The Measuring Workplace for Studying Basic Characteristic of Operational Amplifiers Distributing Through Internet

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Abstract. *This project was created for effective studying practical sections of object „Basics of electronics" by a real remote control measuring workplace. The content of this measuring workplace are circuits of operational amplifiers and measure instruments. In circuits, it is possible to change a value of feedback resistors and setting parameters of measure instruments by PC. A virtual measuring workplace was created for comparison with this real workplace. The measuring workplace is distributed trough the internet. The whole project is created in the development environment LABview with using the measuring card NI- DAQmx.*

Keywords: Labview, Remote Control Measure Workplace, Operation Amplifier, Feedback Resistors, Remote Control Measure Instrument, NI-Daqmx.

1. Introduction

Study of basic electronics without real measuring and exploring features of basic electronics components is not sufficient for students. A solution of this problem is real measuring in a laboratory. However this measure is problematic because of inadequate number of measuring instruments and fast destruction of measuring components. The destruction of electronics components is caused by often using.

A main task of this work is to design a measuring workplace, which can be controlled by a user via internet developed in the LabVIEW. LabVIEW development environment allows to remote access from any client with available web browser like Explore, Mozilla. In order to create laboratory stand as close as possible to the real situation stand alone instruments were used. Those instruments were controlled from the program using their interfaces. Moreover, the laboratory stand allows performing similar measurement off-line from the instruments. In order to increase the real feeling form the measuring stand a web camera was utilized displaying image from front panels of instruments.

2. Design and create mesasuring plant

Laboratory stand consist of four circuits for four laboratory exercises. Each measuring circuits is being controlled by a switching circuit which allow to change circuit component according command by a student from remote computer. The first two measuring circuits contain operational amplifiers connected as inverting and noninverting. Change of feedback elements caused different characteristic of amplifier. Resistors connected through the analog switching circuit show (fig. 1). Third measuring circuit represents integrator. Fourth circuit to be prepared for laboratory measurement was the rectifier with operational amplifier. The input signal from generator is being connected to all four circuits parallel.
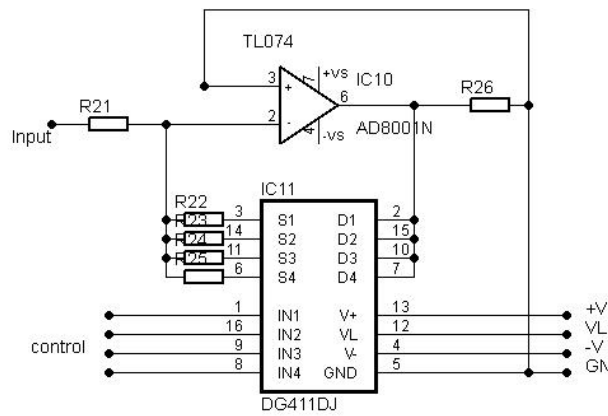
Fig. 1.   Switching of feedback resistor on
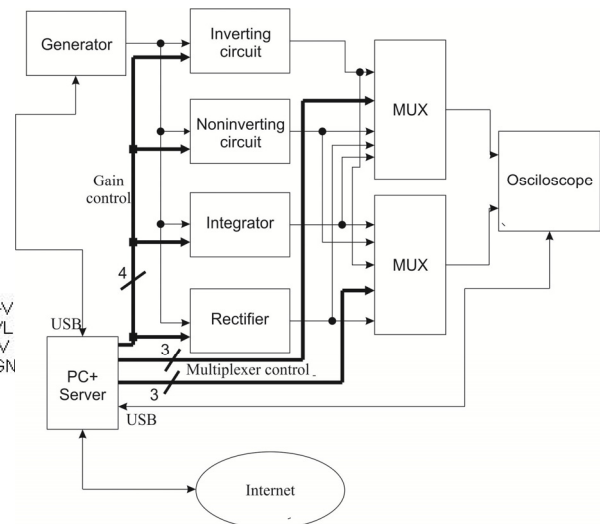inverting circuits of operational amplifier

Fig. 2.   Block scheme of laboratory stand

Each measuring node is connected to one of eight inputs at two analog multiplexers. Outputs from the multiplexers are connected to two inputs of oscilloscope. Selection of measured nodes by any multiplexer is performed independently by 3-bit addressing bus AB1 and AB2. The feedback resistors in both amplifiers and rectifier and feedback capacitors in the integrator are chosen simultaneously by control bus CB3 (fig.2). Multiplexers for control of the feedback resistors and selection of signals from measuring nodes are realized by integrated circuits DG 408, 409 and DG 412. The ON resistance DG 408, 409 is 100Ω and DG 411 is 35Ω. Multiplexers are controlled from measuring card NI-PCI 6251 with NI- SCC 68 is an I/O connector block. Schematic of whole plant is on figure 2.

3.   Materials Supporting Students

Materials for preparation consist of necessary theoretical description of measurement stand, measurement tasks and project for simulation of the measured circuits.

User has on his disposal PSPICE simulation tool as a component of OrCAD program package. Simulation of the measured circuits allows students to compare simulation results with measured ones. Output plots acquired in the simulation environment for some values of component in the circuit are available for those who are not familiar with simulation software. Fig.3 shows output plot from the TRAN. analysis of operational amplifier as rectifier for 1 and 10 kHz input frequency.

4.   Designing a web server for connection a workplace to the Internet

The web server is designed in the environment LabVIEW. The LabVIEW environment allows to generate the html web page from the panel diagram of the control program which is accessible from the client´s computer. Program is running on server which is able to control laboratory stand, instruments and transfer image from the web camera. User from the clients computer can control program using Explorer or Mozilla. These web browsers have to allow pop-up application.

The link of this web page is set on the official web pages of the laboratory Department of electronics and multimedial communication.

5. Control program for control measuring Instruments

Control program allows changing basic setting-up of generator AGILENT 33220A and oscilloscope RIGOL DS1052E. Generator AGILENT 33220A represents arbitrary signal generator of frequency range 0-20 MHz. Oscilloscope RIGOL DS1052E is two channel digital oscilloscope with max 1GSa/s.

Multiplexing circuits for connection of selected measuring points into two inputs of oscilloscope were controlled from the digital outputs of the NI-DAQ board NI6251 by National Instruments. For any multiplexer three digital outputs were utilized. Other four digital outputs were used for control of combination feedback resistors simultaneously in all four circuits. Four digital inputs allow to set-up one of 4 resulting values of feedback resistor in each circuit..
Both instruments were controlled via USB link and using VISA standard.
Control program of oscilloscope allows controlling basic settings: time base, voltage range, triggering level, V and H position, DC or AC coupling of channels, AUTO button and RUN/STOP buttom.
Moreover program allows acquiring following parameters of the measured signals:
- measured signals from two input channels
- transferring values from oscilloscope determining parameters of measuring waves (amplitude, period, minimal voltage, maximal voltage, frequency)

Control program of generator allows controlling basic settings like signal form, signal amplitude, phase, offset, frequency and output polarity
Panels which control generator, oscilloscope and measuring nodes are on fig.4

6. Control program for web camera

This program allows users real watching of measure workplace. For better utilization of performing PC is show only consecutive pictures witch are refresh every 500ms. These pictures give user complete idea about measuring plant and instruments. Picture taken from the laboratory stand allow to get feeling of work in the real laboratory. Moreover user can check whether control commands are being received by measuring instruments (fig.5).
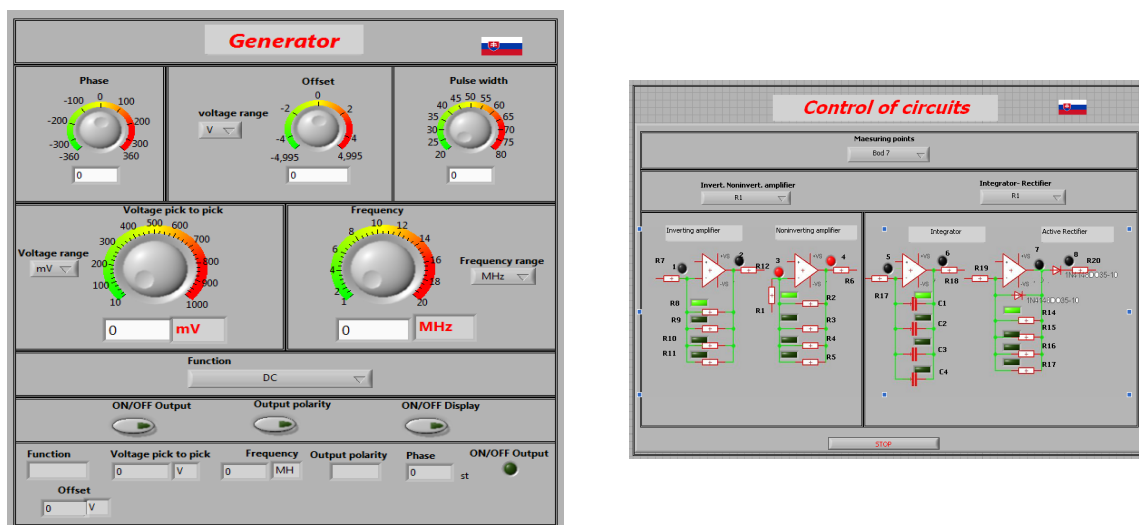

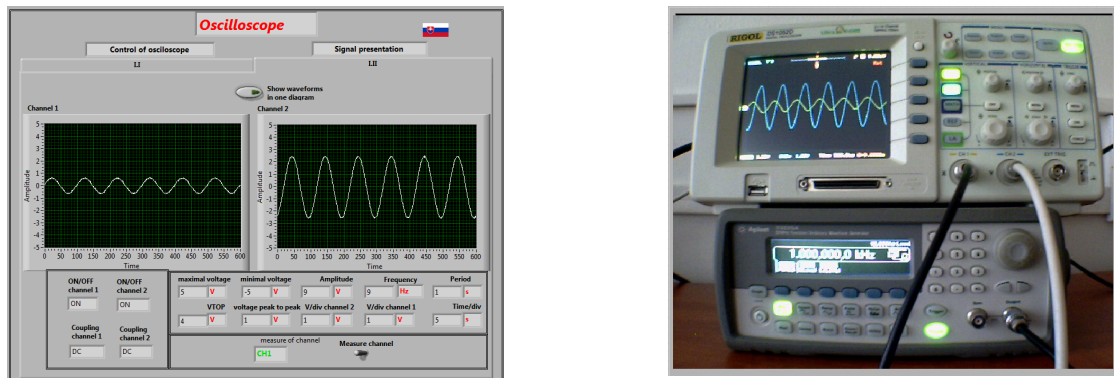Fig. 3.   Panels controlling generator, oscilloscope and measuring nodes.

Fig. 4.   Image from the laboratory stand acquired by a web camera

Conclusion

Presented laboratory stand controlled remotely through Internet serves students of Faculty of Electrotechnic and Informatics for distant laboratory exercises in the course of "Basic electronics". Described stand is one of four stands which are in the trial phase. Three laboratory stands are controlled with DAQ board only. Described one has to increase feeling of work in the real laboratory. Results from questionnaire inquire among students showed that both methods how to control laboratory stands are for users similar. In the future all laboratory stands will be controlled by DAQ boards only. It allows to release instruments utilized here for laboratory stands devoted for laboratory exercises performed personally.

Acknowledgment

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