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## TECHNICS RS-M95 CASSETTE DECK

### Manufacturer's Specifications

**Frequency Response:** 20 Hz to 17 kHz, 20 Hz to 19 kHz with CrO<sub>2</sub> tape, 20 Hz to 20 kHz with metal tape.

**Signal/Noise Ratio:** 60 dB, 70 dB with Dolby NR.

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

**Output Level:** Line, 650 mV; head-

phone, 88 mV at 8 ohms.

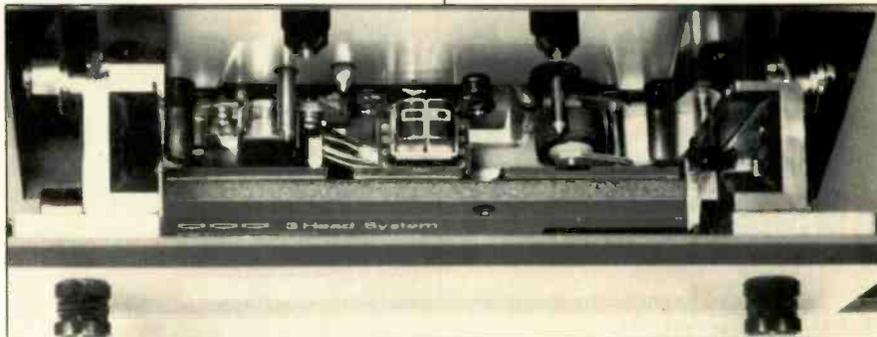
**Flutter:** 0.03% wtd. rms.

**FF & RWD Times:** 80 seconds for C-60.

**Dimensions:** 17 $\frac{3}{4}$  in. (450 mm) W x 5 $\frac{1}{2}$  in. (142 mm) H x 13 $\frac{3}{4}$  in. (348 mm) D.

**Weight:** 26.5 lbs. (12 kg).

**Price:** \$1300.00.



The Technics RS-M95 cassette deck has excellent performance and a number of useful convenience features. The unit incorporates quite an array of front-panel controls and switches, but they are laid out and identified well, so there is little likelihood of confusion. The gold printing on the dark-brown background, however, is difficult to read when the room light is dim. When observing the unit in use, my attention was caught by the three-digit fluorescent tape counter, the flashing Strobe indicator to its right, and the two-channel, fluorescent-bargraph level meters. The tape counter is different from most other units not only in its display but in its mechanism, which uses a magnet

and Hall-effect integrated circuitry to detect motion without actual contact. In addition to the three digits, there is a series of one to four bars, which appears to the right of the numeric display, and the change to the next digit occurs when all of the four are blank. These improve counter resolution and are particularly helpful toward the end of the cassette. (The Strobe indicator flashes on/off continuously at about a one-second rate, whatever mode the deck is in, helpful for timing pauses or short sections of music.)

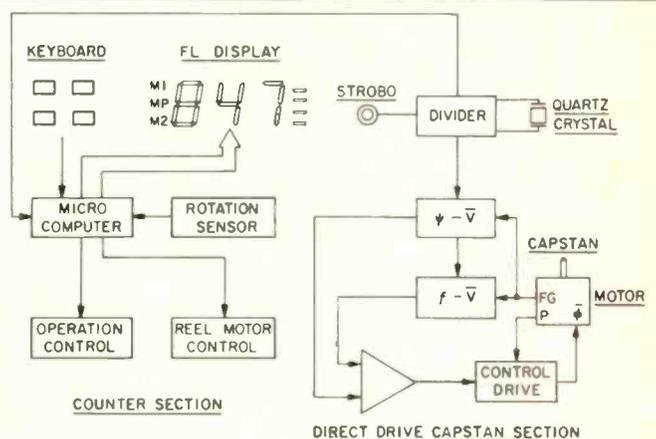
The fluorescent level meters cover a wide range, from below "-40" to "+8" dB, white up to zero and orange-brown above,

with the Dolby-level reference at "+3." There are a total of 30 segments in each channel with individual thresholds, so the resolution is excellent, with 1-dB steps from "-5" to "+4." Next to the top level on the display (on the right), there are annunciators for *Record* mode, *Peak* meter response, and *Dolby NR*, which last also lights up little double-D symbols at "+3" — very nice. Metering can also be set to have VU ballistics, and there is a peak hold function which works with both meter responses. The Technics deck has two memory functions. *Memory 1* has a reset/clear button which resets the counter to "000" and puts on the "M1" annunciator. The deck will now stop at this point in play or either wind mode. A second push clears the stop function and its indicator. The *Stop/Play* button allows adding a *Play* command to the stop-at-zero instruction, and there is an "MP" added below "M1" when it's selected. *Memory 2* allows setting the stop point, storing the counter number for reference. The set button can also be used to recall that number to the display at any time. The *Clear* button does just that, and there's an "M2" to show if that might be necessary. It is a flexible memory scheme, and it is helpful that stops will be made with either direction of wind.

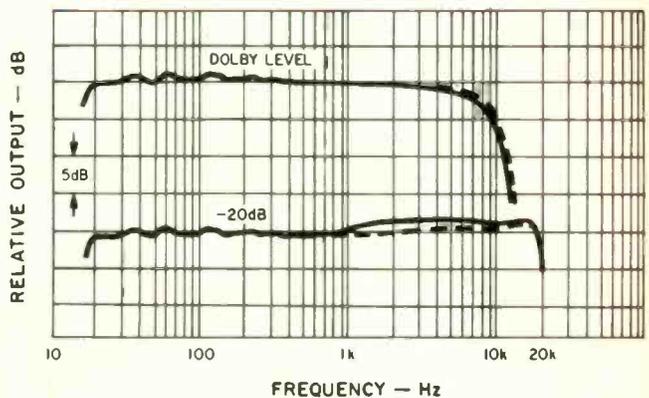
The transport control is with light-touch bar switches, with useful status lights for *Rec*, *Play*, *Pause* and *Rec Mute*. The deck has more flexibility than most units as it is really possible to make any normal mode changes. For example, for *Rec* and *Pause*, use either one first or both together. You can even make flying start recording from a fast wind mode: Just push *Rec* and *Play*, and there it is. *Rec Mute* is the desirable momentary contact type, and the indicator light emphasizes that muting is taking place. The four tape-select switches are interlocked, and the indicators are a must to show which bias and EQ has been chosen. The indicator of the monitor switch shows red for source and green for tape. The friction between sections of the input level pot seemed slightly high; some knurling on the knobs would facilitate making inter-channel adjustments.

Below the items discussed above are four bias adjust pots with handy center detents and knobs, and pots for meter brightness and output level. The adjustment for meter brightness is an unusual one, and it did allow setting the fluorescent display anywhere from medium to high brightness. Rotary switches select the functions of *Timer* (*Play/Off/Rec*), *Dolby NR* (*Out/In/In with Filter*), and input (*Mike/Line/400 Hz/400 Hz & 8 kHz*). In the 400-Hz position, an internal tone is fed to both record channels internally. Then, with monitor in *Source*, the input level control sets a zero level on the meters. Next, in *Tape*, the screwdriver-adjust *Rec Cal* pots are trimmed to get the same zero indication. In the 400-Hz/8-kHz position, the lower frequency goes to the left channel, the higher frequency to the right channel. The bias adjust pot is trimmed, if necessary, for a matching zero indication. The actual tone levels are 20 dB lower on the tape, and a calibration amplifier provides the gain needed for a zero-dB display. It is a good scheme, and in my opinion such capabilities should be part of any top-end deck. The two mike phone jacks are mounted on the same sub-panel, and the manufacturer provides a clear cover panel which can at least slow down unwanted diddling with the adjustments.

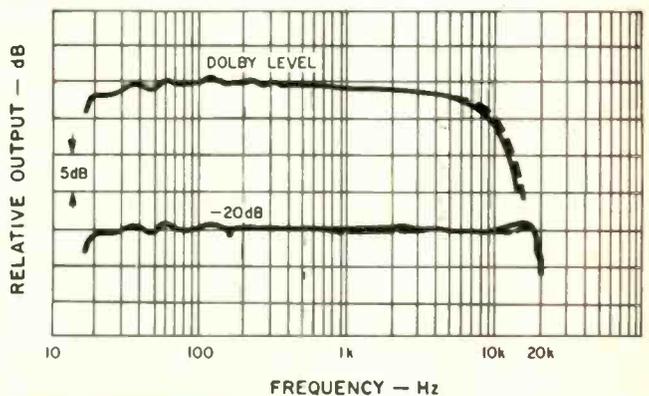
The clear-door cassette carrier moves out and tilts with a push of the color-coded eject button. The power push-button switch and the headphones jack are below. On the top cover are two block schematics, one on the audio portion of the deck and



**Fig. 1 — Block diagram of counter and capstan-drive sections.**

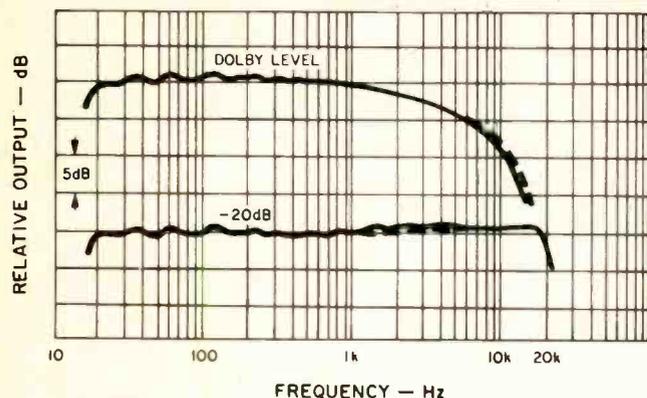


**Fig. 2 — Frequency response with and without (dashed line) Dolby NR using Maxell UD-XL I-S tape.**

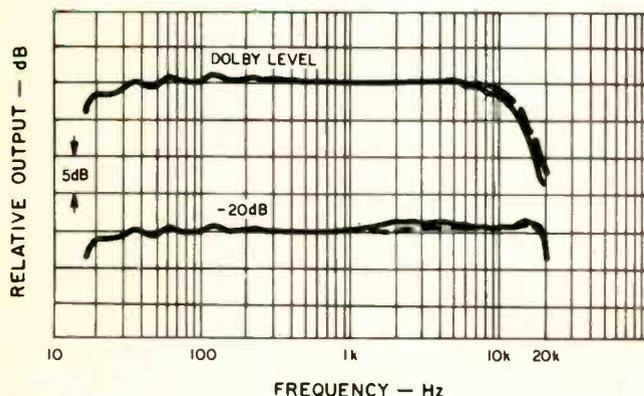


**Fig. 3 — Frequency response with and without (dashed line) Dolby NR using Technics XA II tape.**

Technics RS-M95 cassette deck offers excellent performance and many very useful convenience controls and features.



**Fig. 4 — Frequency response with and without (dashed line) Dolby NR using Sony Duad tape.**



**Fig. 5 — Frequency response with and without (dashed line) Dolby NR using Technics MX tape.**

another on the counter and direct-drive capstan schemes (more below). On the back panel are the dual in/out phono jacks and a socket for a remote control. The unit is supplied with rugged rack adapters, an important feature to some users. The deck is quite a good size, but the interior was found to be fairly well filled with about a dozen circuit cards. A lot of the interconnections were made with multi-pin cables, but there was some direct wiring. Soldering on the p.c.b.s was excellent. Components were all identified, as were adjustments, with some labels on both sides of the cards. The tape drive appeared to be quite rugged and sophisticated, in particular the reel and the large-diameter direct-drive capstan motors and the two solenoids. There were two fuses in clips, and the large power transformer was mounted at an angle, undoubtedly to minimize hum pickup.

#### Circuit Description

As noted above, the RS-M95 has a lot of circuitry in it, and there are some interesting elements associated with the counter

and the drive system. Figure 1 is a block diagram of the functions of interest, and it can be seen that the output of the quartz crystal and its divider goes three ways. For one thing, it controls the Strobe indicator so that it flashes at a very exact rate. Another output from the divider goes to the micro-computer of the counter. The computer also takes inputs from the keyboard for Memory 1 and 2 in setting stop and start points and from the rotation sensor which establishes how much the tape has moved from any reference point. The fluorescent display, of course, shows what the status is of these inter-related things. The output from the micro-computer also controls stop, wind, and play memory functions and the associated actions called for by the reel motor.

The direct-drive, quartz-controlled capstan system is, in many respects, the offspring of the drive system introduced in the Technics RS-1500/US open-reel recorder. As the direct-drive capstan motor rotates, its frequency generator output is fed to both frequency and phase comparing circuits. Both compare the input against a reference voltage, but the phase comparison is done in conjunction with the output from the crystal divider. In a considerable simplification, we can say that the frequency-dependent closed-loop gets the drive on speed, and the phase-dependent closed-loop provides much tighter control of instantaneous speed, substantially eliminating all perturbations. (Results from speed and flutter tests are given later).

#### Performance

The playback responses with standard alignment tapes were excellent at low and mid frequencies, but there was a roll-off at the high end of about 4 dB at the highest frequency for both equalizations. There were also variations in level in this region, cycling about 2 dB with a one-second period. It seemed to match the rotation of the pressure roller, but this was not proven. Play level indications were very close to standard, and tape play speed measured exactly correct (within 0.05%). The majority of the record/playback tests were conducted with the four tapes supplied with the deck, Technics XA II, Sony Duad, Technics MX, and Maxell UD-XL I, with the exception that level variations with the XL I prompted its replacement with a sample of XL I-S received directly from Maxell. Pink noise/RTA tests showed that the adjustable bias allowed matching most tapes in the four type categories, with the exception of low-bias tapes, mostly non-high-fidelity formulations. The record/playback responses were made at Dolby level and 20 dB below that, both with and without Dolby NR. The RS-M95 is a three-head deck, but all plots were made by recording, rewinding, and then plotting on the playback. Experience has shown that many three-head units show a better, but inaccurate, frequency response if plotting is done simultaneously with recording — a matter of inter-head leakage.

The results with the preferred procedure are shown in Figs. 1 to 4, and the response limits are listed in Table I. All of the results are quite good with the exception of Sony Duad at Dolby level. Dolby tracking was very good, no doubt aided by the adjustment of bias and record sensitivity using the built-in calibration scheme. Occasionally, there were level changes of about a dB in the higher frequency portion of the sweeps, similar to those noted with the alignment tapes. The record-sensitivity pot had a broad range from -12 to +5 dB with Technics XA II tape. The bias control went from very low bias (with low output)

Record/playback results were quite good, while separation, crosstalk, and erasure performance figures were all well above average.

**Table 1—Record/playback responses (-3 dB limits).**

Tape Type	With Dolby NR				Without Dolby NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell XL I	18	8.2	18	19.7	18	9.1	18	20.0
Technics XA II	18	6.9	18	19.0	18	7.9	18	19.4
Sony Duad	18	3.6	18	20.4	18	4.0	18	20.6
Technics MX	18	1.2.0	18	20.3	18	12.9	18	20.4

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

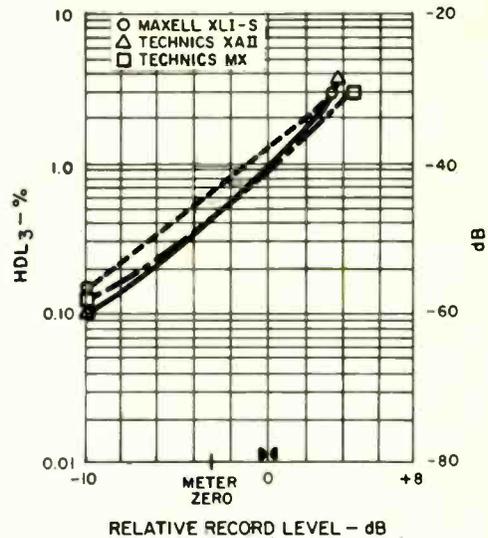
Tape Type	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby NR		Without NR		W/Dolby NR		Without NR	
	@ DL	HC=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Maxell XL I	61.0	64.5	53.3	56.8	59.4	62.9	49.2	52.7
Technics XA II	63.7	66.8	55.5	58.6	62.3	65.4	52.4	55.5
Sony Duad	64.8	68.8	57.0	61.0	64.6	68.6	54.7	58.7
Technics MX	62.8	67.3	54.7	59.2	61.7	66.2	51.8	56.3

through a peak (+2 dB) to a point where the 8-kHz tone was brought back down to -4.5 dB with XA II, a range which would facilitate a match with many tapes. With a 10-kHz test tone, the playback showed just 20-degree phase difference between channels, much better than most decks, and phase jitter was just 25 degrees, also better than typical decks.

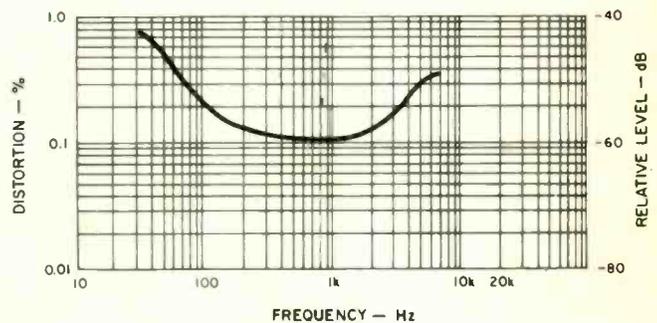
The output polarity of the deck matched the input polarity, whether in source or tape monitor. The response of the multiplex filter was 1 dB down at 15.8 kHz, 3 dB at 16.5 kHz, and 32.0 dB at 19.0 kHz. Bias in the output during recording was very low. The 400-Hz tone (404 Hz actual) had about 3.8% distortion, and the 8-kHz tone (8.66 kHz actual) had about 10% distortion — both adequate for the calibration scheme used. The separation between channels with a 1-kHz test tone was 45 dB. Crosstalk was down 74 dB, and erasure was at least 80 dB. The erasure at 100 Hz with the MX metal tape was 69 dB. All of these figures are excellent.

A 1-kHz tone was recorded from 10 dB below Dolby level with increasing level up to the point where the third harmonic distortion reached 3%. Figure 5 is a plotting of the results obtained with three of the tapes. Other distortion products were quite low in level, particularly with the XA II and MX tapes. Figure 6 shows the level of HDL<sub>3</sub> vs. frequency from 30 Hz to 7 kHz in Dolby mode with MX tape, recorded at 10 dB below Dolby level. The distortion figures are quite good, but lower distortion with XL I-S would have been desirable. The signal-to-noise ratios, with both IEC and CCIR/ARM weightings, were measured for all four tapes. As Table II shows, all of the figures are excellent. The highest values were obtained with Sony Duad, but that tape could only be recommended with this deck where there was relatively little high-frequency energy to be recorded.

The input sensitivities were 0.26 mV for mike and 63 mV for line, very close to spec. Input overloads were at high levels, 48.5 mV for mike and 30.6 V for line. Output clipping appeared at +16.6 dB re: meter zero. The two sections of the input-level pot tracked within a dB from maximum down at least 60 dB, and output level pot tracking was within a dB for 55 dB — excellent



**Fig. 6 — Third harmonic distortion vs. level in Dolby mode at 1 kHz using Maxell UD-XL I-S and Technics XA II and MX tapes.**



**Fig. 7 — Third harmonic distortion vs. frequency in Dolby mode at 10 dB below Dolby level with Technics MX tape.**

results. Output levels were 83 mV to an 8-ohm load for headphones and 635 mV for line, dropping to about 470 mV with a 10-kilohm load. The source impedance of about 4 kilohms is rather high if load impedances will be relatively low. Volume level was good with most phones tried, but slightly weak with one set. The frequency response of the level meters was within 3 dB from 17 Hz to 28.1 kHz. In VU mode, the response time was the desired 300 mS. In peak-responding mode, the display ballistics met IEC Standard 268-10 with 3- and 10-mS bursts, including decay time. The meters correctly showed increased

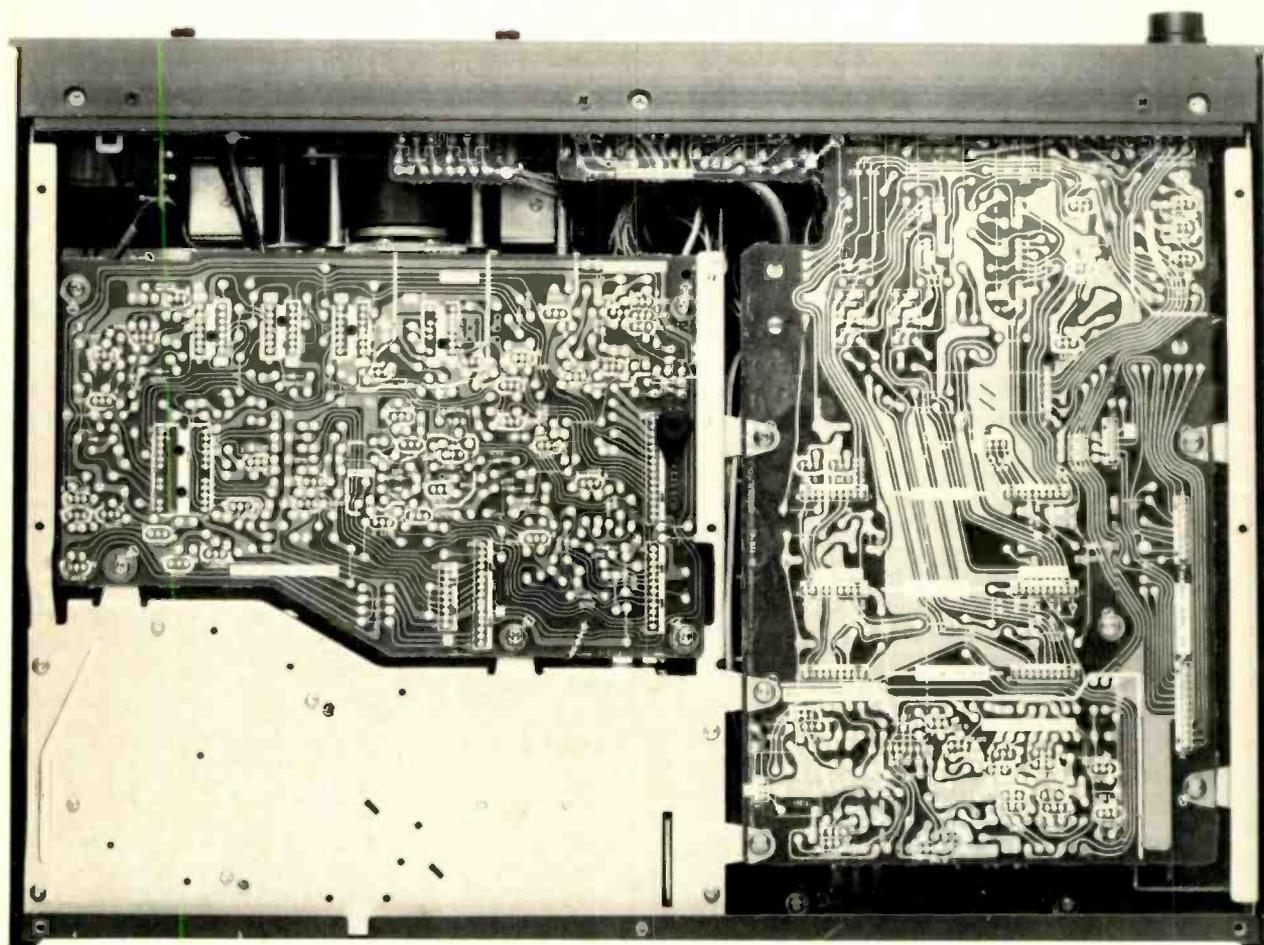
peak levels for both positive and negative d.c. shifts of the tone burst. The level indications were high at the low end of the scale, within 2 dB at "-30," and within 0.5 dB for most points above that.

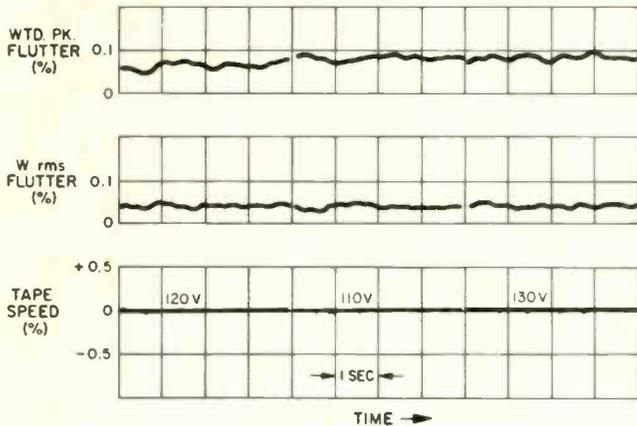
Tape play speed had been shown to be very accurate in earlier tests, and playback of a recorded 3000-Hz tone while changing the line voltage demonstrated that the deck was immune to such effects. The record/play-back flutter was 0.037% wtd. rms and 0.078% on a wtd. peak basis. These figures are excellent, and lower numbers might have been possible if any time had been spent looking for a low-flutter cassette. The wind times were to the specified 80 seconds for a C-60. The time required to make changes in transport mode was always 1 sec-

ond or less. The tape-time strobe flashed about 56 times per minute.

#### **In-Use and Listening Tests**

Good guiding of the cassette aided loading and unloading. Access for maintenance was very good, even better with the clear door plate removed. All switches and controls were completely reliable, and there were no problems with the tapes whatever was done in changing tape motion. I found it worthwhile to remind myself that the tape select switches were mechanically interlocked, going back to *Normal* if another switch wasn't pushed hard enough to latch. All calibrations were most easy to do, and the meters aided in this task. The annunciators for "Dol-





**Fig. 8 — Tape play speed vs. time and line voltage, and wtd. rms and wtd. peak flutter, three trials each.**

by" and "Peak" were continually helpful, and the orange-brown of the segments above zero seemed a good color choice.

The text of the instruction manual is excellent with additional helpful notes set off in blocks. The illustrations are very good and well tied to the text. A detailed schematic is supplied, and there are the schematic blocks on the top panel. Most of the listening checks used discs for sources, and included Cleo Laine's *Born on a Friday*, Fennell's *Macho Marches* on a Telarc digital, Milhaud's *Suite Francais* with Fennell, the dbx-encoded version of Ravel's *Bolero* with Morton Gould and the London Symphony, and other works.

All of the results were very good in every respect, with only one case of high-frequency, high-level roll-off. There was obviously good Dolby tracking, with minimal sonic shifting when switching NR in and out. All record, pause, and stop noises were very low, actually down into tape noise. On timer start, there was a three-second delay after the application of power before starting play or record, as selected.

The Technics RS-M95 cassette deck offers many useful features and excellent performance, particularly in the area of stable tape movement. It has excellent metering and calibration facilities, greatly aiding the process of setting record levels accurately and matching tapes to the machine. It is most worthy of consideration and compares very favorably with any other deck in its general price category.

Howard Roberson

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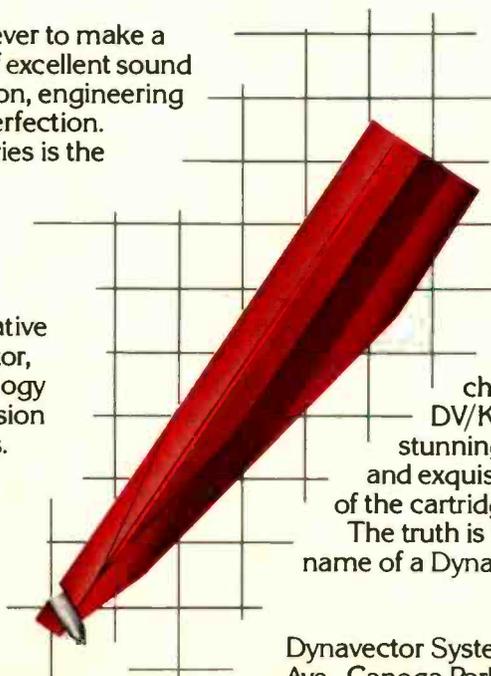
$$C_B = \alpha \sqrt{2\pi f} \left[ 1 - \frac{1}{4} \beta \frac{2\pi f}{\sigma^2} + \frac{1}{4} \delta (2\pi f)^2 + \dots \right]$$

$$\alpha^4 = \frac{EI}{m}, \quad \beta = \rho \alpha^4 \left( \frac{1}{E} + \frac{\gamma}{G} \right), \quad \delta = \frac{\rho^2 \gamma \alpha^4}{EG}$$

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