



RFsRio1

Wideband Spectriometer

Hardware Specification

The RFsRio1 Wideband Spectriometer is part of the RF-shamaanit Oy Scientific Radio generic platform family. The instrument is a self contained standalone system that is designed for superb RF performance, providing first class scientific data. By carefully adhering to the manufacturers instructions, the RFsRio1 will provide the user with many years of reliable service.

Antenna

The antenna is a light weight, portable, dual polarisation log periodic antenna designed specifically for the RFsRio1 wideband riometer. The antenna is DC short circuited by design, giving good protection against low frequency energy and transients such as ESD static discharge, and lightning induced voltage spikes. The antenna system includes a pipe mast onto which the riometer outdoor instrument cabinet is installed during commissioning.

RFsRio1 Receiver Antenna Specification:

Type:	Full wavelength, high efficiency logarithmic periodic antenna
Design:	Specifically for RFsRio1 Wideband Spectriometer Receiver
Structure:	Cross polarised, common boom
Design Objectives:	Following criteria accounted for in antenna design: low mass, ease of installation, bandwidth, passband ripple, minimum wind load, efficiency, radiation pattern, ground effect, height above snow/ice/wildlife, low real estate, snow/ice buildup, vibration, appearance, long life, serviceability
Elements:	2 * 8 elements
Bandwidth:	20 – 60 MHz
Matching:	SWR < 1:2.5 within specified frequency range
Protection:	Galvanic short circuit
Boom length:	300 cm
Mast hight:	300 cm
Mast structure:	Aluminium tubing, 40 * 40 * 3mm
Installation:	Mast foot and anchoring included
Guys:	Guys and anchoring included
Installation:	Vertical, beam towards zenith
Required installation area:	Approximately 10 * 10m



RFsRio1 Receiver Power supply

The RFsRio1 scientific receiver is supplied with a special Low Voltage iron core safety transformer that gives very good protection against mains grid transients. Additionally, the transformer design does not generate Radio Frequency Interference to the very sensitive wideband riometer itself or other nearby radio instruments. It is also possible to feed the RFsRio1 instrument with a solar and/or wind charged battery system in remote locations where there is no power grid connectivity.

RFsRio1 Power supply specification:

Design:	Iron core transformer
Installation:	In warm, dry location
Input voltage:	230 Vac
Output voltage:	12 Vac protection voltage (Low Voltage LoVo)
Instrument consumption:	<20 W
Allowed LoVo loss:	Maximum allowed loss 4 V with a 20 W load (compliance with 100m 2*2,5mm ² Cu)
Cabling:	3*2,5mm ² , 100m (included in delivery)

RFsRio1 Instrumentation

The instrument is designed with strict Radio Frequency Interference protection, far exceeding EMC standard requirements in order to not degrade the wideband riometer performance and to protect any other co-located radio instrumentation. The enclosure has dual EMC-shielding and incorporates extensive filtering and protection on all attached internal and external lines. The receiver proper is designed into a compartmentalized shielded structure of machined aluminium.

Operating temperature:	-30 +40°C
Thermal control:	The instrument incorporates cooling and heating solutions
Status LED's:	PWR OK LNA CH1 ON LNA CH2 ON Calibration Noise CH1 ON Calibration Noise CH2 ON
Data transfer:	Data is transferred over the Internet for external analysis
Physical Interface:	Optical Ethernet
Optical Fiber:	Supplied with 100 m optical fiber cable
Media Converter:	Converter to RJ45 (8P8C modular connector) included (to be installed in dry & warm location)
Extension:	The Media Converter Ethernet interface may be extended to LAN, 3/4G or WLAN devices of choice by the customer



RFsRio1 RF Front End

RFsRio1 RF Front End specifications

Input and output connectors:	Internally SMA(f), 50 Ω
Bandwidth:	BW _{-3dB} 20 – 60 MHz (typical)
Passband Ripple:	± 1 dB (typical)
Gain:	Designed for optimum AD converter dynamic range
Control:	Preampifiers may be enabled/disabled independently (for e.g. remote verification)
Intercept Point:	Output TOI + 33 dBm (typical)
Compression point:	Output -1 dB compression point +15 dBm (typical)
Noise Temperature:	Max. 250 K at instrument input connector
Calibration:	Internal Noise Source
Calibrator internal T_{hot}	Approximately 100 000 K (TBD)
Excess Noise	Approximately 5 dB over cold sky (TBD)
Coupling:	Directional Coupler
Calibration states:	T_{ant} vs. ($T_{ant} + T_{noise}$)
Noise enable:	Noise Sources may be engaged independantly
Built In Test:	Continuous monitoring and housekeeping of instrument currents, voltages, internal and external temperatures

RFsRio1 AD Conversion and Processing

Digitizer Specification

Digitizer:	4 channel RFs sampler
Resolution:	14 bits
Sample Rate:	125 MHz
Sample Clock:	Temperature Compensated TCXO
Clock Aging:	± 2 ppm over first year, ± 5 ppm over five years
Clock Jitter:	<100 fs typical
FPGA Processing:	Xilinx Z-7020 SOM.
Post Processing:	UDOO X86 ULTRA
CPU:	INTEL PENTIUM N3710 2.56 GHZ 4 core
Memory:	8 GB DDR3L DUAL CHANNEL memory
eMMC Storage:	32GB
Mass Memory:	500 GB SSD drive
Operating Sytem:	Linux
Local Control Port:	USB-UART control port on Post Processing Computer



RFsRio1 Performance

The RFsRio1 Scientific Receiver handles 2 * 100 sample frequencies with the 20 – 60 MHz range.

Wideband Spectrometer functionality with separate FPGA firmware to be purchased separately

Measurement Timing Accuracy: Better than 100Hz
Time Stamping: Post Processing Computer timing is over NTP
Typical accuracy: NTP accuracy 0,1 ms (typical) over 100 Mb/s network

Warranty

Standard Warranty: The standard warranty for RFsRio1 is 1 year
Extended Service: Extended Warranty is available, please contact manufacturer for quotation or special requirements

Service

Warranty Service: Carried out at Pietarsaari or Padasjoki facilities
Calibration Service: Calibration Service is available, please contact manufacturer for quotation or special requirements

Training

Training: 1 day training for 6 persons included
Facility: Pietarsaari
Content: Shipping, On-Site Survey, Installation, Commissioning, Maintenance, Service,

Improvements

The manufacturer retains the right to improve the product without prior notice.