V1.0 2608

R1000 Series Quick Start Guide

Embedded RF Receiver
Raspberry Pi Integrated
Up to 40 GHz

HAROGIC

www.harogic.com info@harogic.com +65-8299 8857

Contents

1. Document Purpose and Scope

This document is intended to help users get started with the R1000 Series Embedded RF Receivers. By following this guide, users should be able to power on the device, establish network connectivity, access the embedded host, connect to the control software, view RF signals, acquire IQ data, run API examples, and check GNSS, PPS, timestamp, and trigger-related status.

Item	Description
Applicable Models	R1060 / R1090 / R1200 / R1400, these four models are collectively referred to as the R1000 Series. In this document, R1000 refers to any model in this series.
Core Tasks	Within 30 minutes, complete device power-up, network connectivity, software connection, RF signal viewing, and the first IQ/API example.
Related Documentation	R1000 Series User Manual, SAStudio4 User Guide, HTRA API Programming Guide, and API Example Usage Guide.

2. Operating Environment Requirements

The R1000 uses 1GbE Ethernet for remote control, data transfer, and API communication. The control software and API client can run on a host computer or, depending on the factory-installed system image, directly on the R1000 embedded host. The table below lists the recommended operating environment. For systems below the recommended specifications, actual performance should be verified through testing.

Table 1 Operating Environment Requirements

Operating System	Windows 11/10 (requires Visual Studio 2019 C++ Redistributables) Ubuntu 22.04/20.04/18.04
Memory	4 GB or more
Storage	For IQ signal recording, ensure that the storage system provides a sustained write bandwidth of more than 400 MBytes/s. An SSD is recommended.
Data Interface	1GbE Ethernet interface
Display Resolution	At least 1280 × 768 pixels

3. Safety and Precautions Before Use

This chapter of the R1000 Series Quick Start Guide covers safety instructions, device operation, software operation, and external interfaces.

3.1 Power Adapter Selection

1. **Adapter Selection:** The original power adapter supplied with the device is recommended. The device uses a USB Type-C POWER port. Use only the supplied adapter and cable that fully match the voltage/current ratings and power delivery protocol specified on the device nameplate.
2. **DC Power Requirements:** USB Type-C wide-voltage input. Voltage/current requirements: 9 V/3 A or 12 V/2.5 A.

Note: Using a power supply that does not meet the specified requirements may prevent the device from starting, cause unexpected restarts, or damage the device.

3.2 RF Input

The R1000 RF input uses an SMA (F) connector with a 50 Ω impedance. Before connecting an external signal, ensure that the input power, DC component, and external connection configuration do not exceed the limits specified in the product manual. Refer to the product manual for the maximum damage-level input power (CW) and maximum DC voltage. These limits must not be exceeded.

3.3 Cooling and Installation Environment

Maintain adequate ventilation while the device is operating and do not obstruct the heat-dissipation surfaces. If the device is installed in an enclosure, backpack, test box, or unattended node, provide sufficient airflow and evaluate the cooling conditions based on the ambient temperature.

4. Unpacking and Interface Overview

4.1 Package Contents

Item	Quantity	Description
R1000 Series Main Unit	1	See the device label for the specific model.
Power Adapter	1	PD 35 W, single USB Type-C port.
Power Cable	1	Connects the USB Type-C port on the power adapter to the POWER USB Type-C port on the R1000 Series unit.
1 GbE Cable	1	Used to connect the device to a host computer, network switch, or LAN.
Documentation USB Drive	1	Contains the product manual, user guide, software, drivers, SDK example programs, and other resources.

4.2 Interface Overview

Interface	Purpose	Required for Initial Setup
RF IN, SMA(F)	RF signal input, 50 Ω.	Yes
Power	Device power input; USB Type-C wide-voltage input, 9 V/3 A or 12 V/2.5 A.	Yes
1GbE	LAN port for remote control, data transfer, and API communication. Recommended as the primary connection for initial setup.	Yes
HDMI	Micro HDMI interface for connecting a display when operating the device in standalone mode.	Optional
USB 3.0	Used for standalone interaction and storage expansion. Connection through a docking station is recommended.	Optional
10 MHz REF IN	External reference input, MMCX (F), amplitude ≥ 1.5 Vpp, input impedance 330 Ω.	Optional
Trigger In / Out	Trigger input/output, 3.3 V CMOS.	Optional

AUXIO	Multifunction I/O interface supporting GPIO, triggering, and expansion functions. See the R1000 Series User Manual for the detailed pinout.	Optional
GNSS	GNSS antenna input, MMCX (F).	Optional

Product Documentation

Document	Purpose
HAROGIC R1000 Series RF Receiver Product Manual	Provides a product overview, key features, applications, and technical specifications.
HAROGIC R1000 Series RF Receiver Quick Start Guide	This document. Provides instructions for getting started with the product and completing the initial setup after receiving the device.
HAROGIC R1000 Series RF Receiver User Manual	Covers the complete R1000 user workflow, including interfaces, power supply, networking, desktop software, IQ acquisition, GNSS, triggering, and hardware/software troubleshooting.
HAROGIC HTRA API Programming Guide	Detailed HTRA API/SDK programming guide for secondary development and API integration.
HAROGIC HTRA API Example User Guide	Describes how to use the API example applications, including examples for C/C++, C#, Python, LabVIEW, MATLAB, and other supported environments.
HAROGIC SAStudio4 User Guide	Describes the software supplied with R Series products for hardware configuration and verification, IQ recording and playback, and spectrum preview. For first-time use, it is recommended to read the HAROGIC R1000 Series User Guide first.

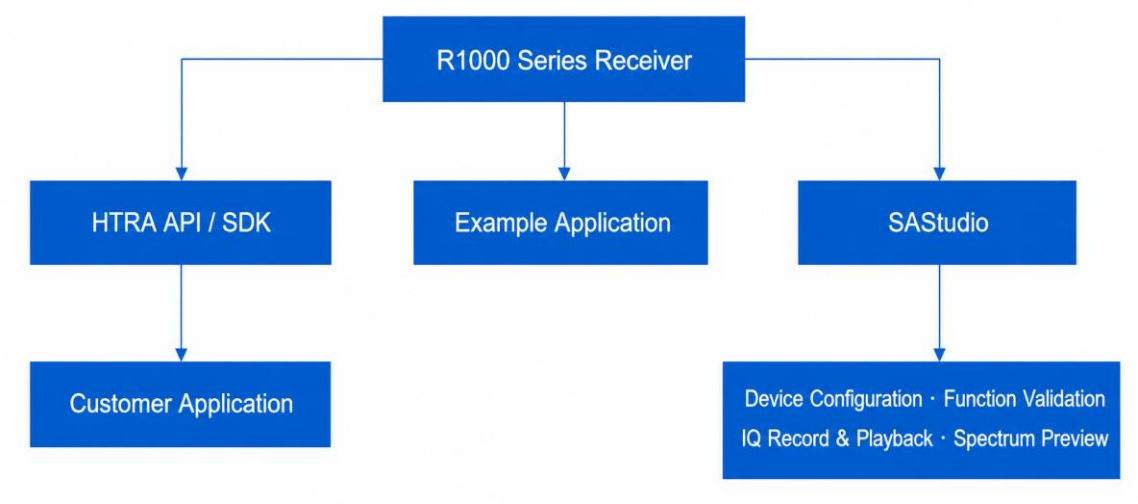


Figure 4-1 Relationship of R1000 Series Receiver Software and SDK

5. Initial Connection and Power-On

5.1 Minimum Connection Setup

1. Place the R1000 on a stable, well-ventilated surface. Connect the supplied power adapter to the R1000 using the USB Type-C cable, and plug the adapter into a power outlet;
2. Use an Ethernet cable to connect the R1000 LAN (1GbE) port to the computer. The connection speed is 1 Gbps. It is recommended to confirm that the computer also has a 1GbE Ethernet port to achieve maximum data throughput. The default IP address of the R1000 is 192.168.1.100. In most cases, the host computer must be configured with an IP address on the same subnet before a connection can be established;
3. For standalone operation, Step 2 can be skipped. Connect a display to the HDMI port, and connect a keyboard and mouse through a USB Type-C docking station connected to the USB 3.0 port;
4. If GNSS or time synchronization is required, connect the GNSS antenna and place it in a clear-sky environment with an unobstructed view of the sky;
5. After power is applied, the fan can normally be heard starting briefly at high speed. Wait for the system to complete the startup process.

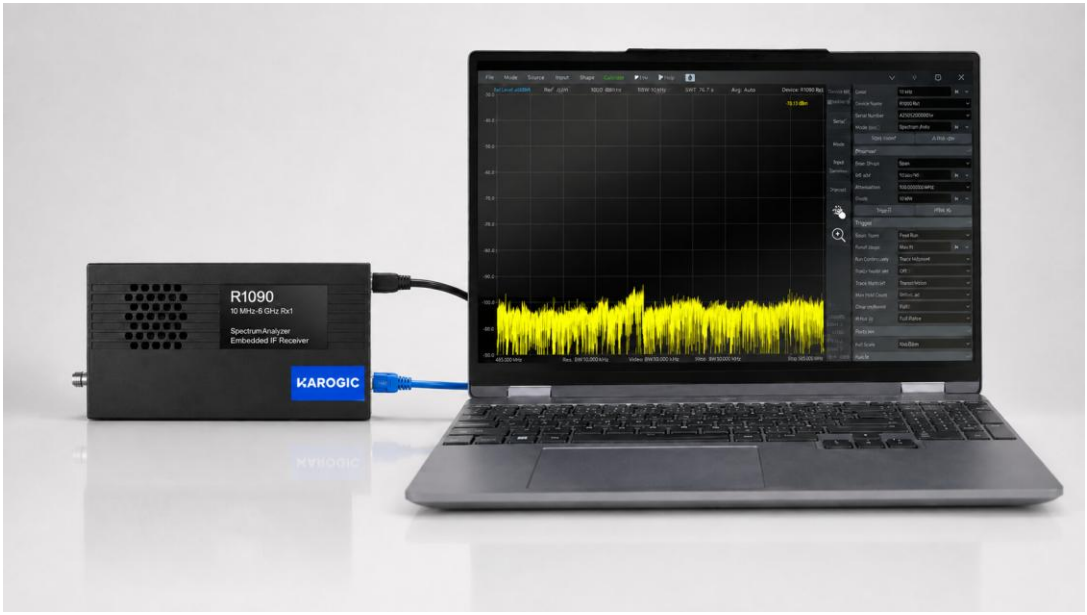


Figure5-1 R1000 Series Device Connection Diagram

6. Network Configuration and Host Access

6.1 Network Configuration

The R1000 can connect to a network through its 1GbE Ethernet (LAN) interface. When an R1000 Series device connects to a network, its built-in logic first searches for a DHCP server. If an active DHCP server is available, an IP address is assigned automatically. If no DHCP server is detected, the device retains its default IP address (192.168.1.100).

For the initial connection, it is recommended to configure the host computer on the same subnet as the R1000, as shown below.

Item	Default Value / Description
Static IPv4 Address	192.168.1.100
Subnet Mask	255.255.255.0
Example Host IP	IP address: 192.168.1.102; Subnet mask: 255.255.255.0; Gateway: 192.168.1.1

6.2 Direct Connection Verification

- Open Windows “Settings” -> “Network & Internet” -> “Ethernet”;
- Open the Ethernet settings, locate the IP settings section, and click “Edit”;
- Select “Manual”, enable IPv4, set the IP address to 192.168.1.102, and set the subnet mask to 255.255.255.0;
- Open Command Prompt and run ping 192.168.1.100. If replies are received, the network connection has been successfully established.

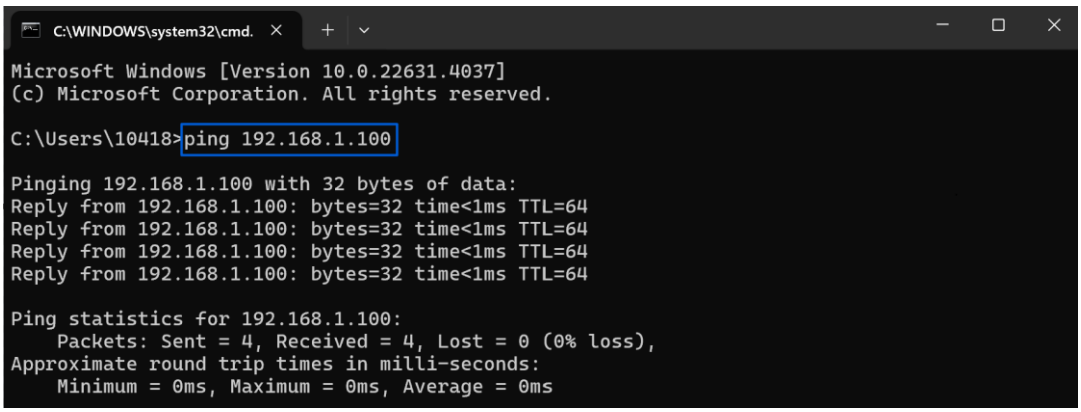


Figure6-1 Testing the Device Network Connection (Ping Command)

6.3 Logging In to the R1000 Embedded Host

The R1000 integrates a Raspberry Pi CM5 host, which can be accessed via SSH or through a locally connected display.

The default SSH credentials are:

Username: htra

Password: htra

MobaXterm is recommended for SSH access.

ssh htra@192.168.1.100

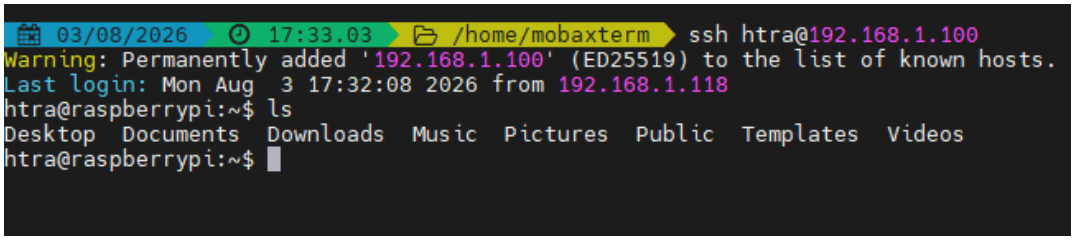


Figure6-2 SSH Login Interface in MobaXterm

6.3.1 Network Configuration

The default network configuration of the R1000 Series device is as follows:

- **IPv4 Address:** "192.168.1.100"
- **Subnet Mask:** "255.255.255.0"

7. Launching the Software and Connecting to the R1000

The R1000 can be controlled using SAStudio4 or the HTRA API.

For a Windows environment, SAStudio4 is included with the software package supplied with the product. The executable is located at:

SAStudio4\SAStudio4\bin\SAStudio4.exe

7.1 Running the Software on a Host PC

On the user's host PC, SAStudio4 can be run or the HTRA API can be used to connect to and control the R1000 via a 1GbE Ethernet interface. After the software starts successfully, the interface should appear as shown below.

If a Bus Open Error message with error code -1 appears, click Hide in the dialog box. Then select System > Device Connection > ETH from the menu bar.

Figure7- 1 SAStudio4 in IQ Streaming Mode After Startup

Click "System" -> "About" on the menu bar to view the device model, serial number, software version, and hardware version.

7.2 Standalone Operation (Running the Software on the R1000 Raspberry Pi)

Close all software used in Section 7.1. Connect the HDMI port to a display, connect a USB Type-C docking station to the R1000 USB 3.0 port, and then connect a mouse and keyboard.

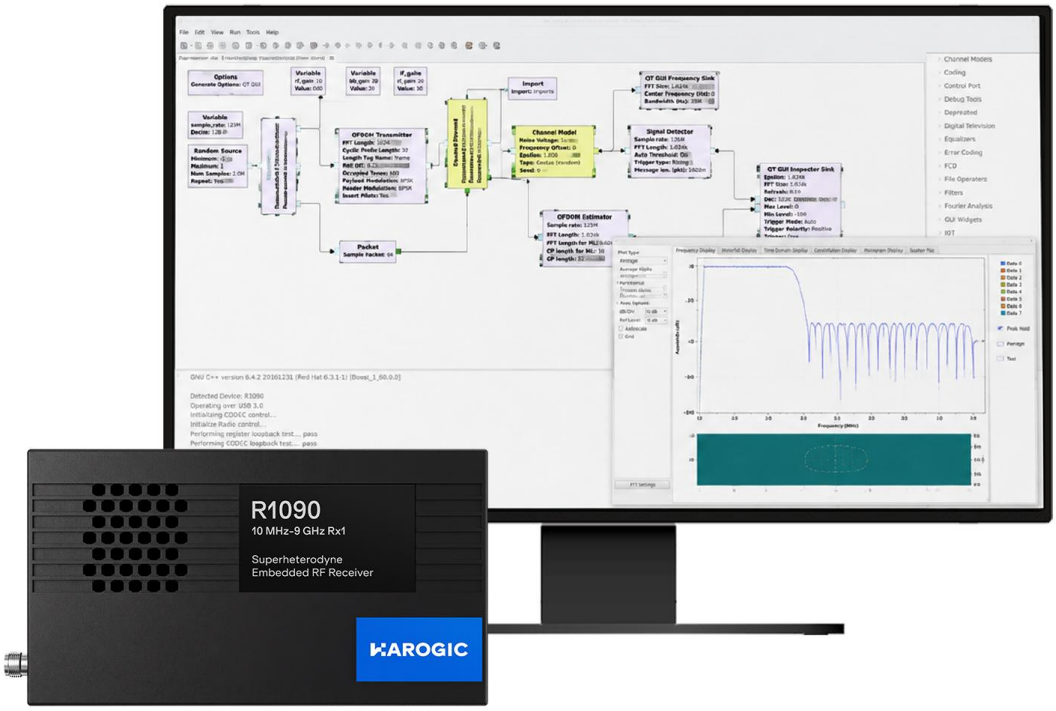


Figure7-2 GNU Radio Development Environment Running on the R1000 Host

After power-on, the system automatically enters the desktop environment, as shown below. Double-click the SAStudio4 icon in the upper-left corner of the desktop. SAStudio4 will launch automatically, indicating that the device is operating correctly.

Figure7-3 Default Desktop of the R1000 Host (Raspberry Pi 5)

8. Viewing an RF Signal for the First Time

Connect a known RF signal source or antenna to the R1000 RF IN port. Open SAStudio4 and select “Mode” -> “Real-Time Spectrum Analysis” from the menu bar to view the RF signal using the afterglow display. The following example uses a Wi-Fi antenna:

- Set the center frequency and leave all other settings unchanged;
- Start the measurement and confirm that the frequency-domain representation of the input RF signal is displayed in the software window;
- Save a screenshot or export the data.

Parameter	Example Value
Center Frequency	2.41 GHz
Span	Full Span
RBW	Auto
Reference Level	0dBm

Note: Ensure that the input signal level does not exceed the device limits or cause damage.

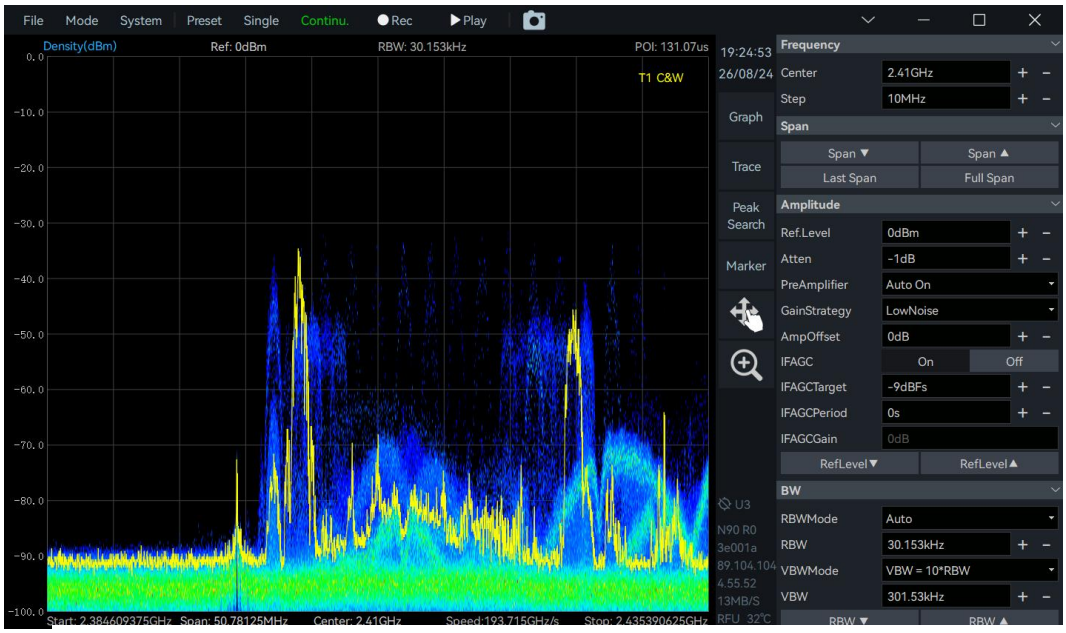


Figure8-1 Real-Time Spectrum Analysis with the Center Frequency Set to 2.41 GHz and an Antenna Connected to the SMA Port

9. Acquiring IQ Data for the First Time

The R1000 supports IQ data acquisition and recording. For first-time use, it is important to distinguish between continuous recording and burst recording, as well as concepts such as sample rate and analysis bandwidth.

9.1 Acquiring IQ Data Using SAStudio4

- From “Mode” on the top menu bar, switch to Receiver/IQ Streaming Mode.
- Set the center frequency, bandwidth, sample rate, and acquisition duration.
- Start IQ acquisition.
- Save the IQ file.
- Check the IQ file path and file format information.

Item	Parameter
Native Sample Rate	62.5 MSPS (continuously adjustable from 55 to 65 MSPS; with the 100 MHz option, adjustable from 110 to 130 MSPS)
Analysis Bandwidth	12.5 MHz
Data Format	Single-channel 16-bit by default
Span	Adjustable as required
Record	Set the recording mode to Fixed Duration with a duration of 5 seconds, or select Manual recording mode

Start recording by switching Record from Off to On, or by clicking the Record button on the top menu bar.

Figure9-1 Fixed-Duration Recording and File Path

The recorded data files can be found in the SAStudio4\data directory and are saved in WAV format.

Click the Playback button to review the recorded RF signal in SAStudio4.

10. Locating the API Example Applications

The API example applications and the corresponding API Example Applications Guide are provided on the documentation USB drive supplied with the product. For the latest API and example applications, visit the HAROGIC Download Center.

The API package provides IQ acquisition examples for C++, C#, Python, LabVIEW, MATLAB, Qt, and other development environments. The following uses C++ as an example.

Software Option: HTRA API

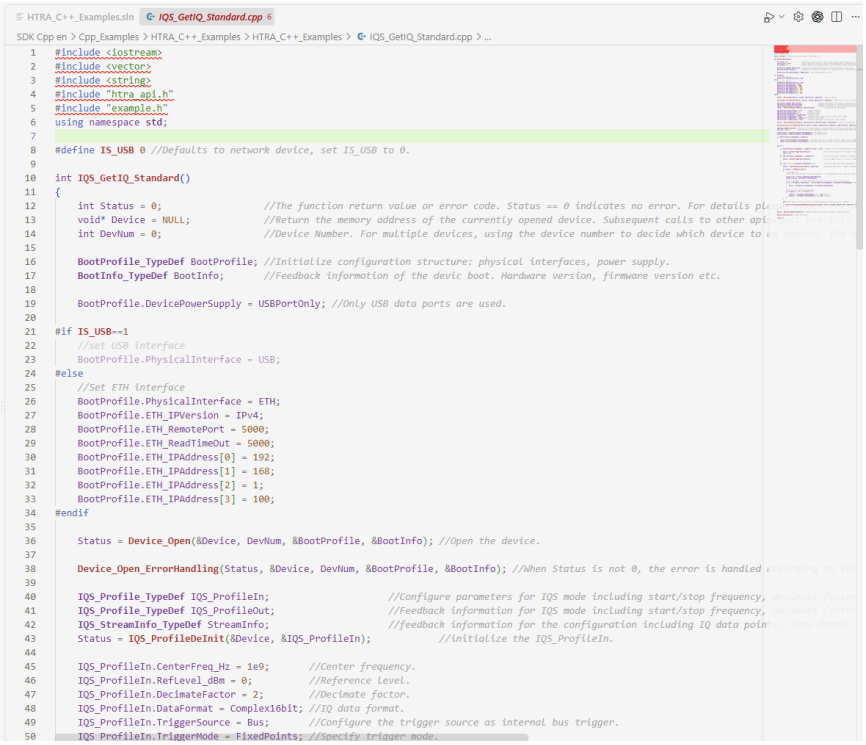
Description: Provides APIs for interacting with R1000 Series devices and supports standard CPU host operations required by most applications.

Use Cases: Discover devices, configure the receiver, acquire RF IQ data, and perform IQ recording and reading.

Location:

Windows SDK\C++_Examples\C++_Examples\ HTRA_C++_Examples\

Windows SDK\C++_Examples\C++_Examples\Htra_RecordingandPlayBack



11. Common Issues and Quick Troubleshooting

11.1 Device Does Not Power On

Check whether the green power indicator is illuminated. A brief fan sound can normally be heard after power-on. Verify that the power adapter is a HAROGIC-recommended model, the power cable is securely connected, and the power input specifications match the current hardware version. Also check for abnormal overheating or unusual odors. If the problem persists, contact HAROGIC Technical Support.

11.2 Unable to Access the R1000 over the Network

Confirm that a 1GbE Ethernet cable is being used and that the computer is connected through a 1GbE LAN port. Verify that the host computer and the R1000 are configured on the same subnet as described in this document. Also check whether the firewall is blocking the software connection.

11.3 SAStudio4 Cannot Find the Device

Confirm that the SAStudio4 version is 4.4.55.44 or later and that Ethernet is selected as the connection method. Check whether the R1000 can be reached using ping. If the ping test is successful, select **System > Device Connection > ETH** from the SAStudio4 menu bar. This switches the SAStudio4 connection from USB to Ethernet. If the device still cannot be detected, restart the computer or the R1000 device.

11.4 GNSS Does Not Lock

Confirm that the GNSS antenna is properly connected and placed in the environment with an unobstructed view of the sky. Allow sufficient time for GNSS lock, and verify whether the antenna requires active power.

11.5 IQ Acquisition Packet Loss or Lower-Than-Expected Data Rate

Check whether the current sample rate exceeds the sustained throughput capability of the network or storage system. Confirm that the computer or host system uses a Gigabit Ethernet or faster network interface, and avoid running background tasks that consume significant CPU or disk resources.

Confirm whether the IQ acquisition mode is continuous recording or burst recording. In burst recording mode, the recording duration is limited by the onboard memory capacity. For continuous recording, the IQ sample rate must not exceed the specifications stated in the product manual.

11.6 Installing a Custom Raspberry Pi System Image

Due to the ultra-compact hardware design of the R1000 Series, user-defined Raspberry Pi system images are currently not supported.

Do not install or flash a custom Raspberry Pi system image, as doing so may prevent the device from booting properly and may invalidate RF-related parameters. If you encounter any system-related issues, contact HAROGIC Technical Support.

12. Further Reading

Task	Document
Refer to the complete product user manual for interfaces, power supply, networking, desktop software, IQ acquisition, GNSS, triggering, and more.	HAROGIC R1000 Series RF Receiver User Manual
Create applications using GNU Radio and obtain the latest GNU Radio and SoapySDR examples from Git (continuously maintained).	GNU Radio Example User Guide HAROGIC Git Repo.
Learn the complete operation of SAStudio4.	HAROGIC SAStudio4 User Guide
Develop applications.	HAROGIC HTRA API Programming Guide
Run example applications.	HAROGIC HTRA API Example User Guide

www.harogic.com

info@harogic.com

+65-8299 8857