SIMULTANEOUS DC VOLTAGE CALIBRATION OF MULTIMETERS AND CALIBRATORS

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Abstract:
This paper describes an automatic method for simultaneous calibration of digital multimeters (DMM) and multifunction calibrators in the 100 DCV range. This method can be also used in other ranges by connecting zeners in series.

Key words: digital multimeter, multifunction calibrator.

1. INTRODUCTION

The most common instruments used in electricity laboratories are digital multimeters (DMM) and multifunction calibrators. These instruments have 5 magnitudes to be calibrated; DCV, ACV, ACI, DCI and resistance.
The calibration procedure of these two instruments is done independently in all magnitudes. A new method for the simultaneous calibration of both instruments in DC voltage will be presented. In addition, this method can be used to determine the linearity of the multimeters.

2. MEASUREMENT PROCESS

To make the calibration of the 100 V range of a HP3458A DMM, well-known voltages are needed to be applied as a reference.
To accomplish this task, we characterize a multifunction calibrator in the 220 V range using the 10 V output of a zener voltage reference Fluke 732B and a DMM.
We make measurements with a Fluke 5700A calibrator and also with a 5720A calibrator. Measurements with the 5720A calibrator show better stability.

Fig. 1 shows a schematic connection.

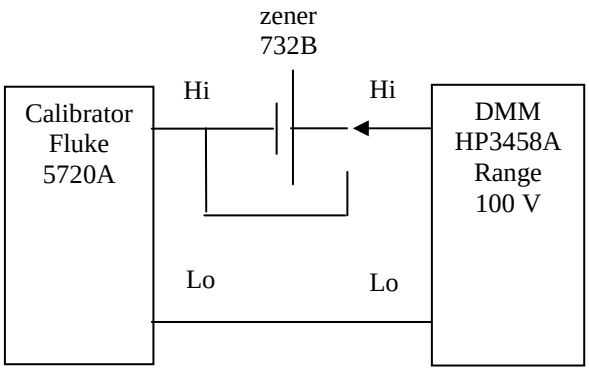

Fig.1. Set up of the system

The first measurement or step consists on connecting the 10 V output of the zener reference to correct the 10 V nominal reading in the 100 V range of the HP3458A DMM. After the measurement reading, the zener is removed from the circuit. Then we connect the multifunction calibrator to the DMM input and generate a 10 V output, a second reading from the DMM is obtained. Using these two measurements we calculate the 10 V output error of the Fluke 5720A. Next, the calibrator is connected in series with the zener. The 20 V, which result from that addition, are measured by the DMM and have a new correction for this new value. Then the zener is removed from the circuit. We apply 20 V from the calibrator output and it is measured by the DMM. When using the 20 V correction value of the DMM, the 20 V output of the calibrator is known.
Using the same step up procedure, that is to say, first getting a voltage reference, then measuring and calculating a correction for the DMM, then adding 10 V nominal from the zener in series we can obtain the next step for the calibrator. Finally applying this result voltage to the DMM which results in a new correction for the calibrator output value, we can get up to 120 V, this is the over range of the 100 V range of the DMM.

Once all the sequence is finished, the 220 V range of the Fluke 5720A multifunction calibrator is known up to 120 V.

The measurement sequence is shown in table 1:

5720 nominal value [V]	732B nominal zener [V]	HP3458A Measured value [V]	5720 value [V]
0	10	9,9999201	
10	0	9,9999975	9,9999933
10	10	19,9999399	
20	0	20,0000152	19,9999845
…	…	…	
…	…	…	
90	10	100,000011	
100	0	100,000089	99,9998941
…	…	…	

Table 1: measurement sequence

3. RESULTS

Figure 2 and Figure 3 show the result of the calibration of the multifunction calibrator 5720A and of the DMM HP 3458.

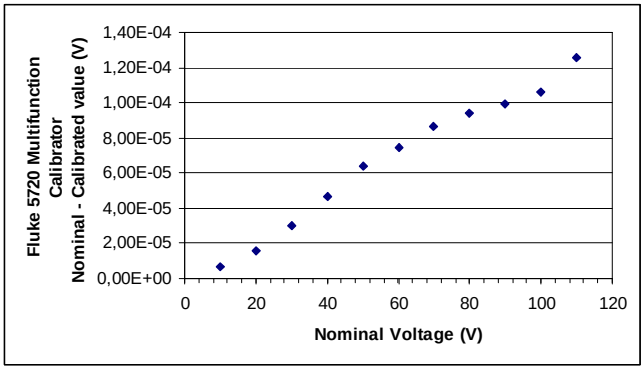

Fig.2: Calibration results for the multifunction calibrator Fluke 5720A

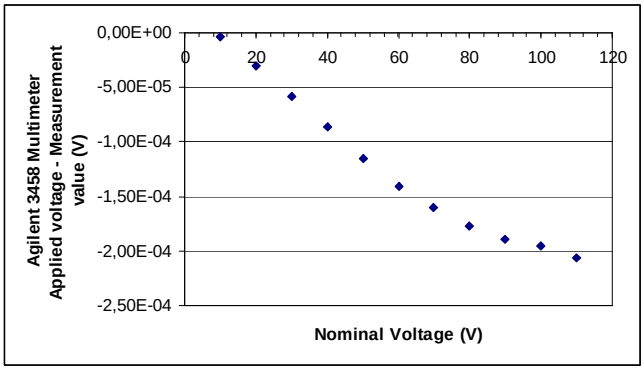

Fig.3: Calibration results for the DMM HP 3458A

4. CONCLUSIONS

A method for the simultaneous calibration of multifunction calibrator Fluke 5720A and for DMM HP348A was developed. In addition, it was described the characterization of the multifunction calibrator to be used in short term as a reference to calibrate the 100 DCV range of a HP3458A DMM.

As a result, this procedure has the advantage that it can be used not only for calibrating the instruments but also to verify the transfer/linearity of 10min. specs for the DMM.

Additionally, the accuracy and linearity up to 120 V of the 220 DCV of a Fluke 5720A multifunction calibrator could be obtained. For different ranges, zeners connected in series can be used.

A detailed analysis and the uncertainty budget of the measurement will be presented in the full paper.

BIBLIOGRAFY

[1] HP3458A calibration manual
[2] Fluke 5720A series II calibration manual
[3]Fluke 732B operator manual