SEE REVIEW ON PAGE 51

TEST RESULTS

That the Unison Research's Unico Primo CD has a valve in its output stage was obvious right at the outset, from one of the very first 'on-the-bench' tests that *Newport Test Labs* performs, which is shown in *Graph 1*: namely total harmonic distortion (THD) at 0dBFS recorded level. As you can see, there's a very prominent second harmonic component visible at –53dB (0.22% THD) that's directly attributable to the 12AU7 triode. There are also a few higher-order harmonics, but the third and fifth are the only ones higher than –100dB, at –93dB (0.002%) and –98dB (0.001%) respectively.

In some cases, distortion at 0dBFS is caused by the output stage being overdriven, because many CD player manufacturers now optimise their output stages for recorded levels of around –10dBFS, because this is more in line with the typical 'highest' levels found on most commercial music CDs. However, you can see from *Graph 2*, which shows THD re –10dBFS, that in the case of the Unico Primo, the second harmonic distortion is still relatively high, at an absolute level of –73dB, or a relative level of –63dB (0.07%) when referenced to actual output level. Note that at this lower level, there is only a single third harmonic distortion component visible above the noise floor, at –110dB (0.0003%).

Note also that the noise floor itself is a long way down, at better than –120dB, so Unico's digital-to-analogue conversion is excellent in this regard. You can see, however, that some mains-related noise components are visible

the charge-pump DAC architecture used by Wolfson Micro in its WM8524, which seems to produce a much cleaner noise floor than Burr Brown's oversampling DACs

to the left of the fundamental, but they're mostly still more than 100dB down (0.001%).

Graph 3 shows the Unison Research CD Primo's performance with a –60dBFS signal and you can see that it has quite a clean noise floor, which I'd attribute to the charge-pump DAC architecture used by Wolfson Micro in its WM8524, which seems to produce a much cleaner noise floor than Burr Brown's oversampling DACs. This exemplary performance continues down at –80.59dBFS, as you can see for yourself in *Graph* 4, however it appears that the many of the distortion components are uncorrelated with the 1kHz test signal. However, this is of academic interest only, since it's an undithered signal, whereas signals from commercial CDs are always dithered, and also because all the components are more than 110dB down.

Performance with a dithered 1kHz test signal is shown in *Graph* 5 and you can see there are no distortion components visible above the noise floor at all (though the mains-related noise components are still present below 1kHz, as you can see at the extreme left of the graph). I noted a small 'blip' on the trace at around 6.2kHz, which may be an artefact of the Unico itself, or evidence of some unwanted interaction between the Primo and the test equipment. I wasn't able to get an answer on this, because the lab had already returned the CD player to the distributor when I rang, but even if it was the Primo causing the glitch all on its own, it's not significant, being nearly 120dB down (equivalent to a distortion level of around 0.0001%.)

The noise/distortion spectrum becomes more 'typical' of digital-to-analogue conver-

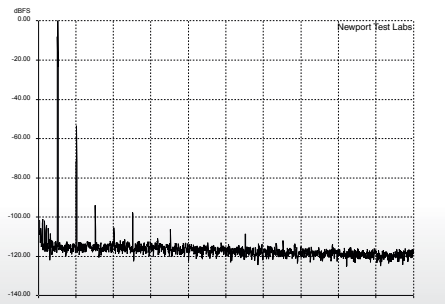
Unison Research CD Primo CD Player

Analogue Section	Result	Units/Comment
Output Voltage	2.1786 / 2.1769	volts (Left Ch/ Right Ch)
Frequency Response	20Hz to 20kHz +/–0.15dB	dB (20Hz – 20kHz)
Channel Separation	76 / 75 / 53	dB at 16Hz / 1kHz / 20kHz
THD+N	0.13%	@ 1kHz @ 0dBFS
Channel Balance	0.006dB	@ 1kHz @ 0dBFS
Channel Phase	0.07 / 0.00 / 0.06	degrees at 16Hz / 1kHz / 20kHz
Group Delay	+176.23 / –14.42	degrees (1–20kHz / 20–1kHz)
Signal-to-Noise Ratio (No Pre-emph)	91 / 98	dB (unweighted/weighted)
De-Emphasis Error	0.37 / 3.50 / 8.80	at 1kHz / 4kHz / 16kHz
Linearity Error @ –60.00dB / –70.00dB	0.02 / 0.04	dB (Test Signal Not Dithered)
Linearity Error @ –80.59dB / –85.24dB	0.05 / 0.09	dB (Test Signal Not Dithered)
Linearity Error @ –89.46dB / –91.24dB	0.18 / 0.15	dB (Test Signal Not Dithered)
Linearity Error @ –80.70dB / –90.31dB	0.06 / 0.10	dB (Test Signal Dithered)
Power Consumption	N-A / 39.9	watts (Standby / On)
Mains Voltage During Testing	242 – 256 volts	(Minimum – Maximum)
Digital Section	**Result**	**Units/Comment**
Digital Carrier Amplitude	264mV	Audioband
Digital Carrier Amplitude	1.09V / 3.2V	Differential / Common Mode
Audioband Jitter	29.6 / 0.143	nS (p-p) / UI (p-p)
Data Jitter	39.4 / 0.194	nS (p-p) / UI (p-p)
Deviation	1154.5	ppm
Frame Rate	44150.929	
Eye-Narrowing (Zero Cross)	41.3 / 0.165	nS (p-p) / UI (p-p)
Eye-Narrowing (200mV)	59.8 / 0.247	nS (p-p) / UI (p-p)
Absolute Phase	Inverted	Normal / Inverted
Bit Activity at Digital O/P	23	Where Fitted

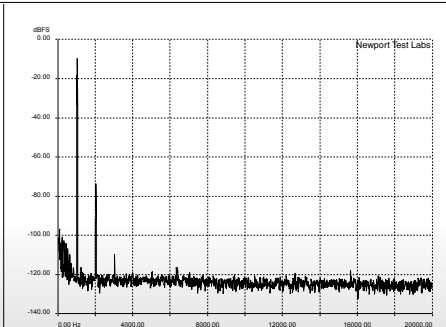
sion with an undithered test signal at a recorded level of –91.24dB, as shown in *Graph* 6, but all distortion components are more than 100dB down. The noise floor itself reduces to –130dB, which is excellent. As expected, dithering the test signal eliminated the distortion components almost completely (*Graph 7*) at the expense of a slight lift in the level of the noise floor, but in this case it's still sitting down below –120dB. This time around, I can tell you that the 'blip' of signal just under 16kHz was due to a nearby computer monitor, so you can ignore it!

Due to the use of a valve in the output stage, I'd expected to see some regenerated 1kHz signal when *Newport Test Labs* tested the CD Primo with a CCIF (twin-tone) IMD signal, and it performed exactly as I expected, with the signal just 60dB below reference. There are also some sidebands clustered around the 19kHz and 20kHz test signals, but all are more than 100dB down. Note that the noise floor does not rise at frequencies higher than 20kHz, which is a definite plus for the Wolfson DAC. There are a few unwanted high frequency signals visible up around 38kHz that don't seem to be related to the sampling frequency or the test signal but either way, they would not be audible because of their high frequency and their low level.

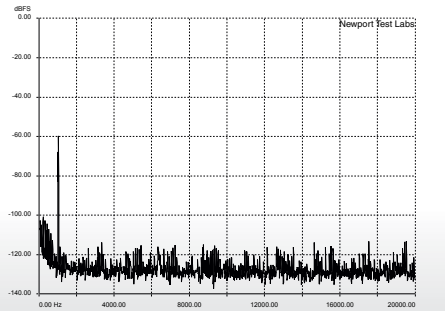
The frequency response (*Graph 9*) of the CD Primo was very flat, particularly up to 4kHz, but was 20Hz to 10kHz ±0.025dB. Above 10kHz the response 'rolls off' quite steeply, as you can see on the graph, seemingly due to Unison Research including the external analogue low-pass filter recommended by Wolfson Micro. However, the extent of this 'roll-off' is exaggerated by



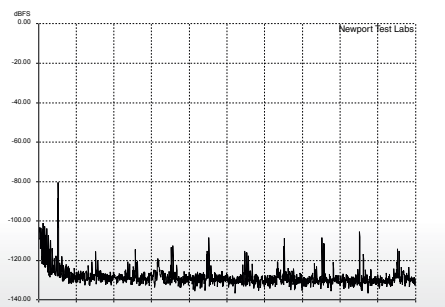
Graph 1. THD @ 1kHz @ 0dB recorded level. [Unison Research CD Primo Player]



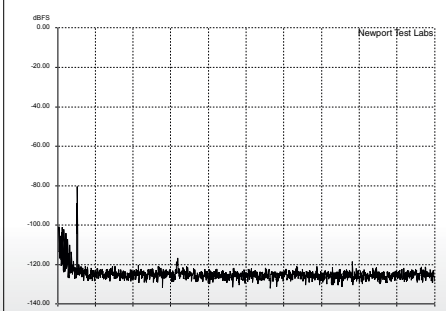
Graph 2. THD @ 1kHz @ -10dB recorded level. [Unison Research CD Primo Player]



Graph 3. THD @ 1kHz @ -60dB recorded level. [Unison Research CD Primo Player]



Graph 4. THD @ 1kHz @ -80.59dB recorded level. (No dither) [Unison Research CD Primo]



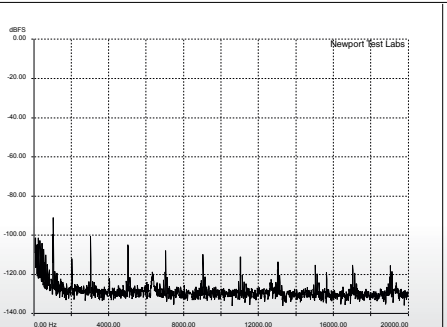
Graph 5. THD @ 1kHz @ -80.70dB recorded level. (With dither) [Unison Research CD Primo]

the vertical scale of the graph supplied by *Newport Test Labs*, which as you can see, is +0.2dB at its top and only –0.2dB at its bottom, for a total display range of ±0.2dB In fact, the Unison Research CD Primo's frequency response was only 0.15dB down at 20kHz, so its overall response (as measured by *Newport Test Labs*) is actually 20Hz to 20kHz ±0.15dB. This same frequency response is also reflected in *Graph 10*, which shows the Unico CD's performance with the famous 'Impulse Train' (a test signal developed by Philips that has one maximum amplitude positive sample every 70 samples, for a signal that produces 630 pulses per second.)

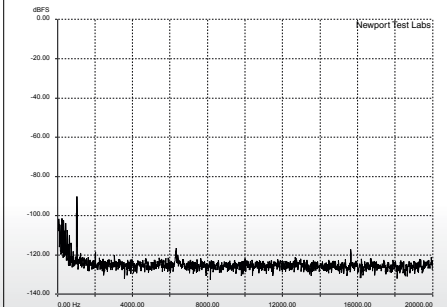
Newport Test Labs measured the CD Primo's output voltage as being just about exactly on average, at around 2.17 volts, and channel balance was a stunningly good 0.006dB! Interestingly, channel separation, although far in excess of what is required to produce stunningly good stereo signals, falls quite a bit short of most other CD players the lab has measured in recent times, and most especially so at midrange and low frequencies, so I assumed this was in part another side-effect of using a valve in the output stage. However, inter-channel phase was also excellent, as you can see from the tabulated results.

The overall signal-to-noise ratio was obviously influenced by the low-frequency mains hum components I noted when commenting on THD, because it came in at 98dB with 'A' weighting. This is nonetheless

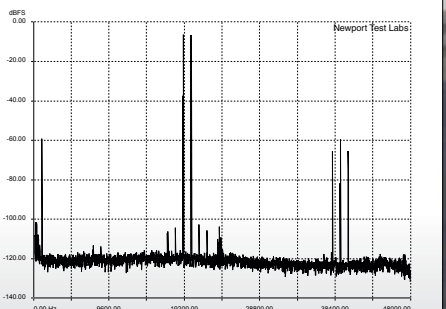
if you're one of those audiophiles who maintains they can actually hear absolute signal polarity, you will need to swap over your speaker cables



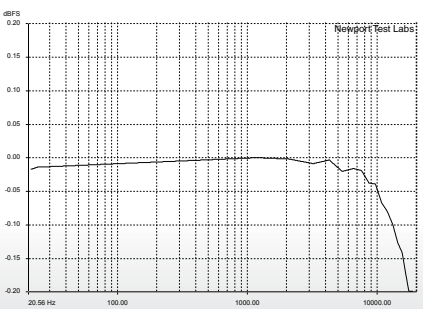
Graph 6. THD @ 1kHz @ -91.24dB recorded level. (No dither) [Unison Research CD Primo]



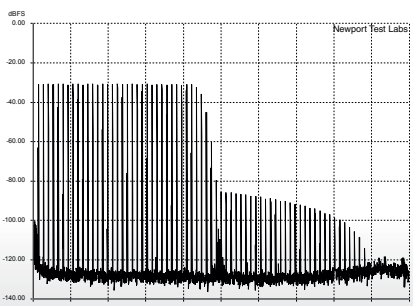
Graph 7. THD @ 1kHz @ -90.31dB recorded level. (With dither) [Unison Research Primo]



Graph 8. CCIF Distortion (Twin-Tone Intermodulation) @ 1kHz @ 0dB using 19kHz and 20kHz test signals in 1:1 ratio. [Unison Research CD Primo Player]



Graph 9. Frequency Response at @ 0dB recorded level. [Unison Research CD Primo]



Graph 10. Impulse Train. (One maximum amplitude positive sample every 70 samples (630 pulses per second). [Unison Research CD Primo Player]

excellent, and better than many amplifiers can manage even when operated at their rated power output.

The de-emphasis testing conducted by the lab showed that either the Wolfson Micro DAC does not support de-emphasis, or that it does but Unison Research has not implemented it. This will only be significant if you own a great many CDs that were mastered and pressed in the early 1980s, because it was only back then that de-emphasis was applied during recording. If you *do* play back emphasised discs on the CD Primo, they will sound too bright, which you can correct by turning your treble control (if you have one!) anti-clockwise. However, speaking of 'tweaks' you might have to make during playback, the Unison Research CD Primo's analogue output inverts absolute phase, so if you're one of those audiophiles who maintains they can actually hear absolute signal polarity, you will need to swap over your speaker cables so that the left (–) speaker output terminal on the amplifier goes to the (+) terminal on the left speaker, and the left (+) terminal from the amplifier goes to the (–) terminal on the left speaker, and then do the same thing for the right speaker. I would not bother doing this, because (a) I don't believe it's possible to hear the difference between absolute and inverted polarity when listening to music and (b) I think that around 50 per cent of commercially available CDs are recorded with 'reverse' absolute polarity anyway, so however you wire your system, you will still be wrong 50 per cent of the time!

Linearity error was very low, as you can see from the tabulated listing, but power consumption was quite high, again presumably the result of including the valve in the output stage. I was surprised that the Primo CD does not have a standby mode: the company will obviously have to include one when the Australian government introduces its mandatory power-saving legislation in 2012!

The signal from the digital outputs of the Primo didn't seem to match the Teac transport's claims for 'low jitter' because both audioband jitter (29.6nS) and data jitter (39.4nS) were quite high, and deviation was higher than I have ever seen on any CD transport (1154.5ppm). The eye-narrowing figures were also very high, at 41.3nS (zero cross) and 59.8nS (200mV). Of the two spectrograms that accompany this review, one shows a pulse exhibiting the reversed absolute polarity I discussed previously, while the second shows a 1kHz square wave that demonstrates the typical time-reversed ringing of a standard oversampling digital filter. ***Steve Holding***