

SU-R1000

Technical Description

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1. Intention

During the five years-plus since its rebirth in 2014, Technics has added many lineups in the Reference, Grand and Premium classes, each of which has been well-received in the marketplace.

Particularly, in the turntable field, SL-1200G, which was revived in 2016, was highly regarded by the market for its sound quality that was greatly improved from the past Technics turntables. This was achieved by adopting a new coreless DD motor and digital control schemes. With SL-1000R, the top of the range turntable that further evolved it, the precise and dynamic sound quality that could not be achieved by the previous turntables was highly evaluated.

The “Music World” that Technics was aiming for was well known to audio enthusiasts, and established a firm position in the market.

This was followed by SL-G700 network/SACD player, which was introduced to the market last year, following in the same direction of sound shown by SL-1000R. The SL-G700 has been highly acclaimed for its sound quality and, like the turntables, is establishing its highly respected position in digital source equipment.

Building on these achievements, Technics is now aiming to achieve the same status in amplification. Based on the evaluation in the market for the past five years, we worked on the development of the SU-R1000 with the goal of evolving the digital technology represented by JENO, LAPC, etc., further improving the sound quality, and expanding the “Music World” of Technics. In this document, three key technologies for improving the overall sound quality are explained.

2. Approach

Our approach to achieve the highest level of amplification performance is as follows.

2-1) Evolution of the digital amplifier

Regarding the amplifier section, Technics has been focusing on the superiority of digital amplifiers compared to analog, and has been developing products based on digital amplification. Based on these technologies, we developed the new "Active Distortion Cancelling Technology" to achieve even higher sound quality by compensating for its shortcomings whilst retaining sound superiority. The details are discussed in Chapter 3.

2-2) Evolution of the power supply

We have been researching switching power supplies since the SU-G30 amplifier. We gained enough knowledge to realize a switching power supply that is superior to analog power supplies in sound quality. The details are described in Chapter 4. Advanced Speed Silent Power Supply.

2-3) A new proposal for Phono playback

We believe that the Technics unique digital signal processing technology can improve even vinyl playback sound quality. We implemented a new proposal in the PHONO-EQ of SU-R1000. For more, see Chapter 5: Intelligent PHONO EQ.

Here we will give a little more background of 2-1) and 2-2).

Over the past five years, Technics amplifiers have received high praise throughout the globe. Magazine reviews and user comments from all over the world confirm the clear sound with low distortion/low noise, precise sound Image and big sound stage. On the other hand, some people say that the lacking sense of energy or limited driving power for large woofers are the weak point. So, what should be done to overcome these shortcomings without compromising the sound quality advantages of Technics amplifiers? This is the key point that we focused on when we started the development of this new amplifier.

How Technics amplifiers are rated in the market are

FOR: Clear sound with low distortion/ low noise.
Precise sound Image
Big sound stage

AGAINST: Lack of energy
Less punchy
Poor Drivability

sorted in technical factors

PROS: JENO engine is a fully digital process.
Free from distortion, noise.
Positive reviews are largely attributing to "JENO".

CONS: Only weak point is power amplification stage
Chance of distortion by Kick-back of Speaker (Back Electromotive Force)
Power supply Voltage Dip at High current

Then down to circuit

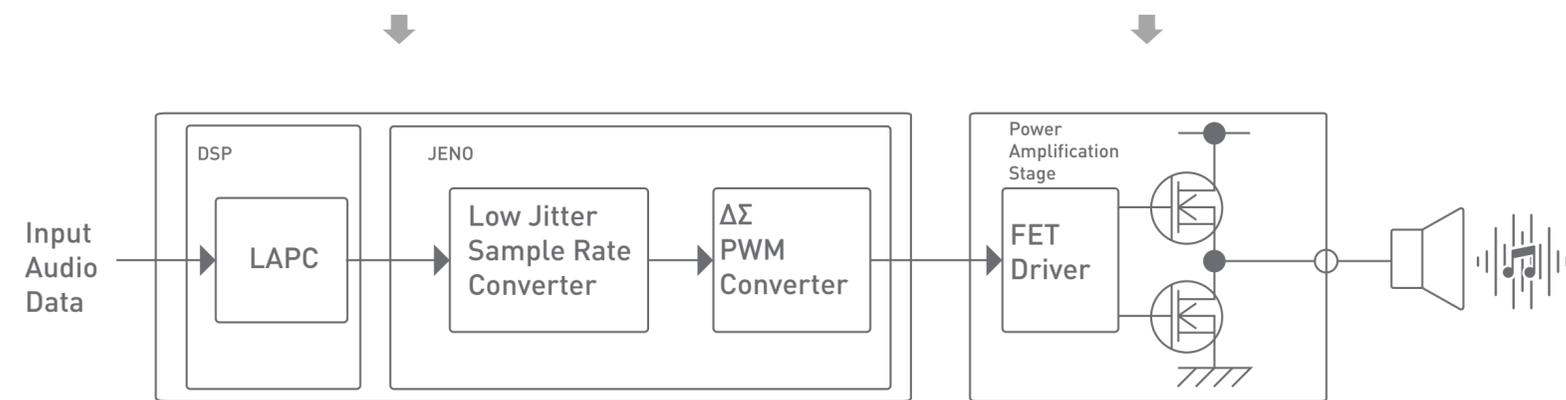


Fig. 1

Comparing this with the block diagram shown in Fig.1, it can be seen that all the advantages are due to the digital processing, and all the disadvantages are in the output stage, which operates in the analog domain, and are the problems related to the transient response operation like kick-back of Speaker (Back Electromotive Force) or Power supply Voltage Dip at High current.

Based on these considerations, we have developed a new digital amplifier system as shown in Fig.2. In addition to the current Technics digital amplifier systems, we have developed a new technology to eliminate distortion caused by the Back Electromotive Force and Voltage Dips in Power supply. They are described in detail in the following section.

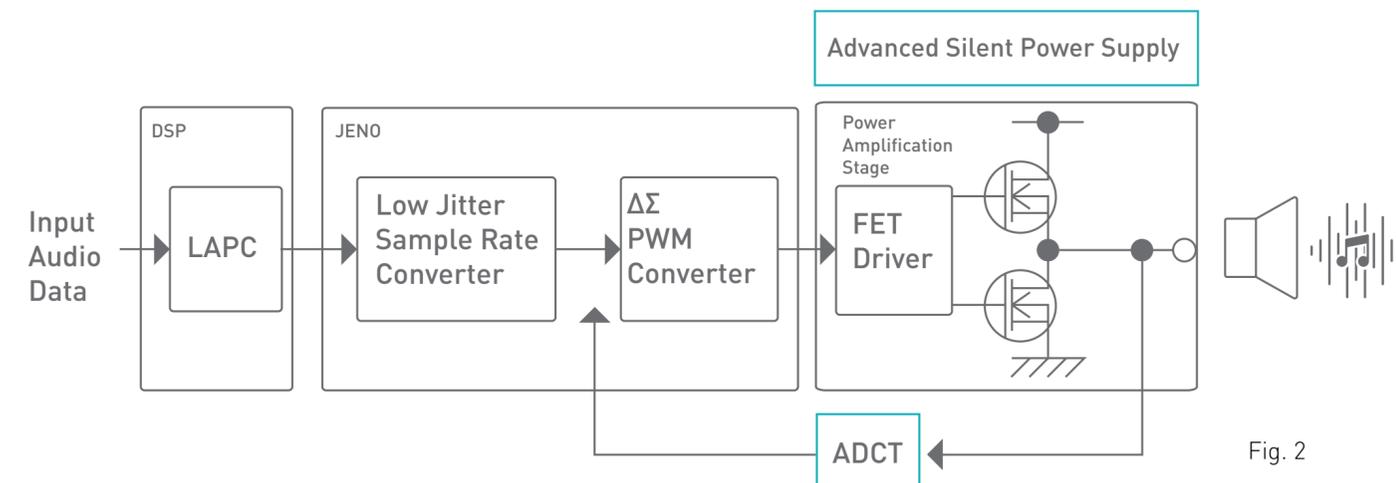


Fig. 2

3. Active Distortion Cancelling Technology

In Fig.3, the distortion caused by the "Back Electromotive Force" of the speaker and the "Power Supply Voltage Dip" occur at the power amplification stage. Distortion cancellation is achieved by subtracting the speaker terminal signal from the JENO output. Since the speaker terminal output is an analog signal, it is converted to a digital signal by an A/D converter, with corrected error by the "Gain/offset Calibration block", and subtracted from the original JENO output digital signal. By subtracting the

distorted component of the analog circuit from the input audio signal, it is possible to compensate the distortion from the output. β in the figure is a constant for matching the $\Delta\Sigma$ -PWM conversion unit and gain.

The advantage of this technology is that it accurately extracts and cancels only the distortion in the digital domain. In Fig.3, the FET driver, the output transistors, the A/D converter and their peripheral components are analog components and

they may cause the output gain variation and DC offset due to the variation of these components' values, which hinders the correct detection of distortion. The "Gain/offset Calibration" block in Fig.3 removes these errors.

Immediately after power-on, the DSP generates a reference sine wave signal, measures the output at that time, and learns the gain and DC offset of the circuit in advance. This learning process is performed in the short period of time with speaker output shut down. The user may not notice it.

During normal playback, by cancelling the learned gain and DC offset value from the A/D converter output, it is possible to accurately extract only the distortion caused in the amplification stage.

The NFB(Negative feedback) in analog amplifiers returns distortion to the input together with the music signal, so the transient characteristics of the music signal are degraded along with the distortion removal. But this "Active Distortion Cancelling Technology" cancels only the distortion and doesn't affect the music signal whatsoever. Clear sound with low distortion/low noise, clear sound image and a large sound stage (which is a characteristic of current Technics amplifiers) are kept. Without interfering to the sound superiority, the speakers' back electromotive force and power drop resistance are improved.

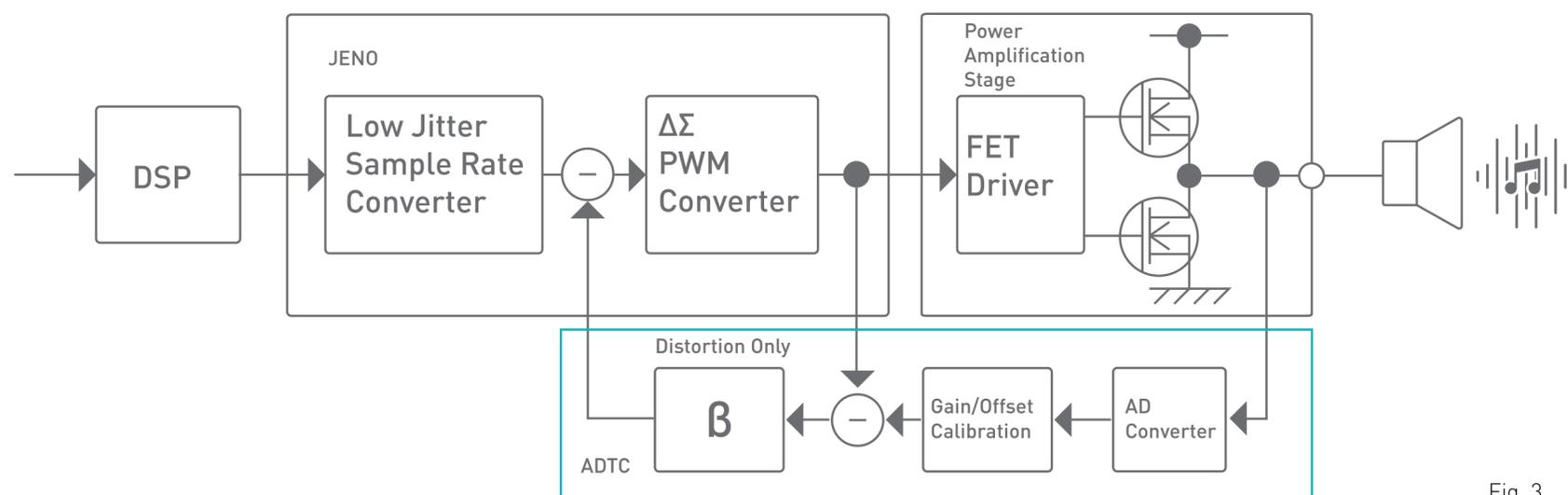


Fig. 3

4. Advanced Speed Silent Power Supply

The first generation amps of the new Technics series in 2014 used analog power supplies. At that time, analog power supplies had an advantage over switching power supplies in terms of noise. But at that time we learned that switching power supplies can provide instantaneous power, as the rectifier circuit runs at higher speed and results in a powerful sound, but on the other hand, switching noise should be taken into consideration and dealt with.

So we continued our research and found that the switching method could achieve a higher S/N than the analog and adopted it in the subsequent amplifiers SU-G30 and SU-G700. The new SU-R1000 is a further evolution of the switching power supply.

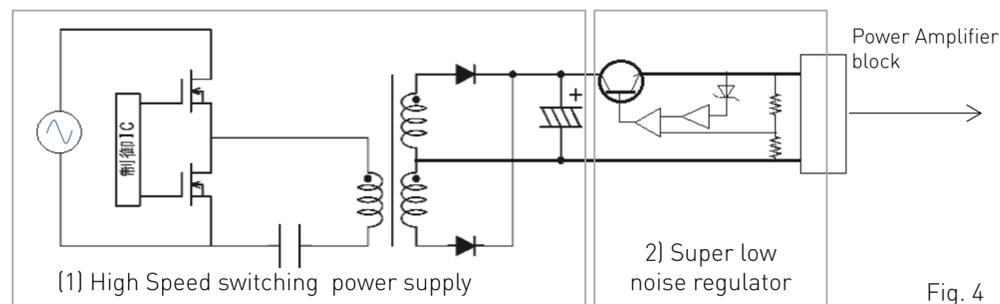


Fig. 4 shows the block diagram of the “Advanced Speed Silent Power Supply” developed for SU-R1000. As shown in the Fig.4, (2) A super low noise regulator is installed in the latter stage of (1) the High speed switching power supply.

Conventional switching power supplies vary the switching frequency in order to keep the voltage regulation. Since the switching frequency itself is sufficiently higher than the audio band, the noise is not a problem, but the modulation noise caused by the switching frequency change may degrade the sound quality. Therefore, Technics uses a power supply with a fixed switching frequency. In particular, the SU-R1000 takes 400 kHz, a higher switching frequency than previous models, that further reduces the impact on the audio band.

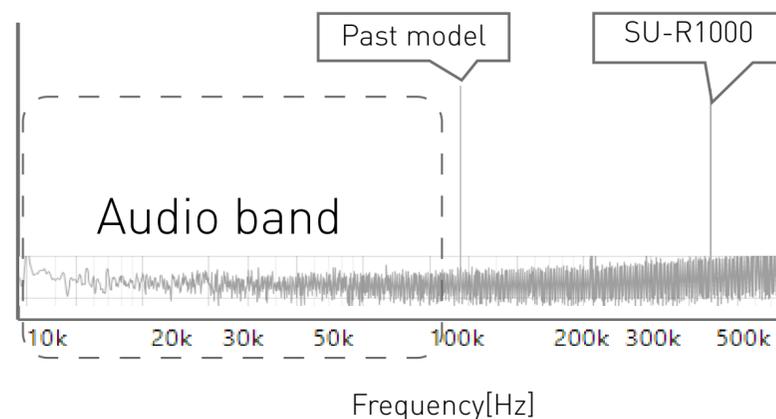


Fig. 5

(2) A super low noise regulator is installed at the latter stage in order to eliminate the reduction of regulation by fixing the switching frequency and to remove the high frequency switching noise component. Here, a broadband low-noise reference voltage circuit and a control circuit with stable high control gain provide flat ultra-low noise characteristics even in the low frequency range.

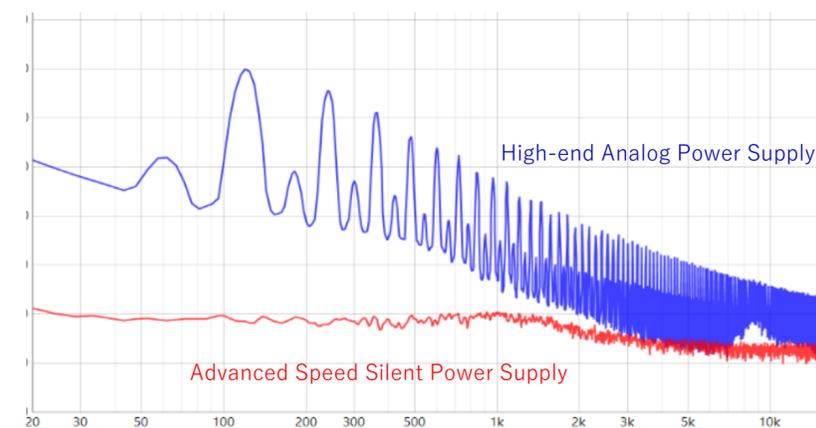


Fig. 6

Fig.6 shows the comparison of the noise between SU-R1000 power supply and other high-grade amplifier analog power supplies. As shown in the figure, good noise characteristics are obtained over the entire band.

Fig.7 shows the comparison of the load variation between SU-R1000 and other high-grade analog amplifier power supplies. As shown in the figure, the voltage does not drop even when the load current changes like a pulse, so high stabilized power supply is obtained.

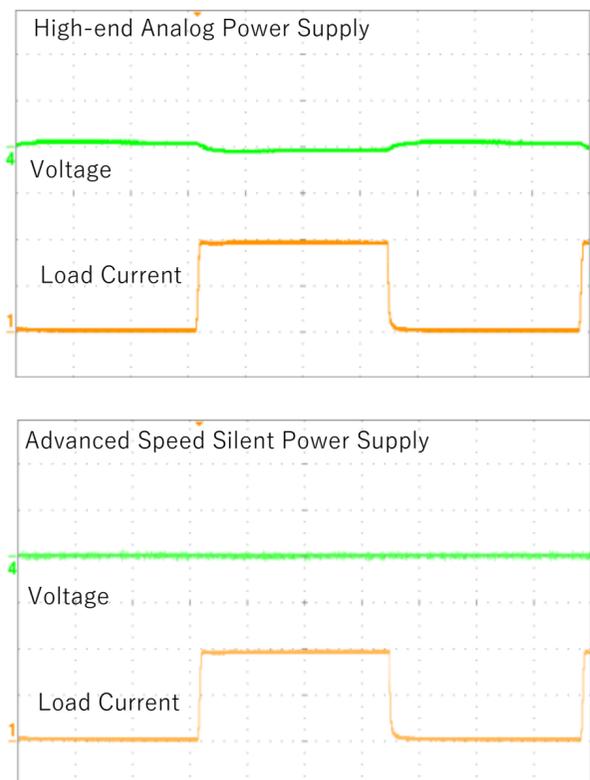


Fig. 7

Because SU-R1000 is an integrated amplifier, the internal circuitry can be separated into "Pre Amp" and "Power Amp" stages, and the analog and the digital circuits are combined. In particular, the PHONO-EQ section, which handles minute analog signals, could be strongly affected by noise from the power supply.

In the "Pre Amp" section, the analog and digital circuits are supplied from separate power supplies, and the power supply for the "Power Amp" section that requires higher power is independent from the L/R channels. By using four power supplies in total, interference through the power supply between each block is prevented and both high S/N ratio and high separation are achieved.

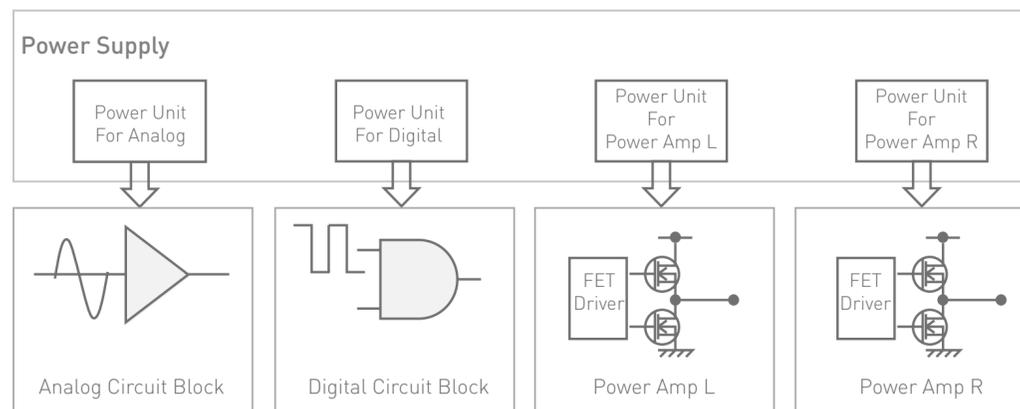


Fig. 8

5. Intelligent PHONO EQ

By applying the DSP technology that Technics has accumulated (such as LAPC) to the PHONO-EQ, a higher level of sound quality from vinyl playback will be realized.

Fig.9 shows block diagram:

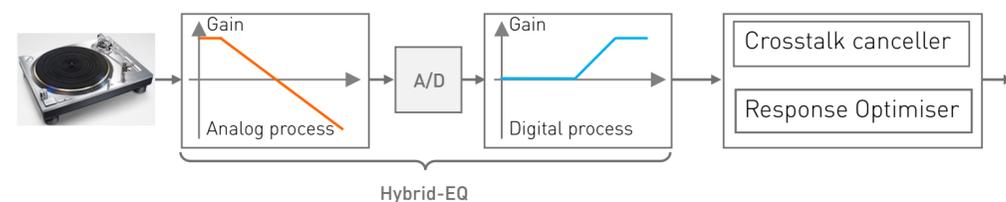


Fig. 9

There are three main components: “Accurate EQ Curve” for high precision phono (RIAA) equalizing, “Crosstalk Canceller” to cancel cartridge crosstalk and “PHONO Response Optimiser” to compensate for frequency response variations caused by impedance mismatches. The details are explained below.

5-1. ACCURATE EQ CURVE

The RIAA equalizing process is done by a hybrid system of analog and digital. A high-gain integral circuit (LPF) is realized in the analog domain, and high frequency information is lifted after A/D conversion. By using a 40dB LPF in the analog region, bit loss due to digital filter processing is avoided, and high S/N is achieved by a high precision high-shelving filter in the digital domain.

In addition to the standard RIAA, certain older EQ curves such as IEC, Columbia, Decca/FFRR, AES, NAB and old-RCA are supported to enjoy a wide variation of vinyl records.

5-2. CROSSTALK CANCELLER

One of the major weak points of vinyl playback is the “crosstalk” which is caused by the stylus picking up information from both channels that can ‘interfere’ with each other.

With this function, the crosstalk of the cartridge is measured by using the signal from the supplied “Calibration Record”. And the crosstalk characteristics (both L to R and R to L) are obtained by the built-in DSP. During the playback, the built-in DSP will cancel the crosstalk by applying these characteristics as shown in Fig.10, Fig.11. This allows more precise sound images and the reproduction of a wider and deeper sound field.

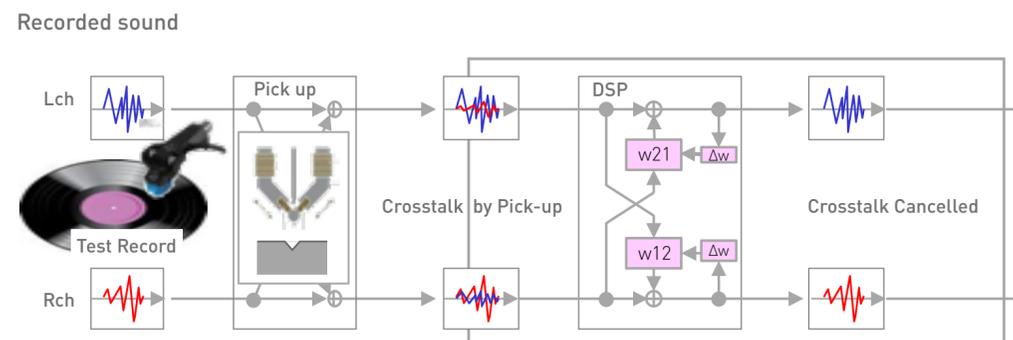


Fig. 10

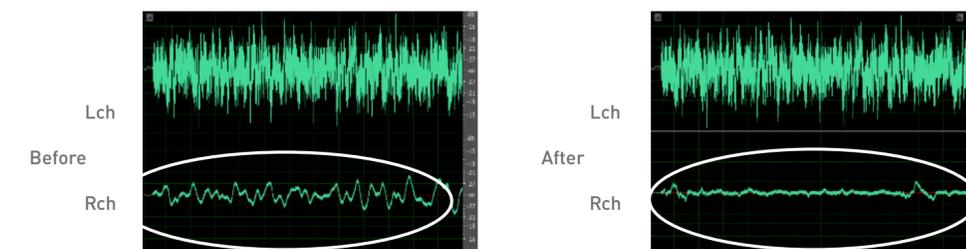


Fig. 11

The crosstalk cancellation is carried out by generating a cross talk signal of one channel through an FIR filter and subtracting it from the signal of other channel. But crosstalk has its frequency and phase characteristics and every cartridge has individual variability. Therefore it's necessary to measure the crosstalk characteristics of the cartridge and find the coefficients set of the filter suitable for that.

As shown in Fig.12, 4096 taps of FIR filter are provided to secure enough frequency resolution. The crosstalk characteristics of the cartridge are measured and the most suitable filter coefficient set (a1~a4096) is purchased from the calibration process, using the test signal recorded on the Calibration Record. On this, one channel is recorded with "White Noise" while the other channel is silent.

In the "calibration process", for getting the most suitable set of coefficients, first an "Error" signal is obtained by subtracting the "Estimated crosstalk" signal that is recognized from the "White Noise" through the FIR filter from the other channel "Silent signal" with crosstalk. The "Coefficients Adjustment" block in Fig.12. then changes some value of coefficients of a1-a4096 in a unique way to get the smaller "Error" signal. The "Coefficients Adjustment" block repeats this cycle to get the smallest "Error" signal.

Each one of the 4096 coefficients has 32bit resolution. This means that a huge amount of such cycle repetition will be required to find the best coefficients set, and it would take an enormous amount of time, but Technics developed a method to achieve this within a shorter time period to implement it in the "Crosstalk cancellation".

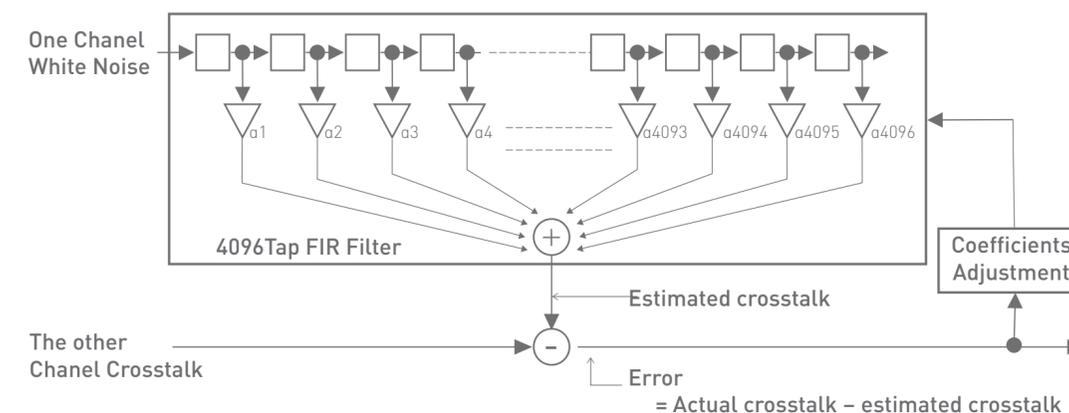


Fig. 12

5-3. PHONO RESPONSE OPTIMISER

In the same way, the frequency response of the cartridge is measured using the TPS (Time Pulse Stretched) signal recorded in the enclosed "Calibration Record", and the error is corrected. As with the Crosstalk Canceller, a 4096tap FIR filter is provided for this function.

Every cartridge has its own unique frequency characteristics that determine the sound character. So the target frequency response of this function is not "completely flat". It flattens only the peak caused by the effect of impedance mismatching between the cartridge and the phono equalizer as shown in Fig.13.

Some high-grade phono preamps are equipped with dip-switches to adjust the input impedance, as shown in Fig.13. But it requires complicated circuit in the sensitive signal paths which may cause noise contamination. The "PHONO Response Optimiser" is aimed to reproduce the original sound quality of the cartridge by compensation. At the same time, it will reduce the chance of noise contamination caused by such a switching circuit in the high-sensitivity phono input line.

Also, the Response Optimizer reduces the output level difference between the L and R channels of the cartridge which is caused by the production tolerance, and improves the auditory lateralization.

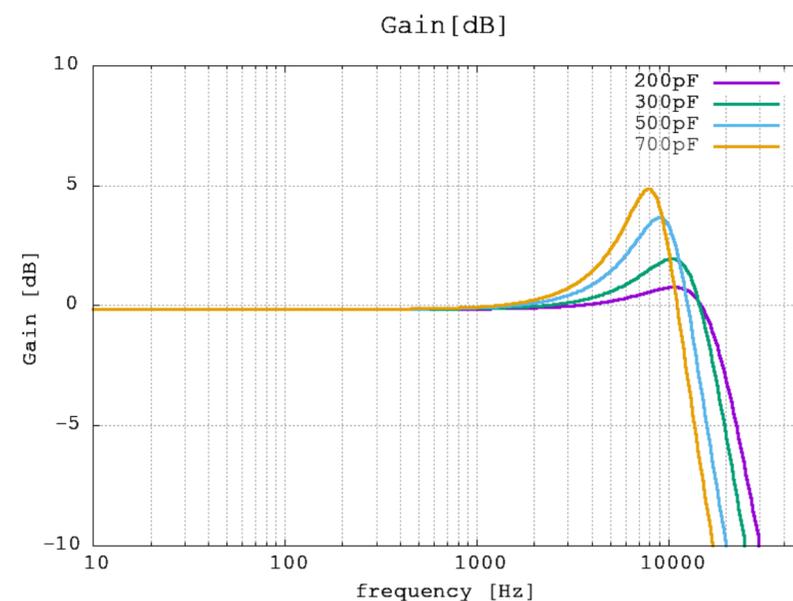


Fig. 13

5-4. MEMORY

The user can calibrate the "Crosstalk Canceller" and the "PHONO Response Optimiser" by using the bundled "Calibration Record" with the cartridge. The measurement and calculation takes around ten minutes, and all the parameters and filter coefficients for both functions are stored in a non-volatile memory inside the SU-R1000. This setting is then used to run the "Crosstalk Canceller" and "PHONO Response Optimiser" on subsequent playback. These parameters and coefficients can be memorized and switched for up to three cartridges. In addition, each function can be turned on and off independently, making it easy for analog enthusiasts to enjoy them in a wide range of ways.

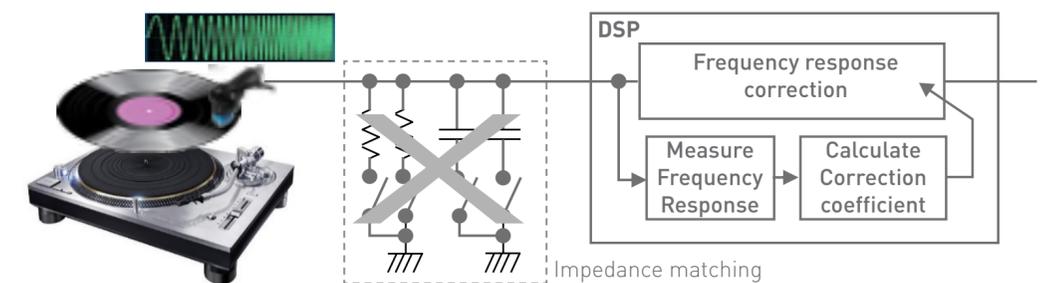


Fig. 14

6. Conclusions

Among the new technologies of the SU-R1000, which is a culmination of Technics digital amplifier technologies, there are three key technologies that are particularly important for sound quality.

The “Active Distortion Cancelling Technology” and the “Advanced Speed Silent Power Supply” drive the sound quality of this amplifier to new performance levels. We are sure that the clear sound with low distortion/low noise, the precise sound imaging, a big sound stage, plus an energetic and dynamic sound will be widely and highly acclaimed among audio enthusiasts, even those who are still doubtful of the merits of digital amplifiers.

The “Intelligent PHONO EQ”, especially the performance of the “Crosstalk Canceller” and the “PHONO Response Optimiser”, introduce a completely new realm of vinyl playback, in a superb way to “rediscover music”.

These unique technologies that no other company has developed or used, takes the ‘music world’ of Technics to a whole new level. This is exactly what we have been aiming for and hope many people will get huge enjoyment from it.