Construction overview

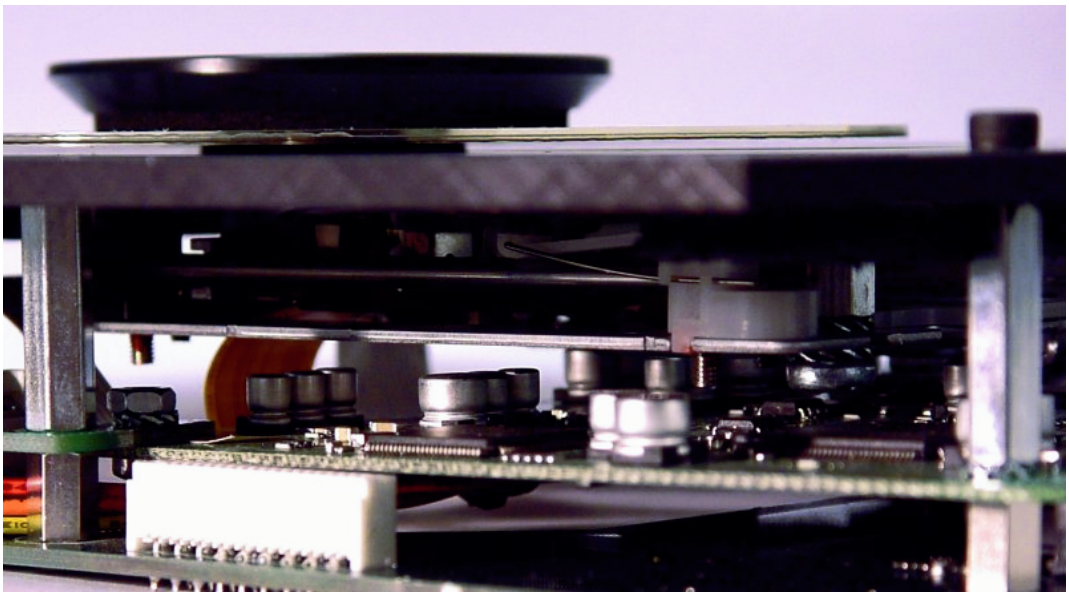
The DVD audio player VIP from Audionet is designed as top-loader – heavy mass transport. Its tonal, electrical and mechanical qualities as well as its wide variety of connectors set the standard in the range of today's DVD-A players.

The chassis, made of 2mm thick sheet-steel – elastically and extensively tied to the 20mm granite plate – and settled on dampening massive aluminium cylinders, makes up the base carrier for the VIP.
The front plate is made of 10mm thick brushed and anodised aluminium and integrates the basic function keys, display and controlling processor. In connection with the top cover and the slider the front plate forms the „face" of the Audionet VIP.
For resonance minimising reason the top cover is made of 18mm thick MDF (middle density fibre) that is coated with fluffy synthetics (NEXTEL). This combination is also used for loudspeaker housings.

Transport unit

Inside the VIP the central component is the transport unit, consisting of reading mechanism and preparation electronic. Both elements are placed as close as possible to each other to offer harmful influences minimized target. They are fitted within a sandwich-construction made of 4mm anodised black aluminium (transport plate) and 2mm sheet-steel. This construction is tied to synthetic belts that define the damping of vibrations and align them to one axis.

The transport plate is plane and has a groove for better CD/DVD handling and in order to offer low resistance to air that can escape from under the disc. The low air resistance eliminates air whirls that can influence the disc.



Transport plate with laser/feed gear and main board for data preparation

Stabilisation and the necessary pressure on DVD/CD is ensured by a black, dampening POM puck. Stabilisation to the sides and additional calming is done by foam rubber at the bottom of the puck. This results in smoother running and reduction of read errors.

Stabilisation – Puck made of POM

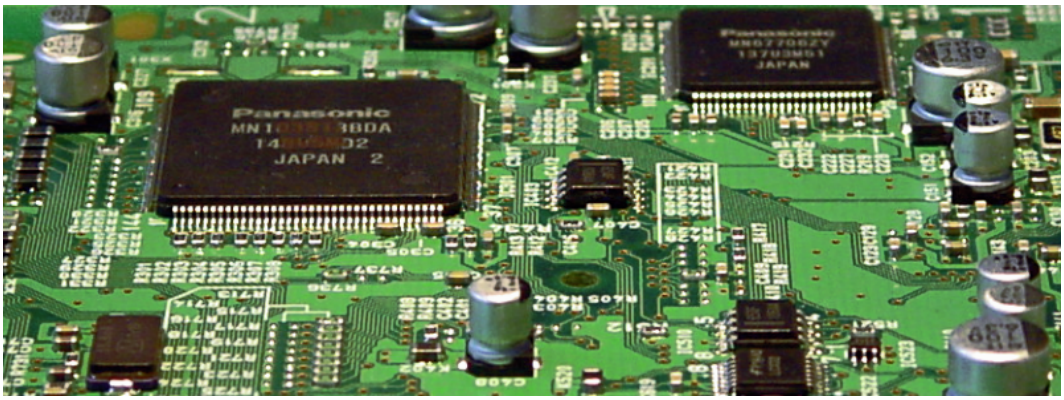
Power supply

The power supply is assured by luscious dimensioned, low-stray field toroid core transformers. In the VIP, three different transformers can be found, each optimised for its special use.

The analog section, the DSP and D/A-converters and the transport unit with the data preparation are supplied separately.
Double-bridge rectifiers with Schottky diodes offer minimum capacitive coupling to the AC net and have minimum interference emission through lowest recovery time. Fast, low-resistance electrolytic capacitors smooth the supply voltages and insure clean working conditions. Locally arranged discrete and integrated linear regulators in connection with low ESR (equivalent serial resistance) current buffers ensure separated power supply very close to the load. Therefore mutual influences between digital and analog sections via there supply routes are excluded.

Data acquisition and preparation

Below the aluminium transport plate lies the pickup unit (laser with feed gear and rotation motor). The main board for data preparation and pickup and motor controlling is located directly below the pickup to keep the distance between pickup and board as short as possible as this connection is susceptible to interference.

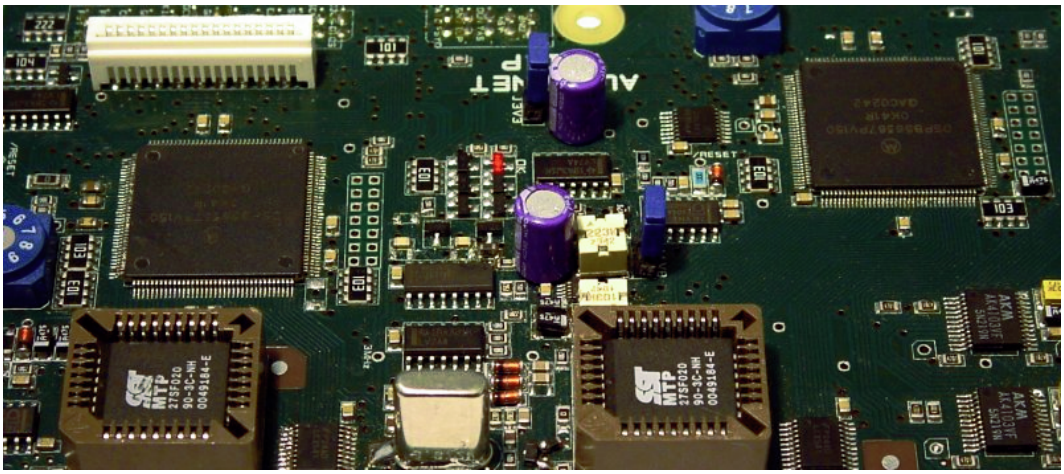


Main board for data acquisition and preparation

This multi-layer board handles the servo controlling of motors and pickup, the separation of audio and video data, the Dolby Digital-, DTS- and DVD-A decoding and the MPEG2 video preparation.
The digital audio data are transmitted from here to the DSPs in parallel format. The video D/A conversion is done with oversampling of the video data at 54MHz to reduce the complexity of the analog reconstruction filters and the susceptibility to jitter. The video DAC word size is 10 bit.

Digital signal processing

For the following signal processing of the digital audio data two Motorola DSP56367 with computing power of 150MIPS each on a multi-layer board are used.

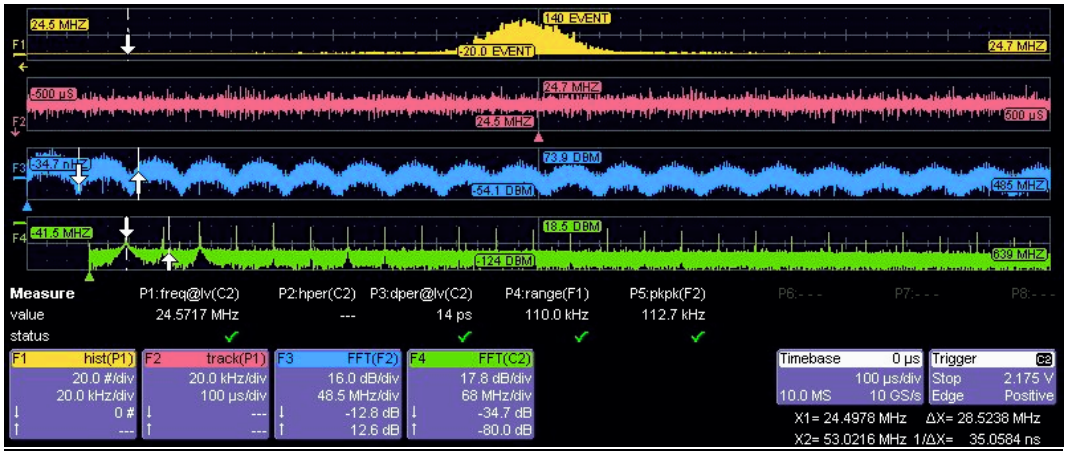


DSP board for signal processing of digital audio data

The first DSP is for the 48bit multichannel bass management (DVD-A) and the computation of the switchable oversampling filters for the three DACs.
The second DSP works in connection with two AKM „SPDIF digital audio“ transmitters and can deliver all digital data for DVD-A, DVD-V and CD to the digital outputs on the rear panel of the VIP (partially in copy protected format).
Both DSPs are software-controlled and can be updated by simply changing an EPROM.

Multichannel D/A conversion

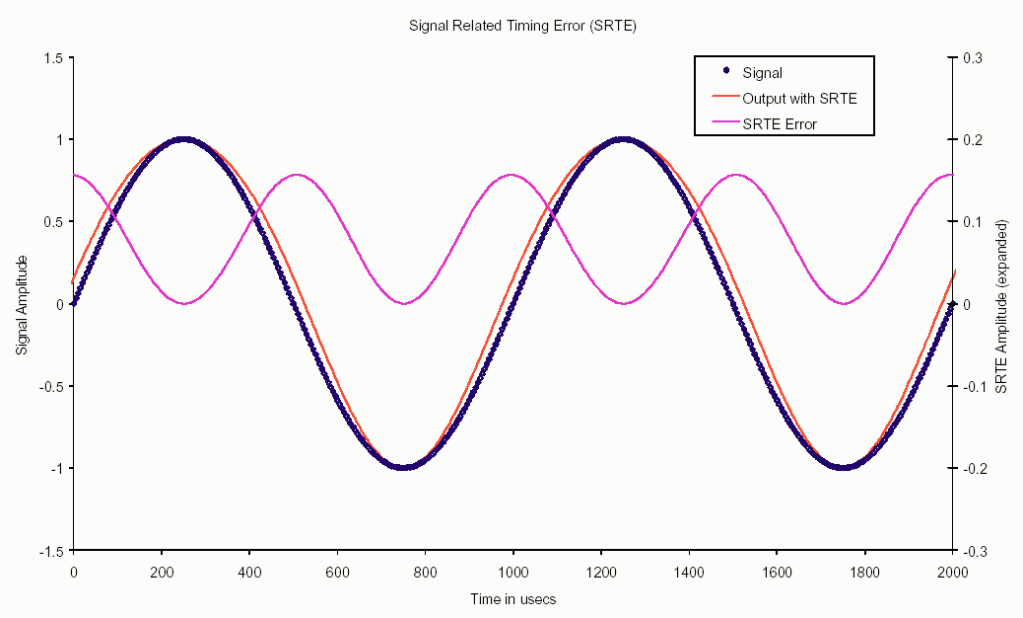
The audio data of the front channels are, independent of their sampling rate, upsampled to 192kHz and 24 bit word size. This is done with an asynchronous sampling rate converter (SRC).



Audio main clock: Histogram, Time deviation, FFT, spectrum of the clock

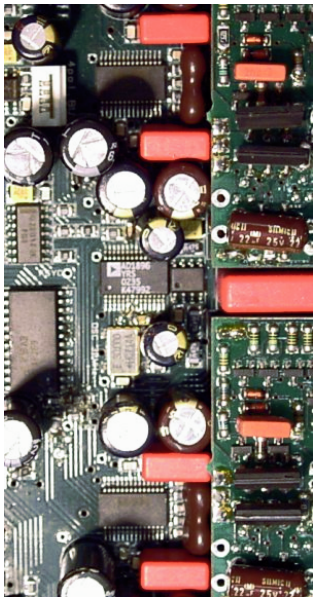
The sample rate converter gets its output clock from a mechanical decoupled „low jitter“ oscillator. Its „cycle to cycle jitter“ is less than 1 psek. (pico = 1/1000 nano). Essential for the D/A conversion is a clock with a pure gaussian distributed jitter. No influences on the audio data must be recognizable.

In case the clock of the DAC is dependant on the data itself, this is called „**s**ignal **r**elated **t**iming **e**rror“.



Example of phase errors from signal related jitter

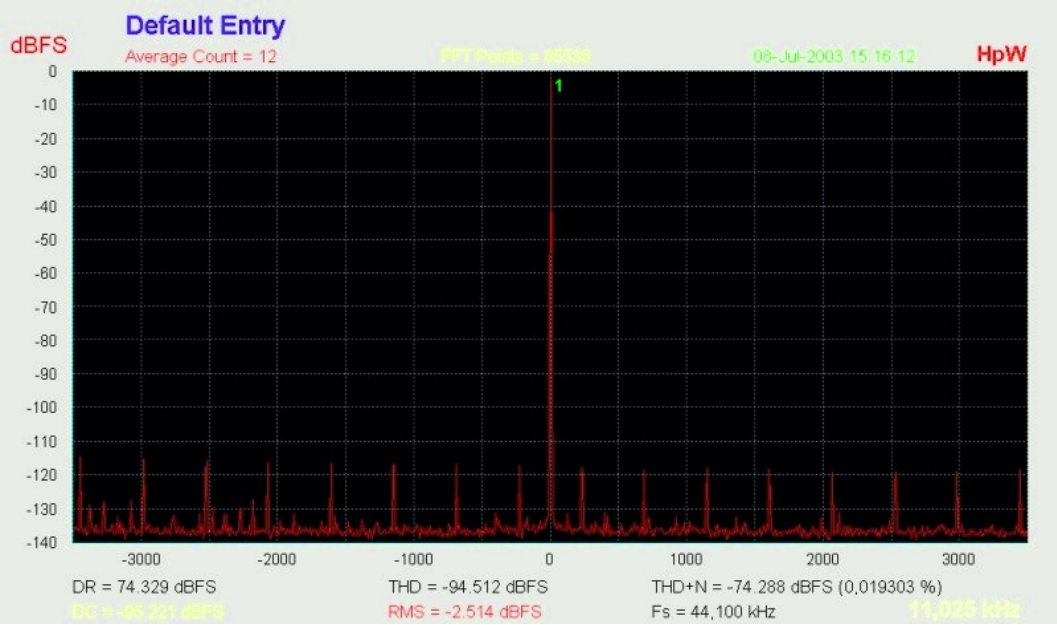
This results in phase distortion of the analog signal (frequency modulation, Doppler effect), which occur at relative small signal magnitudes and high frequencies and which are exceptionally audible. These are no *harmonic* distortions (no THD).



The low jitter clock generator also uses the audio clock and produces bit clock and word clock of SRC and DACs. The generator is designed as a synchronous divider with FAST technology and FAST drivers. This results in complete separation of input and output clock and therefore elimination of signal related timing errors.

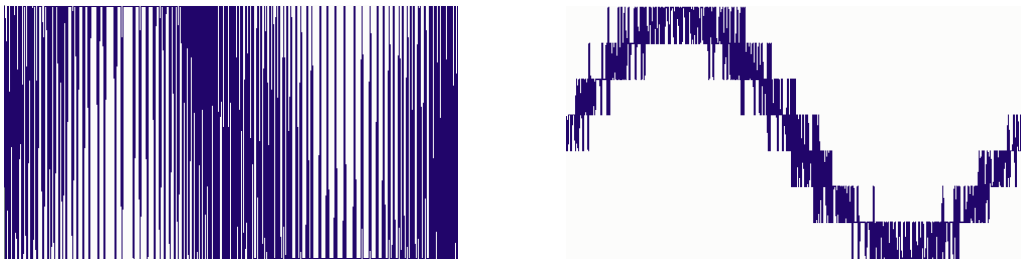
The refined data and clocks are send to two „dual mono DACs“, that convert the data using the so-called multibit-sigma-delta principle with dynamic element matching (D.E.M.). Local discrete regulators (fast and low-noise) supply the analog section of the DACs.

Picture: SRC, Clock divider, DACs



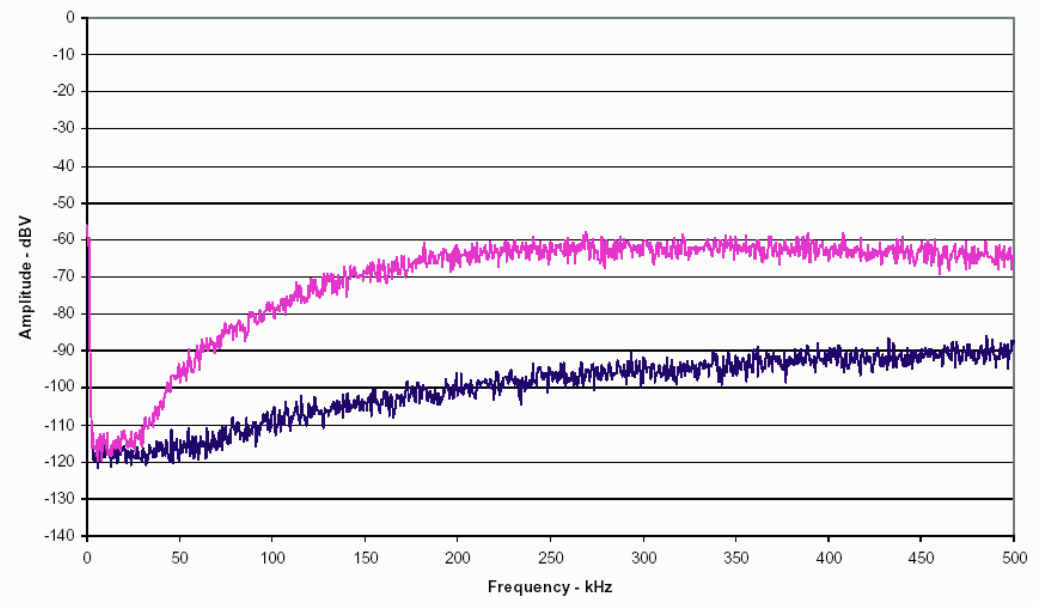
Output spectrum VIP: Signal from CD with 11.025kHz and LSB toggle (Fs/192), > no jitter components, no noise modulation or signal influences !

The principle of multibit-sigma-delta conversion is known since long times and has further been optimised during the last years. Compared to one-bit conversion of the audio signals the sigma-delta-modulator uses more than only two different values for its output data. Therefore the order of the sigma-delta-modulator can be reduced, which brings several advantages. To mention only a few, the modulator output signal has no overflow or truncation effects, contains no high frequency interference signals and already looks more similar to the analog signal.



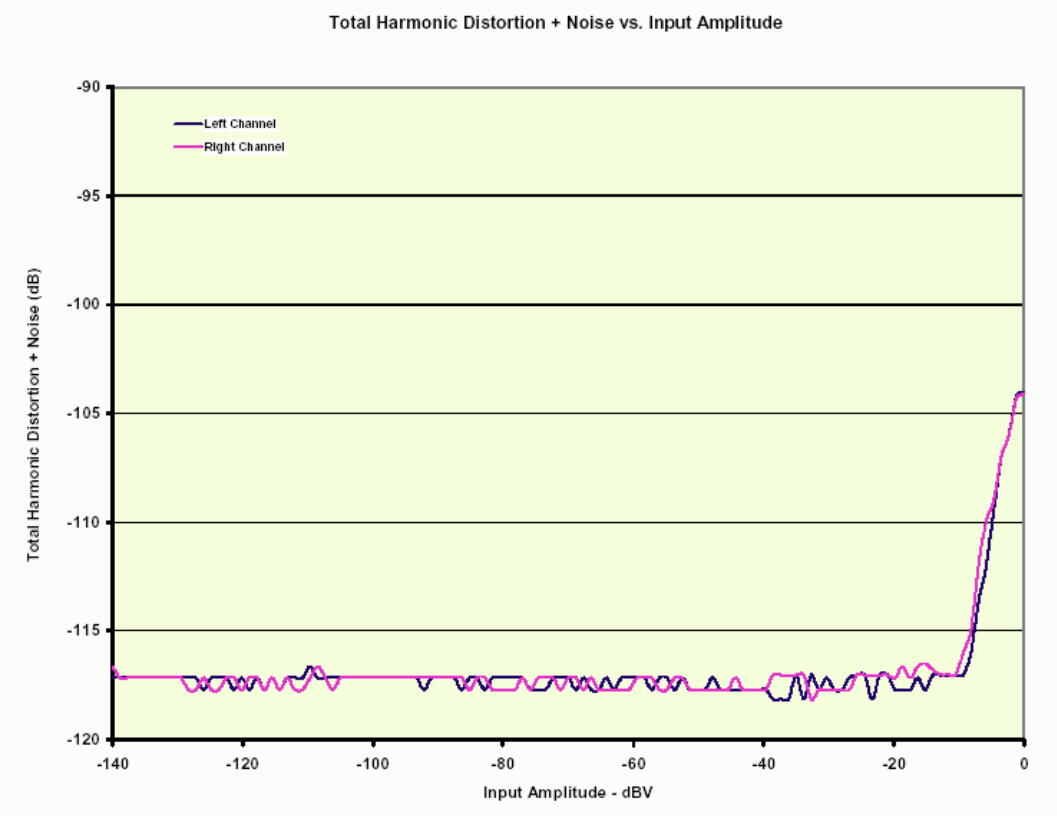
Output signals: One-bit DAC, Multibit- Multilevel DAC

This yields to extremely low sensibility against jitter (because of reduction of the internal converter clock rate) and excellent technical characteristics, e.g. high signal to noise ratio (SNR) and channel separation.
The disadvantage of this method is the higher complexity in the digital domain.
Reduction of the modulator order and the extension of possible output values dramatically reduces the out-of-band-noise in the frequency range above 20 kHz.



Basic comparison: Output spectrum of high-order and low-order modulator

The big advantage arising from this method is the reduction of the required filters in the analog domain and the reduced risk of intermodulation of high frequencies into the audible frequency range within active filter stages.
Another advantage of multibit-sigma-delta-conversion is the absolute linearity of the output signal even at insignificant low signal magnitudes.

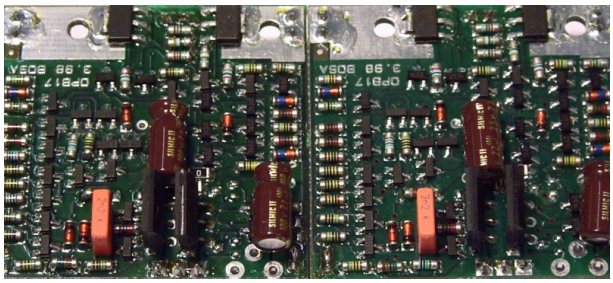


Harmonic distortion plus noise versus amplitude of the digital input signal

The D/A converters of the multichannel section (center/subwoofer and rear channels) are also designed as multibit-sigma-delta DACs (with PWM output) and get their data directly from the DSP.

Analog output stage

The filtering and signal amplification of the front channels left and right are done by two discrete Audionet operational amplifiers. They have „bootstrap"-fourfold-FET input stages (no load for the DAC output) and low-impedance quasi-class-A outputs with extremely high gain-bandwidth-product and inner linearity.



Discrete Audionet operational amplifiers

These operational amplifiers (OPAs) represent the core of a differential second order Butterworth filter with approx. 60kHz upper cutoff frequency. The filter stage is fed back by a slow, low-noise DC servo. This avoids sound-worsening capacitors in the direct signal path and eliminates unwanted DC voltages with a lower cutoff frequency of less than 1 Hz. High internal bias currents and low-impedance filter design result in very low output noise.

The OPAs are supplied by separate discrete, fast and low-noise regulators. All analog outputs work in quasi-class-A mode with constant and low output resistances of 33 ohms.

All capacitors in the analog section are optimised especially for audio. In the digital section exclusively capacitors with low equivalent serial resistance are used.

Digital outputs

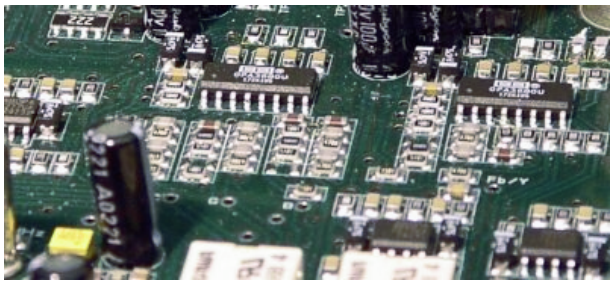
The VIP offers a wide variety of connectors. They are all decoupled by HF pulse transformers in order to minimize signal influences between the VIP as signal source and the connected receiver as signal load. Of course all digital outputs have their own driver stage and stable clock flanks (low output jitter).
Therefore only electrical and no optical outputs are used.

Partial rear view: digital outputs of the VIP

The digital outputs transmit audio data in SPDIF and AES/EBU format for different recording formats like CD and DVD-A with linear PCM 44kHz...96kHz, DVD-A with 96kHz/24bits/6ch or 192kHz/2ch (coded for Audionet decoder). In addition they offer the bit stream formats Dolby Digital, DTS and MPEG.
Two output format groups are switchable (L/H-Bit). Their content depends of program material and sampling frequency. All digital outputs can be switched off electrically.

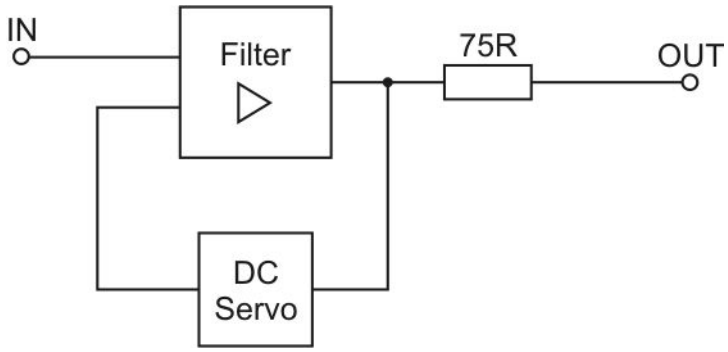
Video outputs

The video signals are linear oversampled to 54MHz and converted by 10 bit parallel video DACs. Each video output has its own driver with extensive decoupling from the supply voltage. Needless to mention that the power supply of the video stage also does not use switching regulators.
The output drivers are realised with wide-range „low noise/distortion“ bipolar OPAs (>200MHz) from BURR-BROWN.



Video output buffer with DC servos

Just like in the analog section the video part uses low-noise DC servos, that filter DC components off from the video signal. No electrolytic capacitors in the signal path are needed, which already have inductive characteristic below 1MHz. They shift the signal phase dependant of the frequency and produce unwanted HF resonance circuits.



Video output stage: Filter with DC servo

This results in a real, constant output resistance of 75 ohms without phase distortion, resonances or other harmful effects of electrolytic capacitors up to frequencies in the high MHz range.

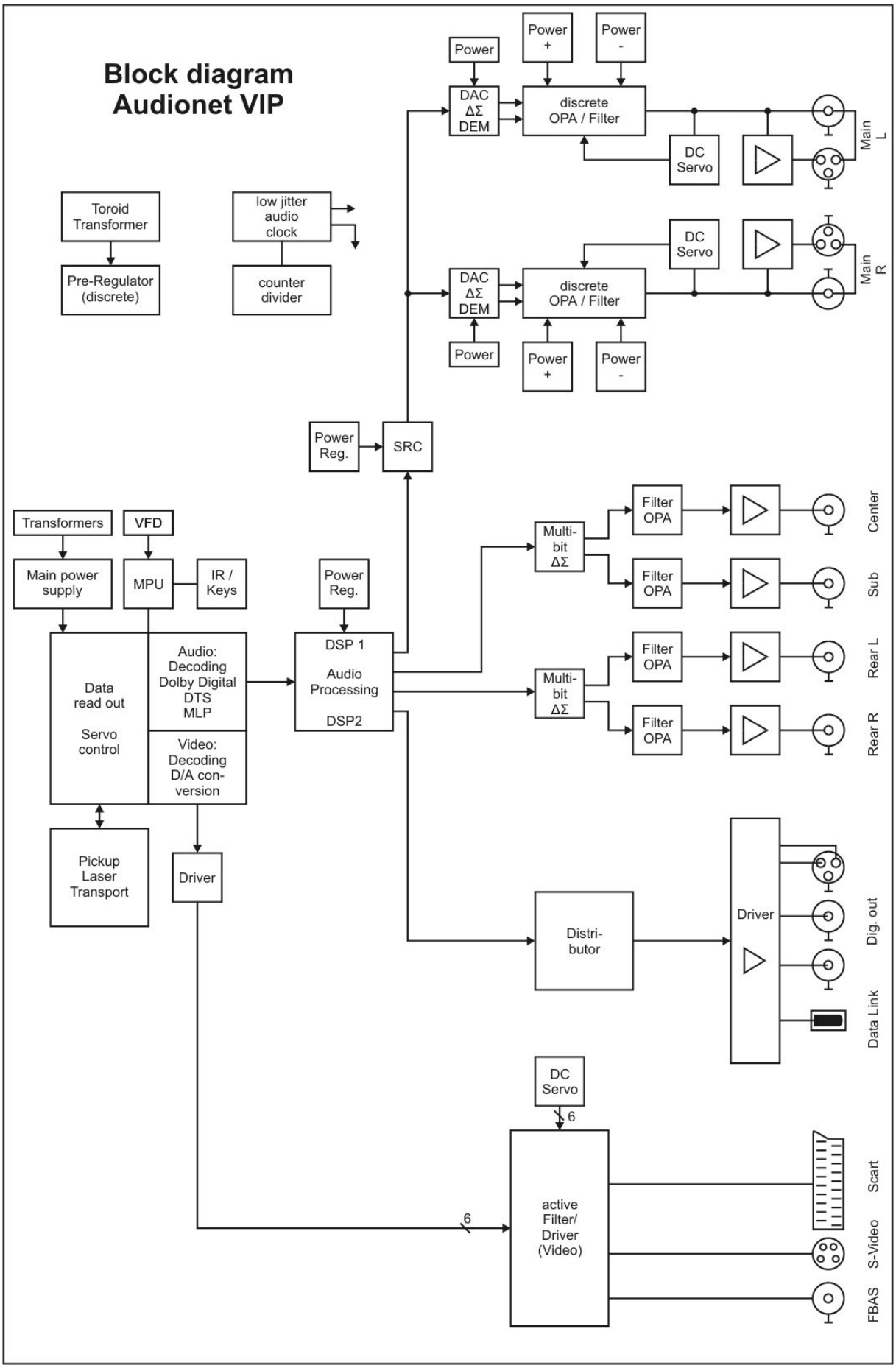
A glance at the rear panel of the VIP offers the wide variety of connectors in the video section. Basically the user can choose between PAL and NTSC playback. The interlaced signals are offered in the formats RGB (SCART), S-video and FBAS (Cinch).

Video outputs of the VIP

Optionally, the video signals can be delivered in progressive scan mode in RGB or YUV format, when the appropriate hardware extension is installed.

Block diagram

For better understanding the block diagram of the VIP should offer support. It is illustrated on the next page.


Block diagram
Audionet VIP
Power
Power +
Power -
DAC ΔΣ DEM
discrete OPA / Filter
DC Servo
Main L
Main R
Toroid Transformer
Pre-Regulator (discrete)
low jitter audio clock
counter divider
Power Reg.
SRC
Transformers
VFD
Main power supply
MPU
IR / Keys
Data read out
Servo control
Audio: Decoding Dolby Digital DTS MLP
Video: Decoding D/A con-version
DSP 1
Audio Processing
DSP2
Multi-bit ΔΣ
Filter OPA
Center
Sub
Rear L
Rear R
Pickup Laser Transport
Driver
Distri-butor
Dig. out
Data Link
6
active Filter/ Driver (Video)
Scart
S-Video
FBAS