M5HESTIA 60GHz-FI downconverter

The 60GHz downconverter architecture is presented on the figure 1

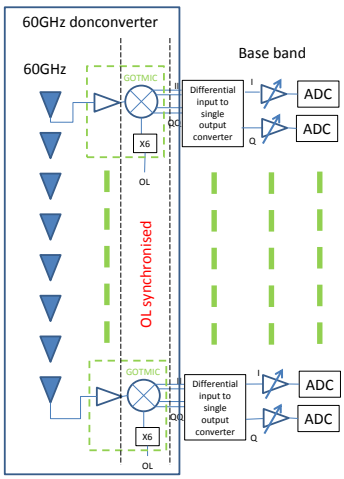


Figure 1: 60GHz downconverter architecture

The 60GHz is composed of three parts:

- The antenna array of primary source
- The downconversion 60GHz- FI
- The LO (Local Oscillator) distribution to ensure the synchronisation

1. The antenna array of primary source

Two topologies have been studied:

- DRA (Dielectric Resonator Antenna) with LTCC technology
- 2X2 patch array antenna with PCB technology

a. 60GHz DRA antenna

DRA antenna is a good candidate for millimeterwave antenna for several reasons:

- Good efficiency
- Wide frequency band
- Compatible with LTCC technology

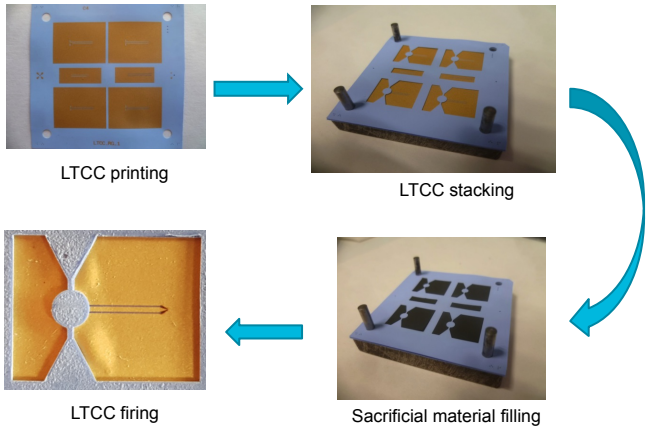


Figure 2: LTCC process

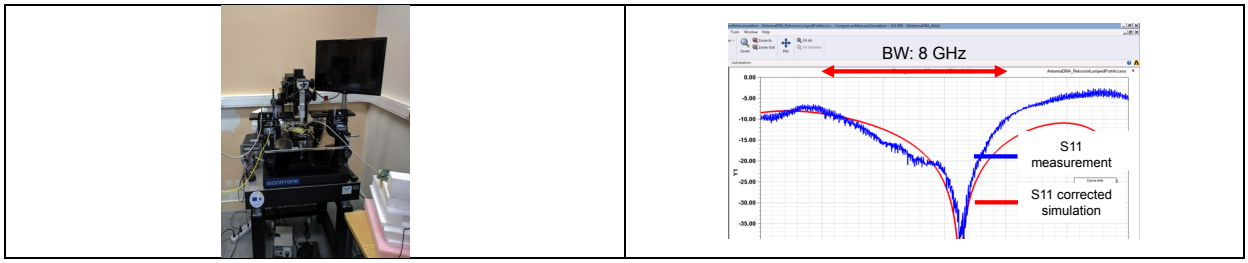


Figure 3: DRA antenna S11 measurement

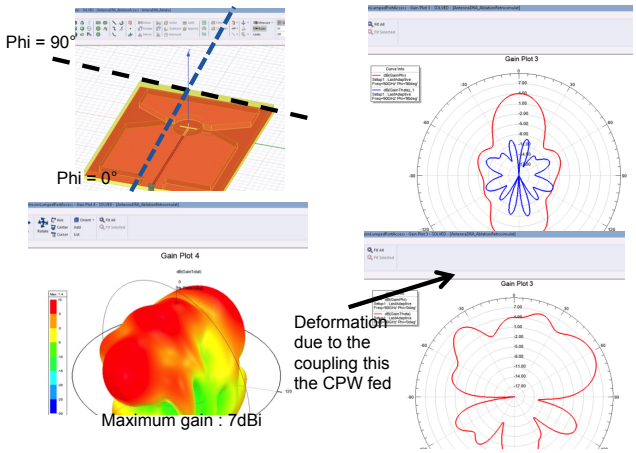


Figure 4: DRA radiation pattern

The performances are :

- Full half power beamwidth in H-plane 40°
- Maximum gain of 7 dBi at 60 GHz

b. 2X2 patch array antenna.

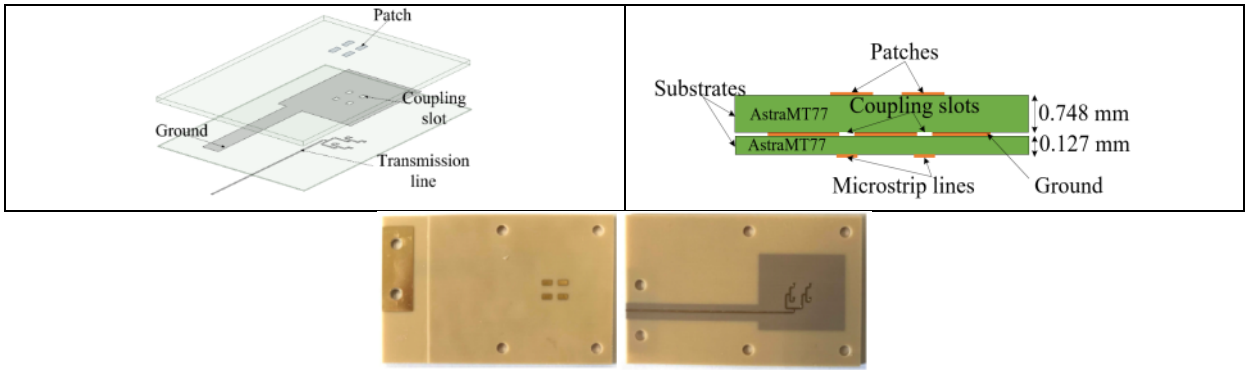


Figure 5: 2X2 patch array antenna

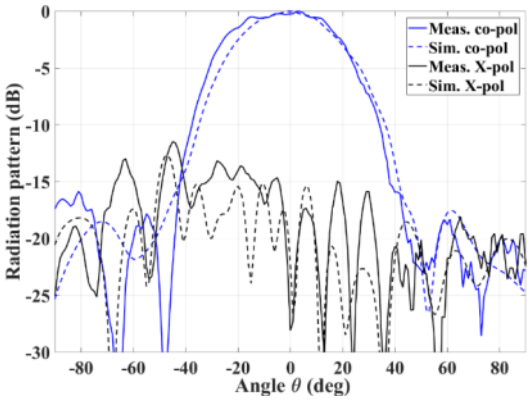


Figure 6: Radiation pattern measurement of the 2x2 patch array antenna

The performances are :

- Full half power beamwidth in H-plane 48.2°
- Gain of 8.1 dBi at 60 GHz and its 1-dB is larger than 6 GHz (10% fractional bandwidth)

c. Choice of topology and technology of the primary source

The choice of the PCB technology is justified by objective to minimize the transmission losses between the antenna and the downconverter chip. For that, PCB technology has been chosen with a substrate compatible for the antenna design and the integration of the chip.

In the project, the array of primary source should be interconnected to the 60GHz down converter for channel sounding application or to the B-COM platform for multi-users transmission. Then for the first prototype, interconnexion with coaxial cable and mini-SMP connectors has been adopted firstable to validate the antenna performance and to have a single design for both applications.

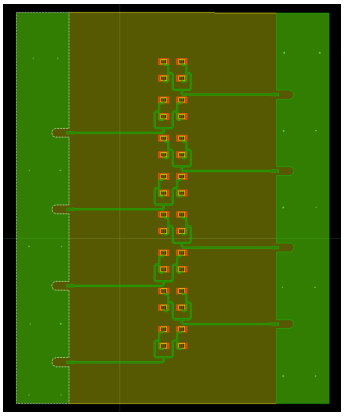


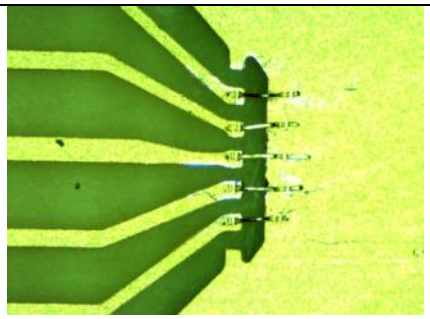
Figure 7: Layout of 8 primary sources antennas

2. 60GHz-FI Downconversion part

The downconversion is based on a commercial chip MMIC provided by GOTMIC. Due to the distance between input antenna imposed by the array antenna, the integration of the chip is a technological challenge with several constraints:

- Small place available
- Minimisation of the losses at 60 GHz
- Several technics of components report used : Bonding, soldering
- Need of several voltage supplies

Wire bonding machine



25 umØ wire bonding

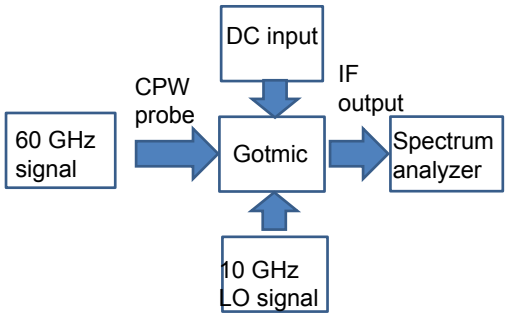
Figure 8: MMIC assembly at Lab-STICC (IMT Altantique)

Top side

Bottom side

Figure 9: First prototype

A specific test bench has been developed to characterize the module.



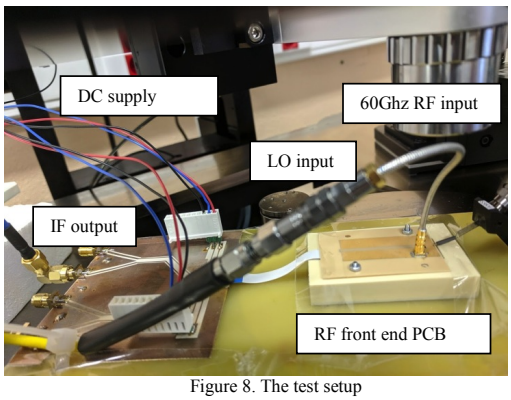


Figure 8. The test setup

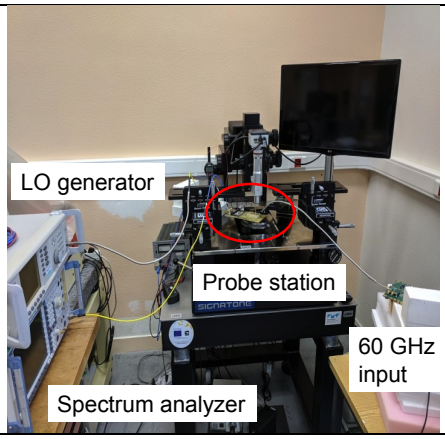


Figure 10: Schematic diagram of the 60GHz-FI Down-conversion test bench

The measurement results are presented on the figure 11.

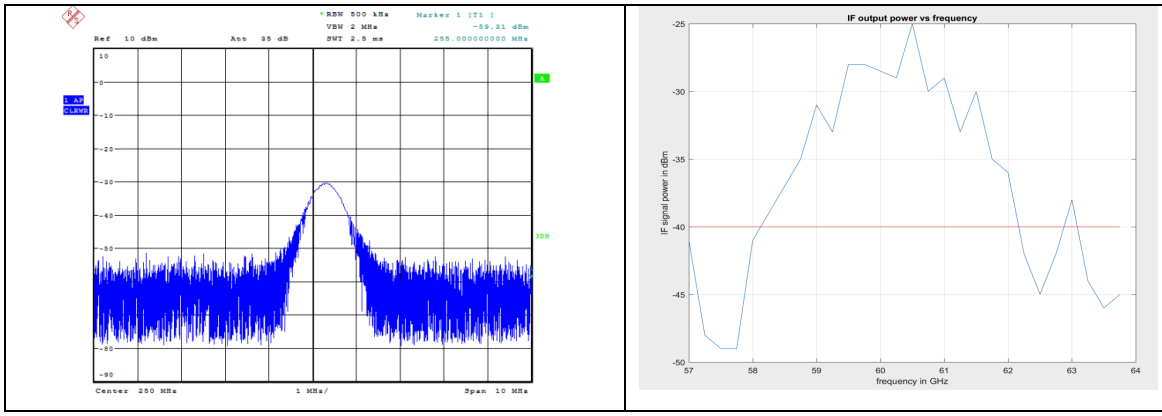


Figure 11: Output power in FI band

LO distribution for synchronisation

A PCB circuit has been design to distribute the same local oscillator signal for the 8 downconverter. The LO is generated from a Analog devices card with a tuning voltage of the frequency to fix the FI frequency depending on the equipment used (Vector Network Analyser, channel sounder,..)

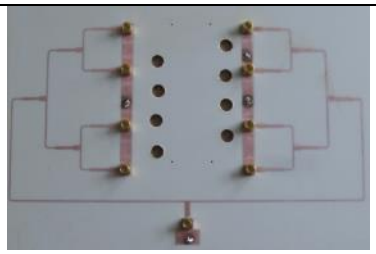
	
PCB LO distribution	10GHz VCO

Figure 12: LO distribution circuit for synchronisation