

PoISNAP™ Stokes Polarimeter

USER MANUAL



Hinds Instruments, Inc.
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Software 025-0000-076 Version 1.0

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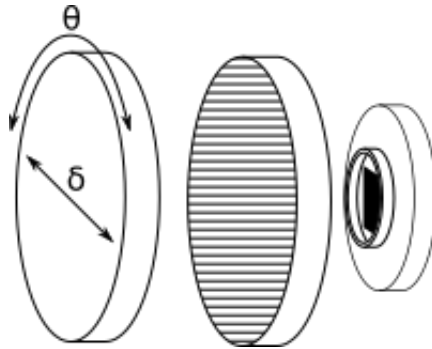
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1

Theory of Operation

A rotating waveplate Stokes polarimeter measures the polarization state of light using a rotating waveplate and stationary linear polarizer. A light beam with an unknown polarization state enters the polarimeter (from the left side toward the detector on the right as illustrated in the diagram below):



The two most important operating parameters for a Stokes polarimeter are the retardance and alignment of the rotating waveplate. As the waveplate rotates, the intensity at the detector is continuously sampled. The measured waveplate angle and measured intensity at the detector are then used to calculate the polarization state of the incoming light beam.

Incoming linear polarization generates a harmonic amplitude at the detector with a frequency of four times the angular velocity of the waveplate: the 4F harmonic amplitude. Circularly polarized light results in a 2F harmonic amplitude. The magnitude of the 2F and 4F signals are scaled by the retardance of the waveplate to measure the four unknown Stokes vectors as shown in the following equations:

$$I = DC - F_{4cos} \frac{1 + \cos\delta}{1 - \cos\delta}$$

$$Q = 2F_{4cos} \frac{1}{1 - \cos\delta}$$

$$U = 2F_{4sin} \frac{1}{1 - \cos\delta}$$

$$V = -|F_2| \frac{1}{\sin\delta}$$

Where $F_{4\cos}$ is the cosine magnitude of 4F harmonic, $F_{4\sin}$ is the sine magnitude of the 4F harmonic, and $|F_2|$ is the signed power of the 2F harmonic. δ is the retardance of the waveplate, and θ , the waveplate alignment which rotates the magnitude between $F_{4\cos}$ and $F_{4\sin}$. From this point, secondary parameters can be calculated. Common derived parameters are the degree of polarization (DOP), degree of linear polarizer (DOLP), degree of circular polarizer (DOCP), orientation (η), ellipticity (e), and eccentricity (ε).

$$DOP = \frac{\sqrt{Q^2 + U^2 + V^2}}{I}$$

$$DOLP = \frac{\sqrt{Q^2 + U^2}}{I}$$

$$DOCP = \frac{V}{I}$$

$$\eta = \frac{1}{2} \arctan\left(\frac{U}{Q}\right)$$

$$e = \frac{V}{I + \sqrt{Q^2 + U^2}}$$

$$\varepsilon = \sqrt{1 - e^2}$$

2

Installation

Software Installation

Windows 10 – Run the included installation software PoISNAP Setup.msi.

Windows 7 and prior – In addition to the required PoISNAP Setup.msi, the user should install the serial drivers included as Serial Install.exe.

Cable Connections

Once the above installations are complete, attach the USB cable between PoISNAP and the computer. Then attach the power cable to PoISNAP. When the power cable is attached, the motor should turn on for a short moment, and then shut off.

System Initialization

When initially running the software, the configured COM port may be incorrect. If this is the case, the user should select Tools→Settings. Once in the settings screen, the user can click on the COM port drop-down box and select the correct COM port. Then click on Connect. If the COM port selected is correct, the settings will automatically be populated with the calibration and settings information stored on the PoISNAP device.

Note: All systems sold by Hinds Instruments are currently installed and supported only through Hinds Instruments, Inc. and authorized distributors.

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Software Interface

Main Interface

The main user interface for POLSNAP is divided into four sections: the user controls, the plotted Stokes vectors, the Poincare sphere, and the polarization ellipse.

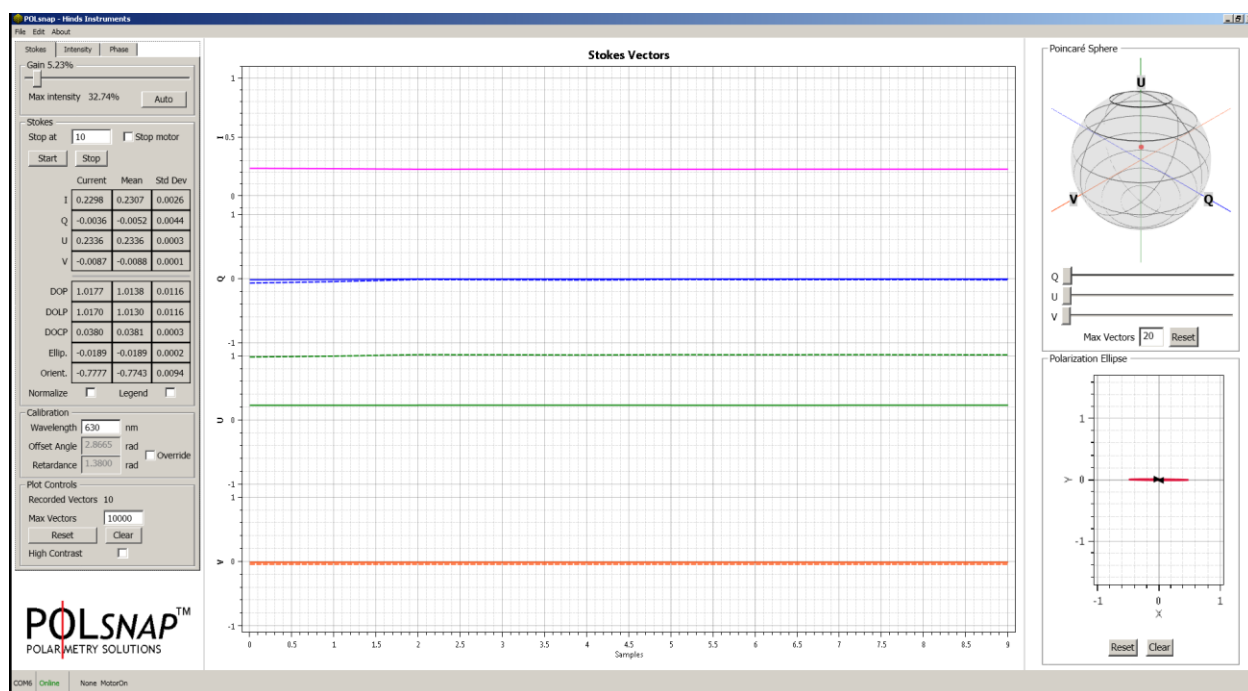


Figure 1: Main Software Interface

User Controls

Gain 5.23%
Max intensity 32.74%

Stokes

Stop at Stop motor

	Current	Mean	Std Dev
I	0.2298	0.2307	0.0026
Q	-0.0036	-0.0052	0.0044
U	0.2336	0.2336	0.0003
V	-0.0087	-0.0088	0.0001

DOP	1.0177	1.0138	0.0116
DOLP	1.0170	1.0130	0.0116
DOCP	0.0380	0.0381	0.0003
Ellip.	-0.0189	-0.0189	0.0002
Orient.	-0.7777	-0.7743	0.0094

Normalize Legend

Calibration

Wavelength nm

Offset Angle rad Override

Retardance rad

Plot Controls

Recorded Vectors 10

Max Vectors

High Contrast

Figure 2: User Controls on Main Interface

The user controls are divided into four sections: gain control, Stokes measurements, calibration controls, and plot controls.

Gain Controls

PoLSNAP contains a high gain amplification circuit capable of amplifying the current from the internal photodiode for measurement by the analog-to-digital converter. The gain can be set from 0% to 100%. As a general guideline, mW amplitude optical signals will require less than 10% gain, while low power signals below the microwatt range will require gains above 90%. The user can either manually move the slider, or run the auto-gain routine by clicking the 'Auto' button. The unit will start the motor and attempt to set the gain automatically. The results will be reported back to the user via a message box.

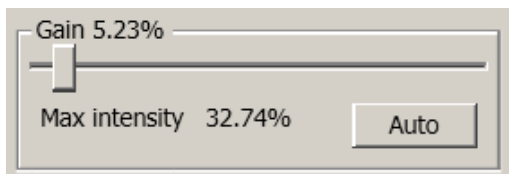


Figure 3: Gain Controls

The maximum recorded intensity will also be reported. If the maximum recorded intensity is above suggested levels, the background will change from gray to yellow to red to indicate that the current gain setting may be too high. The maximum intensity on the detector should be at 50% and not to exceed 75% where non-linearity on the detector is most likely to affect measurements.

Stokes Measurements

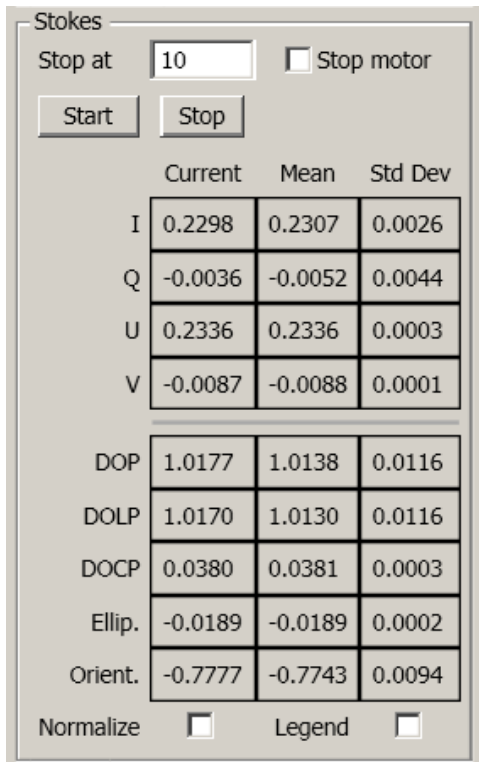
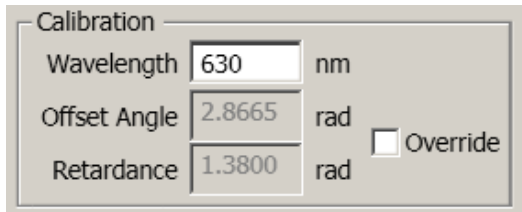


Figure 4: Stokes Measurements Display

The Stokes measurement section displays the current measurement results, and allows the user to measure multiple samples at a time. The 'Stop at' in the text box allows the user to enter the maximum number of measurements to take every time the 'Start' button is selected. If this is set to zero, the device will sample continuously until the user selects the 'Stop' button. If the user desires, the motor can be set to automatically stop after each series of measurements.

Below the 'Start' and 'Stop' controls, are the current measurements, mean of all displayed measurements, and their standard deviations. These statistics are compiled from all currently displayed Stokes parameters.

Calibration Settings



Calibration		
Wavelength	630	nm
Offset Angle	2.8665	rad
Retardance	1.3800	rad
		<input type="checkbox"/> Override

Figure 5: Calibration Settings on Main Interface

The current wavelength of measurement and calibration parameters pulled from the POLSNAP's internal memory are displayed here. If the user wishes to measure a different wavelength, simply enter the new wavelength into the box. The waveplate's offset angle and retardance will be pulled from the unit's internal memory. If the user wishes, they can override these parameters by checking the 'Override' box and then enter their own retardance and waveplate offset angles.

If the reported degree of polarization rises over unity, then the user may wish to override the current calibration parameters and raise the waveplate's set retardation value.

Plot Controls

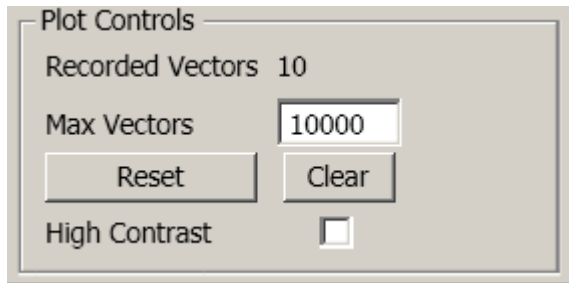


Figure 6: Plot Controls

The Stokes vector plot can be cleared, and axis alignment reset with their respective buttons. The 'Clear' button removes all the currently plotted data, and the 'Reset' button allows the user to re-center the view of the data plot.

Stokes Vector Plot

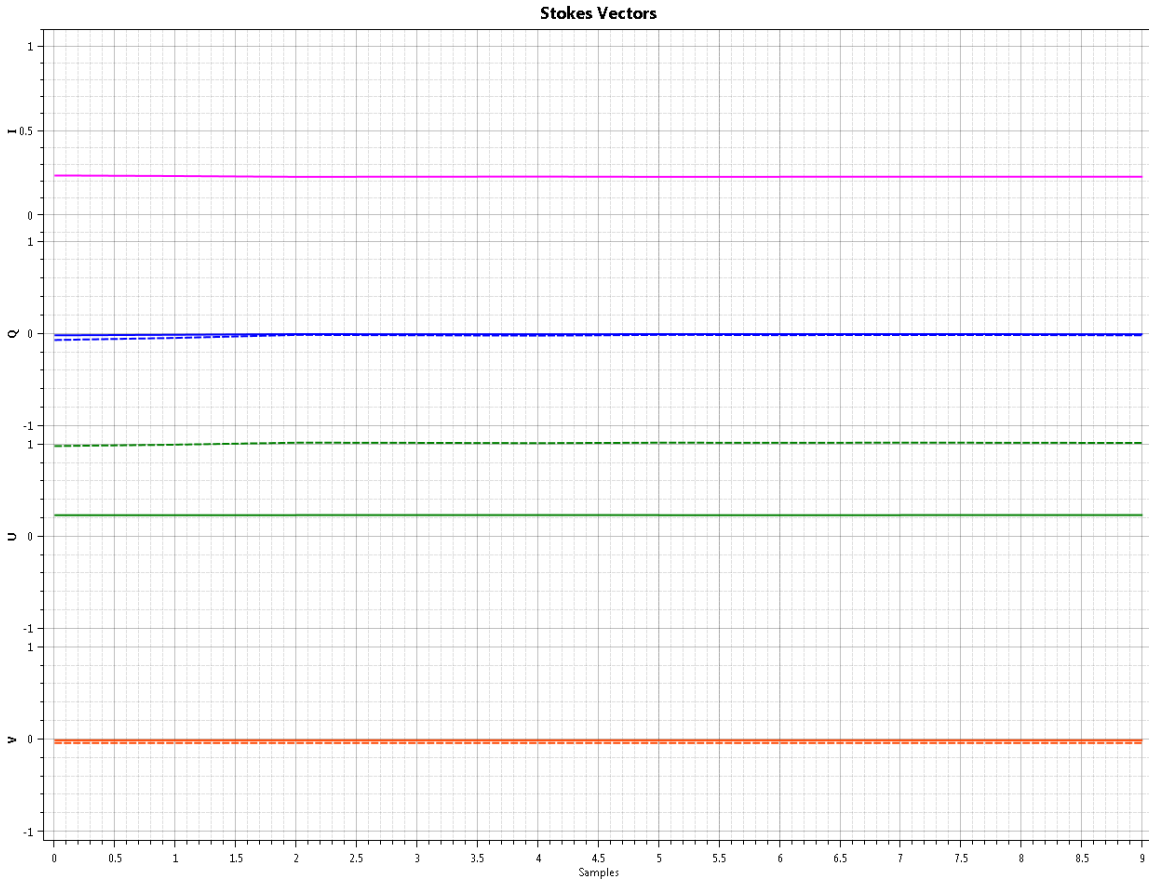


Figure 7: Stokes Vector Plot on Main Interface

The Stokes vectors are plotted on the main section of the screen. The plot is divided into four parts: I for intensity, Q for linear polarization along bisectrix, U for polarization along the Cartesian, and V for circular polarization. The angle of alignment for Q and U can be changed in the settings menu to reference it to the lab's frame of reference.

The measured parameters are shown with a solid line, and the normalized parameters are plotted with dashed lines.

Poincaré Sphere

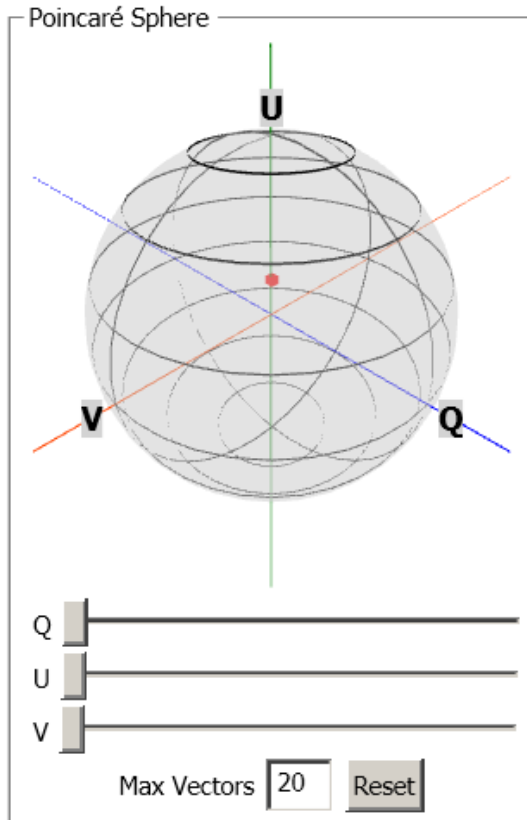


Figure 8: Poincaré Sphere Data

The current data is plotted on the Poincaré sphere here. The newest data point is shown in red and fades away till the number of points reaches the Max Vectors limit.

Polarization Ellipse Plot

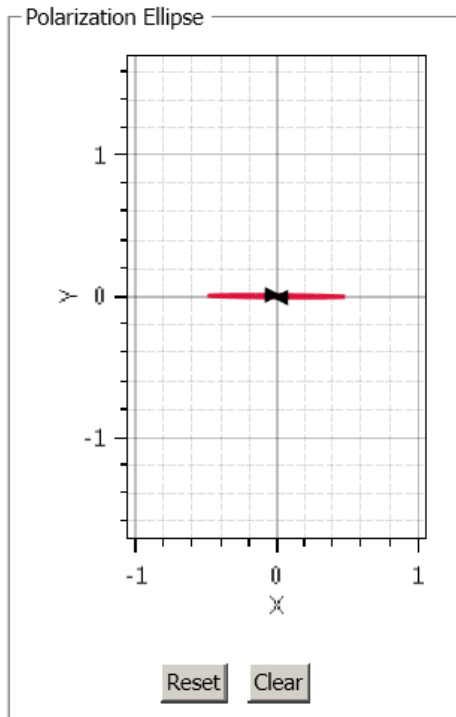


Figure 9: Polarization Ellipse Plot

The polarization ellipse is shown in the lower right corner.

Settings Screen

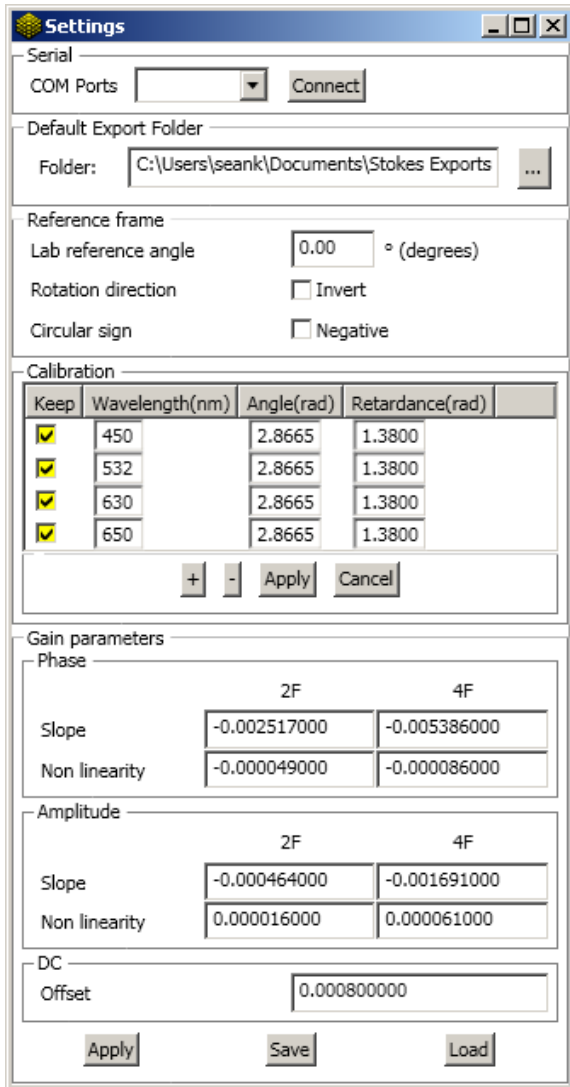


Figure 10: Settings Window

The settings allow the user to change the serial COM port, modify the default export directory, lab reference frame, and calibration parameters.

The lab reference angle allows the user to alter the alignment angle with Q and U. Changing this parameter will rotate the values of Q and U and change the orientation of the polarization ellipse. The rotation direction can also be inverted as well as the sign of the V.

The calibration parameters with wavelength are shown in the Calibration region. The '+' button will add a new wavelength. PoISNAP can store up to nine wavelengths internally. Wavelengths between the listed wavelengths are linearly interpolated.

The gain parameters are responsible for accounting for the phase delay and frequency response of higher gain settings. These parameters can be fitted using the Settings-Calibration tools, but can be manually altered here.

The gain parameters are sent to PoISNAP when the 'Apply' button is clicked. If the user wishes, they can also write the calibration parameters to a comma separated value file by using the 'Save' option. Later, this same file can be loaded with the 'Load' button.

Calibration Tool

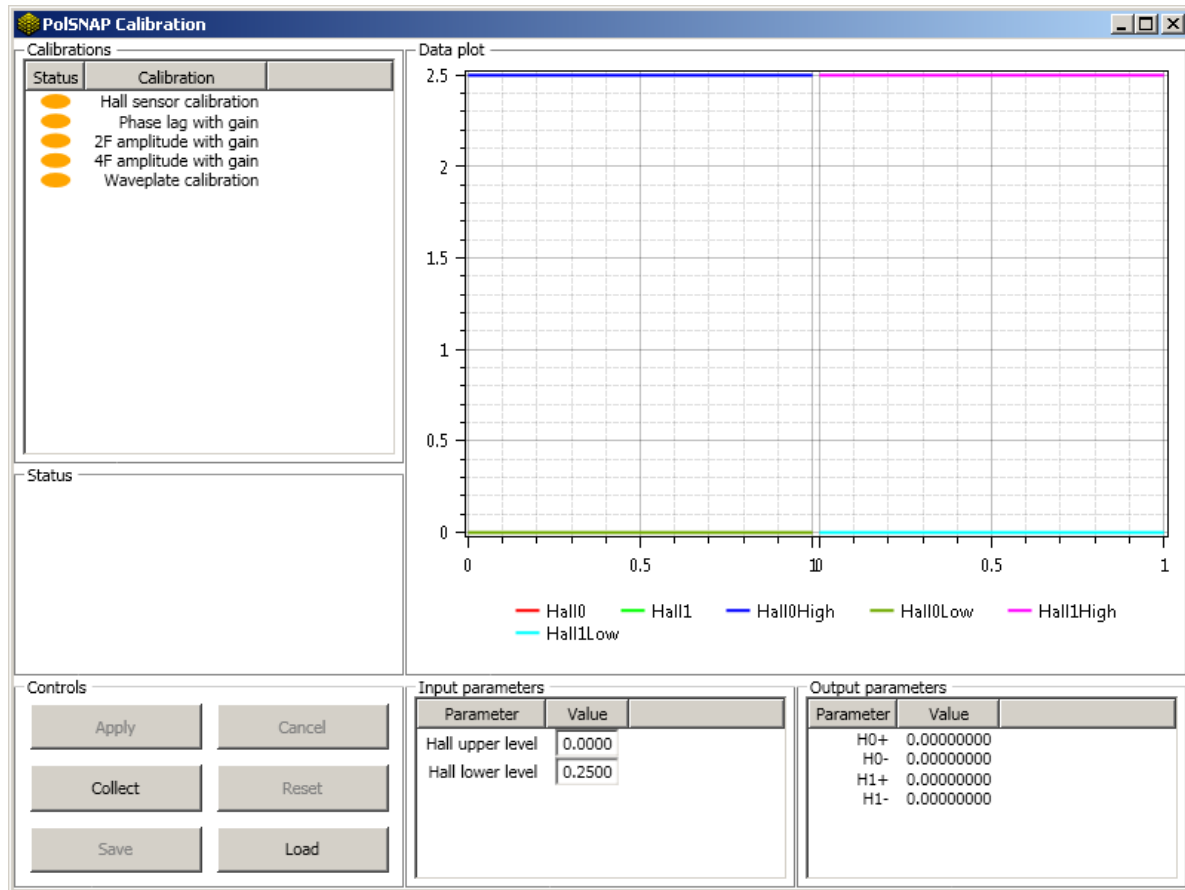


Figure 11: Calibration Window

The calibration screen is where the user can run calibration routines to help solve for important instrument parameters. On the left side are listed the currently available calibration routines. On the lower part of the screen are the calibration controls. The current calibration's input parameters are shown in the Input parameters section. The Output parameters section displays important output parameters. The Status section is responsible for displaying text updates to the user.

Hall Sensor Calibration

The phase of rotation is measured within PoISNAP using two hall sensors and four magnets. The Hall sensors output is fed into a bank of comparators that trigger the sampling engine. If PoISNAP is damaged or takes a significant knock, the comparator settings may need to be reset. This routine requires no tools or setup; simply run the calibration and click 'Apply'.

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Additional Calibration

Phase Lag with Gain

The phase lag with gain calibration measures and calibrates for the phase lag with different gain settings. The user will need a waveplate, a polarizer, a mW power source, and neutral density filters. The suggested neutral density filters are an ND 1.0 and an ND 2.0. The user first sets up the optics path to include a mW power source followed by a linear polarizer to generate linearly polarized light. The user then inserts a waveplate between the polarizer and PolSNAP. The angle of the waveplate is set to generate both a significant portion of linearly and circularly polarized light.

Once the setup is complete, the user can collect the first set of data. The instrument will automatically set the gain level and continue collecting data until the gain is maximized. At this point, the 'Status' will request that the user change the light intensity and collect more data. Now the user can insert an ND 1.0 filter between the light source and linear polarizer. The ND filter will drop the light intensity and allow PolSNAP to increase the gain, and measure the phase shift at higher gains. Now the user should click 'Collect' again. The software will continue to increase the gain and collect more phase data. Once again, the software will request that the user change the light intensity. Switch the ND 1.0 filter for the ND 2.0 filter and collect more data. Then run one more data collection with both the ND 1.0 and ND 2.0 filter in the light path (or an ND 3.0 filter). Once enough data is collected, the user can click 'Apply'. At this point, the software will calculate the phase-to-gain slope and nonlinearity parameters. If the fit line closely matches the collected data, the user can select 'Yes' to send the data to PolSNAP.

2F Amplitude with Gain Calibration

In addition to the phase lag with gain, higher gains can diminish the response from the 2F and 4F frequency amplitudes. To account for this, the 2F and 4F with gain calibrations will measure and calibrate for the reduced frequency amplitudes.

The needed equipment is a mW light source, a polarizer, a waveplate, and a set of ND filters similar to the phase calibration. The optical path should be a light source, a linear polarizer, a waveplate, and finally PolSNAP. The waveplate should be carefully aligned so that the light is only circularly polarized. Once the optical path is set to generate only circularly polarized light, the user can collect the first set of data. The software will then request that the user change the light source intensity. Now an ND filter can be inserted between the light source and linear polarizer. More data is collected. The software will request another change in light source intensity. At this point, another ND filter can be inserted and the process repeats until the whole range of gain parameters is measured. Once this is complete, the 'Apply' button can be selected. The software will then attempt to fit the 2F gain with amplitude. If the fit is similar to the collected data, the user can select 'Yes' to send the data to PolSNAP. If the fit is poor, the user may wish to change the DC offset parameter and try 'Apply' again.

4F Amplitude with Gain Calibration

The 4F amplitude gain calibration is similar to the 2F procedure except that the optical path does not contain a waveplate. The polarizer should be aligned to yield a large negative Q. Otherwise, the procedure is identical to the 2F amplitude calibration.

Waveplate Angle and Retardance Calibration

PoISNAP contains an achromatic waveplate, but if the user wants a more precise measurement of polarization state with wavelength, a waveplate calibration can be run. The waveplate calibration relies upon minimizing the linear polarization and maximizing the circular polarization. The required equipment is a light source, a linear polarizer and a waveplate. The light source should be followed by a linear polarizer, a quarter waveplate and finally the PoISNAP. The angle of the waveplate should be set to 45 degrees to the polarizer. Now, collect a waveplate calibration. If the amount of linearly polarized light is still too great, the waveplate can be tilted slightly to alter its retardance until no linearly polarized light remains. Once the linearly polarization is eliminated and the circular polarization is maximized, the difference between the DC and 4F will yield the retardance of the internal waveplate at that particular wavelength. The user can now click 'Apply'. The calibration parameters of PoISNAP will appear in a pop-up window. The user can alter or remove the calibration parameters and then click 'Okay' to send the new parameters to PoISNAP.

5

Communication Protocol

Protocol

PoISNAP connects to the computer as a USB serial COM port. The communication protocol is an implementation of Standard Commands for Programmable Instruments (SCPI). The connection baud rate is 250,000 bytes per second. As this is a USB serial port, the software defined baud rate can be set anywhere from 9,600 to 250,000 and the PoISNAP should still communicate.

6

Command Syntax

All Syntax

SCPI commands to PolSNAP are structured as either get or set commands. Get queries are appended with a '?'. Commands are ended with a new line character [\n]. Commands are structured with a tree structure and separated by ':' and can be abbreviated. PolSNAP interprets the long or short form of a command the same. For instance, to turn on the motor:

```
:CONFigure:MOTor:ON 255[\n]
```

or

```
:CONF:MOT:ON 255[\n]
```

Command	Parameters	Purpose
*IDN?	None	Get PolSNAP identifier
:CONFigure:ANGLe[?]	Angle of waveplate [rad]	Get/set current waveplate angle
:CONFigure:RETarder[?]	Retardance of waveplate [rad]	Get/set current waveplate retardance
:CONFigure:WAVElength	Load calibration for wavelength [nm]	Set the current calibration wavelength
:CONFigure:WAVEcal[?]	Special see below	Get/set the wavelength calibration table
:CONFigure:HALLsensor:SP[?]	Four voltage set points [V]	Get/set the Hall sensor set points
:CONFigure:HALLsensor:MODE[?]	0,1,2 or 3 to select Hall start sensor	Get/set the Hall sensor responsible for initial sampling
:CONFigure:DETEctor:GAIN[?]	0 – 100.0 gain value	Get/set the gain
:CONFigure:DETEctor:AUTO	None	Run the auto gain routine
:CONFigure:DETEctor:DC:AMPAdj[?]	Three floats see below	Set the offset, slope and nonlinearity of the DC with gain

Command	Parameters	Purpose
:CONFigure:DETEctor:F2:ADJust[?]	Three floats see below	Set the offset, slope and nonlinearity of the 2F phase with gain
:CONFigure:DETEctor:F2:AMPadj[?]	Three floats see below	Set the offset, slope and nonlinearity of the 2F amplitude with gain
:CONFigure:WAVEt	[None]	Get calibration table
:CONFigure:DETEctor:F4:ADJust[?]	Three floats see below	Set the offset, slope and nonlinearity of the 4F phase with gain
:CONFigure:DETEctor:F4:AMPadj[?]	Three floats see below	Set the offset, slope and nonlinearity of the 4F amplitude with gain
:CONFigure:MOTor:ON	Motor speed 0-255	Set the motor speed, use 255 or 0.
:CONFigure:MOTor:OFF	None	Set the motor off. Speed to 0.
:CONFigure:HLReport[?]	0 or 1 [off/on]	Send a high low intensity report for every vector measured
:MEASure:HALL	Number of points	Measure and report the Hall sensor voltages
:MEASure:STOKes	Number of measurements	Measure and report the Stokes vector number of points times
:MEASure:FREqC	Number of measurements	Measure and report the frequency components number of points times
:MEASure:LIGHt	Number of rotations to measure	Measure and report the light intensity
STOP	[None]	Stops the current measurement

Command examples and explanation

Commands are sent to PolSNAP ending with a new line and shown below with [C→P] for computer to PolSNAP. Return data is shown with [C←P]. Newline character is shown as [\n] or newline with carriage return [\r\n]

Command- *IDN?

Reports PolSNAP's version ID. Can be used primarily to identify if the unit is communicating successfully.

Example:

```
[C→P] *IDN?[\n]
[C←P] ID(IDN)DATA(3,1.0.0)[\r\n]
```

Command- :CONFigure:ANGLE[?]

Sets or gets the current angle of the waveplate used to calculate the alignment of Q and U. The units sent or received are in radians. If this value is set with this command, it will be overwritten if the wavelength is changed.

Setting example:

```
[C→P] :CONFigure:ANGLE 0.123[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:ANGLE?[\n]
[C←P] ID(TOFF)DATA(0.123000)[\r\n]
```

Command- :CONFigure:RETarder[?]

Sets or gets the current retardance of the waveplate used to scale Q, U and V. This parameter also affects I as the amplitude of Q affects I. The units sent or received are in radians. If this value is set with this command, it will be overwritten if the wavelength is changed.

Setting example:

```
[C→P] :CONFigure:RETarder 1.41[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:RETarder?[\n]
[C←P] ID(TOFF)DATA(1.41000)[\r\n]
```

Command- :CONFigure:WAVElength

Sets the current wavelength and loads the calibration parameters for waveplate offset angle and retardance. This parameter is not actively stored on PolSNAP, and cannot be retrieved. Instead, the user should examine the waveplate angle and retardance above.

Setting example:

```
[C→P] :CONFigure: WAVElength 632.0[\n]
[C←P] [No return]
```

Command- CONFigure:WAVeT

Gets the current calibration table. The return results will be a long vector of wavelength, angle and retardance followed by another wavelength, angle and retardance. This will continue until up to nine calibration set points.

Getting example:

```
[C→P] :CONF:WAVT[\n]
[C←P]
ID(CALTABLE)DATA(450.0,1.367126,1.362981,532.0,1.364319,1.395198,630.0,1.363829,1.3
95400,650.0,1.362817,1.326202)[\r\n]
```

Command- :CONFigure:WAVeCal[?]

Sets or gets the current calibration table used to set the retardance and angle given a wavelength. The get command is straight forward and conforms to the SCPI protocol. The set command is SCPI non-conforming, and the unit will request additional data from the user.

Getting example:

```
[C→P] :CONFigure: WAVeCal? 632.0[\n]
[C←P] ID(CAL)DATA(1.363829,1.395400)[\r\n]
```

Setting example:

```
[C→P] :CONFigure:WAVeCal[\n]
[C←P] How many sample sets?[\n]
[C→P] 3[\n]
[C←P] N = 3[\n]
[C←P] Enter each set in the form [wavelength], [angle offset], [retarder][\n]
[C←P] Item 0:[\n]
[C→P] 450,0.23,1.412[\n]
[C←P] Item 1:[\n]
[C→P] 530,0.23,1.412[\n]
[C←P] Item 2:[\n]
[C→P] 630,0.23,1.412[\n]
[C←P] Input complete.[\n]
[C←P] ID(CALTABLE)DATA(450.0,0.23,1.412,530,0.23,1.412,630,0.23,1.412)[\n\r]
```

Command- :CONFigure:HALLsensor:SP[?]

Sets or gets the Hall sensor comparator levels. This parameter is used to set the timing parameters for the Hall sensor that detects the phase of the motor. The user should not need to alter these parameters.

Setting example:

```
[C→P] :CONFigure:HALLsensor:SP 0.65,0.65,1.20,1.20[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:HALLsensor:SP?[\n]
[C←P] ID(HALLSP)DATA(0.65,0.65,1.20,1.20)[\r\n]
```

Command- :CONFigure:HALLsensor:MODE[?]

Sets or gets the Hall sensor mode and which hall sensor triggers the initial sampling start. The set command accepts 0, 1, 2 or 3 for each Hall sensor address. The user should not need to alter these parameters.

Setting example:

```
[C→P] :CONFigure:HALLsensor:MODE 0[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:HALLsensor:MODE?[\n]
[C←P] ID(HALLMOD)DATA(H0+)[\r\n]
```

Command- :CONFigure:DETECTOR:GAIN[?]

Sets or gets the current gain setting. The valid values are 0.0 to 100.0.

Setting example:

```
[C→P] :CONFigure:DETECTOR:GAIN 5.5[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:DETECTOR:GAIN?[\n]
[C←P] ID(GAIN)DATA(5.4901962280)[\r\n]
```

Command- :CONFigure:DETECTOR:AUTO

If the motor is running, this starts the auto gain routine and continuously reports back the status. The input parameter is the target intensity at the detector from 0 to 4096. The suggested target level is 2000.

Setting example:

```
[C→P] :CONFigure:DETECTOR:AUTO 2000[\n]
[C←P] ID(IVP)DATA(0,0.992203)[\n\r]
```

[C←P] ... More intensity data
 [C←P] ID(GAIN)DATA(4.8366012573)[\n\r]
 [C←P] ID(AUTOGAIN)DATA(Success! Convergence in 4 iterations.)[\n\r]

Command- :CONFigure:DETEctor:DC:AMPAdj[?]

Sets or gets the current DC to gain parameters. Currently, there are three gain parameters. This alters the DC level used to calculate the Stokes vector as:

$$DC = I_{mean} + DC_{offset}$$

$$DC_{offset} = P_0 + P_1G + P_2G^2$$

Setting example:

[C→P] :CONFigure:DETEctor:DC:AMPAdj 0.002,0.0,0.0[\n]
 [C←P] [No return]

Getting example:

[C→P] :CONFigure:DETEctor:DC:AMPAdj?[\n]
 [C←P] ID(GAD)DATA(0.002000,0.000000,0.000000)[\r\n]

Command- :CONFigure:DETEctor:F2:ADJust[?]

Sets or gets the current F2 phase to gain parameters. Currently, there are three phase adjustment parameters. This alters the phase angle used to calculate the Stokes vector as:

$$\theta_{2F} = \theta_{raw} + \theta_{adj}$$

$$\theta_{adj} = P_0 + P_1G + P_2G^2$$

Setting example:

[C→P] :CONFigure:DETEctor:F2:ADJust 0.000000,-0.002595,-0.000046[\n]
 [C←P] [No return]

Getting example:

[C→P] :CONFigure:DETEctor:F2:ADJust?[\n]
 [C←P] ID(PA2)DATA(0.000000,-0.002595,-0.000046)[\r\n]

Command- :CONFigure:DETEctor:F2:AMPAdj[?]

Sets or gets the current 2F amplitude to gain parameters. Currently, there are three gain parameters. This alters the 2F amplitude level used to calculate the Stokes vector as:

$$F_{2Amp} = F_{2Amp} + F_{2offset}$$

$$F_{2offset} = P_0 + P_1G + P_2G^2$$

Setting example:

[C→P] :CONFigure:DETEctor:F2:AMPAdj 0.0,-0.002595,-0.000046[\n]
 [C←P] [No return]

Getting example:

```
[C→P] :CONFigure:DETEctor:F2:AMPAdj?[\n]
[C←P] ID(GA2)DATA(0.000000,-0.002595,-0.000046)[\r\n]
```

Command- :CONFigure:DETEctor:F4:ADJust[?]

Sets or gets the current 4F phase to gain parameters. Currently, there are three phase adjustment parameters. This alters the phase angle used to calculate the Stokes vector as:

$$\begin{aligned}\theta_{4F} &= \theta_{raw} + \theta_{adj} \\ \theta_{adj} &= P_0 + P_1G + P_2G^2\end{aligned}$$

Setting example:

```
[C→P] :CONFigure:DETEctor:F4:ADJust 0.000000,-0.002595,-0.000046[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:DETEctor:F4:ADJust?[\n]
[C←P] ID(PA2)DATA(0.000000,-0.002595,-0.000046)[\r\n]
```

Command- :CONFigure:DETEctor:F4:AMPAdj[?]

Sets or gets the current 4F amplitude to gain parameters. Currently, there are three gain parameters. This alters the 4F amplitude level used to calculate the Stokes vector as:

$$\begin{aligned}F_{4Amp} &= F_{4Amp} + F_{4offset} \\ F_{4offset} &= P_0 + P_1G + P_2G^2\end{aligned}$$

Setting example:

```
[C→P] :CONFigure:DETEctor:F4:AMPAdj 0.0,-0.002595,-0.000046[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:DETEctor:F4:AMPAdj?[\n]
[C←P] ID(GA4)DATA(0.000000,-0.002595,-0.000046)[\r\n]
```

Command- :CONFigure:MOTor:ON

Sets the current motor speed. The input parameter is from 0 to 255. If the value is greater than 255, the motor should turn on. If the motor speed is less than 255, the motor may stall depending upon the speed. The motor may require a couple of seconds to come up to speed.

Setting example:

```
[C→P] :CONFigure:MOTor:ON 255[\n]
[C←P] [No return]
```

Command- :CONFigure:MOTor:OFF

Turns the motor off. This is the same as the above ON command with a parameter of 0.

Setting example:

```
[C→P] :CONFigure:MOTor:OFF[\n]
[C←P] [No return]
```

Command- :CONFigure:HLReport[?]

Sets or gets the current state of the high low intensity report. If the parameter is 1, PolSNAP will report a high and low intensity value from 0 to 4096 for each Stokes vector or frequency component measurement.

Setting example:

```
[C→P] :CONFigure: HLReport 1[\n]
[C←P] [No return]
```

Getting example:

```
[C→P] :CONFigure:HLReport?[\n]
[C←P] ID(HIGHLOWREPORT)DATA(1)[\r\n]
```

Results example:

```
[C→P] :MEAS:STOK 1[\n]
[C←P] ID(STOK)DATA(0.0378298,0.1055822,0.2359185,-0.1655836)[\r\n]
[C←P] ID(HILO)DATA(1954,0)[\r\n]
```

Command- :MEASure:HALL

If the motor is on, this will begin a Hall sensor measurement. The input parameter is the number of points to measure. To measure a full rotation, set the number of points to measure to about 3000 with the motor running at full speed. The returned parameters are the Hall sensor voltage and the comparator status.

Results example:

```
[C→P] :MEASure:HALL 3000[\n]
[C←P] ID(HALL)DATA(0.743,0.711,0,0,0,0,0)[\r\n]
[C←P] ... more measurements
```

Command- :MEASure:STOKes

If the motor is on, this will begin a series of Stokes measurements. The parameter is a value of the number of measurements to take in a row. If the parameter is 0, then Stokes measurements will be taken continuously. At any time during the sampling, STOP command will halt the sampling. The unit will not respond to other commands during sampling, only the STOP command.

The returned Stokes vector is of the form:
ID(STOK)DATA(I,Q,U,V)

Results example:

```
[C→P] :MEASure:STOKes 1[\n]
[C←P] ID(STOK)DATA(0.368616,0.1035906,0.2392272,-0.1673297)[\r\n]
```

Command- :MEASure:FREqC

If the motor is on, this will begin a series of frequency component measurements. The parameter is a value of the number of measurements to take in a row. If the parameter is 0, then frequency component measurements will be taken continuously. At any time during the sampling, STOP command will halt the sampling. The unit will not respond to other commands during sampling, only the STOP command.

The reported frequency components are raw values and not effected by any calibration parameters. This is useful for trouble shooting, or taking raw measurements and allowing the end user to run their desired data processing.

The returned frequency component vector is of the form:

ID(STOK)DATA(DC, F2 sine, F2 cosine, F4 sine, F4 cosine)

Results example:

```
[C→P] :MEASure:FREqC 1[\n]
[C←P] ID(FREQC)DATA(0.0852367,0.0790722,0.1353706,0.1051064,0.0588355)[\r\n]
```

Command- :MEASure:LIGHt

If the motor is on, this will begin a raw light intensity measurement. The input parameter is the number of points to measure. To measure a full rotation, set the number of points to measure to about 3000 with the motor running at full speed. The returned parameters are the phase count and the measured intensity. The phase count is a raw count that starts at 0 and increases to an arbitrary maximum number that cycles back to 0 at a full rotation.

Results example:

```
[C→P] :MEASure:LIGHt 1[\n]
[C←P] ID(IVP)DATA(17,0.966140)[\r\n]
[C←P] ... more data
[C←P] ID(IVP)DATA(41,0.966873)[\r\n]
```

Running a measurement consists of three steps. Turn on the motor. Set the gain. And take a sample. Sample run:

```
[C→P] :CONFigure:MOTor:ON 255[\n]
Wait for a second or two for the motor to start up.
[C→P] :CONFigure:DETEctor:AUTO 2000[\n]
[C←P] ID(IVP)DATA(0,0.992203)[\n\r]
[C←P] ... More intensity data
```

```
[C←P] ID(GAIN)DATA(4.8366012573)[\n\r]
[C←P] ID(AUTOGAIN)DATA(Success! Convergence in 4 iterations.)[\n\r]
The gain is now set, and measurements can be take.
[C→P] :MEASure:STOKes 1[\n]
[C←P] ID(STOK)DATA(0.368616,0.1035906,0.2392272,-0.1673297)[\r\n]
```



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