ELECTRONICS AND ELECTRICAL ENGINEERING
ISSN 1392 – 1215 2009. No. 8(96)
ELEKTRONIKA IR ELEKTROTECHNIKA

T 000 HISTORY OF TECHNOLOGY
TECHNOLOGIJŲ ISTORIJA

Scientific and Technological Development of Stroboscopic Methods of Conversion at Nizhegorodsky Institute of Electronic Measurements "Kvarz".

Dedicated to the 60-th anniversary of IEM "Kvarz"

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The problems of the development of stroboscopic methods in the superband measurement range in the IEM "Kvarz" and realization of these methods are discussed.

In the 60-s of the last century in the former SU republics the intensive development of broadband oscillographic and stroboscopic conversions as the trends in radio measurement techniques was observed. At that time the interests of leading enterprises and institutes of Nizhny Novgorod, Vilnius, Kaunas clashed. The main trends of development were connected with the need to measure signals of nano and picoseconds duration, that was dictated by the necessity to research the processes in nuclear physics, radar timing, pulse reflectometry, electronics, antennas and other fields requiring clear presentation of the process with measurement accuracy ±5%.

Under these conditions the stroboscopic conversion, that permits to investigate the signals of the very small duration, was the most effective means of investigation of the repetitive pulse signals. It is no coincidence that a number of foreign firms: HP, Tektronics, Iwatsu etc., paid a great attention to the development and perfection of such devices.

The development of stroboscopic convention in our country was accompanied by mastering of the new techniques, the new component base, and by the application of new principles in the design and technological decisions. As a result of a new R&D solutions the first national stroboscopic oscilloscope C1-39 (C7-5) was developed. The oscilloscope has 2 channels, bandwidth 700 MHz, the sensitivity 2 mV, the accuracy ≤5–10%. The instrument was put into full-scale production at the Mahachcala radio plant, and had been produced for 5 years.

At the same time Vilnius and Kaunas – the main rivals of the IEM "Kvarz" developed stroboscopic oscilloscopes and special converters using the stroboscopic principle. As a result the C9-9 high functionality stroboscope was developed in Vilnius. It could communicate with a computer in on-line mode. The R&D Kaunas institute had developed a series of stroboscopic converters for high speed microcircuits (MC) operating in nano- and picosecond ranges. The further development of stroboscopic conversion in Nizhny Novgorod was accompanied by development of the oscilloscopes C7-7, C7-9 with plug-ins providing investigations of signals of pico-, nano- and microsecond duration [1–3].

It should be noted that the C7-9 oscilloscope presented the combination of a sampling oscilloscope and a computing device with programmable control of component parameters. The C7-9 was demonstrated at several international exhibitions (for example in Leipzig in 1965, where it was honored with Medal).The use of the built-in computing devices allowed to enhance the reliability of measurements and to decrease the error down to ±1%.

In the 80s the main trend in development of sampling oscilloscopes was to build a universal oscilloscope which could investigate signals in a wide duration and amplitude range (up to 10V,50ps–500 μs) with ±5% accuracy. The C7-12 and C7-13 universal sampling oscilloscopes provided these specifications. The peculiarity of the C7-12 was the ability of operation at low frequency (from 50Hz).Thanks to special arrangement of the sweep unit the sampling of the repetitive signals was performed not with single pulses that were automatically shifted in relation to the signal but by series of pulses which had the repetition rate more higher that a signal repetition rate. So it very significantly decreased the pulse repetition rate and the total sample time [4].

The very important event in our country was the development of the first oscilloscope C7-13 with bandwidth 10 GHz. The C7-13 was built on the base of the C7-12 with a converter unit with the original mixer [5] using high speed diodes. These diodes were developed at the Electrical Ministry enterprises by a proposal of the IEM "Kvarz".

The important trends in the oscilloscope development were: measurement automation, a wide choice of conversion techniques, signal enhancement, component selection depending on the parameter group.

The oscilloscope became a composite measurement-computing complex that could meet the requirements of

investigations: to measure transmission line discontinuities, to operate as a spectrum analyzer, to measure noise parameters, etc.

In the middle (19)80s the following automatic stroboscopic oscilloscopes were developed:

C7-16 – Computing Oscilloscope with 1 GHz bandwidth;

C7-17 – Computing Programmable Sampling Oscilloscope providing automatic measurements at amplitude, time and frequency parameters of signals at nano- and subnanosecond duration;

C7-18 – Sampling Oscilloscope with the 10 GHz bandwidth combined with a pulse reflectometer with distance resolution of less than 1 cm [5].

The C9-11 Oscilloscope was the apotheosis of the automation trend development. It combined the super wideband with a high computation power (doctor of science, professor Andrianov was chief designer) [6].

At present the development of sampling conversion continues in the form development of complex measurement systems in the converter composition that selects instant values of a signal and memorizes them on a screen. We can mention the instruments developed by doctor of science M.L. Gurevitch [7].

– the U4-4 Pulse Parameter Meter able to sweep a signal in time;

– the B9-5 Sampling Converter;

– the B4-24, B4-25 Sampling Voltmeters;

– automated systems for high speed MC radio measurement instruments parameter control.

The leading in realization of a sampling oscilloscope program development in our country belonged to doctor of science, Professor M.J. Griaznov [4].

We should note that the IEM KVARZ gave many time to broad propagation the knowledge in the field of brood-band conversion of signal and to the conversion theory.

In 1972 the monograph of doctor of science Riabinin "Sampling Oscillography" was published.

In 1979 – The reference book "Radio Measurement Instruments" appeared, in 1991 – the monograph "The Pulse Parameters Measurement" was published. At that time many science papers were published in International Transactions "Radio Electronics" edited by the academician D.JU. Eidukas. The great role in the formation of scientist workers belonged to the scientific community of the Kaunas Technical University. The thesis Council of the University organized the defense of thesis of many doctor dissertation of IEM KVARZ scientific workers: M.I. Griaznov, JU.A. Riabinin, K.G. Kirianov, V.A. Zenkovich.

For the last period of time Nizhegorodsky Institute of Electronic Measurements "KVARZ" in cooperation with other scientific organization provided the development of scientific trends in radio measurement techniques devoted to investigation of signals in time domain of a wide band ranges of duration that provided perspective development of a lot of important branches of industry and science.

Table 1. The specifications of the sampling oscilloscopes developed by the IEM KVARZ

Model	Bandwidth	Sensitivity	Accuracy	Notes
C1-39	700 MHz	2 mV	±5 %	2 channels
C7-7	800 MHz	5 mV	±5 %	2 channels
C7-9	5 GHz	5 mV	±5 %	
C7-12	700 MHz, 5 GHz	5 mV	±5 %	2 channels
C7-13	10 GHz	5 mV		2.5 and 10 times sweep extension
C7-16	1 GHz	2 mV	±2–4 %	2 measurement channels in semiautomatic mode
C7-17	1 GHz	2 mV	±1–2 %	automatic measurement of frequency, time and amplitude parameters
CK7-18	10 GHz	5 mV	distance resolution 1 cm	Sampling Oscilloscope with a Pulse Reflectometer
C9-11	18 GHz	5 mV	±1–2 %	Universal measurement system on an oscilloscope base

References

Received 2009 09 25

1. Радиоизмерительные приборы'90/91. Тематический выпуск. Каталог изделий промышленности средств связи. - М.: ЦООНТИ «ЭКОС», 1989. 220 с.

2. Осциллограф вычислительный, стробоскопический, прецизионный С9-9. Радиоизмерительные приборы. Каталог изделий промышленности средств связи. М.: ЦООНТИ. «Экос», 1989, с.103.

3. **Эйдукас Д. Ю., Янкунас Е. М.** Информационно-измерительные системы пикосекундного диапазона для исследования динамики полупроводниковых приборов. – Сб. «Радиоэлектроника», труды НТК, т.5, Мин. Высшего и среднего спец. Образования Литовской ССР, КПИ. – 1969. – С. 241.

4. **Грязнов М. И., Цаль В. В.** Стробоскопический осциллограф. А.С. №261561, Б.И. – №5. – 1970.

5. **Горячев В. М.** Входное устройство для стробоскопического осциллографа. А.С. №573759, Б.И. – №35. – 1977,.

6. **Андриянов А. В., Захтаренко В. С. и др.** Осциллограф вычислительный комбинированный С9-11. – М.: ЦООНТИ. - – 1988. – С. 30.

7. **Гуревич М. Л.** Разработка методов построения и создание точной аппаратуры контроля напряжения широкополосных сигналов. — Автореферат диссертации на соискание ученой степени доктора технических наук. Нижний Новгород, ННИПИ «Кварц». – 2003.