Universal Bipotentiostat

390.1 Introduction

Bruker's Universal Bipotentiostat™ brings new electrochemical capability to Bruker microscopes. Features include:

- Compatible with all Bruker NanoScope™ Controllers and Microscopes.
- Has 7 decades of gain, from 100nA/V to 100mA/V with a current resolution of 100pA.
- Supports ECAFM (ElectroChemical Atomic Force Microscopy) in TappingMode™.
- Supports SECPM (Scanning ElectroChemical Potential Microscope) and STS (Scanning Tunneling Spectroscopy).

Document Revision History: Universal Bipotentiostat

Revision	Date	Section(s) Affected	Reference	Approval
E	01-28-2011	Re-branded		Ruth Wishengrad
D	30-April-2007	3.3, 4.5		Vinson Kelley
C	10-May-2005	Appendix B		Vinson Kelley
B	14-Mar-2005	All		Vinson Kelley
A	11-Mar-2004	Initial Release		Vinson Kelley

Part Number: 013-390-000
112 Robin Hill Road
Santa Barbara, CA 93117
805.967.1400

The contents of this support note are:

390.1.1 Scope of this Document

This document discusses the hardware and software specific to the Bruker Universal Bipotentiostat. Additional information, including electrochemical cell connections, can be found in the *Electrochemical SPM Manual*, the *Dimension 3100 and Dimension V Instruction Manuals*, the *MultiMode and MultiMode V SPM Instruction Manuals,* the *EnviroScope Manual*, the *NanoScope IIIa, IV(a) or V Controller Manuals* and the *Command Reference Manual*.

390.1.2 Conventions and Definitions

Note: In the interest of clarity, certain nomenclature is preferred. A SPM *probe* comprises a *tip* affixed to a *cantilever* mounted on a *base*, which is inserted in a *probe holder*.

Three font styles distinguish among contexts. For example:
Window or Menu Item / **BUTTON OR PARAMETER NAME** is set to **VALUE**.

390.1.3 System Specifications

Compliance voltage:	±12V
Potential range:	-10V to +10V
Bipotentiostat rise time:	< 100µs
Scan rate:	0.0003 to 10V/s
Minimum potential increment in CV:	0.3mV
Potential update rate:	1kHz
Current range:	0 to 100mA
Current sensitivity:	10nA to 10mA/V
Current measurement resolution:	< 50pA
Input impedance of reference electrode:	$>10^{12}\Omega$
Maximum sampling rate:	100Hz
Bandwidth:	10kHz at 10mA/V
	1kHz at 10nA/V
Techniques:	CV, LSV

390.2 Safety Precautions

This section highlights cautions to observe operating the Universal Bipotentiostat. Additional cautions need to be observed when operating a Dimension, EnviroScope or MultiMode SPM; refer to the *Dimension Manual*, the *EnviroScope Manual* or the *MultiMode SPM Instruction Manual*.

Table 384.2a Safety Symbols Key

Symbol	Definition
	This symbol identifies conditions or practices that could result in damage to the equipment or other property, and in extreme cases, possible personal injury.
	Ce symbole indique des conditions d'emploi ou des actions pouvant endommager les équipments ou accessoires, et qui, dans les cas extrêmes, peuvent conduire à des dommages corporels.
	Dieses Symbol beschreibt Zustaende oder Handlungen die das Geraet oder andere Gegenstaende beschaedigen koennen und in Extremfaellen zu Verletzungen fuehren koennen.
	This symbol identifies conditions or practices that involve potential electric shock hazard.
	Ce symbole indique des conditions d'emploi ou des actions comportant un risque de choc électrique.
	Dieses Symbol beschreibt Zustaende oder Handlungen die einen elekrischen Schock verursachen koennen.

WARNING: Service and adjustments should be performed only by qualified personnel who are aware of the hazards involved.

AVERTISSEMENT: Tout entretien ou réparation doit être effectué par des personnes qualifiées et conscientes des dangers qui peuvent y être associés.

WARNUNG: Service- und Einstellarbeiten sollten nur von qualifizierten Personen, die sich der auftretenden Gefahren bewußt sind, durchgeführt werden.

WARNING: Follow company and government safety regulations. Keep unauthorized personnel out of the area when working on equipment.

AVERTISSEMENT: Il est impératif de suivre les prérogatives imposées tant au niveau gouvernmental qu'au niveau des entreprises. Les personnes non autorisées ne peuvent rester près du système lorsque celui-ci fonctionne.

WARNUNG: Befolgen Sie die gesetzlichen Sicherheitsbestimmungen Ihres Landes. Halten Sie nicht authorisierte Personen während des Betriebs vom Gerät fern.

CAUTION: When imaging fluid samples, use extraordinary precautions against spillage. Do not spill fluids on or around the sample holder, electronic boxes, or other components containing electronic parts. Avoid spilling all corrosive fluids on exposed surfaces; otherwise, damage may result! In the case of a spill, immediately clean and dry all affected surfaces carefully.

ATTENTION: Lors d'un travail en milieu liquide, prendre toute précaution pour éviter des fuites. Les liquides ne doivent pas se répandre sur la platine porte échantillons, le boîtier électronique ou tout autre partie du microscope contenant de l'électronique. Eviter tout fuite de liquide corrosif sur les surfaces exposées. Le non respect de cette recommandation peut entraîner des dommages. En cas de fuite, nettoyer et sécher immédiatement les surfaces touchées.

VORSICHT: Falls Sie Proben in Flüssigkeiten abbilden, lassen Sie äußerste Vorsicht walten, damit keine Flüssigkeit verspritzt wird. Flüssigkeiten dürfen nicht auf die oder nahe der Probenhalterung, der Elektronikbox oder anderen Komponenten, die elektronische Bauteile enthalten, verspritzt werden. Vermeiden Sie bitte, korrosive Flüssigkeiten auf freiliegende Oberflächen zu verspritzen; andernfalls wären Beschädigungen die Folge! Falls Sie Flüssigkeit verspritzt haben, säubern und trocknen Sie alle betroffenen Flächen sorgfältig.

WARNING: Voltages supplied to and within certain areas of the system are potentially dangerous and can cause injury to personnel. Power-down all components and unplug from power sources before doing **any** electrical servicing. (Bruker service personnel, *only*).

AVERTISSEMENT: Les tensions utilisées dans le système sont potentiellement dangeureuses et peuvent blesser les utilisateurs. Avant toute intervention électrique, ne pas oublier de débrancher le système. (Réservé au personnel de Bruker, seulement.)

WARNUNG: Die elektrischen Spannungen, die dem System zugeführt werden, sowie Spannungen im System selbst sind potentiell gefährlich und können zu Verletzungen von Personen führen. Bevor elektrische Servicearbeiten irgendwelcher Art durchgeführt werden ist das System auszuschalten und vom Netz zu trennen. (Nur Bruker Personal.)

390.3 Installation

390.3.1 Unpacking the Universal Bipotentiostat

CAUTION: Do not store the equipment outside, even in a dry weather location.

The Universal Bipotentiostat-specific components are packed together in one box. Carefully unpack the components from their crates.

CAUTION: Handle sensitive electronics with care. Avoid dropping or bumping the Universal Bipotentiostat components, particularly outside the shipping crate.

Provide the proper environmental conditions (see Table 3a) for system operation and storage.

Table 390.3a Environmental Requirements

Equipment Use	Condition	Requirement
Operation	Temperature	15ºC (59ºF) to 35ºC (95ºF)
″	Relative Humidity	45% to 80%, non-condensing
Storage	Temperature	10ºC (50ºF) to 50ºC (122ºF)
″	Relative Humidity	35% to 90%, non-condensing

390.3.2 Universal Bipotentiostat Component List

The Universal Bipotentiostat ships with a “monster” (DB-37) cable and, if you have a NanoScope IIIA with an ADC5 option, a NanoScope IV(a) or NanoScope V, a pair of BNC cables.

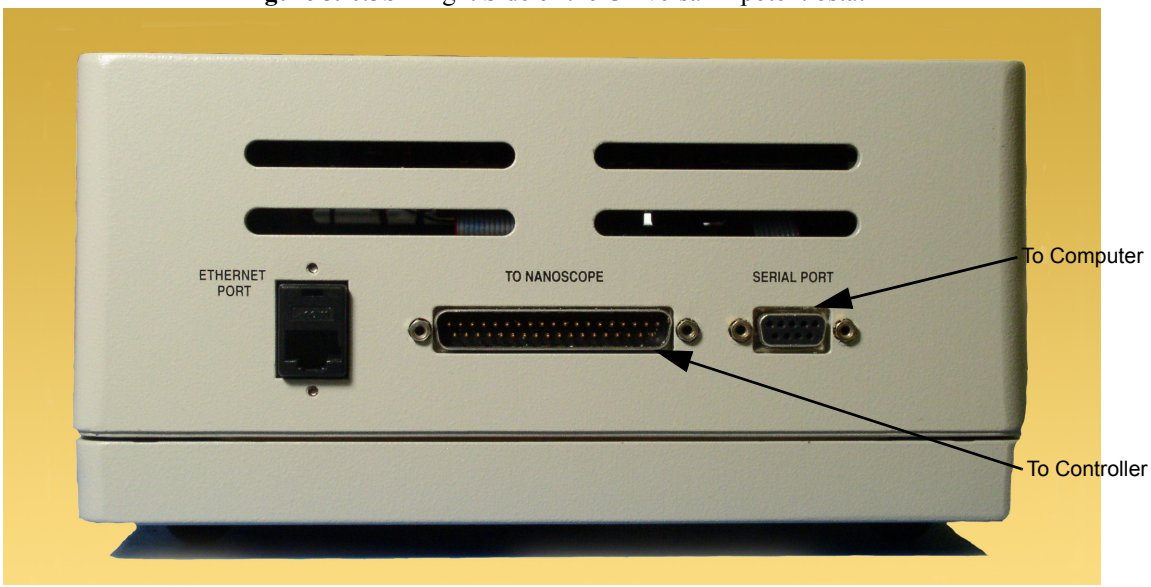
390.3.3 Connecting the Universal Bipotentiostat

In general, the Universal Bipotentiostat is connected in series between a NanoScope Controller and a Bruker Scanning Probe Microscope, normally adjacent to the controller. If needed, a Bruker Extender™ is placed between the Universal Bipotentiostat and the microscope while a Bruker Quadrex™ is placed between the controller and the Universal Bipotentiostat. A serial cable connects the Universal Bipotentiostat to the computer for serial communication; an Ethernet port is provided for future use. The cable used to connect the Universal Bipotentiostat to the EC cell is specific to each microscope.

Connect the Universal Bipotentiostat to the computer:

1. Use a 9-pin serial cable to connect the right side of the Universal Bipotentiostat, shown in Figure 3b, to a free serial port on the computer. On the EnviroScope, this port is typically COM6.

Figure 390.3b Right Side of the Universal Bipotentiostat



Connect the Universal Bipotentiostat to the NanoScope controller:

For a NanoScope V controller:

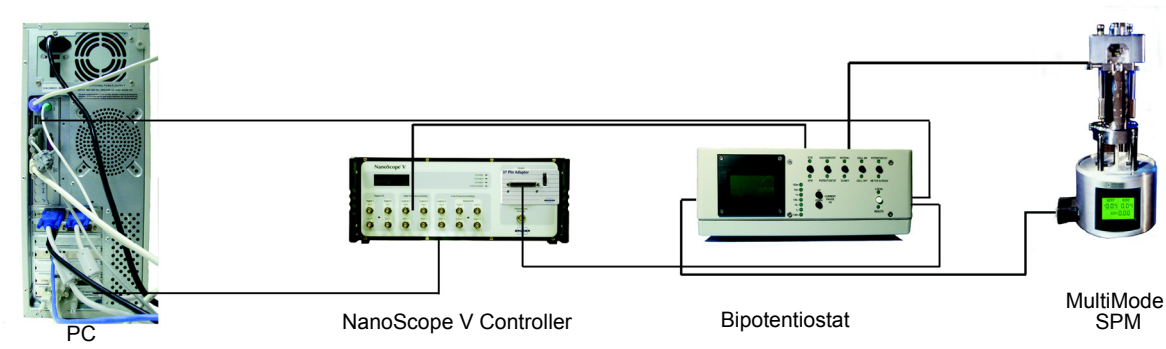
Connecting to the back panel:

1. Use the “monster” DB-37 cable to connect the port labeled TO NANOSCOPE on the right side of the Universal Bipotentiostat, shown in Figure 3b, to the port labeled Microscope on the 37 Pin Adapter on the front of the controller. See Figure 3c.

2. Connect one end of a BNC cable to the BNC connector labeled POTENTIAL OUT on the back panel of the Universal Bipotentiostat, shown in Figure 3e, and the other end to the BNC connector labeled Input 1 on the front panel of the controller.

3. Connect one end of a BNC cable to the BNC connector labeled CURRENT OUT on the back panel of the Universal Bipotentiostat, shown in Figure 3e, and the other end to the BNC connector labeled Input 2 on the front panel of the controller.

Figure 390.3c Basic NanoScope V Configuration



For a NanoScope IV or IVa controller:

Connecting to the back panel:

1. Use the “monster” DB-37 cable to connect to the port labeled TO NANOSCOPE on the right side of the Universal Bipotentiostat, shown in Figure 3b, to the port labeled TO MICROSCOPE on the back of the controller. See Figure 3d.

2. Connect one end of a BNC cable to the BNC connector labeled POTENTIAL OUT on the back panel of the Universal Bipotentiostat, shown in Figure 3e, and the other end to the BNC connector labeled INPUT2 on the back panel of the controller.

3. Connect one end of a BNC cable to the BNC connector labeled CURRENT OUT on the back panel of the Universal Bipotentiostat, shown in Figure 3e, and the other end to the BNC connector labeled INPUT3 on the back panel of the controller.

Connecting through the Emulation port on the front panel:

1. To run a non-extended (“standard”) Multimode or STM, the Bipotentiostat needs to be connected to the NanoScope IV(a) controller through the Emulation port in the front of the controller. Open the port door, remove the twin connector, and connect a “monster” DB-37 cable and the Emulator adaptor to it. See the *NanoScope IV* (or *IVa*) *Controller Manual* 004-115-000 (or 004-114-000) for details.

2. Use the “monster” DB-37 cable to connect to the port labeled TO NANOSCOPE on the right side of the Universal Bipotentiostat, shown in Figure 3b, to the Emulator Adaptor.

Figure 390.3d Basic NanoScope IV(a) Configuration

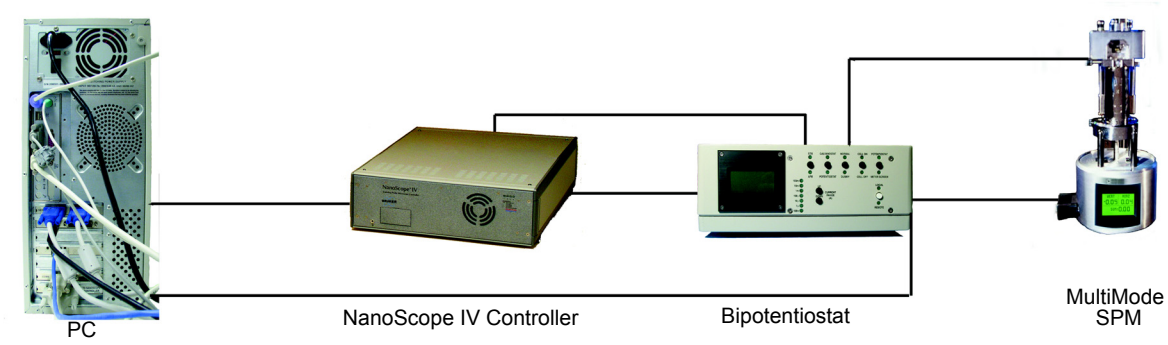


Figure 390.3e Back panel of the Universal Bipotentiostat

For a NanoScope IIIa controller with ADC5:

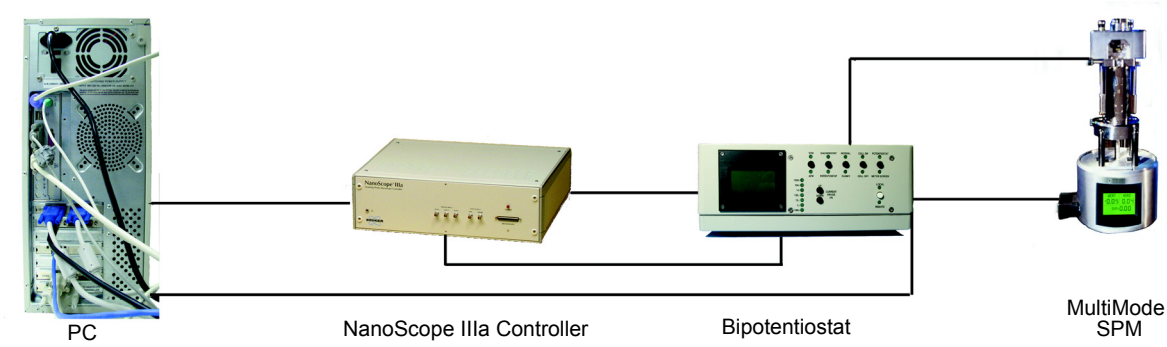
Note: NanoScope IIIa controllers require the ADC5 Option for use with the Universal Bipotentiostat.

1. Connect one end of a BNC cable to the BNC connector labeled POTENTIAL OUT on the back panel of the Universal Bipotentiostat, shown in Figure 3e, and the other end to the BNC connector labeled AUX3 on the front panel of the controller.

2. Connect one end of the a BNC cable to the BNC connector labeled CURRENT OUT on the back panel of the Universal Bipotentiostat, shown in Figure 3e, and the other end to the BNC connector labeled AUX4 on the front panel of the controller

3. **No Extender**: Use the “monster” DB-37 cable to connect to the port labeled TO NANOSCOPE on the right side of the Universal Bipotentiostat, shown in Figure 3b, to the port labeled MICROSCOPE on the front of the controller. See Figure 3f.

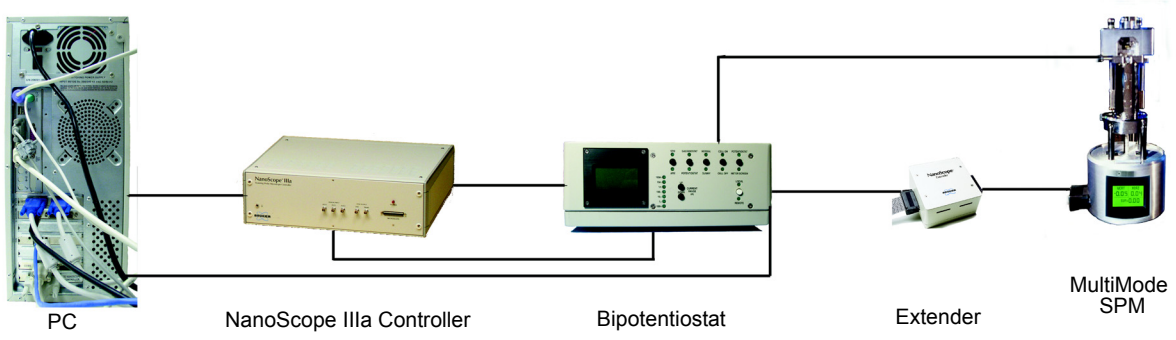
Figure 390.3f Basic NanoScope IIIa, or lower, Configuration



4. **Extender**: Use the “monster” DB-37 cable to connect to the port labeled TO NANOSCOPE on the right side of the Universal Bipotentiostat, shown in Figure 3b, to the port labeled MICROSCOPE on the front of the controller. Use a second “monster” DB-37 cable to connect to the port labeled TO MICROSCOPE on the left side of the Universal Bipotentiostat, shown in Figure 3j, to the port labeled TO CONTROLLER on the Extender. See Figure 3g. Set the **TIP OR SAMPLE** switch on the Extender to **ANALOG 2**.

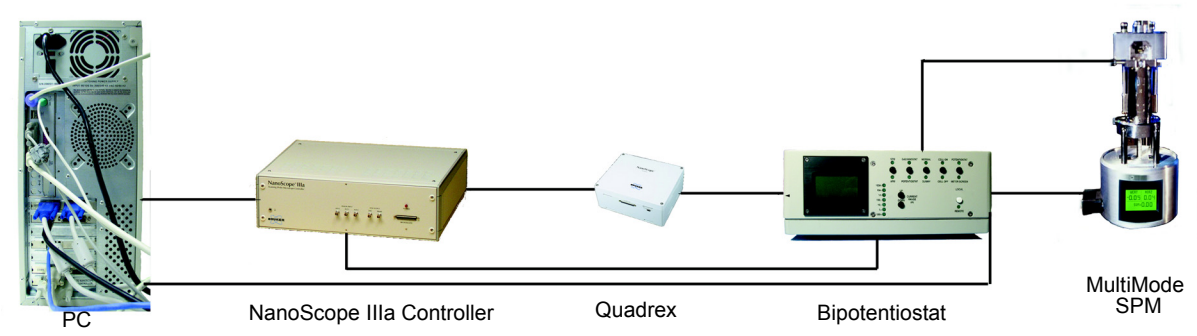
Note: SECPM is not compatible with the Extender. Use the Basic NanoScope IIIa configuration, shown in Figure 3f and select **NONE** for **EXTENDER** in the **Microscope Select** window.

Figure 390.3g Configuration with a NanoScope IIIa and an Extender



5. **Quadrex Extender**: Use the “monster” DB-37 cable to connect to the port labeled TO NANOSCOPE on the Quadrex extender to the port labeled MICROSCOPE on the front of the controller. Use a second “monster” DB-37 cable to connect to the port labeled TO NANOSCOPE on the left side of the Universal Bipotentiostat, shown in Figure 3b, to the port labeled TO CONTROLLER on the Extender. See Figure 3h.

Figure 390.3h Configuration with a NanoScope IIIa and Quadrex



For a NanoScope IIIa, or lower, controller without ADC5:

1. Use the "monster" DB-37 cable to connect to the port labeled TO NANOSCOPE on the right side of the Universal Bipotentiostat, shown in Figure 3b, to the port labeled MICROSCOPE on the front of the controller. See Figure 3f.

Connect the Universal Bipotentiostat to the Microscope:

1. **No Extender or Quadrex**: Use the DB-37 cable to connect to the port labeled TO MICROSCOPE on the left side of the Universal Bipotentiostat, shown in Figure 3j, to the microscope.

2. **Extender**: Use the DB-37 cable to connect to the port labeled TO MICROSCOPE on the Extender to the Microscope base.

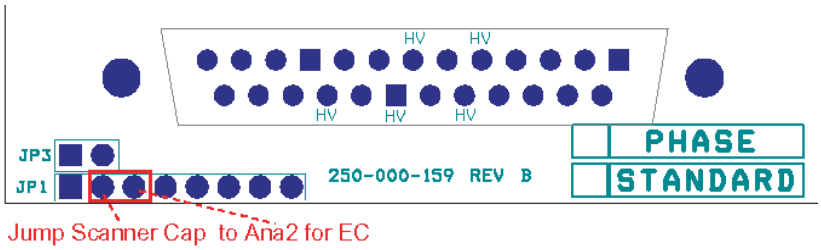
3. **EnviroScope**: Use the DB-37 cable to connect to the port labeled TO MICROSCOPE on the EnviroScope Controller to the EnviroScope.

Connect the Universal Bipotentiostat to the EC Cell:

1. **MultiMode or Standard STM**: Ensure that a jumper, shown in Figure 3i, is set between pins 2 and 3 on jumper JP1 of the MultiMode base. This connects the working electrode to the scanner cap. Connect the 9-pin D-micro-D cable to the port labeled TO EC CELL on the Bipotentiostat. Attach the 9-pin micro-D cable to the other end of the cable. Connect the orange clip to the reference electrode and the violet clip to the counter electrode of the EC cell. For SECPM, connect the SECPM head to the micro-D connector of the cable.

   Note: For more information about MultiMode jumper settings, see **MultiMode Jumper Settings:** Page 40.

Figure 390.3i Jumper Setting for EC in MultiMode Base



2. **EnviroScope**: Connect leg of the EnviroScope stage interface cable labeled EC cell to the port labeled TO EC CELL on the left side of the Bipotentiostat. The cable makes the connections to the working, counter and reference electrodes in the EnviroScope EC cell.

Figure 390.3j Left Side of the Universal Bipotentiostat

Figure 390.3k Configuration with a NanoScope IV(a) and an EnviroScope

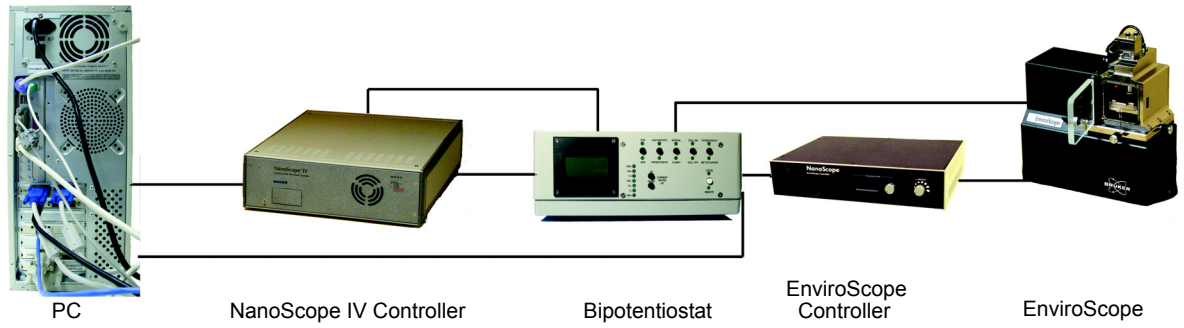
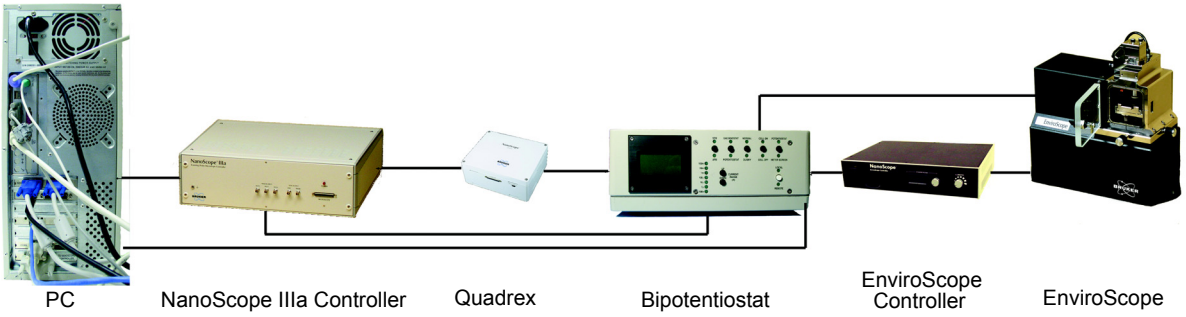


Figure 390.3l Configuration with a NanoScope IIIa and an EnviroScope



390.3.4 Configuration

The Bipotentiostat is configured at Bruker before it is shipped. If you need to configure the Bipotentiostat for different controller, please refer to **Appendix A: Jumper and Dip Switch Settings:** Page 35. Three toggle switches can be set by the user if needed:

> **Note:** These steps are not needed if serial communication between the PC and Universal Bipotentiostat is enabled. See **NanoScope Software Version 5 Operation:** Page 21 or **NanoScope Software Version 7 Operation:** Page 29.

1. **SW1**: Toggles between MM for small sample microscopes such as MultiMode and DIM for microscopes with stages such as Dimension and EnviroScope.

2. **SW2**: Toggles between EXT when an Extender, such as Quadrex, or a NanoScope IV(a) - which includes Quadrex - is used or STD which is used for non-Extended, i.e. standard, systems.

3. **SW3**: NORMAL for normal operation and PROGRAM to upload/upgrade the microprocessor program.

Note: The PROGRAM feature should be used with caution.

390.3.5 Power Up

Important: Powering Sequence

After the unpowered hardware has been configured, attach their power cords to the computer and NanoScope controller and then connect these to appropriate power outlets. Always supply and remove power from components in the correct order.

If the computer is turned off, the NanoScope controller must also be unpowered.

CAUTION: Never supply power to the NanoScope Controller unless the computer is already running.

Power on sequence: 1) computer
2) NanoScope controller

Power off sequence: 1) NanoScope controller
2) computer

The Bipotentiostat receives power from the NanoScope controller and is thus powered up at the same time.

390.4 Operation

390.4.1 Front Panel Operation

The front panel, shown in Figure 4a, has the following controls:

Figure 390.4a Front Panel

STM/AFM:

- **STM**: Selects the Scanning Tunneling Microscopy mode and sets the Universal Potentiostat to be a bipotentiostat, allowing biasing of the sample.
- **AFM**: Selects the Atomic Force Microscopy mode and sets the Universal Potentiostat to be a single potentiostat, virtually grounding the sample.

GALVANOSTAT/POTENTIOSTAT:

- **GALVANOSTAT**: Sets the Universal Bipotentiostat to the Galvanostatic mode. In other words, it controls current.
- **POTENTIOSTAT**: Sets the Universal Bipotentiostat to the Potentiostatic mode. In other words, it controls voltage.

NORMAL/DUMMY:

- **NORMAL**: Connects the electronics in the Universal Bipotentiostat to the electrochemical cell.
- **DUMMY**: Connects the working electrode, counter electrode and reference electrode to the internal dummy cell made of three 10kΩ resistors. This is used for diagnostic purposes.

CELL ON/CELL OFF:

- **CELL ON**: Turns the cell on, i.e. connects the counter electrode to the cell.
- **CELL OFF**: Turns the cell off, i.e. disconnects the counter electrode from the cell and puts the cell in an open circuit condition. The dummy cell's potential will be 0V while the electrochemical cell's potential will be the open circuit potential.

POTENTIOSTAT/METER SCREEN:

Note: This is set to **METER SCREEN** whenever an Extender is used. This includes the NanoScope IV controller as well as NanoScope IIIa controllers used with either an Extender or Quadrex.

- **POTENTIOSTAT**: Used only for NanoScopeE, NanoScope III or NanoScope IIIa controllers without the ADC5 option. This blocks signal used in the **METER SCREEN** on the display monitor and is necessary in order to read the potential and current.
- **METER SCREEN**: Allows AFM meter signals to pass and allows their display in the display monitor.

CURRENT RANGE:

These buttons change the input current sensitivity, indicated by the LEDs at left. When REMOTE control is enabled, the NanoScope software sets and reads this information. When REMOTE control is disabled (i.e. LOCAL control), the user needs to enter the current sensitivity (that was locally set) in **Microscope** > **Calibrate** > **Detector** > **I CELL SENS (VERSION 5)**, shown in Figure 4b, **OR TOOLS > CALIBRATE > DETECTOR (VERSION 6** or **VERSION 7)**, shown in Figure 4c and Figure 4d respectively.

- **UP**: Decreases the input current sensitivity.
- **DOWN**: Increases the input current sensitive.

Figure 390.4b Setting the Current Range in NanoScope v. 5

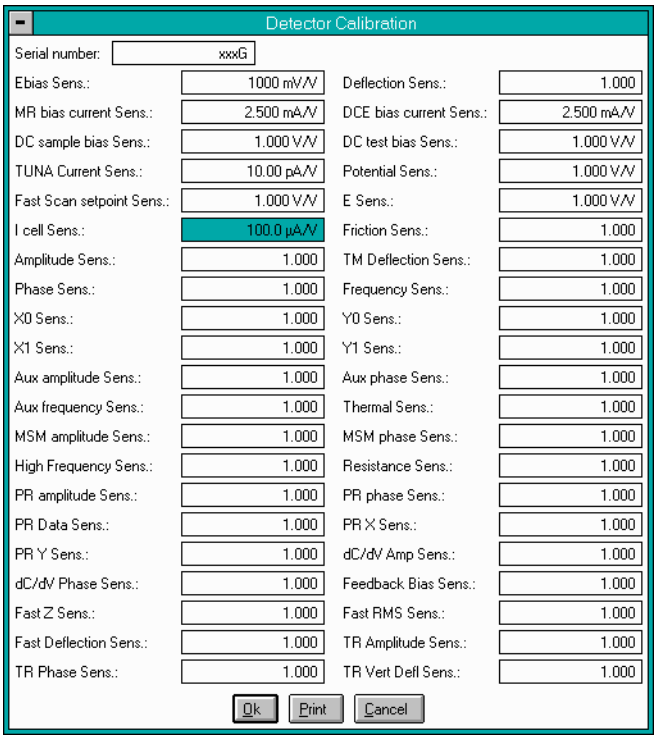


Figure 390.4c Setting the Current Range in NanoScope v. 6

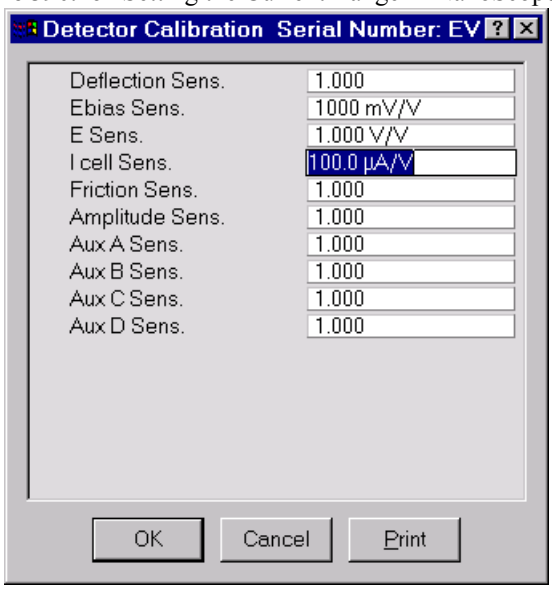
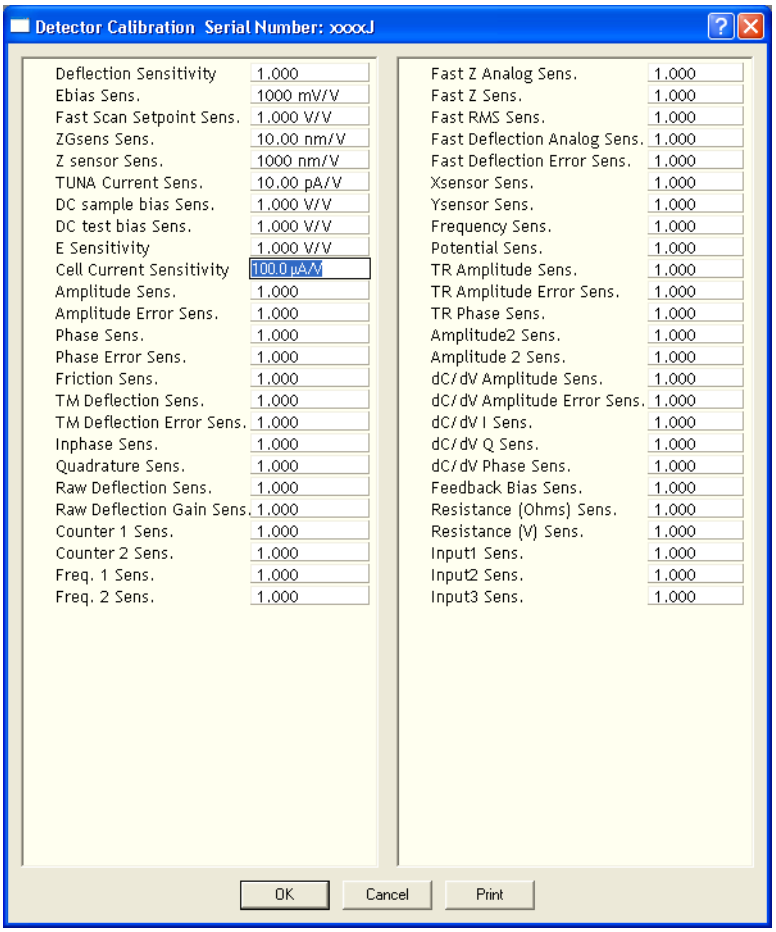


Figure 390.4d Setting the Current Range in NanoScope v. 7



- **LOCAL**/**REMOTE**:
  - **LOCAL**: All controls are operated from the front panel push-buttons.
  - **REMOTE**: Enables software control of the Universal Bipotentiostat.

390.4.2 Potential and Bias Modulation

You may modulate the voltage to the working electrode by connecting a BNC cable between the POTENTIAL MOD connector on the back panel of the Universal Bipotentiostat, shown in Figure 3e, and an oscillator that you supply.

The bias between an STM tip and sample may also be modulated by using the BIAS MOD input, shown in Figure 3e.

Note: The maximum voltage input to either connector is ±10V while the maximum frequency is 10kHz.

390.4.3 NanoScope Software Version 5 Operation

Other than the changes listed below, software usage for the Universal Bipotentiostat is identical to other Bruker Potentiostats.

Software and Firmware

The Universal Bipotentiostat requires NanoScope software version V5.30b25, V5.30r3 or later. Serial communication between the Universal Bipotentiostat and the computer is enabled with the above referenced NanoScope software together with Rabbit microprocessor firmware version 3.01 or later. Refer to **Appendix B: Upgrading the Universal Bipotentiostat Firmware:** Page 37 for instructions on upgrading the Universal Bipotentiostat firmware.

Power-up Delay

Thirty seconds are required for the potentiostat to warm-up and auto-zero its graphic meter. During this period of time, the potentiostat is not responsive to any operation, front panel or serial communication.

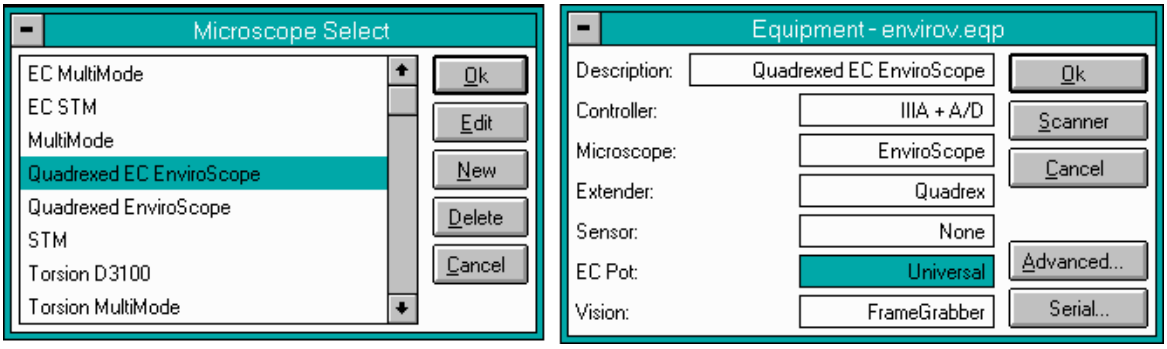
Default Mode

The potentiostat defaults to **REMOTE** to enable serial communication. Pushing the **REMOTE**/**LOCAL** button switches the potentiostat to **LOCAL** to enable front panel operation.

Software Setup

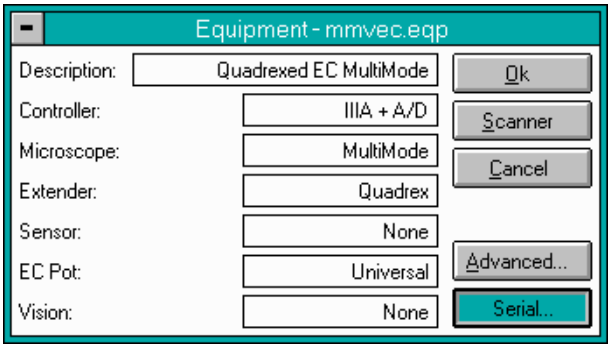
The Universal potentiostat must be added to your equipment list using **MICROSCOPE SELECT**, shown in Figure 4e. For NanoScope IV(a) or NanoScope IIIa + ADC5 controllers, click **EDIT** to open the **Equipment** window and select **UNIVERSAL** for the **EC POT**. For other controllers, select **MMECPOT**.

Figure 390.4e Microscope Select for the Universal Potentiostat



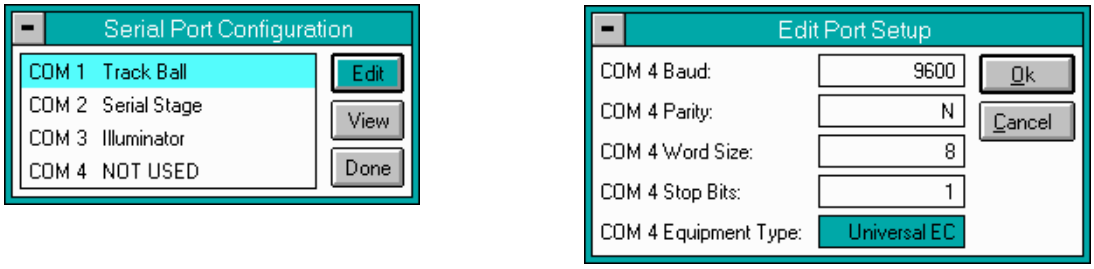
Begin configuring the serial port of the PC that will be used to communicate with the Universal Bipotentiostat by clicking **SERIAL...,** shown in Figure 4f, to open the **Serial Port Configuration** window, shown in Figure 4g.

Figure 390.4f Serial Port Selection



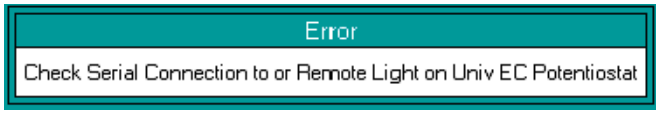
Select the port to which the Universal Bipotentiostat is connected and click **EDIT** to open the **Edit Port Setup** window, shown in Figure 4g. Select **UNIVERSAL EC** for the **EQUIPMENT TYPE**. Click **OK** to close the **Edit Port Setup** window, **DONE** to close the **Serial Port Configuration** window and **OK** to close the **Equipment** window. Click **OK** to close the **Microscope Select** window and open the **NanoScope** real-time window.

Figure 390.4g Serial Port Configuration



If serial communication between the PC and the Universal Bipotentiostat is inactive, an error message, shown in Figure 4h, will appear.

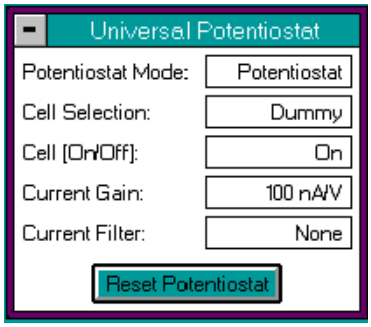
Figure 390.4h Serial Communication Error Window



Universal Potentiostat Panel

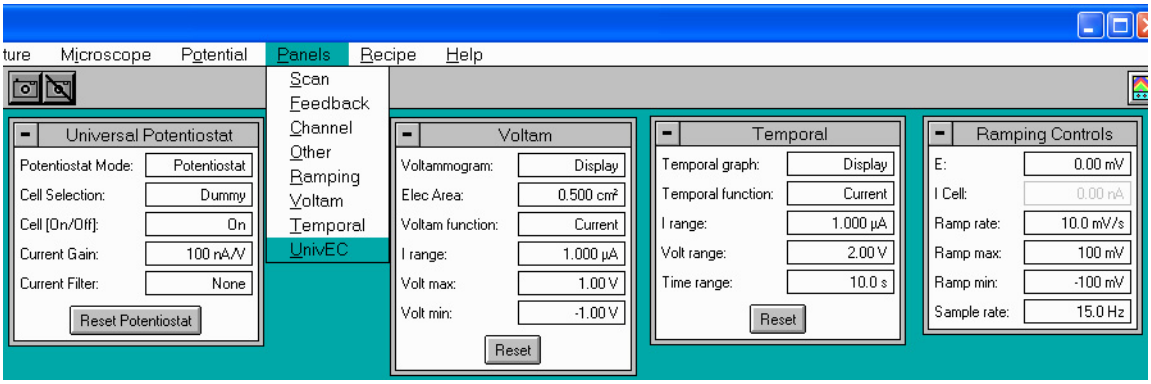
The **Universal Potentiostat** panel, shown in Figure 4i, should be visible in the **Real-Time** window.

Figure 390.4i **Universal Potentiostat** panel



To make the **Universal Potentiostat** panel visible, click **PANELS** (on the menu bar) > **UNIVEC,** shown in Figure 4j.

Figure 390.4j Electrochemistry panels



Functions

- **RESET POTENTIOSTAT**: The NanoScope software will configure the Universal Bipotentiostat for the selected NanoScope controller, Extender, Microscope, and Microscope mode during start-up. However, if the software is started while the controller is powered off, or if the Universal Potentiostat is in **LOCAL** mode, you will need to click **RESET POTENTIOSTAT** after powering up the controller. You will also need to click **RESET POTENTIOSTAT** after switching the Universal Bipotentiostat from **LOCAL** to **REMOTE** mode. This action checks serial communication, configures the potentiostat, auto-zeroes the graphic meter readings and synchronizes front panel settings to NanoScope software.

- **POTENTIOSTAT MODE**:

  - **GALVANOSTAT**: Sets the Universal Bipotentiostat to the **GALVANOSTATIC** mode. In other words, it controls current.

  - **POTENTIOSTAT**: Sets the Universal Bipotentiostat to the **POTENTIOSTATIC** mode. In other words, it controls voltage.

- **CELL SELECTION**:

  - **NORMAL**: Connects the electronics in the Universal Bipotentiostat to the electrochemical cell.

  - **DUMMY**: Connects the working electrode, counter electrode and reference electrode to the internal dummy cell made of three 10kΩ resistors. This is used for diagnostic purposes.

- **CELL [ON/OFF]**:

  - **CELL ON**: Turns the cell on, i.e. connects the counter electrode to the cell.

  - **CELL OFF**: Turns the cell off, i.e. disconnects the counter electrode from the cell and puts the cell in an open circuit condition. The dummy cell's potential will be 0V while the electrochemical cell's potential will be the open circuit potential.

- **CURRENT GAIN**: This changes the input current sensitivity and automatically scales the **Voltam** and **Temporal** plots.

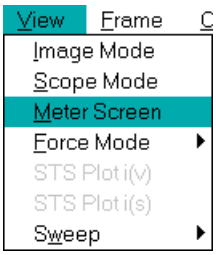
- **CURRENT FILTER**: This sets up the low pass filter to remove noise on current. It is observed that you may need to try different settings a few times to keep the noise down.

Meter Screen

While running electrochemistry on an EnviroScope, Dimension or BioScope, the display monitor is used for voltage and current information. To display AFM signals, click View -> **METER SCREEN**, shown in Figure 4k.

Note: **METER SCREEN** is not available on MultiMode systems.

Figure 390.4k Enabling the Meter Screen



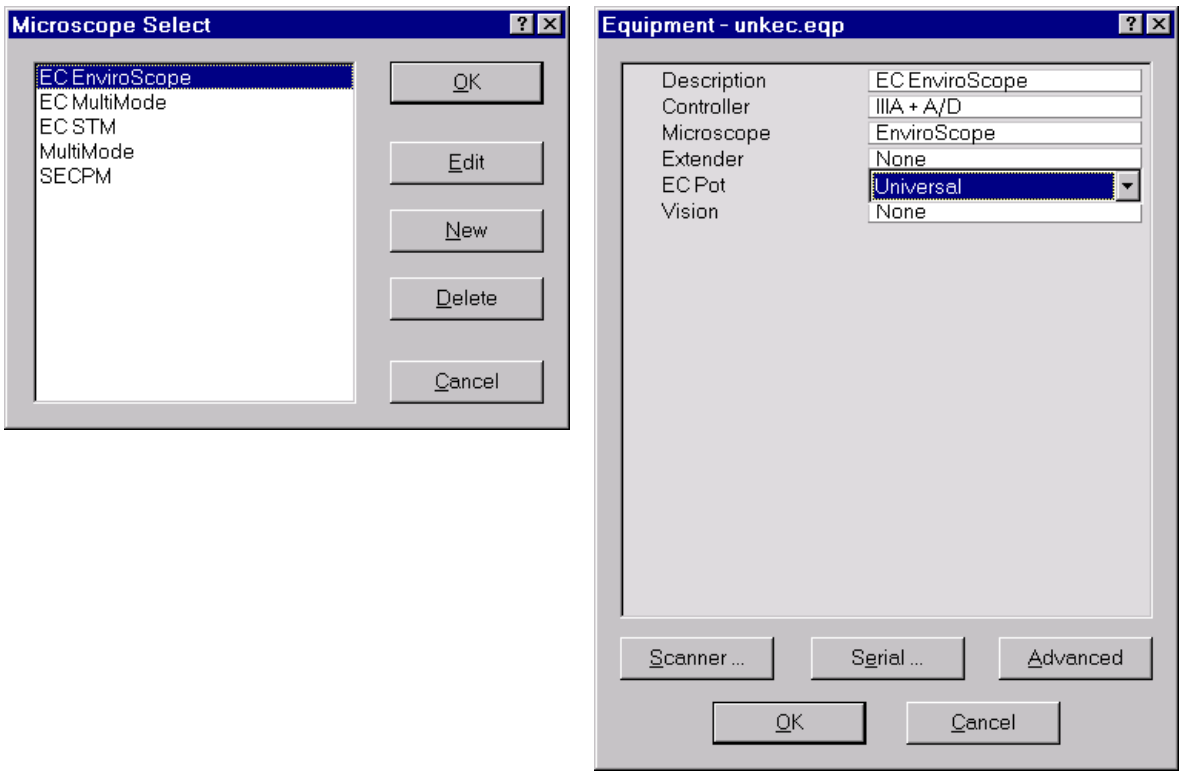
390.4.4 NanoScope Software Version 6 Operation

Other than the changes listed below, software usage for the Universal Bipotentiostat is identical to other Bruker Potentiostats.

The Universal Bipotentiostat requires NanoScope software version 6.13 or later.

The Universal potentiostat must be added to your equipment list using **TOOLS > SELECT MICROSCOPE...**, shown in Figure 4e. For NanoScope IV or NanoScope IIIa + ADC5 controllers, click **EDIT** to open the Equipment window. and select **UNIVERSAL** for the **EC POT**. For other controllers, select **MMECPOT**.

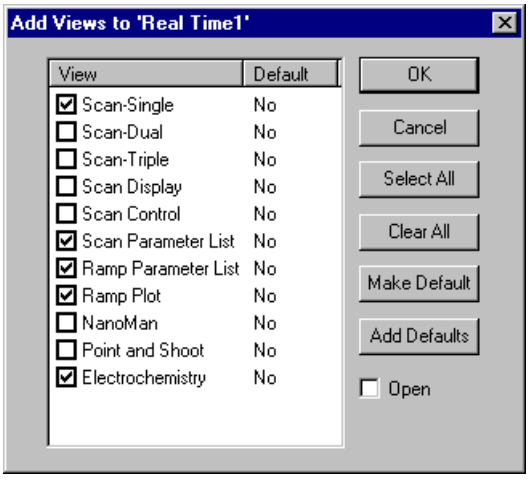
Figure 390.4l Microscope Select for the Universal Potentiostat



Note: Serial communication between the computer and the Universal Bipotentiostat is not supported in NanoScope version 6 software. Use NanoScope version 5.30, or later, for this function.

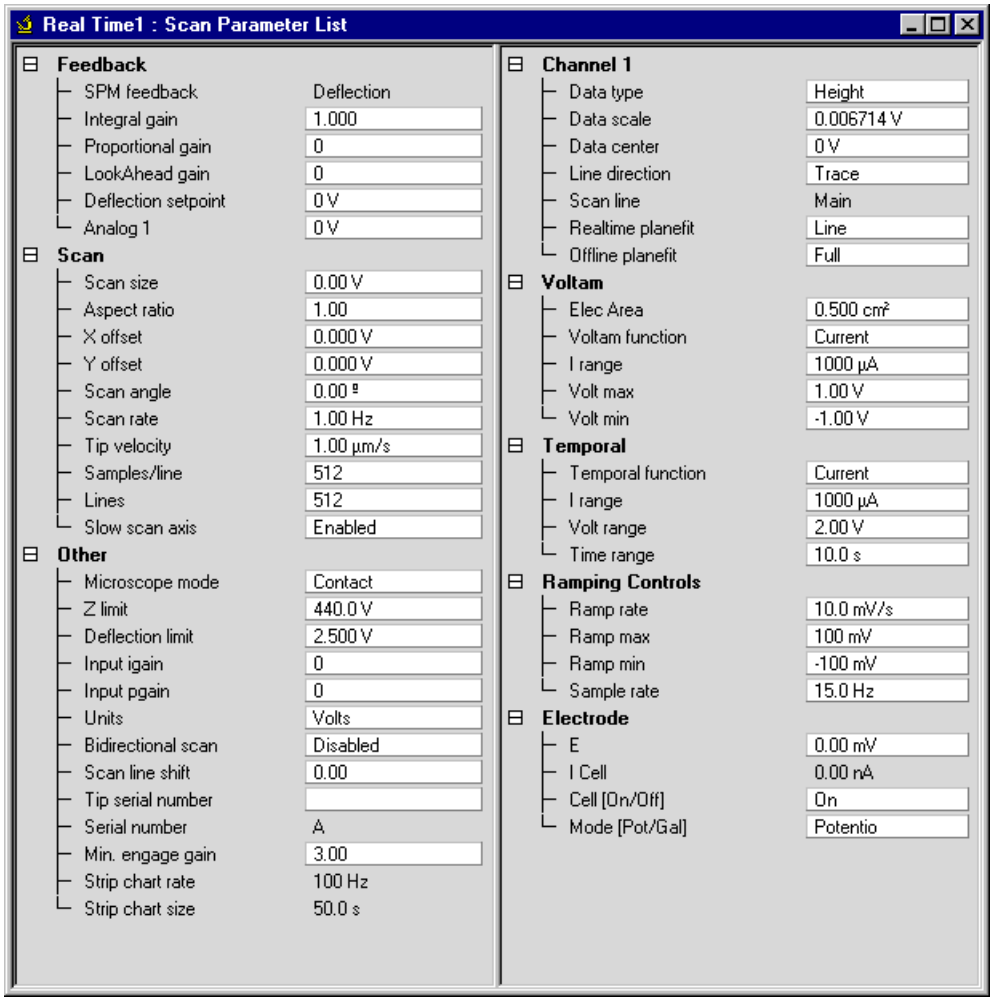
Add **ELECTROCHEMISTRY** to your workspace (see Figure 4m).

Figure 390.4m **ELECTROCHEMISTRY** added to Workspace



This will add EC parameters to the Scan Parameter List, shown in Figure 4n.

Figure 390.4n EC Parameters added to the Scan Parameter List



These parameters are also available in the Electrochemistry window, available by clicking the **EC** workspace (see Figure 4o). Voltage and current information is also available in this window. The **EC** and **Channels** tabs, shown in Figure 4p and Figure 4q respectively, provide an alternate means to adjust EC parameters.

Figure 390.4o Real Time Electrochemistry Window

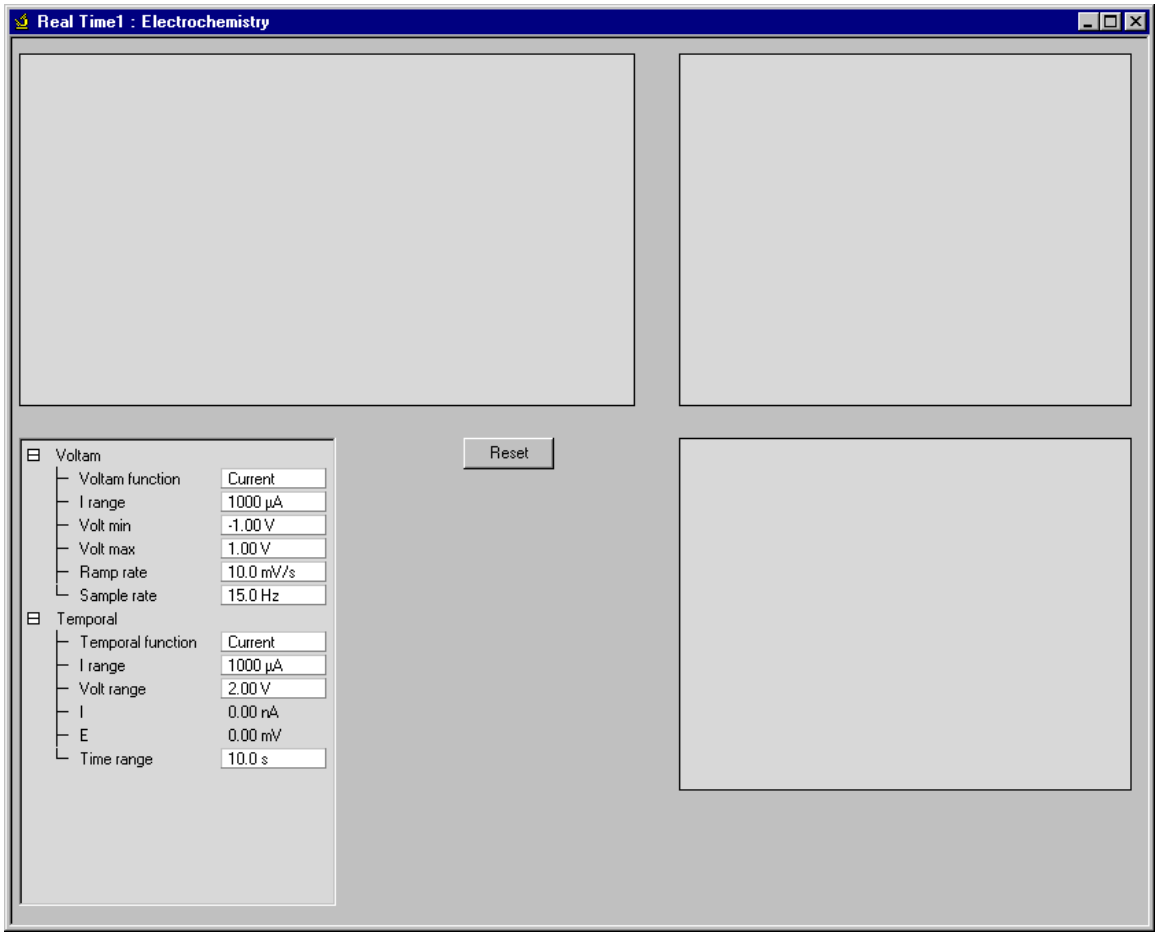


Figure 390.4p EC Tab

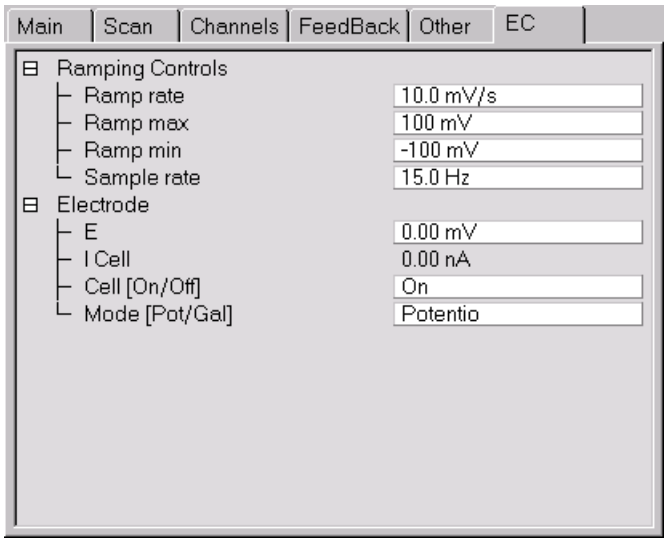
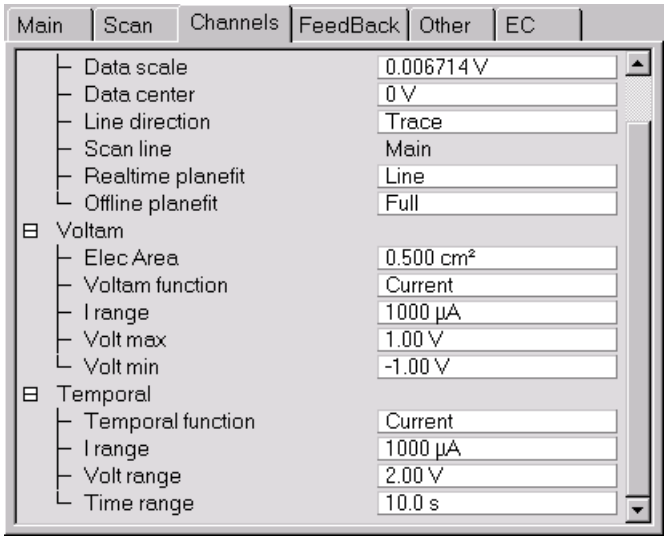


Figure 390.4q EC Parameters in Channels Tab



390.4.5 NanoScope Software Version 7 Operation

Other than the changes listed below, software usage for the Universal Bipotentiostat is identical to other Bruker Potentiostats.

Software and Firmware

The Universal Bipotentiostat requires NanoScope software version 7.20 or later. Serial communication between the Universal Bipotentiostat and the computer is enabled with the above referenced NanoScope software together with Rabbit microprocessor firmware version 3.02 or later. Refer to **Appendix B: Upgrading the Universal Bipotentiostat Firmware:** Page 37 for instructions on upgrading the Universal Bipotentiostat firmware.

Power-up Delay

Thirty seconds are required for the potentiostat to warm-up and auto-zero its graphic meter. During this period of time, the potentiostat is not responsive to any operation, front panel or serial communication.

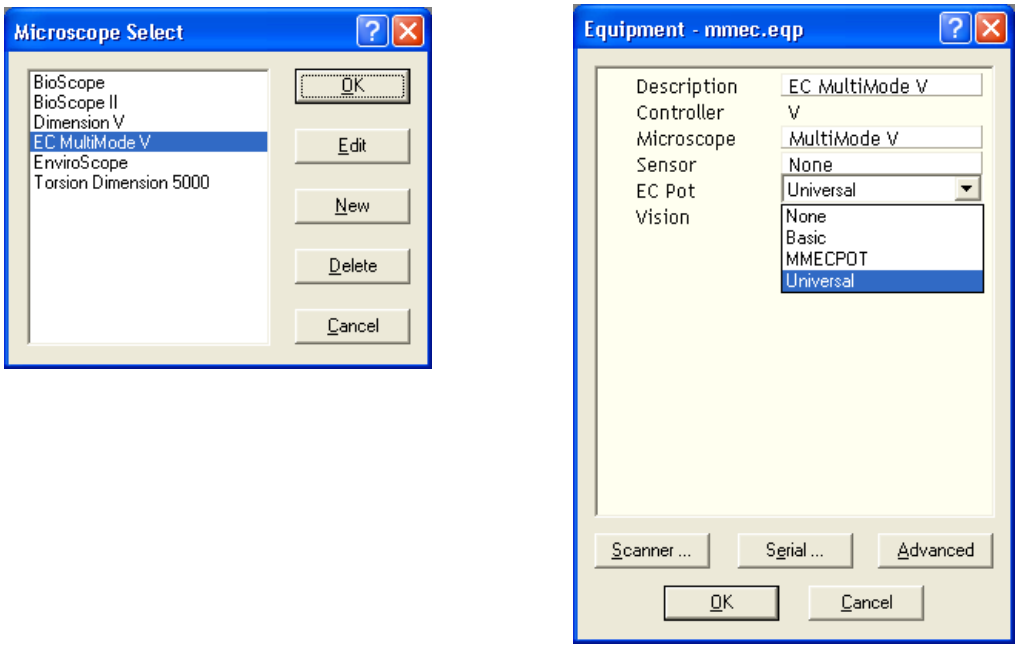
Default Mode

The potentiostat defaults to **REMOTE** to enable serial communication. Pushing the **REMOTE/LOCAL** button switches the potentiostat to **LOCAL** to enable front panel operation.

Software Setup

The Universal potentiostat must be added to your equipment list using **TOOLS > SELECT MICROSCOPE...**, shown in Figure 4r. Click **EDIT** to open the Equipment window, shown in Figure 4r, and select **UNIVERSAL** for the **EC POT**.

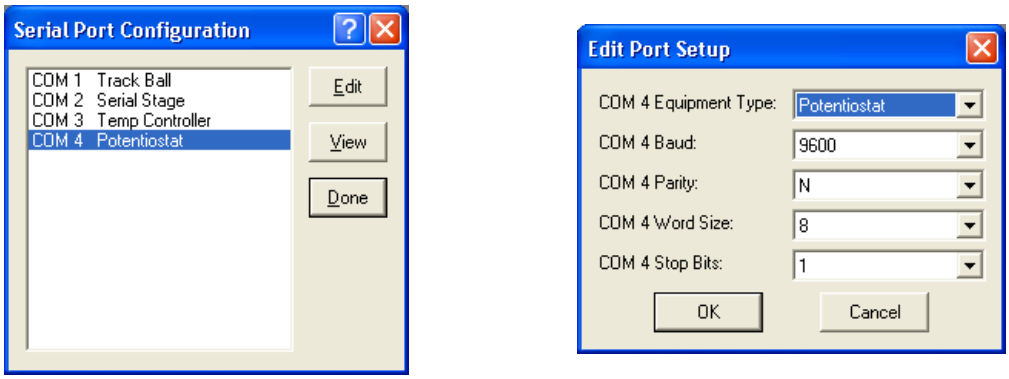
Figure 390.4r Microscope Select for the Universal Potentiostat



Begin by configuring the serial port of the PC that will be used to communicate with the Universal Bipotentiostat by clicking **SERIAL...,** shown in Figure 4r, to open the **Serial Port Configuration** window, shown in Figure 4s.

Select the port to which the Universal Bipotentiostat is connected and click **EDIT** to open the **Edit Port Setup** window, shown in Figure 4s. Select **POTENTIOSTAT** for the **EQUIPMENT TYPE**. Click **OK** to close the **Edit Port Setup** window, **DONE** to close the **Serial Port Configuration** window and **OK** to close the **Equipment** window. Click **OK** to close the **Microscope Select** window and open the **NanoScope** real-time window.

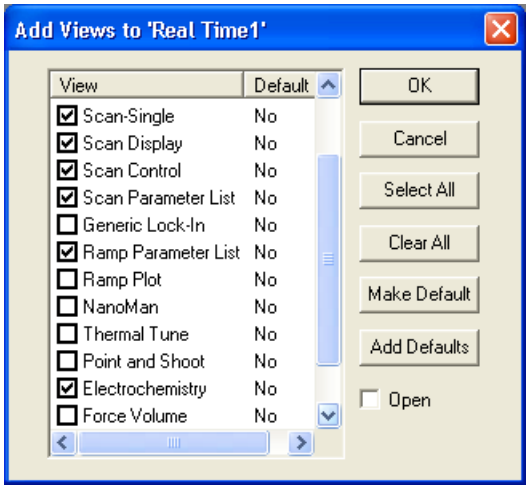
Figure 390.4s Serial Port Configuration



If serial communication between the PC and the Universal Bipotentiostat is inactive, an error message will appear.

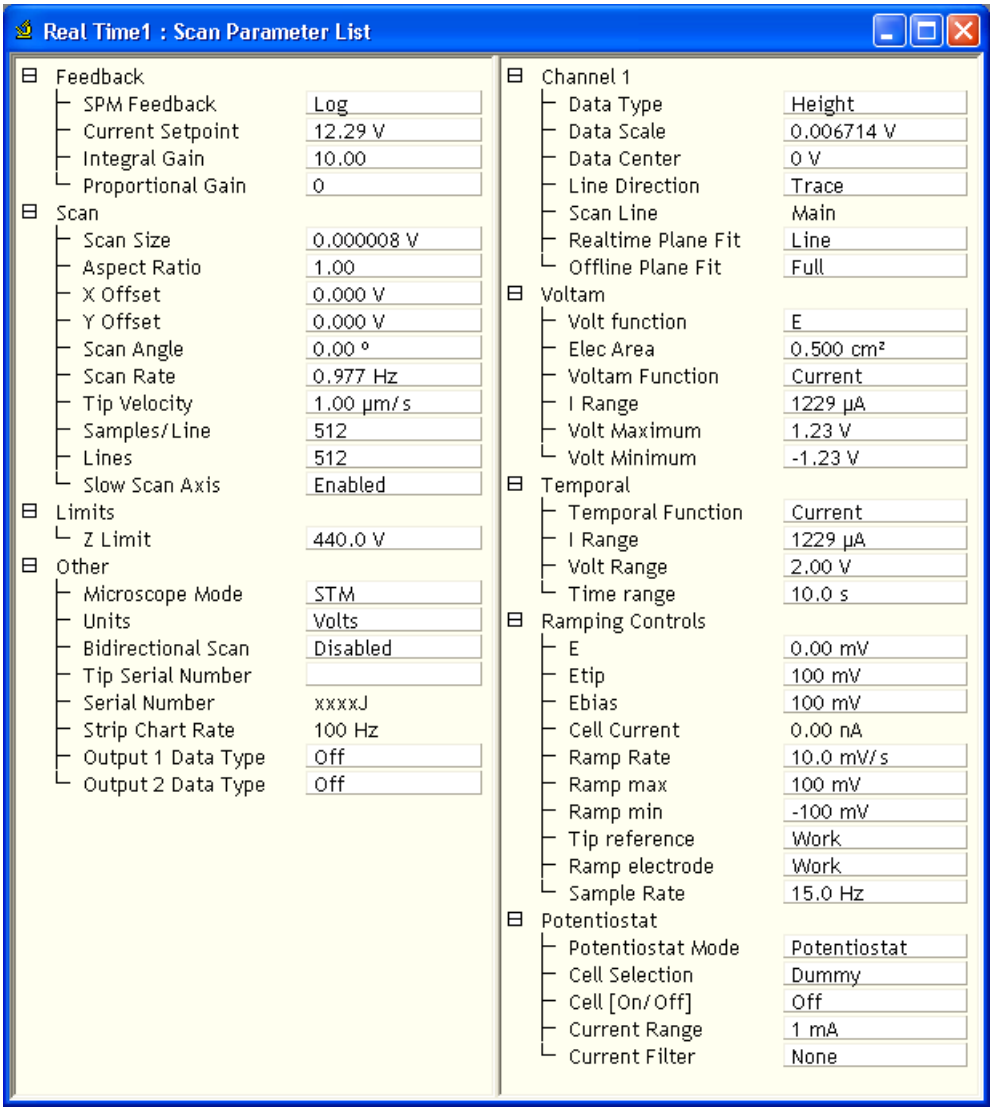
Add **ELECTROCHEMISTRY** to your workspace (see Figure 4t).

Figure 390.4t **ELECTROCHEMISTRY** added to Workspace



This will add EC parameters to the Scan Parameter List, shown in Figure 4u.

Figure 390.4u EC Parameters added to the Scan Parameter List



These parameters are also available in the Electrochemistry window, available by clicking the **EC** workspace (see Figure 4v). Voltage and current information is also available in this window. The **EC** and **Channels** tabs, shown in Figure 4w and Figure 4q respectively, provide an alternate means to adjust EC parameters.

Figure 390.4v Real Time Electrochemistry Window

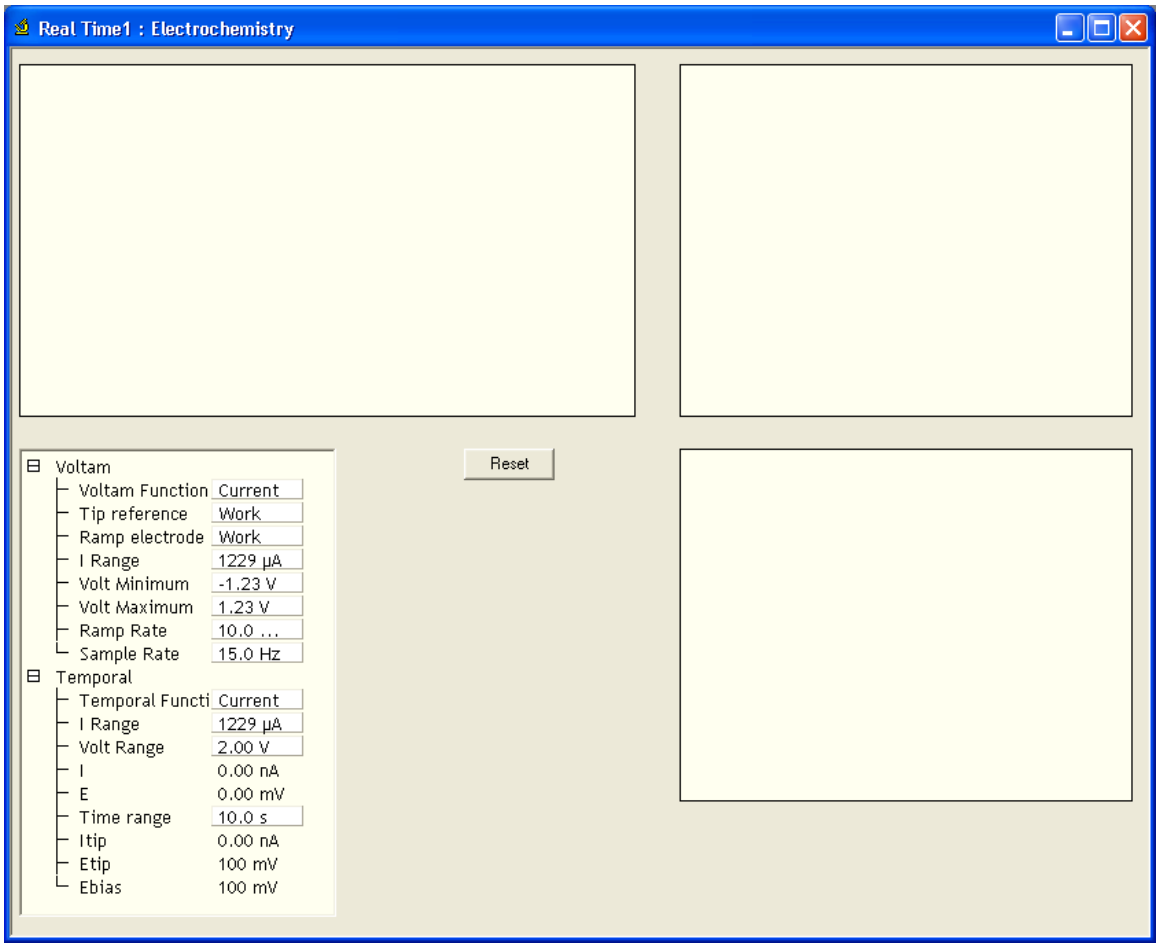


Figure 390.4w EC Tab

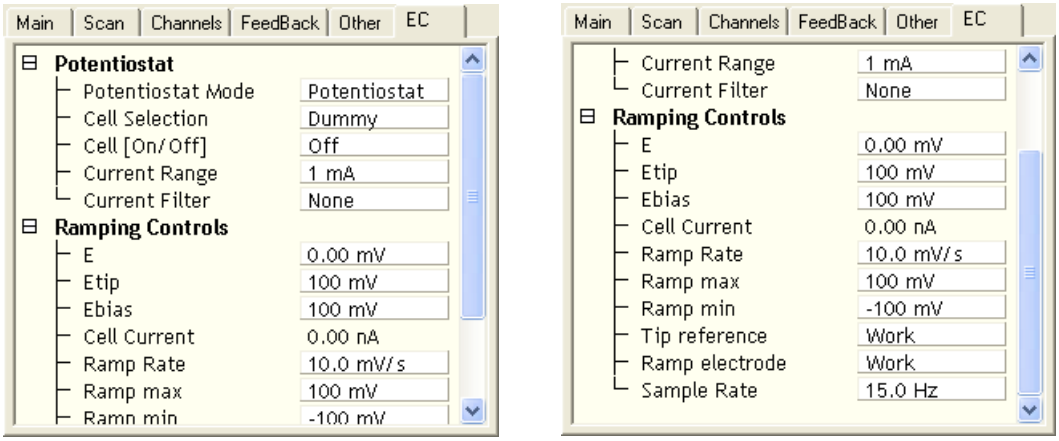
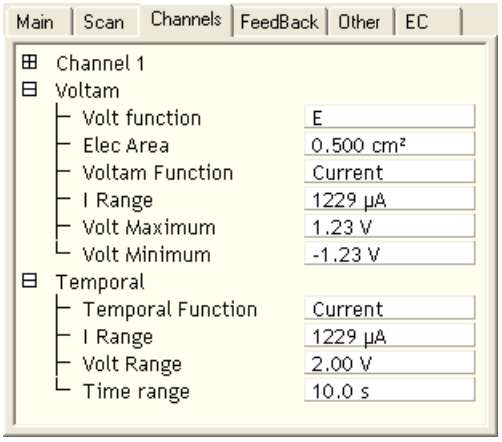


Figure 390.4x EC Parameters in Channels Tab



390.5 Maintenance

The Universal Bipotentiostat does not require special maintenance.

390.6 Appendix A: Jumper and Dip Switch Settings

Figure 390.6a Jumper and DIP switch Settings for NanoScope E, NanoScope III, NanoScope IIIa w/o ADC5. Select **MMECPOT** for **EC POT** in the Equipment setup.

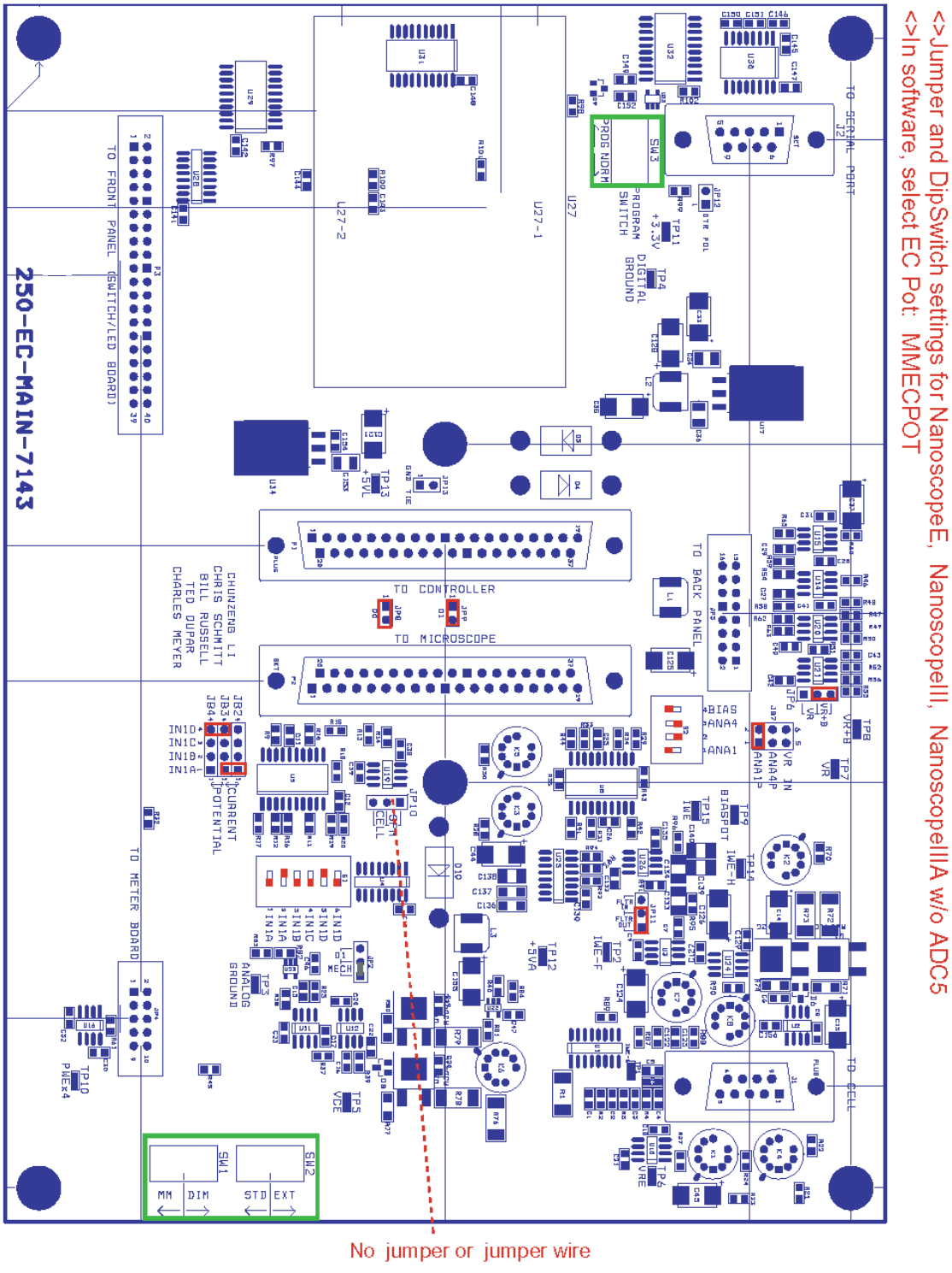
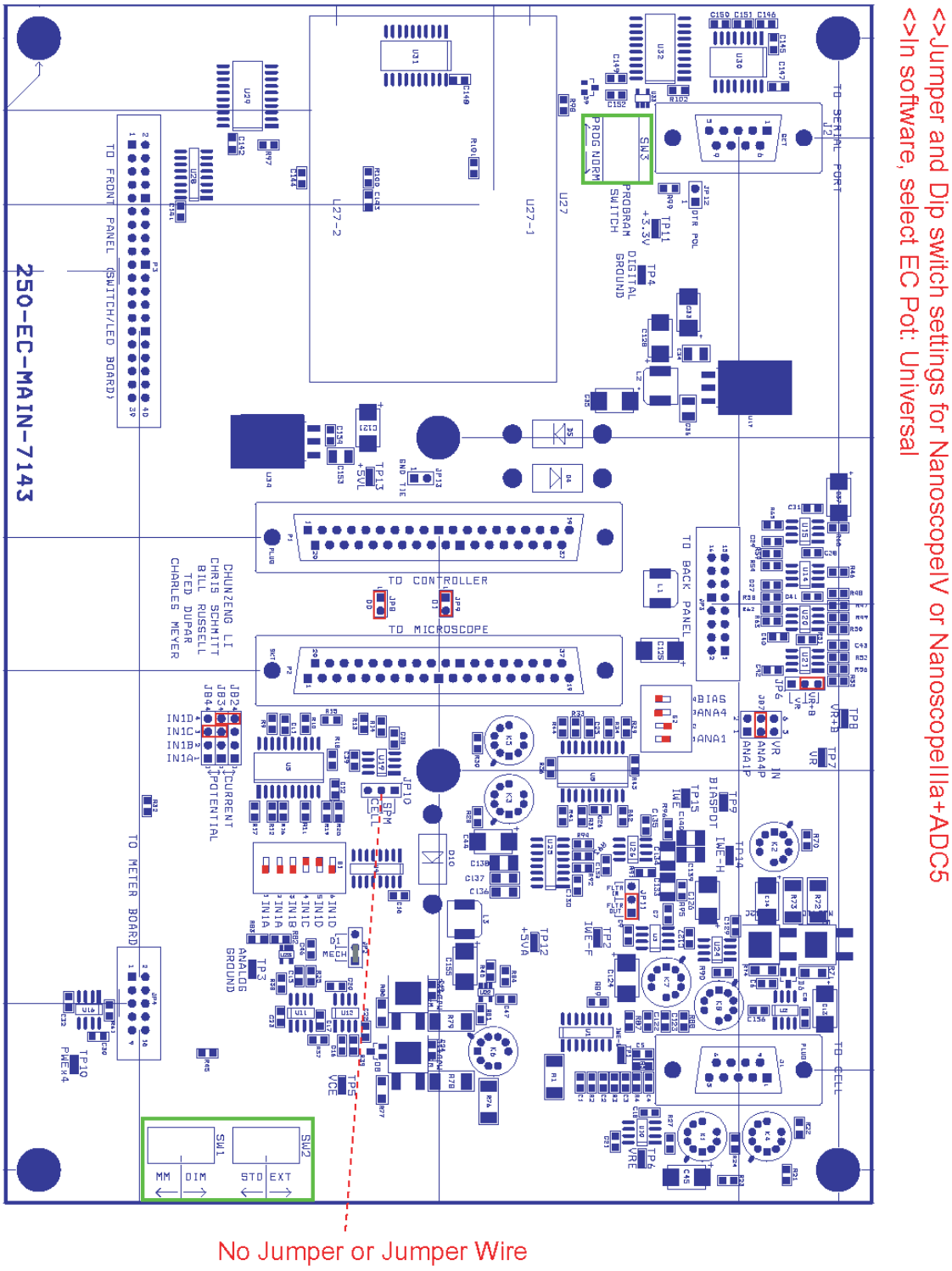


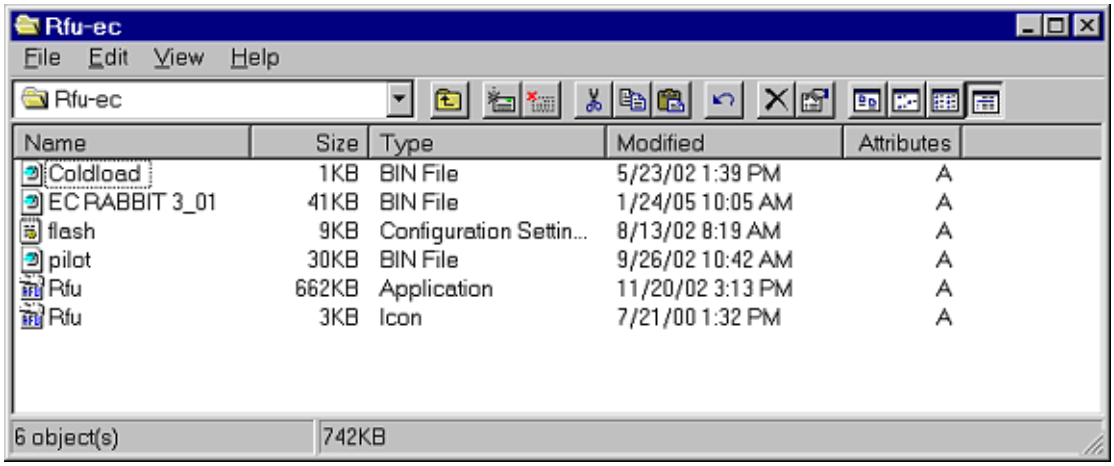
Figure 390.6b Jumper and DIP switch Settings for NanoScope IV(a), including NS IV(a) through the emulation port, or NanoScope IIIa + ADC5. Select **UNIVERSAL** for **EC POT** in the Equipment setup.



390.7 Appendix B: Upgrading the Universal Bipotentiostat Firmware

If you need to upgrade the firmware of your Universal Bipotentiostat, the files, shown in Figure 7a, will be sent to you.

Figure 390.7a Rabbit Programming Files



To upgrade the firmware:

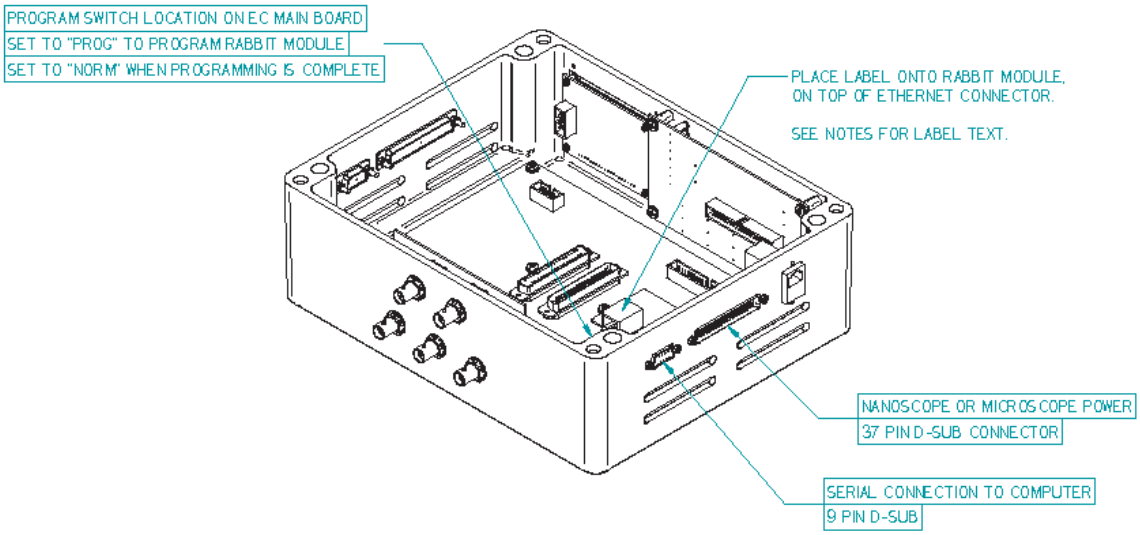
1. Copy the files to the computer that runs the NanoScope software.
2. Create a shortcut to Rfu.exe on the desktop of the computer.

WARNING: Voltages supplied to and within certain areas of the system are potentially dangerous and can cause injury to personnel. Power-down all components and unplug from power sources before doing **any** electrical servicing. If you are not capable of or comfortable performing this upgrade, contact Bruker Service Personnel. This warning supersedes the warning on Page 7 (top) for this upgrade only.

3. Power off the NanoScope controller and disconnect it from the mains.
4. Connect the Universal Bipotentiostat to the controller and disconnect the Microscope from the Bipotentiostat.
5. Plug the COM 1 Serial Cable on the back of the computer to the Serial Port Connection on the Universal Bipotentiostat.
6. Open the Bipotentiostat by loosening the 4 screws on the corners on the bottom of the Universal Bipotentiostat.

7. Locate SW3 on the main board, and switch it to **PROG**. See Figure 7b.

Figure 390.7b Universal Bipotentiostat Firmware Upgrade



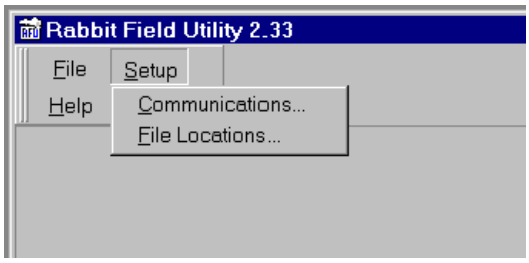
8. Close the Bipotentiostat by tightening the 4 screws on the corners at the bottom of the box.

9. Reconnect the power cord to the NanoScope controller and power it up.

10. From the Desktop, run the Rabbit Field Utility (Rfu.exe) software. Use **HELP** when needed.

11. **CLICK SETUP COMMUNICATIONS...** > **FILE LOCATIONS...,** shown in Figure 7c.

Figure 390.7c **SETUP COMMUNICATIONS** and **FILE LOCATIONS**



12. Select **FILE** > **LOAD FLASH IMAGE**, shown in Figure 7d, and browse to find:
\ \EC RABBIT 3_01.bin (or the current binary file, EC RABBIT X_XX.bin). See Figure 7e.

Figure 390.7d Load Flash Image

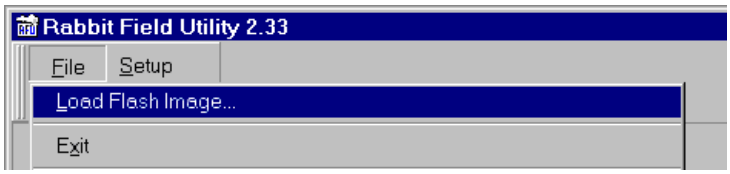
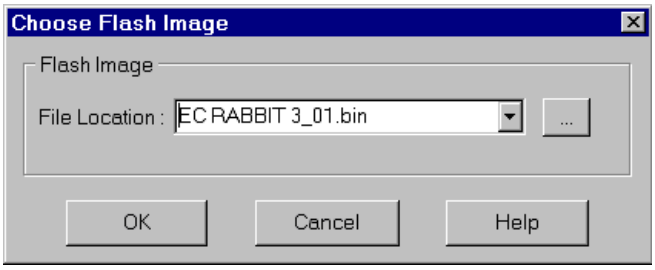


Figure 390.7e Choose a Flash Image



13. Press **OK** to send the program.

WARNING: Voltages supplied to and within certain areas of the system are potentially dangerous and can cause injury to personnel. Power-down all components and unplug from power sources before doing **any** electrical servicing. If you are not capable of or comfortable performing this upgrade, contact Bruker Service Personnel. This warning supersedes the warning on Page 7 (top) for this upgrade only.

14. Power off the NanoScope controller and disconnect it from the mains.

15. Open the Bipotentiostat by loosening the 4 screws on the corners on the bottom of the Universal Bipotentiostat.

16. Switch SW3 to **NORM**.

17. Add a small circular label with text noting the firmware version, e.g. EC 3_01 (or current revision EC X.XX).

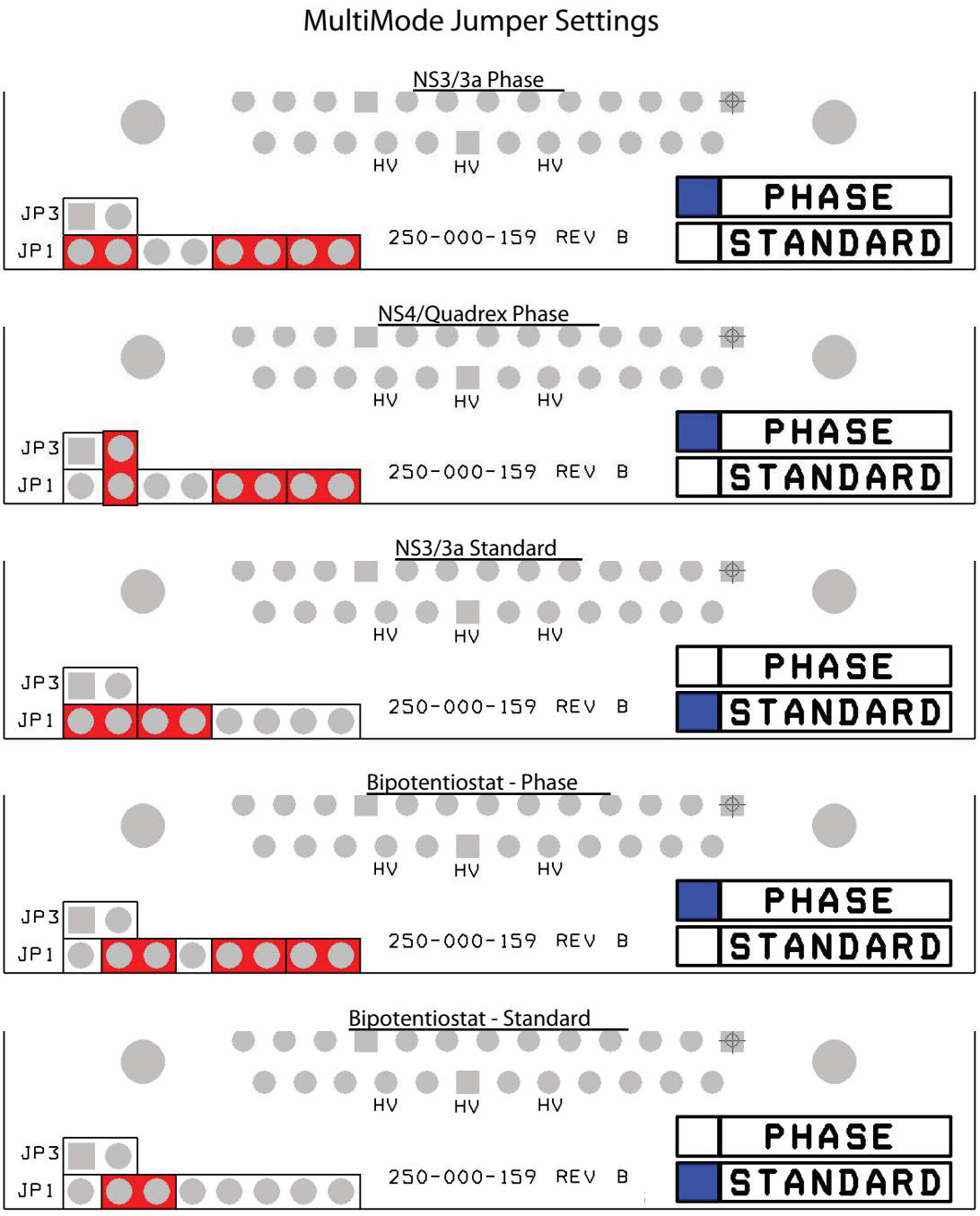
18. Close the Bipotentiostat by tightening the 4 screws on the corners at the bottom of the box.

19. Connect the Extender (if used) and Microscope to the Universal Bipotentiostat as described in **Connecting the Universal Bipotentiostat:** Page 8.

20. Power up the controller and run the NanoScope software to operate the ECSPM system.

390.8 MultiMode Jumper Settings

Figure 390.8a MultiMode Jumper Settings



WARRANTY INFORMATION

This product is covered by the terms of the Bruker standard warranty as in effect on the date of shipment and as reflected on Bruker's Order Acknowledgement and Quote. While a summary of the warranty statement is provided below, please refer to the Order Acknowledgement or Quote for a complete statement of the applicable warranty provisions. In addition, a copy of these warranty terms may be obtained by contacting Bruker.

WARRANTY. Seller warrants to the original Buyer that new equipment will be free of defects in material and workmanship for a period of one year commencing (x) on final acceptance or (y) 90 days from shipping, whichever occurs first. This warranty covers the cost of parts and labor (including, where applicable, field service labor and travel required to restore the equipment to normal operation).

Seller warrants to the original Buyer that replacement parts will be new or of equal functional quality and warranted for the remaining portion of the original warranty or 90 days, whichever is longer.

Seller warrants to the original Buyer that software will perform in substantial compliance with the written materials accompanying the software. Seller does not warrant uninterrupted or error-free operation.

Seller's obligation under these warranties is limited to repairing or replacing at Seller's option defective non-expendable parts or software. These services will be performed, at Seller's option, at either Seller's facility or Buyer's business location. For repairs performed at Seller's facility, Buyer must contact Seller in advance for authorization to return equipment and must follow Seller's shipping instructions. Freight charges and shipments to Seller are Buyer's responsibility. Seller will return the equipment to Buyer at Seller's expense. All parts used in making warranty repairs will be new or of equal functional quality. The warranty obligation of Seller shall not extend to defects that do not impair service or to provide warranty service beyond normal business hours, Monday through Friday (excluding Seller holidays). No claim will be allowed for any defect unless Seller shall have received notice of the defect within thirty days following its discovery by Buyer. Also, no claim will be allowed for equipment damaged in shipment sold under standard terms of F.O.B. factory. Within thirty days of Buyer's receipt of equipment, Seller must receive notice of any defect which Buyer could have discovered by prompt inspection. Products shall be considered accepted 30 days following (a) installation, if Seller performs installation, or (b) shipment; unless written notice of rejection is provided to Seller within such 30-day period.

Expendable items, including, but not limited to, lamps, pilot lights, filaments, fuses, mechanical pump belts, V-belts, wafer transport belts, pump fluids, O-rings and seals ARE SPECIFICALLY EXCLUDED FROM THE FOREGOING WARRANTIES AND ARE NOT WARRANTED. All used equipment is sold 'AS IS, WHERE IS,' WITHOUT ANY WARRANTY, EXPRESS OR IMPLIED.

Seller assumes no liability under the above warranties for equipment or system failures resulting from (1) abuse, misuse, modification or mishandling; (2) damage due to forces external to the machine including, but not limited to, acts of God, flooding, power surges, power failures, defective electrical work, transportation, foreign equipment/attachments or Buyer-supplied replacement parts or utilities or services such as gas; (3) improper operation or maintenance or (4) failure to perform preventive maintenance in accordance with Seller's recommendations (including keeping an accurate log of preventive maintenance). In addition, this warranty does not apply if any equipment or part has been modified without the written permission of Seller or if any Seller serial number has been removed or defaced.

No one is authorized to extend or alter these warranties on Seller's behalf without the written authorization of Seller.

THE ABOVE WARRANTIES ARE EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTIES (INCLUDING THE WARRANTY OF MERCHANTABILITY), AND OF ANY OTHER OBLIGATION ON THE PART OF SELLER. SELLER DOES NOT WARRANT THAT ANY EQUIPMENT OR SYSTEM CAN BE USED FOR ANY PARTICULAR PURPOSE OR WITH ANY PARTICULAR PROCESS OTHER THAN THAT COVERED BY THE APPLICABLE PUBLISHED SPECIFICATIONS.

NO CONSEQUENTIAL DAMAGES. LIMITATION OF LIABILITY. Seller shall not be liable for consequential damages, for anticipated or lost profits, incidental, indirect, special or punitive damages, loss of time, loss of use, or other losses, even if advised of the possibility of such damages, incurred by Buyer or any third party in connection with the equipment or services provided by Seller. In no event will Seller's liability in connection with the equipment or services provided by Seller exceed the amounts paid to Seller by Buyer hereunder.