Switching Supply Noise Filtering Techniques and Tools
SHORT TERM INTERNSHIP PROGRAMME
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Agenda

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- Project Overview
- Project Motivation
- Python Tools
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Presentation

- Student in the Engineering school of the University of Nantes
- Field: Electronics and Digital Technologies
Project Motivation

- Significant portion of noise in UQDS system comes from switching power supplies

- Next QDS generation will integrate 3 channels on the board which currently has 1 channel → Switching supply noise may become an issue

- Facilitate the hardware development process by developing appropriate tools
Project Overview

- Development of a python tool to communicate and analyze data from UQDS

- Investigate general switching supplies noise reduction techniques and apply them to UQDS channel
Python Tool
Python Tool

- Functions for configuration of UQDS system and data analysis
- Object Oriented Programming for modularity and reusability (different QDS, different communication protocols)

![Diagram]

- Description level
  - Functions for signal analysis
  - Functions for system configuration
  - Functions for low-level communications
Noise Reduction Techniques Investigation
Measurement Conditions

- Input is shorted
- FFT resolution of 3 Hz
- Noise is characterized by the amplitude of peaks
Battery supply
DC/DC Converter Supply

Channel 1 FFT

-60
-80
-100
-120
-140
-160
-180

Amplitude (dB)

0 50000 100000 150000 200000 250000 300000 350000
Frequency (Hz)

f = 0.0 kHz
A = -60.03 dB

f = 45.13 kHz
A = -80.08 dB

f = 135.38 kHz
A = -81.98 dB

f = 225.63 kHz
A = -87.65 dB

f = 315.89 kHz
A = -92.39 dB
Filtering Techniques

- AC/DC Converter
- Input Filter
- DC/DC Converter
- Common Mode Filtering
- Output Filter
- Converter shield
- Analog part shield
- LDOs

Connections:
- 5 V to Input Filter
- GND to Input Filter
- +15/-15 V to Output Filter
- GND ISO to Output Filter
- Analog part to LDOs

Diagram shows the flow of power and signals through various filtering stages.
Results With Passive Components

- Input and output filters provide an attenuation of 3 dB for each peak

- Common mode capacitor provides an attenuation of 20 dB
Radiated Noise Measurement

- 3 channels tested at the same time
- Small loop antenna connected to an oscilloscope
Radiated Noise Reduction

- First test: DC/DC coverage
  - 6 dB of attenuation on all peaks

- Second test: Analog part shielding
  - 35 dB of attenuation
Final Test

Which solution should be adopted?

- Zero noise achieved with the following combination:
  
  Input filter, common mode capacitor filtering and analog part shield
Final Noise Reduction Result

- FFT with no filtering technique applied
Final Noise Reduction Result

- FFT with input filter, CM capacitor and analog part shield
Summary

What have been done:

- Python tool for UQDS configuration and noise analysis (communication module, FFT, peaks detection)
- Investigation on noise reduction techniques:
  - Zero-noise achieved with shielding and filters

What should be done:

- Integrate the solution into the design of next generation QDS channel
Thank you for your attention