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UNIVERSAL LABORATORY SYSTEM FOR MEASUREMENT BASED ON PC

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1.0 INTRODUCTION

The general trend in the world is computerization of measuring equipment [1-4]. However, individual instruments are expensive, so it is more rational to use a universal measuring system based on computer.

The authors have developed a system that can replace a variety of separate dedicated devices such as the: oscilloscope, galvanostat, potentiostat, L, C and R meter, signal generator, square wave signal generator, FM signal generator, sine current and voltage generator, wobbler generator, diode and transistor characteristics measurements, electrochemical measurements instruments, and thermal analysis instruments such as DSC, DTA and TGA.

The system is preliminary dedicated to secondary schools and technical faculties for laboratory exercises in electrotechnics, electronics, automation, physics and electrochemistry. Also, system represents an example how computers can be used in the field that pupils and students are studing for.

Importance of the research can be regarded from education point of view because pupils and students are trained to use modern equipment and instruments, but also from economical point of view since many very expensive instruments will be replaced by one such system. Big adventage of one such system is its flexibility, i.e. the possibility of practicaly infinite further development concerning included methods and parameters. One may expect that laboratory experiments organized in such new way will be much more attractive for pupiles and students.

2.0 HARDWARE AND ACCOMPANYING SOFTWARE

For signal generation and monitoring of the investigated system response it is developed measurement and control system based on a PC computer. Beside the PC, hardware includes a commercial AD-DA converter and an external interface for analog signal processing and they will be separately described.

AD-DA Conversion

It is used commercially **available** AD-DA converter NI 6251 [5,6]. Its most important characteristics for this application are:

Number of analog input channels (AI)	8/16 (single-pole)
Number of analog output channels (AO)	2
Range of I / O voltage	± 5 or ± 10 V
Number of bits AD conversion	16
Number of bits DA conversion	16
Gain (adjustable)	1, 10 or 100

In addition to these analog channels board also has digital inputs and outputs, PULS generator and 16 bit counter.

There is also a portable version of the measuring system based on modest module NI USB 6009.

External interface

For the purposes of the voltage and current test of the investigated system, it was necessary to design a circuit with the following characteristics:

Two control voltage inputs ± 10 V

One measuring input power ± 200 mA

One voltage output ± 10 V for an input power ± 200 mA

One output voltage to track the reference potential

More universal analog inputs (oscilloscope, spectrum analyzer, thermal testing ...)

- Voltage in the range ± 1 V with the possibility of superimposing of a small AC signal in the range ± 10 mV;
- Current in the range ± 200 mA.

Block scheme of the interface is given on figure 1.

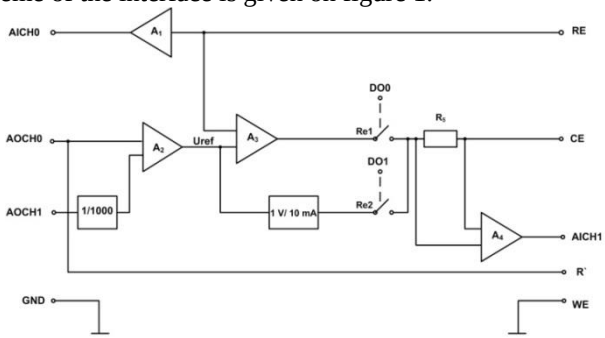

Figure 1. Interface block diagram

Software

The software platform for predicted measurement methods was National Instruments LabVIEW package, which is regarded as a high standard in the area of modern virtual instruments [7,8]. LabVIEW is based on the principles of virtual instruments with the graphical user interface. Graphical user interface has two windows:

- *Front Panel* for process control and monitoring,
- Application diagram (*Block Diagram*) which presents used virtual instruments, relations between them, the course of signals and error detection.

In figure 2, as an example, the Front Panel have been showed for the output characteristics of bipolar transistor.

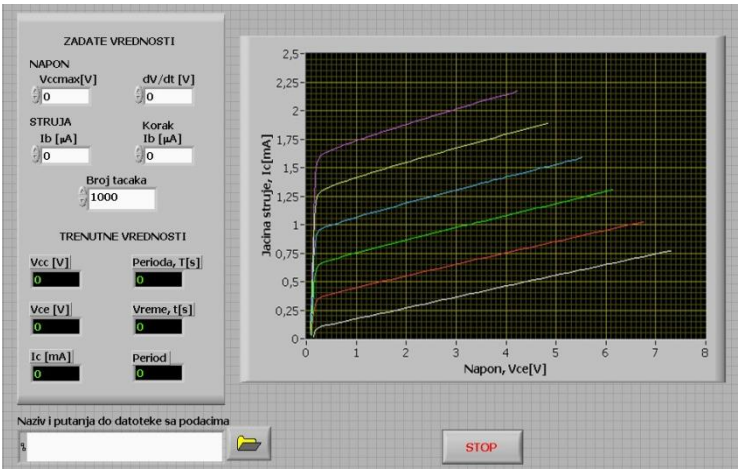

Figure 2. Front panel for output characteristics of bipolar transistor

3.0 CONCLUSION

The hardware and also the software of the described laboratory measurement system has been developed. It has been constructed, calibrated and tested. The system has been tested with different types of loads and methods. All the tests showed the remarkably good behavior of the system, that is, very good stability and correctness.

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