

A Wideband CMOS On-Chip Terahertz Frequency Detector With Slow Wave Structure

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Introduction

- Terahertz frequency band is being actively researched due to its strength in physical bandwidth and spatial resolution.
- Measurement setup for the terahertz MMICs require bulky and expensive instruments which makes system characterization challenging.
- In this work we propose an on-chip frequency measurement solution which could ease the system characterization and further provide a method for on-chip self calibration circuit.

System Design

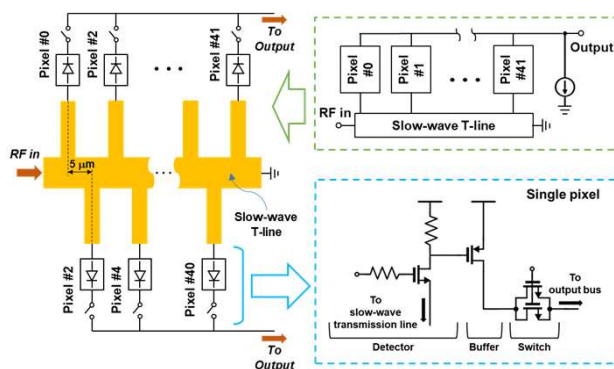


Fig. 1. Basic structure of the implemented frequency detector

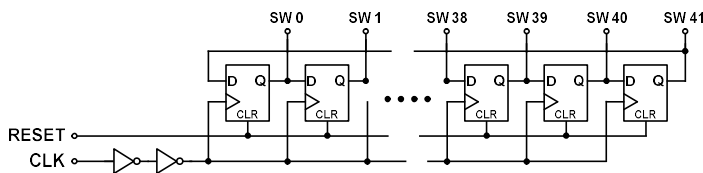


Fig. 2. On-chip integrated flip-flop-based clock distribution network

- Fig. 1 shows the basic structure of the proposed frequency detector, which consists of a shunt transmission line, multiple lead lines formed along the line, pixel detectors, and switches.
- The shunt transmission line with multiple lead lines to the pixel detectors behave as a slow-wave structure, which enables compact design.
- For the pixel power detector, a common gate square-law detection stage followed by a buffer stage was implemented.
- The detected output voltages of each pixel detectors were converted to serial data for off chip data processing via pixel switched and on-chip clock distribution network depicted in Fig.2.

Measurement

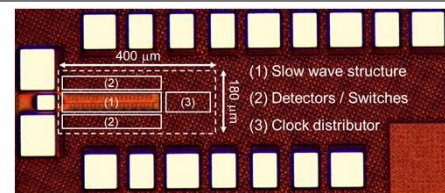


Fig. 3. Chip photo of the frequency detector

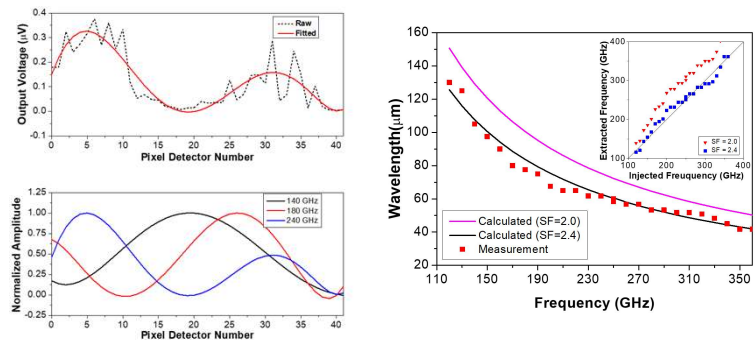


Fig. 4. Measurement results of the frequency detector

- The designed frequency detector was implemented in a 65 nm CMOS technology and consumed area of 400 μm x 180 μm as in Fig. 3.
- The measurement results are shown in Fig.4. The sampled and reconstructed waveform can be seen in Fig.4 (a) and the accuracy of the detected frequency can be seen in Fig.4 (b).

Conclusion

- A wideband on-chip frequency detector based on a slow wave structure and integrated power detectors have been introduced.
- The ideal detection range of the structure is calculated to be between 82 GHz to 3.75 GHz.
- The detector was experimentally verified between 120 to 360 GHz due to limitation in measurement instruments.

Acknowledgement

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Reference

- [1] D. Kim et al., "A Wideband CMOS On-Chip Terahertz Frequency Detector with Slow-Wave Structure," in *IEEE Microwave and Wireless Components Letters*, doi: 10.1109/LMWC.2021.3070401.