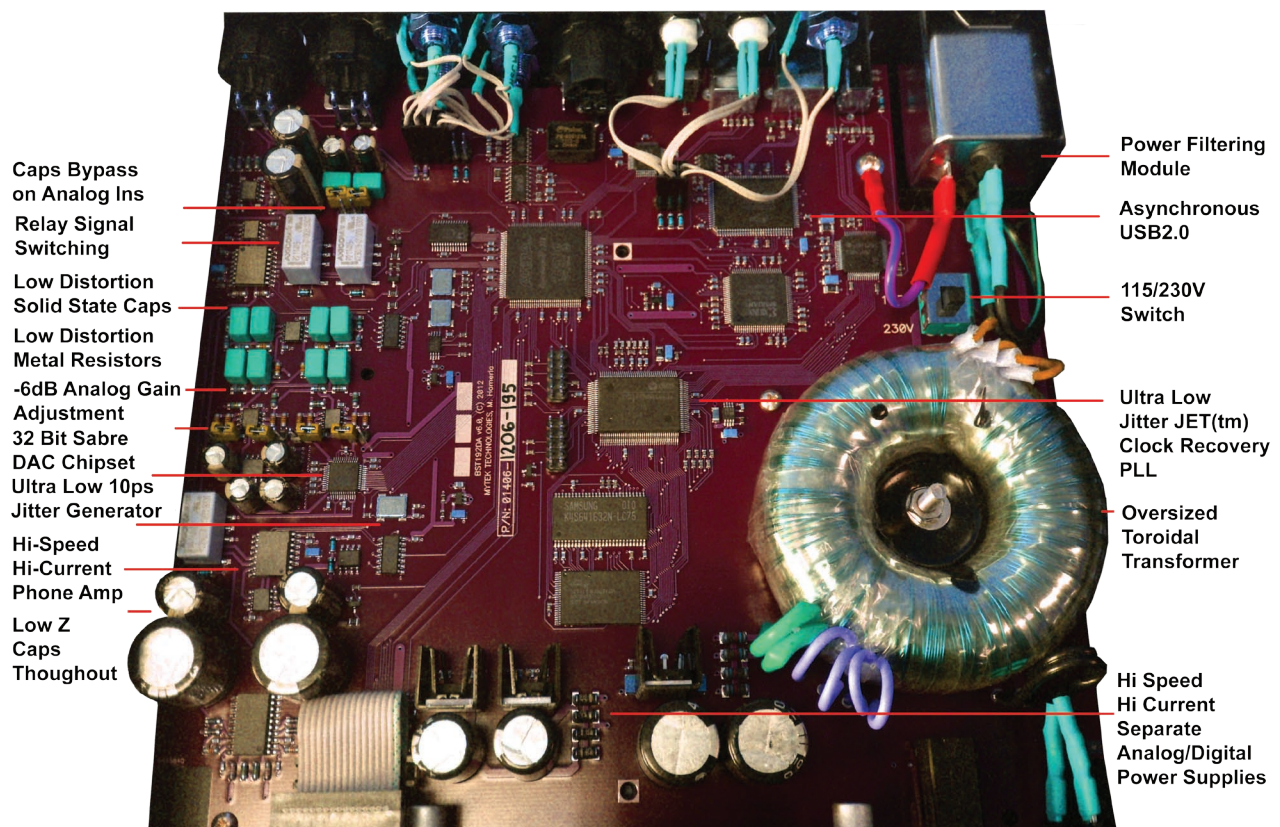


# Engineering and Design of Mytek Stereo192-DSD-DAC

by Michal Jurewicz, Founder and Principal Designer, (c) MyTek Digital 2012

MyTek Digital was founded in 1992 by Michal Jurewicz, E.E., at the time the technical engineer at the Hit Factory and then later Skyline Recording Studios, the two major anchors of a major recording industry of the time in New York City. MyTek Digital was established in response to NYC recording industry needs for the best possible digital conversion quality required for production of the newly introduced Compact Disk. The ADCs and DACs prototypes designed by Michal has been immediately used to record many now classic albums of David Bowie, Lou Reed, Mariah Carey, James Taylor, B52's and many more. Michal has since designed over 20 models of various digital audio converters since that are widely used in studios around the world today. MyTek brand is particularly valued for recording acoustic music because of its signature transparency and detail. In 2005 Michal has been commissioned to design a DSD Master Recorder for Sony SACD project intended for mastering of Super Audio CDs. During that time Michal and other MyTek engineers have gained extensive expertise with DSD format and started to appreciate it's amazing liquid and analog like sound quality ever since. Around 2009, it has become evident to Michal, that the digital high resolution downloads were the inevitable future of the audiophile market and that they will eventually become the vehicle for DSD sound, for a variety of reasons including convenience and finally greatly simplified licensing and distribution. Suddenly, the trends got reversed, the grass roots audiophile demand for DSD music replaced top industry mandated disk formats. There was now opportunity to realize the long standing dream- bring the pristine DSD studio masters to discerning audiophile listeners.

2 years later MyTek released the Stereo192-DSD-DAC, with its amazing 128dB DR sound quality and unprecedented value of advanced conversion engineering in the embodiment of years of Mytek DSD expertise.



# Evaluation and Bench Measurements of the DAC

Stereo192-DSD-DAC engineering was the process of balancing the perceived sound quality, musically, fidelity and transparency and the maximum achievable electric performance specifications, in order of their importance to sound quality.

These specs and design consideration included:

- guaranteed bit transparency from driver to DAC chip
- highest performance 128dB 32 bit Sabre DAC in 4DACs per channel parallel balanced configuration
- special attention to clock jitter. Internal 10ps clock generator
- native DSD conversion (without PCM step)
- native PCM conversion
- optional upsampling
- capacitor free direct analog signal path
- minimal, low distortion, high current, high slew rate output stage
- choice of the most musical analog attenuator
- many user tweaking options including filters, attenuator type choice and bypass etc.

When evaluating the DAC, especially in direct comparison with other DACs it's recommended that:

- DAC must be "broken" in for several day with a music loop or white noise. Breaking in reduces distortion from mechanical performance artifacts, particularly capacitors.
- DAC operates on its internal clock. Use of even the best external clock generators is not recommended as internal clock is of better jitter performance.
- Analog attenuator is relay bypassed. This is particularly required for **bench measurements** as the presence of additional noise floor and pleasant 2nd harmonic distortion from analog attenuator will skew DAC Dynamic Range by as much as 20dB. Analog attenuator is very musical but it does slightly color the sound, albeit less than most preamps.
- Choice of musical sources is carefully picked. This DAC is designed with mastering transparency in mind and is brutally honest: great recording will shine, while bad recordings will have their deficiencies exposed. This is not an euphonic DAC.

Unlikely many DACs in the business MyTek designed the tereo192-DSD-DAC to achieve max. transparency. During design experiments the signal passing through complete ADC>DAC chain has been repeatedly compared to the source signal.



# Details of Design Approach

Stereo192-DSD-DAC product budget was carefully applied to all sections of the DAC to maximize the sound quality and to maintain a great choice of features:

- Sabre 32 bit 128 DR chip was chosen for its unique topology and top notch DSD and PCM performance. DAC chip was configured in 4 DACs/chan balanced configuration to cancel artifacts and increase available Dynamic Range by 6dB.
- unique Sabre master clocking feature allowed placing ultra low jitter 80MHz master clock 1/4" from the chip
- TC JET (tm) PLL -the best clock recovery PLL in the business was used to recover external digital signals
- Asynchronous FW and USB was carefully designed and placed to eliminate interference with DAC circuitry.
- Oversized toroidal linear power supply has split analog and digital supplies with large overcapacity.
- excellent sounding asynchronous hardware upsampler is available as user activated option.
- special low distortion barrel metal film resistors were used in analog section.
- low impedance, high speed electrolytics in combination with low distortion solid state polyester caps were used through the DAC for power filtering.
- hand picked for musicality unconventional analog attenuator was used.
- analog output section was designed for minimum parts and minimum distortion as well as maximum slew rate and current drive.
- double filtered power inlet module precedes the transformer
- multi-layer fiberglass printed circuit board with multiple separate analog/digital large ground planes provides ideal insulation and signal transmission as well as thig transient and bass response.
- connectors are gold plated throughout including Neutrik XLRs.

# Output stage considerations. Average and maximum output levels. Changing the gain of the output.

Introduction:

When the output stage was being designed, a variety of factors had to be included:

- 1) existing professional and consumer standards
- 2) actual large discrepancies of level sensitivities in many existing hi-fi amps and preamps that were not designed to meet these standards.
- 3) signal to noise ratio as large as possible but without large signal distortion
- 4) large discrepancies of average level on existing CDs and other digital recordings, including +3dBFS max level specified for SACD DSD recordings.

When CD standard was announced the CD founding consortium HAS NOT defined the average (0 VU) signal level for the CD the way it was earlier defined for analog recordings. Only max peak level of 0dBFS has been imposed by the nature of the medium. This proved to be a strategic mistake haunting both professionals and consumers of music until today. It has resulted on a huge discrepancies of average levels on CDs (sometimes as much as 20dBs) and overuse of compression to manage that, which in turns significantly damages sound quality intended by original producer.

A high end DAC has to handle these large discrepancies well and in a practical way- a variety of levels have to be converted well without noise , nor overload distortion.

Mytek has been building professional ADCs and DACs since 1992 with majority of them designed for professional studio and mastering applications. We have gain a good level of expertise how best to handle variety of signal levels. Typically in a recording studio an average digital level is defined by the producer and varies from -20dBFS to -14dBFS = 0VU (=1.228VRMS on XLR line) depending on the nature of music and style of recording. For example -20dBFS would be used for live symphony orchestra , while -14dBFS would be used for analog mastering chain where levels are compressed and peak is well controlled. This -20dBFS and -14dBFS is actually the signal headroom- live classical recording requires higher headroom to handle wider dynamic range and loud peaks.

Thus the actual digital recordings vary and DAC must handle them all very well, particularly the wide dynamic range signals more typical for audiophile quality

recordings.

Stereo192-DSD-DAC factory output is designed as follows:

---

XLR output DEFAULT :

Average level (0 VU) = +4dBu= 1.228 VRMS on XLR (between pin 2 and 3)

Output trim (adjustable in menu) = -18dBFS

Max output (sinewave) 9.79V RMS or 13.84V Peak or 27.69 V Peak to peak  
(Voltage swing)

This is the typical professional recording setting well handled by professional and some hi-fi equipment typically powered by +/-15V power rails (or larger)

It's recommended for Hi-Fi systems with well designed high headroom preamps and amps.

---

Output TRIM:

Output TRIM affects both XLR and RCA outputs exactly proportionally

XLR:

Mytek DAC output can be trimmed (within the menu) in 1dB steps between -14dB and -18dB = +4dBu=1.228VRMS on XLR:

When set at -14dBFS trim the XLR out is:

Average level (0 VU) = +4dBu= 1.228 VRMS on XLR (between pin 2 and 3)

Output trim (adjustable in menu) = -14dBFS

Max output (sinewave) 6.14V RMS or 8.68V Peak or 17.37 V Peak to peak  
(Voltage swing)

This is the typical professional mastering setting well handled by professional and some hi-fi equipment typically powered by +/-15V power rails (or larger)

The -14dB setting results in LOWER output from the DAC. It's recommended for Hi-Fi systems which have problem handling -18dB default.

-15 and -16dB trim settings are in between the two.

---

XLR output GAIN PAD :

GAIN PAD is a set of 4 jumpers accessible after removing the top DAC cover. The DEFAULT is Jumpers OPENED. When jumpers SHORT the pairs of pins, additional IV resistors are inserted into DAC circuit and output GAIN is Lowered by 6dB (twice in voltage terms)

PAD affects both XLR and RCA outputs exactly proportionally

Average level (0 VU) = +4dBu = 1.228 VRMS on XLR (between pin 2 and 3)

Output trim (adjustable in menu) = -18dBFS

Max output (sinewave) 9.79V RMS or 13.84V Peak or 27.69 V Peak to peak (Voltage swing)

This is a non typical setting intended for hi-fi equipment typically which cannot handle large signals well (typically powered by less than +/-15V power rails)

INSERTING THE GAIN PAD results in LOWER output from the DAC. It's recommended for Hi-Fi systems which have problem handling standard XLR levels (are distorting or are too loud).

---

RCA outputs:

The standard average level on consumer RCA is defined as -10dBV = 0.312 VRMS. This is pretty much implemented in most standard mass produced off shelf sound equipment. This equipment typically uses lower power rails (often +/- 5V) and consequently has a lower Signal to Noise Ratio than XLR equipment. Most Hi-Fi equipment designs are hybrid- they use RCAs , but on higher voltage rails , thus capable of handling larger signals.

Mytek DAC RCA output takes advantage of this: the default RCA average output (-18dBFS trim) = 0.614 VRMS.

In most cases this level is handled well by Hi FI equipment and results in overall better signal performance and sound quality (as opposed to standard of -10dBV which will decrease performance).

If this level is too loud (signal is too loud or distorted) the following steps should be taken by the user:

a) GAIN PADS should be inserted - this will lower the signal by 6dB resulting in output = 0.307 RMS , pretty much within -10dBV standard

OR

b) If smaller adjustment is needed- TRIM function should be used from with the MENU.

© 2012, MyTek Digital, New York