

Formation of sub-nanosecond UWB impulse using sharp edge generator and planar antenna

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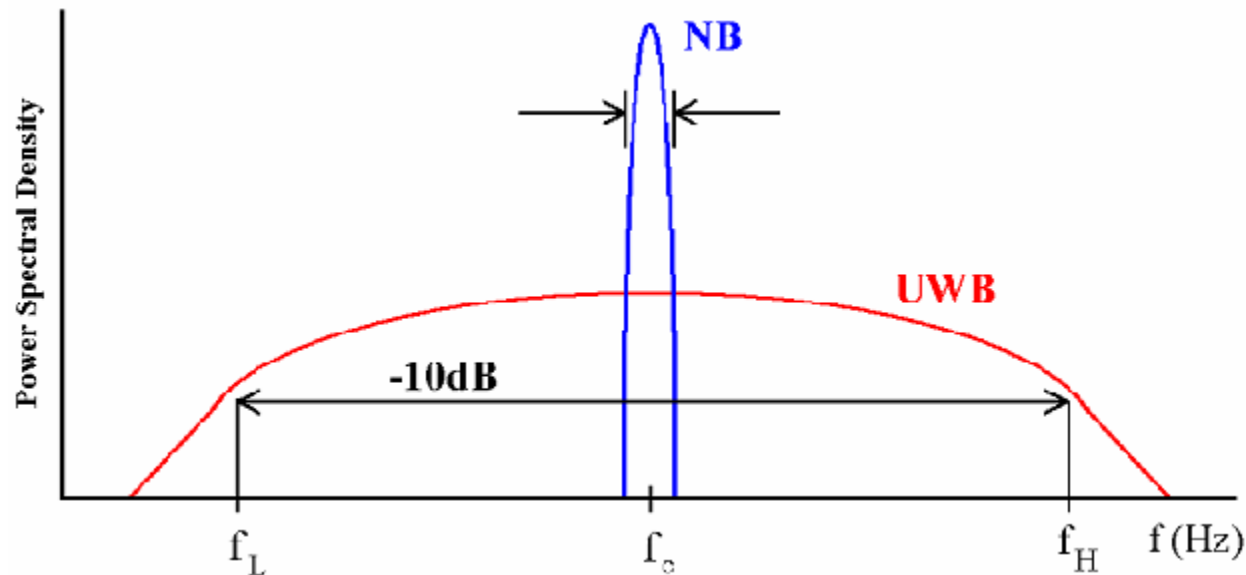
Electronics 2010, May 18-20, KTU, VGTU Lithuania

Outline

- Introduction
- Motivation and goals
- UWB pulse generation
- UWB antennas
- Experimental setup and results
- Conclusions

What is UWB?

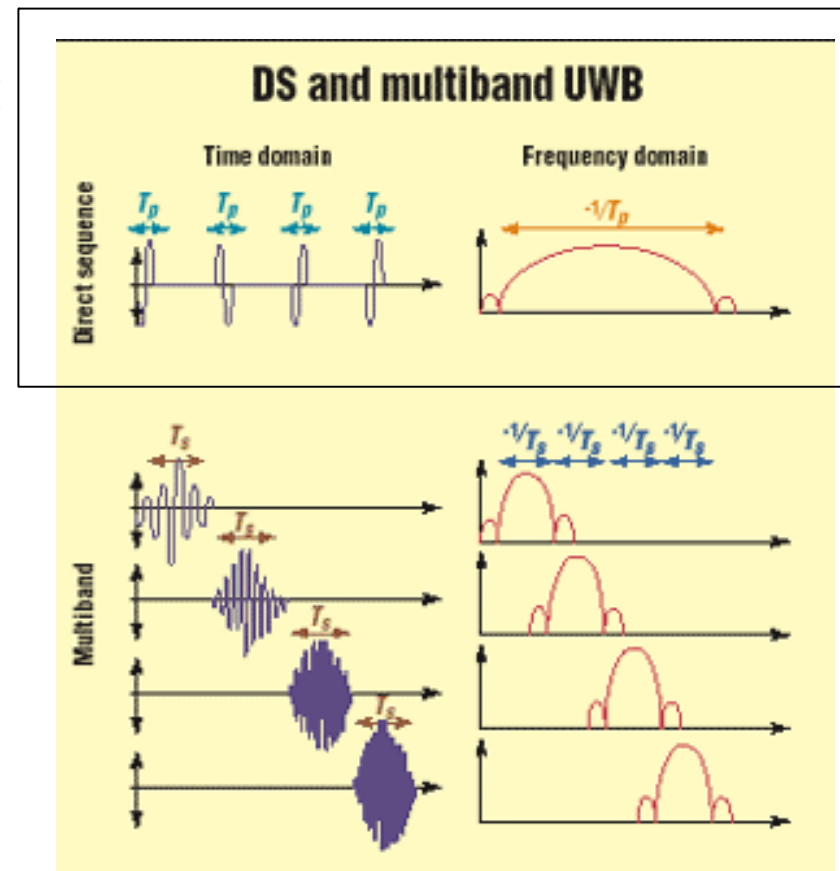
Fractional bandwidth (measured at the -10dB $(f_H - f_L)/f_c$, $> 20\%$ or total BW > 500 MHz.



FCC/ITU-R Definition UWB

UWB types:

- Direct sequence (DS) UWB: using the whole available spectrum
 - transmitting very short pulses (impulse radio)
- Multiband: dividing the available spectrum into several bands, each having a minimum of 500 MHz of bandwidth.



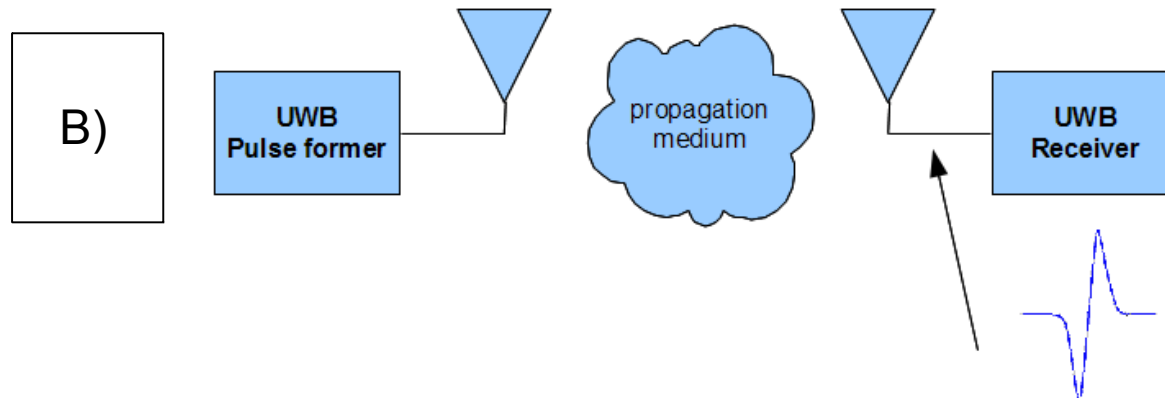
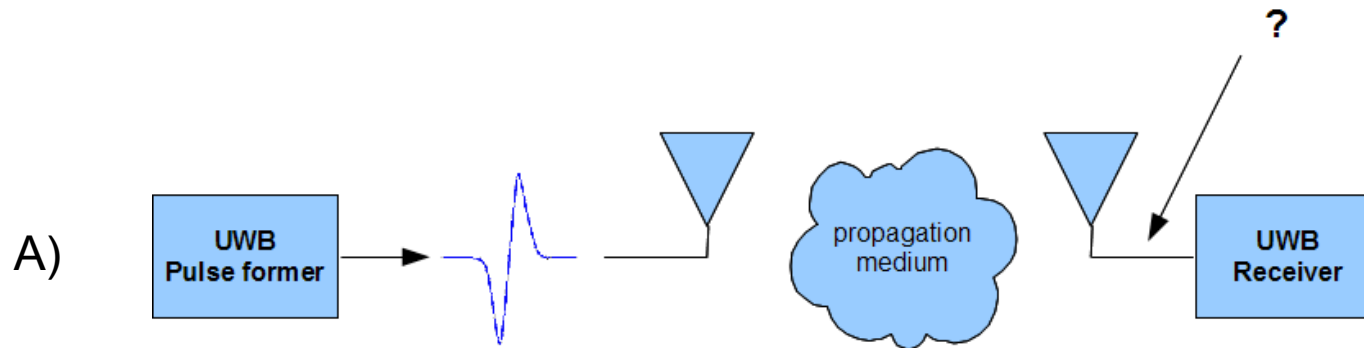
Pulse based UWB. Why?

- Advantages
 - Mixed localisation and data transfer possibility
 - Simple transmitter side design
 - Noise-like spectrum
- Applications
 - Wireless communication systems
 - Road information systems (Car <-> Road signs)
 - Non-contact medical examination
 - Localisation, positioning

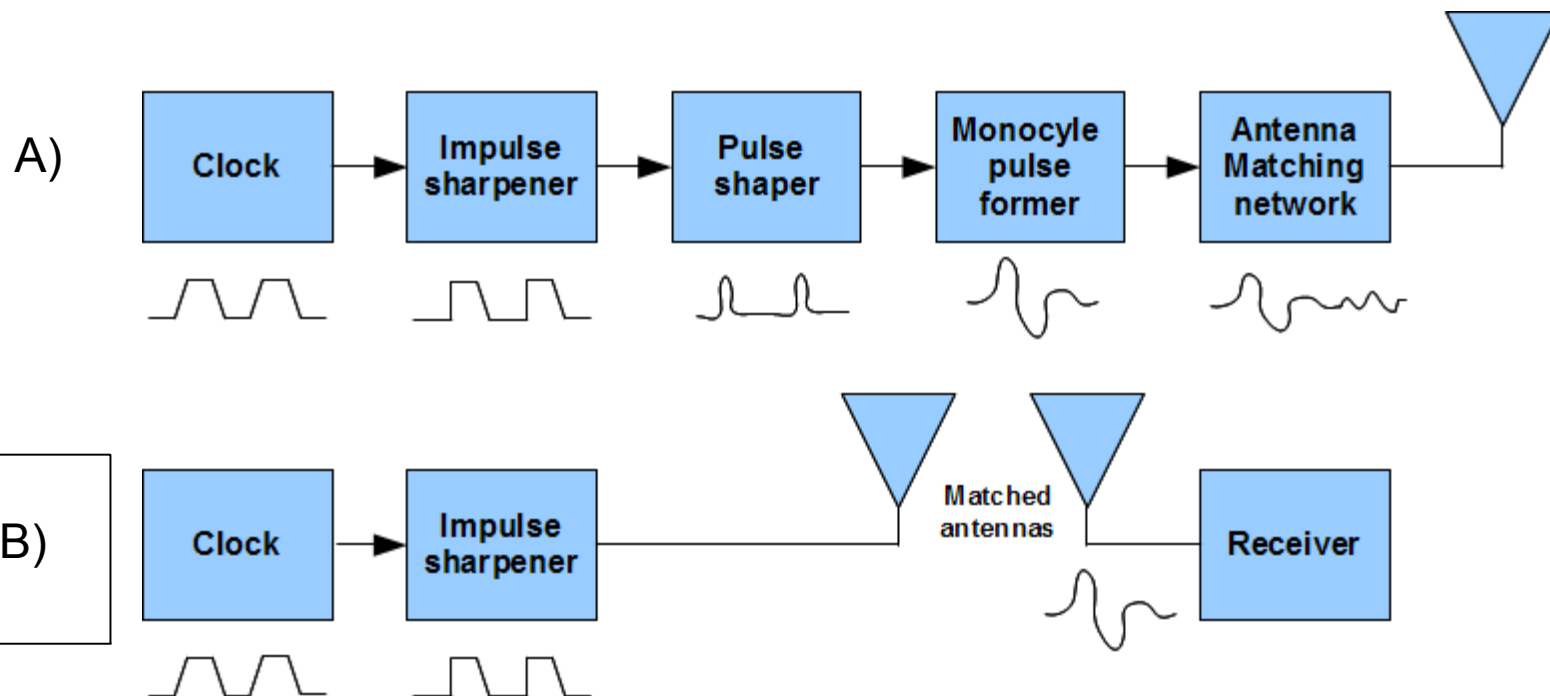
Motivation and goals

- To gain experience/knowledge in design of wideband/microwave systems
- **UWB impulse generation**, antenna, localization and data transfer **experiments**
- Practical goals:
 - Universal UWB antenna test system
 - Ground penetrating radar (GPR)
 - Through wall imaging device (TWI)

Different approaches



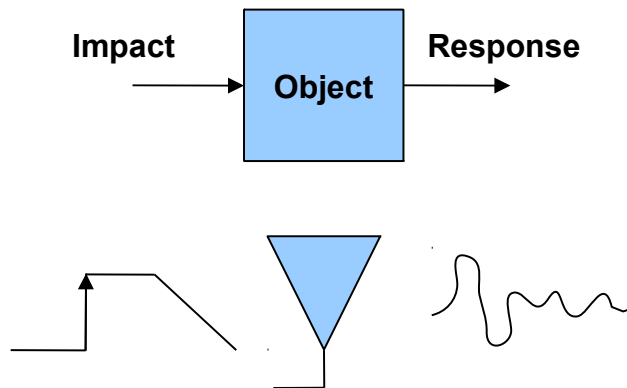
Different approaches



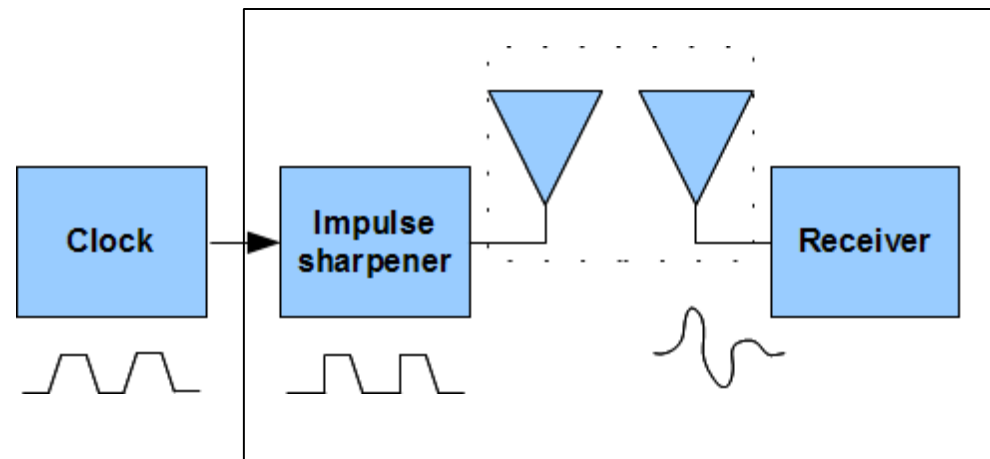
UWB pulse generation

Antenna is a part of UWB pulse generator!

Principle



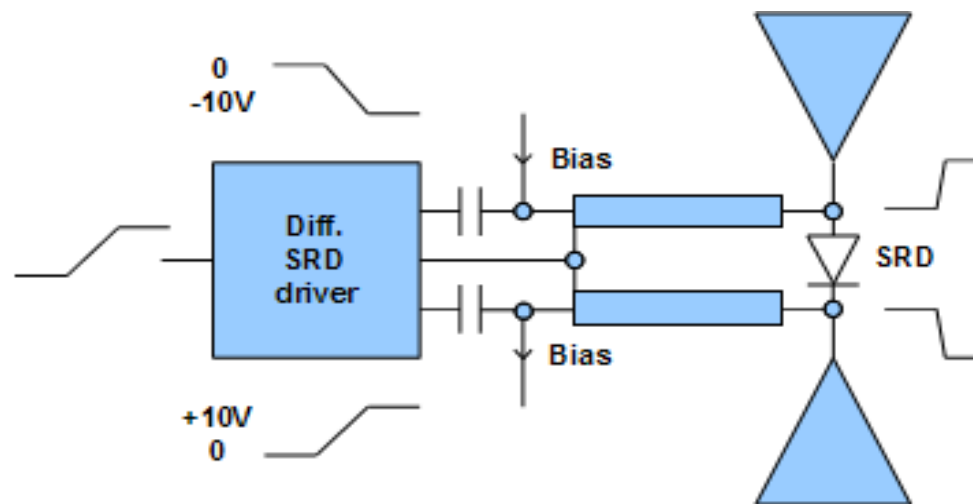
Test system



UWB impulse is formed as an antenna step response

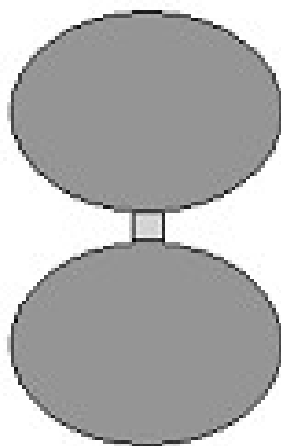
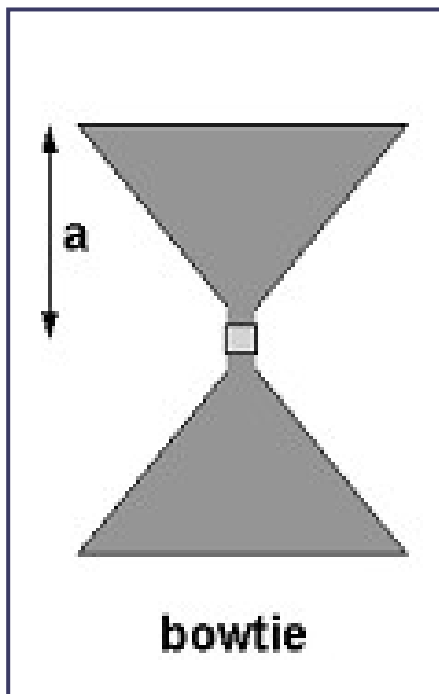
UWB pulse generation

A fast rise time differential pulse generator in combination with a Bow-Tie type antenna on a lossy dielectric

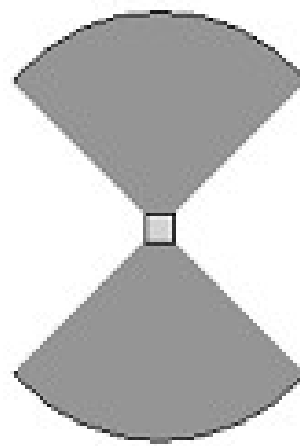


A Step Recovery Diode (SRD) is used as a differential pulse sharpener

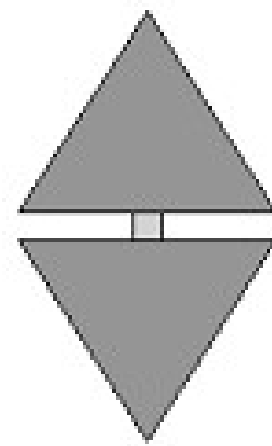
Typically used antennas



elliptical



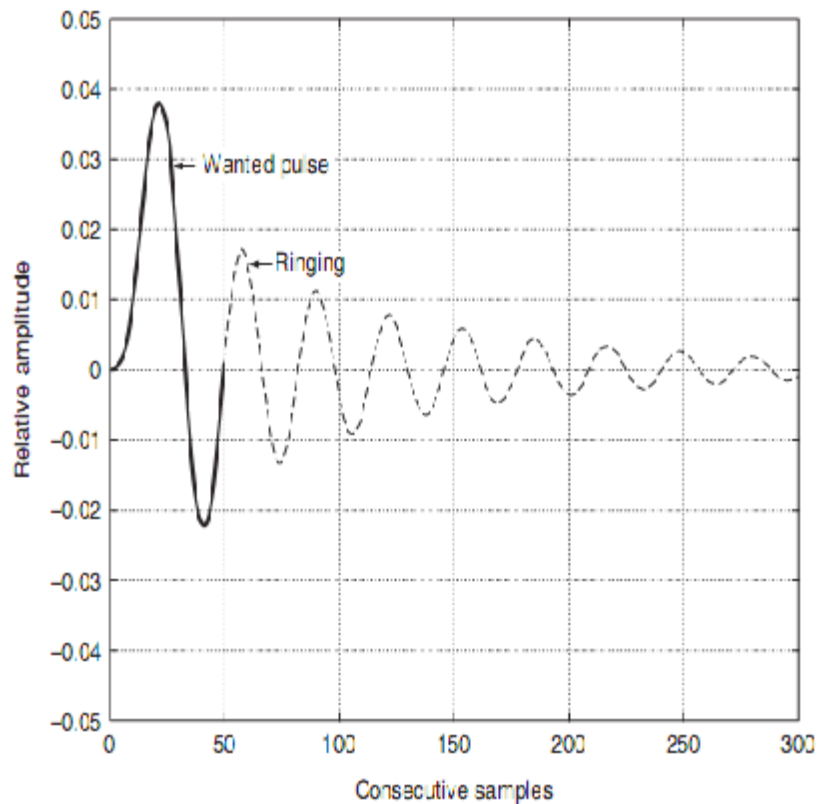
fan



diamond

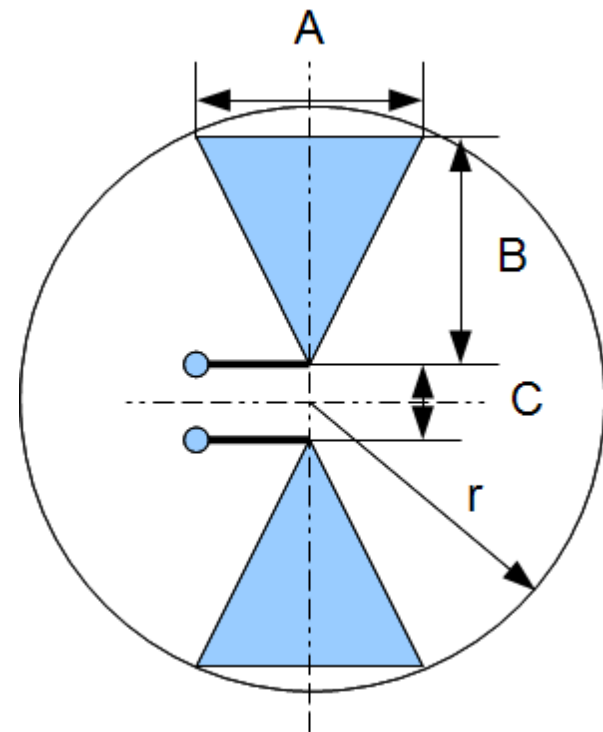
UWB antenna requirements

- Small size (for embedded devices)
- Effective energy transfer
- Linear phase delay
- Wide frequency range impedance matching
- Short step response (radar applications)
- Non-resonant (multi resonant)
- $0 < Q \text{ factor} < 1$

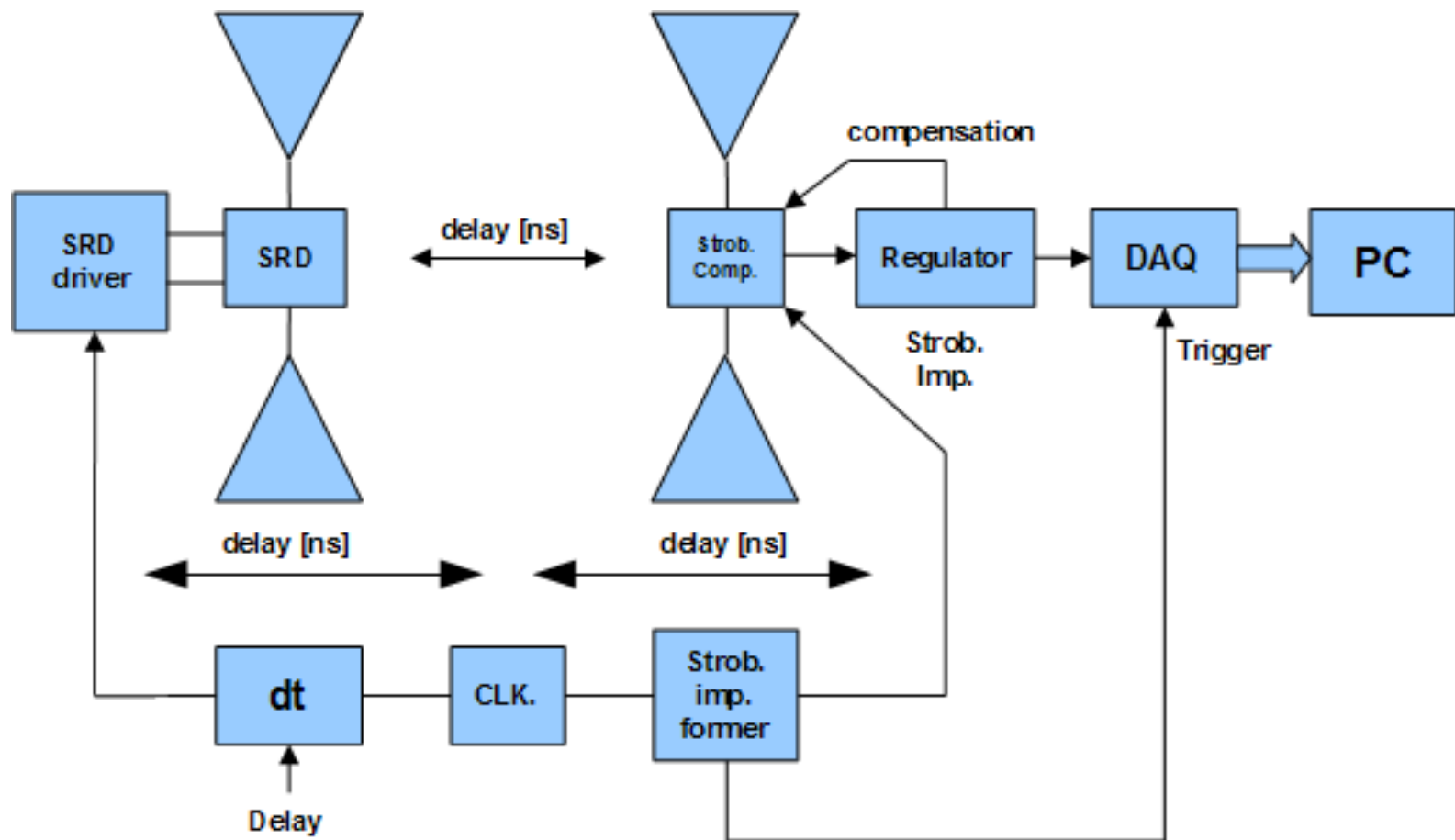


Antenna couple used for experiments

- A Bow-Tie type antenna is used
- Antenna is made on a lossy dielectric material



Experimental setup

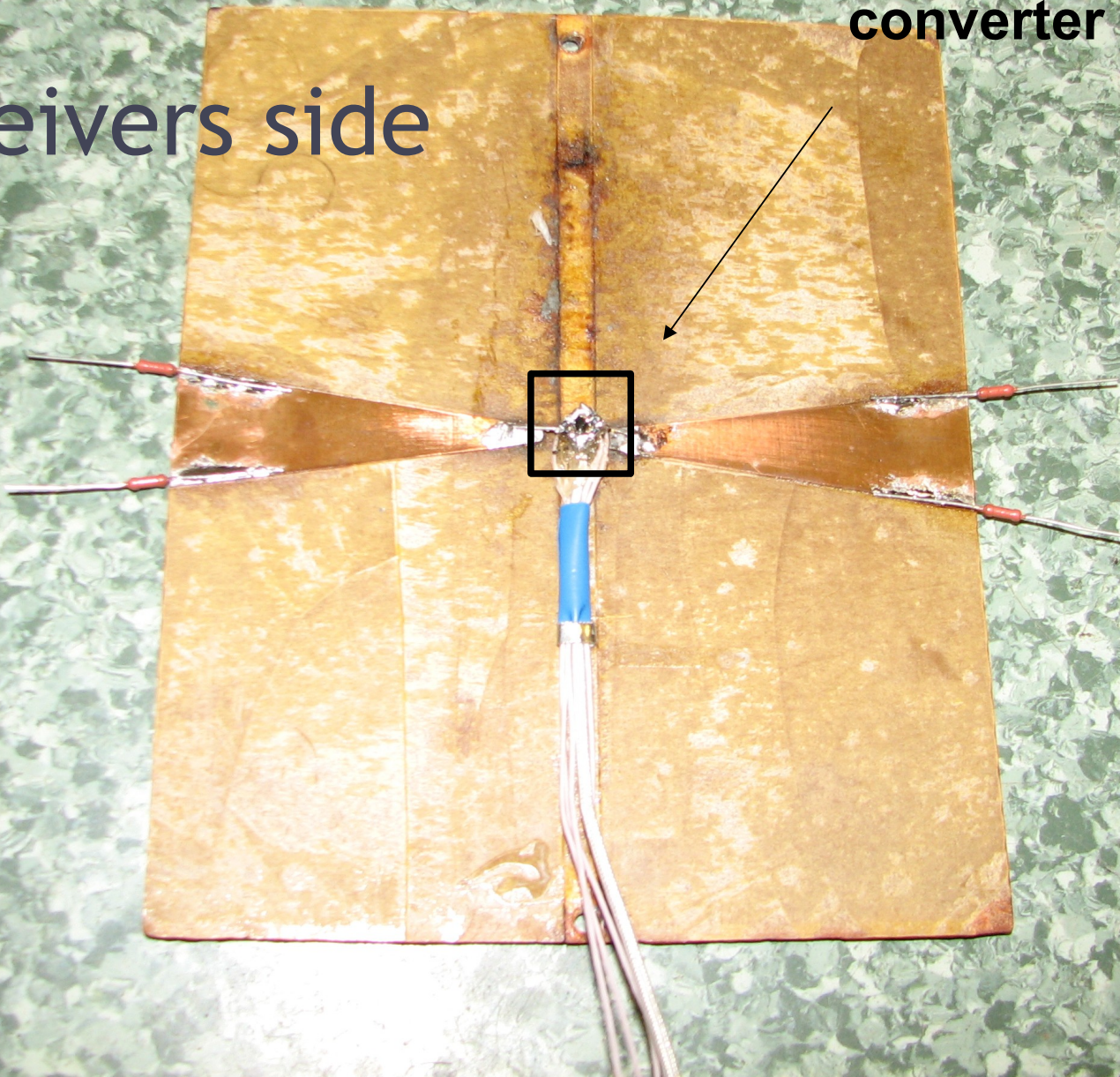


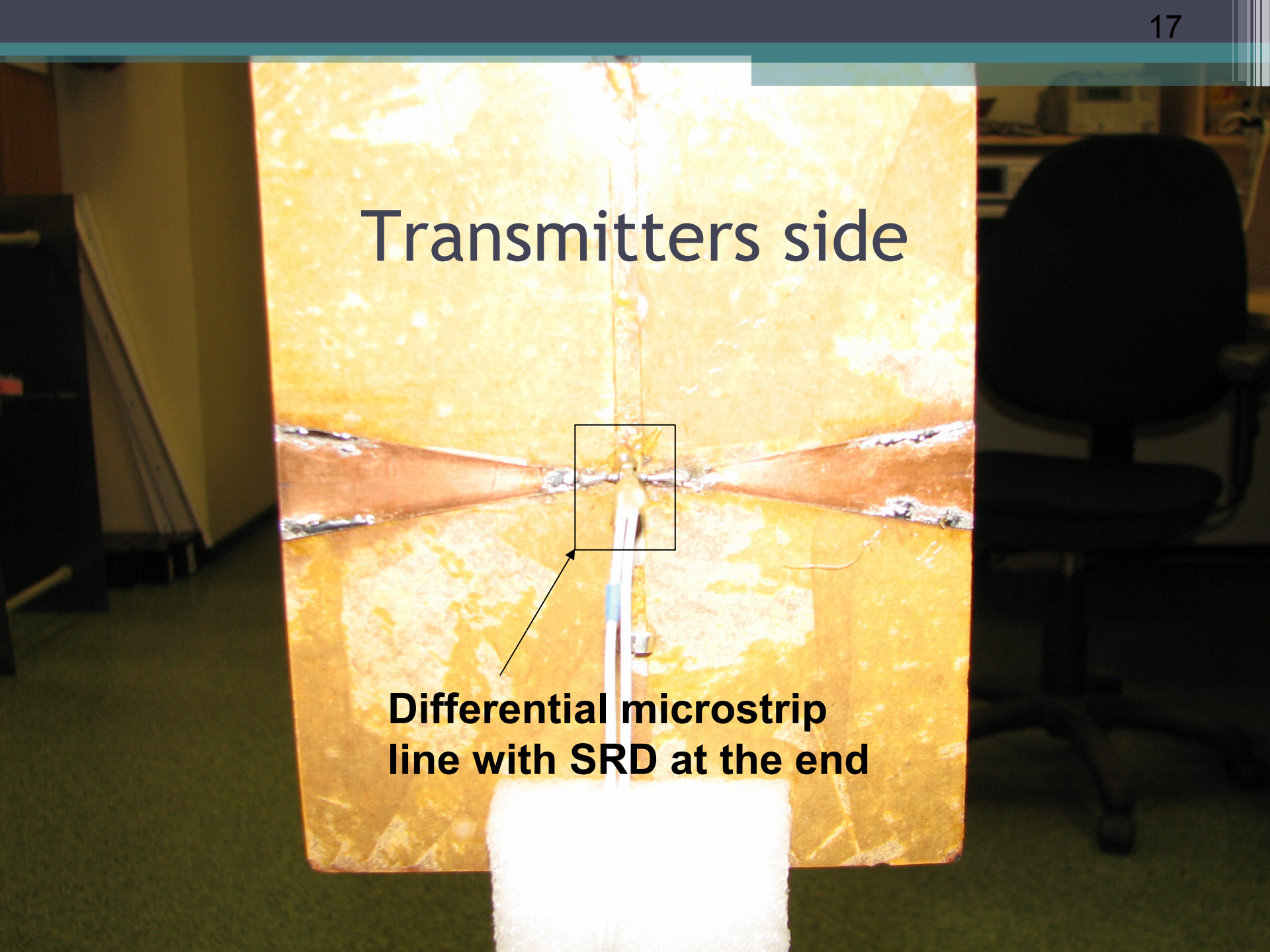
Real-world look



Receivers side

Stroboscopic
converter



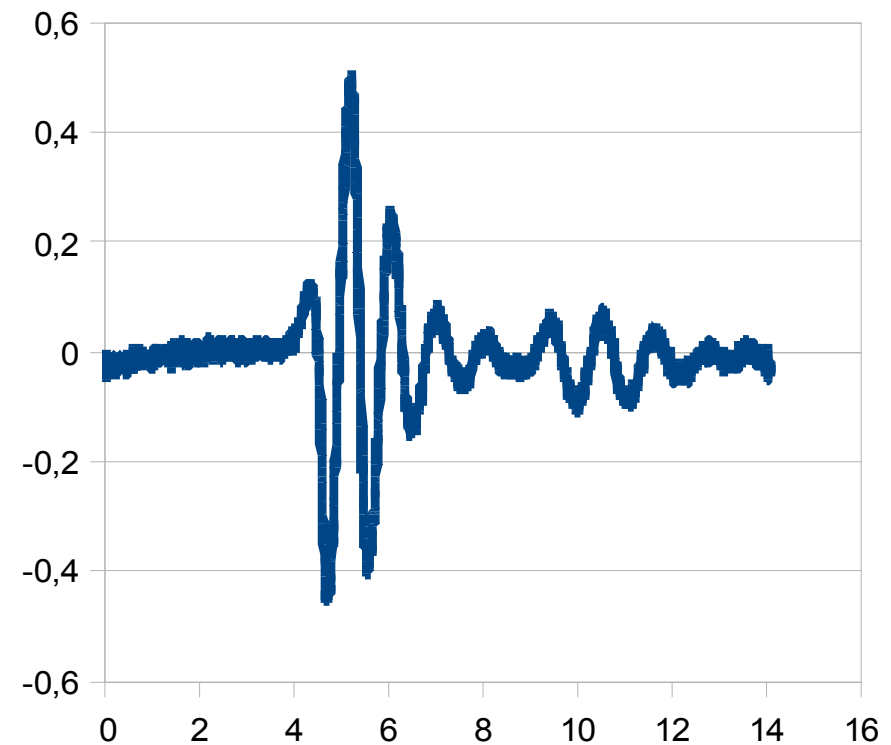
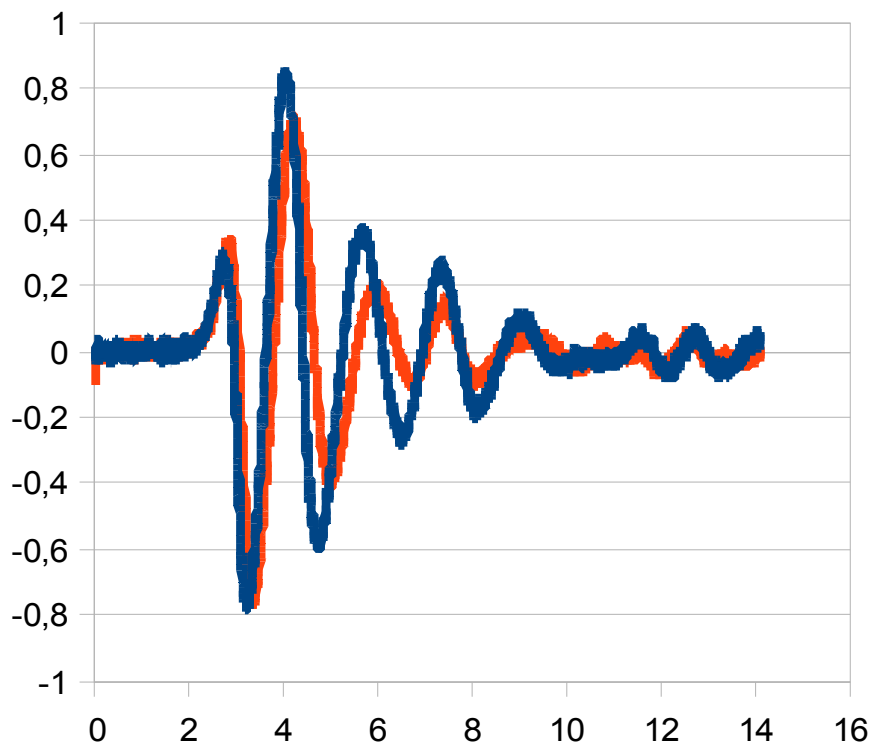


Transmitters side

**Differential microstrip
line with SRD at the end**

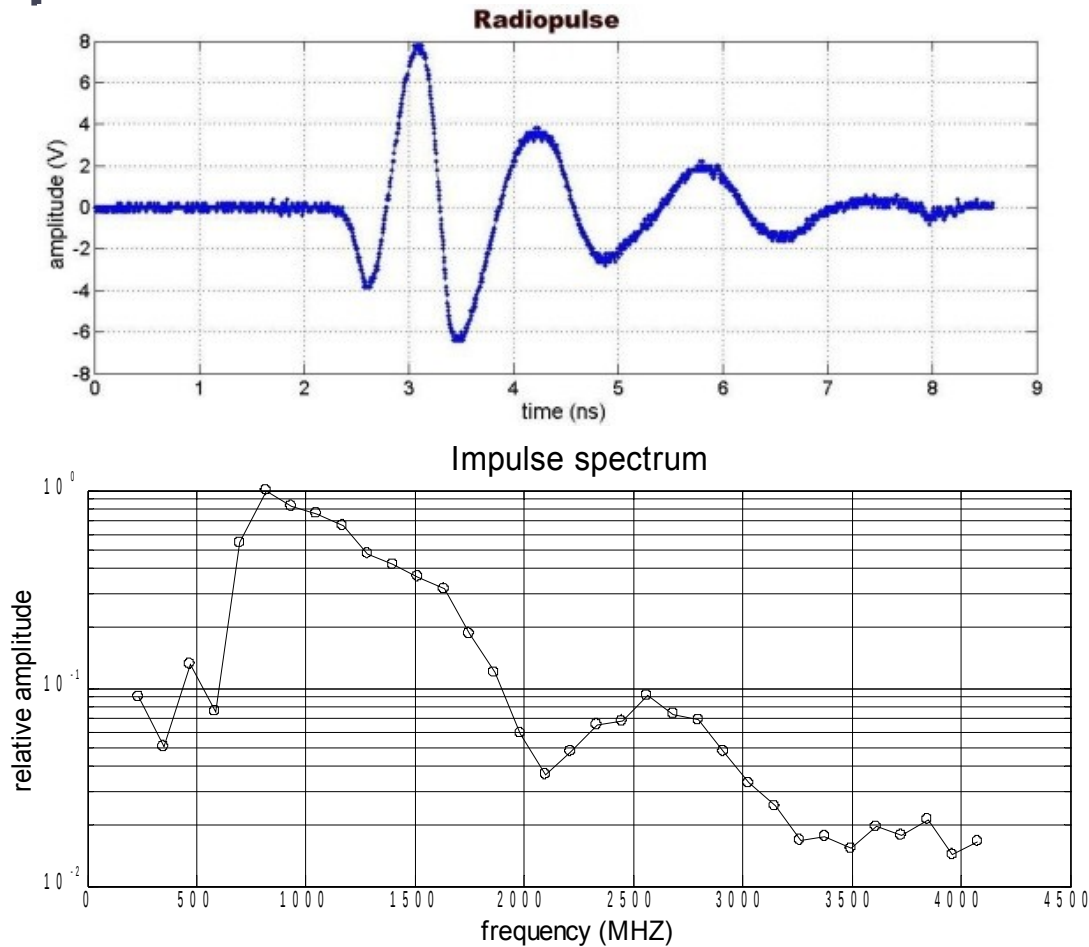
Measurements

Two types of antenna



Time [ns]

Pulse spectrum



Conclusions

- Experimental setup is developed for further research
- Obtained first results confirms the correctness of the approach
- Some experience in high frequency design is gained

Questions?



Research is supported by ESF grant:

2009/0219/1DP/1.1.1.2.0/APIA/VIAA/020

R&D Center for Smart Sensors and Networked Embedded Systems

