MID-FREQUENCY APERTURE ARRAY

High Polarisation Isolation Crossed Ring Antenna Array for SKA-MFAA

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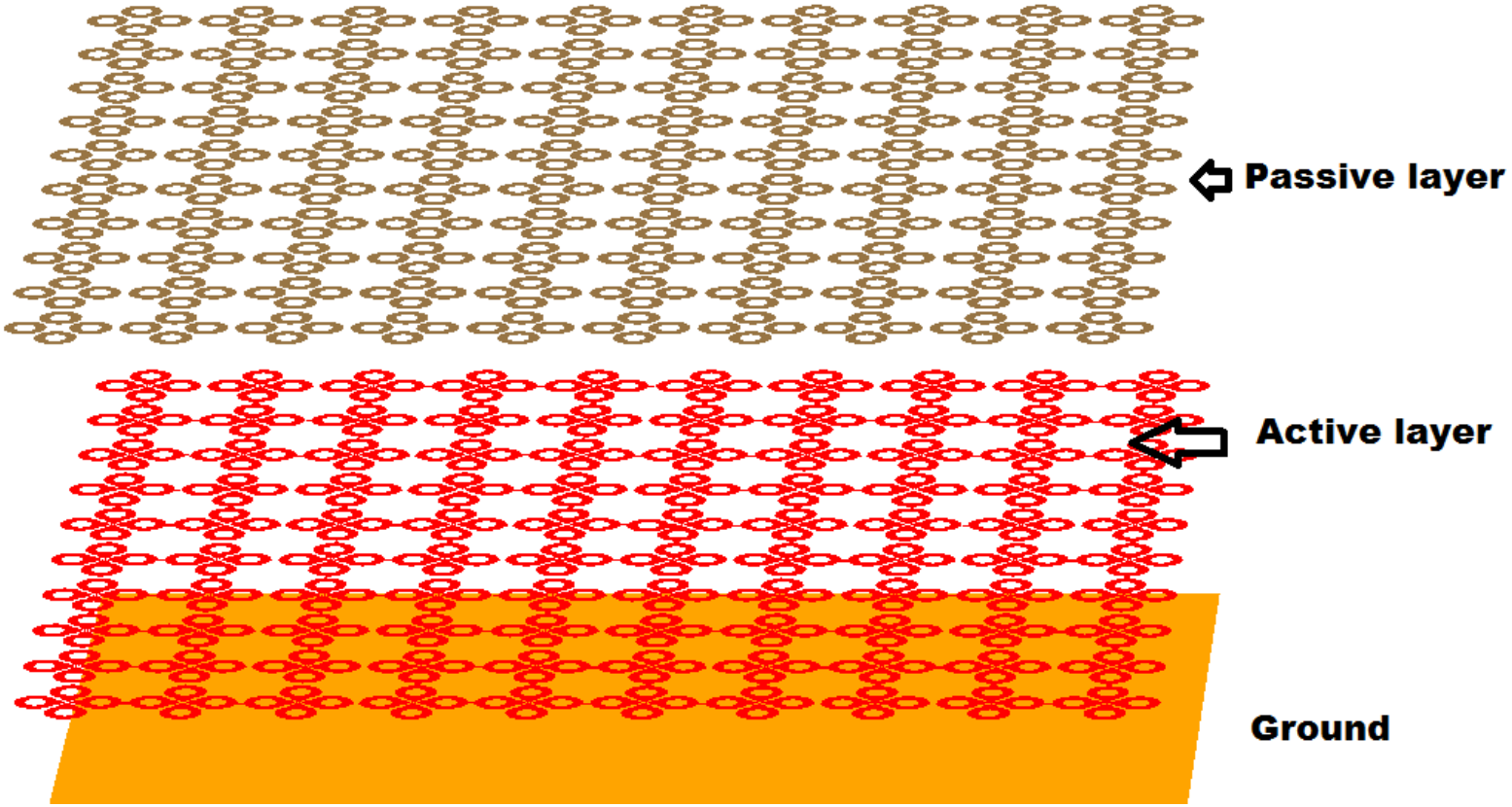
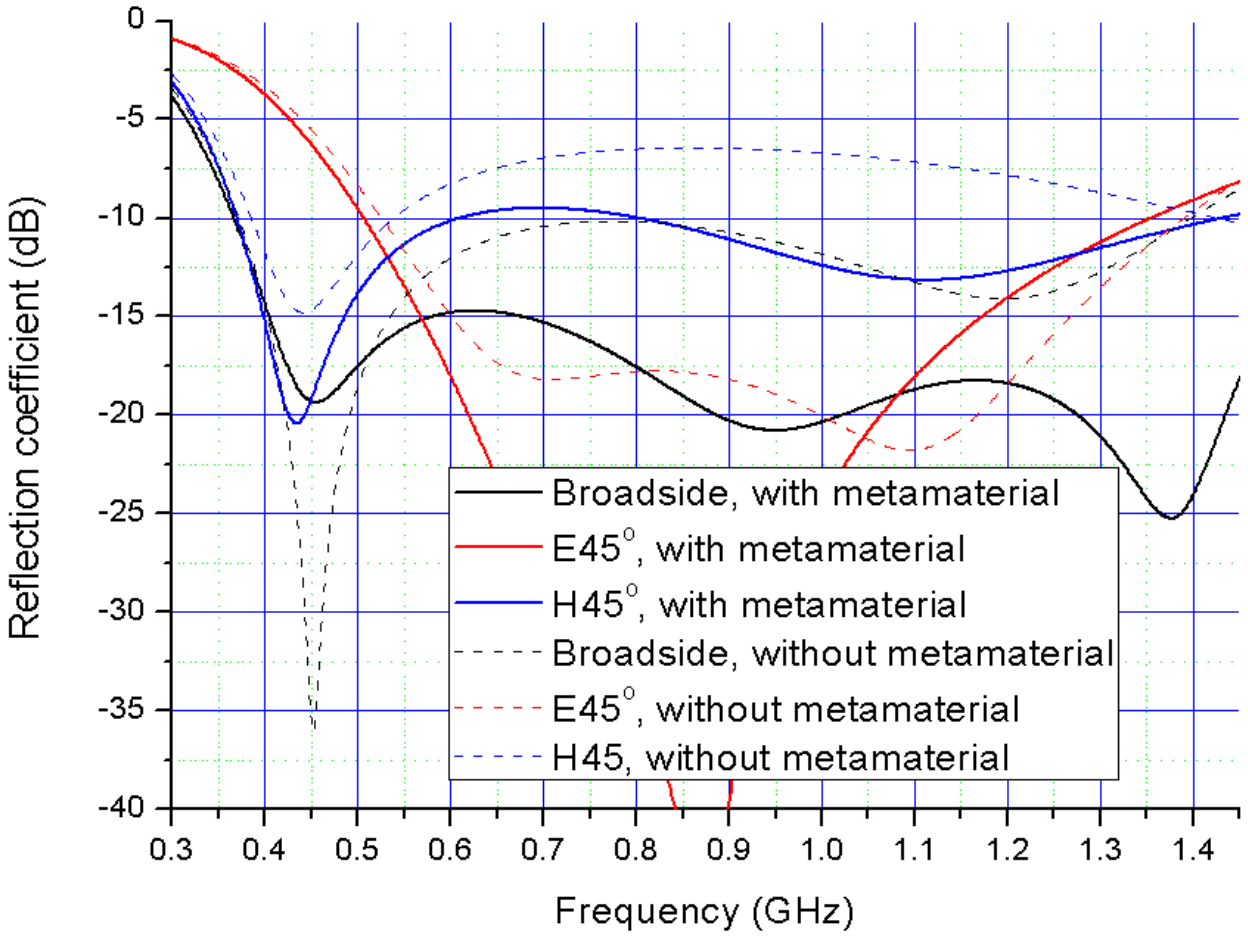
MID-FREQUENCY APERTURE ARRAY

Review of Crossed Ring Antenna Design

Crossed Ring Antenna Design

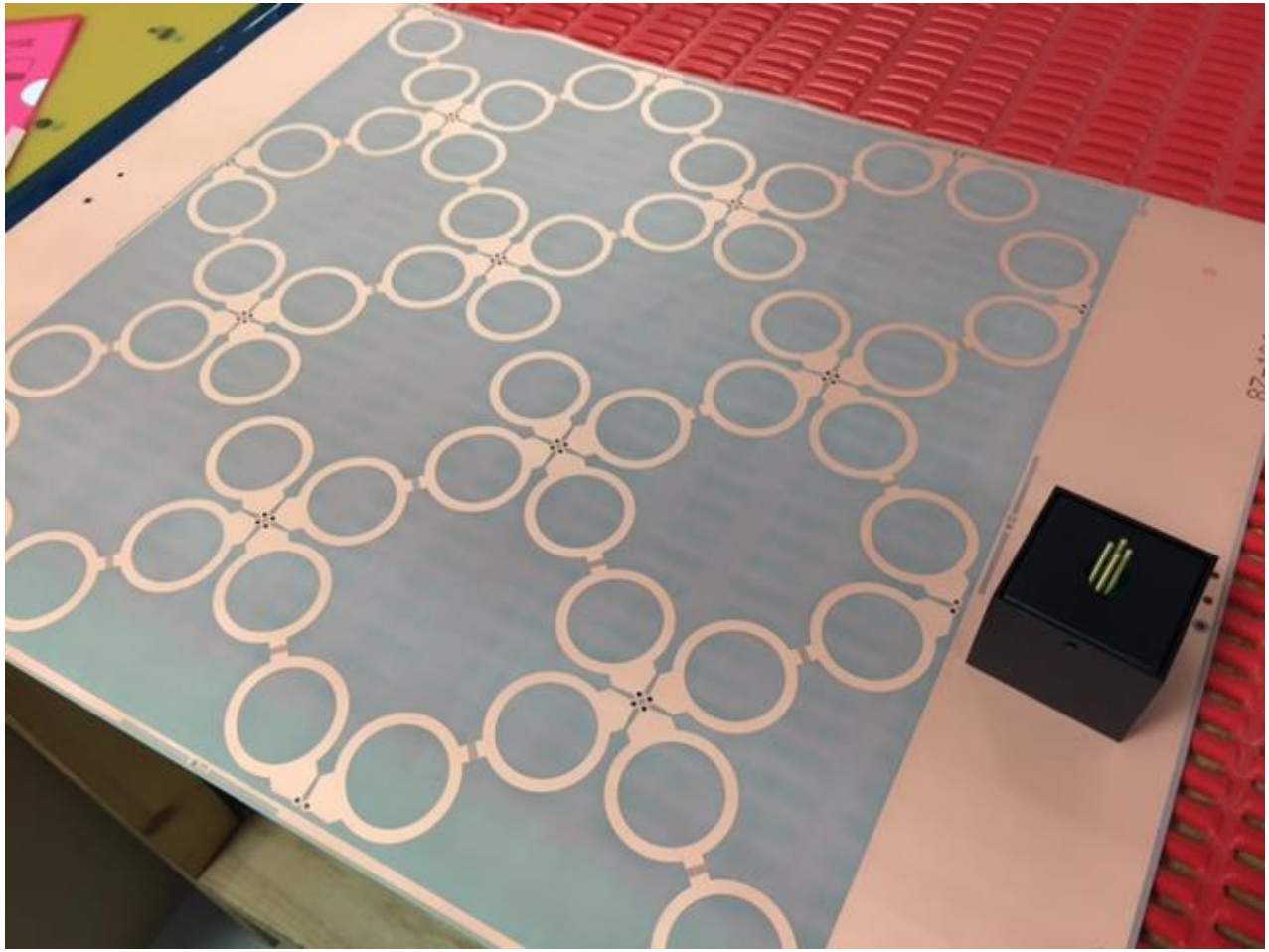


Metamaterial performance



MID-FREQUENCY APERTURE ARRAY

Dual polarised active layer section



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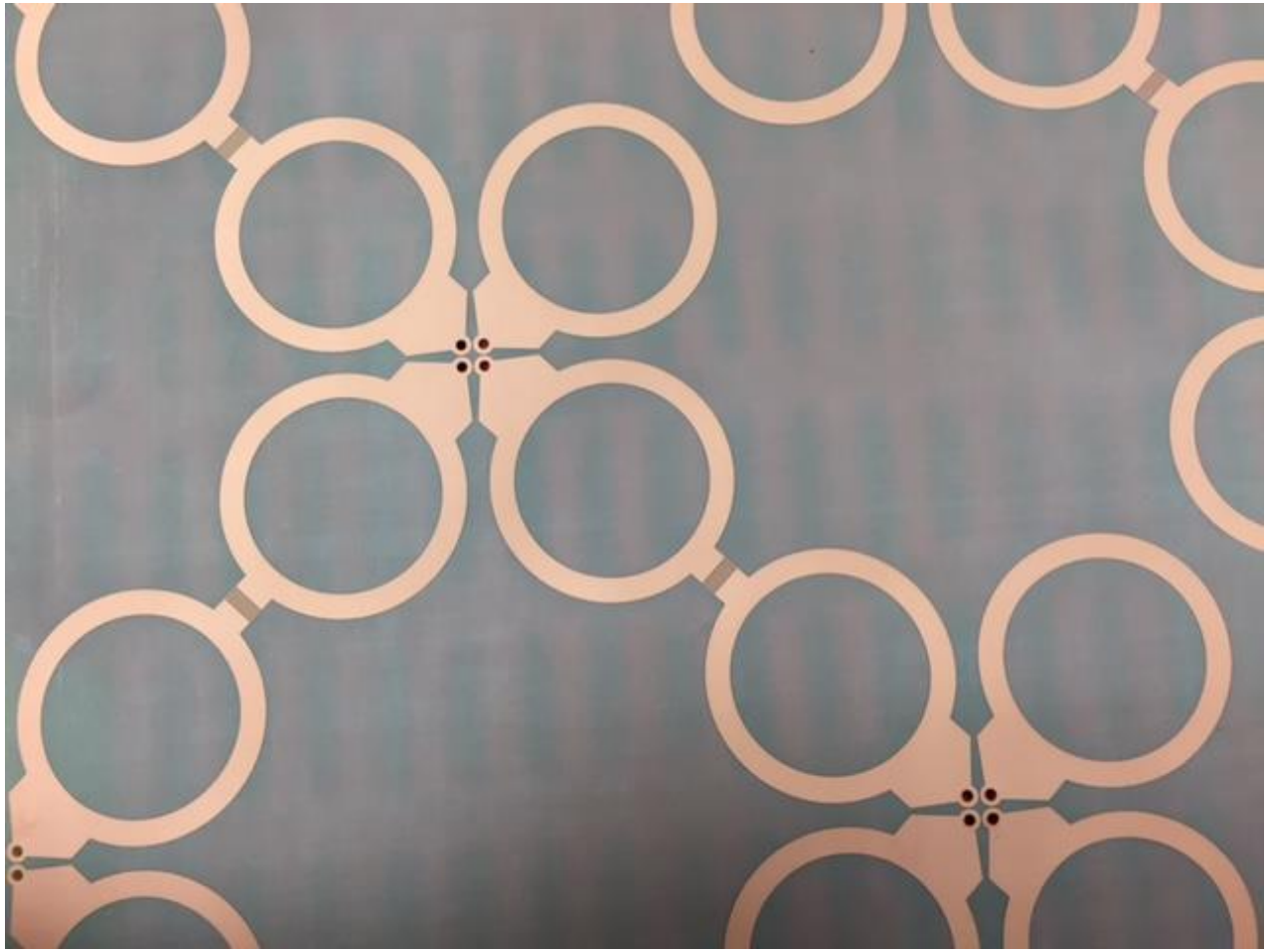
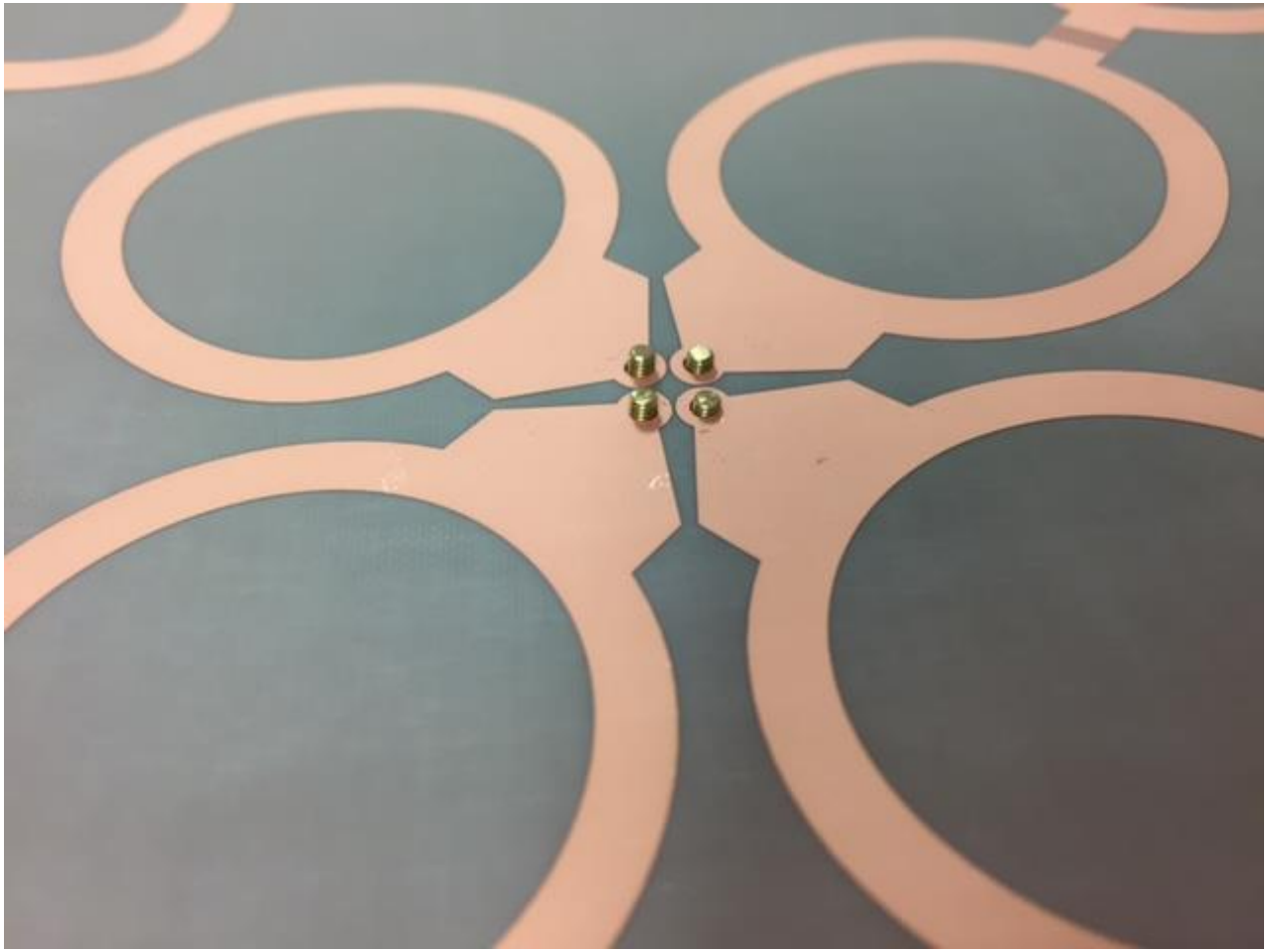
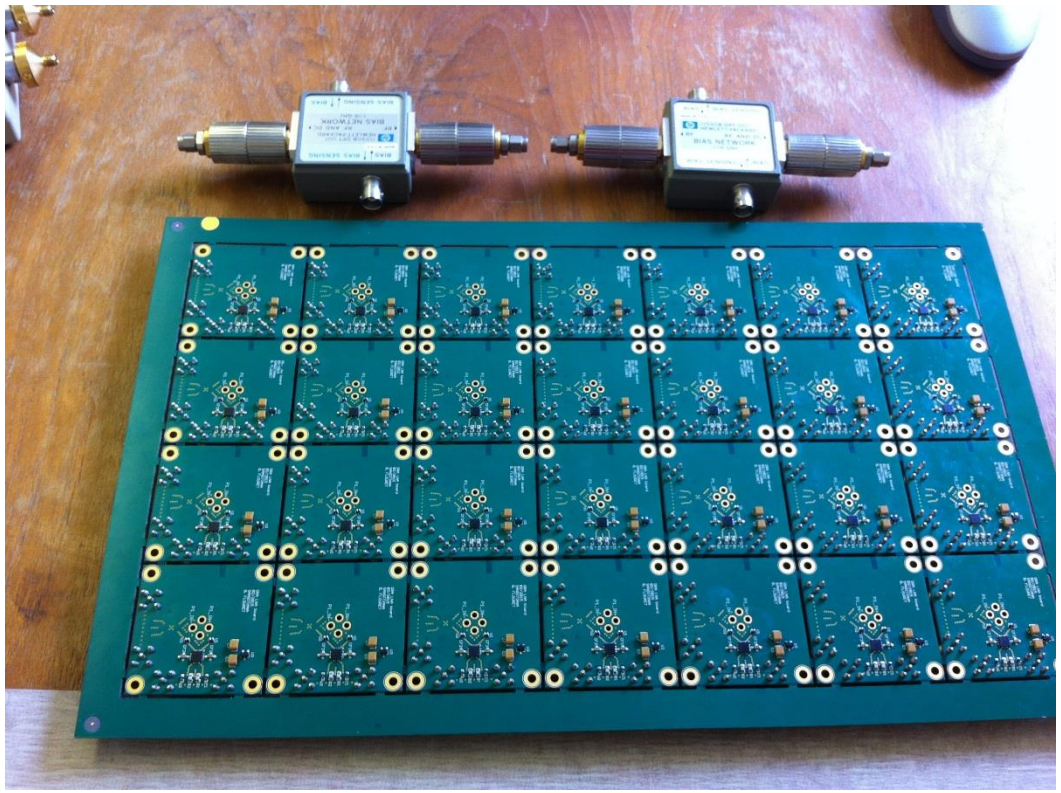
Dual polarised elements coupled together



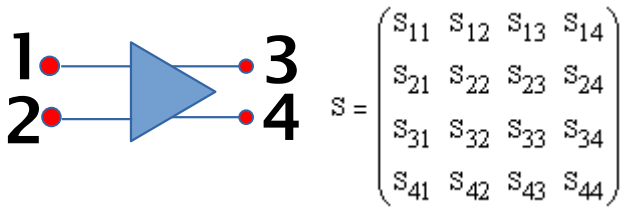
Integrated LNAs with antenna elements

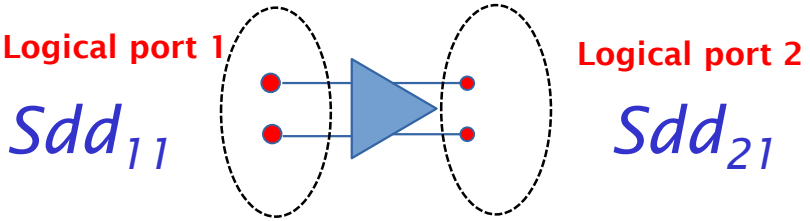


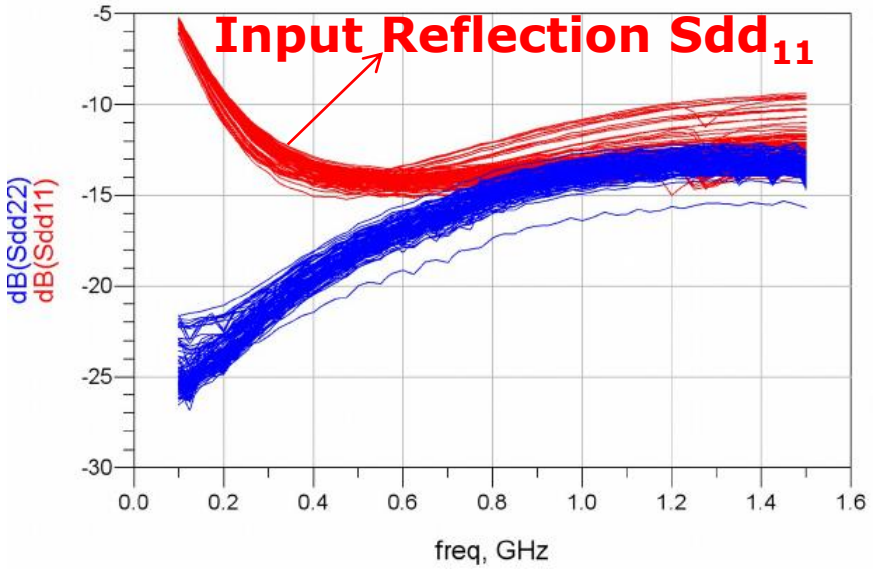
LNAs for dual polarisations in one board (Developed by Nancay)

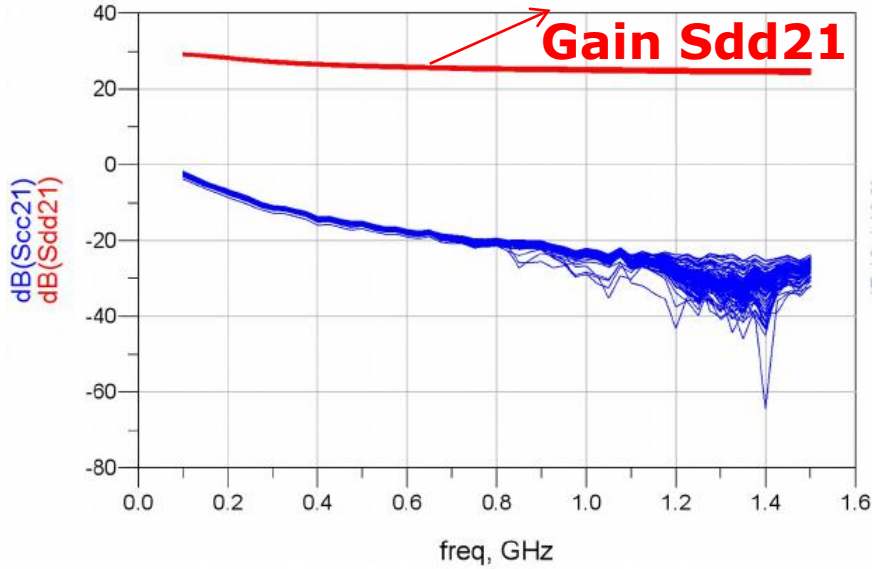


Measured Mixed-Mode S-parameters



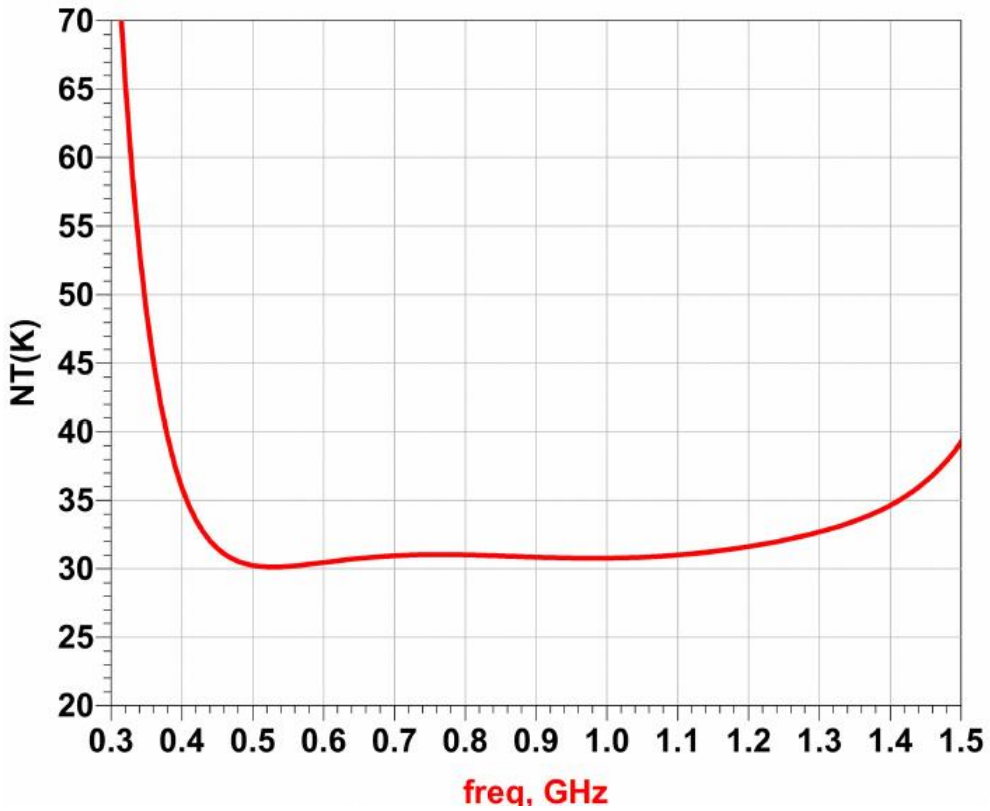






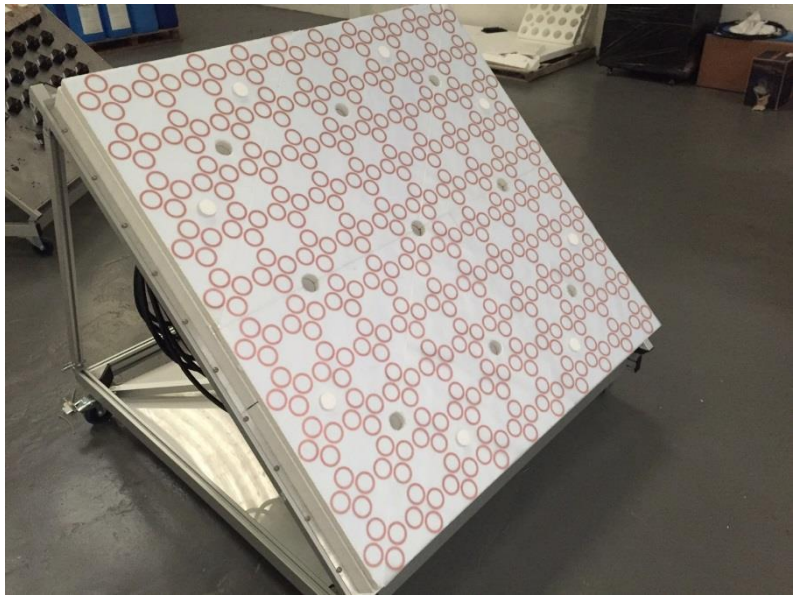
- Mixed-Mode S-Parameter is derived from the Single-Ended S-Parameter measurement of 4 port device

Simulated Noise Temperature of ORA with the integrated LNA

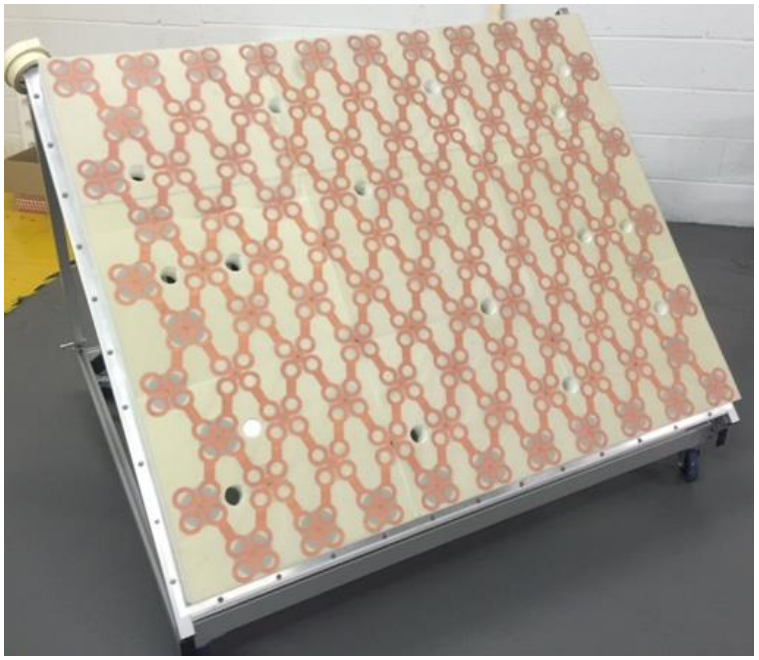


- Simulation shows the low noise temperature performance of ORA with the integrated LNA
- Experimental models are currently under construction

The Prototypes without Cover



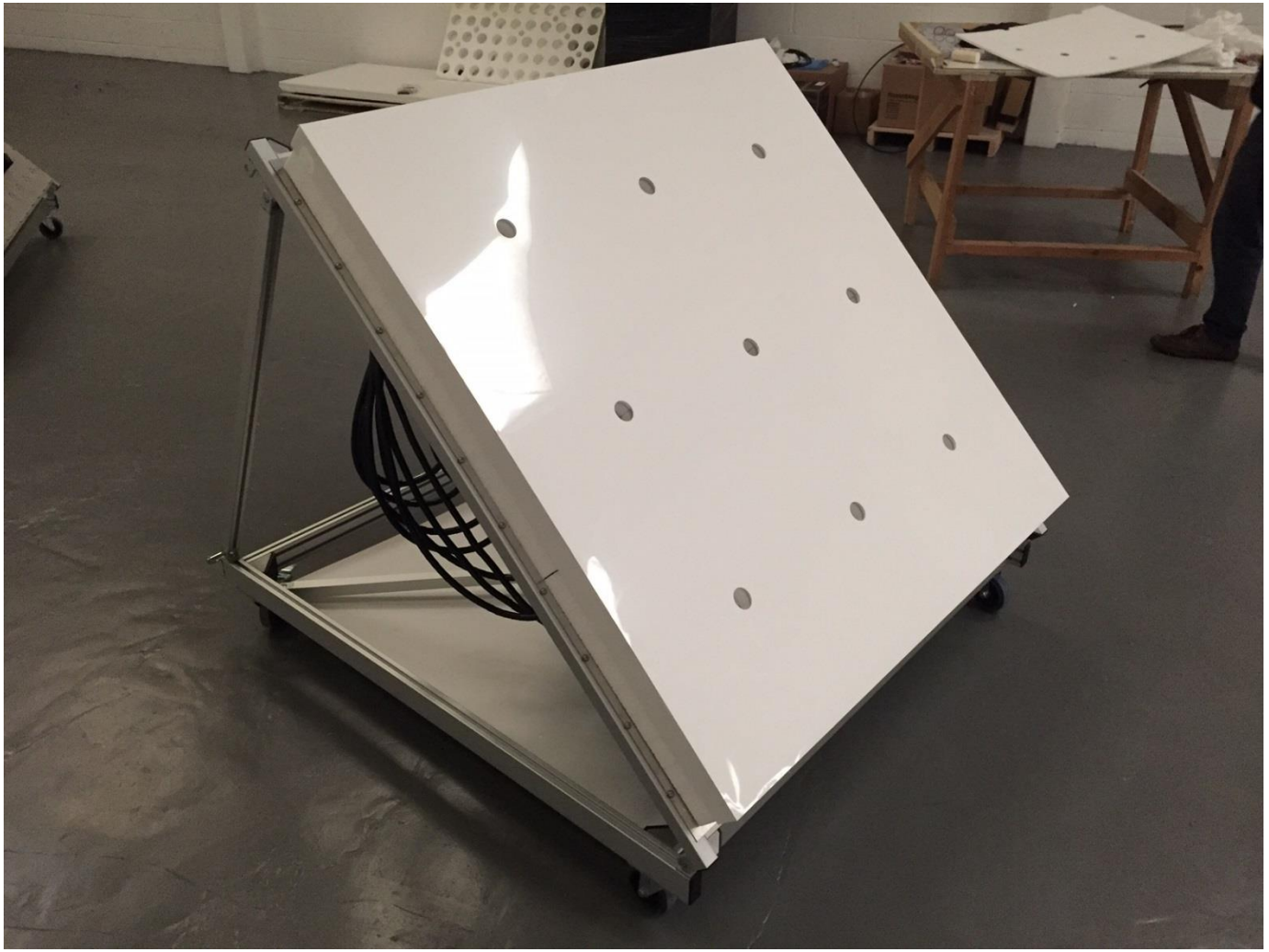
The Square Grid Array (10×10)
1.25m × 1.25m



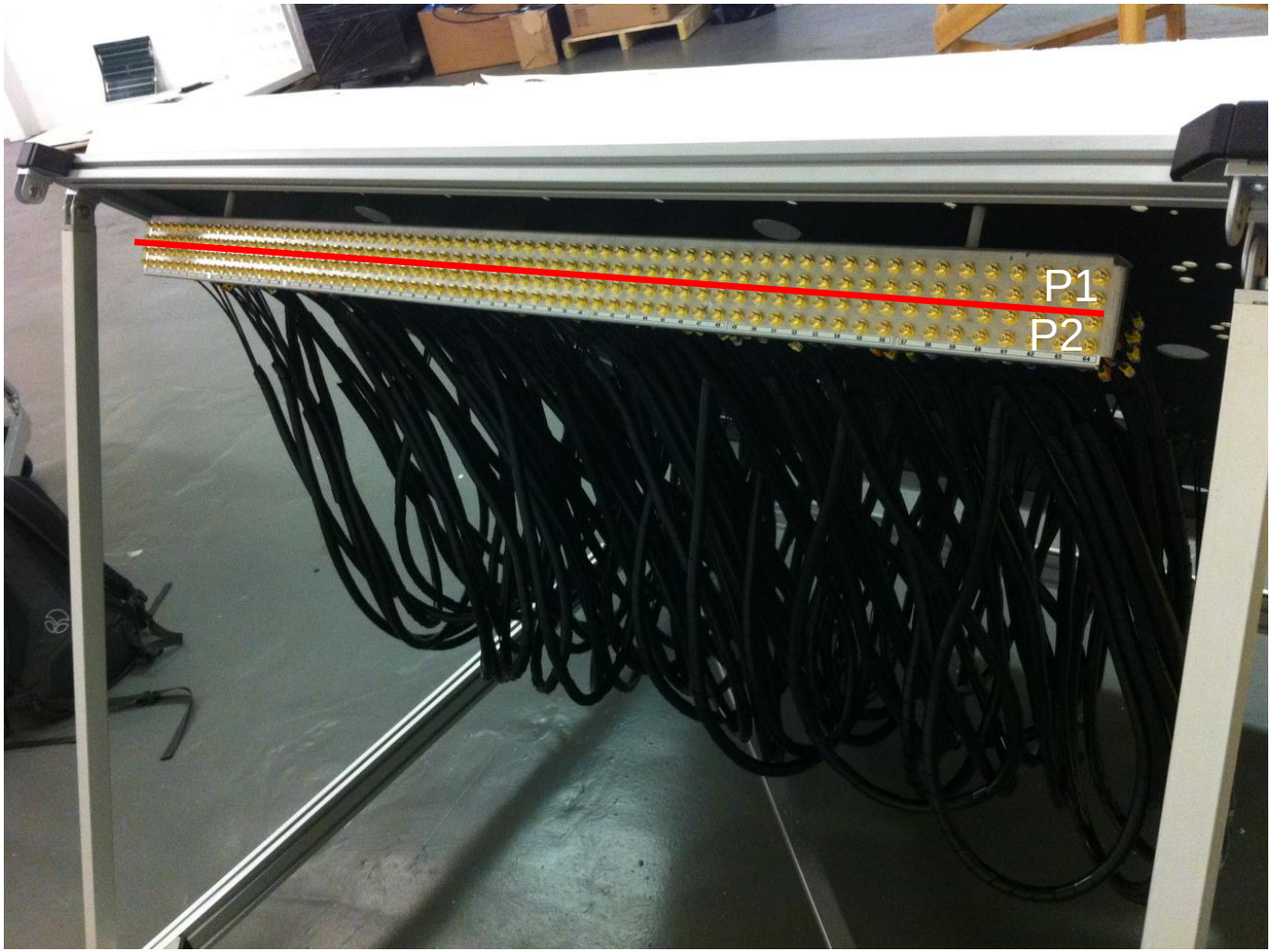
The Triangular Grid Array (10×10)
1.5m × 1.3m

Fully differential front-end design

The Square grid prototype with cover (polypropylene)

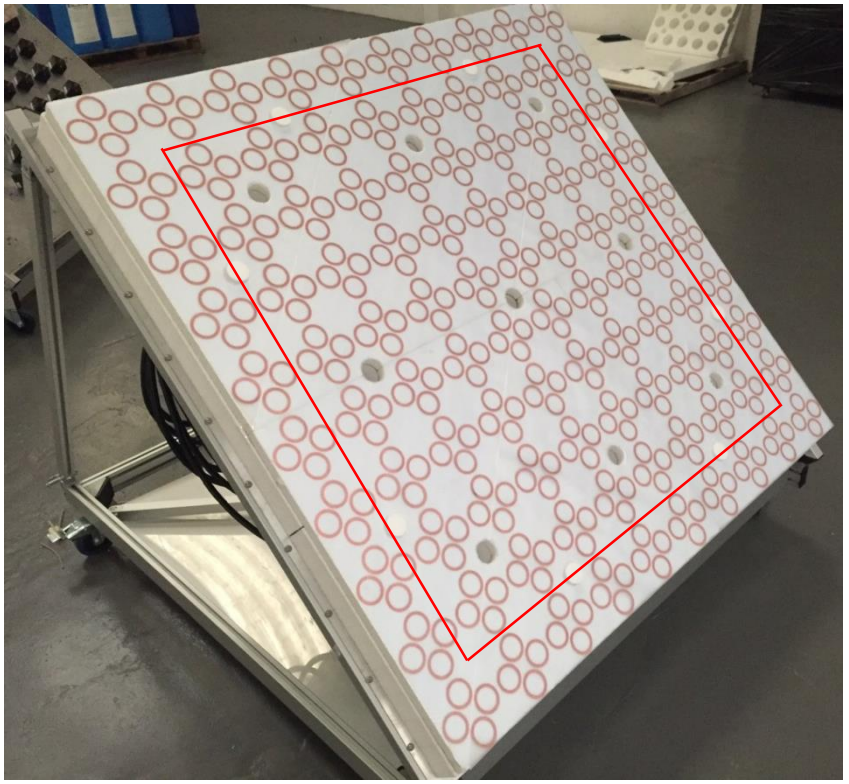


The dual-pol differential outputs

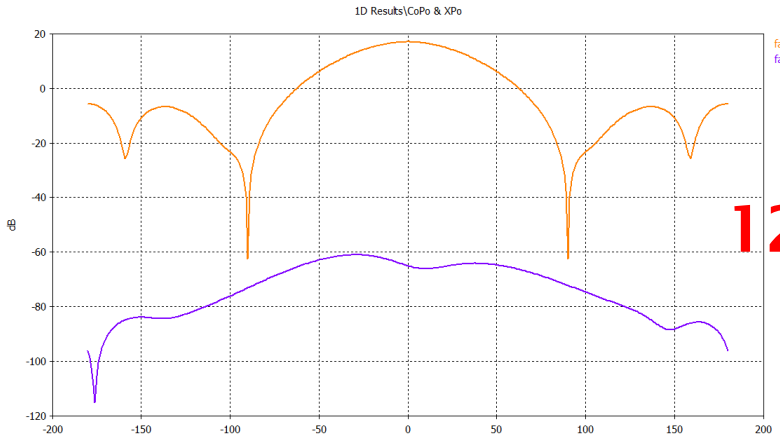


The 1 m^2 ORA prototype facts

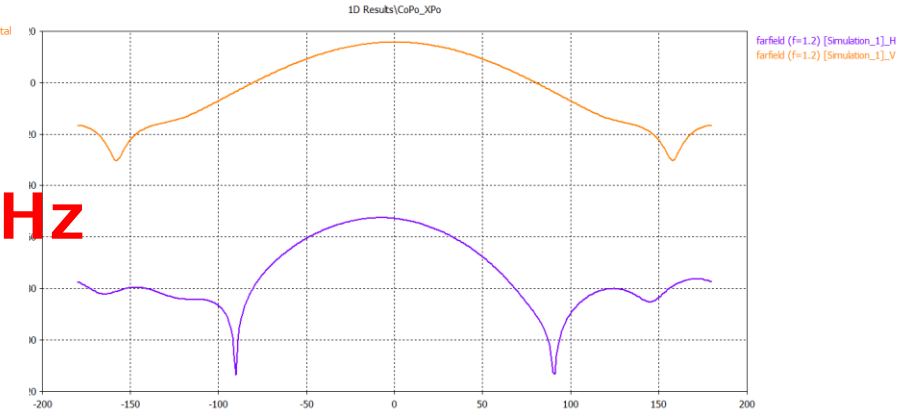
- 10x10 elements(1.25m x 1.25m)
- Dual-polarised for each element
- Frequency 400MHz to 1450MHz
- Element separation: 125mm
- Low profile (array thickness <10cm)
- 64 (8x8) central elements excited (within the red box)
- 36 edge elements terminated with the matched load
- 128 LNAs integrated (64 for each polarisation)

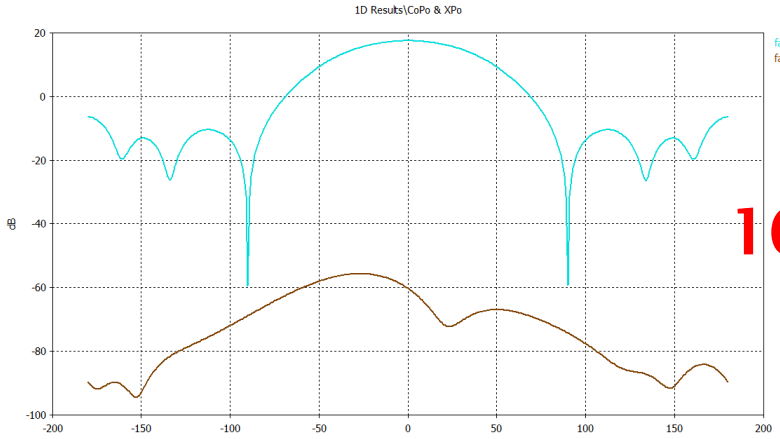


Co-Po/X-Po Azimuth Pattern for different polarisation

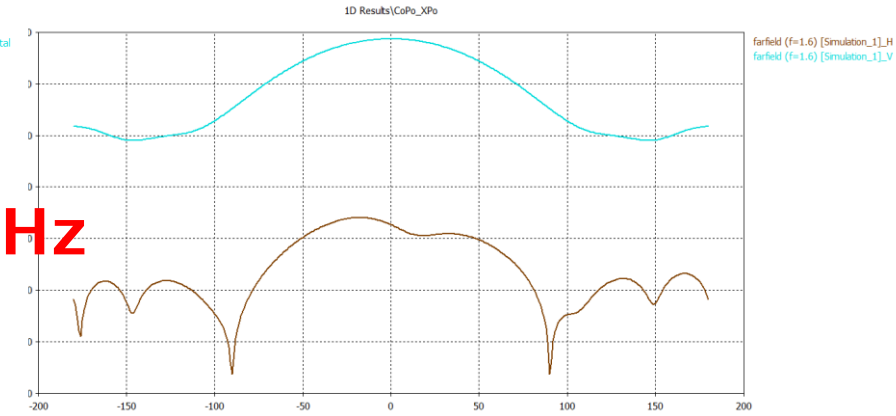


1200MHz



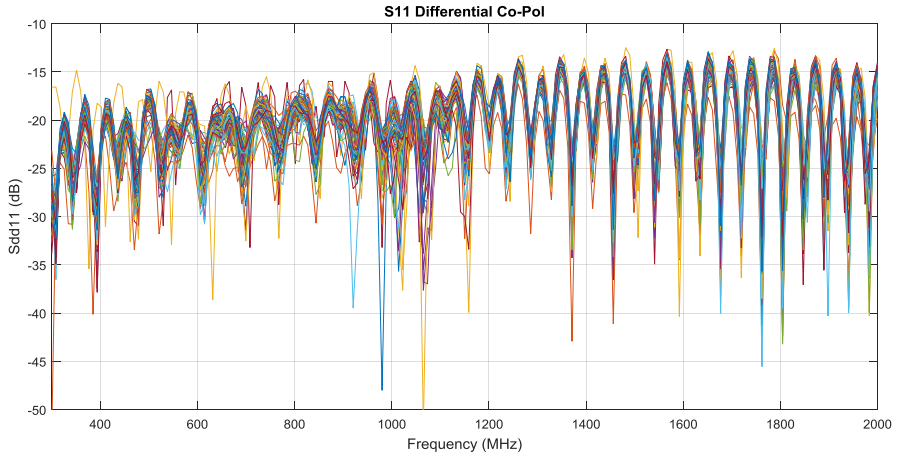


1600MHz

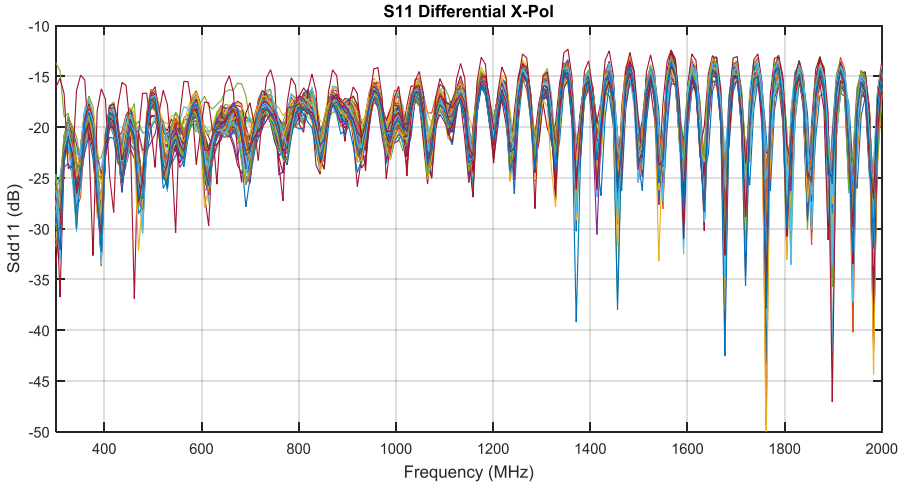


Active ORA Array Measurements

Measured Reflection Coefficients of the active array elements – The Square Grid Array

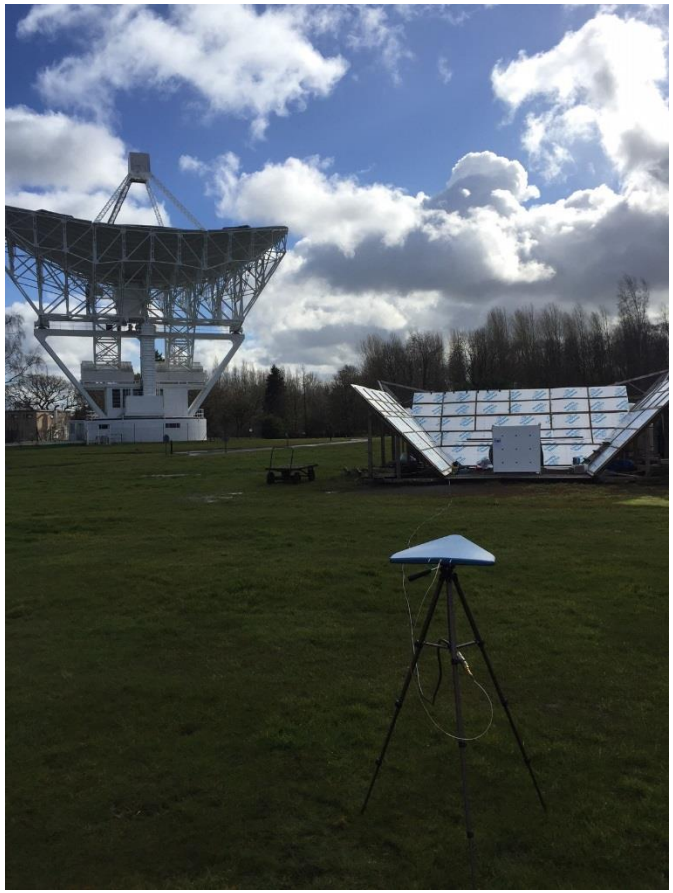


Pol 1

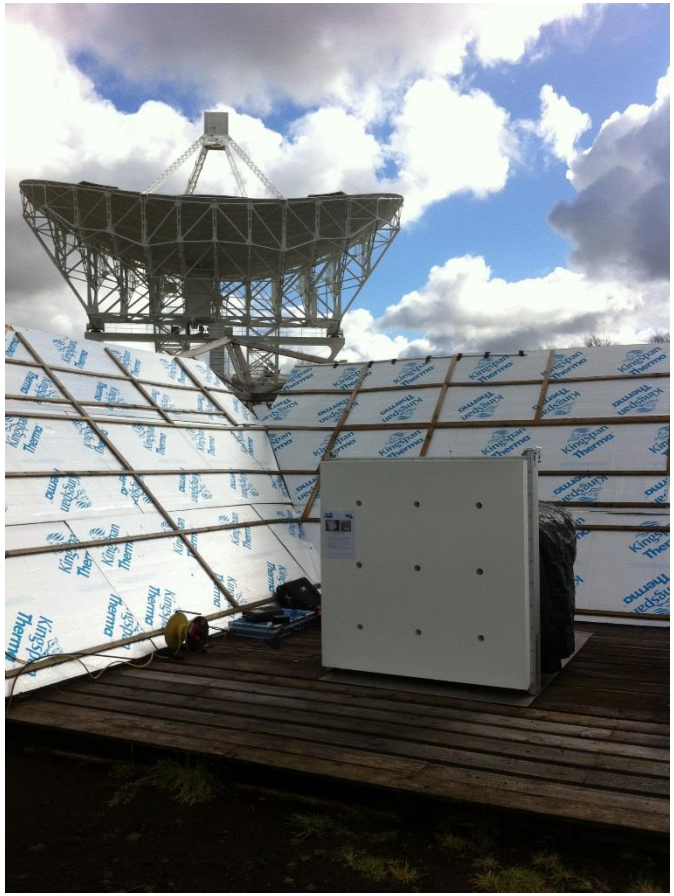


Pol 2

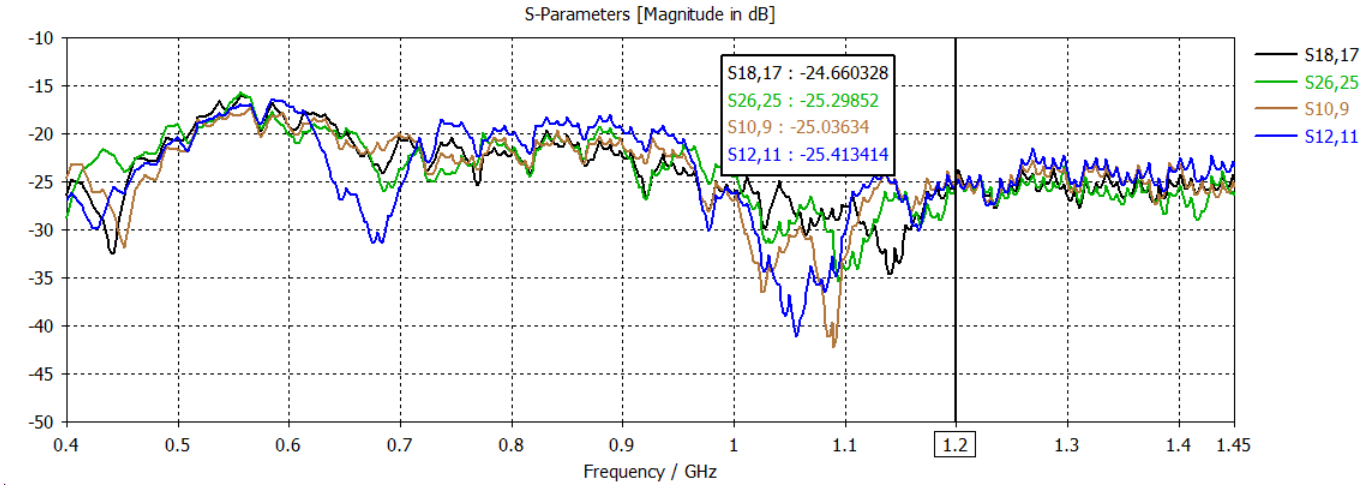
Lineality Test at JBO

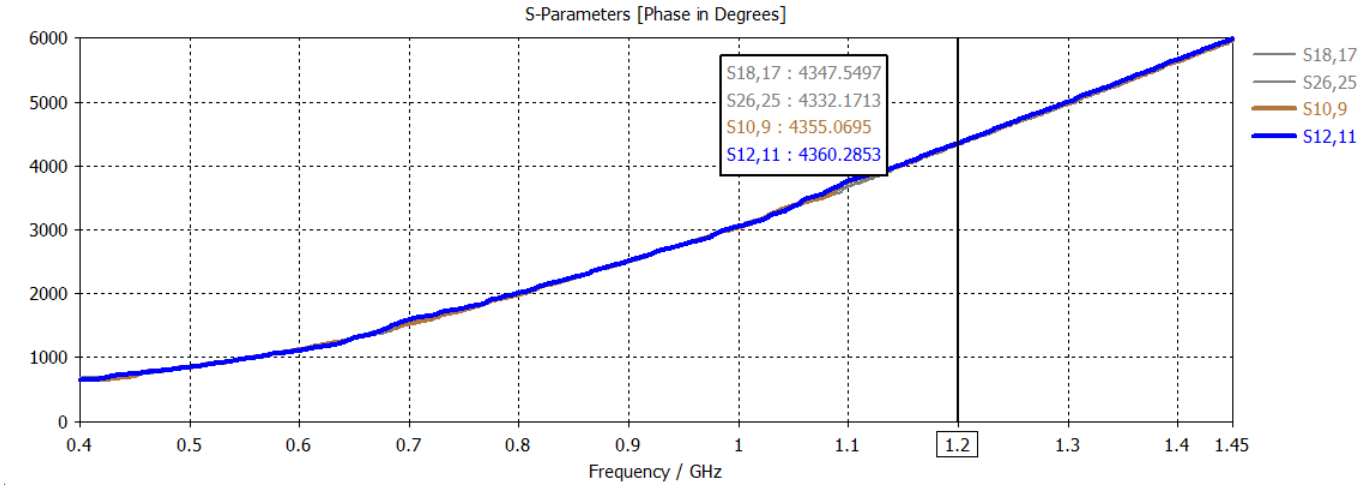


Lineality Test at JBO

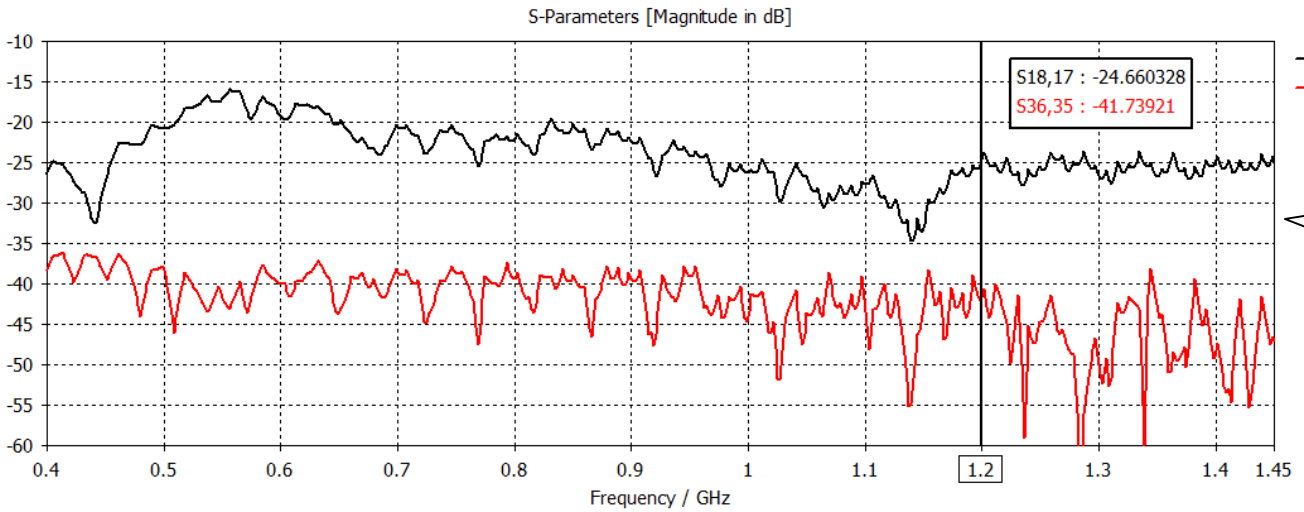


Preliminary results- Amplitude and Phase Response

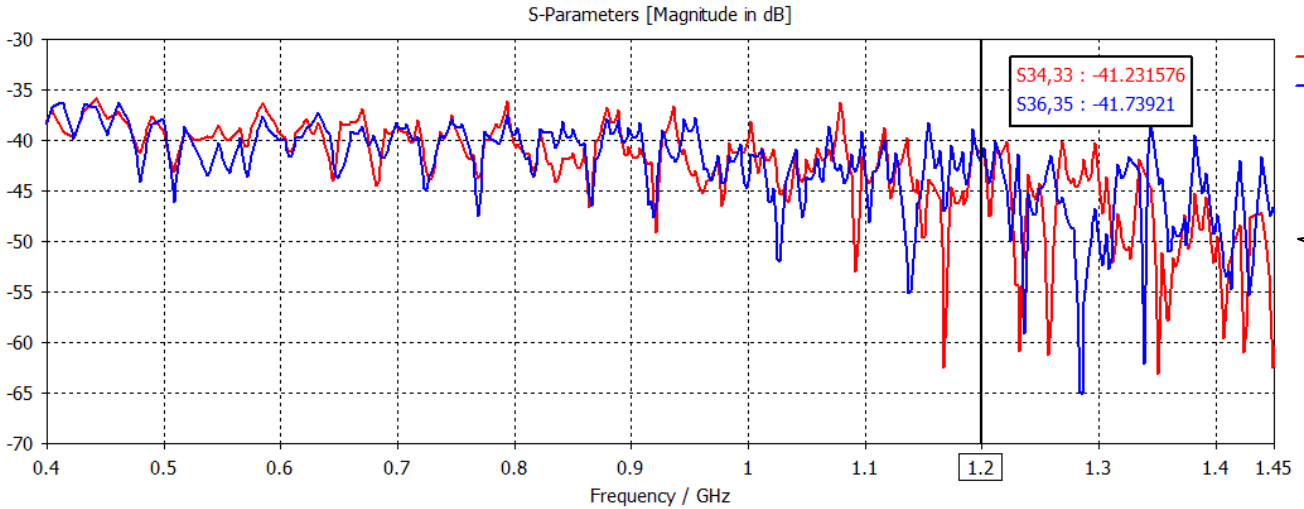




Gain of the individual active element

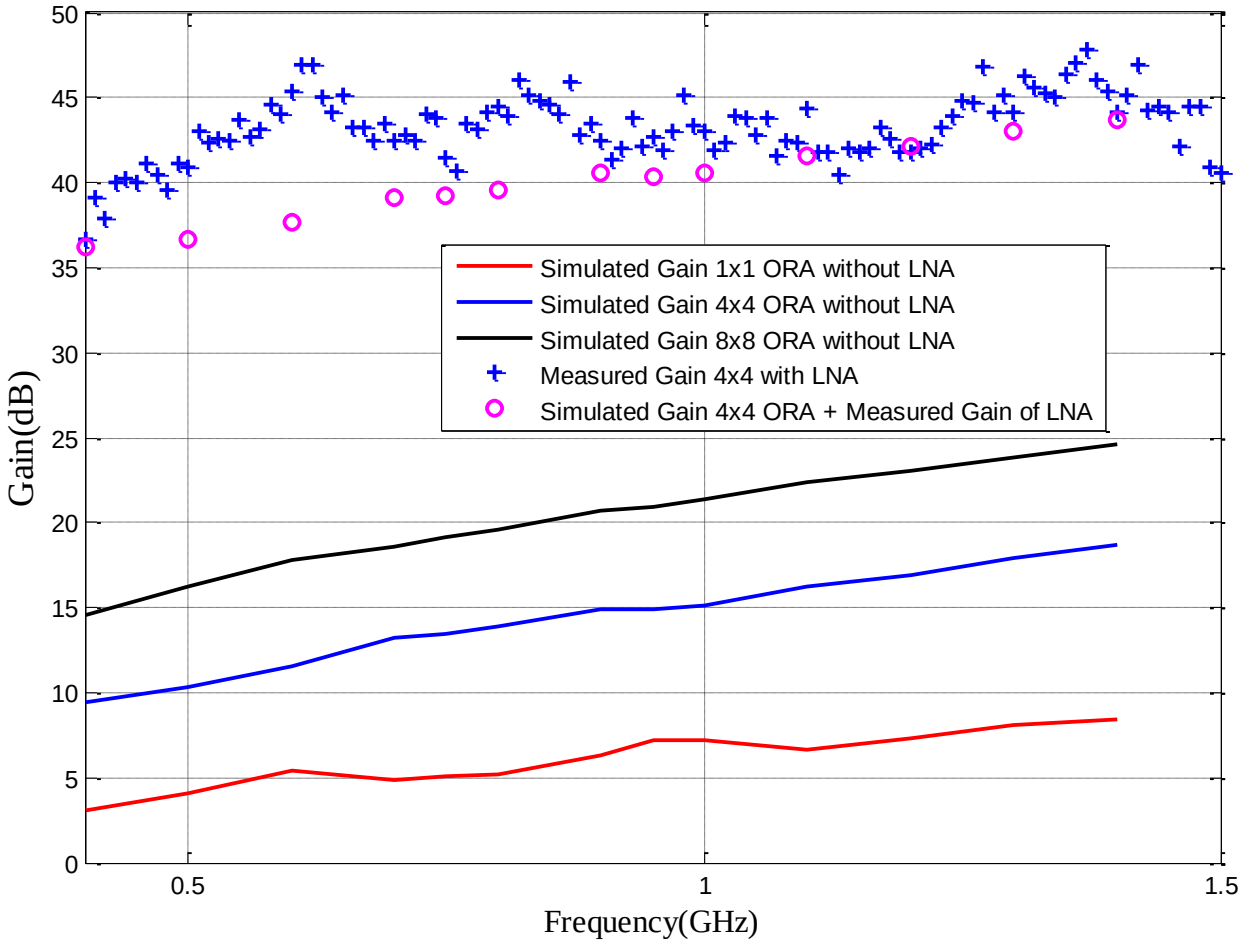


Array Individual element compared with the reference antenna

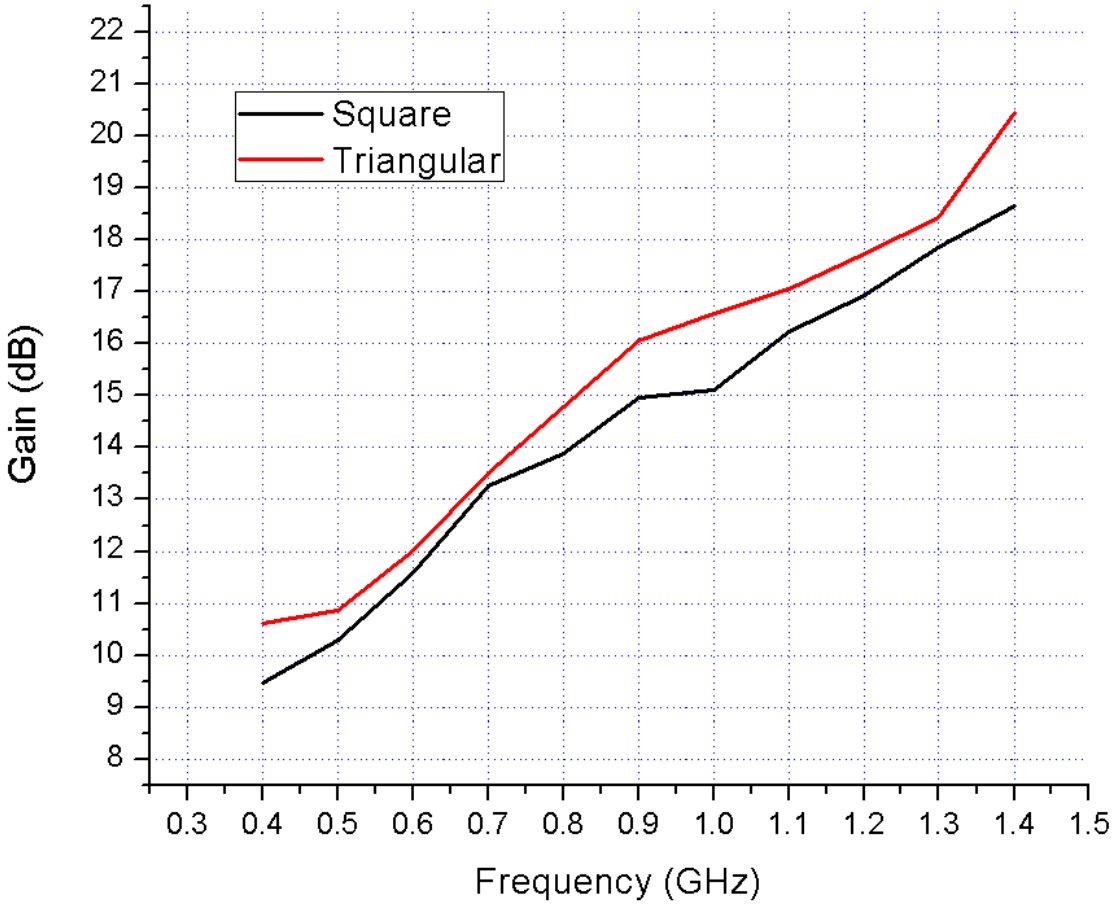


Reference antenna response at different time

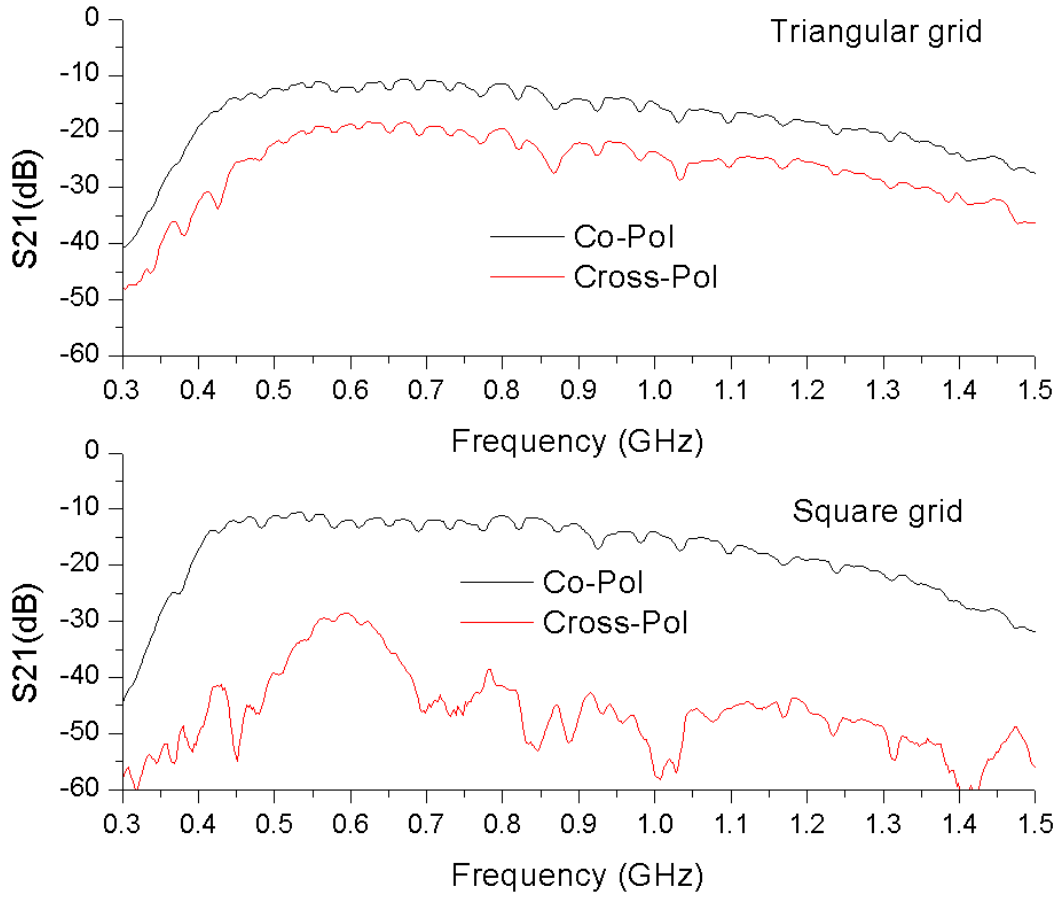
Gain measurement and comparison



Gain comparison for 4x4 Arrays



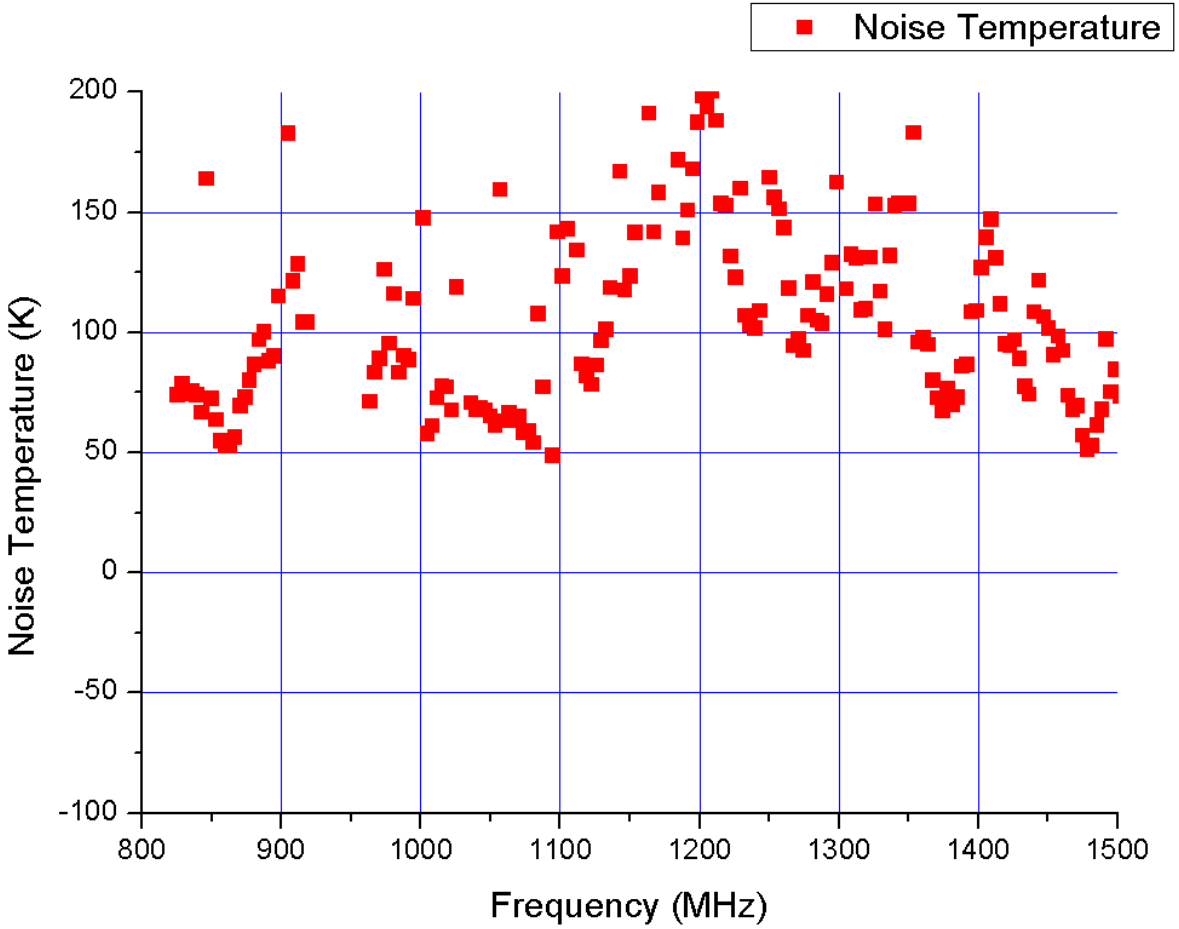
Crossed polarisation measurement



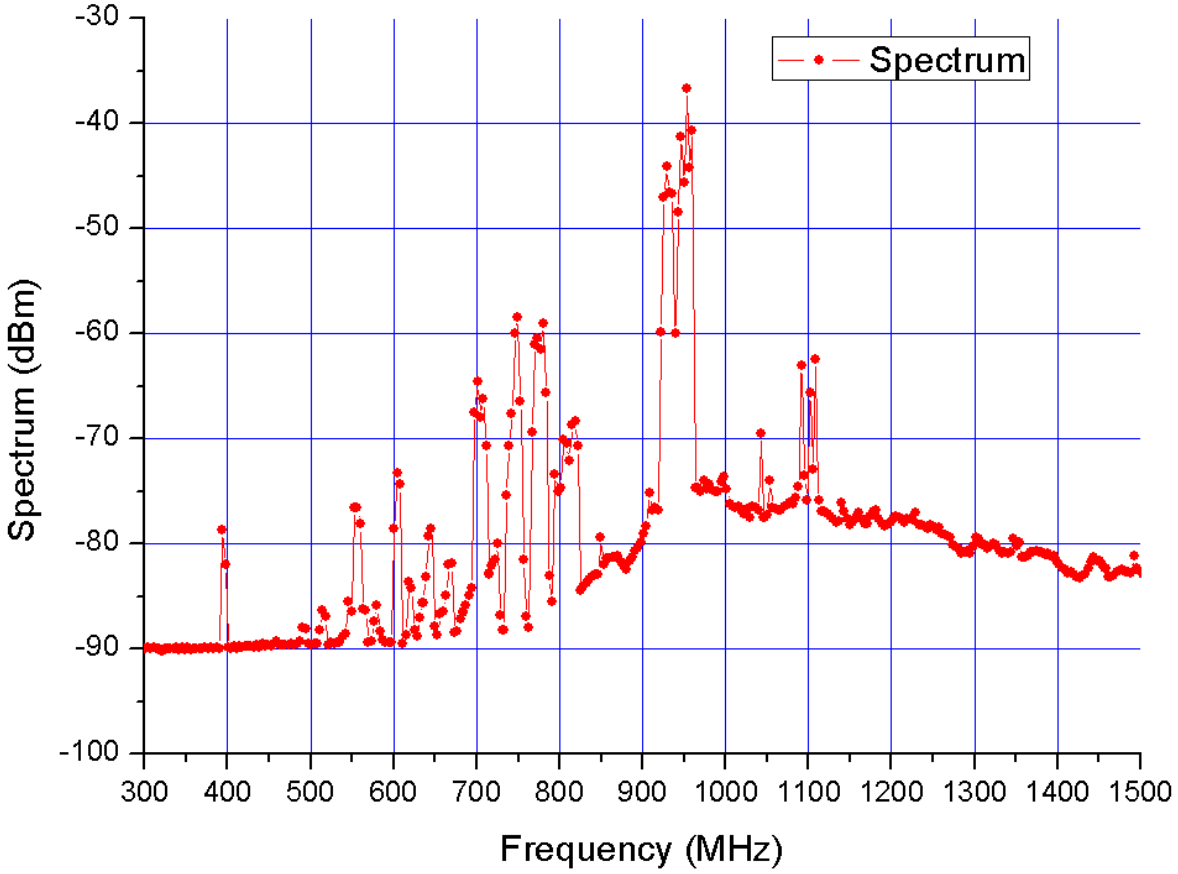
The reference antenna used is **HyperLOG 3080 from AARONIA**

The Noise Temperature Measurement

The Noise Temperature

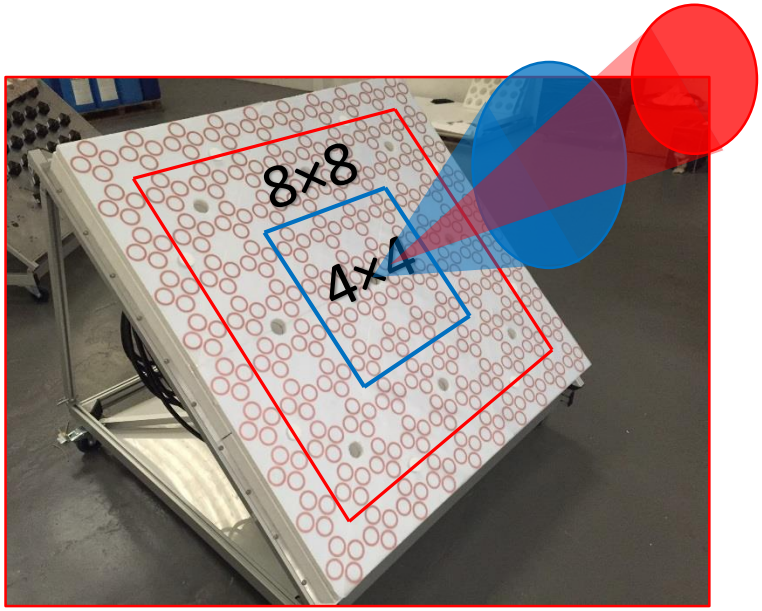


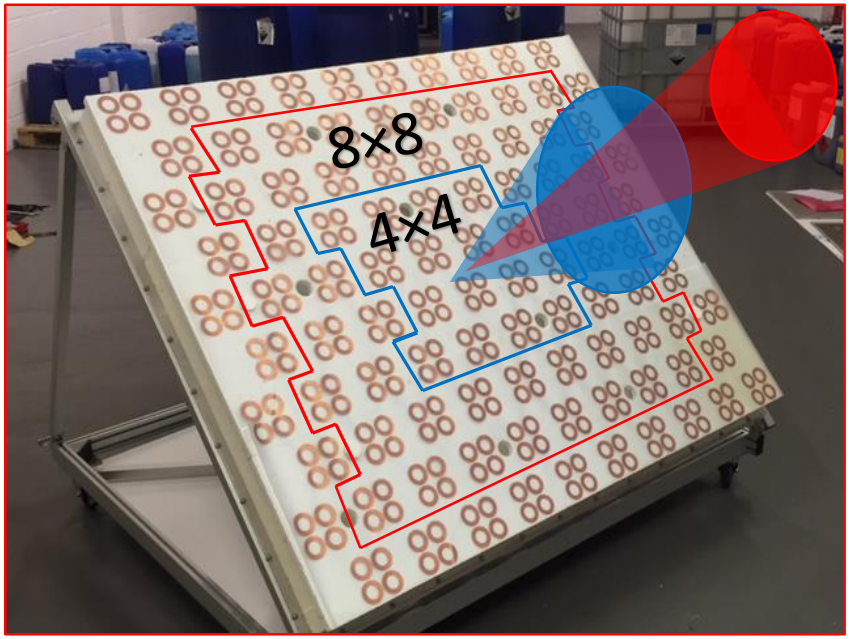
The RFI Environment



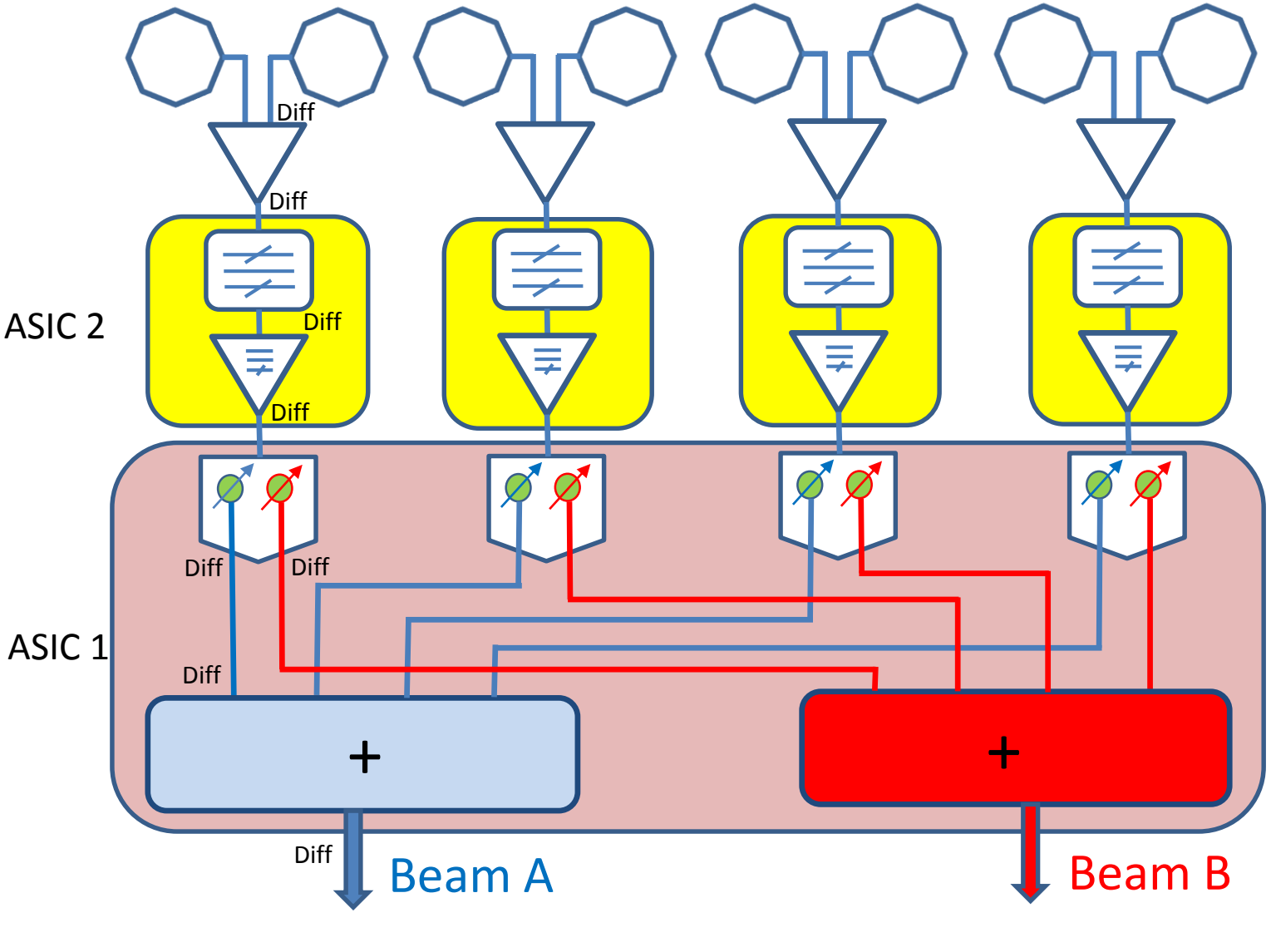
The Forward Planning

Planned Field Measurements





Differential Front-End Design based on ORA



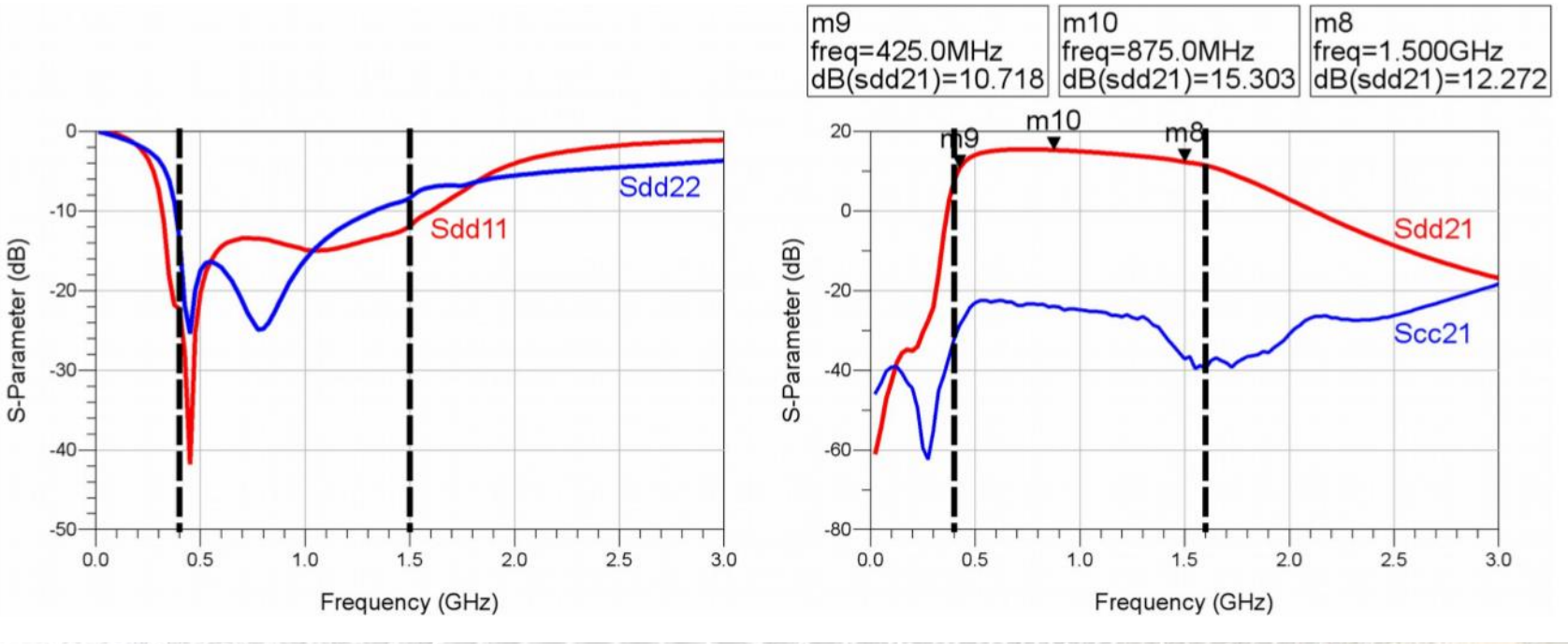
Power Consumption

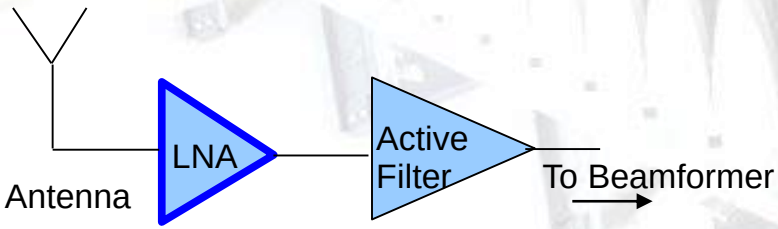
50 mW (High OIP2)

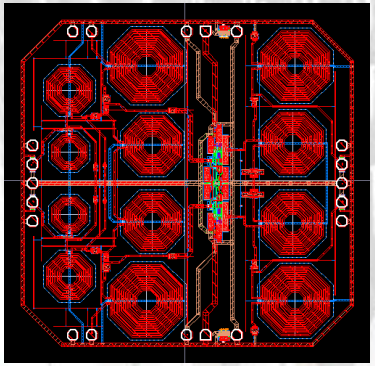
50 mW (High OIP2)

PhaseShifter	TimeDelay
450 mW	700 mW
4 CHs	4CHs
2 Beams	2 Beams
213 mW /CH /Polar	275 mW /CH /Polar

Active Filter measurement



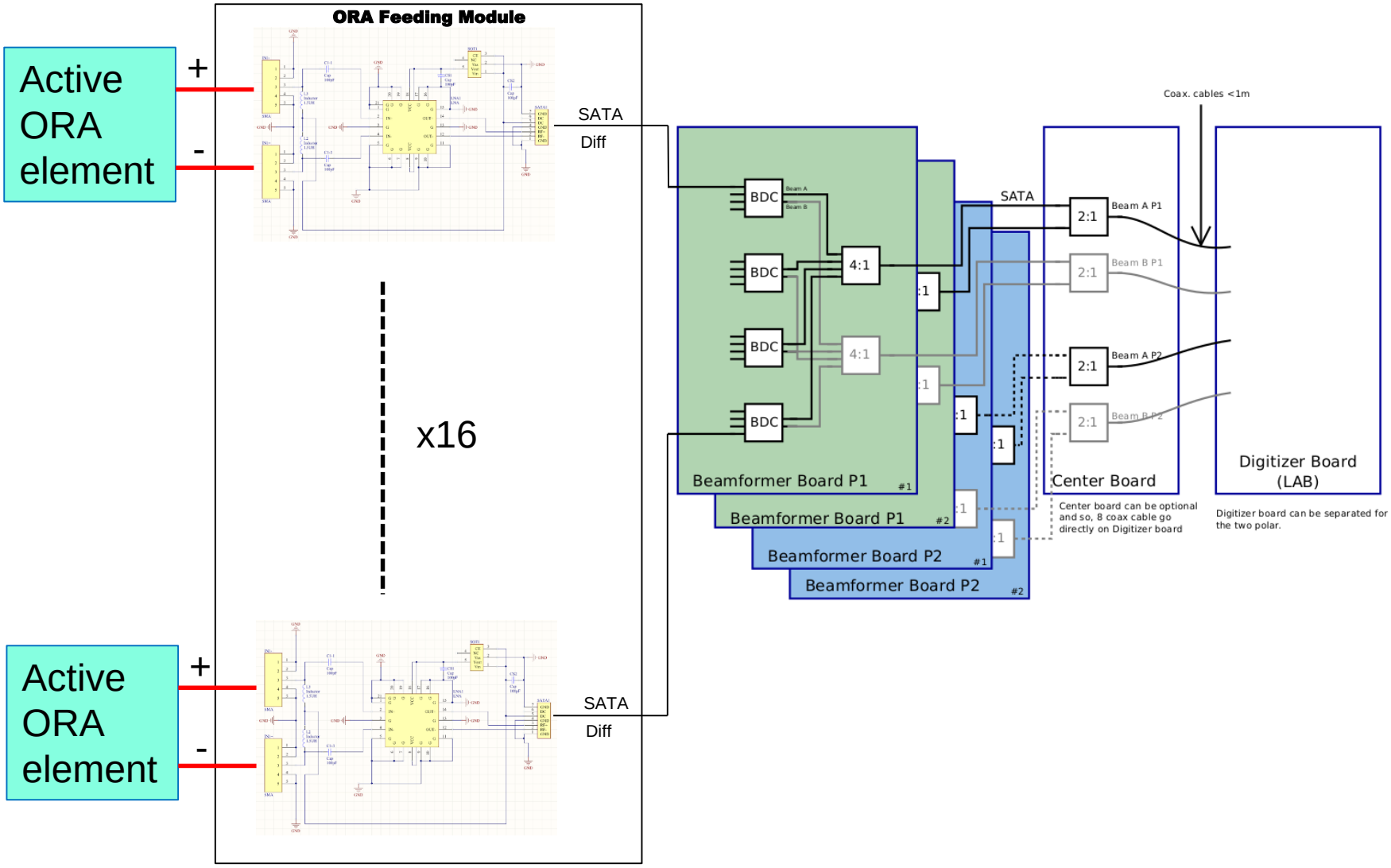




≈ 5 mm²

	Measure	
Impedance	Input	100 Ω
	Output	150 Ω
$P1dB_{min}$	-	
Pdc	39 mW @ 3,3 V	

The ORA Feeding Module



More Verifications on the following items

- More accurate NT measurement in a better RFI environment
- Pattern and gain measurements in an Anechoic chamber
- Bias for Front-End and Integration with the beamformer PCB
- Form Dual polarised beams
- 8 × 8 Analogue beamforming
- 8 × 8 Digital beamforming

Forward looking

- A whole AAMID system based on different front-end will be ready in due course together with the single-end AAMID system
- 30K receiver noise temperature in room temperature
- The power consumption of the LNA so far is still high, over 100mW, the aim is to be less than 50mW
- Closer link will be established between the front-end design and the back-end development for better integration of the system