RF ANALOG FRONT-END

Burak ESER , Burak GAZEL , Onur Can ERKILIÇ

Prof.Dr. Cenk TOKER

Electrical and Electronics Engineering, Hacettepe University

INTRODUCTION

In the scope of RF Analog Front-end Project, RF hardware is designed and constructed to be used as transmitter and receiver front-ends. The 5G technology will initially be working in 3.5 GHz band, that is why this project is also designed for the same frequency band. The front-end requires the inclusion of several blocks which are RF synthesizers, mixers, filters and phase shifters.

SOLUTION METHODOLOGY

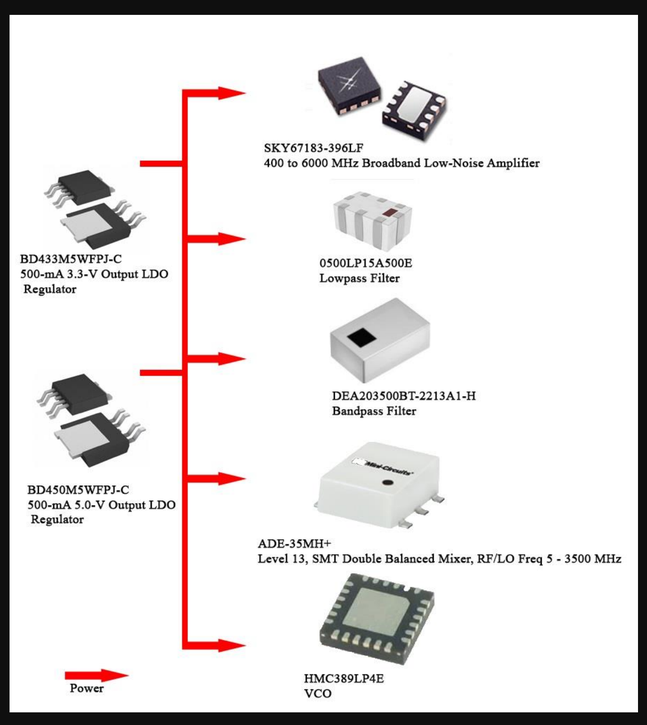

Figure 1. Receiver Components

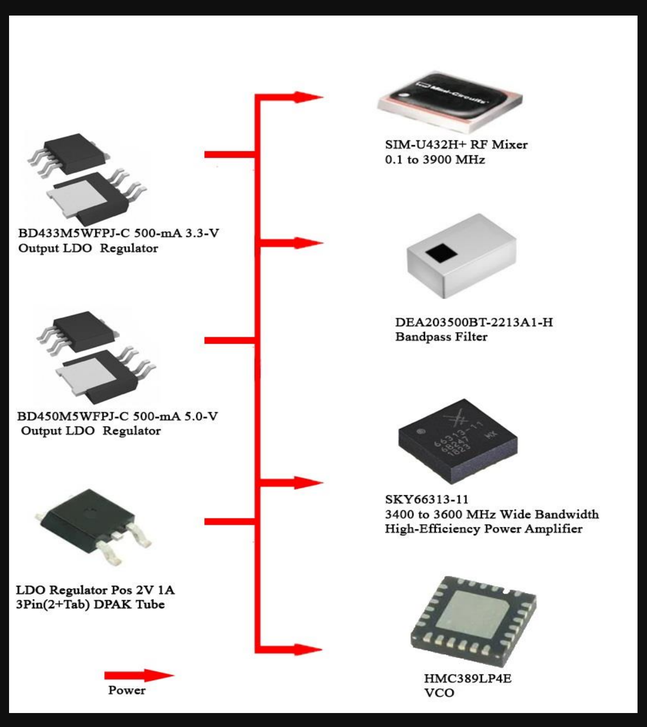

Figure 2. Transmitter Components

To achieve the best possible specifications, many components are investigated from several databases and the components that give the optimum performance are selected.

The noise figure and gain are calculated with the equations given below.

$$G(dB) = G_1 + G_2 + G_3 + \ ...$$

Equation 1. Total Gain

$$NF\ (dB) = 10\log_{10}(nf_1 + \frac{nf_2}{G_1} + \frac{nf_3}{G_1 G_2} + \ ...)$$

Equation 2. Total NF

DESIGN SPECIFICATIONS

Operation Frequency	3.5 GHz
Bandwidth	200 MHz
Transmitter Noise Figure	6.12 dB
Transmitter Gain	28.89 dB
Receiver Noise Figure	0.72 dB
Receiver Gain	9.49 dB
No Out-of-Band Emissions	
Protects Signal Integrity	

RESULTS AND DISCUSSION

- The simulations of the architecture of receiver and transmitter front-ends are made in GNU Radio and MATLAB Simulink. Resulting waveforms taken from GNU Radio is shown below.
- By using the selected components, PCBs are designed and realized. The boards can be seen below.

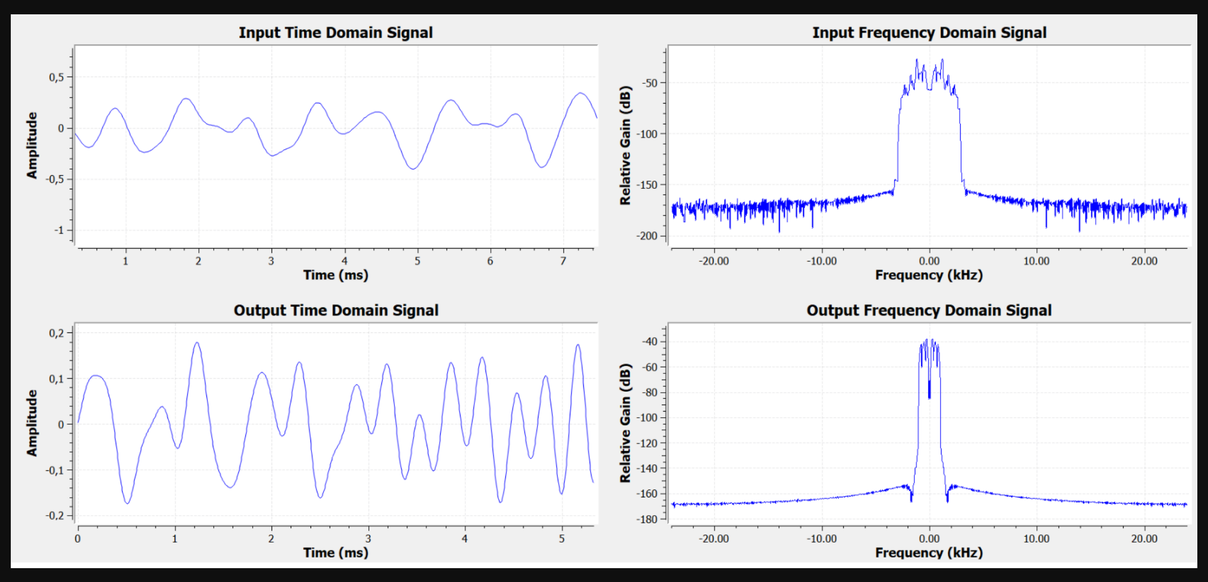

Figure 3. Resulting Waveforms from GNU Radio Simulation

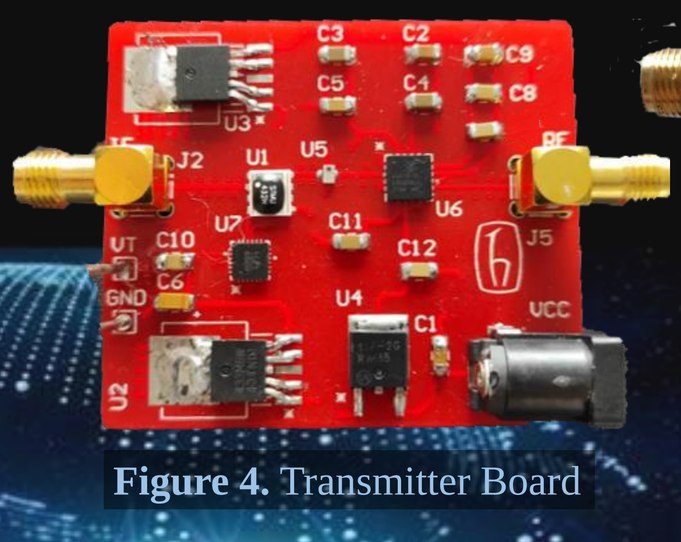

Figure 4. Transmitter Board

Figure 5. Receiver Board

ACKNOWLEDGEMENTS

This project was completed within the context of ELE401-402 Graduation Project courses in Hacettepe University, Faculty of Engineering, Department of Electrical and Electronics Engineering.

We thank Prof. Dr. Cenk TOKER for his invaluable contributions to our project. Special thanks to MATLAB, GNU Radio and Altium for their software used during development.