NEW UNIQUE TECHNIQUE TO MEASURE SIGNAL DEGRADATION

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(Part IV)

The aim of the development of the described technique with time reversing is to obtain a technique which can substitute audio tests in most practical application.

The result of test shows not a set 'some numbers', but it shows (well and fast) evaluation of what impression the listener will obtain.

In the description of the technique in previous parts there were only some words about memory effects in amplifiers like thermal distortions. This kind of distortion are very difficult to measure by tradition techniques because in the harmonic analyzes thermal distortion looks same as set of harmonics from nonlinearity. In the time reversing technique the selection of different types of distortions appear naturally.

The output signal of amplifier at some time $t=0$ is a function of set of data for time interval $t<0$ marked by gray bar on Fig. 11 (+time). Same signal for reversed time is on the Fig. 11 (-time) and set of data before $t=0$ is different. If amplifier contain memory effects the output signal will be different due to different influence of data at $t=0$ on the transfer function. It is a natural way to determine memory effects and way to select specific type of distortions from other types of distortions.
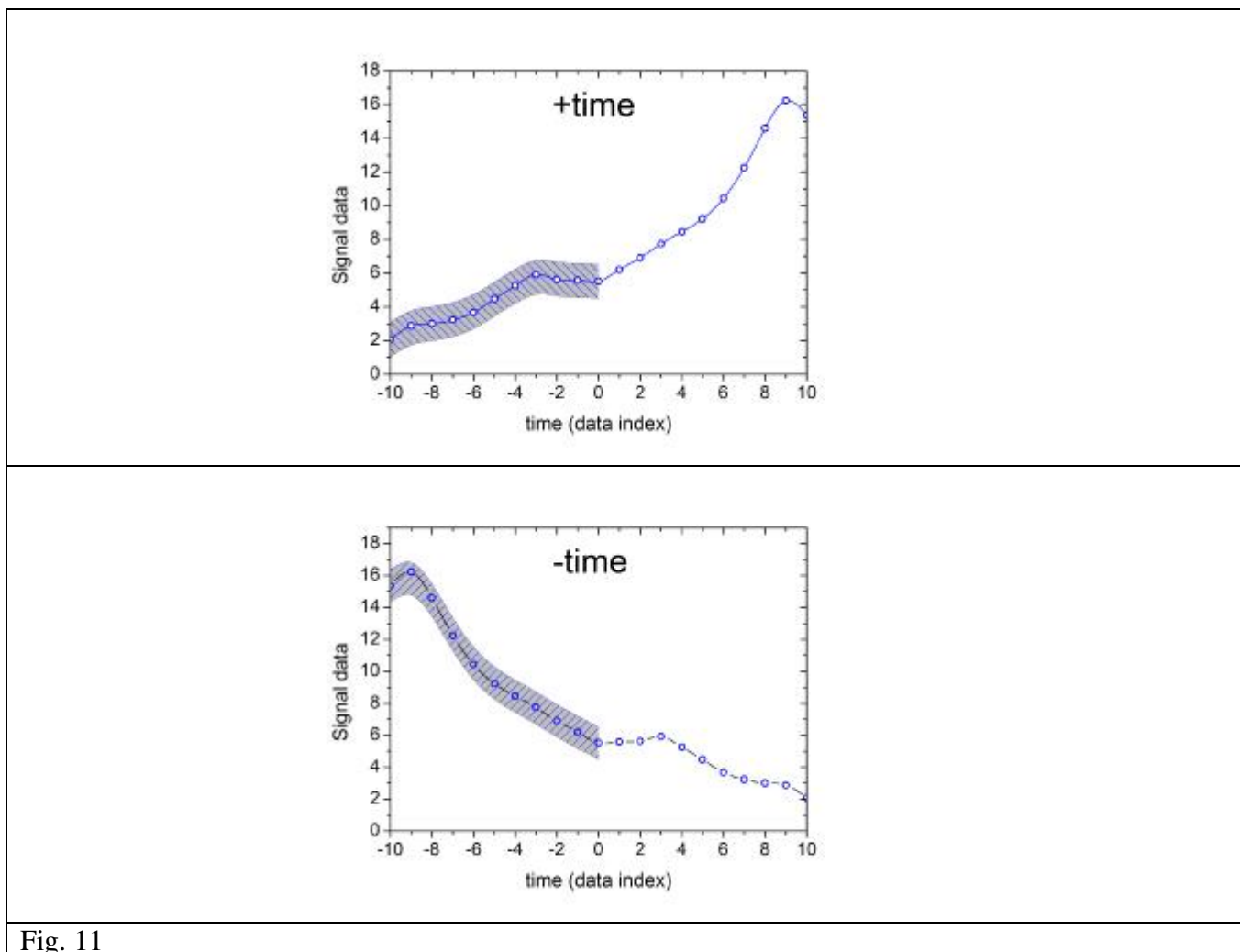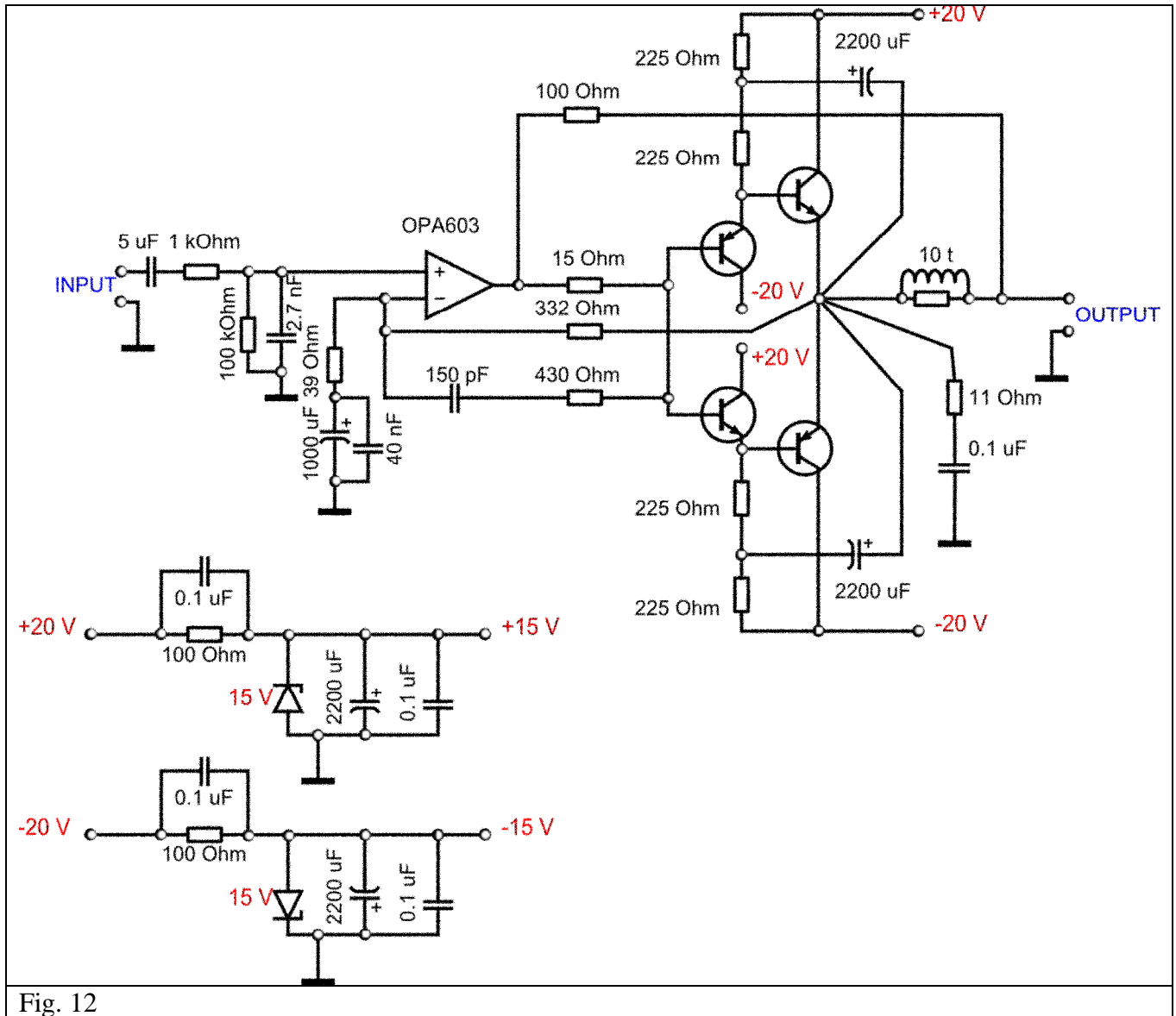

Fig. 11

I did measurements with different test stages like emitter follower, simplest amplifier on old 741 type op-amp and others. For example emitter follower even in regime heaving THD~0.5% shows (by DRT test) better result then 741 amp with (0.01-0.1) % THD, and at high frequencies 741 is awful.

In all cases was a coincidence of test result and knowledge about sounding of tested circuits.

Next Fig. 12 is circuit diagram of the amplifier which I did to listen and to test.

Fig. 12

It has +/-20(21) Volts non-stabilized power supplies for each of two channels with 2x5000 uF capacitors in channel.

Op-amp is OPA603 current feedback type, 100 MHz bandwidth, 1000 V/μs slew rate, 150 mA output current. It drives for transistors, transition frequency 3 MHz, max. collector current 20 A, dc current gain ~100. Initial current through output transistor is about 50 mA.

The amplifier was designed and started to work from first 'turn-on' except adjustment of correction capacitor 150 pF. The output power is enough for small or middle room. Sound is good, very-very clear up most frequencies but lowest, drums if laud are not well. The reason is the bad power supply, small caps in it and old type (from older case). But the total impression is quit well.

In test of amp Fig. 12, with the described time reversing technique of measurement, it was found that it shows same results as my listening impressions were.

I've use the sweep tone. The sweep tone is only one of many possible signals for test. A usual music or pink noise is also a good test signal. But the sweep tone helps to present results in more or less 'usual' form like dependence on the frequency range. The load for amplifier was powerful resistor 4 Ohm. Output was adjusted to ~7 V amplitude and measured by the resistor attenuator to fit the input of sound card. The results are on Fig. 13.
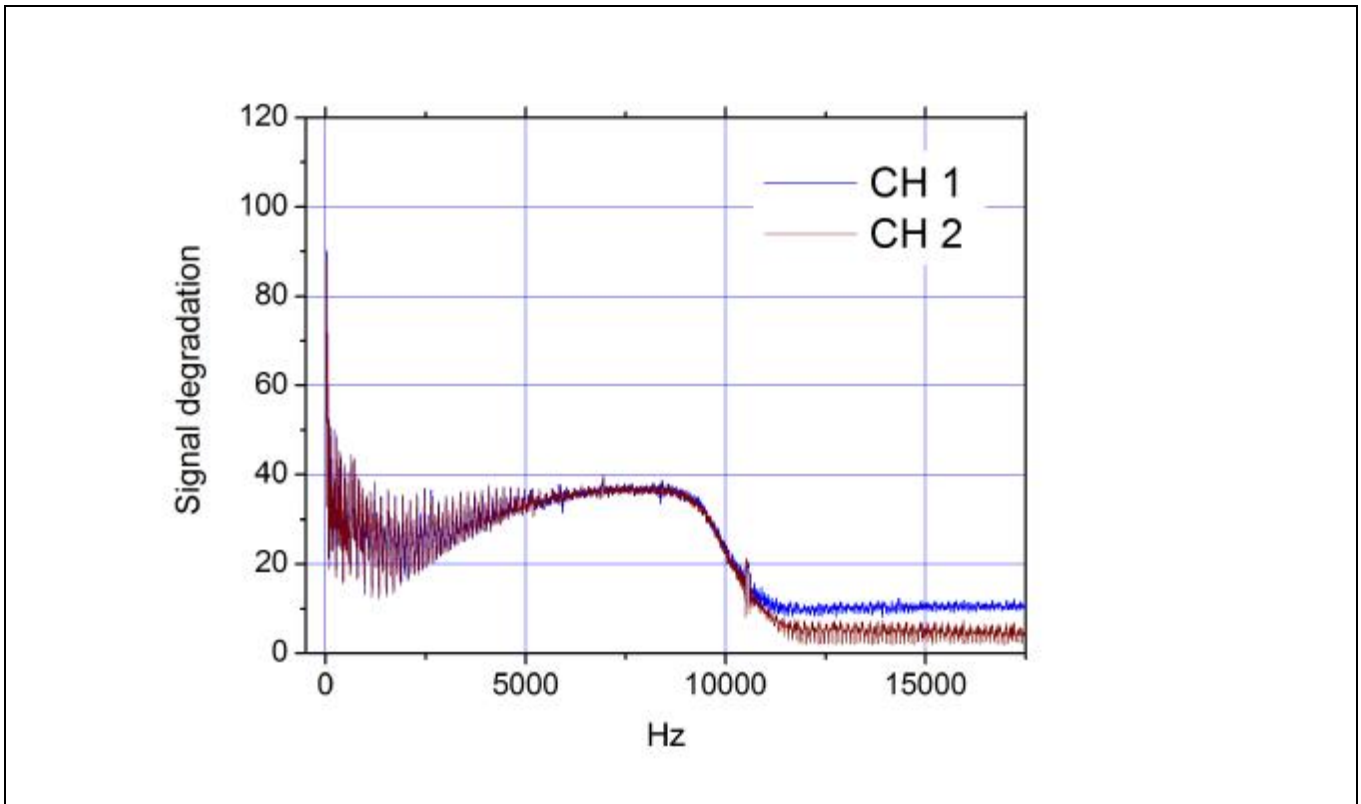

Fig. 12

Channels show some difference due to parts or construction difference. Value about 20-40 units of signal degradation is level of good, but not a area of top high-end amplifier.

Above 10000 Hz signal is excellent. It does not mean that there is no distortion at all! It means that the distortions are mostly of inaudible type like fixed polynomial nonlinearity.

The bad region is lowest frequencies where the degradation sharply increases even on all-view graph.

Sweep test is not a complete estimate of amplifier, but it provided in 10 minutes the picture of what it is possible to expect from amplifier. By the sound it was same impression. The measured distortion in the middle part I listen only on some phonogram. The amplifier has rather exact sound and highest frequencies are always very-very clear.

If to connect the real loudspeaker to output the result of test will be different and more representative.

I compared before any measurements amplifier Fig. 13 and other amplifier class A, like Pass Lab ZEN. It was not a special listening comparison but I switched from one to another and after one month I choose a Fig. 12 amplifier as better one. The test like on Fig. 13 performed for ZEN (ZEN of mine variation) shown that it is really worse with about 200 units of degradation of signal in the middle.

Tests had shown the difference in tens minutes while by listening impression it was take about month to select better amplifier! Test show the main possibilities of amplifier without connection it to loudspeaker.

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