

NEW UNIQUE TECHNIQUE TO MEASURE SIGNAL DEGRADATION

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(Part II)

Other unique characteristic of two pass reverse test connected with the possibility to measure distortions in the same frequency range where the frequency range of test signal is.

For THD measurement for example at 18000 Hz even the 2nd harmonic is at 36000 Hz.

The most of sound frequencies are in the range (20-20000) Hz and why we need for measurement a device (like ADC) with the bandwidth much more then 20 kHz?

If the spectral width of signal of interest is limited by some value of upper frequency then the same upper frequency limit is enough for measurement of the distortion, even the distortion frequencies are out of limit.

The two pass reverse test show possibility to measure distortion practically in most part of full frequency range $f_s / 2$, where f_s is a ADC sampling frequency.

The usual onboard sound chip was used for measurements with good result. The time delay added by the onboard sound card in one step of 'reply-record' was tested and it was rather small, less then 10 ns. Although in the two pass reverse test the delays of the DAC-ADC, cables and the tested amplifier delay all together are precisely self-compensated, the large delay in some type of sound cards more the 200 ns looks too much. The mode of sound card was 48000 Hz, 16 bit.

As an example of test application are results for set of capacitors (was first shown in 2008) [4]. The capacitors was:

Dielectric	Type	Value
ceramic	noname	0.047nF
paper	MBM	0.1uF
PETP	K73-15	0.047uF
PETP	K73-11	0.22uF
PETP	K73-9	0.1uF

The circuit for testing was C-R type. Capacitor was connected into signal line and resistor of 1 kOhm as load to ground.

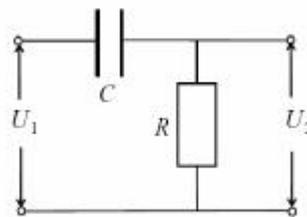


Fig. 6 Capacitor test circuit.

Before measuring of capacitors distortions just close loop was recorded. The result for close loop is rather clear line with 'noise' about several units. Units for signal – the numbers in recorded file. The electromagnetic noise surrounding should be small during measurement. The maximal value for 16 bit is +/- 32768. The initial value of the signal was about 0.7 V and about 20000 units in digital record.

The signal for test was sweep tone (20-20000)+(20000-20) Hz digitally symmetrical near central point (cross in red on Fig 1). The duration of the half sweep was about 2 sec. After performing all procedures illustrated on Fig 2-Fig 4 two near symmetrical ‘wings’ where compared.

The difference:

$$U(-t) - U(t)$$

was averaged in moving window 200 points:

$$\overline{(U(-t) - U(t))^2}$$

and square root value depends:

$$\sqrt{\overline{(U(-t) - U(t))^2}}$$

shown on next Fig. 7 as a function of current frequency of in sweep tone.

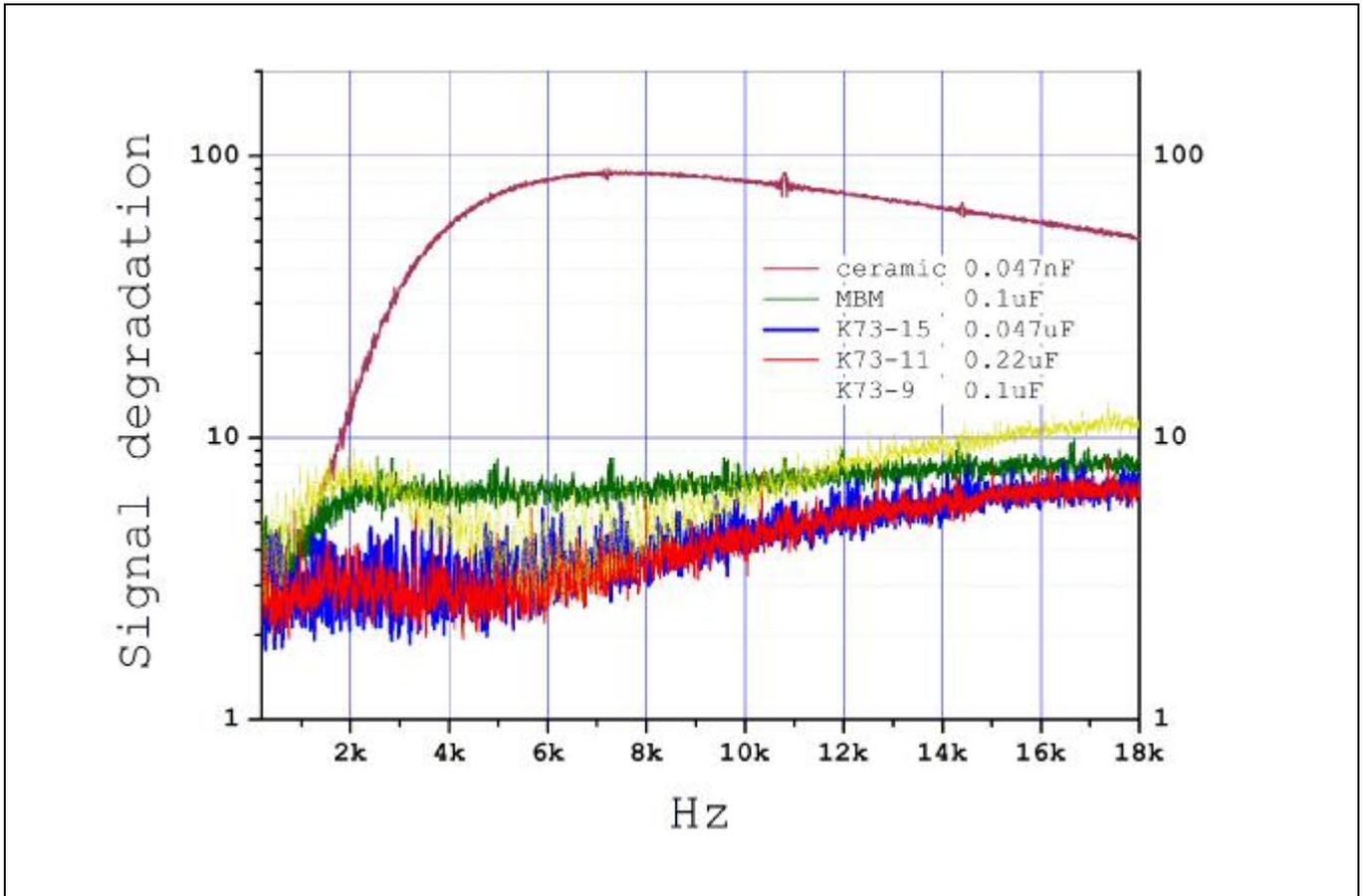


Fig. 7

All capacitors show the signal degradation in chosen for measuring circuit. And ceramic one is one order more than PETP type. The distortions at low frequency end are close to system noise level because C-R circuit cut-off low frequencies. PETP capacitors show similar behavior but not completely. One of them, K73-15 – blue line, have significantly more ‘noise’ with low middle level.

The data are up to 18000 Hz in up end. Above 18000 Hz I found the increasing of the noise in condition of test parameters. The most part of full frequency is on the graph that means the possibility to measure distortions in the same frequency range where test signal is.

If to estimate the distortions in presents, the ceramic value is $(100 / 20\ 000) * 100 = 0.5\%$ maximum and about 0.05% (max.) for other ones.

(More about and some application results will be later)

Literature (preliminary):

[4] -- <http://www.vegalab.ru/forum/showthread.php?2164-%CD%E5%E4%E0%E2%ED%EE-%FF-%E7%E0%EA%EE%ED%F7%E8%EB-%F0%E0%E7%F0%E0%E1%EE%F2%EA%F3-%F3%EB%FC%F2%F0%E0%EB%E8%ED%E5%E9%ED%EE%E3%EE-%D3%CD&p=385451&viewfull=1#post385451>

(07.03.2008 22:25 post #308)