Analogue to digital conversion

Presenter: Prof R. Allan Belcher

Email: rabelcher@signalconversion.com

Signal Conversion Ltd

- Commercially confidential Technical reports
- Patents
- Journal Publications
- International Standards
- On-site training
- ADC/DAC software and test systems

Aims of this course

The general aim of this course is to introduce engineers to theoretical and practical problems and solutions where ADC and DSP are in a measurement system that must meet a target specification.

The practical application of the training will be aimed at digitising the output of ……. and within the four days allocated, cover aspects of:

Priority

1. ADC selection
2. ADC circuit design
3. Circuit & PCB design for EMC
4. Introduction to digital filter selection & implementation

The order of priority is as above but the depth of treatment of each will depend on the actual time required by the course participants. At the request of participants, the priority may be changed after 1 and 2 are completed.

Outline Agenda

Maximum Attention needs short sessions (50 mins) start 9am end 5 pm

- Session A   1 to 1.5 hrs
- 15-30 min Break
- Session B 1 to 1.5 hrs
- Working Lunch 1hr
- Session C 1 to 1.5 hrs
- 15-30 min break
- Session D 1 to 1.5 hrs

Outline Format of a Session

- Presentation
- Discussion
- Exercises
- Review

Course outline Day 1

This day will address ADC circuits through the following

- Introductions: establish baseline knowledge
- Fundamentals of ADC terminology and specifications
- ADC Standards
- Advantages/disadvantages of various ADC circuit topologies
- Testing ADCs in circuit
- How to determine limits of ADC precision and accuracy
- Linearising ADC system

Course outline Day 2

This course will address ADC design through the following

- Examples of interpreting key specifications of ADC data sheets
- Selecting an ADC for ………….
- Writing the specification for the ADC aspects of a …… system
- Student exercises

Course outline Day 3

- Guidelines for circuit and PCB design to maximise immunity to EM interference
- Guard rings on input to ADC
- Balanced vs unbalanced ADC
- The analogue – digital split, star point
- Practical approaches to informal testing of EM susceptibility
- Analysis of an ADC layout /application to illustrate application of guidelines (PCB layout supplied in advance by customer)
- The importance of data capture and analysis in testing an ADC with examples of low cost test solutions

Course outline Day 4

- Design of certain ancillary circuits around ADC, including low noise power supply, external pre-amps (details to be finalised)

Course outline Day 4

Introduction to digital filters

- Mathematical functions /polynomials to describe transfer functions
- settling time and noise reduction.
- Out of band rate of attenuation increases with order of filter
- Gaussian: zero overshoot
- Bessel: good transient response
- Butterworth: constant amplitude response in band
- Example:

Recommended texts

- Digital Signal Processing: Concepts and Applications .Mulgrew, Grant and Thompson. Published by MacMillan 1999

- Data Conversion Technology (see https://signalconversion.com). E-book published by Signal Conversion Ltd

- International Electrotechnical Commission standard IEC 60748-4-3 interface integrated circuits. Published by IEC Geneva   www.iec.ch

Recomended Windows based ADC Software

Signal Conversion Ltd
- WinSATS: ADC simulation and testing, FIR and IIR filter implementation using coefficient files
- WinSATS dlls (microsoft c++ and c#)

National Instruments
- Labview: Filter design modules
- Labview: ADC testing WinSATS c# dlls

The Mathworks
- Matlab: Filter design toolbox
- Matlab: ADC testing WinSATS c++ dlls

Start of todays course