NAD L53 DVD/CD Stereo Receiver

By Charles Hansen

The L53 is a 50W per channel stereo AM/FM receiver that also includes a CD/DVD player. The only other gear required are stereo speakers and a TV monitor. You can dispense with the monitor if you only want to listen to audio. The L53 includes a learning remote with illuminated keys that you can program to replace your TV, and/or cable and satellite remotes, and you can even program it to activate your entire system with only two keystrokes. A clock/timer function is included in the front panel display.

The L53 uses the latest generation DVD-video decoder with progressive scan output to a digital TV display through its component video connections. Composite and S-video connectors are provided as well, although an RF (modulator) output is not available. If your TV is an older model without A/V input jacks, you can always use a VCR as the RF modulator. The CD/DVD drive will play DVD-V, VCD, SVCD, CD, CD-R, CD-RW, MP-3, JPEG, and WMA data. The L53 will not play DVD-Audio or SACD high-resolution audio formats.

The L53 features Sound Retrieval System (SRS) technology to provide a surround sound simulation from only two speakers in rooms that cannot accommodate additional surround speakers. A subwoofer output that tracks the stereo level control allows full compatibility with any of the many powered subwoofers currently available.

The stereo power amplifier section is a discrete transistor design, and all the power supplies use conventional iron transformers and linear regulators rather than the more common computer-style switching power supplies. As such, the L53 is a hefty 18.5 lb.

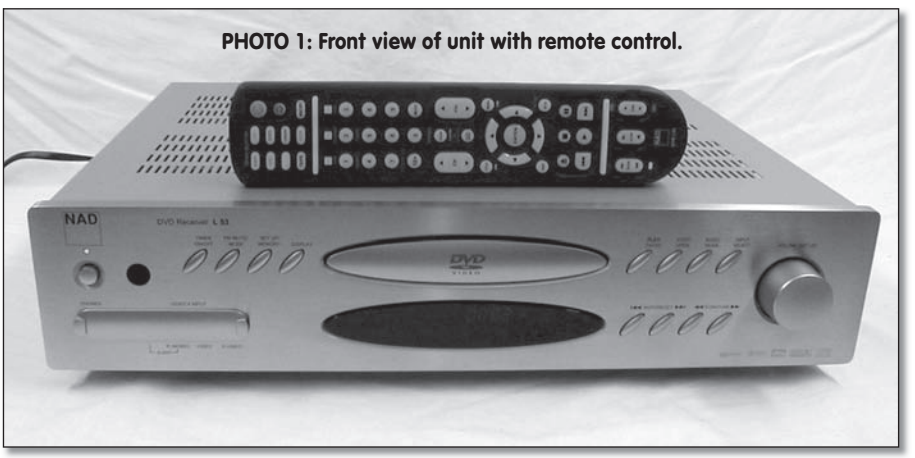


PHOTO 1: Front view of unit with remote control.

INSIDE THE AMPLIFIER

Photo 1 shows the front panel of the L53 along with its HTR-L53 remote control. The power switch is located on the left side just below the blue LED standby indicator. Pressing the drive open/close button will also turn the unit on. After a startup delay, the standby indicator will go out and the main display will come on. There is no off position, so when the power switch is cycled off the unit remains in standby mode. The remote control infrared sensor is to the right of the power switch.

The access door just below the power switch covers a ¼″ headphone jack and the Video 4 composite and S-video input jacks. When headphones are plugged in, the speaker outputs are muted.

To the left of the drive tray are four slanted buttons that control the clock/timer, the FM mute/mode button, the setup/memory button (used to store up to 60 station presets or access the DVD options), and the display format button. The blue vacuum fluorescent main display is located just below the drive tray.

To the right of the drive tray are the play/pause button, the drive stop/open button, the audio mode select, and the input select. The four buttons below them control the forward/back/skip/scan/tune functions. The large knob on the right is the volume control, which is not a dual analog pot, but a servo control that also actuates the bass, treble, and balance controls in conjunction with the setup menus.

The HTR-L53 is an eight-device illuminated learning remote control with macro function. The manual is a bit thin with regard to all its features, but it seems straightforward enough, and the lighted color-coded buttons are a welcome respite from the sea of black-buttons-on-black-background-with-tiny-printing all too common in remotes these days.

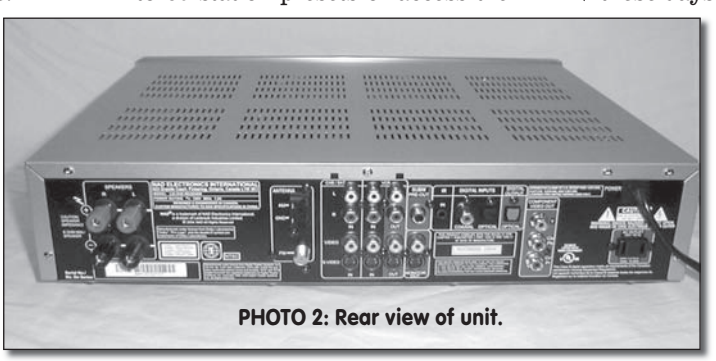


PHOTO 2: Rear view of unit.

The L53 is constructed of heavy gauge gray painted steel, with cooling slots on the top and bottom. The front plate is 10mm-thick aluminum rather than the plastic used on many of the consumer A/V products. Four thick hemispherical rubber mounting feet provide ample finger room for

lifting the L53.

Facing the rear panel (**Photo 2**), the left side has two pairs of speaker binding posts. In accordance with CE requirements, these are not on ¾″ USA spacings, so you cannot use dual banana plugs. Each threaded post has a chassis-mounted plastic guide bushing that accepts heavy gauge wire. The manual says speakers should be rated at 8Ω minimum.

Next in line are the clip terminals for the supplied AM loop antenna and a 75Ω F-connector for the FM input. A 300Ω dipole is supplied along with a matching 300Ω: 75Ω balun.

Composite and S-video input connectors are supplied for a cable/satellite box and a VCR. There are also composite and S-video output jacks that you can use to send A/V signals to a VCR or DVD recorder. Next to the A/V jacks are the subwoofer output jack and the composite and S-video monitor output connectors. All the RCA jacks have gold-plated shells, but the center connectors appear to be nickel- plated.

To the right of all these connectors are a Xantech-style infrared repeater input, S/PDIF coax and optical PCM digital inputs, and an optical PCM output jack. Just below these connectors are SCART/RGB connectors for the European PAL television signals. Finally, the three vertical connectors on the right side of the connector stack supply component video Y/Cb/Cr signals to video monitors that accept them.

The polarized two-prong power cord is permanently attached, with a polarized two-prong accessory outlet rated for 100W/1A just below.

Photo 3 shows the amplifier with the cover removed. A schematic was not furnished with the unit, but service manuals are usually available from NAD at extra cost. Looking just inside the left rear panel, you'll note the power cord is threaded through a toroidal ferrite EMI filter core. The left rear of the L53 has an AC power input board with a MOV transient suppressor, film caps, and the line fuse.

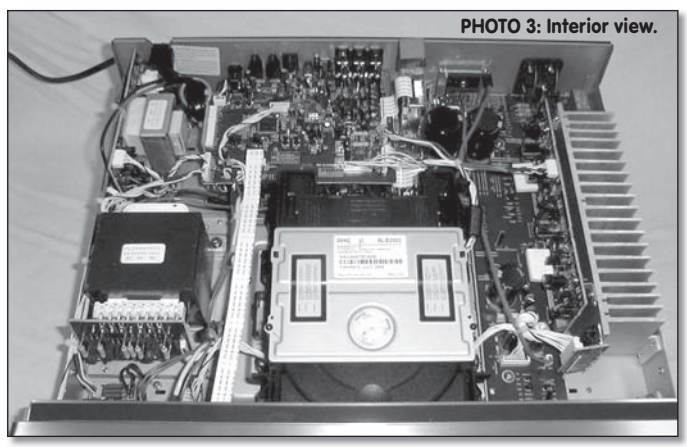


PHOTO 3: Interior view.

The small transformer supplies power to the front panel display/control board just under the front lip of the chassis (out of view in the photo). The larger transformer at the left front supplies the high current requirements for the power amplifier, and the lower voltages needed for the logic, video, digital audio, and analog line-level audio circuits. The

location of these two power transformers makes the L53 much heavier on the left side.

Front and center is a Raymedia CD/DVD drive unit with an A/V control/interface PC board incorporated in the bottom of its housing. The DVD format is handled by an ESS Vibratto 2 MPEG-4 chip set with a 54MHz 10-bit video DAC. A Cirrus Logic CS4391A 24-bit/96kHz stereo DAC decodes 16-bit PCM to analog audio.

Stacked just behind the drive are two horizontal PC boards. The bottom board is the video interface and switching board, while the audio and logic control is on top. The various functions are controlled by means of an STMicroelectronics ST92F124V1T6 8/16-bit microcontroller chip with 128K of flash memory. A minimal number of discrete 74ACT chips provide TTL-to-CMOS glue logic.

The analog audio is processed through an NJR NJW1153P six-channel electronic volume control IC with input select, tone control, mute functions, and three output record channels. Based on the data sheet for this chip, it appears to be entirely analog in the signal path. A Philips SAAA6579T chip demodulates the Radio Data System (RDS) information from the tuner section. An SRS Labs SRS31D0 chip functions as the Sound Retrieval System (SRS) surround ambient decoder.

There are two dual op amps on the audio board. One is an NJM2068M, roughly identical to ye olde RC4558 from the mid-1970s. The other, despite the fact that the silk-screen ID in its location also reads 2068M, is a high-quality Burr-Brown OPA2134 located adjacent to the left/right channel audio inputs to the power amplifier board. The 2068 op amp appears to provide summing and low-pass equalization for the subwoofer output.

Dual supply voltages are provided for the NJW1153 by L7808 and L7908 linear regulator ICs. The rear panel audio input and output jacks are all coupled with aluminum electrolytics. The video board uses discrete RF transistors for video output buffering.

Additional regulated DC supplies (+5, ±12V) for the audio board come from the front area of the power amp supply board on the right side of the unit. The three linear regulator ICs are located on the forward edge of the heatsink. The power amplifier DC supply is at the rear of the supply board.

Main reservoir capacitors are two 6800µF 50V Koshin electrolytics. Supply rail fuses and the speaker Zobel networks and output inductors are located nearby. Just in front of the speaker binding posts is a 5A startup delay/protection relay. The discrete power amplifier circuitry is on the vertical PC board attached by metal clips to the large aluminum heatsink.

The AM/FM tuner and PLL are located in the shielded enclosure directly in front of the antenna jacks. All-in-all, the L53 has a compact, well-thought-out component arrangement. NAD also makes the L73 Surround Sound Receiver with five channels of audio amplification and adds DVD-Audio playback and HDTV-compatible video output.

MEASUREMENTS

Before making any measurements, I set up the L53 for some selected listening to make sure all the audio modes were operating properly. It was at this point I found that the "included" remote control batteries had not been included, and that the L53 was very easy to operate from its front panel controls. When you insert a disk, the unit must determine the format before playback begins, because all shiny silver 120mm discs initially look the same. It took about 15 seconds from the "LOADING" display until the format was recognized and accepted for play. Initially, the drive (Korean-sourced, but made in China like the rest of the L53) was fairly noisy up close to the unit, but the noise gradually subsided until it was no louder than my Rotel CD player.

Because the L53 can also play MP3 files, I listened to the 128K-sampled compressed MP3 CD-R that I had previously made for the Pioneer DV-563A test (*aX* November 2004, p. 36). My perception was that the MP3 tracks were a bit louder than the CD tracks of the same songs. Imaging was better than with the DV-563A, but the soundstage was still flat, with most of the reverb or ambience that was present in the CD version lost in the MP3 encoding. This

actually improved the sound in some pop music songs where various effects were applied to excess in the original CD tracks.

Initially, even though the total time and track count were correct, I couldn't access all the MP3 tracks. Once track 1 began playing, I was able to access any track skip/scan tracks. I don't know whether this was peculiar to MP3 or due to the CD-R media. I didn't see this behavior with commercially pressed CDs.

One nice feature in both CD and MP3 mode is the ability to go directly to track 1 while the last track on a disc is playing by pressing the next track button. Not all CD players will do this, and require you to enter track 1 on the numeric keypad.

LINE LEVEL INPUT PERFORMANCE

Because the L53 includes AM/FM tuners and the DVD/CD/MP3 player in one package, it is unlikely that owners would use the composite audio input jacks for other stereo sources, such as a cassette deck or outboard phono preamp. However, all the internal and

external source options need to flow through the NJW1153P six-channel control IC, so its performance will set the baseline for the audio performance of the L53. There is very little in the way of important audio parameters in the NJW1153 data sheet, other than gain (always near unity) and THD+N curves versus input voltage. Important specifications such as slew rate, unity gain bandwidth, input impedance, bias current/voltage, and noise performance go missing.

I put the L53 in CD playback with a CD test disc for 1 hour before making any line level measurements. The player was just warm to the touch above the heatsink after this period at 1W into 8Ω.

FIGURE 1: Frequency response (line level sources).

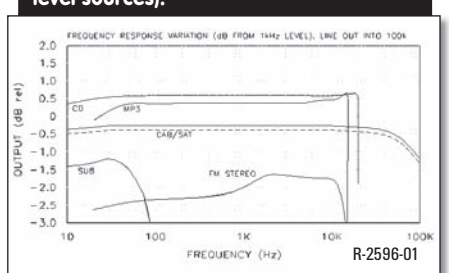


FIGURE 2: THD+N vs. frequency (line level sources).

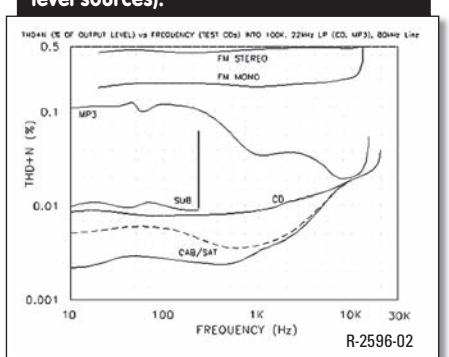
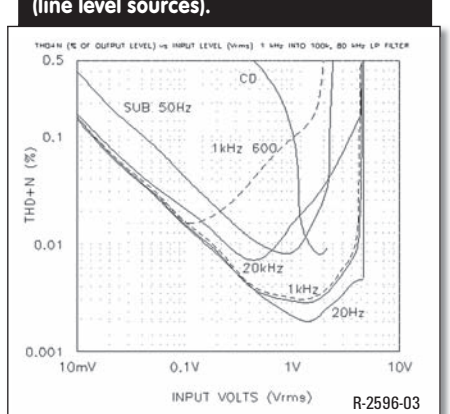


FIGURE 3: THD+N vs. input voltage (line level sources).



Input impedance for the CAB/SAT and VCR audio line inputs was approximately 90k. The S/PDIF digital coax input impedances measured the specified 75Ω. Output hum and noise with the analog inputs terminated in 600Ω measured –89dB (ref 2V RMS), decreasing to –107dB A-weighted. Front left and right channel separation measured a fine –80dB at 10kHz, unweighted.

The output impedance for the two-channel stereo VRC outputs measured 460Ω from 1kHz to 20kHz, and a higher 700Ω at 20Hz where the output coupling capacitor adds to the impedance. L-R channel balance was essentially perfect. The stereo outputs do not respond to variations in the volume, balance, or tone control settings, and are passed through from the sources at nearly unity gain (–0.26dB), although this will change with load.

The subwoofer output does follow the volume control setting, and had an output impedance of 110Ω, and showed unity gain with a volume control indication of "–1" (100k load). The S/PDIF digital coax and the three component video output impedances are all specified to be 75Ω. All input and output jack shells and the speaker negative binding posts are connected to chassis ground.

LINE LEVEL SOURCE MEASUREMENTS

Frequency response for line level sources (CD, MP3, FM tuner, and the VCR line input) into 100k is shown in **Fig. 1**. The VCR line level output is also shown with a 10k load (dashed line). The 1kHz 0dBfs CD line output was 2.12V RMS at 1kHz, or 0.60dB higher than the CD Red Book standard of 2V RMS.

There was just 0.2dB of de-emphasis response error at 1kHz when playing pre-emphasized CD test tracks. The MP3 frequency response with identical CD test tracks ripped to 128k MP3 format was 0.38dB higher through the midband before dropping off just above 15kHz. The subwoofer output response is shown with 2V RMS input and the volume at "–2" to improve clarity on the graph.

I measured the FM tuner frequency response with an RF signal level of 65dBf and 100% (±15kHz) modulation.

In this measurement there are three responses that can contribute to the overall error: the 75µS pre-emphasis and steep 16kHz LP filter on the audio that is fed to the FM signal generator, and the 75µS de-emphasis in the tuner under test. FM stereo crosstalk performance was 42dB at 1kHz.

Note that the FM stereo line level output at 1kHz with 100% modulation is 750mV, or –8dB relative to 2V RMS. Accordingly, the FM frequency response curve has been shifted up by +6dB to keep it within the graph.

THD+N versus frequency is shown in **Fig. 2** for each audio line level mode. I engaged the 22kHz LP filter in my distortion test set for the CD and MP3 tests, and the 80kHz LP filter for the line input and FM tuner. The analog CAB/SAT input voltage was held to 2V RMS because this is the 0dB level on the CD test disc and the VCR line output does not respond to the volume control. Distortion for the FM tuner section is shown for mono and stereo. The analog line input distortion with a 10k load is again shown with a dashed line.

The THD+N for the MP3 test tracks shows a bit of a roller-coaster ride. There is also a dip at 60Hz that may indicate that some 60Hz AC line pickup is being notched out by the distortion test set at that frequency.

THD+N vs. input voltage is shown in **Fig. 3**, at 1kHz for each line level audio mode into 100k (I excluded the FM curve because reducing the modulation level greatly increased the distortion, which was near 0.5% to begin with). I measured the subwoofer THD at 50Hz. This time I added a very low 600Ω line level load at 1kHz (dashed curve).

ANALOG CAB/SAT LINE INPUT PERFORMANCE

The residual distortion signal with an analog input of 1kHz at 2V RMS into 10k is shown in **Fig. 4**. The upper waveform is the VCR line output signal, and the lower waveform is the distortion test set monitor output after the test set notch filter, not to scale. THD+N at this test point is a low 0.0029%. Note the series of 44.1kHz spikes riding on the low-level noise, perhaps due to coupling from the digital audio section (although the CD player is off at this time).

Figure 5 shows the same data, but with the steep 22kHz low-pass filter

FIGURE 4: Line input 1kHz residual distortion with 80kHz LP filter.

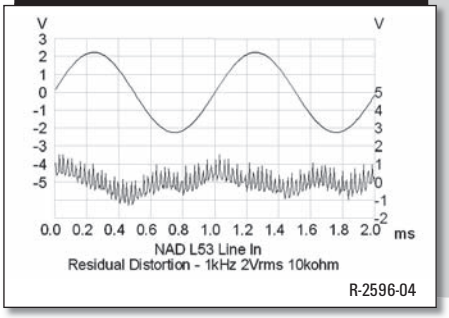
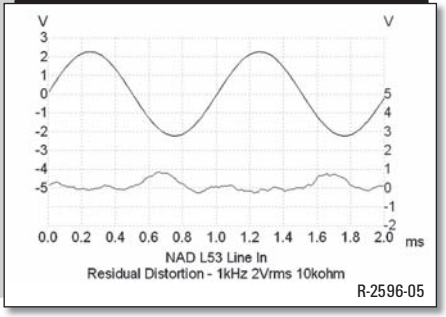


FIGURE 5: Line input 1kHz residual distortion with 22Hz LP filter.



rather than the gradual 80kHz low-pass filter engaged. This confirms that the spikes do not produce any noticeable artifacts within the audio band. The negative half-cycles appear to have a predominant second harmonic, while the positive half-cycles are a mix of higher harmonics and noise.

The spectrum for a 50Hz sine wave at 2V RMS into 100k is shown from DC to 1.3kHz in **Fig. 6**. The THD+N measures only 0.0024%. The levels of the second through fifth harmonics were –108dB, –96dB, –98dB, and –103dB, respectively, for a calculated THD of 0.0021%. Decreasing the load to 10k produced a uniform increase in all the harmonics for a THD+N reading of 0.0061%.

Repeating the spectrum at 1kHz (not shown) saw a similar distribution of harmonics with a THD+N of 0.0031% into 100k and 0.0039% into 10k. The slight rise in THD near 60Hz in **Fig. 2** may be caused by low-level coupling of the power line, but it was not visible in **Fig. 6**.

In view of the presence of coherent HF spikes in the residual distortion of **Fig. 4**, I extended the 1kHz spectrum to 166kHz to see whether they were present (**Fig. 7**). Here you can see the 44.1kHz spike at –90dB and an additional 88.2kHz spike at –95dB. Again, there are no visible artifacts in the audio band, but the presence of these two frequencies with the CD player off is puzzling, if benign. The logic clock remains running for the microcontroller, of course.

Figure 8 shows the L53's output spectrum reproducing a combined 19kHz + 20kHz CCIF intermodulation distortion (IMD) signal just below the ±6.8V clipping level of the NJW1153 chip into 10kΩ. The 1kHz IMD product is –96dB

FIGURE 6: Line input spectrum of 50Hz sine wave.

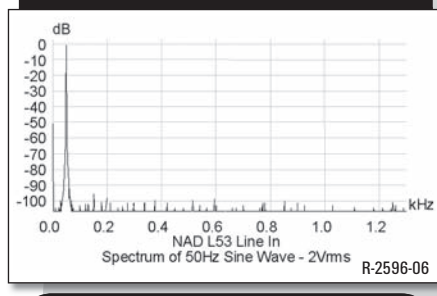


FIGURE 7: Line input extended spectrum of 1kHz sine wave.

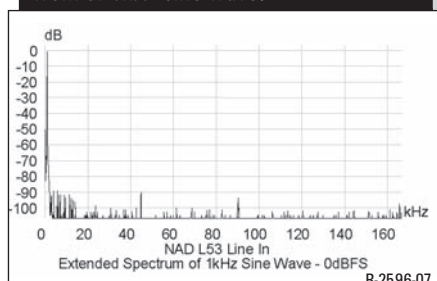


FIGURE 8: Spectrum of 19kHz + 20kHz CCIF intermodulation signal.

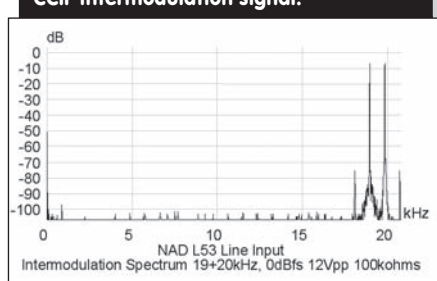


FIGURE 9: Spectrum of 9kHz + 10.05kHz + 20kHz multi-tone intermodulation signal.

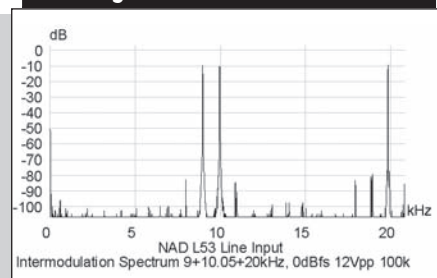


FIGURE 10: Square-wave response at 40Hz into 10k.

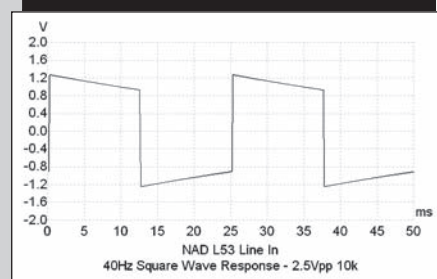
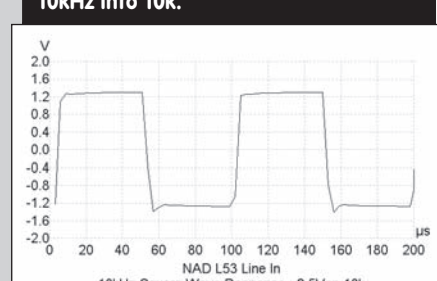


FIGURE 11: Square-wave response at 10kHz into 10k.



(0.0016%), with the 18kHz and 21kHz products at –85dB, or 0.0056%. Repeating the test with a multi-tone 9kHz + 10.05kHz + 20kHz IMD signal (**Fig. 9**) resulted in a worst-case 18kHz product of –79dB or 0.011%. There is also a picket fence of low-level 1kHz products throughout the spectrum.

I viewed the response of the L53 to three square-wave test frequencies using a 10k load. The response at 40Hz (**Fig. 10**) showed a moderate and acceptable amount of tilt, not all that different from the same 40Hz into 100k. The 1kHz square wave (not shown) had a bit of rolloff on the positive-going edges but a single half-cycle peak at the negative-going edges. This is more apparent with the 10kHz square wave shown in **Fig. 11**. Because there is no high-frequency response peaking for the analog input signals into resistive loads in **Fig. 1**, I can't really explain this asymmetry. I ran it long enough to ensure it wasn't due to aliasing with my DSO.

SUBWOOFER OUTPUT

The subwoofer line output frequency response (**Fig. 1**) is fixed and cannot be altered by the tone controls. Matching subwoofer level with the main speakers can be performed using the level control on a powered sub, after which the L53 subwoofer line output level tracks the volume control in the L53. The NJW1153 chip incorporates a subwoofer level control that, like the other five channels, tracks the six-channel Amp Gain setting, but the chip does not have any subwoofer low-pass crossover EQ capability. I surmised earlier that the subwoofer stereo summing and LP filter functions are performed by the 2068 op amp located adjacent to the subwoofer line output jack.

CD AND MP3 PLAYER MODES

I performed measurements on the L53 CD player section using my usual test discs. I did not attempt to measure the Dolby Digital or DTS audio performance because I do not have any DVD-V test discs. The analog VCR line outputs showed normal polarity, a positive-going test pulse producing a positive-going output. The digital black test

tracks measured –100dB, indicating that the L53 was probably muting the outputs during this test.

The channel separation test tracks consist of a 0dB sine wave on one channel, and digital black on the opposite channel whose crosstalk is being measured. The L53 also appears to mute the analog output of the silent channel during this test. I measured the response at the VCR audio line output jacks, as I did with the other sources.

In CD mode, the player performed perfectly in the track defect dropout tests out to track 32 on the Pierre Verany test disc, which contains a 1.25mm gap (Red Book requirement is 0.2mm). Track 33, with a 1.5mm gap, produced clicking sounds and some audio muting.

The residual distortion signal in CD mode for 1kHz at 0dBfs (**Fig. 12**) shows the same harmonic asymmetry as the line level residual in **Fig. 5**. The MP3 residual distortion signal (not shown) was similar, with a bit higher noise level.

The spectrum of a CD 50Hz sine wave at 0dBfs is shown in **Fig. 13**, from DC to 1.3kHz. The calculated THD based solely on harmonics was 0.0078%, while the THD+N measured 0.009% with the distortion test set. It stayed at this level through 1kHz before rising at higher frequencies as shown in **Fig. 2**. The second harmonic measured –91dB, the third was –96dB, the fourth –115dB, and the fifth at –82dB. Since the CD spectrum is characterized by a much higher noise level than that of the line input alone in **Fig. 6**, I trust that the spectrum analyzer has properly isolated the actual harmonics hidden within the noise. There are no 60Hz power line harmonics or other spuria evident in the spectrum.

The MP3 spectrum in **Fig. 14** shows a higher concentration of noise along with harmonically unrelated spikes as high as –73dB. The THD+N measures 0.11%, although it drops to 0.034% at 1kHz (**Fig. 2**).

Figure 15 shows the CD spectrum of response to equal level CCIF 11kHz and 12kHz intermodulation test signals, each at –6dBfs, from DC to 20.8kHz. The 1kHz IMD difference product measures –72dB with a matching product at 2kHz. There are no products evident at 10kHz or 13kHz, but they may be buried in the noise.

When the same IMD signals are ripped to MP3 format, the results are not quite as good (**Fig. 16**). The 1kHz and 2kHz products are higher at –71dB and are joined by visible 10kHz and 13kHz products. The rising skirts around the 11kHz and 12kHz stimulus signals indicate noise that may be due to the MP3 audio compression. There

FIGURE 12: Distortion residual of CD 1kHz sine wave.

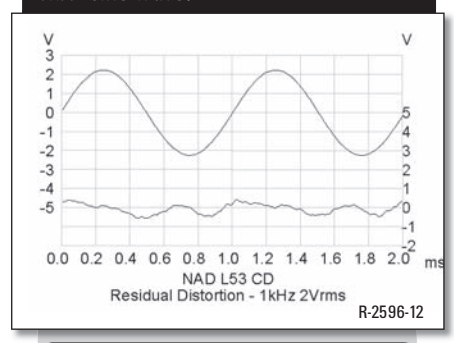


FIGURE 13: Spectrum of CD 50Hz sine wave.

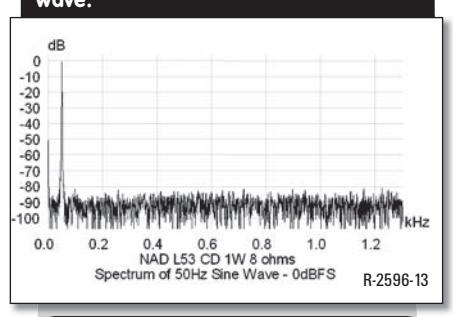


FIGURE 14: Spectrum of MP3 50Hz sine wave.

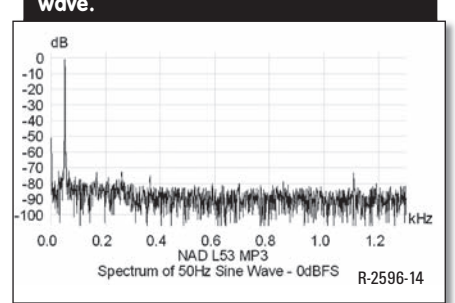
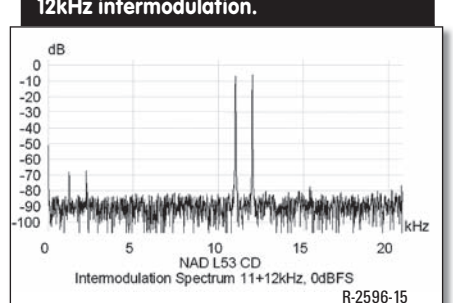


FIGURE 15: Spectrum of CD 11kHz + 12kHz intermodulation.



are also additional spikes that have no relation to the IMD test signals.

A repeat of the test in CD mode with the more difficult 19kHz + 20kHz IMD test track (**Fig. 17**) shows the 1kHz, 18kHz, and 21kHz intermodulation difference products to be about –80dB (0.01%). But for the noise level, this is decent performance.

Figure 18 shows the CD reproduction of an undithered 1kHz sine wave at –90.31dBfs. At this level the signal consists of ±1 bit of data, producing two different voltage levels that are symmetrical about the horizontal axis (time). These discrete voltage steps are obscured in the –80dB noise floor, so the effective bit rate is probably about 14 bits.

Noise also took its toll on the ⅓ octave spectrum of the same undithered 1kHz sine wave at –90.31dBfs shown in **Fig. 19**. There is a slight rise in the spectrum around 120Hz, which may be a power supply rectification artifact, but a discrete 1kHz peak is nowhere to be found. A ⅓ octave spectrum of the –90.31dBfs test track ripped to MP3 showed a series of peaks at multiples of the 60Hz line and higher initial noise floor (**Fig. 20**).

The CD playback of a 0dBfs square wave at 997Hz (**Fig. 21**) exhibits a slightly unsymmetrical Gibbs phenomenon damped sinusoid ringing associated with the steep digital filters used in the L53. Reproduction of the same square wave ripped to MP3 is shown in **Fig. 22**. Note that the Gibbs pre and post echo ripple has a total of 16 "pulses" per full cycle, compared with the 22 pulse CD playback.

You can approximate the PCM Nyquist frequency response limit by mul-

FIGURE 16: Spectrum of MP3 11kHz + 12kHz intermodulation.

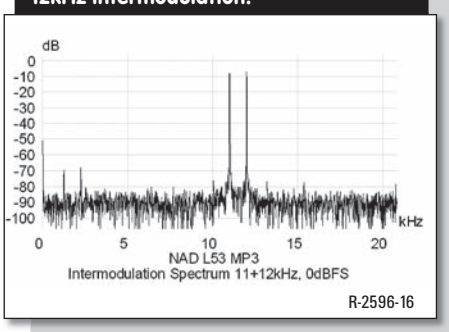


FIGURE 17: Spectrum of CD 19kHz + 20kHz intermodulation.

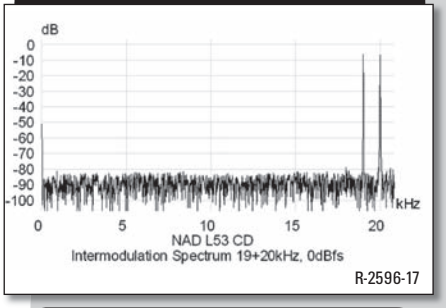


FIGURE 18: Undithered CD 1kHz sine wave at -90.31dBfs.

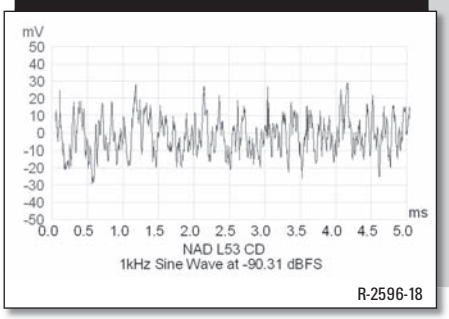


FIGURE 19: 1/3 octave spectrum of CD 1kHz sine wave at -90.31dBfs.

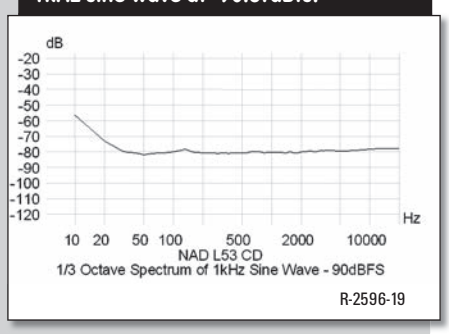


FIGURE 20: 1/3 octave spectrum of MP3 1kHz sine wave at -90.31dBfs.

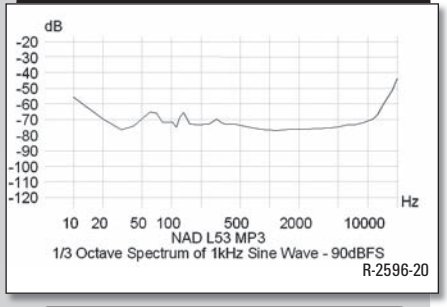
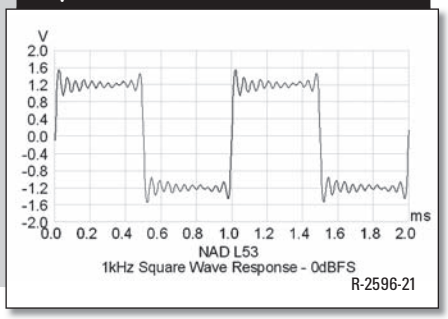


FIGURE 21: 997Hz CD square-wave response.



tiplying the number of pulses by the fundamental square-wave frequency. This demonstrates the more limited high frequency response available as a result of the MP3 compression algorithm. The MP3 waveform is even less symmetrical, and appears to be slightly modulated by 60Hz.

MEASUREMENTS — FM TUNER SECTION

I did not run any tests on the AM section of the tuner, other than making sure it was functional. The FM tuner has two modes: FM and MUTE. The display shows "Tuned" when the tuner locks to a valid FM signal, although there is no meter or bar graph to show signal strength. The L53 FM tuner inverts the audio polarity.

The L53 stops its manual station scan every 100kHz, even though only the odd 0.1MHz channels are assigned in North America. Same reason that the SCART video output connector is provided, I guess, except these additional FM frequency stops are a bit more time consuming and less convenient to the user during manual tuning. (Manufacturer's Note: the SCART connector is supplied in the European version only).

The L53 tuner quieting characteristics are shown in **Fig. 23**. I needed to switch to FM mode (not MUTE) to measure mono sensitivity. The minimum subjective usable sensitivity using manual tuning was 10.6dBf, with some visible noise breakup in the audio signal on the scope. The mono signal became free from visible noise artifacts at 16dBf.

The station auto search threshold, where it would stop at the signal generator's frequency during a station scan, was 19dBf. The red stereo indication came on at 22dBf. The 50dB stereo quieting signal strength was approximately 30dBf. There was no overload at the maximum RF input of 100dBf. The audio output disappeared when I moved the FM test signal 200kHz to either side of the tuned center frequency, so adjacent channel rejection should be adequate.

When I engaged the FM MUTE mode, the auto search threshold increased to 34dBf. Using the supplied FM dipole antenna and 300Ω to 75Ω balun, I could pick up only about half the FM stations in FM MUTE as in FM mode with its lower auto search threshold. Performance was much better in my audio system with its dedicated 75Ω FM antenna.

The FM performance is certainly adequate, especially in a strong signal area, but not quite as good as my venerable NAD 4155 dedicated tuner.

FIGURE 22: 997Hz MP3 square-wave response.

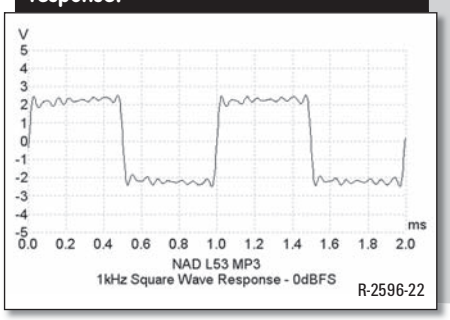
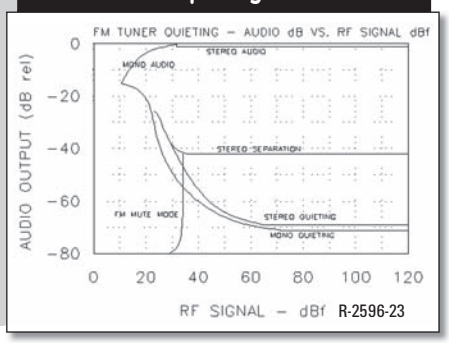


FIGURE 23: FM quieting - NAD L53.



POWER AMPLIFIER SECTION MEASUREMENTS

I operated the L53 amplifier with a line input signal of 0.5V RMS 1kHz and adjusted the volume for 10W into 8Ω. For most of the intended one-hour period, the THD for both channels remained near 0.01%. The temperature above the case cooling slots became quite hot after this period, measuring 58° C. After 45 minutes, the THD suddenly rose to 0.15%. The distortion residual showed a large increase in crossover spikes, so I assume the amplifier bias was decreasing to reduce temperature.

I lowered the power level to 1W and after another 15 minutes things returned to normal. Admittedly, a continuous 10W sine wave is a difficult operating condition. It is close to the ⅓ power or 16.7W that produces maximum dis-

sipation in the output transistors.

The measurements for the right channel are presented here. There is no noise at all when starting up or shutting down the amplifier. Output hum and noise measured –89dB, input shorted (–109dB with A-weighting), and some hiss was audible at full volume with my ear against the speaker. I also measured –40mV (L) and –13mV (R) of DC offset.

The L53 does not invert overall (line in to speaker out) polarity. The gain at 2.83V RMS output into 4Ω and 8Ω loads was a high 35dB and 36dB, respectively. I noticed that the right channel output was about 0.5dB higher throughout the entire volume control range, while the line level outputs tracked perfectly. The output impedance at 1kHz was 0.12Ω, increasing only slightly to 0.13Ω at 20kHz.

The frequency response at 2.83V RMS for loads of 4Ω, speaker (dashed line), 8Ω, no-load, and 8Ω paralleled with 2µF (bottom to top at 30kHz) is shown in **Fig. 24**. Response was within –1dB from 10Hz to 57kHz, at a reference output of 2.83V RMS at 1kHz into 8Ω. It wasn't down to –3dB until 110kHz. There was just a bit more HF rolloff with a 4Ω load.

The response with a complex load of 8Ω paralleled with a 2µF cap (a test of compatibility with electrostatic speakers) produced a pronounced high frequency peak exceeding +5dB at 70kHz, at which point the L53 tripped into its protection mode. The flat response in the audio band tells me the L53 amplifier will be insensitive to variations in speaker impedance with frequency, although it may protest electrostatics.

At low frequencies the noise floor limited the excellent crosstalk performance, but there is adequate isolation between the stereo channels at higher frequencies (**Table 1**). The tone control frequency response range is shown in **Fig. 25**. The tone controls only operate on the power amplifier output and are inactive at the line or subwoofer outputs. The maximum spread at the low and high frequency extremes exceed the specified ±10dB by a few dB.

I made all the amplifier distortion measurements with the tone controls flat and the SRS turned off. In addition to the fixed test loads, I added an NHT SuperOne loudspeaker[1] for this measurement.

THD+N versus frequency is shown in **Fig. 26** for outputs of 8Ω 10W, 8Ω 1W, 8Ω paralleled with 2µF, 4Ω 2W,

TABLE 1: Crosstalk.

Frequency	R to L	L to R
100Hz	–77dB	–77dB
1kHz	–77dB	–76dB
10kHz	–73dB	–72dB
20kHz	–71dB	–70dB

FIGURE 24: Frequency response.

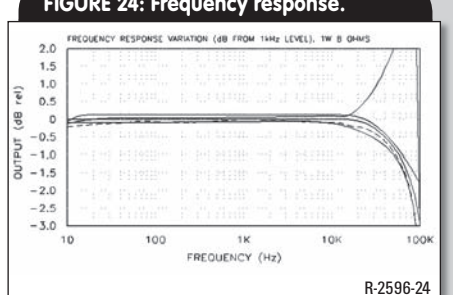


FIGURE 25: Tone control frequency range.

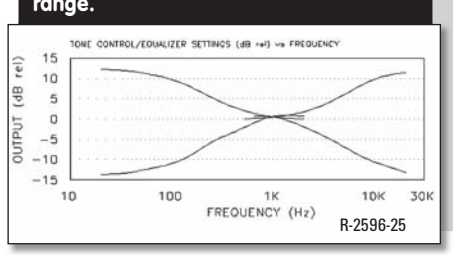


FIGURE 26: THD+N vs. frequency.

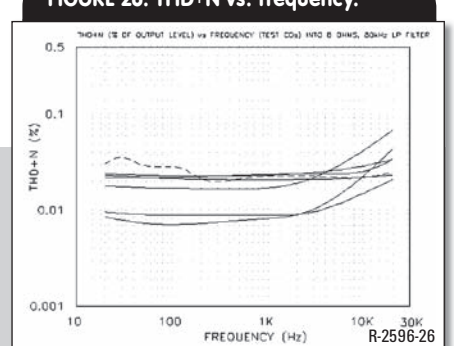
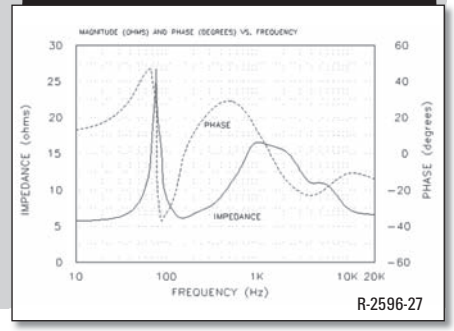


FIGURE 27: Speaker impedance and phase.



8Ω 33W, and 4Ω 10W (bottom to top at 20kHz). The speaker load is shown with a dashed line, and its distortion is inversely proportional to the speaker impedance. The impedance and phase of the NHT SuperOne is shown in **Fig. 27**. During distortion testing, I engaged the test set 80kHz low-pass filter to limit the out of band noise.

Figure 28 shows THD+N versus output power for the loads and frequencies shown in the graph. The L53, with both channels driven, reached its 1% clipping point at 55.8W with the 8Ω load (for 0.47dBW of headroom) and 73.4W with the 4Ω load (1.67dBW). The positive half-cycles clipped just slightly before the negative half-cycles, and both showed a scoop-out at the peak of the sine wave as if the top 5% of the peak were inverted back into the waveform. This was a bit unusual, as most solid-state amplifiers clip flat across the top. The chassis above the heatsink reached a maximum temperature of 61° C after 15 minutes at 16.7W into 8Ω, so I reduced power to avoid another protective trip.

The distortion residual waveform for 5W into 8Ω at 1kHz is shown in **Fig. 29**.

FIGURE 28: THD+N vs. output power.

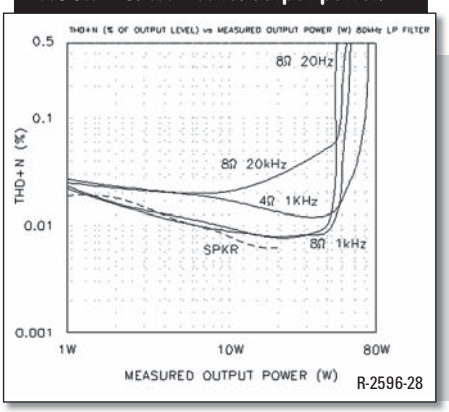
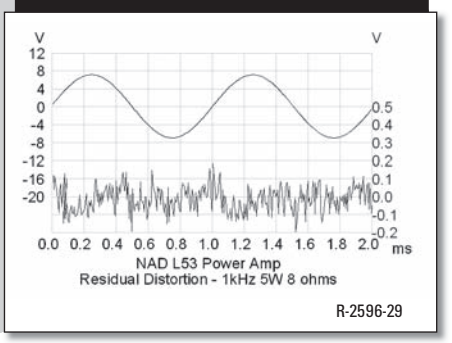


FIGURE 29: Residual distortion 1kHz 5W.



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 distortion residual signal shows mainly noise with perhaps a hint of higher order harmonics. THD+N at this test point is a low 0.01%.

Increasing the output power to 33W (**Fig. 30**) showed a bit of periodic scoop-out in the noise, suggesting second harmonics on the negative half-cycles. Distortion here is even lower at 0.0082%.

The spectrum of a 50Hz line input sine wave at 5W into 8Ω is shown in **Fig. 31**, from DC to 1.3kHz. The second, third, fourth, and fifth harmonics measure -87dB, -90dB, -105dB, and -93dB, respectively. The calculated THD based on the distribution of harmonics is 0.0053%, while the THD+N measured 0.01%. Repeating the 5W spectrum with the 50Hz 0dBfs CD test track (**Fig. 32**) produced a spectrum with a higher noise floor. THD+N is also higher at 0.023% with a more prominent second and fifth harmonic.

Figure 33 shows the amplifier output spectrum reproducing a combined 19kHz + 20kHz CCIF IMD signal at 20Vpp into 8Ω. The 1kHz IMD product is -82dB (0.008%), and the 18kHz product is -79dB (0.011%) with the 21kHz product just off the graph. Repeating the test with a multi-tone IMD signal (9kHz + 10.05kHz + 20kHz, shown in **Fig. 34**) resulted in 950Hz and 1050Hz products of -82dB, a group of spikes around the two lower tones and above 15kHz of -95dB, and an 18.95kHz product of -92dB. This test gives a better indication of the amplifier's nonlinear response, because it is a closer approximation to music than a sine wave. The L53 power amplifier produced good IMD results, even better than the line input signals of **Figs. 8** and **9**, which were taken at a higher voltage and not

FIGURE 30: Residual distortion 1kHz 33W.

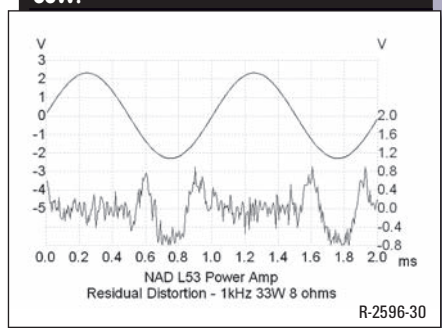


FIGURE 31: Spectrum of 50Hz line input sine wave.

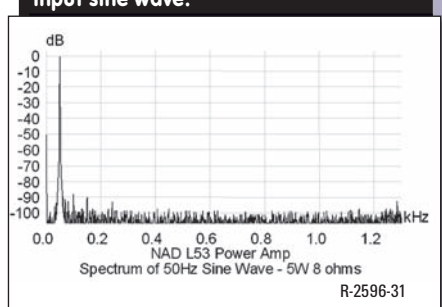


FIGURE 32: Spectrum of 50Hz CD sine wave.

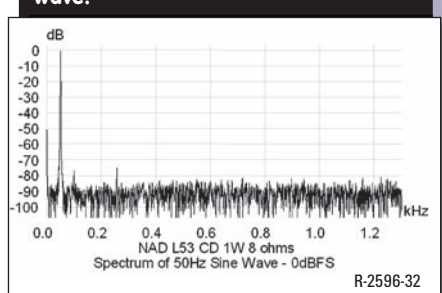


FIGURE 33: Spectrum of 19kHz + 20kHz intermodulation signal.

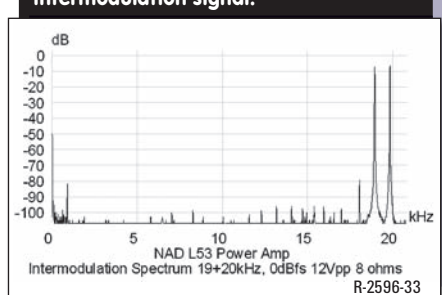


FIGURE 34: Spectrum of 9kHz + 10.05kHz + 20kHz intermodulation signal.

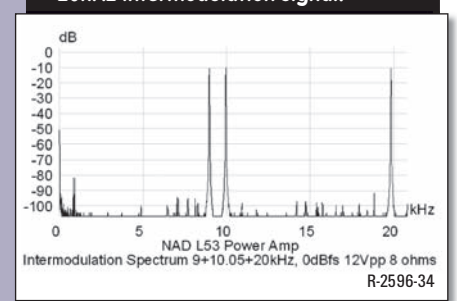


FIGURE 35: Square-wave response at 40Hz into 8Ω.

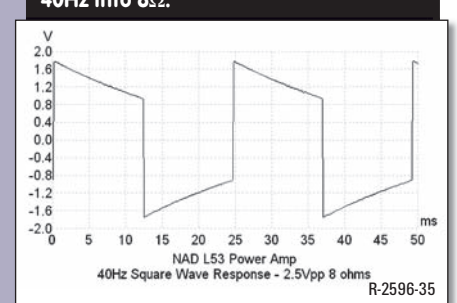


FIGURE 36: Square-wave response at 10kHz into 8Ω.

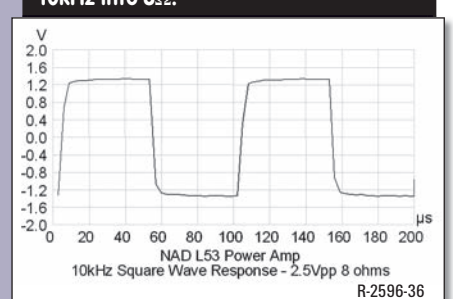
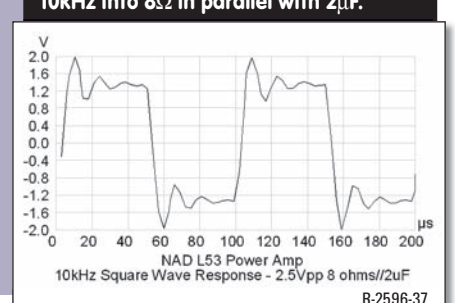


FIGURE 37: Square-wave response at 10kHz into 8Ω in parallel with 2µF.



at the lower level that reflects the additional voltage amplification by the power amplifier.

The 2.5Vp-p 40Hz square wave in **Fig. 35** shows more tilt than that of the line input alone in **Fig. 10**, but the power amplifier does add its own tilt to the initial tilt of the preamp 40Hz. The square-wave response to 1kHz into 8Ω (not shown) was just about perfect. The leading edge of the 10kHz square wave in **Fig. 36** was slightly rounded, but when I connected 2µF in parallel with the 8Ω load (**Fig. 37**), there was significant ringing at 70kHz, conforming to the response peak in **Fig. 24**.

Overall, the L53 is a nicely performing piece of equipment that incorporates a lot of features at this price point. Full disclosure here: I own a number of NAD products: a 214 stereo amplifier, a 304 integrated amplifier, and a 4155 AM/FM tuner. The L53 met or exceeded its published specifications, except for the performance of the CD section, although it could be argued my distortion measurements are within the statistical variation for independent tests. NAD also specifies a different noise test method (EIAJ DVD tests) than I used, and I could not duplicate their test because I don't have a DVD video test disc in my collection. A comparison of the manufacturer's ratings and my measured results is shown in **Table 2**. *aX*

[Watch for listening critique results of this unit in a subsequent issue. —Eds.]

REFERENCES

1. "The case for more testing," Dennis Colin letter, *Stereophile*, June 2004, p. 11.

TABLE 2: Measured Performance.

Parameter	Manufacturer's Rating	Measured Results
Power Output, Stereo Mode	2×50W, 0.08% THD - 8Ω	2×50W, 0.03% THD -8Ω
Frequency Response, 8W, 4Ω	20Hz - 20kHz ±0.5dB	10Hz - 34kHz ±0.5dB, 1W 8Ω
Total Harmonic Distortion	0.08% - 50W - 1kHz	0.08% - 55W - 8Ω
IMD - CCIF (19+20kHz)	0.08% at Rated Power	0.011% CCIF 20Vpp
MIM (9+10.05+20kHz)		0.0079% MIM 20Vpp
Damping Factor	>60	73 (1kHz), 60(20kHz)
Frequency Response	20 to 20kHz ±0.5dB	10 to 41kHz ±0.5dB, 8Ω
Signal/Noise Ratio	>99dB, 50W 8Ω A-weighting >85dB, 1W 8Ω A-weighting	109dB, 50W 8Ω A-weighting 91dB, 1W 8Ω A-weighting
Noise	0.8mV	0.71mV unweighted
Gain	N/S	35dB 4Ω, 36dB 8Ω
Amplifier Output Impedance	N/S	0.12Ω 1kHz, 8Ω 0.13Ω 20kHz, 8Ω
FM Tuner Input Sensitivity	Mono: 16.1dBf Stereo: 36.1dBf	Mono: 16dBf (subjective) Stereo: 30dBf
FM Harmonic Distortion	Mono: 0.2% Stereo: 0.5%	Mono: 0.19% (400Hz) Stereo: 0.48% (400Hz)
Signal/Noise	Mono: 69dB Stereo: 64dB	Not Tested
Stereo Separation, 1kHz	40dB	42dB
Frequency Response	30Hz - 15kHz ±1.5dB	20Hz - 15kHz ±1.4dB
Composite Video Out (RCA jack, yellow)	1Vpp 75Ω negative sync	Not Tested
Component Video Out (3× RCA jacks)	Y (luminance), 1Vpp 75Ω, negative sync, C_B, C_R (color), 0.7Vpp	Not Tested
S-Video Output Mini-DIN, 2× 4-pin	Y, 1Vpp 75Ω, negative sync, C (color), 0.286Vpp 75Ω	Not Tested
SCART video out (EUR only)	CVBS, 1Vpp 75Ω, negative snyc, RGB, 0.63Vpp 75Ω	Not Tested
Analog Audio Outputs	2V RMS, 1kHz 0.dB, 330Ω	Line: 1.94V RMS, 1kHz -0.26dB, 460Ω Subwoofer: 60Hz, 110Ω
Analog Audio Inputs	2V RMS, 1kHz 0dB, 330Ω	2V RMS, 1kHz 0dB, ≈90k
DVD signal	PAL/NTSC/AUTO	Not Tested
CD Audio Frequency Range	4Hz - 20kHz	4Hz - 20kHz ±0.28dB
Signal/Noise (audio)	>100dB (EIAJ)	Not Tested
Dynamic Range (audio)	>95dB (EIAJ)	Noise floor ≈ -80dB (CD)
Harmonic Distortion (audio)	0.008%	0.009% 1kHz 0dBr