HEDD Quantum

Harmonically Enhanced Digital Device

Quantum Clocking
DAC, ADC

Operator's Manual

Version 1.0

CRANE SONG LTD.

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IMPORTANT SAFETY INSTRUCTIONS

1. Read these instructions
2. Keep these instructions
3. Heed all warnings
4. Follow all instructions
5. Do not use this apparatus near water
6. Clean only with a dry cloth
7. Install in accordance with the manufacturer's instructions
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat
9. Protect the power cord from being walked on or pinched, particularly at plugs and the point where they exit from the apparatus
10. Only use attachments/accessories specified by the manufacturer
11. Unplug this apparatus during lightning storms or when unused for long periods of time
12. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped
13. CAUTION: To disconnect the unit completely from the MAINS, unplug the unit. Turning the power switch off does not disconnect the unit from the MAINS.

INTRODUCTION

First of all, thank you for purchasing HEDD Quantum. This updated version of HEDD will open up a whole new world of definition and clarity in your workflow.

HEDD, acronym for Harmonically Enhanced Digital Device, has been engineered to provide musically pleasing sound with the capability of generating tube/analog sounds within the digital domain.

The HEDD QUANTUM has a new clocking crystal. It's Crane Song's 5th generation design, like the ones used in Avocet IIA and Solaris and has less then 1pS jitter. This results in extremely accurate imaging, a very open 3d sound and detailed transient response.

Jitter is one of those "black art", hard to explain phenomena. The artefacts caused by jitter are blurred, harsh and unfocussed sound. It also results in a loss of image stability, depth and space.
Jitter, basically a time deviation in the clock timing, is caused by many factors. The main culprit being the frequency of the clock varying during the conversion process.

The newly developed crystal clock within the HEDD QUANTUM has reduced this jitter to the ,currently, lowest possible value, resulting in a well defined low end and clear top end. This will allow you to judge your work more accurately and will provide you with a much stabler image making panning, EQing a lot faster and truer.

It can take a little time to get to grips with these subtle but extremely important issues. It'll take a bit of ear training. To get you started, head on over to the Cranesong Jitter Page. http://www.cranesong.com/jitter_1.html

In addition to the new AD, DA, Clocking, I/O (Toslink Optical has been added) and extra WC outputs, HEDD QUANTUM still comes equipped with the same great DSP emulation of Triode, Pentode tubes and Tape emulation from the original model.
The operational modes now allow the DAC and the ADC to be used simultaneously and at different sample rates. When set to the DIGI setting,

the unit will run Digital in from one of three sources and output on all three digital outputs and the analog output at the same time.
In the ANA mode the input is analog and it outputs on all three digital outputs as well as the analog output.

The A/D, D/A and ASRC (Asynchronous Sample Rate Convertor) chips are high-end AKM 32-bit components, coupled with proprietary analog filtering and clocking.
Coupled with ultra low jitter, HEDD QUANTUM gives any user who works digitally the ability to sound more analog.

The HEDD QUANTUM controls allow the user to select input source, sample rate and continuously variable tape, triode and pentode sounds. The HEDD can operate as an effects device or as separate A/D and D/A convertor with the harmonic generation process applied to either convertor respectively.

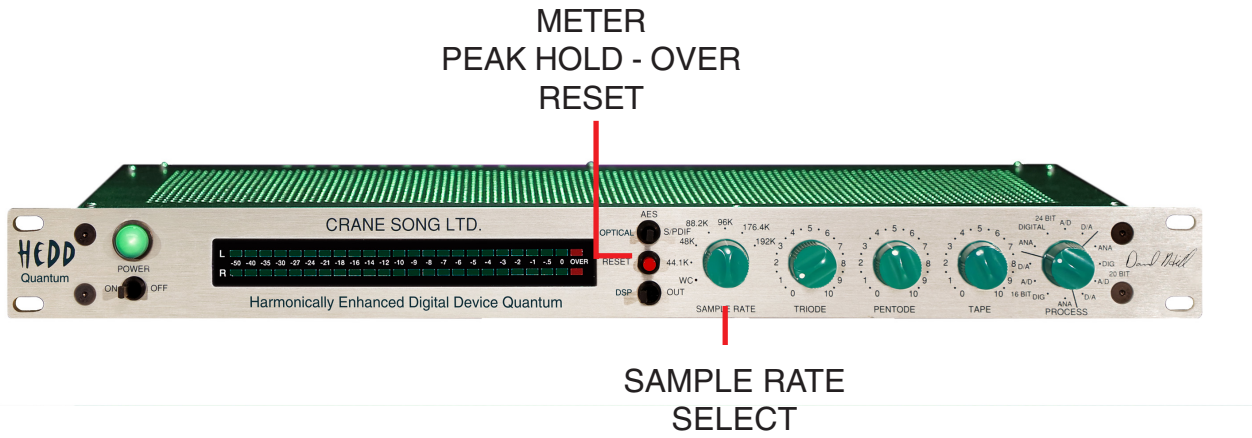
The signal processor performs 24 Bit Processing on digital or analog sources.
HEDD Quantum has transformerless balanced analog inputs and outputs, transformer isolated digital inputs and outputs and uses separate power transformers and supplies for the analog and digital sections.

The HEDD QUANTUM output now has a higher maximum output level +24.5 dBu whereas the original HEDD 192 was around +18.5 dBu.
The max input range is adjustable from +16 dBu to +26 dBu for digital zero

The unit is 1U rack space tall and operates from 110V, 115V, 230V or 240V mains.

The HEDD QUANTUM operates at sample rates from 44.1K to 192K

BOOT UP AND SAMPLE RATE



Here are a few items to be aware of when you boot up the HEDD QUANTUM.

The WC LED will flash 14 times during boot up and
at the end of the 14 times there may be some random lights on the meter for around a second.

When selecting WC input, the WC LED will light at random.
Once it stays on, HEDD QUANTUM is locked to the incoming clock source.

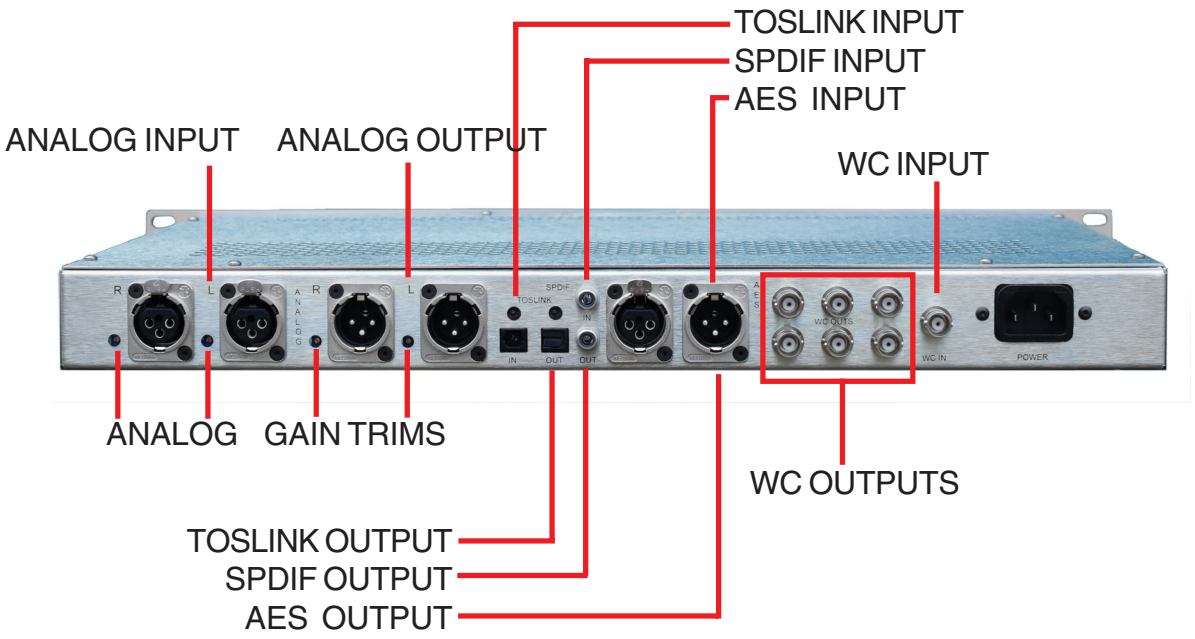
Be aware that there is an additional 4 second delay when booting with WC selected.

The internal clock of HEDD Quantum has the lowest jitter of all pro audio products the we know of. For best sonic and low jitter results use HEDD QUANTUM as the master clock in your set up.

A warm up period of 1/2 hour to 45 minutes will give best results.

FRONT PANEL LAYOUT

BACK PANEL LAYOUT



THE CONTROLS

Let's have a closer look at what the front panel controls have to offer.

POWER SWITCH
A straight forward ON/OFF switch to turn the unit on or off.
Power is indicated by the classic Crane Song green pilot light.

INPUT SWITCH
The input switch selects between the OPTICAL, AES and S/PDIF inputs

OVER RESET BUTTON
Clears the overload LED. It also clears the peak memory value.

BYPASS SWITCH
This switch enables or disables the DSP process. There is a small time lag when the process is turned on and off to reduce the possibility of clicks in the audio.

SAMPLE RATE SWITCH
The clock rate can be set from 44.1KHz to 192KHz or to accept an external WC reference. When a valid word clock is applied and WC is selected the red light next to the switch will light to indicate lock. If lock is lost, HEDD Quantum will default to 44.1kHz and the light will be off. Whenever the sample rate is changed, the convertor is re-calibrated. This will keep the convertor working as accurately as possible.

TRIODE
The triode function creates a triode tube like harmonic structure. The process contains strong, but not strictly, even order harmonics. This affects the bottom end of your signal by fattening it up and it should be noted that even order harmonics are difficult to hear. The harmonic structure changes with signal level and the amount of process being applied, just like it does in a tube in the analog world. In the previous generation HEDD-192 his control made a low level zipper noise when it was engaged. In the new HEDD QUANTUM, this is no longer the case.

PENTODE

The pentode function creates mostly third harmonic information but contains some higher order odd harmonics depending on the signal level and the amount of processing. It is very much like driving a pentode into overload. The pentode process makes things sound brighter and brings out detail. You can also hear this as a compression effect. The pentode process affects the triode processing stage as both processes are in series.

TAPE

The tape function emulates magnetic recording tape. Tape distortions consist of odd harmonics, starting with the third and fifth. As you increase the level on the tape process the harmonic content increases and higher odd harmonics are added. A tape recorder also contains record and reproduce equalizers that modify the harmonic content. The result is a sound that fattens up the bottom and midrange of a recording. As you increase the process there can be loss of higher content with respect to low frequencies if driven far enough. The high frequencies start compressing sooner then the low frequencies. This is a result of the compression function and eq curves in the process. The compression also squashes peaks and results in a higher average level. The tape process sits in series after the triode and pentode processes and thus modifies them both.

PROCESS SWITCH

The process switch selects whether the signal processor is attached to the D/A convertor, A/D convertor, is configured for Digital in - Digital out, or Analog in - Analog out. An analog generated dither source is available to the A/D convertor and to the Digital in - Digital out modes. The dither is enabled by selecting the process in the 16 or 20 bit groupings.

THE PROCESS

HEDD QUANTUM generates harmonically related information. The processing was developed by studiously analysing the harmonic distortion and characteristics found in classic and revered audio equipment and a lot of listening!

The harmonic process runs 24-bit internally. The digital inputs and outputs are also 24-bit, i.e. feed 24-bit digital in and get 24-bit digital out. Feeding 16-bit audio into the HEDD will result in a 24-bit data stream because of its internal 24-bit calculations. This extra resolution is harmonically related information.

We recommend that, if you are recording to 16-bit, you monitor the process from the 16-bit output of your system to get optimum results by adjusting the HEDD's processing and dithering.

By using the process you will affect your average signal level if you turn the process up far enough. When adding harmonic content, the audio is going to get louder. The HEDD process reduces the peaks in your signal while at the same time increasing the low level harmonic content.

This means that the HEDD process will not cause any overs. In fact, what it will do, is reduce the level of existing overs. Just think of it as a tube or tape doing soft clipping, i.e. "squashing" the peaks and causing analog compression.

HOW MUCH PROCESS TO USE

There are no hard and fast rules, you need to use your ears. If it sounds good, it is good.

To get you started, we've provided some general guidelines. Making your recorded material sound "good" is what it's all about. The process is level and program dependent. Settings that will work best for one source may not work at all for another source. As a general purpose setting jump off point, try running the process knobs at 3.5 to 6. This should be safe. When you run into the 5 and up range it is easy to go too far but, don't forget, it could be a cool thing.

The HEDD QUANTUM processing can be extremely subtle or very drastic. It depends on how you use it.

Getting to grips with the diversity of the processes will take a little ear training. When you're tweaking the signal being processed by the HEDD, don't forget to switch the DSP in and out regularly to give you an indication of where you started out from.

The human ear loves a little harmonic generation so you'll quickly find that turning the HEDD DSP off results in an apparent loss of life/excitement in the musical source material.

Even small amounts of DSP, e.g 1 Triode, 2.5 Pentode and 2 Tape, can make quite a big difference. You may not notice this turning up the pots, but by putting the unit in bypass and then switching the processing back in, it will become very apparent.

The amount of process can result in subtle changes or drastic changes depending on what the program is like and how much process is being added. It will be easier to hear in material that is more open as opposed to material that is very dense. The amount of low frequency information will also affect how we hear the process.

DITHERING

The dither process in HEDD QUANTUM is proprietary to Crane Song. It is an analog generated source that has been filtered to a spectrum where the ear is least sensitive. We believe that this process sounds better than other systems and is less likely to cause noise problems as compared to other dither sources. The dither is added to the audio source as apposed to a digital process. This is in our opinion the best way to dither an A/D convertor: Dithering happens in the conversion.

It is also possible to add this dither to an existing audio source. Dither can be added by running digital in, digital out and selecting the part of the Process switch that is labeled 16-bit or 20-bit depending on what you want to dither down to. To disable the dither just run the unit in 24-bit mode.

EXTERNAL WC SYNC

The external WC connections are for A/D convertor synchronization with external devices. Word Clock does not affect the digital inputs since the digital inputs provide their own clock information. The input WC connection is used to synchronize the A/D convertor to an external source. The six new WC output connections allow HEDD Quantum to be used as a master clock at the same time that the AD and DA are being used and are set at the rate of the A/D convertor whether internal or external clock is selected and can be used as a sync source. Use HEDD Quantum as the master clock when ever possible.

When HEDD recognizes and locks to an external WC and WC is selected on the front panel the LED by the sample rate switch lights up to indicate lock. If there is no lock HEDD defaults to a 44.1 KHz sample rate.

METER

The metering on HEDD QUANTUM is very accurate and is calculated by the DSP, following the HEDD process. The peak hold can be set to run in one of two different modes. You can choose for it to be a 2 second hold after which the peak indicator will drop back to a lower level. In the second mode the peak value is held until the OVER RESET button is pressed.

The latter mode is good for those of us that may have to leave the room and want to know what the maximum value was during the transfer. There is an internal jumper that can be changed to select either options. The default mode is memory/infinity hold. The jumper to change this is inside the unit, and is labeled PK HOLD. If you want to change this, disconnect the power before removing the top cover.

OVERS

The Over LEDs light on detecting a digital overload. This is generated by the DSP. The Over indicator will respond from the analog input when the process is selected as analog or A/D. The Over indicator will respond to the digital source when the process is selected as digital or D/A. Cranesong defines a digital over as a single sample overload.

APPLICATIONS

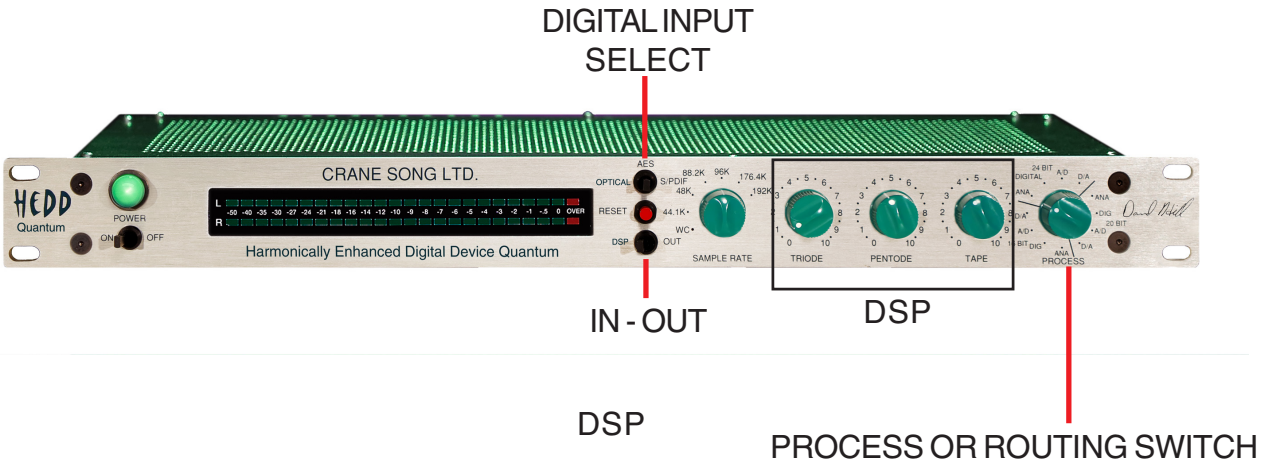
HEDD QUANTUM can be used for many different tasks. It can be operated in the following modes:

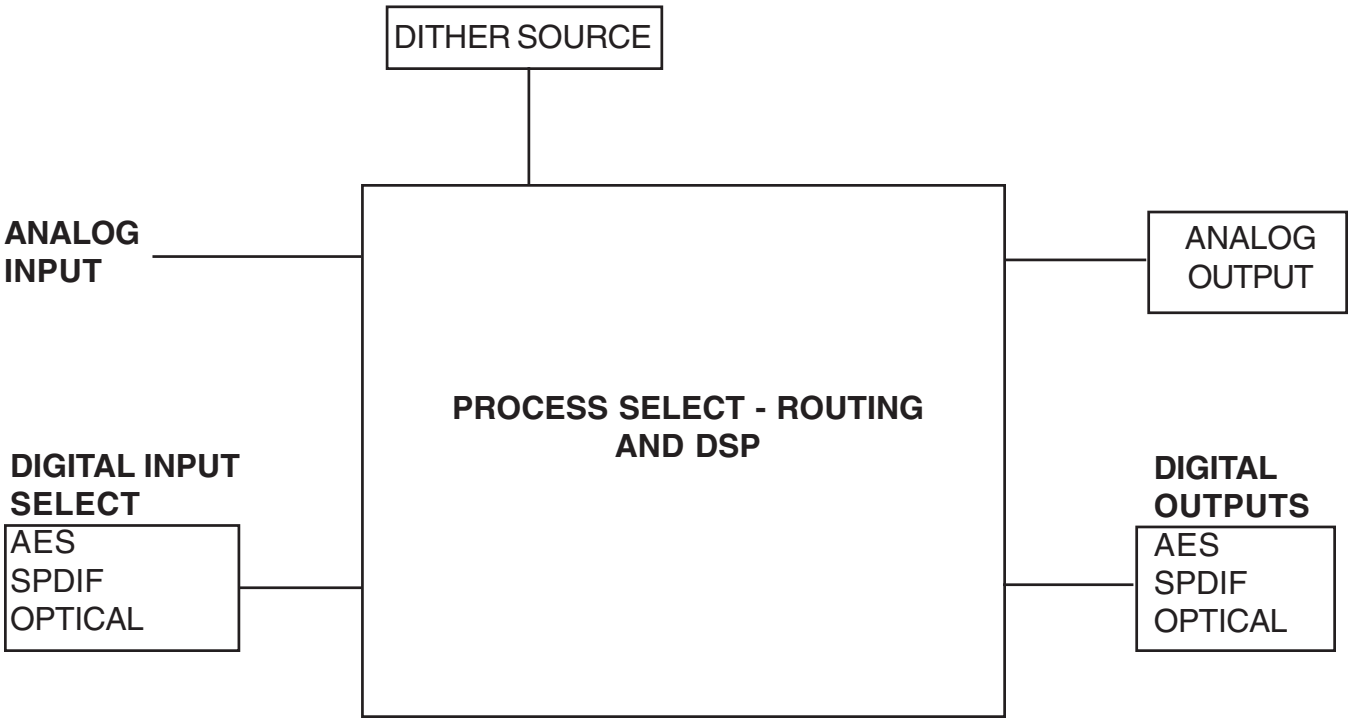
- full analog in / analog out
- full digital in / digital out
- A/D and D/A convertors with the signal processor operation attached to either convertor.

It can be across the stereo bus of a console feeding a digital device or have an analog output.

It can be used as the A/D convertor and D/A convertor in the studio. You can even use it to convert to analog for processing and then back to digital. HEDD QUANTUM is also useful for tracking and mixing. It will allow you to do amazing things to individual tracks. HEDD QUANTUM also holds a high position in the mastering world as a convertor or as a digital in / digital out processor. This unit opens up a new world of signal processing.

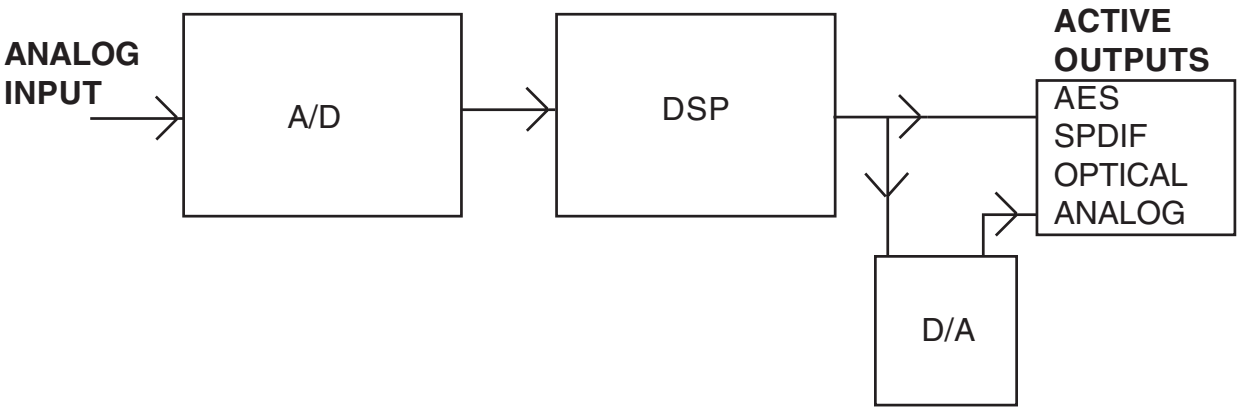
PROCESS BLOCK DIAGRAMS



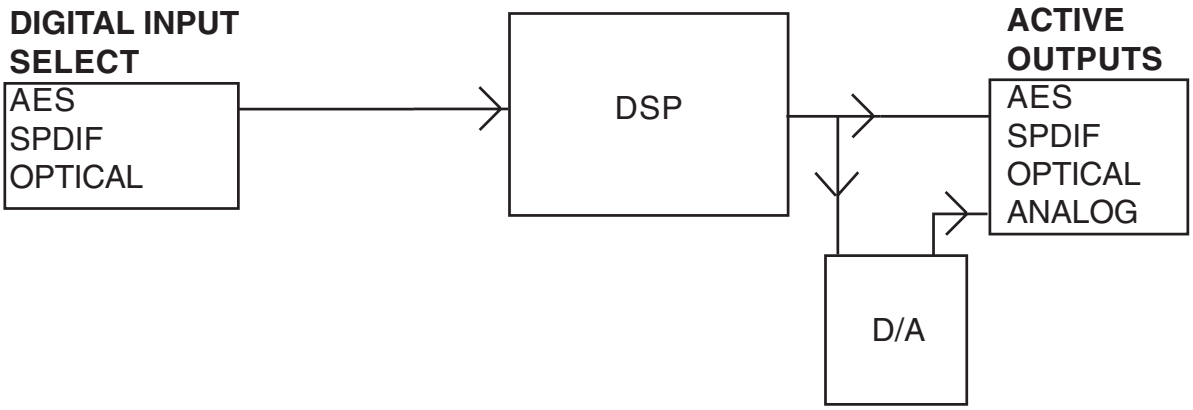


Both the ADC and the DAC can be used simultaneously. They do not require to be at the same sample rate

PROCESS SWITCH SET ANA

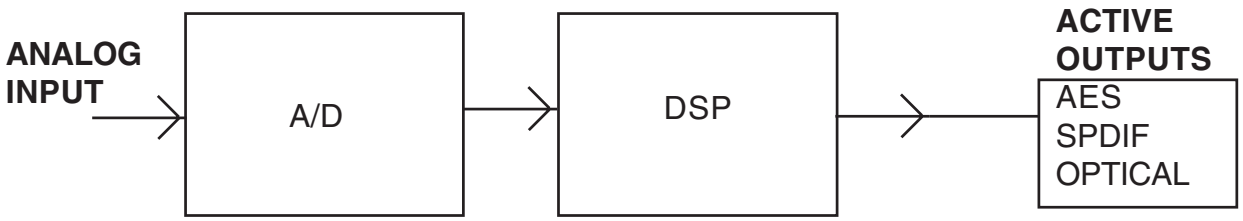


PROCESS SWITCH SET DIGI



PROCESS SWITCH SET AD

ANALOG INPUT PATH

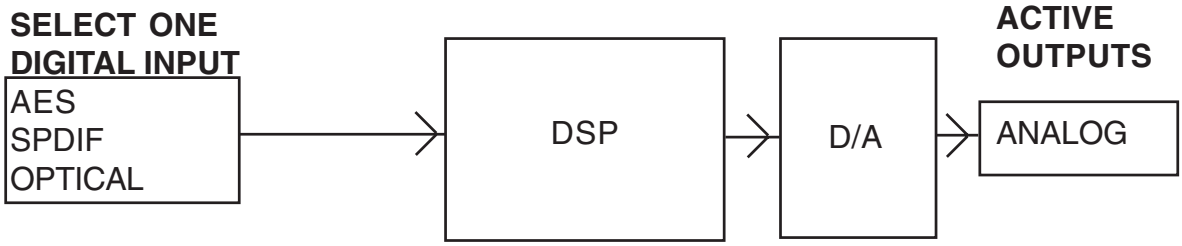


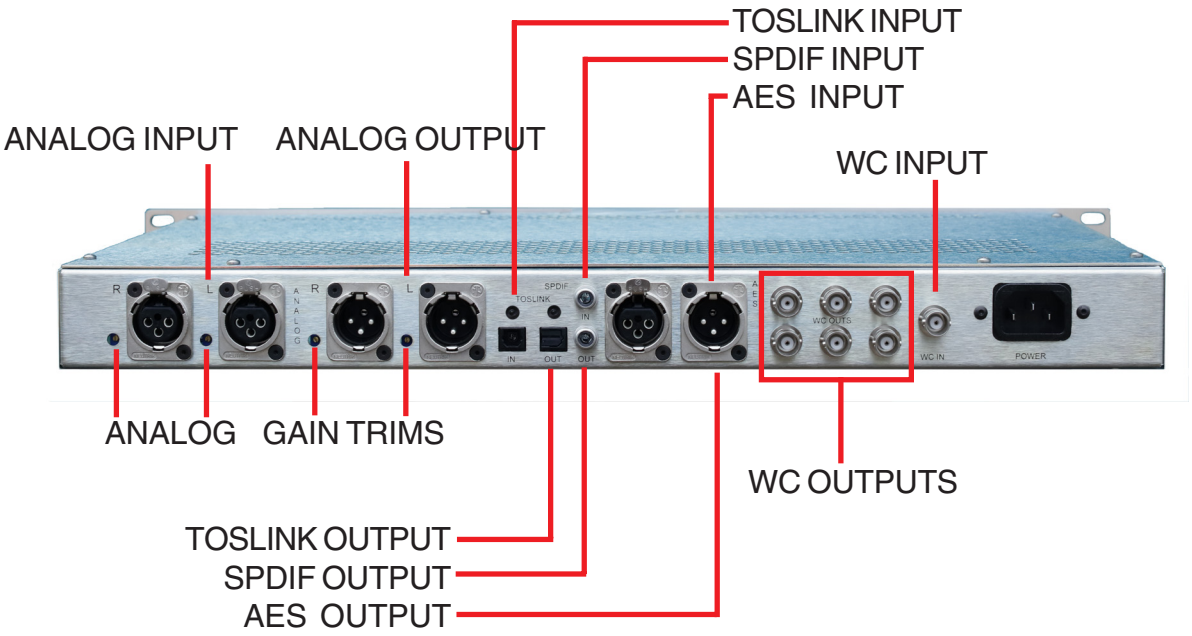
DIGITAL INPUT PATH

PROCESS SWITCH SET DA

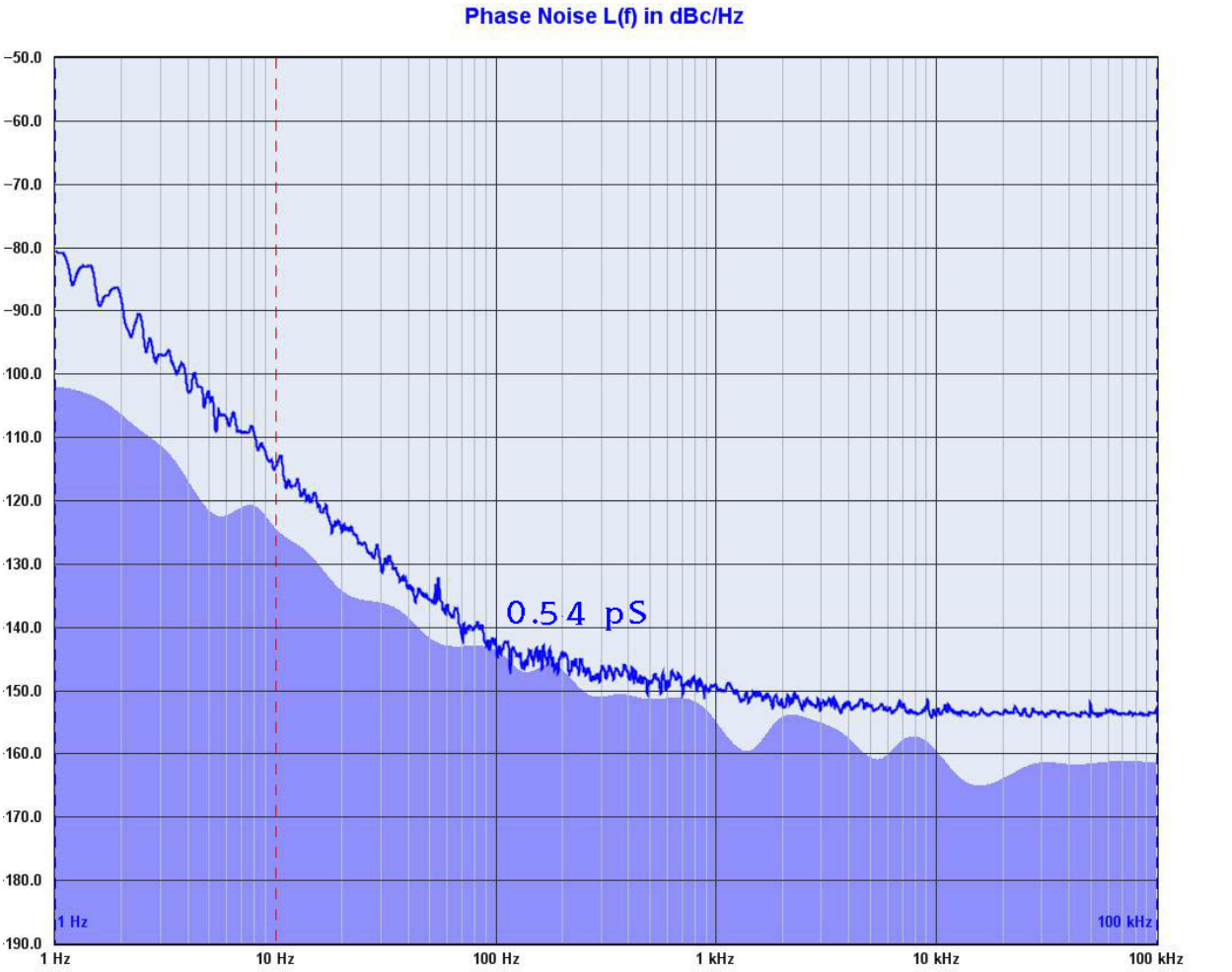
ANALOG INPUT PATH

DIGITAL INPUT PATH




TOSLINK INPUT
SPDIF INPUT
AES INPUT
ANALOG INPUT
ANALOG OUTPUT
WC INPUT
ANALOG
GAIN TRIMS
WC OUTPUTS
TOSLINK OUTPUT
SPDIF OUTPUT
AES OUTPUT

QUANTUM DAC JITTER MEASUREMENT

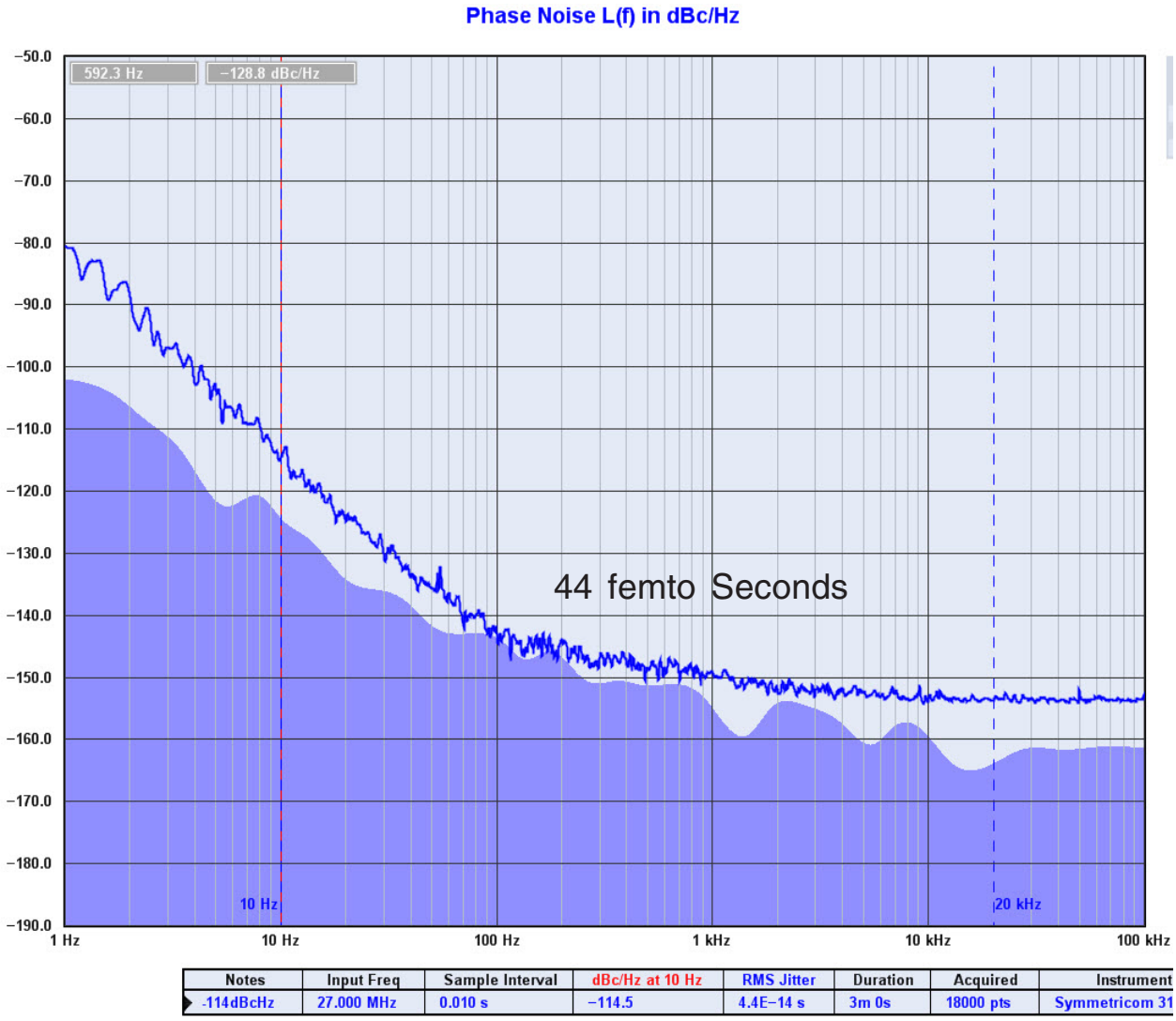


Notes	Input Freq	Sample Interval	dBc/Hz at 10 Hz	RMS Jitter	Duration	Acquired	Instrument
Avocet -114dBcHz	27.000 MHz	0.010 s	-114.5	5.4E-13 s	3m 0s	18000 pts	Symmetricom 3120A

The jitter value in this measurement from 1Hz to 100KHz is 0.54pS typical measured with a Symmetricom 3120A using a Stanford Research Systems Rubidium Frequency Standard, PRS10
Without info on the measurement bandwidth and test instrument used, the measurement is impossible to know about

Test Software does not make a distinction between random and deterministic jitter.
AES-12id-2006 (r2011) excludes modulation components below 10 Hz in it's jitter definition.

Jitter requirements depends on the curcuits being used and the desired results.



Notes	Input Freq	Sample Interval	dBc/Hz at 10 Hz	RMS Jitter	Duration	Acquired	Instrument
-114dBcHz	27.000 MHz	0.010 s	−114.5	4.4E−14 s	3m 0s	18000 pts	Symmetricom 31

Jitter measured from 10Hz to 20KHz is 0.044pS or 44 fS typical
measured with a Symmetricom 3120A using a Stanford Research Systems
Rubidium Frequency Standard, PRS10
without info on the measurement bandwidth and test instrument used, the measurement is impossible to know about

Test Software does not make a distinction between random and deterministic jitter.
AES-12id-2006 (r2011) excludes modulation components below 10 Hz in it's jitter definition.

Jitter requirements depends on the curcuits being used and the desired results.

SPECIFICATIONS

Analog Output: Transformerless balanced floating stereo output on XLR-m connectors. The default calibration is +20 dBu = Digital zero. Gain adjust trims are on the back panel. The maximun analog output is +24.5 dBu

Analog Input: Transformerless balanced floating stereo output on XLR-m connectors. The default calibration is +20 dBu = Digital zero. Gain adjust trims are on the back panel. The analog input range for 0 dbfs is adjustable form +16 to +26 dBu

Word Clock Input: BNC connector takes a TTL level signal at the sample rate to sync the A\D to the external sample rate. HEDD will sync from 20 kHz to 192K kHz. The input impedance is 75 ohms.

Word Clock Outputs: these BNC connectors are a TTL level square wave that can be used to provide sync to other equipment. The WC outputs will be at the selected sample rate or the rate of the WC input.

Internal Sample Rate: 44.1kHz to 192kHz determined by front panel switch.

S/PDIF Input: Unbalanced digital input 75 ohms RCA connector

S/PDIF Output: Unbalanced digital output 75 ohms RCA connector

AES Input: Balanced digital input 110 ohms XLR connector

AES Output: Balanced digital output 110 ohms XLR connector

Optical In / Out: this is the toslink format.

Power: 25 watts at 115 or 230 volts, 50 or 60 Hz.

Fuse size is MDL .3A for 115 volts; MDL .25A for 230 volts

Pilot Lamp: #7335 lamp

Shipping Weight: 15lbs (6.7kg)

Depth Behind Panel: 10 inches (25.4cm) plus user input/output connectors

Registration Form

Please fill out this form and return. It will be used for sending updates and pertinent information as it becomes available.

Thank you.

NAME_____
STUDIO NAME_____
ADDRESS

_____
CITY_____STATE_____
ZIP_____ COUNTRY_____
PHONE _____
SERIAL #

_____
DEALER_____
PURCHASE PRICE _____
E-MAIL_____
WEB_____