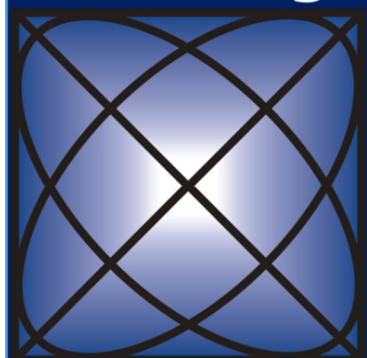


**New Ridge**



**Technologies**

# NRT-8000 User Manual



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## 1 Introduction

The NRT-8000 is the world's smallest fully functional optical spectrum analyzer. The 8000 OSA software controls units directly connected to the device (local access mode). Or through a remote (server) device, which is directly connected to a NRT-8000 (remote access mode). This manual describes the features and functions of the NRT-8000 and its device GUI software.

## 2 Getting Familiar with the NRT-8000

The front panel of the NRT-8000 unit has a power/communication indicator LED and an optical input, as shown in Figure 1.



Figure 1: Front view of the NRT-8000. The LED indicates power and turns green when the USB is connected or flashes with amber when it is addressed.

The rear panel of the NRT-8000 has (see Figure 2 from left to right):

- USB communication port.
- On/Off switch.
- 12 V, 2 Amp DC power input.



Figure 2: Rear View of the NRT-8000

## 3 Installing the NRT-8000 Software

### 3.1 Windows PC Installation

It is preferable to begin the installation by uninstalling any previous versions of the NRT-8000 software program. You can do this by going to the Windows Start Menu in the lower left corner of the Windows desktop and selecting **All apps** . Navigate to the NRT-8000 folder and select **Uninstall** . If the program was installed in a different folder, then the uninstall executable will be found in that folder. Click the icon and follow the instructions to uninstall.

The best way to guarantee the latest version of the software is to go to the product website, [newridgetech.com/nrt-8000/#downloads](http://newridgetech.com/nrt-8000/#downloads). Click the **Downloads and Demos** section, and then **NRT-8000 OSA Downloads** . You will be directed to login (or register) after which you can begin downloading the application file.

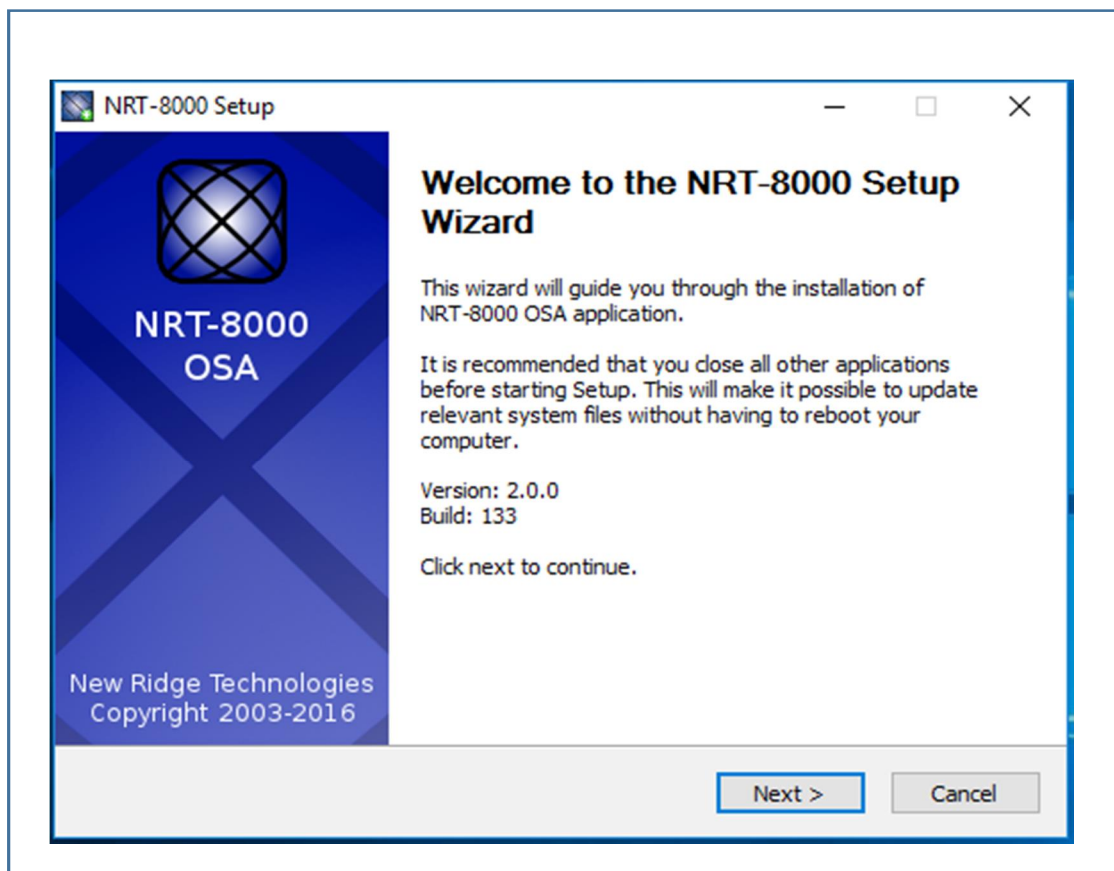


Figure 3: Initial setup page, click on the **NEXT** button.

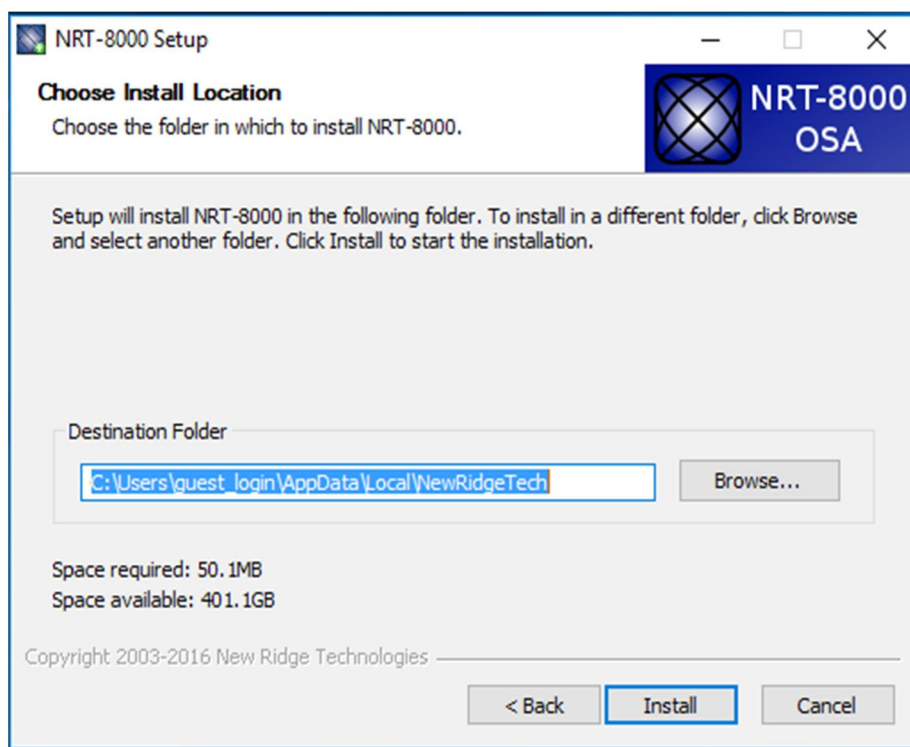


Figure 5: Choose install location. We recommend the default destination folder. Click on the **INSTALL** button.

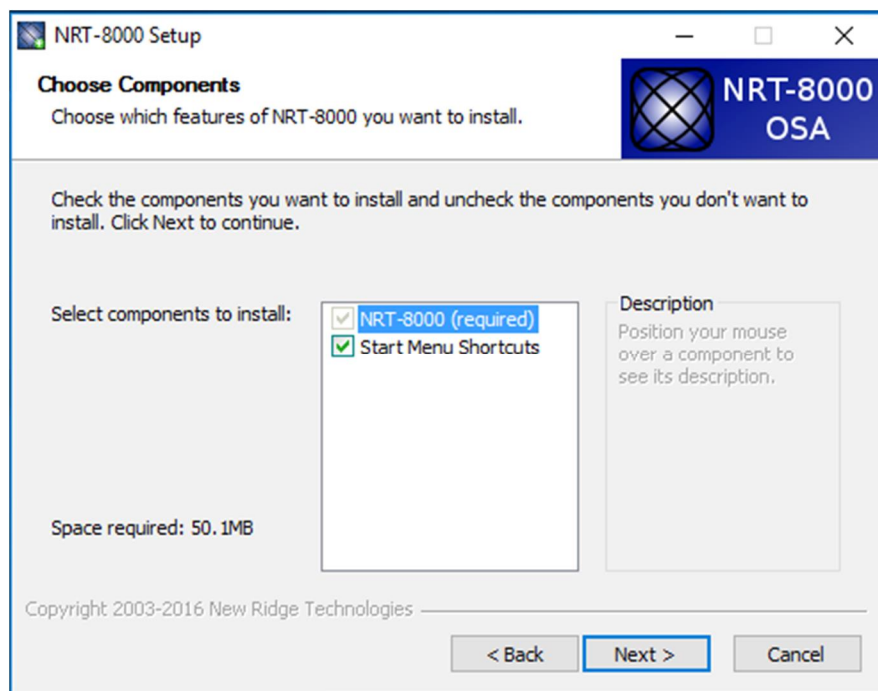


Figure 4: Select components to install. Click on the **NEXT** button.

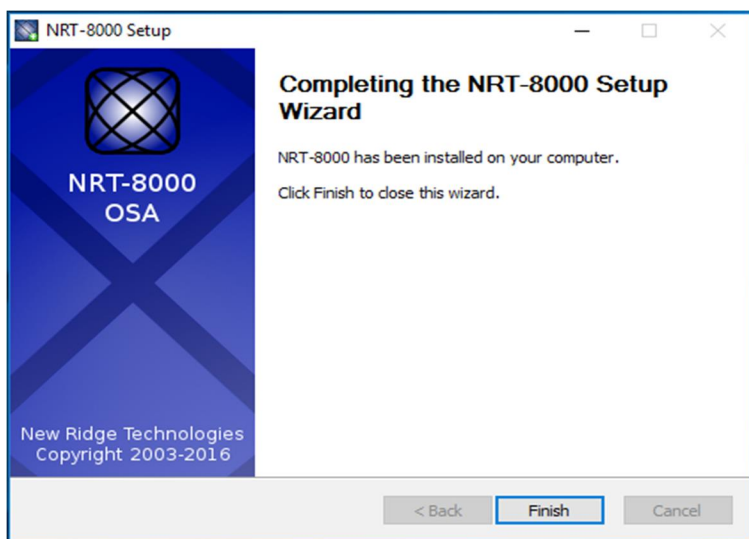


Figure 6: Complete the installation. Click on the **FINISH** button.

### 3.2 Android Installation

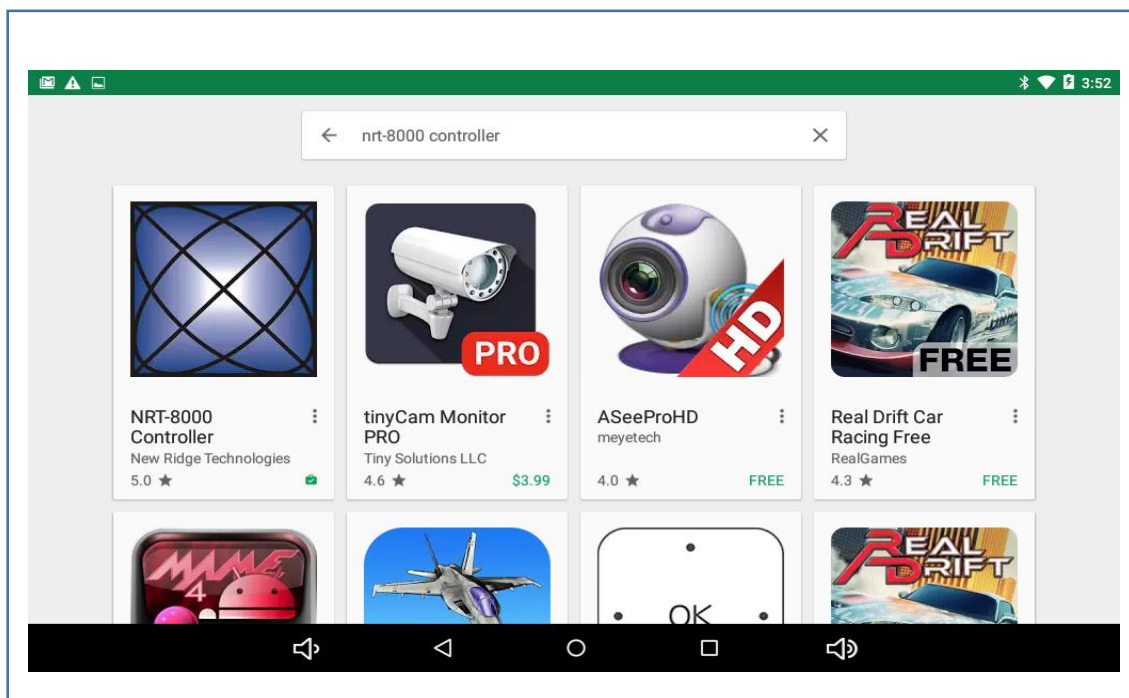


Figure 7: Google Play Store search for the 'NRT-8000 Controller'.

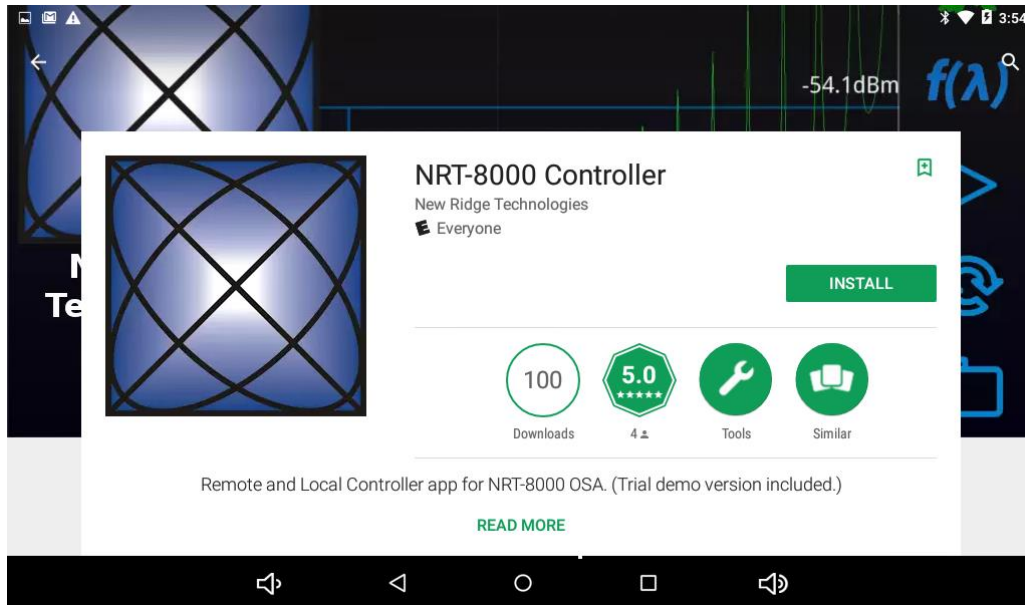


Figure 8: Click on the **INSTALL** button. Follow instructions to install.

## 4 Connecting to the NRT-8000

There are three types of connections possible: **Commuter Devices**, directly connected via USB or Bluetooth, **Nearby Devices**, those NRT-8000s on your LAN, and **Portal Devices**, those NRT-8000s set up on the WAN portal. Once your device is selected, the application will return to the main screen shown in figure 11.

### 4.1 **Computer Devices:** Directly connecting and hosting a NRT-8000

The tablet or computer (device) communicates directly with the NRT-8000 via USB or Bluetooth.

#### 4.1.1 **Connection to the NRT-8000 via USB**

Simply connect USB type A side into the device and the type B side into the NRT-8000. To connect by USB to an Android tablet use the included USB OTG (On-The-Go) cable adapter.

#### 4.1.2 **Connection to the NRT-8000 via Bluetooth.**

First pair your Android smart device or PC with the NRT-8000. When opening the GUI software, the Bluetooth available units should be shown. Just select the Bluetooth unit desired and click connect.



Figure 9: Android Tablet with USB OTG (On-The-Go) cable adapter.

When switching from Bluetooth to USB the NRT-8000 needs to have its power recycled. When your NRT-8000 unit is connected to a device the LED on the unit will change from amber to green.

#### 4.2 Connecting to a Remote NRT-8000: **Nearby and Portal Devices**

The GUI software automatically hosts the directly connected NRT-8000. But the software will also make remote connection services available; via LAN, **Nearby Devices**, or across the WAN, **Portal Devices**. Whether the NRT-8000 is connecting to the NRT-8000 at the end of your USB cable, to the other side of the LAB via a WiFi LAN connection, or across a fiber network span via the internet, the functionality is the same. In all cases you have total control any accessible NRT-8000.

#### 4.3 The **Welcome** Window

After connecting the USB to the NRT-8000 unit, open the NRT-8000 software. When the application first opens, the **Welcome** window shown below should appear displaying all 8000 units available you would like to connect. To connect, click the desired unit from the list of NRT-8000s and then click **Connect**. The window should close automatically and initiate a spectral scan. Otherwise clicking **New Session** will close the window and initiate a spectral scan.

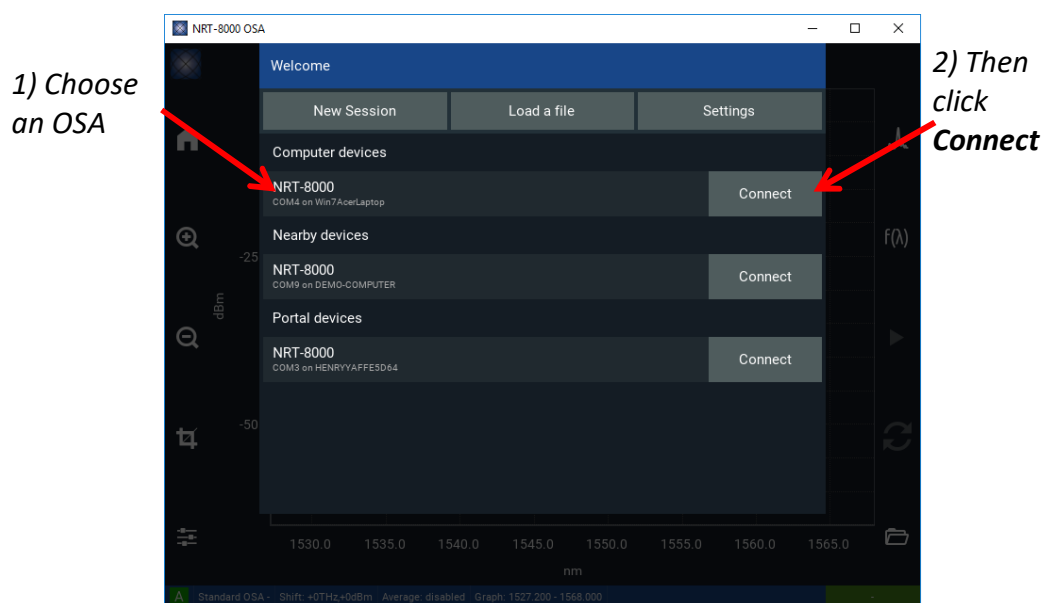


Figure 10: **Welcome** window to select OSA connection.

The **Welcome** window is always accessible by clicking on the NRT logo icon in the upper left corner of the GUI window as shown by the red arrow in figure 12. There are a number of control settings of the NRT-8000 that are managed through the **Welcome** window described below.

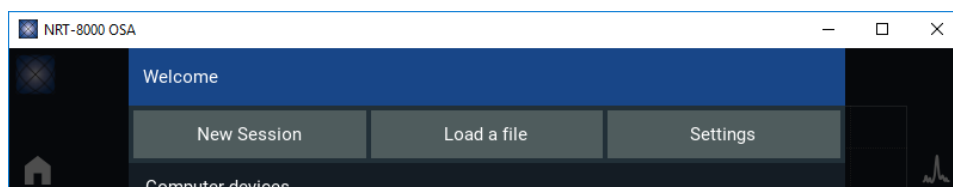


Figure 12: The three tabs at the top of *Welcome* window.

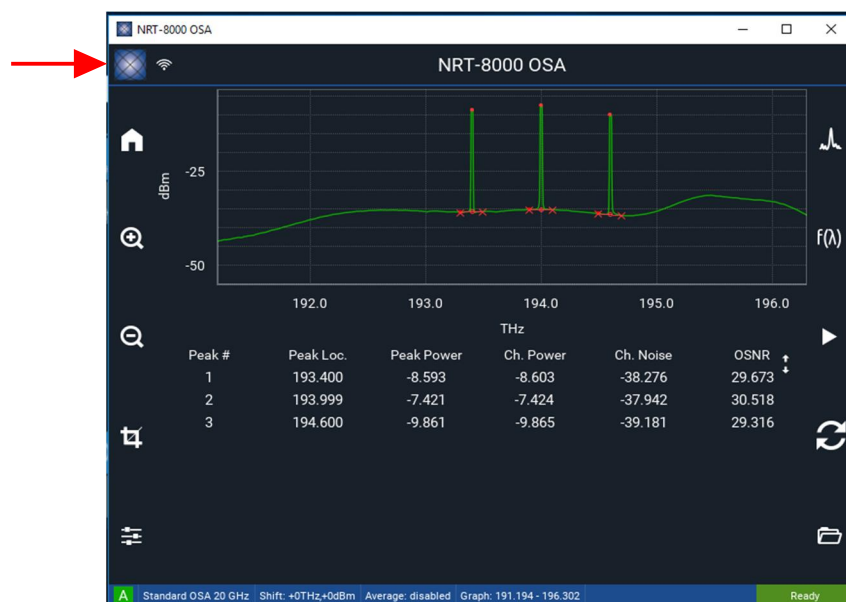


Figure 11: Clicking the NRT logo opens the *Welcome* window.

#### 4.3.1 Load a file Tab

To load an image or csv of a scan, click the **Load a file** tab on the *Welcome* window to select a file. The simple file manager will start at the set file path.

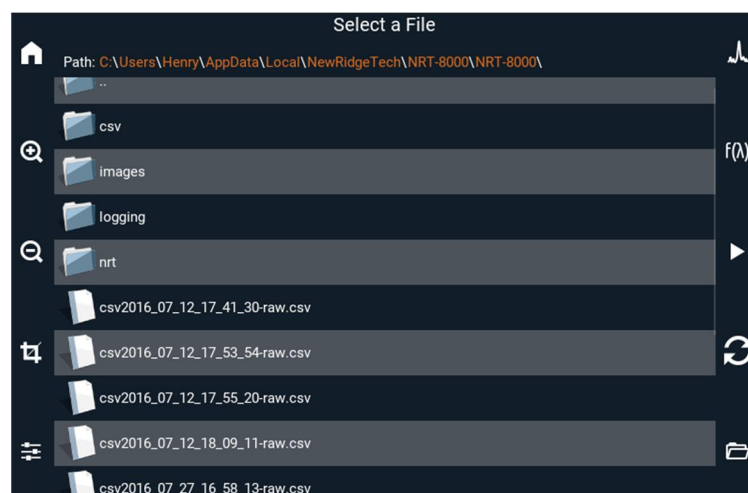


Figure 13: File manager to *Load a file*.

### 4.3.2 **Settings Tab**

The **Settings** tab on the **Welcome** window brings up a few more option settings: **Portal**, **Paths** and **About**.

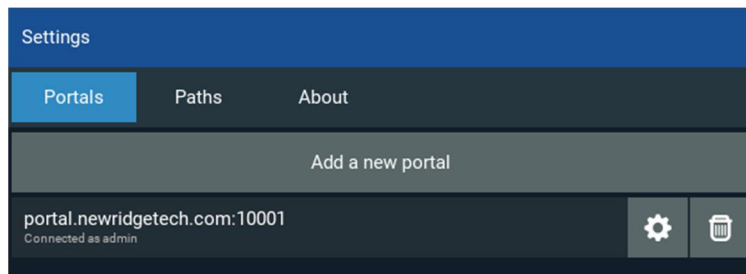


Figure 14: Settings tab window.

#### 4.3.2.1 **Set a Portal**

NRT has designed a cloud portal to allow secure access to NRT-8000s anywhere they sit on the internet. This capability is truly novel to test and measurement and one of the first implementation available. No firewall configuration is necessary.

Presently the only portal is accessible at Host: portal.newridgetech.com, Port: 10001. You can access and view our open portal with the username demo and the password demodemo.

Enter the fields as shown in figure 15.

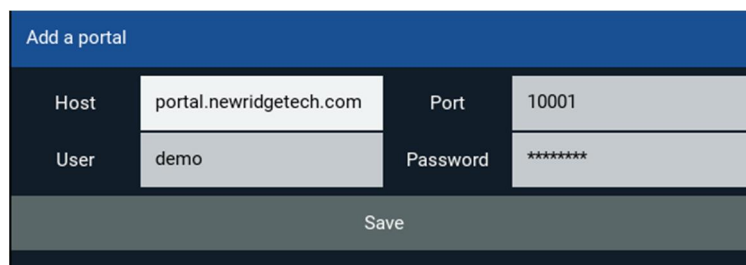


Figure 15: **Portal** settings tab

If you desire your own private access or your own portal please contact NRT.

## 5 Connections and Preferences

On the main window of the GUI there are 5 buttons on the left (L1-L5) and 5 buttons on the right (R1-R5). See figure 16.

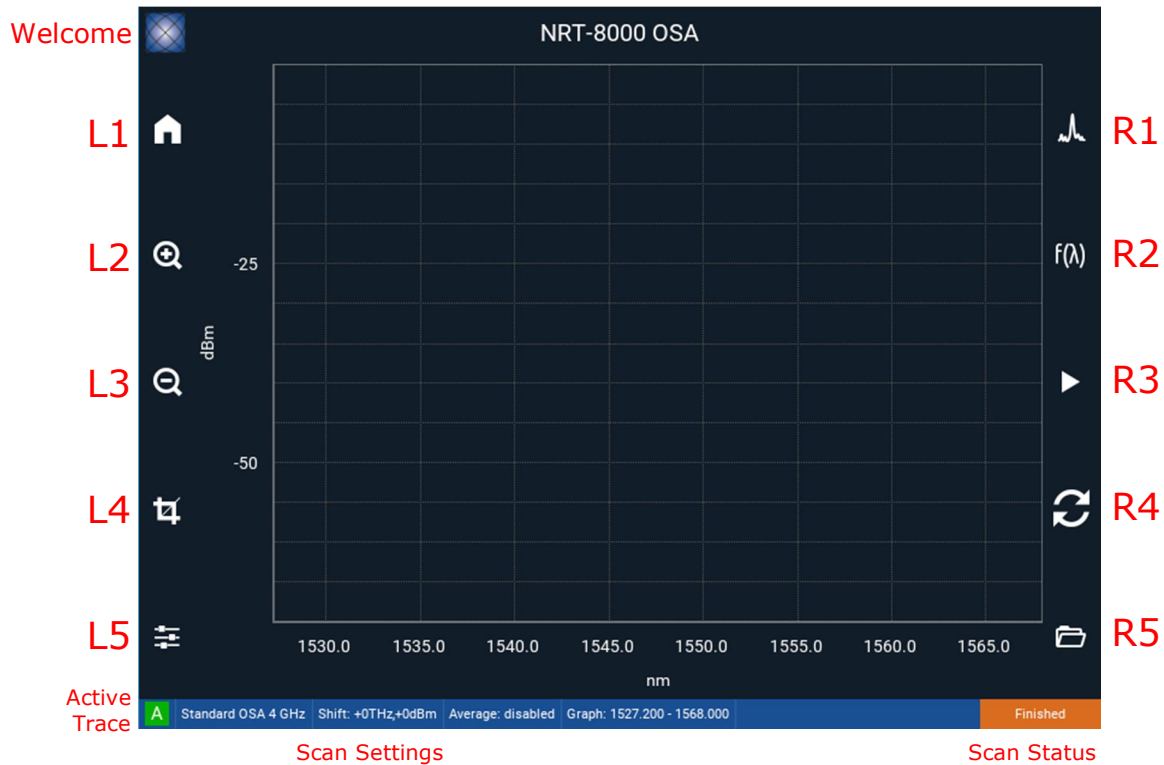


Figure 16: The main window: The left column includes all the configurations and set-up options. The right column allows users to toggle measurements and scanning-related functions.

### Configuration/Set-up buttons on Left

- 5.1 **L1: Home:** Rescales the graph to display the entire NRT-8000 x-scale and auto-scales the y values on the graph to the 110% the y data range.
- 5.2 **L2: Zoom-in**
- 5.3 **L3: Zoom out**
- 5.4 **L4: Crop tool** allows the user to select and zoom in on a specific portion of the spectrum.

1. Click on the **Crop tool** icon.



Figure 17: Initiate the **Crop** tool.

- 2 Using the mouse or finger select the rectangle enclosing the x and y portion of the spectrum to be enlarged.

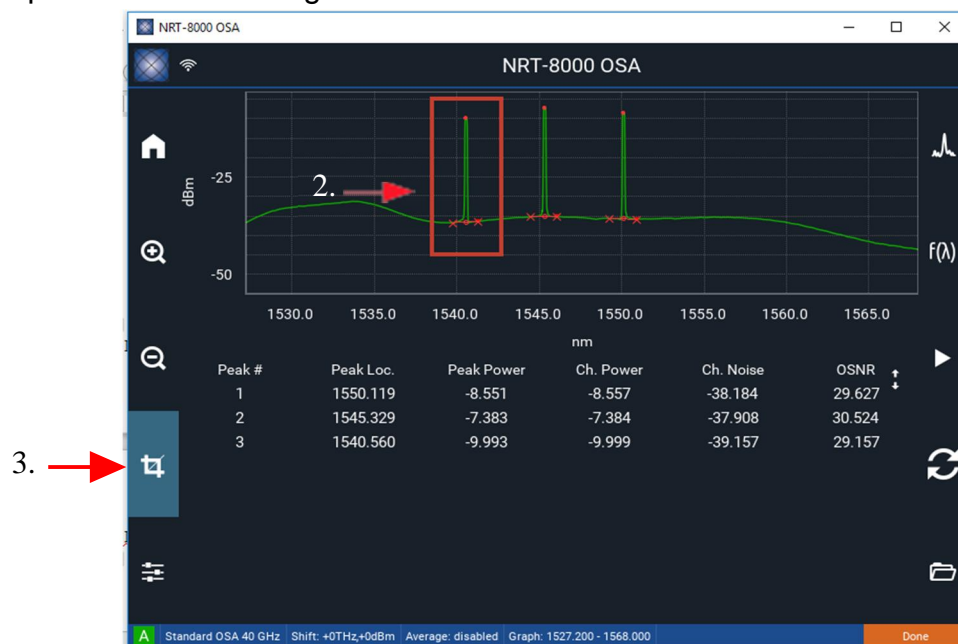


Figure 18: Cropping spectral region to display.

3. Then click the **Crop tool** icon a second time to execute the zoom in to the set rectangle. The designated rectangle will be expanded to fit the entire GUI display.

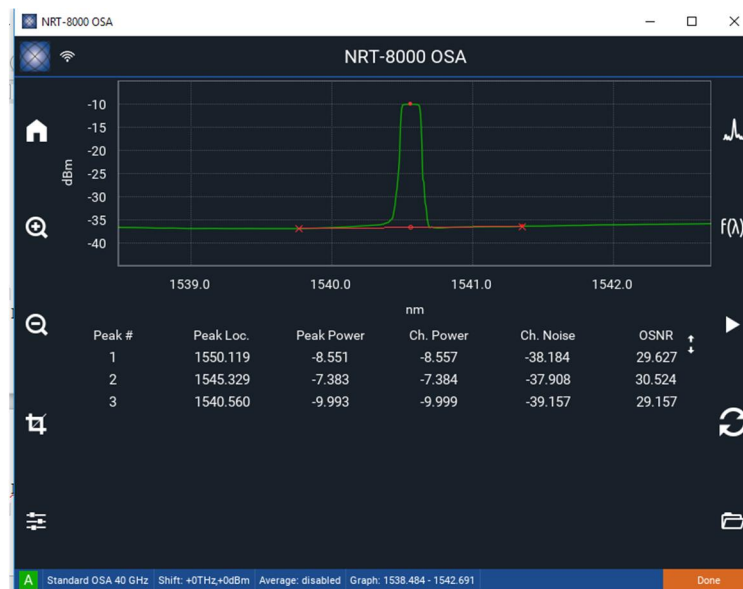


Figure 19: Spectrum resized with **Crop tool**.

5.5 **L5: Settings:** there are three tabs under **Settings: Graph, Trace** and **Calibration**. A long click on the bottom of the GUI frame, in the settings bar, also opens the Setting window.



Figure 20: Two ways to access the **Setting tool**.

### 5.5.1 **Graph Settings** Tab:

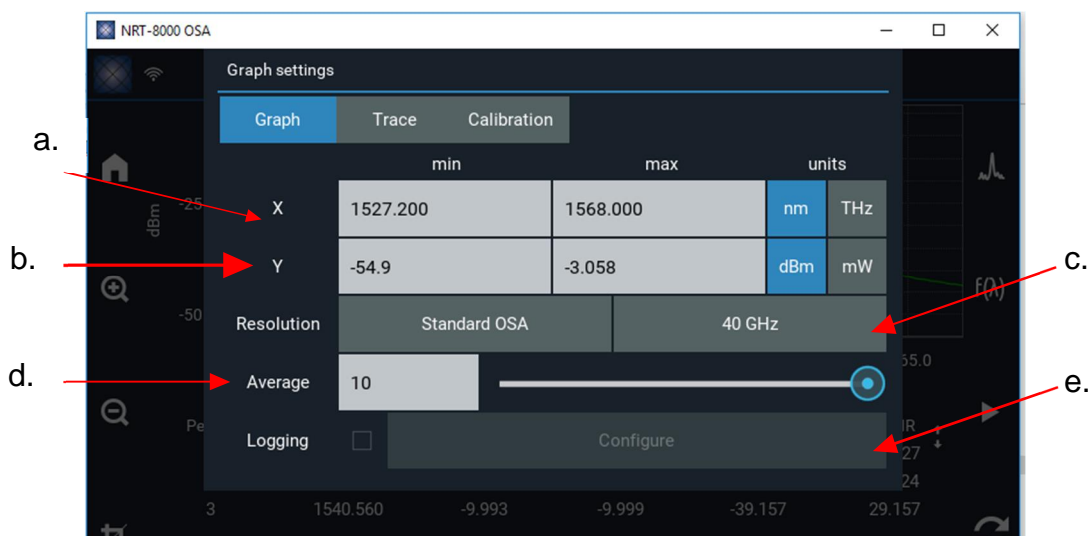


Figure 21: Five graph settings window in **Setting** tool.

5.5.1.1 Set the **X min**, **X max**, and units of the graph, displayed in **nm** or **THz**.

5.5.1.2 Set the **Y min**, **Y max**, and units of the graph, displayed in **dBm** or **mW**.

5.5.1.3 **Resolutions**: The NRT-8000 is able to measure spectra having different resolutions and different line-shapes.

5.5.1.3.1 **Standard OSA Resolutions**: The OSA line-shape familiar to most users is generated by OSAs having a diffraction grating monochromator. These line-shape resolutions are designated in the NRT-8000 GUI software as **Standard OSA**. The setting values match the same values used on the Yokogawa OSA, namely 4 GHz, 20 GHz, 40 GHz, 100 GHz and 200 GHz. The nominal FWHM widths associated with the **Standard OSA** settings are given below.

Setting (GHz)	4	20	40	100	200
FWHM (GHz)	2.2	8.2	16.8	43.3	86.8

Table 1: **Standard OSA** settings on the NRT-8000 and the corresponding measured FWHM of a CW laser line.

5.5.1.3.2 **Constant Bandwidth Resolutions:** The NRT-8000 also generates constant bandwidth resolution line-shapes. These resolution settings maintain a constant noise equivalent bandwidth (NEB) across the entire scan. It may be surprising, but the NEBs of other OSAs varies across the spectral scan. The **Constant Bandwidth resolutions** can be set to have constant NEB in either in the wavelength (nm) or the frequency (GHz) domains.

5.5.1.3.2.1 **Constant Bandwidth Wavelength [nm]** *Continuously settable NEB resolutions 0.0194 nm.*

5.5.1.3.2.2 **Constant Bandwidth Frequency [GHz]** *Continuously settable NEB resolutions 2.42 GHz.*

5.5.1.4 **Average (1-10):** Increased measurement sensitivity is obtained by averaging repeated scans. Choose the number of scans to be included in the moving average-window. Average is only engaged in **Repeat Scan mode (R4)**.

5.5.1.5 **Data logging:** Allows the user to export and save spectral data for extended and unattended measurements when using **Repeat Scan mode (R4)**. Check the box next to **Logging** and then select **Configure** to change the settings.

**Interval:** Allows you to set the time in seconds between NRT-8000 scans to be logged.

**Export:** Select which data, trace and/or analysis table, to save into the log file.

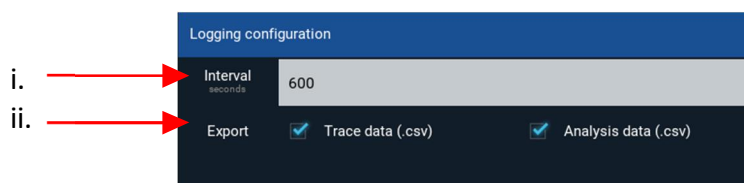


Figure 22: **Data Logging** sub-window

### 5.5.2 **Trace Setting** Tab:

Allows the user to define multiple spectra and spectral calculations as different traces, and display them on the same graph. The **Trace Setting tab** (below) displays the options for defining new traces and their configuration.

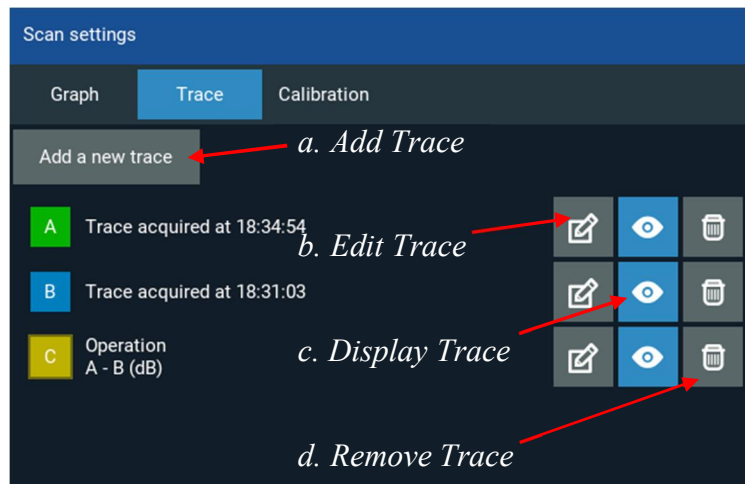


Figure 23: Scan setting - **Trace** window

#### 5.5.2.1 **Edit Trace** ⇌ **Operation** Tab:

Click the **Edit Trace** icon for the trace to be set-up. By default the **Operation** tab will be exposed (below). Then click on the **Type** bar button to set the operations.

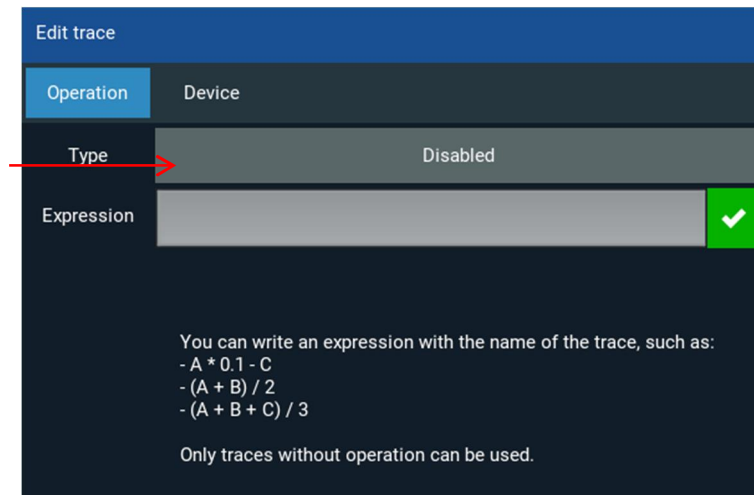


Figure 24: **Edit Trace/Operation** window. Click **Type** button to set operation on traces.

The traditional use of traces in OSA measurements is to compare a succession of OSA scans. For example, a common application is to record and save a

reference trace (e.g. B) and then measure subsequent active traces (e.g. A). The normalized trace is C defined by the operation  $A - B$ .

Formulae for normalizing traces in dB and linear scales are built in. The NRT-8000 also allows the user to define **Custom** functions on and between traces

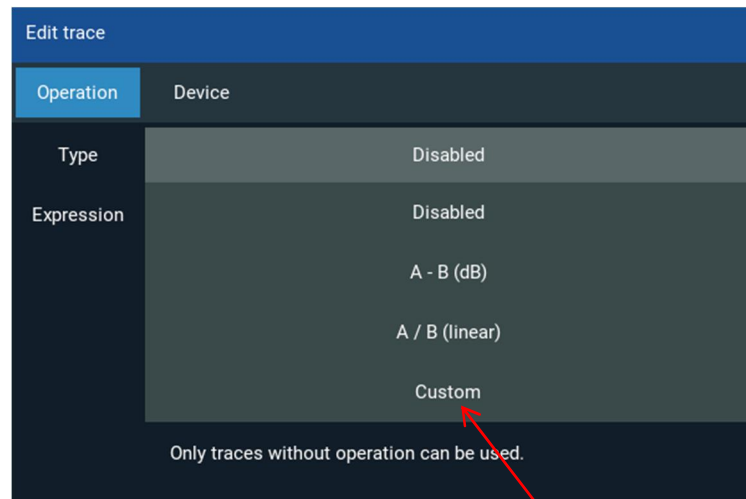


Figure 25: Select a built-in trace function or select **Custom** to write your own expression to define the new trace.

(e.g. scaling, offset, averaging, etc.) is also available.

Traces defined by **Operations** cannot be active traces to be scanned by the NRT-8000.

#### 5.5.2.2 **Edit Trace** ⇒ **Device** Tab:

As noted above, the NRT-8000 is unique with built-in multi-device networking features enabling each trace to be connected to a different OSA. This feature enhances the multiple trace capability of the NRT-8000 enabling simultaneous measurement and comparisons of traces taken from different OSAs.

In order to set up the multi-OSA/multi-traces, click on the **Device** tab in the **Edit Trace** window. Then click on the **Device** button to set the desired OSA.

A new window will open **scan settings** for the selected OSA. The **resolution** can be set. Also, since different OSAs may not align perfectly, a shift can be added to the **X-axis** (in GHz resolution) and to the **Y-axis** (in dBm). See the figure below.

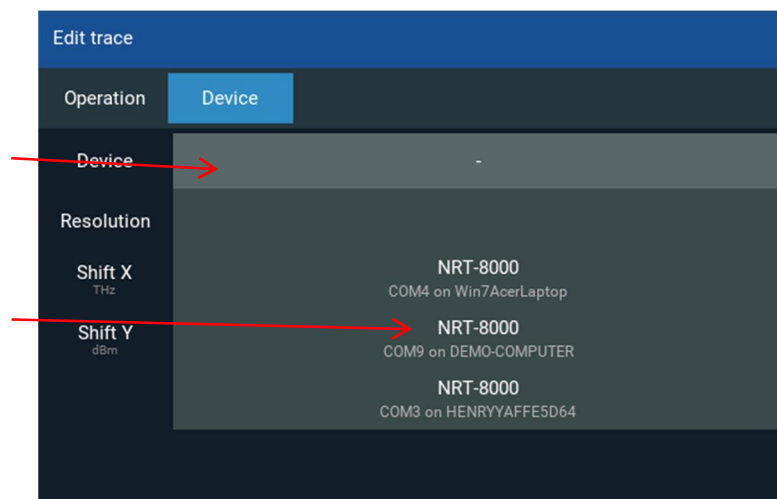


Figure 26: Click on the **Device** button to reveal all available NRT-8000s.

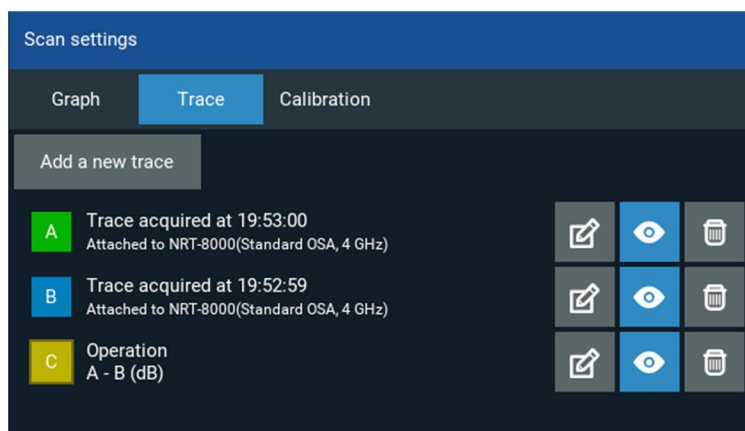


Figure 27: **Trace Scan** settings shows traces A and B are attached to OSAs and trace C is defined by the operation A-B. Note, when scanned, traces A and B are taken recorded practically simultaneously, within 1 sec here

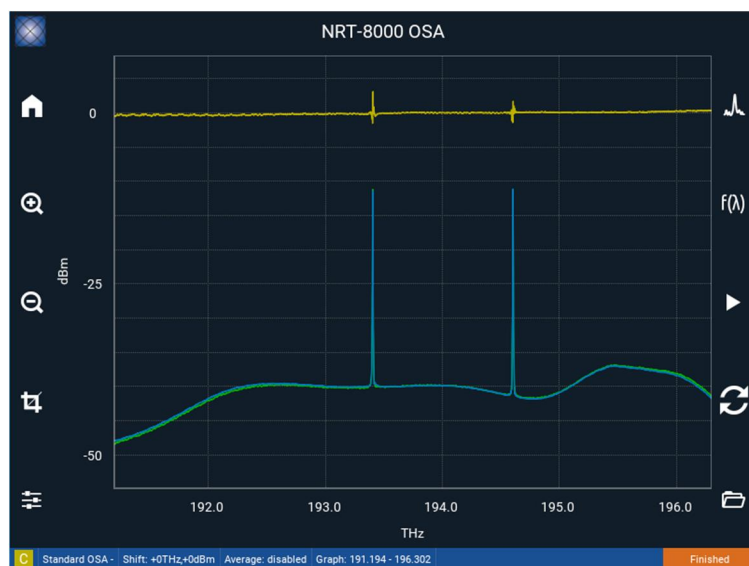


Figure 28: The result of this multi-trace/multi-OSA scan: trace A (green) and trace B (blue) nearly overlap, as shown by the difference trace C (yellow).

5.5.3 **Calibration** is used to make a particular NRT-8000 unit match the performance of a reference or another OSA. Three types of calibrations are offered.

Figure 29: **Calibration** window. The x-axis can be shifted in 0.001 THz (i.e. GHz) increments. The y-axis is offset on dBm. The OSNR calibration is described in the next figure.



1. **Shift X** - Changes the displayed x values by the entered (GHz) value.
2. **Shift Y**: Changes the displayed y values by the entered (dBm) value.
3. **OSNR Calibration**: Used to match OSNR calculations to a reference OSA. This calibration is performed by matching a set measured OSNR values.

#	Measured OSNR	Target OSNR	Calibrated OSNR	ΔOSNR (Calibrated - Target)
1	35.00	35.50	35.49	-0.01
2	30.00	30.25	30.27	0.02
3	25.00	25.10	25.07	-0.03
4	20.00	19.95	19.97	0.02
5	15.00	15.10	15.09	-0.01

☐ Shift
 ☐ Linear fit
 ☒ Cubic fit

Figure 30: **OSNR calibration** is calculated by entering the NRT-8000 OSNR values and their corresponding reference (target) OSA OSNRs. Then the fit method is picked: offset, linear or the (recommended) cubic fit.

## Measurement related buttons on Right

5.6 **R1: Spectrum** scan toggles between the **OSA spectral trace**, , and the **ITU channel checker**, , measurement modes.

5.6.1 The default setting is a standard **OSA spectral trace** identified by the spectrum icon symbol.

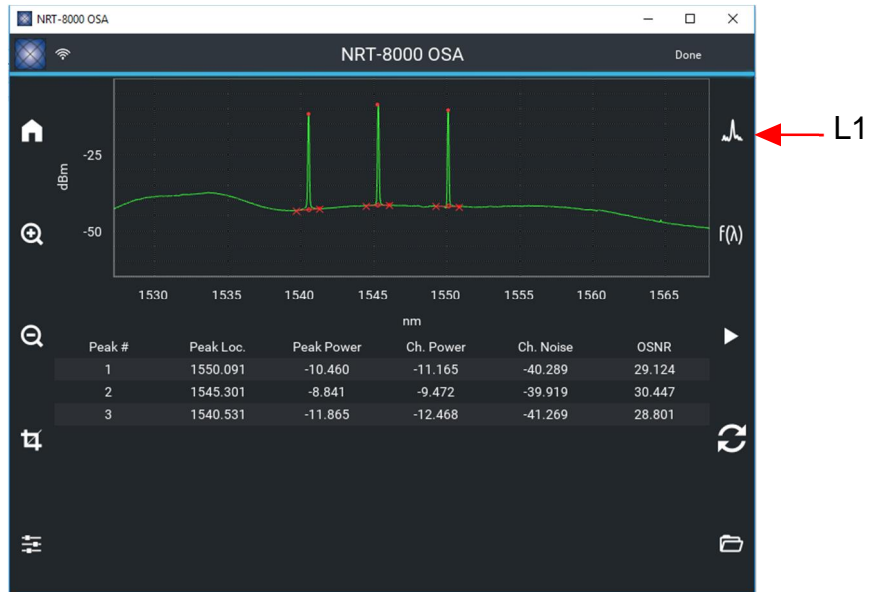


Figure 31: R1 icon sets the scan type


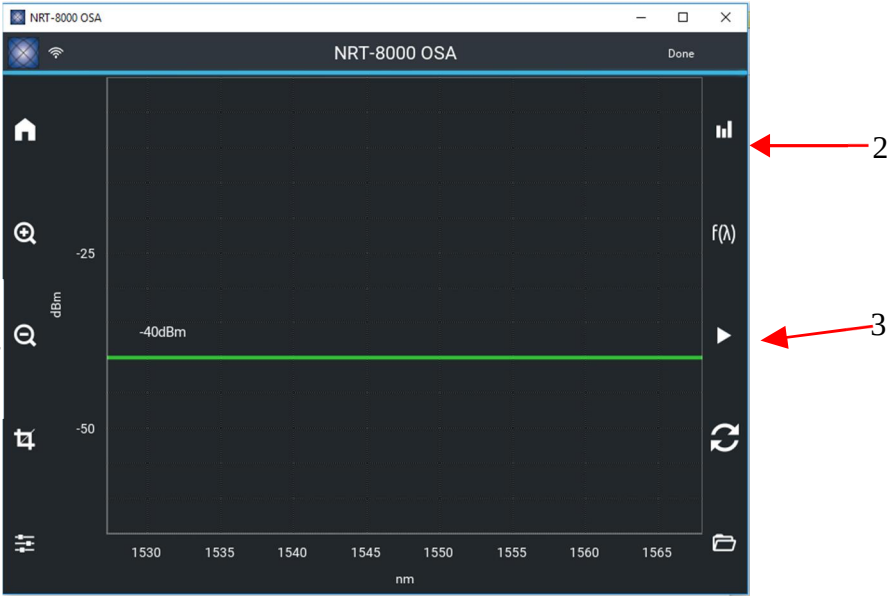
5.6.2 Click on the **R1 Spectrum scan** type icon to toggle to the **ITU Channel Checker** measurement. The following icon, , and graph will appear. The horizontal bar across the graph is the channel power threshold. Moving the bar up and down changes the channel threshold. All ITU channel powers below the bar will appear in red, and those above the bar will be green.

Figure 33: R1 icon set to Channel Checker mode



Click the **R3, Play (or Single) Scan**, button  to scan the (ITU) spectrum, displaying the power for each ITU 50 GHz channel.

Figure 32: Result of Channel Checker scan



## 5.7 R2: $f(\lambda)$ , Spectral Analysis Functions

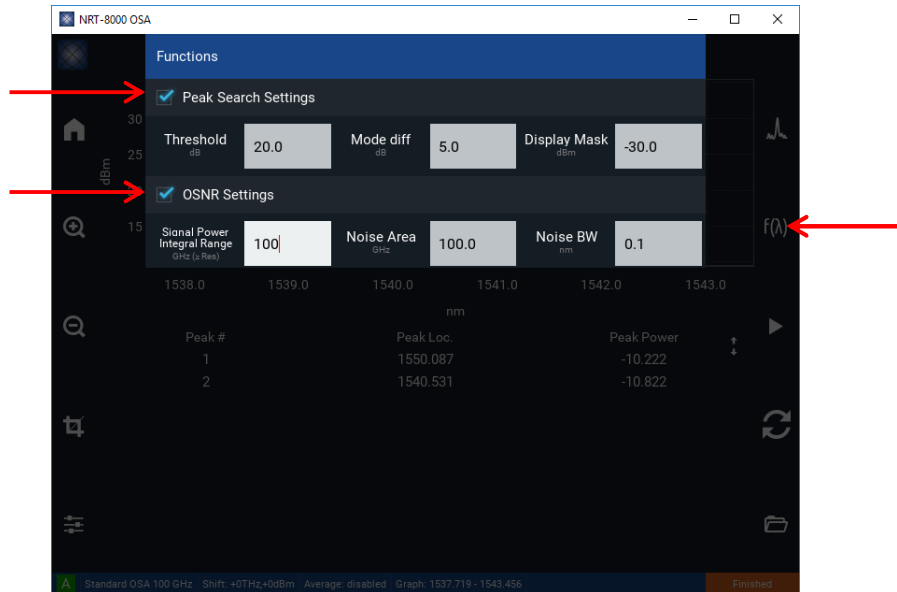


Figure 34:  $f(\lambda)$ , Spectral Analysis Functions, Peak Search Settings and OSNR Settings.

### 5.7.1 Peak Search: parameter settings to help identify spectral peak features, Threshold, Mode diff, and Display Mask.

5.7.1.1 **Threshold** is the power, in dBs, a feature can be below the maximum power in the scan and still be considered a peak.

5.7.1.2 **Mode diff** is the minimum feature height, in dB, the difference between the peak and its noise level, to be considered a peak.

5.7.1.3 Features with peak powers at, or below, in dBm, the **Display Mask** level are rejected as peaks.

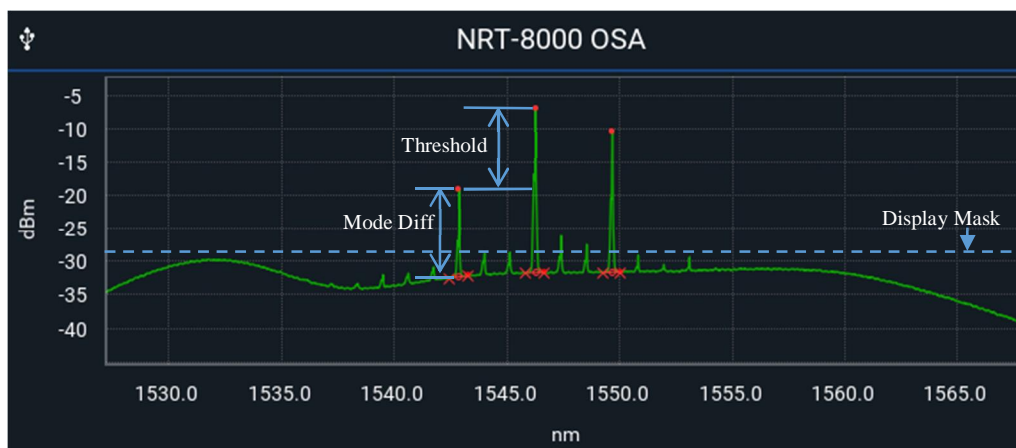


Figure 35: Peak Search parameter definitions

## 5.7.2 OSNR Settings:

### 5.7.2.1 Signal Power Integral Range:

This is the frequency range of integration across the peak to determine the signal power for the OSNR.

### 5.7.2.2 Noise Area:

This is the frequency distance from the peak's central frequency, used to determine the noise under the peak. The NRT-8000 uses a three-point interpolation to determine this noise. The noise power,  $N$ , is measured at the **Noise Area** to the left of the peak position,  $LN$ , and the noise power is also measured at the **Noise Area** to the right of the peak position,  $RN$ . The noise under the peak is then determined by interpolating between these two values,  $N = \frac{1}{2}(LN+RN)$ .

### 5.7.2.3 Noise BW:

Or noise equivalent bandwidth (NEB) is defined as the bandwidth of a rectangular filter which produces the same integrated noise power as that of an actual noise.

The default value is the commonly used 0.1 nm. The user can modify this value.

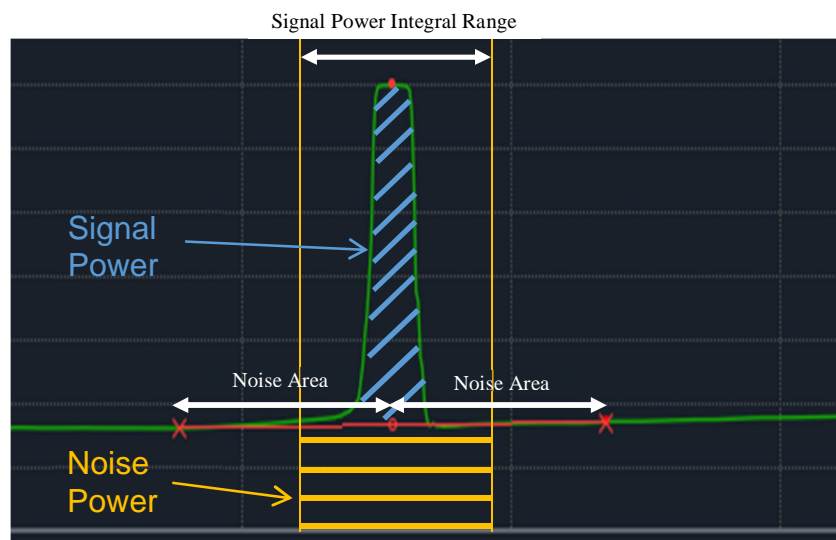


Figure 36: Diagram of parameter definitions used in the **OSNR analysis** calculation.

## 5.8 R3: Scan:

A scan spectrum is initiated with the **Scan** (or **Play**) icon button for a single scan. This is the most commonly used function button of the NRT-8000. The rectangle at the lower right corner of the GUI window will turn orange while scanning, and return to green when the scan is complete and the unit is ready.

1. Press the **R3** button. The status box turns orange, and the **Play** button has a revolving animation during the scan.

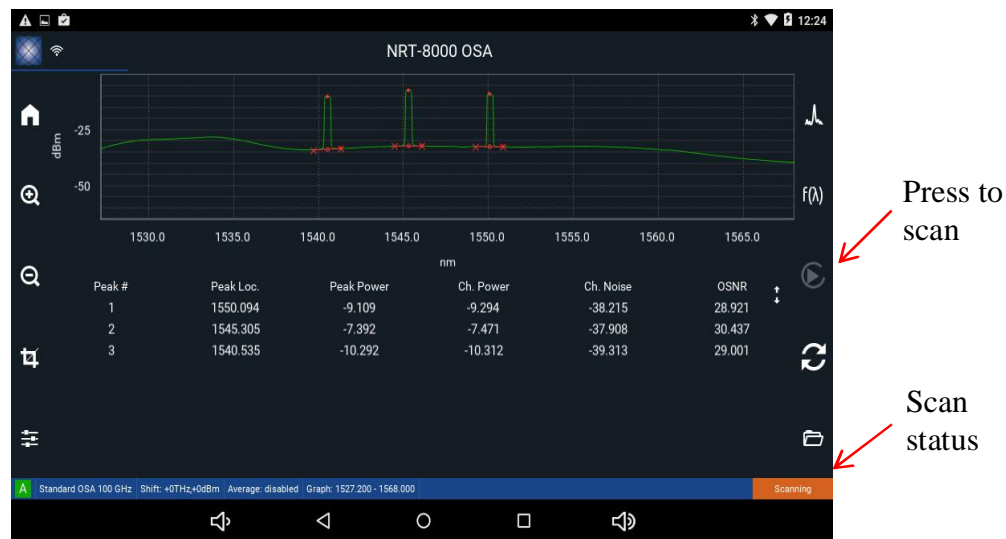


Figure 37: Press the **Play** icon to initiate a scan. The icon spins and status box is orange and reads **Scanning**.

2. Scanning finished, the status box becomes green, and the unit is ready.



Figure 38: GUI window after scan, status box is green and reads **Ready**.

### 5.9 **R4: Repeat scan mode:**

This button enables multiple, repeated scans. The box at the lower right of the window will turn orange when scanning. A second click of **R4** cancels the repeat scan mode at end of the current scan.

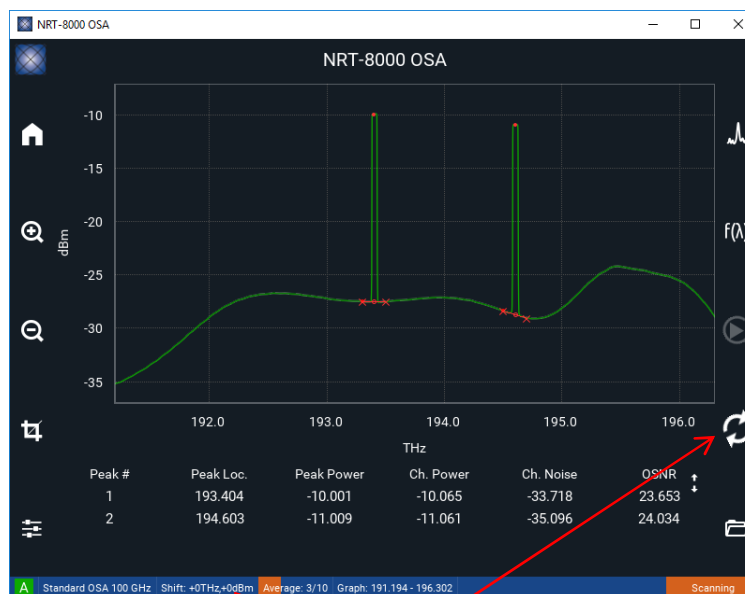


Figure 39: Click to start and stop **Repeat Scan** mode. The **Averaging** is set to  $n=10$ . As shown, 3 scans of the 10 have been completed.

Two features, **Averaging** and **Logging**, are linked to the **Repeat scan** mode.

#### 5.9.1 **Averaging:**

Increased measurement sensitivity is achieved in the NRT-8000 by averaging repeated scans. To enable the **Averaging** function, go to **Graph Setting (L5)** and set the number of averages to  $n > 1$ . The software will scan repeatedly and output the data averaged over a sliding average-window of  $n$  scans. Both the scan and the analysis values in the table will update automatically. An orange status bar, along the bottom of the GUI window, will fill as the number of scans reaches the full average-window of  $n$  scans. When  $n$  scans have been completed and averaged, the bar turns green.

### 5.9.2 **Logging:**

Measurements over extended and unattended periods of time are accomplished with the **Logging** option. Check the **Logging** option box in the **Graph Setting (L5)** and click **Configure**. Then, press the R4, repeat play button, to start the logging session. The data will be exported in the selected file format. To end scanning, press the button a second time.

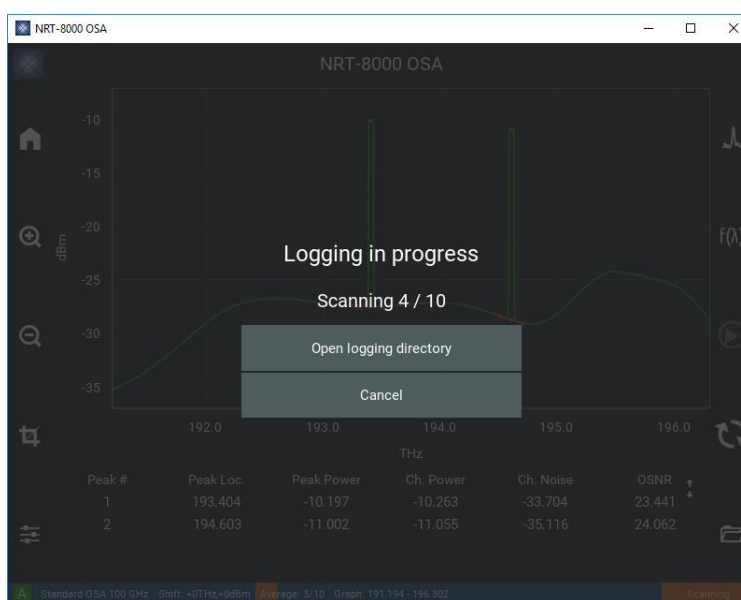


Figure 40: When **Logging**, the GUI is not available, as not to disturb the session. Here each log has **Averaging** of 10 scan to raise the measurement sensitivity. Click the **Cancel** button to stop the log session.

### 5.10 **R5: Loading** and **Saving** Files: Save, Open, and Share in csv and png formats.

All the saved data files are saved folders in a directory on the computer depending on their type. The default path is:


C:\Users\account\_name\AppData\Local\NewRidgeTech\NRT-8000\NRT-8000\.

Files can be saved as **CSV** or **PNG**. To save, select the folder icon, **R5**, at the bottom right hand corner of the GUI.


**CSV:** The spectrometer data is saved to a comma-delimited .csv file, which can be opened by a spreadsheet program such as Microsoft Excel.

**PNG:** a screenshot of the spectrometer GUI window is saved to the images folder inside the set directory.


#### 5.10.1 **Saving Files**

To save locally to your machine choose the  icon. You will then be given two options, **CSV** or **PNG**, to save the file.

### 5.10.2 Uploading Files

To retrieve locally saved scans choose the  icon. Files are uploaded with the built in file manager, as described in section 4.3.1, **Load a file**.

### 5.10.3 Sharing Files

Select the folder icon in the bottom right hand corner of the main screen and then select the  icon. This will open your email app to allow you to immediately email the file.

## 6 Additional Features and Shortcuts



Figure 41: GUI features and shortcuts

### 6.1 Vertical Marker



To create a vertical marker grab either the left or right edge of the graph window and drag it inward by holding down the left mouse button. The x position of the line can be set by clicking the number displayed and then entering your desired input.

When both left and right vertical markers are present the  $\Delta x$  between the markers will be displayed. This is useful in measuring spectral widths or feature separation.

Double clicking the area between two lines will cause the area between the markers to be enlarged to fit the screen.

## 6.2 **Horizontal Marker**



To create a horizontal marker grab either the top or bottom edge of the graph window and drag it inward by holding down the left mouse button. The y position of the line can be set by clicking the number displayed and then entering your desired input

When both top and bottom horizontal markers are present the  $\Delta y$  between the markers will be displayed. This is useful in measuring spectral feature height.

Double clicking the area between two lines will cause the area between the markers to be enlarged to fit the screen.

## 6.3 **Cursor**

Clicking on the spectrum will display a downward pointing triangular cursor with its x, y coordinates. The position of the cursor can be modified by clicking the number displayed and then entering the desired x location.

## 6.4 **Clearing markers and cursors**

An icon with a white circle and x icon will appear in the upper left corner of the spectral window whenever cursors or markers are active. Clicking on this icon clears all cursors and markers.

## 6.5 **Resolution**

Change the resolution by clicking the rectangle displaying the resolution along the bottom of the GUI frame.

## 6.6 **X-axis**

Clicking the X-axis label toggles the units between nm (wavelength) and THz (frequency) scales.

## 6.7 **Y-axis**

Clicking the Y-axis label toggles the units between dBm (log) and mW (linear) scales.

## 6.8 **Switching Active Traces**

The letter of the active trace is displayed in the bottom left corner of the GUI window. By clicking that letter icon, it is possible to cycle through the available traces. Active traces must be scan-able and cannot be an operation of scanned traces.

## 6.9 ***Resize Graph***



The vertical ratio between the spectral graph and the analysis table can be changed by sliding the analysis roll arrows up or down.

## **7 Technical Support:**

For technical assistance please contact us at [support@newridgetech.com](mailto:support@newridgetech.com)

or call us at +1 (410) 753-3055.