Reference Class Integrated Amplifier

SU-R1000

Accompanying Document for the
Digital Product Launch
1st of September 2020

Technics

SU-R1000 | OLD AND NEW HERITAGE

1966
10A/20A

- 2-stage NF circuits
- High dynamics, low distortion
- Power amp with **OTL technology** (Output Transformer Less)
- Superb sound through omission of negative feedback

1969
SU-50A

- Integrated transistor amp
- **OCL Technology** (Output Capacitor Less) = Direct coupling method
- This method became standard for many other companies
- Phono EQ with high s/n ratio

1977
SU-A2/SE-A1

- **Class A+** technology
- Excellent s/n ratio
- SE-A1 with 4 independent power supplies per channel
- 350 W/ch into 8 Ohms
- Real reference standard

1992
SU-C7000 & SE-A7000

- SU-C7000 with **battery-driven power supply** for reduced noise
- Completely separated power supply and NF circuitry
- SE-A7000 in **MOS-FET technology**
- Double-mono construction

2014
SU-R1 & SE-R1

2017
SU-G700

New Technics Digital Amplifier Technologies

- **JENO-Engine**
- **LAPC**
- **GaN MOSFET Driver**
- Technics Digital Link
- High-Speed Silent Linear Power Supply
- Battery Driven Clock Generator
- Digital Noise Isolation Architecture

- **JENO-Engine**
- **LAPC**
- **High-Speed Silent Hybrid Power Supply**
- Battery Driven Clock Generator
- Digital Noise Isolation Architecture
- Low-Noise Phono Input
- Class-AA Headphone Amplifier

PART 1

Basics on Digital Amplifier Technologies

Technics Amplifiers | Full digital amplification instead of Class-D

Block diagram of a Class-D amplifier

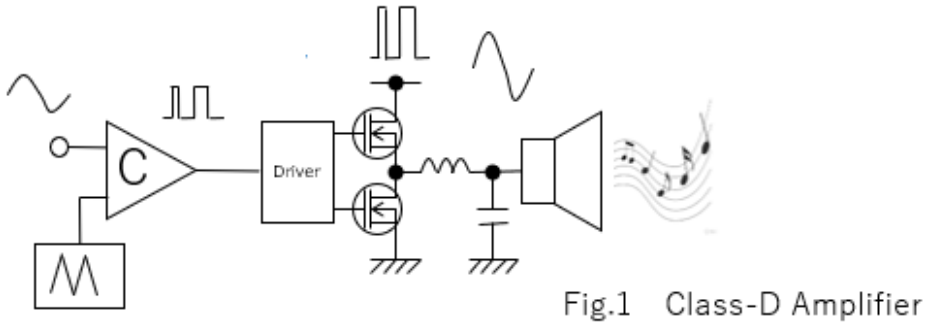


Fig.1 Class-D Amplifier

In Class-D amps, an analog input signal modulates a high-frequency sawtooth wave in order to obtain a rectangular signal for further signal processing. The advantage versus analog amplifiers is the fact that all semiconductors used for signal processing are either fully “on” or “off”. This drastically reduces heat and enhances the efficiency. However, incoming digital signals(even those with high resolution) have to be converted into the analog domain first which bears the risk of lacking accuracy. Also, if the analog signal contains distortion and noise, these will be fully processed during the amplification.

Block diagram of a Technics full-digital amplifier

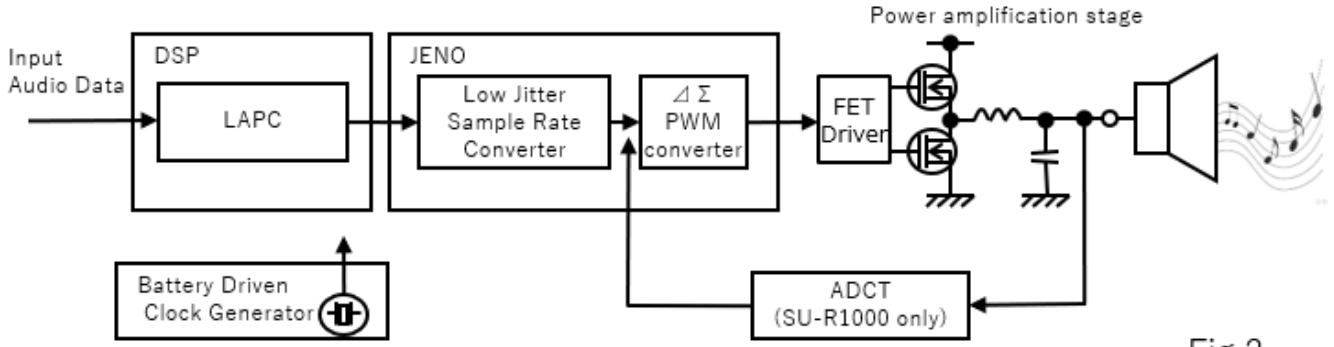
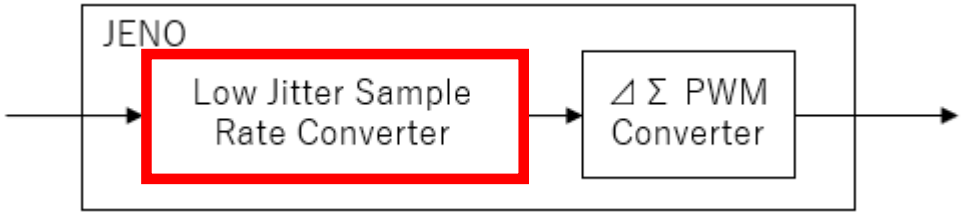


Fig.2

Technics' full digital amplifier processes a digital input signal as it is with high precision. This is vastly advantageous in terms of low noise and low distortion especially when handling high-res signals. When dealing with analog signals, a 192KHz/24bit high-precision A/D converter is used to ensure precise conversion into the digital domain.
However, at the high accuracy of the full digital processing, jitter is the only drawback. Jitter is the fluctuation in the time interval of digitally transferred data, and the output signal is distorted due to the non-uniformity of the time interval of the clock that controls the timing of digital data transfer, resulting in deterioration of sound quality. Therefore, Technics has realized an amplifier that takes advantage of full digital signal processing, yet overcoming the drawbacks of conventional digital amplifiers by providing highly sophisticated treatment of this jitter(JENO-Engine).

PROPRIETARY TECHNICS DIGITAL AMPLIFIER TECHNOLOGIES – JENO-ENGINE

JENO stands for Jitter Elimination and Noise Shaping Optimization



The Low Jitter Sample Rate Converter

Digital signals of various music sources come in with various sampling frequencies such as 36KHz/44.1KHz/48KHz/96KHz/192KHz. Therefore, before processing, these signals have to be upsampled to a sampling frequency that is the least common multiple of the input/output sampling frequency, and then decimated at the output sampling rate again. Since this oversampling signal processing accuracy determines the performance and sound quality of the entire amplifier, it is necessary to ensure maximum accuracy.
The digital audio signal input signal is first input to the **"Low Jitter Sample Rate Converter"**, and the sampling frequency of the sound source input at various sampling frequencies is converted to a single PWM drive frequency (768KHz).
In order to perform PWM drive with high accuracy, the signal must have no time fluctuation. Therefore, a PWM signal is generated from a highly accurate clock signal obtained by the crystal oscillator. On the other hand, the input signal contains **jitter** due to the influence of the transfer path, etc., and is **asynchronous** with the output. In order to synchronize the input signal clock with the internal processing clock of the amplifier, a highly precise Sample Rate Converter is required to have the function of converting the sampling frequency("over"-sampling) while removing the input jitter.

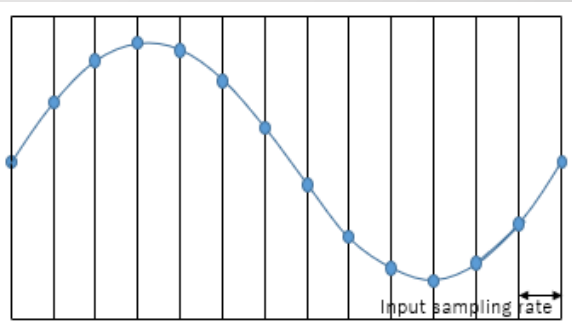


Fig.3-1 Original Data

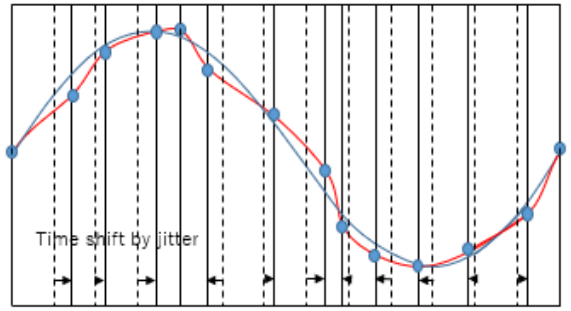


Fig.3-2 Distorted by Jitter

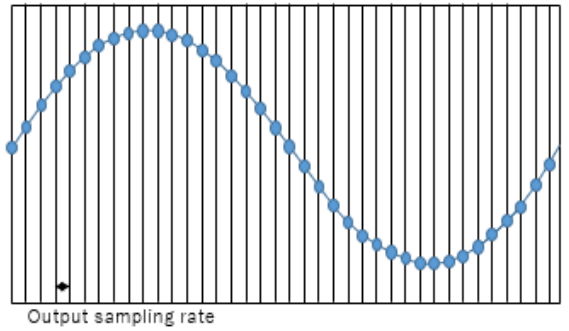


Fig.3-3 Up-sampled data

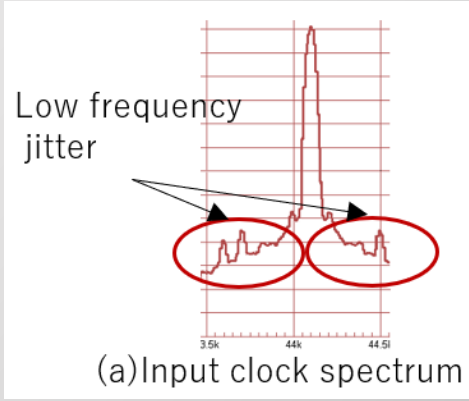
PROPRIETARY TECHNICS DIGITAL AMPLIFIER TECHNOLOGIES – JENO-ENGINE

What is Noise Shaping and how is it applied in Technics amplifiers?

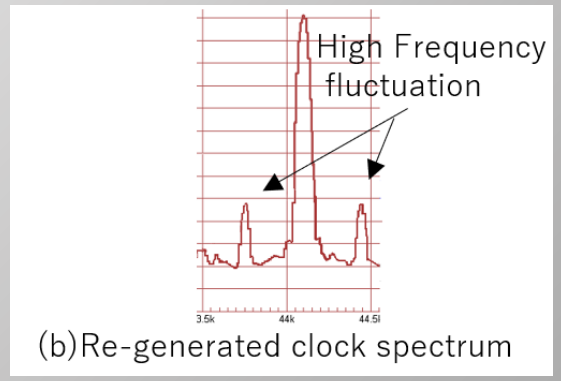
Equally important as the oversampling accuracy in the “Sample Rate Converter” is the accuracy of detecting the sampling frequency of the input audio signal. If this accuracy is low, correct oversampling operation cannot be obtained. Therefore, Technics has developed a unique method that applies “Noise Shaping” technology to the conventional digital PLL(Phase Locked Loop) generally used for triggering the oversampling.

However, as shown in Fig. (a) “Input clock spectrum”, the time axis here fluctuates widely due to the influence of the transmission path, especially in the low frequency. If a frequency is detected using this, a fluctuating sampling frequency appears in the vicinity of the true sampling frequency with a high probability, and it is difficult to accurately obtain the correct sampling frequency. Therefore, a “Noise Shaper” is applied to the clock information to convert the low frequency noise component (which is the frequency fluctuation component) to the high frequency range. The “Noise Shaper” is a technology realized by the ⊿Σ converter that pushes the quantization noise into the high frequency range to reduce the low frequency noise.
The “Noise Shaper” is also applied to the control signal, and a second digital oscillator is driven to re-generate the new clock spectrum shown in Fig. (b). In addition, it is possible to obtain a clock with low-frequency jitter reduced to a level equivalent to the crystal oscillation accuracy. When this signal is used, the probability of occurrence of values near the true sampling frequency is reduced, so that the sampling frequency can be obtained more accurately, and the “High Precision Over Sampler” can be controlled correctly.

The jitter of the input signal that has moved to a higher range can be absorbed by the multistage filter in the “High Precision Over Sampler”, so it is possible to realize a method with extremely high precision frequency detection and jitter suppression.



(a)Input clock spectrum



(b)Re-generated clock spectrum

The lower jitter around the original clock allows much higher precision in the detection of the oversampling frequency.

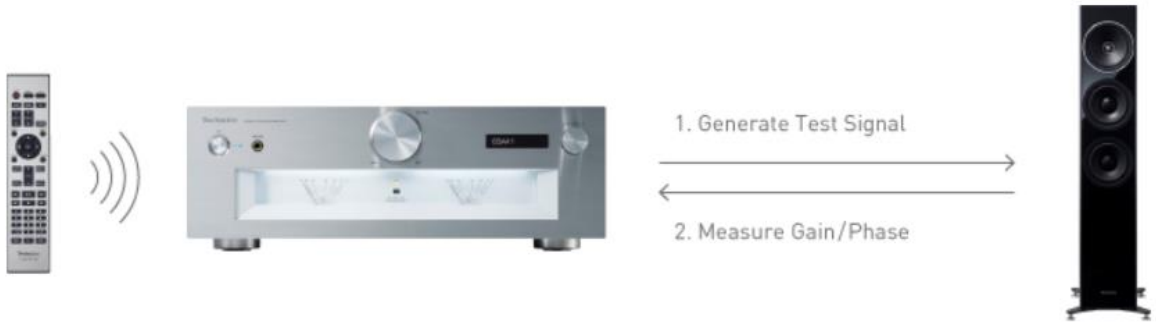
PROPRIETARY TECHNICS DIGITAL AMPLIFIER TECHNOLOGIES – LAPC

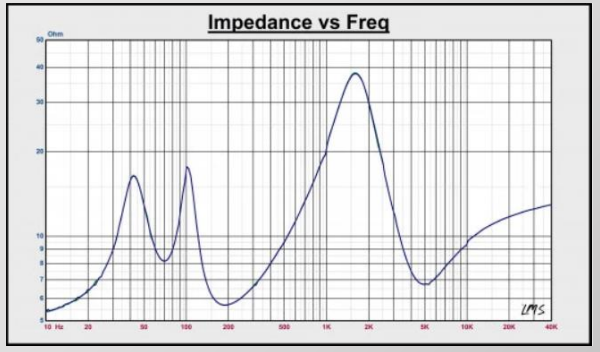
LAPC stands for Load Adaptive Phase Calibration

The impedance of the speaker is not constant as shown in the top figure at the right, but has frequency characteristics. Ideally, the amplifier needs to drive the speaker without being affected by the characteristics of this impedance. Especially in a digital amplifier, an LPF (low-pass filter) for the removal of the carrier signal is required after the output transistor, so the frequency characteristics are disturbed more than in an analog amplifier due to its effect. Of course, these could be improved by applying negative feedback (NFB) technology, but when NFB is applied, there is a side effect that a signal including a sound signal is returned from the output to the input, which causes distortion in the transients and therefore the sound quality of the digital amplifier may be deteriorated.

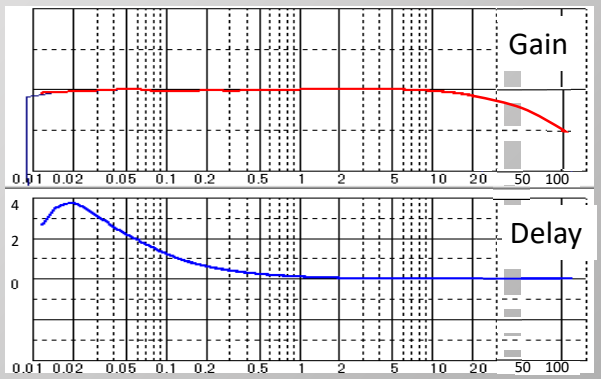
In order to solve this problem, Technics compensates the characteristics by measuring the output gain and phase characteristics of the amplifier at the speaker terminal with the speaker connected, and creates an ideal impulse response secured for any speaker. We have called this proprietary technique “LAPC”. Basically, for performing the measurement and correction of impedance and phase characteristics, a DSP, digital filers and a non-volatile memory are used.

This technique is unique for Technics digital amplifiers and cannot be obtained by conventional analog amplifiers!

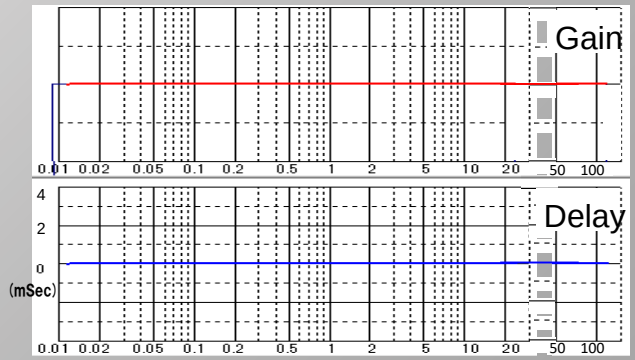




Conventional Amplifier

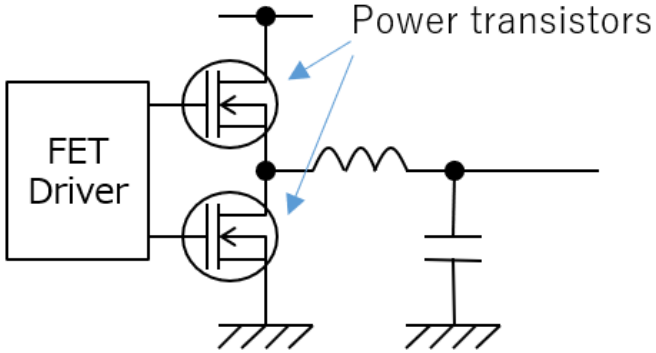


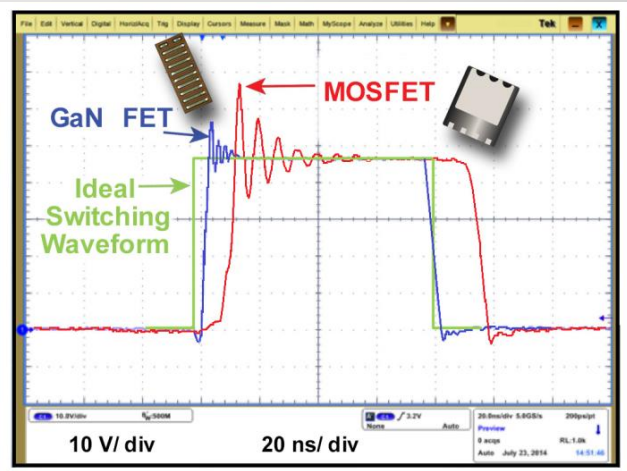
LAPC



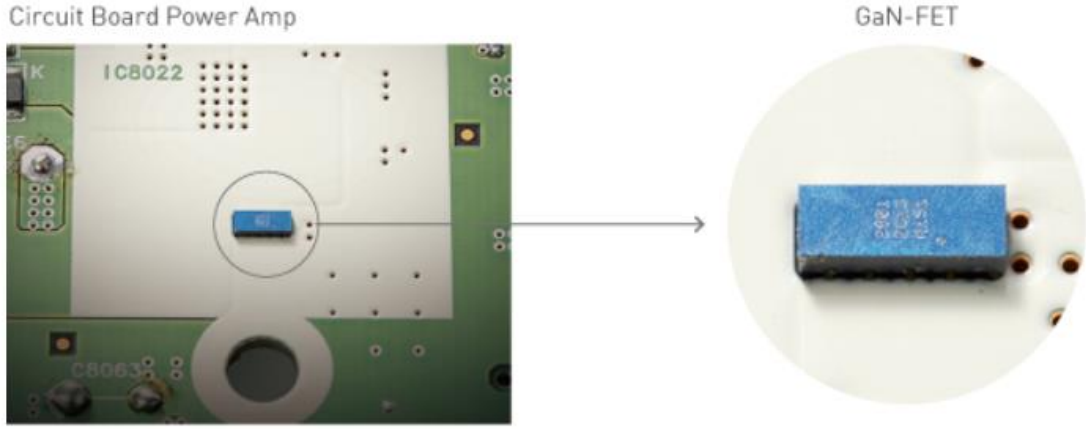
PROPRIETARY TECHNICS DIGITAL AMPLIFIER TECHNOLOGIES – GaN-FET

At the output stage of the digital amplifier, the PWM pulse generated by the JENO Engine is turned ON and OFF(switching) by the FET driver, and power is supplied from the power supply to the speaker.
Since the PWM signal operates at high speed, the response of the output transistor also contributes significantly to the performance.
Normally, a power MOS-FET is used here. In the Technics high-class amplifiers such as SE-R1, SU-G30 and the new SU-R1000, Gallium Nitride (GaN) driver transistors are used in order to switch the output power.
Compared to MOS power transistors, GaN has ideal characteristics of high-speed switching, low distortion and low ON resistance, resulting in very low loss.





GaN vs. MOS-FET characteristics.
Very fast switching ensures extremely low loss, therefore maximum signal fidelity.



PART 2

Introducing the New SU-R1000 Amplifier Technologies

SU-R1000 – DEVELOPMENT INTENTIONS

THE GOAL: CREATE A REVOLUTION ON THE AMPLIFIER MARKET

- Top class sound quality and functionality, with the ease in handling of an integrated Amplifier
- Enhance the Technics Brand recognition in the amplifier field.

THE APPROACH: ENHANCING THE JENO ENGINE

- Improving the sound quality by overcoming the weaknesses without spoiling their advantage:
  - ADCT: Active Distortion Cannceling Technology
  - Advanced Speed Silent Power Supply

NEW TECHNOLOGY PROPOSALS: FOR ANALOG PLAYBACK

- Enhance sound quality of Phono-stage by Digital Technology
- Intelligent Phono EQ:
  - Accurate PhonoEQ Curve
  - Phono Response Optimizer
  - Crosstalk Canceller

SU-R1000 – THE CONCEPT

Reproducing the energy of music and the exact details of the sound source with maximum fidelity

1 **Natural and energetic reproduction of all delicate nuances of music**

- **JENO Engine** [Jitter Elimination and Noise-shaping Optimization]
- **GaN-FET Driver** [High-Speed and Low Impedance Power devices]
- **LAPC** [Load Adaptive Phase Calibration]
- **ADCT** [Active Distortion Cancelling Technology]

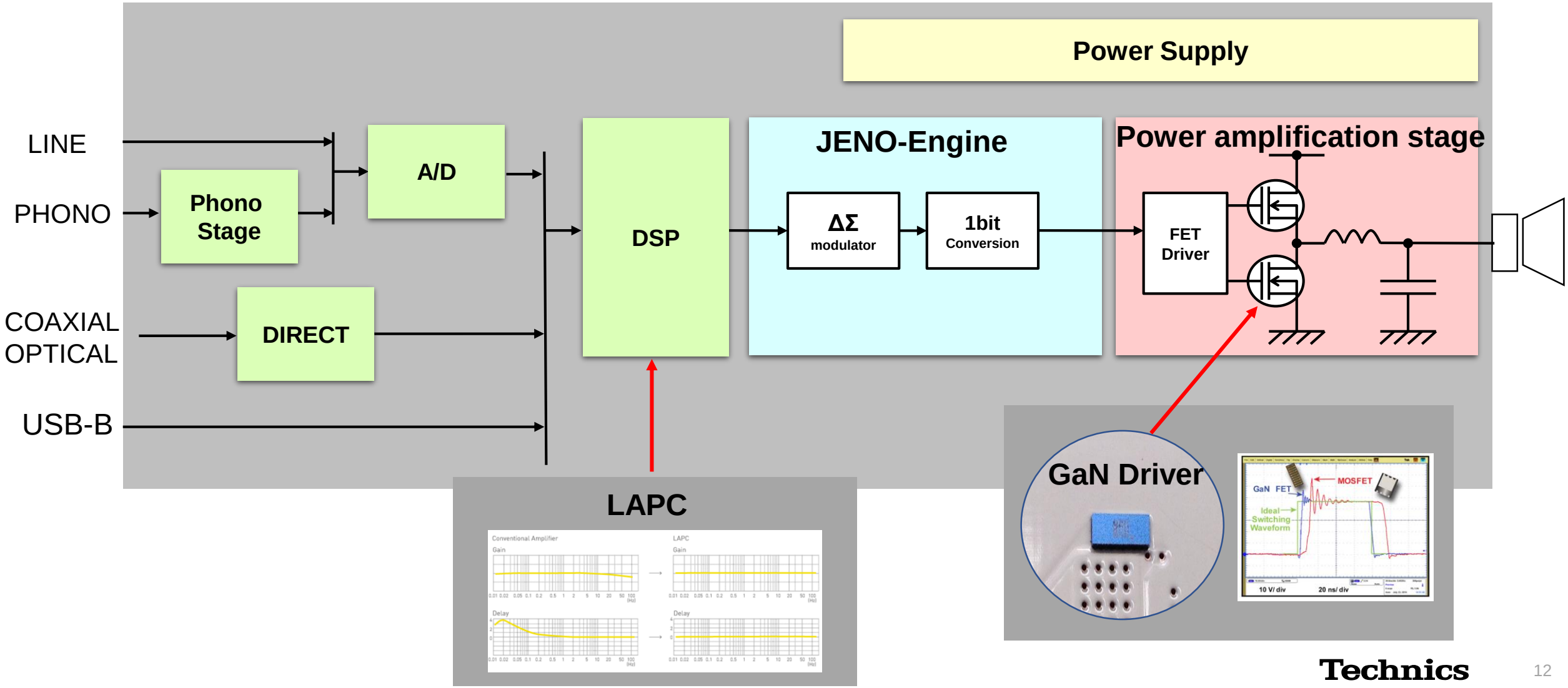
2 **Super high-speed switching power supply delivers energy directly to the amplifier with high stability and responsiveness**

- **AS2PS** [Advanced Speed Silent Power Supply]

3 **Deliver exact detail of music: for digital source with full digital transmission, for analog source with analog / digital hybrid technology**

- **Intelligent Phono EQ**
  - Accurate Phono EQ Curve
  - Phono Response Optimizer
  - Crosstalk Canceller

SU-R1000 – SIGNAL FLOW AND KEY TECHNOLOGIES



SU-R1000 – CHALLENGING NEW TECHNOLOGIES

Improving The Sound Quality By Overcoming The Weaknesses without Spoiling Their Advantages

The Pros:

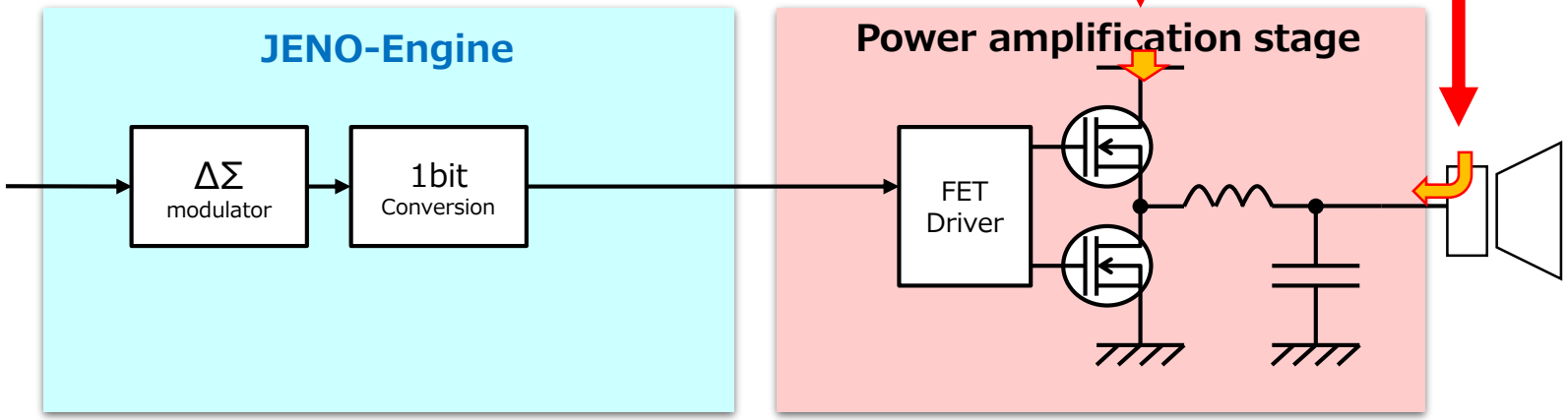
- Clear, smooth sound with low distortion and low noise
- Precise sound image
- Wide sound stage

The new challenge:

- Improve the power amplification stage by removing potential distortions by

Power supply voltage dip at high current

Back Electromotive Force, aka “Speaker Kick-back”



SU-R1000 – CHALLENGING NEW TECHNOLOGIES

1. Kick back of Speaker (Back Electromotive Force)

“Active Distortion Canceling Technology”

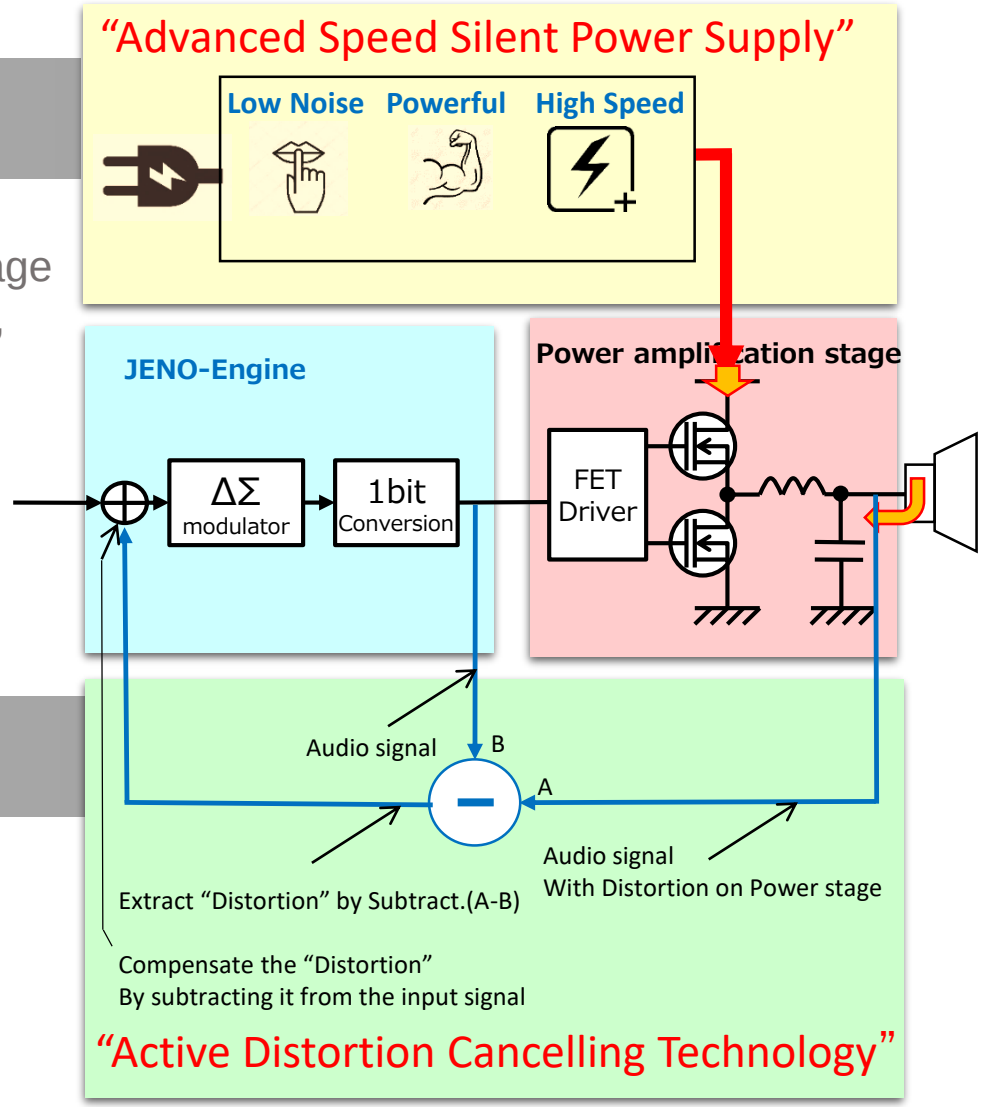
- Feedback of ONLY the distortion caused in the power amplification stage
- Keep advantage of the JENO Engine by NOT feeding back the actual, full music signal

(Feedback in conventional analog amps spoils the transients in the music signal due to feeding back the FULL music signal including the distortion)

2. Power supply Voltage Dip at High current

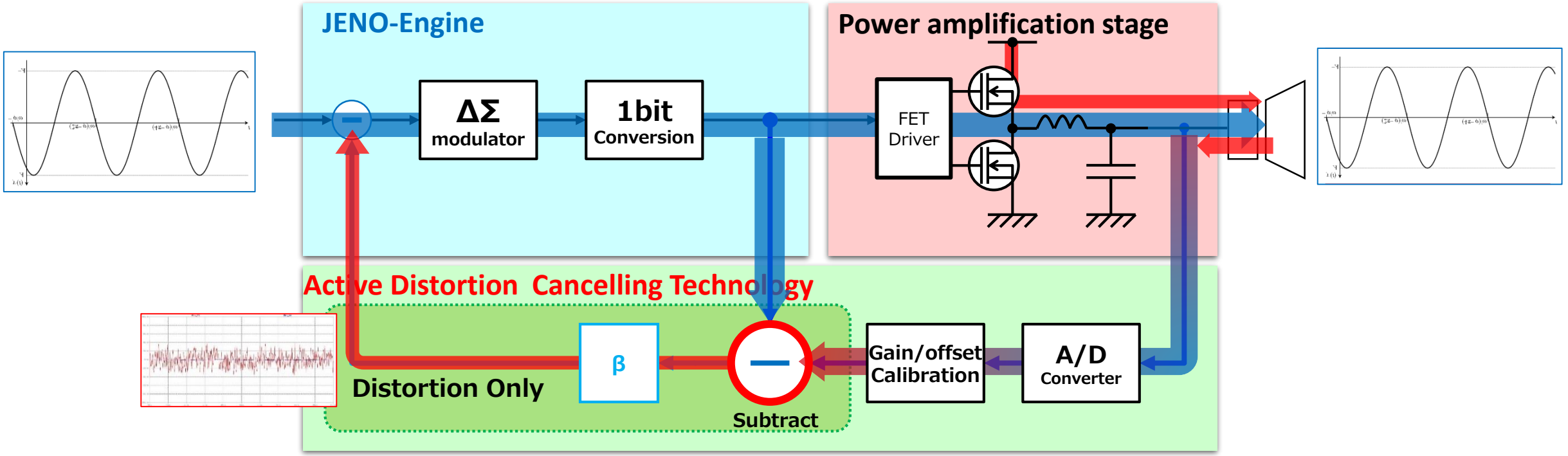
“Advanced Speed Silent Power Supply”

- Super high-speed switching Power supply
- Super low-noise Regulator
- Dual Power Supply



SU-R1000 – ACTIVE DISTORTION CANCELLING TECHNOLOGY (ADCT)

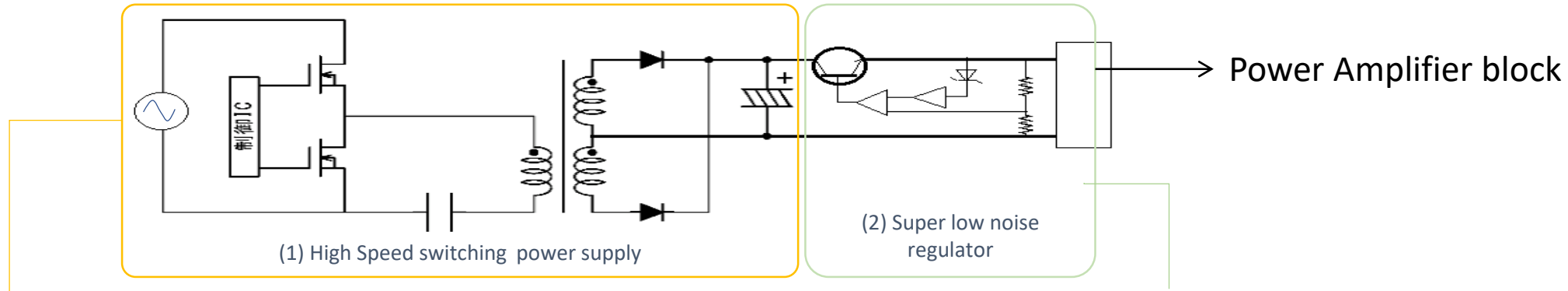
Improve the performance of the digital amplifier and realizes high freshness and powerful music playback.



1. **Cancel the "Back electromotive force", "power supply fluctuation" and "disturbance noise".**
   ⇒ Achieve high drivability , Low distortion sound
2. **High accuracy "distortion extraction" by original "learning circuit".**
   Calibrate variation on analog stage (offset etc.)

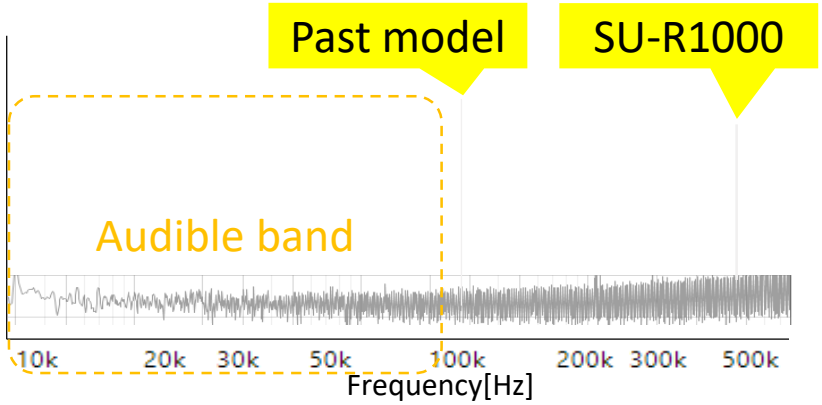
SU-R1000 – ADVANCED SPEED SILENT POWER SUPPLY

High Speed, Powerful and Low Noise New Power supply



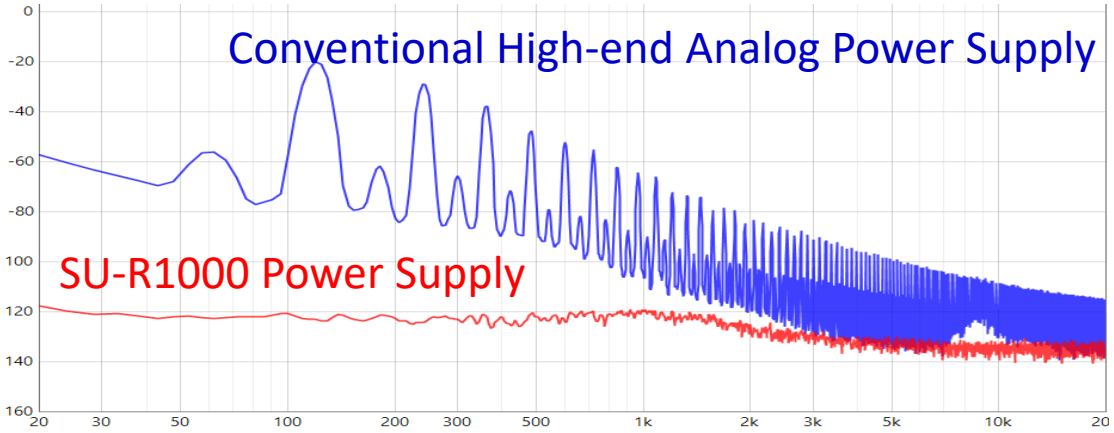
1. Super high-speed switching Power

- High frequency switching reducing ripple noise
- Shifting the switching frequency far away from the audible band avoids negative effect on audio performance.



2. Super low noise Regulator

- Very low noise power supply by strong filter circuit
- Voltage sensing technology realizes high stability power supply.



SU-R1000 – OPTIMALLY DEDICATED POWER SUPPLY CONFIGURATION

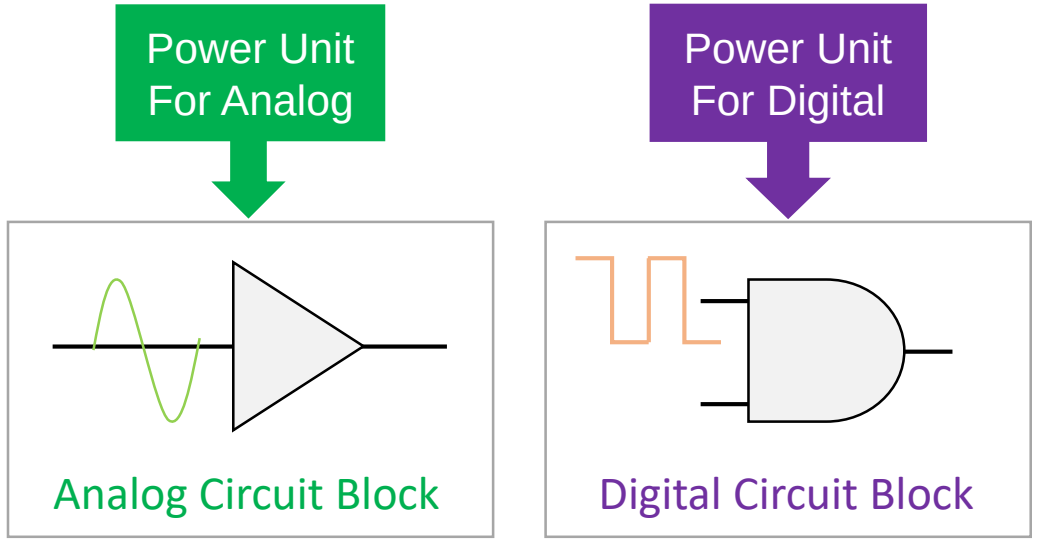
Maximize the performance of each circuit block, realize pure and large sound stage.

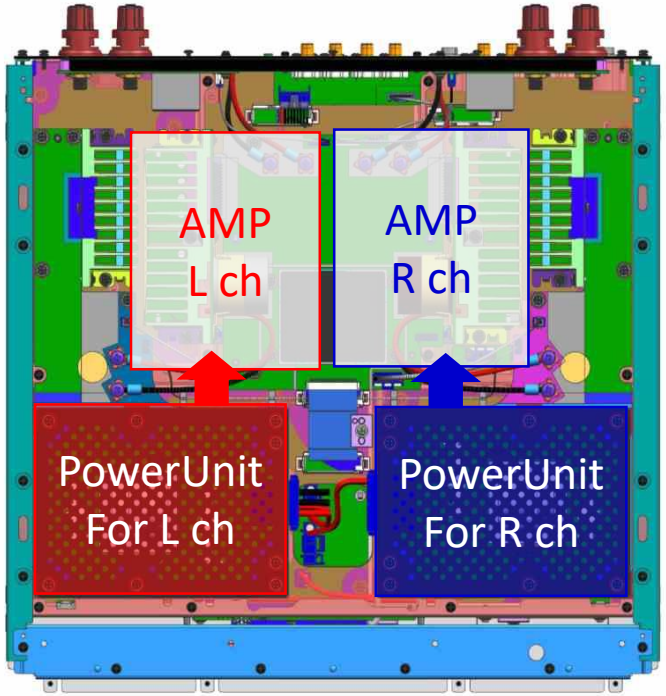
PRE AMPLIFIER BLOCK

Prepare a dedicated power supply unit each for the Digital Circuit Block and the Analog Circuit Block
→Prevent interference between Digital/Analog, Achieve pure sound.

POWER AMPLIFIER BLOCK

Prepare Dual Mono configuration power units for L ch and R ch amplifier blocks
→2-units power supply provides enough power and improves channel separation in order to realize a wide sound stage and powerful sound image





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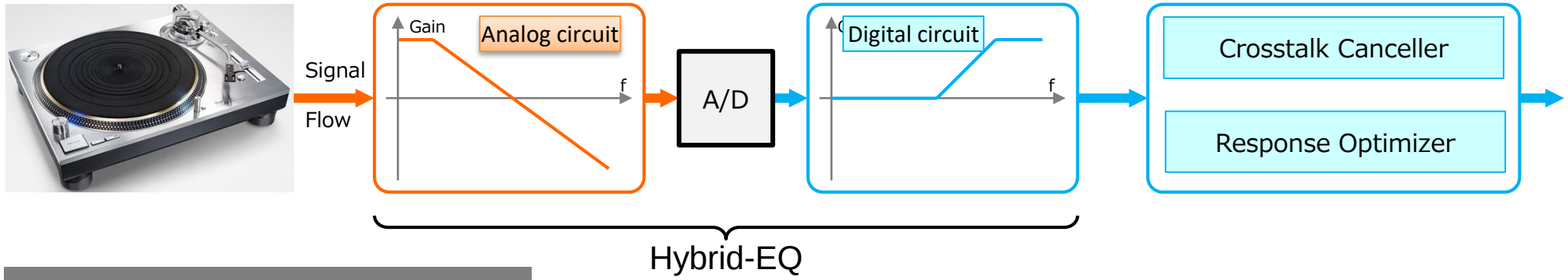
New Phono-Stage Technologies

SU-R1000 – INTELLIGENT PHONO EQ

Exact vinyl playback by combination of analog and digital technology, which cannot be realized by an analog phono equalizer



1. Accurate EQ Curve

High precision EQ curve by the combination of analog circuit and digital filter

2. Crosstalk Canceller

- Cartridge picks L/R signal on the groove by *single* stylus. This may cause crosstalk
- Newly developed technology cancels crosstalk with “learning process” using bundled vinyl

3. Response Optimiser

Correct all Gain/Phase response variations caused by impedance miss matching etc.

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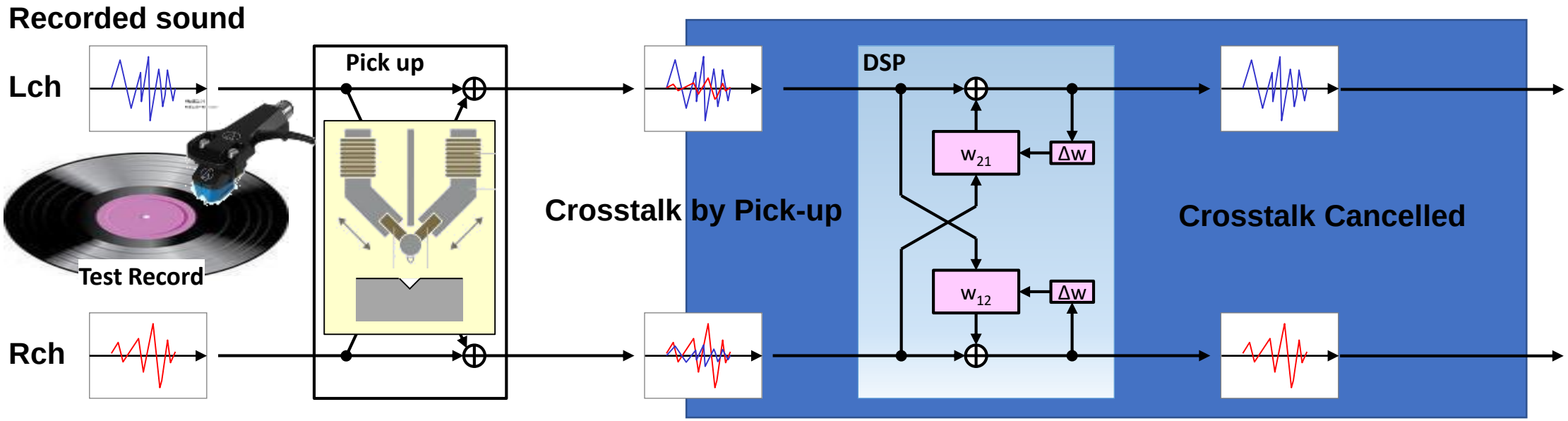
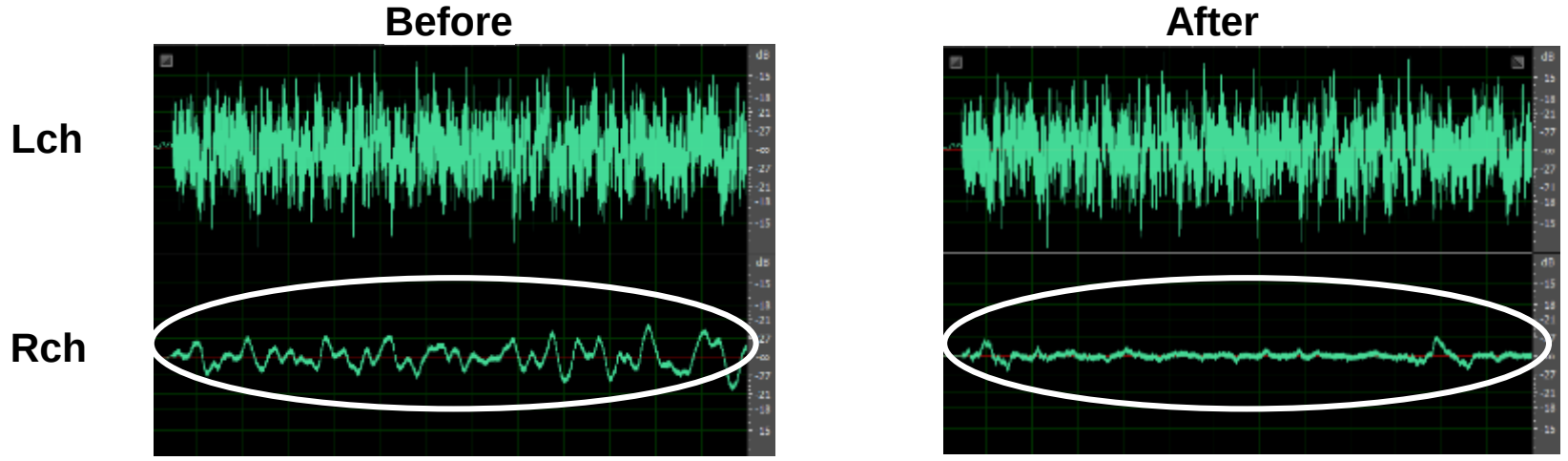
SU-R1000 – CROSSTALK CANCELLER

- Measurement and correction of crosstalk by playback of bundled calibration vinyl





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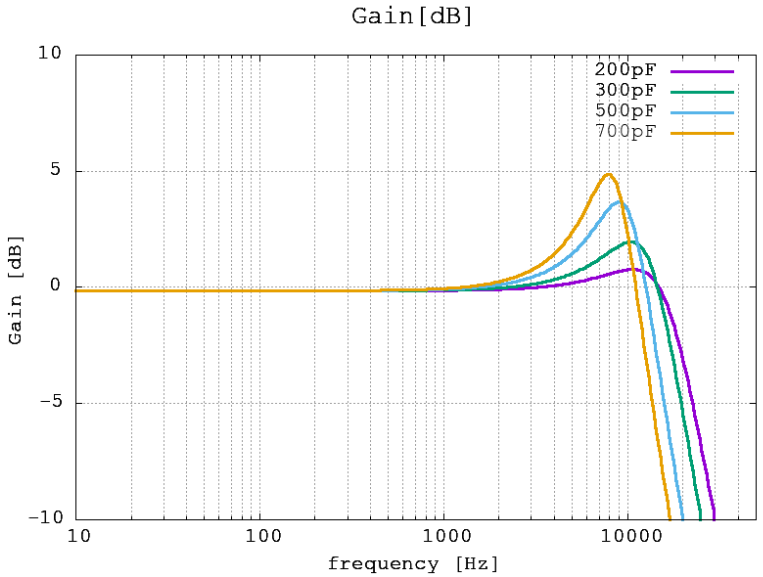
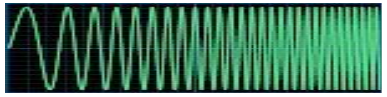
SU-R1000 – RESPONSE OPTIMIZER

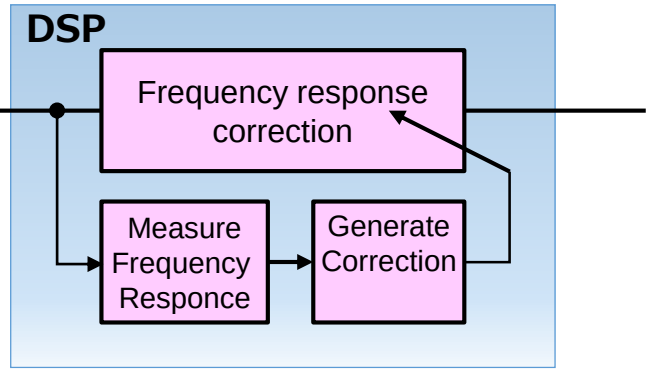
Pickup cartridge needs impedance matching

- **Measurement of the frequency response by bundled vinyl record**
- **Calibration of flat Gain/Phase response over 400 points in frequency range (0-20KHz)**
- **Able to correct all the response variations potentially caused by impedance miss-matching etc.**





Keeps the input path simple



Eliminates impedance matching selector/circuit which potentially creates noise.

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SU-R1000 – OLD AND NEW HERITAGE

A REVOLUTIONARY INTEGRATED REFERENCE AMPLIFIER

with highly innovative technologies, defining a new performance standard it its class.

Groundbreaking digital amplification technology with active distortion cancelling (ADCT).

Advanced Speed Silent Power Supply (AS²PS) for ultimate stability and drivability(control of counter electromotive power, aka speaker “kick-back”)

New, intelligent Phono EQ with “Crosstalk Canceller” and “Response Optimizer” for accurate phono equalization and a perfect matching of the employed pickup cartridge system

Crystal-clear performance with breathtaking authenticity

Impressive power and unwavering speaker control

Tickling a state-of-the art experience out of every vinyl record

SU-R1000 Design

SU-R1000 – DESIGN

- Massive housing with ultra-solid construction
- Thick aluminium panels
- Design consistency of the iconic Technics Amplifier
- Large VU meters
- Silver version + Black version

SU-R1000 – REAR PANEL DESIGN

Analogue Input Terminal

LINE x2, LINE XLR x1
PHONO x1, PHONO XLR x1

*MM/MC support
*PHONO XLR support MC ONLY

Digital Input Terminal

Coaxial x2, Optical x2
USB-B x2
*MQA support

System terminal
Control
For SL-G700,
ST-C700

REC OUT, PRE OUT
REC IN, MAIN IN

SU-R1000 – TECHNICAL SPECIFICATIONS

Output Power	150W + 150W (1kHz, T.H.D.0.5%,8Ω, 20kHz LPF) 300W + 300W (1kHz, T.H.D.0.5%,4Ω, 20kHz LPF)
Load Impedance	4Ω – 16Ω
Input sensitivity/Input impedance	PHONO(MM) : 2.5mV / 47kHz PHONO(MC) : 300uV / 100Ω LINE : 200mV / 22kΩ
USB-DAC (USB-B)	USB Audio Class 2.0, Asynchronous Mode
Support Codec	PCM:32,44.1, 48, 88.2, 96, 176.4,192, 352.8, 384 kHz /16, 24, 32 bit DSD:2.8MHz, 5.6MHz, 11.2MHz 22.4MHz
MQA Support	
Dimensions (W x H x D)	430 x 191 x 459 mm
Weight	Approx. 22kg