

## IMPLEMENTATION OF ICT IN TEACHING OF POWER SUPPLY DEVICES

### ИЗПОЛЗВАНЕ НА ИКТ В ОБУЧЕНИЕТО ПО ТОКОЗАХРАНВАЩИ УСТРОЙСТВА

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*Abstract – The aim of this paper is to present a successful symbiosis between the products of two leading companies, manufacturers of electronics: TI and NI. The developed test bench combines hardware for data acquisition and supervisory control working in the LabVIEW environment and the recently developed innovative Power Management Lab Kit (PMLK) experiment boards. In this way, working with high-tech educational power supply educational boards is accessible for a broader range of students, including also students whose education doesn't comprise a detailed study of power electronic devices. The use of LabVIEW allows for the development of virtual instruments that ease the student's work with the boards – for example if the chosen configuration could possibly damage the circuit under study, LabVIEW's Virtual Instrument (VI) will pop up a message describing what could occur if the system executes the selected configuration and also giving the student directions on how to select the correct working configuration. Moreover, the VI's allow measurements and data acquisition without additional devices.*

*Резюме – Идеята на настоящата публикация е да представи една успешна симбиоза между продуктите на две от водещите фирми в областта на електрониката - NI и TI. Създадената опитна постановка представлява съвкупност от хардуер за обработка на данни и управление работещ с програмната среда LabVIEW и нововъведените иновативни обучителни китове Power Management Lab Kit (PMLK). По този начин работата с високотехнологични макети по токозахранващи устройства става възможна и достъпна за по-широк кръг студенти, включително и за такива, които не изучават в детайли силова електроника. Използването на LabVIEW позволява да се построят виртуални инструменти, които да подпомогнат обучаемите в работата с китовете - например, ако се зададе опасна за работността на макета конфигурация, виртуалният инструмент (Virtual Instrument - VI) ще даде съобщение, което описва какво би се случило, ако в действителност се изпълни заданието и ще даде насоки, как да се отстрани проблема с активното участие на студента. Освен това с VI може да се правят измервания без друга спомагателна апаратура.*

## 1. INTRODUCTION

One of the main problems in education of power supply devices is the fact that apart from theoretical knowledge in mathematics, physics, electrical engineering and control systems, the students should also acquire a sufficient amount of practical experience in order to become highly qualified and competitive professionals.

The department of power electronics at the Technical University of Sofia has a 40-year tradition in training of specialists in the field of engineering. Experience has shown, that the implementation of the acquired qualifications is a steady process and in different stages it is necessary to emphasis on each of the different blocks of power electronic devices. That is why the students are divided into grades, classes and qualification degrees. The University is constantly striving to improve the educational quality, by expanding and upgrading the material base with new and different hardware, by using alternative approaches in educational material presentation and creating a student-friendly environment [1, 8, 9].

## 2. IMPLEMENTATION

The challenge is to provide complex hardware manipulation for lower grade students and eliminating the risks involved by accidental hazardous operation, which could lead to damage of the products.

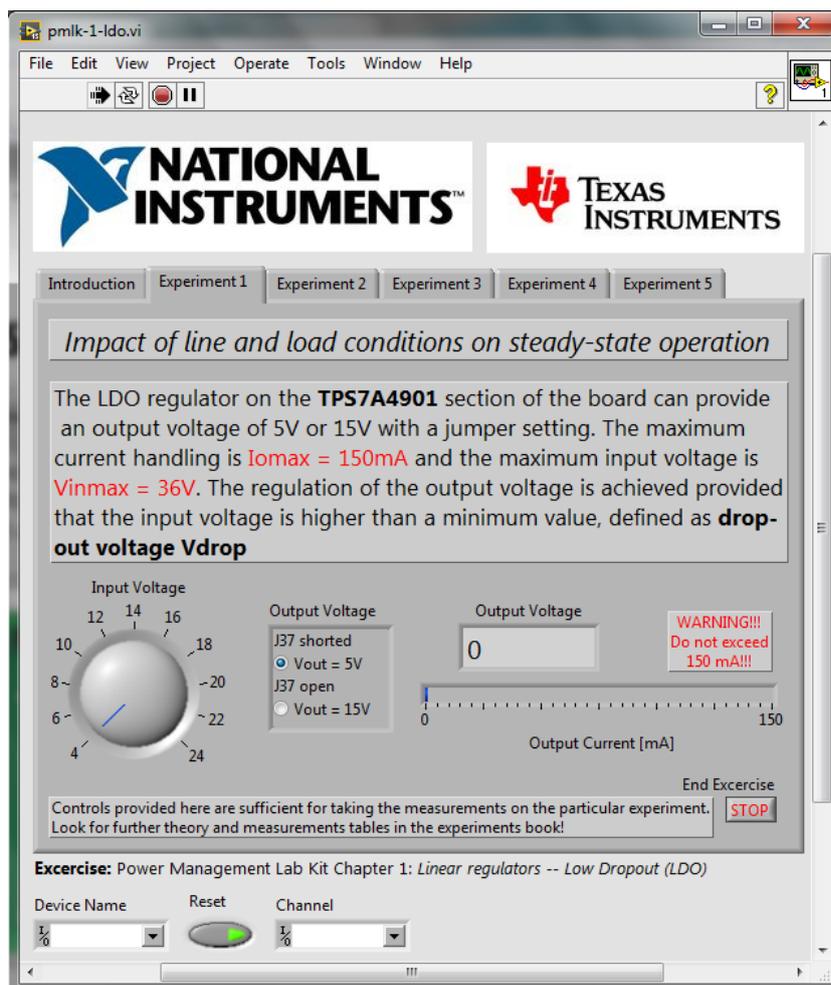


Figure 1: Virtual Instrument for the LDO exercise

By constructing virtual instruments in the LabVIEW the exercise obtains more simplified command interface under a sophisticated construction base, that adds both to the innovative look and to the concern for the better educational process. On figure 1 is shown the front panel of a virtual instrument - Low Dropout (LDO) regulator.

It is composed from knobs, buttons, numerical indicators and plain text that are used for clarification. The exercise contains 5 experiments, which should be done independently and for reducing the clutter on the screen, they are arranged in a manner that provide only the necessary settings for the specific experiment. For example, in one experiment the student must set up the input voltage in range from 5 to 30 volts and measure the current – this should be implemented with a voltage knob and a current indicator. On other example the student should set only two input voltage levels and measure the output voltage – this is implemented with a radio button and output voltage indicator.

### 3. TEST BENCHES

The so constructed virtual instruments are designed to control data acquisition hardware by National Instruments and other third-party vendors by using the Virtual Instrument Software Architecture NI-VISA. Most appropriate for the educational process is the Virtual-Bench series, because they have integrated all that is required for the experimentation – oscilloscope, digital multimeter, power supply block, function generator and digital I/Os. Currently the National Instruments Company supports two models – VB-8012 and VB-8034, in which they differ by analog channels and connector types [2 ÷ 7, 10, 11].

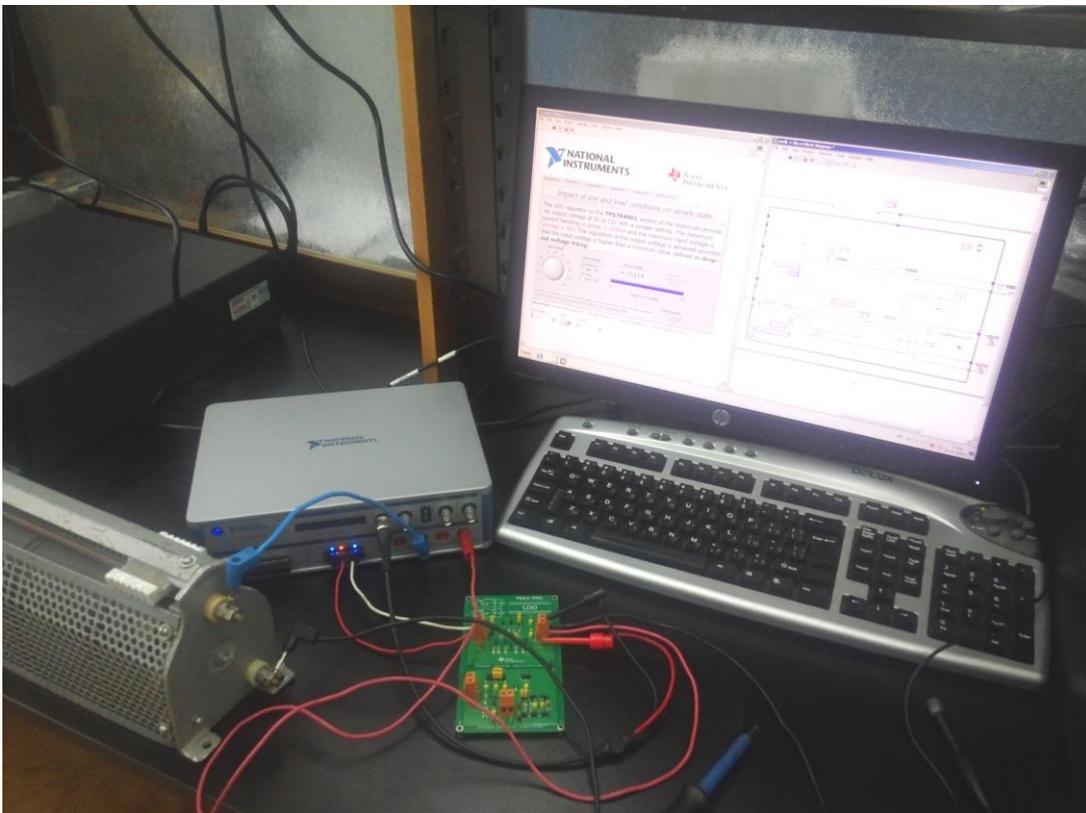


Figure 2: LDO exercise test bench

Also, when these specifications are insufficient the VISA interface allows control of auxiliary instruments. In our case the power supply for the buck, boost and buck-boost experiments the maximum output current of 500 mA is insufficient and we use an auxiliary instrument GwINSTEK PSW 3036, which is able to cover the used current range. On figure 2 is shown the test bench for the LDO exercise.

The maximum current of 150 mA is sufficient so here is used entirely the Virtual-Bench VB-8012. The output current is controlled via the rheostat on the left and the computer is visualizing the output data. The current is limited by the virtual instrument which is detecting the overload and outputs a message and indication that this shouldn't be done. The third figure shows a close-up to the device with the red led.

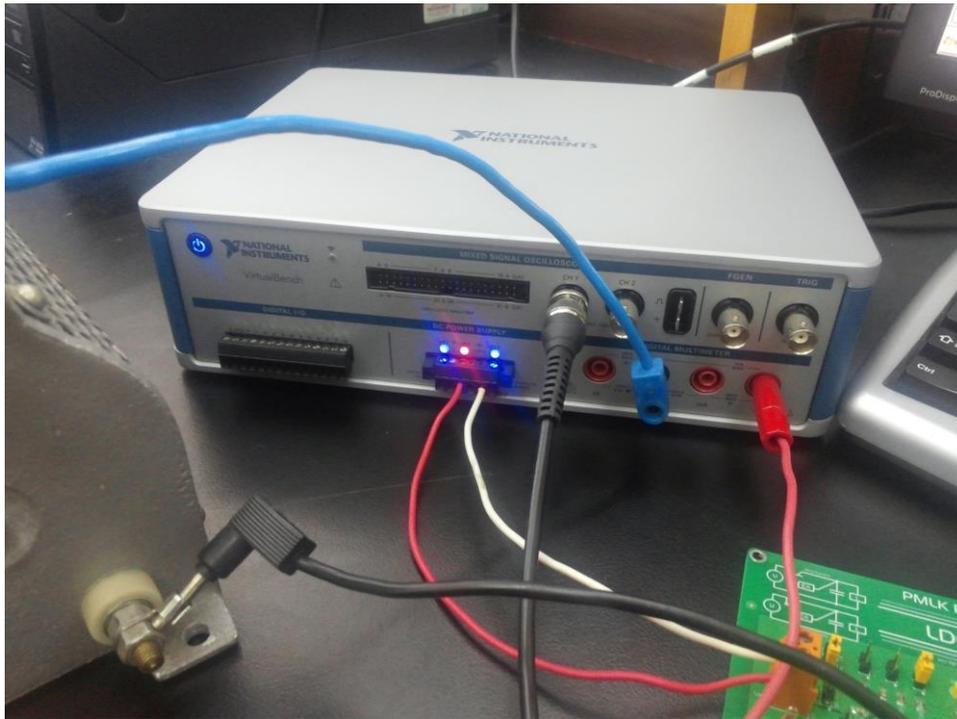


Figure 3: Virtual Bench indicating the overload

The buck test bench is shown on figure 4. For this exercise is used an external power supply GwINSTEK PSW 3036, which provides currents up to 30 amps which is way enough for the buck board requiring up to 5.

On the screen can be seen the waveforms of the board, indicating the buck duty cycle in the operating regime, alongside the other indicators. Again all the hardware is controlled by LabVIEW environment, either by Virtual Bench or by VISA interface.

Similarly, it can be carried out laboratory-related training and learning and other types of electronic devices and converter, AC-DC converters, regulators, analog and digital circuits.

Useful development of the system is to be integrated into training complex that allows remote experiments and therefore remote and e-learning, which is one of the most innovative forms.

On the other hand, this approach does not exclude manual measurement and use models, which allows students to not forget the real problems in power supplies, and they are connected to work at relatively high values of currents and voltages.

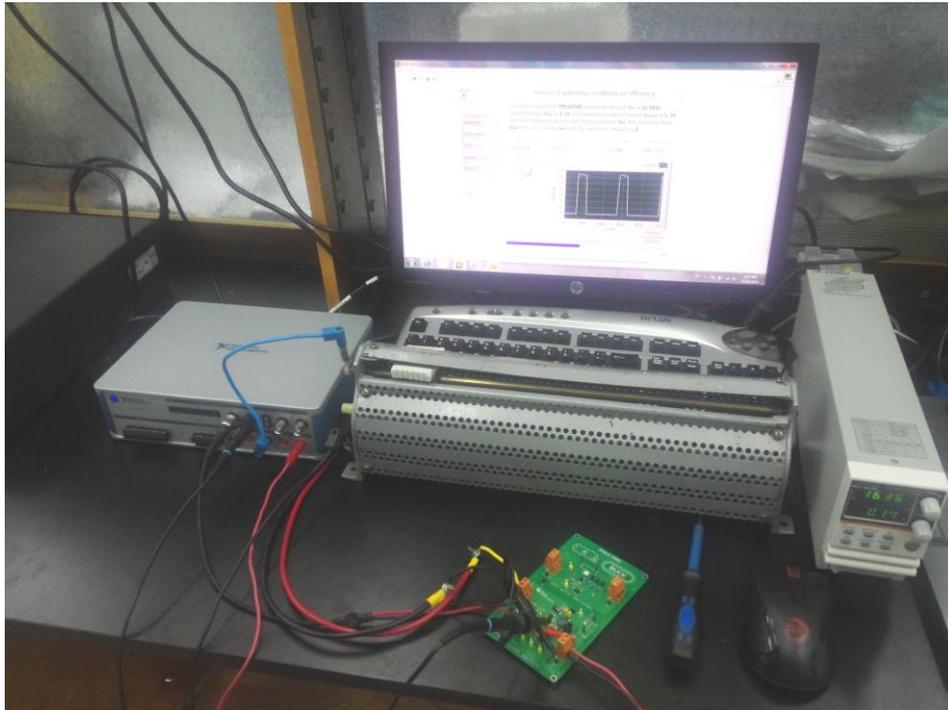


Figure 4: Virtual bench and external power supply unit

#### 4. CONCLUSION

LabVIEW helped us to broaden the range of students that can use the novel Hi-tech boards provided by Texas Instruments – the Power Management Lab Kits, by using the Virtual Instruments (VIs) concept. Now the manipulation of complex hardware is becoming more accessible by implementing software based security measures, that are designed to aid and advice the trainees.

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