PLC Trend Tool

User Guide

Version 1.1

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1. Getting Started

1.1 Overview

The PLC Trend Tool is a portable desktop application for real-time trending of Allen-Bradley PLC tag data. It connects directly to your PLC over Ethernet/IP and displays live tag values as scrolling time-series charts with a synchronized data table below.

The application supports ControlLogix, CompactLogix, Micro800, SLC 500, MicroLogix, and PLC-5 controllers. No RSLinx or FactoryTalk installation is required.

1.2 System Requirements

Requirement	Details
Operating System	Windows 10 or later (64-bit recommended)
Python	3.8 or later (for running from source)
Network	Ethernet connection to PLC network (same subnet)
Libraries	customtkinter, pylogix, matplotlib, Pillow (auto-installed via requirements.txt)
Optional	pycomm3 (required for SLC 500 / MicroLogix / PLC-5 support)

1.3 Installation

Option A: Run from Source

Step 1: Install Python — Download from python.org. Check 'Add Python to PATH' during installation.

Step 2: Download Source Files — Place all files in a single folder: plc_trend_tool.py, assets_data.py, build.py, requirements.txt

Step 3: Install Dependencies — Open a command prompt in the folder and run:

```
pip install -r requirements.txt
```

Step 4: Optional SLC Support — For SLC 500/MicroLogix/PLC-5 controllers:

```
pip install pycomm3
```

Step 5: Launch — Double-click plc_trend_tool.py or run from command prompt:

```
python plc_trend_tool.py
```

Option B: Build Standalone Executable

To create a single .exe file that runs without Python installed:

```
pip install pyinstaller
python build.py
```

The executable will be created in the dist/ folder as PLC_Trend_Tool.exe.

TIP: The build script automatically extracts logo assets, bundles all dependencies, and creates a single portable .exe file. You can copy it to any Windows PC.
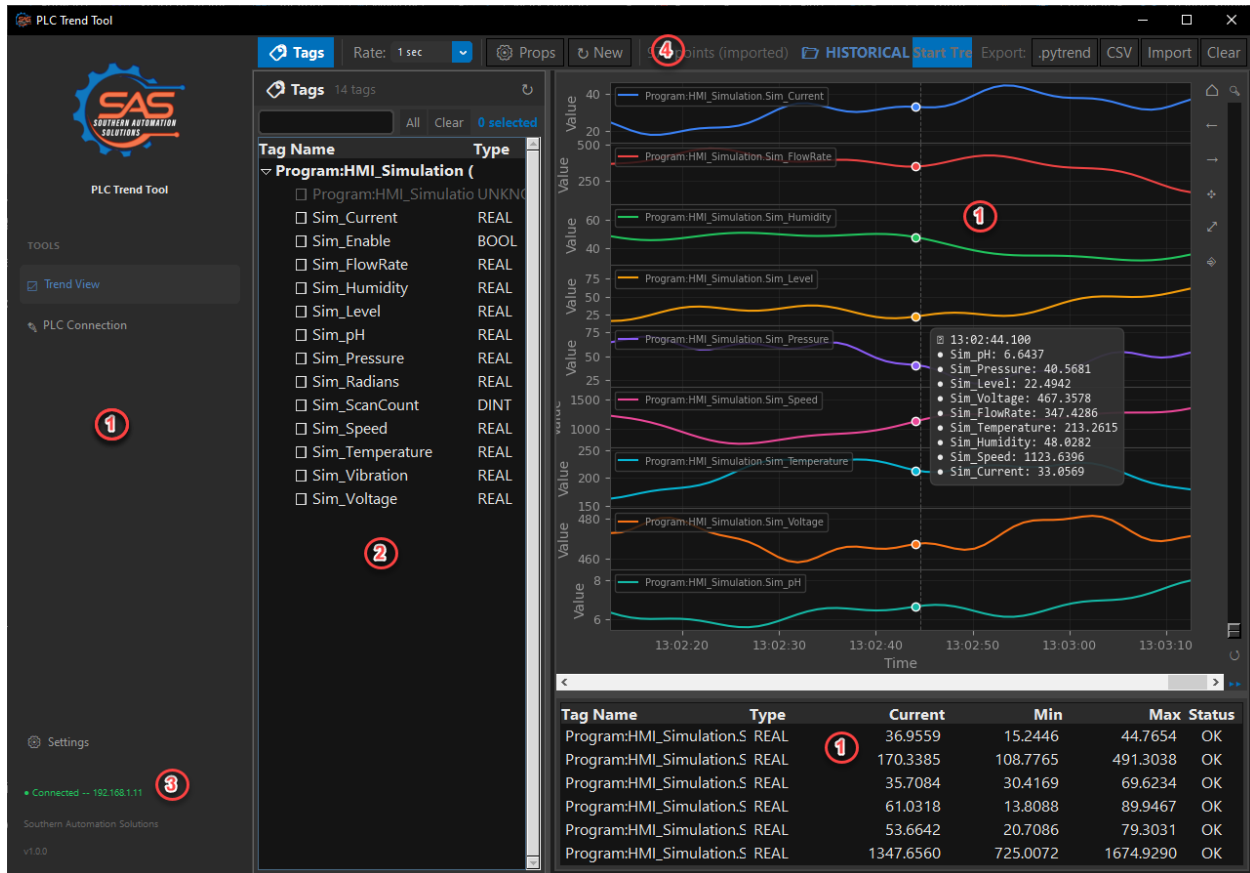
1.4 Application Layout

Figure 1: Main application window with all primary elements

1. Sidebar Logo — SAS branding with application name.

2. Tag Browser — Select tags to be trended by checking the box

3. Connection Status — Shows connected PLC IP, slot number, and number of selected tags.

4. Toolbar — Controls for trending, chart view mode, cursor, time settings, and data export/import.

5. Chart Area — Real-time trend chart with legend, grid lines, and time axis.

6. Live Data Table — Current values, min/max/average statistics, and data type for each trended tag.

2. Connecting to a PLC

Click the Connect button in the sidebar navigation to access the connection settings. The Connect view lets you specify your PLC's IP address, processor slot, and controller type.
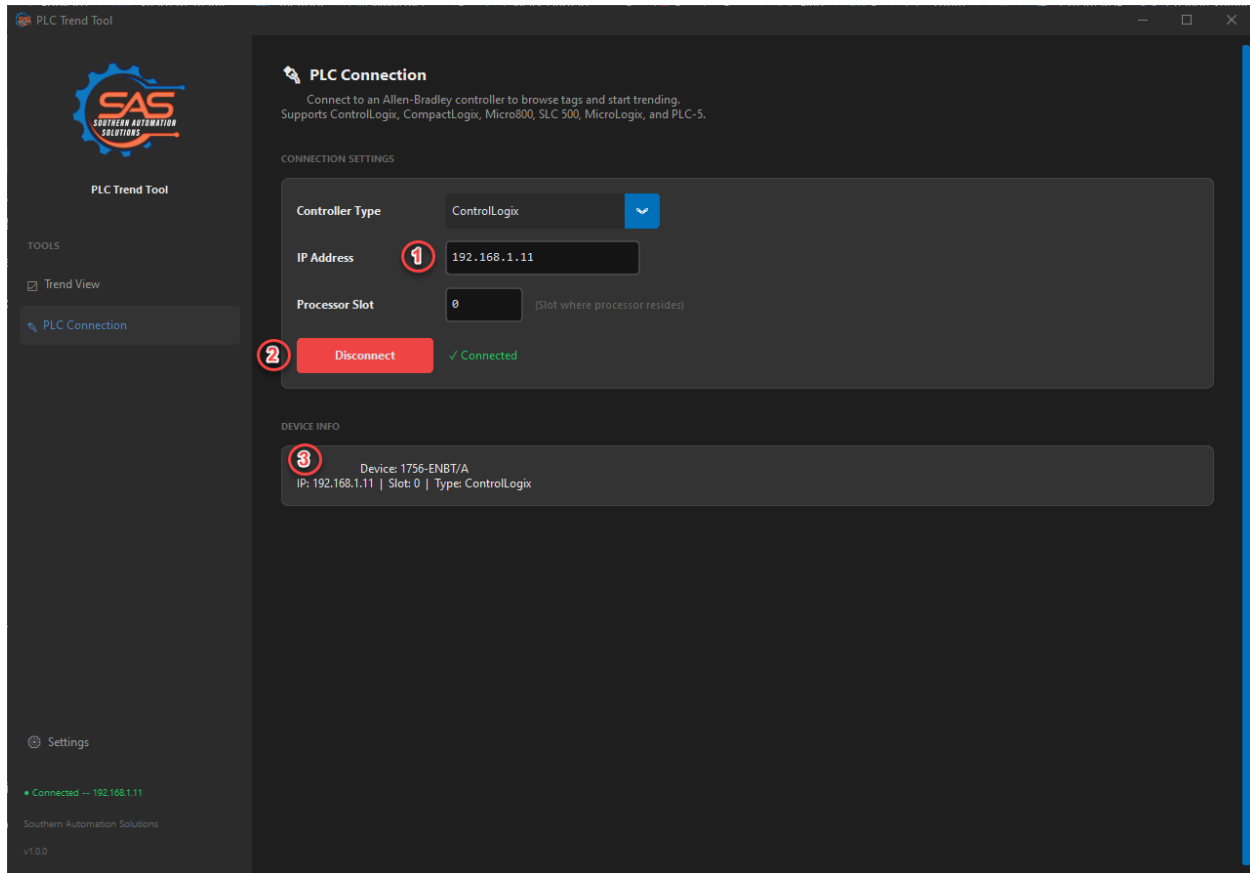

Figure 2: PLC connection settings

1. IP Address and Processor Slot — Enter the PLC's Ethernet IP address. Slot defaults to 0 (correct for CompactLogix). For ControlLogix, enter the slot number where the processor resides.

2. Connect / Disconnect — Click Connect to establish communication. The button toggles to show connection state.

3. Device Information — After connecting, displays the controller model, firmware revision, and serial number.

2.1 ControlLogix / CompactLogix

This is the default mode. Enter the IP address and processor slot, then click Connect. The tool uses the pylogix library to communicate via Ethernet/IP CIP protocol. After connecting, the tag browser automatically populates with controller tags, program-scoped tags, and UDT/AOI structure definitions.

> **TIP:** CompactLogix processors are always in slot 0. ControlLogix processors can be in any slot within the chassis.

2.2 SLC 500 / MicroLogix / PLC-5

For legacy controllers, select 'SLC 500 / MicroLogix / PLC-5' from the Controller Type dropdown. This mode requires the pycomm3 library (install separately with pip install pycomm3).

After connecting, the tool automatically scans data files 0 through 255. Default files (O0, I1, S2, B3, T4, C5, R6, N7, F8) are always included. User-created files 9-255 are probed using typed probes (N, F, B, T, C, R, ST, A, L types) to detect which files exist in the controller.

> **WARNING:** PLCs control dangerous equipment. Do not write tags to a live production system unless you understand the impact. This tool is designed for read-only monitoring.

2.3 Micro800 (820/850)

Check the Micro800 Mode checkbox before connecting. These controllers use a slightly different Ethernet/IP path. Note that Micro800 controllers have limited features compared to ControlLogix — not all tag browser capabilities may be available.

2.4 Connection Tips

- Ensure your PC is on the same subnet as the PLC (e.g., PLC: 192.168.1.10, PC: 192.168.1.100).
- If you cannot connect, try pinging the PLC IP address from a command prompt to verify network connectivity.
- The connection timeout is 5 seconds. If your network has high latency, you may need to retry.
- Disconnecting from a PLC fully resets the session — all trend data, tag selections, and chart customizations are cleared to prevent stale data when switching between different PLCs.

3. Browsing and Selecting Tags

After connecting to a PLC, click Tags in the sidebar or use the embedded tag panel on the Trend view to browse available tags. The tag browser presents a hierarchical tree view organized by scope and data type.
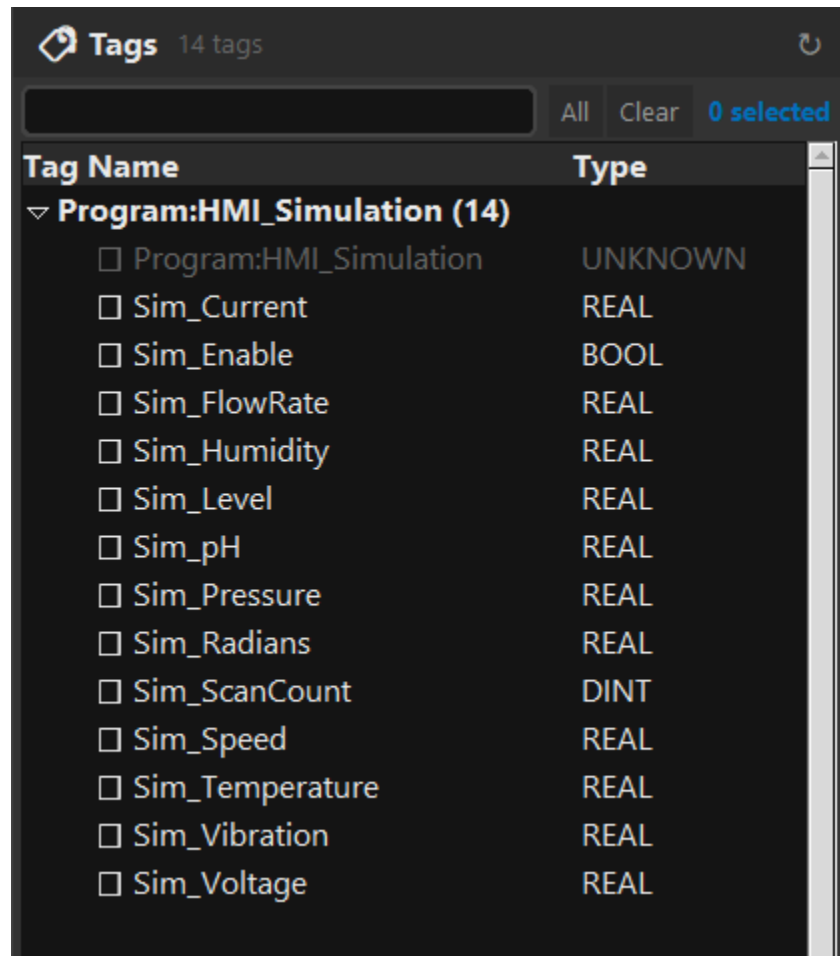

Figure 3: Tag browser showing ControlLogix and SLC tag structures

3.1 ControlLogix / CompactLogix Tags

Tags are organized under Controller Tags (global scope) and individual Program sections (program scope). Each tag shows its name and data type. You can expand UDT (User-Defined Type) and AOI (Add-On Instruction) structures by clicking the arrow to reveal their individual members.

Click the checkbox next to any fundamental data type tag (BOOL, SINT, INT, DINT, LINT, REAL, STRING) to select it for trending. Selected tags appear highlighted in the browser and are immediately added to the chart.

> **TIP:** Use the search/filter bar at the top of the tag browser to quickly find tags by name. The filter matches anywhere in the tag name.

3.2 SLC / MicroLogix Tags

SLC tags are organized by data file number and type. The tree shows each detected data file with its type label (e.g., 'N7 - Integer', 'T4 - Timer', 'F8 - Float').

Integer Word Expansion (N, O, I, S Files)

Integer-type files (N, O, I, S) support bit-level expansion. Each word element (e.g., N7:0) can be expanded to reveal two levels of data:

- **Whole Word (decimal):** Trends the full 16-bit integer value as a decimal number. Labeled as 'N7:0 (word)'.
- **Individual Bits (0–15):** Each bit can be trended separately as a BOOL value (0 or 1). Labeled as 'N7:0/0' through 'N7:0/15'. This is useful when integer words are used as bit fields for status flags or inter-PLC communication.

You can trend the whole word and individual bits simultaneously on the same chart.

Timer / Counter / Control Expansion

Timer (T), Counter (C), and Control (R) file elements expand to show their individual fields:

Type	Numeric Fields	Status Bits
Timer (T)	ACC (accumulated), PRE (preset)	EN, TT, DN
Counter (C)	ACC, PRE	CU, CD, DN, OV, UN, UA
Control (R)	LEN, POS	EN, EU, DN, EM, ER, UL, IN, FD

Float and Long Integer Files

Float (F) and Long Integer (L) data files display their elements directly as trendable items without requiring expansion, since each element is already a single numeric value.

4. Trending Data

Once you have selected tags in the browser, use the toolbar to control the trend. The chart updates in real-time as data is polled from the PLC.
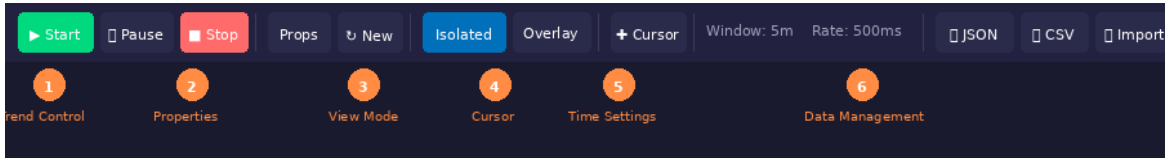

Figure 4: Toolbar with annotated control groups

1. Trend Control — Start, Pause, and Stop buttons control the data collection cycle.

2. Properties — Opens the Trend Properties dialog and the New Session reset button.

3. View Mode — Toggle between Isolated (separate subplot per tag) and Overlay (all tags on one chart).

4. Cursor — Enable/disable the smart crosshair cursor for reading values at any point in time.

5. Time Settings — Shows the current time window and poll rate.

6. Data Management — Export to JSON/CSV, import previous sessions, and clear data.

4.1 Starting and Stopping Trends

Step 1: Select Tags — Check one or more tags in the tag browser.

Step 2: Click Start — The green Start button begins polling the PLC at the configured rate (default 500ms). The chart begins scrolling with live data.

Step 3: Pause / Resume — Click Pause to freeze the display while continuing to collect data in the background. Click Resume to catch up and continue live display.

Step 4: Stop — Click Stop to end data collection. The chart freezes with all collected data available for review.

> **TIP:** You can add or remove tags while the trend is running. New tags will begin appearing on the chart from the moment they are selected.

4.2 Isolated vs. Overlay View

The toolbar provides two chart view modes that affect how multiple tags are displayed:

Isolated Mode: Each tag gets its own dedicated subplot with independent Y-axis scaling. This is ideal when trending tags with very different value ranges (e.g., a temperature tag reading 0–500 alongside a boolean status flag reading 0–1). Charts stack vertically and share a synchronized time axis.

Overlay Mode: All tags share a single chart area with a common Y-axis. This is best when comparing tags with similar value ranges. The legend identifies each line by color.
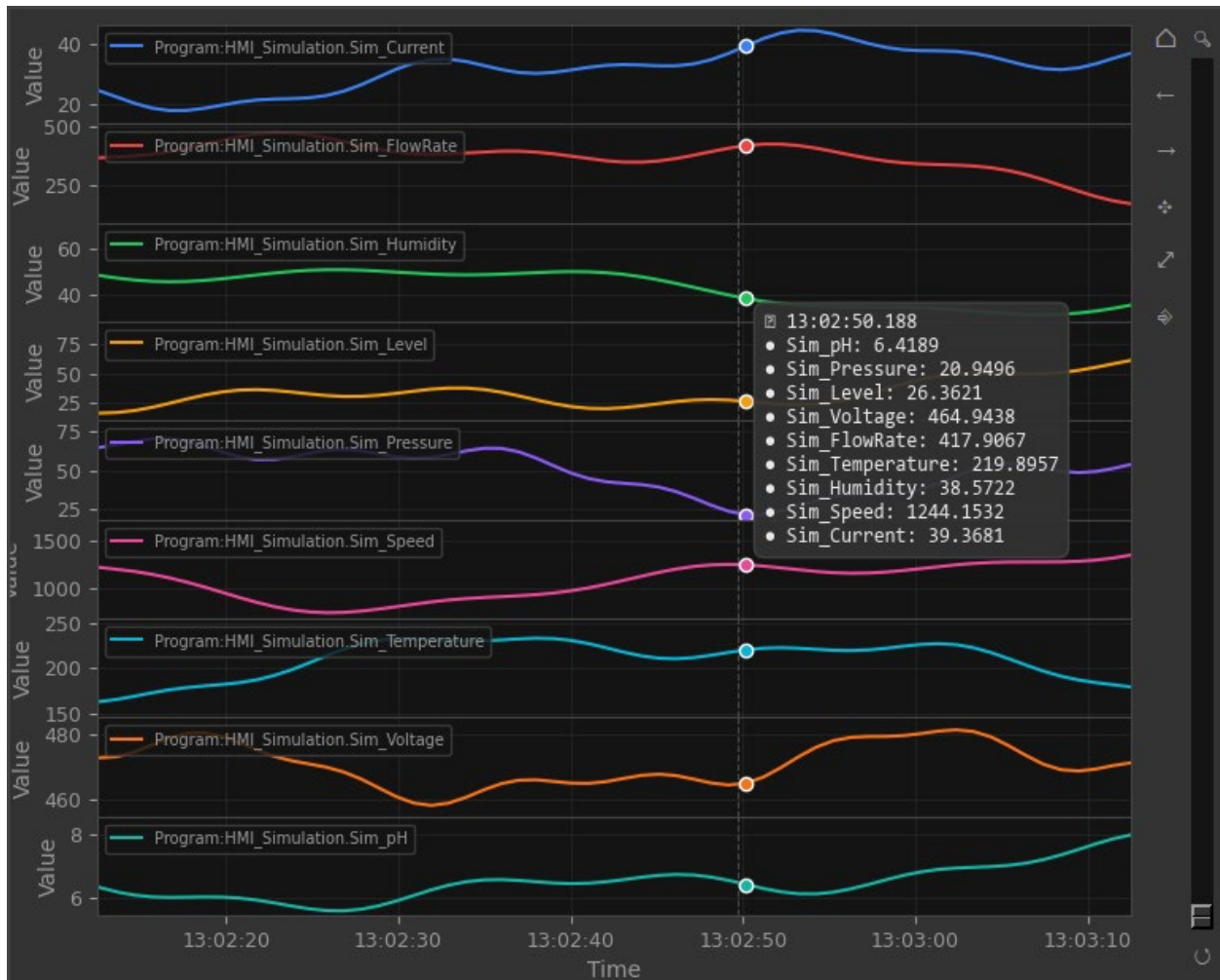
Figure 5: Isolated view with three tags, each in its own subplot with smart cursor active

4.3 Smart Cursor

Enable the cursor by clicking the Cursor button on the toolbar. When active, moving your mouse over the chart displays:

- A vertical dashed line tracking your mouse position across all subplots.
- Color-coded dots on each trend line at the nearest data point.
- A tooltip showing the exact timestamp and interpolated value for every active tag.

When the trend is stopped or paused, left-clicking on the chart locks the data table to show values at the clicked timestamp. This is useful for investigating specific moments in the data.

4.4 Chart Navigation

Action	How To
Pan (drag)	Click and drag on the chart to scroll through time. Works on both X and Y axes.

| Zoom (scroll)	Use the mouse scroll wheel to zoom in/out on the time axis.
Follow Live	Right-click the chart and select 'Follow Live' to snap back to the current time and resume auto-scrolling.
Reset View	Right-click and select 'Reset View' to restore the original zoom and pan state.
Expand Chart	In Isolated mode, double-click any subplot to expand it to fill the entire chart area. Double-click again to return to the multi-subplot view.
Reorder Charts	In Isolated mode, hold Ctrl and drag a subplot up or down to change the display order.

4.5 Right-Click Context Menu
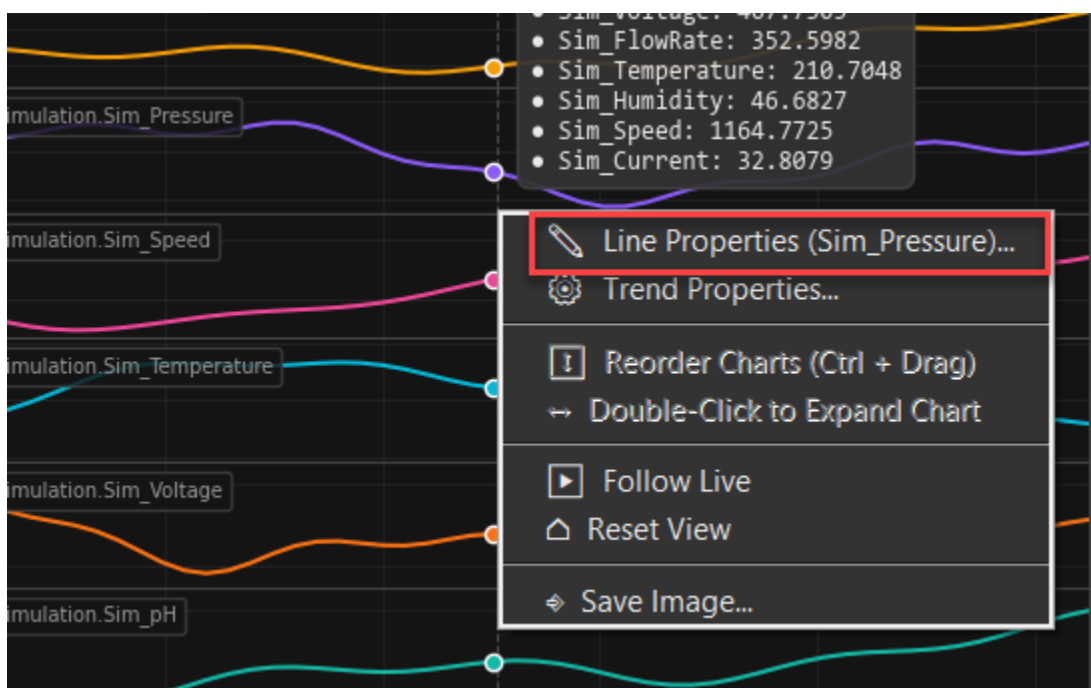
Figure 6: Right-click context menu on the chart area

Right-clicking anywhere on the chart opens a context menu with quick access to common actions. In Isolated mode, right-clicking inside a specific subplot targets that individual chart for line and background color customization.

5. Customizing the Chart

5.1 Line Properties

Access line properties by right-clicking the chart and selecting 'Line Properties', or by clicking the Props button on the toolbar. The dialog lets you customize each tag's appearance:
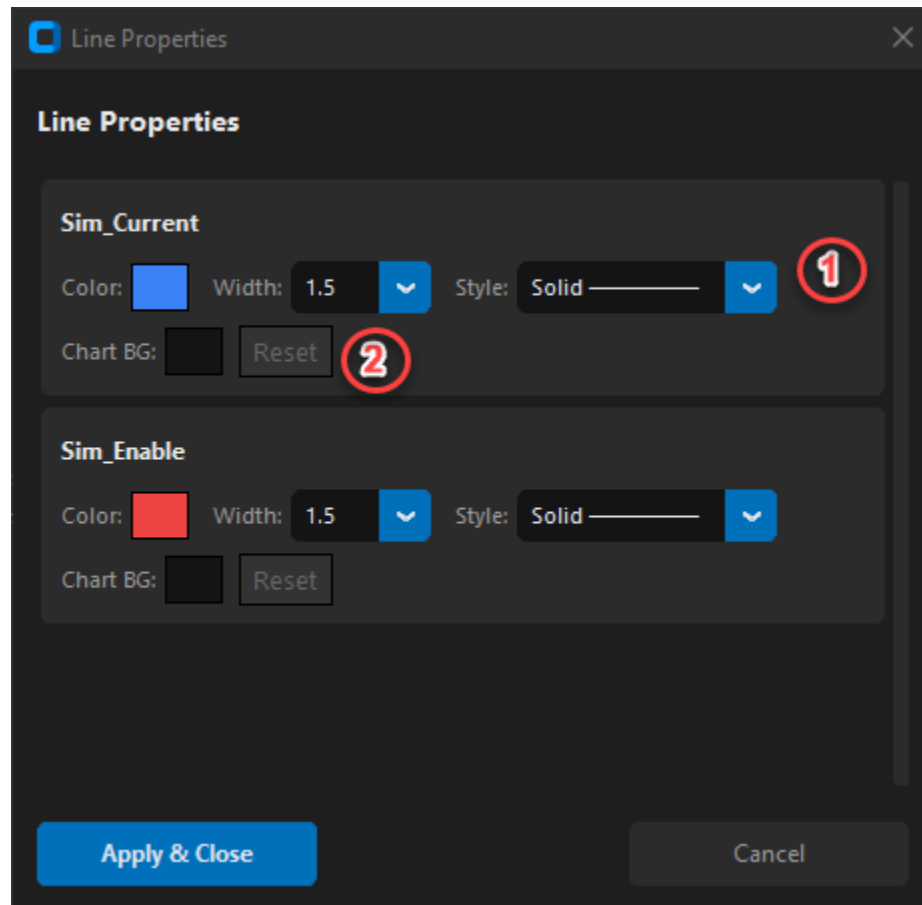

Figure 7: Line Properties dialog with color, width, style, and background controls

1. Line Controls — Set the line color (click the color swatch to open the system color picker), line width (0.5 to 5.0), and line style (Solid, Dashed, Dotted, Dash-Dot).

2. Chart Background — Set a custom background color for each tag's chart area. Click the color swatch to choose a color, or click Reset to revert to the default theme color.

Context-Aware Behavior

The Line Properties dialog adapts based on where you right-click:

- **Right-click on grey/surrounding area:** Shows properties for ALL tags in one dialog. In Overlay mode, any tag's background color applies to the shared chart.

- **Right-click inside a specific subplot (Isolated mode):** Shows properties for only that tag, letting you customize its individual chart appearance.

5.2 Trend Properties

Click the Props button or right-click and select 'Trend Properties' to open the configuration dialog.
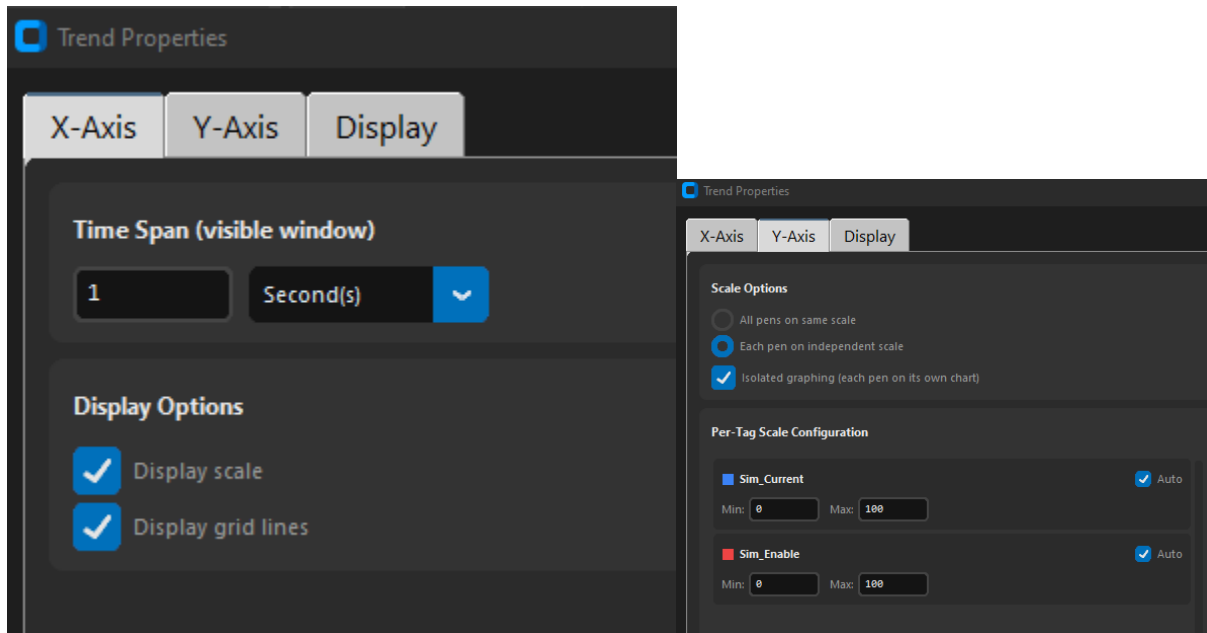

Figure 8: Trend Properties dialog with time, Y-axis, and display settings

Time Settings

- **Time Window:** How much historical data is visible on the chart at once (30 seconds to 4 hours). Use the quick preset buttons for common durations.
- **Poll Rate:** How frequently the tool reads values from the PLC (100ms to 10 seconds). Faster rates provide smoother charts but increase network traffic.
- **Max Data Points:** Maximum number of samples stored per tag. When exceeded, oldest points are discarded. Default is 50,000.

Y-Axis Scaling

By default, each tag auto-scales its Y-axis to fit the data range. You can override this with manual scaling by setting specific minimum and maximum values. This is useful when you want a fixed reference range (e.g., 0–100 for a percentage value).

6. Data Management

6.1 Exporting Data

Two export formats are available from the toolbar:

JSON Export (.pytrend)

Saves the complete session including all tag data, timestamps, chart configurations, line properties, and scaling settings. This is the preferred format for archiving sessions that you want to reload later. Click the JSON button on the toolbar and choose a save location.

CSV Export

Exports tag data as a comma-separated values file compatible with Excel, Google Sheets, and other analysis tools. Each row contains a timestamp followed by the value for each tag. Click the CSV button to export.

6.2 Importing Data

Click the Import button on the toolbar to load a previously saved .pytrend or .csv file. The chart and data table will populate with the historical data, allowing you to review past trending sessions. When importing, the view switches to Historical mode, indicated by a badge in the toolbar.

> **TIP:** You can import data without being connected to a PLC. This lets you review historical trends on any PC, even without network access.

6.3 Session Management

New Session (Reset): Click the ↻ New button on the toolbar to completely reset the application state. This clears all trend data, tag selections, chart customizations, line properties, and background colors. If still connected to a PLC, the tag browser reloads fresh. Use this when switching between different monitoring tasks on the same PLC.

Disconnect: Disconnecting from a PLC performs the same full reset as New Session, ensuring no stale data persists when connecting to a different PLC.

Clear Data: The Clear button removes all collected data points but preserves your tag selections and chart settings. Use this to start a fresh data collection without reconfiguring the display.

7. Application Settings

Click Settings in the sidebar to access application-level configuration.

7.1 Theme

Choose between Dark mode (default), Light mode, or System (follows your Windows theme setting). The dark theme is recommended for extended monitoring sessions to reduce eye strain.

7.2 Saved Settings

The application automatically saves your preferences to a plc_trend_settings.json file in the same directory as the application. Saved settings include: last IP address, processor slot, controller type, theme preference, time window, poll rate, and max data points. These are restored automatically on next launch.

8. Keyboard Shortcuts & Tips

Shortcut	Action
Ctrl + Drag (chart)	Reorder subplots in Isolated mode
Double-Click (chart)	Expand subplot to fullscreen / exit fullscreen
Right-Click (chart)	Open context menu with quick actions
Scroll Wheel (chart)	Zoom in/out on time axis
Click + Drag (chart)	Pan through time / adjust view
Left-Click (stopped)	Lock data table to show values at clicked timestamp
Filter bar (tag browser)	Type to filter tags by name — matches partial strings

8.1 Performance Tips

- Trend only the tags you need. Each additional tag adds network overhead and chart rendering load.
- For high-speed monitoring (100ms poll rate), limit to 5–10 tags for best performance.
- Use Isolated mode when trending tags with very different value ranges to avoid Y-axis scaling issues.
- Reduce the Max Data Points setting if the application becomes sluggish during long trending sessions.

9. Troubleshooting

Issue	Solution
Cannot connect to PLC	Verify IP address and subnet. Ping the PLC from command prompt. Check Ethernet cable. Ensure processor slot is correct.
Tag shows 'None' / error	The tag name may not exist. Verify spelling and scope (controller vs program tags). Check that the data type is supported.
SLC scan finds too many files	This was a known issue with false positives from O/I memory mapping. Update to the latest version which uses typed probes only.
SLC scan finds too few files	User files beyond 8 are scanned using typed probes (N, F, B, T, C, R, ST, A, L). Unusual file types may not be detected.
Old data from previous PLC	Click the New Session button or disconnect and reconnect. Both operations fully reset all session state.
Chart scaling jumps	This can occur with cursor enabled if the auto-scale reacts to cursor elements. Update to latest version for the fix.
Logo/icon missing	Ensure assets_data.py is in the same folder as plc_trend_tool.py. The app extracts icons from this file on first launch.

pycomm3 not found	SLC/MicroLogix/PLC-5 support requires pycomm3. Install with: pip install pycomm3
App crashes on startup	Verify all dependencies: pip install -r requirements.txt. Check Python version is 3.8+. Delete plc_trend_settings.json to reset.

End of User Guide

For technical support or feature requests:

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