



# Wideband Signal Processing

Using Berkeley Nucleonics RTSA7500 RF  
Tuner/Downconverter

(WBIQ Option)

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# Introduction

Modern wireless signals are increasing in both operating frequencies and bandwidths.

The latest Wi-Fi standard 802.11ac, for instance, utilizes a bandwidth of 80 MHz, which will soon increase to 160 MHz.

Berkeley Nucleonics' RTSA7500 offers a cost-effective platform for test, measurement and monitoring of wideband signals up to 160 MHz bandwidth through the new Wideband IQ (WBIQ) options. This document provides a description of these options.

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# Architecture

The RTSA7500 has a hybrid receiver architecture that supports both Super-heterodyne and Direct-conversion modes of operation through software control.

Direct-conversion receivers offer the advantage of providing the widest bandwidth in the simplest and most cost-effective way. However, they introduce artifacts such as DC and IQ-offsets\* that the user has to account and/or compensate for.

Super-heterodyne receivers by comparison are more complex and have about half the bandwidth. The advantage however is that they do not introduce DC and IQ offsets.

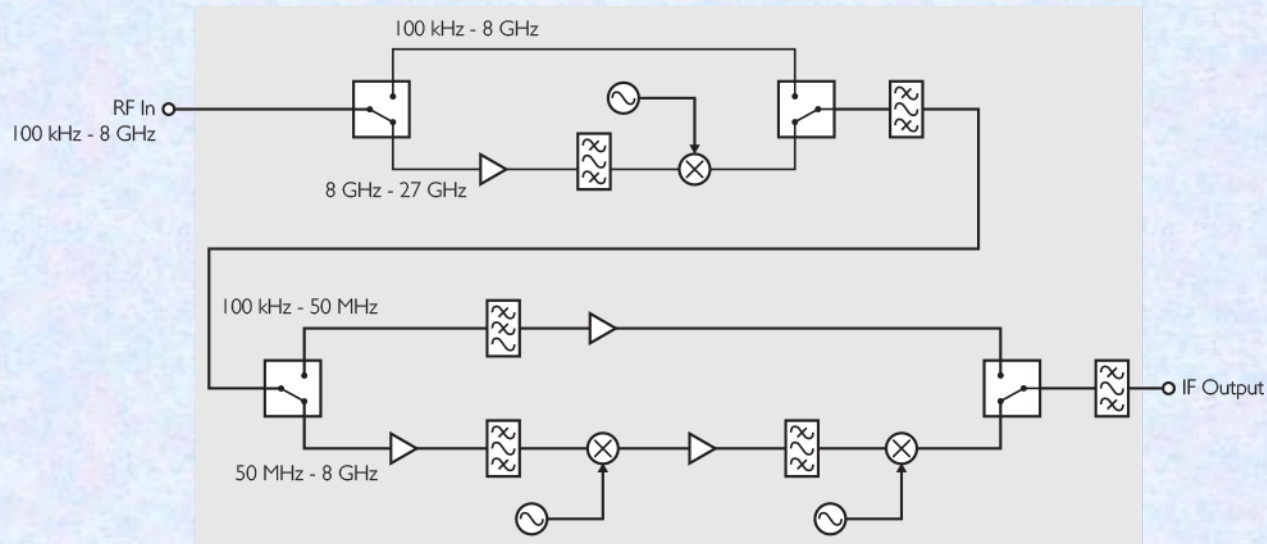
A key advantage of Berkeley Nucleonics' receivers is that they are based on a hybrid architecture that allows the user to software-reconfigure the receiver to either architecture depending on the application.

\* While DC offset correction is, to a large extent, managed within the hardware, IQ offsets must be corrected in software. Berkeley Nucleonics provides sample code to accomplish this.

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# RTSA7500 block diagram

The front-end processing blocks of the RTSA7500 utilize up to 20 pre-select filters to mitigate input-related spurs and image responses. There are three mixing stages and various IF filter banks to further condition the signal. The block diagram for the RTSA7500 RF front end when operating in Super-heterodyne mode, is shown below.



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# IF outputs

The RTSA7500 has a single RF input and three software-selectable IF bandwidths of 160 MHz, 80 MHz and 10 MHz. When the receiver is in Direct-conversion mode, the analog signal is present on both the I and Q outputs. In this case, each output is band-limited to 80 MHz. When the receiver is in Super-heterodyne mode, the analog output is present on the

I output only and centered at either 55 MHz (80 MHz bandwidth) or 35 MHz (10 MHz bandwidth).

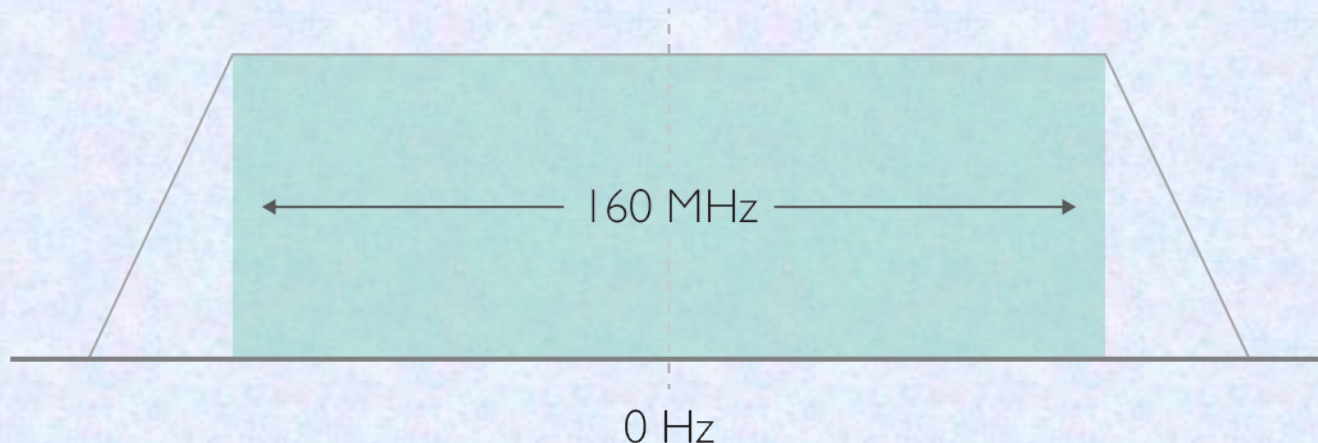


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# 160 MHz bandwidth

In the widest bandwidth mode of operation the RTSA7500 is configured as a Direct-conversion receiver. This mode is well suited for applications such as ISM band signal detection/analysis and RF data acquisition.

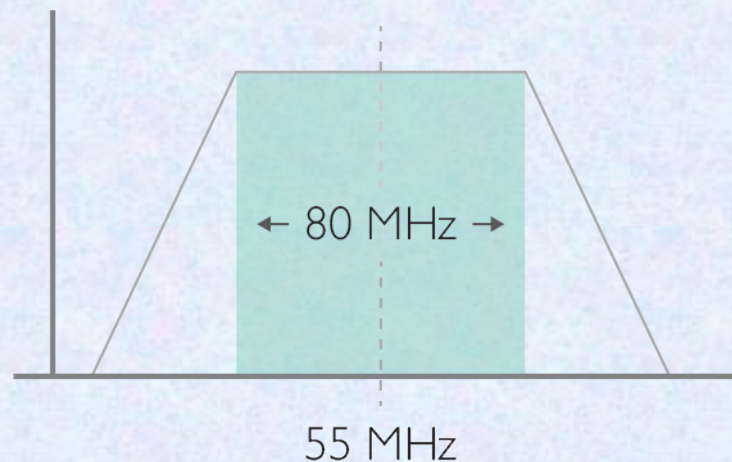
The final IF signal is centered at DC (0 Hz) and available on both the I and Q output connectors. In order to process this signal, a dual-channel digitizer with a sampling rate of at least 250 MS/s is required.



# 80 MHz bandwidth

The RTSA7500 has a wideband Super-heterodyne mode of operation that allows the processing of signals with a bandwidth of up to 80 MHz. This mode of operation is best suited for signal demodulation and spectrum analysis.

The downconverted signal is centered at 55 MHz. Depending on the roll-off that can be tolerated by the application, the user may choose to utilize 100 MHz of bandwidth. In this case, the band begins at 5 MHz and ends at 105 MHz. In order to process this signal, a single channel digitizer with a sampling rate of at least 250 MS/s is required.

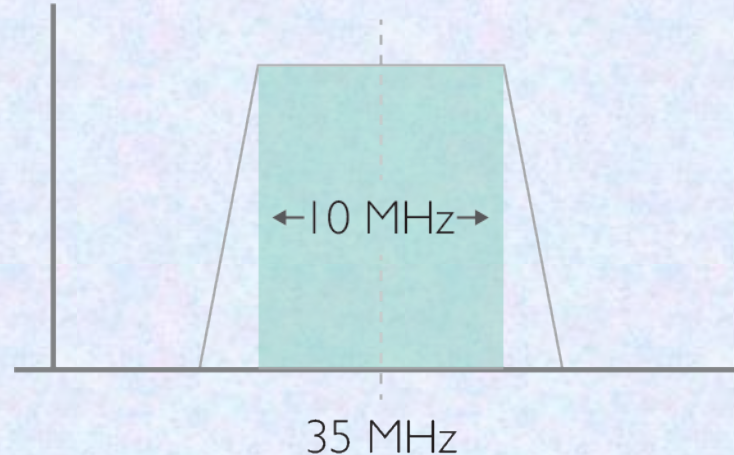


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# 10 MHz bandwidth

The RTSA7500 has a narrower 10 MHz Super-heterodyne mode of operation. The narrower bandwidth filter centered at 35 MHz offers best rejection of adjacent signals, best spurious performance and flattest noise floor of all available receiver modes. This signal, while present at the analog I output, can also be processed using the internal digitizer sampling at 125 MS/s\*.

\* This option is software enabled and standard with all RTSA7500 products.



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# Recommended Digitizers

The following is a list of recommended digitizers that interface with the RTSA7500:

1. Gage EON Express: <http://www.gage-applied.com/digitizers/12-bit/pcie/digitizer-compuscope-eon-express.htm>
2. Signatec PX1440D2: <http://www.signatec.com/products/daq/high-speed-digitizer-fpga-pcie-board-px1440d2.html>
3. Nutaq PicoDigitizer-250: <http://www.nutaq.com/signal-intelligence-spectrum-monitoring>

# Summary

Berkeley Nucleonics's RTSA7500 is a versatile RF tuner/downconverter that can either be used stand-alone or in conjunction with an external wideband digitizer to process signals that operate to 27 GHz and with bandwidths up to 160 MHz.

The ability to use external digitizers allows the systems integrator to provide a highly customizable COTS solution to a variety of radio frequency analysis challenges. Many existing systems with embedded digitizers can benefit from the increased frequency coverage and bandwidth options provided by the RTSA7500-WBIQ. This advantage can be readily applied in military spiral development programs.

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