CD player - PULSAR CD 3000 R

The **CD 3000 R** employs a fully programmable signal processor (DSP) which can process digital signals in any conceivable way. For this reason it produces better oversampling characteristics than are possible otherwise using ready-made commercially available chips.
Commercial oversampling filters are invariably designed to produce as flat a frequency response as possible, without taking into account time-related characteristics, i.e. those concerning transient response. The inevitable result is long pre- and post-echoes which can seriously distort the listener's perception of the music - especially where peak signals are concerned.
Different types of filter - known as polynomial filters - are now available which exhibit perfect transient signal handling. Unfortunately these filters show a slight drop in treble response at 20 kHz. The **CD 3000 R** makes use of one class of these filters - **BEZIER** polynomial filters - combined with an **IIR** filter in a three-stage oversampling process.
The result is a filter which produces no pre-echoes. The human ear is particularly sensitive to pre-echoes for two reasons: on the one hand they never occur at all under natural conditions, and on the other they are not masked by the main signal - as is the case with post-echoes. This filter also has a flat frequency response, which is a considerable improvement over other polynomial filters (e.g. cubic splines).
Since filters of such refinement cannot be purchased ready-made, the **CD 3000 R** utilises a digital signal processor to fulfil this purpose.
Since the signal processor is completely programmable the **CD 3000 R** is not tied to a particular filter type. As a result we have been able to give the machine a total of five different filter types, each with a different sound character, ranging from the classic **long FIR** filter to the **BEZIER filter**, with **short FIR** filters between the two.
Each of these filters can be activated directly via its own button on the machine's front panel.

Internal view of the **CD 3000 R**

Connection elements

ANALOG-OUT (CHINCH)	Asymmetrical analogue output for use with co-axial cables terminating in Cinch plugs.
ANALOG-OUT (TRIAX)	Asymmetrical analogue output for use with triple co-axial cables terminating in Triax plugs.
ANALOG-OUT (XLR)	Symmetrical analogue output for use with cables terminating in XLR plugs.
VOLUME CONTROL	This slide switch can be used to set the **CD 1500 R** to either of two modes of operation: in the '**OFF**' position the unit is in **CD player mode**. In this mode the volume control of the unit does **not affect the overall volume**, but instead adjusts the output level. If the switch is set to '**ON**', the unit operates in **pre-amplifier mode**. In this mode the volume control on the unit **controls overall volume**, and mirrors the volume control on the remote control handset.
ON/OFF	This slide switch switches the digital outputs (optical and co-axial) on / off.
DIGITAL-OUT (optical)	Digital output for use with light-pipe cables.
DIGITAL-OUT (co-axial)	Co-axial digital output for use with co-axial cables terminating in Cinch plugs
RC-IN	RC input socket for connection to an "R"-series pre-amplifier, integrated amplifier or receiver.

Standard-filter (long FIR-filter)

The long **FIR**-filter is the standard oversampling filter used in digital technology. Advantages: Extremely linear frequency response in the audible range, very high stop band attenuation, linear phase, constant group delay.

Filter 1 (short FIR-filter)

The short **FIR**-filter has similar characteristics to the long **FIR** filter, but very much lower coefficient (160) and consequently considerably lower pre- and post-echoes. Advantages: Extremely linear frequency response in the audible range, high stop band attenuation, linear phase, constant group delay.

Filter 2 (IIR-filter)

This filter is a classic 8th order **IIR**-filter. It exhibits absolutely no pre-echo effects, albeit a slight tendency to post-echo. This is also a feature of natural instruments, and in any case the post-echo is usually masked by the normal audible signal. Advantages: No pre-echo at all, no treble loss, very high stop band attenuation.

Filter 3 (Bezier- / IIR-filter)

This combination circuit consists of three cascaded filters: a Bezier filter, an IIR filter and a second Bezier filter. It represents a good compromise between transient response and frequency response. Advantages: Virtually no pre-echo, minimal post-echo (in masking

range), relatively flat frequency response, no pronounced treble loss.

Filter 4 (Bezier filter)

The **Bezier**-filter is the ideal filter in terms of transient response, virtually no pre- or post-echo, linear phase, slight treble roll-off at 20 kHz. Advantages: Optimum transient response, linear phase, constant group delay.

2-way converter

Multi-bit and Sigma/Delta (1-bit) converters both offer their own unique advantages in terms of sound quality.

Multi-bit converters provide a particularly powerful but rounded sound, especially in the bass part of the frequency range, whereas Sigma/Delta converters offer unexcelled fine detail and resolution in the treble range.

In the D/A conversion section of the **CD 3000 R** the frequency spectrum is divided up into two part-ranges, each of which is processed by its own set of converters.

- The advantage of this technique is that each part of the frequency range is processed by the converter technology best suited to it. BURR-BROWN multi-bit converters (maximum K selectivity) for the bass range
- NPC Sigma/Delta converter for the mid-range / treble range

This complex arrangement combines the positive qualities of multi-bit converters (tight, rounded, powerful bass) with the complementary features of fine detail resolution and low distortion which are characteristic of Sigma/Delta converters.

In both cases these converters are implemented in the form of complex double-differential circuits. This type of circuit design requires a total of eight individual converters, but the outstanding dynamics and overall reduction in hiss and harmonic distortion are so impressive that they easily justify the extra complexity.

Analogue filters

The analogue section of the **CD 3000 R** features a consistent policy of symmetrical, channel-separate (double-mono) construction.

Channel symmetry is maintained throughout the circuit, and is established at the digital level where there is no chance of phase errors. The advantage of this arrangement is that a symmetrical signal is generated without the danger of introducing phase and amplitude errors.

All four converters on each channel are operated in the optimum double-differential mode, which reduces the hiss level of the converters by an additional 3 dB.

However, we have maintained the symmetrical construction even in the analogue reconstruction low-pass circuits, the volume control and the output stages.

The advantage of this sophisticated type of circuit design lies in the fact that no earth currents are present in the filter stages or the output and control stages, with the result that the analogue signal earth stays extremely clean.

Output stages

We have developed a new circuit for our output stages:

We have abandoned the use of standard operational amplifiers (op-amps) in favour of a combination of a high-quality BURR-BROWN audio op-amp followed by a driver amplifier

(BURR-BROWN BUF 634 T). The driver amplifier features very high bandwidth (180 MHz), high slew rate (1800 V/µ s) and good current supply capacity (250 mA).
These characteristics mean that it can drive practically any cable of any length.
This in turn means that the audio op-amp is relieved of the stress of driving the capacitive load represented by the cable, and therefore works even more accurately than in a standard configuration.

CD mechanism

The machine is based on a close-tolerance linear drive mechanism, now combined with an improved, newly developed precision support plate made of rigid, machined brass with a galvanically gold-plated finish. This component eliminates mechanical resonances in the CD virtually completely.
The CD mechanism is isolated from the case and the atmosphere with extreme effectiveness by a complex, laminated 5-layer housing, supplementary internal encapsulation, and a mechanical three-point suspension system which supports the mechanism module in bonded rubber buffers.
A statistical assessment of the c1/c2 error rates shows that this arrangement reduces the mechanism's sensitivity to vibration and sound by more than 20 dB.

Mains section

The analogue and digital sections of the **CD 3000 R** are powered by completely separate mains sections. This means that the danger of impairment in the analogue section due to digital interference signals on the secondary side is eliminated.
We have also developed new transformers and complementary mains filters in order to preclude any undesirable coupling of interference signals on the primary side of the mains section.
These new "C-core" transformers feature a static shield winding which suppresses the coupling capacitance of the primary and secondary side of the transformers virtually completely.

Triax-outputs

In addition to the asymmetrical **Cinch** and symmetrical **XLR** outputs the unit also features the newly developed T+A **TRIAX** outputs.
The **TRIAX** system exploits a triple co-axial construction. Instead of one shield the cable features two concentric shields (see drawing). The outer shield is the earth, while the inner shield carries the same output signal as the signal conductor, fed by its own driver amplifier.
This construction prevents the actual output stage of the **CD 3000 R** being subjected to any capacitive load.
Normally the resistance of the output and the capacitance of the cable form an additional pole in the transfer function, but this technique eliminates the problem.
The net result is an increase in the signal slew rate, and a drastic improvement in the top limit frequency of the circuit.

Specifications

Mechanism	Professional, close-tolerance linear disc mechanism, completely encapsulated for vibration de-coupling, mechanical three-point suspension, triple-beam LDGU optics, 780 nm semi-conductor laser, 2mW power
Wow and flutter	Quartz-controlled, not measurable
Mechanical construction	Rigid metal case, multi-shielded sub-assemblies, multi vibration de-coupled, mechanism air-isolated by own housing
Digital filters	Freely programmable signal processor with five different filter types, 8-times oversampling and 56-bit resolution, FIR short FIR long, IIR, Bezier, Bezier IIR filters
D/A converter type	Double differential mode and double-mono construction, two 1-bit Sigma-Delta converters with 256-times total oversampling and four multibit DAC 20-bit co-linear converters in 2-way circuit
Noise shaping	4th order (ZSNS)
Analogue filter	Phase-linear Bessel filter, 3rd order with 60 kHz limit frequency
Frequency response	2 Hz – 20 kHz
Distortion / intermodulation	< 0,001 %
Effektive system dynamics	98 dB
Signal: noise ratio (A-weighted)	110 dB
Signal: noise ratio (unweighted)	107 dB
Channel separation 1 kHz / 10 kHz	> 107 / 107 dB
Digital output	Data format SP-DIF
	1 x opto = 660 nm / - 18 dBm
	1 x coax = 0,5 V / 75 Ohms
	optional: optical output
Analogue output	Analogue volume control with gold-contact relays
Cinch	nominal 4 V eff, 10 Ohms
	XLR 8 V eff, 10 Ohms
	Triax 4 V eff, 10 Ohms
Dimensions	15 x 44 x 39 cm
Weight	20 kg
Colours	Black (9005), silver (Lack)
Remote control	Incl.
Special features	Completely separate analogue and digital mains power supplies, 3 transformers, galvanic separation between analogue and digital sections

We reserve the right to alter technical specifications.