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LDaC: A Wideband Loran Data Acquisition System

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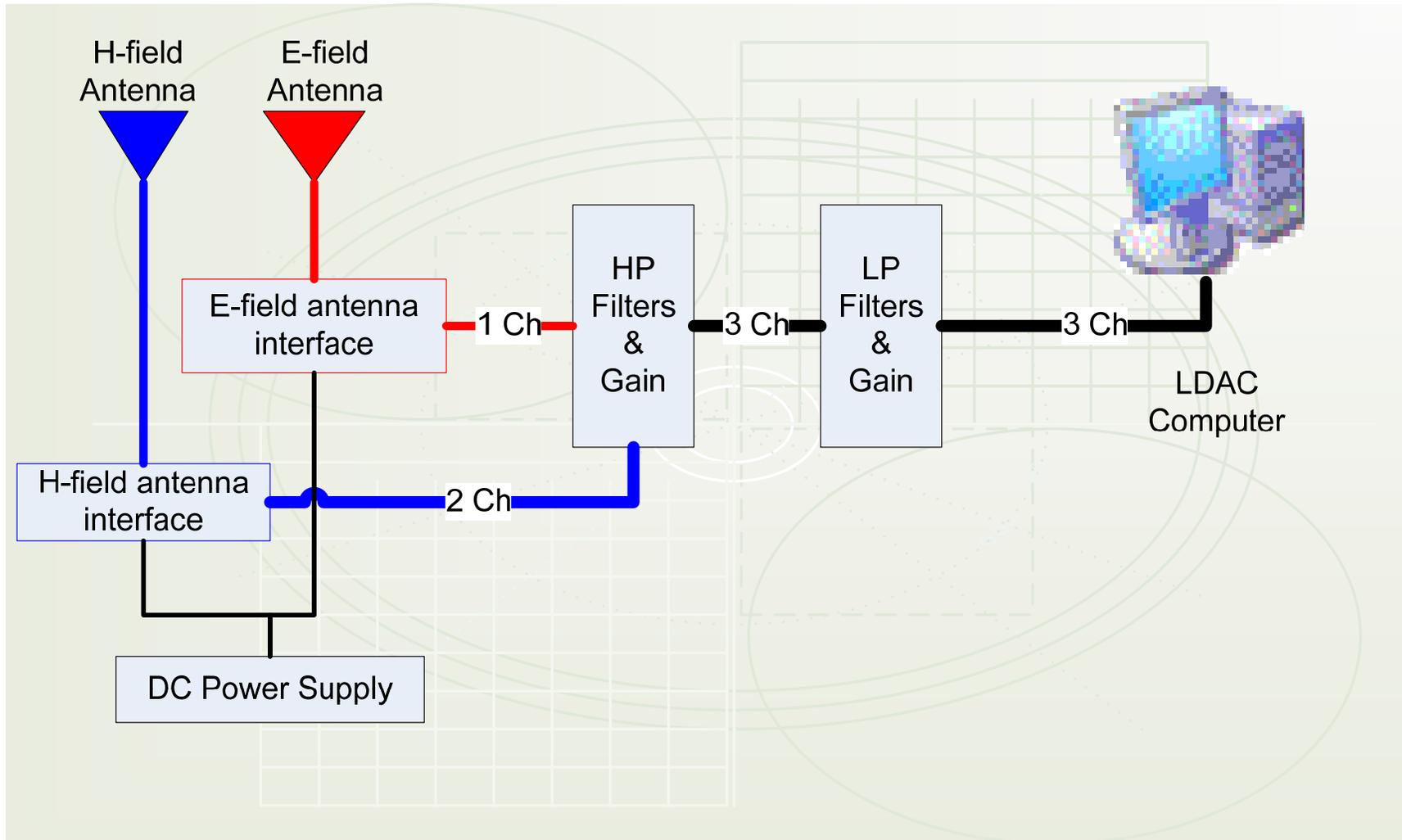SCIENCE AND TECHNOLOGY

Goals

- Work for FAATC, subcontract through AMA

- Design/build wideband data acquisition system for Loran

  - >30kHz bandwidth

  - Multi-channel

  - Low cost

  - Open data format

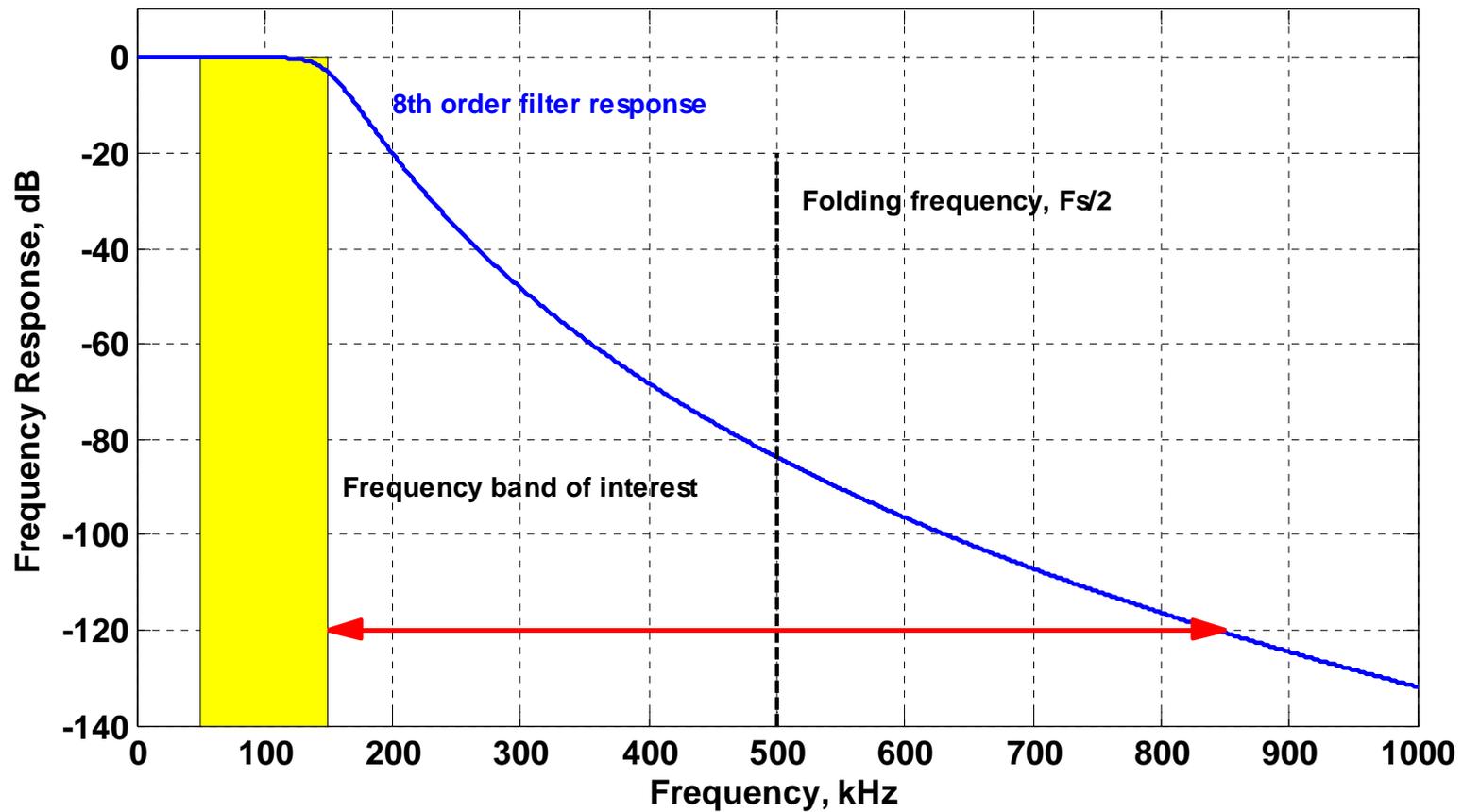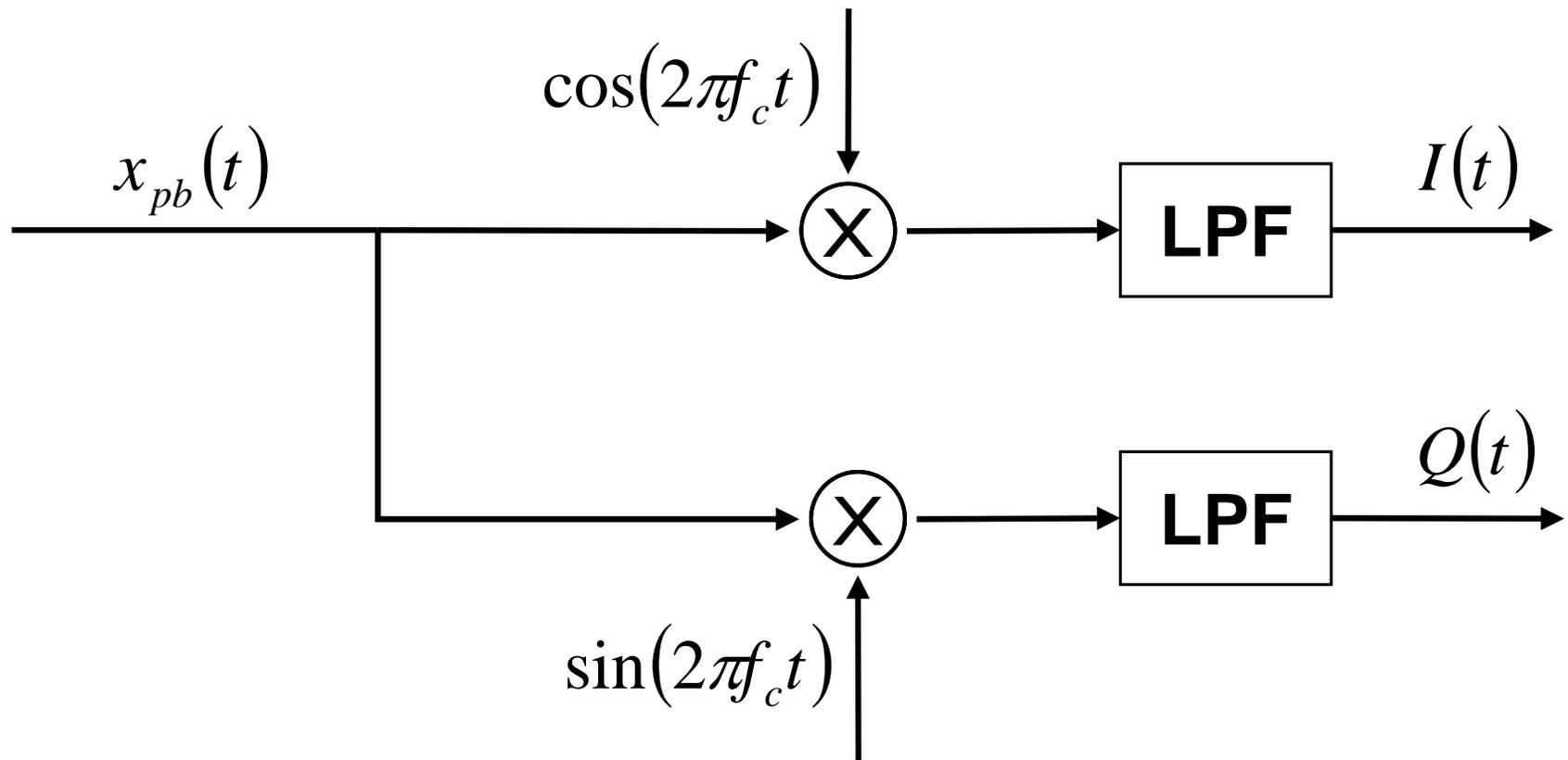 - System design freely available to Loran community

General Design

H-field
Antenna

E-field
Antenna

E-field antenna
interface

1 Ch

HP
Filters
&
Gain

3 Ch

LP
Filters
&
Gain

3 Ch

LDAC
Computer

H-field antenna
interface

2 Ch

DC Power Supply

8th Order LP Filter Response

8th order filter response

Folding frequency, Fs/2

Frequency band of interest

Frequency Response, dB

Frequency, kHz

I&Q Demodulation then decimation

Down-conversion Optimization

- I&Q demodulation requires a large number of multiplications (2 per data sample) plus the calculation of the sine and cosine terms
- Low-pass filtering adds additional multiplications and additions (filter order multiplications and additions per data sample)
- Also, the filter has a delay equal to the number of taps or filter coefficients
- Make use of the following facts to reduce the number of calculations, reduce complexity, and improve performance
  - data will be decimated by a factor of 10 so only every 10th sample needs to be calculated
  - If the filter length is equal to the decimation then the filter delay products will not need to be saved due to the decimation
  - At 1MHz sampling and 100kHz carrier, cosine, sine are periodic every 10 samples so only 10 sine, cosine coefficients are needed

9th Order FIR Filter Response
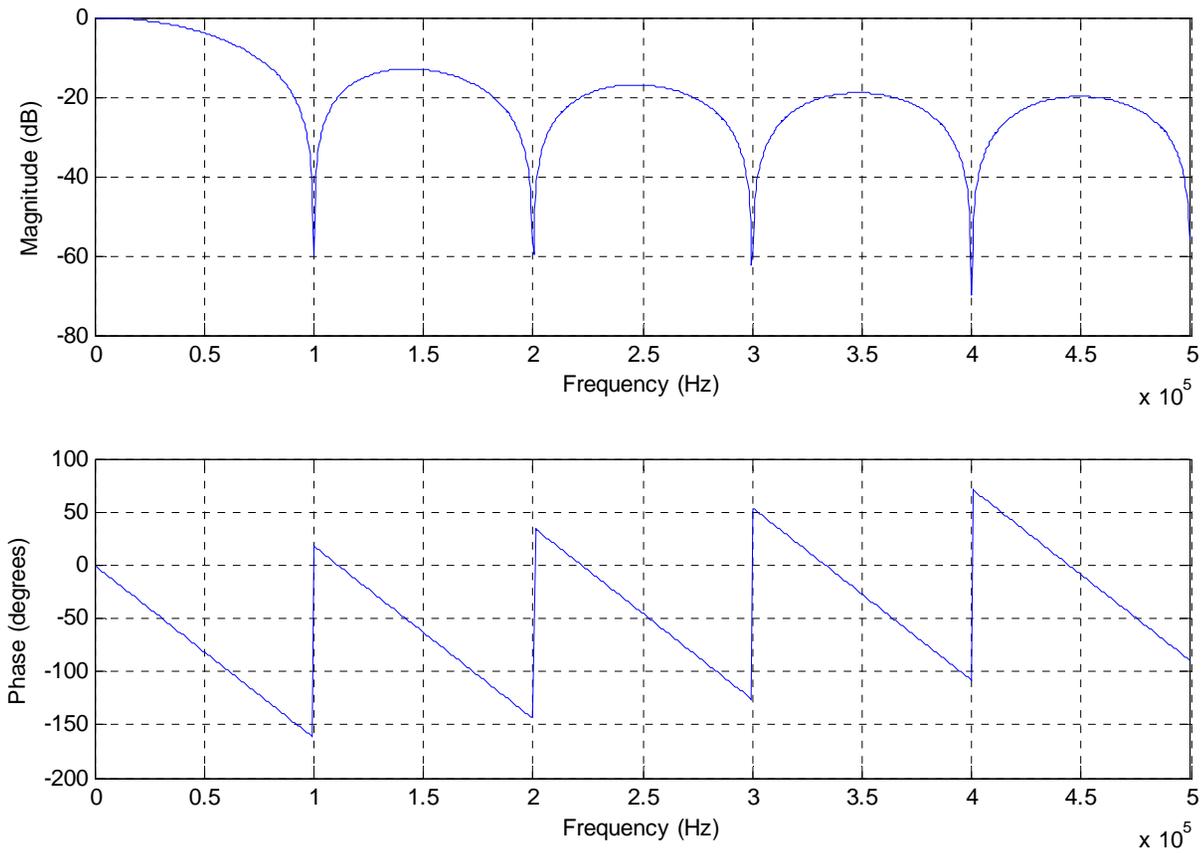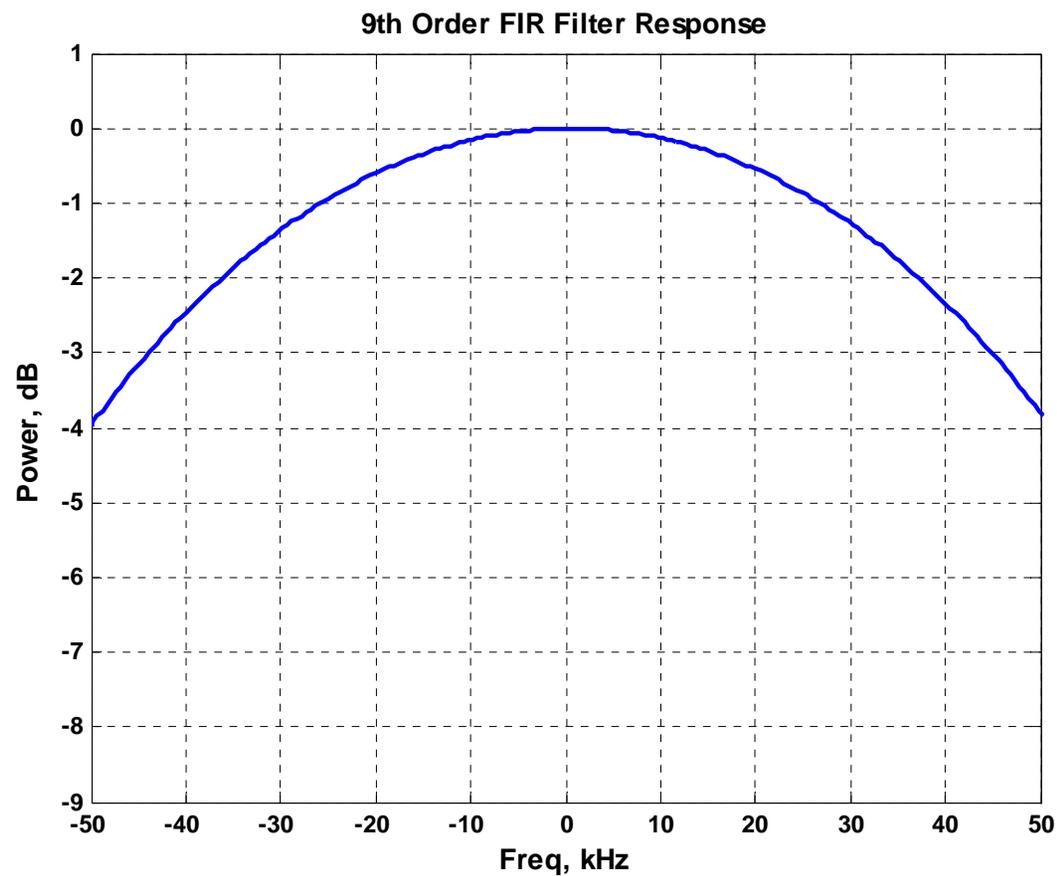
Filter magnitude response over -50 to 50 kHz region

Final System

E-field antenna

H-field antenna

H-field antenna interface

LDaC Computer
Adlink PCI-9812 A/D

E-field antenna interface

E-FIELD FILTER

H-FIELD FILTER

HP filters and gain

LP filters and gain

LDaC Software

File Format

Table 1. LDaC File Format for One Channel of Data.

Channel	Data	Size	Type
One	I	100,000	16 Bit Integer
One	Q	100,000	16 Bit Integer

Table 2. LDaC File Format for Two Channels of Data.

Channel	Data	Size	Type
One	I	100,000	16 Bit Integer
One	Q	100,000	16 Bit Integer
Two	I	100,000	16 Bit Integer
Two	Q	100,000	16 Bit Integer

Table 3. LDaC File Format for Three Channels of Data.

Channel	Data	Size	Type
One	I	100,000	16 Bit Integer
One	Q	100,000	16 Bit Integer
Two	I	100,000	16 Bit Integer
Two	Q	100,000	16 Bit Integer
Three	I	100,000	16 Bit Integer
Three	Q	100,000	16 Bit Integer

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Questions?

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