

# ThinkRF R5500

## Real-Time Spectrum Analyzer

9 kHz to 8 GHz / 18 GHz / 27 GHz

Featuring

- Real-Time Bandwidth (RTBW) up to 100 MHz
- Spurious Free Dynamic Range (SFDR) up to 100 dBc
- Small form-factor, GigE networked and remote deployable





## Overview

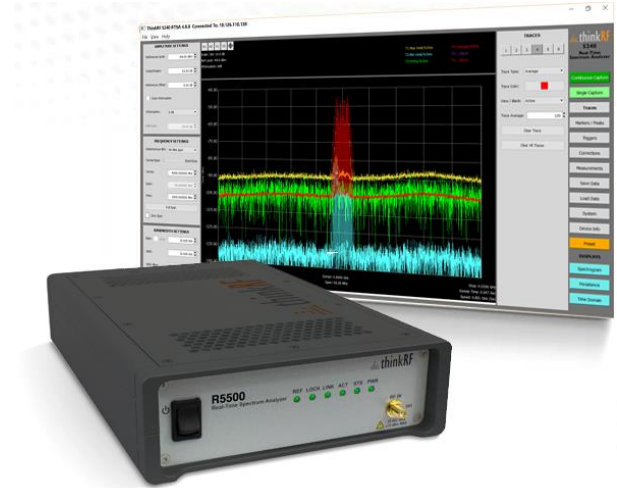
### ThinkRF's 10x Better Solution

ThinkRF makes possible the cost-effective testing and monitoring of billions of wireless devices.

Using patented innovation, ThinkRF's R5500 real-time spectrum analyzer has the performance of traditional high-end lab spectrum analyzers at a fraction of the cost, size, weight and power consumption and is designed for distributed deployment.

The R5500 Wireless Signal Analyzer has a highly optimizable software-defined radio receiver coupled with real-time digitization and digital signal processing. This enables wide bandwidth, deep dynamic range and 27 GHz frequency range in a small one-box platform.

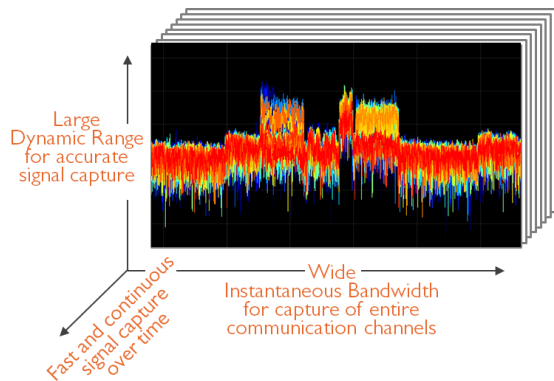
On top of this market disruptive platform, ThinkRF provides a rich set of standard APIs and programming environments for easy and quick use with existing or new test and monitoring applications.



## R5500 Performance

### Large Frequency Range

The frequencies and bandwidths of commercial wireless systems have been increasing steadily to accommodate the growing demand for larger data rates. The R5500 supports frequency ranges from 9 kHz up to 27 GHz which enables testing of modern systems and doesn't exclude tests such as third-order intercepts.



### Wide Instantaneous Bandwidth

Modern waveforms such as 802.11ac standard utilize waveforms that occupy up to 80 MHz in bandwidth and LTE-Advanced aims to utilize bandwidths of up to 100 MHz. The R5500 provides up to 100 MHz of instantaneous bandwidth in its direct conversion mode.

### Deep Dynamic Range

RF measurements for characterizing IP3 generally require a dynamic range of around 100 dB. The R5500 supports multiple ADCs thereby providing wide IBW with 70 dB dynamic range and a narrow IBW with 100 dB dynamic range.

### Real-Time Acquisition Memory and Trigger Capability

Modern waveforms such as those associated with the wireless LAN standards utilize packet-based signaling techniques. The R5500 enable real-time capture of multiple data packets by providing real-time hardware-based frequency domain triggering capability in conjunction with real-time memory storage of up to 128 million samples.

### Fast Scan Speed

Scan speed determines how fast the analyzer can jump from analyzing one set of frequencies to another set. The R5500 has fast setup times and provides sophisticated capture control.

### Small Size, Weight, and Power

The R5500 has a length and width less than a sheet of paper, weighs less than 3 kg and consumes less than 20 W of power making it a fraction of the size, weight and power of traditional lab spectrum analyzers.

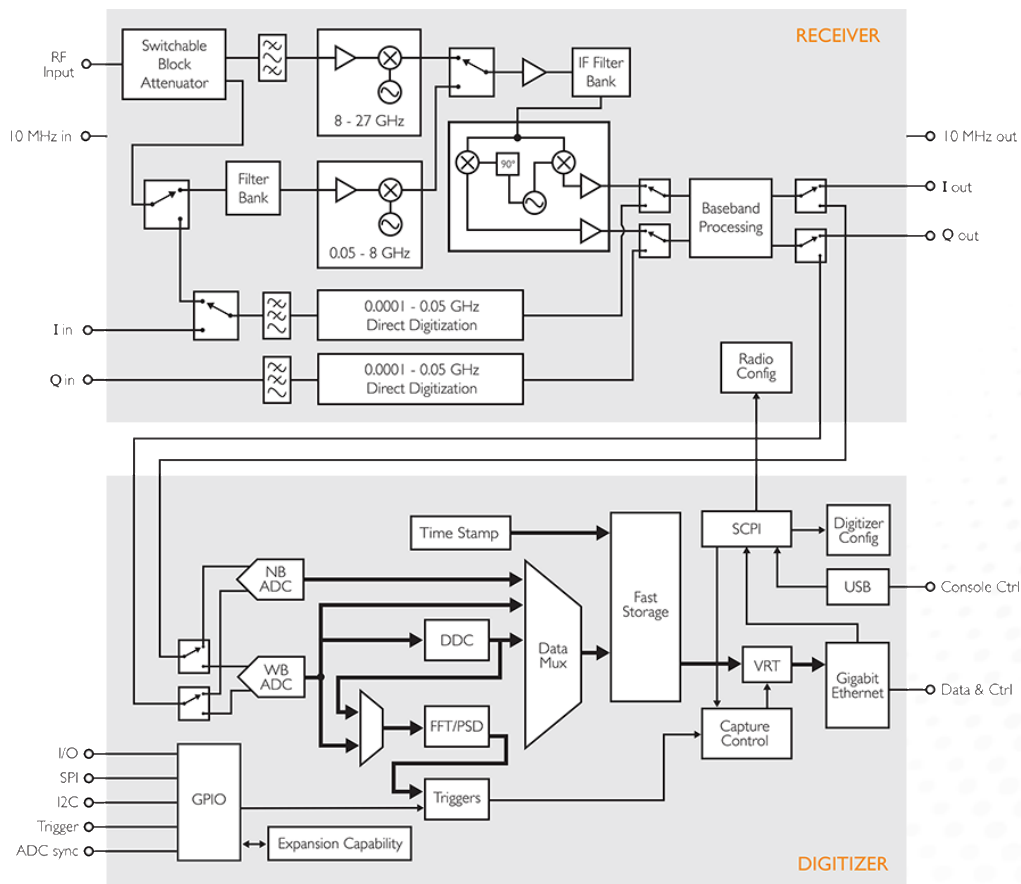


## R5500 Architecture

### The Receiver

The R5500 has a patented hybrid receiver consisting of a super-heterodyne front-end with a backend that utilizes an I/Q mixer similar to that in a direct-conversion receiver. Depending on the frequency of the signals being analyzed, one of three receiver signal processing paths is selected. Signals in the frequency range 9 kHz to 50 MHz are directly digitized, while all other signals are translated to the frequencies of the first IF block via one of the two signal processing paths.

The IF block consists of a bank of multiple surface acoustic wave (SAW) filters. Depending on the mode of operation, i.e. super-heterodyne or homodyne, either one or both outputs are utilized to process either 40 MHz or 100 MHz instantaneously. The IF analog outputs are digitized using one of two ADCs: a 125 MS/s sampling rate with a typical dynamic range of 70 dB; or a 300 KS/s sampling rate with a typical dynamic range in excess of 100 dB.



### The Digitizer

The digitized signal is real-time and continuously processed. The R5500 provides digital signal processing including optional digital down conversion; FFT and optional frequency domain triggering; sophisticated capture controlled; and optionally stored in fast local memory for subsequent forwarding or streaming across the Ethernet.

User configurable sophisticated capture control combined with fast deep caching enables fast signal searches, sweeps, triggering and captures of only the signals of interest.

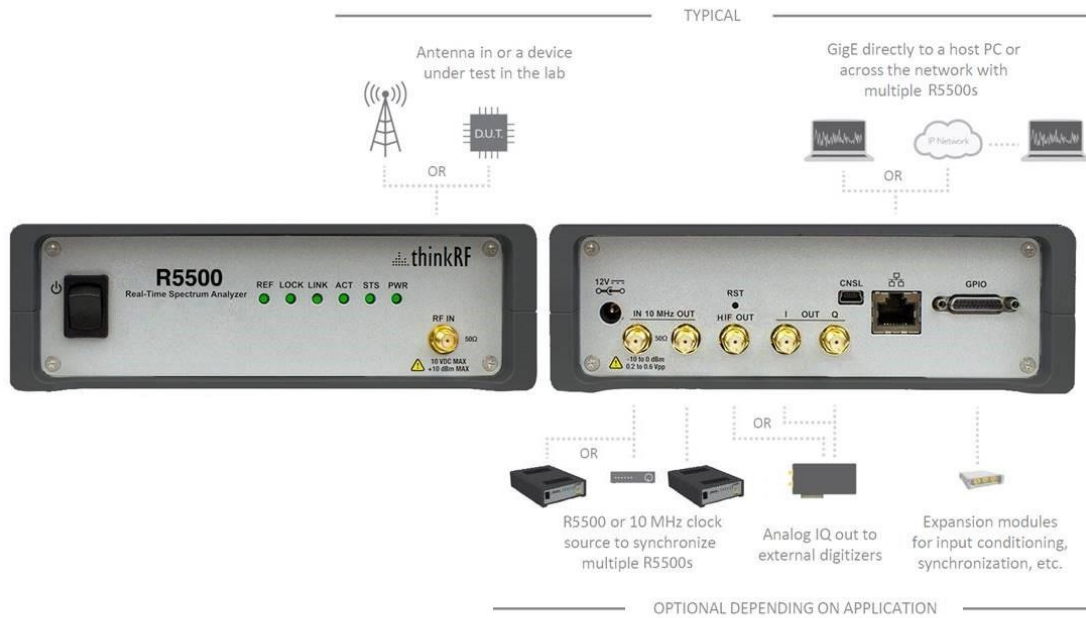
The R5500 digitizer has a dual-core embedded microprocessor with a Linux OS and control, management and remote maintenance application. It supports the SCPI standard for user control and VITA VRT for data path.



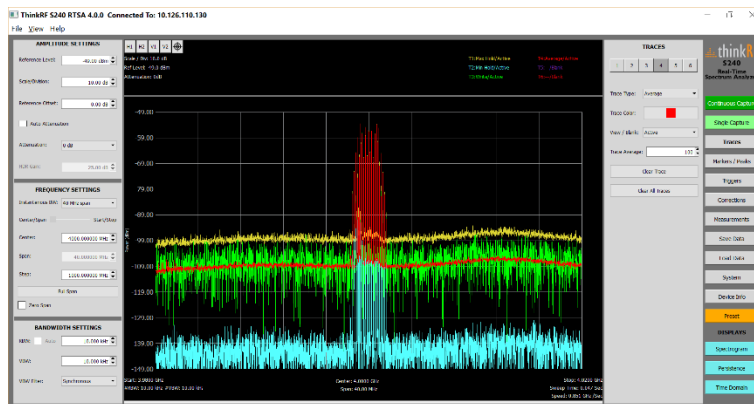
## R5500 Extensible Hardware Interfaces

Whether you're looking for a high-powered receiver to integrate with your existing digitizer solution or you need powerful, cost-effective spectrum analyzer hardware to pair with your software, the R5500 Wireless Signal Analyzer is a universal and versatile platform designed for use across wireless industries and applications.

- 10 MHz input and output clock references for multi-unit synchronization
- Analog I/Q and HIF outputs enable OEM high speed digitizers
- GPIO for external triggers 10/100/1G Ethernet port for control and networking
- +12 V DC power input allowing automobile sources and personal mobility with an external battery
- External support for 80 MHz and 160 MHz RTBW (optional)



## S240 Real-Time Spectrum Analysis Application



By utilizing the power of the R5500, the S240 application has all the standard features you expect from a traditional lab spectrum analyzer as well as powerful features such as real-time triggering.

The S240 will run on any Windows PC. Simply install the software and connect your device through an Ethernet or Internet connection and you're ready to get started.

With the S240's simple and intuitive user interface you'll be using your new device in no time.



## R5500 APIs and Programming Environments

By supporting a rich set of industry-leading standard protocols, the R5500 can easily integrate into your new or existing applications.



### Python™ and PyRF development framework

PyRF enables rapid development of powerful applications that leverage the new generation of measurement-grade software-defined radio technology. It is built on the Python Programming Language and includes feature-rich libraries, example applications and source code and is openly available, allowing commercialization of solutions through BSD open licensing.



### NI LabVIEW®

Easily and quickly integrate the R5500 into your existing or new NI LabVIEW® based acquisition, measurement, automated test and validation systems.



### MATLAB®

ThinkRF provides MATLAB® drivers for connecting to ThinkRF's R5500 Wireless Signal Analyzers and MATLAB® program code examples to get you started towards developing your own.



### C/C++ Drivers and DLL

Underneath our rich set of APIs and programming environments is the C/C++ driver and DLL which abstracts the SCPI command and VITA VRT dataflow from the R5500. The C/C++ driver is openly available to you in source code allowing commercialization of solutions through BSD open licensing.

# SCPI

### SCPI and VITA VRT

Compliance with standard protocols provides you both multi-vendor independence and device interoperability.



The R5500 supports the Standard Commands for Programmable Instruments (SCPI) for control and the VITA-49 Radio Transport (VRT) protocol for data flow. ThinkRF provides extensive documentation and examples for programming and interfacing at the SCPI and VITA-49 VRT level.



## RF and Digitization Specifications

Frequency		
Frequency Ranges	9 kHz to 8, 18 or 27 GHz	
Frequency Reference	±1.0 x 10 <sup>-6</sup> per year	Aging
	±1.0 x 10 <sup>-6</sup> per year	Accuracy + aging
Real-time bandwidth (RTBW)	0.1 / 10 / 40 / 100 MHz	
Probability of Intercept (POI)	≥ 25.552 μs signal duration	For 100% POI
	≤ 17.360 μs signal duration	For 0% POI
Spurious free dynamic range (SFDR)	60 dBc (typical)	100 MHz RTBW
	70 dBc (typical)	10 / 40 MHz RTBW
	100 dBc (typical)	0.1 MHz RTBW

Amplitude		
Amplitude Accuracy 25 °C ± 5 °C	± 2.00 dB typical	50 MHz to 8 GHz
Amplitude Ranges	DANL to maximum safe input level	8 GHz
Measurement Range	0 to 30 dB in 10 dB steps	IF Attenuator for 18 and 27 GHz only
Attenuator Range	0 to 25 dB in 1 dB steps	
Maximum Safe RF Input Level	+10 dBm, 0 V DC	

Spectral Purity				
Displayed Average Noise Level (DANL)				
At 25 °C ± 5 °C, typical				
Frequency	8 GHz (typical)	8 GHz Pre-Amp (typical)	18 GHz (typical)	27 GHz (typical)
100 MHz	- 151 dBm	- 164 dBm	- 164 dBm	- 162 dBm
500 MHz	- 151 dBm	- 163 dBm	- 163 dBm	- 162 dBm
1 GHz	- 150 dBm	- 161 dBm	- 161 dBm	- 160 dBm
2 GHz	- 149 dBm	- 152 dBm	- 152 dBm	- 144 dBm
3 GHz	- 145 dBm	- 157 dBm	- 157 dBm	- 157 dBm
4 GHz	- 140 dBm	- 155 dBm	- 155 dBm	- 154 dBm
5 GHz	- 142 dBm	- 149 dBm	- 149 dBm	- 145 dBm
6 GHz	- 134 dBm	- 143 dBm	- 143 dBm	- 143 dBm
7 GHz	- 134 dBm	- 149 dBm	- 149 dBm	- 143 dBm
8 GHz	- 131 dBm	- 163 dBm	- 163 dBm	- 158 dBm
9 GHz			- 162 dBm	- 158 dBm
10 GHz			- 162 dBm	- 157 dBm
11 GHz			- 160 dBm	- 160 dBm
12 GHz			- 158 dBm	- 154 dBm
13 GHz			- 156 dBm	- 146 dBm
14 GHz			- 155 dBm	- 150 dBm
15 GHz			- 159 dBm	- 147 dBm
16 GHz			- 155 dBm	- 150 dBm
17 GHz			- 152 dBm	- 145 dBm
18 GHz			- 149 dBm	- 147 dBm
19 GHz				- 147 dBm
20 GHz				- 151 dBm
21 GHz				- 146 dBm
22 GHz				- 145 dBm
23 GHz				- 149 dBm
24 GHz				- 151 dBm
25 GHz				- 148 dBm
26 GHz				- 143 dBm
27 GHz				- 133 dBm
Third Order Intercept (TOI) at max gain	+12 dBm, typical			At 1 GHz



## RF and Digitization Specifications (cont'd)

### Spectral Purity (cont')

SSB Phase noise 25°C ± 5°C	At 1 GHz	Carrier Offset
	-90 dBc/Hz	100 Hz
	-92 dBc/Hz	1 kHz
	-100 dBc/Hz	10 kHz
	-101 dBc/Hz	100 kHz
	-121 dBc/Hz	1 MHz

### Digitization

Data Acquisition		
A/D Converter Sampling Rate and Resolution	125 MS/s, 14 bit	10 / 40 / 100 MHz RTBW
	300 kS/s, 24 bit	0.1 MHz RTBW
FFT lengths	128 to 524288 in powers of 2	
Sweep Rate	28 GHz/s @ 10 kHz RBW	40 MHz IBW
Stream Rate	360 Mbit/s	

## General Specifications

### Connectors

RF In	SMA female, 50 Ω	
10 MHz Reference In and Out	SMA female, 50 Ω	0 or 35 MHz
Analog I and Q Out	SMA female, 50 Ω	
HIF Out	SMA female, 50 Ω	
10/100/1000 Ethernet	RJ45	
USB Console	mini-USB	
GPIO	25-pin male D-Subminiature	
Coaxial Power	Type A: 5.5 mm OD, 2.5 mm ID	

### Status Indicators

PLL Lock / 10 MHz reference clock status  
 Ethernet Link and Activity Status  
 CPU and Power Status

### Power

Physical Power Supply	+12V DC
Power Consumption	18W

### Physical

Operating Temperature Range	0°C to +50°C	
Storage Temperature Range	-40°C to +85°C	
Warm up time	30 minutes after connecting to the PC with the S240 Software	
Size	269 x 173 x 61 mm (10.58 x 6.81 x 2.40 inches)	with mounting feet (shipped installed on unit)
	269 x 173 x 55 mm (10.58 x 6.81 x 2.15 inches)	without mounting feet
Weight	2.7 kg (6 lbs.)	

### Regulatory Compliance

Security	Kensington Security Slot	Located on back end-plate
RoHS Compliance	RoHS/RoHS 2	
Marks	CE	European Union
EMC Directive 2014/30/EU	EN 61326-1:2013	Electromagnetic Compatibility
Low Voltage Directive 2006/95/EC	EN 61010-1:2010 Class 1)	Safety



## Software Specifications

### S240 Real-Time Spectrum Analysis Software

Resolution Bandwidth (RBW)		
Range	0.24 kHz to 976.56 kHz 0.62 Hz to 2543.12 Hz	10 / 40 / 100 MHz RTBW 0.1 MHz RTBW
Windowing	Hanning	
Traces	6	Clear/Write, Trace Average, Max Hold, Min Hold
Markers	12	
Modes	Normal (Tracking), Delta, Fixed	Peak Search, Next Peak, Next Left/Right, Center
Marker Frequency Resolution	0.01 Hz	
Record/Playback	VITA Radio Transport (VRT)	VITA-49.0 – 2007 Draft 0.21
Preferences	Save/Load Settings	Save settings for easy recall
Export Data	CSV	Comma Separated Values

### APIs and Protocols

Python™	PyRF RTSA	
LabVIEW	LabVIEW Base Development System for Windows	
MATLAB®	MATLAB® Release 2014b	
C/C++	ISO/IEC 14882:2011	
SCPI	IEEE 488.2 - Standard Commands for Programmable Instruments	
VRT	VITA-49 Radio Transport	

### Recommended PC

Operating System	Windows 7, 8, 10 (32 or 64)	For best performance, a dedicated PC is recommended
Minimum RAM Size	4 GB	
Minimum Free Hard Disk Space	2 GB	
Ethernet Port	1 GigE	
Display Resolution	1920 x 1080	

## Ordering Information

Base Units	Part Number	Description
8 GHz RTSA	R5500-408	9 kHz to 8 GHz, RTBW up to 100 MHz
18 GHz RTSA	R5500-418	9 kHz to 18 GHz, RTBW up to 100 MHz
27 GHz RTSA	R5500-427	9 kHz to 27 GHz, RTBW up to 100 MHz

Options		
8 GHz Preamp	R5500-408-P	8 GHz spectrum analyzer with 100 kHz to 100 MHz RTBW with pre-amp and additional preselect filtering. Applicable only to the R5500-408.
80 MHz and 160 MHz RTBW Support	R5500-xxx-WBIQ *	External support for 80 MHz Super-Heterodyne and 160 MHz Zero-IF RTBW. The RTBW of 160 MHz is intended for IQ out only. The internal digitizer remains at 125 MSa/s.

Accessories		
Software Included	S240	Real-Time Spectrum Analysis Software
Rack Shelf	R5500-RACK-SHELF	19" rack shelf supports two horizontally mounted R5500s or WSA5000s

\* xxx = 408, 418 or 427 for 8 GHz, 18 GHz, or 27 GHz models respectively

## Contact us for more information

sales@thinkrf.com  
+1.613.369.5104