R5XX0-XXX

Analog Operating Bandwidths

Introduction

The three main analog radio receiver architectures are super-heterodyne (SH), direct-conversion and direct-digitization (DD). Each of these architectures have their benefits and disadvantages as described in [1], thereby making them more or less suitable for specific applications.

For instance wideband signal detection benefits from the DC architecture, while the SH architecture is better suited for applications such as spectrum analysis and signal demodulation. The ThinkRF Real-Time Spectrum Analyzer (RTSA) R5XX0-XXX (namely R5500/R5550/R5700/R5750-XXX) integrates multiple receiver architectures thereby providing optimal flexibility and supporting a diverse range of applications.

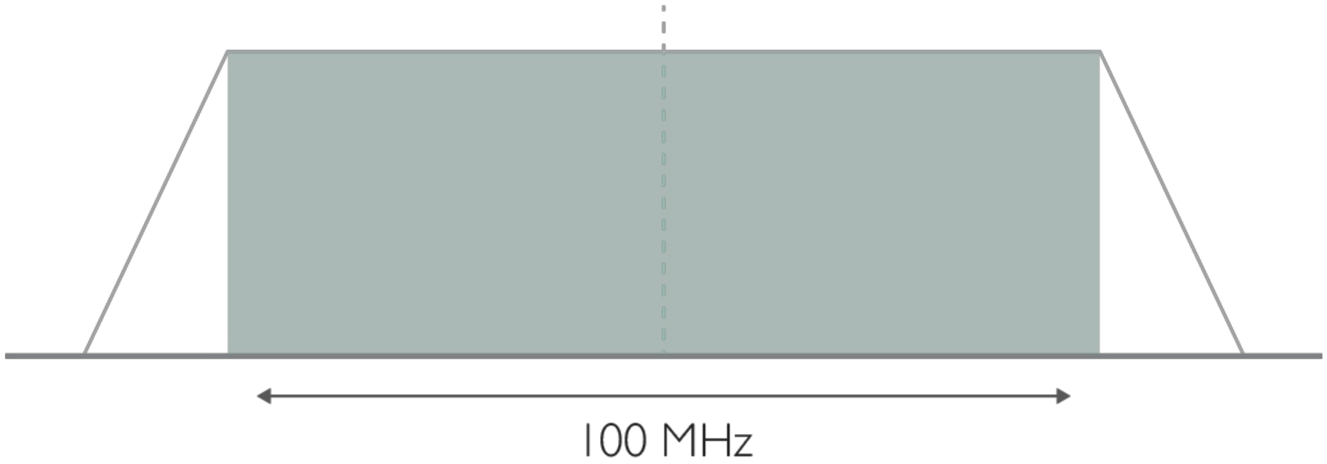
This document describes the analog bandwidths supported by the R5XX0-XXX products.

These bandwidths are determined by various filters that precede the analog-to-digital converter in the receiver. Decimation through 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.

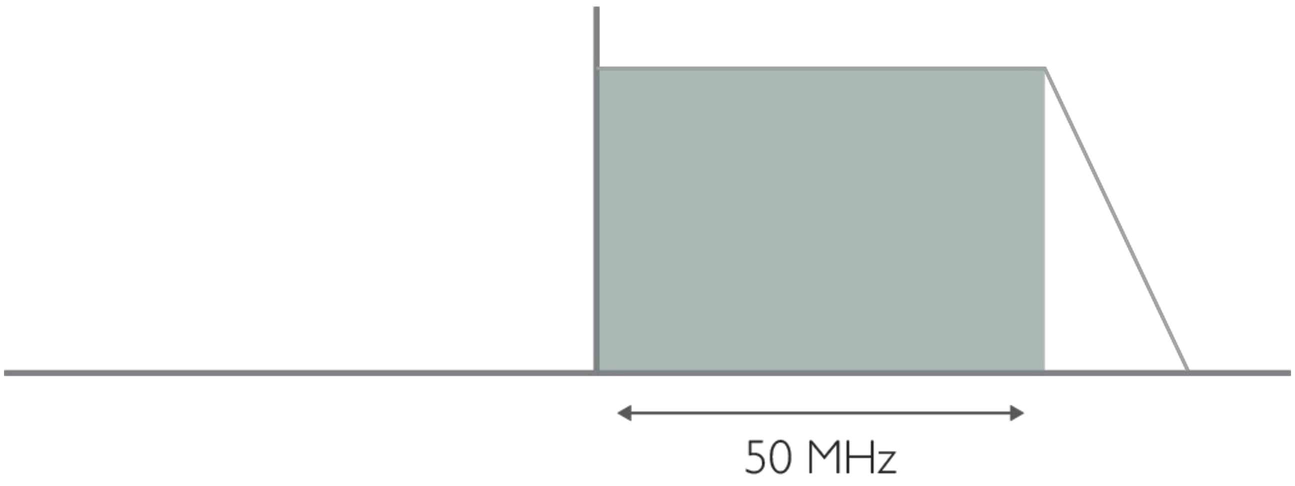
100 MHz bandwidth

In the widest bandwidth mode of operation the R5XX0-XXX is configured as a direct-conversion receiver (aka Zero-IF or ZIF). This mode is well suited for applications such as ISM band signal detection/analysis 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.



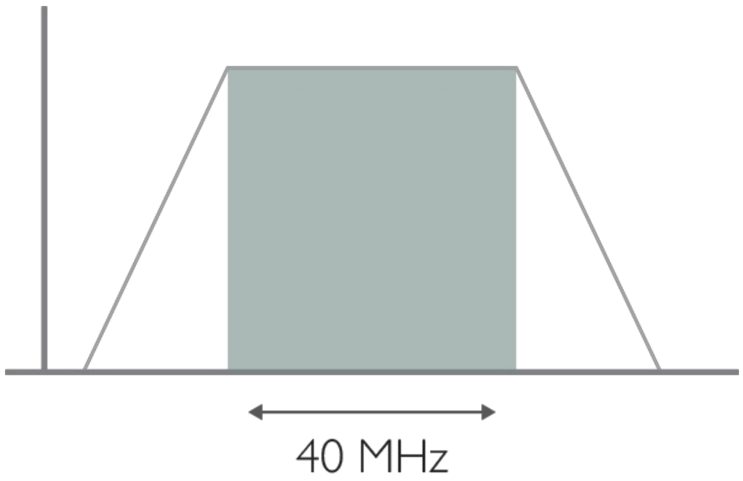
50 MHz bandwidth

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 Wi-Fi signal can 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.



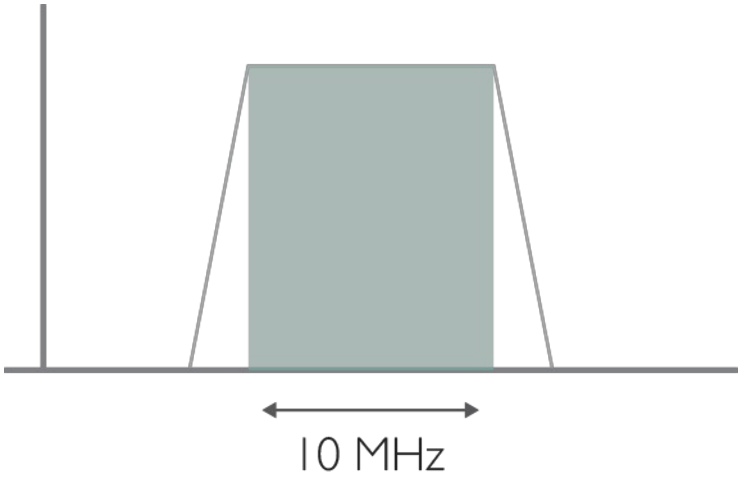
40 MHz bandwidth

The R5XX0-XXX has a super-heterodyne mode of operation that allows the processing of signals with a bandwidth of up to 40 MHz. This mode of operation is best suited for signal demodulation and spectrum analysis. The downconverted signal is centered at 35 MHz.



10 MHz bandwidth

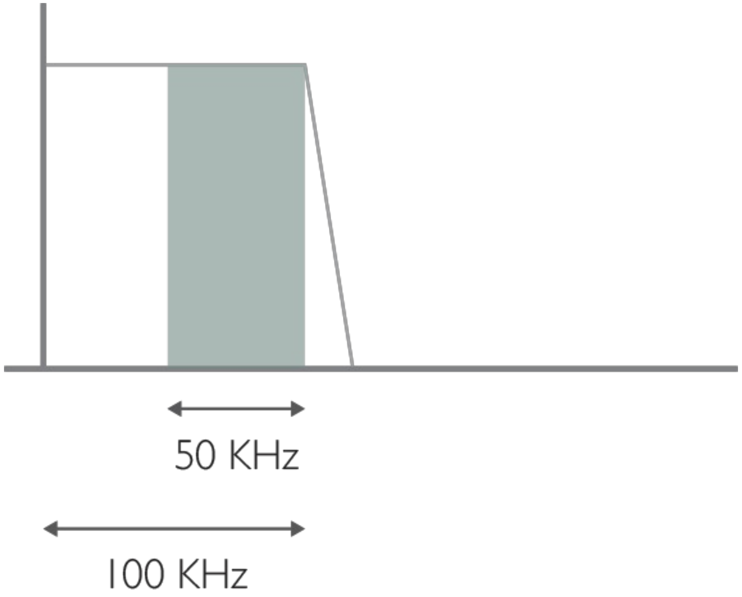
The R5XX0-XXX has a narrower 10 MHz super-heterodyne mode of operation. The narrower bandwidth filter centered at 35 MHz offers better rejection of adjacent signals. Also, this mode of operation provides the best spurious performance of all available receiver modes.



100 kHz bandwidth

The narrowest analog bandwidth supported by the R5XX0-XXX is 100 kHz. The narrowband analog filter that supports this bandwidth precedes a high-dynamic range (HDR) 24-bit ADC.

This bandwidth is useful for applications that include RF component and device characterization; in particular, the HDR enables measurement of third-order intermodulation products. As well, it enables the detection of very weak signals.



Summary of applications and recommended bandwidth settings

Application	100 MHz	50 MHz	40 MHz	10 MHz	100 kHz
Demodulation of wideband signals such as LTE and Wi-Fi in the lab		●	●		
Demodulation of wideband signals such as LTE and Wi-Fi in the field			●		
Signal demodulation			●	●	
Signal demodulation of video and audio signals in an interference environment				●	
Spectrum analysis			●	●	
RF measurements of CW signal amplitude, IP3, etc. in the lab					●
Detecting weak signals					●
Fast, low-latency spectrum scanning	●		●		
Wideband signal detection	●				