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Spectraware

Spectrum Viewer User Guide

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Important notice

Trademarks

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Preface

The intended audience, document organization, and conventions used herein are described. Related documentation is identified, as are instructions for accessing other electronic product documentation.

Audience

This document is intended for technical users who have a basic level of understanding, familiarity and experience with network test and measurement equipment.

Conventions

The following conventions are used in this document.

Convention	Description
Grayed-out Font	Indicates a command or a feature is not available in the current release.
`Courier Font`	Illustrates an example command or a concept.
Light Blue Font	A clickable hyperlink to a referenced source.
Normal Bold Font	A concept or idea important enough that the reader's attention is being explicitly focused.
Red Font	Additional information on the topic.

Note: This symbol means **take note**. Notes contain helpful suggestions or references for 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.

Obtaining Latest Documentation and Software

Please visit the thinkRF website at https://thinkrf.com/documentation/ to obtain the latest product documentation. Software and firmware releases are also available on the thinkRF website at https://support.thinkrf.com/support/solutions.

Document Feedback

Please send any comments regarding thinkRF documentation to support@thinkrf.com. We appreciate your feedback.

Obtaining Technical Assistance

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 https://support.thinkrf.com/ or by calling **+1.613.369.5104**.

Before contacting support, please have the following information available:

- thinkRF product's model, serial number (S/N), version (located on the identification label on the product's underside), and firmware version. Or see “Device Info” in the Menu Bar section.
- The Spectraware version’s information from the Spectraware’s About page.
- The operating system and version you are using.
- If the web version is being used instead of the standalone version, provide the browser and its version.

Spectraware Overview

The Spectraware (hereafter referred to as Spectraware) is a modern, web-based spectrum analysis application designed to interface with a range of thinkRF products, including:

- **Real-Time Spectrum Analyzers** (RTSAs), such as the current **R55x0, R57x0** and **R6000** series,
- **Spectrum eXperience Management (SXM)** products and solutions, which incorporate RTSA products in their hardware components, and
- as well as future devices.

Designed for usability and performance, Spectraware offers both standard and advanced spectrum analysis capabilities. Key features include precise frequency and bandwidth controls, power measurements, flexible windowing options, and robust support for multiple marker configurations and trace configurations. The application also offers multiple plot types as well as recording and playback for post-analysis.

thinkRF RTSA devices are high-performance, software-defined RF receivers, digitizers, and analyzers. Leveraging patent-pending receiver technology, RTSAs deliver industry-leading sensitivity, tuning range, instantaneous bandwidth (IBW), and scan rates. The hybrid RF front-end (RFE) architecture integrates super-heterodyne, direct-conversion, and/or direct digitization techniques, using wideband ADCs to enable both streaming and sweeping modes for real-time signal capture.

As the software companion to thinkRF hardware, Spectraware serves as a user interface window for visualizing and analyzing RF signals such as 4G LTE, 5G NR, Wi-Fi, and other wireless technologies. Communication with RTSA devices is handled through thinkRF's proprietary API, *libtrf*, while with SXM solutions communicate via the SXM API and associated cloud services.

This document serves as the User Guide for the Spectrum Viewer and Demodulation features of the Spectraware application.

Supported thinkRF Products

Spectraware currently supports the following thinkRF RTSA products:

- R55x0-408/418/427
- R57x0-408/418/427
- R6000-408 Ethernet connection

And SXM products

- SXM v2.1 with direct or local network internet connection

User Interface

Spectraware is a modern, web-based Graphical User Interface (GUI) application that significantly enhances the user experience and feature set compared to the earlier thinkRF S240 software series. While introducing substantial improvements and new features, Spectraware retains a familiar set of controls to ease the transition for existing users. As with the S240, it emphasizes intuitive **Center, Span, Start, and Stop**

frequency settings, focusing on user-centric interaction rather than the underlying RTSA technology and modes.

The application currently includes two primary features – **Spectrum Viewer** and **Demodulation**.

- The **Spectrum Viewer** module allows users to control key parameters such as **Frequency, Amplitude**, and **Bandwidth**, and provides access to additional visualizations like **Spectrogram**, **Persistence**, and **Time-Domain I/Q plots**. It includes various **measurement tools** and supports **recording and playback** of signal data in both the frequency and time domains.
- The **Demodulation** module enables demodulation of **AM** and **FM** signals (see Demodulating Data for further details). It includes plotting options and the ability to play back audio derived from demodulated signals.

When the Spectraware application is launched, the **Spectrum Viewer** tab is selected by default.

This section provides an overview of the user interface (UI) layout and the placement of its components, as illustrated in Figure 1.

Figure 1: The Spectraware UI layout and the placement of its components

Plots and Top Panel

The application is centered around its main Plots display area. The **Spectral Plot** (as illustrated in Figure 1, for example) shows the processed power spectrum of the captured signal as a function of frequency, in either real-time or playback mode. When available for a Spectral plot and enabled from the top panel, the **Zoom Control** offers a convenient

way to navigate and explore the spectrum while the spectrum is zoomed in, allowing users to easily glide across the current frequency span.

Key parameters—**Center**, **Span**, **Start** and **Stop** frequencies, Resolution Bandwidth (**RBW**), **Refresh Time**, **Sweep Time**, and **Sweep Speed**—are displayed directly below the plot for easy reference.

The **top panel** above the plot area contains context-specific information and control buttons related to the plot(s). For instance, the Spectral Plot's top panel includes trace and marker details (when applicable), along with cursor control buttons. In the Persistence Plot, users can adjust the persistence Decay Time using a dropdown menu. Hovering over any icon provides a tooltip with a brief description of its function.

For the Spectrum Viewer, additional panels such as **Persistence**, **Spectrogram**, **Time-Domain Plots**, and the **Marker Table** can be enabled and will appear below the Spectral Plot. These panels can be **vertically resized** by dragging the horizontal divider between them, allowing users to customize the layout and optimize the interface to suit individual needs and preferences.

At the bottom of the Spectrum Viewer's plot area, the **Span Control** bar, which can be enabled from the **Frequency settings** panel on the left, offers a fast and convenient way to adjust the frequency range, serving as an alternative to using the controls in the Frequency settings panel.

Plot Zooming

Every plot, except the spectrogram, can be zoomed in and out by scrolling the mouse-wheel on the point of interest. Users can also do **Rubber-band zoom** by dragging an area to zoom in on the selected plot section (see Figure 2).

The zooming can be reset by double-clicking the plot area or clicking on the **Reset Zoom** icon  on the top-right of the plot which will be shown when hover over the plot.

Note: When using this zoom feature and the vertical or horizontal cursors happen to be outside the zoomed range, they won't be repositioned automatically to the zoomed in area in order to preserve their original positions.

To bring them to the zoomed area, enter the desired value to the cursor input field. Note that toggle the cursor button off and on will, by default, place the vertical cursor to the Center frequency or the horizontal cursor to -100 dBm.

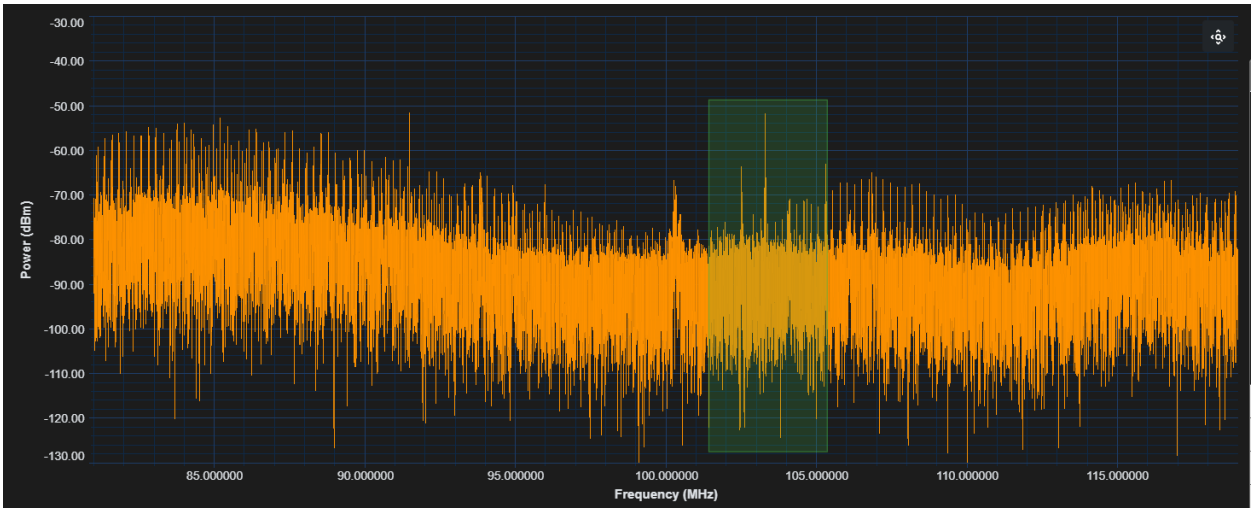
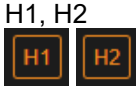


Figure 2: Draw a box on a plot area to zoom

Some plots, such as the Spectral plot, provides a convenient **Zoom Control** bar that can be used in conjunction with the direct zoom on the plot.

Cursor Buttons of a Plot

Above the Spectral and Spectrogram plots, there are cursors and crosshair buttons in the top left section. These tools are typically used for more precise analysis and measurements within spectral and spectrogram displays.

Button	Function
H1, H2 	Add a horizontal cursor to the plot. A text input will be shown beside the button to allow user viewing or editing (when available) the cursor position when the button status is ON. When both H1 and H2 cursors are added, the delta value between two horizontal cursors will be displayed beside the cursor buttons. See Adding Cursors and The Crosshair section for more information.
V1, V2 	Add a vertical cursor to the plot. A text input will be shown beside the button to allow user viewing or editing (when available) the cursor position when the button status is ON. When both V1 and V2 cursors are added, the delta value between two vertical cursors will be displayed beside the cursor buttons. See Adding Cursors and The Crosshair section for more information.
Crosshair 	Add a crosshair to the plot. See Adding Cursors and The Crosshair section for more information.

Configuration Panels

The Plot section is surrounded by various **configuration panels** and **control buttons**, organized as follows:

- **Left-side configuration panels** contain frequently used settings that directly affect the RTSA, such as Amplitude, Frequency, and/or Bandwidth. More details on these settings can be found in the relevant sections of this document. These panels can be expanded or collapsed by clicking their titles or the arrow icons beside them. All left-side configuration panels can be expanded simultaneously.

- The **top-right control button panel** contains 'run control' buttons used for changing capture modes and resetting the application. See Run Control Buttons section for more information.
- **Right-side configuration panels** contain settings that influence plot behavior, signal display, and recording/playback functions. Like the left-side panels, they can be expanded or collapsed via their titles or arrows. However, only one right-side panel can be expanded at a time.

By default, all configuration panels and control buttons are visible. The left and right panels can be shown or hidden using the **Show**  or **Hide**  **Settings Panel** button as described in the Layout Buttons section. The availability and content of these panels vary depending on the active Spectraware feature module, as detailed throughout this document.

Run Control Buttons

The following table summarizes the run control buttons for the plotting in the top right panel with a brief description of their function.

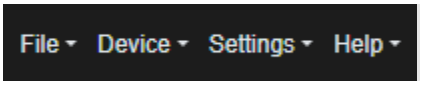
Button	Function
 **Pause Capture**	Pauses the Continuous Capture and displays the last frame that was captured. Only available when continuous capture is playing.
 **Continuous Capture**	Start the continuous capture and display of signals. Only available from a paused capture.
 **Single Capture / Next Capture**	Performs a single capture (or next capture in playback) and display of signals. Only available from a paused capture.
 **Preset**	Restores the application to its start-up state. See Restoring Spectrum Viewer Defaults section for more information.

Layout Buttons

The layout buttons on the top right of the screen allow user to take a screenshot or show/hide the configuration panels.

Button	Function
 Take Screenshot	Captures the current Spectraware's user interface view. See Capturing a Screenshot section for more information.
Show/Hide Config Panels  	Shows or hides all the left and right configuration panels.

Menu Bar



The Menu Bar, which can be found on the top left of the screen, offers a tidy location for additional controls for the RTSA device or the application itself.

Menu	Options	Function
File	**Load Settings**	Load a previously saved configuration file, as explained in Loading Configuration Settings.
	Save Settings	Save the current Spectraware settings into a file, as explained in Saving Configuration Settings.
Device	**Disconnect Device**	Disconnect the currently connected device and open the Connect Device dialog.
	Device Info	Display the IP, network MTU, model, serial number, product version, and firmware version of the currently connected device.
	Device Location	Display the geolocation tracking data of the currently connected device only if that device has the GNSS module.
Settings	**DC Offset Correction**	Turn on/off the DC Offset Correction setting, which is on by default.
	Spectral Flattening	Turn on/off the Spectral Flattening setting, which is on by default.
	Themes - Dark (Default)	Change the user interface to dark color theme (as shown in Figure 22).
	Themes - Light	Change the user interface to light color theme (as shown in Figure 23).
Help	**User Guide**	Opens the Spectraware User Guide documentation (this document).
	About Spectraware	Opens a dialog that contains application information including version number, support contact and copyright notice.

Feature Navigation Headings

The Feature Navigation Headings under the Menu Bar are tabs for different Spectraware product features such as **Spectrum Viewer**, **Demodulation**, Network Analysis and Drive Test. Currently, we only support **Spectrum Viewer** and **Demodulation**. Other features are planned additions to the Spectraware and currently, thus, disabled.

Getting Started

System Requirements

Before installing Spectraware, ensure that your PC meets the following minimum system requirements:

- Operating System:
  - 64-bit
  - Windows 10, 11
  - Debian based distributions (Debian, Ubuntu, Mint, Kali, etc.)
- **RAM:** 4 gigabytes (GB). Recommendation: 8 to 16 GB improves performance.
- **VRAM/GPU:** minimally 256MB. Preferred 1GB or more.
- **Hard Disk:** Minimally 1 GB available. Recommend: SSD drive improves the record and playback performance.
- Supported Browsers (for the SXM online version as mentioned in the section below):
  - Microsoft Edge v97 or higher
  - Chrome v108.x.x or higher

Issue Note: The plots in Spectraware are implemented with WebGL. Computers with **Intel HD 620/630** hardware have some known issues with WebGL, which might cause the GUI to hang while the application is running. Please update the Intel HD to the latest driver license.

Installing Spectraware Software

The section will go over acquiring the Spectraware installer, installing, and running the software on your computer.

The latest Spectraware could be downloaded from the “Spectraware” section of https://support.thinkrf.com/support/solutions or via thinkRF’s customer support team.

The software comes in two versions:

- **Standalone version** – Provided to RTSA users (with valid device licenses) and SXM users (with an active Spectrum Analysis subscription). This version works with or without an internet connection. Proceed to Standalone Version Installation section for the installation steps.
- **Embedded version** (coming soon) – SXM Dashboard users with an active subscription will no longer need to install software. Proceed to Running Spectraware and Connecting to an SXM Device section to get started.

Notes: For Windows users:

- If you receive a permission error during installation, right-click on the installer file and select ‘Run as administrator’.
- If your antivirus software blocks the installation, temporarily disable it and try again
- The common "code 299" error can be safely ignored — it does not affect installation or functionality.

Standalone Version Installation

For **Windows** installation,

1. Double-click on the `Spectraware_Spectraware_[version]_[product]_x64.exe` executable file to launch the Setup Wizard, then follow the prompts to select your installation options to proceed.
   Replace:
   - `[version]` with the Spectraware version downloaded.
   - `[product]` with 'RTSA' for RTSA users and 'SXM' for SXM Solution users.
2. On the **Ready to Install** prompt screen, review your installation settings. Click **Install** to proceed with the installation, or **Back** to change your settings.
3. When the Setup Wizard has completed the software installation, click **Finish** to exit the Wizard.
4. After installation, a shortcut named "Spectraware" should appear in your Start Menu and/or on your Desktop (depending on your install options).
   Click the shortcut to launch the application.

For **Linux** installation on Debian based distributions (Debian, Ubuntu, etc.),

1. Spectraware relies on other third-party libraries, these dependencies need to be installed first. To find out what dependencies you will need, run in a Terminal the following command:

   ```
   sudo dpkg -I Spectrawarespectraware-[version]-[product].deb
   ```

   Replace:
   - `[version]` with the Spectraware version downloaded.
   - `[product]` with 'RTSA' for RTSA users and 'SXM' for SXM Solution users.
2. Install the required dependencies using `sudo apt-get install <package>` command as needed. The list below provides an example of the necessary dependencies; however, the exact packages may vary depending on your system configuration.

   ```
   sudo apt update
   sudo apt install -y ffmpeg libfontconfig libopengl0 libegl1
   libxcb-cursor0 xdg-utils libnss3 libqt5core5a libqt5widgets5
   libqt5gui5 libqt5dbus5 libqt5network5 meta-utils
   ```

   '-y' option is to be used as needed.

Note: For Users using WSL via Windows, this installation might be needed:

```
sudo apt install libgtk-3-0
```

In addition, Spectraware might not be able to discover the devices through WSL, manual IP or addition USB configuration might be needed.

3. Start the Spectraware installation:

   ```
   sudo dpkg -i Spectrawarespectraware-[version].deb
   ```

4. After installation, a bash shortcut called "Spectraware_Spectraware" should be created in your system as well as in `/usr/bin`.

5. To start the application, either click the installed shortcut icon or type the name `Spectraware_Spectraware` in a terminal window.
5. If the installation fails due to missing dependencies, follow these steps to recover:

```
sudo apt install -f
sudo dpkg -r Spectrawarespectraware
```

Then start again from step 1.

Note: Spectraware and the Linux installation instructions have only been tested on Ubuntu 22.x and 24.x, with limited testing on Fedora and Debian.

Running Spectraware and Connecting to an RTSA Device

This section explains how to connect an RTSA device to the Spectraware application to view real-time signal data.

When launched, Spectraware automatically for available RTSA devices and displays a connection dialog listing:

- **network-connected RTSA devices** *on the same subnet* as the host computer. If your device is on a different subnet, you can manually enter its IP address.
- **USB3 RTSA devices**, if directly connected.

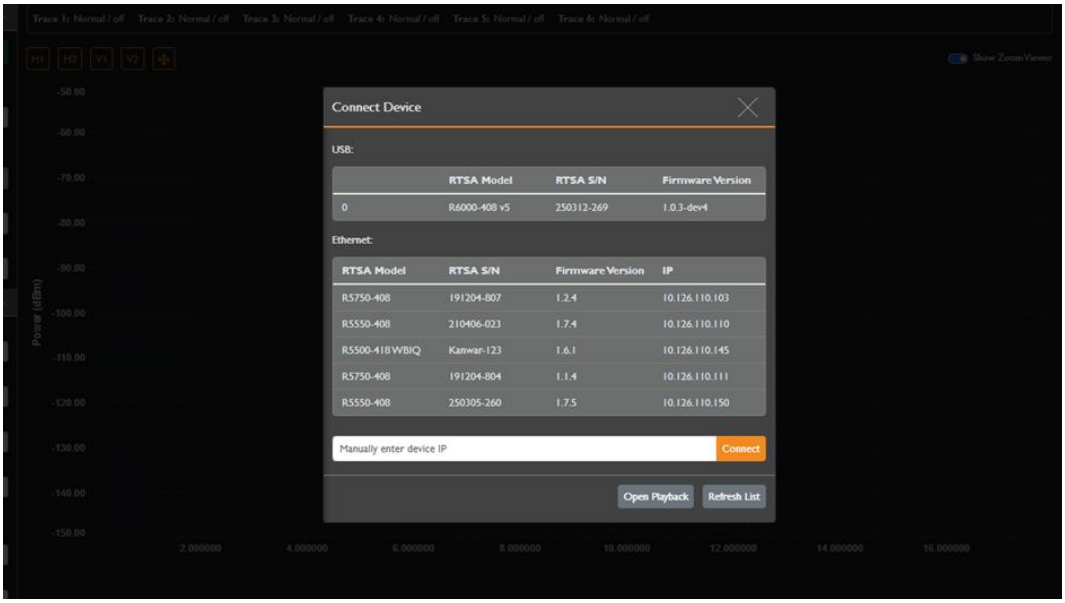


Figure 3: Start-up Screen for RTSA users

Caution: Connecting to an RTSA device that is already in use will interrupt the active session. Current RTSA devices do **not** support multiple simultaneous connections.

1. Launch the installed Spectraware from your computer.
2. When Spectraware launches, a **Connect Device** dialog will appear (see Figure 3).

The **Connect** button will only become active once the Spectraware_Server (back-end agent) is running in the background.

3. Select a compatible RTSA device from the list, or manually enter its IP address in the **IP** input field below the list if it was not automatically
4. If your RTSA device (USB or network) does not appear in the list, click **Refresh List** to scan again.
   The **IP** input field will auto-fill with the *first* detected device and update when you select a different device from the list.
5. Click the **Connect** button to start the connection.
   Note that an entry of a detected device can also be double-clicked to connect directly.

Upon successful connection, the Spectraware user interface will begin displaying the captured signal using the default application settings, which includes the maximum frequency span supported by the RTSA used.

6. To connect to a different RTSA device, first disconnect from the previous device by clicking **Device > Disconnect Device** in the **Menu Bar**. The **Connect Device** dialog will reappear, allowing you to repeat steps 3 to 5.

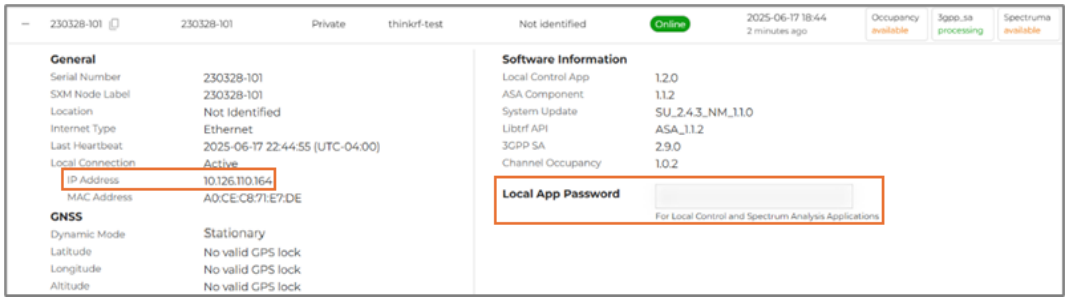
Running Spectraware and Connecting to an SXM Device

This section explains how to connect to an SXM device with the Spectraware application to view real-time signal data. To proceed, you'll need a valid **SXM Dashboard** account and access to your assigned SXM nodes.

Before connecting, make sure you have the necessary login credentials, as described in the next section.

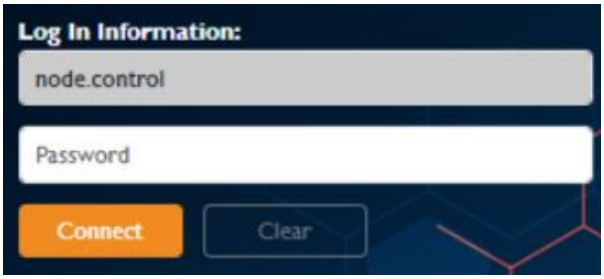
Obtaining SXM Node's IP and Password

The SXM node is an IoT device that is managed through the Node Management application of the SXM Dashboard. A node's typical information panel is as follows:



If the node is online and its ethernet port is connected to a local network or the user's computer, an **IP Address** will be displayed under **Local Connection** section as shown in the picture above.

To access data from an SXM node, licensed users must log in using the following credentials:



- **User**: `node.control` (default for all users)
- **Password**: Available from your SXM account administrator. This value is listed as **Local App Password** in the node's information panel on the SXM Dashboard.

Running Spectraware Application

Caution: Connecting to an SXM device that is already in use will interrupt the active session. Current SXM devices do **not** support multiple simultaneous connections.

1. Launch the installed Spectraware from your computer. A startup dialog screen as shown in Figure 4 will be displayed. While the initial screen differs from the RTSA version, the application functions the same after connection.

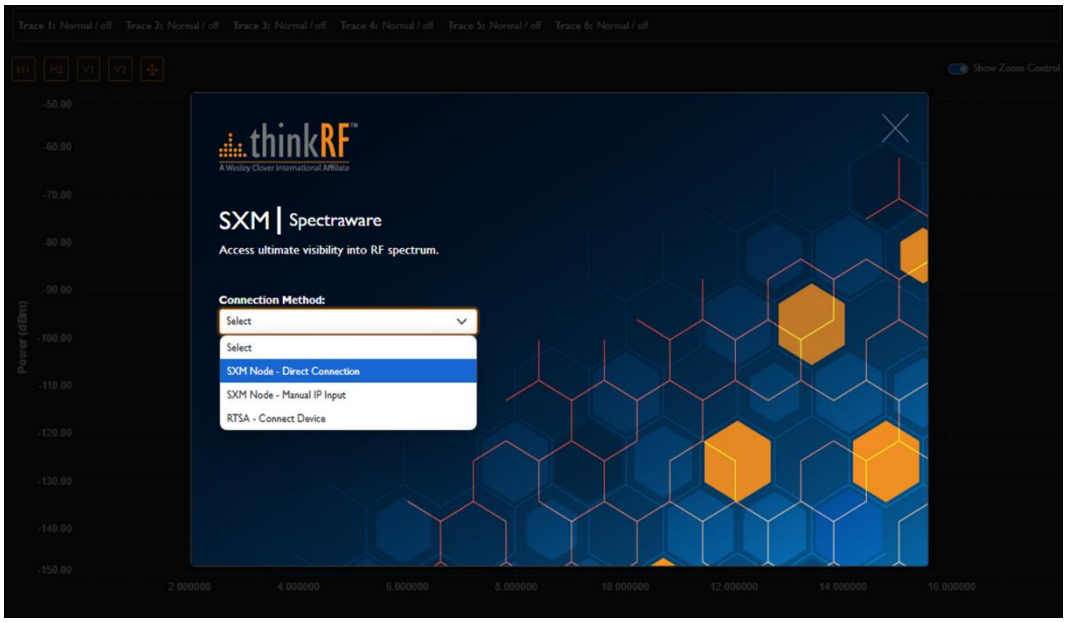
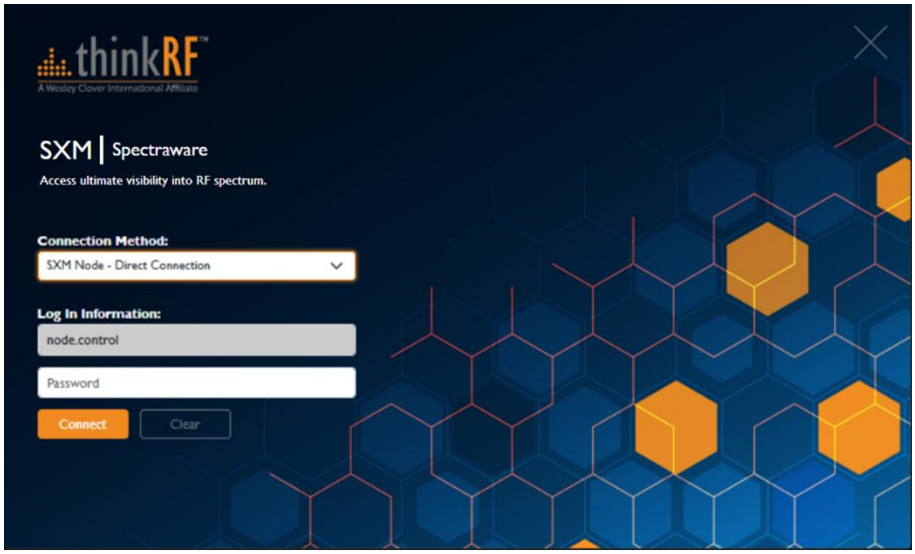


Figure 4: Start-up Screen for SXM users

2. SXM users have three connection options, depending on how the SXM devices are connected and whether the users also own RTSA devices. Users without RTSA devices can disregard the RTSA connection option.

   a. **SXM Node - Direct Connection**: Use this option if you're connecting your computer directly to the Node's Ethernet port, or through a switch that connects both devices. The option is also recommended for when the node lacks an internet connection or has a slow or restricted SIM connection, as direct connection offers faster data transfer to Spectraware.

      Refer to Obtaining SXM Node's IP and Password section for the password. The IP is only available if the node is online.



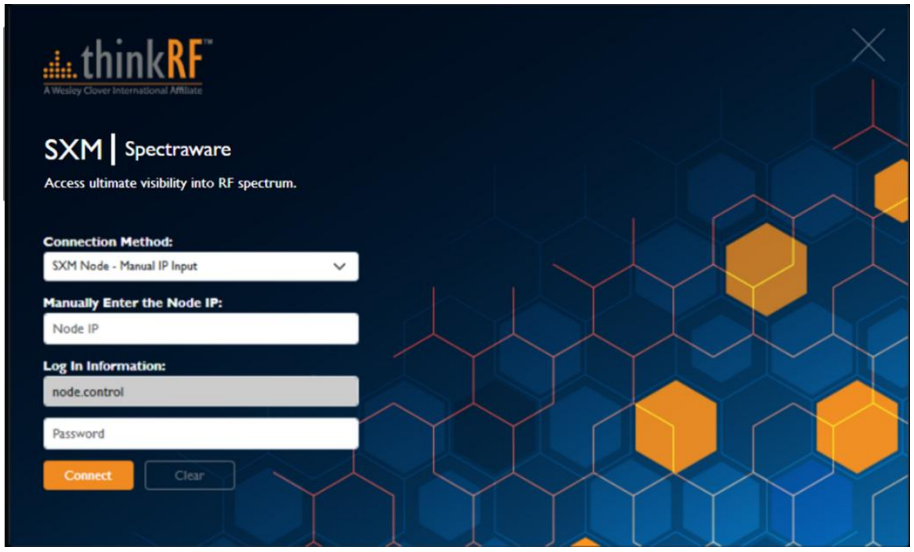
i. Node login credential is required. Enter the node's Password and click on **Connect** to proceed.
ii. After login, the node and the Spectraware application will automatically establish a connection. This may take up to **5 minutes** due to AutoIP configuration and background discovery.
iii. If a connection issue occurs, follow the instructions shown in the pop-up message.

Once connected, the Spectraware interface will display live signal data with a default span of **200 MHz**. This reduced span (compared to RTSA default) is optimized for SXM node performance, especially over slower connections.

iv. To connect to a different SXM device, first disconnect from the previous device by clicking **Device > Disconnect Device** in the **Menu Bar**. The Spectraware will display the startup dialog, and from there you can repeat the steps.

b. **SXM Node - Manual IP Input**: Use this option if you know the Node's IP address, either assigned by your IT network or available through the Node Management section of the SXM Dashboard, where the Node's information is displayed. For the latter, the IP is available on the SXM Dashboard only when the node is online via supported SIM or local network.

   Refer to Obtaining SXM Node's IP and Password section for the IP and password.



i. Node login credential is required. Enter the node's Password and click on **Connect** to proceed.

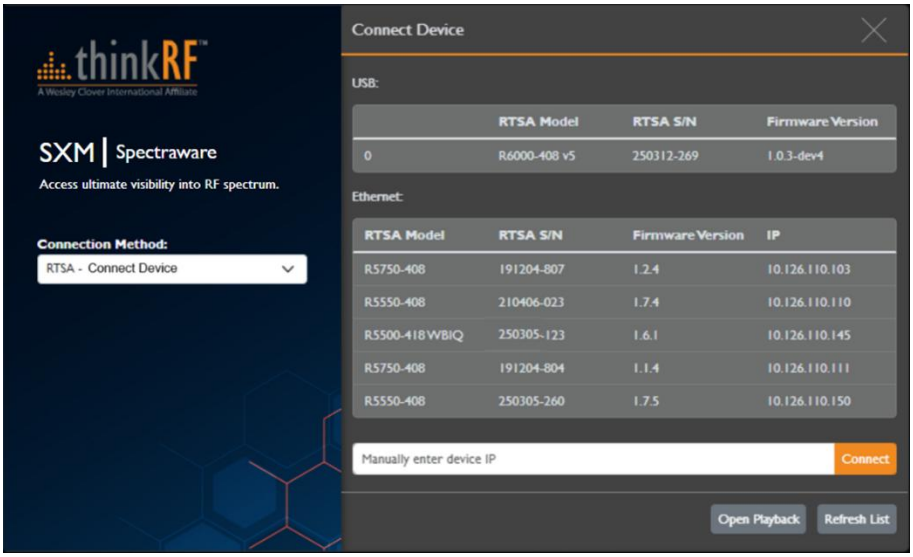
ii. If an issue arises during the login and connection stage, follow the suggested action from the popup message.

Upon successful login, the Spectraware user interface will begin displaying the captured signal using the default application settings with 200MHz frequency span. This default span differs from the RTSA's usage default because SXM nodes may be limited by network speed. Using a smaller span instead of the receiver's maximum helps optimize data transfer and overall performance.

iii. To connect to a different SXM device, first disconnect from the previous device by clicking **Device** > **Disconnect Device** in the Menu Bar. The Spectraware will display the startup dialog, and from there you can repeat the steps.

c. **RTSA - Connect Device**: Use this option if you are an SXM user with access to an RTSA device. Follow the same steps outlined in the Running Spectraware and Connecting to an RTSA Device section.

No login credentials are required, as shown in the following figure.



Uninstalling Spectraware Software

For **Windows**, its native uninstallation application could be used; otherwise, the user's selected install directory will contain unins000.exe which can be used to uninstall the "Spectraware_Server" and "Spectraware_Client".

For **Linux**, open a terminal window and run the following command:

```
sudo dpkg -r spectraware
```

for the Standalone version.

Spectraware Spectrum Viewer

The Spectraware Spectrum Viewer application provides several options for controlling and displaying signal captured through a thinkRF RTSA product. For example, you can specify the frequency span and amplitude, adjust the RBW, change how the spectrum data is windowed, add or remove traces, and add and manipulate markers.

Note: This section provides the explanation regarding how to use Spectraware Spectrum Viewer feature to configure the connected RTSA, it does not go into detail what the configuration on the device entails. Refer to the RTSA product specific documentations for such details (see Obtaining Latest Documentation and Software).

The Spectraware Spectrum Viewer application supports the following displays:

- Spectral Plot (default, main display)
- Persistence Plot
- Spectrogram, and
- Time Domain Plot

This section will go over these plots in detail. When these plots are enabled along with the Spectral Plot, the plots can be resized as needed.

Understanding Spectral Plot

- The Spectral Plot of Spectrum Viewer (see Figure 5 below) shows the processed power spectrum of a captured signal as a function of frequency, in real-time or playback. It is controlled by Amplitude, Frequency and Bandwidth Settings on the left panels. The plot image below shows the various information pertaining to the plot as such:
- **Start, Center, Stop, Span** and **RBW** – the actual values of the spectrum as returned by the *libtrf* API (which might be slightly different from the input settings).
- **Refresh Time** – the GUI's refresh rate for each plotting update time.
- **Sweep Time** – the RTSA sweep capture time for the specified frequency range, from the first to the last sample of the sweep.
- **Sweep Speed** – the RTSA sweep rate of the specified frequency range.
- **Zoom Control** bar – an interactive slider for navigating and exploring the spectrum while the spectrum is zoomed in.
- **Span Control** bar - an interactive slider allowing users to conveniently adjust the Start, Stop, Span, and Center frequency values simultaneously.

Figure 5: Spectral Plot, in dark mode

The top panel contains trace and marker (when available) information and the cursor control buttons.

Zoom Control Bar

In the Spectrum Viewer application, the **Show Zoom Control** toggle button is located at the top right of the Spectral and Time Domain plots. It shows or hides the Zoom Control slider bar located beneath the main Spectral plot.

The Zoom Control bar provides an overview of the entire specified spectrum span. It allows users to control the horizontal zoom of the main plot by dragging the **white left and right handles** on the Zoom Control bar. This enables a closer look at specific frequency regions without altering the actual Frequency settings menu.

While dragging a handle, a tooltip displays the exact x-axis value, indicating the current boundary of the zoomed-in view. **To zoom out**, simply drag the handles outward to widen the range, or double-click anywhere on the main chart to reset the zoom to the full span.

Users can perform zooming on the main plot directly as well; the glider of the Zoom Control bar will adjust accordingly.

Display Persistence Plot

The Persistence Plot is a view of how long a signal remains present; as the signal grows weaker, the trace fades in color to eventually disappear as time lapses, as shown in Figure 6. The amplitude is displayed on the vertical axis, and the frequency on the horizontal axis.

Figure 6: Persistence Plot shown below the Spectral Plot

1. To view the plot, click on the **Persistence** button located on the top-right button panel of Spectraware. The Persistence Plot appears below the Spectral Plot or marker table when activated.
2. To select which trace the plot is tracking, click the **Trace** dropdown which contains active trace numbers on the top right of the plot and select the appropriate trace. The default value of the Trace dropdown is the first active trace number.
3. To hide the Persistence plot, click on the Persistence button again.

Display Spectrogram

The Spectrogram (a.k.a. Waterfall Plot) displays spectrum changes over time in a three-dimensional view, as shown in Figure 7. Time is displayed on the vertical axis and frequency on the horizontal axis. The amplitude of the frequency components is expressed by user-adjustable color gradients located to the left of the display.

Figure 7: Spectrogram Plot below the Spectral Plot

1. Click the **Spectrogram** button located on the top-right button panel of Spectraware. The spectrogram appears below the Spectral Plot / marker table (when activated) / Persistence Plot (when activated).
2. The color gradients of the signal display can be enhanced by sliding the flags on the color palette (left side of the display) to adjust the threshold at which the signal changes the power levels. This allows for better contrasting of signal levels against the noise floor level.
3. To change the trace to which the spectrogram is mapped, click the **Trace** dropdown at the top right of the spectrogram and select the trace you want.
4. The spectrogram is equipped with cursors and a crosshair much like the Spectral Plot (see Adding Cursors and The Crosshair for more details). They can be toggled on and changed in much the same ways as the Spectral Plot. The largest difference is that horizontal markers can only have their values changed by dragging, not edited via the input. The vertical axis measures the time at which a frame on the spectrogram was captured in 24-hour form with thousandth-second accuracy (a time reading might look like: 15:43:21.601).

Note: The spectrogram will be reset when Window Type, Reference Offset and actual Frequency Settings values applied to the RTSA are changed. Please note that sometimes small changes of Frequency Settings won't trigger spectrogram reset as the actual values applied to the RTSA didn't change.

Display Time Domain Plot

A Time Domain Plot of a captured signal complements the frequency-domain display and is useful for visualizing the signal's voltage level over time. It shows a time-domain IQ

waveform in green for in-phase (I) data and another in red for the quadrature (Q) data when available. Figure 8 shows an example of the time domain I/Q waveforms.

Time Domain plot is **only available** for spans less than or equal to an **RTSA's usable IBW**. This value varies with different RTSA products.

- For R55x0/R57x0, the value is 40MHz.
- For R6000, the value is 100MHz.

Figure 8: Time Domain Plot below the Spectral Plot

1. Click the **Time Domain** button located on the top-right button panel of Spectraware. The Time Domain Plot appears below the Spectral Plot / Marker table (when activated) / Persistence Plot (when activated) / Spectrogram (when activated).
2. To hide the Time Domain Plot, click on the **Time Domain** button again.

Important Note: Time Domain plot makes use of the RTSA's streaming feature, which allows for fast data availability. However, the RTSA always captures faster than the host side's transfer rate. This results in data being stored in the RTSA's internal buffer. Therefore, for any given settings, the expected signal might not show up right away as it might still be in the buffer, waiting to be transferred out.

Configuring Spectrum Viewer

This section describes the settings that affect the signal capture and display of the Spectrum Viewer application.

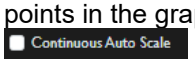
Important Note: The input values of **Center, Span, Start** and **Stop** frequency and **RBW** may differ from the actual values shown under the Spectral Plot. The actual values are calculated by the underlying RTSA API (libtrf) based on the hardware's sample rate.

Configuring Signal Capture

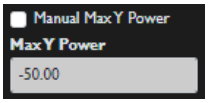
Configuring Amplitude Settings

The **Amplitude Settings** panel of the left-side panels manages power levels and offsets for the device and the Plots.

- 

Auto Scale: Performs a **one-time** adjustment to the Reference Level and vertical scale to fit the current signal range. This is useful for quickly viewing the full dynamic range of the signal, including the highest and lowest points in the graph.
- 

Continuous Auto Scale: Keeps the Reference Level and scale automatically adjusted continuously, ensuring the full signal range remains visible as it changes in real time.
- **Reference Level**: Controls the upper value of the spectral plot's Y-axis, which indicates the maximum power level that can be displayed. Adjust it to bring signals into view.
More importantly, the Reference Level also controls the RTSA's attenuation and gains to provide an applicable sensitivity level. The higher the reference level the more attenuation, and vice versa. The default value is -50dB. The minimum and maximum values vary with different RTSA products.
- **Manual Max Y Power**: Enables manual control of the Y-axis upper limit on the spectrum chart. When checked, the Max Y Power input field becomes editable, allowing users to fine-tune the Y-axis scale for a more detailed view of the graph. When unchecked, the Y-axis maximum adjusts automatically based on the Reference Level. This setting does not affect the Reference Level or any other amplitude values.



- **Scale / Div**: Controls the distance between the major Y-axis tick marks (major horizontal divisions) on the spectral plot. It is useful for zooming in or out to the signal. The range is 0.1dB to 20dB, with 10dB as the default.
- **Reference Offset**: Changes the signal's location within the plotted scale. Also used for adjusting known discrepancies between the displayed signal and the actual signal reference location. It does not affect the device's input signal. The range is -200dB to 200dB, with 0dB as the default.

Configuring Frequency Settings

Based on the chosen span and frequency ranges, the **Frequency Settings** panel, the middle among the left-side panels, leads Spectraware to configure the device to switch between sweep-tuned mode or single frequency step capture mode. Span and frequency

ranges also affect the down-sampling rate and dynamic ranges of the device as managed by Spectraware and libtrf.

- **Center – Span – Start – Stop**: These four parameters run in *coupled mode* such that when one of them is changed, they all change when necessary to maintain accurate frequency endpoints, center frequency, and span. The minimum and maximum values of these parameters vary with different RTSA devices.

Note: For SXM users, the maximum **span is restricted to 200MHz**, regardless of the RTSA's full capabilities. This restriction is in place because SXM nodes may be constrained by network bandwidth or speed. Using a smaller span helps optimize data transfer and improve overall performance and usage experience.

- The absolute minimum span is 12.5kHz. The minimum span can also be reached by adjusting **Start** or **Stop** in the direction of the other endpoint. When reached, further adjustments move the **Center** frequency with the **Span** remaining at minimum value. Hitting the minimum or maximum frequency for the device will adjust these four parameters appropriately until minimum or maximum frequency is reached.
- The minimum span will also be adjusted based on the RBW by preventing frequency Settings resulting in an incredibly low number of data points that the RTSA won't support. The underlying algorithm will adjust RBW or put limits on Span to achieve this, though this usually will not impact users in a meaningful way. See the Configuring Bandwidth Settings for more clarification.
- **Show Span Control**: Toggles the visibility of the Span Control located at the bottom of the app. The Span Control is an interactive slider that lets users adjust the **Start**, **Stop**, **Span**, and **Center** frequency values. Dragging the left or right handles updates the Start or Stop values, while dragging the colored selection bar adjusts both simultaneously.

Caution: Increasing Span while leaving RBW in manual mode at a very low value will dramatically increase sweeping times, which might make Spectraware less responsive.

Tip: If you're unsure of the device's full span, you can simply enter a very large number (e.g., 9999999) into the **Span** field, the Spectraware will automatically adjust it to the maximum supported value. Alternatively, you can drag the right handle of the Span Control all the way to the right.

- **Increment Step**: The step value for changing any frequency fields in this panel when pressing the up/down  arrows or when using the middle mouse scroll on top of Center, Span, Start, and Stop fields. The range is 0.1 to 1000MHz, with 1 as the default.
- **Reference Clock**: Allows you to change the reference clock between Internal, External, and/or GNSS when available. Refer to the RTSA's product manual for more information on the options (see Obtaining Latest Documentation and Software).

Configuring Bandwidth Settings

Spectraware provides the resolution bandwidth (**RBW**) field and signal processing **Window** options to apply to RTSA captured data for plotting.

- **Auto RBW**: When selected (by default) causes the RBW to be recalculated on every frequency range adjustment to provide the optimum balance of resolution and speed.
- **RBW**: Increase the RBW for faster sweep speeds or lower for finer signal resolutions. Adjusting this control directly will disable **Auto RBW**. The minimum RBW and maximum RBW varies with different RTSA products. The minimum and maximum RBW are also affected by the Span to prevent the Spectraware becoming too resource consuming or to prevent settings that would yield next to no data.

Caution: Leaving RBW in manual mode at a very low value while using a large frequency span will dramatically increase sweep times, which might make Spectraware less responsive.

To keep an optimal performance, Spectraware controls and overwrites the smallest allowed RBW to constraint the maximum number of data points at a given Span. Therefore, it is important to note that the minimum RBW value allowed in Spectraware **does not** reflect the actual min value supported by the RTSA, which could be down to 1 Hz.

- **Window Type**: List of windowing options to apply to the spectral data. The default window type is Hann, when available.

Configuring Measurement Settings

Spectraware provides power measurement settings such as the channel power measurement for a specific span in the current Spectral Plot or the occupied bandwidth of a given power percentage.

Channel Power

The Channel power feature measures the average of all the power within the defined start and stop frequency. In other words, it is the power integrated over the frequency band of interest, with the results expressed in dBm.

Click the **Channel Power** button in the right-side configuration panel to view its settings and the measured data (while active).

- **Status:** Toggles to turn on/off the channel power measurement. When turned on, *it will disable* the **Occupied Bandwidth** measurement if activated.
- **Trace:** Select the trace for which channel power is being measured.
- **Frequency Start:** Sets the lower boundary for the channel power region of interest.
- **Frequency Stop:** Sets the upper boundary for the channel power region of interest.

The frequency range is set to 50% of the current spectrum by default. When activated, the range is also reflected on the Spectral Plot as a transparent blue highlighted channel

power region of interest, as shown in Figure 9. The measured channel power result can be seen at the bottom of the Channel Power panel.

When the channel power measurement is not active, the measured channel power displays 0dBm.

Hint: Mouse dragging could be applied to the highlighted region or to each vertical line to quickly change the frequency settings for the channel power computation.

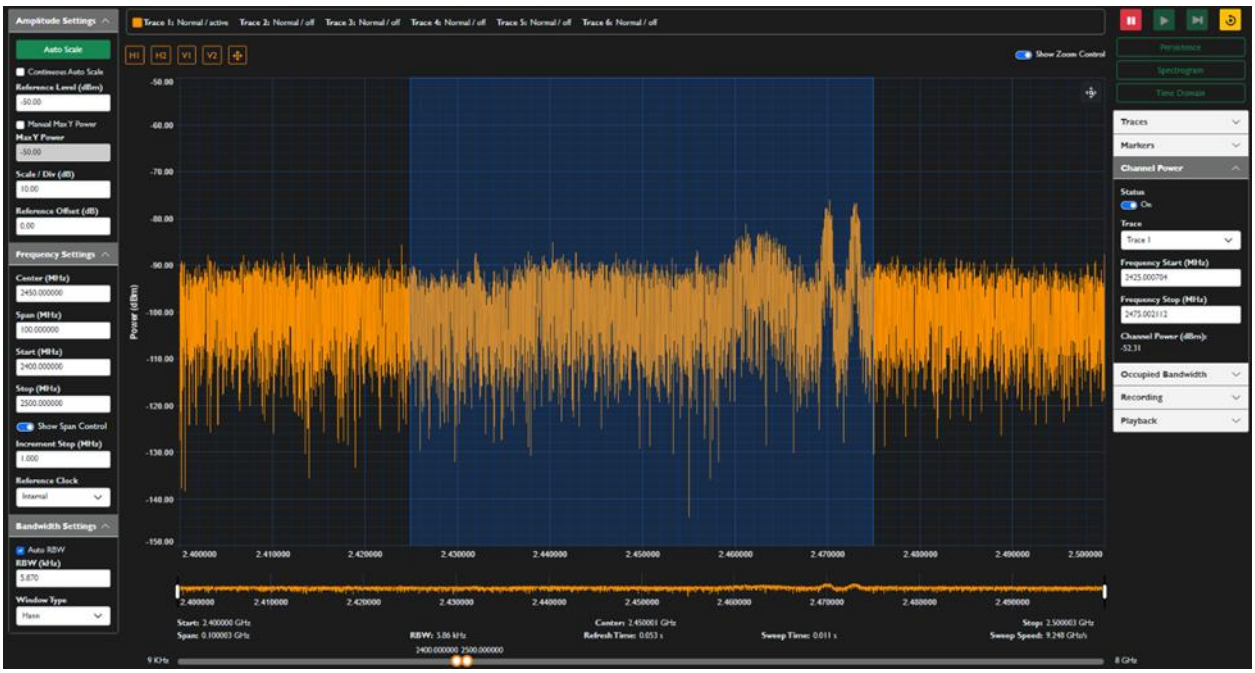


Figure 9: Channel Power measurement view

Occupied Bandwidth

The Occupied Bandwidth (OBW) feature finds the bandwidth (i.e., frequency range) containing the user's specified percentage of the total integrated power in the spectrum displayed.

Click the **Occupied Bandwidth** button in the right-side configuration panel to view its settings and the measured data (while active).

- **Status:** Toggles to turn on/off the occupied bandwidth measurement. When turned on, *it will disable* the **Channel Power** measurement if activated.
- **Trace:** Select the trace for which the occupied bandwidth is being measured.
- **Power (%):** Choose the percentage of the channel power for which the occupied bandwidth is to be found. The default value is 99.999%.

When turned on, a blue highlighted region appears on the graph showing the region in which the specified power % is contained, as shown in Figure 10. Below its control fields, the results for the occupied bandwidth and the start and stop frequencies are displayed. They appear as 0 when **Occupied Bandwidth** is not active.

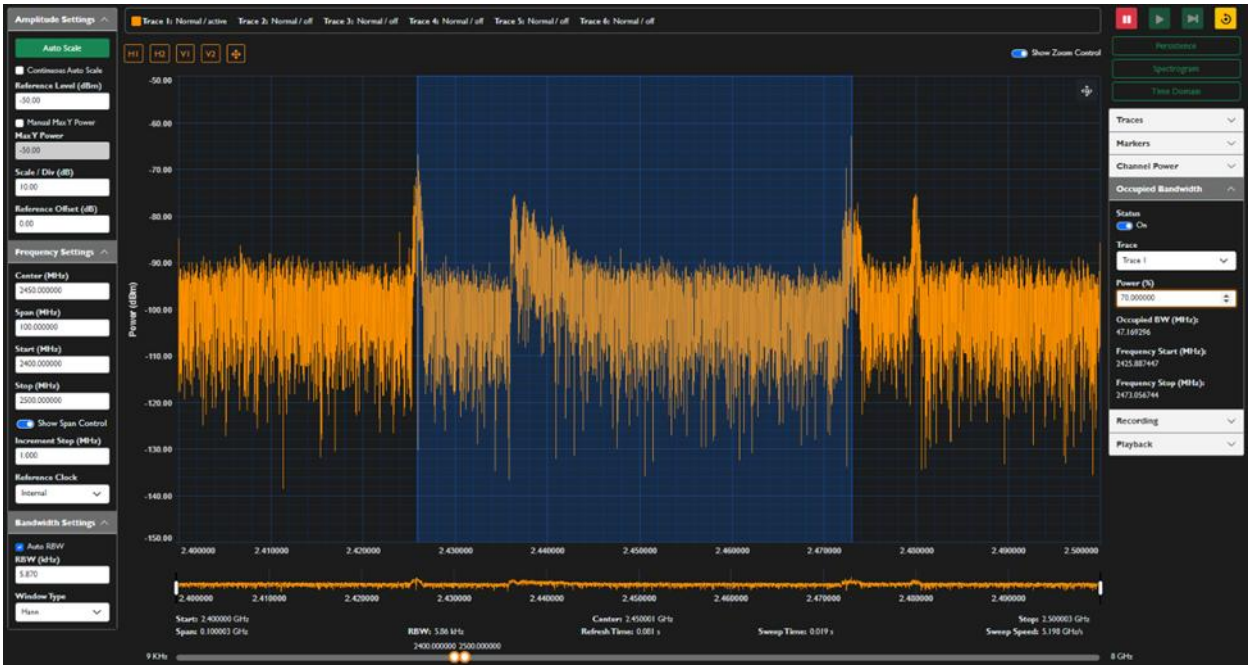


Figure 10: Occupied Bandwidth measurement

Customizing the Spectral Plot Display

Spectraware supports up to:

- six spectral traces on the Spectral plot;
- six markers for peak detection and analysis on the traces; and
- two horizontal and two vertical cursor lines, which may be added to the Spectral Plot to mark specific power or frequency locations, respectively.

A crosshair cursor is also available for convenient reading of the power and frequency values at the crosshair point.

Adding Traces

You can configure up to six traces in the signal display, as shown in Figure 11. By default, the first trace is initially configured to actively display the power spectrum of the captured signal (a “Normal” and “Active” trace). The following procedure applies for changing a trace:

1. Click the **Traces** button in the right-side configuration panel to access the **Traces** panel.
2. Select a trace by clicking on a number (from 1 to 6) from the tabs at the top of the trace panel. Activate it by selecting Active in the **Status** drop-down list.
3. In the **Status** drop-down list, select a state for the trace:

View Type	Description
Off	Trace is turned off. The tab for that trace is colored grey.
Active	Trace is turned on. The tab for that trace is colored red.

View	Pause the current trace, which is equivalent to *Trace Hold* on other spectrum analyzer equipment. The tab for that trace is colored blue.

4. In the **Type** drop-down list, select a display mode for the trace:

Trace Type	Description
Normal (Default)	Plot the power spectrum result of each captured signal.
Max Hold	Plot and hold the maximum power values across frequency for the captured signals.
Min Hold	Plot and hold the minimum power values across frequency for the captured signals.
Average	Plot the weighted smoothing average spectrum based on the following formula: $$A = (A' * \alpha) + (S * (1 - \alpha))$$ where: $A' = New\ Calculated\ Average$ $A = Average\ Spectrum\ Signal$ $\alpha = Weighted\ Filter,\ (0 - 0.99)$ $S = Incoming\ Spectrum\ Signal$

5. The **Color** field may be used to select a different color for the trace if desired.
6. Repeat steps 2 - 5 for each additional trace (to a maximum of six).

Note: Each trace type color and status are also indicated on the information section of the top panel above the Spectral Plot.

7. Click the **Reset** button to reset the selected trace on the display. This means that if the trace is of Min Hold, Max Hold or Average, accumulated results will be discarded, and the trace will start fresh. The **Reset** button is only enabled when the trace is in Active mode.
8. Click the **Reset All** button to reset all traces on display.
9. To turn off a trace, change the **Status** field to Off.

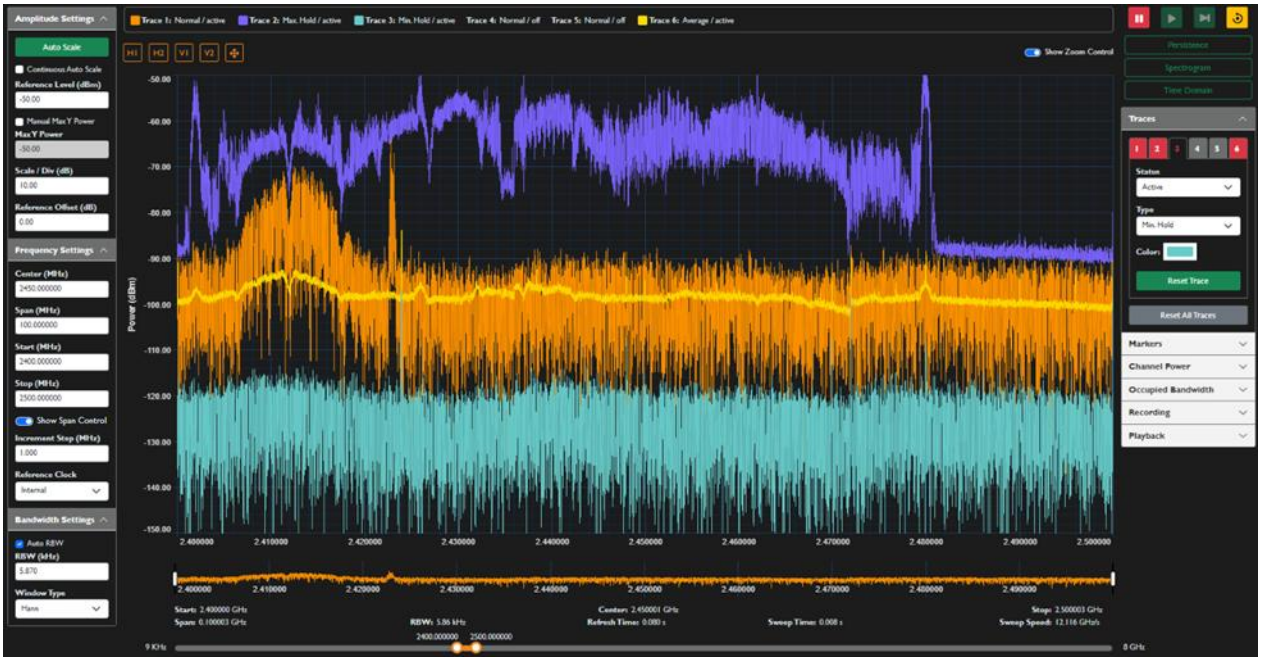


Figure 11: Spectrum with several active traces

Adding Markers and Finding Peaks

Up to six markers may be added, configured and have their results saved to a CSV file. Markers are positioned on the Spectral Plot in association with an *active trace* (i.e. trace in Active or View status) to identify peaks or differences in power and frequency relative to another primary marker, as shown in Figure 12. When peak search is applied, the *currently selected* marker is positioned at the highest peak on the signal.

Follow these steps to use the **Markers** feature:

1. Click the **Markers** button in the right-side configuration panel to access the **Markers** panel.
2. Select a marker (from 1 to 6) from the tabs on the top of this panel.
3. In the **Mode** drop-down list, select a mode:

Mode	Description
Off	The marker is removed from the display. When turn off a marker, its settings will be reset.
Normal (Primary Marker)	The marker tracks the amplitude (power) value of the active trace but remains at the same frequency position unless **Continuous Peak** search is applied. Upon first activation, the marker is positioned at the Center frequency by default. The marker appears as a diamond shape with its marker number hovering above it in the display.
Fixed (Primary Marker)	The marker stays at the same frequency and power level, regardless of changes in the amplitude of the incoming signal. The marker appears as a diamond shape with its marker number hovering above it in the display.

Mode	Description
Delta <n>	When more than one marker is active and at least one is a primary marker, a marker may be set as a **Delta Marker** relative to a primary marker <n>. For example, if there are two primary markers on the signal display, you can designate Marker 3 as Delta 1 (relative to marker 1) or Delta 2 (relative to marker 2). The Delta Marker allows users to compare frequency and power between two markers. The delta marker appears on the display as an inverted triangle icon with its marker and delta numbers hovering above it.

Note: When turning off a trace with attached marker(s), the corresponding marker(s) will be turned off.

Note: Each activated marker's frequency and power are also indicated on the information section of the top panel above the Spectral Plot.

4. In the **Trace** field, assign the marker to a trace from the trace drop-down list containing all active traces on the display. This field defaults to the first active trace (usually Trace 1).
5. In the **Frequency** field, specify a frequency value to position the marker.

Hint: A marker can be clicked and dragged directly on the display to a desired frequency position. This action will also set the marker being dragged as the *currently selected marker*.

6. The **Power** field, which is only editable for a fixed marker, shows the power level of the marker in real-time.
7. Optionally, a marker can be configured to indicate a peak in its associated trace by clicking on one of the following buttons:
    - **Peak Search**: positions the marker at the highest peak signal of the current trace.
    - **Next Peak**: positions the marker at the next highest peak signal, wherever it occurs.
    - **Next Peak Left**: positions the marker at the highest peak signal to the left of the current marker position.
    - **Next Peak Right**: positions the marker at the highest peak signal to the right of the current marker position.
    - **Marker -> Center**: changes the center frequency to match the current marker position.
8. Select the **Continuous Peak** checkbox to have the Normal or Delta (not Fixed) marker track the highest peak on each new capture as it occurs on the display. When this checkbox is selected, most marker settings aside from Mode, Trace, and Peak Threshold are disabled as all the frequency change or peak search results are quickly overwritten by the continuous search.

9. Select the **Peak Threshold** checkbox to enable definition of the minimum power threshold for the peak detection. Markers are not assigned to peaks that fall below this power level.

Repeat steps 2 to 9 for each additional marker (to a maximum of six).

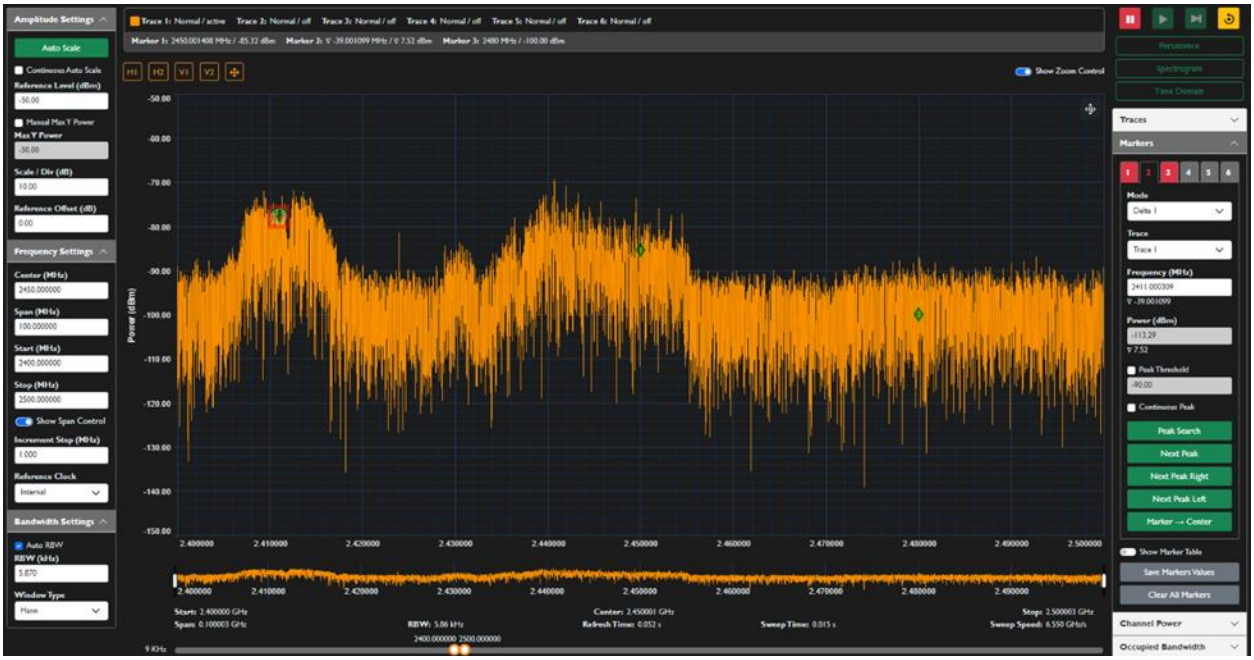


Figure 12: Normal trace with multiple attached markers

10. Optionally, click the **Show Marker Table** switch to display a table listing all active markers (with their corresponding marker mode, trace assignment, frequency, power level, frequency delta and power delta) below the Spectral Plot, as shown in Figure 13. The marker table can be closed by clicking the Show Marker Table switch again or the Close button × above the marker table.

Figure 13: Marker table below the Spectral Plot

11. Optionally, the information of the current markers (power level, frequency position and delta values) may be saved in a CSV file by clicking on the **Save Marker Values** button or the Save button above the marker table. Specify a file name and location in the *Save As* dialog and save it.
12. To remove a single marker, change the **Mode** field to **Off**.
13. To remove all markers from the display, click **Clear All Markers** button.

Adding Cursors and The Crosshair

The cursor buttons are available at the top of the **Spectral Plot** and **Spectrogram**.

1. To add a horizontal cursor, click the **H1** or **H2** button.
2. To add a vertical cursor, click the **V1** or **V2** button.

When selected, the cursor button will be filled with orange color and with an input displayed. The input allows users to view or edit the cursor position. The **H1** and **H2** inputs of the Spectrogram are read-only. By default, the cursor line will be positioned in the center of the display. The cursors are also draggable by mouse over the top of the cursor, click and drag them to the desired location on the plot display. When both horizontal (**H1** and **H2**) / vertical (**V1** and **V2**) cursors are selected, the horizontal (**ΔH**) / vertical delta (**ΔV**) will be displayed on the right side of the crosshair button.

Note: Synchronized horizontal and vertical cursors will be displayed on the Persistence Plot when cursors are added or modified on the Spectral Plot, as shown in Figure 14. When the cursor is removed from the Spectral Plot, it will be removed from the Persistence Plot as well.

Figure 14: Synchronized cursors on Spectral Plot and Persistence Plot

3. To add a crosshair cursor, click the **Crosshair** button  .
4. When selected, the crosshair button will be filled with orange color. When mouse over the trace(s) in the Spectral Plot, the x and y values of trace(s) will be displayed on a green tooltip, as shown in Figure 15.
5. When mouse over the Spectrogram, the **Time** and **Power** will be displayed on a green tooltip, as shown in Figure 16.

Note: When the Crosshair cursor is activated, activated horizontal or vertical cursors are no longer mouse selectable for dragging; use their input to change the cursor position.

6. To remove any cursors or crosshair from the display, click on their button again.

Figure 15: Spectral Plot with cursors and crosshair buttons selected

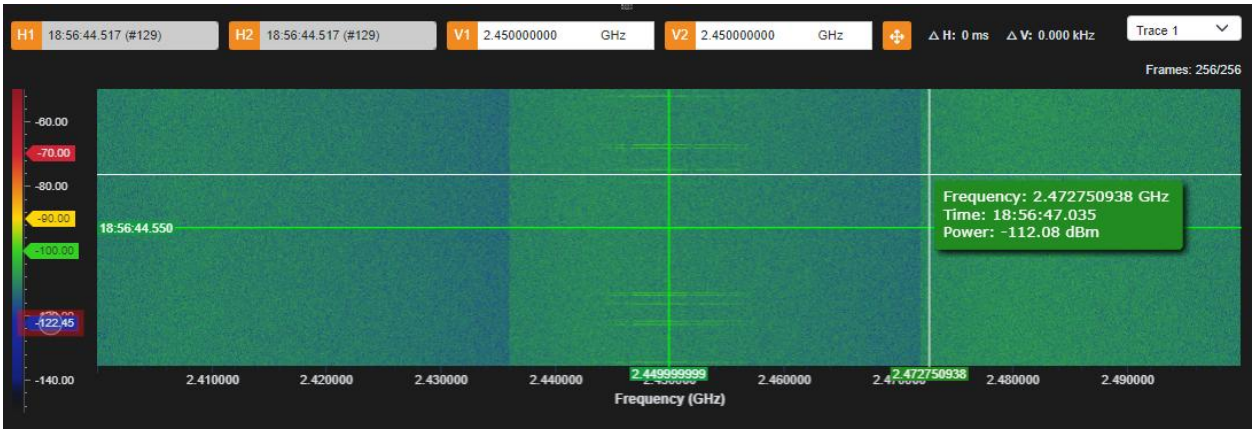


Figure 16: Spectrogram with cursors and crosshair buttons selected

Restoring Spectrum Viewer Defaults

The **Preset** button  in the top-right button panel of Spectraware provides a means to reset all parameter values to the application's start-up defaults. If you want to save your custom settings before restoring the system defaults, see the Saving Configuration Settings section.

Capturing Signal Data

In addition to viewing real-time signal data on the Spectraware web application, signal data and information can also be screenshot handily or saved for playback or for further processing by another application.

Capturing a Screenshot

Spectraware allows for capturing a screenshot of the current window. The screenshot is stored in the PNG file format.

1. Click the **Take Screenshot** button  in the top panel of Spectraware.
2. In the *Save As* dialog, specify a file name (or use the default) and a storage location.
3. Click **Save** to save the image.

Recording Signal Data

Spectraware allows recording real-time signal data in a file for playback or further processing by another application. The data file will be saved settings to the user's local home directory.

When saving data, Spectraware also saves two .json files with full application settings. These files allow for automatically loading those settings to restore the visual application state when playing back a data file.

To record data to a file:

1. Click the **Recording** button in the right-side configuration panel to access the **Recording** panel.
2. Set the **Duration** in seconds, indicating how long you want to record data for. The range is 1s to 86400s (24 hours), with 10s as the default.
3. Before you record, check if you are presently viewing data in the time domain. If you are, the recording will be saved as such. Otherwise, it will be saved as frequency domain.
4. Click **Start Recording**. A **Save As** dialog will be shown. Specify a file name and save it. The default file name format will be as such:

Recording Type	Default File Name Format
Spectrum	`spectrumData_sn[serial number]_span[span frequency]_fc[center frequency]_rbw[RBW]_ts[yyyy-mm-dd-hhmmss]`
Time Domain	`iqData_sn[serial number]_IQToSpectrum_ifbw[RBW]_fc[center frequency]_ts[yyyy-mm-dd-hhmmss]`
FM Demodulation	`iqData_sn[serial number]_FMDemodulator_ifbw[analysis BW]_fc[center frequency]_ts[yyyy-mm-dd-hhmmss]`

Recording Type	Default File Name Format
AM Demodulation	`iqData_sn[serial number]_AMDemodulator_ifbw[analysis BW]_fc[center frequency]_ts[yyyy-mm-dd-hhmmss]`

5. A progress bar will appear on the panel indicating how much of the recording duration has passed, and the Start Recording button will turn into a **Stop Recording** button.

Note: While recording, you will not be able to change most settings, and a recording icon  will be displayed beside the Recording title.

6. You can click the **Stop Recording** button at any time to stop the recording and save the captured data. Otherwise, the recording will stop when the duration is reached, and the captured data will be saved.
7. The recorded data will be saved as a raw data file with corresponding settings files.

Playing Back a Recorded Signal

Spectraware can playback a previously recorded signal. The following steps can be used to playback a signal.

1. Click the **Playback** button in the right-side configuration panel to access **Playback** panel.
2. Click **Choose File**. An **Open** dialog will be shown. Choose the desired file and click **Open** (or double click on the file).

Caution: File name containing "." is not supported and will cause file saving failure.

3. The Spectraware will begin displaying the signal. In the Playback panel, a **Progress Bar** will appear to indicate how far through the playback the current frame is in the form of a percentage value. When continuous (looping) playback of a file is used and happens rapidly, the Progress Bar might give an impression of never reaching the end.

Note: During playback, a playing back icon  will be displayed beside the Playback title. Also, all the settings except **Scale/Div, Reference Offset** and **Window Type** *(in time-domain playback only)* in the left-side configuration panels will be disabled as those settings can no longer be changed during playback. The **File** and **Device** menus in the **Menu Bar** will also be disabled as they are not supported in playback.

4. To stop playback of the recorded file, click the **Stop Playback** button in the Playback panel. If a device was connected before playback, Spectraware will reconnect to that device. Otherwise, the Connect Device dialog will be shown.

Note: When a recorded FM/AM Demodulation file is selected for playback under the Spectrum Viewer page, it will switch to the Demodulation page automatically and play the data. Similarly, when a recorded spectrum/time domain file is selected for playback under the Demodulation page, it will switch to the Spectrum Viewer page automatically and play the data.

5. Alternatively, from the Connect Dialog, you can start a playback by clicking the **Open Playback** button and doing steps 2 and 4.

Demodulating Data

Spectraware can demodulate AM and FM signals. Click the **Demodulation** tab in the Feature Navigation Headings to launch the demodulation page (see Figure 17). The receiver is placed into a gapless streaming mode.

Demodulation Page

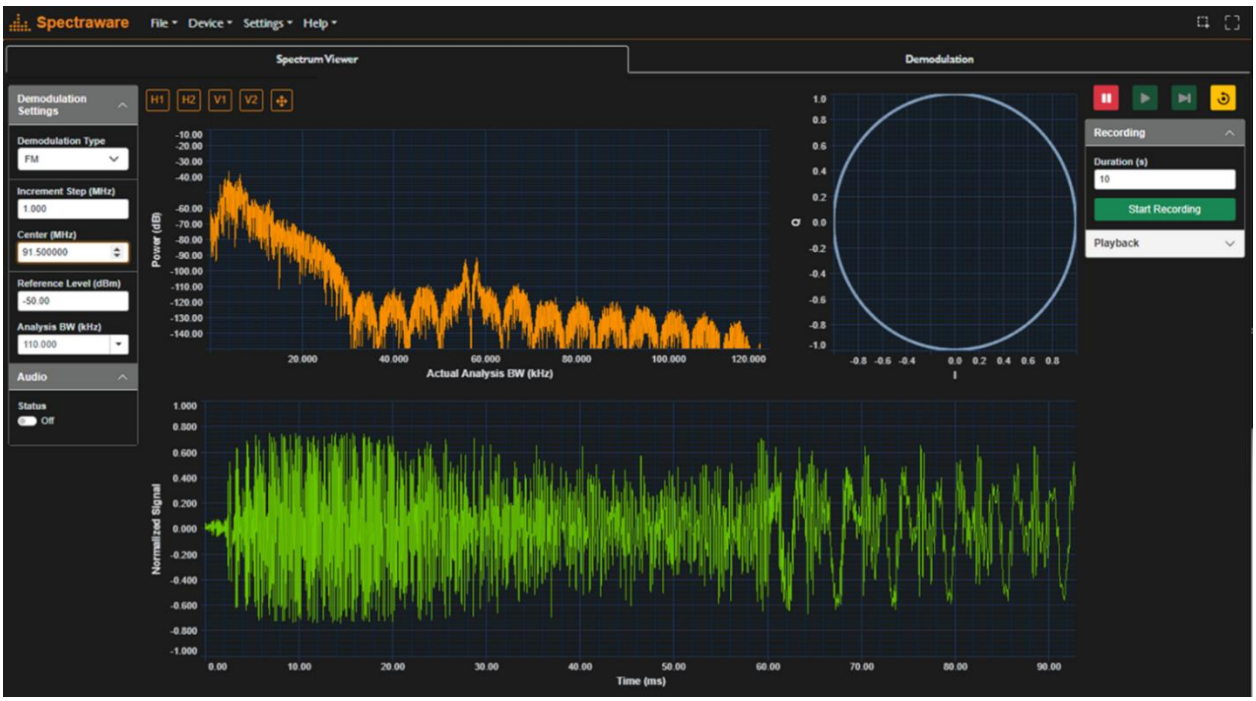


Figure 17: Demodulation view

The demodulation page has configuration panels and control buttons surrounding three main plots as such:

- **Left-side** configuration panels contain demodulation settings such as Demodulation Type, Center Frequency and Analysis Bandwidth. More information on these settings can be found in Configuring Demodulation Settings.
- The **top-right** button panel contains run control buttons for changing capture modes and resetting the application. See Run Control Buttons section for more information.
- **Right-side** configuration panels contain settings for Capturing Demodulated Signal Data.

Configuring Demodulation

This section describes the settings that affect the demodulated signal capture and display.

Configuring Demodulation Settings

Setting Name	Function
Demodulation Type	Options are **AM** and **FM** (default).
Subtype	The subtype options are only available for AM demodulation. The supported subtype values are **DSB** (Dual-SideBand), **LSB** (Lower-SideBand) and **USB** (Upper-SideBand).
Increment Step (MHz)	The number of MHz by which the Center frequency will step when the Center's up and down buttons are pressed.
Center (MHz)	The frequency to which the Receiver was tuned or to which the Receiver was tuned when the file being played was recorded.
Reference Level (dBm)	The Reference Level controls the RTSA's attenuation and gain when applicable sensitivity. The higher the reference level the more attenuation, and vice versa.
Analysis BW (kHz)	Analysis BW (bandwidth) is used to demodulate and filter the signal. The BW value is defaulted to 244kHz for FM demodulation, and 35kHz for AM. The smallest supported BW is 35kHz. In a near future release, the BW value will be lower to 12.5kHz.

Configuring Audio Settings

The audio can be turned on or off (default) by clicking on the **Status** toggle button in the **Audio** panel of the left-side panels. This button is only available in continuous capture mode. When the Status toggle button is **On**, the audio stream flowing will start. The audio can be paused at any time by changing the Status toggle button to **Off**, which will empty the audio buffer until it turns on again.

Capturing Demodulated Signal Data

Recording Demodulated Signal Data

Spectraware allows for recording real-time demodulated signal data in a file for playback or further processing by another application. Please refer to the Recording Signal Data section.

Playing Back a Recorded Demodulated Signal

Spectraware can playback a previously recorded demodulated signal. Please refer to the Playing Back a Recorded Signal section.

Demodulation Plots

Spectral Plot

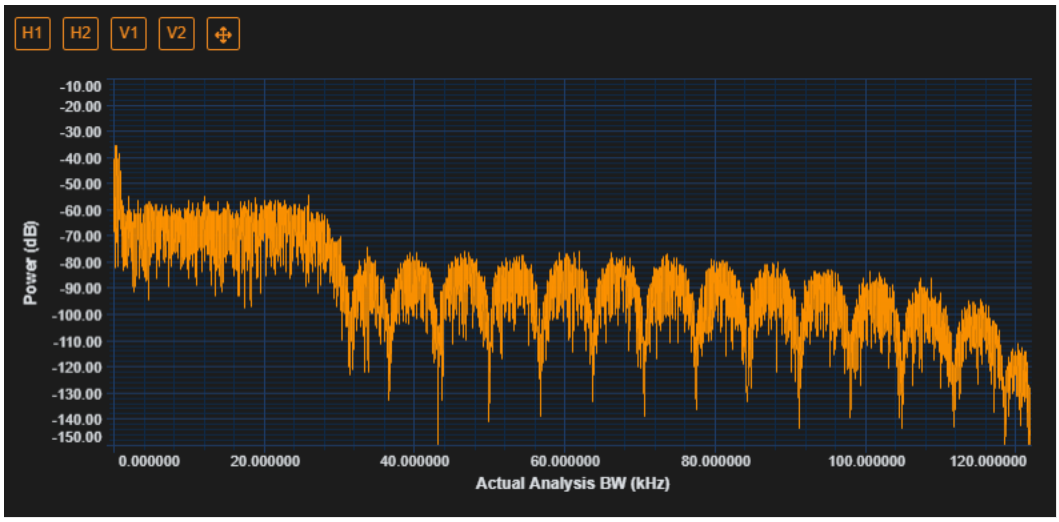


Figure 18: Spectral plot of a mono FM signal

The demodulated spectral plot shows the power spectral density of the signal after demodulation. An FM signal, for example, has an obvious spectral signature that can be seen in Figure 18 above.

The cursor buttons are available at the top of the frequency domain graph. The usage of these cursor buttons is the same as those above the Spectral Plot in Spectrum Viewer. Refer to the Adding Cursors and The Crosshair section for usage details.

Constellation Plot

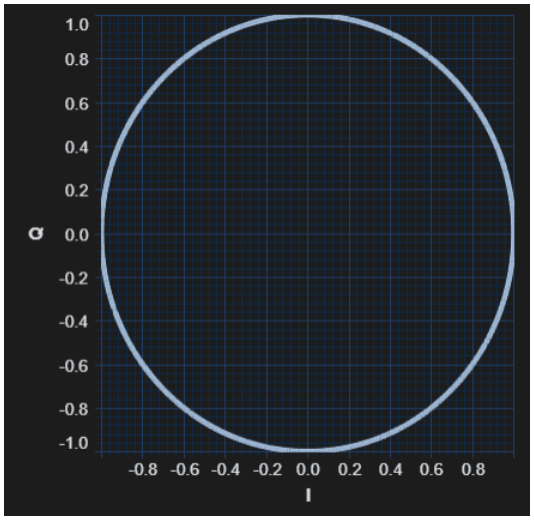


Figure 19: Strong Signal

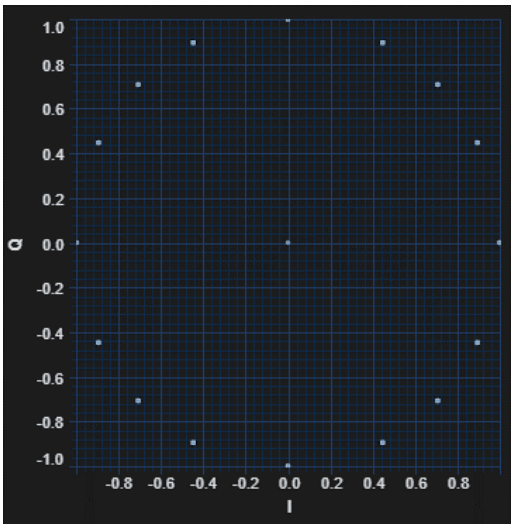


Figure 20: Weak Signal

The constellation graph is always active when there is a connected device or file. It displays the calibrated signal prior to demodulation (i.e. IQ data) on a unity graph, which

is essentially signal power and phase. The quality of an FM signal is denoted by how closely the values are plotted to a perfectly clean circle. A perfect circle (see Figure 19) denotes a clean, strong signal, which will be obvious when listening to the demodulated signal. As the circle gets more diffuse (see Figure 20), the quality of the audio quality might be diminished.

Time Domain Plot

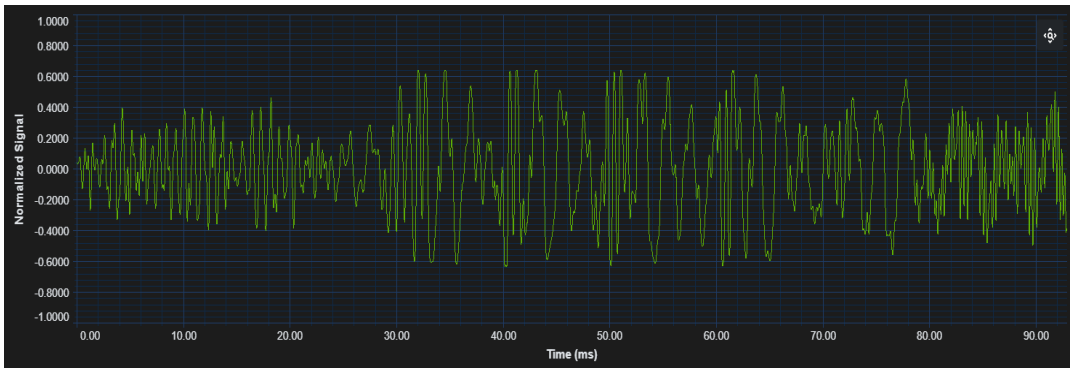


Figure 21: Time domain plot of an FM speech signal

The time domain graph (see Figure 21) shows signal amplitude in voltage over time, which corresponds to the audio that is played when the signal is down-sampled to 44.1kHz and sent to the audio system.

Note that there might be some small amount of lag from the displayed signal to the audible signal owing to the need to buffer the audio stream to mitigate the risk of annoying dropouts.

Administration

In addition to signal capture functionality, the Spectraware application provides additional features that allow you to save and store configuration profiles and to customize the configuration panel display.

Saving Configuration Settings

Spectraware allows for saving current configuration settings in a file that can be reloaded later.

To save the existing Spectraware settings,

1. Open the **File** menu from the Menu Bar and select the Save Settings option.
2. Specify a file name (default file name format is `Spectraware-config-YYYY-MM-DD-SSSSS`) and location in the **Save As** dialog and save it.

The contents of the saved .json file can be viewed in a text editor, however, however, manual modification of this file is not recommended.

Note: If you are a user of the libtrf library, the file saved using either libtrf or Spectraware can be played back by both. This is because Spectraware makes use of libtrf's recording function directly.

Loading Configuration Settings

Spectraware application settings can be customized based on a previously saved configuration file.

1. Open the **File** menu from the Menu Bar and select the Load Settings option.
2. Navigate to the storage location of the .json file to be opened in the **Open** dialog.
3. Select the .json file and click **Open** (or double click on the file).

Spectraware loads configuration settings from the file and updates the application state accordingly.

Note: If an improper format of file is loaded, an error dialog will be displayed with message "Invalid settings!" and your current settings will remain as normal. If a properly formatted file is loaded with invalid data for some reason (for example, a letter is where a number should be), data may fail to be plotted. In this case, click the **Preset** button to reset the capture settings.

Viewing Device Information

Information specific to the connected RTSA device can be obtained by clicking **Device** > **Device Info** from the Menu Bar. A dialog with device information will be displayed.

The dialog displays the following information of the RTSA device currently connected to:

- **IP Address:** the IP address of the device

- **Model:** the device's model number
- **Serial Number:** the device's serial number
- **Product Version:** the device's hardware version
- **Firmware Version:** the device installed firmware version

For the R57x0 and R6000 product family with inbuilt GNSS module, the panel displays the following additional position information with real-time updates:

- **Latitude:** degrees, minutes, and seconds
- **Longitude**: degrees, minutes, and seconds
- **Altitude**: meters (m)
- **Speed**: meter per second (m/s)
- **Track**: the direction of traveling in degrees

Changing The Display Theme

The Spectraware user interface supports two different themes – **Dark** (default, Figure 22) and **Light** (Figure 23). To change the theme, open the **Themes** menu from the **Menu Bar** and select the desired theme. Changing the theme changes the visual style and color scheme of the user interface but has no impact on the data display; they are purely there for aesthetic purposes.

*Figure 22: The Spectraware user interface and its main Spectral Plot in **dark mode**.*

*Figure 23: The Spectraware user interface and its main Spectral Plot in **light mode**.*

Accessing Product Documentation

Access to this User Guide PDF document is available in the Spectraware's **Help** menu, or this User's Guide link.

See Obtaining Latest Documentation and Software for any other documentation related to the device or Spectraware.

Document Revision History

This section summarizes document revision history.

Document Version	Release Date	Revisions and Notes
v1.0.0	07/10/2023	First release
v1.1.0	11/30/2023	• Updated Spectraware Overview section • Added the new Demodulating Data section. • Changed Getting Started section with new installation steps for Standalone and Browser mode and modification throughout the section accordingly. • Changes to images to reflect new UI enhancements.
v1.1.1	02/27/2024	Improved Linux installation instructions and a note.

v1.2.0	07/17/2025	• Improved explanations throughout the document
		• Moved Plot Zooming to be under User Interface section to serve as a generic usage.
		
		For software release v1.3.0,
		
		- Added:
		• thinkRF SXM Solutions support throughout the document
		• sections on new features
		  ○ Zoom Control Bar
		  ○ “Span Control” bar for Frequency Settings
		  ○ “Continuous Auto Scale” and “Manual Max Y Power” for Amplitude Settings
		• new figures due to new changes
		• Running Spectraware and Connecting to an SXM Device section
		
		- Removed “S1000” or renamed it to be “Spectraware” where applicable. S1000 naming is no longer needed.
		- Renamed “Spectrum Analyzer” to “Spectrum Viewer”
		- Removed “Web Version Installation” and its mentioning throughout the document as this option is deprecated.