

Proposal for free-of-charge tutorial at PEMC

Title:

Free-of-Charge Tutorial on Practical Digital Multi-Channel Measurement

Target group: PhD students and senior lecturers at universities that have limited resources in funds for equipment but demanding tasks in measurements at power electronics, temperatures, etc.

Cost:

Zero for attendees (limited number for keeping a high practical information level)
Zero for conference organizer except providing a lecture and components presentation room

Main idea: Practical self-organized and realized set-up of a complete measurement environment (sensors, potential separation issues, low distortion signal transfer, measurement channel amplifiers including overvoltage-protection, analog filtering, analog-to-digital conversion, digital filtering, on-line data display, data storage, data post-processing, data export, including software opportunities, comparison of self-built-devices to high-level and medium-level and low-level industrial equipment

Abstract

Industrial solutions for measurement tasks are really great in both performance and cost. The potential separation implementation, implementation of direct connection to high-priced sensors, channel amplification and filter selection, the integrated software opportunities are an excellent choice for e.g. industrial measurements tasks done by university departments in case that equipment is financed by fulfilling several tasks. However, for education such equipment might be out of scope due to the very high cost: Approximate values can be 1500 Euro/channel for variable input and full potential separation units, 500 Euro/channel for difference amplifiers of higher bandwidth and simultaneous acquisition at e.g. 100 kHz, and e.g. 200 EUR/channel for lower rates of data acquisition and simpler input circuits. Such examples will be shown inside the tutorial for comparison to much cheaper solutions presented in detail in the following.

At limited financial resources and some preparation time, a quite similar performance of commercial equipment can be obtained by a self-designed and self-built multi-channel data acquisition system at a fraction of cost mentioned before. Taking only hardware into account, about 20 Euro per channel are easily reached using standard operational amplifiers in circuits described in this tutorial on a basis of fully documented circuit proposals that are easy re-buildability by students. Thus, the design can also be very helpful for a cost-effective master thesis of a student that includes the practical realization of digital measurements over several channels.

The general system design is based on overvoltage-protected difference amplifiers as input circuits, correspondingly designed Bessel-filter circuits (including dimensioning for any desired cut-off frequency) and a cheap version for analog-to-digital conversion using a used e.g. National Instruments® card for 16 channels (i.e. 10 Euro per channel), computer connection cables, and a reasonable software. A self-written software based on e.g. LabView® can be great but might take a rather long time for proper and comfortable function. Here a time-limited evaluation version of a commercial software with full internal function can be another solution. Such a software will be used in this tutorial.
