ThinkRF R5750
Real-Time Spectrum Analyzer with GNSS

User Guide
Version 1.0

HARDWARE WARRANTY AND LIMITATION OF LIABILITY

Read this warranty carefully before you use the product.

R5750 Real-Time Spectrum Analyzers with GNSS are warranted for workmanship and materials for a period of one (1) year from the date of shipment as identified by the Customer's packing slip or carrier waybill. ThinkRF reserves the right to void the warranty on any equipment that has been altered or damaged due to Customer negligence, unauthorized repair, misuse of equipment, evidence of physical or environmental damage, transportation abuse or removal of any ThinkRF identification labels or serial numbers.

It will remain the responsibility of the Customer, having obtained a Return Material Authorization (RMA) and shipping instructions from ThinkRF, to return, at the Customer's expense, the defective unit to ThinkRF's repair facilities. ThinkRF will incur shipping charges for the return of warranty repaired equipment. The RMA number can be secured by calling ThinkRF Customer Service and Support (1-613-369-5104). If the product does not fall within ThinkRF's warranty period or the product is found to be functioning as designed, then under the terms of ThinkRF's warranty policy, all costs of repairs and shipping will be charged directly to the Customer. ThinkRF will warrant repaired units for a period of 90 days from date of shipment from ThinkRF to the Customer. If the remaining period on the original hardware warranty is greater than 30 days, then ThinkRF will honor this remaining warranty period.

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Table of Contents

Preface

This section describes the audience for, the organization of, and conventions used in this document. It also identifies related documentation and explains how to access electronic documentation.

Audience

This document is written for technical people who have basic understanding, familiarity and experience with network test and measurement equipment.

Conventions

The following conventions and notations are used in this document:

Note: This symbol means **take note**. Notes contain helpful suggestions or references to additional information and material.

Caution: This symbol means **be careful**. In this situation, you might do something that could result in equipment damage or loss of data.

Warning: This symbol means **danger**. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with the standard practices for preventing accidents.

Obtaining the Latest Documentation and Software

Please visit the ThinkRF website at https://www.thinkrf.com/documentation/ to obtain the latest R57500 documentation. Latest software and firmware releases are also available on the ThinkRF website at https://www.thinkrf.com/download-updates/.

Document Feedback

Please send your comments about this document or any ThinkRF documentation to **support@thinkrf.com**. We appreciate your feedback.

Obtaining Technical Assistance

The ThinkRF Support website provides online documents for resolving technical issues with ThinkRF products. Visit https://www.thinkrf.com/documentation/ for more information.

For all customers who hold a valid end-user license, ThinkRF provides technical assistance 9 AM to 5 PM Eastern Time, Monday to Friday. Contact us at **support@thinkrf.com** or by calling **+1.613.369.5104**.

Before contacting support, please have the following information available:

- R5750 serial number (located on the identification label on the R5750 device's underside)
- The product version
- The firmware version running on the R5750
- Versions of ThinkRF software you are using, potentially including the API libraries to third-party applications
- Operating system and version on your PC

Overview of the ThinkRF R5750

The R5750 Real-Time Spectrum Analyzer (RTSA) with Global Navigation Satellite System (GNSS) is a high-performance software-defined RF receiver, digitizer and analyzer with integrated GNSS technology to offer location and time information in one package.

It is designed for stand-alone, remote, distributed, and/or embedded real-time spectrum analysis, monitoring and intelligence applications.
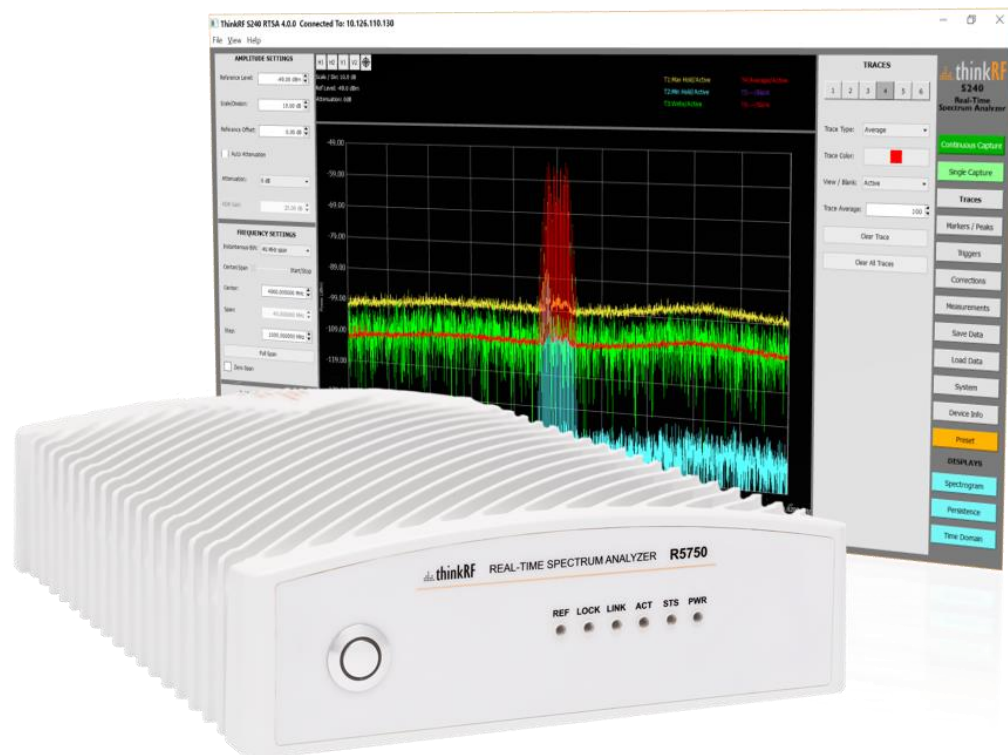
ThinkRF has patented software-defined RF receiver technology that provides industry leading combined sensitivity, tuning range, instantaneous bandwidth and scan rate. Additionally, the R5750 provides real-time sophisticated triggering, search and loss-less capture of signals of interest using an integrated patented digital signal processing engine.

The R5750 is ideal for monitoring, management and surveillance of transmitters, whether they are in-building or spread across a geographic area. Applications include but are not limited to spectrum analysis, 5G wireless technology, research, test and measurement, spectrum monitoring and OEM integration. When the GNSS module is enabled, GNSS position and time information is sent to users through VRT context packets roughly every second.

In addition to the two internal and external 10 MHz reference clock sources, the GNSS module also provides a third 10MHz reference clock source option for synchronized time-stamps on VRT packets.

The R5750 Real-Time Spectrum Analyzer provides Gigabit Ethernet for stand-alone, remote and distributed applications. ThinkRF supports a rich set of industry-leading standard protocols and APIs, enabling the R5750 to easily integrate into your new or existing applications.

Standard protocols include the Standard Commands for Programmable Instruments (SCPI) protocol for controlling and obtaining status from the R5750 and the VITA 49 Radio Transport (VRT) protocol for digitized data and its associated context information. APIs are provided for interfacing and performing data acquisition and spectral analysis with Python™, C/C++, MATLAB® and LabVIEW®.

Applications can also be built within the PyRF development framework. PyRF is built on the Python programming language and is open-source under BSD licensing. PyRF handles the low-level details of real-time acquisition, signal processing and visualization, and provides feature rich libraries, example applications and source code, all specific to the requirements of signal analysis.

Getting Familiar with the ThinkRF R5750

This section provides information about the front and rear panels, connection ports and identification label of the R5750 Real-Time Spectrum Analyzer.

Note: The type and placement of connectors and components on the panels and the case may vary depending upon the product variant and version.
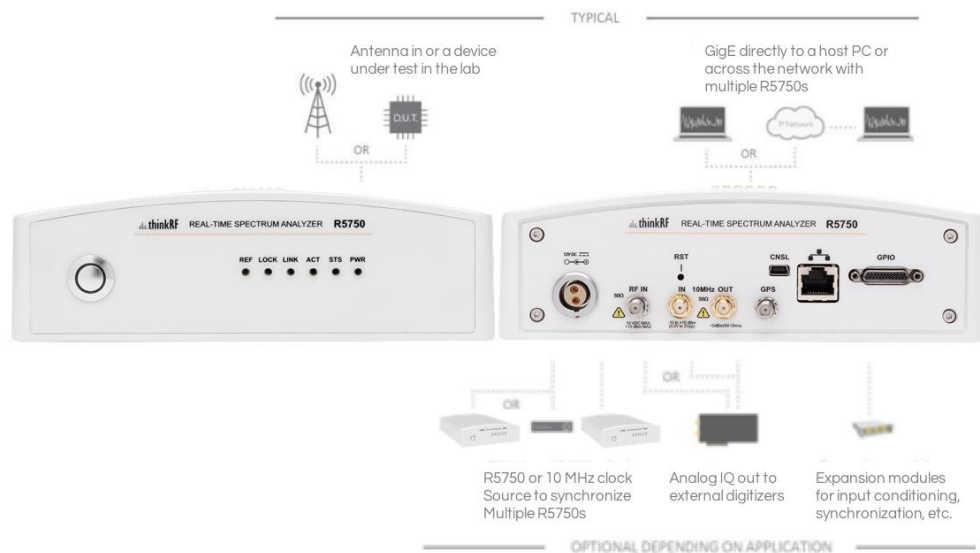
Front Panel

The front panel of the R5750 contains the power switch, status indicator LEDs, and the input connector for the RF antenna port.
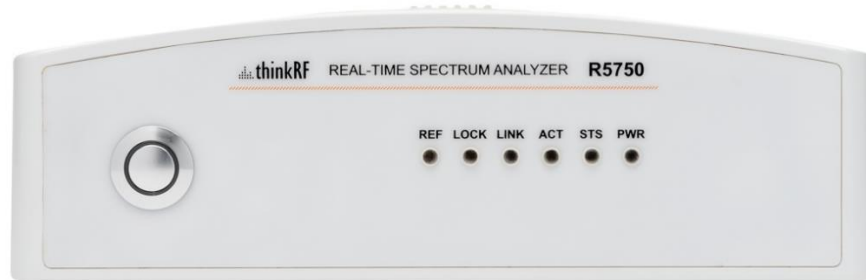
Rear Panel

The rear panel of the R5750 contains the power input, 10 MHz reference clock I/O, hardware reset button, input connector for the GNSS antenna, USB console (CNSL) port, Ethernet port, and GPIO port.

Underside

The underside of the ThinkRF R5750 includes a label that identifies the device. The information on the label may vary depending on your product variant and version. The product "Version" number is important for identifying which firmware can be used to update your product.

Installing the ThinkRF R5750

Ensure that you read and understand the following information about safety and electrostatic discharge before you unpack and install the R5750 device.

Warning: Only trained and qualified personnel should be allowed to install or replace this equipment. Read the installation instructions before you connect the system to its power source.

Preventing Electrostatic Discharge Damage

Electrostatic Discharge (ESD) is a single-event, rapid transfer of electrostatic charge between two objects, such as an operator and a piece of electrical equipment. ESD can occur when a high electrostatic field develops between two objects in close proximity. ESD occurs when electronic components are improperly handled and is one of the major causes of device failures in the semiconductor industry.

Electrostatic discharge is more likely to occur with the combination of synthetic fibers and dry atmosphere. Always follow these steps to prevent ESD.

Warning: Never open the front or rear panels of the R5750 as personal injury may result and opening the chassis will void the warranty. There are no user-serviceable parts inside. Always contact ThinkRF support for service through the online support form at http://www.thinkrf.com/support/.

Caution: To prevent ESD, wear an ESD-preventive wrist strap that you provide, ensuring that it makes good skin contact.

Caution: Do not touch any exposed contact pins or connector shells of interface ports that do not have a cable attached. If cables are connected at one end only, do not touch the exposed pins at the unconnected end of the cable.

Unpacking the Box

This section lists the items that come with your R5750 analyzer. If any of the items are missing or damaged, please contact your ThinkRF customer service representative.

The R5750 shipping box contains the following:

- R5750 Real-Time Spectrum Analyzer

- Power adapter and cable

- Straight-through Ethernet cable

- USB console cable

- Receiver antenna

- GNSS antenna and cable

- Precautions & Quickstart Guide

Note: The receiver antenna is included for your convenience and only intended to perform adequately across a limited frequency range.

Connecting the Antennae, Ethernet and Power Cables

Caution: Never connect a transmitter directly to the receiver with a cable.

Follow these steps to connect the receiver and GNSS antennae, the Ethernet cable, and the power cable:

1. Screw the antenna on to the R5750 "RF IN" antenna input SMA connector on the device's front panel.

   Carefully turn the antenna screw by hand until you encounter resistance. See the System Specifications section for the maximum allowable input and cautions.

Caution: Do not over-tighten the antenna connector on the jack. Using a wrench, pliers or even your hand to over-tighten the antenna can cause permanent damage to the receiver. See the SMA Connectors section for the torque recommendations.

2. Screw the GNSS antenna on to the R5750 "GPS" antenna input SMA connector on the device's rear panel.

   Carefully turn the antenna screw by hand until you encounter resistance. See the System Specifications section for the maximum allowable input and cautions.

3. Connect one end of the Ethernet cable to the R5750's Ethernet port (on the rear panel) and the other end to an Ethernet port on your router or PC.

4. Connect the R5750 analyzer to its power adapter.

Warning: Use only the power adapter provided with the unit.

5. Plug the power adapter into a power outlet.
6. Push the power switch towards the power symbol to power the unit on.

Note: See the Using the ThinkRF R5750 Administration Console section for a description of the R5750 status.

Choosing the Mount Location for the R5750

After you have connected the R5750 receiver and GNSS antennae, Ethernet Cable, and power cable, you can select a location to mount the R5750 analyzer.

Caution: To prevent damage to the R5750 radio receiver, do not install or operate the R5750 within 2 feet (60 cm) of devices that transmit more than +15 dBm power, such as Wi-Fi access points.

Connecting to the ThinkRF R5750

The R5750 analyzer is a network device. Typically, all communications with the R5750 analyzer occur via a Gigabit Ethernet connection, either directly from a computer or across an IP network.

The R5750 analyzer's Gigabit Ethernet connection allows control and monitoring of the R5750 using SCPI commands, and transmission of data using the VRT protocol.

Determining Your Network Topology and IP Address Allocation

To connect with the R5750 analyzer, you must decide the topology of your network connection and how your R5750 obtains its IP address.

Network Topology

The R5750 analyzer supports any IP network topology via its Ethernet port, including:

- direct connection to a computer across an RJ-45 Ethernet cable (as described in the Connecting Directly to the R5750 section)

- connection across a routed local network, whether on the same subnet or across different subnets or a routed wide-area network (WAN) such as the Internet (as described in the Connecting to the R5750 across a Network section)
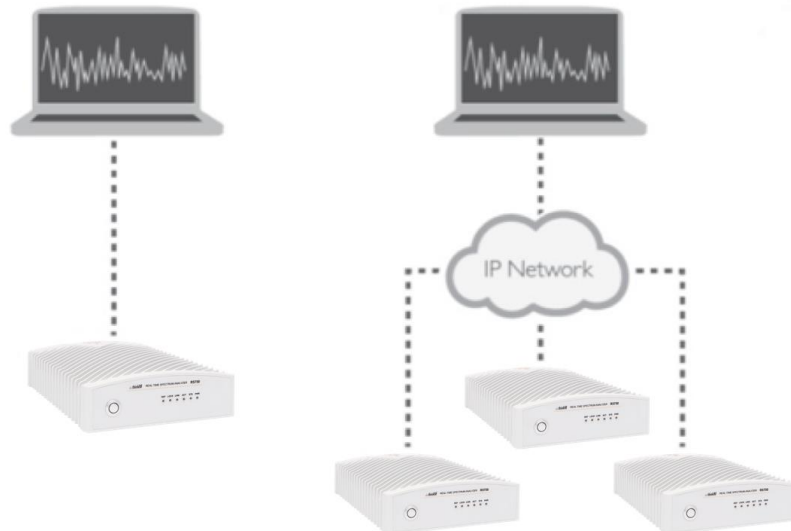
IP Address Allocation

The R5750 analyzer also supports different methods for obtaining its IP address, including:

- **Dynamic IP address allocation (DHCP)**

  The IP address is assigned via the Dynamic Host Configuration Protocol (DHCP), for a routed network topology that has a DHCP server.

- **Dynamic IP address allocation (APIPA)**

  The IP address is assigned via the Automatic Private IP Addressing (APIPA) protocol (otherwise known as Auto-IP), where a DHCP server is not available. This method allows a direct connection to a computer that supports Auto-IP or to a local network using a switch. With Auto-IP, a host network device randomly assigns itself a link-local address in the 169.254.x.y subnet when it fails to contact a DHCP server. Many operating systems, including Windows, support Auto-IP.

- **Static IP address allocation**

  IP address is assigned locally. This method is applicable to any network topology.

By default, the R5750 analyzer is configured for dynamic IP address allocation. You can change the method of IP address allocation from one supported method to another.

For instructions on configuring a static IP address (via the Administration Console), see the Configuring the R5750 IP Address section.

If your R5750 is configured with a static IP address, you can configure dynamic IP address allocation using the Administration Console or USB console, or via a hardware reset.

A hardware reset is the simplest method for reconfiguring the R5750 to dynamic IP allocation.

Connecting Directly to the R5750

This section provides instruction on connecting the R5750 analyzer directly to a computer via the Ethernet port.

The host PC might require a spare Ethernet interface that is not otherwise used as its primary network connection. For example, you may use a wireless connection for primary network connectivity or obtain a second Ethernet card or USB adapter to connect to the R5750.

Note: The Ethernet interfaces on both the PC and the R5750 must be configured for the same IP address allocation method before you can make a direct connection.

For the purposes of these instructions, the ThinkRF S240 Real-Time Spectrum Analysis software is used to connect to the R5750 analyzer. The latest version of this software is available at http://www.thinkrf.com/resources.

To connect your computer directly to the R5750 analyzer:

1. Connect the Ethernet cable provided with the R5750 to the Ethernet port on the PC and the Ethernet port on the R5750.

2. Power up the R5750 and wait a minute for it to complete booting.

3. Check to ensure that the R5750 LINK indicator is illuminated. If it is not illuminated, your PC may not support automatic crossover on its Ethernet connection and you may require an RJ-45 crossover Ethernet cable.

4. If you are using static IP allocation, go to the next step. If you are using dynamic IP address allocation, check the STS LED for the Auto-IP setup completion (this takes approximately one minute or longer).

Note: While the R5750 is searching for a DHCP server, the STS LED blinks yellow slowly until it obtains an IP address either via DHCP or Auto-IP. The STS LED blinks in a green heartbeat pattern if it has set up successfully to using an Auto-IP address.

5. Verify the PC's IP configuration by opening a Command window and typing the `ipconfig` command to show the IP addresses assigned to each interface.

   The Ethernet interface should show a 169.254.x.y address as shown in the example below:

   ```
   Select Command Prompt                    —   □   ×

   C:\Users\ThinkRF Support>ipconfig

   Windows IP Configuration


   Ethernet adapter Ethernet 2:

      Connection-specific DNS Suffix  . :
      Link-local IPv6 Address . . . . . : fe80::3829:c778:2283:ae54%19
      Autoconfiguration IPv4 Address. . : 169.254.174.84
      Subnet Mask . . . . . . . . . . . : 255.255.0.0
      Default Gateway . . . . . . . . . :
   ```

6. Launch the S240 Real-Time Spectrum Analysis Software to determine the assigned IP address of the R5750.

   ```
   Open Device              —   □   ×

   Devices Detected on Local Network

   R5700-427 180522-659 1.0.0 169.254.60.100




   Manually Enter Device IP: 169.254.60.100
      Connect      Refresh      Cancel
   ```
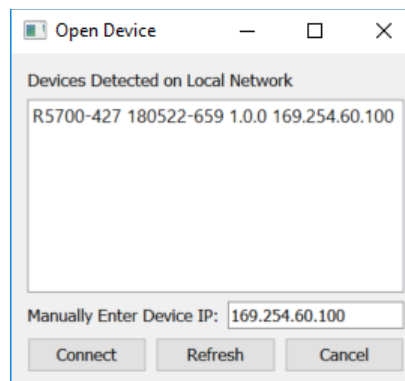
   In order for the Discovery tool to locate the R5750, your computer and the R5750 must be configured for the same subnet. If you are using Auto-IP dynamic IP allocation, then they will both be on the same 169.254.x.y subnet.

If you are using static IP and the Discovery tool cannot locate the R5750, you must have prior knowledge of its static IP address or use the USB console.

Once you have the R5750 IP address, you can use it to communicate with the device.

Note: Link-local addresses used for Auto-IP are non-routable, so communications is limited to devices within the local subnet. This restriction may be an issue when running virtual machines (e.g. Mac Parallels, VirtualBox, etc.) that may be connected through virtual routers to the host PC's physical network interface.

Note: After obtaining a link-local address, the R5750 continues to request a DHCP address. If a DHCP server responds at a later time, the link-local address is overwritten with the offered IP address. This new address is retained until the network cable is physically unplugged or the R5750 is restarted.

Connecting to the R5750 across a Network

You can connect to the R5750 analyzer from a computer across a local area network (LAN), whether on the same subnet or different subnets, or across a wide area network (WAN), such as the internet.

Before you connect to the R5750, you must decide on your IP address allocation method. The PC and R5750 do not need to use the same IP address allocation method, but if you are using the ThinkRF Discovery tool to locate the R5750 analyzer, they must be on the same subnet.

If you are using dynamic IP address allocation, your router or network must support a DHCP server.

To connect to the R5750 across a network:

1. Connect the Ethernet cable provided with the R5750 to the Ethernet port on the router and the Ethernet port on the R5750.

2. Power up the R5750 and wait a minute for it to complete booting.

3. Check to ensure that either your PC's or the R5750 LINK indicator is illuminated.

4. If your R5750 is behind a firewall or a router with firewall capability, then your network's DHCP server is likely assigning private IP addresses (e.g. 192.168.x.x, 10.x.x.x, 172.x.x.x), and the firewall is likely providing some form of network address translation (NAT) function. If this is the case and you require access to the R5750 from outside your firewall, then you will likely have to configure the firewall to allow port forwarding on port 37000 and 37001. If necessary, consult your network administrator.

5. Use the PyRF Discovery tool or the S240 Real-Time Spectrum Analysis software to determine the R5750's assigned IP address.

   In order for the Discovery tool to locate the R5750, both your computer and the R5750 must be configured for the same subnet. If you are using DHCP then you may have to query your router's allocation tables to determine the IP that is allocated to your R5750 MAC address.

If you are using static IP and the Discovery tool cannot locate the R5750, you need to have prior knowledge of its static IP address or use the USB console. If necessary, consult your network administrator.

Once you have the R5750 IP address, you can use it to communicate with the device.

Using the ThinkRF R5750 Administration Console

This section provides instruction on connecting to the R5750 via its web-based Administration Console. The Administration Console provides the ability to:

- obtain status information from the R5750

- change date and time configuration

- change IP configuration

- upgrade the R5750 software and firmware

- upload customized calibration settings

- restart the R5750

 All of these functions may be performed over the network either locally or remotely.

You can connect to the R5750 Administration Console by entering the IP address of your R5750 into a web browser. The IP address is shown in the S240 software as the connected device.

Viewing Device Status

When you connect to the Administration Console, the main window shows Device Status by default, and includes information such as the device serial number and firmware version.
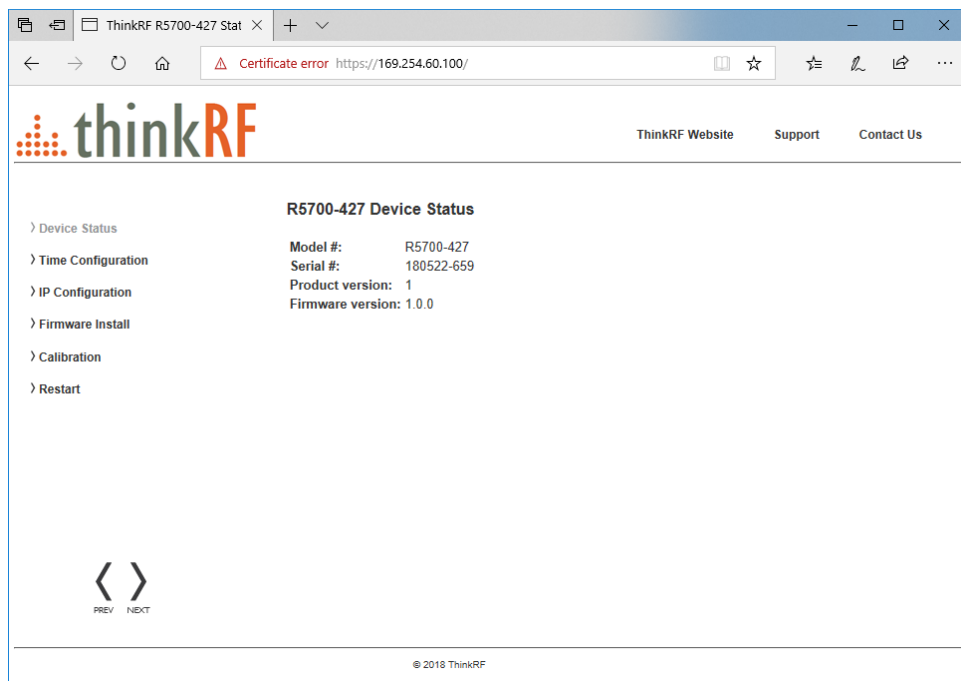
Configuring R5750 Time Synchronization

You can set the R5750 analyzer time manually, configure the R5750 to synchronize with the PC's time, or configure time synchronization with an NTP server.

Note: The R5750 analyzer stores its time based on the Coordinated Universal Time (UTC) and otherwise has no notion of local time-zones. Conversely, the web dialog translates and displays the R5750 time based on the local time-zone setting of the PC.

To configure the R5750 time synchronization method:

1. Click on the **Time Configuration** link in the left pane of the Administration Console.

2. In the **R5750 Device Time Configuration** window (main pane), select "**NTP**" as the Time sync source.

3. Enter the IP addresses for up to 3 NTP servers (you can find the NTP server list at https://www.ntppool.org/en/)

4. Select "**Continuous**" as the Time sync mode.

   The R5750's time is synchronized to the NTP server on a regular basis (the interval is optimally determined automatically).

Note: It is important that NTP be set up in order to get a precise time and provide a synched VRT time to global time.

5. Click **Apply** to save your changes.

Configuring the R5750 IP Address

You can configure the R5750 to obtain an IP address dynamically (using DHCP) or you can set the IP address manually (using a static address).

Caution: If the R5750 IP address is set to a static IP, the only way to communicate with the R5750 is via that IP address. If you mistakenly enter the wrong IP address and/or subnet mask, or forget the IP address, you can change the IP configuration using the USB console or by resetting the R5750.

To configure the R5750 IP address:

1. Click on the **IP Configuration** link in the left pane of the Administration Console.

2. In the **R5750 Device IP Configuration** window (main pane), select the method for IP address allocation.

3. If you select the static IP address option, enter the IP address information as appropriate.

4. Click **Apply** to save your changes.

    The configuration changes take effect immediately, and your current connection (based on the previous IP address) will no longer be valid.

Updating the R5750 Firmware

This section describes how to update the R5750 firmware.

The firmware installation file contains firmware images associated with the R5750 FPGA, Linux operating system and the embedded application. The update process copies the new images to the R5750, but does not remove the currently installed images. The new firmware installation will only take effect after the R5750 is restarted.

You can obtain the latest R5750 firmware file from the ThinkRF website (at https://www.thinkrf.com/firmware-updates/).

Note: Updating the R5750 firmware may over-write any user-defined calibrated values. See the Customizing R5750 Calibration Settings section for more information.

To update the R5750 firmware:

1. Click on the **Firmware Install** link in the left pane of the Administration Console.

2. In the **R5750 Device Firmware Install** window (main pane), enter or browse to the location of the `ThinkRF_R5750_firmware_vX.Y.Z.img` (or similar *.img) firmware image file.

3. Click **Install** to install the firmware.

Warning: Do not unplug the R5750 during a firmware update or the device may become inoperable.

When the firmware image for the intended product version is installed, the **Installing** page appears, showing the progression of the firmware being uploaded and installed.
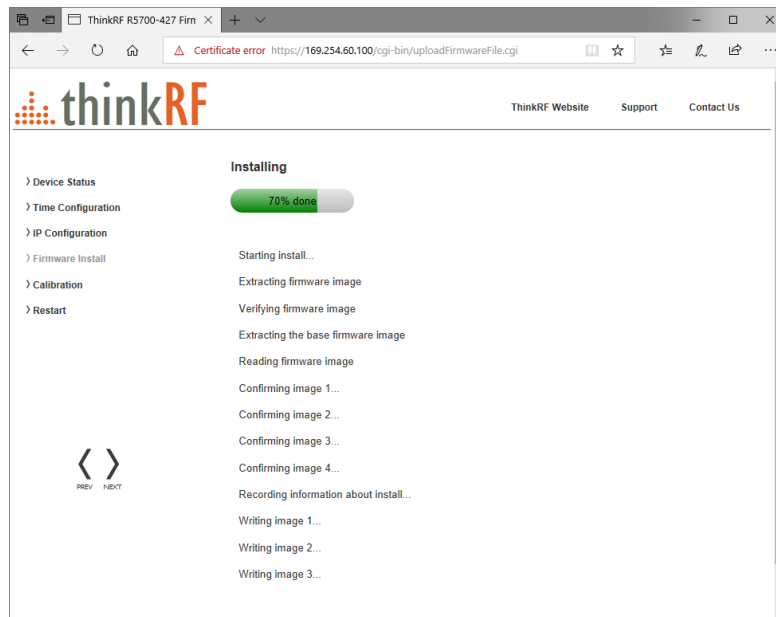
4. When firmware installation is complete, a web dialog appears requesting confirmation that you want to restart the R5750 for the changes to take effect. You can click **OK** to proceed, or **Cancel** to defer the device restart.
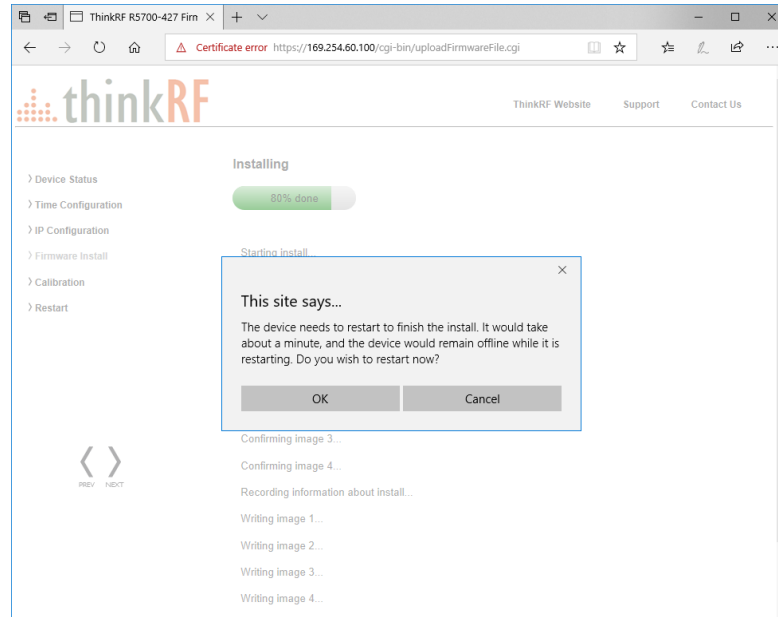
Note: If the R5750 is not restarted immediately after a firmware install process, then the newly installed firmware will take effect upon the next restart of the R5750 regardless of whether it is a software restart or a power-on reset.

In addition, the boot-up might take over a minute when there are new changes to the calibration setup or Auto-IP connection method is used.

Customizing R5750 Calibration Settings

The R5750 supports user-defined calibration settings if you do not want to use the ThinkRF default calibration settings. This allows you to calibrate the R7500 analyzer's RFE with reference levels based on, for example, frequency ranges, temperature ranges, and insertion loss of the attenuator that are specific to your own applications.

You can upload your own calibration settings through the R5750 Administration Console using the instructions described in the following section.

Uploading a Custom Calibration File

You can upload your custom calibration settings file to the R5750 via the administrative console. Changes to calibration settings do not take effect until you restart the R5750.

Note: Custom calibrated values may be over-written by a new firmware update. After restarting the unit once the firmware update is done, check on the **Calibration** link in the Administration Console to see which calibration file is specified at the top of the Filename list (for example, "System" or your customized file).
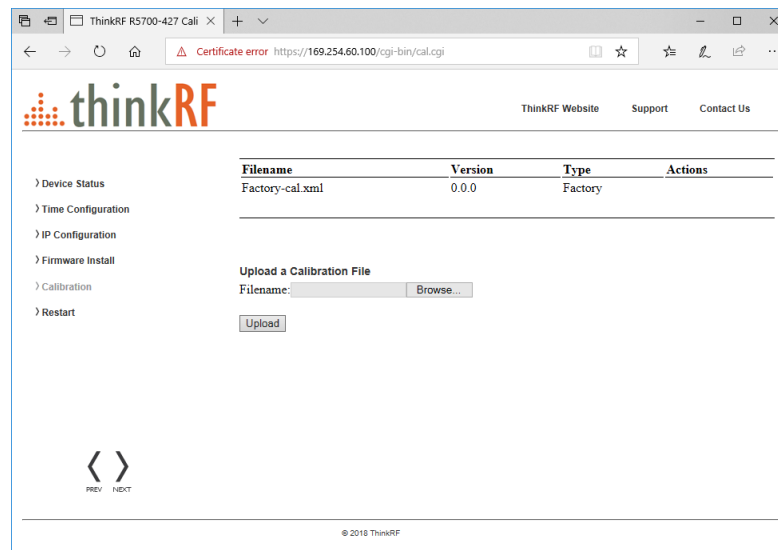
To upload a custom calibration file:

1. Click on the **Calibration** link in the left pane of the Administration Console.

2. In the **R5750 Device Calibration** window (main pane), click **Browse** to open an Explorer window to navigate to the calibration setting file you want to upload.

3. Click **Upload** to upload the file.

   When the upload is complete, the custom calibration file appears on the list of calibration files. The most recently uploaded file is listed at the top of the table.

4. Restart the R5750 (you can click **Restart** in the left pane, or toggle the power switch).

   The boot-up may take longer than usual because the embedded system applies the new calibrated values.
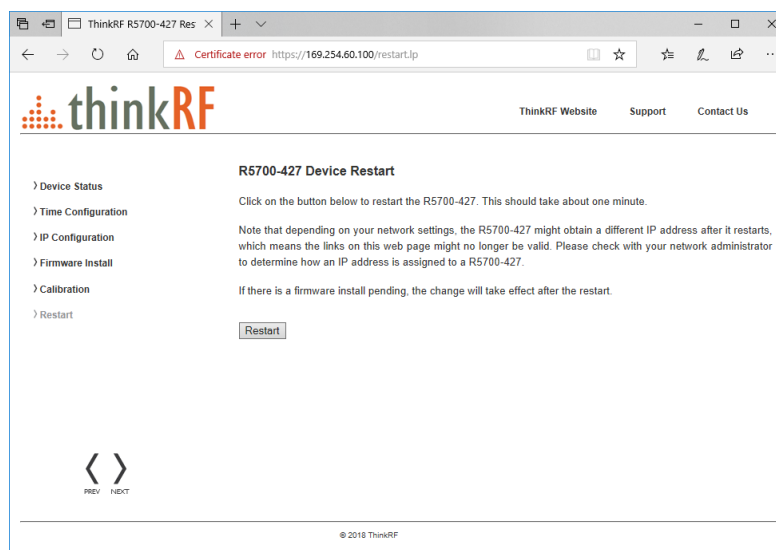
If more than one calibration settings file are present when you restart the R5750, the R5750 selects the calibration source in the following priority:

- firmware version specified in the calibration file

- user-defined file

- factory defaults (from ThinkRF factory calibration)

Any calibration data that is not specified or missing in the new calibration file is retrieved from the calibration file of the next highest priority.

Restoring the Default Calibration Settings

You can restore the calibration settings to system defaults at any time by deleting all custom calibration files from the system. You cannot delete the system calibration file.

To restore the default calibration settings:

1. Click on the **Calibration** link in the left pane of the Administration Console.

2. In the **R5750 Device Calibration** (main pane), select a custom calibration file from the list and click DELETE in the **Actions** column.

3. Repeat step 2 for all custom calibration files listed in the table.

4. Restart the R5750 (you can click **Restart** in the left pane, or toggle the power switch).

Note: If you perform a factory reset (as described in the Restarting the R5750 section), the calibration settings are also reset to factory defaults or system defaults, according to the file source selection priority described above.

Restarting the R5750

You can restart the R5750 via the Administration Console. Performing a device reset from the Administration Console is equivalent to a power-on reset.

To restart the R5750:

1. Click on the **Restart** link in the left pane of the Administration Console.

2. In the **R5750 Device Restart** window (main pane), click **Restart**.
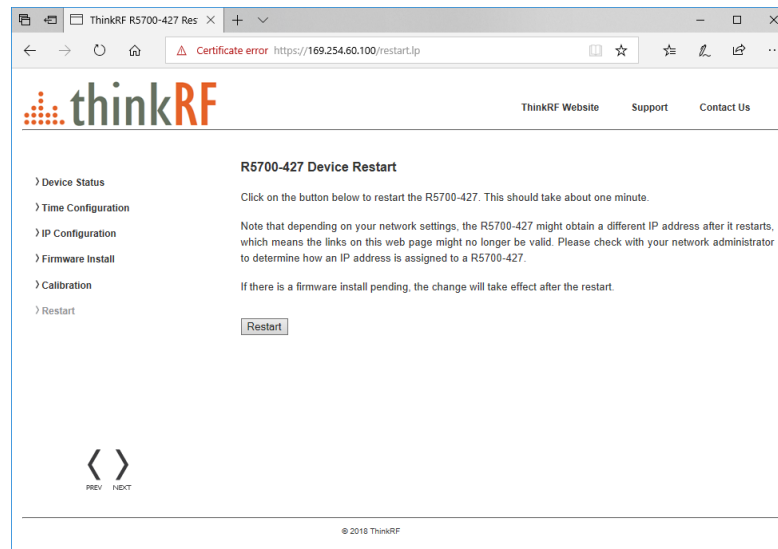
Depending on your network settings, the R5750 may obtain a different IP address after it restarts, which will result in the links to the Administration Console being interrupted. This will only happen when the unit is not in static IP address mode or a factory reset has been initiated.

Please check with your network administrator to determine the IP address of the R5750.

Using the ThinkRF R5750 USB Console

This section provides instruction on connecting to the R5750 via its USB console. The USB console provides control and status of the R5750 using SCPI commands. Typical applications may include configuring and querying the R5750 network IP or controlling and querying the R5750 in an external digitizer application.

The R5750 USB console supports communication of SCPI commands and status. It does not support the transfer of VRT data or commands via the Administration Console.

Installing USB drivers

The R5750 USB console uses a Silicon Labs CP210x USB to UART Bridge Virtual COM Port driver, which may require configuration of drivers on your PC.

To install the USB drivers:

1. Power on the R5750 and wait approximately 30 seconds for boot-up.
2. Connect The USB cable to the R5750 USB console port and your PC's USB port.

    Your PC should automatically detect the R5750 as a new USB device and install the appropriate driver.
3. Open the Windows **Control Panel** > **Device Manager** > **Ports (COM & LPT)**, and verify that there is an entry for "Silicon Labs CP210x USB to UART Bridge (COM7)" (or equivalent COM#).

    If the driver is not installed or there are errors, go to http://www.silabs.com/products/mcu/pages/usbtouartbridgevcpdrivers.aspx to obtain the drivers.
4. Note the assigned COM port number.

Connecting to the USB Console

You must have a serial terminal program on your PC to connect to the R5750 USB console. These instructions provide an example using PuTTY from http://www.putty.org/.

To connect to the USB console:

1. Install the required USB drivers, as described above.
2. Launch your terminal application (for example, PuTTY) on your PC.
3. Configure the terminal application to connect via the COM port associated to the USB to UART Bridge (as shown in the terminal configuration panel image below).
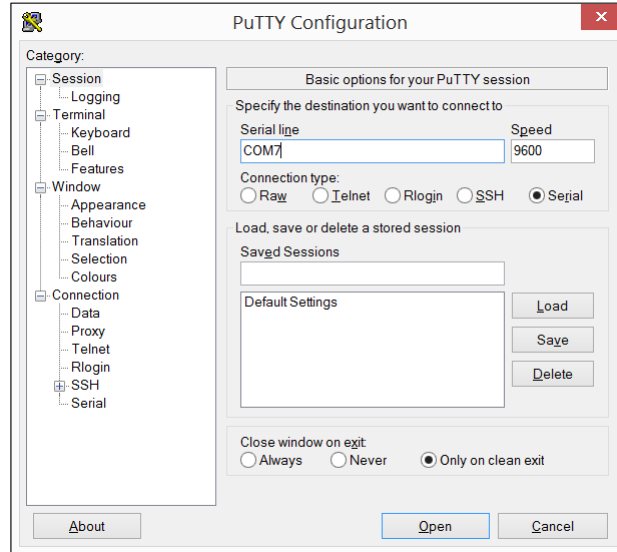
If you are using a different serial terminal program, ensure the serial settings are as follows:

- Baud speed (bits per second): 9600
- Data bits: 8
- Stop bit: 1
- Parity: none
- Flow control: none

4. Open the terminal session.

5. Press the "**Enter**" key until the ">" cursor appears in the terminal window.

   If the cursor does not appear, the USB to UART Bridge may be expecting a typical VT100 terminal response. Press "**Ctrl + C**" and "**Enter**" until the cursor appears. The cursor may take several seconds to appear.

6. Enter the `*IDN?` command and press the "**Enter**" key.

   The R5750 returns a message with its device identification such as "ThinkRF, R5750...."

7. Refer to the *R5750 Programmer's Guide* associated with the firmware release of your R5750 for the SCPI commands to use with your R5750 via the USB console terminal window. The firmware release version of the R5750 is returned with the `*IDN?` SCPI command.

Configuring the R5750 IP Address

The R5750 supports dynamic IP address allocation using DHCP, or manual IP address configuration (via static IP address).

Caution: If the R5750 IP address is set to a static IP, the only way to communicate with the R5750 is via that IP address. If you mistakenly enter the wrong IP address and/or subnet mask, or forget the IP address, you can change the IP configuration using the USB console or by restarting the R5750.

To configure the R5750 IP address via the USB console:

1. Open a connection to the R5750 USB console (as described above).

2. Enter the following SCPI commands. Press "**Enter**" after each line and substitute the appropriate IP address for your R5750 analyzer:

    ```
    :SYST:COMM:LAN:CONF STATIC

    :SYST:COMM:LAN:IP?

    :SYST:COMM:LAN:IP <IPs address>

    :SYST:COMM:LAN:GATE?

    :SYST:COMM:LAN:GATE <gateway address>

    :SYST:COMM:LAN:NETM?

    :SYST:COMM:LAN:NETM <netmask address>

    :SYST:COMM:LAN:DNS?

    :SYST:COMM:LAN:DNS <DNS address>[,DNS address 2]

    :SYST:COMM:LAN:APPL
    ```

Using the GNSS Module

The R5750's Global Navigation Satellite System (GNSS) supports location coordination activities with a number of different satellite constellations, including GPS/QZSS, GLONASS, and BeiDou. The R5750 GNSS module supports up to 2 concurrent receptions.

Location position and time are transmitted through VRT packets, along with timestamping and data output for captures.

The ThinkRF R5750 GNSS module supports GPS and GLONASS. Please refer to the R5750 datasheet (available on the ThinkRF website at https://www.thinkrf.com/documentation/) for detailed specifications.

Configuring the ThinkRF R5750 GNSS Module

GNSS settings are accessible via SCPI commands, through the USB console, or via Telnet or HiSLIP protocols. Please refer to "Appendix A: Connecting to RTSA" in the *ThinkRF R5750 Programmer's Guide* for more information on Telnet and HiSLIP connections.

You can also configure GNSS settings via various APIs such as C API, Python, etc.

Note: GNSS timestamp information is recorded in the GNSS VRT packets, which are returned approximately every 1 second. Refer to "Table 21: Formatted GNSS Geolocation Fields" in the VRT section of the *ThinkRF R5750 Programmer's Guide* for more information.

Selecting the GNSS 10MHz Reference Source

In addition to the two internal and external 10 MHz reference clock sources available with the R5750 analyzer, the GNSS module also provides a third 10MHz reference clock source option for synchronized time-stamps on VRT packets.

You can configure the R5750 to use the GNSS reference clock, via the USB console, or via Telnet or HiSLIP connections. The USB console is used in the following examples.
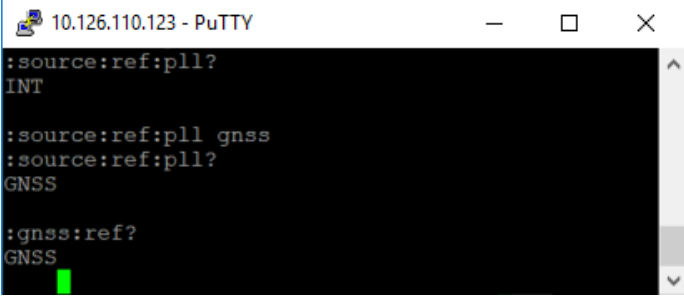
Follow these steps to ensure the device is using the GNSS module for clock reference:

1. Connect to the R5750 USB console (as described in the Connecting to the USB Console section).

2. In the terminal application (for example, PuTTY), check the reference source the R5750 PLL is currently locking to with the following command:

   `:SOURCE:REFerence:PLL?`

3. Set the reference source to the GNSS reference clock with the following command:

    `:SOURCE:REFerence:PLL GNSS`

4. Verify that the internal 10 MHz clock is disciplined by the GNSS system with the following command:

    `:GNSS:REFerence?`

    If the system response is "`GNSS`", the internal 10 MHz is disciplined by the GNSS module and the GNSS module has a valid fix.

    If no GNSS fix is available, the system response is "`INT`".
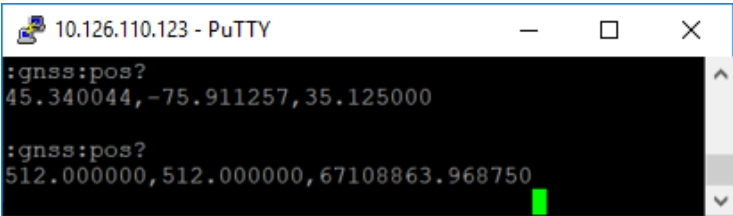
Getting Real-Time Geolocation Data

You can obtain real-time GNSS position data from the R5750 GNSS module.

During data capture, the real time GNSS location context packets are sent periodically in the VRT data stream. It is up to the host application to make use of this information. Please refer to "Formatted GNSS Geolocation" section in the *ThinkRF R5750 Programmer's Guide* for more information.

To obtain geolocation data:

1. In the terminal application (for example, PuTTY), retrieve GNSS position data with the following command:

    `:GNSS:POS?`

    The system returns the last known GNSS position by latitude (degrees), longitude (degrees) and altitude (meters) data.

    If GNSS is out of lock, the response is "`512.000000,512.000000,67108863.968750`".

2. You can also check the status of the GNSS geolocation data with the following command:

    `:STATus:QUEStionable:CONDition?`

    This command queries the Questionable Status Register (QSR) and returns the decimal equivalent of a binary value. When 0 is returned, the GNSS data is current. When 512 (or bit 9) is returned, the GNSS is out of lock.

    See "Appendix D: Questionable Status Register (QSR) in the *ThinkRF R5750 Programmer's Guide* for more information.

Resetting the ThinkRF R5750 to Factory Settings

If for any reason you cannot connect to the R5750 via the Ethernet port, you can restore device factory settings to reset IP configuration, and obtain an IP address dynamically using DHCP.

Performing a factory resent also sets the reference level calibration back to factory default values.

Follow these steps to reset your R5750 analyzer:

1. If not already powered on, power on the R5750.

2. When the R5750 is powered on, *press and hold* the Reset button on the rear panel of the device for at least 5 seconds. You can insert a pin or paperclip to push the Reset button.

   The STS LED blinks green quickly several times to acknowledge the factory reset.

3. Wait for the device to finish booting up (approximately 20 seconds) and use the PyRF Discovery tool to determine the unit's IP address, or use the USB Console to verify the network settings (as described in the **Configuring the R5750 IP Address** section).

Status Indicator LEDs

The front panel of the R5750 analyzer includes status indicator LEDs as shown in the following figure and described in the following sections.
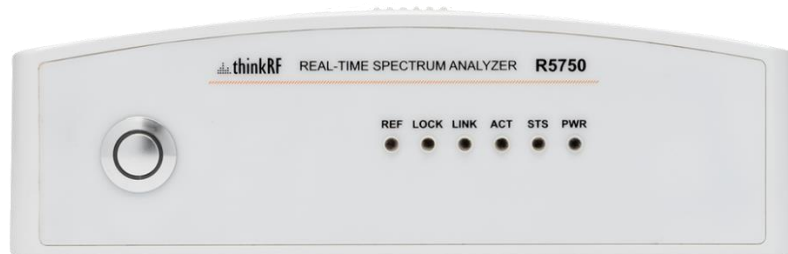
Power (PWR) Indicator LED

The PWR indicator LED indicates that the input and internal power voltages are correct.

During normal boot-up, the Power (PWR) Indicator LED is green while the remaining LEDs will flash orange in sequence, from left to right, until the firmware is initialized. The sequence may occasionally stop briefly during the boot-up phase.

PWR Indicator LED	Internal Power Status
Off	Not receiving power from power adapter
Green	All internal power conditions are good
Orange or Red	One or more of the internal power conditions are not present or corrupted

Status (STS) Indicator LED

The STS indicator LED indicates the status of the R5750 as it boots from power-on and/or reset and the network activity.

STS Indicator LED	Boot Error Condition
Off	Not applicable
Slow blink orange	Waiting for DHCP address
Solid orange	Hardware failure

STS Indicator LED	Boot Error Condition
Slow blink red	Firmware failure
Fast blink red	Hardware failure
Slow blink green	Busy
Heartbeat blink green	Auto-IP address used
Solid green	Ready for connection

Reference (REF) Clock Source LED

The REF LED indicates whether the R5750 is using the internally generated 10 MHz reference clock or an external reference clock provided via the 10 MHz IN SMA connector, and whether that selected reference clock source is of sufficient quality for the internal PLL to lock to it.

REF LED	10 MHz Reference Clock Source
Solid green	Internal clock reference selected and PLL has successfully locked to it
Slow blink green	External clock reference or GNSS clock reference selected and PLL has successfully locked to it
Slow blink amber	GNSS clock reference selected but no signal received
Slow blink red	External clock reference selected but PLL cannot lock to it
Solid red	Internal clock reference selected but PLL cannot lock to it

LOCK Indicator LED

The LOCK LED indicates whether the clock sources in the selected RF chain are of sufficient quality for the internal PLLs to lock on them.

LOCK LED	Reference Clock Quality
Green	All PLLs in the current RF chain have locked to their corresponding frequencies
Red	One or more PLLs in the current RF chain have not locked to their corresponding frequencies

LINK Status LED

The LINK Status LED indicates the status of the Ethernet connection.

LINK Status LED	Ethernet Link Status
Off	No Ethernet link connection
Orange	10/100 Mbit Ethernet link connection
Green	GigE Ethernet link connection

ACT Indicator LED

The ACT indicator LED indicates whether there is any activity on the Ethernet connection.

ACT Indicator LED	Ethernet Activity
Off	No Ethernet activity
Green	Ethernet transmit or receive activity

Hardware Reference

This section provides physical and performance specifications, and port and cable pinouts for the R5750.

System Specifications

The following table outlines the physical and electrical specifications for the R5750.

Description	Design Specification
Dimensions H x W x D (D with rubber feet)	257.3 x 193.7 x 60/66 mm (10.13 x 7.63 x 2.36/2.61 inches)
Weight (approximately)	< 2.5 kg / 5.5 lbs
Digital interface ports	Ethernet 10/100/1000, USB 2.0 console, micro-DB25 GPIO
Analog interface ports	RF IN, 10 MHz REF IN and OUT[1], GPS
Input supply voltage	12 VDC +/- 5%
Input supply current	1.8 A maximum
Operating temperature	32 to 122°F (0 to 50°C)

[1] Availability depends on the product model or application. Check your product specification.

SMA Connectors

The SMA connectors on the front and rear panels are all female jacks with 50Ω nominal impedance.

Note: The recommended torque setting for all SMA connectors is 45 N.cm (4lbs.in). An example of a torque wrench that can be used for this is Huber-Suhner P/N 74 Z-0-0-79.

The following table outlines the maximum and minimum power level restrictions on the SMA connectors.

Caution: Injecting signal levels that exceed the specifications described in the following table will result in permanent damage to the receiver.

Connector Name	Direction	Max Power Level	Min Power Level
RF IN[1]	in	+10 dBm, 0 V DC	N/A
10 MHz IN[2,3]	in	+ 10 dBm	-10 dBm
10 MHz OUT[4]	out	N/A	N/A
GPS	in	N/A	N/A

[1] It is recommended that the output of a signal source be verified with the use of a power meter prior to connecting the source directly to the RF IN connector. Until you can determine that the front-end attenuator is in the circuit (see the *R5750 Programmer's Guide*), it is best to inject signals lower than 10 dBm. Additionally, any external signal sources connected to RF IN must be turned on only after powering on the R5750 and turned off prior to powering down the R5750.

[2] The 10 MHz reference input must be powered down prior to powering down the R5750.

[3] To set the R5750 to use the external 10 MHz reference, see the `SOURCE:REF:PLL EXT` command (see the *ThinkRF R5750 Programmer's Guide*).

[4] Availability depends on the product model or application. Check your product specification.

Ethernet RJ-45 Port Pinout

The following figure shows the R5750 Ethernet RJ-45 pinout:
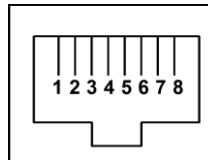
Pin	Signal
1	BI_DA+
2	BI_DA-
3	BI_DB+
4	BI_DC+
5	BI_DC-
6	BI_DB-
7	BI_DD+
8	BI_DD-

GPIO Port Pinout

The GPIO (General Purpose Input/Output) port supports extended hardware capability including SPI (Serial Peripheral Interface) bus, I2C serial interface, PPS (Pulse Per Second) input, external triggering input/output and specific radio front end control and status.

Caution: Improper use of the GPIO may cause irreparable damage to the R5750. Do not use the GPIO without prior consultation with ThinkRF's service organization.

The following pinouts are specific to the R5750 models only.

| Pin	Direction	Voltage	Signal
1-2, 5-8, 10-13	not applicable	3.3 V	Reserved
3	out	3.3 V	TRIG OUT
4	in	3.3 V	TRIG IN
14	in	3.3 V	PPS
16	out	3.3 V	Spectral Inversion
17-20	bidirectional	3.3 V	EXT IO D[3:0], respectively
23-25	power	12 V	VCC12V
9, 15, 21, 22	ground	0 V	GND

Note: The functionality of the EXT IN/OUT/IO pins is application-specific and thus could vary. Refer to ThinkRF's Application Notes or contact ThinkRF support for more information.
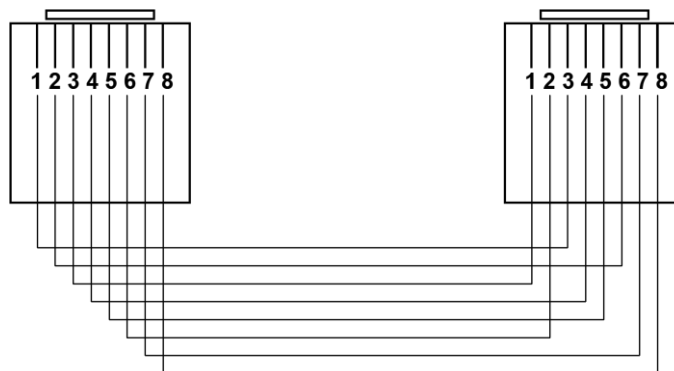
USB Console Port Pinout
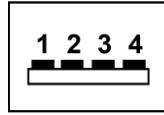
Pin	Signal
1	+5 VDC
2	Data -
3	Data +
4	Ground

RJ-45 Straight-Through Ethernet Cable
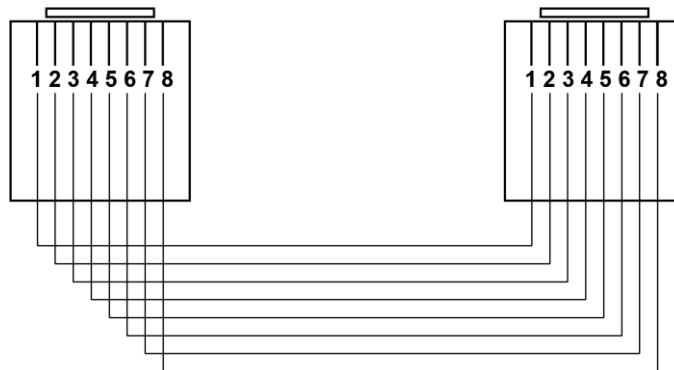
RJ-45 Crossover Ethernet Cable

Operational Considerations and Maintenance

The R5750 should be operated only within its specified operation temperature and specification of 0°C to 50°C. The ideal operating temperature for optimum performance is between 20°C to 25°C.

⚠️ **Caution**: Do not expose the device to direct sunlight or radiation from other sources of heat.

Some regular maintenance is needed to maintain the unit in its good working state. This includes:

- cleaning the box with a slightly damp cloth from time to time to remove any dust or debris that may accumulate in the device through any openings
- keeping all connectors clean (especially the threads) with a soft cloth
- cleaning the device with a fan (for example, an air can) to remove dust