

PicoPOL-PC User Guide

Introduction

This guide explains how to install, connect and operate the PicoPOL-PC automatic polarimeter system. Much more detailed information about the instrument can be found on the pages at www.epolarimeter.com.

PicoPOL-PC is a compact LED-based automatic polarimeter designed for classroom, teaching laboratory and experimental use. The instrument communicates with a Windows PC via a supplied LabVIEW™ Runtime Executable (RTE), allowing automatic waveform acquisition, optical rotation measurements and kinetic data logging.

Quick Start

Here is a summary of what is required to take measurements using the PicoPOL-PC polarimeter. The following sections will describe the instrument setup in full detail.

1. Install PicoPOL-PC Runtime Environment
2. Reboot PC
3. Connect Validation Module
4. Run PicoPOL-PC.exe
5. Confirm green indicator + “Validation Mode” – gain familiarity with the interface
6. Disconnect Validation Module
7. Assemble optical bench
8. Connect controller and 9 V supply
9. Run PicoPOL-PC.exe

10. Insert BLANK and click Mode to "Blank" – wait till optical rotation reads zero

11. Taking measurements - click Mode to "Sample" then insert SAMPLE

Items Supplied with PicoPOL-PC

PicoPOL Optical Bench Components

The following items are supplied:

- Detector module
- Source module
- Two-wire detector-to-source connection cable
- Acrylic baseplate
- Cell carrier blocks (2)
- Polarimeter sample cell
- Cell cover
- M4 mounting screws, nuts, washers and cable ties

The internal optical components are pre-aligned within their respective housings. Assembly simply consists of mounting the modules to the supplied baseplate and connecting the supplied cables. Details are given in a later section.

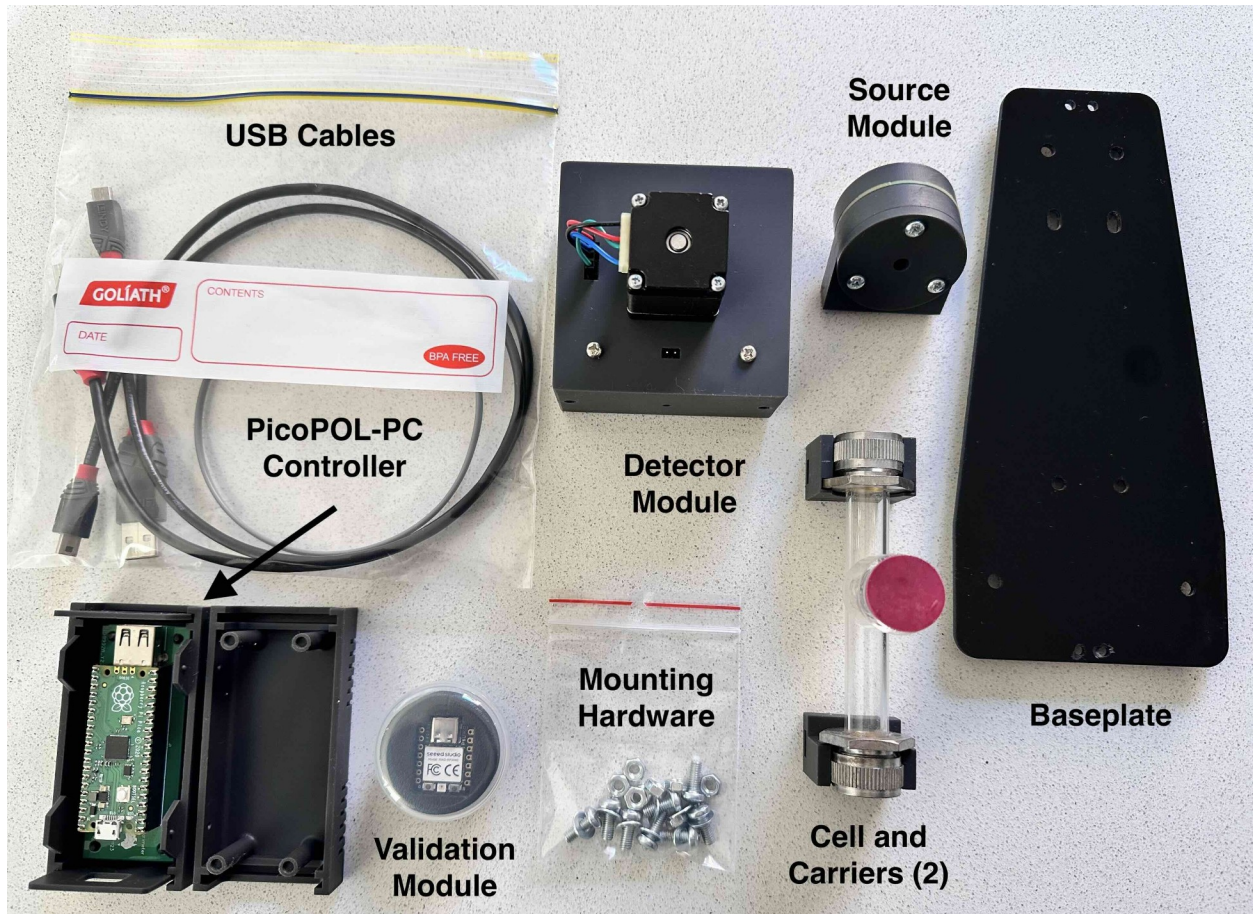


Fig. 1 PicoPOL-PC Optical Bench and -PC Controller Components (cell cover not shown)

PicoPOL-PC Controller Components

The following PC interface components are supplied:

- PicoPOL-PC controller module mounted in a 3D-printed enclosure
- USB-A to mini-USB cable
- USB-A to micro-USB cable
- PicoPOL-PC Validation module (XIAO RP2040 based)
- A USB-A to USB-C cable

The Validation module is used to verify correct installation and operation of the LabVIEW Runtime environment/executable and the USB communication environment prior to connecting the optical instrument.

System Requirements

To operate PicoPOL-PC, a 64-bit Windows 11 PC is required.

A LabVIEW 2025 Runtime Environment must also be installed. We provide an installer that includes all required components, including NI-VISA for communication with the instrument.

Interaction with the instrument is via a supplied LabVIEW Runtime Executable. LabVIEW™ (developed by National Instruments) is widely used for instrument control and data acquisition. The PicoPOL-PC graphical interface is provided as a standalone runtime application, so no LabVIEW licence is required.

Once the runtime environment is installed and the controller is connected via USB, the PicoPOL-PC controller is automatically recognised by the PC as a serial (COM) port. The software then connects to the instrument without any manual configuration.

Power Supply Requirements

A mains adapter is required to operate the optical bench. This is not supplied in order to accommodate regional mains standards.

Required power specifications for the adapter are:

- Regulated 9V DC output
- Minimum 1 A current rating
- 2.5 mm inner diameter DC barrel plug
- Tip positive polarity
- Metal barrel length ≥ 12 mm (shorter plugs will not engage reliably).

Before connecting power to the optical bench (later), use a multimeter to verify that the output voltage is close to 9 V DC.

Please ensure the adapter is a **regulated** supply, as unregulated adapters can exceed 12 V and damage the detector module.

If in doubt regarding any of these requirements, please contact Instruments4Chem before applying power.

Installing the LabVIEW Runtime Environment

The *PicoPOL-PC_FullPackage.zip* (approx. 600 MB) can be downloaded from GoogleDrive using the link below. This software has been designed for straightforward operation; however basic familiarity with Windows operations is assumed.

[Download Link Here]

After downloading, unzip the package. You will then see two folders:

- **Installer**
- **Application**

⚠ Do not move any files out of either of these folders. The .exe files in each folder depend on their respective folder structures to operate correctly.

Installer Folder

Run **PicoPOL-PC-Setup.exe** to configure your 64-bit Windows 11 PC with the required LabVIEW Runtime Environment and NI VISA support for serial communication.

👉 Right-click the installer and select **“Run as administrator”**

Virus detection or security software may occasionally slow the installation or display warnings when installing low-volume scientific software applications. If necessary, temporarily allow or whitelist the Runtime Environment installer executable.

Note : the installation may take several minutes — this is normal – and a restart will be required.

Once installation is complete, the *Installer* folder is no longer required and this may be deleted.

Application Folder

PicoPOL-PC.exe is the application you will run to control your polarimeter (see next section for details). This application can only be run after the runtime environment has been installed. Once the PicoPOL-PC controller is connected to your PC, the instrument will be seamlessly recognized as a COM port.

PicoPOL-PC Validation Module and Runtime Test

Purpose

PicoPOL-PC systems include a small USB Validation Module based on the XIAO RP2040 microcontroller platform.

The Validation Module is designed to verify correct installation and operation of the complete PicoPOL-PC software environment before connecting the polarimeter optical bench. This allows the Windows PC, LabVIEW Runtime Environment, NI-VISA communication drivers and USB serial communication to be tested independently of the polarimeter hardware.

When connected via USB, the Validation Module communicates with the PicoPOL-PC software in exactly the same manner as a real instrument. The module responds to the software handshake sequence and transmits synthetic waveform data that mimics normal PicoPOL operation.

The LabVIEW software then:

- acquires waveform data
- performs waveform fitting
- computes optical rotation values
- updates graphical displays
- exercises the data logging system

Important point : Using the Validation Module during initial setup helps distinguish software or communication issues from instrument-related issues and greatly simplifies troubleshooting.

Connecting the Validation Module

1. Connect the Validation Module to the PC using the supplied USB cable.
2. The RGB LED on the module should illuminate blue.
3. Leave the PicoPOL optical bench disconnected during this test.
4. Open Windows Device Manager and confirm that the module appears under:

Ports (COM & LPT) as : USB Serial Device (COMx)



Fig.2 Left image : In Device Manager the Validation Module appears as a COM port. Right image : RGB LED at the bottom of the module is blue

Starting PicoPOL-PC

1. Open the Application folder.
2. Run : PicoPOL-PC.exe
3. The LabVIEW front panel (polarimeter control screen) will appear.
4. Press the white Run button near the upper-left corner of the LabVIEW toolbar.

During startup the software will:

- search for available USB serial devices
- test communication with the connected device
- establish communication with either:
 - the PicoPOL-PC controller (when the instrument is connected – see later)
 - or the Validation Module (VM connected – in this case)

If communication is successful:

- the Connected? indicator turns green
- the software will display “Validation Mode” in the Instrument Status field

If communication cannot be established:

- the Connected? indicator will be red
- the Instrument Status will indicate “Invalid Device” or “Device not Connected”
- the RTE will stop, but the front panel remains open

In this case:

- check the USB connection at the PC
- confirm the Validation Module is connected
- confirm that the module appears as a COM port in Device Manager
- press the Run button again to retry

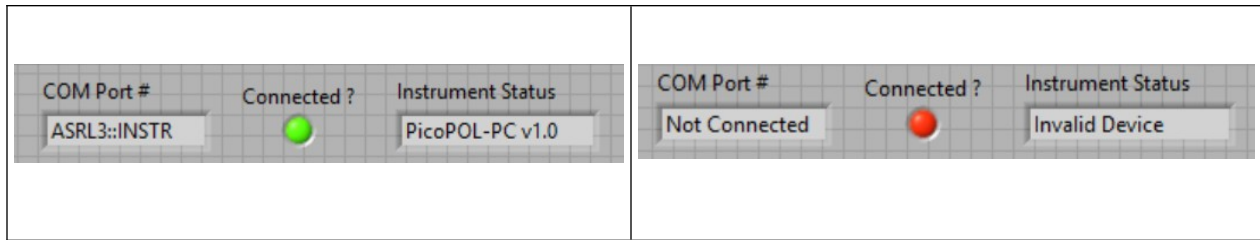


Fig. 3 Left : The Validation module has successfully connected and the LabVIEW RTE is running (forward arrow will have changed to solid black). Right : The PicoPOL-PC controller has not been recognized and the RTE has stopped (forward arrow will revert to white) – troubleshooting is required to resolve the connection issue.

Validation Mode Operation

After successful connection, the Validation Module generates synthetic waveform data that exercises the complete PicoPOL-PC acquisition and analysis system.

First, a dialog box will appear offering data-saving. For this test simply click OK.

After a short delay :

- a waveform and fit will appear in the graph window
- optical rotation values will update automatically

Typical displayed readings are:

- approximately 0.00° in blank mode (when Mode switch is set to “Blank”)
- a fixed non-zero optical rotation in simulated sample mode (Mode switch set to “Sample”)

Small fluctuations in readings are normal and intentionally included in the generated data.

During data acquisition/transmission:

- the RGB LED on the module changes to red during acquisition
- this LED briefly flashes green during each waveform upload

Successful operation confirms correct functioning of:

- the LabVIEW Runtime Environment
- NI-VISA communication

- USB serial communication
- waveform acquisition
- curve fitting and optical rotation analysis
- graphical display updating
- general software operation

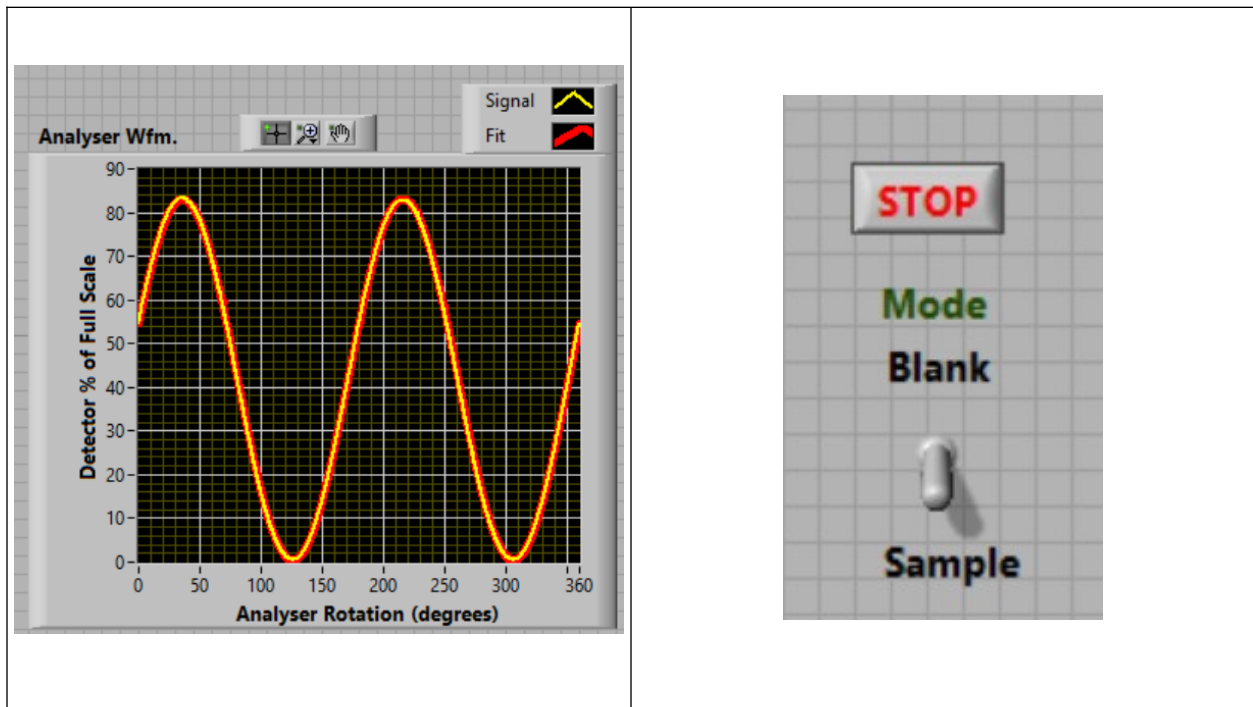


Fig. 4 A simulated blank waveform (yellow trace) and fit (red trace). Blank measurement is selected by clicking the Mode switch to the “Blank” position. Moving the switch to “Sample” allows sample measurements. Note : This switch is a software toggle in LabVIEW, not a physical switch on the instrument. In the right screen grab note the STOP button above the Mode switch – clicking on this button will terminate a run.

Stopping the Program

To stop operation:

1. Press the red STOP button on the front panel.
2. Wait briefly for execution to terminate.

3. The Run button will return to white.

Once Validation Mode has been successfully tested, disconnect the Validation Module before connecting the PicoPOL-PC instrument.

Optical Bench Assembly

To assemble the polarimeter optical bench, first mount the detector module, then the source module and lastly the two cell carrier blocks securely onto the baseplate in the positions as shown in the image below. Mounting is achieved using the M4 screws, captured nuts and washers that are provided. The washers should be fitted under the screw heads that are placed on the underside of the baseplate.

Note - the two carrier blocks need to be accurately positioned so that the cell will fit neatly into the slots when mounted. They need to be fitted with their vertical slots each facing toward the middle of the baseplate. Once the carrier blocks are in their correct positions the cell should be set aside for the time being to avoid risk of breakage.

During fitting of the above 4 components you may find that the captured nuts rotate as the screws are tightened. If so, cut off and then wedge a short length of cable tie (provided) into the captured nut slots to prevent the nut spinning - then tighten the screws - but don't over tighten.

To finish the optical bench assembly connect the custom two wire cable that runs between the 2 pin header at the rear of the detector module to the 2 pin header at the rear of the source module - this passes 9V DC power from the detector module to the source module.

This cable is gray – inspect it and note that there is black stripe on one of the wires. That wire is the ground (GND) connection and the other wire carries the 9V DC. First, make the connection at the detector end of the instrument. Looking at this from the back (facing the stepper motor) the black stripe (GND) should be positioned on the left when the 2-pin female header is inserted into the 2-pin male header.

Now moving to the source end of the instrument, make the corresponding connection but this time with the black stripe (GND) positioned on the right hand side.

If these connections are made incorrectly the diode-protected source module will not receive power and the yellow LED will not come on when the instrument is powered up

(see the Power Up Check section later on for further information). Check the polarity carefully before proceeding.

Finally, secure the 2-wire power cable at each end of the baseplate using the two black cable ties provided (there are 2 holes at each end to accommodate insertion of the cable tie).



Fig.5 The PicoPOL Optical Bench – Detector module at left, Source module at right and two cell carrier blocks in between.

Connecting the PicoPOL-PC Instrument

Connect the system as shown below.

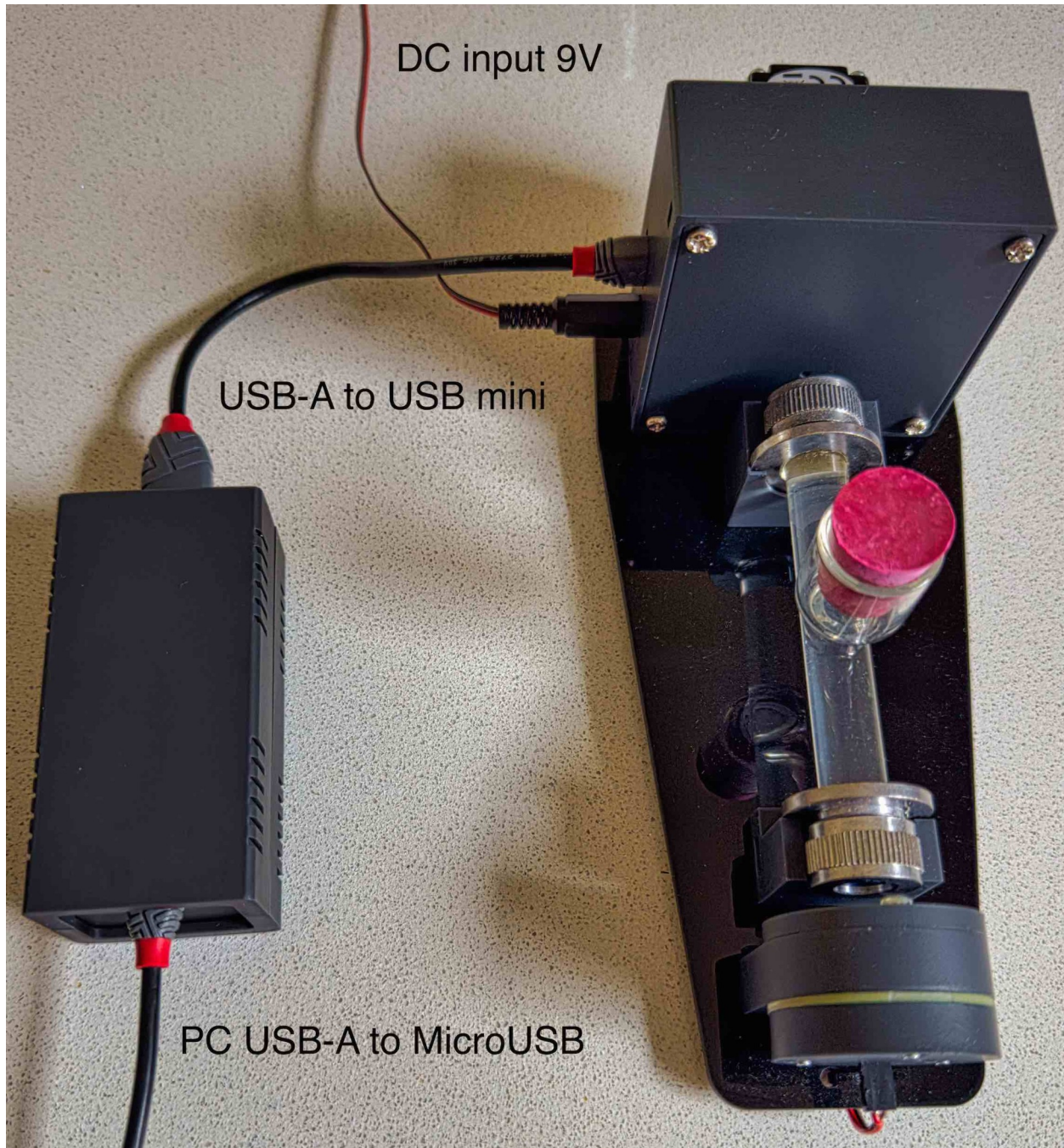


Fig. 6 PicoPOL-PC USB Cable and 9V Power Connections

Make the following three connections (the power supply must be off while doing so) :

1. A USB-A to mini-USB cable between the PicoPOL-PC controller and the polarimeter head
2. A micro-USB cable from your PC to the PicoPOL-PC controller

3. A 9 V power supply connected to the detector module
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Power-Up Check

Once these 3 connections have been made, switch on the 9 V power supply.

Verify the following:

- Glow from a small red LED is visible at the rear of the source module
- A yellow light beam emerges from the front of the source module
- The detector module is illuminated by a well centered yellow patch

A piece of white paper or card can be used to confirm illumination from the source module and alignment of the light patch on the small aperture at the front of the detector module. If the patch is not well centered please carefully check the positioning of the source and detector modules on the polarimeter baseplate.

Running PicoPOL (also see www.epolarimeter.com)

Starting a Run

Double-click PicoPOL-PC.exe

- The Connected? radio control should go green,
- the Instrument Status should display PicoPOL-PC v1.0 and
- the LabVIEW control screen will open.

Next, click the forward arrow (Run) button.

A dialog box will appear asking whether Optical rotation vs. time data should be saved – checking the box with the mouse enables file saving.

When an instrument is connected and after a brief delay:

- the stepper motor will begin rotating
- a sinusoidal waveform will appear on the screen

At any point during a run the current 8000 point detector waveform can also be saved, if desired by clicking on the Save Waveform button.

During operation:

- slight fluctuations in optical rotation are normal
- the stepper motor will produce audible stepping sounds
- waveform amplitude may vary slightly during warm-up

For highest stability and precision, allow the optical bench to warm up for approximately 10–15 minutes before critical measurements.

Sample Cell Handling

- Ensure the cell is completely filled
- Avoid trapped air bubbles
- Wipe cell windows with lint-free tissue
- Handle cells by the sides
- Re-insert the cell with a consistent orientation during comparative measurements
- The cell cover should be placed over the cell for best results

Source LED Intensity Adjustment

Prepare a polarimeter cell filled with a blank solution and insert this onto the two cell cradles.

The instrument is fitted with a yellow LED source. With the cell in place and the motor running, examine the amplitude of the detector waveform – this is displayed as a percentage of full scale. For the blank measurement, the peak of the cosine-squared waveform should ideally lie between 80 and 90%.

If the waveform appears flat-topped, the intensity is too high and the detector is saturating. Conversely, if the peak is well below 80%, the intensity is lower than ideal.

LED intensity is adjusted using the small trimpot on the source PCB, accessible from the rear of the source housing using a jeweller's screwdriver. Turning the screw anti-clockwise reduces intensity; clockwise increases it.

Two things to note : (i) With PicoPOL it is normal for the detector response to differ between an air path (i.e. no cell) and when a cell filled with a blank solution is in-place. Always adjust the intensity with a cell fitted. (ii) The LED intensity can fall by 10% or more during warm-up so allow a 15 minute wait before performing the intensity adjustment described above.

Once this procedure has been carried out using a blank, further adjustment is rarely required.

Zeroing the Instrument

After adjusting the source LED intensity, click the Mode toggle switch to "Blank" to zero the optical rotation whenever your blank solution is in place.

The Theta/Degrees indicator will update after several measurement cycles and the reading should then be close to 0.000 degrees. Fluctuations from reading to reading should be less than 0.01 degrees. If this is not the case check that the waveform looks both noise-free and stable in amplitude (set to 80-90% of full scale as done earlier).

Once zeroing is complete, return the Mode switch to the "Sample" position to enable sample measurements.

Point Interval (Delay Control)

The Point Interval/sec control sets the delay between successive measurements.

The default value is 5 seconds.

With this setting, each cycle consists of:

- approximately 5 seconds of motor rotation and data acquisition
- waveform transfer to the PC
- a 5 second pause before the next cycle

Although this parameter can be adjusted, the default value is recommended for long runs because it helps minimise stepper motor warming.

Graphical Displays

Two graphs are displayed:

Left:

- most recent 8000-point waveform (yellow)
- cosine-squared fit (red)

Right:

- optical rotation versus elapsed time (light blue)

An elapsed time indicator also shows the total run time in seconds.

Each measurement cycle takes approximately 5 seconds + the nominated point Interval in seconds.

As mentioned earlier the option to save optical rotation vs. time data can be invoked by checking the checkbox that is displayed at the start of a run.

In addition, the most recently accumulated full 8000 point waveform can also be saved at any time during a run by pressing the Save Waveform button. Waveform file(s) are saved with a running index number that is added at the time the button is pressed. A display field on the screen also shows the file path to the folder where these data files are being saved.

PicoPOL-PC Front Panel Controls and Displays

The PicoPOL-PC LabVIEW front panel provides real-time control of data acquisition, waveform fitting and optical rotation measurements.

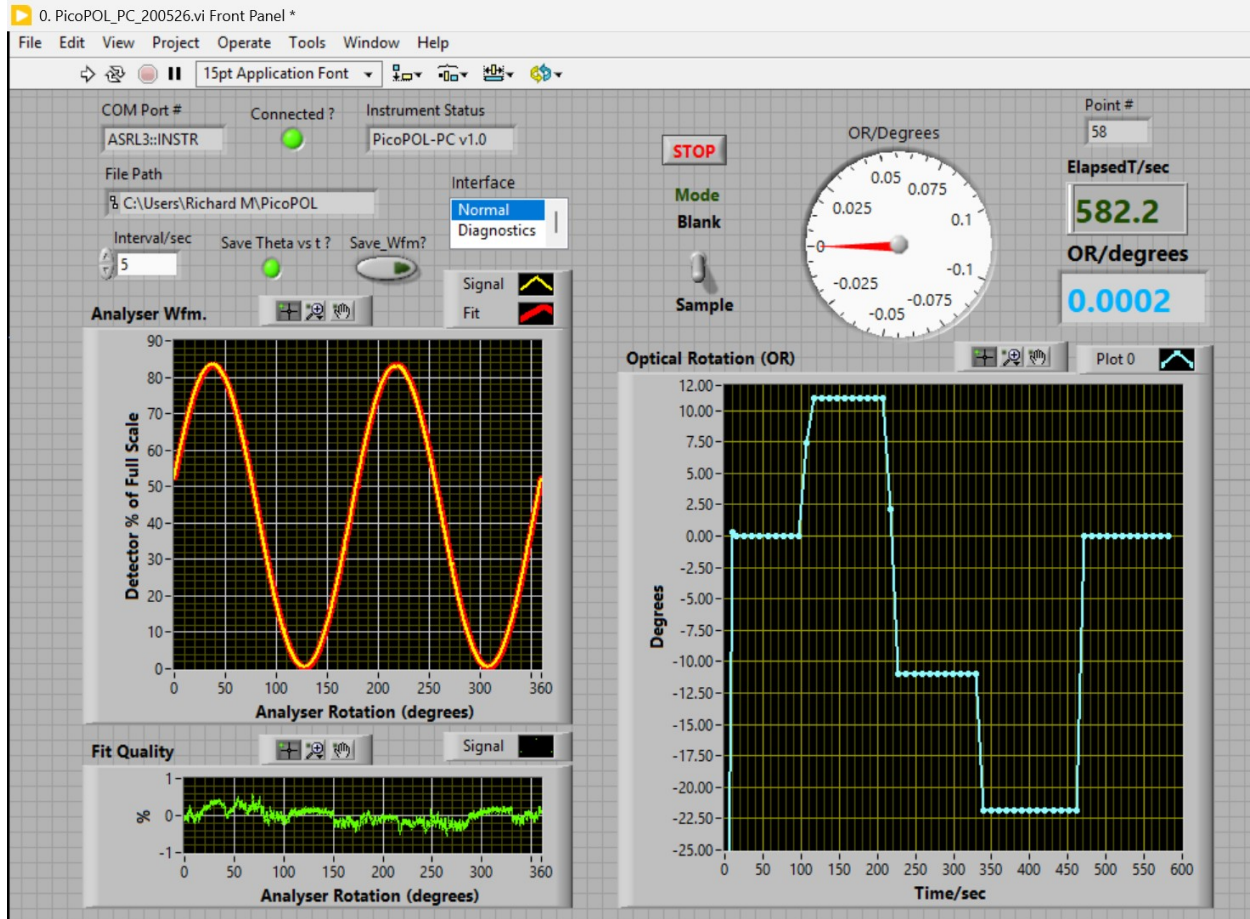


Fig. 7 The LabVIEW control for PicoPOL-PC. Here the instrument has been used to measure the optical rotations of three certified quartz calibration plates – see the Performance Metrics page of www.epolarimeter.com for full details.

The major controls and indicators in Fig. 7 are described below.

Communication and System Status

COM Port

Displays the VISA serial port currently assigned to the PicoPOL-PC controller (for example COM3 will appear as ASRL3 : : INSTR).

Connected ?

Green indicator showing successful communication between the PC and the PicoPOL-PC controller.

Instrument Status

Displays firmware identification and operating status information.

STOP

Terminates data acquisition, stops the stepper motor rotating and closes communication with the instrument.

Always use STOP before disconnecting the USB cable or exiting the application.

File and Data Logging Controls

File Path

Displays the directory used for saving waveform and optical rotation data files.

Interval/sec

Sets the delay between successive optical rotation measurements.

Save Theta vs t ?

Enables automatic saving of optical rotation versus time data.

Save_Wfm?

Enables saving of analyser waveform data for later inspection and analysis.

Operating Mode Controls

Interface

Selects the operating mode of the software.

Normal

Standard operating mode used for routine optical rotation measurements.

Diagnostics

Engineering and troubleshooting mode providing some additional system information (this is password protected).

Mode Selector (Blank / Sample)

Blank

Stores the reference waveform phase used for zero rotation calibration.

Sample

Measures the optical rotation of the sample relative to the stored blank.

Waveform Display Area

Analyser Wfm.

Displays detector intensity as a function of analyser rotation angle.

The waveform follows Malus-law behaviour and is fitted internally to determine optical rotation.

Signal

Measured detector waveform acquired from the instrument.

Fit

Calculated best-fit waveform superimposed on the measured data.

X-Axis — Analyser Rotation (degrees)

Angular position of the rotating analyser polarizer (taking 0 degrees as the stepper motor's start-up position).

Y-Axis — Detector % of Full Scale

Detector output expressed as a percentage of ADC full-scale range.

Fit Quality Display

Fit Quality

Displays the residual difference between the measured waveform and the fitted waveform.

This graph provides a visual indication of waveform quality, mechanical stability and fit performance.

Low-amplitude structured residuals are normal and arise from minor optical and mechanical imperfections.

Signal

Residual waveform displayed as percentage deviation from the fitted signal.

X-Axis — Analyser Rotation (degrees)

Angular position of the analyser.

Y-Axis — %

Residual deviation between the analyzer waveform and the fit, expressed as a percentage of detector full scale. This should always remain significantly less than +/- 1%.

Optical Rotation Displays

OR/Degrees Meter

Analogue-style meter displaying the current measured optical rotation.

OR/degrees Numeric Display

High-resolution digital display of the measured optical rotation value.

Point

Displays the current measurement number within the optical rotation versus time dataset.

ElapsedT/sec

Displays elapsed acquisition time since the start of the measurement sequence.

Optical Rotation Trend Plot

Optical Rotation (OR)

Displays optical rotation as a function of time.

Useful for observing drift, kinetics, equilibration or long-term stability measurements.

X-Axis — Time/sec

Elapsed time in seconds.

Y-Axis — Degrees

Measured optical rotation in degrees.

Stopping and Restarting

Important

Always use the on-screen STOP button to terminate a run.

Do NOT use the LabVIEW Abort button located on the toolbar.

Using the Abort button may leave the communication port open or the instrument in an undefined state.

To end a run:

- Press the red STOP button
- Wait until the Run arrow changes from black to white
- The motor will stop

A new run can then be started normally by pressing the Run button again. Be sure to always measure a blank prior to measuring any samples when a new run is initiated.

If the communication port remains open accidentally, restarting the application will normally restore communication.

Laboratory Use and Care

PicoPOL is intended for normal classroom and laboratory use.

As with other optical and electronic scientific instruments, reasonable care should be taken to avoid significant liquid spills and exposure to aggressive solvents.

The optical components are enclosed within sealed module housings, and the modular construction allows the baseplate and cell carrier assemblies to be cleaned if required.

Routine cleaning and occasional inspection are recommended in shared teaching laboratories.

Safety

- Use only regulated low-voltage DC supplies meeting the stated specifications.
 - Always disconnect power before modifying connections.
-

Troubleshooting

Connected? Indicator Remains Red

Check:

- USB cable connections
- that the device appears as a COM port in Device Manager
- that the correct device is connected
- that the PicoPOL-PC controller is powered correctly

Validation Mode Works but Instrument Does Not

This indicates that:

- the LabVIEW Runtime Environment is functioning correctly
- VISA communication is functioning correctly
- USB communication is functioning correctly

In this case the issue is therefore likely related to:

- optical bench connections
- instrument power
- controller connections
- hardware setup

No or Low Signal Waveform Displayed

Check:

- optical bench connections
- source illumination (check detector-to-source cable polarity)
- detector alignment (is beam visible ?)
- power supply voltage low
- fluid level and/or bubbles in cell

Before Contacting Instruments4Chem

Please verify:

- Validation Mode operates correctly

- PicoPOL-PC controller appears in Windows Device Manager
- Power supply polarity is correct
- Source LED is illuminated
- USB cables are firmly connected
- STOP button was used for previous shutdown

If possible, include:

- a screenshot of the PicoPOL-PC window
- a Device Manager COM port screenshot
- a photograph of your optical bench setup

In Summary

PicoPOL-PC was designed to provide affordable access to high-quality automatic optical rotation measurements using modern microcontroller and waveform-analysis techniques. The instrument combines compact modular hardware with full-waveform digital analysis to provide rapid and reproducible measurements suitable for teaching laboratories, experimental investigations and kinetic studies.