



SPA120 User Manual

Dual Source Picoammeter

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1 Notices

1.1 Copyright

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The latest version of this document can be found on our website:

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Hereafter referred to as **Electron Plus**.

1.6 Notes

- We frequently update our manuals and add new features and improvements as they become available, please ensure that you check our website for an updated version of this document, especially if updating your **Electron Plus** software.
- We make every effort to ensure the accuracy of this manual's contents. If you find any errors, have suggestions for expanding on a feature, or feel that we can improve its contents then please contact us at support@electron.plus
- Copying or reproducing this document or any part of this document without written permission of **Electron Plus** is strictly prohibited.

1.7 Trademark Acknowledgement

Electron Plus fully recognises and acknowledges any trademark(s) of the respective trademark holder.

Windows[™] is a trademark of Microsoft Corporation.

1.8 Purpose of Manual

The purpose of this manual is to enable you to safely setup, configure and operate your **Electron Plus** instrument, associated software and/or accessories.

Please pay particular attention to any section with a warning symbol.

1.9 Safety Warnings

Warnings, cautions and notes are colour coded through-out this manual. These are divided into several categories and are described below:

WARNING - Pay special attention to anything written here - this is for your safety and continued protection and is critical information!

CAUTION - Damage may occur to your equipment or any DUT (device under test).

NOTE - General text, with useful information or tips.

1.10 REACH / CLP Compliance Statement

Statement on Safety Data Sheet (SDS) for product:
SPA120 Dual Source Picoammeter

According to EU Regulation (EC) N° 1907/2006 (REACH) and Regulation (EC) N° 1272/2008 (CLP), no Safety Data Sheet is required for this product.

This product is classified as an article under REACH and:

- has no hazardous classification under CLP
- contains no Substances of Very High Concern (SVHC) in concentrations above 0.1% w/w and no intentional released under normal or reasonably foreseeable conditions of use (REACH Article 33)
- complies with Directive 2011/65/EU (RoHS) as amended by Directive (EU) 2015/863 (RoHS 3)

For safe use, please refer to the user manual and product labelling.

Should any changes occur in product composition or regulations, we will notify affected customers promptly.

Issued by:

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2 Getting Started

Welcome to the EPIC software for the **SPA120 Dual Source Picoammeter** by **Electron Plus**. This manual covers every aspect of operating the instrument and software. The SPA120 provides two independent measurement channels (Ch.1 and Ch.2), each with its own current measurement input and programmable bias voltage source.

2.1 What is the SPA120?

The SPA120 is a Dual Source Picoammeter that provides two independent measurement channels (Ch.1 and Ch.2). Each channel has its own current measurement input and programmable bias voltage source, allowing simultaneous measurement of two devices or two points on the same circuit. Both channels offer the full range of measurement capabilities, with the added benefit of dual-channel operation for comparative or differential measurements.

2.2 Key Specifications

Parameter	Specification
Current measurement ranges	2mA, 200uA, 20uA, 2uA, 200nA, 20nA, 2nA, 200pA
Number of ranges	8
Bias voltage supply	0V to +40V (or -40V)

Parameter	Specification
Polarity control	Positive / Negative
Sample rates	2Hz, 10Hz, 20Hz
Rolling averaging	1x, 2x, 4x, 8x, 10x, 16x, 20x, 32x, 40x, 64x
Channels	2
Interface	USB 2.0
Software	EPIC (free updates)

2.3 System Requirements

- Windows 10 or later
- USB 2.0 port for instrument connection
- Minimum 1440x900 display resolution (1920x1080 recommended)
- EPIC software (free download from www.electron.plus)

2.4 What is in the Box

- 1x SPA120 Dual Source Picoammeter
- 1x USB cable

3 Instrument Indicators

The SPA120 has one LED indicator:

- **GREEN LED** - Indicates the unit is connected and communicating with the EPIC software.

The source output state is shown by the **Source** button indicator in the EPIC software. There is no physical LED for source status.

4 Quick Start

1. Connect the SPA to your computer via the USB cable
2. Launch the EPIC software
3. Select **SPA120** as the active instrument (if not already selected)
4. Click the **Connect** button to establish communication
5. Select the desired current measurement range
6. Set the bias voltage and polarity as required

7. Connect your device or circuit to the input terminals
8. Enable the **Source** output by clicking the Source button
9. Click **Run** to begin recording and observe the live current on the graph

Always ensure the source output is disabled in EPIC before connecting or disconnecting devices from the input terminals. The Source button indicator must show OFF before handling the input connections.

5 Introduction

5.1 Welcome

Congratulations and thank you for purchasing an **Electron Plus** product.

Please take a few minutes to read the 'Before you start' section of this manual, especially as misusing this product can result in damage to it, your device-under-test or potentially place you in danger.

5.2 Before You Start

General

The SPA120 is a USB-powered instrument and does not require an external power supply under normal operating conditions.

Handle the input terminals and connectors with care. Do not force connections or over-tighten terminal posts.

The SPA120 can generate bias voltages up to 40V at the output terminals. Users are expected to be fully aware of the risks posed by these voltages and the precautions required to maintain safety.

If the Source button in EPIC shows ON, assume that a bias voltage is present at the output terminals and act accordingly!

5.3 Safety and Handling

WARNING - Read this section carefully before operating your Source Picoammeter

5.4 Maximum Ratings

The SPA120 has the following absolute maximum ratings that must never be exceeded:

Parameter	Maximum Rating
Bias voltage output	0V to ± 40 V DC
Input current (measurement terminal)	Do not exceed selected range full-scale
Operating temperature	0°C to 40°C
Storage temperature	-20°C to 60°C
Humidity	20% to 80% RH, non-condensing

Exceeding these limits may permanently damage the instrument and void your warranty.

5.5 Electrostatic Discharge (ESD) Precautions

The SPA120 contains sensitive electronic components that can be damaged by electrostatic discharge. When handling the instrument:

- Use an anti-static wrist strap when connecting/disconnecting measurement leads
- Store the instrument in its anti-static packaging when not in use
- Avoid touching the input connector centre pins directly
- Discharge yourself by touching a grounded metal object before handling

5.6 Package Contents

Your SPA120 package should contain:

- 1x SPA120 Dual Source Picoammeter
- 1x USB 2.0 cable

If any items are missing or damaged, please contact Electron Plus immediately at support@electron.plus

5.7 Initial Inspection

Before use, inspect your instrument for any damage that may have occurred during shipping:

1. Check the enclosure for cracks, dents, or other physical damage
2. Inspect the input connectors for bent pins or damage
3. Examine the USB connector for damage
4. Verify the instrument label shows your serial number

If you notice any damage, do not operate the instrument. Contact Electron Plus or your distributor immediately.

5.8 Measurement Best Practices

For accurate low-current measurements, follow these guidelines:

- Allow the instrument to warm up for a few minutes before precision measurements
- Use the Null/Zero function to cancel offset currents before taking critical readings
- Keep measurement cables as short as practical
- Use shielded cables for measurements below 20nA to minimise noise pickup
- Use guarded connections where possible for measurements below 2nA to reduce leakage paths
- Avoid fluorescent lighting and other sources of electromagnetic interference near the measurement area
- Ensure all connections are clean and free from oxidation or contamination
- Allow the measurement to stabilise - settling time increases for lower current ranges
- For ultra-low current measurements (200pA range), use a Faraday cage or shielded enclosure

5.9 Operating Environment

- **Temperature:** 0°C to 40°C (32°F to 104°F) operating, -20°C to 60°C storage
- **Humidity:** 20% to 80% relative humidity, non-condensing
- **Altitude:** Up to 2000m above sea level
- **Location:** Indoor use only, in a clean, dry environment
- **Ventilation:** Ensure adequate airflow around the instrument

5.10 What You Will Need

To operate the SPA120, you will require:

- A Windows PC meeting the system requirements
- Available USB 2.0 port
- EPIC software (free download from www.electron.plus/pages/software)
- CH340 USB driver (free download from www.electron.plus/pages/software)

5.11 Installation Sequence

Please install the **EPIC** software BEFORE connecting your instrument to a computer for the first time.

You do not need to remove a previous copy of **EPIC**, the new copy will overwrite the necessary existing file(s). The "settings.txt" file will only be created if it is not present.

When **EPIC** is first started, it will build a number of files (unless they are already there from a previous installation) in the installation directory.

EPIC software is specifically for the **Electron Plus** range of products including curve tracers, source picoammeters, analog signature analysers, and power analysers ONLY.

If upgrading from an earlier version of EPIC please be aware that the program EXE is named after the version (e.g. EPIC_26600.exe). Previous desktop shortcuts may not work or may link to the previous version.

5.12 Installing EPIC Software

Electron Plus products require a USB connection to a PC running **EPIC** (our proprietary software) in order to function.

You can download the latest copy of **EPIC** for free from www.electron.plus/pages/software. **EPIC** is being constantly revised with new features, updates and bug fixes.

1. Download the installer ZIP file from the software page (e.g. EPIC_26600.zip)
2. Open the downloaded file (Windows will recognise the ZIP format and display the contents like a folder), then double click the EXE installer inside
3. Follow the on screen instructions to complete the installation

Before starting **EPIC**, we recommend installing the USB driver - see next section for details.

This manual MAY NOT represent the most up-to-date features and screen-shots, if something is unclear, please contact support@electron.plus and we will promptly try to assist you.

5.13 Installing the USB Driver

This product communicates with the host PC via USB using a CH340 bridge IC made by WCH.

A copy of the official WCH device driver is available from the SOFTWARE section of our website www.electron.plus/pages/software, device drivers can also be downloaded directly from WCH's website.

The driver we use with Windows machines is: CH341SER and is available as .EXE or a .ZIP

6 Connecting Your Instrument

6.1 USB Connection

The SPA connects to your computer via a USB 2.0 cable. The instrument uses a CH340 USB-to-serial bridge which creates a virtual COM port.

The SPA120 is USB-powered and does not require an external power supply for normal operation.

6.2 COM Port Selection

The software will attempt to auto-detect the SPA on startup. If auto-detection fails:

1. Open **Settings** by clicking the Settings button
2. Navigate to the **Comms** tab
3. Use the **Scan** button to search for available COM ports
4. Select the correct COM port from the dropdown list
5. Click **Set** to confirm

The SPA120 has its own COM port setting stored independently from other instruments. The assigned COM port is displayed under the instrument button on the Instrument selection tab.

6.3 Connection Status

The connection status is displayed in two places:

- **Connect button** in the top bar - shows the current connection state
- **Comms Status widget** (if enabled via the Advanced panel) - shows detailed communication statistics including TX, RX, and Errors

Status	Meaning
Connected	Instrument is communicating normally
Disconnected	No communication with instrument
Searching	Software is attempting to find the instrument
Error	Communication error detected

6.4 Troubleshooting Connection Issues

- Ensure the USB cable is firmly connected at both ends
- Check that the GREEN LED on the SPA is lit (indicates power and USB connection)
- Try a different USB port on your computer
- Check that the correct COM port is selected in Settings
- Ensure no other software is using the same COM port
- Check Windows Device Manager for the COM port listing
- Try restarting both the software and the instrument

7 Input Settings

The input settings control how the SPA measures current from the device under test. These controls are located in the left-hand ribbon of the main display.

7.1 Range Selection

The SPA provides eight current measurement ranges, each optimised for a specific decade of current. Select the range using the **Range** control in the left ribbon. Use the + and - buttons to step through the available ranges.

Range	Full Scale	Best For
2mA	2 milliamps	General-purpose current measurement, LED testing
200uA	200 microamps	Moderate leakage currents, sensor characterisation
20uA	20 microamps	Low-current device testing, photodetector characterisation
2uA	2 microamps	Insulation resistance testing, low-leakage semiconductors
200nA	200 nanoamps	High-resistance material characterisation
20nA	20 nanoamps	Ultra-low leakage measurement, capacitor leakage
2nA	2 nanoamps	Picoammeter-grade measurement, thin-film characterisation
200pA	200 picoamps	Ultra-low current measurement, guard-ring structures

Choosing the correct range: Select the lowest range that can accommodate the expected current without over-ranging. A lower range provides finer resolution and lower noise. If the measured current exceeds the selected range, the display will indicate an over-range condition.

For best accuracy at very low currents (2nA and 200pA ranges), allow the instrument to warm up for a few minutes and use the Null/Zero function to cancel any offset before taking measurements.

7.2 Sample Rate

The sample rate determines how frequently the instrument acquires current readings. Select the sample rate using the **Sample Rate** control.

Sample Rate	Description
2Hz	Slowest rate. Provides the lowest noise and best accuracy. Ideal for stable, low-current measurements where speed is not critical.
10Hz	Balanced rate. Good compromise between noise performance and update speed. Suitable for most general-purpose measurements.
20Hz	Fastest rate. Best for capturing rapidly changing currents or for fast data logging. Higher noise floor than slower rates.

A slower sample rate allows the instrument to average over a longer integration period, reducing noise and improving measurement stability. Use 2Hz for the most demanding low-current measurements and 20Hz when you need to capture transient behaviour.

7.3 Null / Zero

The **Null** (also called **Zero**) function cancels residual offset current in the measurement path. This is essential for low-current measurements where offsets from cables, connectors, and the instrument's input circuitry can be significant.

To perform a null/zero:

1. Disconnect the device under test (or ensure zero current is flowing)
2. Allow the reading to stabilise
3. Click the **Null** button
4. The instrument captures the current offset and subtracts it from all subsequent readings

The null offset is stored for the currently selected range. If you change ranges, you may need to perform the null procedure again.

On the SPA120, each channel has its own independent Null function. Click the Null button in the Ch.1 or Ch.2 controls to null that channel separately.

Null/zero is particularly important when measuring on the 200pA, 2nA, and 20nA ranges, where input offset currents can be a significant fraction of the full-scale reading.

7.4 Input Short

Each channel has its own **Short** button that shorts that channel's input terminals together. Click to toggle between **SHORT: ON** (input shorted) and **SHORT: OFF** (normal measurement). Use it to check the baseline offset and cable integrity before connecting a device under test.

7.5 Rolling Averaging

Rolling averaging reduces noise by computing a moving average of multiple consecutive readings. Select the averaging factor using the **Averaging** control.

Averaging Factor	Effect
1x	No averaging. Each displayed reading is a single sample.
2x	Average of 2 consecutive readings
4x	Average of 4 consecutive readings
8x	Average of 8 consecutive readings
10x	Average of 10 consecutive readings
16x	Average of 16 consecutive readings
20x	Average of 20 consecutive readings
32x	Average of 32 consecutive readings
40x	Average of 40 consecutive readings
64x	Average of 64 consecutive readings. Maximum smoothing.

Trade-off: Higher averaging factors produce a smoother, more stable reading but increase the response time. With 64x averaging at 2Hz sample rate, the displayed reading reflects the average over 32 seconds of data. For fast-changing signals, use a lower averaging factor or no averaging (1x).

Typical usage:

- **1x to 4x** - Fast-changing signals, transient capture, initial setup
- **8x to 20x** - General-purpose measurement, moderate noise reduction
- **32x to 64x** - Stable DC measurements where maximum noise rejection is needed

7.5.1 Per-Channel Averaging (SPA120)

On the SPA120 each channel has its own independent averaging control, so Channel 1 and Channel 2 can use different averaging factors at the same time. This is useful when one channel measures a fast transient while the other monitors a stable DC level. The two **Averaging** controls appear stacked in the left ribbon, one per channel. To drive both from a single control, see **Channel Sync** below, which can link Channel 2 averaging to Channel 1.

8 Source Supply

The SPA includes a programmable bias voltage source for applying a controlled voltage to the device under test. The source supply controls are located in the left-hand ribbon of the main display.

8.1 Voltage Control

The source supply provides a continuously adjustable output from **0V to +40V** (or **-40V** when negative polarity is selected). Use the **+** and **-** buttons to step through preset voltage levels, or click the **centre** of the control to enter a custom voltage value directly via a dialog.

The voltage output is suitable for biasing semiconductors, driving sensors, characterising high-resistance materials, and measuring insulation resistance.

Always start with a low voltage when testing an unknown device and increase gradually to avoid damage.

8.2 Polarity

The source supply polarity determines whether a positive or negative voltage is applied to the output terminals. Click the **polarity toggle** to switch between Positive and Negative.

- **Positive:** Applies a positive bias voltage (0V to +40V)
- **Negative:** Applies a negative bias voltage (0V to -40V)

Select the polarity appropriate for your device under test and measurement configuration.

8.3 Source On/Off

The **Source** button enables or disables the bias voltage output.

- Click **Source** to toggle the voltage output on or off
- The Source button indicator in EPIC shows the current state
- The source will automatically disable if a communication error occurs
- On the SPA120, each channel has its own Source on/off control

Always ensure the device under test is properly connected before enabling the source output. The Source button must show OFF before connecting or disconnecting devices.

Safety: source enable requires a valid calibration.

The SPA120 will refuse to enable the Channel 1 or Channel 2 source output until a valid calibration is loaded for the corresponding channel. This is enforced as a safety feature: with no calibration loaded, the firmware's "0 V" set point measures approximately -45 V at the front terminals, because the digital-to-analog converter mid-point is offset and there is no correction available in passthrough mode. Engaging the source in this state could damage your device under test.

If you click Source: ON on either channel while no calibration is loaded: - The source stays OFF (the click is refused). - A warning notification appears explaining which channel was refused. - The Source button indicator stays in the OFF state.

To resolve: 1. Connect to a previously calibrated SPA120. When a calibration from a prior session against this same instrument is present, EPIC loads it on connect and both channels' sources become available immediately. 2. Run a calibration cycle. Open Settings → Calibration and run the SPA120 calibration procedure. Once the device's flash calibration has been read back and the file written, the sources can be enabled.

The guard fires per channel - you may have one channel's source available and the other refused if the calibration data is incomplete.

This guard cannot be overridden from the user interface.

9 Graph Display

The main graph area plots measured current against time.

9.1 Main Graph

Current (Y-axis) is plotted against time (X-axis). The display updates continuously as new readings are acquired, showing stability, transient events, drift, and the effect of voltage changes on current.

9.2 Graph Title

Click the graph title at the top of the main graph to edit it. The title is saved with setup files.

9.3 Graph Key

Below the main graph, a colour-coded key identifies each channel's trace. Ch.1 is shown in yellow, Ch.2 in cyan. Toggle the key on or off from the **Graph Keys** button in the Advanced panel.

9.4 Sub-Graph Overview

Below the main graph, a **sub-graph overview** provides a miniature view of the entire recording. This is particularly useful for long recordings where only a portion of the data fits in the main graph view.

Key features of the sub-graph:

- Shows the complete recording at all times, giving context for where the current view sits within the full dataset
- **C and D markers** (vertical dashed lines) bracket the portion of the recording shown in the main graph. They are labelled C and D so they don't get confused with the main graph's A and B measurement cursors
- **Click anywhere INSIDE the C/D box** (between the two markers, boundaries inclusive) to pick up the box and drag it. The cursor's position within the box is preserved as you move - the box does not snap its centre under the cursor, so a careful grab gives a careful drag
- **Click OUTSIDE the C/D box** to snap the box centre directly to the click point. Useful for jumping a long distance through a recording in a single click
- **D never goes off-screen.** The right edge of the C/D box is clamped to the latest data sample, so you cannot drag the visible window past the end of the recording

Auto-follow mode: When first started, the D marker automatically tracks the right edge of the incoming data so the main graph always shows the latest measurements. This is indicated by the **D marker turning green**. If you drag the box back to browse earlier data, auto-follow disengages and the D marker returns to the normal grid colour. To re-engage auto-follow, drag D all the way to the right edge of the sub-graph - when the chart is connected and live, it snaps back into auto-follow mode and the D marker turns green again. If the chart is not actively recording (paused, stopped, or disconnected) dragging D to the right edge simply parks it there: auto-follow only re-engages when there is fresh data to follow

Trace dimming: Click on a column of the sub-graph to dim that trace, useful for focusing on specific time regions or comparing before/after segments.

Splitter bar: The boundary between the main graph and sub-graph can be dragged vertically to adjust the relative sizes of each graph. Drag up to give more space to the sub-graph, or down to enlarge the main graph. The splitter position is saved with setups.

9.5 Timebase

The **Timebase** control in the left ribbon sets the horizontal time scale (seconds per division) for the main graph. Use the + and - buttons to zoom the time axis in or out. The timebase determines how much time is visible in the main graph window at once. Smaller timebase values show finer detail; larger values show more data.

9.6 Y-Axis Scale

The **Y-Scale** control sets the vertical current scale (amps per division) for the main graph. Use the + and - buttons to adjust the vertical zoom. The Y-axis scale determines how much current range is visible in the main graph.

9.7 Y-Axis Mode

Below the Y-Scale control, mode buttons control how the Y-axis is positioned:

Mode	Description
AUTO	Automatically adjusts the Y-axis range to fit all visible data. Click again to switch to manual mode with +/- buttons for stepping through fixed Y-axis ranges.
CENTRE	Symmetric around zero - the Y-axis range is set so that zero is always centred on the graph, with equal positive and negative extent.
POS	Forces the Y-axis from 0 to the full-scale of the current range. Zero is at the bottom.
NEG INV	Forces the Y-axis from -full-scale to 0. (Appears when NEG is selected) Inverts the negative axis so that zero is at the bottom and magnitude increases upward. This matches the CTL503 convention for negative polarity curves.

9.8 Recording

Click the **Run** button to begin recording current measurements to the graph. The instrument will continuously acquire and display readings at the selected sample rate.

Click the **Stop** button to end the recording session. The session is automatically saved, and the graph is cleared ready for the next recording.

9.9 Pause and Resume

Click the **Pause** button to temporarily suspend recording without ending the session. The graph retains all data collected so far.

Click **Pause** again (or **Run**) to resume recording. New data is appended to the existing session. The boundary between paused and resumed segments is marked on the graph.

9.9.1 Pause Markers

In Local Time and UTC display modes, pause boundaries appear as a filled gap on the graph with a rotated text label showing the duration of the pause (e.g. "RECORDING PAUSED FOR 00:01:23.456").

9.9.2 Range Change Warning

If the measurement range is changed on either channel during a pause, a bright red warning is displayed alongside the pause duration text:

CH1 RANGE: 200 pA → 2 nA | CH2 RANGE: 20 nA → 200 nA

This alerts you that data either side of the pause was measured with different sensitivity, so readings across that boundary are not directly comparable. Warnings appear independently for each channel - only the channel(s) whose range actually changed will be shown.

9.10 Markers

The **Marker** button drops a numbered reference line on the graph at the moment you click it. Use markers to flag points of interest while recording, for example the instant you apply a bias step, switch a device, or see an event you want to find again later.

The Marker button sits on the action strip at the top of the experiment page, alongside the Run, Pause, Stop and export buttons.

How to use:

- Click **Marker** while recording. A red dashed vertical line appears on the next incoming sample, with the marker number printed at the top of the line.
- Markers are numbered sequentially from 1. The numbering restarts at 1 each time you begin a new recording.
- Markers appear on both the main graph and the sub-graph overview, so you can locate them whether you are zoomed in or viewing the whole session.

The Marker button is only active while a recording is running. When recording is stopped or paused it is dimmed, because there is no incoming sample for the marker to attach to.

Markers are saved with the recording. When you review a saved session in the Session Browser, the markers you dropped during that recording reappear at the same positions.

10 Session Browser

The Session Browser provides access to previously recorded measurement sessions.

10.1 Browsing Sessions

Use the < > arrow buttons to step through saved session files. The session data is loaded and displayed on the graph, allowing you to review historical measurements.

10.2 Opening a Specific Session

Click the **centre** of the Session Browser panel (where the session name is displayed) to open a file chooser dialog. This lets you navigate directly to any session JSON file in the sessions folder without stepping through files one at a time.

10.3 Returning to Live Data

After browsing session files, start a new recording to return to live data display.

11 Results Display

The right-hand ribbon displays live numerical data from the instrument.

11.1 Live Current

The primary result displayed is the **live current** reading, shown in engineering notation with appropriate units (mA, uA, nA, or pA). This value updates continuously at the selected sample rate.

11.2 Max / Min Tracking

The results display tracks and shows:

- **Maximum (MAX+)** - The highest current reading observed since the last reset
- **Minimum (MAX-)** - The lowest (most negative) current reading observed since the last reset

Click on the **MAX+** display to reset the positive maximum to the current reading, or click on the **MAX-** display to reset the negative maximum independently. Each reset only affects the value you click on. If a tracked value exceeds 4 digits, the display shows **OVR** (over-range) instead of the numeric value.

Max/Min tracking identifies peak and trough values during a session.

11.3 Resistance Calculation

The SPA calculates and displays the resistance of the device under test using Ohm's law:

$$R = V / I$$

Where **V** is the applied bias voltage and **I** is the measured current. This provides a real-time resistance reading that updates as the voltage or current changes.

The resistance reading requires a non-zero bias voltage.

12 Cursors

The SPA provides a full cursor measurement system for making precise measurements on recorded graph data.

12.1 X Cursors

Click the **X Cursor** button on the toolbar to enable horizontal (time) cursors. Two vertical cursor lines (A and B) appear on the main graph.

- **Drag** cursor A or B directly on the graph to position them
- Use the +/- fine-adjust buttons in the cursor controls to nudge cursors by small increments
- Cursor values are displayed in absolute time (seconds from the start of recording), regardless of the current view position

12.2 Y Cursors

Click the **Y Cursor** button on the toolbar to enable vertical (current) cursors. Two horizontal cursor lines (A and B) appear on the main graph.

- **Drag** cursor A or B directly on the graph to position them
- Use the +/- fine-adjust buttons to nudge cursors by small increments
- Cursor values are displayed with the correct current units (A, with appropriate SI prefix)

12.3 Slope Measurement

Click the **Slope** button to enable slope measurement between the cursor positions:

$$\text{Slope} = (XB - XA) / (YB - YA)$$

12.4 Cursor Results

Toggle the cursor results table using the **Cursor Measurements** button. When visible, the table appears in the right-hand ribbon and displays:

Measurement	Description
XA	Time position of cursor A
XB	Time position of cursor B
XB-XA	Time difference between cursors (delta time)
YA	Current value at cursor A
YB	Current value at cursor B
YB-YA	Current difference between cursors (delta current)
Slope	Rate of change (when slope measurement is enabled)

Measurement	Description
-------------	-------------

Activating **Slope** mode automatically enables the cursor results table.

13 Dual Channel Features

The SPA120 provides two independent measurement channels, referred to as **Ch.1** and **Ch.2**. Each channel has its own current measurement input, bias voltage source, and associated controls.

13.1 Channel Operation

- **Ch.1:** The primary measurement channel. All controls in the main left ribbon apply to Ch.1.
- **Ch.2:** The secondary measurement channel. Ch.2 controls appear in a dedicated section below the Ch.1 controls.

Each channel operates independently with its own:

- Current measurement range
- Bias voltage setting and polarity
- Null/zero offset
- Source on/off control

Both channels share the same sample rate. Each channel has its own independent rolling averaging setting (see Per-Channel Averaging).

13.2 Dual Channel Display

When using the SPA120, the graph display shows both channels simultaneously. Ch.1 is plotted in yellow and Ch.2 in cyan, allowing direct visual comparison. The bottom information text also shows settings for both channels in their respective trace colours.

The results display shows live readings for both channels, including individual current, max/min, and resistance values.

13.3 Typical Applications for Dual Channel Operation

- **Comparative measurement:** Measure two similar devices side-by-side under identical conditions to identify differences
- **Differential measurement:** Monitor current at two points in the same circuit simultaneously

- **Before/after testing:** Use one channel as a reference and the other for the device under test
- **Matched pair selection:** Compare devices to find closely matched pairs for precision circuits

14 CSV Export

The CSV export feature saves measurement data in comma-separated values format, suitable for opening in spreadsheet applications (such as Microsoft Excel or LibreOffice Calc) or importing into analysis software.

14.1 Saving CSV Data

Click the **CSV Export** button on the action strip at the top of the experiment page to save the current recorded data. Each chart in the experiment writes its own file to the per-experiment results folder.

Right-click the CSV Export button to open the naming and location options without leaving the experiment page. The options match the **File Export** tab in Settings (see Configuration Options below) and a live preview shows the filename that will be written.

14.2 CSV File Format

The SPA CSV file contains one row per recorded sample. The columns are:

Column	Description
Record	Sequential record number (starts at 1)
Time (s)	Time in seconds from the start of recording
Ch.1 (A)	Channel 1 current in Amps
Ch.2 (A)	Channel 2 current in Amps

Where a channel has no sample at a given timestamp, its cell is left empty.

14.3 Configuration Options

Configure CSV export in the **Settings** window under the **File Export** tab:

Setting	Description
Save Location	Folder where CSV files are saved
Auto-Name	Automatically generate sequential filenames
Prefix	Text prefix for auto-named files

14.4 Auto-Naming

When auto-naming is enabled, files are saved with a sequential counter:

[Prefix]_001.csv, [Prefix]_002.csv, [Prefix]_003.csv...

The counter can be reset or preset to a specific value in Settings.

15 PNG Capture

The PNG capture feature saves the current graph display as a PNG image file.

15.1 Saving a PNG

Click the **PNG Export** button on the action strip at the top of the experiment page to save the current display as a PNG image. Each chart in the experiment writes its own image to the per-experiment results folder.

Right-click the PNG Export button to open the naming and location options (the same settings as the **File Export** tab), with a live preview of the filename that will be written.

15.2 Configuration Options

Configure PNG capture in the **Settings** window under the **File Export** tab:

Setting	Description
Save Location	Folder where PNG files are saved
Auto-Name	Automatically generate sequential filenames
Prefix	Text prefix for auto-named files
Include Sub-Graph	Include the sub-graph area in the capture (checked by default)
Include Top Ribbon	Include the top ribbon (toolbar) in the capture
Include Left Ribbon	Include the left ribbon (controls) in the capture
Include Right Ribbon	Include the right ribbon (results) in the capture
Use CSV Name	Match the PNG filename to the CSV filename

The capture always includes the main graph area. Use the checkboxes to extend the capture to include surrounding ribbons. By default only the sub-graph is included.

15.3 Auto-Naming

When auto-naming is enabled, files are saved with a sequential counter:

[Prefix]_001.png, [Prefix]_002.png, [Prefix]_003.png...

The counter can be reset or preset to a specific value in Settings.

16 Metadata Overlay

The Metadata Overlay displays key settings as a semi-transparent table on the graph. Toggle it using the **Info** button on the top ribbon or via the Advanced panel. Each click cycles through four corner positions before turning off.

16.1 Displayed Information

Field	Description
Ch.1 Range	Channel 1 measurement range (e.g. 200 pA, 2 nA, 20 nA)
Ch.1 Null	Channel 1 null offset, shown only when Null is active
Ch.1 Source	Channel 1 bias supply voltage; displays "0 V" when the source is off
Ch.2 Range	Channel 2 measurement range
Ch.2 Null	Channel 2 null offset, shown only when Null is active
Ch.2 Source	Channel 2 bias supply voltage; displays "0 V" when the source is off
Sample Rate	Current sample rate (2 Hz, 10 Hz, or 20 Hz)
Averaging	Rolling average multiplier (e.g. 10x)

The Null rows only appear when Null is enabled on the respective channel. Null values are displayed in engineering notation with 5 significant digits (e.g. "20.000 nA" or "1.9546 pA"). Channel-specific information is grouped together: Range, then Null (if active), then Source for each channel.

16.2 Draw Order

By default the INFO box is drawn in front of the traces, which may obscure parts of the measurement data. To draw the INFO box behind the traces instead, go to **Settings > Graph Tab** and change the **INFO Box Draw Order** to "Behind Traces". This allows traces to be drawn over the INFO box, keeping the measurement data fully visible.

17 Data Streaming

Data Streaming (CSV Write, HTTP POST, MQTT Send) is planned for a future release.

18 Channel Sync (SPA120 Only)

Channel Sync links a Channel 2 setting group to Channel 1, so changes you make on Channel 1 automatically apply to Channel 2. It is available for three groups independently: **Input**, **Source**, and **Averaging**.

Each Channel 2 group carries a **Sync** banner pill on its header (the same style as the "+Add" pill elsewhere in EPIC). Click the pill to link that group to Channel 1; the pill fills in to show the group is synced.

18.1 What Each Sync Does

When **Input** sync is active, Channel 2 follows Channel 1's range and auto-range mode, including range changes the autoranger makes on Channel 1.

When **Source** sync is active, Channel 2 follows Channel 1's source voltage, polarity, and on/off state.

When **Averaging** sync is active, Channel 2 follows Channel 1's rolling-averaging factor.

When you first enable a group's sync, Channel 2 immediately snaps to Channel 1's current values for that group, then tracks Channel 1 from then on.

18.2 Turning Sync Off

There are two ways to release a group:

- Click the lit **Sync** pill again to turn that group's sync off.

- Adjust the Channel 2 control directly. Changing a Channel 2 setting that is currently synced knocks that group out of sync automatically, the same way pressing Range +/- knocks a channel out of auto-range. This lets you break the link simply by reaching for the Channel 2 control you want to set independently.

Once a group is released, Channel 2 keeps whatever values it was last synced to; they are not reverted. The three groups are independent, so you can keep Input synced while setting Source or Averaging per channel.

Channel Sync is useful when you want both channels to measure under matched conditions, for example comparing two devices or monitoring two points in the same circuit with identical settings, while still being able to break out one group when you need the channels to differ.

19 Save / Load Setups

19.1 Saving a Setup

1. Click the **Save Setup** button (in the Advanced panel or top bar)
2. Choose a filename and location in the save dialog
3. The current configuration is saved as a JSON file

What is saved:

- Current measurement range (both channels)
- Bias voltage and polarity settings (both channels)
- Source on/off state
- Sample rate and rolling averaging factor
- Null/zero offset values
- Export settings (CSV/PNG paths, auto-naming, prefixes)
- Display settings (graph title, trace colours)
- Graph configuration (sub-graph height, time display mode, UTC offset)
- Cursor positions and enable states
- Both Ch.1 and Ch.2 channel configurations

19.2 Loading a Setup

1. Click the **Load Setup** button
2. Select a previously saved setup file (.json)
3. All settings are restored from the file

The setup file includes the instrument type. A setup saved for the SPA120 cannot be loaded on a different instrument type.

20 Settings

The **Settings** window provides access to all application configuration options. Open it by clicking the **Settings** button.

When an SPA instrument is selected, the settings window displays only the tabs relevant to SPA operation. CTL503-specific tabs (Test/Graph Mode, Collector Supply, Step Generator, Sweep/Live Values, Key/Measurement, Sweep Settings) are automatically hidden.

The available settings tabs for SPA instruments are:

20.1 Language Tab

Select the display language for the software interface. EPIC supports a wide range of languages including English, French, German, Spanish, Italian, Portuguese, Japanese, Chinese, Korean, Arabic, Hindi, Russian, and many more.

20.2 Instrument Tab

Select which instrument the software should communicate with. The instrument selection is organised by instrument family:

- **Row 1:** CTL503 (Curve Tracer) - with COM port displayed
- **Row 2:** SPA100, SPA120 (Source Picoammeters) - with COM ports displayed

The currently active instrument is highlighted in green. Each instrument button shows the assigned COM port number below it.

20.3 Comms Tab

Configure communication settings:

- COM port selection and scanning
- Connection method (auto-detect or manual)
- Manual COM port entry

20.4 File Export Tab

Configure CSV and PNG export settings:

- File save locations
- Auto-naming options and prefixes
- PNG capture area (full window or graph only)
- Sequential counter management

20.5 Graph Tab

Configure graph display options including trace colours and display preferences:

- **Display Decimation Algorithm** - Choose between Min/Max (preserves peaks) or LTTB (preserves shape) for trace rendering
- **INFO Box Draw Order** - Controls whether the Metadata Overlay (INFO box) is drawn in front of or behind the measured traces. When set to "Behind Traces", the traces are drawn on top of the INFO box, making them more visible. The default is "In Front of Traces"

20.6 Cursors Tab

Configure cursor behaviour and display options.

20.7 Calibration Tab

Instrument calibration management. The SPA120 is factory-calibrated and adjusted during production testing at **Electron Plus** facilities. Recalibration can be performed via the EPIC calibration utility. The calibration data is stored automatically and loaded when the instrument connects.

20.8 Colours Tab

Customise the display colours for traces, backgrounds, and UI elements. Trace colours can be independently set using RGB values with real-time preview.

20.9 Setups Tab

Manage instrument setup files, including save/load configuration presets.

20.10 Data Streaming Tab

Data Streaming is planned for a future release; its configuration options will appear here when it ships.

21 Calibration

The SPA120 is factory-calibrated and adjusted during production testing at **Electron Plus** facilities. If recalibration is required:

1. Open **Settings** and navigate to the **Calibration** tab
2. Follow the on-screen calibration procedure
3. The calibration data is saved automatically and loaded the next time you connect

Calibration ensures accuracy across all eight current measurement ranges and the voltage source output.

22 Advanced Panel (Smorgasbord)

The Advanced panel (also known as the Smorgasbord) allows you to toggle the visibility of various toolbar buttons and controls. Click the **Advanced** button to open the panel.

Each button on the smorgasbord panel has a small **blue ring** indicator in its top-left corner. A filled blue circle means the button is currently enabled and visible in the main ribbon. A hollow blue ring means the button is hidden. Click the blue ring to toggle a button's visibility without changing its function - this lets you keep the main ribbon uncluttered by hiding controls you don't use frequently.

22.1 Export Functions

- **PNG** - Show/hide the PNG capture button
- **CSV** - Show/hide the CSV export button

22.2 Cursor/Measurement Functions

- **X Cursors** - Show/hide X-axis (time) cursors
- **Y Cursors** - Show/hide Y-axis (current) cursors
- **Slope** - Show/hide slope measurement
- **Cursor Measurements** - Show/hide the cursor results table

22.3 Graph Functions

- **Graph Keys** - Show/hide the colour-coded channel key below the graph (see Graph Key section)
- **Metadata Overlay** - Toggle the metadata overlay on the graph area (see Metadata Overlay section)

22.4 Miscellaneous

- **Save Setup** - Save current configuration
- **Load Setup** - Restore saved configuration

Channel 2 is linked to Channel 1 from the **Sync** banner pills on the Channel 2 Input, Source, and Averaging groups (see the Channel Sync section), not from this panel.

This is useful for simplifying the interface by hiding controls you don't regularly use, or for maximising the graph display area.

23 Safety Information

The SPA120 can generate voltages up to 40V at the output terminals. Always observe the following safety precautions:

- **Never touch** the output terminals while the source is enabled (Source button shows ON)
 - **Always disable the source** before connecting or disconnecting devices from the input terminals
 - Use appropriate **voltage settings** to protect devices under test
 - Ensure proper **grounding** of the instrument and test setup
 - Do **not** operate the instrument with damaged cables or connectors
 - Keep the instrument in a **dry environment** away from liquids
 - Use **shielded cables** for ultra-low current measurements to minimise noise pickup
 - **Guard connections** should be used where possible for measurements below 2nA to reduce leakage paths
-

24 Troubleshooting

24.1 Connection Problems

Symptom: Cannot connect to the instrument

- Check USB cable is firmly connected at both ends
- Verify the GREEN LED on the SPA is lit
- Check that the correct COM port is selected in Settings
- Try scanning for COM ports again
- Restart the instrument and software
- Check Windows Device Manager for the COM port

Symptom: Connection drops intermittently

- Use a shorter USB cable
- Avoid USB hubs - connect directly to the computer
- Check for electromagnetic interference near the USB cable

24.2 Measurement Problems

Symptom: Readings are noisy or unstable

- Select a slower sample rate (2Hz) for lower noise
- Increase the rolling averaging factor
- Use the Null/Zero function to cancel offsets
- Use shielded cables and keep leads short
- Ensure the test environment is free from vibration and air currents (important for ultra-low current measurements)
- Allow the instrument to warm up for a few minutes before taking critical measurements

Symptom: Readings are zero or very small

- Verify that the source output is enabled (Source button shows ON in EPIC)
- Check that the bias voltage is set to a non-zero value
- Verify that the device under test is properly connected
- Ensure the correct polarity is selected for your device
- Try a more sensitive (lower) current range

Symptom: Over-range indication (OVR displayed)

- Switch to a higher current range
- Reduce the bias voltage if the current is too high
- Check for short circuits in the test setup
- If MAX+ or MAX- shows OVR, this indicates the tracked peak value exceeded 4 digits; click the individual display to reset its tracking

Symptom: Large offset current on sensitive ranges

- Perform a Null/Zero calibration with no device connected
- Allow the instrument to warm up before nulling
- Check for contamination or moisture on connectors and cables
- Use guarded connections to minimise leakage paths

24.3 Display Issues

Symptom: Graph is not updating

- Verify that recording is active (Run button pressed)
- Check that the instrument is connected (GREEN LED lit)
- Ensure the correct instrument type is selected in Settings

Symptom: Sub-graph not visible

- Check that the splitter bar has not been dragged fully to the bottom
- Drag the splitter bar upward to reveal the sub-graph overview

Symptom: Cursors not responding to clicks or drags

- Ensure X or Y cursors are enabled via the toolbar buttons
- Click directly on the cursor line to initiate a drag
- Use the +/- fine-adjust buttons as an alternative to dragging

24.4 File Export Issues

Symptom: Cannot save CSV or PNG files

- Check that the save location exists and is writable
- Verify there is sufficient disk space
- Check file permissions on the save directory
- Try changing the save location in Settings

24.5 Data Streaming Issues

Data Streaming is planned for a future release.

25 Support & Contact

If you need further assistance:

- **Email:** support@electron.plus
- **Website:** www.electron.plus
- **Manuals:** Latest manuals are available for download from the Electron+ website under the Manuals section

Electron+ provides free software updates for all instruments. Check the website regularly for the latest version of EPIC.