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ACQUISITION SIGNALS FROM ELECTROMAGNETIC FIELD-METERS USING DIGITAL MULTIMETERS WITH EVENT LOGGING MODE

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Abstract – The portable digital multimeters (DMMs) frequently recommended to be used for data acquisition from electromagnetic field meters are the data logging DMMs. In this paper it is shown that it is better to use for this task the DMMs with event logging mode instead of the ones with the data logging mode. The advantages obtained using these DMMs are presented. The performed experimental results prove that the DMMs with event logging mode performed the best.

Keywords: electromagnetic field measurement, event logging mode, data logging mode.

1. INTRODUCTION

It is very important to know with high accuracy the electromagnetic (EM) field disturbances in order to determine theirs impact on the electric equipments and on the people's health.

It is well-known that the EM field has two components: electric field (**E** field) and magnetic field (**H**-field). In order to determine the behaviour of the EM field the two-region model is often used [1], [2]. According to this model around an EM source exist two regions (near field and far field), with a boundary between them. In the near field the components **E** and **H** are not in phase. Therefore, both **E** and **H** should be measured in order to characterize the EM field. In the far field the components **E** and **H** are in phase (are interdependent) and the ratio between them **E**/**H** is constant, equal to the free-space impedance Z_0 (Z_0 = 377 Ω). Thus, in this case it is sufficient to measure only one component, **E** or **H**, in order to characterize the EM field.

In the scientific literature many methods for **E** and **H** field measurements are presented [2]-[4]. The block diagram of a system used for numeric measurement of the EM field disturbances is presented in Fig. 1.

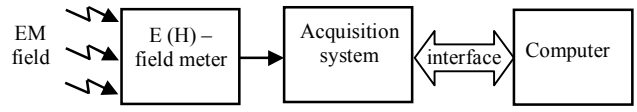


Fig. 1. Block diagram of the system used for numeric measurement of the EM field disturbances.

As acquisition system often the portable data logging digital multimeters (DMMs) with PC link are used. The communication between the DMM and PC is established via the serial interface RS232C.

Recently in [5] has been proposed a system for **E** field measurement. In this system the E field-meter is the Smart FieldMeter model RFP-04 with a detachable omni directional (isotropic) probe – model PI-02 [6]. The Smart Fieldmeter can be used to measure the peak, pulse, and average values in the ranges of: 0 - 2V/m (0.01 V/m resolution), 0 – 20V/m (0.01 V/m resolution), 0 – 200 V/m (0.1 V/m resolution) and 0 – 600 V/m (1 V/m resolution). For the acquisition process a DMM with event logging mode, which is the true rms DMM - Fluke 189, is used in the system.

Unfortunately, in [5] the performances of this system are not compared with those obtained when a DMM with data logging is used.

In this paper, based on the system proposed in [5], the performance obtained using a DMM with event logging mode is compared with the one obtained using the DMM with data logging mode. To this aim some experimental results are carried out.

2. EVENT LOGGING MODE VERSUS DATA LOGGING MODE

The goal of the data logging mode is to sample the input signal at a rate sufficient enough to catch all the input events. Thus, a large amount of data is acquired. If the input signal contains portions with practical unchanged values a lot of redundant data is acquired. Moreover, these DMMs always need a PC to save, via the serial interface, the acquired data since they do not have any memory or have a small memory size (smaller than 100 samples).

The above specified disadvantages are eliminating using DMMs with event logging mode. In this mode only the transition events are catching and recording and not the entire signal. For this purpose during the logging process as each period of stability ends the DMM will log information about that period to its internal memory. Thus, a small amount of data is acquired. It should be noticed that when a DMM with event logging mode is used a PC is not needed. After the end of the measurement process the acquired data can be visualized by means of a dedicated software. One of the most used DMMs with event logging mode are the true

rms Fluke models 189 and 289. Fluke 289 has a greater memory size (10,000 samples) compared with the Fluke 189 (995 samples). In both models the log information is the maximum, minimum, and average readings. The acquired data can be visualized using the FlukeView Forms software [7].

The signal acquired from the **E**(**H**) field-meters frequently contains portions with practical unchanged values. From this reason, in these applications it is recommended to use DMMs with event logging mode instead of DMMs with data logging mode. In addition, since a PC is not needed when a DMM with event logging mode is used, it follows that a measurement system with such DMM is recommended to be used in environments with high EM field disturbances.

3. EXPERIMENTAL RESULTS

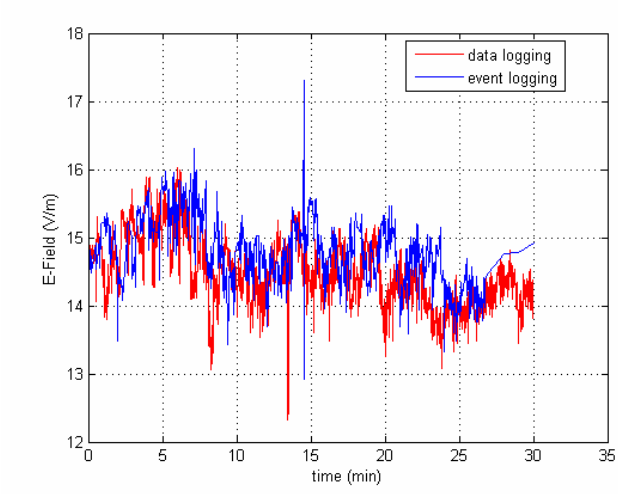
The aim of this section is to compare the **E** field measurements obtained using the system proposed in [5] with the ones obtained when for the acquisition process a DMM with data logging mode is used. UT60A is a DMM only with the data logging mode. The **E** field radiated by some GSM antennas (900 MHz frequency band) situated at the roof of the building of Faculty of Electronics and Telecommunications from Timisoara (see Fig. 2(a)) was measured. The Smart Fieldmeter probe was situated at about 3 m from antennas. The peak values of the **E** field were measured by means of the Smart Field Meter (the range 0 – 20 V/m was used). The sampling rate of UT60A was 1sample/s (as the DL-02 DMM recommended by the manufacturer of the Smart Fieldmeter [6]). For the Fluke 189 the logging interval was 1 minute. The observation time was 30 minutes. The portable computer was used only for the UT60A. The maximum values acquired by the Fluke 189 and the values acquired by the UT60A are shown in Fig. 2(b). The measurement results are also shown in Fig. 3 by using the graphical interface implemented for the measurement system proposed in [5]. During the observation time 1800 samples were acquired by the UT60A and 737 samples by the Fluke 189 (see Fig. 3). Thus, using Fluke 189 much less samples are acquired.

From Fig. 2(b) it is clearly evident that the sample corresponding to the maximum value of the **E** field radiated by antennas (about 17.3 V/m – see Fig. 3), that is the most important value, is acquired only by the Fluke 189. UT60A is not able to acquire this value since its sampling rate is not high enough. Thus, to catch the maximum value of the **E** field another DMM with data logging mode with a higher sampling rate should be used instead of the UT60A, as for example the DL-01 which is recommended, by the manufacturer of the Smart Fieldmeter [6], which has the 20samples/s sampling rate. It should be noticed that when the DMM is employed, in the observation time used, 36,000 samples will be acquired, which it is a very large amount of data.

The total weight of the system components is about 870 g when the Fluke 189 is used and about 4 kg, due to the portable computer, when the UT60A is used.

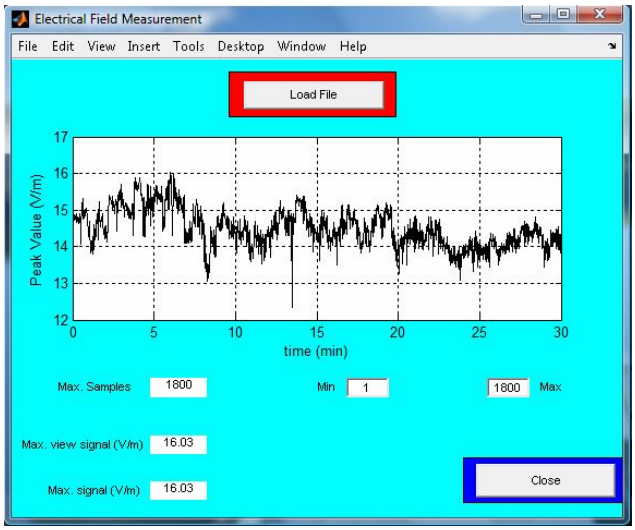
The weight of the equipment is very important when the measurements are made in inaccessible or hard accessible places such as television towers or transmission towers placed on high altitude mountains.

(a)

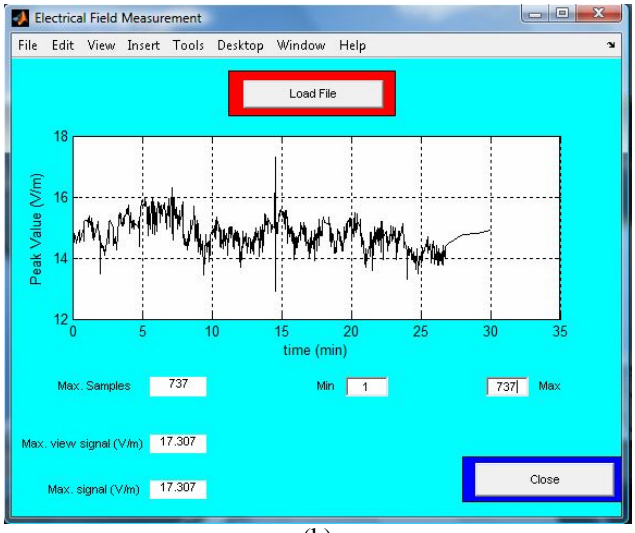


(b)

Fig. 2. **E** - field measured by a DMM with a data logging mode and by a DMM with an event logging mode: (a) Experimental setup, (b) Measurement results.



(a)



(b)

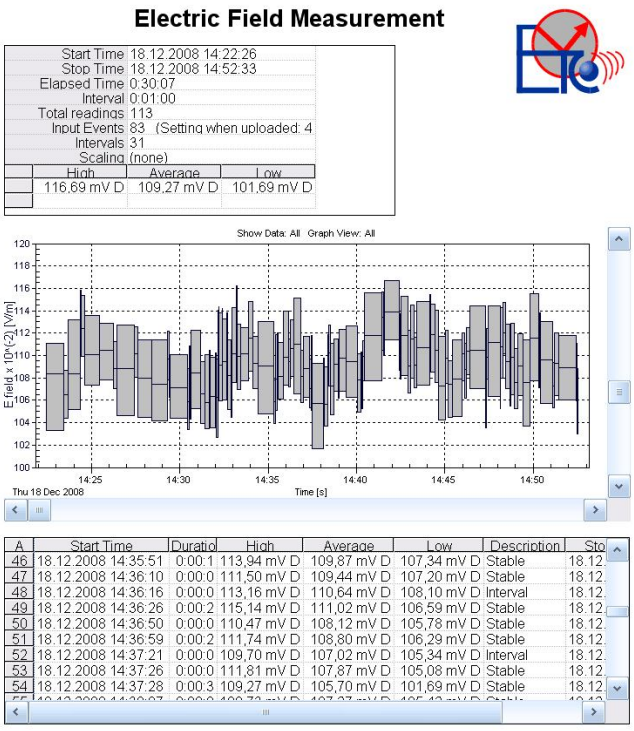
Fig. 3. (a) Measurement results obtained using: (a) Fluke 189, (b) UT60A.

The number of samples acquired by Fluke 189 can be reduced by increasing the logging intervals. In order to shown this behaviour some experimental measurements are made.

In the second measurement set, two Fluke 189 DMMs with data logging were used. For the first DMM the logging interval was 1 minute and for the second DMM was 30 seconds. The observation time was 30 minutes. The measurement setup is shown in the Fig. 4, and in Fig. 5 the measurements made by both DMMs are given. The data are captured using Fluke View Forms software.

The number of samples acquired by the first DMM was 113 and by the second DMM was 768 samples. Thus, by using 1 minute sampling rate the amount of data captured is reduced about seven times than using a 30 seconds sampling rate. In addition from Fig. 5 it can be seen that all the **E** field peak values are captured when the first DMM is employed. Therefore, it is more advantageous to use a higher logging interval for the DMM.

Fig. 4. Experimental setup of the **E** field measured using using two Fluke 189 DMMs.



(a)

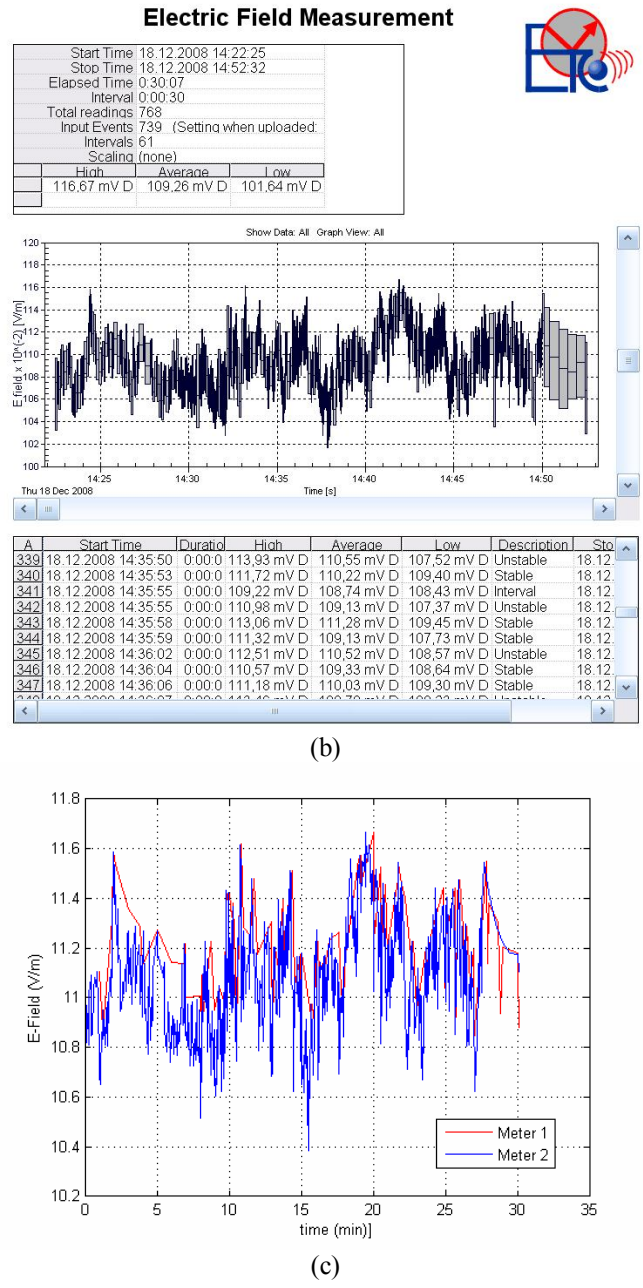


Fig. 5. (a) Measurement results obtained using: (a) Fluke 189 with sampling time of 1 minute, (b) Fluke 189 with sampling time of 30 seconds, (c) Measurement results obtained using each DMM.

4. CONCLUSION

The portable DMMs frequently recommend to be used for data acquisition from **E**(**H**) field-meters are the DMMs with data logging mode. In this paper has been proved, based on the system proposed in [5], that the DMMs with event logging mode are most suited to be used for this task since in this case the length of data acquired is relatively small, the important data are always acquired, the total weight of the system components is smaller. Moreover, a measurement system with such DMM not requires a PC, and so it is well suited to be used in environments with high EM field disturbances.

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