Lynx P71 preamplifier

The development and creation of this amplifier took place after a relatively long period of time since the manufacture of the previous model. During this period, I created several intermediate models that differed in circuitry, ideological basis and execution, but none of them was brought to the state of a complete device due to various, both objective and subjective reasons. One of these reasons - the duration of the installation process of the device, consisting of several separate independent modules, suggested the idea of creating a simple single-board pre-amplifier with high technical characteristics and excellent subjective sound quality. At the same time, I deliberately rejected various service and information functions, as, in fact, meaningless for individual sound reproduction systems and only complicating the design. To obtain the best sound quality of the device, special attention was paid to the choice of the element base and the layout of the PCB routing.

The device is based on the classic structure of preamplifiers: a relay switch - a potentiometric level regulator - a buffer stage.

For the switch of signals from various sources, it is desirable to use electromechanical relays that provide the lowest possible contact noise and thermo-EMF. Such requirements are met by a number of domestic and imported signal relays, in particular our RES49, REK11, RY and RA Takamisawa series, FX2, HF3, D2n Axicom / Tyco series and others. The use of such devices guarantees reliable switching of weak signals with a dynamic range of more than 120 dB.

Several alternative nodes were considered as a level regulator - a continuous potentiometric regulator (based on carbon or wire potentiometers), a discrete potentiometric regulator (based on a multi-position switch), and a relay L-attenuator. Each type of regulator has both its obvious advantages and less obvious, but no less serious disadvantages from this.

The L-attenuator provides the smallest number of connections of dissimilar materials in the audio signal circuit, and, accordingly, the highest achievable linearity, but at the same time it has large ranges of output and input impedance variation, has significant dimensions and, accordingly, increased sensitivity to interference, and also has a significant distributed capacitance of the control circuit, which, together with a change in resistance during regulation, changes the shape of the transient response and in some cases can cause unstable operation of the buffer stages, especially broadband ones with OOS.

Discrete "potentiometers" like the notorious DACT, at a very significant price, unfortunately, are far from optimal in terms of the distribution of the attenuation step, have a very coarse adjustment at low volume levels and a fairly short service life. I have ruled out their use in my products for several years now due to a significant number of complaints about the operation of such regulators.

Potentiometers with a moving contact in many cases in their operational parameters turn out to be much more successful than regulators based on multi-position switches, but due to the presence of a moving multipoint contact exposed to the environment, they often lose to discrete ones in terms of distortion and contact noise. However, a number of designs of potentiometers with a carbon resistive element and a moving contact have been brought to technical perfection by their manufacturers and provide extremely high quality parameters and a service life, several times longer than the life of many discrete regulators. Such potentiometers include, in particular, the well-known products of the company ALPS - RK18, RK27, RK40, RK50.

The buffer stage of the pre-amplifier largely determines the technical parameters of the device and the subjective nature of its sound.

Numerous experiments carried out in the last 10 years have shown that there is practically no alternative to the use of high-quality op amps in buffer stages of preamplifiers, of course, when a number of conditions are met, such as: ensuring high-quality power supply, buffering the op-amp output, selecting a mode with a small value of the input voltage common-mode component, optimizing the PCB topology boards. In today's high-frequency environment, it is best to use op-amps with FETs at the input and high intrinsic speed for buffer stages. It is desirable that the FET of the differential stages have a low slope and a high cutoff voltage. Many devices meet these requirements, and the choice of a particular type is largely determined by the personal preferences of the developer. For me, the optimal and most acceptable are op-amps of the AD744 type, which have low intrinsic distortions, sufficiently high speed and excellent subjective sound. Since the output stage of these op amps is rather "weak", it needs to be buffered with an additional repeater, which can be either integral or made on discrete elements.

Based on these considerations, a high-quality Lynx PA71 preamplifier was developed, all elements of which (with the exception of power transformers, switching elements and external connection connectors) are located on a single printed circuit board. The schematic diagram of the device is shown in Fig. 1.

The amplifier consists of two completely identical channels, interconnected only by a common wire. The signal from the selected input is connected to the level control by a relay switch based on the FX2 Axicom / Tyco relay. The level regulator uses a double potentiometer RK40 ALPS with a resistance of 50 kOhm. The regulator potentiometer and additional ballast resistors form an input signal divider 3 times (in normal mode) and 8 times (in quiet mode). Such attenuation is necessary in order to ensure the operation of the buffer amplifier in the mode with a gain of more than 10 .., 13 dB and thereby exclude the possibility of “input” distortion of the op-amp under conditions of a large common-mode input signal.

The buffer amplifier is based on an AD744 op-amp with an additional buffer source follower at the output. It is possible (by installing the appropriate jumper) to supply a signal to the buffer both from the standard output of the op-amp (pin 6) and from the output of the UN cascade (pin 5). The repeater uses our field-effect transistors with pn-isolation of the gate of the KP601 type. These devices have a unique combination of parameters (high initial drain current, high cut-off voltage, small interelectrode capacitances) and the highest inherent linearity, which makes them extremely convenient for use in op amp buffer stages. There are no direct foreign analogs for KP601, the closest devices of the CP66x series have approximately twice the relative change in slope, three times higher interelectrode capacitances, in addition, their relative change is three to four times greater. Direct comparison revealed a significant superiority of the amplifier sounding when working with the buffer on the KP601 compared to the buffer on the NES CP665, and the measurements showed the presence of additional harmonic components of the 5th and 6th order, which were absent in the first version. The op amp and the buffer stage are covered by a common OOS, which determines the gain of 12.5 dB. The signal from the buffer output goes through a protective RC filter to the output connectors.

Each amplification channel is powered by its own bipolar parallel stabilizer of the compensation type, built according to the structure "ION - noise filter -OU", which provides an extremely low level of intrinsic noise of the stabilizer, high suppression of power ripple and good stability. The reference voltage is set by the avalanche tunnel breakdown Zener diode, which has a relatively low level of intrinsic noise. A significant decrease in the latter is facilitated by the shunting of the zener diode with a capacitor of relatively large capacity and the use of a PN with a low cutoff frequency. The power supply of the zener diodes is carried out from the GSC (stable current generator) on field-effect transistors.

The use of a parallel stabilizer has no fundamental advantages over a sequential one, but it allows providing a constant current consumed from the rectifiers and eliminating the modulation of the switching noise of the rectifier elements by the current of the signals amplified in the powered device. Bridge rectifiers on Schottky diodes are used to rectify alternating voltage from transformers.

In order to exclude possible interference from transient processes when the device is turned on, as well as to reduce the charging currents of the power filter capacitors, the preamplifier uses a simple "soft start" scheme in the form of two capacitor time relays. The first of them provides shunting of the limiting resistors in the mains supply circuit in 2-3 seconds after switching on, and the second - unblocking the amplifier output after 7-10 seconds.

A separate rectifier and stabilizer are used to power the time relay and the windings of the switching relays.

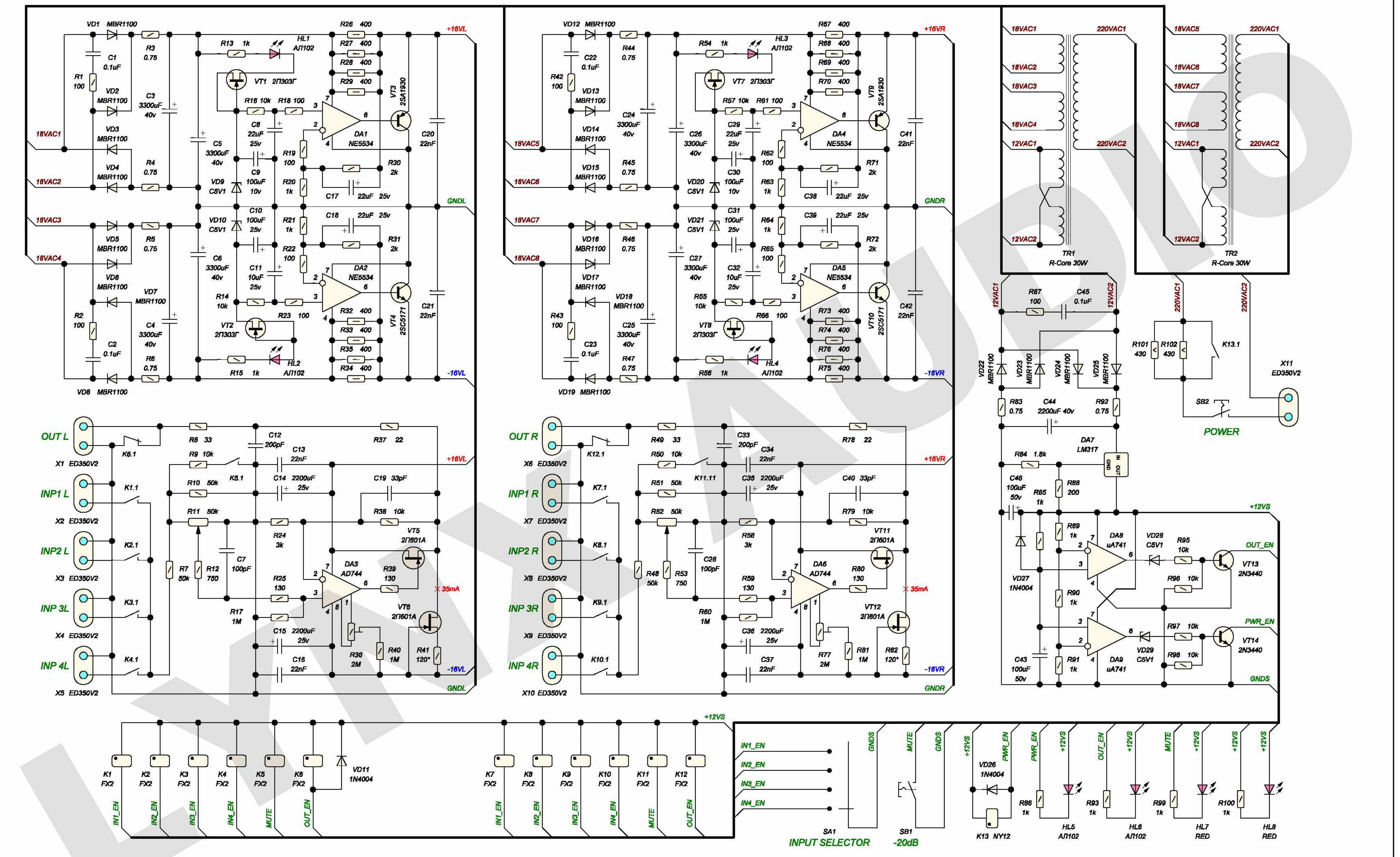
The Lynx P71 preamplifier uses Vishay / Dale RN55, RN60 output resistors, Roederstein EGM, Panasonic ECA electrolytic capacitors, EMZ KP2 foil polypropylene capacitors. Relays for switching power supply circuits - Takamisawa NY12, switching signal circuits - Axicom / Tyco FX2. Level regulator - ALPS RK40312A0 50k. Buffer transistors and operational amplifiers are equipped with individual heat sinks. Power transformers (one per channel) manufactured in China - 30W, on R-Core cores, with two 18V windings and one or two 12V. The printed circuit board of the module is double-sided, with 35 micron thick conductors. The board has LED indicators for supply voltages and output enable.

As a complete device, the Lynx P71 preamplifier is assembled in an aluminum case of type 1NSLA02280N supplied by the Italian company HI-FI 2000 (www.modushop.biz online store). The view of the device with the top cover removed is shown in Fig. 2, and the appearance from the front panel (paired with a Lynx PA72 power amplifier) is shown in Fig. 3. Installation of control circuits was carried out with a 10-wire flat cable, power circuits - with Radox125 Huber + Suhner wire, signal circuits - with twisted pairs of Tara Labs single-core conductors in polyethylene insulation. CMC-805 RCA sockets are used as input and output connectors.

The author's copy of the device has the following technical characteristics:

1. Nominal small-signal range of reproducible frequencies with uneven frequency response no more than +/- 1 dB, Hz	0….100000
2. Rate of rise of output voltage, V / μs	20
3. The level of harmonic distortion at the output voltage +/- 3 V, at a frequency of 1000 Hz and a load of 2.4 kOhm, dB, less than	-118
4. The level of intermodulation products, dB (sum and difference) for frequencies of 9 kHz and 10 kHz with a total thermal power of 2 mW at a load of 2 kΩ, dB, less than	-116
5. The level of noise and interference at the output, dB, less than	-120
6. Background level of frequency 50 Hz at the output, dB, less than	-118
5. Channel separation at a frequency of 5000 Hz, dB, more than	88
7. Output resistance (with output protective filter), Ohm	55 ± 2
8. The transient response is aperiodic.	

The spectrogram of a signal with a frequency of 1000 Hz and an amplitude of 3 V with a minimum signal attenuation is shown in Fig. 4, and the oscillogram of the transient response is shown in Fig. five



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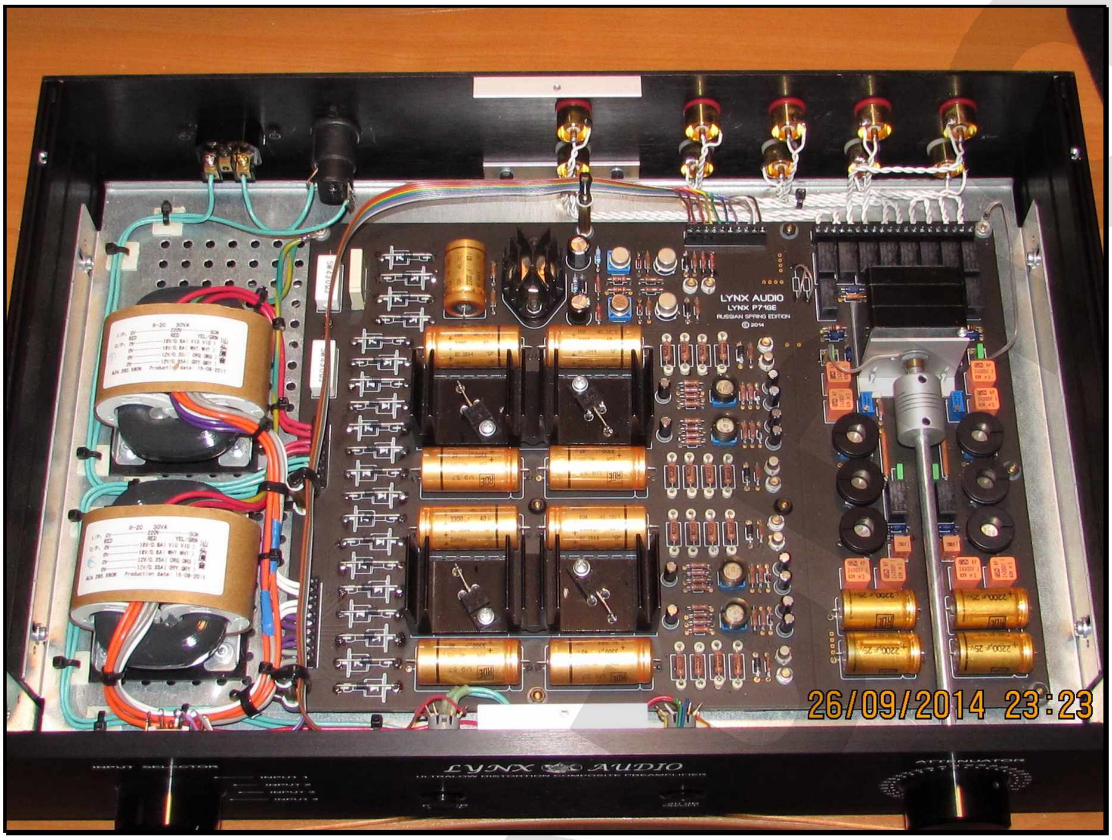

Fig. 2 Preamplifer view without top cover

Fig.3 Lynx P71 front panel view
(together with PA72 power Amplifier)

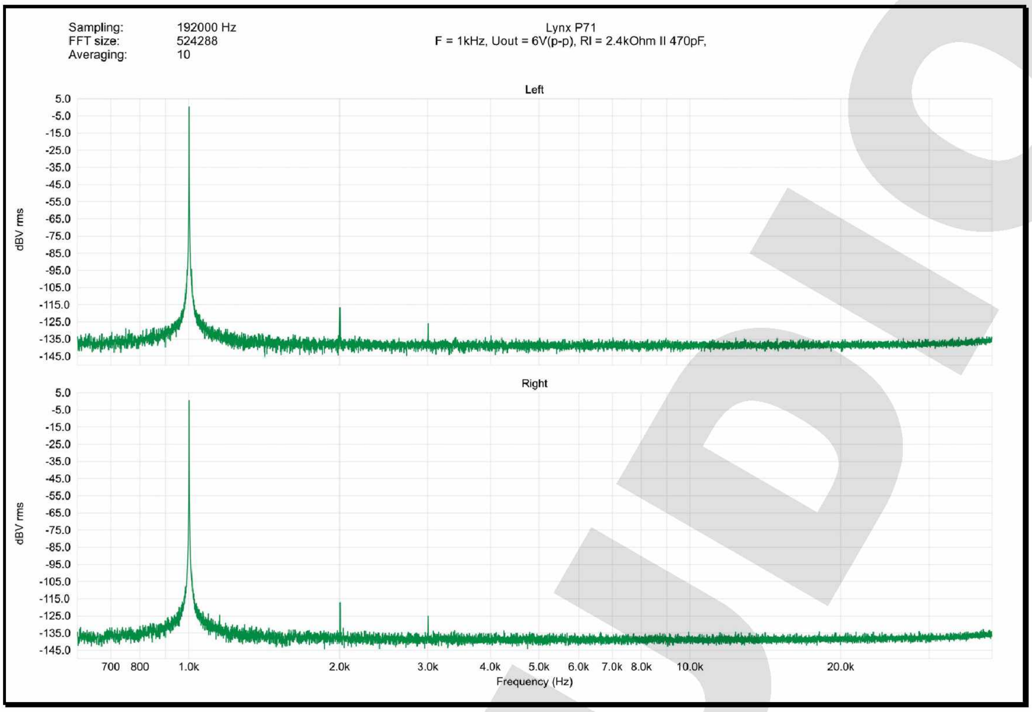

Fig.4 Spectrum of the output signal

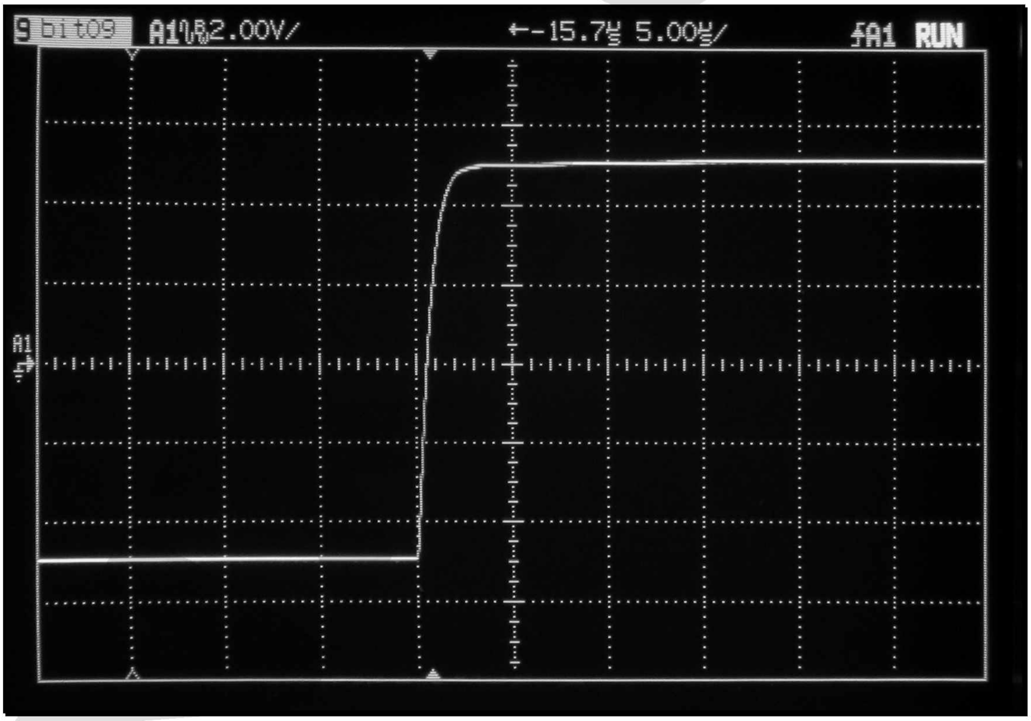

Fig.5 Transient response

Subjectively, this preamplifier is distinguished by exceptional transparency and neutrality and lightness of sound, its presence in the signal path in the overwhelming majority of cases is almost invisible. These properties of the considered device remain at any signal attenuation and at different maximum levels of the latter.

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