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EQUIPMENT REPORTS

GOLD WITHOUT GUILT

Muse Kastanovich auditions affordable CD players

Rotel RCD-950: single-disc CD player. Outputs: analog on RCA jacks, coaxial S/PDIF digital on RCA jack. Maximum analog output level: 2.0V RMS. Output impedance: 220 ohms. SN ratio: >100 dB, A-weighted. Dynamic range: 99dB. Dimensions: 17½" W by 3½" H by 11½" D. Weight: 10.5 lbs. Warranty: 2 years. Serial number of unit tested: 537 72099. Price: \$449.90. Approximate number of dealers: 130. Manufacturer: Rotel America, 54 Concord St., North Reading, MA 01864-2699. Tel: (800) 370-3741. Fax: (508) 664-4109.

I confess. I missed out on analog! I fear being chastised by my audiophile brethren and sistren for not owning a turntable, or even any LPs. How could I have been so insensitive as to desert the crusade to free Holy Vinyl from the evil clutches of the digital infidels? Not beginning to collect albums in earnest until the era when new vinyl was relegated to the "grab bag" racks in the backs of record stores is one reason. But neither did I turn to CD.

This may have been a primary reason for the resurgence in spending on audio during the 1980s, but I felt CDs sounded so artificial that I turned to factory-recorded cassette tapes instead for musical enjoyment. In the past few years, however, much more natural-sounding CD players have been developed, and



Rotel RCD-950 CD player

better professional A/D converters for CD mastering. Along with most audiophiles, I have made peace with a medium that has the potential to sound quite a bit better indeed than cassette tapes. CDs can also be played without worry of wear. Not to mention my desire to concentrate all my money on a single source component, thereby affording higher quality.

I understand that most old albums sound better in analog. That makes sense, since they were recorded in ana-

log, and tailored specifically to sound good at the end of that reproduction chain. But new digital recordings tailored for CD release sound better in digital, no? Sure. Also, every vinyl recording I have ever heard, with the exception of one Classic Records 45rpm test pressing, seemed to have a slightly dirty top octave compared to good digital. I am more sensitive than most to the top octave, though.

If you are going for the gold in the audiophile Olympics, you'll need two, three, maybe eleven boxes in your digital system, including outboard power supplies, electric fuel pump, vegetable slicer, etc. There are some advantages to a single-box CD player over a multipiece digital system, however. Sound for sound, you pay a lower price for the same performance, since there is only

one shipping box and only one chassis. Also, in a single-box player the transport and DAC run from the same clock signal, so there is no distortion-inducing jitter resulting from the S/PDIF connection between the two.

PLUGGED INTO WHAT?

Associated equipment used in this review included the Audio Electronics AE-2 preamplifier, made by a division of Cary Audio that supplies kits as well as fully built units. The line stage in this preamp is the Bride of Zen circuit, designed by Nelson Pass and described in the *Audio Amateur* hobbyist magazine. The power amplifier was the AE SET-II. Again, the circuit appears to be almost identical to Nelson Pass's Zen amplifier (the world's simplest power amp!) from the *Audio Amateur*. These single-ended class-A MOSFET units are wonderfully minimalist, and I shall be reviewing the current versions soon.

An Audio Alchemy DAC-in-the-Box digital processor (\$295) was used as a sound-quality benchmark for comparisons with the CD players. It was driven directly by the Audio Alchemy DDS III or one of the CD players. The coaxial digital link was either an Audio Magic Presto, or a Sound & Video (division of HAVE) 75 ohm DigiFlex Gold I, made from Canare components.

All of the CD players were broken-in by driving 67k resistors for over 48 hours before any critical listening was done. The players and the DITB were left continuously powered throughout the entire review period, ensuring that their circuitry maintained a thermal equilibrium so that they would sound their best. (This is especially important for D/A converters.) They all have reasonably low output impedances; the Nakamichi's is the highest at 600 ohms—still low enough to avoid problems with all but the most brutal passive pre-amp/power amp combinations. The AE-2 preamplifier has a high input impedance, minimizing the possibility of problematic interactions with any of the CD players.

Speakers were my slightly modified B&W Matrix 804s, each with a 3kg slab of steel placed on top to increase mass. Interconnects were 1m lengths of XLO

PRO type 150 between the CD players and preamp, while 1m of Audio Magic Sceptor connected preamp to power amp. Speaker cables were bi-wire sets of Audio Magic Apprentice, then, later, AudioTruth Argent Hyperlitz. Let's see ... Audio Alchemy, Audio Magic, AudioTruth. What's next, Audio Justice?

Power-line filtering was provided by a separate MagneTek isolation transformer for each player and for the pre-amp. All CDs used had their edges painted green with AudioPrism CD Stoptight. Line-level components resided in a RoomTune JustaRack held together with the cool-man brass nuts, and the power amp sat on concrete bricks. I use various sound-absorbing materials around my room, the best of which is a small, beautiful tapestry created by my mother, the late visual artist Vivian Grelick.

ROTEL RCD-950: \$449.90

The Rotel is a good-looking player, though not, I think, to the level of the luscious Nakamichi. Rotel has the coolest literature, though. In the RCD-950 owner's manual, you find: "We have designed this CD player for high performance and musicality using test equipment and the human ear. We believe that both methods are useful in the design of audio electronics. This is time-consuming but we feel that the music benefits from this care and attention to detail." Okay, okay, this is the same spiel you've heard from every manufacturer of really expensive electronics. But how many companies with Rotel's distribution and prices have it right there in the owner's manual, right next to the "Do not stick your fingers into the disc chamber and look googly-eyed at the laser while pouring Kool-Ade on it outdoors in a thunderstorm"?

The analog and digital boards in this player are separate entities. The wires from one to the other, connecting the digital filter to the DAC, take a few turns through a large ferrite core. The wires to the digital output likewise pass through a separate core. I presume the reason for this is to lower the amount of digital noise passed on to the analog board. The digital filter and DAC chips are hidden underneath the boards; the

DAC is described as being a "multiple-bit Bitstream continuous-calibration" type. The digital filter performs the equivalent of 96x-oversampling, so the DAC cannot be a conventional multibit ladder-type converter.

The first stage of the power supply is located on the far side of the analog board, and uses fairly large, medium-quality Nichicon and Jamicon electrolytics. I applaud Rotel's opportunistic use of modestly priced parts in noncritical locations. The power supplies are then separately regulated for the analog and digital stages. The digital board has small, conventional-looking electrolytics, but the analog supplies use large, expensive, audio-grade Rubycon Black Gate electrolytics bypassed with tiny film caps.

The analog output stage is based on the expensive Burr-Brown OPA2604 dual-op-amp IC, and appears to be followed by discrete transistors. The analog board is populated by good-sized $\pm 2\%$ metal-film resistors, all of them cosmetically blemished. Did Rotel get a special deal on a job lot of high-quality resistors, blemished yet electrically fine?

But the digital output jack in this player is the funniest little electronic part ever. It appears to be a plump green inductor, with red eyes and a golden heart tattooed on its side. As they say in New Mexico, "que cute!"

Rotel sound: This player has some very big shoes to fill. Its predecessors, the RCD-955 and the almost identical RCD-855, were regarded as giant-killers in their day, and were long-time residents of *Stereophile's* "Recommended Components." Well, with a new Rotel player in that price bracket ... expectations, anyone? I had actually asked for a sample of Rotel's \$600 player, the RCD-970BX, in the interest of "full price equity" among the review group. I was talked into taking this one instead.

The RCD-950 takes a while to fully break in. (Audio Slo-Mo?) At first I wasn't that impressed with its sound, but as time went by it seemed to improve noticeably. Make sure to put more than 100 hours of playing time on one of these players before you audition it seriously.

The Rotel's bass was sufficient. Don't

misinterpret; that's a compliment. You can't expect the deepest, most solid-sounding bass from a player at this price. The upper bass was particularly strong, the midbass about average in level, and the low bass was a bit weak. There was enough low bass to hear what was going on down there, but it was not enough to fully satisfy. That's okay. The low bass is certainly not the most important part of music, and can only be done properly, I feel, with a very large, expensive power supply that just cannot be provided at this price.

The midrange sounded a little recessed, not to the point of being annoying, but making things sound slightly on the bright side of reality. Listening to *Stereophile's Festival* disc, the instrumental timbres were not quite right, being a tad bright. Instruments with any energy in the upper bass also had that portion of their sound slightly emphasized. Some of my system's somewhat ruthless treble balance could be attributed to the Audio Electronics pre-amp and amp. These ultrasimple circuits tend to pass more treble information on to the speakers than most, which tilts things a little too far if anything else in the system is treble-happy. But it's worth it! Such delicious immediacy. The Rotel may not be super-neutral in terms of perceived frequency response, but it doesn't stray too far from the straight and narrow.

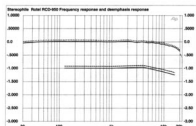


Fig. 1 Rotel RCD-950, frequency response (top) and de-emphasis response (bottom) (right channel dashed, 0.5dB/vertical div.).

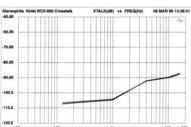


Fig. 2 Rotel RCD-950, crosstalk (R-L channel bottom, 10dB/vertical div.).

The '950 provided an extraordinary amount of detail for such an affordable player. The identities of the diverse instruments on *Festival* were readily discerned. All of their overtones were present, and well enough defined to give me a feel for their individual characters as well as that of Santa Fe's St. Francis Auditorium. No, this player did not create the feeling that the musicians were there in the room with me. But the fact that I didn't pull out the disc cursing "that doesn't #5%&ing sound like live music!" counts for a lot.

Reaching for some rock music, I put on Mobile Fidelity's Gold Ultradisc II of U2's *The Unforgettable Fire* (UDCD 624). With the Rotel, it was obvious that this was not just your standard CD. The A/D converter used for this MoFi release is the GAIN processor, designed by Mike Moffat and Nelson Pass, and it sounds magnificent. Though the Rotel didn't quite give the MoFi the "alive and kicking like the original master tape" sound, as do some more expensive systems, it still had that special sparkle that lets you know it's a truly superior digital transfer.

There was some depth to the presentation. Not the full measure of depth that exists on the recordings, but much more than one gets from lesser players, some of which present no depth at all. It also had

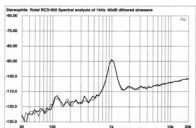


Fig. 3 Rotel RCD-950, spectrum of dithered 1kHz tone at -90.31 dBFS, with noise and spurious (16-bit data, 1/2-octave analysis, right channel dashed).

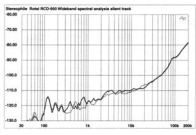


Fig. 4 Rotel RCD-950, spectrum of digital silence (16-bit data, 1/2-octave analysis, right channel dashed).

the best microdynamics of this group of players, which went hand in hand with the RCD-950's excellent detail to give it a very lively, involving presentation.

Used as a transport, the Rotel again was my favorite. With its digital out driving the DITB, the sound was just a tiny bit better than that of the AMC. Though the difference was small in absolute terms, the Rotel as a transport sounded just a little more dynamic and alive. It's obvious that Rotel has taken special care to ensure a good digital output signal.

—Muse Kastanovich

Measurements from RH: The RCD-950's maximum output was 2.3V, about 12dB higher than the CD standard of 2V. It sourced this output voltage from a moderate impedance of 220 ohms. DC levels were low at 2.3mV (left channel) and 2.5mV (right channel), and the RCD-950 doesn't invert absolute polarity. Using the Pierre Verany Test CD's intentional datastream dropouts to test the player's tracking ability, the RCD-950 played only to track 29 without skipping. (The higher the track number played smoothly, the better the player's tracking.) This was among the poorest tracking performances *Stereophile* has measured; most players reach track numbers in the mid-30s.

Fig. 1 shows the RCD-950's frequency response with and without de-emphasis. The passband ripple in the frequency

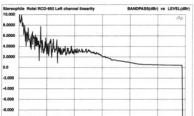


Fig. 5 Rotel RCD-950, left channel, departure from linearity (2dB/vertical div.).

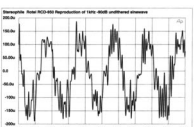


Fig. 6 Rotel RCD-950, waveform of undithered 1kHz sine wave at -90.31 dBFS (16-bit data).

response is due to the digital filter associated with the RCD-950's 1-bit DAC. The de-emphasis tracking was perfect, exactly following the treble rolloff seen with no de-emphasis engaged. Channel separation (fig.2) was good, with the crosstalk at 1kHz more than 100dB down. The left and right channels had identical crosstalk performance.

The RCD-950 performed well on the $\frac{1}{2}$ -octave spectral analysis of the player's output when decoding a 1kHz, -90dB dithered sinewave (fig.3). The DACs appear quite linear, though with a slight positive level error (both channels perform identically), the overall noise level is fairly low, and the RCD-950's analog output stages are relatively free from power-supply noise. We can see a hint of 120Hz power-supply noise, but this is well down in level. The DACs appear to have just a trace of harmonic distortion, seen as the small bumps at 2kHz and 3kHz.

A wideband spectral analysis of the RCD-950's output when playing a signal of all zeros (fig.4) reveals the noise-shaping featured by the player's DACs. Given the slightly lower overall noise level in this measurement compared to that of fig.3, I suspect that the DAC partially shuts down when no signal is detected. The lower noise floor makes the power-supply noise seen in fig.3 more prominent. Overall, the RCD-950's performance on this test was excellent for a player of this price.

Fig.5, the RCD-950's left-channel linearity, shows a positive error beginning at about -80dB. At -90dB, the positive linearity error is nearly 2dB. This isn't bad, but it isn't as good as the linearity routinely available these days from multibit ladder DACs.

The RCD-950's reproduction of a 1kHz, -90dB undithered sinewave (fig.6) revealed a good waveshape for a budget CD player. The three level transitions are clearly evident, and the waveform is overlaid by only a moderate amount of high-frequency noise. Driving the RCD-950 with a full-scale mix of 19kHz and 20kHz tones and taking an FFT-derived spectral analysis

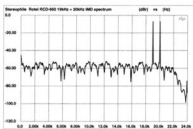


Fig.7 Rotel RCD-950, HF intermodulation spectrum, DC-24kHz, 19+20kHz at 0dBFS (linear frequency scale, 20dB/vertical div.).

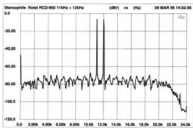


Fig.8 Rotel RCD-950, output spectrum, DC-24kHz, 20kHz at 0dBFS (linear frequency scale, 20dB/vertical div.).

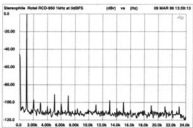


Fig.9 Rotel RCD-950, output spectrum, DC-24kHz, 1kHz at 0dBFS (linear frequency scale, 20dB/vertical div.).

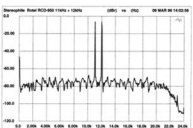


Fig.10 Rotel RCD-950, HF intermodulation spectrum, DC-24kHz, 1+12kHz at 0dBFS (linear frequency scale, 20dB/vertical div.).

of the player's output produced the highly unusual plot of fig.7. When I saw this extremely high noise floor, I thought it had to be a measurement artifact. To investigate, I substituted a single 20kHz full-scale sinewave for the 19+20kHz mix (fig.8), and a 1kHz full-scale sinewave (fig.9). These graphs confirmed that when the RCD-950 was driven by a single tone,

the noise floor appeared at the expected level. I then played a full-scale mix of 11kHz and 12kHz tones, which produced the spectrum of fig.10. Again, we see the huge rise in the noise floor. I experimented with different twin-tone pairs, along with single-frequency signals, and concluded that the RCD-950's noise floor rises in the presence of any multiple-tone signal, but not when decoding any single tone. Moreover, the higher the test-signal frequencies and the higher their amplitude, the greater the rise in the noise floor. Because music is composed of many frequencies occurring simultaneously, I'd expect the noise floor to be high when the RCD-950 was playing music. Note, however, that almost no music contains full-scale components at 11kHz and above, which may well mean the Rotel's nonlinearity will not have a significant effect. I haven't seen such unusual behavior before; perhaps Rotel's engineers can shed some light on this phenomenon in their "Manufacturer's Comment."

Because the RCD-950's 1-bit DAC was mounted underneath the printed circuit board, it was inaccessible for jitter measurements. Other than the odd rise in the noise floor in the presence of twin-tone signals, the RCD-950's bench performance was excellent for a CD player at this price. —Robert Harley

SUMMING UP

Because of its faithfulness to the source, its detailed and balanced sound, I recommend the Rotel RCD-950. It reveals more information about the music it is playing, and sounds a little more dynamic than several others in its class. The RCD-950 has a bit of a bright sound, but not enough to be annoying unless the disc is also very bright. There are just too many incredible-sounding digital products available today for the Rotel to be considered a giant-killer. However, it is a wonderful-sounding little CD player, and a bargain at \$450. It also has decent-sounding digital output, making it a good choice as an inexpensive transport. —Muse Kastanovich