Onkyo Home Theater

Reviewed by Charles Hansen and Ken & Julie Ketler

PHOTO 1: **TX-DS787 front view.**

PHOTO 2: **TX-DS787 rear view.**

Onkyo USA Corp., 200 Williams Dr., Ramsey, NJ 07446, 201-825-7950, www.onkyousa.com. Suggested retail price: $1,050 US. Dimensions: 435mm W × 453mm D × 175mm H, (17⅛" × 17¹³⁄₁₆" × 6⅞"); net weight: 16.9kg, 36.6 lbs. Warranty: two years parts and labor.

Onkyo's press release states that its TX-DS787 home-theater audio/video (A/V) model is the only 6.1-channel surround EX receiver in the $1,000 price class and is the first Onkyo home-theater receiver to earn THX Select certification from LucasFilm.

The TX-DS787 is compatible with Dolby Digital and DTS 5.1 program materials. The system is also compatible with program materials encoded for 6.1-channel DTS-ES Matrix with a rear center surround channel. The TX-DS787 has six channels of power amplification rated at 100W per channel into 8Ω with all channels driven (120W per channel into 6Ω).

INTRODUCTION

The receiver has composite and S-video inputs for all four video sources, plus two assignable component video inputs and one component video output. The video circuitry includes component video switching for use with HDTV systems.

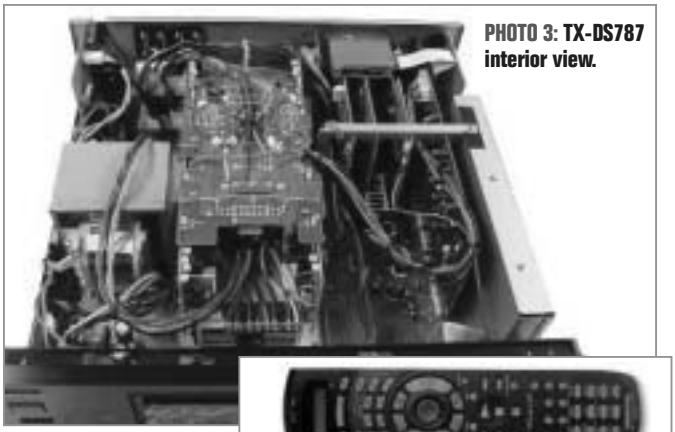


PHOTO 3: **TX-DS787 interior view.**

PHOTO 4: **RC-390M remote control.**

In addition to one 7.1 multichannel input for future DVD-Audio players and other components, the TX-DS787 includes analog source inputs for a turntable, a CD player, and a tape deck. You can assign two optical and two coaxial digital inputs to any audio or audio/video source. The unit is equipped with line-level analog preamplifier outputs (after the tone and volume-control alterations) for all eight channels, including the two back surrounds and a subwoofer. A single digital optical output connector provides an MD, DAT, or CD digital rec out signal from the selected digital input.

With these preamp outputs, the TX-DS787 is designed for multi-room, multi-source two-zone operation, with dual-zone infrared remote inputs, an assignable 12V trigger, and stereo speaker outputs for a second zone. The AM/FM tuner provides you with 40 presets. Given the rapidly changing nature of home-theater A/V technology, Onkyo has provided an RS-232C serial port for future software updates. There is also a good troubleshooting guide in the instruction manual.

The programmable Theater-Dimensional (T-D) setup mode allows you to select speaker listening angle, center speaker level calibration, front expander, virtual surround level, dialog enhancement, and room size for each surround mode. With all those surround modes and other options to play with, you are sure to muck up the sound sooner or later. I know I did any number of times in setting up the various menus during my measurements.

In that event, you simply hold down the video-1 button and then press the rec out button. This resets all settings to the factory defaults and puts the TX-DS787 into standby mode. In my opinion, this important instruction deserves a prominent place in the beginning of the manual, not merely as a note back on page 72.

CONTROLS

The receiver has a black, anodized aluminum front panel and heavy-duty steel chassis. *Photo 1* shows the front panel. The left side of the unit features a standby/on switch, standby and zone 2 indicators, power switch, rec out and zone 2 buttons, a standard stereo headphone jack, and audio selector button. The latter control cycles the audio input selection between auto (automatic detection), multi-channel, and analog.

The central display screen is surrounded by a number of controls. Across the top are the FM mute/stereo/mono button, tuning up/down selectors (50kHz increments for FM and 10kHz increments for AM), a character/memory control (to add or delete names for radio stations and input sources, and to assign tuner station presets), bass/treble mode, channel-level selector, and zone 2 volume.

The Smart Scan Controller (SCC) knob is to the right of the display and the remote-control IR sensor. This dial controls the setting for the parameter displayed in the central display. Pressing this knob cycles among the controllable parameters (speakers, inputs, listening modes, preferences, and OSD on-screen display setup).

Below the screen are the display input information button, listening mode buttons (direct, stereo, Dolby or DTS, and THX), the OSD menu, on-screen cursor, and OSD exit buttons. The OSD menu will also appear on a TV monitor connected to the TX-DS787.

To the right of the display is a large master volume dial for the main zone. Below this dial are video 4 and video cam input connectors. Finally, there are ten input source buttons below the display area for DVD, video 1–4, tape, FM, AM, phono, and CD. You can assign any of these inputs to zone 2 or record out by first selecting the rec out or zone 2 button.

CONNECTIONS

The left side of the rear panel (*Photo 2*) is festooned with the input/output connectors I described in the introduction. The digital optical jacks are Toslink, and the S/PDIF digital jacks accept RCA-type coax connectors. All analog input/outputs are tin-plated RCA jacks.

There is a ground terminal for connecting a turntable ground wire next to the digital coax jacks. An Onkyo "RI" remote-control connector allows the RC-390M remote control to operate other Onkyo equipment such as cassette decks and CD players also equipped with "RI" connectors. You can control Onkyo DVD players directly with the RC-390M remote.

TABLE 1
MEASURED PERFORMANCE

PARAMETER	MANUFACTURER'S RATING	MEASURED RESULTS
Power output (FTC)	100W per channel, 8Ω 120W per channel, 6Ω	142W per channel, 8Ω
Dynamic power, stereo	2 × 210W, 4Ω 2 × 130W, 8Ω	
Frequency response	20Hz–20kHz 100W, 8Ω	4Hz–54kHz ±1dB, 1W, 8Ω
Output impedance	N/S	0.11Ω 20Hz–1kHz, 0.25Ω 20kHz
Damping factor	60 at 8Ω	
Total harmonic distortion	Max 0.08%, 8Ω; 0.1% 6Ω 1W to rated power	0.031% max, 8Ω; 1W–100W
IMD—CCIF (19 + 20kHz)	0.08%, 1W to 100W	0.008% CCIF 12V p-p
MIM (9 + 10.05 + 20kHz)	N/S	0.01% MIM
INPUT LEVEL AND IMPEDANCE		
Phono	2.5mV, 50k	48k
Line (CD, tape, DVD, video)	200mV, 50k	51k
Multi-channel	200mV, 50k	51k
Subwoofer	36mV, 50k	51k
Coax digital	0.5V p-p, 75Ω	75Ω
DVD, video 1–4	1V p-p, 75Ω (Y) 0.28V p-p, 75Ω (C)	75Ω
Component video 1, 2	1V p-p, 75Ω (Y) 0.7V p-p, 75Ω (P_B, P_R)	75Ω
OUTPUT LEVEL AND IMPEDANCE		
Rec out (tape, video 1, 2)	200mV, 2k2	3k2
Pre out	1V, 470Ω	465Ω
Monitor, video 1, 2	1V p-p, 75Ω (Y) 0.28V p-p, 75Ω (C)	75Ω
Component video	1V p-p, 75Ω (Y) 0.7V p-p, 75Ω (P_B, P_R)	75Ω
Phono overload	110mV, 1kHz, 0.5% THD	123mV, 1kHz, 0.5%
RIAA deviation	20Hz–20kHz: ±0.8dB	±0.35dB
Frequency response (CD in direct mode)	20Hz–30kHz, ±1dB 10Hz–100kHz, +1/–3dB	4Hz–64kHz, ±1dB 4Hz–108kHz, +1/–3dB
Bass control	±10dB at 100Hz	±10.4dB
Treble control	±10dB at 10kHz	±10.5dB
SIGNAL TO NOISE RATIO (STEREO)		
Phono	80dB, (IHF A, 5mV in)	
CD, tape	100dB, (IHF A, 0.5V in)	
Muting	–50dB	–52dB
FM TUNER SECTION		
Tunable range	87.5–108.0MHz, 50k step	
Sensitivity (mono)	11.2dBf, 1.0μV, 75Ω IHF	11dBf
Sensitivity (stereo)	17.2dBf, 2.0μV, 75Ω IHF	
50dB quieting (mono)	17.2dBf, 2.0μV, 75Ω	17dBf
50dB quieting (stereo)	37.2dBf, 20μV, 75Ω	36dBf
Capture ratio	2.0dB	
Image rejection	40dB	
IF rejection	90dB	
Signal-to-noise (mono)	76dB	
Signal-to-noise (stereo)	70dB	
Alternate channel rejection	55dB	
Selectivity	50dB (DIN)	
AM suppression	50dB	
THD+N (mono)	0.2%	
THD+N (stereo)	0.3%	
Frequency response	30Hz–15kHz, ±1dB	20Hz–15kHz, +0.1/–1dB
Stereo separation	45dB at 1kHz 30dB, 100Hz–10kHz	48dB at 1kHz

AM TUNER SECTION	
Tunable range	530–1710kHz, 10k steps
Usable sensitivity	30μV
Image rejection	40dB
IF rejection	40dB
Signal-to-noise	40dB
THD+N	0.7%
Power requirements	5.5A, 440W maximum

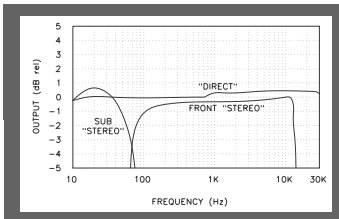


FIGURE 1: Phono stage RIAA response.

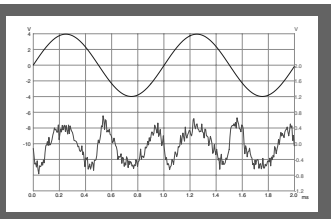


FIGURE 5: Spectrum of residual distortion, 1kHz.

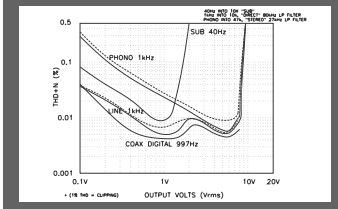


FIGURE 2: Preamp/phono distortion versus output voltage.

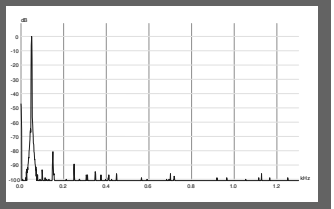


FIGURE 6: Spectrum of 50Hz sine wave.

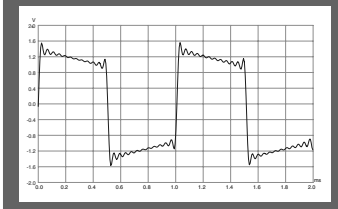


FIGURE 3: Preamp DSP square-wave response, 1kHz 2.5V p-p 8Ω.

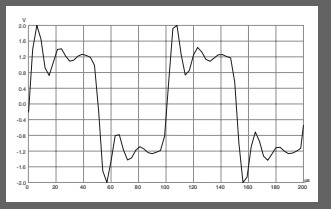


FIGURE 7: Square-wave response, 10kHz 2.5V p-p 8Ω in parallel with 2μF.

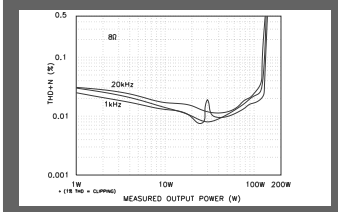


FIGURE 4: THD+N versus output power.

CRITIQUE

■ Reviewed by Ken and Julie Ketler

Do you find yourself waiting in line at the same coffee shop every morning? Although you're given choices of 32 different blends of coffee or tea—hot or cold, in large, extra large, or jumbo sizes—most probably get the same thing every time you open your car windows and yell into the little circle in the drive-up menu. It's just a sign of our times, isn't it? Any company that knows beans about running a business these days understands that it must cover the plethora of peoples' desires or swiftly declare Chapter 11. Apparently, less is not more!

Another example of this is the audio/video world (you knew we were going there, didn't you?). If you are the owner of a home theater system, you may have a 4.1, 5.1, or 6.1 audio configuration with Dolby Digital, DTS, and/or Dolby Pro Logic decoding. Perhaps you have CD, minidisc, cassette, or DVD players. Maybe you're still using a laser disc player, VHS, or even a Betamax!

Do you use surround sound for movies or music or both? Harrumph! Before you know it, filling out your tax return seems like a real pleasure compared to figuring out which media configuration you need to buy. Enter the Onkyo TX-DS787 A/V receiver.

THE INS AND OUTS

The TX-DS787 steps right up to the plate as a preamplifier/control center, offering you:

- CD in (1)
- Phono in (1)
- Tape in/out loop (1)
- Coaxial digital in (2)
- Optical digital in (2)
- Optical digital out (1)
- Audio/video throughput with both RCA and S-Video connectors (5)
- Line level in/out for center, fronts, subwoofer, surrounds, and back surrounds

The Onkyo TX-DS787 offers six output channels of 100W/8Ω simultaneous power. Additionally, this receiver has an independent two-channel second zone output, which allows you to, for example, run a movie in one room and listen to another input (or radio station) in another room. This is a very attractive feature that saves you the trouble of setting up receivers and music sources all over your house.

As a surround decoder, the Onkyo TX-DS787 receiver can handle Dolby Digital, Dolby Pro Logic, and DTS (Digital Theater System) multi-channel schemes as well as straight stereo and mono. Like many surround decoders on the market today, the TX-DS787 includes some additional DSP artificial "ambience" schemes, which are supposed to enlarge your apparent listening space by adding various delay and reverb effects to the output channels.

As far as we are concerned, these are fun toys, but don't typically sound very good. The only possible exception is a mode called "all channel stereo," which can be useful for filling your room with background music. Great for parties!

At first, we were somewhat overwhelmed by the number of features offered by the Onkyo TX-DS787. Each feature is accessible via Onkyo's On Screen Programming, but this requires a fairly steep learning curve. We highly recommend spending time with the 75-page manual, which accompanies the receiver. Oh yes, we know that operator's manuals are often the first things to be thrown away when people purchase new products, but believe us, you just may want to keep this one. It's well written, easy to understand, and impossible to live without!

After becoming used to programming the TX-DS787, we find many of its features invaluable. For instance, the TX-DS787 includes a very nice backlit programmable remote control. It does a great job learning the commands of our other remotes and, therefore, putting them out of business!

By using the built-in pink noise generator and our Radio Shack SPL meter, we can set the relative level of each speaker to match one another according to our viewing/listening position. Once we set the relative levels, the TX-DS787 is kind enough to remember them for the next time we return to our living room-turned-cinema.

Have you ever turned on your receiver only to jump out of your skin when the program starts at full volume? Oh, the war stories we could tell! This receiver offers the Onkyo IntelliVolume feature, which allows you to set the level at which the TX-DS787 will play when you power it up.

If someone in your household cranked the volume for their umpteenth viewing of *Jurassic Park* during the previous night, your nerves can be spared the next morning when you turn on some Strauss with a relaxing cup of tea. Conveniently, the IntelliVolume function is individually programmable for each input, allowing you to match input levels from different sound sources. You can even limit the maximum volume at which the TX-DS787 will play; an elegant solution to loud "volume-creep," which happens to all of us from time to time.

Besides comprehending different surround systems and allowing many customized setup attributes, the Onkyo TX-DS787 receiver also offers you many different ways to configure your speakers. For surround sound playback, you can use a minimum of four loudspeakers (left/right front and left/right rear) all the way up to a 7.1 configuration! The latter setup requires three front speakers (left/center/right), four surround speakers (left/right side and left/right rear, which require an additional stereo amplifier), and a powered subwoofer! Whew, where are those tax returns?

OUR SETUP

For this review, we used the Onkyo TX-DS787 in both stereo and 6.1 surround mode, which provides the standard left/center/right front channels along with left/center/right surround channels, plus a subwoofer. The center surround channel from the TX-DS787 is not a "discrete" signal, but is derived from the other two surround channels. We used a Boston Acoustics Lynnfield VR 6.1-channel speaker system, which we will review in an upcoming issue of *audioXpress*.

The back panel of the TX-DS787, although a veritable cornfield of connectors, is very easy to follow, but we do have one complaint. The speaker output connectors are quite close to one another, making them somewhat difficult to twist and secure. We highly recommend using banana plugs; save your knuckles!

TEST TRACKS

The Sound of Music—Twentieth Century Fox presents this release in digitally remixed 4.1 surround sound on DVD, which means that the audio comes from the left/center/front channels, a subwoofer channel, and the rear channels in mono. This movie tends not to have wiz-bang effects flying around our heads, but we decided to mention it for those of you who may enjoy classic musicals.

JK: As you probably can guess, this movie pick was mine! The story and music have inspired me ever since I was a young girl. As we watch the DVD release, our living room comes alive as Maria sings "The Hills Are Alive" at the opening of the movie. I hear it mostly through the front speakers, but it is very full and rich sounding. This movie looks and sounds better than I ever remember it.

During "My Favorite Things," Maria's gentle voice calms the children even through the harsh thunderstorm. The opposing sounds of her voice and the thunder work very succinctly together and make the scene extremely dynamic.

KK: There was very little information in the rear channels for the most part. Apparently, the re-mix engineers didn't have enough available signal to produce a "real" surround channel and decided to make a spacious "ambience" channel. Let's face it, when *The Sound of Music* was released in 1965, surround sound wasn't even an idea yet. I am, however, particularly impressed with the left-to-right stereo panning of the characters according to their on-screen locations during close-up shots. The aural dynamics of this classic flick are surprisingly super with the soft sound of the rain surrounding Liesl and Rolf as they sing "You Are Sixteen."

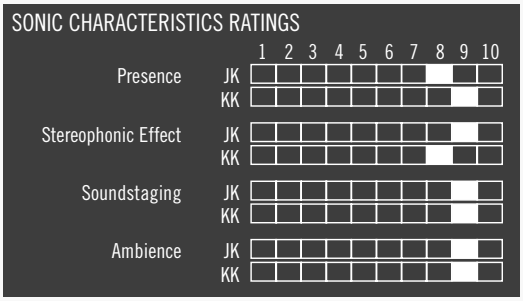
The music, itself, sounds absolutely wonderful, as though it was recorded yesterday! The strings and woodwinds are perfectly crisp, without being strident. The bass violins are full and deep—brilliantly encompassing!

Get Shorty—We're using this DVD simply because we haven't seen it before! Since it was highly recommended to us and we're reviewing a surround receiver, this seems like a good review piece.

JK: When Ken suggested we watch this movie, I thought he was making fun of my vertically challenged stature of barely 5′. Then he handed me the DVD! One part of the movie stands out to me because it makes me glad to be me! Mobster Chili Palmer (played by John Travolta) decides he wants to retrieve his stolen jacket from another mobster. So Chili marches straight to this guy's place, bangs on his apartment door and whacks him straight in the nose as the door opens. The sound of Chili's fist smashing the mobster's nose is so life-like, I can actually hear it crack!

If that isn't enough, Chili turns without a word and walks straight out the door, slamming it behind him. Bam! If I closed my eyes and listened, I would be able to "see" through my ears! This entire scene seems very real. Aren't you glad you're you, too?

KK: The quiet and loud transitions are impressive and at times stunning. Although this movie has its occasional obligatory surround effects, there is a scene at the airport where we are "surrounded" by the whine of jet planes. Although this is a bit jarring, it's diffi-



cult to miss the change of scenes. I suppose that's the goal of the sound engineers...to use the audio portion of the movie to transport the viewer to different places. It worked.

The Perfect Storm—This is a great DVD to use for testing a home theater. The majority of the movie has great music, stormy weather, and crashing sea vessels. The storyline and drama are very moving and are greatly enhanced by a properly set up surround system with subwoofer.

JK: This was a great movie to hear through the Onkyo TX-DS787 sound system. Before the storm hits, the receiver nicely depicts the gentleness of the ocean. The splashes come from all around us, but it is very calming. When the fishing crew lifts a large swordfish out of the water, its fin flaps, hitting the wooden floor of the ship. Each tap from the fish's fin is hard, yet slimy sounding!

During the height of the storm, the aggressive sea envelops us from every angle (every speaker) alternating from the left to the right and center depending on which side the waves are crashing. It is awesome being part of the storm! The 6.1 surround system does a superior job of making us feel as though we're with the crew of the Andrea Gail right in our own living room.

KK: Highlighting the tragic end of the Andrea Gail fishing boat, this movie has many scenes with devastatingly stormy weather and panic. I must say, the subwoofer rumbling as the boat flies over enormous waves only to abruptly hit the waters below, along with the gushing and splashing of water randomly from all channels is staggering!

Days after the sinking of the Andrea Gail, there is a memorial service in a rather large church. The church acoustics are beautifully represented with a choir in the back of the sanctuary (front channels) echoing in the surround channels. Although I can see only a small piece of the ceremony on our video screen, the music is all-encompassing.

Chick Corea "Remembering Bud Powell"—With the rapid death of quadraphonic systems still lingering in the minds of many audiophiles, even after all these years, we were very curious to hear this 5.1 DTS surround mix on CD. Whether multichannel audio will or should become the next new permanent standard for audio is still up for debate, but for now, it's certainly an option for home theater audiophiles.

JK: We listen to a lot of music in our house, but this is the first time we've played a music CD in surround sound. It is wonderful how the instruments seemed three-dimensional. As I listen, I imagine I am in a club watching Chick Corea, rather than having him and his band in our living room (not that they aren't welcome).

KK: I was, admittedly, somewhat afraid of a music-only program in surround. Although I like to stay open-minded, the thought of different instruments coming from all corners of the room is really quite cheesy! However, "Remembering Bud Powell" is tastefully mixed, very pleasant, and enveloping. I can practically hear Christian McBride's fingers rub the strings of his upright bass as he plays. Roy Haynes's meticulous cymbal work is also highlighted by the subtle surround-to-front 3D placement.

This makes me realize, though, that speaker versus listener placement is even more critical for "proper" music listening than it is for conventional two-channel audio. Another lesson I learned is that CDs encoded in DTS surround are unfortunately incompatible with standard CD players and will play a continuous stream of pink noise-like signal. Do I smell another Betamax?

SUMMARY

We auditioned many different pieces of stereo music through the TX-DS787. Overall, we believe it performs best in "straight stereo" mode and isn't bad in "all channel stereo" mode. It tends to have a nice, bright top end, sounding very much like the solid-state device that it is, meaning that tube fans may not want to ditch their valves any time soon.

However, Onkyo seems to have rated the TX-DS787's output power quite conservatively, resulting in very clean-sounding output even at higher SPLs than our household can handle. The good news is that you can customize its configuration in an infinite number of ways to fit your A/V needs. The bad news is that folks who are new to surround sound may have a helluva time figuring out the TX-DS787's menus.

This is a wonderful piece of equipment, especially in the $1,000 range, and we give it two thumbs up for quality and features. With a little patience, the menu-driven nature of this receiver will likely become second nature to you.

Antenna jacks are provided for the AM loop antenna and the 75Ω FM "F" connector. If the receiver is in a location that does not allow the remote beam to reach the IR sensor or exceeds its 16′ range, you can plug an optional remote sensor into the rear of the TX-DS787.

Component video jacks are RCA types and the S video jacks are DIN. All jacks on the rear panel are color-coded to reflect their intended input/output signal. Preamp output jacks are available for connecting external power amplifiers to the front, surround, surround back, subwoofer, and center channels.

Eight pairs of tin-plated multiway binding posts are provided for the speakers (six main speakers and two zone 2 speakers). These binding posts are on US 0.75" spacings, so you can use dual banana plugs.

The non-polarized power cord is attached to the unit, and does not have a chassis-grounding third pin. The power cord is looped through a toroidal ferrite EMI suppression core (three turns) inside the unit. There are also two switched two-prong AC outlets rated 1A each.

INSIDE THE AMP

Photo 3 shows the amplifier without the top cover, which engages two tabs on the front panel and is secured with seven screws. It has cooling slots above the central and right-side heatsink areas, while the bottom cover has cooling slots below the power transformer and along the front edge. Vent slots are located in the center of the rear panel, through which the cooling fan exhausts heated air.

While there is adequate finger space under the unit to lift it easily, several screw heads are located in this area, which can make lifting uncomfortable should your hands not be in the proper location.

There are two relay protection boards just inside the speaker binding posts. The large E-I power transformer occupies most of the left side of the unit. Another PC board interfaces with the power and standby switches. The front video input board lies just below the master volume dial.

The center of the receiver has two large heatsinks, each carrying three pairs of Toshiba bipolar output transistors. Only one pair of output transistors is used for each channel for 100W per channel into 8Ω load with all channels driven, so I imagine the cooling fan is necessary for high-volume listening. A caution label notes that speaker impedance cannot be less than 6Ω. The remainder of the power amplifier circuitry for each channel is located on PC boards between the heatsinks.

Most of the circuitry consists of surface-mount discrete components and ICs. The right side of the chassis resembles a personal computer. A large phenolic motherboard supports six vertical PC boards, whose rear-facing input/output jacks protrude through the rear panel. A bracket ties four of the boards together for support.

The shielded AM/FM tuner front end sits just inside the antenna jacks, while a larger shielded box is located on the right sidewall of the receiver. Three TO-220 power devices are mounted on heatsinks located between the vertical PC boards.

The Onkyo TX-S787 is supplied with the RC-390M remote control (*Photo 4*), with LCD back-lighting that makes it easy to read in the dark. This remote has a learning capability and macro functions. The TX-DS787 uses the Smart Scan Setup feature that allows simple, intuitive system setup and control.

A full description of the remote-control capabilities is beyond the scope of this section of the review. Suffice it to say that it duplicates all the controls on the receiver and adds remote-control capability for compatible CD/Tape/DVD and MD operation. A four-page basic operating guide is useful for day-to-day operation.

TOPOLOGY

A schematic was not furnished with the unit. Presumably you could obtain it by ordering the service manual, as is common with many consumer audio components. Each power amplifier channel consists of a low-feedback Class-B 100W per channel complementary-symmetrical amplifier using one pair of 15A 150W Toshiba bipolar output devices.

Analog circuitry (prior to digital conversion) is implemented with 4570 and 5532 dual op amps. The TX-DS787 has 96kHz/24 bit digital-to-analog converters (DACs) for Dolby Digital and DTS soundtracks and music. The dual 24-bit DSP processors use a non-scaling configuration.

An "Optimum Gain Volume Control" feature adjusts low-level sig-

TABLE 2
CROSSTALK PERFORMANCE

FREQUENCY	PHONO (DB)	PREAMP (DB)	POWER AMP (DB)
100Hz	–67	–72	–67
1kHz	–58	–63	–57
10kHz	–43	–53	–53
20kHz	–41	–51	–51

nals to keep them well above the noise floor, even on the quietest passages. The master volume control is an encoder rather than a set of analog volume controls. It communicates directly with the display PC board by means of a three-wire cable.

MEASUREMENTS

I preconditioned the TX-DS787 using white noise at 10W output for one hour. There is no sound other than the protection relays cycling at power-on and shutdown.

The receiver has four listening modes. Direct mode bypasses the digital signal processing (DSP) "sound alteration" sections and other filters, for all-analog performance. I made most of my measurements in this mode, with the tone controls off. For THD measurements I used the test-set 80kHz LP filter to limit out-of-band noise.

The stereo mode is similar in performance to the direct mode when the subwoofer is selected off. With the subwoofer on, the audio is processed by the DSP, sending the low frequencies to the subwoofer output and the higher frequencies to the left/right front outputs. I made some comparative preamp measurements in direct mode, using the test-set 27kHz LP filter to limit noise from the DSP, since the frequency response was consistent with 44.1 to 48kHz digital conversion.

The DTS Surround and THX modes are designed to decode movie soundtrack information on DVD disks, so I did not measure those 24/96kHz modes for their audio performance. I did some listening and, as with most A/V receivers, I found the audio surround effects somewhat exaggerated.

PHONO STAGE

The TX-DS787 has a moving-magnet phono stage, whose performance I measured using the Old Colony Inverse RIAA Network. Input impedance was 48k, although using an ohmmeter, it was initially 50k then rose to 57k. This suggests the cartridge loading is a combination of pure resistive and capacitor-coupled resistive loads. The phono stage preserves input signal polarity.

A fixed 1.63V RMS signal from the distortion test set produces an output from the Inverse RIAA that tracks the equalization standard within ±0.15dB, based on 10mV at 1kHz. The direct-mode left-front preamp output in *Fig. 1* shows 1/3dB peaking at higher frequencies, but still remains within the RIAA limits. I also ran the phono preamp signal through the DSP in stereo mode, with the subwoofer on. The results for the subwoofer and left-front preamp outputs are shown in *Fig. 1* as well. This frequency-band division also occurs when you use the line inputs.

THD+N versus preamp output voltage into 10k is shown in *Fig. 2*. I again used the Inverse RIAA network to generate the phono input signal. The solid phono trace is the direct mode, and the dashed line just above it is stereo mode with the subwoofer off.

The direct-mode phono stage distortion at 2V RMS preamp jack output was 0.012% from 20Hz–4kHz, gradually rising to 0.024% at 20kHz. Using the stereo mode, the distortion at the subwoofer output was noticeably higher—0.47% at 20Hz—while the higher frequencies were only slightly more distorted than the direct mode.

Phono input overload (1kHz, 0.5% THD) was 123mV for 9.5V RMS output, probably representing the ±13V maximum output swing of op amps with ±15V DC supplies. Since the phono stage signal is only available through the following preamp stage, I cannot tell which of the op amps reached its limit first.

The phono stage square-wave response was very good. The 40Hz response showed only a slight tilt, and the 1kHz response was just about perfect. The 10kHz response barely rounded the leading edge, with no sign of ringing or oscillation.

PREAMP LINE INPUTS AND OUTPUTS

Line-level analog inputs are available for CD, tape, DVD, and four video inputs. I used the CD input for most measurements. Input impedance at 1kHz was 51k, although DC resistance was over 1M, indicating capacitively coupled line inputs.

The phono jack video input impedances all measured 10k. The line output impedance was 465Ω at 1kHz, so the output levels varied only 0.2dB for output loads from 10k–100k. Video outputs all measured 75Ω.

The preamp section does not invert polarity in direct mode. However, when an input signal is processed through the DSP, the output polarity constantly varies with frequency. For instance, polarity was normal at 460Hz, lagged 90° at 480Hz, was inverted at 500Hz, led 90° at 525Hz, and was back to normal at 550Hz.

This phase modulation was not evident from the CD input to tape out, however. Tape out impedance measured a high 3k2, and both output level and frequency response were affected somewhat by the tape out load. With a 100k load, the tape out level was the same as that presented to any of the analog inputs, dropping 1dB with a 10k output load. The distortion level was about equal to the distortion test-set oscillator, so the tape output does not appear to be buffered. There was also some drop in frequency response above 50kHz, so I assume the tape out is simply RC-coupled from the selected line input.

The master volume control is a position encoder that requires approximately three turns from minimum "0" to maximum "80." "Ref" appears in the display where "62" would be. Tracking is excellent, with no measurable difference between the left and right front-channel levels from 50mV–5V output. At the minimum setting, I could hear a very faint pop in the speaker. I assume this is a type of muting circuit.

At maximum volume there is noticeable hiss and a very low hum in the speaker. This is not apparent at "Ref" level. Even at relatively low output levels I could occasionally hear the cooling fan quietly cycling on and off.

True unity gain is not available, being somewhere between "64" (–0.63dB) and "65" (+0.42dB). The "Ref" level produced a gain of –2.6dB. Maximum preamp gain ("80" in both direct and stereo modes) was +14.3dB.

For most of the preamp tests I used a volume setting of "77," which produced (as closely as possible) an output of 2V RMS for a line input of 0.5V RMS (+12dB). The right-channel preamp output had slightly higher distortion than the left, so I present its measurements here.

The direct-mode line-input frequency response was very flat. It was down only 1dB at 4Hz and 64kHz, and down 3dB at 108kHz.

When I selected stereo mode, with the subwoofer on, the divided response was similar to that in *Fig. 1*. The receiver response was also the same for a digital CD coax input signal. The subwoofer output was down 1dB at 4Hz and 47Hz. The –3dB point was 63Hz, and –5dB occurred at 75Hz.

I repeated the test in the default DD/DTS Surround mode using the DVD input (not shown in *Fig. 1*). Frequency response in the front channels was 3.7dB lower than direct mode and rolled off above 12.5kHz. The rear surround channels were 8dB lower than the fronts, and their response rolled off above 8kHz. Distortion was about 0.2% at the respective response peaks.

Refer to *Fig. 2* for the line-level THD versus output voltage. The CD input performance in direct mode is the fifth trace down at 1V output. Just above (dashed line) is the distortion after processing the signal through the DSP section. The maximum preamp output voltage (1% THD+N) was 9.5V RMS, the same as the phono stage. The analog inputs were successfully converted to digital without overloading the A-D converters.

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The THD at higher input frequencies showed closely spaced excursions between 0.01% and 0.2% after processing through the DSP. I guess that this is due to interaction of the analog audio signal with the digital conversion sampling frequency.

The distortion curve for the subwoofer output at 40Hz shows fairly high distortion above 1.5V RMS. This curve continues to increase gradually with no hard clipping, and the LF sine waves became fatter in perspective as the subwoofer output level increased (somewhat tube-like in appearance, although I did not find a hidden 12AX7 among the PC boards).

I also applied a digital test signal from my CD player's coax output using the CBS-1 Test CD 997Hz linearity tracks. Its distortion curve is at the bottom of *Fig. 2*. The digital input THD versus frequency is also better than that of the analog inputs, especially above 1kHz. In the lower three curves you can see a curious bump in the distortion at about 2.5V RMS output. Since this appears in the direct-mode curve that theoretically bypasses all digital processing, it probably is not a DSP-related phenomenon.

The bass and treble processing is engaged by a pushbutton on the front panel. This control has a display-indicated range of ±12dB for each function. The bass control has an actual range of ±10.4dB at 100Hz. Similarly, the treble control range at 10kHz is ±10.5dB.

At 1kHz each control still has some effect: ±3.4dB for the bass and ±1.3dB for the treble. In a DSP-related phenomenon, the bass control still exerted ±3dB of control at 10kHz, while below 800Hz the treble actually increased its gain slightly when the display indicated –8dB to –12dB. The mute function caused a decrease in the output of –52dB.

Preamp square-wave performance in direct mode has the same excellent response as the phono stage. In stereo mode, with the subwoofer on, the 1kHz response (*Fig. 3*) exhibited the Gibbs Phenomenon ringing associated with the steep digital filters used in the DSP section of the receiver. For the same reason, the 10kHz square wave was rounded over into nearly a sine-wave shape.

The Onkyo's reproduction of a CCIF-combined 19kHz + 20kHz intermodulation distortion (IMD) signal at 12V p-p into 10kΩ produced a low 1kHz IMD product of 0.004%. Repeating the test with a multi-tone IMD signal (9kHz + 10.05kHz + 20kHz, not shown) resulted in a 1kHz product of 0.003%. The CCIF performance in stereo mode was 0.006%.

MEASUREMENTS—POWER AMPLIFIER

There are no straight connections to the power amplifier inputs, so their performance is a function of the preamp as well as the listening mode. Since I explored the various modes in the preamp tests, I used only the direct mode during the power amplifier testing. The TX-DS787 is not designed for speaker loads less than 6Ω, so I performed all these tests using my 8Ω loads.

I ran the two front channels at 10W for one hour into an 8Ω resistive load. The left-channel preamp/power amp combination had slightly higher distortion than the right (just the opposite of the preamps alone), so I present its measurements here and summarize them in *Table 1*.

The TX-DS787 power amplifiers do not invert polarity. The maximum ("80") overall gain at 2.83V RMS output into 8Ω was 43.5dB. Using the "Ref" volume-control level, the gain was a more normal 26.6dB. The output impedance at 1kHz measured 0.11Ω, rising to 0.25Ω at 20kHz. The amplifier proved insensitive to frequency-related changes in speaker impedance using an IHF speaker load.

The frequency response for the TX-DS787 was within ±1dB from 4Hz–54kHz, at an output of 2.83V RMS at 1kHz into 8Ω. It was down –3dB at 3Hz and 94kHz. The curve was smooth and flat, with no evidence of high-frequency peaking.

Crosstalk performance for the phono stage, preamp, and power amp are shown in *Table 2*. Power amplifier crosstalk is a function of the preamp section. The same is true for the phono stage, whose output signal is not directly available.

THD+N versus frequency with 1W into an 8Ω load did not exceed 0.031% from 20Hz–20kHz. With a complex load of 8Ω paralleled with 2µF, the THD+N increased from 0.035% at 8kHz to 0.083% at 20kHz. The CCIF IMD performance was very good at only 0.008%.

Increasing the output power to 10W per channel dropped the distortion even lower, never exceeding 0.017% over the audio band. This fine performance was maintained out to 2/3 rated load (67W per channel) into 8Ω. The cooling fan began cycling at about 7.5W per channel, and was operating continuously above 20W per channel. This fan is very quiet, so you would not hear it in your listening room.

Figure 4 shows THD+N versus output power into 8Ω at 20kHz (top), 20Hz (middle), and 1kHz (bottom). I engaged the test-set 80kHz low-pass filter to limit the out-of-band noise. There was absolutely no strain right up to the point of maximum power, and the amplifier seemed quite happy to continue at this load all day long.

There is a curious bump in the distortion at 30W in the 1kHz curve. This may correspond to the bump in the preamp section distortion at 2.5V output (*Fig. 2*). I checked this response anomaly a number of times to be sure it was real, and it was.

Using a 1kHz signal, I achieved 142W per channel into 8Ω at 1% THD+N. 128W per channel was available at 20kHz, and 138W at 20Hz. I repeated the test driving only a single front channel. Here I saw 157W, 153W, and 149W, respectively. This is pretty respectable performance for amplifiers rated 100W into 8Ω.

The distortion waveform for 10W into 8Ω at 1kHz is shown in *Fig. 5*. The upper waveform is the amplifier output signal, and the lower waveform is the monitor output (after the THD test-set notch filter), not to scale. This 0.013% distortion residual signal shows mainly the third harmonic, along with some high-frequency noise.

The spectrum of a 50Hz sine wave at 10W into 8Ω is shown in *Fig. 6*, from zero to 1.3kHz. The THD+N measured 0.015%, and the highest harmonic is the third at –81dB. The next highest second harmonic lies just below –93dB.

The 2.5V p-p square wave into 8Ω at 40Hz showed only a slight tilt. The 1kHz square wave was perfect, while the leading edge of the 10kHz square wave showed a very slight rounding. When I connected 2µF in parallel with the 8Ω load, there was some ringing evident, as you can see in the 10kHz response in *Fig. 7*.

MEASUREMENTS—FM TUNER

I did not run any tests on the AM section of the receiver, except to make sure it was functional. The FM stereo section was quite sensitive. I could find a station near or far, across almost the entire 88–108MHz FM band. My FM stereo signal generator is set to 98.1MHz, since there is no station at that frequency in my area. However, in FM/mute mode (mono), the TX-DS787 managed to find one about 85 miles away, though barely listenable.

Frequency response in direct mode measured +0.1/–1dB from 20Hz–15kHz, and maintained normal polarity (audio signal to the FM modulator compared to the line output of the tuner).

With a 75Ω RF signal at the antenna F-input jack, stereo sensitivity (full quieting) was 36dBf, below which the tuner went into muting. Stereo separation at 1kHz was 48dB. I needed to switch to FM/mute mode to measure mono sensitivity at 17dBf, and usable sensitivity was about 11dBf, which is fairly good. ❖