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## The Design in Details

The Vanity HD modules are designed as an upgrade to be installed into the Oppo BDP-93 and BDP-103 universal players. They provide digital outputs carrying up to eight channels of full resolution audio data via standard S/PDIF, and support all audio formats including Blu-Ray, SACD and DVD-A.

### Digital Outputs

The original analogue outputs on RCA connector block are replaced by digital outputs. As the S/PDIF signal is two-channel, 4 of the total of 8 RCA connectors in the lower of the two connector rows remain active with the Vanity HD. The mapping of digital output channels therefore corresponds to the diagram on the player's rear panel.

The output is transformer-coupled, at 75R impedance. The signal passes a digital re-clocking stage in order to achieve maximum noise attenuation and prevent interference with internal signal-processing circuits of the player. The entire output circuit is powered from a discrete low-noise regulator. The maximum sampling frequency on the output is 192 kHz, with 24 bit maximum word length.

### Jitter Rejection

In universal players, the internal circuitry is always designed mainly with the video signal in mind. Sampling frequencies for the audio signals are usually derived in a complicated manner from the video clock signal. Their stability is far from ideal, this results in an audible degradation of sound by so called "jitter". To redress this flaw, Vanity HD employs its own digital PLL techniques and low-noise pullable oscillators, whereby the data is perfectly de-coupled from the clock source of the player and a precise dedicated clock signal is used to provide timing of the output signal.

Data from the player is stored in a buffer memory. The utilisation of the buffer memory controls the frequency of a local voltage-controlled oscillator to ensure that the buffer memory is utilised in an optimal manner. This method allows the

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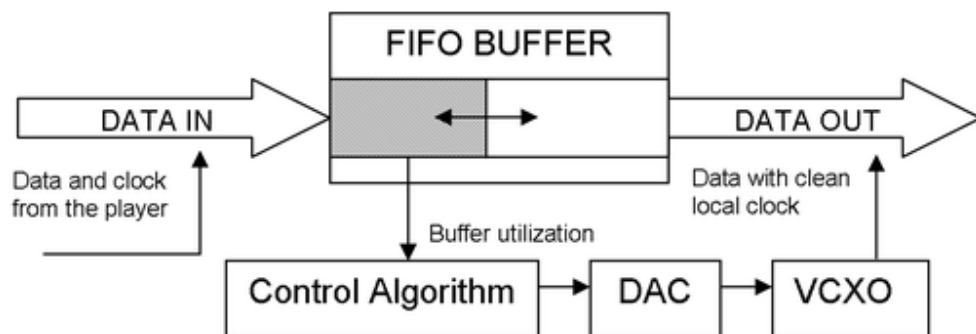
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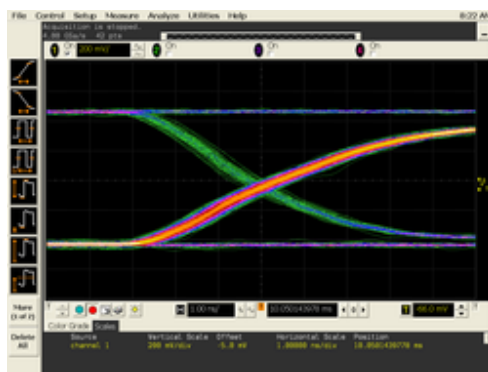
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local oscillator adjusts the frequency with delays between individual frequency corrections satisfactorily long and they can reach dozens of cycles. The

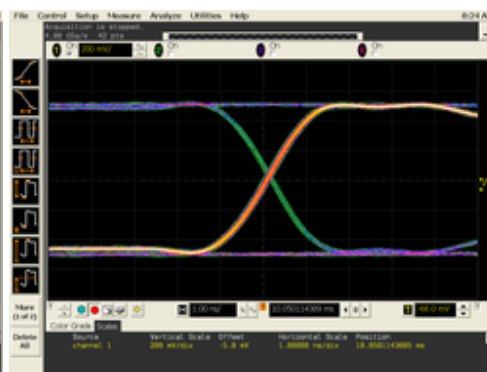
is adjusted by a discrete R2R DA converter, powered just like the oscillator – by a discrete low-noise voltage regulator. The principle of digital PLL is presented in the following diagram:



The result is a perfectly stable clock signal used to provide a time base for the digital output. The benefit of this technique is obvious on the pictures below. Parts of an eye diagram are shown, taken from the player's own digital output, and the Vanity<sup>93</sup> HD output.



Oppo BDP-93 original digital output

Vanity<sup>93</sup> HD digital output

Both measurements were taken under the same conditions. A 44.1 kHz output sampling frequency was used, the output was not terminated, the diagram shows the signal 10 milliseconds after the oscilloscope trigger – at this time, the frequency instability of the timing signal can have a visible impact. The differences are easily visible in the stability, length and symmetry of the edges.

## DSD to LPCM Conversion

In conjunction with the re-clocking system the Vanity HD offers the highest quality digital SACD playback possible. In raw DSD mode of the player it converts SACD media into 24bit, 88.2/176.4kHz LPCM format for stereo, and for all 6 channels of multi-channel layer. The widely used 4.0 speaker configuration is covered by the dedicated down-mix algorithm implemented in the Vanity HD module. For multi-channel systems using other than 5+1 and 4+0 loudspeakers,



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