

Abstract

ALBA is a 3GeV synchrotron light source located in Barcelona and operating with users since May 2012. The RF systems are based in IOT transmitters and a total of thirteen 80kW IOT amplifiers are used to power the Storage Ring and Booster cavities at 500MHz. A modular Solid State Power Amplifier (SSPA) has been proposed for an already designed active 3rd Harmonic RF system of the ALBA Storage Ring. This SSPA is aimed to provide up to 20kW power per cavity in a Continuous Wave (CW) mode at 1.5GHz nominal frequency. Accordingly, a 250W power amplifier module, as the primary unit, has been designed and tested. This SSPA system will be composed of modules of 1kW, combining four primary units. For these modules, a parallel combination array using a 4-way power divider/combiner of microstrip type has been designed and tested.

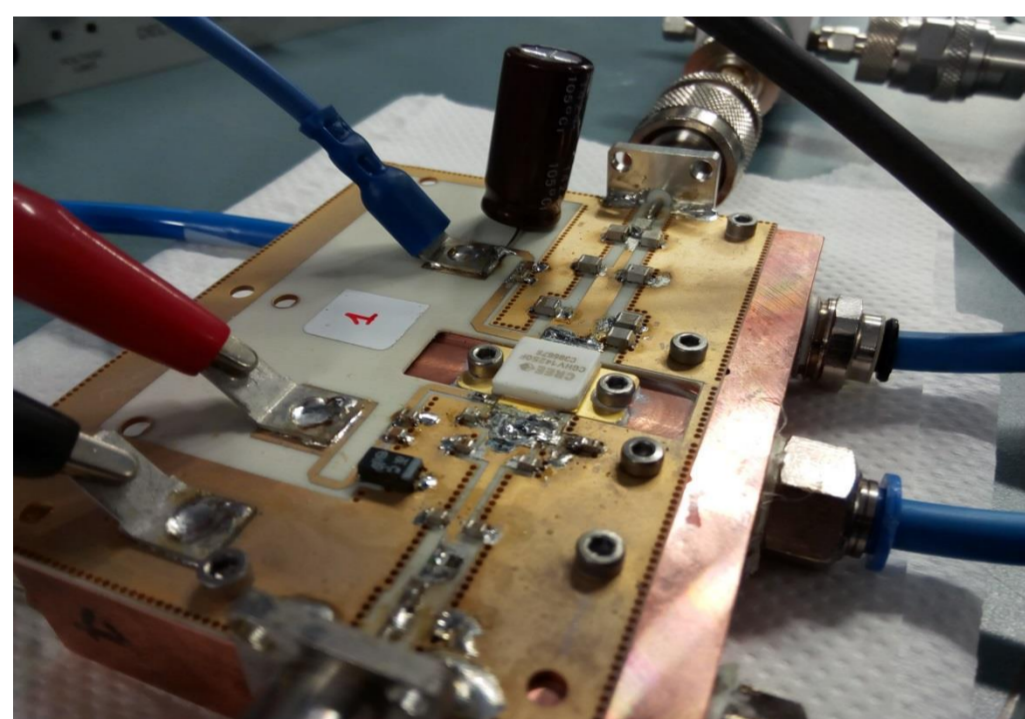
The measurement results showed a good agreement with the simulations. In this poster the design of the primary unit and combination array as well as their test results will be presented.

250W Power Amplifier Module

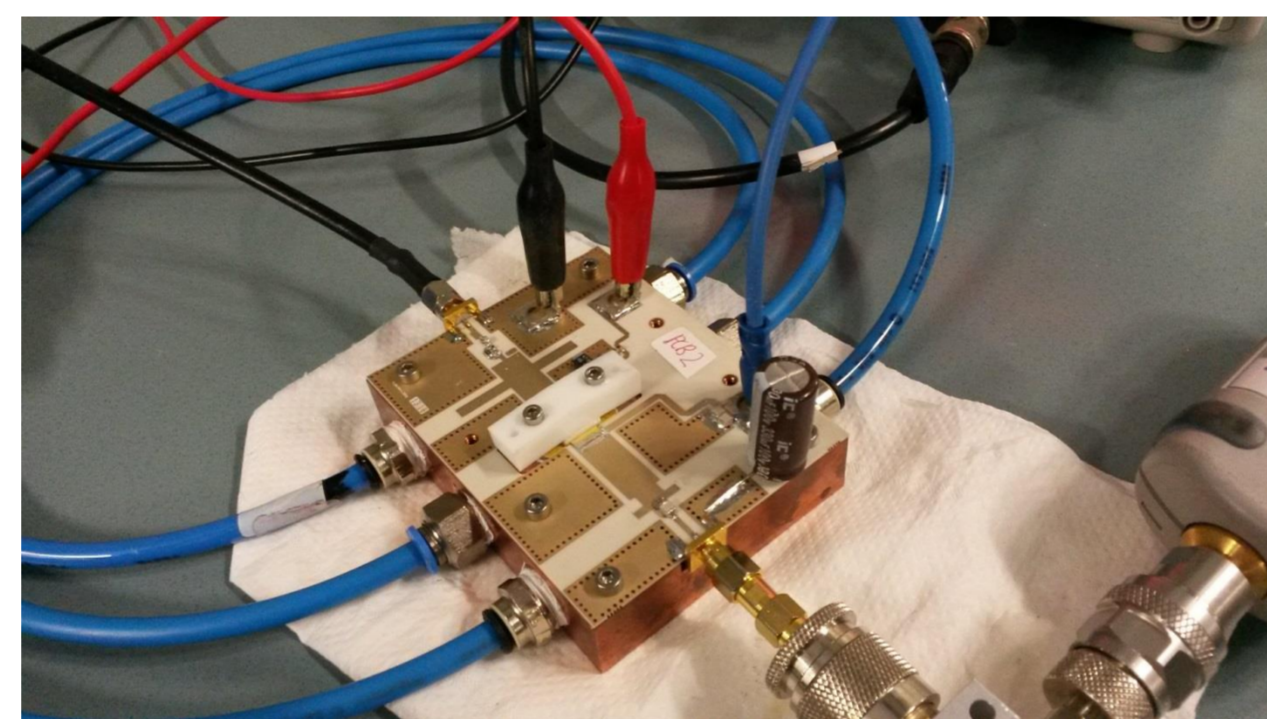
In this project three SSPA module have been designed. The transistor is of GaN from Cree(Wolfspeed) -CGHV14250- with 250W average power and more than 60% efficiency. The 1st SSPA, where capacitors had been used in the matching networks was unstable from (80-110 MHz) which obliged us to the 2nd SSPA. Due to thermal issues of the output matching capacitors while testing, the 3rd SSPA was designed with stubs to substitute the capacitors. The primitive measurement results for output power, gain and efficiency of these three designees are as in the table below.

In the following graphs 2nd and 3rd SSPA before tuning, with 3rd SSPA after tuning have been compared.

CW measurement results of designed High Power Amplifiers @ 1.5GHz				
Designed SSPA	Matching network type	output power (W)	Gain (dB)	Efficiency (%)
1 st	capacitor	unstable		
2 nd	capacitor	136	14.2	47.7
3 rd	stub	151	14.4	67



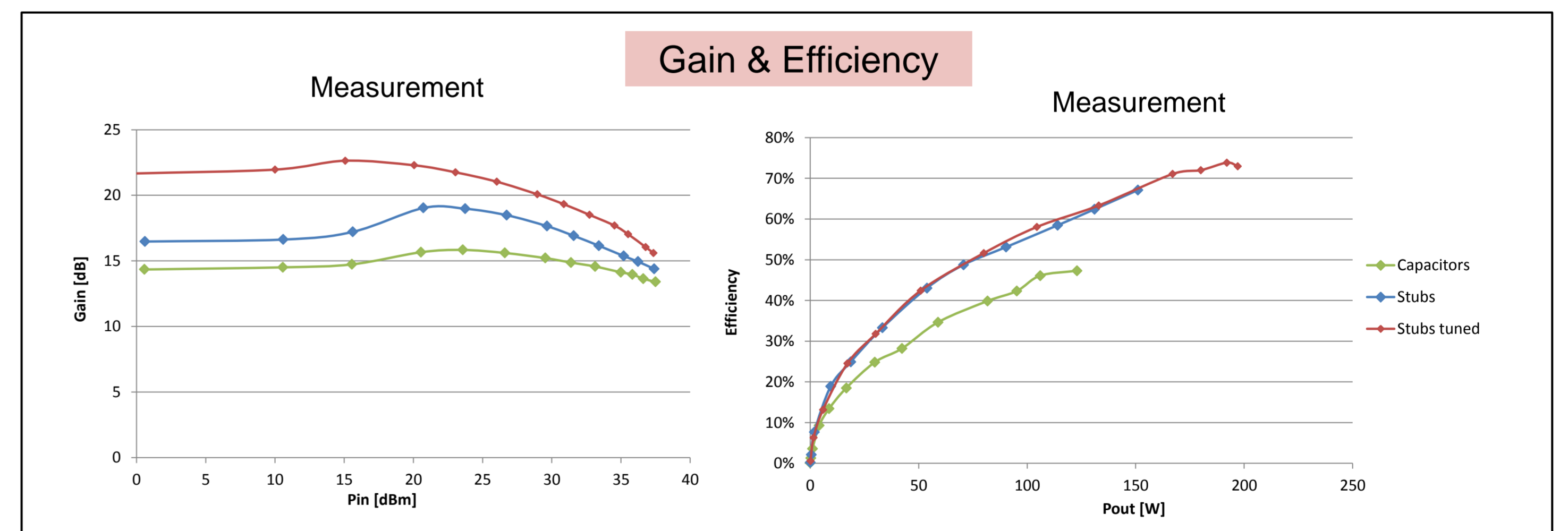
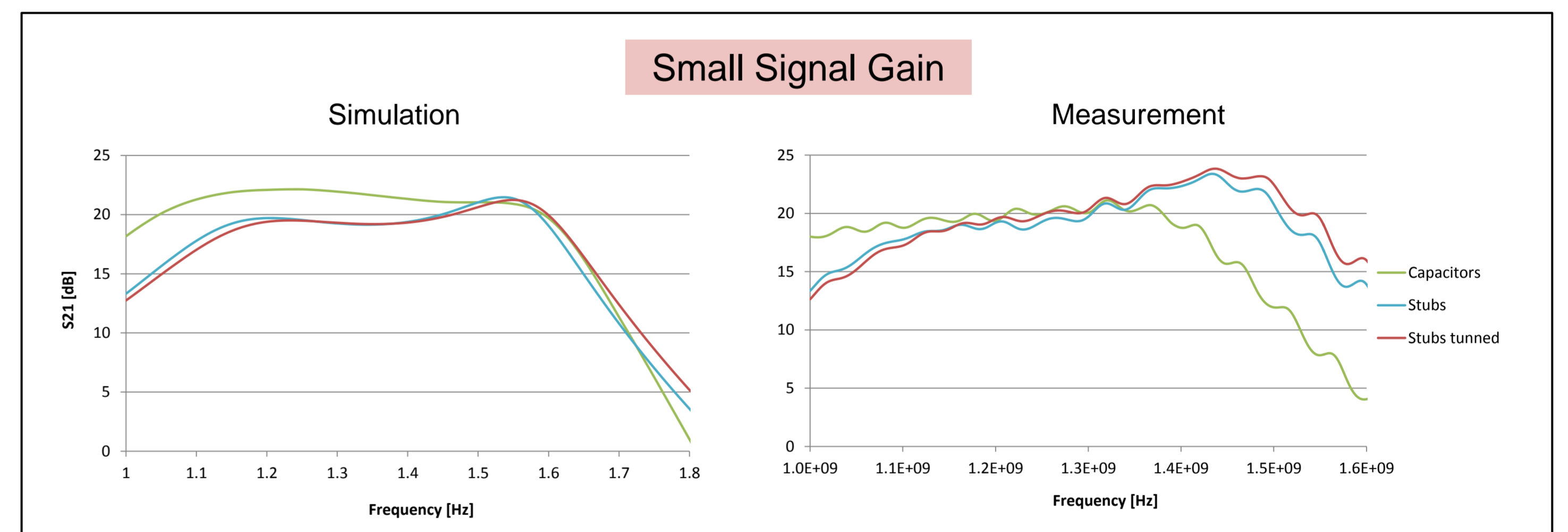
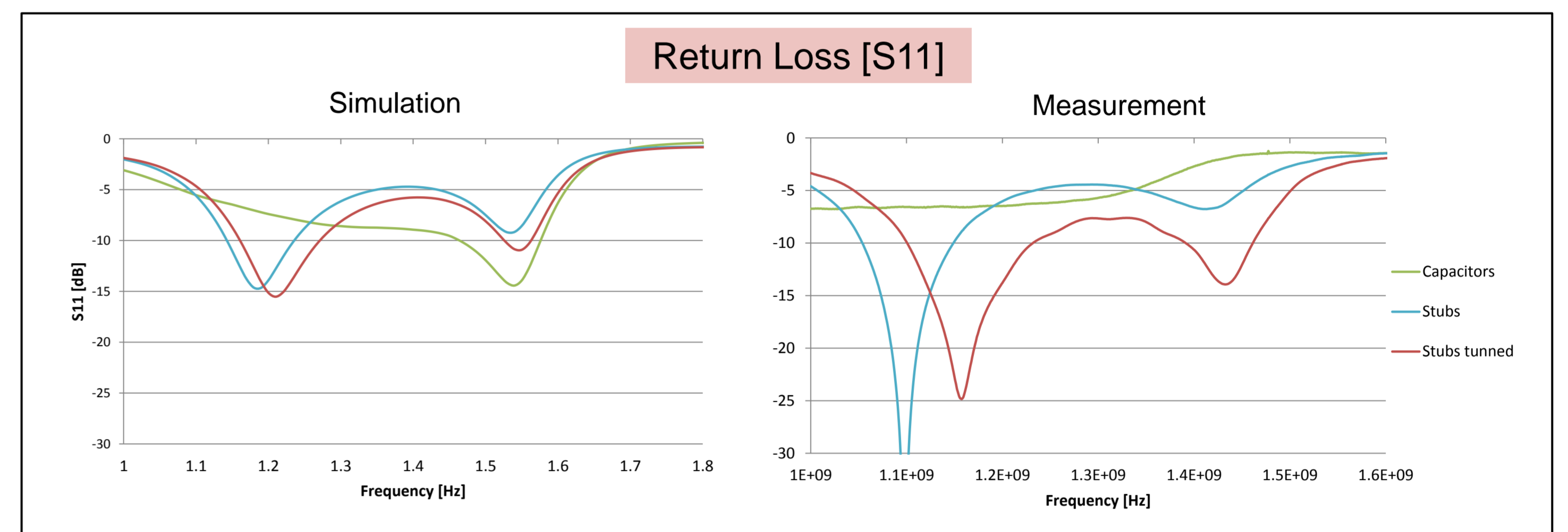
2nd SSPA



3rd SSPA

After some modifications in the 3rd SSPA, in terms of matching networks stub length, the overall specifications has been improved which is still ongoing.

Designed SSPA	Matching network type	output power (W)	Gain (dB)	Efficiency (%)
3 rd - tuned	stub	181	15.5	67



Power divider/combiner

For a 1kW Power Amplifier module at 1.5GHz, a 1:4 Wilkinson power combiner should be utilized to merge the output power of 4 SSPA modules in a parallel array. This power divider in a revers direction, has a functionality as a 4:1 power divider.

characteristics

- ✓ Dimension: 100 × 284 sq.mm
- ✓ Substrate: RT6035HTC
- ✓ Thickness: 18um
- ✓ Height: 1.6mm

PORT	Freq (GHz)	Insertion loss Amplitude (IL) dB		Insertion loss (IL) Phase	
		Simulation	Measurement	Simulation	Measurement
2	1.5	-6.090	-6.374	166.148	-120.675
3	1.5	-6.136	-6.324	166.398	-119.283
4	1.5	-6.152	-6.329	165.027	-119.648
5	1.5	-6.106	-6.260	164.730	-118.496

PORT	Freq (GHz)	Return loss (RL) - Measurement	
		Amp (dB)	phase
1*-2	1.5	-23.183	137.147
1*-3	1.5	-23.130	136.658
1*-4	1.5	-23.423	139.067
1*-5	1.5	-23.667	139.484

