

AUTOMATED CALIBRATION OF DIGITAL MULTIMETERS WITHOUT COMMUNICATION INTERFACE

V.L. Lalev, K.I. Banev, B.I. Borisov, K.K. Bosilkov

Abstract: The report describes the process of automated calibration of digital multimeters through optical recognition (OCR) of display indications. NI LabView software was used for processing the image taken by the video camera, and Fluke MET/CAL software was used for calibrator managing and the measurement results analysis.

The algorithm for optical recognition, the flow chart of the implemented LabView software and the subprogram for automated calibration MET/CAL are described.

Key words: Calibration, multimeters, OCR, LabView, Vision Assistant, MET/CAL.

1. Introduction

More than 100 digital multimeters (DMM) without communication interface are calibrated at NPP, and this process takes a lot of time and is related to the increased probability of making mistakes by the operator who enters the measured values.

In order to optimize the calibration, an automated workplace is prepared that uses the possibilities of text optical recognition at LabView and automated calibration procedures at MET/CAL.

2. Automated workplace

The automated workplace has a number of advantages in comparison with the classical one, such as:

- Decreased probability of error occurrence in the course of obtained results processing;
- Absence of an operator's error;
- Large volume of operations performed;
- High productivity;
- Displays with friendly human-machine interface and possibilities for developing additional displays and modification of the present ones;
 - Reliable data archiving and its visualization on graphical displays;
 - Analysis of the data from the archive;
 - A possibility to modify and supplement the software and the hardware without significant cost.

3. Automated workplace structure

Fig. 1 presents the flow chart of the workplace including a personal computer with a GPIB controller, a multifunctional calibrator, a web camera and a digital multimeter.

The software part is implemented by two separate subprograms:



Fig.1. Flow chart of an automated workplace

- for the optical recognition of DMM values measured: LabView medium, which uses NI Vision Assistant and NI-IMAQ driver for USB Cameras.
- for the calibrator management, calculation of errors and recording of measurement results: MET/CAL software, Fluke ownership.

4. Calibration procedure and software.

The work with the automated workplace, shown on Fig.2, undergoes four separate and important stages:



Fig.2. vi main display

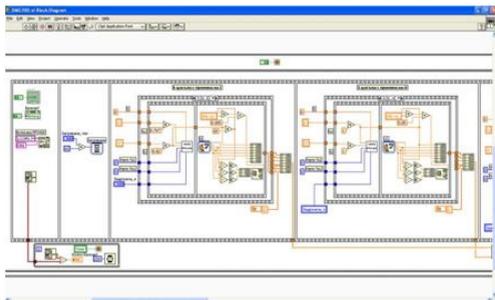


Fig.3. vi flow chart

1. Setup;
2. Measurement;
3. Data recording;
4. Document report generation.

During the first stage the camera is manually set up to align with the DMM display, the image is transformed to be 256 shades of gray, and the display area (ROI) is chosen, on which the optical recognition will be performed by NI Vision software: OCR Training Fig. 4.

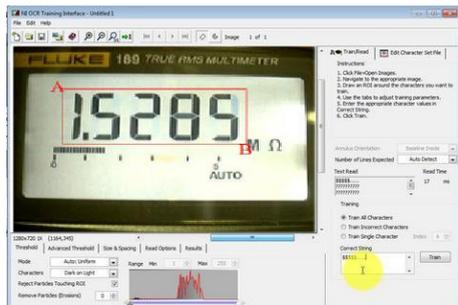


Fig.4. NI Vision work pane

The software processes and recognizes the image of the recorded digital multimeter display, the text symbols and the decimal digits.

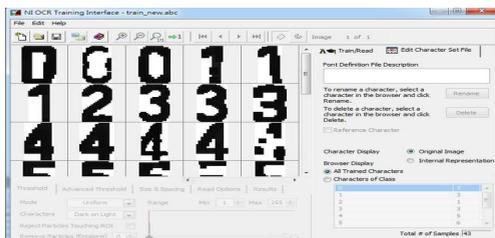


Fig.5. Work pane with recognized digits

During the second stage the selection of multi-

meter scope takes place, installation of the calibrator, recording of measured value in a text file and consequent error calculation.

During the third stage data recording takes place. The second and third stages are performed by MET/CAL software, and a part of the automated calibration procedure is shown on Fig. 6.

```

4.001 HEAD      Пост. напряжение: {Обхват 2V}
4.002 DISP      Превключете СИ на обхват 2 VDC.
4.002 DISP      Настройте мултиметра за вярно
4.002 DISP      OCR разчитане.
6.001 5520      1.0000V                S 2W
6.002 TARGET    -m
6.003 WAIT      [D1000]
6.004 MATH      MEM = READ("Y:/OCR/Result.txt", 1)
6.005 MEMCX 2   V                0.04% 0.0002U
    
```

Fig.6. MET/CAL procedure

Calibration points correspond to the laboratory methods. For each point the following is performed consequently:

- Setting values at the calibrator output according to the methods points;
- Setting time for identification of readings;
- Reading the text file containing the result from the value, measured by multimeter;
- Calculation of the allowable error, visualization and record in the results database.

After the processing of the last point from the automated procedure, you should start stage 4, document report (calibration certificate) generation, Fig.6.

5. Conclusions

The adaptation of the automated workplace reduced significantly the time for calibration of digital multimeters without communication interface and the probability of entering wrong values by the operator working with the multimeters without communication interface.

6. Reference

- [1] <http://www.ni.com>
- [2] <http://www.flukecal.com>

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Section III: MEASUREMENT AND INFORMATION SYSTEMS AND TECHNOLOGIES



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СВИДЕТЕЛСТВО ЗА КАЛИБРИРАНЕ

№18.МО.СВК.342

Средство за измерване: **Мултимер**

Производител: **EXTECH, Тайван**

Тип (описание): **MultiMaster570A**

Идентификационен №: **111060205**

Наименование и адрес на заявител: **П-ЕП2-Р-ИР-СКУ-ТИА-ТИ-КНИ**

Дата на издаване: **19.04.2018 г.**

Прегорвявателна дата на следващото калибриране: **19.04.2020 г.**



Дата на калибриране: 19.04.2018 г.

Свидетелството съдържа 4 стр.

Н-к отдела МО: *[Signature]*
/ Тоодор Тоодоров /

Не се допуска използването на ютия на свидетелството и част от него, без писменото разрешение на лабораторията, издава свидетелството!

СВИДЕТЕЛСТВО ЗА КАЛИБРИРАНЕ №18.МО.СВК.342 / 19.04.2018 г. стр. 2 от 4

МЕТОД НА КАЛИБРИРАНЕ:
Практически метод на измерване.
Метрология (п) за калибриране: ДБК.МО.МТ.184/04
Met/Cal процедура: MultiMaster 570A; (1 year) CAL VER RS-232/5520

УСЛОВИЯ НА КАЛИБРИРАНЕ:
Температура: 21,4°C; Относителна влажност: 54 %

ПРОСЛЕДИМОСТ НА ЕТАЛОНИТЕ:

Импозирани еталони:	Свидетелство №:	Дати:
Многофункционален калибратор FLUKE 5520A, №1702008	1881409	12.06.2017

РЕЗУЛТАТИ ОТ КАЛИБРИРАНЕТО:

	Измерена ст-ст	Действителна ст-ст	Неточност
ПОСТОЯННО НАПРЕЖЕНИЕ			
Обхват 500 mV			
50.00 mV	49.99 mV	50.000 mV	0.006 mV
450.00 mV	450.03 mV	450.000 mV	0.008 mV
-450.00 mV	-450.06 mV	-450.000 mV	0.008 mV
Обхват 5 V			
0.5000 V	0.5000 V	0.50000 V	0.00006 V
1.5000 V	1.5002 V	1.50000 V	0.00006 V
2.5000 V	2.5004 V	2.50000 V	0.00006 V
3.5000 V	3.5006 V	3.50000 V	0.00008 V
4.5000 V	4.5007 V	4.50000 V	0.00008 V
-4.5000 V	-4.5009 V	-4.50000 V	0.00008 V
Обхват 50 V			
5.000 V	5.001 V	5.0000 V	0.0006 V
45.000 V	45.012 V	45.0000 V	0.0009 V ?
-45.000 V	-45.014 V	-45.0000 V	0.0009 V ?
Обхват 500 V			
50.00 V	50.01 V	50.000 V	0.006 V
450.00 V	450.12 V	450.000 V	0.009 V
-450.00 V	-450.14 V	-450.000 V	0.009 V
Обхват 1000 V			
100.0 V	99.9 V	100.00 V	0.06 V
500.0 V	500.0 V	500.00 V	0.06 V
900.0 V	900.2 V	900.00 V	0.06 V
-900.0 V	-900.2 V	-900.00 V	0.06 V
ПРОМЕНЛИВО НАПРЕЖЕНИЕ			
Обхват 500 mV			
50.00 mV @ 50 Hz	50.00 mV	50.000 mV	0.013 mV
450.00 mV @ 50 Hz	449.61 mV	450.00 mV	0.10 mV
450.00 mV @ 1 kHz	449.91 mV	450.00 mV	0.10 mV
Обхват 5 V			
0.5000 V @ 50 Hz	0.4999 V	0.50000 V	0.00012 V
1.5000 V @ 50 Hz	1.4994 V	1.50000 V	0.00025 V
2.5000 V @ 50 Hz	2.4984 V	2.5000 V	0.0004 V
3.5000 V @ 50 Hz	3.4966 V	3.5000 V	0.0009 V
4.5000 V @ 50 Hz	4.4942 V	4.5000 V	0.0010 V
4.5000 V @ 1 kHz	4.4975 V	4.5000 V	0.0010 V
4.5000 V @ 10 kHz	4.4922 V	4.5000 V	0.0010 V
Обхват 50 V			

Извършил калибрирането: *[Signature]* Р-л лаборатория ЕРИ: *[Signature]*
/ Радослав Ентинков / / Кирил Банев /

Fig.6. Calibration certificate

**28th INTERNATIONAL SCIENTIFIC SYMPOSIUM
METROLOGY AND METROLOGY ASSURANCE 2018**

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