ELEKTROCHEMICAL MULTIMETER

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ABSTRACT

The electrochemical multimeter has been designed for the measurement of a variety of items that measure corrosion processes. The main purpose for the design of the electrochemical multimeter system was for the measurement of electrochemical noise and electrochemical impedance. A measurement of low current and voltage is needed in electrochemical noise studies of corrosion. A harmonic signal of low current or potential is also needed. These two objectives have to be synchronised.

1   INTRODUCTION

The design of the electrochemical multimeter was caused by urge of analyze of corrosion processes. Analyze of the metal materials is very important factor for their protection, specially investigate of the corrosion processes.

2   DESIGN OF HARDAWARE PART OF THE MULTIMETER

The inputs of the electrochemical multimeter contain two a 24-bit sigma delta analog to digital converter, AD7714 are used [1]. The converters are working in the frequency bandwidth of up to tens hertz with a high accuracy of about 20 bits. For the measurement of higher frequency, eights internal converters of digital signal processor are used. These converters allow the system to work in a bandwidth up to hundreds of kHz. The overexertion between the sigma delta converters and the internal converters is driven from the PC throught relay. The output part of the digital system works as a generator of the sinusoidal waveform in the range up to ±10 mA with a frequency of up to tents of hertz. The sinusoidal waveform is generated inside the DSP processor and sent through the SPI interface to the 18 bit digital to analog converter, AD1861 [1]. The core of the digital system is the digital signal processor, DSP56F805 [2]. The DSP microprocessor drives all operations as communication between converters, manipulates the input and output signals and sends the results of the data to the

personal computer. The communication between the development system and the PC is through a USB interface. The block schematic is depicted in figure 1 and all the construction of the development system is detailed in figure 1.
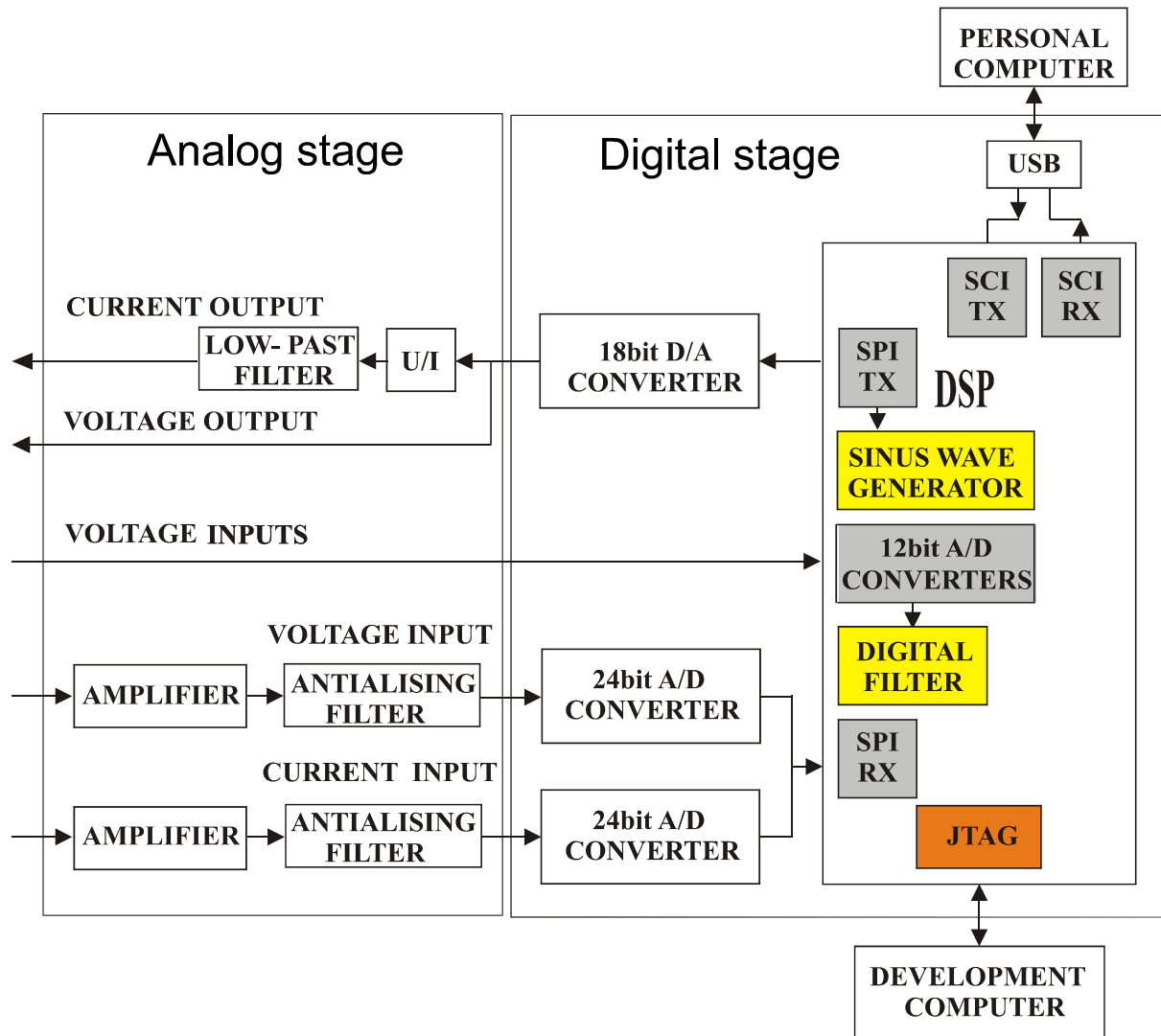
Fig. 1: *The block schematic of the multimeter*

3   SOFTWARE PART OF THE MULTIMETER

Software part of this equipment is divided to two separated sections. One is implemented into DSP processor and second one is provided the user interface. The user can chose of the many possibilities of the measurement.

First possibility is measurement of electrochemical noise. For this measurement is possible chose the voltage ranges (±0.5 V or ±2.5 V) and current ranges (±10 nA, ±100 nA, ±1 μA, ±10 μA and ±10 mA).

The other application of the electrochemical multimeter is for measurement of simultaneous impedance. This measurement uses the same input ranges as measurement of electrochemical noise plus generation of the sinusoidal signal. The sinusoidal signal is

possible generate from few mili hertz up to 70 Hz with amplitude in range (±2.5 V). The generate signal can be mixed from one to tree signals with different frequency and amplitude.

The third possibility of the use of measurement system is measurement of electrochemical impedance. The function of this measurement provides the generation of the sinusoid signal with frequency changes. The user can apply frequency waveform form start to end frequency with definite number of decade. The amplitude of the frequency waveform is constant for whole measurement. The user can also emends stabilisation of the apply wave form. That is to save that number of stabilisation cycles of generated signal is throw away. The measurement data are saved to the text file in requested format. One of the other functions is displays of the data in monitor in real time.

Finally, the multimeter is possible use also as data acquisition system with eights independents inputs.

Both parts of the software (for DSP and for PC) are written in language C. Debug of the part for DSP was done in Metrowerks Codewarrior from Motorola Company. Debug of the second part was done in Microsoft Development Environment 2003.

Fig. 2: *The construction of the multimeter*

4   CONCLUSION

The electrochemical multimeter has been designed for measurement of electrochemical values. The multimeter was designed specially for the measurement of electrochemical noise and electrochemical impedance. The development of the multimeter is for use at the Corrosion and Protection Centre Department, UMIST.

REFERENCES

[1] www.analog.com

[2] www.motorola.com