2

NAKAMICHI TD-700 CAR STEREO

Manufacturer's Specifications

Tuner Section

FM Sensitivity: Mono, 18 dBf.
50-dB Quieting: Mono, 20 dBf.
S/N Ratio: Mono, 65 dB.
THD: Mono, 0.15% at 1 kHz; stereo, 0.3% at 1 kHz.
Frequency Response: 30 Hz to 15 kHz, ±3 dB.
Capture Ratio: 2.0 dB.
Alternate-Channel Selectivity: 65 dB.
Image Rejection: 55 dB.
I.f. Rejection: 80 dB.
Stereo Separation: 35 dB at 1 kHz.

Tape Section

Frequency Response: 20 Hz to 21 kHz, ±3 dB (using Nakamichi test tape).
Wow and Flutter: 0.05% wtd. rms; ±0.1% wtd. peak.
S/N Ratio: 64 dB, A-weighted, with Dolby B NR; 70 dB, A-weighted, with Dolby C NR.
Stereo Separation: Greater than 34 dB at 1 kHz.
Crosstalk: Greater than 60 dB.
Fast-Wind Time: 75 S with C-60 cassette.

Preamplifier Section

Frequency Response: 10 Hz to 50 kHz, ±1.0 dB.
Output Level: 0.35 or 1.1 V, selectable.
THD: Less than 0.005%.
Tone Control Range: Bass, ±18 dB at 20 Hz; midrange, ±10 dB at 200 Hz; treble, ±12 dB at 20 kHz.

General Specifications

Power Requirements: 14.4 V d.c., negative ground (10.8 to 15.6 V allowable), 6.5 amperes maximum.
Dimensions: 7 in. W × 2 in. H × 6½ in. D (17.8 cm × 5 cm × 16.5 cm).
Weight: 4 lbs., 3 oz. (1.9 kg).
Price: $790.
Company Address: 19701 South Vermont Ave., Torrance, Cal. 90502.
For literature, circle No. 91

If you install the Nakamichi TD-700 yourself, you will love the way the unit has been configured. The outputs (two for the front amplifier and two for the rear one) use standard phono-tip jacks—no nonstandard, difficult-to-match, multi-pin plugs here! However, the TD-700 offers a great deal more than just ease of installation. In fact, I was truly amazed at the number of features and controls incorporated in so small a unit. Many of the features are activated by means of multiple-function controls, thereby reducing the number of buttons and knobs that would otherwise appear on the front panel. Nevertheless, the controls *are* very close together, especially those associated with tuner operation. While most of the TD-700's features have been found in competing units, this is the only car stereo I know of that features front-panel adjustment of tape-head azimuth alignment. The importance of this feature will be evident when I discuss the test results.

Both Dolby B and Dolby C noise-reduction circuitry are included in the tape deck section, as are automatic repeat of a cassette side and a program-search function which looks for 4-S silent spots on a tape to identify the start of the next song. You can instruct the program-search feature to skip up to 10 selections in the forward direction during fast wind, and up to nine selections in the rewind mode. The tuner section has six station presets for FM and six for AM, plus manual tuning and "Scan" tuning, which homes in on usable signals and lets you listen for 5 S before going on to the next available signal.

Control Layout

Above the "Azimuth" control at the lower left of the front panel is a concentric pair of controls that actually serve four functions. The rear ring is a front-rear fader control; the front knob, when pushed, serves as a power on/off switch for the tuner section. Rotating this knob adjusts output levels, and pulling the knob forward, until it clicks into a new position, turns it into a channel balance control.

Below the cassette slot (into which cassettes are loaded conventionally, with the tape side facing forward) are buttons that control tape play. These include a large play button, a load button (which also controls ejection), a pause button, and the two fast-wind buttons, which initiate program search when pushed two or more times. Three tiny pushbuttons near the large azimuth adjustment knob turn on noise reduction, select Dolby B or C NR, and choose 70- or 120-μS tape equalization. Three more buttons, symmetrically placed to the right of the fast-wind switches, activate automatic tape repeat, choose local or distant reception, and select AM or FM radio bands.

The upper right section of the panel is dedicated to tuner functions. A display shows selected frequency, stereo reception, and, when applicable, which preset number has been used to call up the tuned-to station. During cassette playback, when the tuner section is off, or when the car ignition is off, the display shows the time of day. If the clock function is not desired, a clock switch on the side of the chassis can be set to "Off" before the unit is installed.

The six preset buttons are just below the display area. Below these tiny buttons are the up and down manual tuning buttons, the "Scan" tuning button, and the memory button used with the six presets to store station frequencies. Finally, below this bank of switches are three rotary tone-control knobs. Once the bass, midrange and treble have been adjusted to your taste, the knobs can be pushed in, out of the way, so that they are flush with the front panel. This not only prevents the settings from being tampered with or accidentally changed, but also makes it somewhat easier for large-fingered people such as myself to get at the tuning buttons. (As cleverly as Nakamichi has laid out all of these controls, things are still pretty tight on this 7-inch by 2-inch panel!)

On the top surface of the chassis is a switch which selects output level. Since this is a one-time adjustment determined by the sensitivity of associated amplifiers, it has been placed, wisely, out of reach of the user once the chassis is installed in a car.

Tuner Measurements

Figure 1 shows the mono and stereo quieting characteristics for the TD-700's FM tuner section, as well as the harmonic distortion for a 1-kHz modulating signal, as functions of signal strength. Usable sensitivity in mono measured 15 dBf, better than claimed. Mono 50-dB quieting sensitivity was 18 dBf, slightly better than the 20 dBf claimed. Stereo sensitivity really cannot be specified, nor can the stereo 50-

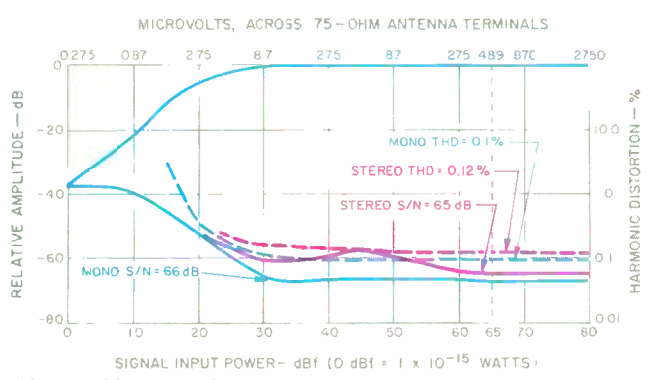

Fig. 1—Mono and stereo quieting and distortion characteristics, FM section.

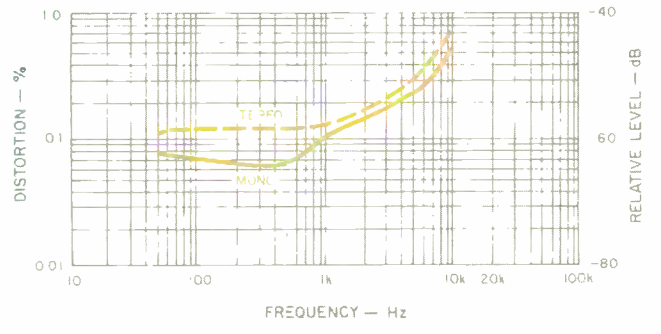

Fig. 2—THD vs. frequency, FM section.

Stereo gradually blends into mono reception as signal strength decreases. For mobile use, that's better than constant switching back and forth.

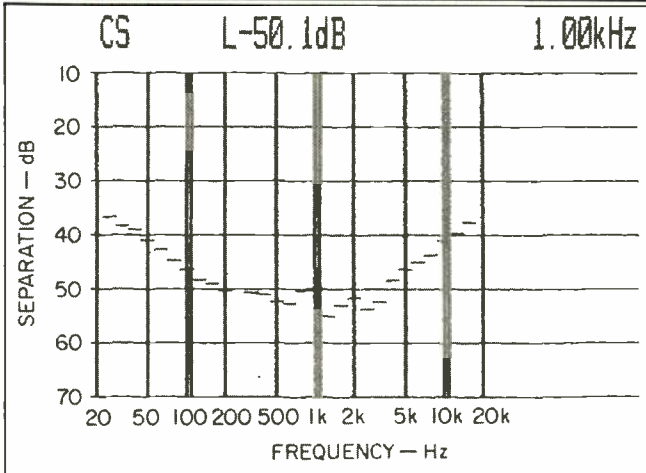

Fig. 3—Stereo separation, FM section.

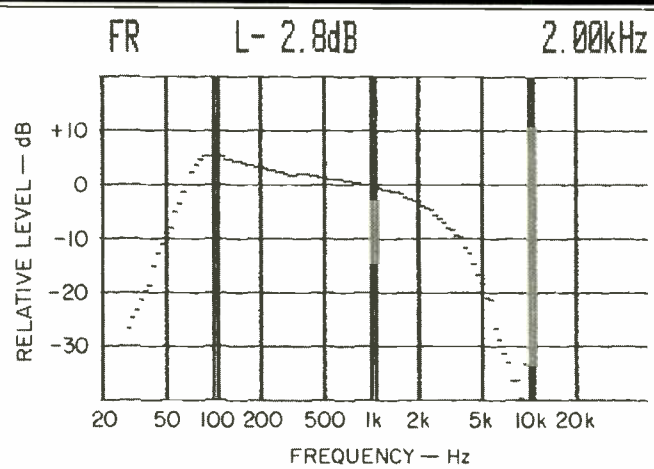

Fig. 4—AM frequency response.

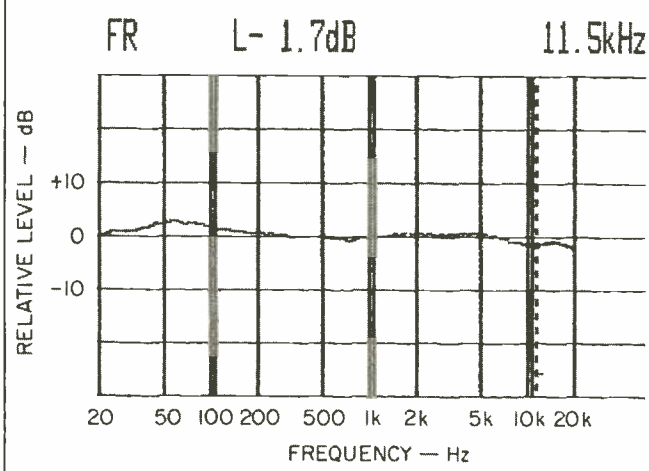

Fig. 5—Frequency response, tape section, using Type I test tape.

dB quieting point. That's because Nakamichi has wisely elected to have stereo separation gradually diminish or blend into monophonic reception as signal strength decreases. For mobile use, that's better than having the system constantly switch back and forth between mono and stereo as signal strength fluctuates. This gradual transition from stereo to mono accounts for the rather odd shape of the stereo S/N curve (Fig. 1) in the region from about 45 dBf down to 30 dBf, where S/N appears to be increasing as signal strength decreases. What's actually happening in this region is that the received signal is becoming more and more monophonic as the signal level decreases. Since mono reception is quieter than stereo reception—especially at weak signal levels—the noise curve actually reverses direction for a while, until the signal is so weak that, even in mono, noise rises steeply again. The THD curves for mono and stereo also eventually blend together as signal strength decreases. At strong signal levels, mono S/N measured 66 dB and stereo S/N was 64 dB. THD in mono was 0.1% for a 1-kHz modulating signal; in stereo it was only slightly higher, 0.12%. Figure 2 shows how THD varies as a function of frequency, with 100% modulating signals and a 65-dBf r.f. signal.

Figure 3 is a plot, in third-octave increments, of FM stereo separation versus frequency. At 1 kHz, separation measured 50.1 dB. At 100 Hz, it was about 46 dB, and it decreased to 40 dB at 10 kHz. Nakamichi might just as well have applied its conservative separation specification of 35 dB to the entire audio band, rather than to 1 kHz alone.

The FM tuner section's frequency response was flatter than that of most home tuners, with no measurable attenuation at 15 kHz and an attenuation of only 0.5 dB at 30 Hz. The same cannot be said for the frequency response of the AM tuner section (Fig. 4), which was down nearly 3 dB at 2 kHz and which had a bass "bump" centered at around 100 Hz. The bump was undoubtedly put there deliberately, to give some sonic weight to what would otherwise be a very thin AM response.

Capture ratio for the FM tuner section measured 1.8 dB, and alternate-channel selectivity was precisely 65 dB, as claimed. Image rejection, measuring 60 dB, was a bit better than claimed; so was i.f. rejection, which on my sample measured 82 dB.

Tape Deck Measurements

Frequency response of the cassette tape player, shown in Fig. 5, was outstanding. It remained flat to above 20 kHz despite the fact that I did not have Nakamichi's Type II frequency-response test tape, and had to use one recorded on Type I (ferric-oxide) tape.

Figures 6A and 6B show the tape section's S/N. Without noise reduction, the A-weighted reading (shown in Fig. 6B) was 59.4 dB. With Dolby B NR (Fig. 6A), the S/N improved to 72.4 dB, A-weighted. With Dolby C NR (Fig. 6B), the A-

The best feature of the unit's tape section is the azimuth adjustment. After using it a while, you begin to wonder how you could get along without it.

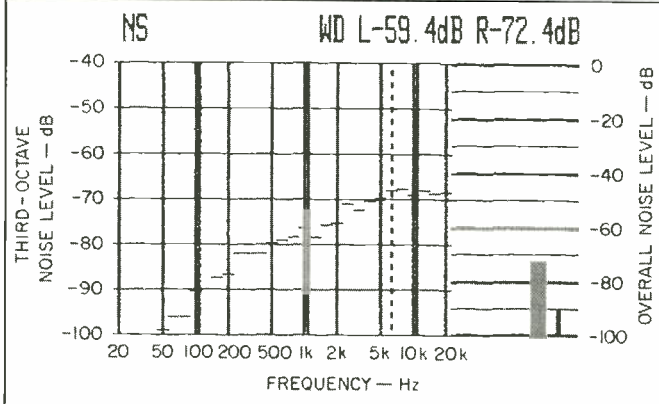

Fig. 6A—Tape section S/N, A-weighted, with Dolby B noise reduction ("R" readout at top).

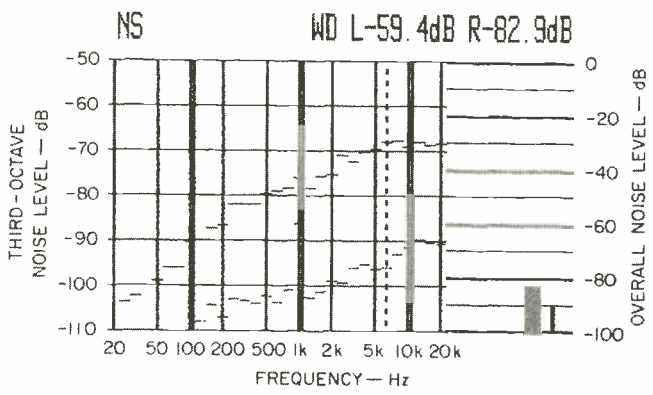

Fig. 6B—Tape section S/N, A-weighted, without noise reduction (upper trace and "L" readout at top) and with Dolby C noise reduction (lower trace and "R" readout at top). Note shift in vertical scales between Figs. 6A and 6B.

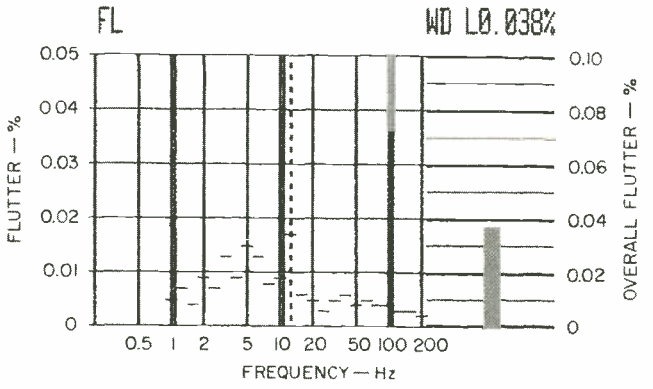

Fig. 7—Wow and flutter, wtd. rms.

weighted overall figure improved still further, to 82.9 dB. The reference level for these tests was 250 nWb/m. I used normal-bias tape that had been previously recorded but with no audio signal applied, so any bias noise produced by my recorder is included in the measurement.

Wow and flutter was far better than claimed. I measured only 0.038% wtd. rms, as shown in Fig. 7. Unweighted wow and flutter, not shown, was also much better than claimed by Nakamichi; it measured only 0.08%.

I've saved the best feature of the cassette deck section for last—that wonderful azimuth adjustment control, which can be fully appreciated only when you use it. Since car-stereo decks play only tapes which have been recorded on other machines, some azimuth mismatch is inevitable. After you've used the azimuth control and hear the difference it makes, you wonder how you could possibly get along without it in a playback-only deck. Figures 8A, 8B, and 8C show in detail the action of the azimuth control. The test signal shown is from the azimuth test tape made for use with a Sound Technology tape tester. The tape has four frequencies, from 0.0 to 15.8 kHz, recorded on both channels. While the unit under test plays this test tape, the instrument compares the phase of the signals on the two channels and displays the degree of difference (phase error) as four vertical lines. When the electronic cursor (the dotted line in Figs. 8A, 8B, and 8C) is positioned on one of these phase-error lines, the error is displayed in degrees.

In my first test, I adjusted the azimuth control to its nominal center. When I played my test tape, the phase error between the two 15.8-kHz signals was 162°. In terms of time error, 162° of a 15.8-kHz signal is about 28 μS. You can, if you like, calculate the angular error of the playback head from this, the tape's speed, and the distance between the head gaps. For myself, it was enough to note that 162° of error at 15.8 kHz is a pretty serious azimuth misadjustment. For Fig. 8B, I flipped the tape over to measure error in the opposite direction and got a reading of 92°, still quite substantial. (The difference between the two numbers may be due to differences in tape orientation in each direction, and to the relative angle of the head and the recorded signal.) However, when I adjusted the front-panel control to obtain minimum azimuth error (Fig. 8C), I managed to get the residual misadjustment so low (12° of phase with a 15.8-kHz sine-wave signal) that it can be regarded as insignificant.

The great thing about this front-panel control is that you won't need any fancy test tapes or test equipment to come just as close with any prerecorded tape. Simply *listen* to the tape. Turn up the treble control all the way, to help you listen for a high-frequency maximum as you slowly turn the azimuth control. (The control is 15 "click stops" on either side of center, each of which shifts playback head alignment by 2.9°.) When you hear the most treble, you've adjusted the playback head for optimum reproduction and minimum azimuth error. It's that simple.

Figure 9 shows the maximum range of the bass and treble tone controls: About ±14 dB at 10 kHz for the treble control, and about +12 and −16 dB at 100 Hz for the bass control. Figure 10, a similar plot, shows the action of the midrange tone control. Its frequency of maximum boost or cut is around 200 Hz rather than the more usual 500 Hz to 1 kHz

The front panel has been crammed with so many worthwhile features that it may take a while to learn how to operate the unit when driving.

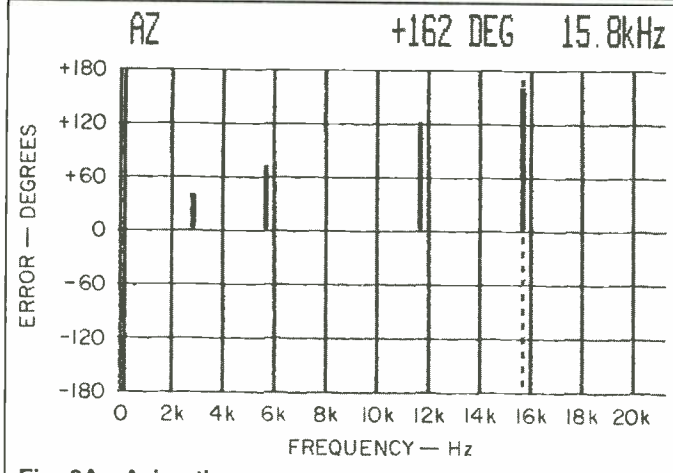

Fig. 8A—Azimuth error before adjustment, with tape in forward direction.

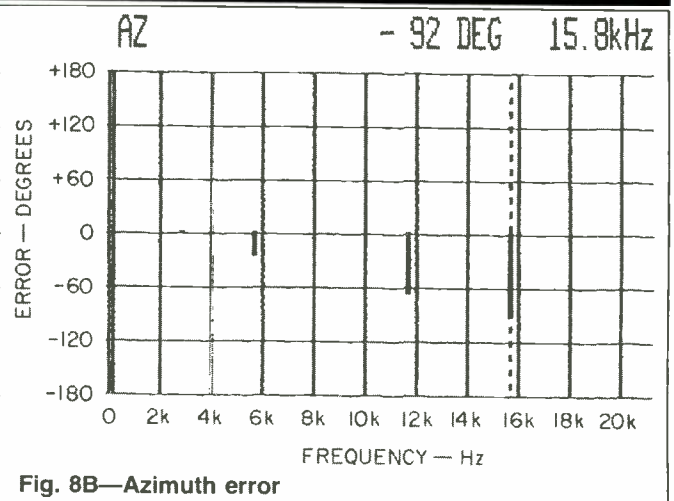

Fig. 8B—Azimuth error before adjustment, with same tape in reverse direction.

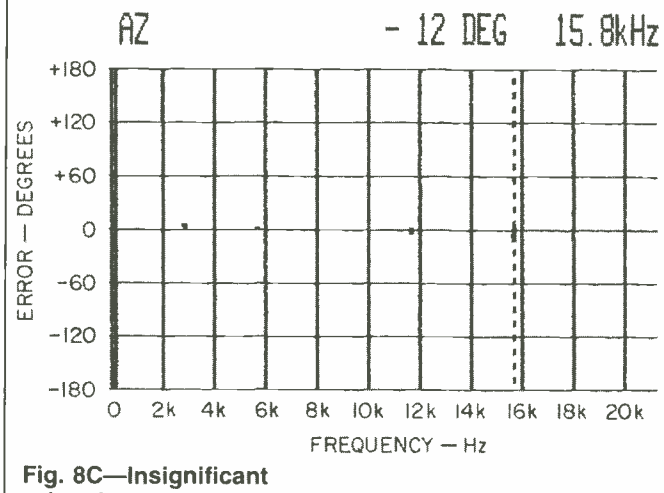

Fig. 8C—Insignificant azimuth error observed after adjustment, with playback of same tape used for Figs. 8A and 8B.

used for midrange controls in home audio components. This center frequency seems more appropriate for car audio, since turning it down helps tame the resonance which most car interiors exhibit at 150 to 200 Hz or so.

Use and Listening Tests

Although I did not conduct my listening tests in a moving vehicle, I can say with reasonable assurance that the TD-700 should do very well in a car. For one thing, the cassette deck's performance was typical of the excellent home tape decks for which Nakamichi is justly famous. The TD-700's important tape-playback characteristics remained constant over a wide range of operating voltages (10 to 15 V d.c.).

The FM tuner section has been ideally designed for use in a car or other moving vehicle. The blend from stereo to mono occurs so gradually and smoothly that you probably won't be aware of it as you drive through areas where signal strengths fluctuate greatly. This should help mask the more serious multipath problems, and even some amount of "picket-fence" noise (which is always more annoying when the tuner is allowed to remain in full stereo mode, as is done with some other units I have tested). The tuner section's performance, like the tape deck's, stays constant with changes in supply voltage. The AM section is just another typical AM tuner.

Nakamichi has combined the best things they know about tape transport and tape electronics with good FM r.f. engineering, and have come up with a very versatile tuner/cassette deck that will not disappoint even the most discriminating car-audio buff. If anything, they have crammed the panel with so many worthwhile features that it may take you a while to be able to operate the unit while driving. Once you've learned how, you'll have a wonderful car stereo for your trouble. Meanwhile, don't be distracted by all those buttons and knobs while you drive. Just listen—and enjoy!

Leonard Feldman

Behind the Wheel

One glance at the TD-700's control panel shows you that tape dominated Nakamichi's thinking in their design of this unit. The tape controls are big, and they cover most of the panel; the tuner controls are small, and mostly squinched up into one corner.

The tape-motion controls give me a bit less tactile feedback than I like. But they're easy to find and to operate by touch, and small LEDs (visible even in daylight) show clearly which functions are in use. I soon began to wish more car-stereo decks had pause controls; the TD-700's proved helpful, letting me shut off the tape to hear directions, listen to funny engine noises, or just concentrate on traffic, without having to eject the tape or turn down the volume (and miss the music while the tape ran on). Like most tape decks with pause controls, the TD-700 releases the pause when you hit