Volodymyr SOKOLOV, Artem PLATONENKO, Lidiia KUZMENKO, Volodymyr BURIACHOK

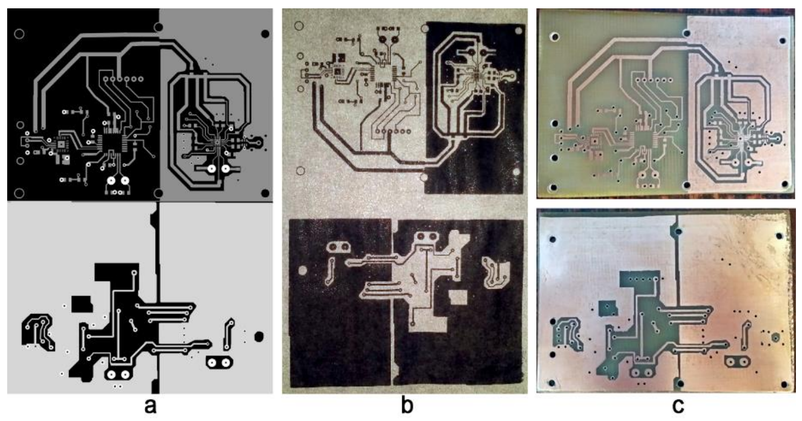
DEVELOPMENT OF LOW-BUDGET SPECTRUM ANALYZERS FOR IOT AND SENSOR NETWORKS

The article describes the development, implementation, and research of the work of spectrum analyzers for sensor networks and IoT (2.4 GHz). Comparative analysis of existing available microcontrollers for spectrum analysis, selection of hardware interfaces, ordering of required modules, and electrical components. Several variants of spectrum analyzers were implemented during development.

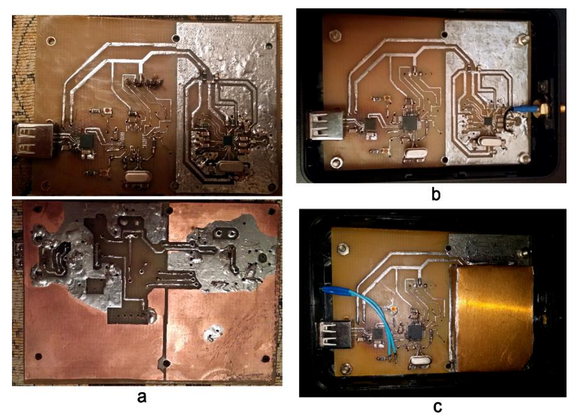
This article addresses the main issue of securing information transmission in wireless systems: its accessibility. When designing a wireless network, it is not possible to anticipate all the nuances: re-reflection, shading, the directionality of the antennas of the receivers, etc., so after the construction of a real system, you need to check it and reduce the impact of negative factors. Spectrum analyzers help solve this problem.

To analyze the integrity of the data transfer, we will use a hardware spectrum analyzer built on a radio transceiver.

Spectrum analyzer PCB on Chipcon CC2500:
- in the graphic editor (a);
- thermal paper with the printed circuit board (b);
- finished board (c)



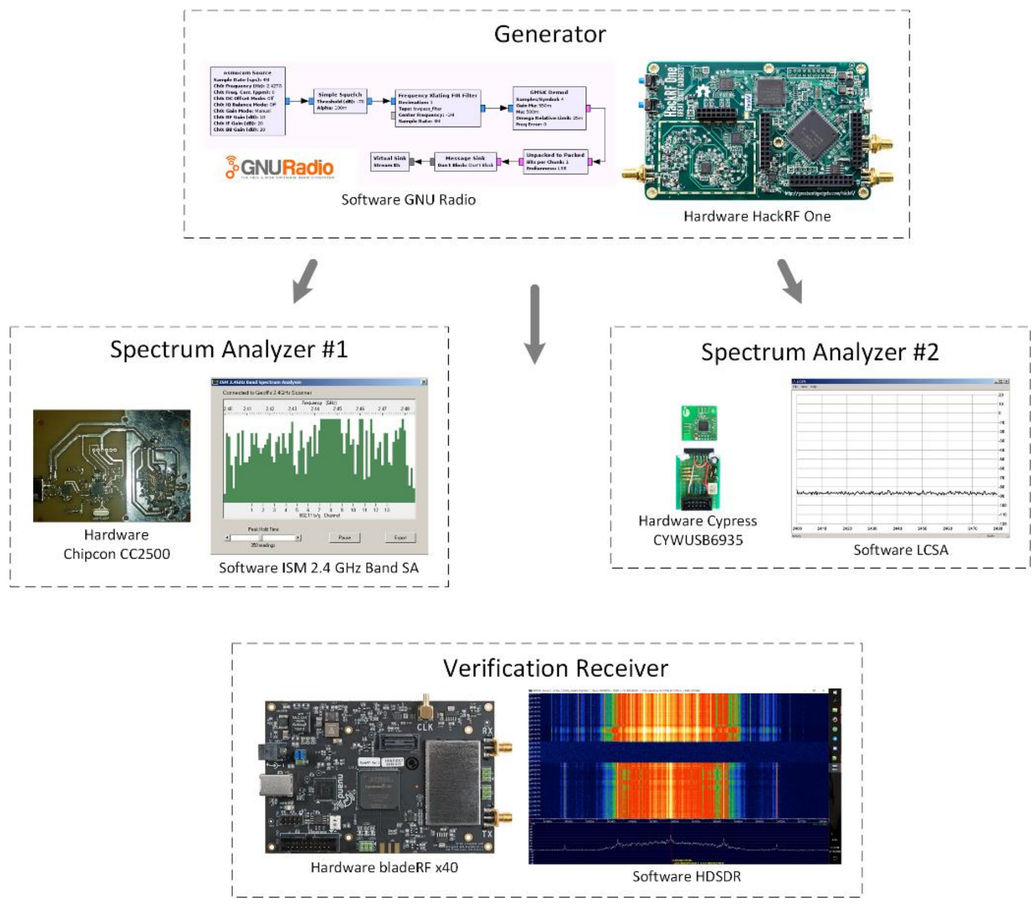
Chipcon CC2500 spectrum analyzer board:
- with mounted elements (a);
- installed in the housing (b);
- with a soldered screen (c)



CYWUSB6935-Based LPT Analyzer and CYWUSB6935-Based USB Analyzer

General view of all spectrum analyzers

Calibration scheme for hardware spectrum analyzers



The article presents the results of designing and manufacturing spectrum analyzers on pre-made components (ICs for IEEE 802.15.4/ZigBee). The process of designing, manufacturing printed circuit boards, collecting devices, and programming microcontrollers are described in detail. Testing and improvement of existing devices were carried out. The wiring of the board revealed the dependence of the quality of work of the device on the quality of its assembly, the presence of an electromagnetic screen, and the type of antenna.

The article uses third-party software, as well as software developed at the Department of Information and Cyber Security to analyze data collected from different spectrum analyzers. After detailed testing and testing of the devices, we concluded that a more compact solution for serial production of devices could be made.

Possible areas for further research include deeper statistical analysis, improved approaches to information measurement, and forecasting. In the future, these devices can be integrated into the software complex of the situational center, which consolidates the work with various low-budget models of analyzers of the spectrum of a given frequency range.