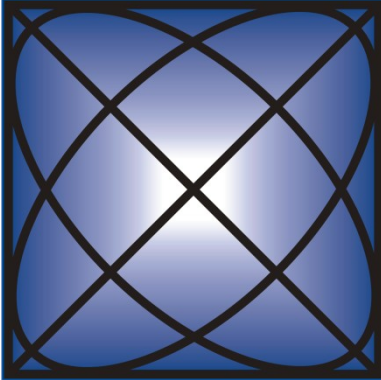
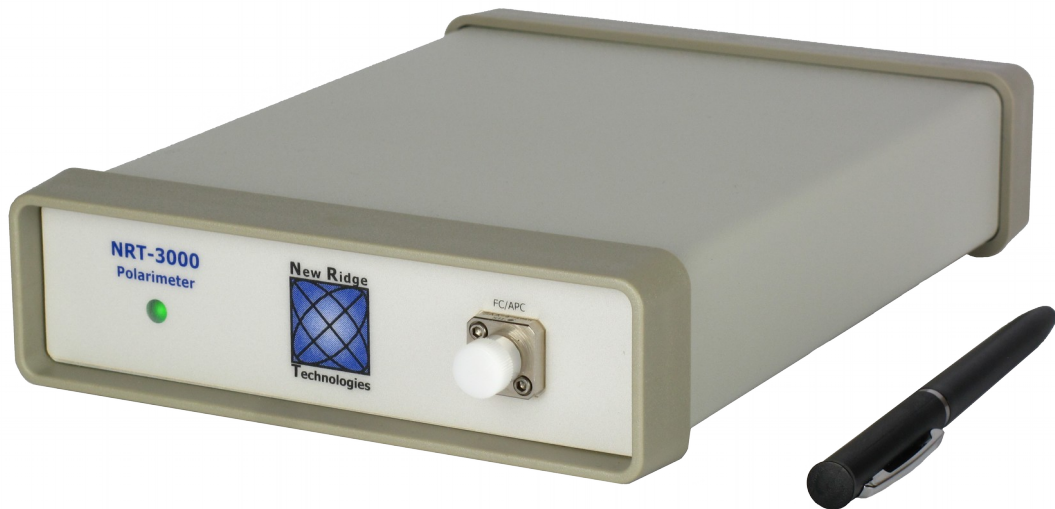


**New Ridge**



**Technologies**

# **NRT-3000 User Manual**



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## 1. Introduction

The NRT-3000 is a small, ultra-fast, portable polarimeter. Its state-of-the-art technology, combined with its easy-to-use software and interface tools, makes it the ideal polarimeter for measuring State of Polarization (SOP), and changes in SOP ( $dSOP/dt$ ).

## 2. Getting Familiar with the NRT-3000

The front panel of the NRT-3000 has a power/communication indicator and optical input, as shown in Figure 1.



*Figure 1: Front view of the NRT-3000. 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-3000 has (see Figure 2 from left to right):

1. Digital Link for NRT-2500 Polarization Control Platform.
2. USB 2.0/3.0 communication port.
3. On/Off switch.
4. 12 V DC power input.
5. 5 V USB charger output.



*Figure 2: Rear view of the NRT-3000*

### 3. Installing the NRT-3000 Software

The user can choose between two options of installing the NRT-3000:

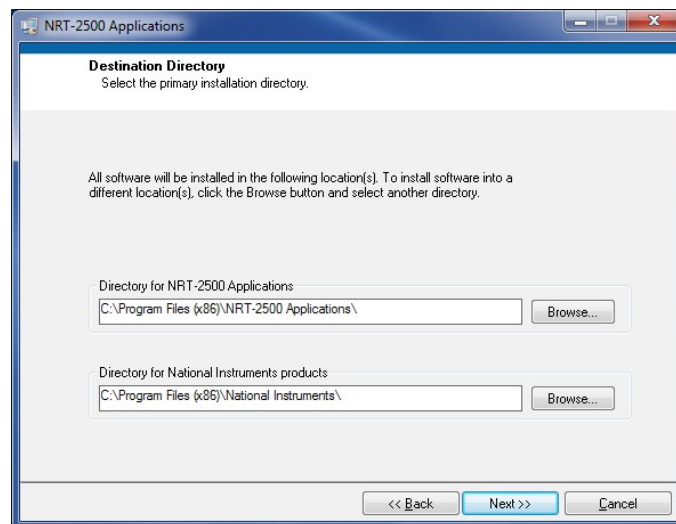
- Automatic setup will install all the required 3<sup>rd</sup> party software (LabVIEW and VISA Run Time Engines), copy the NRT-3000 software to a designated folder, and create a shortcut in the Start menu.
- Manual install, requires the user to install all the 3<sup>rd</sup> party software, create a folder for the NRT-3000 software and copy all the necessary files from the CD to that folder.

The two methods are described in sections 3.1 Automatic Setup and 3.2 Manual setup.

***The manual setup is not recommended for Windows versions 8.0 and above due to driver security requirements of these modern operating system.***

#### 3.1 Automatic Setup

In the automatic procedure, 3<sup>rd</sup> party software will be installed first. Three license-free components from National Instruments will be automatically installed: LabVIEW Run Time Engine, VISA Run Time Engine and NI-488.2 Run Time Engine. All components must be installed for the NRT-3000 to operate properly. Follow the procedure shown in Figures 3 through 5.



*Figure 3: Initial setup screen; Use the default folders or change the folders used for the installation as needed and click NEXT.*

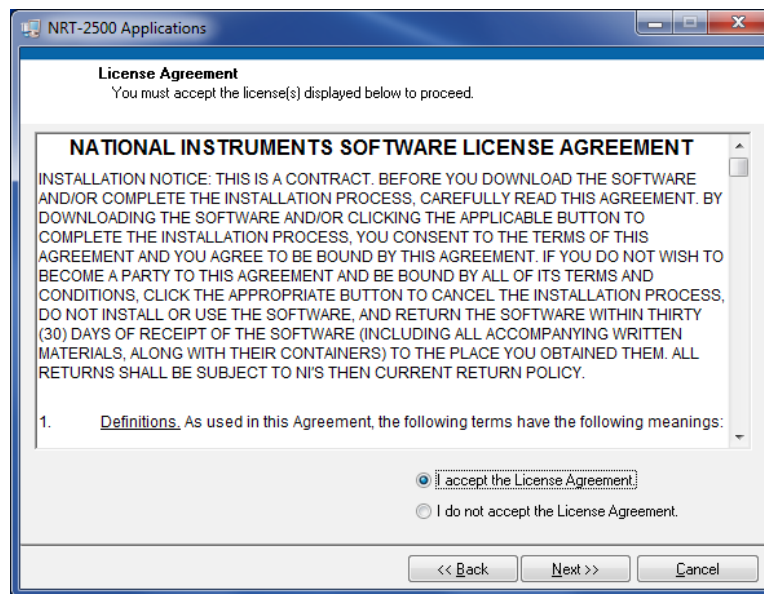


Figure 4: License agreement for National Instruments software. Select “I accept the license agreement” and click on the NEXT button.

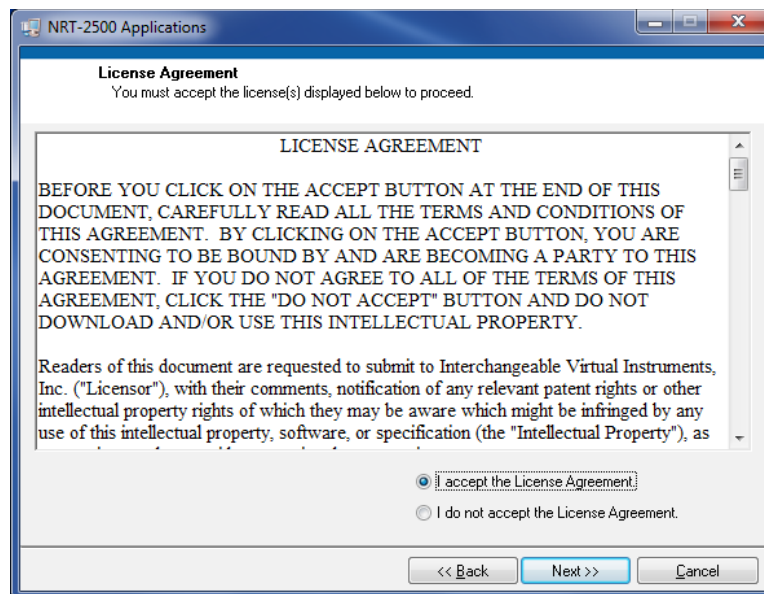


Figure 5: License agreement for the NRT-3000 GUI software. Select “I accept the license agreement” and click on the NEXT button.

Let the installation procedure complete, and follow the instructions on the screen. **We recommend to restart your computer before attempting to execute the GUI software.** This will ensure that all the software components were properly installed and configured.

## 3.2 Manual setup

If the user chooses to install the necessary components manually, refer to the procedure described in Figures 6 through 9.

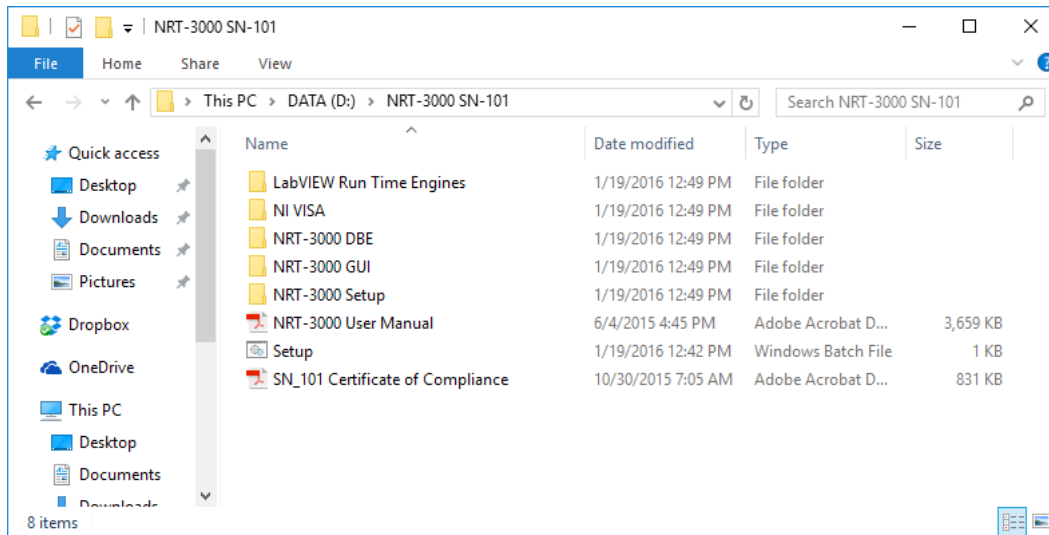


Figure 6: On the NRT-3000 CD received with the instrument, navigate to the root directory of the CD, and double click on the “LabVIEW Run Time Engines” folder to display its contents.

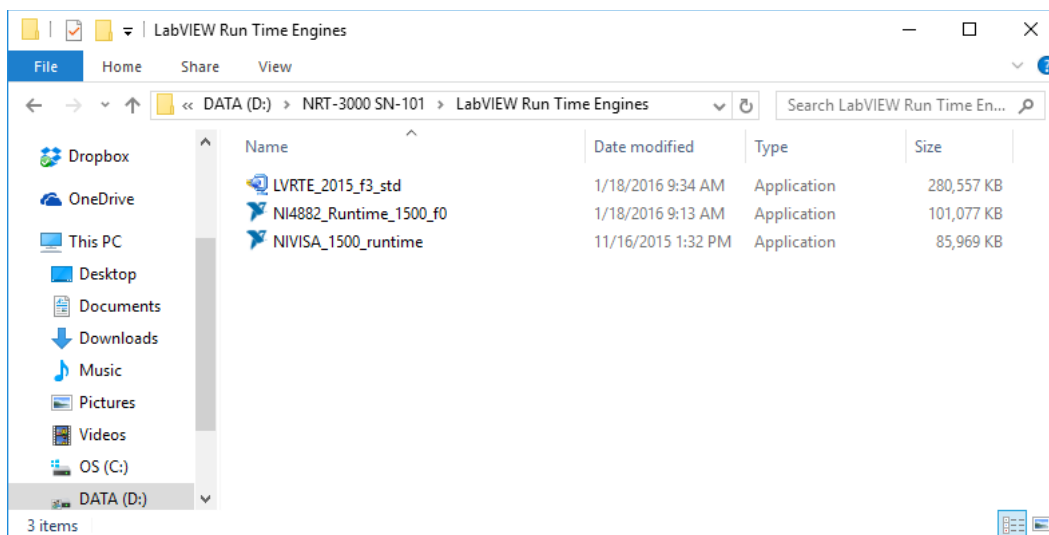
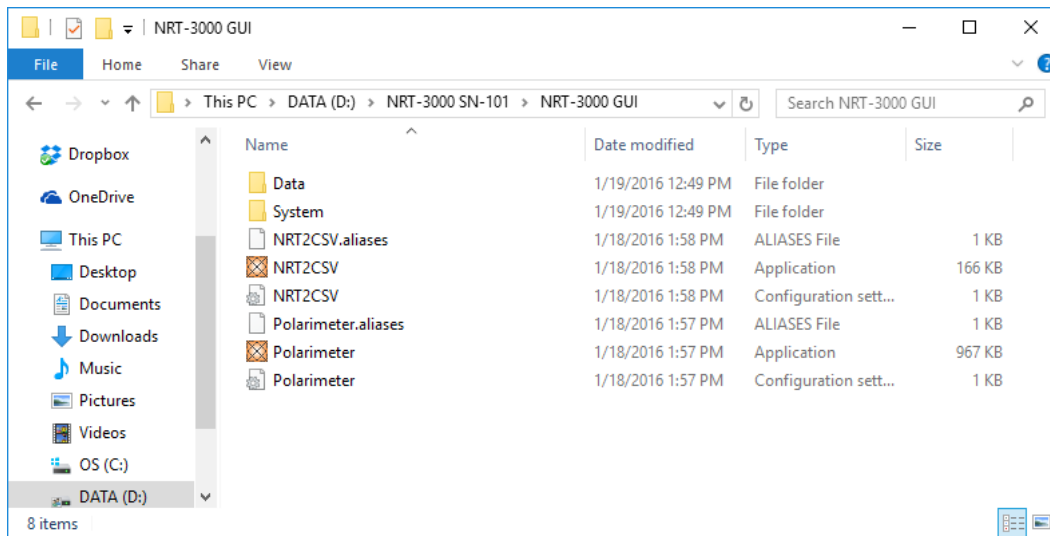
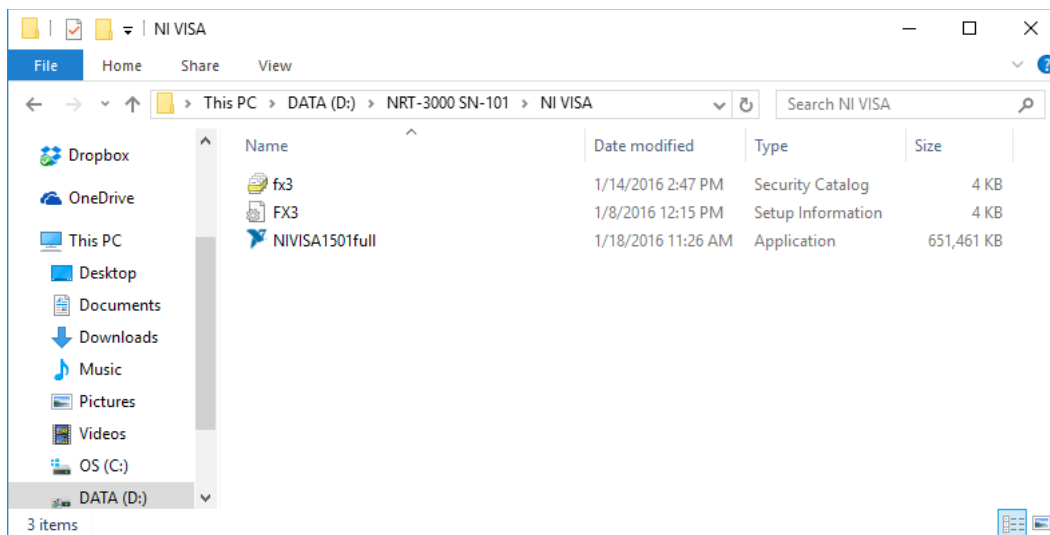


Figure 7: In the “LabVIEW Run Time Engines” Folder, double click on the file LVRTRE\_2015\_f3\_std to install the LabVIEW run Time Engine. Follow the instructions on the screen. When the application is installed, repeat the procedure for the NIVISA\_1500\_runtime and NI4882\_Runtime\_1500\_f0 files.



*Figure 8: Once all Run Time Engines are installed, navigate to the NRT-3000 GUI folder on the NRT-3000 CD. Copy the entire folder, keeping its exact structure, onto a location on the computer.*



*Figure 9: Navigate to the NI VISA folder and right click on the FX3.inf file (setup information file). Choose the install option. The NI Visa driver will be installed on the computer.*

**Restart the computer.** The NRT-3000 is now ready to test by double clicking on the NRT-3000 icon.

## 4. Connecting to the NRT-3000 from a PC

The PC communicates with the NRT-3000 via USB. Double-click on the NRT-3000 icon to start the GUI. The polarimeter software will automatically connect to an available NRT-3000 polarimeter via the USB to the computer. The default GUI window will show up (See Figure 10).

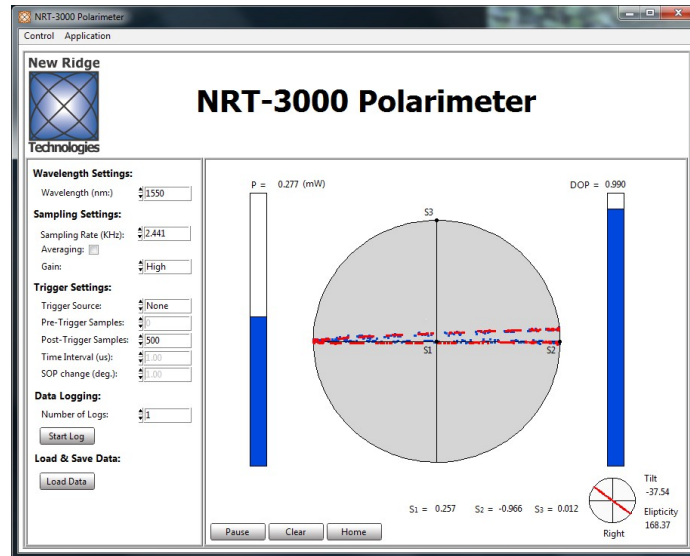


Figure 10: The default start-up screen of the NRT-3000 polarimeter GUI.



## 5. Taking, Recording, Exporting, and Loading Data

Once the NRT-3000 is connected, the Polarimeter app will start streaming live data, and showing it on the Poincaré Sphere, using the following default parameters: Sampling Rate: 2.5Ksa/sec, Trigger: None, Post Trigger Points: 500. See Figure 11.

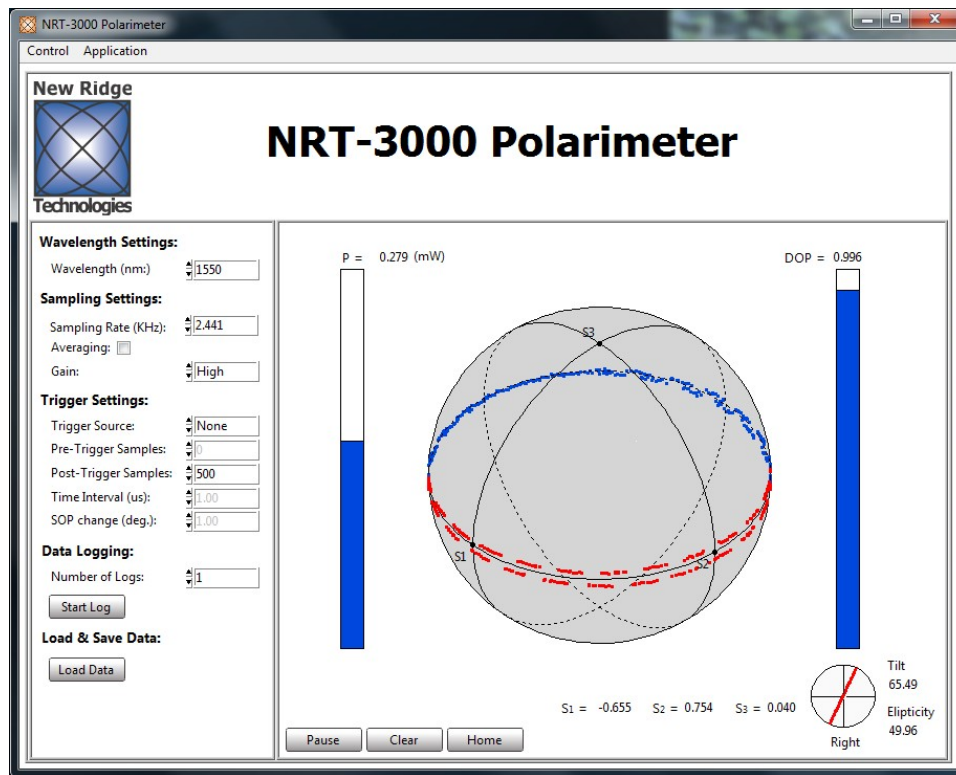


Figure 11: The main window: The left pane includes all the user controlled acquisition parameters such as the Wavelength, Sampling Rate, Gain, etc. The application menu at the top allows access to the modes of operation on the NRT-3000.

The acquisition parameters of the NRT-3000, and how the user should select the parameters for the desired measurements are covered in sections: 5.1 Wavelength Settings, 5.2 Sampling Settings, 5.3 Trigger types and settings, 5.4 Data Logging, and 5.5 Loading and Exporting Data.

### 5.1 Wavelength Settings

The polarimeter calibration is wavelength sensitive, therefore, the user should select a wavelength settings close to the laser line he is using to assure that the proper calibration parameters are loaded to the polarimeter. The default value is 1550 nm, however, any integer wavelength value in the range of 1520-1580 nm can be set. The user can change the value either by clicking on the up-and-down arrows next to the control or by physically entering the desired value in the text field (see Figure 12).

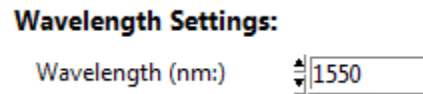


Figure 12: The user can highlight the number value in the text field and type a new value, or click on the arrows to the left, changing the wavelength value by +/- 1 nm.

## 5.2 Sampling Settings

The sampling settings include the Sampling Rate, Averaging and the Gain level. The accessible sampling rates of the NRT-3000 depends on the Trigger Mode of operation, however, the full range of Sampling Rate is 38 Sa/sec to 80 MSa/sec. When averaging is used, the maximum Sampling rate is  $\leq 40$  MSa/sec. At low input powers, when the gain setting is high, the quality of measurement might be reduced at high sampling rates. Measurement of low level signals requires more averaging and/or slower sampling rates.

### 5.2.1 Sampling Rate

The Sampling Rate can be adjusted from 80 MSa/sec down to 38.1 Hz in factors of 2. The maximum allowed sampling rate changes for different Trigger Modes. In live streaming (Trigger set to None) the maximum allowed Trigger Rate is 9.77 KSa/sec. The full sampling rate range is accessible in other Trigger Modes.

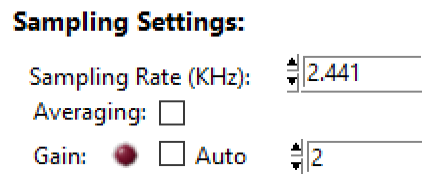


Figure 13: The user can enter a value in the text field or click on the arrows to the left to change the sampling rate. The sampling rate will be set to the closest allowed value.

## 5.2.2 Averaging

The NRT-3000's polarimeter DACs collect SOP data up to 80 MSa/sec . This maximum sampling rate is limited to 40 MSa/sec when averaged data. Low averaging levels are applied at high sampling rates (averaging of 2 at 80 MSa/sec to get 40 MSa/sec). The number of sample averages increases as the sampling rate is reduced. Click on the check box to enable/disable averaging.

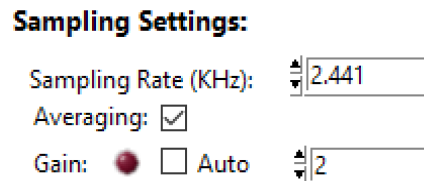


Figure 14: Click the check-box to enable averaging; click again to disable averaging.

## 5.2.3 Gain

The Gain defines the sensitivity of the polarimeter. There are two gain settings: *High* and *Low*. They correspond, respectively, to high and low analog gain stage amplifications of the polarimeter photodetectors. The desired option can be selected as shown in Figure 15. Low gain is used when high optical powers are measured with the polarimeter. The gain settings does nor affect the sampling rate.

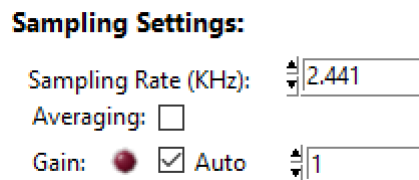


Figure 15: When the the GUI starts, the gain setting will default to “Auto”. The NRT-3000 will sense the input optical power and automatically select the appropriate gain level. Dis-select the “Auto” gain using the check box to allow manual setting of the gain. There are 4 gain settings, labeled 1 through 4, where 1 is the lowest gain and 4 is the highest gain. The 1xx Series of the NRT-3000 has only 2 gain stages (Low and High) and therefore have a more limited dynamic range. The RED gain indicator will lit if the gain selected in not suitable for the optical input power (over- and under-power).

## 5.3 Trigger Settings

The default Trigger Source of the NRT-3000 is “None”. In this trigger mode the NRT-3000 streams SOP data in real time at relatively low sampling rates, up to 9.77 KSa/sec. The NRT-3000 collects and displays SOP data in real time without buffering. The other Trigger sources available are “Internal”, “SOP”, and “External”. Each of the trigger modes of operation and its related parameters are described in the following sections.

### 5.3.1 Trigger Source “None”

By selecting Trigger Source “None” the NRT-3000 will stream of SOP data in real time, up to 9.77 KSa/sec. The user may choose the number of SOP states to present by changing the value of the Post-Trigger Samples. The SOP data is shown in a first-in first-out manner. The parameters Pre-Trigger Samples, Time Interval and SOP Change are inactive in this trigger mode.

**Trigger Settings:**

|                       |                                   |
|-----------------------|-----------------------------------|
| Trigger Source:       | <input type="text" value="None"/> |
| Pre-Trigger Samples:  | <input type="text" value="0"/>    |
| Post-Trigger Samples: | <input type="text" value="500"/>  |
| Time Interval (us):   | <input type="text" value="1.00"/> |
| SOP change (deg.):    | <input type="text" value="1.00"/> |

*Figure 16: Trigger Source set to "None". Live streaming of SOP states, the user may choose only the number of Post-Trigger Samples to present.*

### 5.3.2 Trigger Source “Internal”

When selecting Trigger Source “Internal”, the NRT-3000 starts buffering SOP data to fill the number of Post-Trigger Samples requested by the use. When the buffered data is ready, it is transmitted to the control PC and presented on the GUI. The NRT-3000 will automatically re-arm and send new data repeatedly. In this trigger mode the full scale of the Sampling Rate is Accessible. The parameters Pre-Trigger Samples, Time Interval and SOP Change are inactive in this trigger mode.

**Trigger Settings:**

|                       |             |
|-----------------------|-------------|
| Trigger Source:       | ▲▼ Internal |
| Pre-Trigger Samples:  | ▲▼ 0        |
| Post-Trigger Samples: | ▲▼ 1000     |
| Time Interval (us):   | ▲▼ 1.00     |
| SOP change (deg.):    | ▲▼ 1.00     |

Figure 17: Trigger Source set to "Internal". Buffered SOP data is continuously streamed to the GUI. The full scale of Sampling Rate is accessible.

### 5.3.3 Trigger Source “SOP”

When Selecting Trigger Source “SOP” the NRT-3000 is waiting for a SOP change equal or larger then the set value to start recording SOP data. The NRT-3000 is storing enough dSOP/dt data at all times to record a “SOP” trigger event with a leading edge showing the SOP states just before the event started. In this trigger mode all the trigger parameters are active (see Figure 18). When an event is measured, the data is transferred to the computer and the NRT-3000 immediately rearms to record the next trigger event.

#### 5.3.3.1 Pre-Trigger Samples

The *Pre-Trigger Samples* field determines how many samples prior to a trigger event are saved. Currently the total number of SOP samples that can be saved is 16,000. Up to 4000 samples can be set as *Pre-Trigger* samples.

The value of the *Pre-Trigger Samples* field, like other fields in the control panel, is adjusted by either entering a value in the number field or by clicking on the arrows to the left of the field.

#### 5.3.3.2 Post-Trigger Samples

The *Post-Trigger Samples* field determines how many samples following a trigger event are saved. Currently the total number of SOP samples that can be saved is 16,000. The maximum number of Post-Trigger Samples will be determined by 16,000 minus the value set for the *Pre-Trigger Samples*.

*The value of the Post-Trigger Samples field, like other fields in the control panel, is adjusted by either entering a value in the number field or by clicking on the arrows to the left of the field.*

**Trigger Settings:**

|                       |         |
|-----------------------|---------|
| Trigger Source:       | ▲▼ SOP  |
| Pre-Trigger Samples:  | ▲▼ 1000 |
| Post-Trigger Samples: | ▲▼ 3000 |
| Time Interval (us):   | ▲▼ 1.00 |
| SOP change (deg.):    | ▲▼ 1.00 |

Figure 18: Trigger Source set to "SOP". The NRT-3000 will wait for a SOP change equal or larger than determined by the Time Interval and SOP change. The number of SOP states sent to the computer is determined by the sum of the Pre- and Post-Trigger samples. In the example above the SOP Trigger level is 17,453 radian/sec, the data will consist of 4,000 SOP states from which 1,000 are before the SOP trigger occurred, and 3,000 SOP states after the trigger occurred.

### 5.3.3.3 Time Interval

The *Time Interval* ( $\mu\text{s}$ ) field sets the maximum amount of time in which the desired change in SOP is to occur for the change to be deemed a trigger event. The value is adjusted by either entering a value in the number field or clicking on the arrows to the left of the field. The range of possible values for the *Time Interval* is 0.01-20000.00  $\mu\text{s}$  (i.e. 10 nsec to 0.02 sec).

### 5.3.3.4 SOP Change

When *Trigger Source* is set to *SOP*, the *SOP Change* parameter defines the minimum  $\Delta\text{SOP}$  in degrees that is required to occur during the given *Time Interval* for the change to qualify as a trigger event. The possible values for this field are in the range 0.00-1000.00 deg. The value is adjusted by either entering a value in the number field or clicking on the arrows to the left of the field.

### 5.3.3.5 Determining the SOP Trigger Level

To determine the minimum SOP rate that will qualify as a SOP Trigger use the following formula:

$$\text{SOP Rate}(\text{rad/sec}) = \frac{\text{SOP Change}(\text{deg}) \times \pi}{180 \times \text{Time Interval}(\text{sec})}$$

The value calculated is the rate  $d\text{SOP}/dt$  of the optical power in rad/sec on the Poincaré Sphere.

### 5.3.4 Trigger Source “External”

By selecting Trigger Source “External” the NRT-3000 will wait for an external signal to start sampling data. This trigger mode is similar to the “SOP” trigger; the NRT-3000 will be storing enough dSOP/dt data at all times to record a triggered event with a leading edge showing the SOP states just before the trigger signal was received. All the trigger parameters are active (see Figure 18 for reference). When a trigger is sensed, the NRT-3000 collects the data and saves it to a file on the computer and immediately rearms and waits for another trigger signal. Refer to Chapter 9. Digital Interface (HDMI Connector) for a detailed description of how to connect the External Trigger In signal.

### 5.4 Live Sampling

By default, once the Polarimeter interface app connects to the NRT-3000, the user will see a Poincaré Sphere with live data from the NRT-3000 (Figure 19). This is the live sampling mode. None of the data is saved. In live sampling mode, samples are taken and displayed in any of the three available visualizations (see chapter 6. Data Visualization).

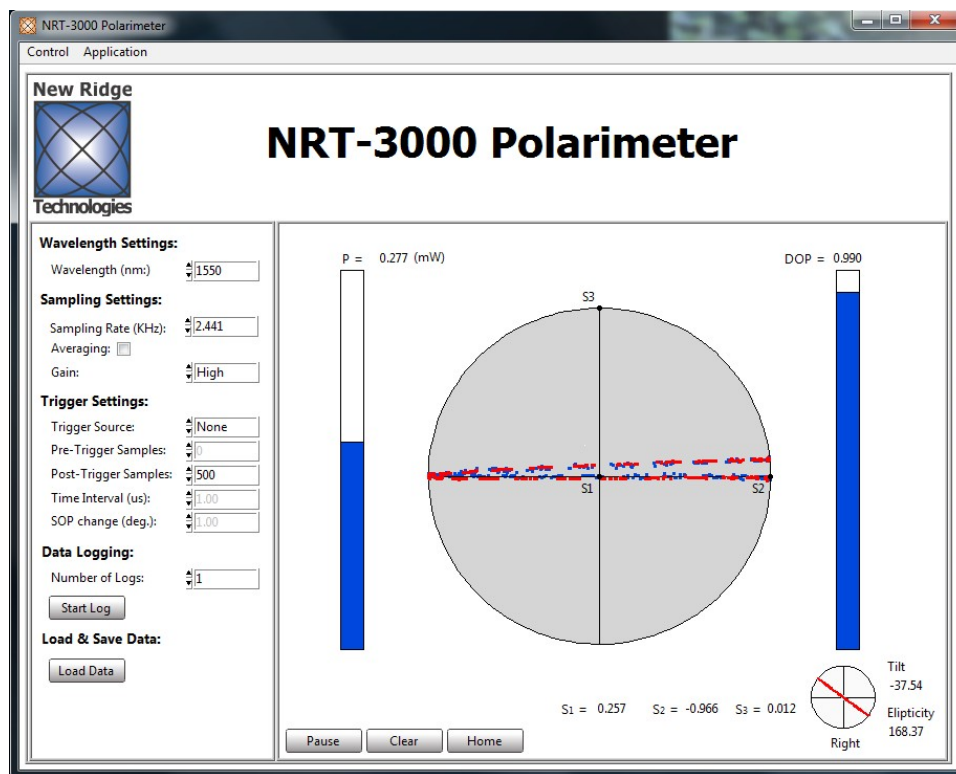


Figure 19: The initial screen for the NRT-3000 is the live sampling of SOP data on the Poincaré sphere.

Once the number of samples reaches the number of allowed *Post-Trigger Samples*, the oldest data points are dropped as newer data points are recorded. At any given point, no more than the *Post-Trigger Samples* number of data points can be displayed by the app.

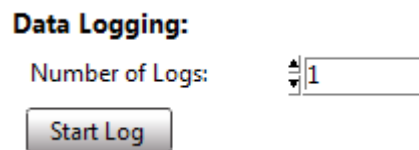
The user can click the *PAUSE/RESUME* button (*Figure 19*) in the bottom left of the visualization box to pause or resume data collection. When the user pauses, the data display will “freeze” with the current set of data, whereas resuming data collection resumes the process as before. Switching between different visualization modes does not affect data collection.

The *RESET* button, located to the immediate right of the *PLAY/PAUSE* button, clears all data currently displayed, and resumes live data streaming.

Live sampling is unaffected by the *Pre-Trigger Samples*, *Time Interval*, *SOP Change*, and *Number of Logs* settings (the latter will be discussed in Section 5.5 Data Logging).

## 5.5 Data Logging

In addition to displaying data on a screen, the Polarimeter app can also record batches of data and save them on the user's PC in a binary file with a “.nrt” extension. This is done through the *Data Logging* function, which is located on the control panel, below *Sampling Settings* (*Figure 20*).



*Figure 20: Data Logging; set the number of files to log, and press the Start Log button. The corresponding number of binary files will be saved to the computer. The user can later import these files and export them to a CSV file.*

The *Data Logging* section is composed of a field labeled *Number of Logs* and a button labeled *START LOG*.

The *Number of Logs* field controls how many data files will be logged once initiated by pressing the *START LOG* button. If *Trigger Source* is set to *None*, the app will record a *Post-Trigger Samples* number of samples repeated by the *Number of Logs* field value. Each data log will then be saved as a .nrt file and to the app's DATA directory. This directory can then be accessed through the *LOAD DATA* button as described in 5.6 Loading and Saving Data. When the trigger source is set to SOP, the data will continue to log until data collection has been triggered by the *Number of Logs* events. In this case, each data log will contain a the requested *Pre-Trigger Samples* and *Post-Trigger Samples*. All the data logs can be accessed through the *LOAD DATA* button.



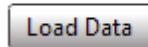
## 5.6 Loading and Saving Data

All the saved data files are saved to a Data directory at the location of the polarimeter application on the computer. The data can be loaded and viewed in the Polarimeter application by pressing the *Load Data* button. Once a file is selected and loaded, the data can be exported to a CSV file for further analysis.

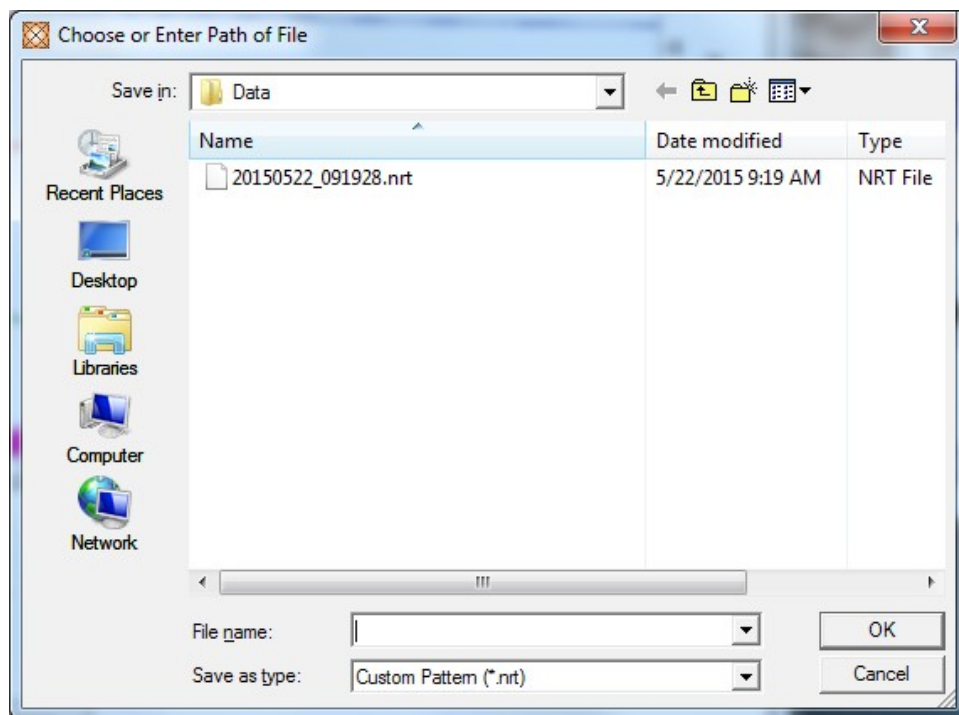
### 5.6.1 Loading Data

Press the “Load Data” button and select a file from the list (see Figure 21-22). The data will show on the Polarimeter application.

#### Load & Save Data:



*Figure 21: Press the Load Data button to show a list of the logged data files currently saved on the computer (see Figure 22).*



*Figure 22: Select a file from the list and press OK or double click on the file to load the data to the polarimeter application.*

## 5.6.2 Exporting Data

Once the user has loaded the data file into the Polarimeter app, a new button appears, that allows the user to export the data to a .csv file (see Figure 23). Click the *EXPORT DATA* button underneath the *LOAD DATA* button. A directory window will appear. The user can now navigate to the desired directory, enter a file name into the field labeled “File name:” (Figure 24). Remember to include the desired file type extension (.txt, .dat, .csv, etc.) *in the file name*. Click *OK* to save the file.

### Load & Save Data:



Figure 23: Click the *EXPORT DATA* button in the Load & Save Data section to start the export process.

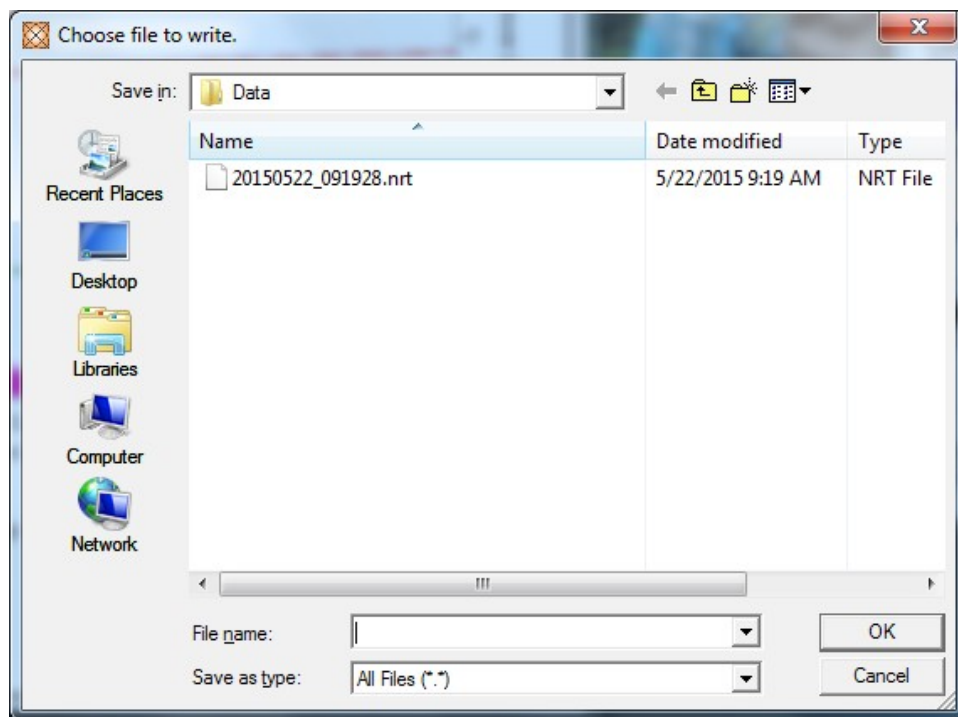


Figure 24: Navigate to the desired directory and enter a file name followed by the desired file type extension. Click *OK* to save.

## 5.6.3 Batch Data Conversion

In case the user has to translate multiple .nrt files to .csv files an automatic *Batch Data Conversion (BDC)* application can be used to translate all the .nrt files in the *Data* folder to .csv files. This procedure can be performed internally by the Polarimeter app or externally using the stand alone application installed with the GUI.

### 5.6.3.1 Internal BDC

From the Polarimeter app, go to the *Data* menu and select *NRT to CSV* (see Figure 25). All the .nrt files in the *Data* folder will now have .csv replicas, maintaining the same time-stamp name.

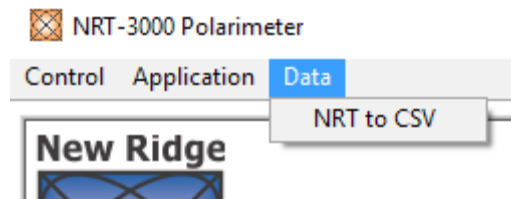


Figure 25: Translating all the .nrt files in the *Data* folder to comma separated files (.csv) from inside the Polarimeter app.

### 5.6.3.2 External BDC

Navigate to the NRT-3000 GUI folder on the local machine (see Figure 8) and double click on the *NRT2CSV* application. The window shown in Figure 26 will show up. When the progress bar will reach 100% the app will close automatically. All the .nrt files in the *Data* folder will now have .csv replicas, maintaining the same time-stamp name.

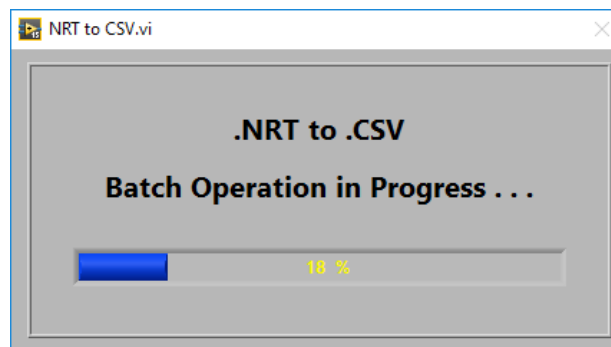


Figure 26: Translating all the .nrt files in the *Data* folder to comma separated files (.csv) using the stand-alone application.

## 6. Data Visualization

There are three modes to visualize data in the Polarimeter app: *Poincaré Sphere* (6.1 Poincaré Sphere), *Strip Chart* (6.2 Strip Chart), and *Analysis* (6.3 Analysis).

To Choose the visualization mode, click on the *Application* menu, found at the top of the main Polarimeter app window (Figure 27).

Data visualization works the same way for live sampling (5.4 Live Sampling) and pre-loaded data (5.6.1 Loading Data). The difference being that during live sampling, the visualization reflects the constant inflow of new data, whereas the re-load data set will be fixed.

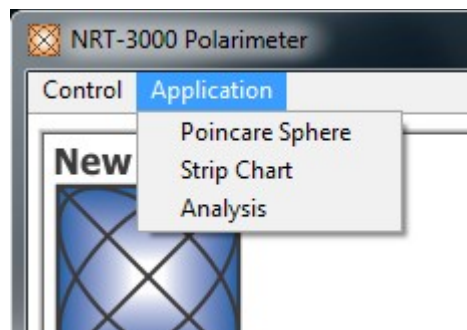


Figure 27: Click the *Application* button at the top of the window to make the drop-down menu appear. The user can navigate between the different visualization modes.

### 6.1 Poincaré Sphere

The default visualization mode in the Polarimeter app is the *Poincaré Sphere* (Figure 28). The three Stokes parameters' axes are labeled on the sphere. The sphere itself has the following two functions:

*Drag* – Click anywhere on the sphere, now click again and keep the button pressed while moving the mouse to activate the drag. The Poincaré sphere will rotate to any desired orientation. To stop rotating, release the mouse button. Press the Home button to rotate the sphere back to its default orientation.

*Zoom* – Use the mouse wheel to zoom in and out on the sphere.

*Home* – Click on the home button to zoom-out and reset all rotations done using the *Drag* function.

To the right of the sphere is a bar labeled DOP, showing the Degree Of Polarization visually, as well as numerically above the bar. 0.00 corresponds to 0% DOP and 1.00 corresponds to 100% DOP.

Just below the sphere, are the numerical values of the three Stokes parameters, shown to three decimal places.

The bottom right shows the *Ellipticity* and *Tilt* of the polarization visually, on a model ellipse, while providing numerical values for both. Below the small ellipse, it will say “Right” or “Left,” indicating the rotation direction of the elliptical polarization.

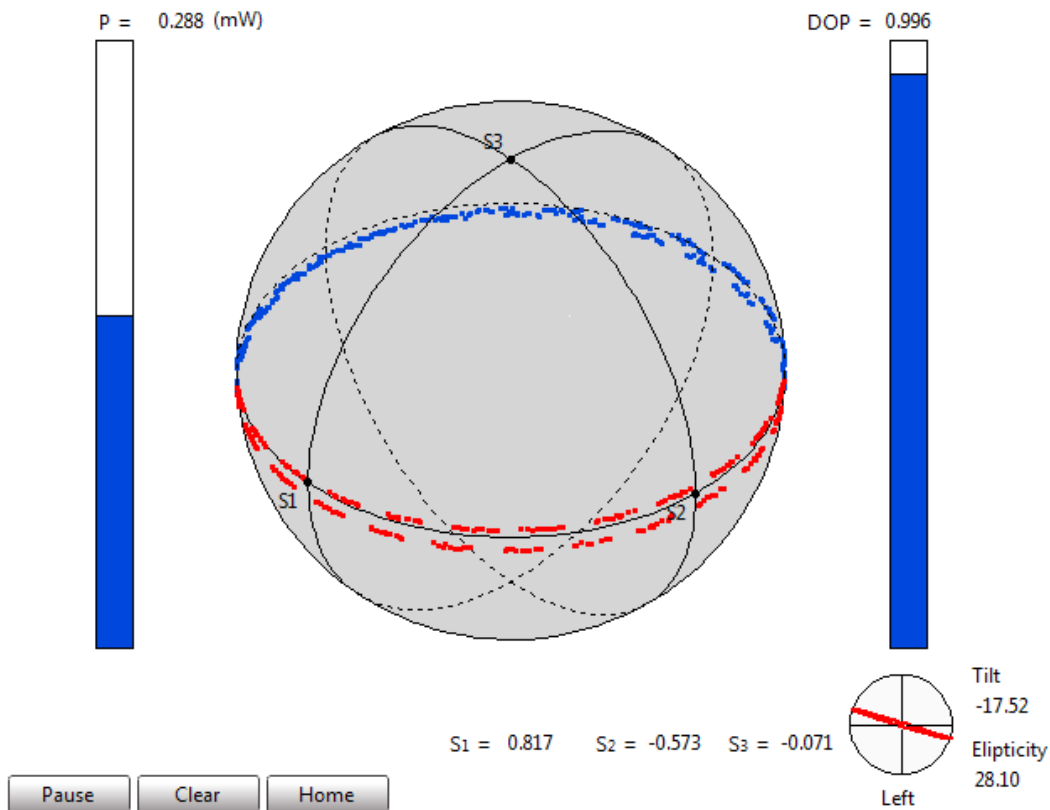


Figure 28: The Poincaré sphere.

To the left of the sphere is a bar labeled  $P$  for optical Power measured by the polarimeter. Above the bar, next to “ $P =$ ”, is the numeric value of the power in mW. Clicking on the units enables toggling between mW and dBm units (See Figure 29).

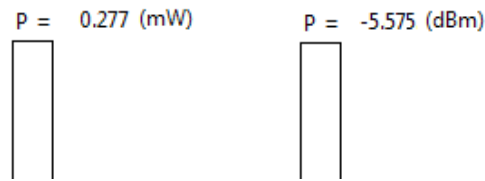


Figure 29: The power level shown in mW. Switch between mW and dBm by clicking on the unit name.

## 6.2 Strip Chart

The second mode is the *Strip Chart* (Figure 30), which plots the Stokes parameters, DOP, Power (in mW) and SOP rate, as a function of time. The left Y-axis is for the Stokes parameters and DOP, while the right Y-axis is for the power and dSOP/dt. The power and SOP rates are scaled to fit the range of 1-10, and the multiplier is shown under the legends (see the bottom of Figure 31).

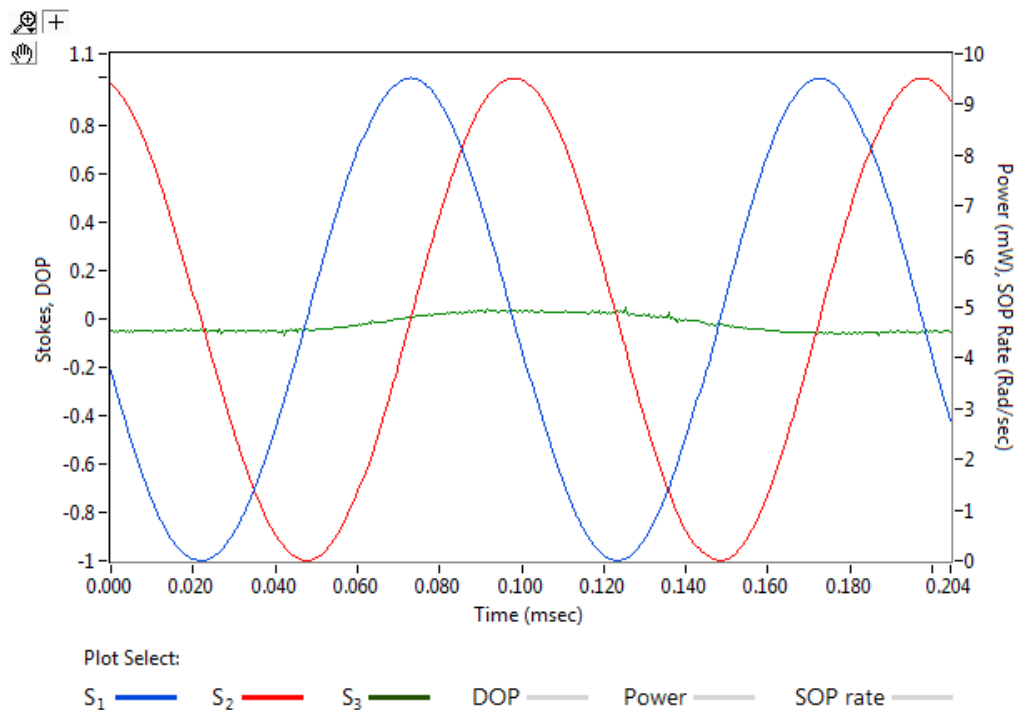


Figure 30: The Strip Chart: by default only the stokes parameters are shown. Click on the gray line/colored line next to a legend to activate/deactivate a plot.

By default, only the Stokes parameters are shown on the strip chart. To activate or deactivate a plot, click on the gray line/colored line next to a legend. Once activating the Power and SOP rate plots, the line will be plotted and the value multiplier will show next to the legend (see Figure 31).

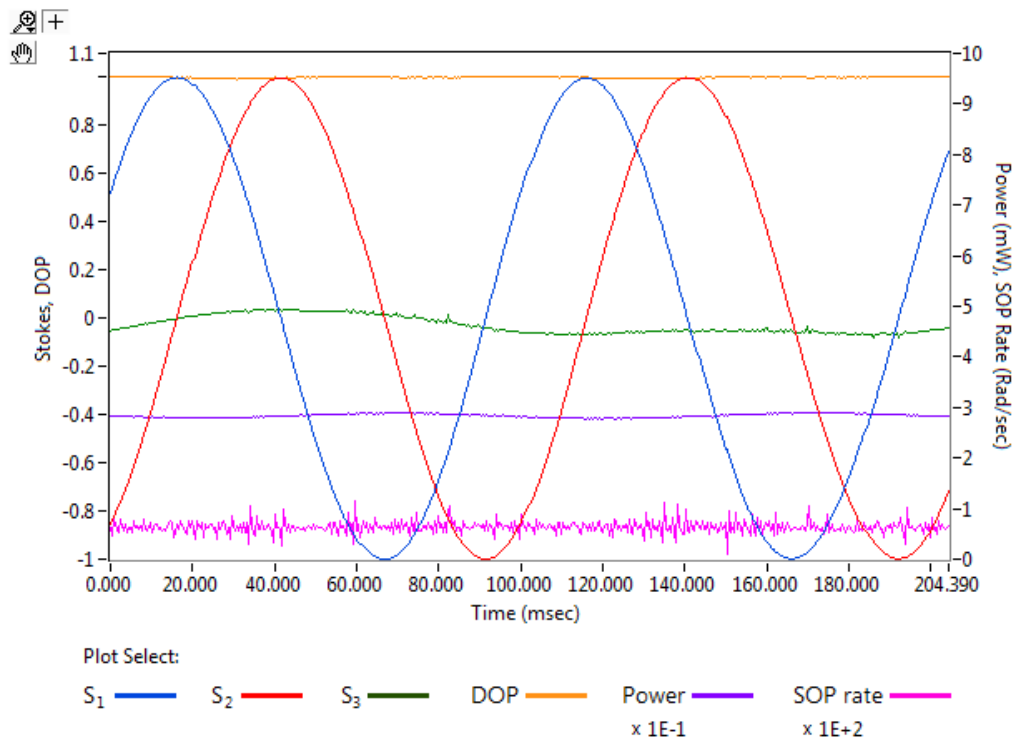


Figure 31: The Strip Chart with all parameters activated. Note the multipliers next to the Power and SOP rate legends.

The user may change the scales by highlighting the extreme limits (double click on the value) and entering the desired value, or by using the *Graph Palette* (see Figure 32).

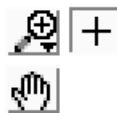


Figure 32: The Graph Palette.

The *Graph Palette* has several functions, each of which we will now explained:



*Zoom Palette* – clicking this button will bring up the following six zoom functions:



*Zoom box* – this allows the user to select a rectangular portion of the graph, which will then be scaled both vertically and horizontally to cover the entire graph window.



*Horizontal zoom* – this enables the user to grab either the left or right edge of the graph window and drag it inward by holding down the left mouse button. When the button is released, the portion of the graph *covered* during the dragging is horizontally stretched to cover the entire graph.



*Vertical zoom* – this does the same as *horizontal zoom*, but in the vertical dimension. Grab the top or bottom edge of the graph window and drag inward to cover the desired vertical magnified area.



*Full view* – pressing this button undoes any zooming, either in or out, and makes it so that the entire graph fits exactly inside the graph window.



*Zoom in* – after selecting this option, click anywhere on the graph to zoom in towards the clicked point.



*Zoom in* – after selecting this option, click anywhere on the graph to zoom in towards the clicked point.



*Cursor* – selecting the cursor button enables the cursor functionality (currently not used).



*Drag* – after selecting the drag button, click and hold the left mouse button anywhere inside the graph. Moving the mouse will drag the graph inside the graph window.



The following figures demonstrates the NRT-3000 SOP trigger data collection capability together with the visualization tools of the NRT-3000 app.

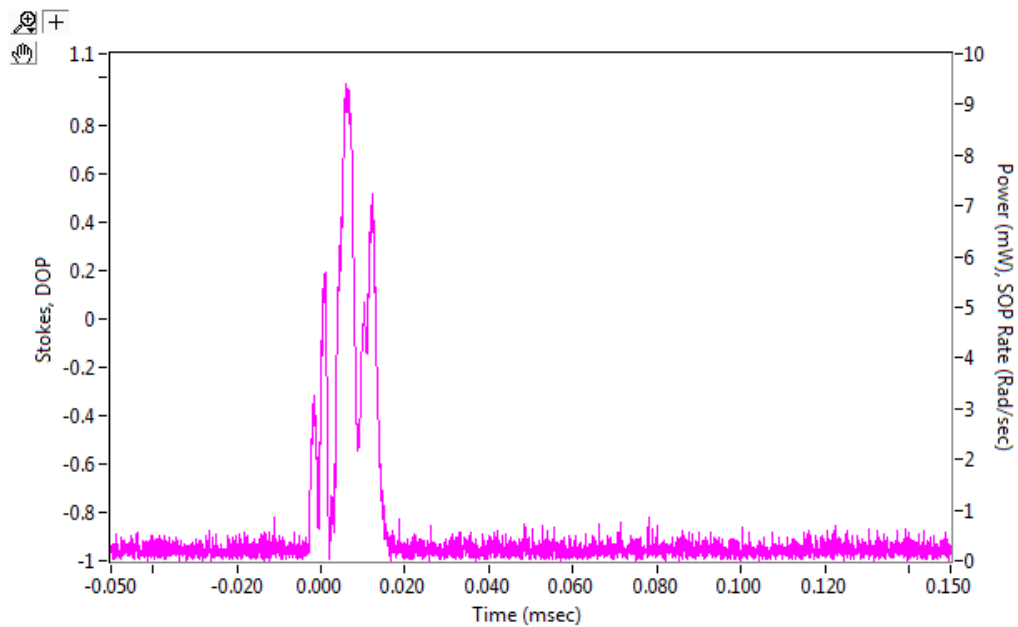


Figure 33: SOP trigger in strip chart mode, showing the  $dSOP/dt$  trace only.

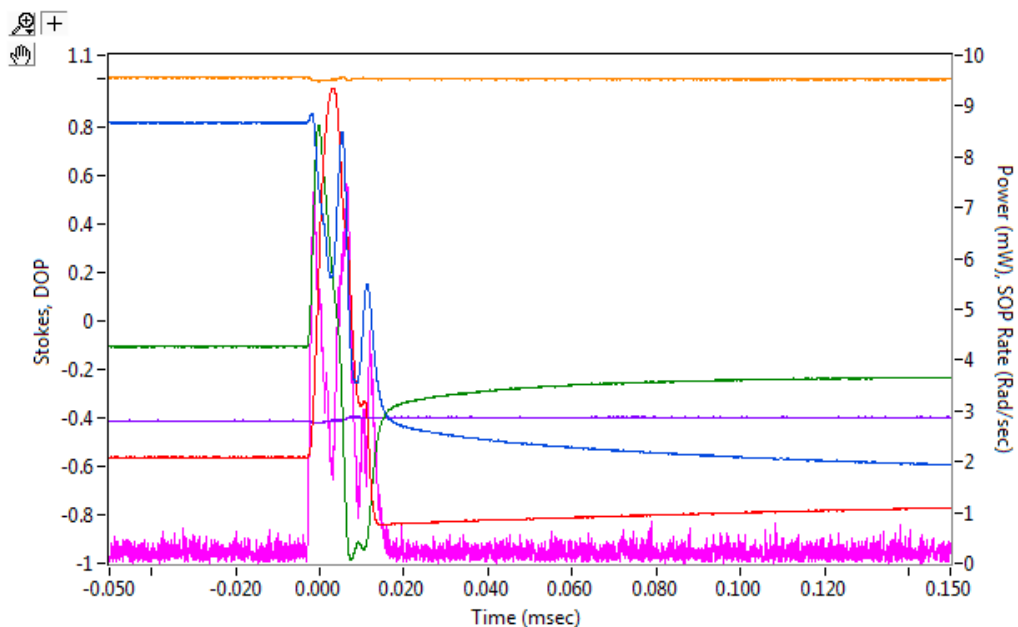
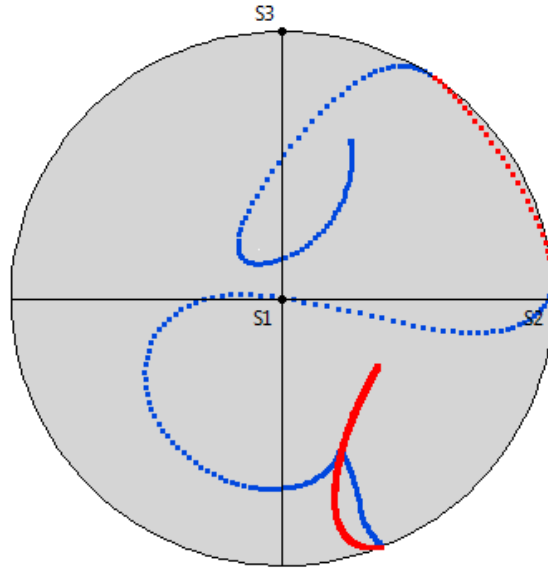


Figure 34: The same SOP trigger data shown in Figure 33, displaying all of the Stokes parameters, DOP and power.



*Figure 35: The same SOP trigger data shown in Figures 33 and 34 displayed on the Poincaré sphere.*

## 6.3 Analysis

The third and last visualization mode is *Analysis*. It consists of two histogram graphs: the *Speed Distribution* histogram graph and the *Stokes* histogram graph, where each of the Stokes parameter is displayed in a different color (Figure 36).

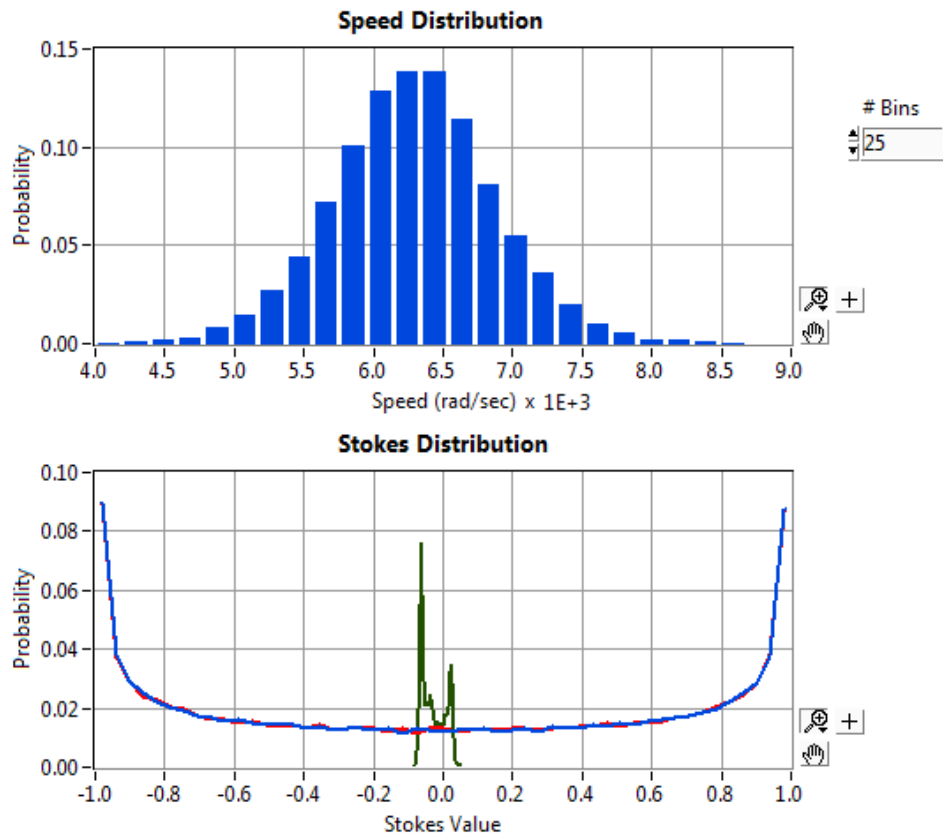


Figure 36: Analysis Mode; the top graph shows the Speed Distribution histogram. The number of bins can be changed by setting a new value in the # Bins control to the right of the graph. The lower graph shows the Stokes vector distributions (S1 in red, S2 in blue and S3 in green).

Note the *Zoom palette*, *Drag*, and *Cross* buttons to the lower right of each graph. These functions operate on their respective graphs in the exact same way as was laid out under *Graph navigation* functions in 6.2 Strip Chart.

Additionally, the axes of the graphs are scalable by highlighting and changing the extreme limits (double click on the value) to the desired value.

For the *Speed distribution* the user can change the number of bins calculated in the distribution by

highlighting the value in the *# Bins* field and entering the desired value, or adjusting the value using the arrows next to the field. One arrow click changes the *# Bins* value by +/- 1.

## 7. Setting a Reference SOP

The 2-point Reference SOP method explained below is used to set the *Reference SOP* and rotate the Poincaré sphere to the user's frame of reference:

- i. Set the SOP state in the user's frame of reference to  $S_1=1$
- ii. On the GUI, press the *Set  $S_1$*  button (See Figure 37). The measured SOP state will move to the  $S_1=1$  state. The *Set  $S_1$*  button will now read *Set  $S_2$*  and the selection box on the left of the button will be activated (See Figure 38).

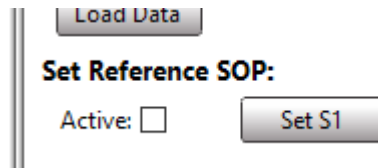


Figure 37: Press the *Set  $S_1$*  button to rotate the measured state to the  $S_1=1$  state.

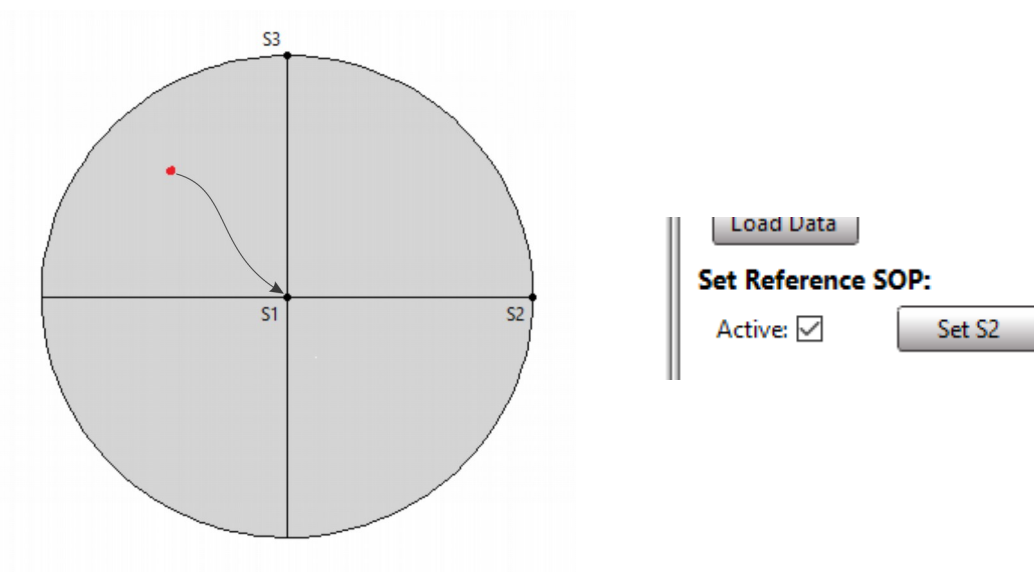
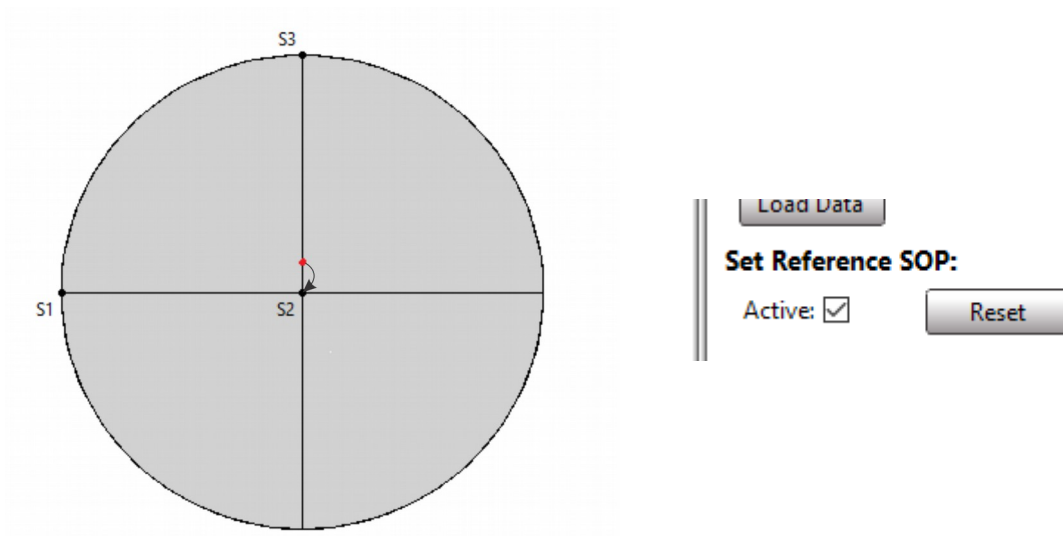


Figure 38: Pressing the *Set  $S_1$*  button will set the measured SOP to the  $S_1=1$  state. The *Set  $S_1$*  button changes to *Set  $S_2$*  and a check appears in the *Active* box.

- iii. Set the SOP state in the user's frame of reference to  $S_2=1$  (See Figure 38).
- iv. On the GUI, press the *Set  $S_2$*  button. The dot representing the SOP state will move to the  $S_2=1$  state (See Figure 39). The *Set  $S_2$*  button will now read *Reset*.



*Figure 39: Pressing the Set  $S_2$  button will set the measured SOP to the  $S_2=1$  state. The Set  $S_2$  button changes to Reset and the Reference SOP is now set.*

The *Reference SOP* is now set. To toggle between the NRT-3000 internal SOP and the *Reference SOP* just check or uncheck the *Active* state. To delete the *Reference SOP*, press the *Reset* button. The *Set  $S_1$*  button will show again, and the *Active* check box will be unchecked. Follow the procedure above to set a new *Reference SOP*.

## 8. Control Menu

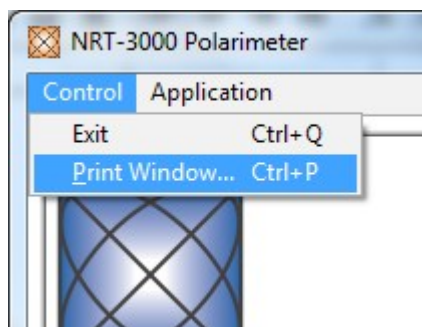


Figure 40: The Control menu.

The *Control* menu is located at the top of the window, next to *Application*. Clicking on it brings up a drop-down menu with two options: *Exit* and *Print Window* (Figure 40). Clicking *Exit* quits the application. Clicking *Print Window* opens the system print dialog to print the window.

## 9. Digital Interface (HDMI Connector)

The digital interface of the NRT-3000 uses a HDMI connector to bring in / take out signals. The pin-out diagram is shown in Figure 41. The signal pin assignment is shown in Table 1.

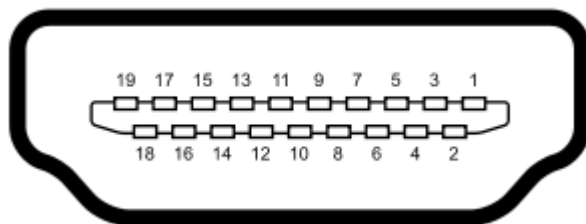


Figure 41: The HDMI pinout diagram numbers

| Signal      | Pin #       | Description                                              |
|-------------|-------------|----------------------------------------------------------|
| Trigger Out | 15          | 1 $\mu$ s 3.3V LVCMOS pulse out                          |
| Trigger In  | 19          | 3.3V LVCMOS pulse in (positive edge 100ns minimum width) |
| Clock Out   | 13          | 1Hz 1ms 3.3V LVCMOS pulse out                            |
| Ground      | 2,5,8,11,17 | Common ground                                            |

*Table 1: The digital interface pin assignment.*

The Clock Out can be looped back as a Trigger-In signal in order to test the NRT-3000 triggering functionality.

#### Technical Support:

For technical assistance please contact us at [support@newridgetech.com](mailto:support@newridgetech.com) or call us at +1 (410) 753-3055