VISHAY PRECISION GROUP

CASE STUDY

Product Group: Vishay Foil Resistors

Monitoring extremely low current at power levels as low as 5 nanowatts

Author: Dainius Obelienius (Electronics Engineer),
Kaunas University of Technology

A meter to monitor extremely low dynamic current with a high degree of accuracy unaffected by noise, temperature variations and thermal EMF; developed by Kaunas University of Technology (KTU), Lithuania .

Industry/Application Area Electronic monitoring systems where extremely low current must be measured and isolated from parasitic effects that may be of lesser importance in higher levels of current Electronic monitoring systems

Product Used: VCS1625Z (Z-Foil), 0.5 Ω, 0.5%

- TCR : ± 0.2 ppm/°C typical (- 55 °C to + 125 °C,+ 25 °C ref.);
- Current Noise < -40dB;
- Thermal EMF: 0.05 µV/°C typical)

The Challenge

To precisely measure extremely low currents (100uA - 400mA) where parasitic effects from thermal EMF, noise, and temperature coefficients of resistance could be many times greater than the quantities to be measured.

The Solution

For small current measuring, a high-precision current sense resistor is needed. I used the VPG high-precision Z Foil resistor (VCS1625Z) with 4-terminal configuration (Kelvin connection), which eliminates the IR-drop error voltage that would be present in the voltage sense leads if a standard 2-terminal resistor were used. In current sense resistors the contact resistance and the termination resistance may be greater than that of the resistive element itself, so the lead connection errors can be significant if only two terminal connections are used. Moreover, the low thermal EMF, low noise and low TCR of the foil resistor assure that the measured current is not lost in the parasitic effects of these characteristics present in other resistor technologies. With an output voltage as low as 50uV and potential parasitic errors possibly being much greater, both being fed into an amplifier, and the error being amplified as well, there is a very real possibility that the system displays only the error while the actual current of interest is completely lost. Thus the defining characteristics of the foil resistor are essential to the proper operation of the monitoring system.
This method is most accurate and allowed me to precisely measure the current as needed.

Product Group: Vishay Foil Resistors

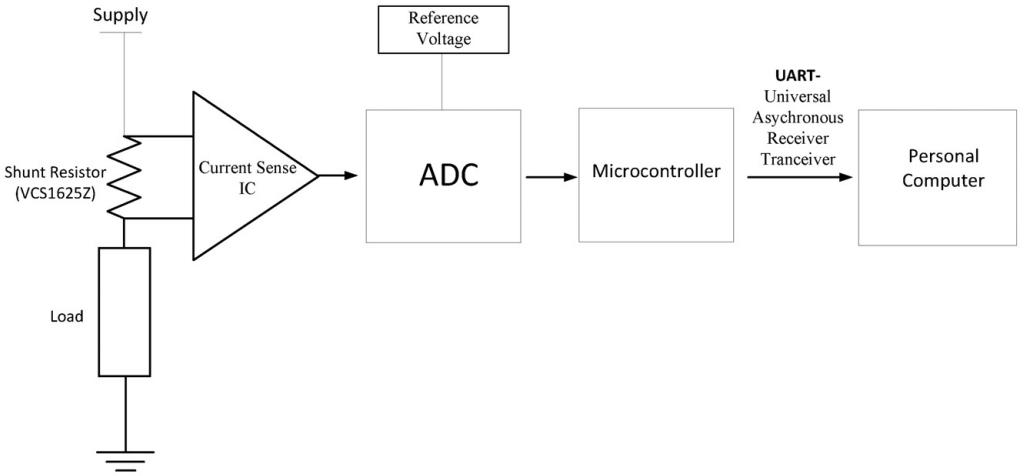

Figure 1 - Dynamic current meter simplified scheme

The User Explains

We designed a monitored dynamic current meter (Figures 1 and 2). The meter measures current using a high-side current measurement method. We accomplished this by inserting a shunt resistor between the power supply and the circuit load. The sensed voltage is then amplified by a dedicated current sense amplifier which is supplied to an analog-to-digital converter (ADC). In the ADC the sensed voltage is converted into a code and transmitted to a computer via a universal asynchronous receiver transceiver (UART) interface using a microcontroller. The code received in the computer is processed and the results are displayed on a Graphical User Interface (Figure 3).

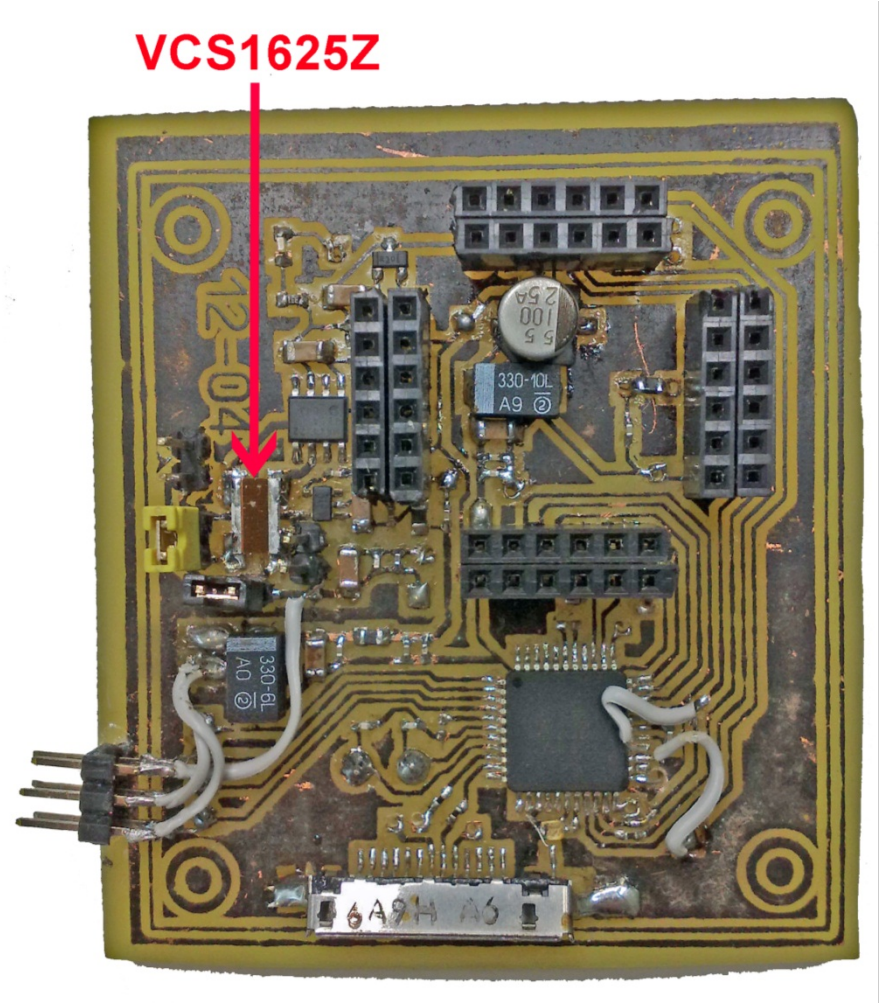

Figure 2 - Dynamic current meter printed circuit board

Product Group: Vishay Foil Resistors

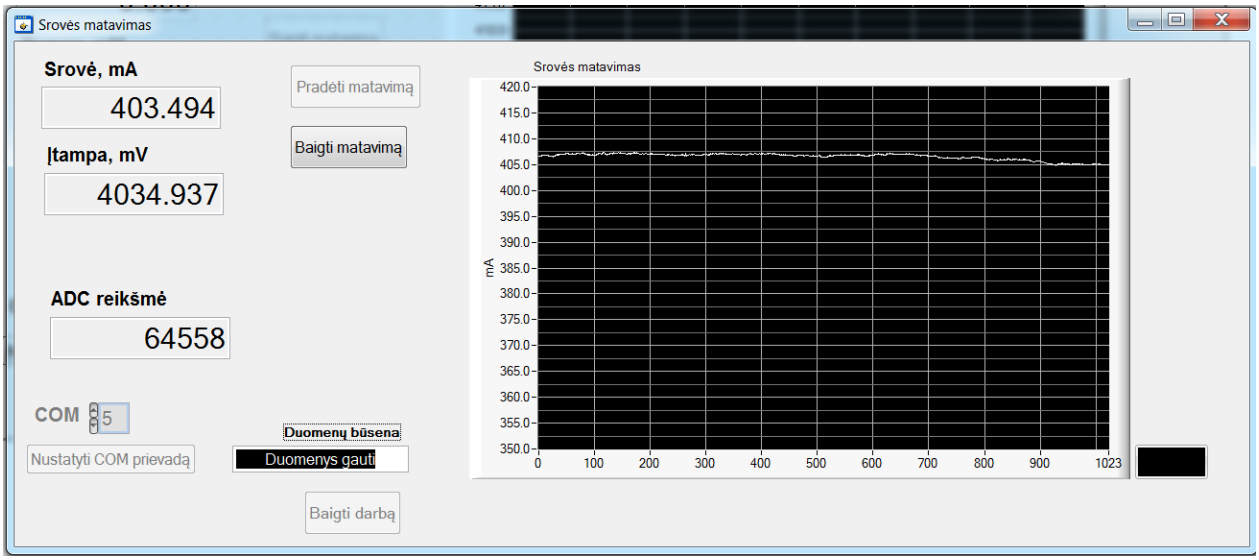

Figure 3 - Graphical User Interface - Current measuring program print screen

Contact Information
Dainius Obelienius, Electronics Engineer
Kaunas, Lithuania
Email: dainius.obelienius@gmail.com
Phone: +37062140995

Vishay Precision Group, Inc. (VPG)
Vishay Foil Resistors
foil@vishaypg.com

Click here for your regional VFR contact.

The project was supervised by:
Assoc. Dr. Marius Saunoris
Department of Electronics and Measurement Systems,
Faculty of Telecommunications and Electronics,
Kaunas University of Technology,
Kaunas, Lithuania
Email: Marius.Saunoris@ktu.lt
Phone: +37037300883

Kaunas University of Technology at a Glance:

The Kaunas University of Technology (KTU) is the largest technical university in the Baltic States, being one of the most dynamic schools of higher education in Lithuania. KTU is widely known as a leader in research and study in various fields.