WSA5000 analog operating bandwidths

Introduction

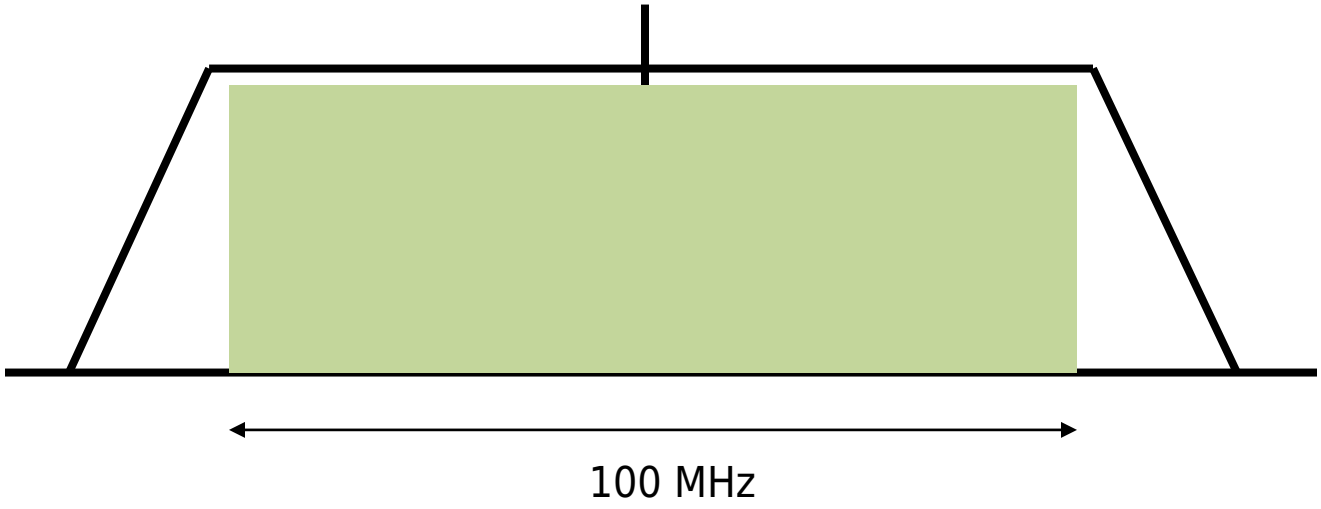
The three main analog radio receiver architectures are super-heterodyne, direct-conversion and direct-digitization. Each of these architectures have their benefits and disadvantages as described in [1], thereby making them better or less suited for specific applications. For instance LTE signal reception and demodulation benefits from the direct-conversion architecture, while the super-heterodyne architecture is better suited for applications such as RF component characterization. The WSA5000 integrates multiple receiver architectures thereby providing optimal flexibility and supporting a diverse range of applications.

This document complements [1] and describes the widest analog bandwidths supported by the WSA5000. These bandwidths are determined by the anti-aliasing filters that precede the analog-to-digital converter in the receiver. Cascaded integrator-comb and finite impulse response DSP filters within the FPGA can be used to further filter digitized signals.

[1] N. Adnani, T. Hember, T. Helaly, M. Farhan and I. Ward, "Wideband 20 GHz RF Digitizer and Python-based Open Application Framework for Test and Measurement," Autotestcon 2013.

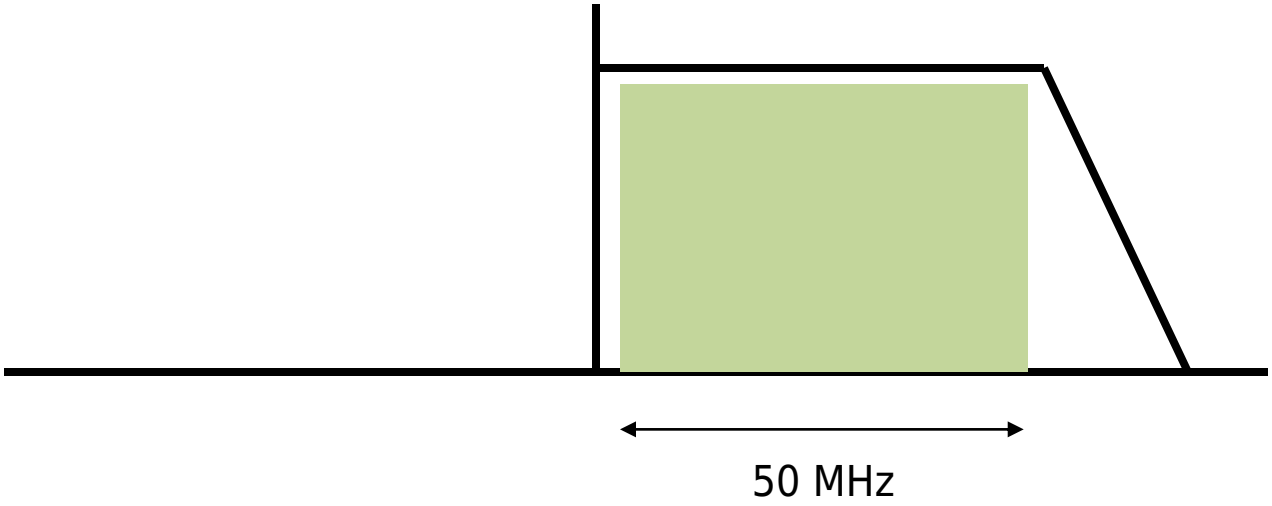
100 MHz bandwidth

In the widest bandwidth mode of operation the WSA5000 is configured as a direct-conversion receiver. This mode is well suited for applications such as ISM band signal analysis; LTE signal processing and RF data acquisition. Direct conversion receivers typically have artifacts such as DC and IQ offsets. While DC offset correction is to a large extent managed within the hardware, IQ offsets must be corrected in software. ThinkRF provides sample code to accomplish this.



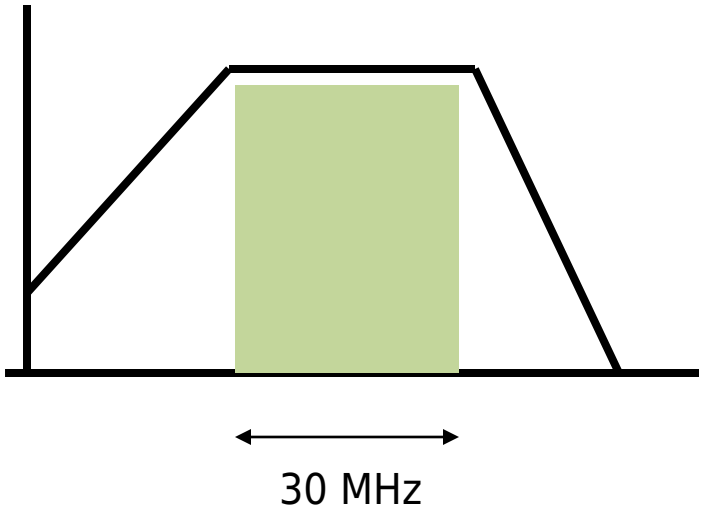
50 MHz bandwidth

One half of the down-converted spectrum in a direct-conversion receiver can used to process up to 50 MHz of RF bandwidth. This mode of operation is well-suited for applications where the input signal is known; for example a Wi-Fi signal processing application in a lab environment. The 40 MHz signal can for instance be centered at 30 MHz and processed. The main benefit is the absence of direct-conversion receiver artifacts. There will however be wrap-around when the signal bandwidth exceeds 50 MHz.



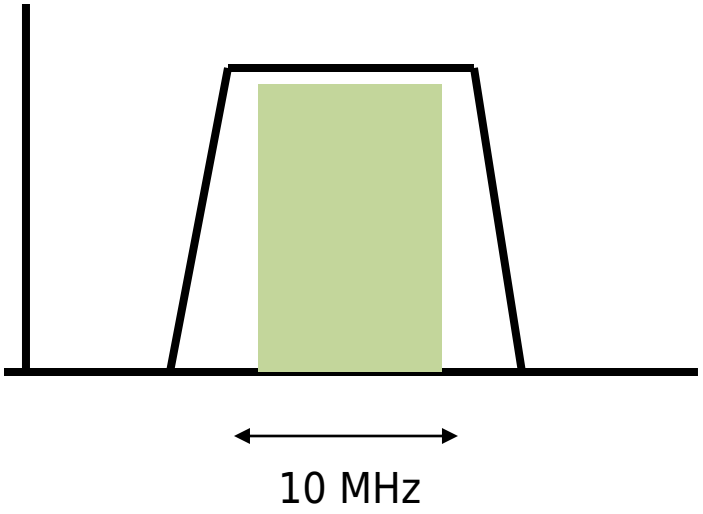
30 MHz bandwidth

The WSA5000 has a super-heterodyne mode of operation that allows the processing of signals with a bandwidth of up to 30 MHz. The roll-off of this filter is however not symmetric around its center frequency and as a result there will be a little (to be quantified) wrap-around resulting from signals in adjacent bands having an amplitude at the high end of the receiver dynamic range.



10 MHz bandwidth

The WSA5000 has a narrower 10 MHz super-heterodyne mode of operation. The roll-off of this filter is symmetric around its center frequency of 35 MHz. This mode is most suitable for applications such as demodulation of video and narrower bandwidth signals.



100 kHz bandwidth

The narrowest analog bandwidth supported by the WSA5000 is 100 kHz. The narrowband analog filter that supports this bandwidth precedes a high-dynamic range 24-bit ADC. This bandwidth is useful for applications that include RF component and device characterization; in particular the dynamic range enables measurement of third-order intermodulation products. As well it enables the detection of very weak signals.