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Selected projects, overview

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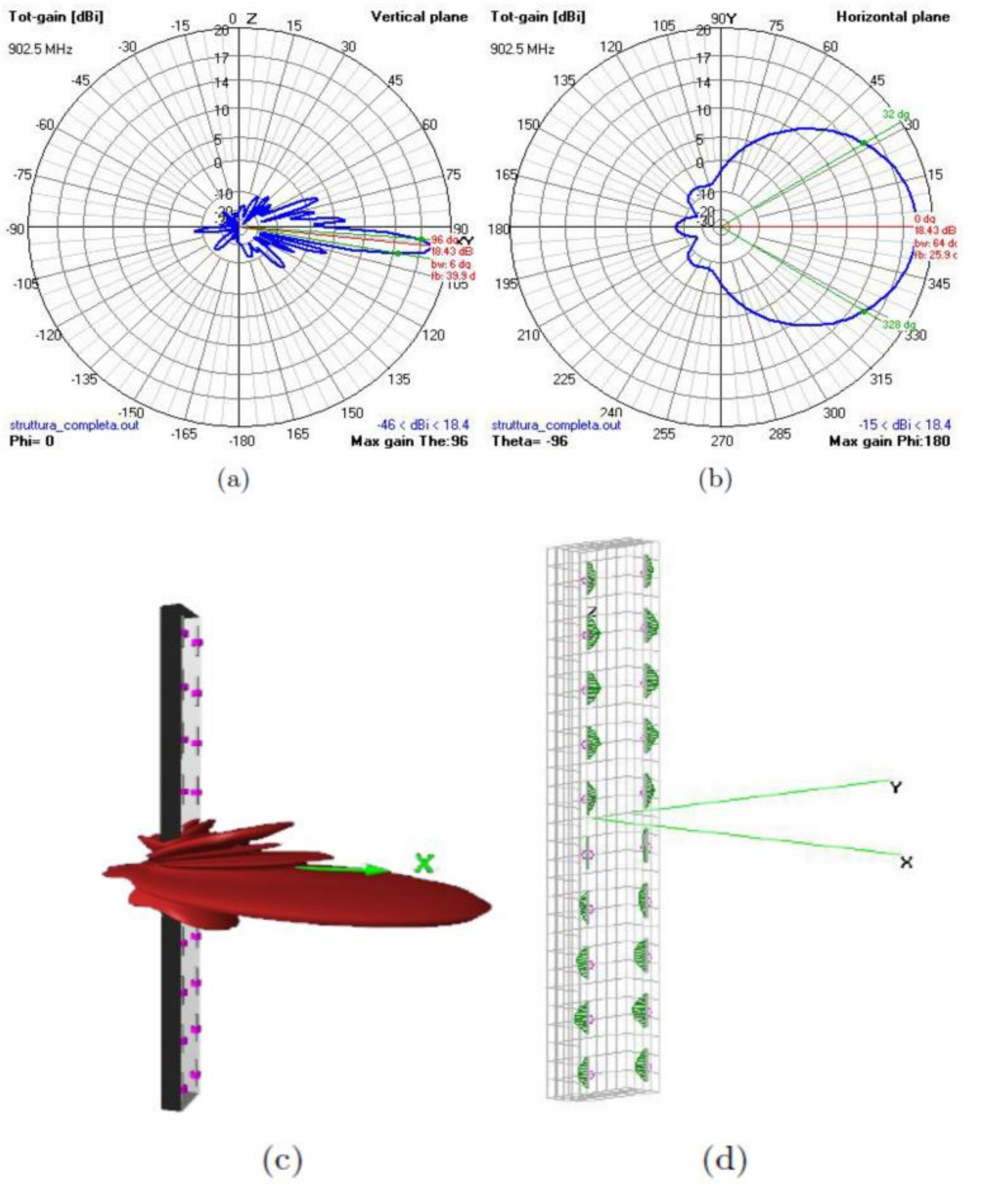
Design of GSM array at 902.5 MHz using method of moments on 4NEC

Objective of the project was to find the geometrical and electrical parameters and the optimal number of elements necessary to satisfy the design spec. Physical constrains of the max array width, haight and depth were taken into account.



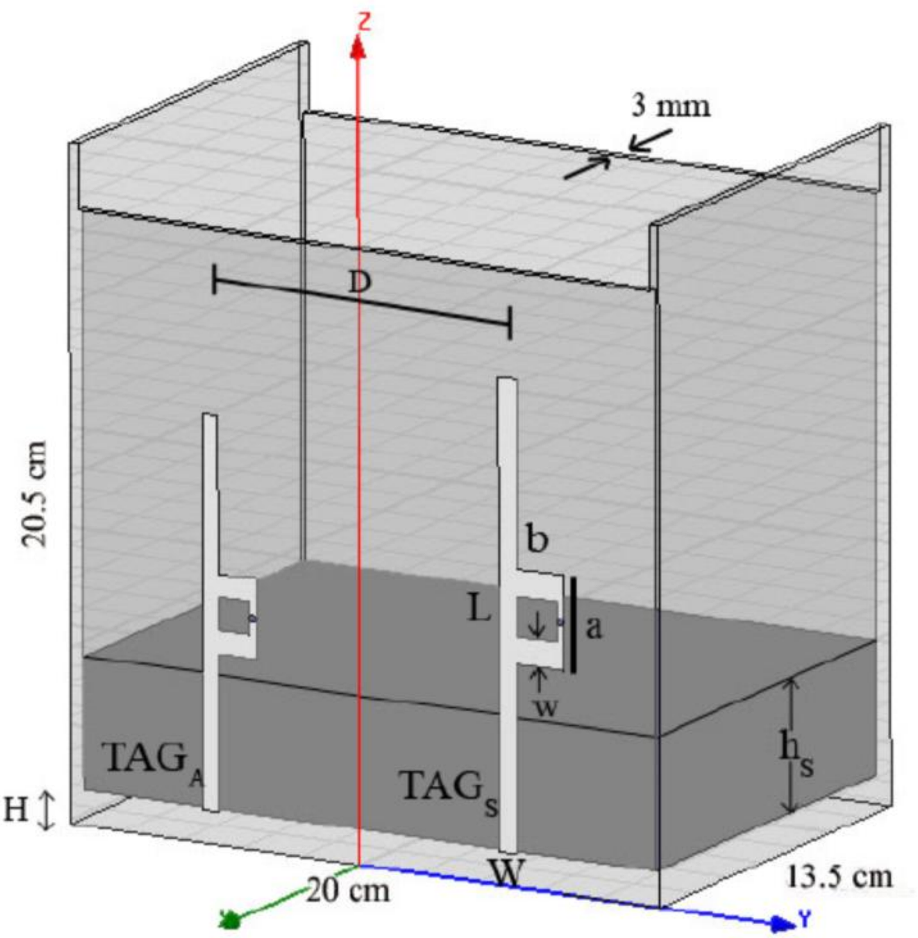
Radiation diagrams of a) Vertical plane and b) horizontal plane for an array uniformly excited. Tridimensional representation of c) the array antenna pattern and d) the array element position in the radome.

Specs vs Simulation results

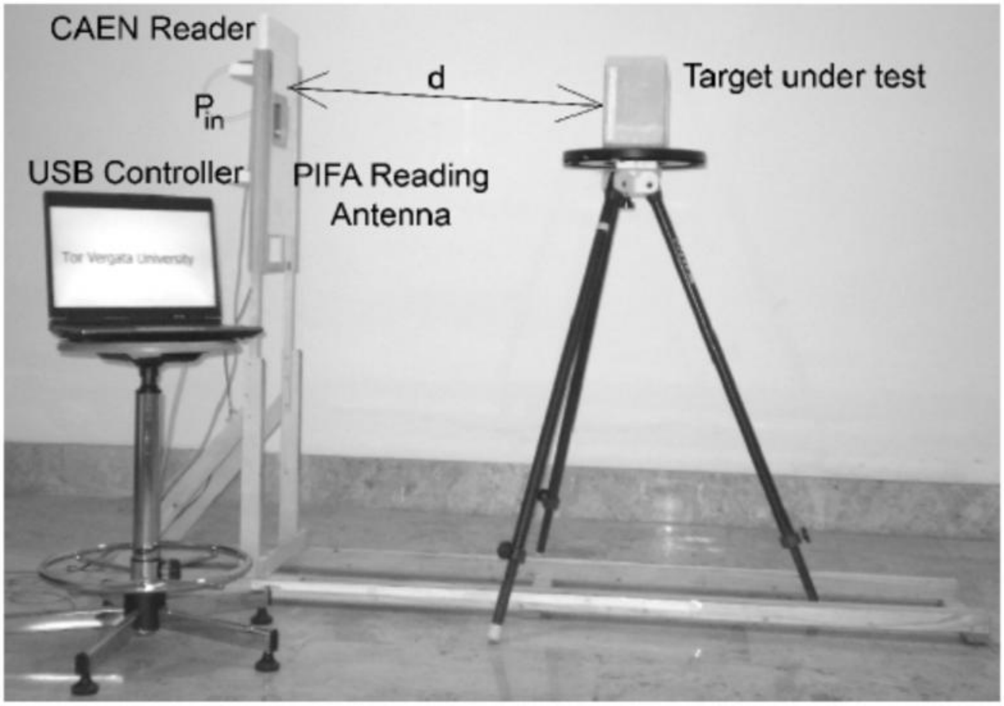
	Specification	Simulation results
Front to back ratio	>25 dB	26 dB
Gain	18.5 dBi	18.45 dBi
Horizontal 3 dB beam width	65 deg	64 deg
Vertical 3 dB beam width	6.5 deg	6 deg
Beam tilt	6 deg	6 deg
VSWR ratio	<1.3	1.03
Input Impedance	50 Ohm	50 – j1.48 Ohm

RFID antenna design (HFSS) and measurement setup realization (C++) for passive sensing of objects

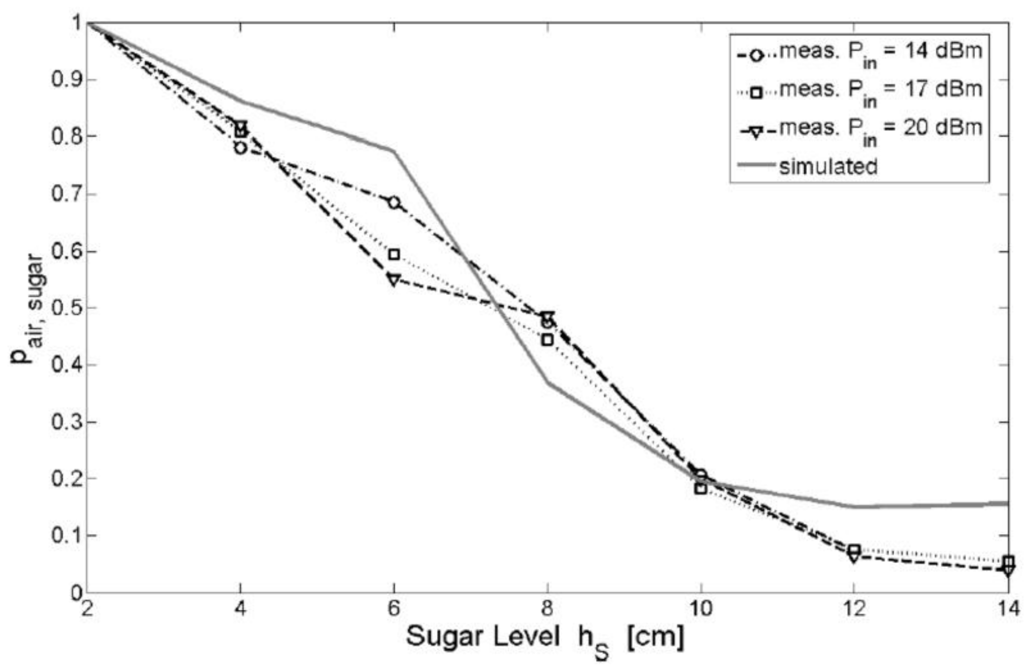
A passive UHF RFID system has been used as a self-sensing devices able to sense the geometrical and physical variation of a tagged object without the use of any specific sensor.



Passive tags to sense the level of sugar powder within a perspex box. Geometrical size (in [mm]): H=12, D=95; TAGS L=142.8, W=6, a=28.8, b=15.6, w=8.4; TAGA L=119, W=5, a=24, b=13, w=7.



Measurement set-up comprising a low-range reader, a PIFA linear polarized antenna and a computer controller.



Sugar box: Normalized simulated and measured backscattered power for the multi-chip system which is monitoring the sugar level inside the box. The measurements have been repeated for some input powers.

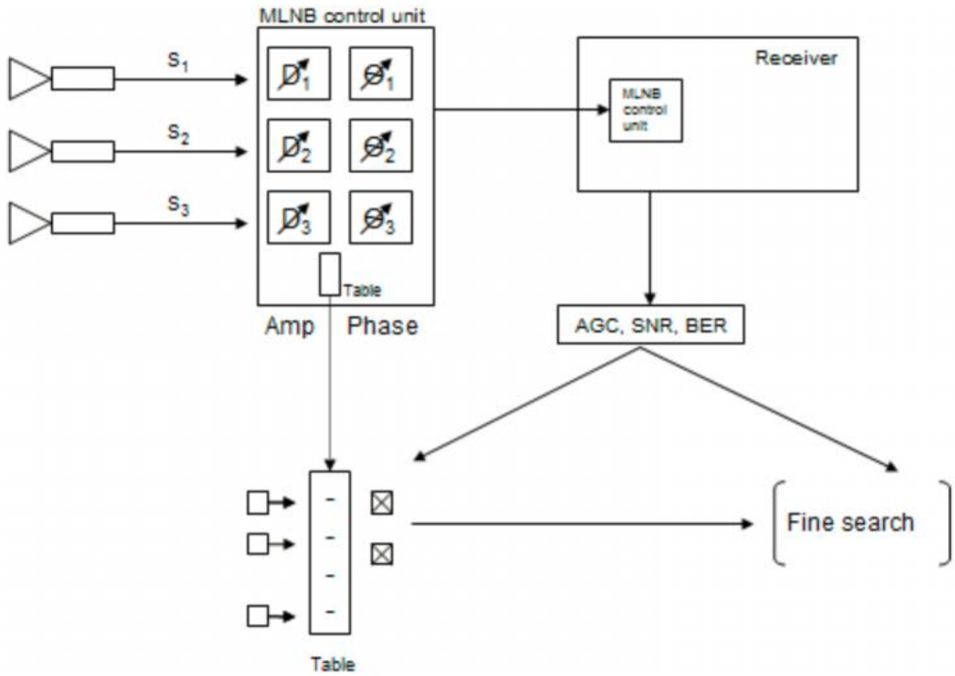
MULTI INPUT LNB – DEMONSTRATOR OF A REFLECTOR FEED ARRAY RECEIVER FOR SATELLITE BROADCAST RECEPTION

This antenna concept is based on a reflector feed array reception antenna for satellite Ku-band broadcast reception. In specific circumstances the Ku-band broadcast reception can be subject to interference form adjacent satellites give the customer demand for compact and easy to install reception antennas suitable for direct-to-home (DTH) reception. In this context, a compact 45cm Ku-band reception antenna with coherent 3-element feed has been defined according to specific reception system requirements for broadcast system and setup and tested in the context of the ESA ARTES 5.2 Project.

The demonstrator consist of an antenna prototype for coherent reception of 3 feeds and a beamforming chipset operating in L-band and based on an NXP SiGe technology and chipset processes as well as beamforming control software. Antenna measurements in a compact antenna test range (CATR) as well as over satellite demonstrate the achievable reception gain re-configurability which permits to adapt the broadcast antenna front end to different reception scenarios.

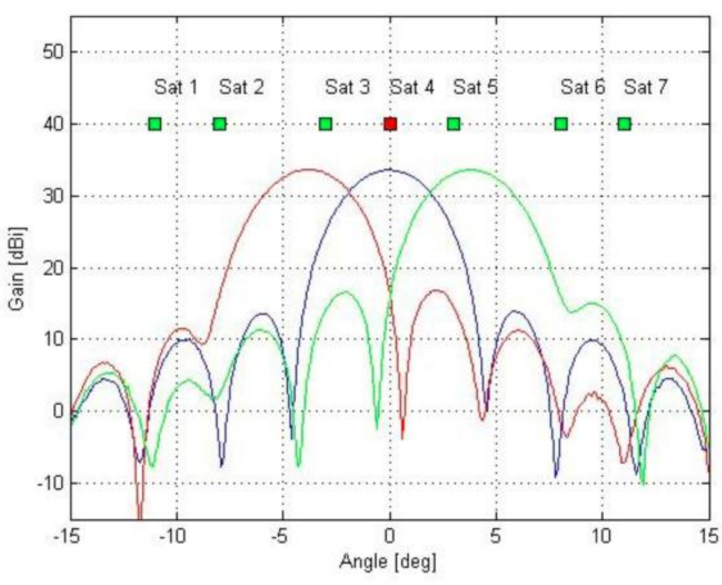
The demonstrated benefits to satellite broadcast reception are to first provide an antenna system to mitigate adjacent satellite interference via reconfigure antenna gain nulling, second provide an antenna system for reception of any desired satellite signal within a given azimuth opening angle as well as third provide assistance at installation via an auto-fine-pointing procedure.

My role consisted, among others, in designing the control unit for dynamically reshaping the antenna array pattern to enhance the signal from one designated satellite and suppress the interference from the others nearby.



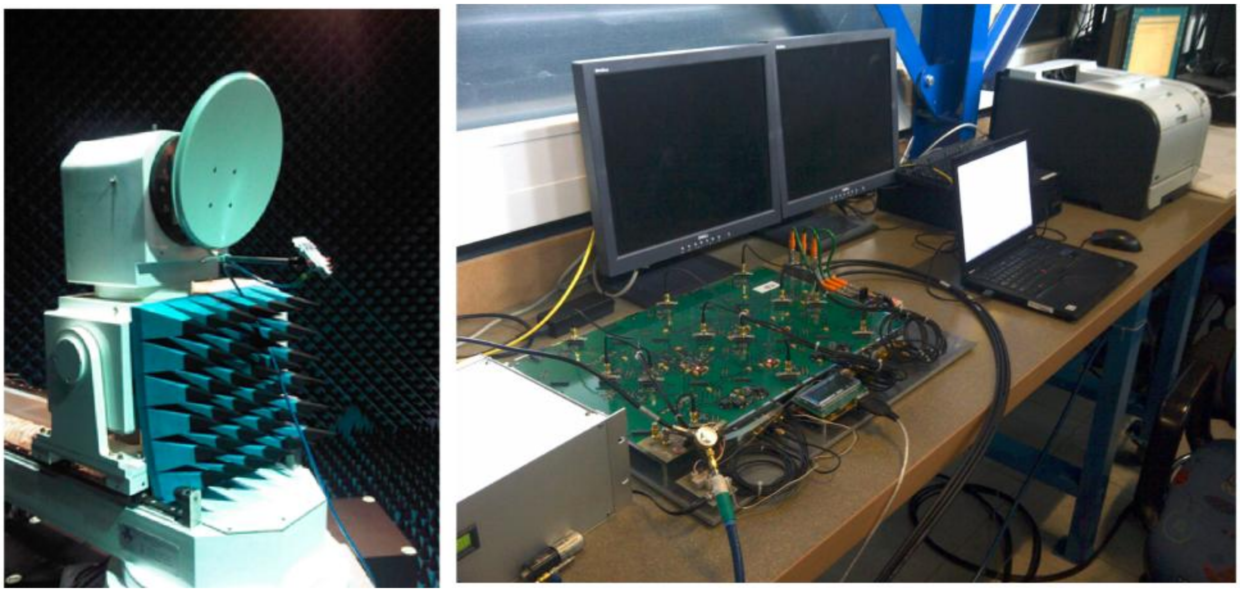
Setup of the beamforming demonstrator. Illustration of the beamforming setup with the receiver and signal quality metrics (AGC, SNR, BER) for fine pointing.

Simulations

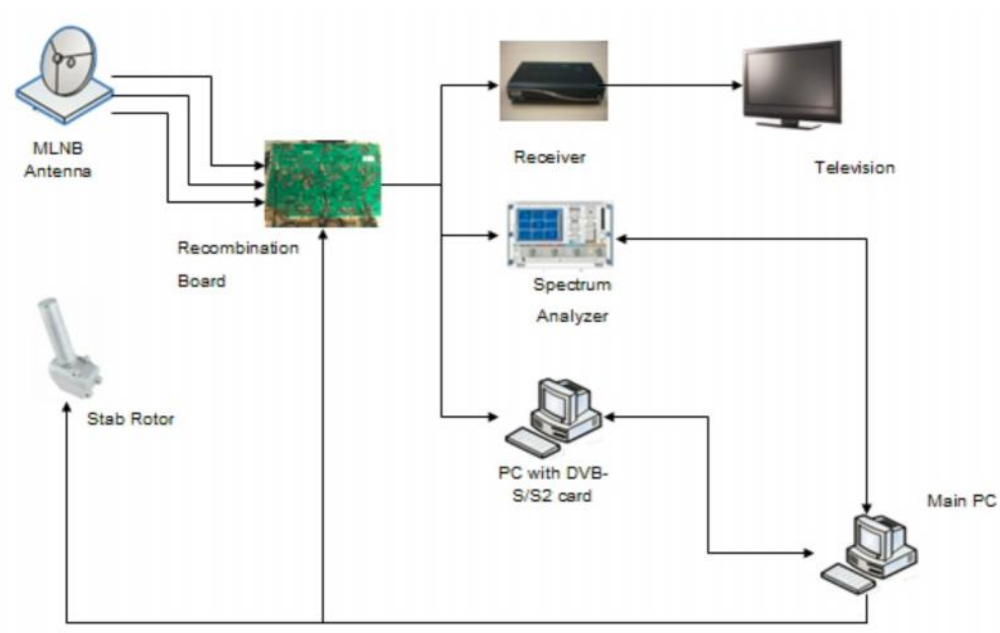


Azimuth cut of the simulated beam gain patterns for the prototype and illustration of a possible reception scenario with Sat3, Sat4 and Sat5 within the field of view of the receiver.

Setup

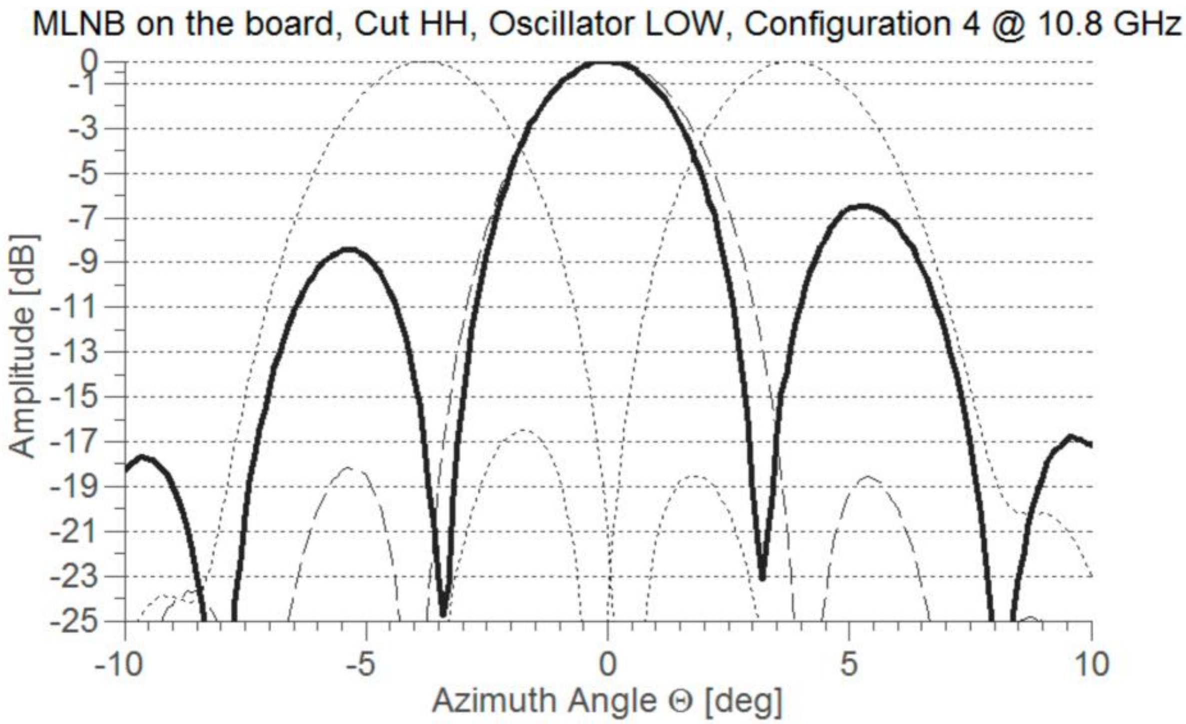


Picture of the MLNB demonstrator antenna in the anechoic chamber at the compact antenna test range (CATR) at ESTEC, Noordwijk. The board beamforming hardware demonstrator is on the right.

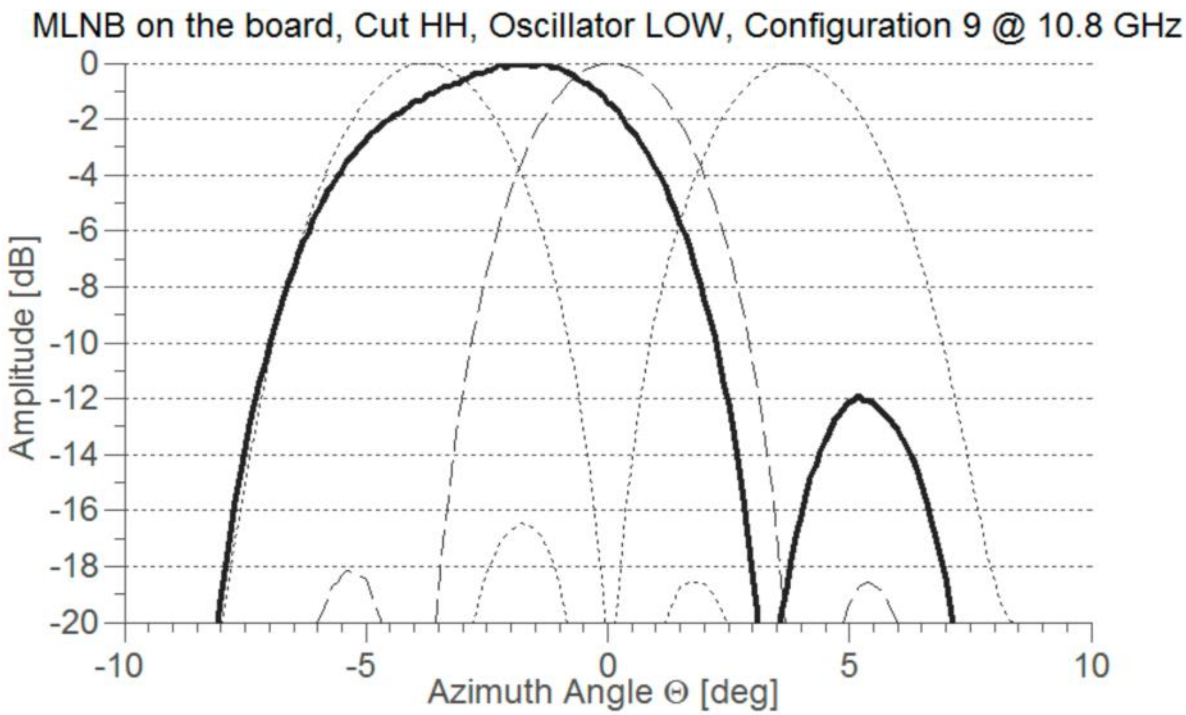


Demonstrator setup in the lab with connected test and measurement PC with DVB-S/S2 card and reception chain for broadcast reception in parallel. Tests over azimuth pointing angles are automated with a conventional Stab motor.

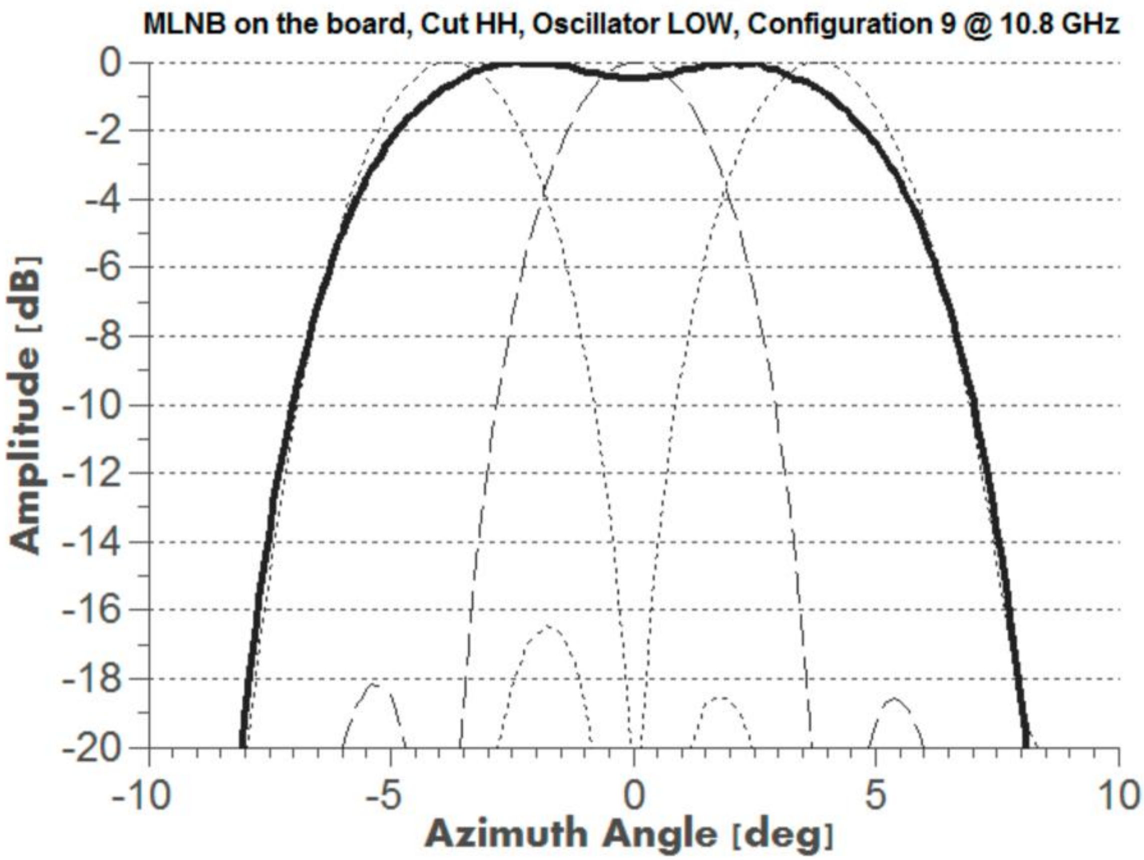
Results



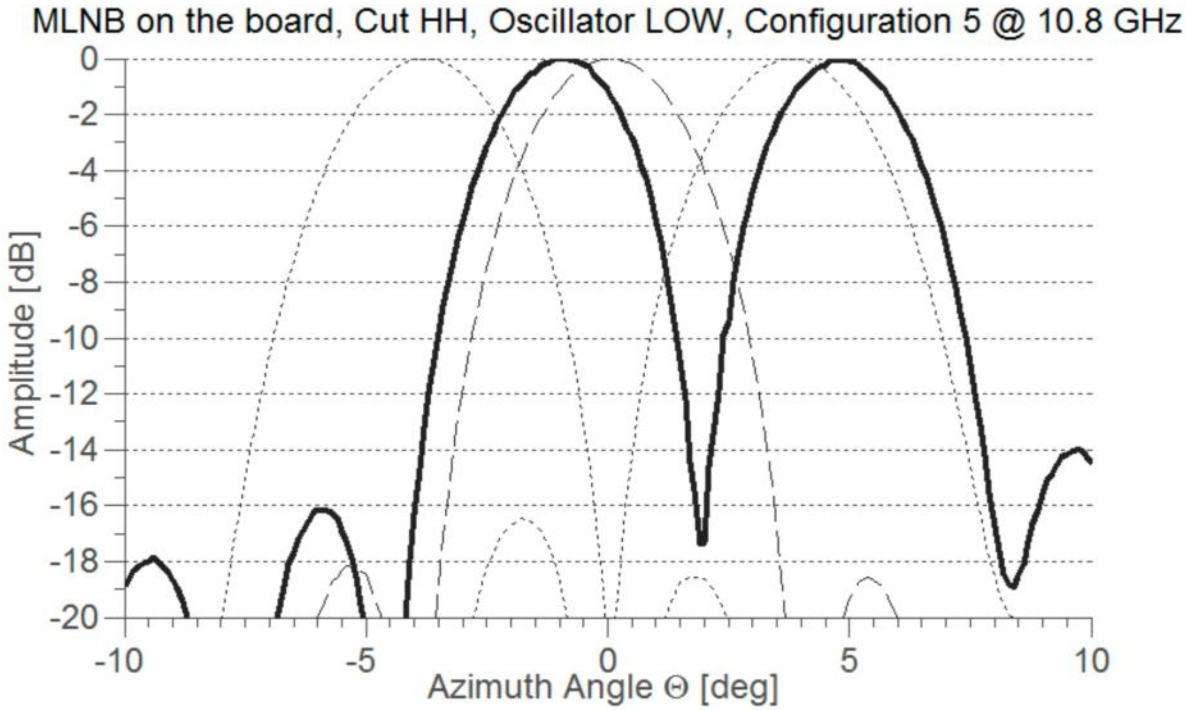
Measured recombination gain pattern example configuration over azimuth angular direction at 10.8GHz. The solid line is an example beamforming recombination of a narrow beam with nulls close to +3 degrees offset.



Relative amplitudes of example antenna recombination pattern (solid) with a high gain at -2 degrees offset direction and a null close to +3degrees offset direction. Angle in azimuth direction and amplitude as relative gain measurement.



Measured example relative beamforming recombination pattern with a high gain over the entire azimuth field of view and compared to the individual 3 feed gain patterns (dashed line). The amplitude is a relative measurement and the angle is in azimuth direction.

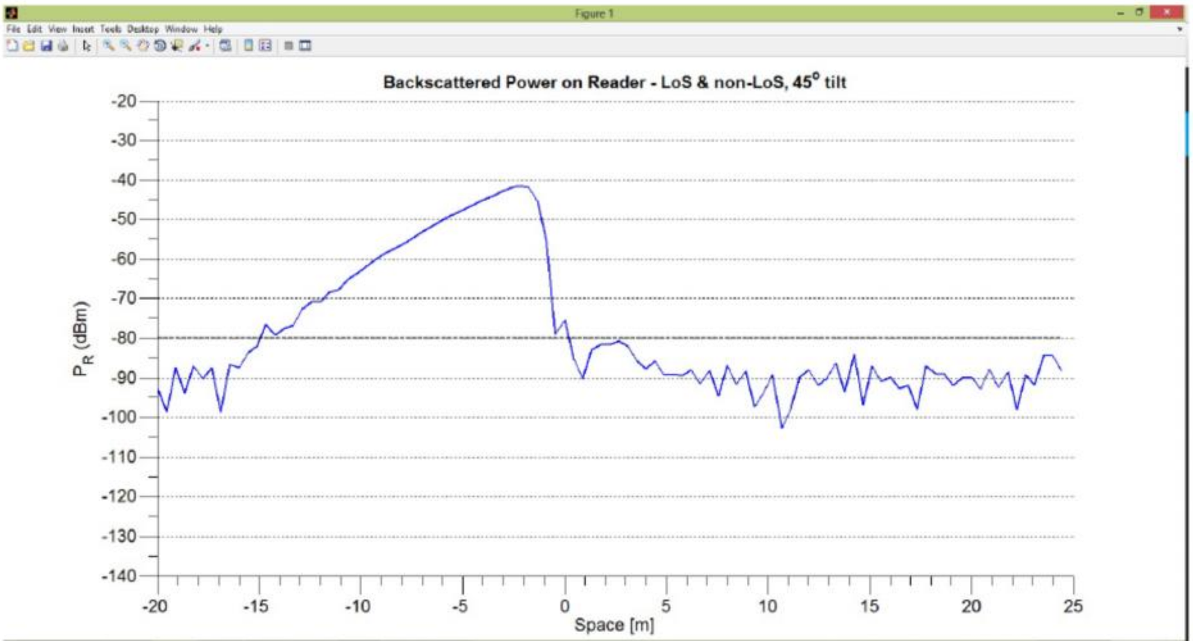


Relative amplitudes of an example antenna recombination pattern (solid) with a specific null at +2 degrees offset.

RFID toll tag simulation tool

I developed a software to simulate the propagation of RF signals backscattered by RFID antennas mounted on moving vehicles.
A GUI enriches the software to simplify its use for the end user.

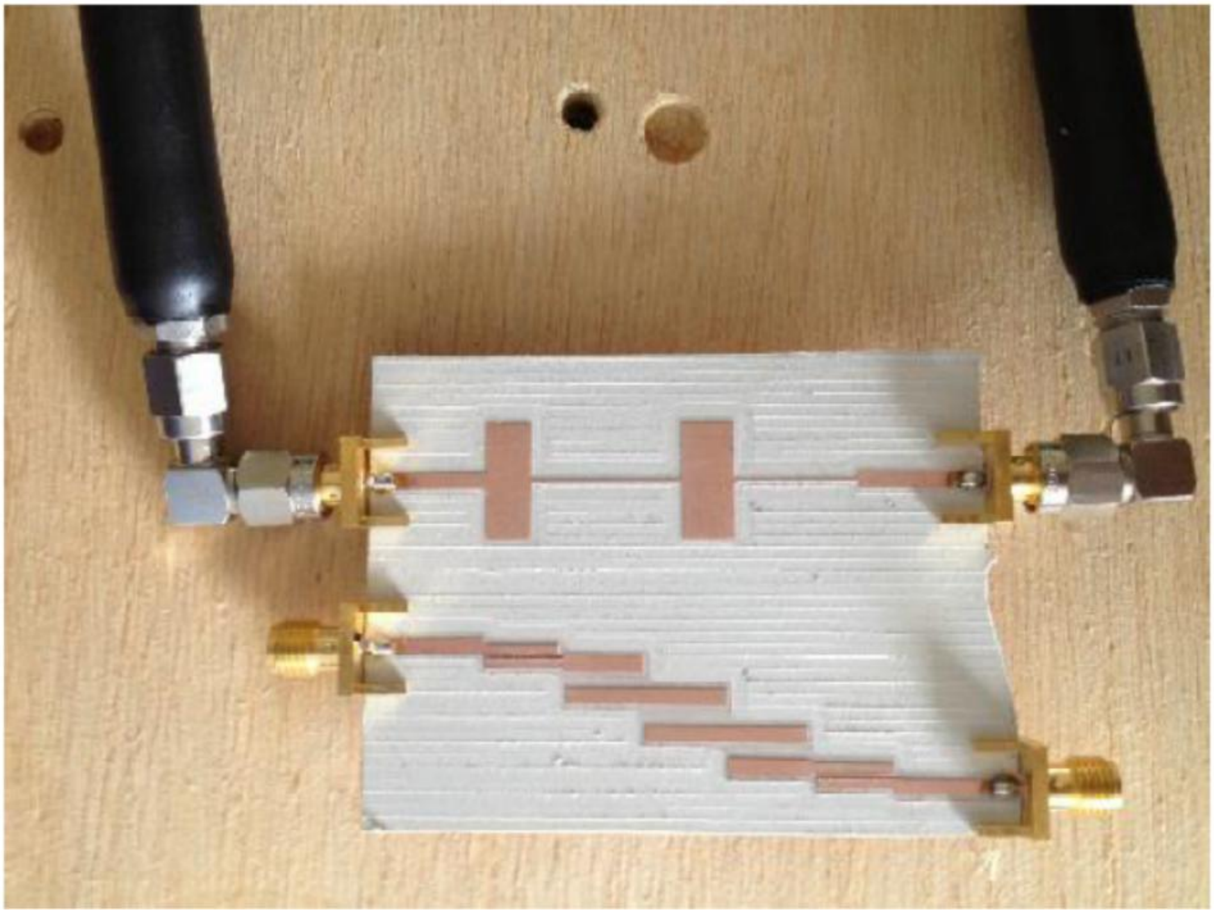
Toll tag simulation tool: GUI



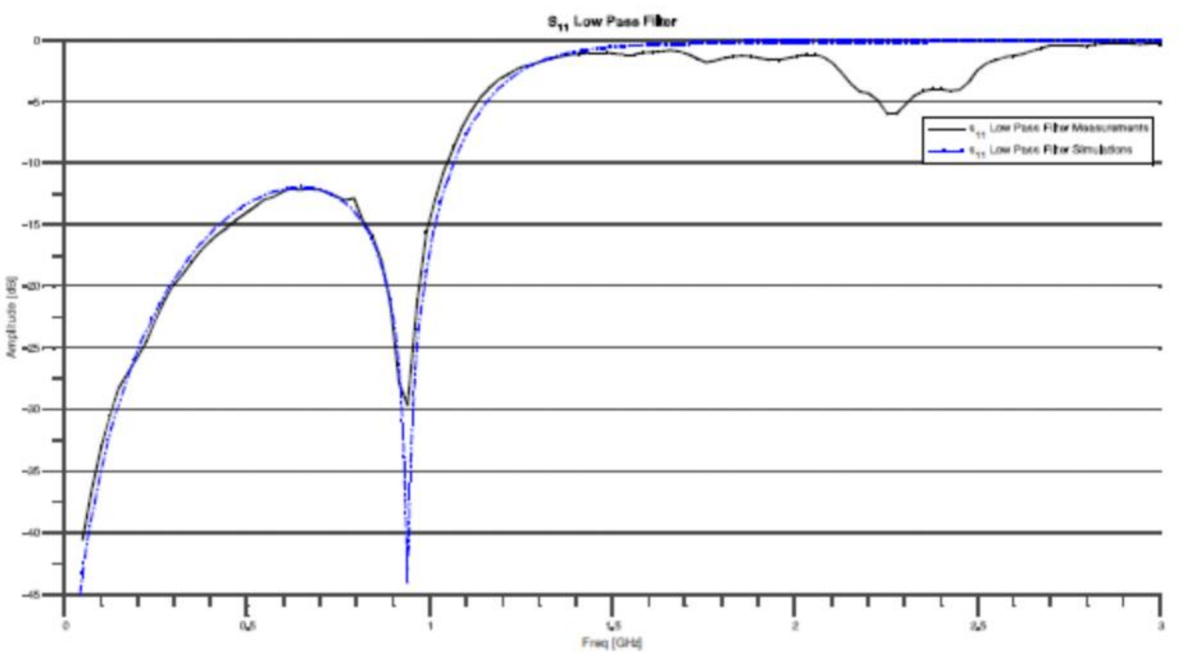
Example of a simulation output: received power level from the antenna mounted on the moving vehicle and at variable distance from the receiver.

Design (ADS) and test of microwave (5.8 GHz) filters

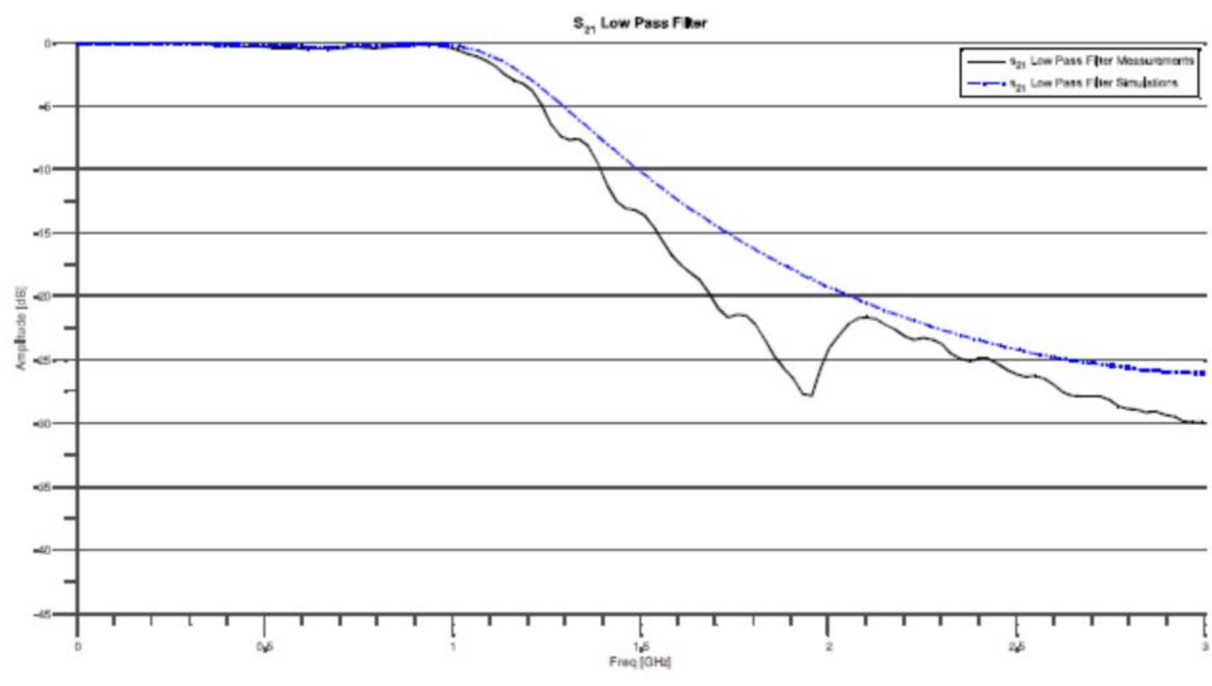
An RF band pass and low pass filter have been designed using ADS tools and tested on VNA. Final results agree with the simulations and are in spec.



Fabricated RF low pass filter (above) and band pass filter (below) on duroid substrate.



Low pass filter, S21. Measurements (black) vs Simulations (blue)



Band pass filter, S21. Measurements (black) vs Simulations (blue)

Other Projects

Design and realization of a high gain, RFID-reflection amplifier exploiting the quantum mechanical tunneling effect.
Work to be published.

Design of a 5.8 GHZ RFID reader.
Work in progress.

Publications

Self-sensing Passive RFID: from Theory to Tag Design and Experimentation. G. Marrocco, F. Amato.
European Microwave conference 2009

Multi Input LNB – Demonstator of a Reflection Feed Array Receiver for Satellite Broadcast Reception. Joel Grotz, Ainhoa Braun-Lois, Elise Guedin, Thierry Coutelier, Dogan Hakan Caner, Francesco Amato, Daniel Roche, Thierry Abraham, Frederic Roelens, Klaas Visser, Dion Kant, Erik van der Wal, Koos Kegel. ESA-ESTEC Antenna Week, 2012

A 45 uW Bias Power, 34 dB Gain Reflection Amplifier Exploiting the Tunneling Effect for RFID Applications. F. Amato, C. W. Peterson, B. P. Degnan, G. D. Durgin.
(Accepted, RFID conference 2015 San Diego)

RFID Tag Load Impedance Measurement Using Backscattered Signal. M. B. Akbar, F. Amato, D. G. Durgin, G. Pisharody, S. Y. Suh.
(Accepted, Antenna and Propagation conference 2015, Vancouver)