

## ► Review: Tent Labs CD Kit Player

By Neville Roberts

New from the Tentlabs site is a CD player that you build yourself! Neville Roberts raises the flaps on the kit.

I was first introduced to the world of electronics kits back in 1967 when, as part of a school electronics course, I built the Heathkit EK-1 multimeter and EK-2 valve radio educational kits. Since then, the prospect of building a piece of electronic equipment from a kit has always been an exciting one and my enthusiasm has not dwindled over the years. Not surprisingly, therefore, I was more than a little delighted when asked to build and review a new CD player kit from the Dutch Tentlabs company.

The man behind Tentlabs is Guido Tent, who started his company in 2005 producing modules for retrofitting into existing equipment. These units are primarily high specification digital and power supply modules. This CD player is Guido's first standalone product and incorporates many of these high specification modules in its design. Currently priced at 2,500 Euros, which is just under £1,700 (and also available ready-built for a 600 Euro, or £400 premium), this DIY version fills the gap between much cheaper multi format playback devices and high priced CD players.

### THE TECH SPEC

As with most modern CD players, this machine will playback CD, CD-R, and CD-RW discs. It does not handle higher resolution formats such as SACD or DVD audio, but the designers claim that CD playback on this player sounds much better than SACD on currently popular multi-format machines.

The player has both analog and digital

outputs and a valve-based output stage. To spin the discs a Philips CDproM LF drive is used, clocked by a separate low jitter Tentlabs clock.

The DAC takes in the data from the CD drive where it is re-clocked and processed to feed the 20 bit digital-to-analog converters. These converters run in non-oversampling mode. The main advantages of this is that the DACs run at a lower clock rate and less jitter enters the DACs due to the absence of a digital filter. Before feeding the data to the PCM1704 DACs, it is re-clocked again by the onboard Tentlabs master clock.

The CD drive, DAC, and output stage all have their own toroidal power transformer. The player makes use of six fast, low noise shunt regulators. One regulator supplies the master clock, one the re-clocking circuits, and the remaining four power the analog supplies of the DACs.

The output from the PCM1704 DACs is a current signal, which needs to be converted to a standard voltage output from the player. In this unique design, this is accomplished by using an ECC88 double triode as a valve-based transimpedance (current to voltage or IV) amp, which has a very low input impedance (typically well below

1Ω). It is claimed that this approach generates a much lower level of distortion in the DAC chips than is found when using IV converters input impedances of, say, 100Ω, which is found in most valve-based output stages. The actual current to voltage conversion takes place using an Audio Note tantalum resistor coupled with Audio Note copper foil paper-in-oil capacitors. The high voltage power for the ECC88 is fed from a TungSol 6X4 (EZ90) full-wave rectifier valve.

The output from the ECC88 stage feeds a passive filter. Two pairs of outputs are available: a straight output of 2,500Ω impedance, and a buffered output with an impedance of well below 200Ω.

### BUILDING THE KIT

The CD player is of a modular design and all of the main modules are supplied preassembled and tested. The internal wiring is mostly pre-cut and the cabinet



PHOTO 1: Complete kit of parts.

comes as a set of parts. Assembly does not therefore require high levels of experience in electronics. All that is needed is a methodical approach and it is estimated that the player can be completed in 6-12 hours.

The 75-page assembly manual has been translated into English by Guido himself, who has done an excellent job as the instructions are extremely clear—although they do have a charm all of their own! In the introduction (along with the usual warnings to keep parts away from children, and so on) is the advice to “make sure you will not be disturbed by others who have no idea of what you are doing!”

### THE FUN BIT—THE ELECTRONICS!

Having laid out and identified all the parts as recommended, I set to work on

the construction. The first job was to populate the base plate with stand-off studs to hold the printed circuit boards and to fit the IEC mains connector, together with the phono and BNC connectors to the rear panel.

Next came the side panels. The toroidal transformers were fitted to the left panel and both panels were screwed to the decorative wooden strips. Each strip, incidentally, is machined from solid wood and the kit even includes some furniture oil to treat the wood afterwards!

Building the mains printed circuit board is a simple job of soldering four blocks of screw terminals and a relay to the PCB. This board and the three ready-built regulators (two 5V and one 9V) were fitted to their studs on the left-hand side of the player. The left side panel was then fitted to the base plate.

Wiring up the power supplies simply involved cutting the wires from the toroidal transformers to length, twisting them together, and screwing them into the appropriate terminal blocks. Separate instructions are given for connecting the transformer primaries to suit 230V or 115V mains voltage.

Having dealt with the power supplies, attention is turned to the right hand side of the unit. The IV converter circuit board, complete with the two valves, is installed on studs and the outputs are wired to the phono sockets using the supplied coax cables. This requires some delicate soldering on the component side of the printed circuit board as the wires are connected to solder pads on the surface of the board. The boards, incidentally, are extremely well made and clearly labelled with silk-screen printing on the

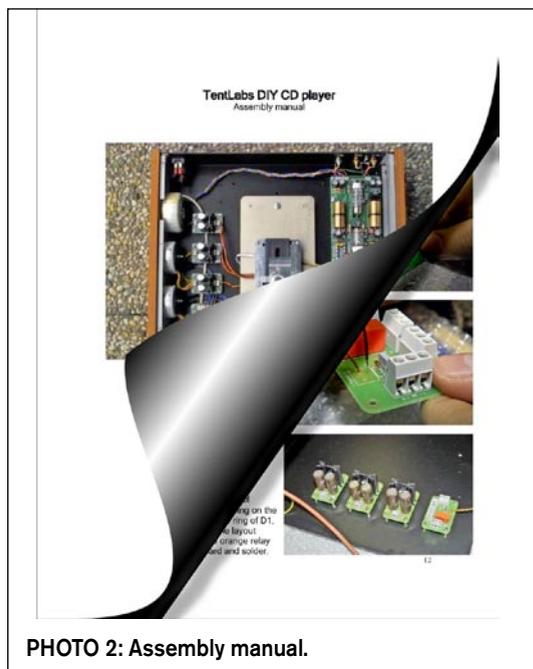


PHOTO 2: Assembly manual.

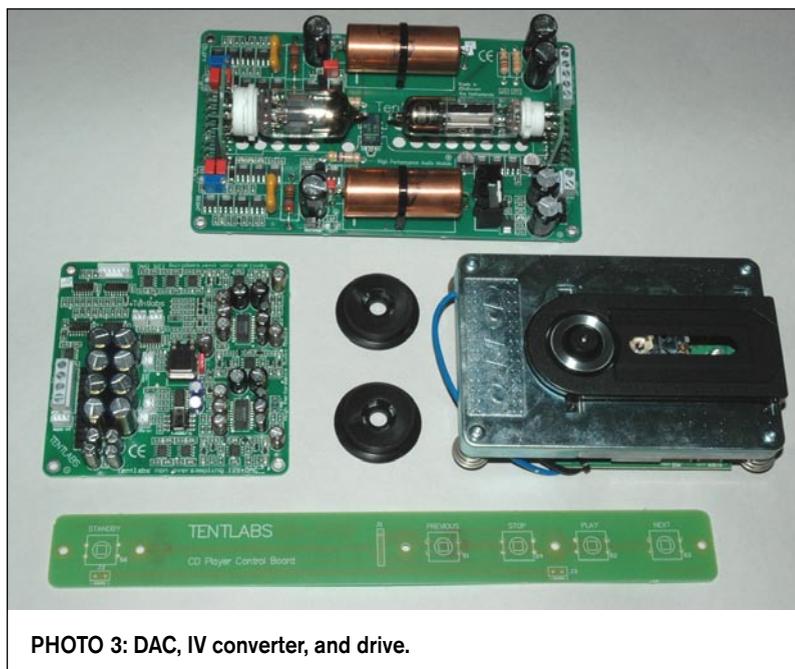


PHOTO 3: DAC, IV converter, and drive.

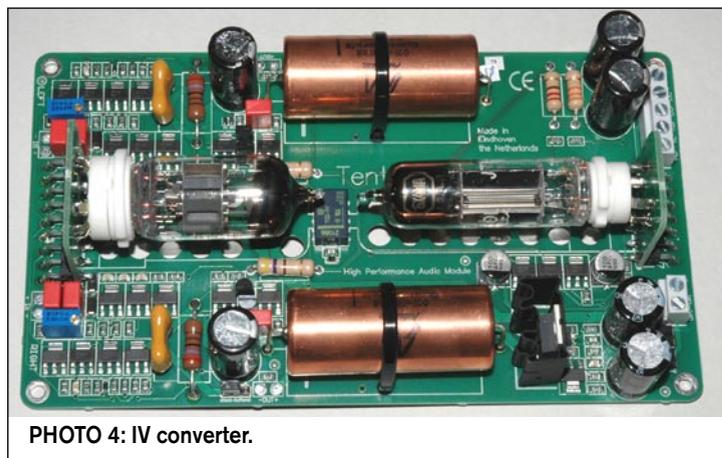


PHOTO 4: IV converter.

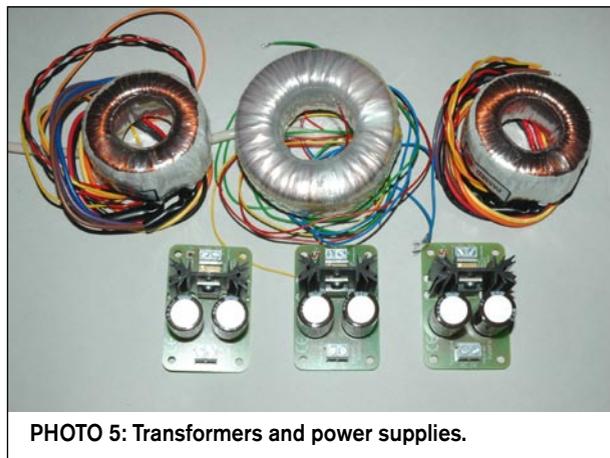


PHOTO 5: Transformers and power supplies.

component side. All double-sided connections are made using plated-through holes, so there is no need to fit wires through the holes.

The DAC board is installed in its place in front of the IV converter board and connected using more coax cable. The S/PDIF output is connected to the BNC connector on the rear plate using a ready-made cable with bare wires at one end for soldering to the connector and a plug at the other end to connect to a socket on the DAC board.

After connecting the IV converter and DAC boards to the appropriate power supplies, it was time to focus on the CD drive mechanism. An incredibly heavy base plate was fitted with rubber damping feet and screwed firmly to the CD player base. In addition, two large metal stand-off studs were fitted to the base plate. These studs line up with holes in the base plate, but since they are about 1mm shorter than the rubber damping feet, they do not touch the base plate. These are used to clamp the mechanism for transit of the CD player by fitting two screws in the base of the player.

The CDpro drive is supplied with four coil suspension springs, which are removed and discarded. The drive can then be screwed firmly onto the rubber-suspended base plate. Care must be taken

during this process to avoid damaging the laser mechanism or drive motor and a protective plastic cover is left in place until all the work is complete. The drive is connected to the DAC and power supply using the supplied ready-made cables. Fitting the right side panel to the base plate completed this part of the job. So far, so good!

Next up was the construction of the front panel. First, five push-button switches were fitted to the control panel printed circuit board and six wires were cut to size, stripped and soldered ready for interfacing to the display panel. A piece of blue Perspex was glued to the metal front panel ready to cover the display unit that was yet to be installed. Five little aluminum buttons were dropped into holes in the front panel. These were held in place by fitting the control panel over a row of bolts in the front panel and the spacing was then adjusted using nuts so that the push-buttons just touched the aluminum buttons. Very neat!

The display itself was supplied as two printed circuit modules to be stacked on top of each other and then wired to the control panel. This required screwing the panels to the control board, soldering 11 wires between the two boards and then connecting the top board to the six wires from the control board. Although fiddly,

this was quite straightforward and no problems were experienced, resulting in a very professional looking finished front panel. The front panel was connected to the power supply and CDpro drive using ready-made cables and plug-and-socket connections. This point marked the end of the electronic wiring and the start of the mechanical assembly.

## THE TRICKY BIT—THE MECHANICS!

The mechanical part of the project involved the construction of two units: the

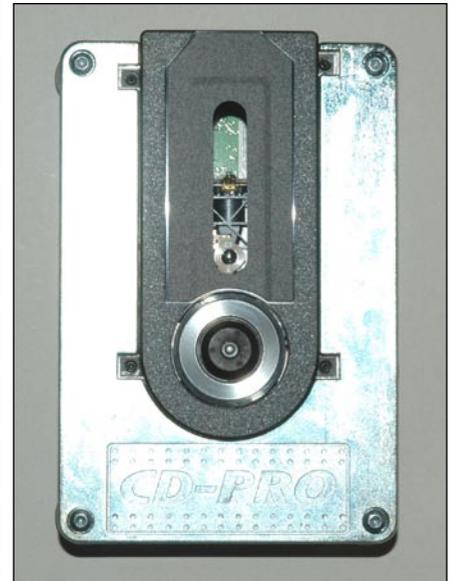


PHOTO 7: CDpro drive.

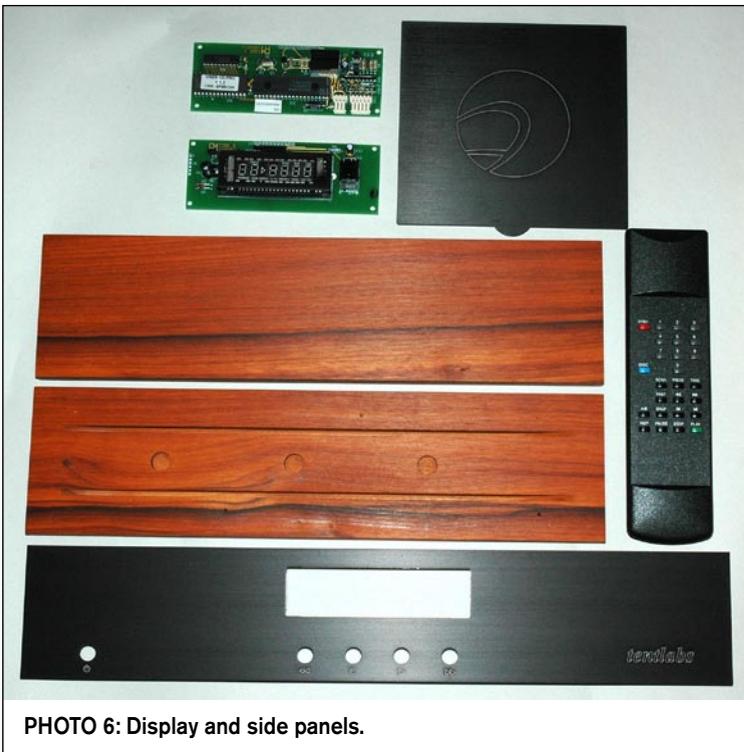


PHOTO 6: Display and side panels.

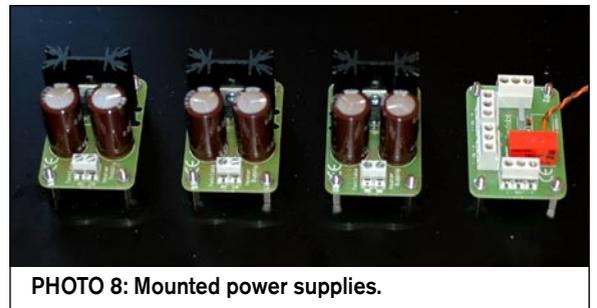


PHOTO 8: Mounted power supplies.

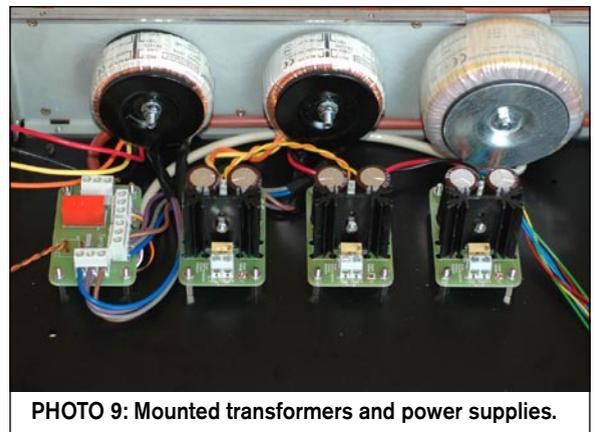


PHOTO 9: Mounted transformers and power supplies.

bridge and the carrier. First, a word or two of explanation. The bridge sits over the CDpro drive, supports the carrier and holds a microswitch. The carrier has the decorative cover fixed to it and this covers the CD when it is playing. The microswitch is a safety feature which disables the laser when the lid is open to prevent laser light entering the eye if a CD is not loaded. The carrier runs on two ball-bearing wheels that sit on tracks on the bridge. The carrier is held in place on the bridge by a metal rod running through two phosphor-bronze slide bearings. The carrier can move vertically and is supported by two spring-loaded scissor levers.

If all this sounds rather complicated for what is essentially a manually operated CD loader, I agree! You load a CD by pressing the lid down and pushing it toward the back of the player, revealing the CD drive (and disabling the laser). Drop the CD onto the motor spindle and a magnetic puck (a separate part) is popped onto the CD, clamping it to the

motor. The lid is then pulled forward to cover the CD and the springs lift the lid into the closed position, thus activating the laser and powering the motor, allowing the CD to be read.

The bridge is supplied in three parts: a center section and two end pieces. The pieces slot together and metal tags are bent to lock the pieces in place.

Alas, the carrier is not as easy to build and the photographs in the assembly manual are essential in order to work out what goes where and which way around each piece is fitted. The huge number of parts supplied to build the carrier and the lifting mechanism gave me a feeling that a kit to build a complicated mechanical clock had been supplied by mistake! Anyway, armed with a selection of tiny pivots, screws, levers, and a bottle of nail varnish (the latter was not included in the kit, but pinched from my wife!), I set to work assembling the lifting mechanism and locking all the pivot screws with the nail varnish. The next job was to dismantle the parts I had fitted the

wrong way around and re-assemble them with the correct orientation! When finally complete, the carrier, supported on its vertical spring-loaded scissor jack, was fitted to the bridge so that it ran on the tracks with the ball-bearing wheels and slid along the guide rod. Last, the microswitch was installed and adjusted to operate correctly when the carrier was in the fully closed position.

Before installing the bridge, the player could be tested by connecting the front panel and bridge microswitch to the player. This is always a nerve-wracking moment as, however many times you check and re-check your wiring, there is always a chance of missing something obvious. The manual sensibly recommends getting someone else to check the wiring through for you. The phono outputs were connected to the Hi-Fi system, the plastic cover was removed from the CDpro drive lens, a CD was placed on the spindle and clamped with the puck (do *not* run the partly-assembled player without a CD in place because there is

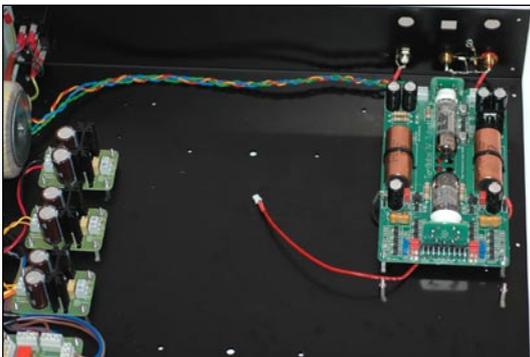


PHOTO 10: Power supplies and IV converter.

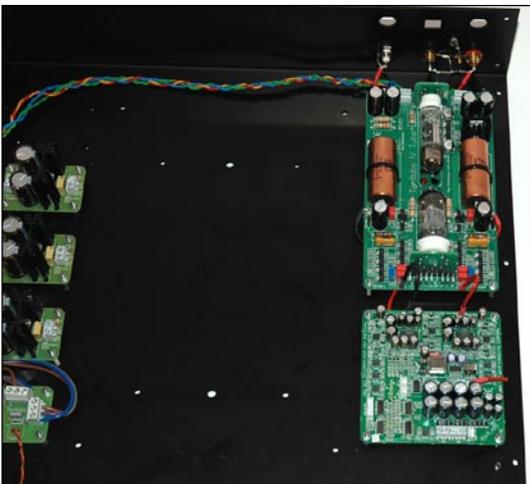


PHOTO 11: DAC and IV converter fitted.

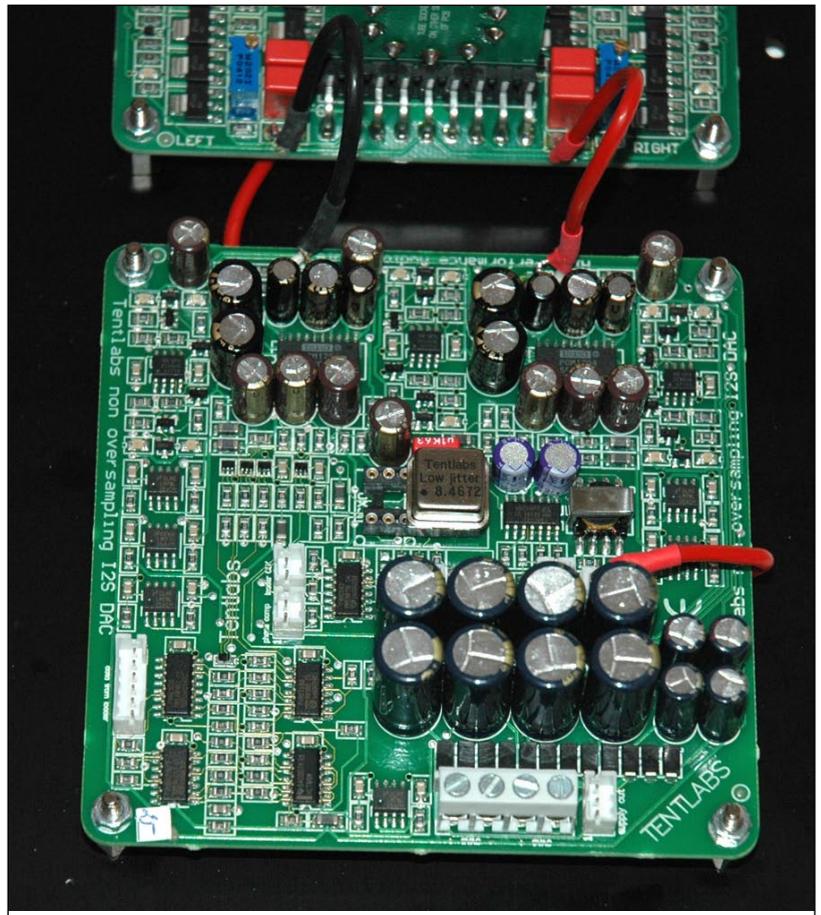


PHOTO 12: Closeup of DAC.

the risk of the light from the laser entering the eye), the carrier was moved to the closed position to operate the microswitch, the power lead was plugged in and the unit was switched on. No bang, no smoke—a good sign! Instead, lots of little green LEDs lit up on the DAC board (they are used as voltage references in the design), the valves warmed up, CD spun around and the green display displayed the track information. After about 30 seconds, a little “click” could be heard as the relay released the analog output from the IV converter. The “play” button was pressed on the front panel and I was extremely relieved to hear music coming from my system—the player worked first time!

Reassured that all was well, I was able to switch everything off and finish the construction. The front panel is unplugged to allow for the installation of the bridge and carrier. Care must be taken to ensure the delicate laser mechanism and motor of the CDpro drive are not damaged and that wires are not trapped between the metalwork when fitting the carrier into the player.

With the bridge in place and the car-

rier running smoothly along the track, the front panel was re-connected and screwed into position. Although all the modules are supplied tested and pre-aligned, I recommend you adjust the IV converter input offsets. These need to be set to zero  $\pm 25\text{mV}$  and this is achieved by warming up the player for about 10 minutes, then connecting a test meter set to 100 or 200mV DC range across each input and rotating a multi-turn potentiometer to minimize the offset voltage. Although my unit was within tolerance (both channels were about  $+14\text{mV}$ ), it was a simple matter to set this close to zero by adjusting the potentiometers.

Finally, with the player disconnected, the lid was fitted and the CD cover balanced on three grub screws on the carrier (adjusted so that the cover is slightly proud of the lid). The lid was secured to the carrier by applying glue over the three grub screws and leaving it to dry overnight. Job done—all in all, about 7 hours work!

### THE PLAYER ON TRIAL

With the player completed, tested, adjusted, and left powered on for several

hours to run in, it was time to connect it to my system and settle down to some serious listening. First to audition was a good all-rounder—Vivaldi Violin Concertos, Op.6, on Decca 455 653-2. Initial impressions were most favorable: a clear, open sound with an overall sense of effortless realism. The strings were smooth and harmonious with no hard edges to betray their feline ancestry!

Moving on to choral music, a copy of Faure’s Requiem (Decca 436 486-2) was lowered onto the drive. Choirs can often sound muddy and unclear, but this was certainly not the case here. I was treated to an open and silky sound that was easy to listen to—something that few CD players can accomplish, in my experience. Staying with vocal music but with something considerably more up-tempo, the incredible Cecilia Bartoli accompanied by Il Giardino Armonico on The Vivaldi Album (Decca 289 466 569-2) demonstrated that the player effortlessly negotiated all the wild crescendos and extremes of this fabulous recording.

Focusing on the lower frequencies, bass lines of large church organs, for example, sometimes left me thinking that

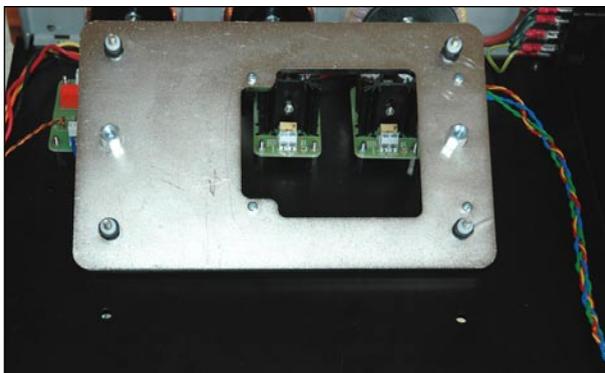


PHOTO 13: Ready to fit the drive mounting plate.

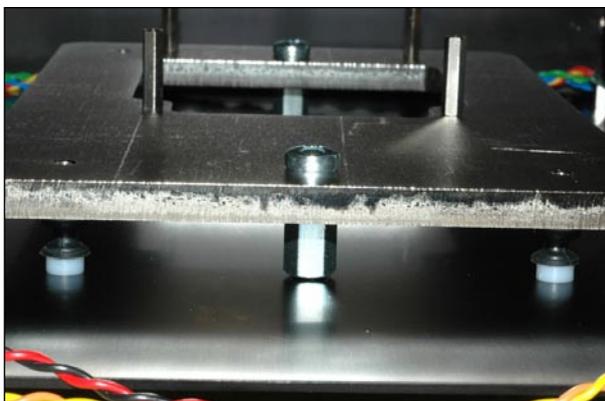


PHOTO 14: Underneath the fitted plate.

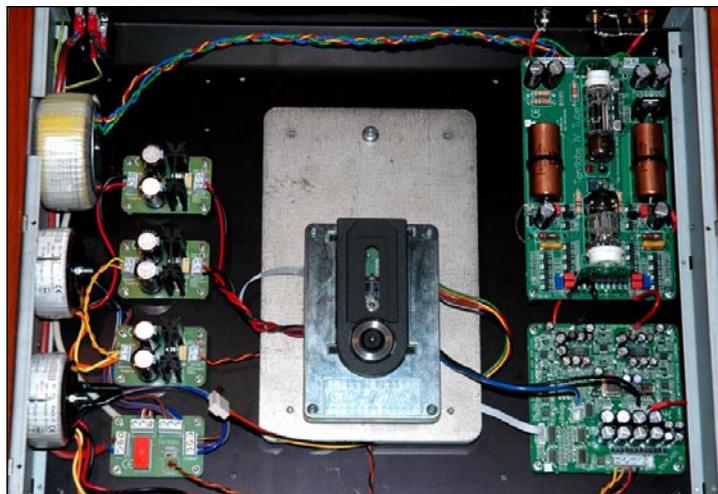


PHOTO 15: Fitting the CDpro drive.

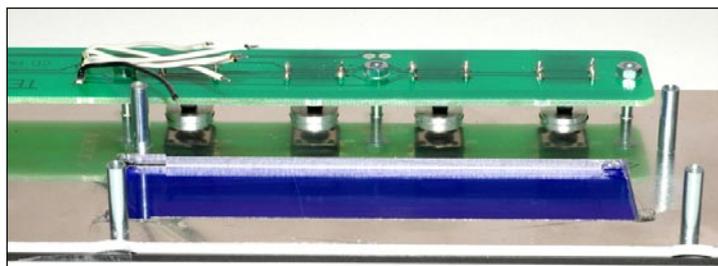


PHOTO 16: Building the switch panel.

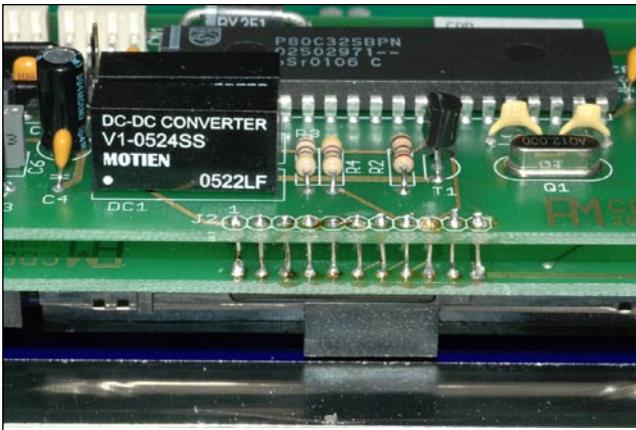


PHOTO 17: Fitting the display.



PHOTO 18: Finished front panel.

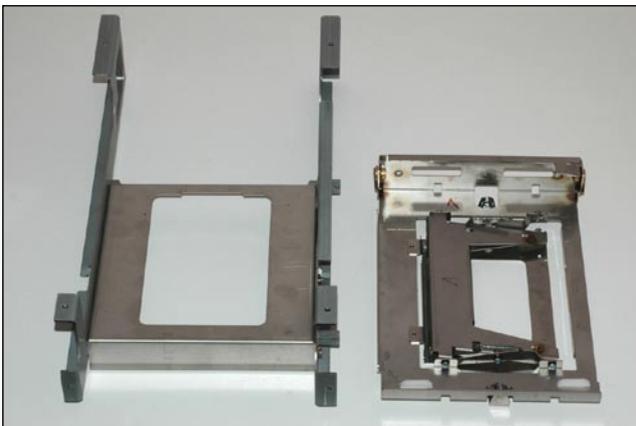


PHOTO 19: Bridge parts.

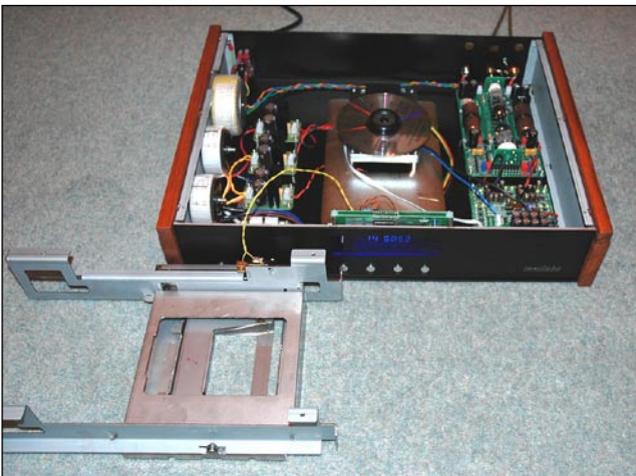


PHOTO 20: Testing the player.



PHOTO 21: Inside the completed player.

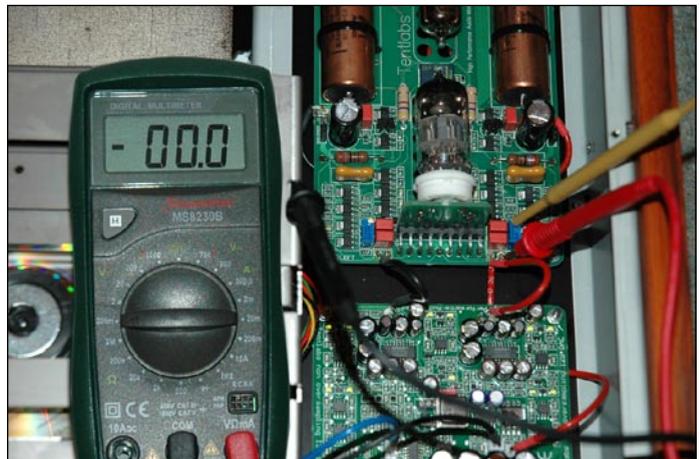


PHOTO 22: Adjusting the IV converter input offset.



PHOTO 23: Completed player and remote control.

the response was rolling off a little too early in that the very lowest registers were a little light. Having said that, drums were punchy, yet tight and well-controlled, which is far more important in the overall scheme of things.

Disc after disc was played, spanning a wide range of musical styles and this confirmed my view that the player produces a musical sound that is easy to listen to with no trace of digital harshness or any other obvious defects or shortcomings. In particular, the player was able to reproduce all the subtle detail, such as the breathing and fingering on a particularly fine solo flute recording in my collection, something that only a handful of players can achieve due to the unit's extremely low noise floor.

## CONCLUSION

The Tentlabs CD player uses top quality components throughout and its solid, sturdy, and heavy construction reinforces a sense of excellence. The sound quality produced by this player is superb and it can certainly hold its own among the other high-end units on the market, including those that cost considerably more. The manually operated top loader will not be to everyone's taste and the relatively complex mechanics employed here do seem a little "Heath Robinson!" Having said that, the smooth and solid mechanism won me over in the end and I must say I ended up rather enjoying the process of loading a CD in much the same way that lowering a cartridge onto a record on a top-end record deck is curiously satisfying!

The building instructions are clear and well presented in the supplied hard copy manual. The player was very easy to construct and is well within the capabilities of anyone who has, say, completed a Heathkit EK-1 course in basic electricity in the 60s! The end result is very easy on the eye and the wooden end pieces give the unit a stylish classic look.

At the price, the CD player kit represents good value for money for a player of this quality and it will certainly leave well and truly behind many far more expensive players. Erecting this Tent(labs) was a highly enjoyable process and the pleasure of the finished unit was consequently enhanced by the feeling of a job well done! *aX*



PHOTO 24: Completed player with lid open.



PHOTO 25: Completed player.