Product Brochure and Technical Datasheet

ThinkRF R5750

Real-Time Spectrum Analyzer with Global Navigation Satellite System (GNSS)

9 kHz to 8 GHz, 18 GHz and 27 GHz

Features

- 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
- Integrated GNSS for positional and temporal information
- Beautifully designed, lightweight, and silent

Applications

- Spectrum Monitoring
- Signal Analysis
- Direction Finding & Transmitter Localization
- Signal Intelligence
- Research & Development
- Test & Measurement

thinkRF

Overview

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

Using innovative software-defined radio technologies, the ThinkRF R5750 Real-Time Spectrum Analyzer with GNSS has the performance of traditional lab-grade spectrum analyzers at a fraction of the cost, size, weight and power consumption.

The sleek, lightweight, and fanless ThinkRF R5750 analyzer provides the benefits of a high-performance software-defined RF receiver, digitizer and analyzer along with integrated GNSS technology offering location and time information.

The R5750 Real-Time Spectrum Analyzer is based on an optimized software-defined radio receiver architecture 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, stylish platform.

Designed for stand-alone, outdoor, mobile, remote and/or distributed wireless signal analysis, the R5750 analyzer can be deployed as a single unit or a network of radio sensors, making it ideal for monitoring, management and surveillance of transmitters, whether they are in-building or spread across a geographic area. Optional IP66 rating is available for increased durability and ruggedness in challenging environments.

R5750 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 R5750 supports frequency ranges from 9 kHz up to 27 GHz which enables testing of modern systems including tests such as third-order intercept.

Wide Instantaneous Bandwidth

Modern waveforms such as 802.11ac standard utilize waveforms that occupy up to 80 MHz in bandwidth and LTE-Advanced utilizes bandwidths of up to 20 - 40 MHz. The R5750 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 R5750 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 R5750 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.

Global Navigation Satellite System (GNSS)

The integrated GNSS capability allows location coordination activities with a number of different satellite constellations, including GPS/QZSS, GLONASS, and BeiDou. Location position and time are through VRT packets along with time-stamping and data output for captures.

Small Size, Weight, and Power

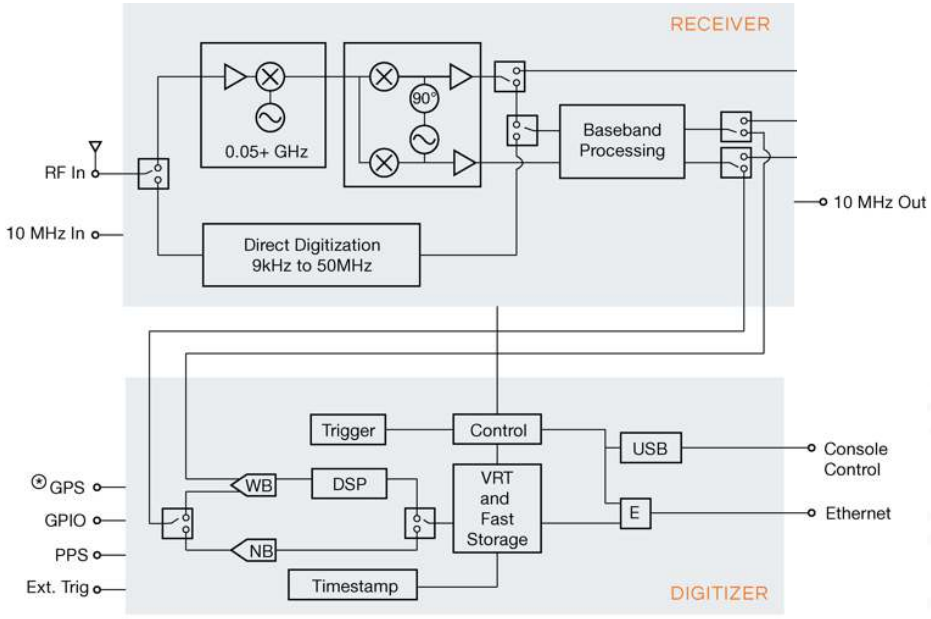
The R5750 has a length and width less than a sheet of paper, weighs less than 3 kg and consumes less than 25 W of power making it a fraction of the size, weight and power of traditional lab-grade spectrum analyzers.

R5750 Architecture

The Receiver Front End

The R5750 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 IF 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 continuously processed in. The R5750 provides digital signal processing including optional digital down conversion; 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.

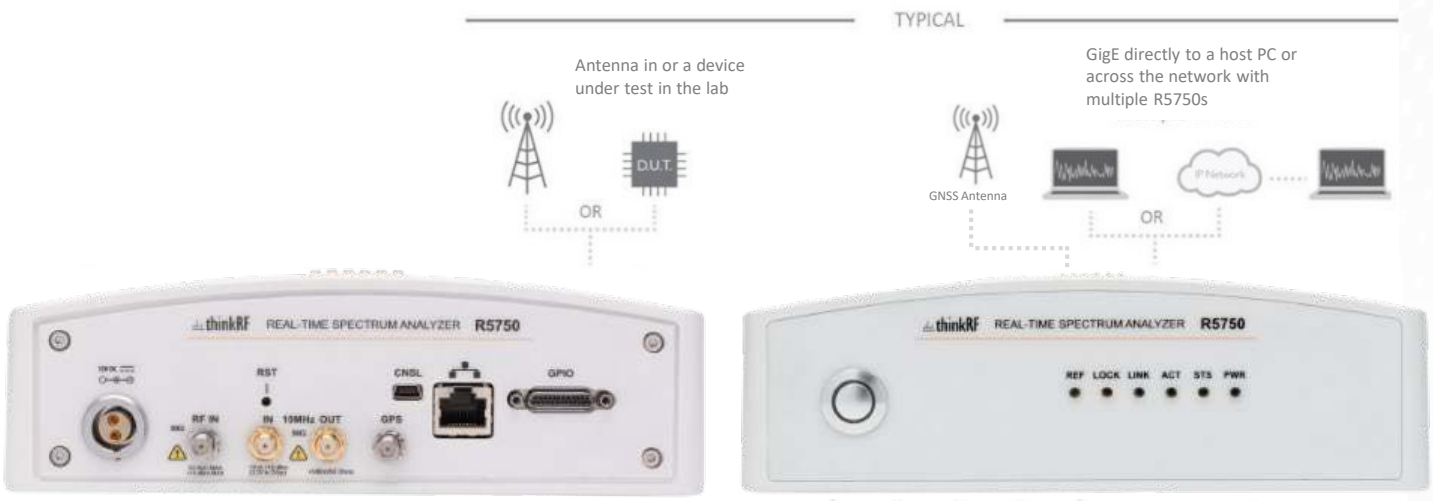
The R5750 digitizer has a dual-core embedded microprocessor with operating system, control, management and remote maintenance application. It supports the SCPI standard for user control and VITA VRT for data path.

R5750 Extensible Hardware Interfaces

If you're looking for a powerful, cost-effective spectrum analyzer hardware to pair with your software, the R5750 Real-Time Spectrum Analyzer is a universal and versatile platform designed for use across wireless industries and applications.

The R5750 hardware largely consists of:

- a hybrid super-heterodyne, direct-conversion and direct-digitization RF receiver front-end (RFE);
- receiver front end inputs and outputs to support clock synchronization;
- a 125 MSample/sec 14-bit wideband (WB) ADC with a dynamic range of greater than 70 dB;
- a 325 kSample/sec 24-bit narrowband (NB) ADC with a dynamic range in excess of 100 dB;
- a GNSS module with embedded 10MHz reference clock source for further RTSA's time synchronization;
- a Xilinx Zynq FPGA with built-in dual-core ARM®-based processor, Gigabit Ethernet interface and custom embedded digital signal processing (DSP) logic;
- 1 GB of DDR3 shared between firmware and real-time caching of digitized data;
- a general purpose input/output (GPIO) port.



R5750 APIs and Programming Environments

By supporting a rich set of industry-leading standard protocols, the R5750 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 R5750 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 R5750 Real-Time Spectrum 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 R5750.

R5750 Standard Protocols

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

SCPI and VITA VRT

The R5750 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 GHz, 18 GHz and 27 GHz	
Frequency Reference	±1.0 ppm ±1.0 ppm 0°C to 55°C ±1.0 ppm per year	Accuracy at room temperature Stability over temperature Aging
Real-time bandwidth (RTBW)	0.1 / 10 / 40 /100 MHz	
Probability of Intercept (POI)	≥ 25.552 µs signal duration ≤ 17.360 µs signal duration	For 100% POI For 0% POI
Spurious free dynamic range (SFDR)	60 dBc (typical) 70 dBc (typical) 100 dBc (typical)	100 MHz RTBW 10 / 40 MHz RTBW 0.1 MHz RTBW

10 MHz Disciplined Oscillator	
Frequency Accuracy (Lock to GNSS)	± 0.005ppm
Frequency Accuracy (Holdover, 24 hours)	± 0.100ppm

Amplitude		
Amplitude Accuracy 25 °C ± 5 °C	± 2.00 dB typical	50 MHz to 27 GHz
Measurement Range Attenuator Range	Amplitude Ranges DANL to levels in figure below 0 to 30 dB in 10 dB steps	
Maximum Safe RF Input Level	+10 dBm, 10 V DC	

Spectral Purity			
SSB Phase noise 25°C ± 5°C At 1 GHz	With External 10MHz oscillator -90 dBc/Hz -93 dBc/Hz -98 dBc/Hz -106 dBc/Hz -120 dBc/Hz	Without External 10MHz oscillator -90 dBc/Hz -92 dBc/Hz -99 dBc/Hz -109 dBc/Hz -118 dBc/Hz	Carrier Offset 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz

Digitization		
Data Acquisition A/D Converter Sampling Rate and Resolution	125 MS/s,14 bit 300 kS/s, 24 bit	10 / 40 / 100 MHz RTBW 0.1 MHz RTBW
Sweep Rate	Up to 28 GHz/s @ 10 kHz RBW	40 MHz IBW
Stream Rate (directly from device)	360 Mbit/s	

RF and Digitization Specifications, continued

Displayed Average Noise Level (DANL)

At 25 °C ± 5 °C, typical

Frequency (GHz)	8 GHz (typical)	18 GHz (typical)	27 GHz (typical)
0.1 GHz	- 157 dBm/Hz	- 161 dBm/Hz	- 160 dBm/Hz
0.5 GHz	- 155 dBm/Hz	- 160 dBm/Hz	- 159 dBm/Hz
1 GHz	- 156 dBm/Hz	- 160 dBm/Hz	- 159 dBm/Hz
2 GHz	- 154 dBm/Hz	- 154 dBm/Hz	- 153 dBm/Hz
3 GHz	- 152 dBm/Hz	- 158 dBm/Hz	- 157 dBm/Hz
4 GHz	- 151 dBm/Hz	- 162 dBm/Hz	- 162 dBm/Hz
5 GHz	- 150 dBm/Hz	- 158 dBm/Hz	- 158 dBm/Hz
6 GHz	- 149 dBm/Hz	- 157 dBm/Hz	- 157 dBm/Hz
7 GHz	- 150 dBm/Hz	- 153 dBm/Hz	- 155 dBm/Hz
8 GHz	- 144 dBm/Hz	- 160 dBm/Hz	- 161 dBm/Hz
9 GHz		- 158 dBm/Hz	- 161 dBm/Hz
10 GHz		- 160 dBm/Hz	- 161 dBm/Hz
11 GHz		- 156 dBm/Hz	- 160 dBm/Hz
12 GHz		- 158 dBm/Hz	- 157 dBm/Hz
13 GHz		- 151 dBm/Hz	- 157 dBm/Hz
14 GHz		- 154 dBm/Hz	- 154 dBm/Hz
15 GHz		- 160 dBm/Hz	- 157 dBm/Hz
16 GHz		- 157 dBm/Hz	- 157 dBm/Hz
17 GHz		- 150 dBm/Hz	- 156 dBm/Hz
18 GHz		- 144 dBm/Hz	- 156 dBm/Hz
19 GHz			- 149 dBm/Hz
20 GHz			- 154 dBm/Hz
21 GHz			- 153 dBm/Hz
22 GHz			- 152 dBm/Hz
23 GHz			- 153 dBm/Hz
24 GHz			- 155 dBm/Hz
25 GHz			- 153 dBm/Hz
26 GHz			- 150 dBm/Hz
27 GHz			- 148 dBm/Hz

Third Order Intercept (TOI) at max gain	+12 dBm, typical	At 1 GHz

Global Navigation Satellite System (GNSS)

Global Positioning System (Concurrent reception of up to 2 GNSS)

GNSS Types supported	GPS, GLONASS, BeiDou				
GNSS Antenna Power	3.3 V, 50 mA				
Time to first fix, maximum	From 2 sec (hot) to 36 sec (cold start), -130dBm input signal power				
Horizontal positional accuracy*	GPS & GLONASS	GPS & BeiDou	GPS	GLONASS	BeiDou
	2.5m	2.5m	2.5m	4.0m	3.0m
Data Timestamp Resolution	8 ns				

*CEP, 50%, 24 hours Static, -130dBm, >6SVs

Spectral Purity on GPS Disciplined Oscillator

Freq=10.000000MHz Jitter=0.6ps (Typ, 10Hz-1MHz)

Offset	Phase Noise
10Hz	-101 dBc/Hz
100Hz	-125 dBc/Hz
1kHz	-144 dBc/Hz
10kHz	-155 dBc/Hz
100kHz	-156 dBc/Hz

General Specifications

Connectors		
RF In	SMK female, 50 Ω	
10 MHz Reference In and Out	SMA female, 50 Ω	
10/100/1000 Ethernet	RJ45	
USB Console	Type B mini	
GPIO	25-pin male D-Subminiature	
GNSS Antenna Port	SMA female, 50 Ω (Active 3.3VDC)	
Power	LEMO Connector, female	

Status Indicators		
PLL Lock / 10 MHz reference clock status	Refer to R5750 User Manual	
Ethernet Link and Activity Status		
CPU and Power Status		

Power		
Physical Power Supply	Use AC Wall Power Adaptor provided	Input AC 120V-240V/Output +12V
Power Consumption	25W with Power Adaptor provided (427)	At room temperature
Can also be used with ThinkRF P120 – Vehicular Power Conditioner		

Physical		
Operating Temperature Range	0°C to +50°C	
Storage Temperature Range	-40°C to +85°C	
Warm up time	30 minutes	
Size	257.3 x 193.7 x 66 mm (10.13 x 7.63 x 2.61 inches)	With mounting feet (shipped installed on unit)
	257.3 x 193.7 x 60 mm (10.13 x 7.63 x 2.36 inches)	Without mounting feet
Weight	2.7 kg (6 lbs.)	
Security	Kensington Security Slot	Located on back end-plate

Regulatory Compliance		
RoHS Compliance	RoHS	
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
FCC		

Environmental	
Shock and Vibration	MIL-STD-PRF-28800 Class 3
	Sections:
	Non-Operating Temp (3.8.2.1)
	Operating Temp (3.8.2.2)
	Relative Humidity (3.8.2.3)
	Vibration Limits (3.8.4.1)
	Sinusoidal Vibration (3.8.4.2)
	Shock Functional (3.8.5.1)

Ordering Information

Base Units	Part Number	Description
8 GHz RTSA	R5750-408	9 kHz to 8 GHz, RTBW up to 100 MHz
18 GHz RTSA	R5750-418	9 kHz to 18 GHz, RTBW up to 100 MHz
27 GHz RTSA	R5750-427	9 kHz to 27 GHz, RTBW up to 100 MHz
8 GHz RTSA	R5750-408-O	9 kHz to 8 GHz, RTBW up to 100 MHz, IP66 Outdoor option
18 GHz RTSA	R5750-418-O	9 kHz to 18 GHz, RTBW up to 100 MHz, IP66 Outdoor option
27 GHz RTSA	R5750-427-O	9 kHz to 27 GHz, RTBW up to 100 MHz, IP66 Outdoor option

R5750 Power Plug Options	Description
0	North American power plug (115 V, 60 Hz)
1	Universal Euro power plug (220 V, 50 Hz)
2	United Kingdom power plug (240 V, 50 Hz)
3	Australia power plug (240 V, 50 Hz)
4	Switzerland power plug (220 V, 50 Hz)
5	Japan power plug (100 V, 50/60 Hz)
6	China power plug (50 Hz)
7	India power plug (50 Hz)

Accessories		
Software Included	S240	Real-Time Spectrum Analysis Software
Rack Shelf	R5750-RACK-SHELF	19" rack shelf supports two horizontally mounted R5750s
Vehicular Power Conditioner	P120-012	

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