-XL I (Type I) tapes.

been selected, a real need for any serious user. The third row is primarily for input selection: "Line," "Mic" and "dbx disc," plus the "MPX Fil" switch for use with the Dolby modes to reject above-band energy, such as from FM pilot tones. The remaining three buttons control the timer "Out," "Play" and "Rec" functions.

The "Power" and "Eject" buttons are recessed below the above panel. The "Power" switch has a nice, orange designation, but it is push-on/push-off and too close to the "Eject" button, in my view. Below is the headphone jack with its own level control, always a nice feature. Next to it is a similar push-in/push-out "Pitch Cont," which must be latched in to be off. When the knob is out, tape speed is controlled ($\pm 10\%$) both in play and record modes. The range is very good, being about a full tone in either direction, but because there is no center detent in the out/operating position, I would have liked a "Speed Off" annunciator on the display.

The peak-responding meter display is very bright and easy to read under any lighting conditions. There are 30 segments in each channel, blue-white from "-40" to "-1" and orange from "0" to "+10." In addition, there are 1-dB steps from "-10" to "+10," which provides outstanding resolution in this important level range. In normal mode, the topmost segment is held for about 2 S after being turned on by a music peak. With "Peak Hold" selected (from a group of buttons at the panel's top right), the highest level indication will be held indefinitely, and a "Peak Hold" reminder illuminates on the display panel.

Also appearing on the display panel are the following: The NR system selected (as mentioned earlier), the tape type (determined by sensing holes in the cassette shell), the tape length (entered by the user), the elapsed playing time corresponding to the length of the tape in use, and the "CPS" (programming) number. As tape type is sensed automatically, it is obvious that some older Type II tapes could indicate "Norm," and even some current Type IV cassettes would show "CrO₂." The elapsed-time indicator does not calibrate itself to the actual position on the tape, nor does it

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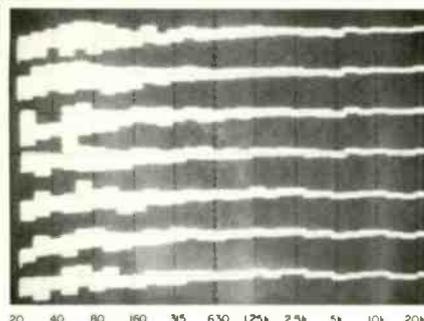


Fig. 2—Pink-noise response using dbx NR. From top to bottom: At +10 dB with Maxell MX (Type IV) tape, at 0 dB with MX, at 0 dB with

Maxell UD-XL II (Type II), at 0 dB with UD-XL I (Type I), and at -20 dB with MX, UD-XL II and UD-XL I.

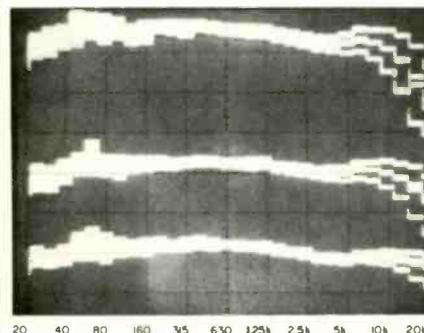


Fig. 3—Effects of MOL balance, "Hi-Extend" and Dolby C NR on frequency response. All curves are with Maxell UD-XL II tape at +5 dB; major curves are (top to bottom) with low, standard and high MOL balance settings. High-frequency ends of

each curve show effects of (top to bottom) Dolby C NR and "Hi-Extend" together, Dolby C NR alone, "Hi-Extend" alone, and response with neither Dolby C NR nor "Hi-Extend." Vertical scale: 5 dB/division.

reset upon insertion of a tape or rewind the tape to the beginning to set zero. Actually, I do prefer that counters *not* reset with cassette removal or insertion, and the Teac time counter keeps track of real time relative to tape position even in the fast-wind modes, which is good. The Computomatic Program System ("CPS") fast-winds to a desired selection, skipping a programmed number of selections (up to 19) en route.

Below the meter/display panel (another logical control placement) are the horizontal "Rec Preset Level" sliders for each channel and a "Master" slider with nearly 3 inches of travel. The "Master" control has a good-sized, square knob

with a clear window and index line in its center, making settings very easy to read. The channel-slider knobs are small but easy to use; I was made a bit dubious, however, by the springiness of the arms connecting these knobs to their internal controls. Just to the right is the output-level slider, of the same mechanical design. Below it are the left and right microphone jacks and the socket for the RC-200 wired remote control (supplied).

Above, on the right side of the front panel, are rows of pushbuttons, most with indicators. The top row includes "STZ" (search to zero), "Cue," "STC" (search to cue) and "STR" (search to record). The "STZ" fast-winds the deck to the position where the counter reads zero. "Cue" sets into memory whatever counter reading is displayed at the time; "STC" will then fast-wind the Z-7000 to that position. "STR" functions only in the record mode and will fast-wind the deck to the beginning of the last recording. In the next row of buttons are "SES" (spot-erase system), "Position," "Repeat" and "Intro Check." "SES" is used in conjunction with "Position" to pinpoint a section to be erased (as little as 0.3 S) and then to have the erasure made automatically. It includes a check run to verify the accuracy of the position choices before actual erasure. This is a good use of micro-processor capability. "Repeat" will initiate repeated playback between counter zero and the selected cue point. "Intro Check" makes the deck play the first 10 S of each selection on the tape.

The third row of buttons consists of "Counter Clear" to zero the counter, "CPS" to enter the number of selections to be skipped, and "Peak Hold" to get that metering mode. The next row is for setting tape length: "C-46," "C-46L" (large hub), "C-60" or "C-90." It is necessary to input this information to ensure accurate elapsed-time indications for the cassette in use.

The next group of buttons and readouts are all part of the Z-7000's tape-calibration system. When a cassette is loaded, the tape type ("Norm," "CrO₂" or "Metal") lights up, as does a button labelled "Reference" and one designated "Std." This tells the user that the tape will be recorded with reference bias, equalization, and record sensitivity with "standard" MOL (maximum output-level) balance. "Low" MOL balance would get lower low-frequency distortion but less high-frequency headroom, and "High" MOL balance would favor better high-frequency headroom with higher distortion at the low end.

For any tape not meeting the reference criteria, the user pushes "Auto Cal," and the three MOL-balance button LEDs will flash, calling for that decision. Once made, "Record" flashes and the actual calibration takes place. At the end, an "OK" appears, at which time the settings can be entered into any one of the three memories. The versatility of the system is further enhanced by the fact that each memory will store settings for each of the tape types, a total of nine calibrations stored—quite impressive. "Hi-Extend" can be used with Type II or IV tapes for further improvement in high-frequency headroom. The setting of this function is included in the stored information for recall later.

On the back panel are gold-plated line-in/out stereo pairs and a jack for the supplied 5-V power supply which ensures that the memories are fed constant power even if the deck is

The counter keeps track of elapsed time relative to tape position, even in the fast-wind modes, which is helpful.

turned off. I was unsure of the functions of a number of screws holding on the top/side cover, so the normal disassembly was not made. A peek in from the bottom after taking off that cover showed many p.c. boards, with all parts identified and excellent soldering.

Measurements

The playback responses were very close to standard, within a dB for both equalizations, except for fringing effects at the lowest frequencies. The Z-7000 auto-calibration system produced at least very good responses for all tapes tried, with the exception of low-bias, non-premium Type I and II cassettes, which were rolled off. Test data supplied with the deck had been taken with Maxell UD-XL I, UD-XL II and MX tapes, and they were used for the detailed tests. Figure 1 shows the swept-frequency responses for these three tapes, with and without Dolby C NR. The results are quite good to excellent, with MX responses most notable. The -3 dB points are listed in Table I.

Figure 2 shows the pink-noise responses with dbx NR for all three tapes. There are small differences at the lowest frequencies, but overall the responses are excellent and very consistent. The three families of overlapping curves in Figure 3 show the results of recording pink noise at +5 dB on UD-XL II at the three MOL balance settings. The different responses above 5 kHz or so in each curve family show the effects of NR and "Hi-Extend." In each case, response was poorest when neither was used; using "Hi-Extend" alone produced a noticeable improvement, and using Dolby C NR by itself produced a slightly greater one. When both "Hi-Extend" and Dolby C NR were used, the responses were flattest of all—and distortion was slightly reduced, as well.

Tape play speed was only about 0.2% high, and a standard level tape played about 1 dB low. Table II lists a number of measured recorder characteristics; these results were good to excellent, save that phase error was just average.

Table III lists the distortion values measured at levels from 10 dB below Dolby level to the 3% distortion limit for the three tapes in both Dolby C and dbx NR modes. Note that UD-XL I used standard MOL balance, while UD-XL II and MX used high MOL balance. There are three interesting facets to the data: The higher distortion of the Type II and Type IV tapes, the much higher maximum levels with dbx NR, and the converging and limiting lower distortion limit around -10 dB. Additional checks were made to determine the effect on 400-Hz distortion with changes of MOL balance. At 0 dB with Dolby C NR, the figures for UD-XL I tape were 0.42%, 0.71% and 1.26% for low, standard and high MOL balance, respectively. Results for UD-XL II tape were 1.41%, 2.2% and 3.4%, while with MX tape results were 0.73%, 1.19% and 2.5% respectively. With dbx NR, distortion also increased with higher MOL balance, but the actual distortion figures were much lower, and the spread between the figures was less. Using "Hi-Extend" increased mid-band distortion slightly, but also reduced distortion at 6 kHz to half what it was when this circuit was not used.

Table IV has the signal-to-noise ratios for the same conditions as for Table III, with the addition of test results for MX tape with standard MOL balance. Note the sizable in-

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

Tape Type	With Dolby C NR				Without NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell UD-XL I	15.7	12.5	11.7	21.2	11.2	10.1	10.6	22.6
Maxell UD-XL II	17.7	12.7	12.7	22.1	12.9	9.0	10.4	23.3
Maxell MX	20	21.6	12.2	23.2	12.5	14.3	10.2	24.3

Table II—Miscellaneous record/playback characteristics.

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	
61 dB	44 dB	-80 dB	50°	10°	-30.3 dB

Table III—400-Hz HDL₃ (%) vs. record level (0 dB = 200 nWb/m).

Tape Type	NR	Record Level						HDL ₃ = 3%
		-10	-8	-4	0	+4	+8	
Maxell UD-XL I*	Dolby C	0.15	0.18	0.29	0.71	2.2		+ 4.8 dB
	dbx	0.13	0.16	0.17	0.22	0.47	0.77	+13.8 dB
Maxell UD-XL II**	Dolby C	0.32	0.56	1.3	3.4			- 0.4 dB
	dbx	0.40	0.47	0.77	1.2	1.8	2.6	+ 8.4 dB
Maxell MX**	Dolby C	0.32	0.45	1.2	2.5			+ 0.7 dB
	dbx	0.36	0.42	0.60	0.95	1.5	2.0	+11.3 dB

*Std. MOL Balance
**High MOL Balance

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

Tape Type	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		With dbx NR		W/Dolby C NR		With dbx NR	
	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Maxell UD-XL I*	69.1	73.8	74.4	88.2	67.2	71.9	70.6	83.8
Maxell UD-XL II**	70.7	70.4	74.3	81.7	68.4	68.1	70.3	77.7
Maxell MX**	70.4	70.9	72.9	82.5	68.6	69.1	70.7	80.3
Maxell MX*	70.5	75.1	73.9	87.9	68.7	73.3	71.2	85.2

*Std. MOL Balance
**High MOL Balance

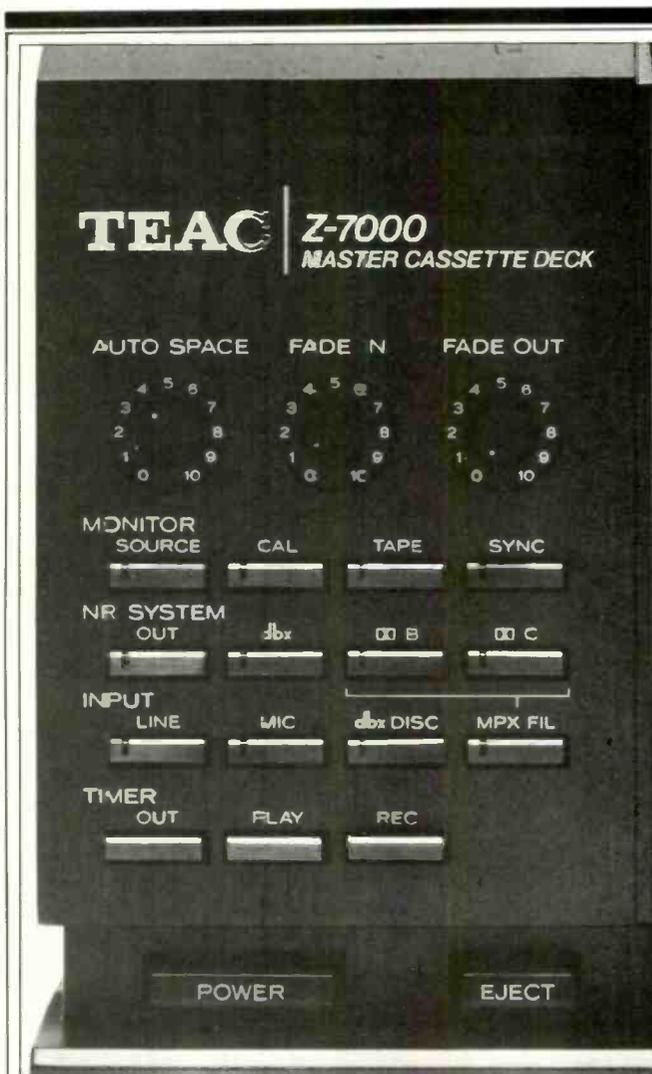
Table V—HDL₃ (%) vs. frequency at 10 dB below Dolby level.

Tape Type	NR	MOL Bal.	Frequency (Hz)							
			50	100	400	1k	2k	4k	5k	
			Maxell UD-XL II	Dolby C	Low	0.24	0.32	0.22	0.22	0.07
		High	0.47	0.50	0.40	0.40	0.15	0.16	0.36	

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	36 mV	10.4 V	84	Line	906 mV	895 mV	11	+12.9 dB
Mike	0.33 mV	224 mV	9.1	Hdphn.	113 mV	105 mV	3.5	

I judged that the Z-7000 cassette deck delivered the best dbx NR sound I have heard to date.



The three knobs and the "Sync" button on this, one of the Z-7000's two multi-button panels, control some of its more uncommon features.

creases in the ratios because of the higher distortion limits. Table V shows that the lower MOL balance gained lower distortion except for the very highest test frequency.

Various input and output properties are shown in Table VI. The output impedances are very low, quite superior to many other decks. The sections of the master input-level pot tracked within 1 dB over a 45-dB range, which is quite good. The output-level pot sections and those of the headphone control tracked very well, within 1 dB for 55 dB. A very high level was delivered to any of the headphones tried, easily moderated with the pot. The polarity of the output matched that of the input in "Source" or any of the

playback monitor positions. The action of the auto-fade controls was very smooth, with gain changing by a full 60 dB in anywhere from an instant to about 9 S. The auto-space range appeared to be from 2 to 10 S.

The meters in the Teac Z-7000 deck were truly peak-responding, reaching very close to zero with a 10-mS burst. Decay time was slightly fast, at 800 mS. There were momentary peak holds of about 2 S; this characteristic, and the selectable "Peak Hold," were operative even down at -35 dB. This is far superior to many such devices which hold peaks only above zero. The thresholds were very accurate over the entire range of the metering, also superior to most other bar-graph meters.

The measured flutter was 0.023% wtd. rms, which is a very low figure, albeit slightly higher than the specified 0.019%. On a weighted peak basis, the result was $\pm 0.044\%$, also excellent. Any observed speed deviations, including those from voltage changes, were less than 0.02%. Average wind times for a C-60 cassette were 78 S. The pitch control range was from -11.2% to +13.3%, substantially a full tone in both directions, about twice the range of most pitch controls. All logic-transport mode changes took less than 1 S.

Use and Listening Tests

The five-language owner's manual presents lots of detail in its 74 pages, and there certainly are a lot of features to discuss. The illustrations are good, and the full collection of schematics supplied gave quite an indication that I had missed seeing a lot when I did not get the unit's cover off. I did feel that there should have been more discussion of what auto-cal actually did, and also of the expected effects for selecting a particular MOL balance. Considering the good performance of auto-cal, I found it puzzling that the manual recommended that the owner have the "bias circuitry of this deck adjusted" to match his favorite tapes.

All of the controls and switches were convenient in use and completely reliable, including the remote control. The white designations on the dark front panel were easy to read, whatever the lighting. Record, pause and stop clicks were well down in noise, even with Dolby C NR. Metering was outstanding in use, and "Peak Hold" was a big help in checking for maximum levels without having to stare at the meters continually. The spot-erase system worked very well, and it's definitely a nice extra. I used auto-cal and the three memories to store the three MOL balance settings for all three tape types. This made it possible to record and change MOL balance without even stopping the tape.

In general, I preferred the results with Dolby C NR with the MOL balance on standard or low. If I recorded at an extra high level, I always preferred the low MOL setting. I must add that for such levels, dbx NR was preferable. I also judged that, in general, the Z-7000 delivered the best dbx NR sound I have heard to date.

The Teac Z-7000 is a sophisticated deck with many features and generally excellent performance. As is true with other microprocessor-controlled decks in this higher price range, evaluation and rating of the numerous conveniences is in order to assess the value of the required investment.

Howard A. Roberson