

Front-End Communication System-: Recent & Emerging Trends

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The recent security requirement has revealed an intensive data gathering for fiber or radio communication. Besides the fiber technology, there are varieties of wireless activities, which are typically analyzed by off the air monitoring. The spectral density of signals these days is very high and therefore such monitoring receivers require high performance. The technique in designing such receivers is a composition of microwave engineering of the building blocks preamplifier, mixer, synthesizer and necessary filters and this presentation will cover important highlights about pros and cons of these designs. What is needed: high dynamic range, typically the highest in the frequency range between 80 and 160 MHz, as the broadcast band is full of strong signals (80- 109 MHz) and the frequency range above covers the aircraft radio band, the amateur radio band (144-148 MHz) and the mobile communication above the 160 MHz [1]-[3].

A typical receiver consists of an input stage, first mixer stage including the necessary synthesizer, a possible second mixer stage, and then the output is fed to signal processing down at the IF level of choice. There is a variety of important receiver parameters. The noise figure determines the minimum discernible signal, sometimes also called minimum detectable signal, typically expressed in dBm and overall dynamic range, the key intermodulation distortion products [1]-[2]. System noise and noise floor defines the spurious free dynamic range. Second order intermodulation distortion products can be reduced by the appropriate input filters. This signal is then up converted to an IF of about 20 GHz using a highly cleaned-up LO chain (detailed schematics will be shown in full length paper). This is achieved by frequency-doubler and very large amount of filtering of the signals. Spectral purity of the oscillator chain is of the essence. Finally, a second converter is used to down convert the signal to the IF level. This arrangement allows a very high performance signal analysis. Fig. 1 shows a frequency panorama display and a waterfall time event. On the left hand of the frequency display, there are a large number of FM broadcast stations, and on the right side shows air traffic control frequency range, police and other mobile radioactivity. The waterfall display shows the various transmissions, which are useful for frequency occupancy analysis over time, and the spectral display shows a range where demodulation of transmission is possible while observing all the activity. Fig. 2 shows a five-channel arrangement for signal analysis. The wideband monitoring receiver can handle five individual channels simultaneously, including transmission monitoring. In this case, two ATC frequencies and two FM broadcast stations. The systems performance s determined by hardware, firmware and software. Even if everyone has access to the same chip-set the implementation may differ depending upon the market price of the equipment. The detailed implementation of modern receivers will be shown in full-length paper.

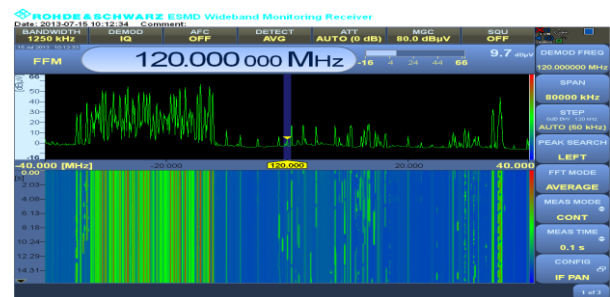


Fig. 1: Wide bandwidth waterfall



Fig. 2: Five channel arrangement for signal analysis

- [1] U. L. Rohde and A. K. Poddar, "A Digital Frequency Synthesizer Using Adaptive Mode-Coupled Resonator Mechanism for Low Noise and Low Jitter Applications", IEEE International Symposium on Circuits and Systems (ISCAS), pp. 414-417, May 15-18, 2011, Brazil
- [2] Ulrich L. Rohde and David Newkirk, "RF/Microwave Circuit Design for Wireless Applications", John Wiley & Sons, April 2000, ISBN 0-471-29818-2
- [3] James Tsui, Special Design Topics in Digital Wideband Receivers, 2010