Rail-to-Rail Signal Transducers for USB Sensor Devices

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Abstract – **Design principles and microelectronic parts of sensor devices signal transducers (including thermo-magneto-, photo- measuring converters) meeting requirements of up-to-date low-voltage energy-efficient apparatus driven and fed through USB port are considered. It is shown that such sensors in order to providing high technical characteristics have to have possibility of high-precision functional transductions at low-voltage unipolar supply source (5 V or less), consume small power (tens of mW or less) and be compatible with USB interface.**

Keywords – **signal transducer, sensor device**

I. INTRODUCTION

Present level of sensor devices development sets new terms for measurement precision improvement, power consumption minimization, ability of operation at low-voltage unipolar supply sources, front-end compatibility with personal computers and implementation of intelligent sensors standard conception. In compliance with the above-mentioned requirements this work gives consideration of construction principles of signal transducers of thermo-, magneto-, photo-sensor devices that operate with range of voltage almost equal to source voltage (usually 3÷5V). Structure, circuit design and interface protocols of developed sensors meet requirements of USB Plug & Play devices and standard IEEE 1451.2 – Intelligent Sensors [1, 2].

II. MAIN RESULTS

In this work design principles of signal transducers for USB devices meeting requirements of up-to-date sensor devices are given. Developed sensors are implemented on the newest energy-efficient rail-to-rail semiconductor integrated circuit: a number of high-precision rail-to-rail operational amplifiers, including type AD8551/52/54 (Zero-Drift Single-Supply Rail-To-Rail Input/Output Operational Amplifier) and microconverters that integrate high-precision analog-to-digital converters, microcontrollers, memory and interfaces (for example, microconverters ADuC812, ADuC824). The fundamental novelty of such elements base is ability to operate with range of analog signals in the whole voltage range of low-voltage power source. This possibility is achieved by combining low-threshold CMOS FETs and relevant structural and circuit decisions.

The main results of the work are new mathematical models of rail-to-rail operational amplifiers, new approaches to circuit modeling of rail-to-rail signal transducers, new solutions of micropower low-voltage circuits and approaches to USB FT232R microcontroller application.

Figure 1 shows some results including proposed by authors equivalent circuit of rail-to-rail operational amplifier input stage based on combination of p-channel and n-channel MOS transistors, which makes possible to describe adequately rail-to-rail input stage characteristics (a); example of experimental research of instability behavior of micro power rail-to-rail operational amplifier loaded by capacitance transducer (b); PCB of developed signal transducers specimens (c).

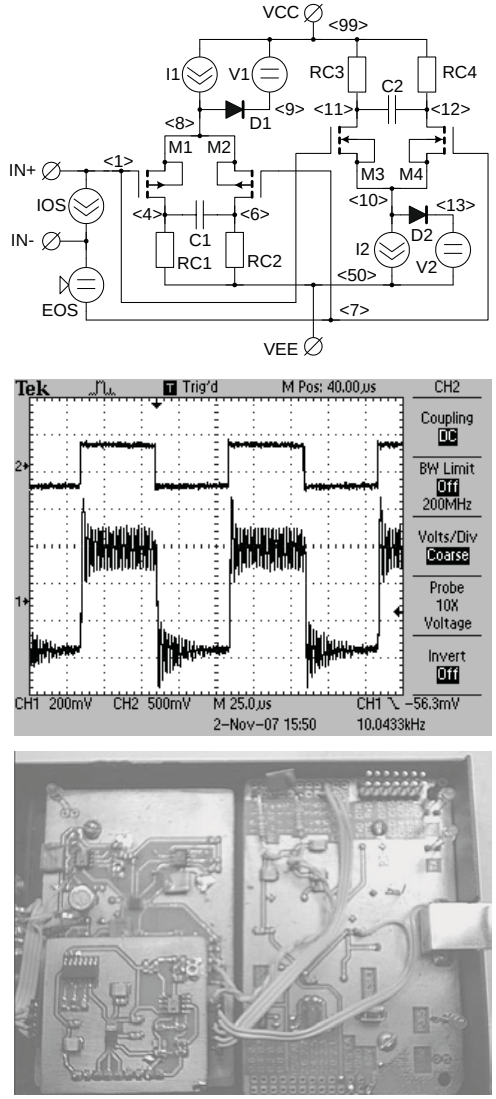

Fig.1 Examples of USB sensor devices signal transducers development and research

III. CONCLUSION

Development of rail-to-rail signal transducers for USB sensor devices assumes performance of complex investigations aimed at providing high technical characteristics at low supply source voltage and power consumption.

REFERENCES

[1] Rabaey J., Ammer J., Otis B.; Burghardt F., Chee Y.H.; Pletcher N., Sheets M., Qin H. Ultra-low-power design // Circuits and Devices Magazine, IEEE. 2006. – Vol. 22. № 4.– PP. 23-29.

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