On Some PC-Based Electrical Measurements in EET Laboratory

Andrzej J. Gapinski
Penn State University-Fayette
Electrical Engineering Technology
Uniontown, PA 15401

Introduction

It has become a standard in the EET programs to incorporate the personal computer as a tool in various stages of student work. Writing reports using word processing, learning computers programming skills, and application of many software packages like PSPICE, in the case of circuit analysis, are the areas that have to be mastered by any successful student. However, recent advances in learning technologies have made it possible to go one step further and facilitate interactive environment in which the PC can be used in a more interactive mode to take measurements, to monitor, and to control the processes.

The purpose of this paper is to describe some of the PC-based technologies as available tools for the EET program. The devices considered are: Micronta[1] and Texas Instruments CBL[2,3] system PC-linked. The instruments allow students to become acquainted with current measurement and data processing technology. Students can automate data acquisition and to perform post-processing of the collected data. Furthermore, TI-CBL system linked with a calculator enables the student to take advantage of their TI-85 calculators in a more active way.

Thus, the paper shows how to utilize currently available technology in the EET laboratory. The devices used in an interactive mode make the learning more attractive and interesting to students.

Micronta 22-182, TI-CBL:
Inexpensive and Programmable Data Acquisition Devices

An electrical engineering technology (EET) instructor often faces the challenge of making the best utilization of outdated equipment. Any acquisition of inexpensive measurement tools that can be applied in the EET curriculum is most welcomed. Micronta ($100) and TI-CBL ($170) are such tools that can be used in a variety of EET lab measurements.

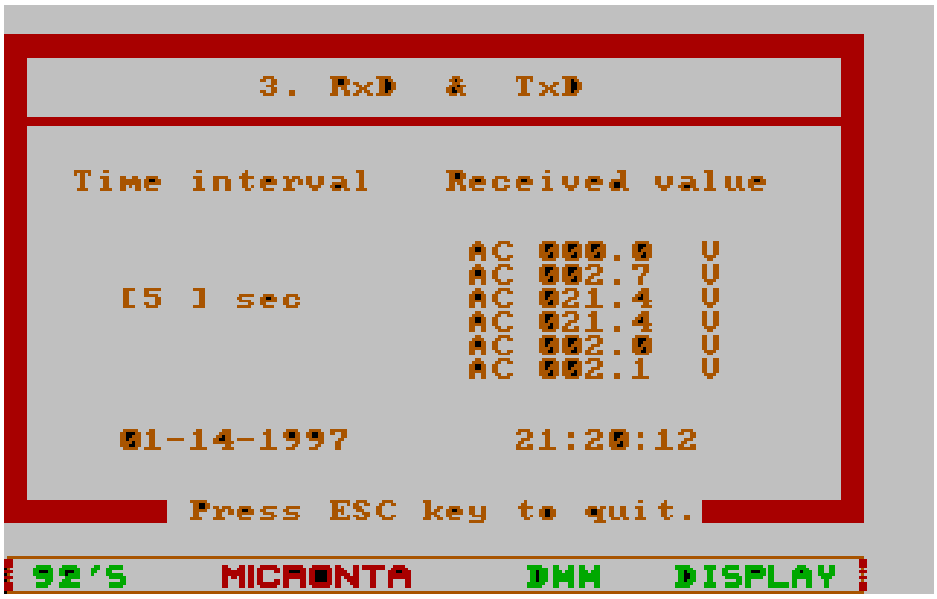
Micronta 22-182-Basic Data:

It is a digital multimeter equipped with bi-directional serial interface (modified RS-232 standard). Baud rate: 1200 BPS, parity bit: none, data bit: 7 bits ASCII, stop bit: 2 bits. Data frame consists of 14 bytes in length.
Two modes of communication allow transmission and/or receiving of data from a host computer. The software supplied with this device enables the user to set the desired mode of operation and basic parameters for data acquisition. Figures 1 and 2 show the actual screens.

```
+-------------------------------------------------------------------------------+
|MICRONTA MANUAL RANGE BAR GRAPH DMM RS-232C|
|-------------------------------------------------------------------------------|
|  Function       ; AC VOLTAGE          |  Comparison ; OFF    |
|  Interval       ; 5 sec              |-----------------------------------|
|  Printer On/Off ; ON                 |  Low Limit    |  High Limit  |
|  File Open/Close; OPEN               |---------------+---------------|
|    File Name   ; a:meas.prn                  |              |              |
|     Time Rec.  ; ON         Port     |-----------------------------------|
|  Beep    On/Off ; ON         Com 1   |  NO |   TIME    |  VALUE|
|-----------------------------------------------+-----+------------+-----------|
|   VALUE                               |   1 |  20:08:55  | 021.3  V |
|                                       |---- --+------------+-----------|
|                                       |   2  |  20:09:00  | 021.3  V  |
|-----------------------------------------------+-----+------------+-------------|
|  Desired activity ?                   |   3  |  20:09:05  | 021.3  V |
|   F=Function  I=Interval  P=Printer   |-----+------------+-------------|
|   L=File      B=Beep      C=Compare   |   4 |  20:09:10  | 021.3  V |
|   R=Run       O=Port      Q=Quit      |-----+------------+-------------|
|                                       |   5  |  20:09:15  | 021.3  V  |
+-------------------------------------------------------------------------------+
```

METDEMO.EXE's control screen shows five measurements of AC voltage taken in 5 seconds intervals.

Figure 1



DMM.EXE's R & T option (Receive & Transmit) screen.

Figure 2

The meter can store up to 5 measured values while not connected to host computer. Furthermore, the meter can be operated by programs written in Basic or other language to meet specific user's requirements. Thus, students, by experimentation, will learn programming and I/O communication basics.

The instrument is used in a variety of laboratory assignments to take basic electrical measurements.

TI-CBL System

The Texas Instruments Calculator-Based Laboratory System (TI-CBL) is a portable, multichannel, handheld data collection device that can be linked to a TI-85 Graphic calculator and to a PC via TI-Graph Link[3]. A CBL system with appropriate sensors allows measurement of various types of physical quantities such as: voltage, temperature, light intensity, motion, sound, etc. Data can be collected at rates of up to 10,000 per second for up to 512 points per channel. The collected data can be postprocessed.
In particular, here we are concerned with voltage measurements which can be automated based on programmability of TI-85 calculator linked to CBL. Furthermore, a student can use a PC screen to edit programs, transfer the files to and from TI-85 calculator, and to see plots of taken data, as indicated on figures 3 & 4.
As an example of the CBL programmability, consider three lines in the program from figure 3, which read:

:{1,1,2} → L1

```
:Output("CBLSEND",L1)
.
{3, M, N, 1} → L1.
```

While the first line sets up a channel for data collection, the second sends command to CBL in the form of a list, and the third line specifies the sample and trigger setup. The first number, 1, inside the brackets of the first line, indicates ***command 1***. The command sets up parameters for channel connected to a probe. The second number 1, selects an analog channel 1 for data collection. The third number, 2, selects the type of data to collect: voltage measurement. The sign, →, transfers the programmable options to list variable L1. In the third line, the number 3, refers to programmable ***command 3*** that selects the sample and trigger setup. Here, the ***command 3*** sets up the sampling rate: M; number of samples: N (M & N quantities entered by user); and trigger type: 1 (manually operated). It is this command that puts CBL into ready mode to start data acquisition.

The CBL systems are used in EET lab as data acquisition setups. Laboratory experiments have been selected to provide interesting exercises in two areas of EET curriculum: electrical machinery and microprocessor interfacing. The examples of measurements taken include: magnetic field density, light intensity, motion detection, etc. In electrical machinery class, in addition to dc & ac machinery, the transformers are covered in depth. CBL system provides opportunity to make the measurements of magnetic field more meaningful. In laboratory assignments students take measurements of the following items:

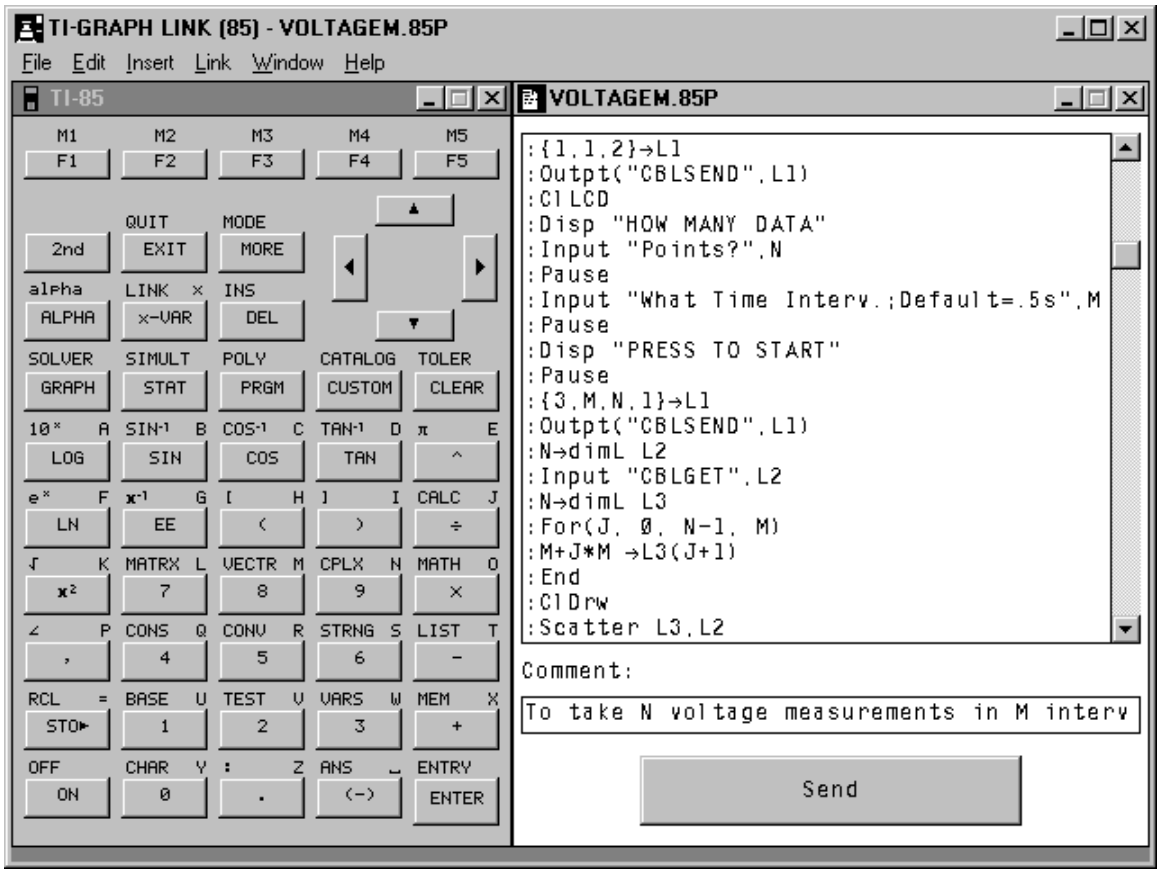
-earth's magnetic field
-magnetic field near permanent magnet and coil windings
-magnetic field near a current-carrying wire
-solenoid's magnetic field (at various distances).

A variety of measurements[4] can be chosen or design based on availability of various types of sensors provided by Texas Instruments and other producers.

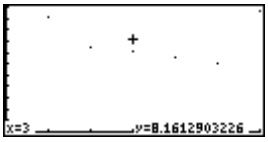
Programmability, flexibility, and PC-linkage make the CBL system an enjoyable educational tool to work with.

Conclusion

The objective of this paper was to describe PC-linked, inexpensive, portable, programmable devices, that can be used in EET curriculum to set up simple data acquisition systems. By experimenting, a student can get practical knowledge of programming, designing the basic set-ups, and analyzing obtained data.



TI Graph Link: PC screen.
Figure 3



Plot of the collected data: 5 DC voltage measurements taken every 1 sec. when triggered by the CBL user.

Figure 4

References

1. Micronta LCD Digital Multimeter No. 22-182. Owner's Manual. Tandy Corporation. Forth Worth, TX 76102. 1992.
2. TI-CBL GuideBook. Texas Instruments. 1994.
3. TI-Graph Link for Windows. GuideBook. Texas Instruments. 1995.
4. CBL System. Experiment Workbook. Texas Instruments. 1994.

ANDRZEJ J. GAPINSKI received his Ph.D. in Electrical Engineering from Texas Tech University in 1988 and a M.S. in Electronics from Technical University of Wroclaw (Poland) in 1978. He worked as a software engineer for shipbuilding industry. Currently he is an Associate Professor of Engineering at Penn State University-Fayette. His research areas are control theory and applications, optimization, and engineering education.