A LIFE DEDICATED TO SCIENCE AND INNOVATION – DOCTOR HONORIS CAUSA FOR DR. BARRIE GILBERT

Abstract: Technical University of Cluj-Napoca awarded the title of Doctor Honoris Causa to one of the greatest pioneers in the field of semiconductor circuits - Mr. Barrie Gilbert, North West Lab, USA. Tuesday, September 2, 2014, the Auditorium Alexandru Domsa, in Technical University of Cluj-Napoca, Romania, hosted an event highly important to the academic community and users of modern data processing and communication devices: the granting of the Doctor Honoris Causa title to Mr. Barrie Gilbert from North West Lab, USA, one of the great pioneers in the field of semiconductor circuits. Author of over 100 inventions started in the USA but used in various applications worldwide, in communications, medicine, transportation and IT, Mr. Barrie Gilbert is widely recognized as a great visionary in the field of semiconductor devices and analog integrated circuits. Also, Mr. Barrie Gilbert is a well known author and highly cited as special reference. The great scholar and man of the art that is Mr. Barrie Gilbert agreed to become Doctor Honoris Causa of the Technical University of Cluj-Napoca as a recognition of the University's value and rewarding the achievements in the area of scientific research on international scale, for the members of the Faculty of Electronics, Telecommunications and Information Technology.

Keywords: *Barrie Gilbert, Doctor Honoris Causa, Technical University of Cluj-Napoca*

THE CEREMONY

After the opening speech of Prof. Dr. Aurel Vlaicu, Rector of the Technical University of Cluj-Napoca, in the Laudatio, Prof. Dr. Dan Pitica, the Dean of The Faculty of Electronics, Telecommunications and Information Theory, emphasized the main achievements of Dr. Barrie Gilbert:

"Barrie Gilbert is born in 1937 in Bournemouth, England, in a family in which the father used to play piano, especially Beethoven, and little Barrie seems to be predestined to this art. At only the age of three, in 1940, as a result of an air raid of the German aviation, he loses his father. Although the family has to sell the instrument soon after, music and playing the piano remains forever one of his greater joys in life. It is maybe this artistic gene that is the hidden element behind the profound ideas that makes him later famous in the world of electronic circuits. The artistic sense is obvious in all of his approaches: inventions which seem timeless, countless integrated circuits (all remarkable in the history of electronics), lectures which seem from another planet and essays with a deep philosophical understanding.

Before the age of ten, orphan of a father, with knowledge accumulated from books from the local library or journals popularizing science, without a mentor, without resources and even without mains electricity in their home, he becomes passionate about chemistry and physics. His passion for playing and curiosity always aroused by the questions "Why?" and "What if?" allow him to rediscover things for himself which have also been discovered by scientist not much earlier. He builds on his own radio receivers, oscilloscopes and many other apparatuses, all of these in an era in which the transistor is yet to be discovered. He was a pupil in elementary school when he first builds his first TV receiver. It is with the help of this TV receiver that a few years later his family and friends watch the pompous coronation festivities of Queen Elisabeth II. Just imagine a child, barely passed ten, with the soldering gun in his hand, building from salvaged parts, in the era of electronic tubes, high voltage blocks (fatal at the smallest mistake) necessary to deflect the spot of an oscilloscope of television, and you'll for surely see the forming of a genius. At the age of 14, profoundly impressed by the "Festival of Britain" exhibition, he realizes that electronics will be his life. The first confirmation of this fact comes soon, as at the age of 17 he is hired as "Assistant, Scientific", at the "UK Signals Research and Development Establishment". Here he meets the one who will be his lifelong companion: the bipolar transistor. At that point, the device known as "point contact germanium transistor" was expensive and slow, far from the performances of the vacuum tube, at its full maturity.

Instead of military service he chooses the role of assistant at a hospital, where alongside the surgeons on the operating rooms he understands the needs of the moment and creates various electronic devices for monitoring patients.

In 1958 he is hired by "Vickers-Armstrong", a subcontractor of the "Atomic Energy Research Establishment". Here he works on an experimental reactor and develops an ultra-sensitive device for detecting sodium vapors, a device used in the nuclear reactors in Great Britain at the time.

Around the age of 25, at "Mullard Semiconductor Applications Laboratory" he takes command of a daring project for that time: an oscilloscope with two channels at 700 MHz, in which two instruments coexist, one real time and one sampling channel. It is here that he uses for the first time the discrete negative feedback loop which enables him to obtain unprecedented results in terms of linearity and noise. It is the first oscilloscope relying almost entirely on transistors. With this great achievement he instantly attracts attention of the great manufacturers in the field, and almost simultaneously receives offers of employment from Hewlett-Packard and Tektronix. He chooses the option with the lesser salary at Tektronix but where he receives all the support in applying his revolutionary ideas that will

make him famous all over the world. It is here that he undertakes, together with George Wilson, transferred from Motorola, the founding from the ground of a factory that will soon deliver the first bipolar transistors at 600 MHz and 1.2 GHz, respectively.

Due to family issues he returns to England in 1970, where he leads a group at "Plessey Research Labs" with the responsibility of developing optical character recognition systems. Soon after he realizes that the experiences from the USA have changed his vision on the world, he accepts the invitation of Ray Stata, the founder of Analog Devices to unite their forces. In the first stages he works remotely, transforming two bedrooms of his Dorset house in a laboratory and an office. Here he develops more than a handful of "world-first" integrated circuits: the first laser trimmed multiplier/divider, the first RMS-DC monolithic converter, AD536, AD636, the first voltage-frequency monolithic converter, AD537, AD654, AD539, the universal trig function generator, AD639.

In 1977 he returns to Tektronix where the works at the IC factory and introduces the laser adjustment at wafer level of integrated circuits but encounters strong opposition when he suggests the production of Tektronix ICs for the free market. As a result, he accepts the invitation of the CEO of Analog Devices, Jerry Fishmann, to again join their family. The company agrees to open in Oregon, his residence at the time, an IC production business unit, later becoming North West Lab, where he is also currently active.

Today, at 76, he declares that he is just getting into his stride, and has numerous projects waiting to be put into production.

A short overview of what the name Barrie Gilbert represents in the field of electronics can be overwhelming. He is a theoretician and a visionary of great profoundness: he is unanimously accepted as having the deepest knowledge about the semiconductor junction; he introduces the translinear circuit class with a wide applicability; he has essential contributions to the field of multipliers, voltage references, linear and logarithmic amplifiers, variable gain amplifiers (VGAs), RMS-DC converters and many other analog integrated circuits.

He is the author of over 40 scientific papers in the biggest specialty journals: „Journal of Solid State Circuits", „Analog Integrated Circuits and Signal Processing", „Transactions on Circuit Systems", „Electronic Letters". The paper "A precise four-quadrant multiplier with sub nanosecond response" published in 1968 holds the fifth place of the most cited papers published in IEEE's "Journal of Solid-State Circuits" and is the first paper ever to be cited more than 100 times. In 2003 the paper was selected independently by two subcommittees of the "International Solid-State Circuit Conference (ISSCC)" as the most significant one in the history of 50 years of the conference.

He is frequently invited to present at the most prestigious manifestations in the field, is a reviewer at numerous prestigious journals, is the mentor and guide of many specialists in the whole world (not just at Analog Devices), is invited as guest lecturer at the greatest universities and specialty workshops or summer schools. He is also the author of more than 100 applied inventions mainly in designing and manufacturing electronic circuits, all of which generate revenue of many billion dollars. The "Gilbert cell", in use in all modern communication systems, of course needs to be also mentioned. Anghel Saligny, the famous Romanian engineer, called inventions "a passing perfection". However, the inventions that bear the name "Gilbert" seem to defy time. The exceptional value of his inventions can only be illustrated by two examples. At the time when Gilbert invented the cell which bears his name, multipliers (the consecrated ones, relying on the log-antilog principle) had an upper frequency limit of a few hundreds of kilohertz, due to the associated amplifiers. The Gilbert cell makes them leap directly to working frequencies in the gigahertz range, a leap of more than 1000 times! When inventing the logarithmic amplifier which carries his name, the best devices of this kind had a dynamic range of around 80 dB. The Gilbert logarithmic amplifier has a dynamic range of 140 dB. The most important fact is that these two inventions (and not only these) seem not to be affected by time. The Gilbert cell was invented in the '60s and since then nothing significant has changed. Hundreds of circuits with nearly the same functions have been invented, but the Gilbert cell remained untouched.

Countless papers have been written about the life and activity of Barrie Gilbert. The IEEE Solid State Circuits Society has even issued a dedicated edition under the title "The Gears of a Genius". Dan Fost includes him in a short and very exclusive list in the article "Analog Artists / Die-hard engineers stay passionate about their craft in a world gone digital" published in The San Francisco Chronicle.

All these achievements have been rewarded by the scientific community with numerous titles, diplomas and medals, from which we mention:

- *In 1970 he receives The IEEE "Outstanding Achievement Award" for pioneering work on merged logic;*
- *In 1979 he is declared the first fellow at Analog Devices;*
- *In 1984 Barrie Gilbert becomes Life Fellow of the Institute of Electrical and Electronic Engineers (IEEE), Solid State Circuits Society*
- *He is awarded in 1986 by the IEEE Solid-State Circuits Council with the "Outstanding Development Award";*
- *He is declared Oregon Researcher of the Year in 1990;*
- *In 1992 he receives The IEEE Solid-State Circuits Award "For contributions to non-linear analog signal processing circuits"*
- *5 times in a row The International Solid-State Circuits Conference Outstanding Paper Award is awarded to him*
- *He obtains „Honorary Doctorate from Oregon State University";*
- *In 2009, he is selected as member in the U.S. National Academy of Engineering;*

In his free time, alongside his wife, Alicia, they collect works of fine art; enjoy music at home and at symphony concerts or the opera and read about everything. When his muse drops by for a visit he feels the need to repay her by writing poetry or by composing classical music which he then performs either on a virtual orchestra (a rack of about 16 synthesizers and 6 keyboards) or the old fashioned way, on one of their 3 pianos. The rare moments of silence are spent in the company of their three felines.

For the Technical University of Cluj-Napoca, especially for the Faculty of Electronics, Telecommunications and Information Technology, the existence of professional ties with specialists from Analog Devices and in a very special manner with Mr. Barrie Gilbert represents more than an opportunity in our efforts for emancipation in a more and more competitive global academic context. That is why, the

awarding of the title Doctor Honoris Cause of the Technical University of Cluj-Napoca to Mr. Barrie Gilbert represents a great honour for us."

Professor Mircea Bodea, from IEEE Romania, delivered a speech presenting the personality and achievements of Mr. Gilbert.

Prof. Dr. Mihai Iliescu read the decision of the Senate of Technical University awarding the title of "Doctor Honoris Causa".

The ceremony ended with Dr. Gilbert's speech. In his acceptance speech, Dr. Barrie Gilbert thanked to the Technical University of Cluj-Napoca and UTCN Rector Aurel Vlaicu for the award and the honour. He then gave a lecture ("The Continuity of Concepts: Lessons from a Lifetime of Learning") on the continuous importance of analog IC design for the development of new technologies in IT, but also in various other domains. An important idea emphasized in his speech is continuity of great ideas: *"In the creative life, whether that is of the artist, the composer, or the humble technological innovator- it is usually apparent that a small set of seminal ideas recur over and over again. Each time they are used, they're transformed a little bit, becoming "better" in small way: more refined; more potent in their cultural impact; more definitive in their statement of some art. While the unusually creative mind may accommodate a much broader scope of concepts, most of us are stuck with a just a few, on which we strive to base our entire career."*

Dr. Gilbert's speech

A group photo after the ceremony