

Design of Switch-LNA module for Spectrum Sensing RF Receiver in Cognitive Radio

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Abstract

In this paper, we present the design, fabrication and measurement of switch-LNA module for spectrum sensing RF receiver for the cognitive radio in TVWS (470 ~ 698 MHz). The switch-LNA module consists of two LNAs and band-pass filters between two switches. A switch-LNA module is designed to have two signal paths for wide dynamic range, so that one of two paths is selected depending on input power levels. For high input powers, path A, which has a band-pass filter only without gain, is selected. On the other hand, path B is turned on for low input powers, containing amplifiers and band-pass filter with a high gain. The measurement result of fabricated switch-LNA module shows S_{21} (insertion loss) of -2 dB in path A and 36 dB in path B, which corresponds to the dynamic range of 38 dB.

Keywords: cognitive radio, LNA, TVWS, spectrum sensing.

1. Introduction

Due to the rapidly increasing supply of wireless communication devices and service, there is a increasing demand for the use of limited frequency resource. CR (cognitive radio) technology is one of the solutions for usage of limited frequency resources. Spectrum sensing, a method to identify an unused spectrum, is needed in CR technology. Many researches of spectrum sensing RF receiver in TVWS (470 ~ 698 MHz) have been carried out [1~3].

In this work, switch-LNA module for spectrum sensing RF receiver for the cognitive radio in TVWS is designed and fabricated. There are two signal paths to increase dynamic range in the designed module. Each path is selected by the switches according to input power level. A designed module also utilizes band-pass filter to enhance frequency selectivity. The measurement result of designed module shows

dynamic range of 38 dB and improved frequency selectivity.

2. Design of switch-LNA module

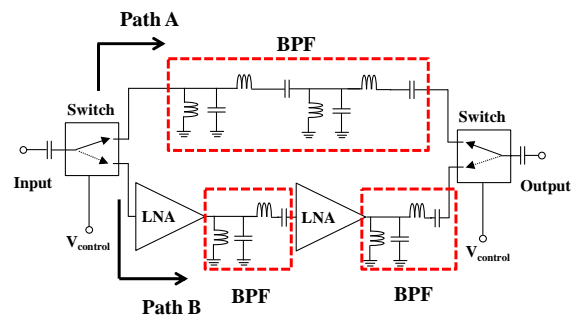


Fig. 1 Schematic of designed switch-LNA module.

Fig. 1 shows the schematic of designed switch-LNA module consisting of two paths for wide dynamic range. Path A consists of band pass filters (BPF) only for improved frequency selectivity without any gain component. For high input power, path A is selected without signal amplification. The BPF was designed using series and parallel resonators with pass-band in TVWS.

The role of another path (path B) is signal amplification for low input power. There are two LNAs and BPFs in path B. Each LNA has a gain of 20 dB in 400 ~ 2000 MHz. The BPF is added after LNA to improve frequency selectivity in TVWS. When input signal power is low, path B is selected by using switches. SPDT switches are used in the input and output of the module, to pass the signal to one of the paths.

3. Experimental result

The designed module was fabricated on a 1.5-mm thick substrate with relative permittivity of 3.0 (RO 3003 from Rogers). The commercial products were selected for LNA (TQP3M9036) from TriQuint and

switch (HMC348LP3) from Hittite. Fig. 2 shows the photograph of the fabricated module. The size is 70 mm \times 17 mm.

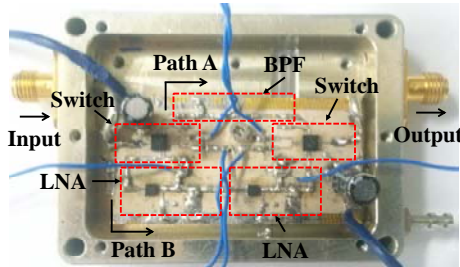


Fig. 2 Fabricated switch-LNA module.

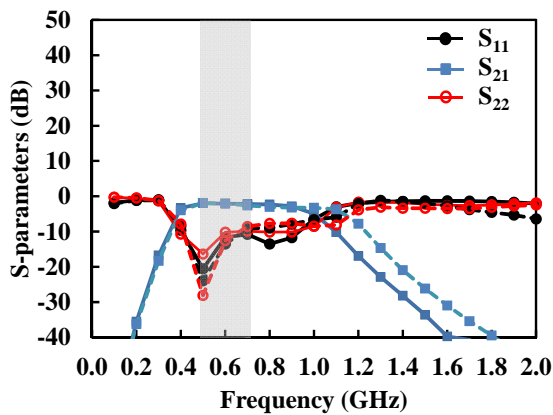


Fig. 3 Measurement result of path A (slotted lines: simulation, solid lines: measurement)

Fig. 3 is the measured s-parameters in path A with S_{21} (insertion loss) of -2 dB, S_{11} (return loss) of -9.6 ~ -20 dB, and S_{22} of -10 ~ -20 dB in TVWS (470 ~ 698 MHz).

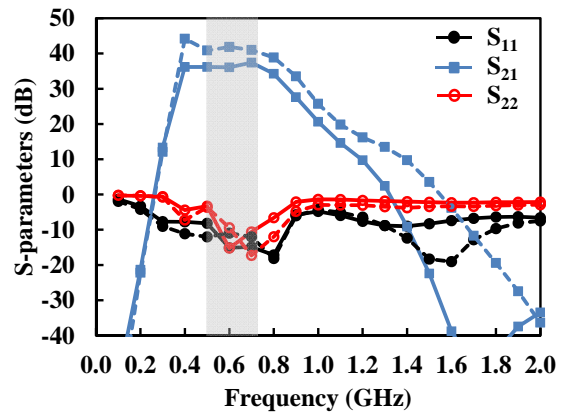


Fig. 4 Measurement result of path B (slotted lines: simulation, solid lines: measurement)

Fig. 4 shows the measurement result of S-parameters in path B. It shows S_{21} (gain) of 36 ~ 37 dB, S_{11} (return loss) of -7 ~ -16 dB, and S_{22} of -2.7 ~ -12 dB in TVWS. Most of the measurement results are similar to simulated ones, although the measured S_{21} (gain) of path B shows some discrepancy with simulation. This difference seems to be due to parasitic effects in passive component. The fabricated switch-LNA module shows dynamic range of 38 dB.

4. Conclusion

In this paper, we presented the design, fabrication and measurement of switch-LNA module for spectrum sensing RF receiver for the cognitive radio in TVWS. The designed module shows 38 dB of dynamic range and improved frequency selectivity in TVWS. This result shows that the switch-LNA module can get an additional dynamic range for spectrum sensing RF receiver.

Acknowledgements

This research was funded by the MSIP (Ministry of Science, ICT & Future Planning), Korea in the ICT R&D Program 2013.

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