

## Influence of Time Propagation Delay on microdynamics

There is an opinion that the time propagation delay does not affect the parameters of the amplifier, and therefore the sound quality. However, the signal propagation delay (Time Propagation Delay - tPD) is a speed parameter associated with parameters such as SR, RT. Practice shows that the lower the tPD, the faster the transient distortions end, the lower the distortions already from the first period of burst-type pulsed signals, the lower the noise bias in the audio passband during IMD measurements, the less degradation of the signal microlevel information.

To check the last statement, we will create a circuit for generating a test signal with a frequency of 20 kHz with an additional signal in the region where the signal crosses zero, Fig. 1

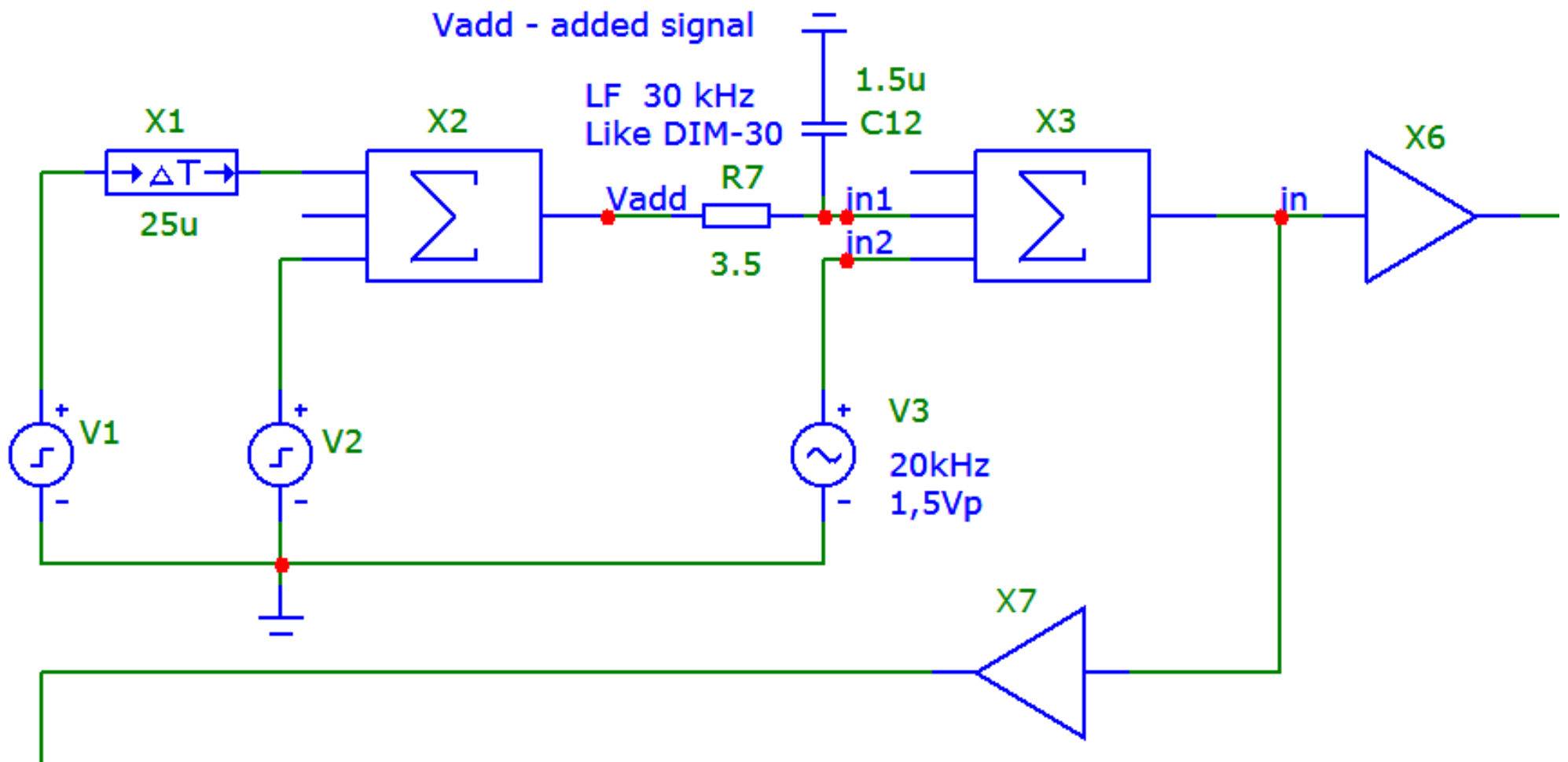


Fig. 1

The signals at the breakpoints are shown in Fig. 2

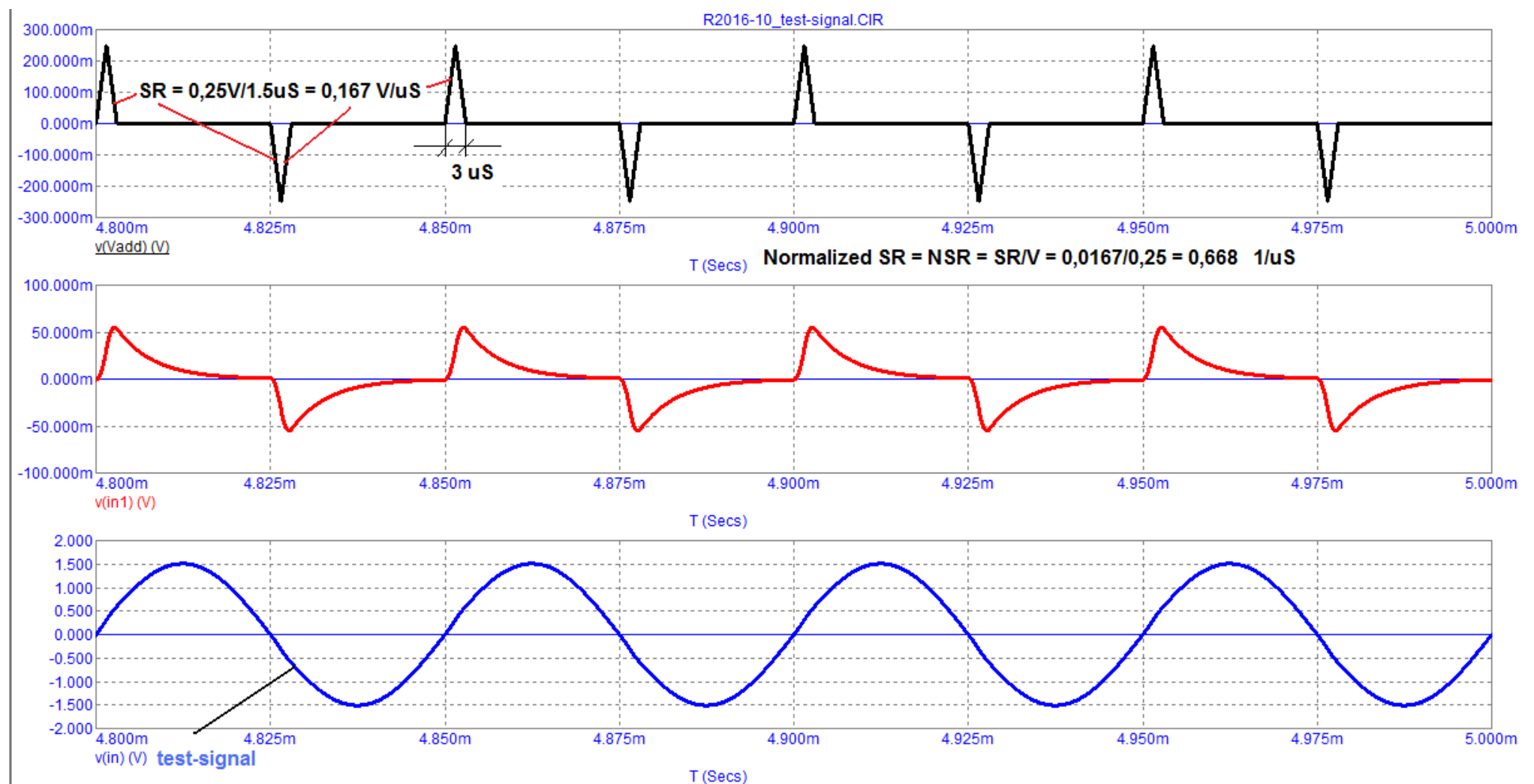


Fig. 2

Let us investigate the following amplifier using such a test signal, the Bode diagram of which is shown in Fig. 3

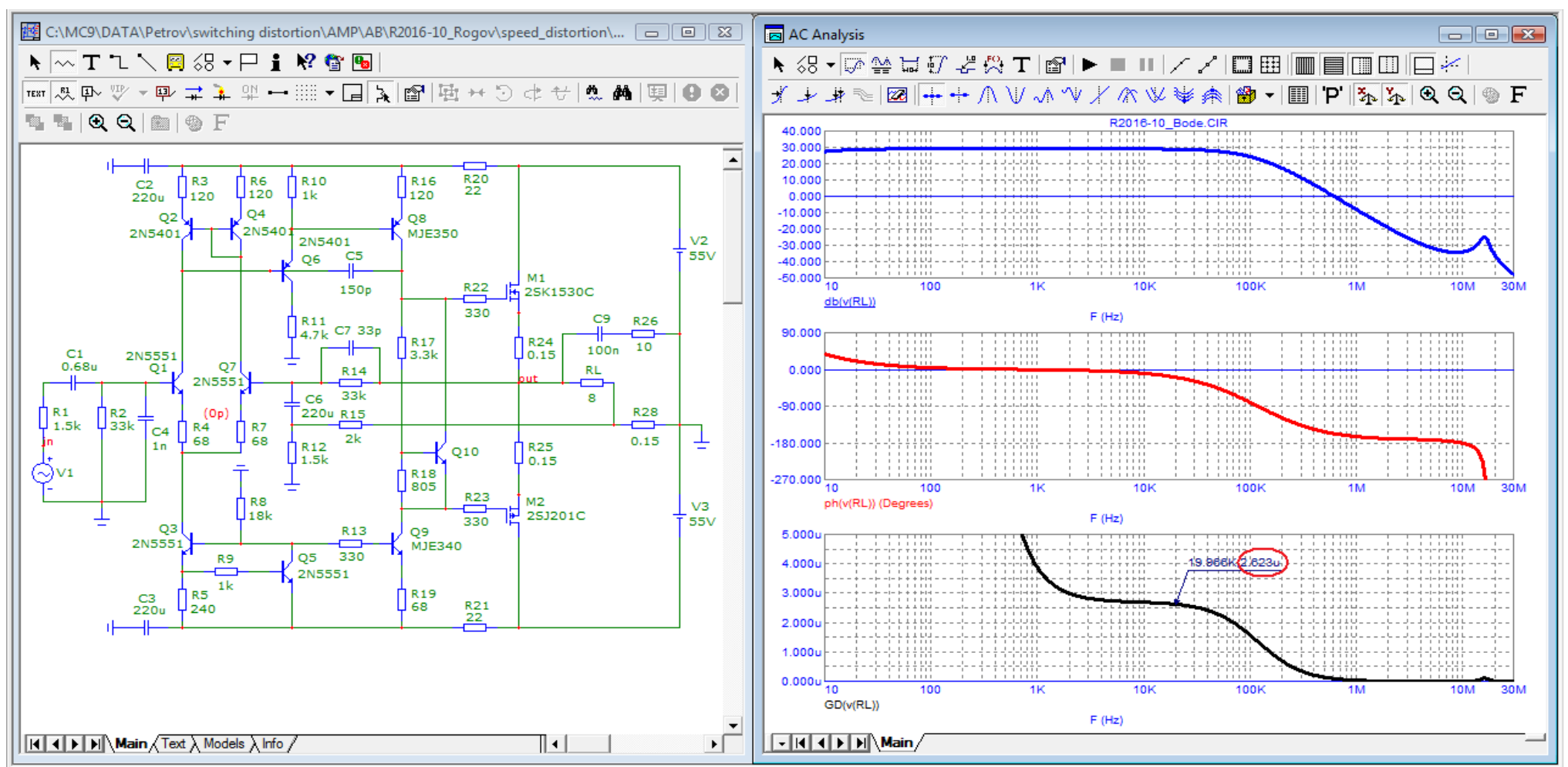


Fig. 3

The amplifier with combined feedback (with voltage feedback, and with current feedback) is made according to the typical scheme of Douglas Self. Combined NFB allows you to adjust the output impedance. The signal transit time is  $2.6 \mu\text{s}$ . The bandwidth of this amplifier is 60 kHz,  $\text{SR} = 15 \text{ V} / \mu\text{s}$ .

Let's apply a test signal to the input of the amplifier and to the input of the filter, and from the output of the amplifier to the input of the second filter, Fig. 4

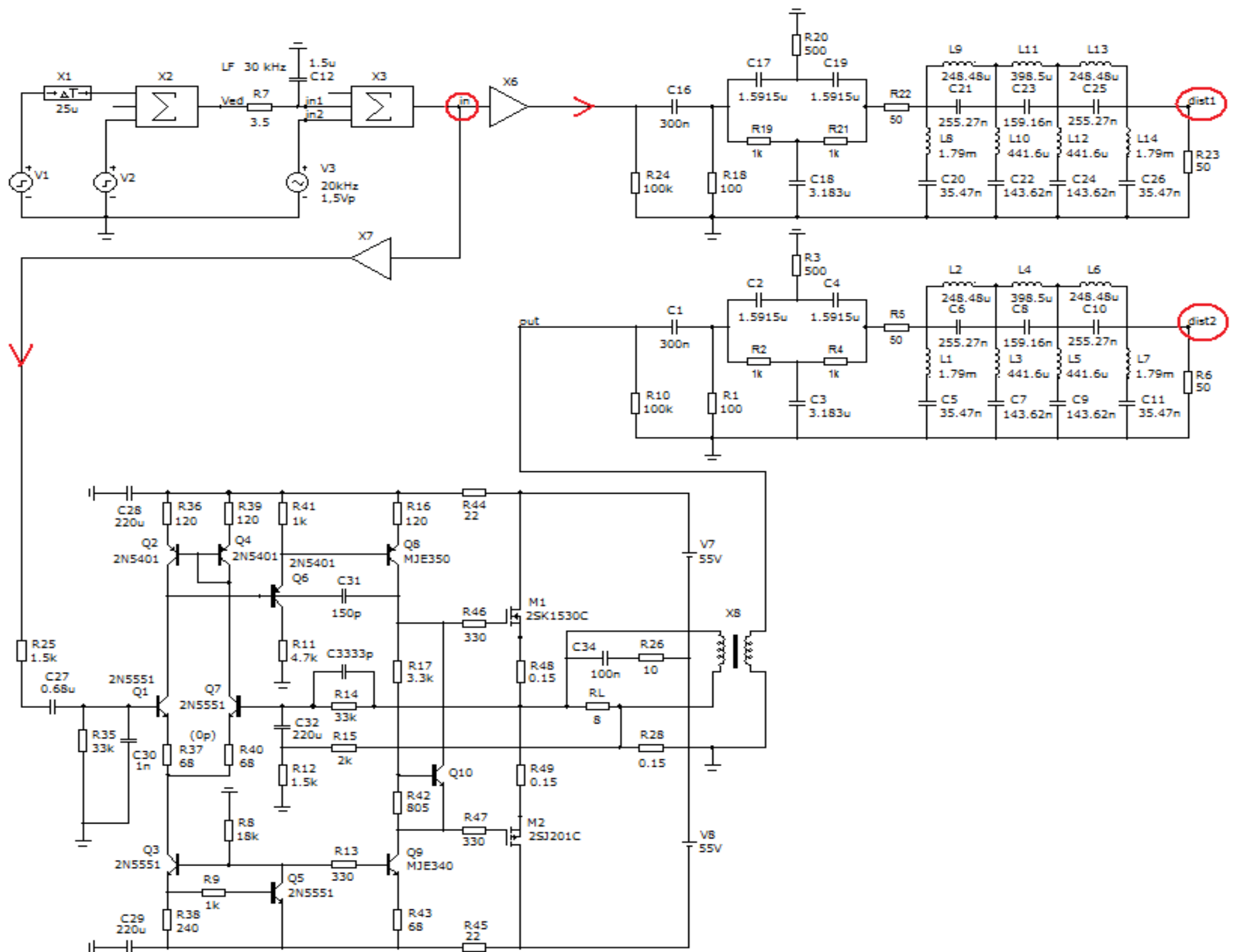


Fig. 4

The signals at the filter outputs are shown in Fig. 5

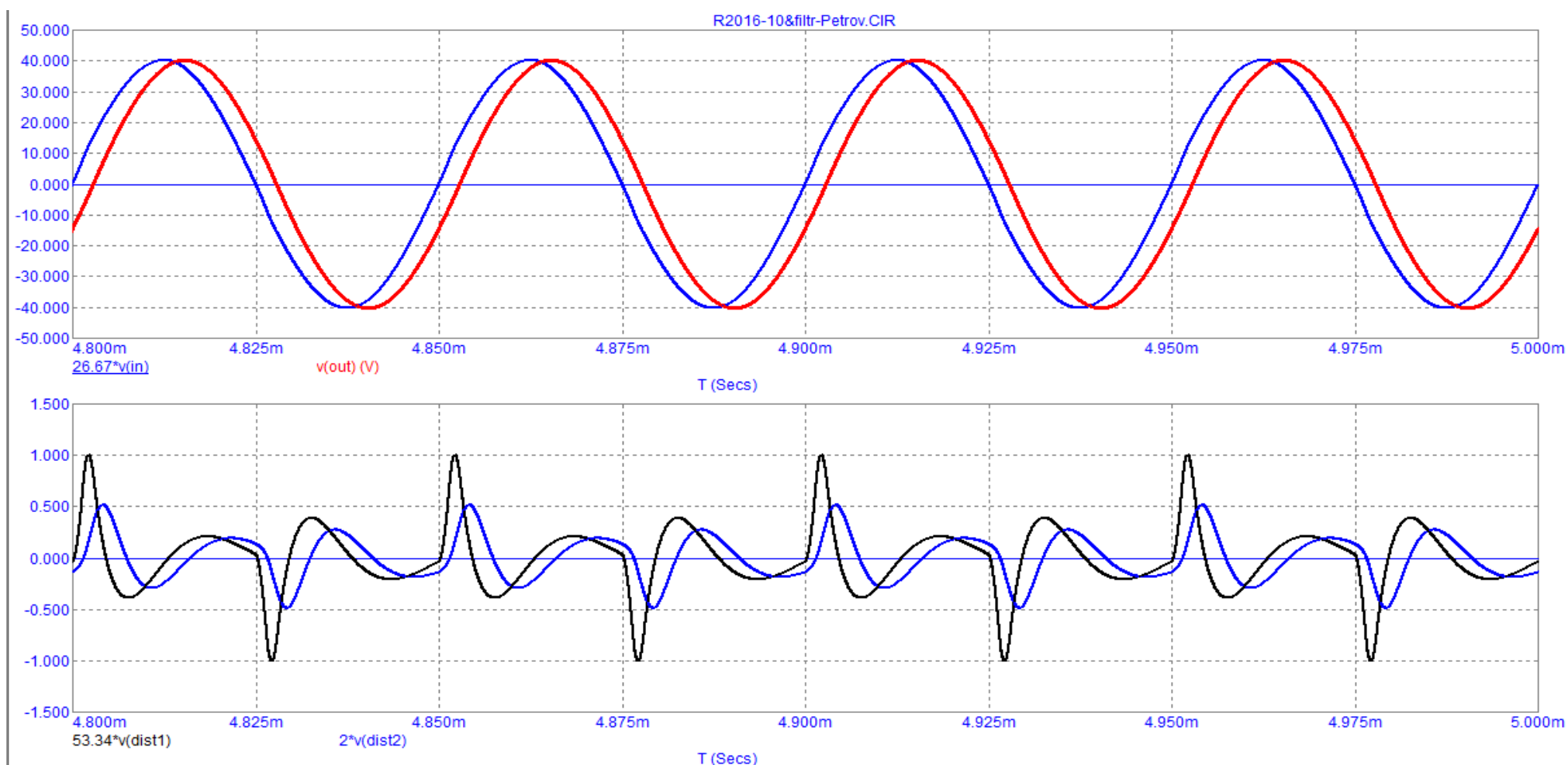


Fig. 5

The top graph in Fig. 5 shows the output voltage of the amplifier and the input voltage reduced to the output level by multiplying by  $K_u$ .

The lower graph shows the signals at the output of the filters reduced to the same level. Figure 5 shows that the amplitude of the added signal has decreased by 2 times (6 dB), and its shape has changed significantly due to the low slew rate of the amplifier output voltage.

To measure the introduced distortion, let's add a delay line at the input of the upper filter, Fig. 6

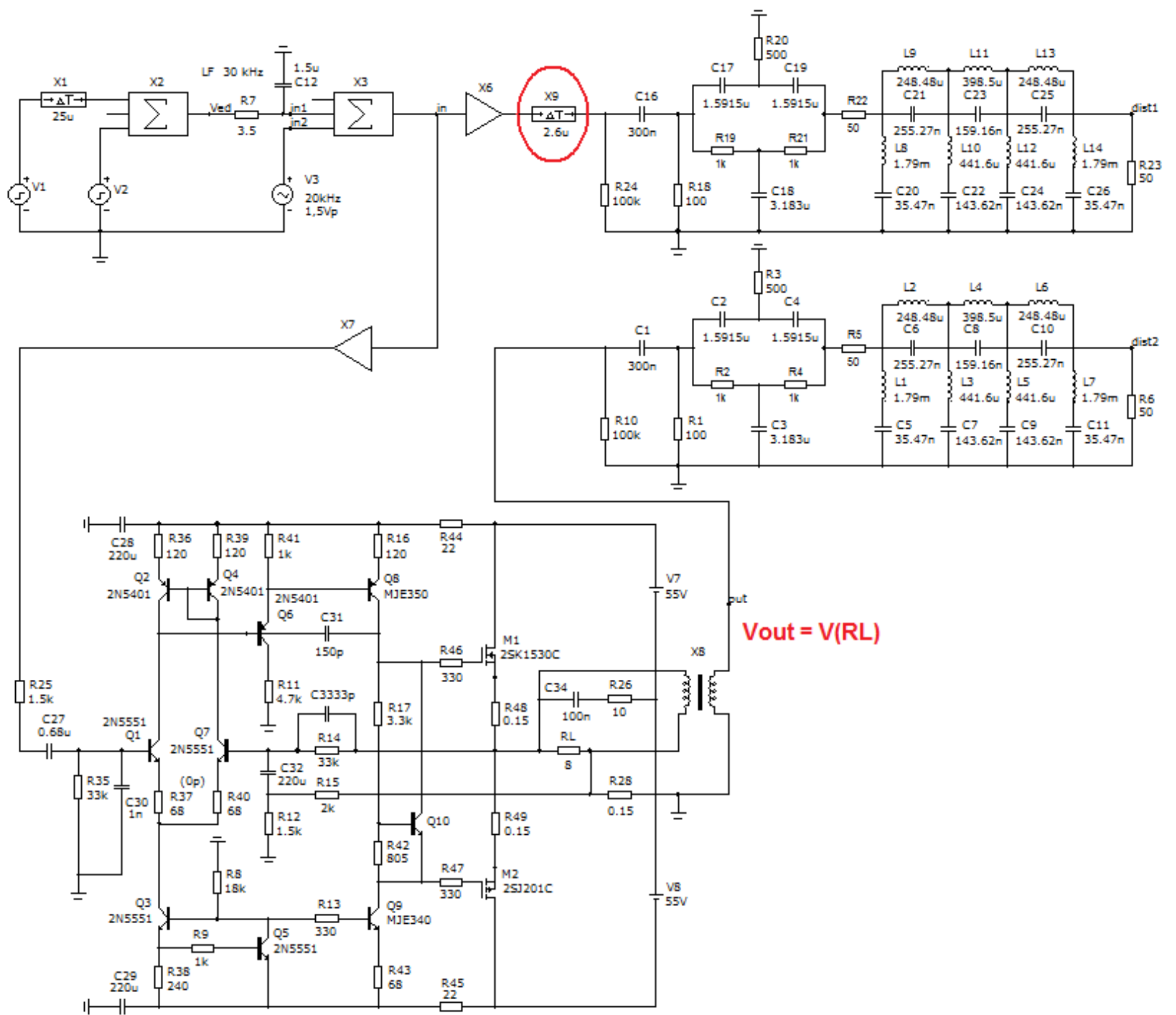


Fig. 6

If we subtract the output voltage of the second filter from the output voltage of the first filter, we get the distortion products introduced by the amplifier, Fig. 7.

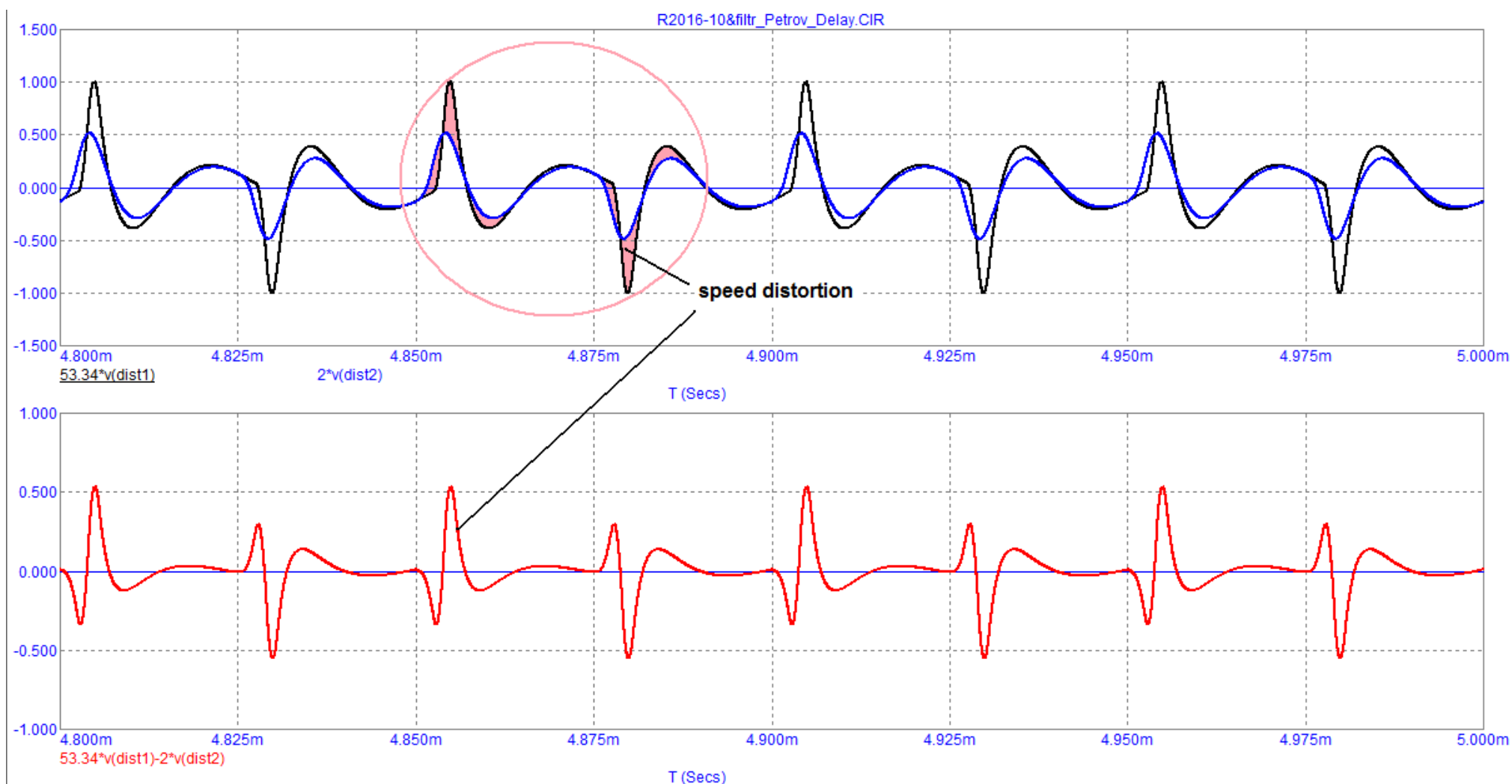


Fig. 7

The upper figure shows the signals aligned in phase, and the lower figure shows the result of their subtraction - the products of distortion.

The conducted test showed that low-level high-frequency signals can be attenuated by 2 times. This is precisely the “loss of microdynamics”. I hope there is no need to explain that the less the signal transmission delay, the less the loss of microlevel information will be.

На верхнем рисунке показаны сигналы совмещенные по фазе, а на нижнем результат их вычитания — продукты искажений.

Проведенный тест показал что низкоуровневые высокочастотные сигналы могут быть ослаблены в 2 раза. Это как раз и есть «потеря микродинамики». Надеюсь не надо объяснять что чем меньше будет задержка прохождения сигнала, тем меньше будут потери микроуровневой информации.

Amplifier microdynamics test conducted  
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