DISTURBANCE IMMUNITY OF A/D PC CARDS (PCMCIA) AND EMC CONDITIONS IN NOTEBOOKS

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Abstract – *Portable measuring systems based on notebooks use various types of A/D PC Cards (PCMCIA). Applying such systems, the precision of measurement depends not only on the quality of an A/D PC Card being used, but also on the influence of disturbance. The methods used both for the determination of EMC conditions in PC Card (PCMCIA) slots, and for the disturbance immunity measurement of A/D PC Cards is described. An experimental verification of these methods was also made and some concrete results are published here.*

Keywords - DAQ system, notebook, A/D PC Card, EMC, disturbance immunity

1. INTRODUCTION

The precision of dynamic measurement using modular DAQ systems depends not only on the parameters of the A/D module used. In contrast to the stand-alone instruments, the EMC conditions in the system case and disturbance immunity of a used A/D module are important parameters of the DAQ system's quality. This can cause difficulties with the correct use of commercially available products. It is valid also for portable systems using notebooks with A/D PC Cards. Therefore, suitable methods have to be designed and a number of measurements are to be executed for determining both EMC conditions in the PC Card slots and the disturbance immunity of A/D PC Cards.

The investigation concerning PC systems was executed in the last several years [1]. The methods for disturbance immunity measurement of A/D modules were designed and the system for testing PC plug-in boards with ISA or PCI interface was realised. To describe the disturbance immunity of different types of A/D boards, a disturbance immunity factor *DIF* was defined [3]. All measured values can be used as a base for a limited determination of conventional environments in PC cases. However, there was no investigation concerning transportable systems based on notebooks. Recent investigation in this area has pointed to notebooks and A/D PC cards designated for transportable systems. The system for testing A/D PC Cards and EMC conditions in PC Card (PCMCIA) slots in notebook has been developed.

2. INFLUENCE OF DISTURBING MAGNETIC FIELD

There are two kinds of sources for a disturbing magnetic field in a PC Card slot in a notebook - internal and external ones. The internal sources are e.g. a motherboard, drives, a PC Card in a neighbouring slot etc. The external disturbing field is typical for industrial environments, e.g. for area near pulse controlled engines etc.

2.1 Measurement of internal disturbing magnetic field

To be possible to measure the average value of a disturbing field in PC Card (PCMCIA) slots in a notebook, the testing PC card (similar to the testing board used for PC systems [1]) was designed and developed. A special board made from an insulated material with 6 measuring coils is placed in the standard PC Card aluminium box - see the Fig. 1. It enables to measure the disturbing fields in three main directions - two parallel to the PC Card (axis X, Y - see the Fig. 1) and one perpendicular (axis Z). Individual measuring coils were calibrated in Helmholtz coils.

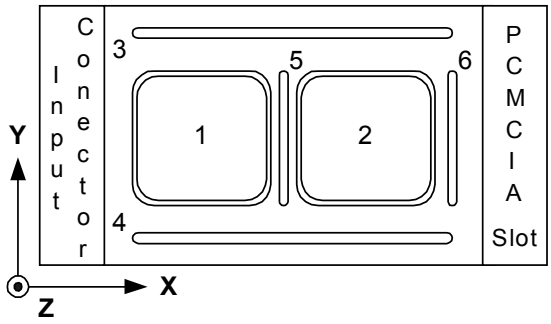

Fig. 1 - The testing board with 6 measuring coils

The product of frequency and intensity of the magnetic field $f_D H_D$ is used as a typical parameter for assessment of the disturbing field level, because the disturbing component in the output signal arising due to the disturbing field is proportional to this product.

Two types of notebooks with a different arrangement of PC slots and hardware configurations were tested. An example of the measured spectrum (notebook 1, right slot, measuring coil 4) is shown in the Fig. 2. The general results are published in Table 1 (only the main disturbing components are mentioned here).

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Table 1 - Values of $f_D.H_D$ in the area of measuring coils (kHz·A/m)

Notebook		f_D (kHz)	Measuring coils					
Type	Slot		1	2	3	4	5	6
1	Right	31	6	14	3	47	3	14
	Left	102	35	18	12	29	6	10
2	Upper	562, 776	15	10	9	10	12	12
	Lower	562, 776	12	9	9	12	13	12

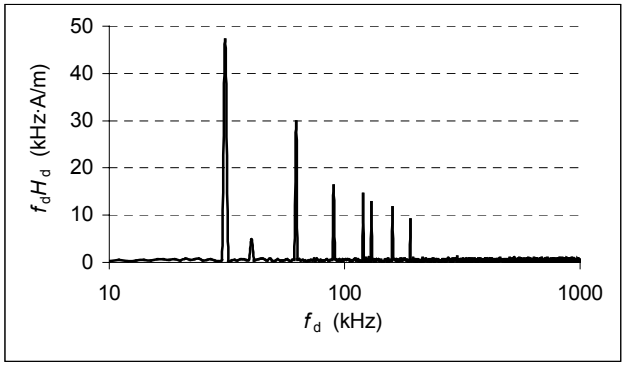

Fig. 2 - The spectrum of the disturbing field in the right slot of the notebook 1, coil 4

2.2 Measurement of an AC component of the supply voltage

Also an AC component of the PC Card supply voltage can cause a disturbing component in the output signal. Therefore, its parameters should be also measured. However, there are several problems how to execute it. At first, the supply voltage is not always present in the relevant pin of the PC Card connector - it depends on the software configuration. Using older notebooks with 16-bit PC Card (PCMCIA) slots, it is sufficient to interconnect voltage identification pins. It was realised on the measuring PC Card mentioned above, including the connection for supply voltage measurement.

Unfortunately, it is not sufficient for new notebooks with a PC Card bus, where additional software configuration problem arises. Therefore this test was not executed for notebook 1 with a PC Card bus yet (to execute it, a special testing card with configuration circuits will have to be designed and developed).

The spectrum measured by spectrum analyser is shown in the Fig. 3. The most significant component with RMS value about 6 mV was noticed at frequency 101 kHz. However, the next significant component with frequency about 5 kHz and the RMS value about 10 mV was found using the digitising scope.

2.3 Testing the influence of the disturbing magnetic field to the A/D PC Card

The measuring system for testing a magnetic field disturbance immunity applied for ISA boards testing (see [2]) was also extended for testing PC Cards. The tested PC Card was inserted into the PCMCIA-ISA interface, which was placed in Helmholtz coils generating the defined magnetic field. The method using a measurement of output noise arising due to a disturbing field to determine the decrease of the effective number of bits was applied. The tests were made in all three main axes. Two A/D PC Cards were examined (12 bits DAQCard-1200 with selectable gain from 1 to 100, and 16 bits DAQCard-516 with fixed range ± 5 V, both made from National Instruments).

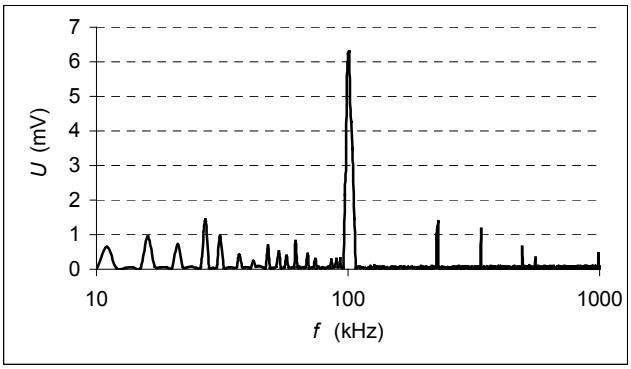

Fig. 3 - The spectrum of the AC component of the supply voltage in the upper slot of the notebook 2.

The influence of a disturbing field for DAQCard–516 is negligible towards of internal noise. The results for DAQCard–1200 are published in the Fig. 4. The disturbing effect for the gains smaller than 10 and an internal disturbing field (usually smaller than 50 kHz·A/m) is also in this case negligible towards internal noise.

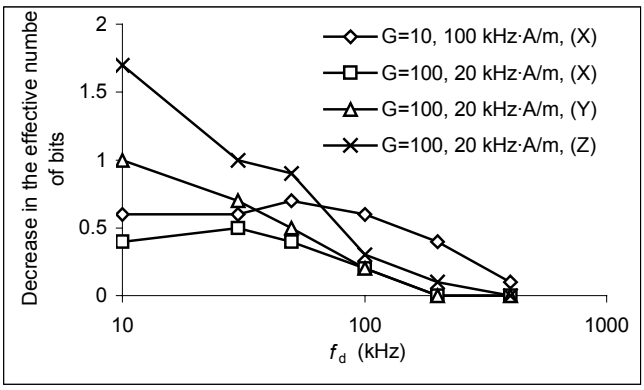

Fig. 4 - Frequency dependence of the decrease of the effective number of bits board - DAQCard–1200

2.4 Testing the influence of an AC component of the supply voltage for the A/D PC Card

Also in this case the PCMCIA-ISA interface (the same as for testing the influence of a disturbing magnetic field) and the method published in [3] was used. The disturbance immunity (concerning the disturbance propagating due to

supply lines) was measured using a similar way, as in the case of the disturbing magnetic field (see above). The RMS level of an AC component of the supply voltage was used as the typical parameter of disturbance in this case. The sine wave voltage was injected into the supply line + 5 V. The AC component of the supply voltage was measured using a digitising scope. The A/D PC Cards mentioned above were tested. The results are published in the Fig. 5 (DAQCard-516), and the Fig. 6 (DAQCard-1200).

CONCLUSION

A low disturbance, or even ideal EMC conditions are not a realistic case using portable DAQ system based on a notebook complemented with an A/D PC Card. The real effective number of bits of A/D channel depends not only on the dynamic quality of the A/D PC Card used, but also on the influence of both the internal EMC conditions in the system case and the external disturbing field. The measured results showed that while a non-ideal supply voltages does not influence the real resolution using a notebook with an A/D PC Card, the disturbing magnetic field (both internal and external) could significantly cause a decrease in the effective number of bits.

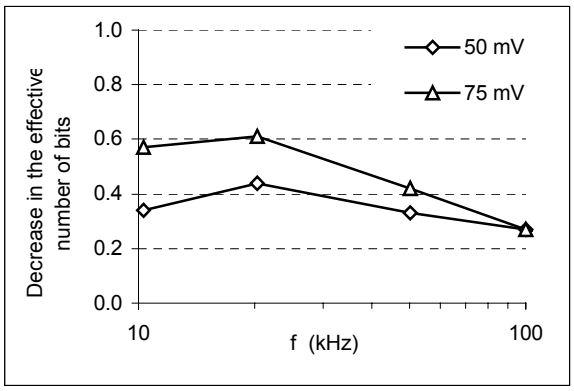

Fig. 5 – Frequency dependence of the decrease of the effective number of bits arising due to the AC component of the supply voltage, DAQCard–516

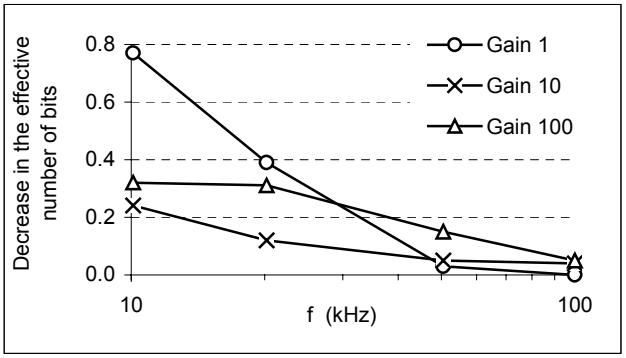

Fig. 6 – Frequency dependence of the decrease of the effective number of bits arising due to the AC component of the supply voltage 40 mV (RMS), DAQCard–1200

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