SPECs User Manual

PPC 5—Pico Probe Controller, Version 1.0

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Chapter 1 – Introduction

Welcome to the user manual for the SPECS PPC 5. This is a modular system for measuring current from a few picoamps up to 2 mA. Up to five Pico Probe measurement heads can be controlled.

This chapter explains briefly how to use the manual and points you toward further sources of information.

Most importantly, it contains safety notices that you should read before operating the equipment.

1.1 About

The manual is divided into the following chapters:

Chapter 2 covers the installation of the PPC 5.
Chapter 3 describes operation using the software package SpecsLab Prodigy.
Chapter 4 has technical details about the PPC 5, including an overview of the features on the front and rear panels and pin assignments.
Chapter 5 is an overview of the technical details of the Pico Probe measurement head.

1.2 Information

The control interface for the PPC 5 is SpecsLab Prodigy. The controls which apply to the PPC 5 are described in this manual; however, you should refer to the SpecsLab Prodigy Online Help and the SpecsLab Prodigy Quick Guide for more information about using the software.

For further advice and assistance, please also contact SPECS support:
Tel.  +49 30 46 78 24-0
email: support@specs.com

If you need to return this SPECS product for repair, service or upgrade, please first contact SPECS support. We will provide you with an RMA as well as details for correct packaging and shipment of the instrument. This will ensure safe transportation and speedy processing.

1.3 Safety

The document "Safety Instructions" is contained with this instrument. This contains important warnings and procedures that you should adopt when using SPECS equipment.
In addition to the advice in the safety instructions, warnings and cautions are included in this manual at appropriate places. Please observe these warnings for your own safety and to ensure reliable operation of the equipment.

**Danger—High Voltages Present!**
You can apply an external bias voltage of up to ±90 V. This voltage is present on the central pin of the BNC connector of the selected Pico Probe measurement head and on the 15-pin female D-sub connector on the rear of the PPC5.

If you need to return the instrument to SPECS for repair, please fill out the declaration at the end of this manual.

### 1.4 Environmental Operating Conditions

The equipment must be installed in a dry, dust free laboratory. The following conditions are required for operation.

Temperature (normal system operation):
- absolute limit range: 15–30 °C (60–85 °F)
- recommended range: 20–25 °C (68–77 °F)

Relative humidity:
- absolute limit values: 40–80%
- recommended range: 50–60%
There must be no condensed water on the equipment.

Atmospheric pressure:
- 800–1200 mbar

Air conditioning is advisable in order to ensure the ambient requirements, especially for dissipating heat produced by the equipment.
The installation of the PPC 5 and its probe(s) involves two steps:

- Electrical connections.
- Software configuration, so that the device is recognized by SpecsLab Prodigy.

Following these steps, the instrument is ready for use.

### 2.1 Electrical Connections

The diagram below shows the basic connection scheme for the PPC 5. Only a single channel is shown—the other channels (if used) are connected in the same way.

You can apply an external bias individually to each of the channels. The PPC 5 is able to supply a ±40 VDC bias without the need for an external supply.

**Figure 1: Electrical connections**

**Danger—High Voltage!**

Any bias voltage will be present on the center pin of the Pico Probe BNC connector and on the 15-pin feedthrough on the rear of the PPCS. If you are connecting an external bias with a high voltage, take appropriate precautions to avoid an electric shock.
2.2 **Software Installation**

The PPC 5 is controlled by SpecsLab Prodigy, which also shows the output of the Pico Probes. It is assumed that you already have SpecsLab Prodigy installed on your computer. The SpecsLab Prodigy Configuration Tool allow you to add a device to SpecsLab Prodigy. After storing the configuration, controls for the PPC 5 will appear in SpecsLab Prodigy.

**Note**
The SpecsLab Prodigy Quick Guide provides details about the installation procedure as well as how to use the SpecsLab Prodigy Configuration Tool. This section expands on the information concerning the Configuration Tool.

**Note**
You need Administrator privileges in MS Windows to run the SpecsLab Prodigy Configuration Tool.

To configure the Pico Probe device control:
1. Start the SpecsLab Prodigy Configuration Tool. You can find this under Start/ SPECS SpecsLab Prodigy/ Configure SpecsLab Prodigy.
2. Select the **License Configuration** tab.
3. Enter a license for the device using one of the following methods:
   - Copy and paste the license key into the field provided.
   - Click **Import License File** and select the license file.
4. Click **Activate License**. On expanding the **Devices** tree in the **Module** pane, you should see that there is a green indicator next to the Pico Probe to show it is licensed.

**Note**
Please contact SPECS support if you need a license key.

5. Select the **Device Configuration** tab.
6. Click **Add Device** and select Pico Probe from the list.
7. Select the number of channels from the drop-down list. This is the number of inputs for Pico Probe measurement heads on the PPC 5. This setting must be correct for the test in the next step to work.
Figure 2: Configuring the PPC 5

8. Click **Test**. The SpecsLab Prodigy Configuration Tool will establish a connection to the PPC 5 and display a message to shown if it is successful. If an error appears, check the following:
   - Is the PPC 5 switched on?
   - Is the PPC 5 connected to the same LAN as the computer? Is the network correctly configured?
   - Are the IP address and port settings correct?

9. If the test is successful, click **Store** in the toolbar. The settings will be written to the MS Windows registry. The device will be available in SpecsLab Prodigy in the Experiment Editor and in the Device Controls view.

There are two other buttons in the dialog:
- **Revert** returns the settings to those stored in the registry.
- **Delete** removes the device and its configuration.
Chapter 3 – Software Control

The PPC 5 and its probes are controlled by SpecsLab Prodigy. This provides the interface for configuring, reading and recording the instrument.

There are two main ways of controlling the PPC 5 in SpecsLab Prodigy:

- Using the device control. This is for configuration of the probes and also displays the status of the probes, including their measurements.
- Acquiring data from the Pico Probe as part of an experiment and displaying it in the Plot View.

There is also a section outlining other features in SpecsLab Prodigy that are of interest when using the PPC 5.

3.1 Device Control

The Device Control allows you to read the output of the measurement heads of the PPC 5. You can also set the status of the instrument as well as save the configuration as templates for future applications, using the standard SpecsLab Prodigy functionality.

The following topics are covered:

- Viewing the output of the probes attached to the PPC 5.
- Changing the settings of the PPC 5.

![Table of Probe Values](image)

**Figure 3: The Pico Probe device control**

Before using the Device Control, you need to make a connection:

- Click **Connect**. On establishing the connection, the Device Control frame turns blue.
Clicking the Disconnect button breaks contact with the instrument. The bias on all channels is set to none (that is switched off) and all controls are inactive. There are two buttons, ▲ and ▼, which collapse and expand the Device Control respectively.

### 3.1.1 Viewing the Probe Status

After connecting the Pico Probe device, the device control shows the status of the connected probe(s). You can change the configuration of the probes in the Settings tab.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe Name</td>
<td>Name of the probe. Only activated probes are shown in the list.</td>
</tr>
<tr>
<td>Value</td>
<td>Reading of the probe in A.</td>
</tr>
<tr>
<td>Warning/ Error</td>
<td>An icon appears next to the value if there is a problem. There are two types:</td>
</tr>
<tr>
<td></td>
<td>• Warning (yellow)—for non-fatal problems such as the detected value being out of range (change the range setting) or while changing the device configuration (wait a few seconds).</td>
</tr>
<tr>
<td></td>
<td>• Error (red)—fatal error which prevents operation. These may be caused by a faulty ADC in the device or a calibration problem with the Pico Probe. If you experience such an error, contact SPECS for assistance.</td>
</tr>
<tr>
<td>Hovering the mouse over the icon will produce a tooltip showing the cause of the warning or error.</td>
<td></td>
</tr>
<tr>
<td>Bias</td>
<td>Shows the bias applied to the signal, if any. The PPC 5 can supply a +40 V and –40 V bias. An external bias can also be applied.</td>
</tr>
<tr>
<td>Range</td>
<td>Shows the range selected for the probe reading.</td>
</tr>
</tbody>
</table>

Table 1: Status information of the Pico Probe

![Figure 4: Connected Pico Probe device control](image)
3.1.2 Changing the Settings

Clicking the ☐ icon expands the device control to reveal the settings. These settings are summarized in the table below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check box</td>
<td>Check the boxes to activate the respective probe.</td>
</tr>
<tr>
<td>Probe</td>
<td>The name of the probe. You can edit this setting. The name is used in the status area of the device as well as in the Experiment Editor.</td>
</tr>
<tr>
<td>Bias</td>
<td>Sets the bias. The following options are available:</td>
</tr>
<tr>
<td></td>
<td>• None—no bias is used.</td>
</tr>
<tr>
<td></td>
<td>• +40 V—switches on the internal +40 V bias.</td>
</tr>
<tr>
<td></td>
<td>• –40 V—switches on the internal –40 V bias.</td>
</tr>
<tr>
<td></td>
<td>• External—allows you to apply an external bias to the signal.</td>
</tr>
<tr>
<td>Range</td>
<td>Select a range for the current reading:</td>
</tr>
<tr>
<td></td>
<td>• 0...2 nA</td>
</tr>
<tr>
<td></td>
<td>• 0...0.2 μA</td>
</tr>
<tr>
<td></td>
<td>• 0...20 μA</td>
</tr>
<tr>
<td></td>
<td>• 0...2000 μA</td>
</tr>
<tr>
<td></td>
<td>• Autorange</td>
</tr>
</tbody>
</table>

Table 2: Pico Probe device control settings

After making changes to the settings, click Store to apply them and save them to the registry.

Clicking the Read button restores the current registry settings.
3.2 Using the PicoProbe in an Experiment

You can add the Pico Probe to your experiment so that its signal is recorded with the detector data. This data is displayed with the spectrum data in the Plot View and can be used to normalize the spectrum. The following sections describe these features in more detail.

3.2.1 Adding the Pico Probe to the Schedule

The Pico Probe can be added to the experiment as an external device. When running the scan, the output from the Pico Probe is recorded with data points from the detector.

To record the Pico Probe current during an experiment:

1. Create a new experiment in the Experiment Editor in the usual way:
   - Select a type of experiment, for example XPS, UPS, etc.
   - Add an analyzer and source to the configuration, as well as any other devices you may want to use, such as a manipulator.

2. In the list of devices, click External Input and select Pico Probe: Channel Input from the list. A device for the Pico Probe will be added to the experiment which shows all the active channels.
3. Select the channels you want to record in the Pico Probe device.

You can now define the spectrum group in the normal way and run the experiment.

3.2.2 Viewing Data from External Devices

Data acquired from external inputs, such as the Pico Probe, is saved with the spectrum and displayed in the Plot View.

The interface for displaying the data from external devices such as from the Pico Probe follows the standard SpecsLab Prodigy principles and are covered in the Plot View section of the SpecsLab Prodigy Online Help. The following points are particularly relevant to displaying the Pico Probe data:

- In the screenshot below, the data and the picoammeter signal are both shown, with the result that the current signal is too small to be viewed. You can display the picoammeter signal alone, for example by clicking the icon next to the item in the data browser and selecting *Show This And Hide Others* from the context menu.
There are options for applying a scaling factor or offset to the results. Clicking the icon next to the item will display these options. You can use exponents in these settings, for example $1e5$ is the same as 10000.

3.2.3 Normalizing Data

A typical reason for recording a current while acquiring data is so that you can normalize the data to the sample current. SpecsLab Prodigy offers a convenient method for normalizing the data to the sample current:

- Click the icon in the title bar for the spectrum group and select Normalize Spectrums, then the external signal you want to use from the context menu. The normalization is applied to all spectra in the spectrum group.
3.3 Further Features in SpecsLab Prodigy

In addition to the features described in the previous sections of this chapter, there are other ways to view and record the output of the PPC 5 and Pico Probe.

**Note**

Depending on the license of your SpecsLab Prodigy installation, some of these features may not be available. If you would like to use these features, please contact SPECS support for licensing details.

**Live Parameter View**

The live parameter view shows the instantaneous value of any parameter from connected devices. The display is large enough for it to be easily read from a distance.

![Live Parameter View](image)

Figure 10: Live Parameter view showing the Pico Probe output

**Live Data View**

The Live Data view plots the value of a selected parameter as a function of time. You can therefore see trends as you make adjustments or view the development of the parameter value over a longer time period.

Parameter values are recorded and can be viewed at a later time.
Data History View
The Data History view is a companion to the Live Data View. It displays saved data, completing the use of SpecsLab Prodigy for logging data.
Chapter 4 – Technical Details

This chapter contains a technical description of the PPC 5 for reference and maintenance purposes. It provides an overview of all the features on the front and rear panels as well as additional specifications.

4.1 Front Panel

The front panel contains a power switch, inputs for an external bias voltage for each channel as well as status LEDs for each channel. These are described in more detail in the sections below.

**Figure 12: Front panel of the PPC 5**

**Power**

This switches the PPC 5 on and off.

**Bias external input**

You can apply a bias to each channel individually. This is typically useful for photocurrent measurements or to suppress secondary electrons from the sample. The connectors are standard BNC.

The maximum allowed bias voltage on this connector is ±90 VDC.
Danger—High Voltages Present!
Any bias you apply to the external channel will be present on the input of the measurement head (inner conductor) and on the 15-pin feedthrough on the rear of the PPC5.
The internal bias is limited to 40 VDC, 4 mA.

LED indicators
There are five LEDs to show the status of each channel. These are listed in the table below.

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>green</td>
<td>Channel active and ready to measure. Overload:</td>
</tr>
<tr>
<td></td>
<td>red</td>
<td>• Current above measurement range.</td>
</tr>
<tr>
<td></td>
<td>red</td>
<td>• Internal bias overloaded.</td>
</tr>
<tr>
<td></td>
<td>red</td>
<td>• Measurement head faulty.</td>
</tr>
<tr>
<td></td>
<td>off</td>
<td>Channel not ready, e.g. measurement head not attached.</td>
</tr>
<tr>
<td>Internal polarity</td>
<td>yellow</td>
<td>Two LEDs, + and –. The respective LED lights to show the polarity of the internal bias.</td>
</tr>
<tr>
<td>On/ Off</td>
<td>yellow</td>
<td>Lights to show if the internal bias is active.</td>
</tr>
<tr>
<td>External input</td>
<td>yellow</td>
<td>Lights to show if an external bias is applied.</td>
</tr>
</tbody>
</table>

Table 3: LED indicators on the front panel

4.2 Rear Panel
The rear panel of the PPC 5, shown in the picture below, contains connections for the Pico Probe measurement heads as well as an ethernet connection and the power inlet. These features are described in more detail in the following sections.
Channel connectors
The connections for each channel connector are the same. They are listed in the table below.

**Danger—High Voltages Present!**
When a bias is applied to a channel, the internal circuits of the channel float to the bias voltage. This voltage is therefore present on the pins of the corresponding channel connector.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-U(I)</td>
<td>Measurement signal input.</td>
</tr>
<tr>
<td>2</td>
<td>AGND</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>P15</td>
<td>Measurement head power +15 V.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Rel_P</td>
<td>Power for range switch in measurement head.</td>
</tr>
<tr>
<td>6</td>
<td>/Rel2</td>
<td>Range switch.</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>PAR2</td>
<td>Reference point calibration storage.</td>
</tr>
<tr>
<td>9</td>
<td>COM</td>
<td>Reference point measurement signal.</td>
</tr>
<tr>
<td>10</td>
<td>FE</td>
<td>Functional earth: Reference point Measurement head GND.</td>
</tr>
<tr>
<td>11</td>
<td>N15</td>
<td>Measurement head power –15 V.</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>/Rel1</td>
<td>Range switch.</td>
</tr>
<tr>
<td>14</td>
<td>/Rel3</td>
<td>Range switch.</td>
</tr>
<tr>
<td>15</td>
<td>PAR</td>
<td>Data calibration storage.</td>
</tr>
<tr>
<td>Case</td>
<td>PE</td>
<td>Case ground.</td>
</tr>
</tbody>
</table>

Table 4: Pin assignment of channel connectors

**Power input**
The power requirements are:
- 24 VDC, 0.5 A.

A mains adaptor is included to provide the power. The table below shows the pin assignment of the power connector.
### Ethernet
The ethernet connector is a standard RJ45. The PPC 5 is controlled via a computer connection and sends the measured current readings using the ethernet connection.

### 4.3 Specifications
The table below lists additional specifications of the PPC 5.

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power requirements</td>
<td>24 VDC, 0.5 A max.</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>105 x 105 x 225 mm (3 height units)</td>
</tr>
<tr>
<td>Weight</td>
<td>2 kg</td>
</tr>
</tbody>
</table>

Table 6: Specifications

---

**Table 5: Pin assignment of power connector**

<table>
<thead>
<tr>
<th>3-pin M8 male</th>
<th>Pin</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>+24 VDC</td>
<td>Power in.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>GND</td>
<td>Reference ground.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

---
Chapter 5 – PicoProbe

The PPC 5 does not measure current. Current measurement is performed by a Pico Probe measurement head. The Pico Probe is a current to voltage converter. It delivers an output voltage proportional to the input current which is then read by the PPC 5.

There are several ranges so that a wide range of input currents can be read with acceptable accuracy. The table below lists the ranges. There is also an autorange feature where the unit selects the appropriate range for the input current.

The resolution of the current measurement is 1 pA. The Pico Probe is capable of measuring currents in the range from a few pA (≤10 pA) to 2 mA.

<table>
<thead>
<tr>
<th>Range</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 nA</td>
<td>−1.9999…1.9999 nA</td>
</tr>
<tr>
<td>200 nA</td>
<td>−199.99…199.99 nA</td>
</tr>
<tr>
<td>20 μA</td>
<td>−19.999…19.999 μA</td>
</tr>
<tr>
<td>2 mA</td>
<td>−1.9999…1.9999 mA</td>
</tr>
</tbody>
</table>

Table 7: Measurement ranges

Figure 2 shows the dimensions of the Pico Probe. All measurements are in mm.
Figure 15: Dimensions of the Pico Probe
Chapter 6 – Upgrade

The PPC 5 is sold in three variants, with 1, 3 or 5 Pico Probe measurement heads provided. The base unit supports a single head. SPECS supplies modules that can easily be fitted inside the PPC 5 as upgrades. Each module supports two Pico Probe heads. With space for two modules, you can control up to five measurement heads.

The following procedure describes how to install an extra module into the PPC 5:
1. Switch off the PPC 5 and remove all connectors.
2. Use a nutdriver or spanner to remove the screws that hold the D-sub connector(s) in place.
3. Remove the four screws that hold the rear panel on the case. You can now remove the rear panel from the unit.
4. Insert the new card(s) into the PPC 5 and push them into place so that they are properly connected internally.
5. Remove the plastic covers that protect the holes on the rear panel so that the 15-pin D-sub connectors can pass through the holes.
6. Fit the rear panel and screw it into place.
7. Screw the D-sub connectors into place.

The cards and Pico Probe measurement heads are already calibrated. Before using the PPC 5, you need to change the configuration in SpecsLab Prodigy so that the new measurement channels are available—see "Software Installation" on page 4 for this procedure.
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HEALTH AND SAFETY DECLARATION FOR USED VACUUM EQUIPMENT AND COMPONENTS

The repair and/or service of vacuum equipment/components can only be carried out if a correctly completed declaration has been submitted for every component.

1. Description of components
   Model
   Serial number

2. Reasons for return

3. Equipment condition
   Has the equipment ever come into contact with the following (e.g. gases, liquids, evaporation products, sputtering products...)

   • toxic substances?  Yes ☐  No ☐
   • corrosive substances? ☐
   • microbiological substances (incl. sample material)? ☐
   • radioactive substances (incl. sample material)? ☐
   • ionizing particles/radiation (α, β, γ, neutrons, ...)? ☐

   Is the equipment free from potentially harmful and hazardous substances? ☐

4. Decontamination Procedure
   List all harmful substances, gases and by-products which have come into contact with the vacuum equipment/component and the decontamination method used. Continue on a separate sheet if necessary.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Decontamination Method</th>
</tr>
</thead>
</table>

5. Legally Binding Declaration
   Organization
   Address
   Phone/Fax
   Name/Position

   I hereby declare that the information supplied on this form is complete and accurate.

   Date __________________ Signature __________________ Company Stamp  

SPECS Health and Safety Declaration | Page 1/1