# Klipsch Cornwall

## loudspeaker system

## Test Report

on electroacoustic measurements and listening evaluation

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## INTRODUCTION

Much has been written about Paul Klipsch who back in early 40's first pioneered the use of horns in loudspeakers and patented legendary Klipschorn, folded-horn loudspeaker which exploits walls and floor as an extension of the horn to achieve necessary length.

Besides flagship speaker Klipschorn, Klipsch created, and produced during a period of 40 years - which may now be considered as "Golden Audio Age" - a wide selection of well known La Belle, La Scala, Cornwall, and Heresy loudspeakers. Only Klipschorn and La Belle are still in production in Hope, Arkansas.

Design of all these loudspeakers followed the basic idea of high performance, wide frequency range, low distortion, high sensitivity, and minimal amplification. Maybe some of the readers still remember a Klipsch's belief written in Audio Review back in the 70's: "*All you need is a good 5W (tube) amplifier*". In the days of "tube amplifiers' renascence" this concept proves to be more actual and true than ever.

It would certainly be out of scope of this report to repeat well known facts about this eccentric genius and inventor, but it is one of the authors' intentions to acknowledge Mr. Klipsch's contribution to the development of audio science and to show great respect and pay tribute to the man who laid down one of most recognisable corner stones in audio, and Hi-Fi.

## PURPOSE

The legendary Klipsch Cornwall loudspeaker was introduced in 1959. It is no longer produced but may be considered as one of the finest speakers ever made. Its basic concept guarantees qualities which have an ever-lasting value. After 40 years these speakers can still outperform many contemporary high-end speakers. The purpose of this Test Report preparation was:

- to present and comment results of electroacoustic and vibration measurements of the Klipsch Cornwall loudspeakers - the item under test was type C II - OO, serial 8612781,
- to stress that measurements - although less important for the average audiophile - are very important and indispensable tool for every research, development and test engineer,
- to describe some of the measurement techniques by simple and easy understandable approach,
- to show correlation between objective (measurement) and subjective (listening) results.

The purpose of electroacoustic measurements was:

- to determine whether Klipsch Cornwall loudspeaker still complies to product specifications,
- to verify its overall condition status,
- to get more objective insight and uncover some technical details, and facts,
- to discover virtues, strengths, and weaknesses.

Listening test were performed, using various signal sources, amplifiers, media and types of music. It was the purpose of listening test:

- to obtain subjective listening evaluation in order to complement objective measuring results,
- to stress the importance of "His Majesty The EAR", and "The Culture of Listening", since EAR - which is rather a perception integrator than a measuring instrument – should always be the final judge about the sound quality.

Measurements and listening test were performed in MBS Audiolab, Ljubljana, Slovenia. They were not supported by any party whatsoever and may be considered as strictly non-profit, and impartial.

## PRODUCT SPECIFICATIONS

| | |
|---|---|
| • Frequency Response +/- 5 dB | 38 to 17,000 Hz |
| • Power Handling | 100 watts maximum continuous |
| • Sound pressure level / Efficiency | 98.5 dB SPL for 1 W at 121.92 cm<br>101 dB SPL at 1 watt/1 meter |
| • Impedance | 8 Ohms |
| • Total Modulation Distortion (Max) at 90 dB SPL at 61 cm (2 ft.) | 3.0% |
| • Network | Type B 600/6000 Hz |
| • Manufacturer | Klipsch & Associates, Hope, Arkansas, USA |
| • Item under test | Klipsch Cornwall, Type CII-OO, Serial 8612781 |

## GENERAL

Klipsch Cornwall is a smaller brother of Klipschorn. It is of smaller dimensions indeed, but is still a huge loudspeaker. With 90.8 cm (35.75") H, 64.8 cm (25.5") W , 39.4 cm (15.5") D, and weighing 49 kg (108 lbs.) it is one of the biggest if not the biggest 3-way ducted-port design ever produced for home use.

Klipsch Cornwall is a quality sound system, particularly suitable for a home, theatre or clubs, giving best results in auditoriums larger than 30 $m^2$ (480 $ft^2$). It wa also designed as a monitor loudspeaker for recording, and broadcasting studios.

Klipsch Cornwall II loudspeaker

Cornwall cabinets were available in a selection of fine woods and finishes including Walnut Oil, Oak Oil, Oak Clear, and Black Finish. Klipsch still recommends oak oiled cabinets to be oiled about once a year, using an oil such as "Chinese" TUNG OIL (be sure to wipe off all excess oil when cabinet is completely covered).

Corner placement of this loudspeaker is not mandatory. Cornwalls may require proper positioning due to polar characteristics of mid and high frequency horns which provide $80^0$ horizontal and $30^0$ vertical coverage with less than 10 dB loss at stated extern angles. Cornwall is almost insensitive to room impedance.

In order to obtain best listening results the required listening distance should be above 3 meters (12 feet); Cornwalls sound better the farther apart you can place them, as most large (horn) speakers do.

## COMPONENTS AND CONSTRUCTION

Cornwall I uses the same driver components as Klipschorn. Cornwall II comprises of: K-34-E (15") woofer, K-57-K squaker, and K-79-K tweeter (which is not identical to the famous EV T-35 tweeter). High frequency system comprises straight-axis horn with rugged phenolic diaphragms in the high frequency compression drivers.

All components are of highest quality and reliability and this is definitely the main reason why these speakers also age so well. Some Cornwall owners report that they haven't noticed any degradation of main electroacoustic parameters at all, even after 30 years of operation.

Ducted-port woofer is used with separately but integrally joined midrange and treble horn systems. It is obvious that there is no dumping material used inside Cornwall II.

Ducted port

The low-frequency section is a single 38 cm classic paper cone driver unit. Horn-loaded woofer maintains the low diaphragm amplitudes and velocities necessary for low modulation distortion.

Klipsch Cornwall: K-34-E woofer

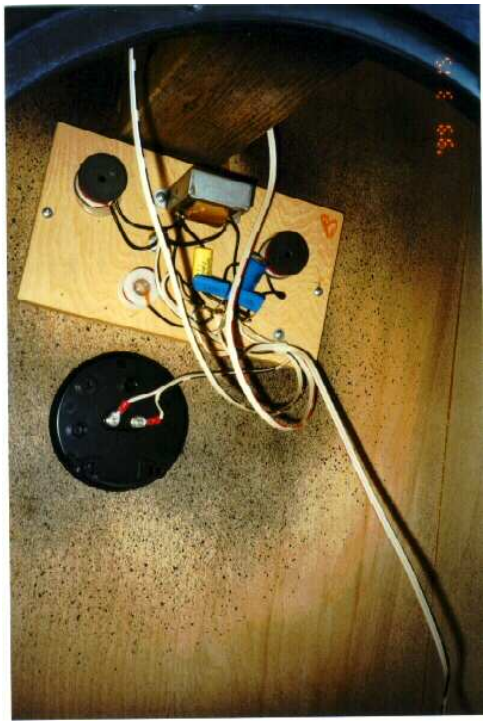
K-34-E paper cone - close view

Although looking quite old-fashioned this famous woofer really works very well. Due to low diaphragm amplitudes its distortion is really low even at 100 dB SPL.

Besides, woofer classic paper cone membrane has no problems of foam surround "flaking apart". Such problems - I am sure readers are well aware of this fact - were observed with many marvellous state-of-the-art loudspeakers after approx. 10 years of operation. What a pity. What a loss.

On the contrary, all results of electroacoustic measurements confirm that Cornwall II - item under test was produced in 1986 – still fully complies to product specifications, and over-all excellent condition of the loudspeaker was also verified; only some of the front cover plastic clamps has loosened and need temporary reattachment onto the front panel.

Crossover elements are point-to-point mounted on a wooden base. No printed circuits. Classic, and reliable.



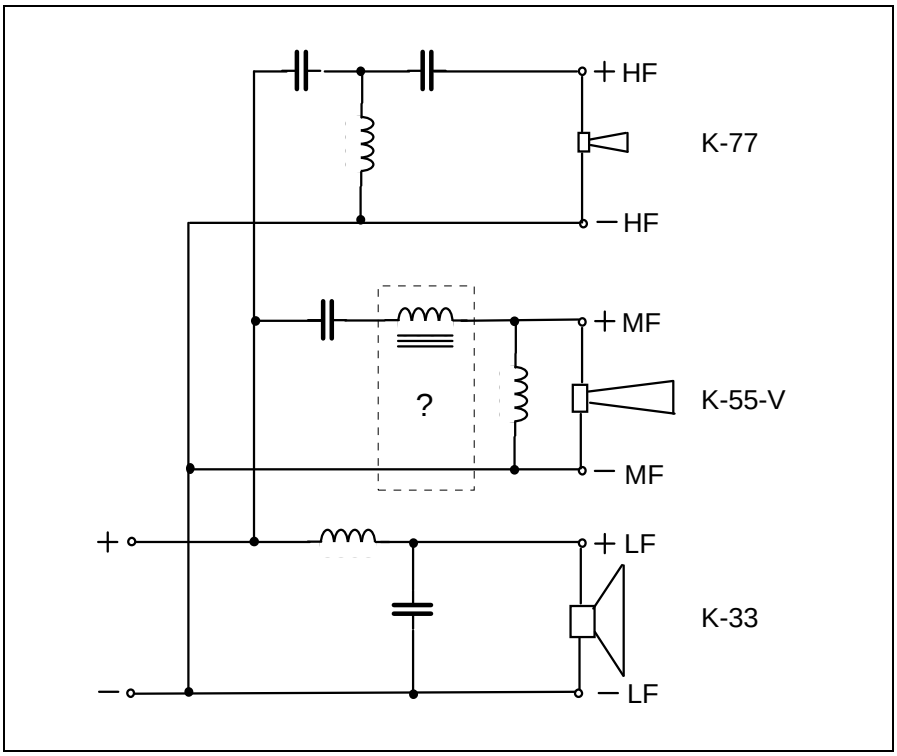
Klipsch Cornwall II crossover network (B600/6000Hz)

It is very likely that it was the crossover which contributed most to the birth of the new version - Klipsch Cornwall II - in June 1981. This year Klipsch took step to a complete re-design of the crossover with the main goal to constrict electrical signals received by each driver to the spectral band over which the driver displays optimum characteristics.

Boosted woofer output was obtained in the 400 Hz to 600 Hz region, and substantially decreased low-frequency energy was applied to the midrange driver too.

There was also substantial improvement in the stop-band attenuation provided by the high-pass filter associated with the K-77 tweeter. More energy can be derived from the tweeter above 6 kHz because of a reduced current-flow into the tweeter in the mid-band. Better coherence near the crossover frequencies was also achieved. Technically speaking, the modification was quite simple, logical, and clear. New crossover measured better, assuring safe, and distortion free operation at higher power levels.

However, the question about which version - Cornwall I, or Cornwall II - sounds better at a normal listening level has still no uniform answer …




Klipsch Cornwall II crossover network (B600/6000Hz) schematic

Crossover schematics - it was derived out of wired elements - it may be incomplete with regard to mid-range auto-transformer attenuator - is simple and straightforward. It is a second order (12dB/oct) for the woofer, and a third order (18dB/oct) for the tweeter.

As for midrange, it is 12dB/oct, and 6dB/oct respectively for the squaker, but - according to measuring results – actually "0dB/oct" for "high-cut". It means that midrange driver operates free from 600Hz up to 20000Hz and above, i.e. without crossover's "high-cut" limitation. It is limited only by its own acoustic response characteristics with natural roll-off around 6 kHz.

Maybe this solution is not for purist, but it is not necessarily bad. On the contrary, it just follow another philosophy, and prove to be quite a "good sounding" solution.

Later we will discuss this simple solution in a more theoretical way, less known to the audiophiles.

About cabinets. Well, while Cornwall is - no doubt - huge loudspeaker, its cabinet is light, constructed of only 20 mm thick panels, covered with different selected woods and finishes. Internal console reinforcement between front and back panel assures better cabinet rigidity.

About components. No official information was available about driver component suppliers. All drivers are marked Klipsch. All we know is that Klipsch used CTS (woofer) and Electro-Voice (midrange & tweeter) drivers. But as we also know, Electro-Voice retired from Hi-Fi business in the '80.

Klipsch Cornwall loudspeaker system has been discontinued at the end of the '80. Co-incidence?

## MEASURING EQUIPMENT AND LICENSED SOFTWARE

- Multimeter (RS-232) — FLUKE 45, SN 4935175
- Precision SPL meter — Brüel & Kjær Type 2203, Ser. No.: 487276
- Octave filters — Brüel & Kjær Type 1613, Ser. No.: 480850
- Condenser microphone — Brüel & Kjær Type 4165, Ser. No.: 709110
- Accelerometer — Brüel & Kjær Type 4323, Ser. No.: 31068
- Integrator — Brüel & Kjær Type ZR 0020
- Digital storage oscilloscope (RS-232) — Tektronix TDS 210, Ser. No.: B027410
- Communication module — Tektronix TDS 2CM
- PC Computer (RS-232 at COM-2) — 386 and above, MS Windows 3.1 and above
- PC Software for FLUKE 45 — FLUKE Quickstart 45
- Software for TDS 200 oscilloscopes — TEKTRONIX WaveStar Version 1.1.2
- Appl. Software, various modules, Quick Basic — MBS Audiolab Ver.1.2
- Standard test record — CTC CBS CD-1
- Test record — Brüel & Kjær Type CD-4090

## EQUIPMENT USED IN LISTENING EVALUATION

- Power Amplifier — Mc Intosh MC-2505
- Power Amplifier — Unison Research Simply Two (Tube)
- Preamplifier — Mc Intosh C-28 (Phono Section, input selector and tape output only)
- CD Player — Sony CDP-M35
- LP Player — Linn Axis with Shure V15III Phono Cartridge
- Tuner — Mc Intosh MR-77
- Headphones — Koss ESP-9B electrostatic with E-9B self-energizer
- Loudspeaker — MBS Audiolab Cabasse Escadre
- Loudspeaker — MBS Audiolab Rogers LS3/5a
- Loudspeaker — MBS Audiolab Kef 3W/CS7
- Speaker cable — Linn K 20
- Interconnection cables — (consumer type, no name)

## ELECTROACOUSTIC AND VIBRATION MEASUREMENTS

## ACOUSTIC FREQUENCY RESPONSE

Acoustic Frequency response in listening (living) room (appr. 36 $m^2$ or appr. 576 $ft^2$) was measured using third-octave pink-weighted random noise, as recorded on Brüel & Kjær Type CD-4090 test record (Tracks 19 and 21).

Calibrated condenser (electrostatic) microphone Brüel & Kjær Type 4165 was mounted on a Brüel & Kjær Type 2203 precision Sound Pressure Level meter (SPL), positioned 1m in front of the loudspeaker front panel, and in the axe of the tweeter horn. The test signal applied to loudspeakers terminals was linear from 20 Hz to 20 kHz wit 0.1 dB tolerance.

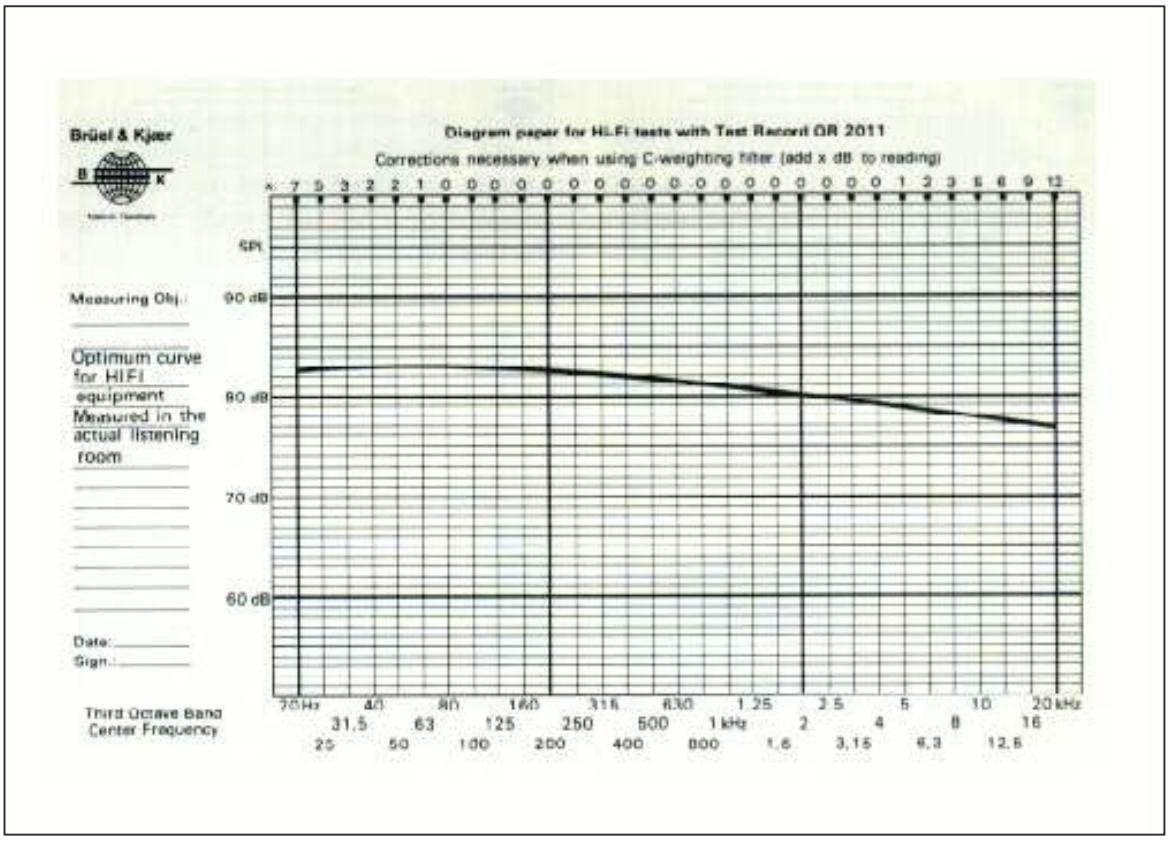
Since the listening room is an extremely important factor in evaluation of loudspeaker performance, an **objective test method** was used which gave very good correlation with **subjective listening tests**.

The measurements were performed in accordance with principles described in one of the most important articles ever written on that particular topics, by Henning Møller (Brüel & Kjær, Denmark): *Relevant loudspeaker tests in studios in Hi-Fi dealer's rooms in the home etc. - using 1/3 octave, pink-weighted, random noise*. This paper was presented at the 47th Audio Engineering Society Convention (1979) in Copenhagen, Denmark and issued as Brüel & Kjær application note.

NOTE 1: Actual measurements performed in MBS Audiolab exceeded criteria as described in the mentioned article with respect to technology used (PC Computer based, direct plotting), test records (CD instead of LP), accuracy and tolerances of test signals (0.05 dB instead of 1 - 2 dB) and repeatability as well.

NOTE 2: It is true, many of sophisticated measurements and tests which were 20 years ago reserved only to well equipped electroacoustic laboratories (with anechoic chambers) and performed by extremely expensive equipment, can be performed today at home, using generally available and reasonably priced PC computer based RS-232 controlled equipment.

In the upper mentioned paper an optimum curve for Hi-Fi equipment measured in listening room was presented.




Simple explanation of this curve is that the best listening results can be expected when living room when actual frequency response of the particular loudspeaker corresponds to described curve. This curve could therefore be used as an "optimum", "calibration", "standard", "reference" or "flat" in any listening room loudspeaker evaluation.

SHURE proposed a slightly different "optimum" curve, with even stronger (3db/octave) roll-off above 1 kHz, but loudspeaker which corresponds to this curve generally sounds "quite dull".

This approach shows excellent compliance with the subjective listening tests, but it is reasonable to mention that 1/3 octave response in the listening room does not necessarily disclose other characteristics which determine good sounding Hi-Fi system as a whole.

It is therefore a very great chance for the particular loudspeaker to be evaluated as optimaly balanced, when its frequency response in a living room corresponds to this optimum curve. The loudspeakers like that show optimum results irrespective of the type of music - classic, opera, jazz, beat, rock, popular, etc.

According to the experimental results of measurements on more or less known loudspeakers and personal experience as well, I can only agree with Henning Møller and Giancarlo Gandolfi (ref.: *Qualli casse suonano meglio in ambiente*, SUONO - N.87, 1979 and *Analizatori di spectro ed equalizatori*, SUONO - N.92, 1980) that this curve represents optimal curve for loudspeaker evaluation in a living room.

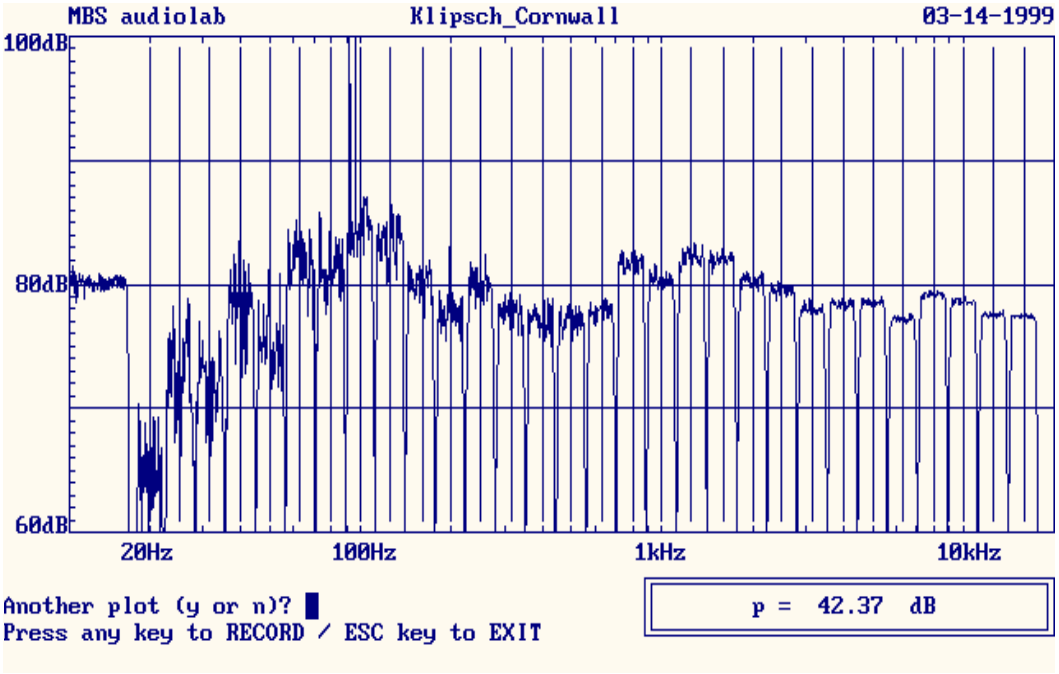
Measurement results performed by MBS Audiolab on Klipsch Cornwall II, Klipsch Heresy, Kef Model 107/2 Reference Series, Kef Model 105/3 Reference Series, Kef Model 105 Series II, Kef Q50 SP3174, Rogers LS3/5a, Rogers LS3/5a Monitor loudspeaker (heritage), Kef BBC LS3/5a Class 2 Monitor (heritage), JBL Control 1 Plus, JBL L100 Century, Linn Sara, Linn Nexus, Allison One, The Advent Loudspeaker, Acoustic Research AR11, AR17 and AR7x, JPW Sonata and others, some of MBS Audiolab loudspeaker

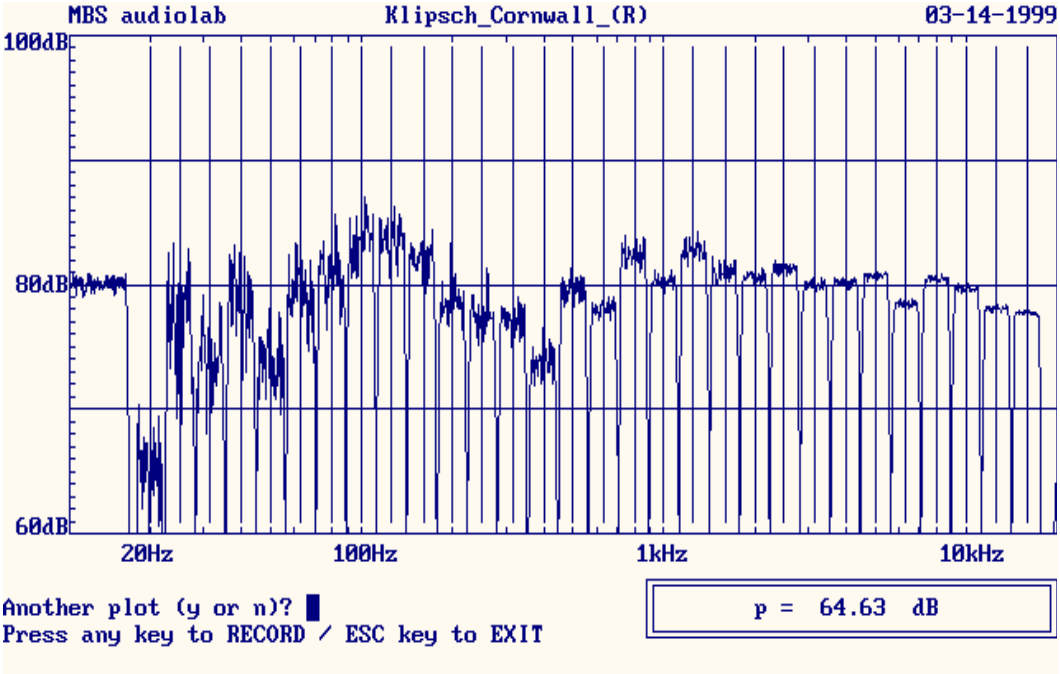
projects (Kef Constructor series CS7 and CS3, Linn Isobarik, Rogers LS3/5a, Cabasse Escadre, JBL L65 Jubal, etc.) and experiments with various loudspeaker components (Kef, Scanspeak, Audax, Eton, etc.) strongly support and confirm this statement.

When mid and high frequency response of the particular loudspeaker is above this optimum curve, then in most cases the loudspeaker sounds "open" and "bright" - and vice versa - when MF and HF response is bellow that curve the loudspeaker in most cases sounds "dark", and "dull".

It is also true that some speakers which deviate from optimum curve might even give better sonic results with particular kind of music and recorded material, but then generally fail with other!

Back to Cornwalls again ... its listening room frequency response is obviously very regular. For both, left and right loudspeaker it fits to the "reference" curve almost ideally.



Frequency response is smooth from 25 Hz up to 20 kHz. A "deep" at 350 Hz is due to floor reflection (microphone was 1 m from front panel, and the acoustics in my quite reverberant room is not an easy problem) and a narrow resonance at 100 Hz is due to door (!) resonance.

Woofer self-dumping assures quick roll-down below 30 Hz, so this speaker is quite insensitive to inaudible sub-sonic frequencies. It is true, in some cases this part of spectra contribute to additional physical sensation of sound (like: walking on the stage, closing the door, sea waves, etc.), but in most cases information bellow 25 Hz represents disturbance (rumble, bumps, etc.).

The concept of transmitting whole audible range while cutting subsonics at the same time so effectively proved to be an advantage for Cornwalls. This is definitely one of the reasons why they work so very well with LP records. With Cornwalls LP turntable rumble level is negligible.

## SOUND PRESSURE LEVEL (SENSITIVITY)

Broadband Pink Noise was applied to loudspeaker terminals. The applied voltage was 2.83 V which correspond to electrical power of 1W at 8 ohm (nominal impedance).

The loudspeaker sensitivity is defined as sound pressure level (SPL) at specified distance 1.21 meter (4 feet). The specified value for Klipsch Cornwall is 98.5 dB/1W/4 ft which corresponds to 100 dB/1W/1m.

Measured sensitivity was exactly as specified: 98.5 dB at 4 feet (121 cm), broadband pink noise. It was quite impressive to see SPL meter needle "dancing" +/-1 dB around 98.5 dB value.

This fact contributes to conclusion that 14 years old Cornwalls show no noticeable degradation of electroacoustic parameter whatsoever.

## CROSSOVER FREQUENCY RESPONSE

Crossover frequency response was measured using sweep signal, as recorded on CTC CBS CD-1 test record (Tracks 11). It is 60 seconds lasting sine sweep from 5 Hz to 21.5 kHz, with 5 seconds of pre-recorded 1 kHz pilot (trigger) tone.

Test signal applied to loudspeakers terminals was linear within 0.1 dB. Repeatability of measurements was also bellow 0.1 dB.

Frequency response on each particular driver's terminals was plotted with reference to 0 dB. Crossover frequency response is classic and expected - except for in one parameter.

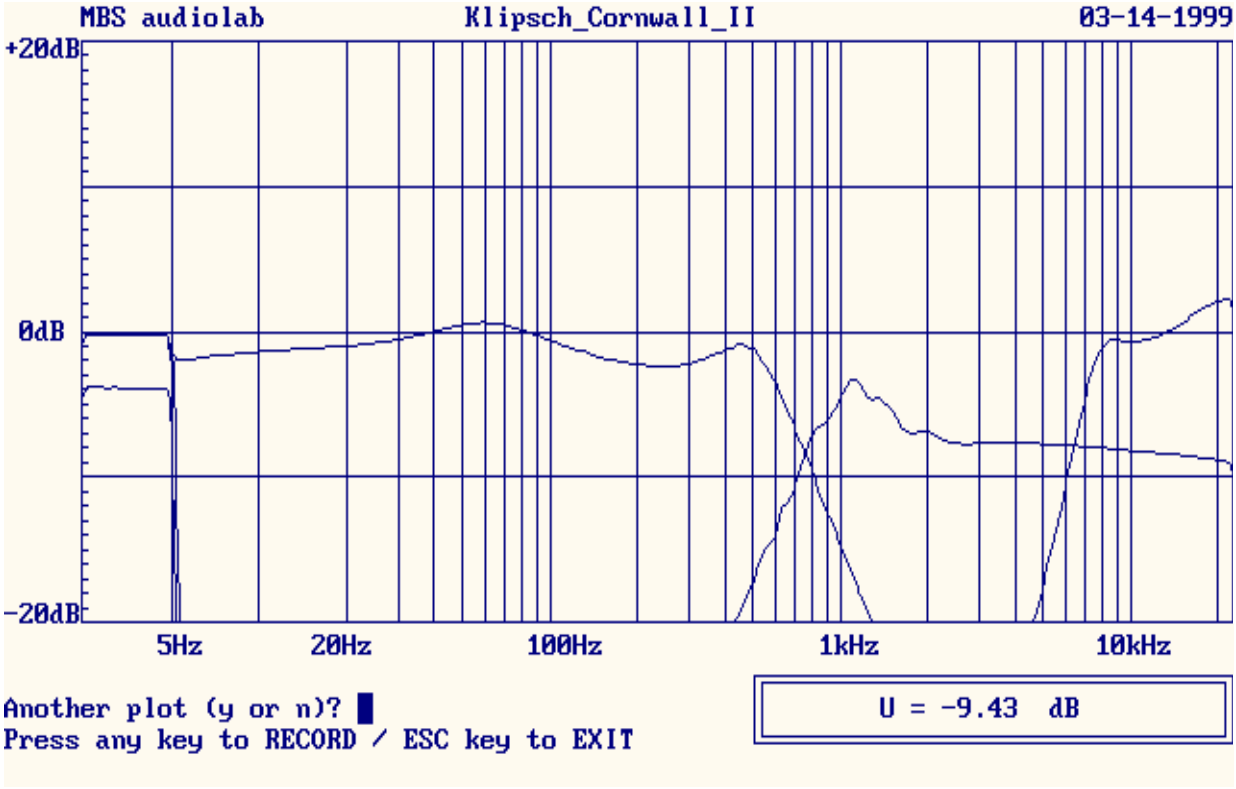
The woofer operates regularly without being noticeably attenuated up to 600 Hz as specified, with well defined roll-off above 600 Hz. You may note slight influence of woofer resonance at 60 Hz.

In addition tweeter regularly works from 6 - 7 kHz up to 20 kHz.

Mid-range driver is attenuated nearly by 5 dB. It works from 600Hz up to 20 kHz and above, free and without any crossover limitation. So, above 6 kHz mid-range speaker - limited only by its natural roll-off frequency - electrically operates in parallel with the tweeter.

This is a bit strange approach at first sight, and maybe it is not for purist, but it is not necessarily bad, or wrong solution. To the contrary, it is a quite consistent part of Klipsch's philosophy, and proves to be a "good sounding" solution.

Why is it a good solution, and what is its advantage? The answer could be found in deeper understanding of crossovers task. Let's describe these tasks by explaining a "railway", and an "umbrella" concepts which could be used in crossover project approaches.




1. **"Railway" concept**. In general people know that the of the crossover is to electrically divide audible frequency spectrum into two, three, or more parts - and this is absolutely true. Evidently, the main task of crossover networks is to assure loudspeakers to operate within the limits of the particular crossover ranges. Well, is it a bad solution? No, it is nott a bad solution, but it is not sounds a good one either - and here is a catch. Quite often natural frequency response of particular loudspeaker exceeds limits given by the crossover. In this situation, loudspeaker is forced to operate within a narrow frequency range, determined by the crossover. Loudspeaker natural frequency range is artificially reduced.

   Most of the readers know Kef B110 bass-midrange driver. This excellent loudspeaker was used as woofer-midrange in the famous Rogers LS3/5a studio monitor, where it operates within its natural frequency range, and sounds absolutely perfectly. But B110 was also used only as a midrange in many other applications, and in general the results are sonically less favourable than in LS3/5a.

2. **"Umbrella" concept**. Let's suppose that we have ideal bass, mid and high frequency drivers which cover particular part of frequency spectra just by their natural frequency ranges - natural woofer frequency range - within optimal cabinet volume of course - is from 20 to 600 Hz, midrange normally operates from 600 Hz to 5 kHz, and tweeter normally operates from 5 to 20 kHz.

   These - not so very hypothetical speakers at all - theoretically need no crossover to divide a spectrum. They only need crossover to protect them from unwanted power signals outside their natural frequency ranges. Signals outside theirs natural frequency range can only cause distortion when unproperly applied.

   Applications where crossover R&D follows an "umbrella" concept, i.e. where speakers operate without restrictions, and artificial limitations generally give more favourable sonic results.

It is obvious that in the first case crossover controls drivers, and forces them to operate within predefined area ("railway" concept), while in the second case crossover only protects drivers from unwanted frequencies ("umbrella" concept) which might increase distortion, and/or even damage a driver.

Talking about Research and Development concepts, "railway" concept generally gives serious and theoretically pure loudspeaker system solutions, while "umbrella" concept generally gives quite relaxed, harmonic, and "good sounding" ones.

Not only in the case of Cornwall, Klipsch obviously took advantage of both concepts. It is well known that product-evaluation program at Klipsch and Associates constitutes the lion's share of R&D effort. The aim is also to utilise quantitative tests which closely corroborate the psychological sensations of the listener.

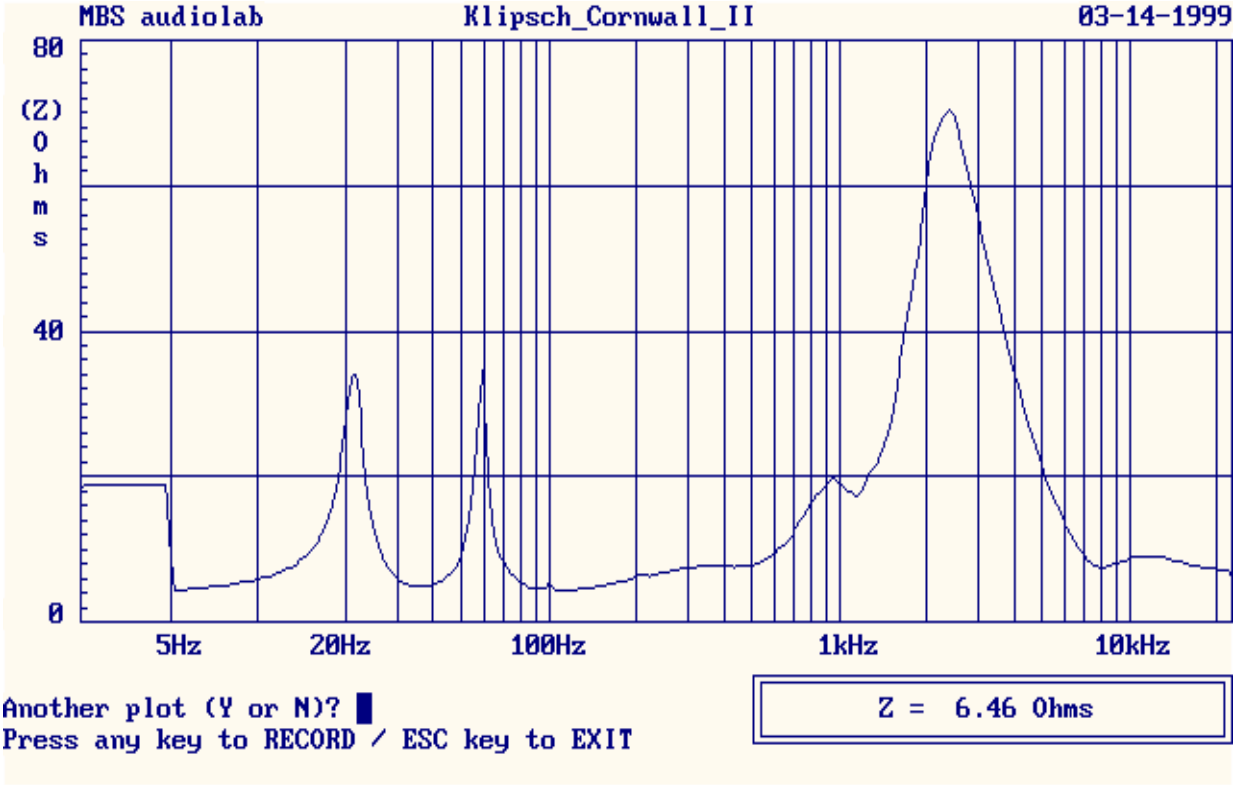
It is obvious that Acoustics is both interdisciplinary Science and Art. And Technology is just a tool to pour them together.

## IMPEDANCE FREQUENCY RESPONSE

Impedance frequency response was measured using the same sweep signal described above. Here the power amplifier - "voltage generator" was transformed into "current generator" feeding loudspeaker with "constant current" of approx. 10 mA. This can simply be achieved by inserting Rs=1000 Ohm resistor in series with loudspeaker system.

In this case actual test signal applied to loudspeaker system terminals is a function of both impedances: the one of the "current generator" and of the loudspeaker as well.

Frequency response of Klipsch Cornwall impedance curve is quite classic.




The lowest value is 5 Ohms at 20 and 100 Hz and the highest value is 75 Ohms. Nominal impedance corresponds to average "8 Ohms" value. But, according to tolerances given by well known German Hi-Fi standard DIN 45500 it might also be defined as "6 Ohms" as well.

It is obvious that woofer resonance is at 60 Hz while ducted port is tuned to 22 Hz (frankly, I expected it to be higher, at approx. 28 Hz).

Someone might expect more uniform impedance response all over the range, but it is more important that impedance does not represent problematic load to amplifier. Cornwall impedance is an easy load.

Small peak at 950 Hz is the point where woofer impedance passes to (attenuated) mid-range impedance area while peak at 2400 Hz indicate transition point between mid-range, and tweeter. If mid-range were not attenuated, this transitions would be more obvious probably at 600 Hz, and at 6 kHz respectively.

There is actually nothing wrong with this impedance curve. True, it is not as linear as some purists might prefer, but it is obvious that Klipsch simply had to attenuate mid-range in order to make frequency response more linear. Frequency response linearity was the goal, not impedance linearity itself.

## TOTAL HARMONIC DISTORTION

Total harmonic distortion (THD) - total modulation distortion, as denominated by Klipsch - was measured using test sine signals, as recorded on CTC CBS CD-1 test record (Tracks 1, 7 and 9).

Due to the fact that automatic THD measurements demand both sweep generator, and automatic tracking filter all-in-one-unit (very costly indeed), and in order to obtain at least basic information about how woofer, mid-range, and tweeter speakers behave, fixed frequencies of 61 Hz, 1 kHz and 10 kHz were chosen.

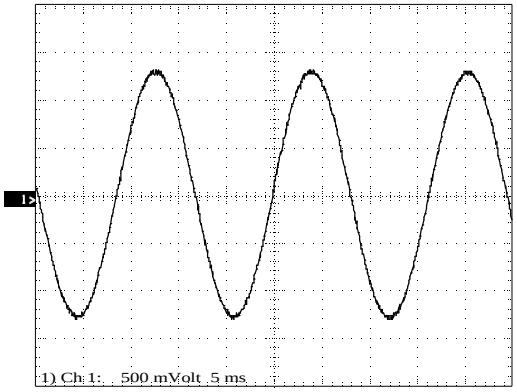
Acoustic output was measured by Brüel & Kjær Type 2203 precision SPL meter, and fed to Tektronix TDS 210 digital storage oscilloscope.

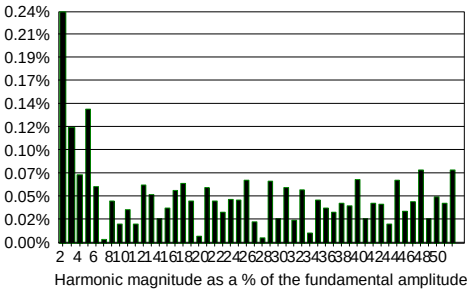
Distortion spectrum was determined by Fourier analysis of recorded signals using Tektronix WaveStar Software for TDS oscilloscopes.

THD was measured at nominal 90 dB SPL, at 61 cm (2 ft.) distance and on the axis of particular driver. Measurements were then repeated also at 100 dB SPL.

All measurement results of the acoustic output and distortion spectrum at 61 Hz, 1000 Hz and 10000 Hz are shown bellow:

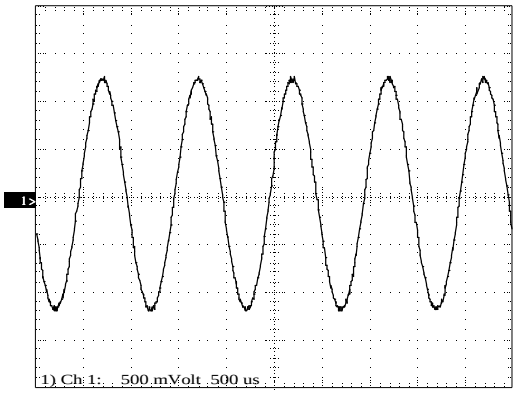
### Test frequency: 61 Hz

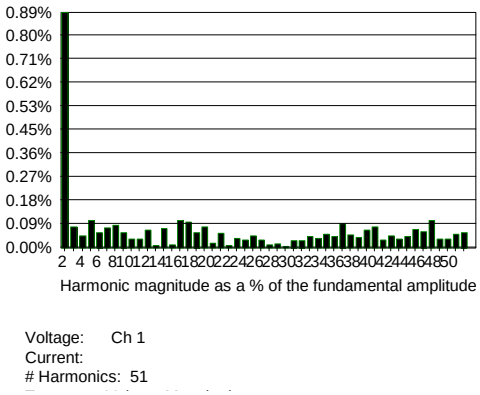



Voltage: Ch 1
Current:
# Harmonics: 51

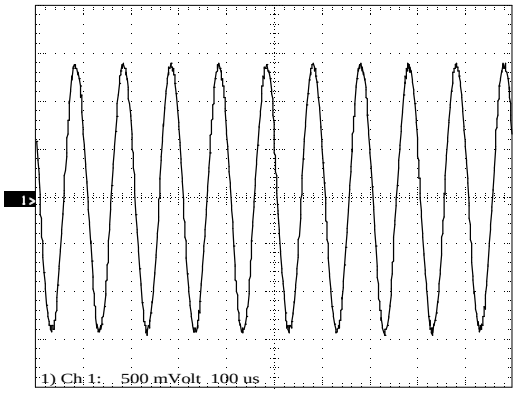
### Test frequency: 1 kHz

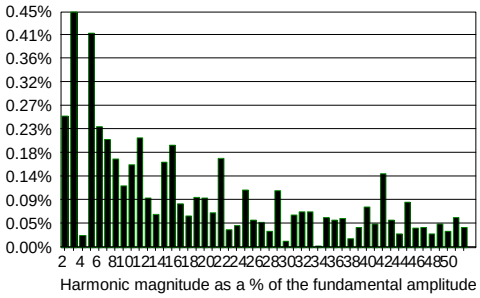



Voltage: Ch 1
Current:
# Harmonics: 51

### Test frequency: 10 kHz




Voltage: Ch 1
Current:
# Harmonics: 51

Let's summarise these results:

**Total Harmonic Distortion (THD)**

| SPL | F = 61 Hz | f = 1000 Hz | f = 10000 Hz |
|---|---|---|---|
| 90 dB (nominal) | 0.39% | 0.98% | 0.48% |
| 100 dB | 0.75% | 2.75% | 1.06% |

NOTE 3: Measurements were performed in a living room, not in anechoic chamber. Basic environmental acoustic noise in the listening room, and amplifier distortion (approx. 0.05%) are therefore included in the measuring results. The influence of environmental noise is especially evident in distortion spectra at 61 Hz and 10000 Hz. Actual loudspeaker THD value is therefore always lower than recorded result.

Distortion of Klipsch Cornwall at specified level of 90 dB is well bellow specified value (3%). Cornwall did not reach nominal distortion value of "3%" not even at 10 dB higher SPL (i.e. power) level than specified. These are very high "overhead margins" indeed.

I was quite impressed with almost perfect woofer response - its low distortion reproduction is definitely one of the reasons, why we feel and hear it working so effortlessly. 2nd harmonic distortion is prevailing.

Tweeter works with exceptionally low distortion. It is not "crisp" at all, but very clean and pure! Here the 3nd and the 5nd harmonic distortion are prevailing.

Mid-range distortion at 1000 Hz and 100 dB SPL reached 2.75%, while the woofer and the tweeter still stayed bellow 1%. This is a quite impressive result, but with regard to distortion, it is obvious that at higher volume levels the most difficult area for Cornwalls to reproduce is mid-range area between 600 Hz and 1200 Hz. It is also obvious that the 2nd harmonic distortion component is dominating.

It is worth to remind about the opinion which is quite prevailing among experts that "even" distortion components are subjectively less annoying than "odd".

I can't stress enough the real value of Klipsch's concept of low distortion, low power, high sensitivity, and horn-loading, because right here in these low distortion values I found an answer to the question why Klipsch Cornwall sounds so well, so pure, and so clean! Modulation distortion is directly affected by the amplitude of diaphragm motion, and would thus be greatly reduced by horn loading.

What this low distortion really means in practice becomes more evident if we bear in mind that actual acoustic distortion of some other loudspeakers can easily reach 10 times higher value at same SPL level.

I can assure you that some loudspeakers of good quality with 87 dB nominal sensitivity, and driven with 20 Watts achieve 100 dB SPL level in some cases even with 15% acoustic distortion and more.

## ACOUSTIC SQUARE WAVE RESPONSE

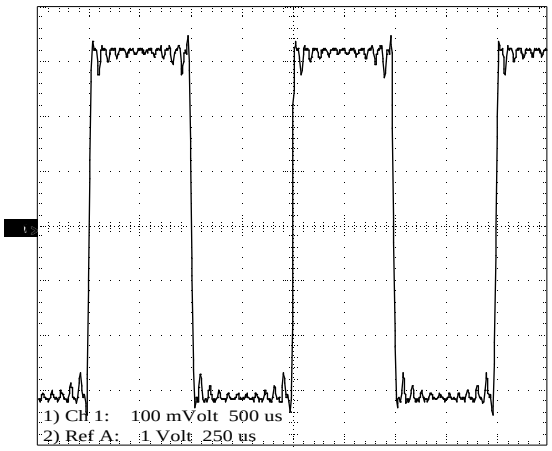
"Acoustic square wave response" measurement - please do not confuse it with "burst tone response" measurements (see bottom line) - is definitely one the most difficult acoustic measurements to perform.

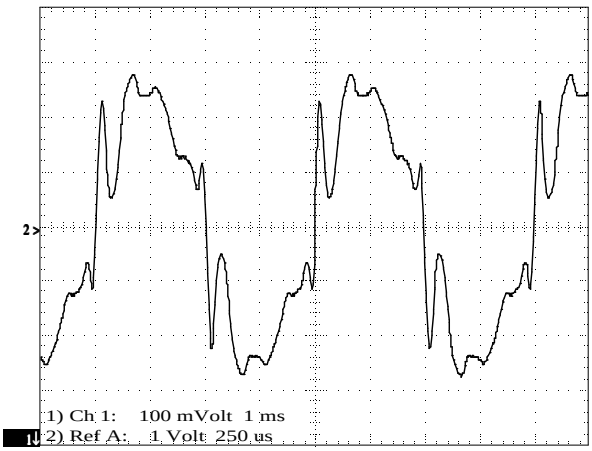
The biggest problem associated with this kind of measurement is to find a proper measuring point within three-dimensional space where at least a minimum repeatability of mesuring results can be obtained. Everyone who ever measured loudspeaker response in a reverberant field within a living room knows how difficult it is to find a measuring point where relevant result can be recorded.

Besides this, this is also a very difficult test for loudspeakers to sustain.

These are probably two main reasons why it is so difficult to find these results published.

I have decided to publish them just because they are so exceptionally good (but frankly, I am afraid of possible miss-interpretations).



First picture shows 1002.27 Hz square wave signal as recorded on CTC CBS CD-1 test record (Track 16). Please note that even the shape which serves us as our input signal is not of ideal square wave at all.

It can't be ideal because according to Fourier theorem a square wave includes all odd components from F1 to infinity according to the formula: Usqw = F1 + F3/3 + F5/5 + … + F21/21 + ….. + Fn/n.

Theoretically upper frequency which can be recorded on CD record is only 22.5 kHz. All square wave components above 21 kHz must therefore be omitted on actual CD record format. Square wave signal recorded on CDs today is therefore incomplete by definition (and this is one of the reasons why author personally does not believe in the "44,1 kHz" digital audio).

At the right picture acoustic square wave response of Klipsch Cornwall is shown. It is plotted at 1 m distance in the axe of tweeter loudspeaker.

At a first glance this acoustic response might seem even poor. But for all who know how complex acoustic field within living rooms is, this picture is not poor at all. On the contrary it is very good response indeed. Picture only indicates that at an exact point in space, phase relationship of sound, radiated by three drivers is not ideally coherent.

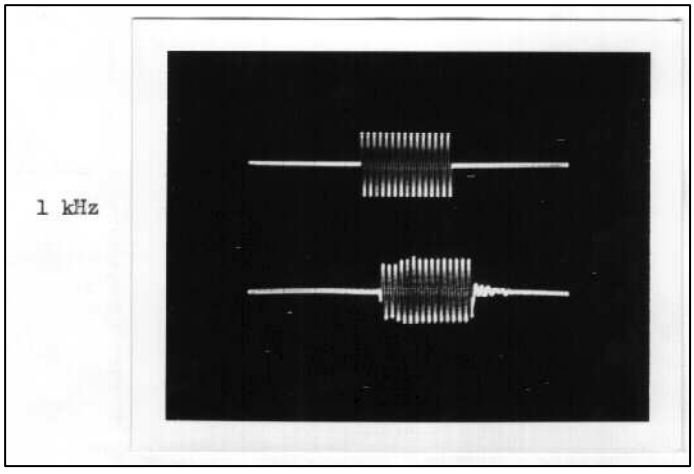
Transients are excellent. A square wave leading and trailing edge demonstrate how very fast, and how responsive this speaker really is.

And here you may find one of the strongest points of Klipsch Cornwalls which can easily be confirmed by all listening tests too.

Drums are explosive, trumpets are absolutely persuasive, piano has its punch, voices are dynamic, everything is on its place - just every single detail …

There are very few loudspeakers around (in absolute meaning of the word) which can do this job so very well. Regardless of the price range.

NOTE 4: "Burst tone" measurement are based on "bursted" sine signal (not continuous square wave), which is "delivered" to loudspeaker terminals in "packets". Usable contents of "packets" is adjustable generally from 20 Hz up to 20 kHz and above. Repetition frequency for "packet delivery" which is also adjustable is usually around 1 Hz . Special "burst tone" generator is required to perform this test (but it was unfortunately not available at the moment).

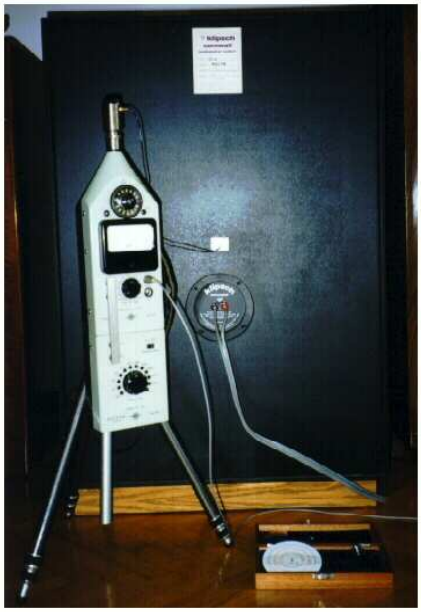


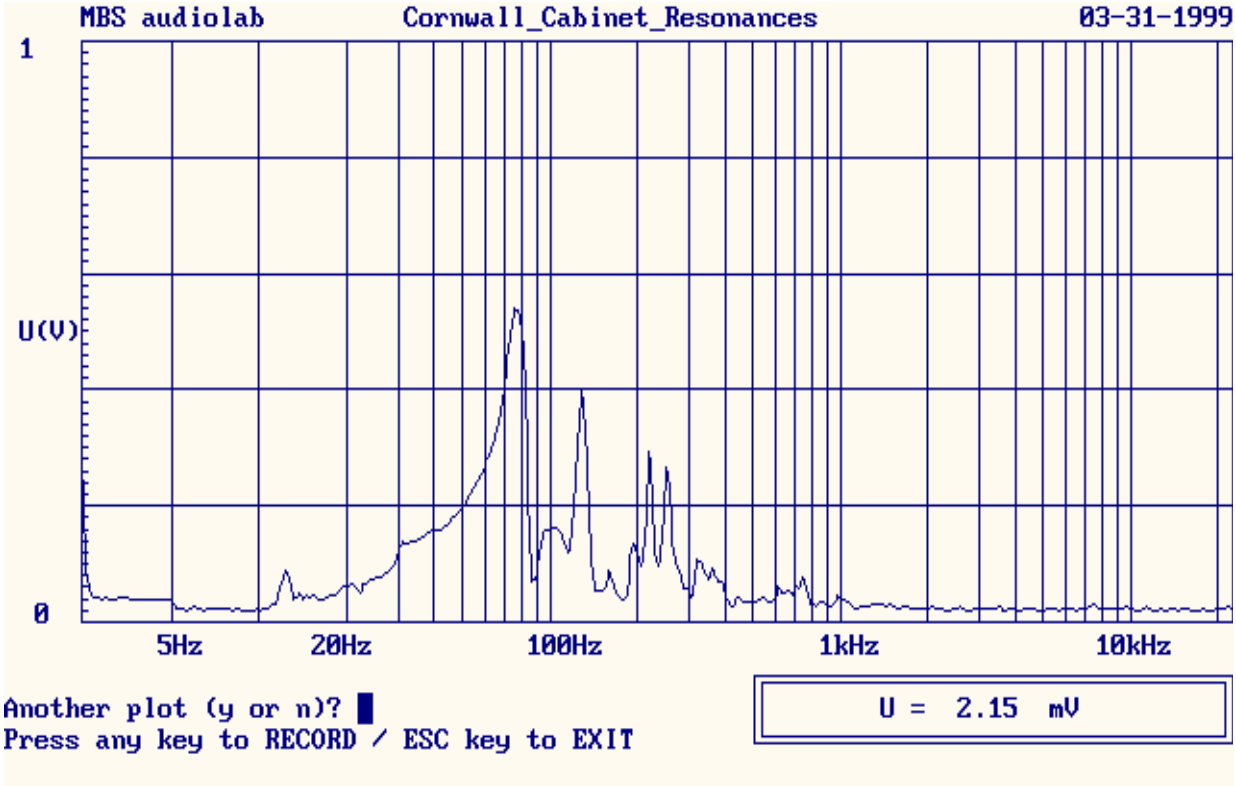

"Burst tone" response, 1 kHz within "packet"

Upper trace is electrical 15 ms "burst tone", lower trace is acoustical response of loudspeaker under test (not Klipsch Cornwall). Delay is 3 ms - this value corresponds to 1 m (measuring) distance.

## CABINET RESONANCES

Measurement of cabinet resonance are vibration measurements. Vibration transducer - accelerometer is required instead of sound transducer - microphone. Accelerometer must be mechanically attached on a cabinet surface at a specific point. Various vibration parameter can be measured: displacement, velocity, or acceleration. A special integrator unit is needed in order to switch between these parameters. Sweep signal, as recorded on CTC CBS CD-1 test record (Tracks 11) was fed into the amplifier, and loudspeaker was driven at 100 dB sound level.





Vibrations of Klipsch Cornwall cabinet were measured in order to detect unwanted resonances, and concomitant sounds which might influence original loudspeaker's sound.

Vibration plot - yet not calibrated - was taken. The velocity parameter showed the best picture of the actual vibration of back panel.

It is indicative that only woofer movement can make resonate cabinet, and furniture around. Cabinet resonances around 77 Hz, 125 Hz, 215 Hz and 250 Hz were found as dominating ones.

But it was not the cabinet which audibly resonated during measurements. Doors, and window glasses resonated instead …

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The results of electroacoustic measurements confirm that Klipsch Cornwall complies to product specifications. Also, overall excellent condition of loudspeaker was verified.

## LISTENING EVALUATION

I am well aware that most readers prefer verbal description over technical diagrams. So, I decided to perform listening evaluation too, using various signal sources (CD, tuner, phono), amplifiers, (transistor, tube) and media (CD & LP records, radio transmission).

Different types of music - classic, opera, rock, beat, jazz, popular and country, musical ensembles - symphonic orchestra, string quartet, duos - flute and harp, trumpet and organ, solo instruments - violin, piano, trumpet, saxophone, organ, cello, clarinet, guitar, counter-bass, accordion, cymbals, zither, drums, etc., vocals - singing, speech, whistling and other most interesting natural sounds - clapping, rain dropping, storm, sea waves, etc. were auditioned during evaluation.

I will try to describe every element of this "matrix" with at least a word or a sentence.

But prior to the description let me give you additional information about two subjects which by my opinion and in the context of this test report deserve additional explanation.

1. Relationship between objective measurements, and subjective listening evaluation.
2. Measurable differences between transistor and tube amplifiers (for unknown this obvious fact is quite often completely overlooked).

These subjects play very important role in many loudspeaker evaluation tests, but are quite frequently not given the attention they deserve.

## NOTE ON OBJECTIVE MEASUREMENTS VS. SUBJECTIVE LISTENING EVALUATION

I hope that correlation between objective (measurement), and subjective (listening) results is quite obvious in this test report, i.e. that objective measuring results can only complement subjective listening evaluation and help readers to get more complete information about the loudspeaker being evaluated.

Of course it is a clear message of this test report that for the author too, it is "His Majesty The EAR" which is a final, and the most important judge of the percieved sound quality.

It must be stressed again that electronic measuring instrument can not replace the ear. But it is also true that measurements, although less important for the average audiophile, are very important, and indispensable tool for every serious research, development, and test engineers.

There is very little chance - if any - to design good loudspeaker with no measurement at all.

Many more or less sophisticated measurements can only help us to understand things better.

Some of the measuring instruments are even more accurate, and stable than the ear. It is very easy for the frequency generator to generate frequencies with great precision, and for the voltmeter to measure very small changes in voltage magnitude.

But all these instruments only enable us to see only a small, actually a differential part of the sound information. They all give us precise but incomplete answers.

On the other side the ear, this miraculous Creation and natural perception instrument, never says anything about differential parts which constitute a sound information. The ear is a perceptor, and it just percepts.

Of course it is the brain which finally processes, integrates, and evaluates musical information, it is a similar case with the EAR as with EYES which are nothing but miraculous camera - photograph pictures are processed, and "developed" in brains ..... but it would certainly be out of scope of this report to talk about ear anatomy, and physiology of sound perception.

My only intention is to express the basic difference between (technical, electronic) measuring instrument and the ear as a natural perception instrument.

While electronic measuring instruments measure sound information selectively, the ear (and the brain) evaluate, and assess it integrally. The measuring instrument is a sort of "information differentiator", while the ear, and the brains are "perception integrator, and evaluator".

While precision and accuracy of electronic measuring instruments are the functions of "technology" and "calibration", while ear, and brain evaluation, and assessment capability are function of physical condition (youth, health) on one side, and "The Culture of Listening", and "Recognising Ability" (as per E. Kant) on the other.

It is only here where we may look for and discover common points between measurements, and listening tests, between objective, and subjective sound evaluation.

## NOTE ON MEASURABLE DIFFERENCES BETWEEN SOLID STATE AND TUBE AMPLIFIERS

Discussions among audiophiles about advantages, and disadvantages of solid state, and tube amplifiers are no doubt about that, some of the most interesting, and most often discussed subjects.

Like with other equipment, audiophiles compare amplifiers directly, using different kinds of music material.

They debate, agree, or disagree, buy, and sell ... you know this beautiful, and never ending story.

Of course basic assumption of all upper mentioned amplifiers comparative tests is that they are honest and objective, i.e. performed under the same conditions, with the same sources, the same records (i.e. the same input signals), the same cables and the same loudspeakers.

Only amplifiers are replaced with each other. Then most often differences are evaluated subjectively.

Sounds fair enough, I agree. So, where is the catch? Where is the mistake? Is there any mistake in this approach?

No, actually there is no mistake at all about the approach, but there is a significant, and the initial difference between solid state, and tube amplifiers I would like to point out and clarify.

It is the most general, and quite obvious difference, but so often completely overlooked during comparative listening test evaluation.

Difference I am talking about is a NON-LINEAR, AND UNPREDICTABLE FREQUENCY RESPONSE OF TUBE AMPLIFIERS as a function of loudspeaker's impedance, and generally quite low amplifier damping factor.

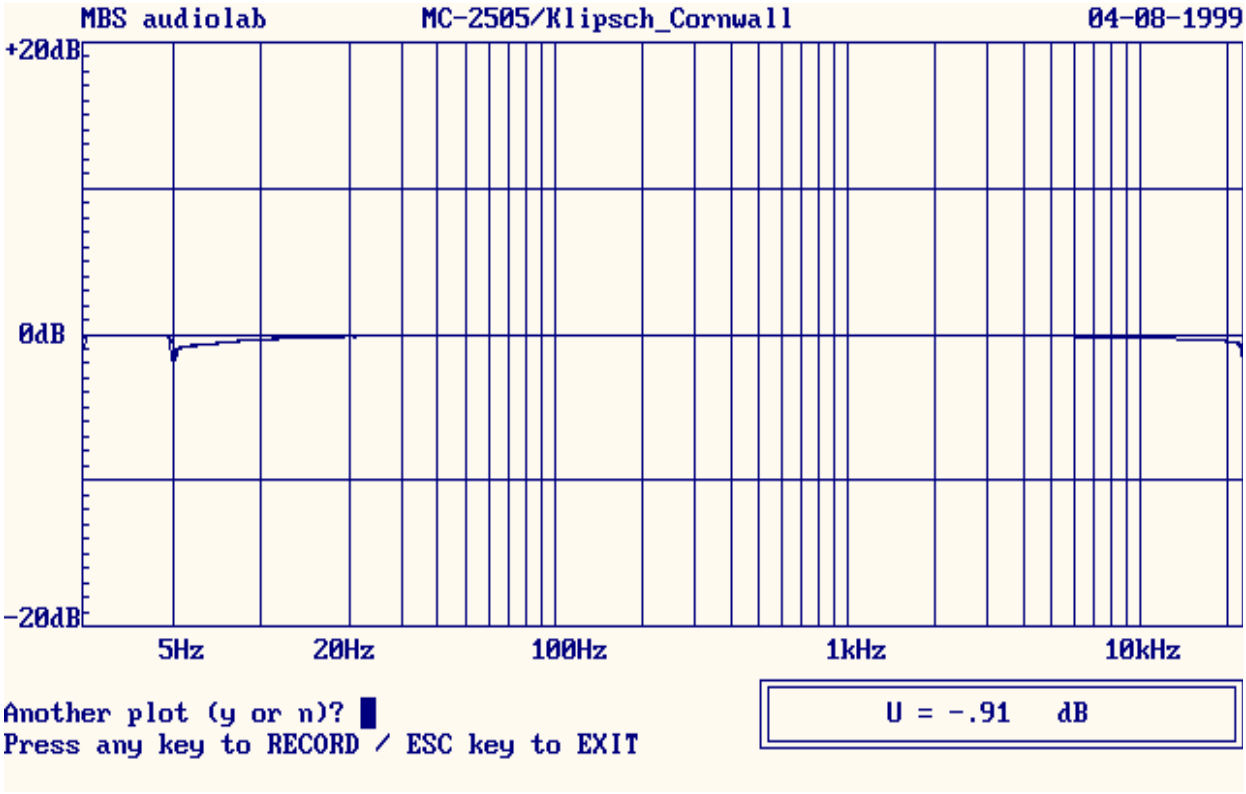
Comparative listening evaluation tests on Klipsch Cornwalls included also very good amplifiers: solid state amplifier McIntosh MC 2505, and pentode tube amplifier Unison Simply Two.

I would like to show, and comment these differences by two diagrams, but at the same time I would like to take a chance, and try to discover some answers concerning rumours among audiophiles that "horn loudspeakers" work especially good with "tube amplifiers".

Of course, I have no intention to disclose other absolutely meaningful debates about other audible differences of tube sound v.s. solid state sound, concerning non-linear measurements of tube and transistor characteristics, transient behaviour of amplifiers, distortion, psycho-acoustics, etc.

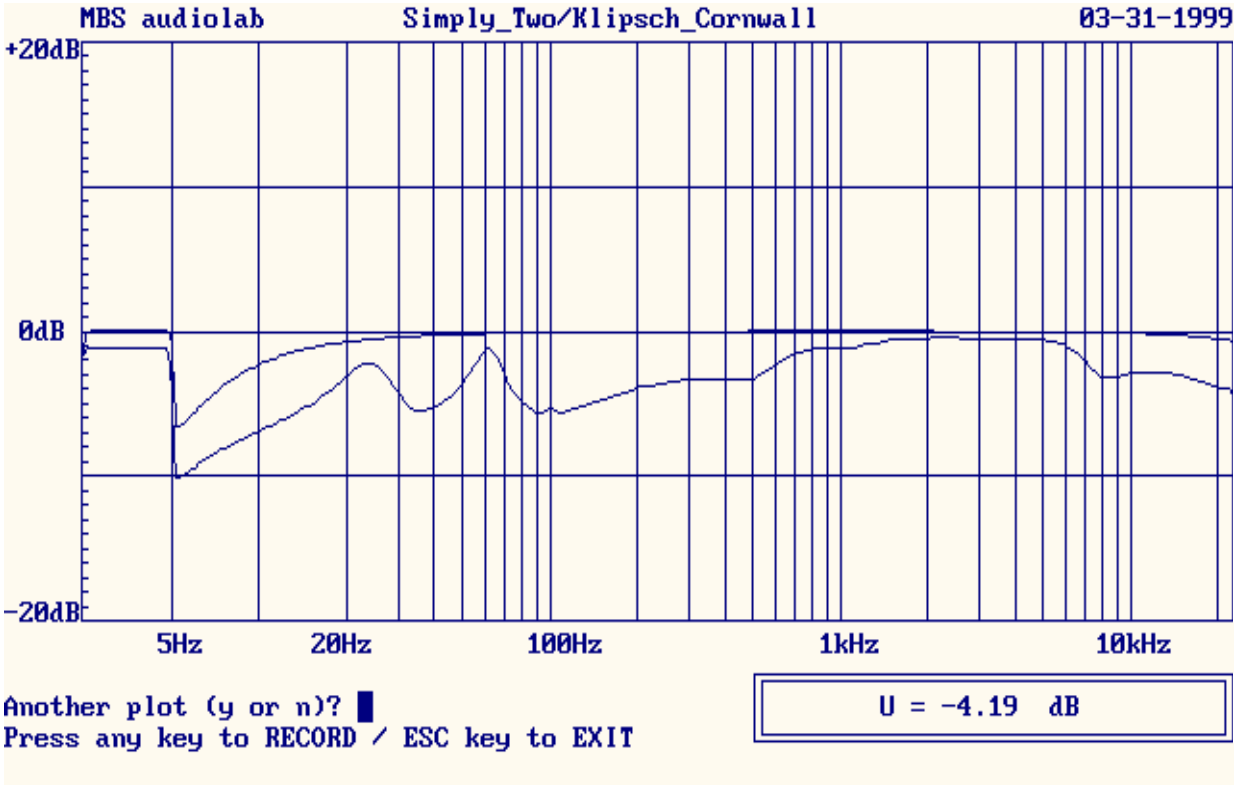
Frequency response on amplifier - loudspeaker terminals was recorded using already familiar sine sweep test signal from 5 Hz to 21.5 kHz, as recorded on CTC CBS CD-1 test record (Tracks 11).

Each measurement was repeated and plotted twice. The first time with open and the second time with closed amplifiers terminals, i.e. first with loudspeakers being disconnected and then reconnected.




Please note, the two plots on the upper diagram obtained with McIntosh MC 2505 transistor amplifier are practically the same. The difference between them is less than 0.1 dB. Similar results could be expected with all good solid state amplifiers with higher damping factor (> 50). Please, note that amplifier frequency response is flat within 0.5 dB from 10 Hz up to 20 kHz.

Similar plot was then obtained with Unison Simply Two pentode tube amplifier, set for lower "Feedback 2".




It is very easy to determine not only the differences between amplifiers, but also differences between open and closed terminals of the tube amplifier itself.

Upper trace is the "open terminals" frequency response (not to be confused with the "open loop" response - term dealing with amplifier internal feedback) of Unison Simply Two tube amplifier without loudspeaker being connected, which is flat within 1 dB from 18 Hz up to 20 kHz.

The lower trace is the "closed terminals" frequency response of the same amplifier with the loudspeaker being connected, which is "flat" only within 5 dB from 18 Hz up to 20 kHz.

This is the actual frequency response of tube amplifier with the loudspeaker being connected. It is true that there are differences between tube amplifiers - due to design solutions - but in general all tube amplifiers, especially those with lower damping factor (< 5) show similar, not so very linear response.

Of course, these "6 dB" differences, and deviations from linearity can be heard, even by untrained ear.

The main difference is in significantly different solid state, and tube amplifier output impedance combined with particular loudspeaker (input) impedance.

Some of the readers may also notice similarities between second plot and impedance plot. Indeed there are similarities; effects of impedance peaks are visible - those of ducted port, and woofer resonance.

Yes, the main difference is a function of substantially different amplifier damping factors, and loudspeaker impedance, and every single combination results in its specific frequency response curve. Let's take 10 tube amplifiers + 30 loudspeakers, and 3 people evaluating them. You might get 300 curves, and 900 opinions. How to compare them? What a wide field for speculation! And as this all is not enough, in some particular conditions, all these differences might really result in extremely nice and pleasant sound.

And as you know, these (obvious) differences are so very often the object of discussions, different opinions, personal preferences, excitements, and disappointments, miss-interpretations, and speculations as well. Unfortunately they could sometimes be intentionally abused in some specific situations. But, this is another story. What can we learn out of this? Quite a lot.

We must first bear in mind that here in this non-linear area there are substantial differences between solid state vs. tube as well as in tube vs. tube amplifier comparative testing, and evaluation.

Reading upper characteristics with reference point at 1 kHz it is quite easy to determine that "this amplifier has good mid-range response" (+0dB/Mid), or that "it has 'relaxed' bass response" (-3dB/Bass), or "soft high-end response" (-3dB/High), etc., etc. Very flexible indeed. Very relative. Very speculative.

It is also obvious that soft "-3 dB/High" tube amplifier is ideal counterpart for bright ("+3 dB/High") loudspeakers. Bright loudspeakers might profit more than neutral loudspeakers (0 dB/High) when working with Simply Two. This is the case for example with Cabasse which is a bit bright, but not with Cornwall which is quite neutral loudspeaker.

So, what is the real problem?

The problem, the only real problem of all these non-linear characteristics seems to be "Reference Lost" (paraphrase to "Paradise Lost" by John Milton). Within that problem “linearity” seems as it is not important evaluation tool at all. As it does not exist anymore. Believe me, this is really an unbearable idea. Everybody need something to rely on. You cannot just simply replace linearity with something else, something undetermined. What could it be? What could then serve us as a reference instead? No, LINEARITY can not be displaced! We all need linearity as a REFERENCE!

> NOTE 5: The upper paraphrase is not chosen just accidentally, but it has its deeper meaning every audiophile should be aware of. There is a pure coincidence between LINEARITY in the context of the topics and GOD in John Milton's poem. A firm belief about "Where God is at the first place, everything is at its right place" is absolutely applicable to the concept of linearity and Hi-Fi as well. Understanding this can help us understand everything else.

The problem becomes more evident when you have to evaluate audible differences, and to choose between rational "linear & REAL", and emotional "less-determined & PLEASANT".

If the main goal of Hi-Fi is still, and by definition - faithful reproduction, i.e. truth, and nothing but the truth - we should therefore always vote for REAL. Our decision should always be referenced to linearity.

But at the same time it is also very clear that we all are emotional human beings as well. Therefore we may also vote for NICE, and PLEASANT. Nothing is wrong with that.

We should only remember what our REFERENCE is, and not forget that when we vote for nice and pleasant we always follow our EMOTION. It is like a dream; it may be nice, but not necessarily real.

The solution of the upper mentioned problem is therefore always free, personal, and subjective decision, which must always follow personal preferences and attitudes.

My recommendation is to maintain harmony between RATIO and EMOTIO, and maybe the best decision is to obtain both types of amplifiers - transistor and tube.

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So, I would kindly ask readers to understand that the results of my subjective listening evaluation are based on my personal rational and emotional decisions (see more about my audiophile profile at the end of this test report).

I will do my best to describe listening tests as honest as possible, but the results will still reflect my personal listening preferences and attitudes. My only intention is to share them with you.

## LISTENING TESTS

Listening tests were performed - as described previously - using various signal sources, media and types of music.

All findings were directly recorded, and they are presented here almost as precisely as original records. They were only grouped in order to show more comprehensive evaluation results.

There was no firm criteria about choosing records, but there was always at least one good reason – good, or interesting recording, or interpretation, well-known piece, or artist, etc. It is also true that not only the best recordings were chosen.

Some LPs were old, and scratched, and some comments are therefore given also with regard to good, or poor recordings which always play an important role in all listening evaluations.

I sincerely hope that this description is adequate, objective (but unavoidably weighted by subjective factor*), well balanced, complete enough, true and fair.

* See author's audiophile profile at last page.

**CLASSIC, Flute and harp** Bach, 3 Sonatas for Flute and Harp, Irena Grafenauer and Maria Graf, PHILIPS 422 061-2 DIGITAL.

Flute. Magic and subtle, and delicate. I wish Irena (Slovenian, born in Ljubljana) would join me, and say to me "Yes, this is my flute". And harp - this heaven gift - rich and precise, vibrating free, both silent and decisive, punctual, and soft. Speaker's volume with its low-end capability might seem over-dimensioned for flute, but contributes to proper harp breathing. Optimal.

**CLASSIC, Violin** Niccolo Paganini, Variations on Theme by G. Rossini from the opera "Cinderella", Victor Pikaizen - violin, Serafima Chernyakovskaya - piano, Melodia (Made in USSR, 1972) C10-18013-14 (LP)

This is almost an archive recording. Probably all-tube recording, and plating process. One of the best "scratchy" recordings. Amazing. Violin is so vivid, and pizzicato so persuasive. No sound compression at all. You can sense 60 dB dynamics in its purest sense, and hear violin playing from whispering and trembling silence up to the "broken string" crescendo. Even the echo within the violin body can be heard.

Bravo to E. Shakhnazaryan, recording engineer. Many of us - including Tim de Paravicini - could learn from you, unknown expert ! Bravo!

Here is the opportunity to share my feelings with Michael Shed, Cornwall owner from Orlando, who owned Cornwalls almost 25 years, and wrote: "Turn up the volume, Mitja. Let all of Europe enjoy them … "

**CLASSIC, Piano concert** Sergej Rachmaninow, Konzert für Klavier und Orchester Nr.2 C-moll op.18, Agustin Anievas, Das neue philharmonia orchester London, Moshe Atzmon, EMI C 063-00-364 (LP)

I listen to this beautiful record quite often. It is a complete work - composer's and artist's masterpiece. Piano, this marvelous instrument, so difficult to reproduce with all its punch, and its energy is here. It is so difficult to manufacture a loudspeaker which can reproduce piano properly - from the lowest to the highest note - with all its energy, and with all its strengths, and dynamics. Cornwalls can do this. Have you ever felt - not only heard - real piano being reproduced in your room? Only those of you who have, know what I am talking about.

**CLASSIC, Clarinet concert** Carl Maria von Weber, Concert for clarinet and orchestra No.1 in F minor, J114, (op.73), Charles Neidich, Orpheus chamber orchestra, Deutsche Grammophon, 435 875-2 (CD)

Clarinet is present, real and vivid. It definitely has its proper balance, and "weight", and "body". But orchestra tends to "boom a bit" at its fortissimo. And I would prefer violins and the rest of orchestra to be a bit more accentuated at high frequencies. CD recording?

**OPERETTE, Die Fledermaus (The Bat)** Johann Strauss, Carlos Kleiber, Bavarian State Orchestra, Deutsche Grammophon, 2530 692 (LP)

Act Three. The Prison Governor's Office. Starting from jailer Frosch (Franz Muxender), singing at the background first, passing to Ida (Evi List), and Adele (Lucia Popp). Voices are always absolutely clear. Natural stage and depth are evident.

**ORGAN AND TRUMPET** Trumpet & Organ - Music of the baroque, Ronald Thompson - trumpet and Emma Lou Diemer - organ, Water Lily Acoustics 1990 Limited Edition, Stereo WLA-WS-13 (LP).

Can any speaker (except Klipschorn) do such a marvelous job? Especially with organs, at low-end. Sound is open. The trumpet is very present. Hey trumpet, would you please stop blowing into my face?

**CLASSIC, Violin concert** Ludwig van Beethoven, Konzert für Violine und Orchester D-dur op.61, Anne-Sophie Mutter, Berliner Philharmoniker, Herbert von Karajan, Deutsche Grammophon, 413 818-2

Violin is smooth, subtle, and tender - it makes my skin to stand on end. Excellent artistic performance, conductor, and the orchestra. But overall quality of that particular CD recording is not so very good. Low-end tends to boom a bit, and I would prefer a bit more expressed high-end. What happened to Deutsche Grammophon? It was once capable to produce reference LP recordings.

**CHANSON** Je suis comme je suis (Sem kakrsna sem), Vita Mavric and The Big Band of Radio Slovenia, SAZAZ 104305 (CD).

Reference. Perfect. Pure vocal interpretation accompanied by Big Band. Everything is at its own place. Nothing to add, nothing to take away. Full-Frequency-Range-Recording. Recording masterpiece.

A word about good quality CD recordings. I chose it instead of the fact that Vita Mavric, an excellent Slovenian singer, and theatre player (Café Theater) is probably not known abroad. And Slovenian music production is barely recognizable either. This recording is of reference quality, comparable - if not better, than Prophone (Proprius) *Jazz at the pawnshop* recording, or various Sheffield Lab CD editions.

**BLUES** Eric Clapton, Unplugged, Reprise Records, 9362-45024-2 (CD).

Relaxed, and open sound. You are there on the stage, you can feel emotion, and you can clap together with the audience. Sound is fast, and you can feel the punches. Dynamics is explosive, and dynamic range is awesome. It is a physical energy that excites. It is not only the sound you are hearing. Hearing is empty without feeling. And horn sceptics - do not worry too much about imaging and spaciousness.

**ROCK** Bruce Springsteen, Greatest hits, Columbia, COL 478555 2 (CD).

What an emotion to hear *Streets of Philadelphia* and *My home town*. What an effortless sound energy. I would like to share my sincere opinion with Scott Cox, Cornwall owner from Bakersfield, California, who wrote: "*Cornwalls are large speakers and they sound like it! They present a very large, natural sound stage. These things cover entire audible spectrum and sound perfect at any volume that you can physically withstand.*"

**POPULAR** Vaya con dios, Night Owls, BMG Ariola, Sabam 210 600 (LP).

*Quand Elle Rit Aux Eclats* is marvelous. Extremely relaxed, and dynamic sound. Dani's voice is fascinating. Inter-tracking sound in this LP can also be heard behind. Heavenly beautiful, and transparent accordeon reminds me of one in *Vesoul* by Jacques Brel (Barclays Nº 8002).

**VOCAL** Carol Kidd, Nice work, Linn Records AKH 006 (LP)

Reference LP recording. Vocal is detailed, and transparent. Piano is rich, and full, and works effortlessly, but with all its natural punch. Woofer fills the space with velvet softness, but my big listening room is too small … maybe I should open the door, and move Cornwalls onto the garden.

**JAZZ** Jazz at the pawnshop, Proprius PRCD 7778.

Sitting in the Pub. Listening to the voices. Feeling atmosphere. Clarinet solo in front, and xylophone, and counter-bass, some visitors clapping, drum section. Everything is there, nothing is missing. Complex sounds are handled very easy, every detail can be heard separately. It's like every single instrument would have its own, well defined place within Cornwall sound stage. Or maybe even its own loudspeaker as a source. Excellent dynamics, very musical, and effortless reproduction indeed. Magic. Reference. Listenability, and musicality are unbelievable.

**JAZZ** The King James Version, Harry James & his big band, Sheffield Lab-3, (SL21/SL22) (LP)

Clear, rich, full frequency, and spacious sound. One single stereo AKG C-24 microphone recording. Everything is on the scene, clear, and loud. Saxophone, piano, bass and the drums, everything. And the trumpet, oh trumpet, is there any speaker around that can do this job better than Klipsch? Probably not.

## FM RADIO TRANSMISSION

**Holly Mass- direct transmission from Catholic Church** You are attending Sunday morning Mass, sitting in the first line. You can hear people entering, the echo, and reverberation within the Church. You can feel the space, and the depth of the Church.

Statements like "I am sitting there", and "Mass is taking place right here in my living room" have the same meaning. Hearing Cornwalls, it seems that there is no difference between these two statements at all, i.e. there is no barrier between these two places.

The priest's voice is absolutely clear, balanced, distinctive, and present. Simply, it is REAL. The organ is amazing - from silent notes to crescendo. Cornwalls reproduce organ with all its natural power. Cymbals are charming while echoing through-out the church. The choir is singing behind.

**What I hear via Mc Intosh MR 77 FM tuner is far better than most of the best LP and CD recordings. There is no complicated sound processing, mixing, digitalization, recording process - just pure FM transmission. Yes, yes … this sound is simply REAL. This is what High Fidelity is all about. Yes, I believe in God! All these "academic" questions about "spaciousness", "depth-in presence", "bass/ mid/treble response", "channel separation", or "polar characteristics" instantly disappear (dissolve), and seem to be completely obsolete.**

P.S.: My dear and silent wife's comment: " ... well ... good ... maybe too forward, and present (?!?) ... a bit intrusive ... maybe you should reduce volume ... " (her comment could generally be applied to all my listening tests). My comment: "Oh, women, they always prefer music to be only 0.1 dB louder than noise within the living room ..."

**Music** Very delicate. Sometimes, listening to (analog?) recordings it seems that tuner could be equal or even better source than CD player. Suprising, indeed.

**Speech** When listening to the radio news, voices are very clear, and correct; male voice may sometimes, and especially at levels which exceed normal speech level, seem to be accentuated at low-end, probably due to proximity, close-microphone effect.

**NATURE SOUNDS** Thunderstorm in the wilderness, Solitudes, CDG013.

The rumble of a distant thunder over the far shore. Natural. Wild. Beautiful. Lightning flashes, and enormous acoustic and vibration thunder energy is transferred into the room. Explosive. Dynamic. Frightening. Revealing sub-conscious emotions.

**NATURE SOUNDS** Ocean Surf timeless and sublime, Solitudes, CDG014.

Waves lapping onto rocks, and sweeping across the beaches. Natural "white noise" sound generator. Full frequency range recording from subsonic frequencies of tremendous energy (at higher volume levels CD player lost its tracking several times) up to the delicate pebble purl.

**NATURE SOUNDS** Best of Chesky Jazz and more Audiophile Tests/Volume 2, Chesky JD 68 D.

Tracks 51 - 61. Forest, Railway station, Kids in a park, Police, Supermarket, Drinking beer, In a subway, Rain drops, Playing Tuned Glasses. Marvelous! Complete and rich information. From deep low-end up to the highest notes. Even within traffic noise, voices are very distinctive. Klipsch Cornwall proved its absolute tonal balance. It is an optimum-curve loudspeaker and true monitor.

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Finally I would like to mention that all listening test - except thunderstorm, and ocean surf - were performed at moderate to high listening levels, generally around 85 dB; maximum listening level within the room was bellow 97 dB. Therefore, average power applied to Klipsch Cornwalls rarely exceeded 0.25 W (one fourth of watt) per channel!

One watt per channel was too loud, five watts per channel were physically very difficult to withstand.

But it was very easy job indeed for both amplifiers – solid state MC 2505 and tube Simply Two as well.

Yes, with Klipsch Cornwall you do not need anything but a good 5 W amplifier. And a good source.

The listening test performed with various signal sources, the media and the types of music, gave very favorable results indeed.

## SHORT COMMENT ON TRANSISTOR V.S. TUBE LISTENING EVALUATION EXPERIENCE

Listening to the "tubes" was very impressive at the first hearing, but on the long-term it left me somehow unsatisfied. I was missing something, without knowing precisely what it should be. Perhaps just a simple, linear and uncolored sound.

A **pure and clean** vs. **nice and sweet**, this was obviously the dilemma. What to choose, natural water or cola, bread, or delicate sweet, REAL natural woman, or NICE coquette. Hmm, sometimes I like to drink cola, I enjoy eating sweets, yes … frankly … sometimes I would maybe even opt for coquette too, but actually, there was no real dilemma for me at all.

The tube Simply Two amplifier sounded nice, warm, soft, with certain bass punch, sweet, never intrusive, touching, sometimes dramatic, a bit artificial, and colored, non-linear. Ideal for late-night hours' dreams.

Long-term listening left deeper trace when I was listening to solid state amplifier. It was more persuasive than impressive. Transistor based Mc Intosh sounded natural, real, straightforward, convincing. and linear. But far for being sterile. With Mc Intosh Cornwall sounded like an optimal transducer of unlimited capability. The Real Reference.

Quick comparative testings of Klipsch Cornwall with MBS Audiolab Rogers LS3/5a loudspeaker monitor and Koss ESP-9B electrostatic headphones were also performed for informative purposes only. However three monitor sound sources were compared, and all of them proved their noble origin again.

Rogers LS3/5a is a real Mini-Monitor for small studios and listening rooms. Like a small, 5 year old nephew walked proudly along with its 40 year old uncle Cornwall. And Koss ESP-9B is a real reference unit, mostly used with tape mastering machines, recording consoles, and ideal for audiometry and sound evaluation. Koss ESP-9B sounds extremly coherent within all 10 octaves, subjectively with approx. 3 dB less accentuated low-end energy than Klipsch Cornwall.

Tube Unison Simply Two amp with its 12W RMS had some problems to drive Rogers LS3/5a, and Koss ESP-9B because they both need at least 25 to 50W for full output. Mc Intosh 2505 was a Sovereign here.

OUT OF SCOPE: I connected Mc Intosh MC 2505 at the LEFT channel of Koss ESP-9B, and UNISON Simply Two to the RIGHT channel in order to compare both amplifiers on headphones. Both outputs were really extremly good, but LEFT channel was wide-range linear and noticeably cleaner, while RIGHT channel was sweet, charming and noticeably nice. Subjective listening tests confirmed objective measuring results.

## CONCLUSION

If the loudspeaker can reproduce the whole frequency spectra, from the lowest to the highest note a human ear can perceive, if it can reproduce a wide range and the most complex sounds effortlessly and with lowest distortion, and if it can reproduce music in its whole dynamic range it must really be a good loudspeaker.

No doubt Klipsch Cornwall can do this. And no doubt, it is an exceptional loudspeaker.

Cornwalls are large speakers and they sound like it. They present a very large, natural sound stage They are one of the few speakers you will ever hear that you will instantly love.

They reproduce music effortlessly, whereas most speakers color the sound in some way. They have a transparency to them that I have not heard before, or since.

The other remarkable thing is volume. These things sound perfect at any volume that you can physically withstand. I can honestly say that I have never heard them distort.

Cornwalls not only reproduce sound. They transfer-transform-restore original power, and energy! Cornwalls transmit, and restore total sound energy within entire audible frequency range. They restore it within tremendous dynamic range.

And there is a direct functional correlation between energy being radiated by the loudspeaker as a system and the physical and emotional excitation of the listener. That’s why Cornwalls excite so much.

Cornwall is unbeatable in terms of dynamics, presence and the ability to transform a real life feeling into your living room.

They reproduce music with absolute clarity. The sound is pure and clean. Bras is reproduced with the blatt intact. Trumpets and trombones are right there. That's why Cornwalls are so persuasive.

Internal volume of 220 litres assures effortless and unique low-end response. It is practically impossible to replace this exceptional "mechanical" characteristic with any "electrical" means adequately.

Reproduction of LP is unbelievably good. Even when playing old and worn LPs.

**When reproducing directly transmitted signals (directly from microphone or via FM tuner) Cornwalls sound absolutely spectacular - there is no difference at all between "they are here" or "we are there" statements. With good recordings, Cornwalls sound fabulous; really very good. With poor recordings, Cornwalls sound poor - of course, they are not designed to "improve" or color sound. But always, whatever the source is, Cornwalls sound REAL. ALWAYS!**

Cornwalls is a TRUE monitor and a REAL speaker. It is an OPTIMAL loudspeaker as well.

There is literally thousands of good loudspeakers around. Regardless of price it is hard to find few of them to come close to this masterpiece.

Sometimes I tried to find deficiencies and deviations, but I simply couldn't. I always find them on some other part of the signal processing path.

Cornwalls work well with tube amplifiers. Of course they do. But not with just any tube amplifier. Best results can be expected with well-designed amplifiers with "closed terminals" frequency response within +/- 1.5 dB at least. The tube amplifiers with accentuated frequency roll-off above 5 kHz should be avoided. Such amplifiers may play well with some other "+3dB/High" or "+6dB/High" tweeter horns, but cannot be recommended as a good mate for the Cornwalls.

Maybe Cornwall is less capable concerning low end reproduction than Klipschorn but it may also be more optimised choice with regard to placement and capability to properly reproduce sounds which do not comprise low frequency information like vocals or some musical instruments like a violin, flute, etc.

Klipsch loudspeakers are immortal! They will be out of date only when the laws of physics change.

Or when physiological sound perception characteristics of human race change. We all know it is quite certain that it will not happen within the next few thousands years.

Maybe Klipsch loudspeakers are a status symbol, but it is very likely for Cornwalls to became the cult object.

Like Marantz did with Models 7, 8B and 9, Klipsch should probably reconsider Cornwall re-creation, with the minute attention paid to every detail of its original construction, in order to reproduce precisely the performance that made if famous.

Finally I would like to tell you that I do not dance and I do not say "Yes, yes …." very often, I do not conduct an orchestra either. But Klipsch Cornwalls encourage me to do all these. Day by day. They put me into complete harmony with the music. Yes, they make me happy.

And this report? Is it an Ode to the Legend? Yes it is, it certainly is.

*Mitja Borko*

## The author's audiophile profile

(my audiophile philosophy description for better understanding of subjective evaluation factors)

I am an electronic engineer and a constructor with many years of experience in electroacoustic measurements and analysis in audio and Hi-Fi, electroacoustic projects, and PC software development for evaluation in audio engineering. "Hi-Fi" is my hobby*, and my love for more than 40 years. Within this period I auditioned and measured a 'hundreds' of loudspeakers and audio system components, and went through all audiophile phases. Today I have at least 7 audio systems in my home, which I call »a house of music«. I am an optimist by nature and very dynamic. I prefers sunny days over foggy ones, movement over slow motion. Similary I prefer open, dynamic, and effortless sound over soft, velvet, or compressed one. I prefer natural and pronounced wide-range sound over artificial "subsonics&ultrasonics", and "sterile high-end". I prefer American "West coast" over "East coast" sound, and I admire "british" sound, electronics, and engineering-craftmanship. According to my belief music should be reproduced with low harmonic (modulation) and dynamic (compression) distortion. I am still quite reluctant about closed-box loudspeaker designs, but I admit LS3/5a is a very succesful and coherent design. According to my opinion closed boxes work like "heavy-duty workers", "very hard" and with too big compression distortion, desperately trying to tell the listener more about real music. I love tube amplifiers, but I can not deny some clear advantages of the best solid state amplifier designs. I sincerely respect legends in Hi-Fi, knowing who the real winner and survivor is, and why. I like all types of music but I prefer CLASSIC over all. I appreciate highy the aestetic essence and the cultural value of the MUSIC and I am well aware of the ethic message of this universal COSMIC LANGUAGE. I prefer LP over CD; according to my experience LP only is capable to recreate the holographic dimension of the stereo sound. I estimate "44.1 kHz" digital audio as insufficient and incapable to satisfy state-of-the-art sonic demands of serious audiophile. The need for the new technological breakthrough is obvious. New standard should be set with "at least 64 bit" quantization and "at least 441 kHz" sampling frequency. Since current Hi-Fi *technical standards* are obviously insufficient and incomplete, a new interdisciplinary aproach is necessary in order to determine psychoacoustic, psychological, civilization, cultural and emotional parameters of sound perception. For better and more precise quality evaluation of the reproduced music, a set of new *audio principles and standards* should be prepared by linking together the best of the current expert knowledge. I prefer analog over digital, but I can not deny that digital recordings with 24 bit quantization, 96 kHz sampling, 110 dB dynamic range, and 0.001% distortion give really incredible sound quality results. You may call me nostalgic conservative.

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* I am a TQM Consultant (Quality and Standardization, ISO 9001 - Quality Management Systems ISO 27001 – Information Security Management Systems, ISO 14000 - Environmental Management, EN 45000 - Accreditation of Testing Laboratories and Certification Bodies, EFQM - TQM and Business Excellence Model, European Quality Award, Baldrige and Deming Quality Awards, etc.). I consult large companies trying to achieve ISO 9001:2000 and ISO 27001:2005 and ISO 14001:2004 registration. I have many years of professional experience in conformity testing, assessment, and certification.

  I live in Ljubljana, Slovenia. I am married to my dear and understandible wife Apolonia, and we have 3 sons, Jan, Marko and Matej. I like active recreation, competition badminton, skiing, swimming, and mountaineering.