electronplus+

SPA100 User Manual

Source Picoammeter

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Check for latest version of this manual here:
http://electron.plus/pages/manuals

1 Notices

1.1 Copyright

1.2 Part Number

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1.3 Issue

V26600, June 2026

1.4 Location

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

www.electron.plus/pages/manuals

1.5 Published By

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Unit 8 Manor Farm Business Centre
Manor Lane
Stutton
Suffolk
IP9 2TD
UK

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:
SPA100 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:
Electron Plus Instruments Limited

Issue date:
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2 Getting Started

Welcome to the EPIC software for the **SPA100 Source Picoammeter** by **Electron Plus**. This manual covers every aspect of operating the instrument and software.

2.1 What is the SPA100?

The SPA100 is a single-channel Source Picoammeter designed for measuring ultra-low currents from 2mA down to 200pA. It includes a programmable bias voltage source providing 0V to +40V (or -40V) with polarity control, making it ideal for characterising high-resistance materials, leakage currents, photodetectors, sensors, and semiconductor devices. The SPA100 combines a precision current measurement instrument with a programmable voltage source in a compact, USB-powered unit.

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)
Polarity control	Positive / Negative

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

2.3 What's New in V26301

EPIC V26301 is a ground-up rewrite of the SPA100 software, matching the CTL503 Curve Tracer rewrite. Key improvements:

- **Modern dark-themed UI** with professional instrument-panel appearance
- **Configurable measurement displays** - right-click any measurement box to change its data source, decimal places, format, colours, and size. Add up to 16 displays, arrange in full or half width
- **Data Processing Engine** - live, averaged, max+, max-, mean, RMS, peak-to-peak, and resistance values computed from the measurement stream
- **Auto-ranging** - toggle between manual and automatic range selection
- **X axis navigation** - elapsed/local/UTC time formats, rolling/manual mode, jump and step navigation
- **Y axis modes** - AUTO, CENTRE, POS, NEG with invert option, plus manual +/- scale control
- **Graph text size** - four sizes (XS/S/M/L) via the Aa button
- **Box zoom** - draw a selection rectangle to zoom into a region, with Back to unzoom
- **X and Y cursors with slope** - measure values at specific positions on the strip chart
- **Graph title** - click to edit, saved with setup
- **Right-click graph settings** - adjust graticule divisions (X/Y major, minor per major)
- **Info overlay** - shows input range, source voltage, sample rate, and averaging
- **Sub-graph overview** - miniature view of the entire recording
- **Context-sensitive help** - clicking Help opens the relevant section of this manual

2.4 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)

2.5 What is in the Box

SPA100:

- 1x SPA100 Source Picoammeter
- 1x USB cable

3 Instrument Indicators

The SPA100 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.

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4 Quick Start

1. Connect the SPA to your computer via the USB cable
2. Launch the EPIC software
3. Select **SPA100** 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.

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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 SPA100 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 SPA100 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 SPA100 has the following absolute maximum ratings that must never be exceeded:

Parameter	Maximum Rating
Bias voltage output	0V to ±40V 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 SPA100 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 SPA100 package should contain:

- 1x SPA100 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 SPA100, 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

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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 SPA100 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

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

Range	Full Scale	Best For
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.

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

The **Short** button shorts the 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

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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

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 SPA100 will refuse to enable the source output until a valid calibration is loaded. This is enforced in the instrument firmware/driver 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 midpoint 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 while no calibration is loaded: - The source stays OFF (the click is refused). - A warning notification appears explaining that no calibration is loaded. - The Source button indicator stays in the OFF state.
To resolve: 1. Connect to a previously calibrated SPA100. When a calibration from a prior session against this same instrument is present, EPIC loads it on connect and the source becomes available immediately. 2. Run a calibration cycle. Open Settings → Calibration and run the calibration procedure. Once the device's flash calibration has been read back and the file written, the source can be enabled.
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 Bottom Information Text

Below the main graph, configuration information is displayed:

- **Ch.1 (yellow text):** Shows the current input range, null status, source voltage, sample rate, and averaging factor

This information updates in real-time as you change settings, providing an at-a-glance summary of the measurement configuration.

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	Forces the Y-axis from -full-scale to 0.
INV	(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

The **Run** button on the toolbar controls recording. It cycles through three states:

State	Button Label	Action
Idle	**Run**	Press to start recording. Graph clears and begins capturing new data.
Recording	**Pause**	Press to pause. Data is preserved, no new samples are added.
Paused	**Resume**	Press to resume recording. New data appends to the existing session.

A separate **Stop** action ends the recording session entirely. When stopped, the session can be saved to CSV and the session number increments automatically if configured.

9.9 Pause and Resume

When recording is paused, a **shaded region** appears on the graph marking the pause period. This makes it clear where gaps in the data exist.

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 Markers

When the input range changes (manually or via auto-ranging), an **orange dashed vertical line** is drawn on the graph at the point of change, with the text **"Range change"** displayed vertically along the line. This alerts you that data either side of the marker was measured with different sensitivity - readings across the boundary may not be directly comparable.

The rolling average is automatically reset at each range change to prevent old-range data from contaminating new-range readings.

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 Results Display

The right-hand ribbon displays live numerical data from the instrument using **configurable measurement display widgets**.

10.1 Measurement Display Widgets

Each display box on the right ribbon is independently configurable. The default layout shows:

Display	Data Source	Description
CURRENT	Ch.1 Averaged	Live averaged current reading
MAXIMUM +	Ch.1 Max+	Highest reading since reset
MAXIMUM -	Ch.1 Max-	Most negative reading since reset
RESISTANCE	Ch.1 Resistance	Calculated R = V/I (requires bias source on)

10.1.1 Configuring a Display

Right-click any measurement display to open the configuration flyout:

- **Label Override** - type a custom label, or leave blank to auto-generate from the data source
- **Data Source** - select what the display shows. Available sources include:
  - Ch.1 Current Live, Ch.1 Current Averaged
  - Ch.1 Current Max+, Ch.1 Current Max-
  - Ch.1 Current Mean, Ch.1 Current RMS
  - Ch.1 Current Peak-Peak
  - Ch.1 Resistance, Ch.1 Null Current
- **Decimal Places** - 0 to 6 (default 4)
- **Format** - Normal (range-locked units: mA/µA/nA/pA) or Scientific notation
- **Text Size** - Small, Normal, Large, Extra Large
- **Background Colour** - choose from preset colours
- **Text Colour** - choose from preset colours
- **Width** - Full or Half. Two half-width displays sit side by side.
- **Move Up / Move Down** - reorder displays
- **Remove** - delete this display (minimum 1 must remain)
- **Reset to Default** - restore factory settings for this display

10.1.2 Adding Displays

Click **+ Add Display** at the bottom of the right ribbon to add a new measurement display (up to 16 maximum).

10.1.3 RESET Button

Displays bound to resettable data sources (Max+, Max-, Mean, RMS, Peak-Peak) show a **RESET** button. Click it to reset the tracked value. The button is styled to match the display's colours - it appears subtly, with an outline appearing on hover.

10.1.4 Display Persistence

All display configurations (data source, colours, sizes, positions) are saved automatically and persist across sessions.

10.2 Units

The displayed unit is locked to the current input range - when on the 200nA range, the unit is always nA regardless of the magnitude of the reading. The number of decimal places is user-configurable via the right-click flyout.

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

10.3 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.

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11 Session Browser

The Session Browser provides access to previously recorded measurement sessions.

11.1 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.

11.2 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.

11.3 Returning to Live Data

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

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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:

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.

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13 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.

13.1 Displayed Information

Field	Description
Input Range	Current measurement range (e.g. 200 pA, 2 nA, 20 nA)
Null	Null offset value, shown only when Null is active (e.g. 1.9546 pA)
Source Voltage	Bias supply voltage; displays “0 V” when the source is switched off
Sample Rate	Current sample rate (2 Hz, 10 Hz, or 20 Hz)
Averaging	Rolling average multiplier (e.g. 10x)

The Null row only appears when Null is enabled. It shows the captured offset value in engineering notation with 5 significant digits.

13.2 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.

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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. One current column is written per channel (the SPA120 also has a Ch.2 column).

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.

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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.

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16 Data Streaming

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

17 Save / Load Setups

17.1 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
- Bias voltage and polarity settings
- 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

17.2 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 SPA100 cannot be loaded on a different instrument type, and vice versa.

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18 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:

18.1 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.

18.2 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 (Source Picoammeter) - with COM port displayed

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

18.3 Comms Tab

Configure communication settings:

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

18.4 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

18.5 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"

18.6 Cursors Tab

Configure cursor behaviour and display options.

18.7 Calibration Tab

Instrument calibration management. The SPA100 is factory-calibrated and adjusted during production testing at Electron+ facilities. Recalibration can be performed via the EPIC calibration utility. The calibration data is stored automatically and loaded when the instrument connects.

18.8 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.

18.9 Setups Tab

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

18.10 Data Streaming Tab

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

19 Calibration

The SPA100 is factory-calibrated and adjusted during production testing at Electron+ 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.

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20 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.

20.1 Export Functions

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

20.2 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

20.3 Graph Functions

- **Metadata Overlay** - Toggle the metadata overlay on the graph area (see Metadata Overlay section)

20.4 Miscellaneous

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

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

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21 Safety Information

The SPA100 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

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22 Troubleshooting

22.1 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

22.2 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

22.3 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

22.4 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

22.5 Data Streaming Issues

Data Streaming is planned for a future release.

23 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.