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R1000 Series Embedded RF Receiver Product Manual

6/9/20/40 GHz



HAROGIC

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R1000 Series Embedded RF Receiver Product Overview

Product Overview

The R1000 series integrates a high-performance single-channel RF receiver with Raspberry-Pi 5 platform to form a compact embedded RF receiver. Serving as a high-computing-power edge device, it is capable of independent complex-task processing and well-suited for distributed field-side deployment.

Advanced RF Performance

The R1000 series adopts a high-performance superheterodyne architecture, equipped with up to 14 high-performance preselector filter bands. A single unit supports ultra-wide frequency coverage from 10 MHz up to 40 GHz (covering X, Ku, Ka, FR2 and FR3 bands). It delivers excellent noise performance, wide dynamic range, interference resilience, fast signal analysis and embedded deployment readiness, while lowering overall system cost without compromising receiving performance.



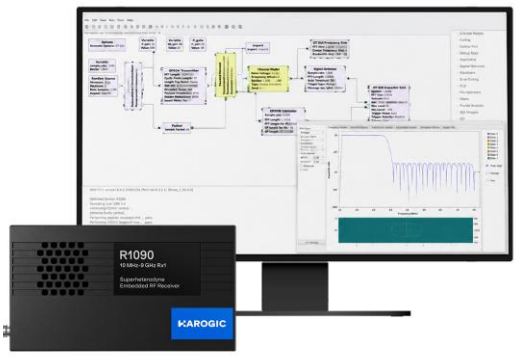
Compact Design and Easy Deployment

Featuring a highly compact design, the R1000 series can be readily integrated into diverse systems. The built-in computing platform is Raspberry Pi 5 (quad-core Cortex-A76
@2.4 GHz, 4 GB memory, 32 GB flash storage), supporting standalone operation without host PC. It preserves full RF performance while greatly reducing deployment complexity, ideal for space-constrained and cost-sensitive applications.



Powerful API and Comprehensive Ecosystem

The R1000 series implements unified API interfaces, enabling seamless hardware migration without source-code modification. Supported development environments include C/C++, C#, Python, MATLAB, Qt, LabVIEW and GNU Radio. Both Windows and Linux operating systems are supported.



Key Features

- Single-channel embedded RF receiver with integrated Raspberry Pi 5
- High-performance superheterodyne receiver with up to 14 preselection filter bands
- Frequency range: 10 MHz - 6/9/20/40 GHz
- Maximum real-time bandwidth: 50/100 MHz (Opt-50)
- Noise figure: 6 dB (1 GHz) , 7 dB (9 GHz), 14 dB (20 GHz), 24 dB (40 GHz)
- 1 GHz phase noise: < -110 dBc/Hz@ 10 kHz
- IF and image rejection: > 95 dBc (≤9 GHz)
- On-board GNSS module, supports frequency calibration via GNSS
- Remote data interface: 1 GbE
- Comprehensive API interfaces and example applications
- GPIO capability, external reference input and PPS trigger support
- Host-side OS support: Windows, Linux

Typical Applications

- **Spectrum Observation and Monitoring**

  The R1000 series provides high-performance signal reception for weak-signal spectrum observation, real-time spectrum analysis, memory scanning, and analog demodulation. Its compact form factor and onboard edge computing capabilities simplify field deployment for spectrum monitoring applications.

- **Distributed Signal Acquisition and Processing**

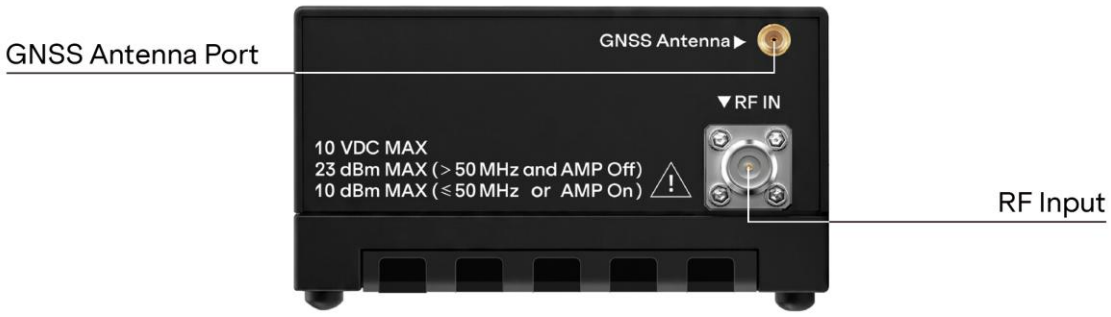
  Built upon the integrated Raspberry-Pi compute node, the unit can be networked over Gigabit Ethernet to establish distributed RF signal acquisition nodes. Each node provides substantial local compute resources for in-node deep signal processing.

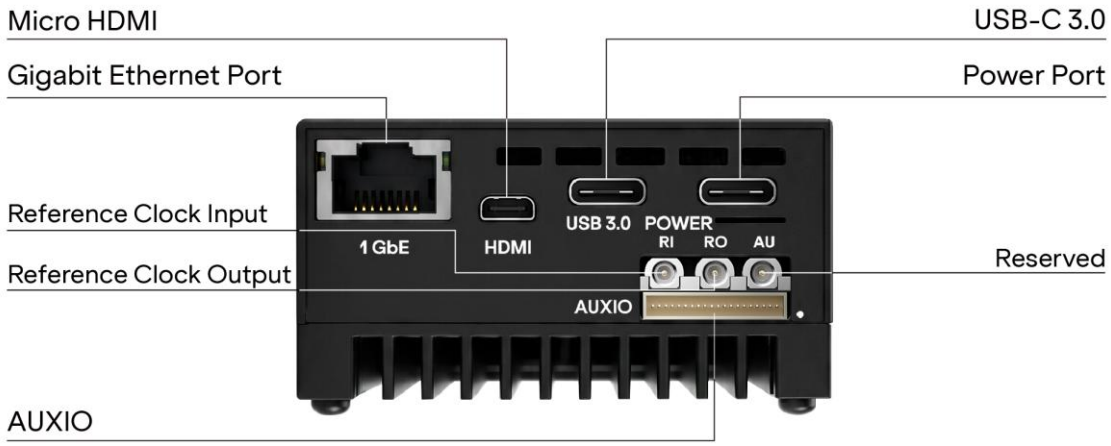
- **Education and Radio Enthusiasts**

  Supplied with SDK built upon unified HTRA-API, compatible with open-source tools such as GNU Radio. It accelerates hands-on signal-reception experiments and algorithm validation for academic and hobbyist users.

R1000 Series Interface Description





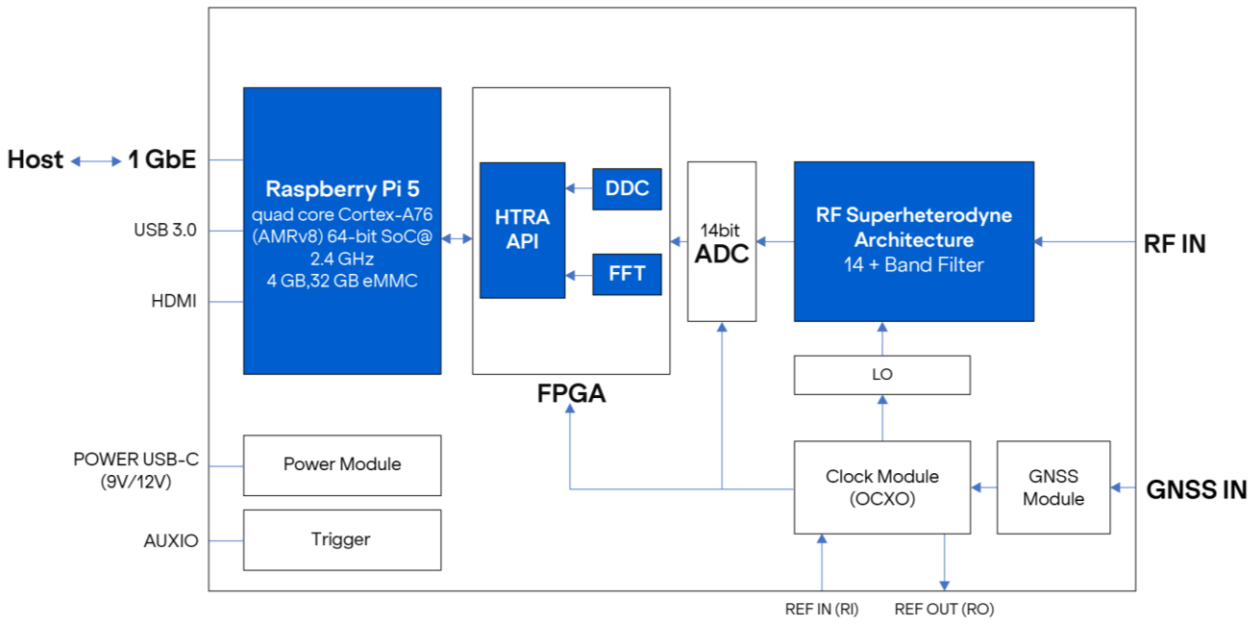


Specifications Overview

	R1060	R1090	R1200	R1400
RX Channels	1	1	1	1
TX Channels	0	0	0	0
Frequency Range*	10 MHz to 6 GHz	10 MHz to 9 GHz	10 MHz to 20 GHz	10 MHz to 40 GHz
Maximum IBW (MHz)	50 MHz / 100 MHz (Opt-50)		100 MHz	
Maximum IQ Sample Rate	62.5 MSPS / 125 MSPS (Opt-50)		125 MSPS	
RF Architecture	Superheterodyne			
Noise Figure	6 dB (1 GHz), 7 dB (9 GHz), 14 dB (20 GHz), 24 dB (40 GHz)			
SFDR	>70 dB			
Image and IF Rejection (≤9 GHz)	>95 dBc			
LO Leakage	Maximum LO leakage point: 5.8 GHz, −108 dBm			
Data Interfaces	1 GbE, 2.4 GHz/5 GHz Wi-Fi			
Reference Clock Input	10 MHz external reference input; PPS/GNSS supported			
Embedded Compute Platform	Integrated Raspberry Pi 5, 4-core A76, 4 GB Memory, 32 GB eMMC			
Power Consumption	R1060, R1090: <22 W R1200, R1400: <25 W			

*The R1000 Series can be tuned down to 9 kHz–10 MHz; however, performance specifications in this frequency range are not guaranteed.

System Block Diagram



Technical Specifications*

Frequency and Clock

Model	R1060	R1090	R1200	R1400
Number of Channels	1	1	1	1
Frequency Range	10 MHz to 6 GHz	10 MHz to 9 GHz	10 MHz to 20 GHz	10 MHz to 40 GHz
Frequency Step	1 Hz			
Reference Clock	Internal or external; supports manual correction or calibration via built-in GNSS			
Frequency Accuracy	≤0.5 ppm, supports manual correction		≤ 0.05 ppm, GNSS-aided frequency correction	
Aging and Temperature Drift	≤1 ppm/year, ≤1 ppm			
Built-in GNSS 1PPS Accuracy	≤ 100 ns /≤ 20 ns (Opt- 05), under clear-sky conditions			
External Reference Input	10 MHz, MMCX (F), amplitude ≥1.5 Vpp, 330 Ω			
Reference Output	100 MHz, MMCX (F), amplitude ≥0.3 Vpp, programmable on/off			

Amplitude

Model	R1060	R1090	R1200	R1400
Maximum Input Power Before Damage	23 dBm (pre-amp OFF); 10 dBm (pre-amp ON)			
Max DC voltage at RF-IN	±10 VDC			
Level Accuracy	±1.5 dB			

Noise Figure(dB)

Reference Level: -70 dBm	R1060	R1090	R1200	R1400
1 GHz	6	6	9	9
6 GHz	6	6	11	11
9 GHz	-	7	12	12
20 GHz	-	-	14	14
40 GHz	-	-	-	24

Phase Noise (dBc/Hz)

Carrier Frequency	1 GHz	6 GHz	9 GHz	20 GHz	40 GHz
1 kHz	-97	-86	-91	-89	-83
10 kHz	-110	-100	-100	-96	-90
100 kHz	-114	-104	-100	-96	-90
1 MHz	-131	-118	-116	-111	-105

Local Oscillator (LO)

LO Leakage	Maximum leakage point at 5.8 GHz: < −108 dBm
LO-Related Spurs	<-65 dBc offset from center frequency ±(N/M) × 100 MHz，N，M = 1，2，3，4，5…

IIP3 (dBm)

	Ref Level	1 GHz	6 GHz	9 GHz
R1060, R1090	+20 dBm	44	42	39
	0 dBm	26	23	21
	-20 dBm	10	2	3
	Ref Level	**1 GHz**	**20 GHz**	**40 GHz**
R1200, R1400	+20 dBm	41	32	32
	0 dBm	25	30	26
	-20 dBm	17	7	5

Anti-interference

R1060，R1090	Image Rejection	10 MHz-9 GHz	>95 dBc
	IF Rejection	10 MHz-9 GHz	>95 dBc
R1200，R1400	Image Rejection	10 MHz-9 GHz	>90 dBc
		9 GHz-20 GHz	>80 dBc
		20 GHz-40 GHz	No rejection
	IF Rejection	10 MHz-40 GHz	>85 dBc

General Specifications

RF Input	R1060, R1090	SMA (F)
	R1200, R1400	2.92 mm (F)
Power	USB Type-C， 9 V 3 A / 12 V 2.5A PoE power supply (Opt-24)	
Wired Data Connection	1 GbE	
Wireless Data Connection	Wi-Fi, Bluetooth 5.0; factory-default disabled, manual activation required. (To order versions without wireless module, please contact HAROGIC.)	
Peripheral I/O	Micro HDMI (HDMI 2.0), USB 3.0	
External Trigger Input	Integrated into AUXIO, 3.3 V CMOS, high-impedance input	
Trigger Types	Bus trigger, digital edge trigger, level trigger, etc.	
Trigger Output	Integrated into AUXIO, 3.3 V CMOS	
GNSS Antenna Input	MMCX (F)	
External Reference Clock Input	MMCX (F), 10 MHz, amplitude ≥1.5 Vpp, 330 Ω impedance	
Reference Clock Output	MMCX (F), 100 MHz, amplitude ≥0.3 Vpp, programmable enable/disable	
Overall / Core Weight	R1060, R1090: ≤ 357 g / ≤ 212 g R1200, R1400: ≤ 375 g / ≤ 236 g	
Overall / Core Dimensions (L × W × H)	R1060, R1090	120×63 × 33 mm / ≤ 119×60×21 mm
	R1200 ,R1400	128×63 ×33 mm / ≤ 127 × 60 ×21 mm
Power Consumption	R1060, R1090	≤ 22 W
	R1200, R1400	≤ 25 W
Package Accessories	USB flash drive * 1, 1 GbE Ethernet cable * 1， USB power cable * 1, power adapter * 1	
Host System Requirements	Windows 11/10 Ubuntu 24.04/22.04/20.04/18.04 (x64, AArch64)	
Operating / Storage Temperature(Ambient)	T0 class (std.)	0 - 50 °C / -20 - 70 °C
	T1 class (opt.40)	-20 - 65 °C / -40 - 85 °C
Operating Relative Humidity	Ambient Temp.: 0 to 40 °C	5 - 75%
	Ambient Temp.: > 40 °C	5 - 45%

Compute Platform

Processor (SoC)	Raspberry Pi 5， Broadcom BCM2712, quad core Cortex-A76 (ARMv8) 64-bit SoC @ 2.4 GHz
Memory	4 GB LPDDR4-4267 SDRAM with ECC
Storage	32 GB eMMC Flash Memory
OS	Debian 12 Bookworm 64-bit

Baseband

ADC Resolution		14 bit
SFDR		>70 dB
IQ Sample Rate	Standard	55 MS/s to 65 MS/s, adjustable with a tuning step of ≤ 10 Hz
	Option 50	110 MS/s to 130 MS/s, adjustable with a tuning step of ≤ 10 Hz
FPGA Decimation factors		Supports decimation factors of 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, and 2048.
Continuous Streaming Band-width		Maximum: 12.5 MHz (to host PC or local disk)
Burst capture bandwidth		Maximum: 50 MHz / 100 MHz （Opt-50），maximum burst length 128 Mbytes
Timestamp		Supports timestamping recorded with the IQ stream
Trigger Types		Supports multiple trigger methods for IQ acquisition, including edge trigger, level trigger, etc.
External Trigger Response		Maximum frequency response: 500 times/s

*Specification applies under the following conditions:

(1) Start up and warm up for 10 minutes, All values are typical unless otherwise specified.

(2) Ambient temperature 25 °C

(3) Specifications may vary with hardware and software versions without prior notice

OPTIONS

Code	Option	Type
05	Internal high precision GNSS	Built-in hardware
20	AUXIO IO expansion board	External hardware
24	PoE Power Supply	External hardware
40	T1 temperature class	Built-in hardware
50	100 MHz analysis bandwidth, only for R1060 and R1090	Built-in hardware
71	Basic vector modulation analysis	Software
72	Pulse analysis	Software

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