



# PARSTAT MC

## Hardware Manual

P/N 224233

**AMETEK**<sup>®</sup>

# PARSTAT MC Hardware Manual

Safety Instructions and Symbols.....	4
Cleaning Instructions.....	4
<b>1. INTRODUCTION.....</b>	<b>5</b>
1.1. General.....	5
1.2. Hardware Circuitry .....	5
1.2.1. Potentiostatic mode.....	6
1.2.2. Galvanostatic mode .....	7
1.3. Software .....	7
1.4. Polarity Convention .....	7
1.5. Inspecting Your New Instrument.....	7
1.6. Maintenance, Service, and Support.....	8
1.7. About this manual .....	8
<b>2. SAFETY AND COMPONENT PLACEMENT .....</b>	<b>9</b>
2.1. Safety Considerations .....	9
2.1.1. Line Voltage Settings and Fuses .....	9
2.1.2. Defects and Abnormal Stresses.....	9
2.1.3. Component Placement.....	9
2.2. Ventilation.....	10
2.2.1. Transient Sensitivity .....	10
2.3. Lifting.....	11
<b>3. PARSTAT MC (PMC) INSTALLATION .....</b>	<b>12</b>
3.1. Enabling the USB port on your PC.....	12
3.2. High Data Acquisition Rates and Number of Channels .....	12
3.2.1. USB performance.....	12
3.2.2. Processor speed .....	12
3.2.3. Read/Write speed of the hard drive .....	12
3.3. Connectors and Indicators .....	13
3.3.1. Rear Panel .....	13
3.3.2. Front Panel.....	13
3.4. Connecting to the PC and Cell.....	14
3.4.1. Connecting to the PC .....	14
3.4.2. Connecting the Cell.....	15
3.5. Floating Operation.....	17
3.5.1. Setting Operation Modes of Float and Normal.....	17
<b>4. REPLACING MODULES OF THE PARSTAT MC CHASSIS .....</b>	<b>20</b>
4.1. Introduction.....	20
4.1.1. Safety Information .....	21
4.1.2. The Power Supply Module .....	21

## PARSTAT MC Hardware Manual

4.1.3.	The Potentiostat Module (PMC-1000) .....	23
4.1.4.	The Blank Module .....	24
4.1.5.	The Fan Module (PMC FAN01) .....	26
4.1.6.	The Backplane Module (PMC BPLN01) .....	26
4.1.7.	Replacing a Power Supply Module (PMC PWR01) .....	26
4.2.	Replacing a Fuse on the Power Supply Module .....	29
4.3.	Installing a New Potentiostat Channel .....	30
4.4.	Replacing an existing potentiostat .....	33
4.5.	Replacing the Fan Module .....	36
4.6.	Replacing the Backplane Module .....	44
4.7.	Airflow considerations .....	51
5.	<b>SPECIFICATIONS AND PINOUTS</b> .....	<b>54</b>
5.1.	Electronic Specifications .....	54
5.1.1.	System Performance.....	54
5.1.2.	Power Amplifier .....	54
5.1.3.	Voltage Control.....	54
5.1.4.	Current Control.....	54
5.1.5.	Differential Electrometer.....	54
5.1.6.	Voltage Measurement .....	54
5.1.7.	Current Measurement .....	54
5.1.8.	iR Compensation.....	55
5.1.9.	Potential/Current Control.....	55
5.1.10.	Impedance Specifications, available on PMC-1000.....	55
5.2.	Physical and Power Specifications .....	56
5.3.	Standard Environmental Conditions .....	56
5.4.	<b>AUXILIARY INTERFACE Pinouts</b> .....	<b>57</b>
5.4.1.	Pin Numbers for PMC Auxiliary connection and Analog Connection. ....	57
5.4.2.	Pins Outs for PMC AUX01 Cable.....	57
5.4.3.	Pin Outs for Analog Output. ....	58
5.5.	Cell Cable Pinouts.....	59
6.	<b>AVAILABLE OPTIONS</b> .....	<b>60</b>
6.1.	FRA, available with PMC-1000 .....	60
6.2.	Auxiliary Cables Options .....	60
6.3.	Advanced Auxiliary Interface Option.....	60
7.	<b>WARRANTY</b> .....	<b>61</b>
8.	<b>Appendix: Table of Figures.</b> .....	<b>62</b>

## Safety Instructions and Symbols

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

- DANGER** Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.
- WARNING** Indicates a hazard that could result in bodily harm if the safety instruction is not observed.
- CAUTION** Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

## Cleaning Instructions

**WARNING:** Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

To clean the instrument exterior:

Unplug the instrument from all voltage sources.

Remove loose dust on the outside of the instrument with a lint-free cloth.

Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution.

Do not use abrasive cleaners.

**CAUTION:** To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

Allow the instrument to dry before reconnecting the power cord.

## 1. INTRODUCTION

The PARSTAT MC (Figure 1), teamed with the VersaStudio software package, comprises a simple, flexible, and extremely powerful system for performing a wide range of electrochemical techniques. The PARSTAT MC is a product line and consists of chassis (PMC CHS08A) and a combination of potentiostat channels. Channels are available as the PMC-1000, which have the ability to perform both DC and AC experiments, using a frequency response analyzer (FRA) and the PMC-1000/DC variant which performs only DC experiments. It is controlled from any suitably equipped PC by a Universal Serial Bus (USB) interface using the VersaStudio electrochemistry software package.



Figure 1. PARSTAT MC. 1 x PMC CHS08A and 7 x PMC channels. Staggered position to demonstrate user-installation of different models.

### 1.1. General

The host computer provides memory, data processing, input-output, and interface capabilities. The PARSTAT MC electronically controls the measurement under the direction of the software and parameter values entered from the host computer. The computer must be equipped with a USB port, and the operating system must support the USB interface.

### 1.2. Hardware Circuitry

The PMC-1000 circuitry includes:

Two 16-bit digital-to-analog converters (DACs) for versatile waveform generation.

Three 16-bit analog-to-digital converters (ADCs) to measure current (I), potential (E), SYNC ADC INPUT.  
 An onboard microprocessor to perform the experiment defined by the operating software.  
 Onboard memory to store the programmed parameters and data point values.

Each PMC-1000 operates with VersaStudio in either the potentiostatic or galvanostatic mode, described below.

### 1.2.1. Potentiostatic mode

In this mode, the PMC-1000 controls the potential at the working-sense electrode with respect to the reference electrode (see Figure 2). The counter electrode is driven to the potential required (consistent with the  $\pm 12$  V compliance of the control amplifier) to establish the desired working potential. The range over which the working electrode potential can be controlled is  $\pm 10$  V.

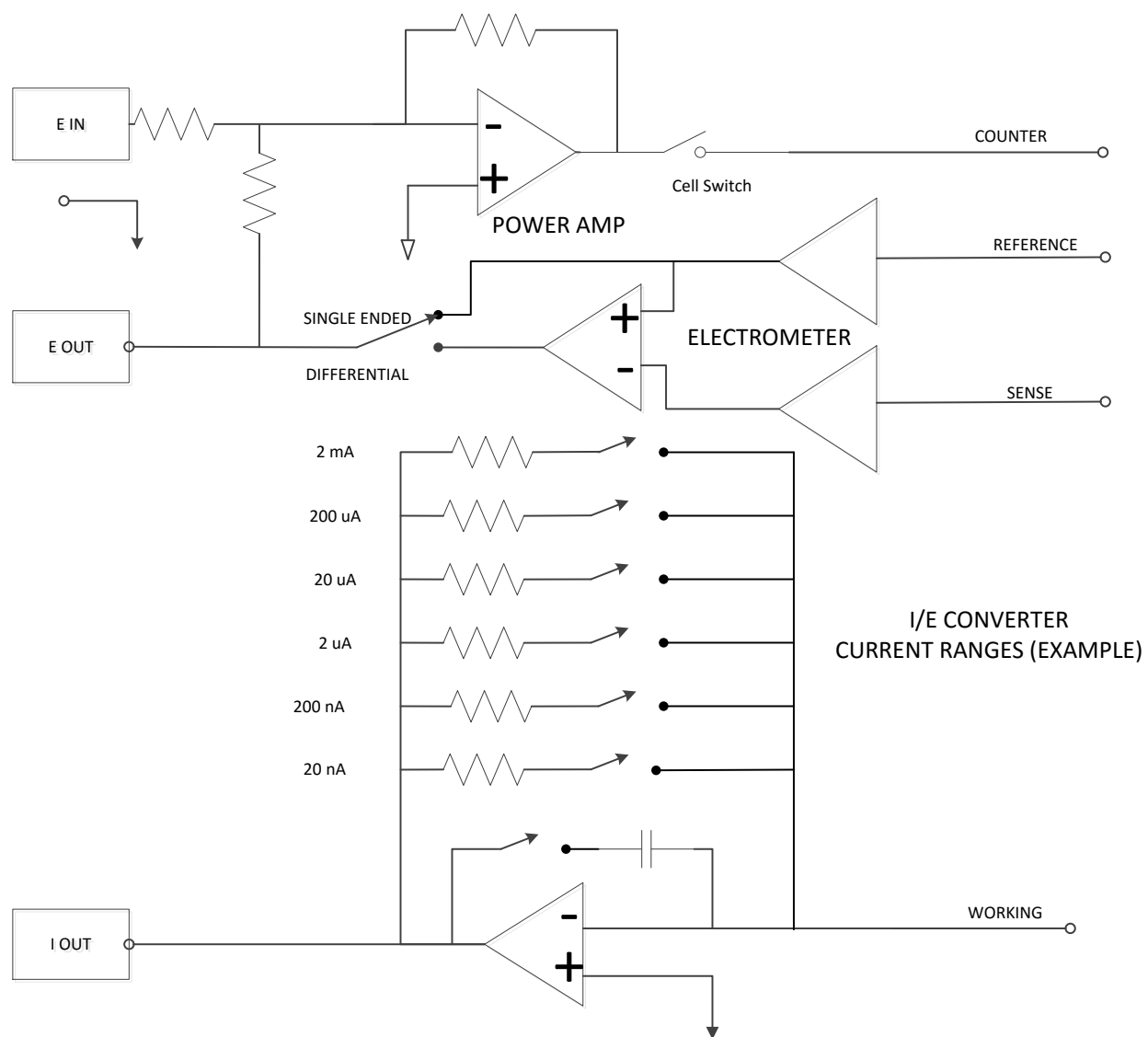


Figure 2. Potentiostat-Mode Block Diagram

## 1.2.2. Galvanostatic mode

In galvanostatic operation, the PMC-1000 controls the current between the counter and working electrodes at the specified fraction of the selected current range (up to the maximum of the current range; see Figure 3). The counter electrode is driven to the potential required (consistent with the  $\pm 12$  V compliance of the control amplifier) to establish the desired cell current. The reference electrode is not used in the control loop, but is usually used to measure the potential at some point in the electrochemical cell relative to the working-sense connection point.

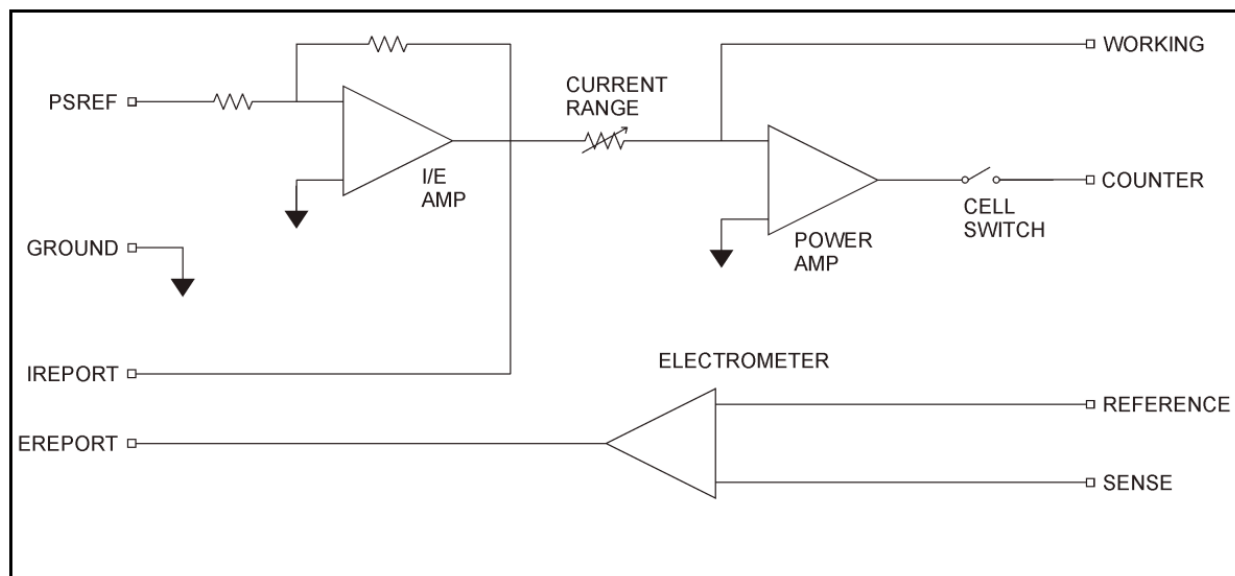


Figure 3. Galvanostat-Mode Block Diagram

## 1.3. Software

The PMC-1000 is fully compatible with the VersaStudio software *only*. The PMC-1000 will not operate with any other software other than that specified in this manual or the most recent documentation available on the web site (<http://www.princetonappliedresearch.com>). Likewise, the PMC-1000 does *not* have an open command set to allow user programming outside of the VersaStudio software. The software is designed specifically to work with Windows 7, Windows 8 and Windows XP. It is highly recommended that either Windows 7 or XP be used.

## 1.4. Polarity Convention

The PMC-1000 hardware follows the American polarity convention. (Positive current is cathodic; that is, a current is defined as positive if reduction is taking place at the working electrode. Negative current is anodic; that is, a current is defined as negative if oxidation is taking place at the working electrode. If the working electrode is driven positive with respect to the equilibrium potential, the resulting current is anodic. If the electrode is driven negative with respect to the equilibrium potential, the resulting current is cathodic.)

## 1.5. Inspecting Your New Instrument

As soon as you receive your new PARSTAT MC, inspect it for shipping damage. If any damage is noted, immediately notify Princeton Applied Research and file a claim with the carrier. Save the shipping container for possible inspection by the carrier.

**WARNING:** If your instrument has been damaged, its protective grounding might not work. Do not operate damaged equipment! Tag it to indicate to a potential user that it is unsafe to operate.

### 1.6. *Maintenance, Service, and Support*

The PARSTAT MC has been designed for optimum reliability and requires no periodic maintenance.

The PARSTAT MC Chassis (PMC CHS08A) is designed on user-replaceable modules. This does not mean that parts are user-serviceable. A following section of the manual will discuss the PMC CHS08A with details on how to replace components.

Contact the factory service department or the affiliate in your area if your unit needs service (see the Warranty in Section 7. for more information).

Remember that our worldwide staff continues to support you after you have purchased your instrument. We provide top quality service, applications support, and a variety of helpful information in the form of application notes, technical notes, and training materials. For more information, visit our website at [www.princetonappliedresearch.com](http://www.princetonappliedresearch.com).

### 1.7. *About this manual*

**Chapter 2** describes recommended safety precautions for operating this instrument, including the provision of adequate ventilation. It also tells how to deal with transients on the power line, and discusses the unlikely possibility of the instrument causing radio frequency (RF) interference.

**Chapter 3** shows how to set up the hardware. It describes the functions of the connections and indicator lights, and shows how to connect the PARSTAT MC to the host computer and test cell.

**Chapter 4** gives the instructions on replacing modules, including potentiostats, into the PARSTAT MC Chassis.

**Chapter 5** gives the physical and electrical specifications of the PMC-1000 including the AUXILIARY and ANALOG connector pinouts.

As noted above, the PARSTAT MC is completely computer controlled; operation and experimental procedures are covered in the software section of this manual.



## 2. SAFETY AND COMPONENT PLACEMENT

This chapter lists safety precautions for use when operating the PARSTAT MC; please read them. There are suggestions for system component placement and information on possible RF interference and transient sensitivity.

### 2.1. *Safety Considerations*

#### 2.1.1. Line Voltage Settings and Fuses

The PMC CHS08A has a Corcom™ Power Entry Module on the left side of the rear panel. The Corcom module contains the power connector. The fuses are mounted on the back of the power supply module (PMC PWR01). **The PARSTAT MC automatically detects the correct line voltage and frequency, so there is no line voltage changes required in the Corcom. Consult min/max on box and section 5.2.**

The PMC CHS08A is supplied with the line voltage fuses in place. Replacement fuses can be source from Ametek or locally.

For all power sources, the fuse is a 16 Amp 5mm x 20mm FAST blow. There are 2 fuses per PWR01 module.

Caution: Do not use makeshift fuses or short-circuit the fuse holders

Please refer to Chapter 4 for specific details on replacement of fuses.

#### 2.1.2. Defects and Abnormal Stresses

**WARNING:** If your instrument has been damaged, its protective grounding might not work. Do not operate damaged equipment! Tag it to indicate to a potential user that it is unsafe to operate.

The PMC CHS08A's ground protection is likely to be impaired if, for example, the instrument shows visible damage  
fails to perform the intended measurement.  
has been subjected to prolonged storage under unfavorable conditions, or  
has been subjected to severe transport stresses.

The instrument should not be used until its safety has been verified by qualified service personnel.

The PMC CHS08A chassis contains three different user-replaceable parts – Fan (PMC FAN01), Power Supply (PMC PWR01) and Backplane (PMC BPLN01).

**NOTE:** The modules are user-replaceable but the modules themselves are not user-serviceable. The modules should not be further opened.

Before doing any user-replaceable exchanges, the AC power should be off AND the power cord should be disconnected. Use caution when replacing fan module.

#### 2.1.3. Component Placement

Before assembling the system, give some thought to component placement. You will of course need convenient access to the computer keyboard and, if applicable, the printer. Depending on the application, you might also need to connect and disconnect the cell leads regularly.

Prevent objects from contacting or interfering with the chassis fan (PMC FAN01).  
Take caution with moving parts.

When you are satisfied that the system is ready to install, connect the units according to the instructions in Chapter 3.

**NOTE:** The standard system does not include an electrochemical cell. You must supply a suitable cell and electrodes.

## 2.2. *Ventilation*

PMC CHS08A specifications apply at the nominal line voltage  $\pm$  and at a temperature of 25° C (77 ° F) unless otherwise noted. Ambient temperature must not exceed 40° C (104° F). See Section 5 for more detailed environmental specifications.

To maintain a safe operating temperature, allow some free space (minimum 15 cm) at the back of the PMC CHS08A for adequate air circulation. There must be adequate circulation between the spaces at the back of the chassis and the ambient laboratory air. In a typical bench top installation, these requirements are satisfied with a large safety margin.

**CAUTION** Because the ventilation for the PMC CHS08A is at the back and bottom of the chassis, rack mounting in an enclosed cabinet is not recommended. Well ventilated rack mounts should not pose any issue.

When the instrument is running all slots of the PMC CHS08A should be occupied by either potentiostat channels or blank modules. This will successfully baffle the air flow from the fan module of the chassis (PMC FAN01) over the active potentiostat cards.  
If the potentiostats are active and not all slots are occupied, overheating the channels is possible and may cause them to shut down until they cool.

### 2.2.1. Transient Sensitivity

Princeton Applied Research instruments are designed and constructed to ensure normal operation in the presence of moderate transient levels. Although these provisions are sufficient for operation in most places where the equipment is used, it is certainly possible for transient levels in particular environments to be so severe that they make reliable operation uncertain. There are three general types of high-level transients:

#### 1. **Static discharge**

Transients from this source generally affect input or output circuits, input circuits that include MOS field-effect transistors to achieve high input impedance are particularly susceptible to damage from this source. Damage typically occurs when the charge built up on a user's body discharges into an input or output connector as a connection is being made. Among the factors determining the tendency for charges to build are the kind of clothing fabrics worn, shoe materials, and the materials in the floor or floor covering.

#### 2. **High-level transients generated internal to the place of use**

Such transients almost always enter the instrument via the line cord. Possible sources include heavy-duty electric motors, RF equipment, diathermy machines, arc welder, spark chambers, and others.

### **3. Lightning**

Transients caused by lightning almost always enter the instrument via the line cord.

Static discharge problems can sometimes be avoided by judiciously selecting the floor covering in the work area. The simplest approach to the problem is to discharge your body by touching a grounded metal object just before touching the instrument, particularly when making connections to the cell. External line-transient filters can generally suppress transients that enter the instrument via the line cord. A suitable transient suppressor is available from Princeton Applied Research. Various kinds of power-line conditioners are also commercially available.

### **2.3. Lifting**

The recommendation to lift from the front handles.

If you are going to lift from the side, do so from the bottom. The ledge of the side panel should not be used for lifting.

### 3. PARSTAT MC (PMC) INSTALLATION

This chapter describes the PARSTAT MC connectors and indicators and shows you how to connect it to the host PC, electrochemical cell, and other equipment you might wish to use with it. The pinouts for Auxiliary and Analog Connector and cell cable connector are listed in Sections 6.

#### 3.1. *Enabling the USB port on your PC*

Some PC manufacturers ship their PCs with the USB port disabled. Check for this before trying to use the PARSTAT MC. If the port is disabled, follow the manufacturer's instructions for enabling it.

#### 3.2. *High Data Acquisition Rates and Number of Channels*

The VersaStudio control software can run up to 32 channels of potentiostats from a single computer. High channel counts especially in combination with high data acquisition rates can burden the system with the requirement for high-speed data transfer.

There are three possible rate-limiting parameters that should be considered if operating this configuration: data from the potentiostat (USB performance), data at the PC (Processor speed), and data to the hard drive (Time to Write for the Hard Drive).

##### 3.2.1. USB performance

VersaStudio and the PARSTAT MC are compatible with both USB 1.1 and USB 2.0. USB 2.0 is recommended for faster data transfer rate requirements.

##### 3.2.2. Processor speed

The processor of the computer itself is another possible bottleneck to fast data transfer. While minimum specifications are published, the fastest processor possible will help ensure that this does not limit the performance of the system at high-speed data transfer.

##### 3.2.3. Read/Write speed of the hard drive

There is a certain amount of time required to both read and write from/to the hard drive. Minimizing this time helps to make sure it is not a bottleneck. Currently solid-state drives are the fastest write/read technology in the market. However, large sizes may be difficult to source. The faster the Read/Write time, the better.

The consequence of data acquisition rate of the total number of channels exceeding the capability of the system to process the data is latency in the display of the data on the computer.

There is a 4 million data point buffer per potentiostat channel. Data collection is not affected by latency in display. The experiment continues to run and data files and display are populated as data transfer happens. However, if the 4 million data point buffer per channel goes into an overrun condition, data outside of its buffer will be lost.

### 3.3. Connectors and Indicators

#### 3.3.1. Rear Panel

The PARSTAT MC rear panel is shown in the figure below

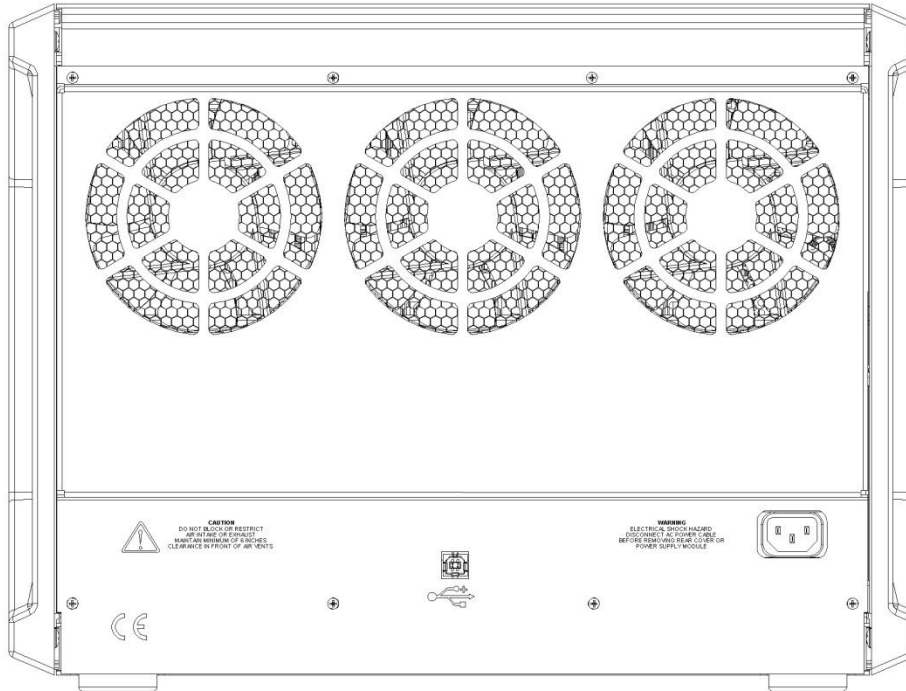


Figure 4. Rear panel of PARSTAT MC (PMC CHS08A Chassis)

##### 3.3.1.1. INPUT POWER

120-240-V; the supplied AC power cord can be connected to 120-240

##### 3.3.1.2. USB

Attach the supplied USB cable to this connector and to the USB connector on the PC. You can connect to and disconnect from the PC without shutting down or restarting Windows or VersaStudio.

#### 3.3.2. Front Panel

The PARSTAT MC front panel is shown in the figure below.

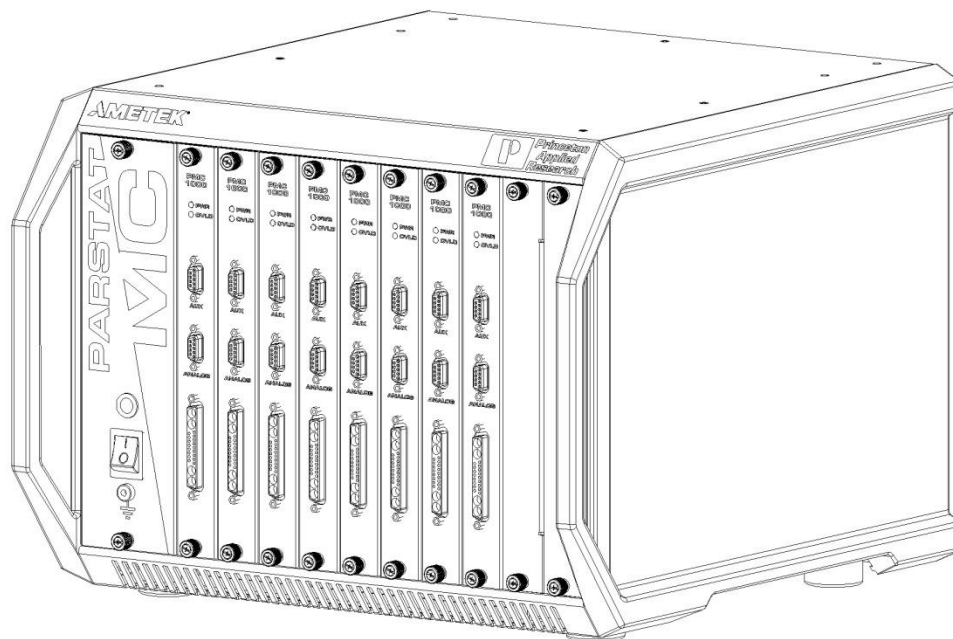


Figure 5. Front panel of PARSTAT MC (PMC CHS08A Chassis)

3.3.2.3. *CELL CABLE Connector* The cell cable connector provides a means of connecting a cell cable to the instrument. The cell cable is described in more detail below.

#### 3.3.2.4. INDICATORS

**OVERLOAD:** This red LED lights if the working electrode current exceeds 2x the full-scale current range.

**POWER:** This green indicator lights when the PMC-1000 channel is powered on.

### 3.4. **Connecting to the PC and Cell**

This section gives instructions on connecting the PARSTAT MC to the host PC and to electrochemical cell and other equipment.

#### 3.4.1. **Connecting to the PC**

The PMC CHS08A is shipped with a standard USB cable. Connect it between the rear-panel USB connector and a USB port on the PC. As noted above, it is not necessary to shut down and restart Windows or VersaStudio.

### Installing the USB Driver

The first time the PARSTAT MC is connected to the host PC and powered on, Windows® should display a “Found New Hardware” message, and request driver installation. Upon this request, insert the VersaStudio CD into the CD-ROM drive, and select “Automatic” to install the driver. This driver should be located in the C:\Program Files\Princeton Applied Research\VersaStudio\ folder.

### 3.4.2. Connecting the Cell

To connect the cell cable (part no. 223945) to the PMC-1000 or PMC-1000/DC:

1. Make sure the POWER switch is off.

Match and attach the D connector side of the Cell cable to the front of the PMC-1000, and secure the screws on either side.

After cell cable is connected to front panel, power the unit on and let it boot fully (approximately 1 min to boot up) before connecting a cell to the leads of the cell cable.

**CAUTION:** Having a cell connected at power-on or at power-off should be avoided to prevent any voltage or current spikes from reaching the cell, or in the case of energy storage devices (such as batteries, capacitors, or fuel cells), preventing spikes from discharging back into the PMC-1000 and causing damage to the instrument.

The opposite end of cell cable is color-coded at the tip as follows:

Green – Working (WE) electrode lead. This lead connects to the electrode of interest at which the desired reactions will occur. The current (I) is measured through the WE.

Red – Counter (CE) electrode lead. This lead connects to the electrode opposite the WE and controls the power output of the PMC-1000.

Gray – Sense (SE) electrode lead. This usually connects to the working electrode (the combination often referred to as the working-sense), and is a component of the differential amplifier that measures/controls the voltage between itself and the reference electrode.

White – Reference (RE) electrode lead. This connects to the reference electrode, a component of the differential amplifier that measures/controls the voltage between itself and the sense electrode.

Black – Ground lead. The use of the ground lead depends on the application, but it is not ordinarily used in most experiments. It can be used to supply a ground point to a Faraday shield for the experimental cell, and is used in some open circuit experiments to form a zero-resistance ammeter (ZRA).

The following descriptions and figures explain how to connect a two-, three-, or four-terminal electrochemical cell to the terminals of the PMC-1000 cell cable.

a) Batteries, capacitors, resistors, fuel cells, and some sensors are generally connected using a two-terminal connection (Figure 6). The connectors for the cable leads are designed to allow easy interconnection of the working/sense and reference/counter leads. **Note:** If your cell has low impedance (battery) and/or your experiment generates currents in excess of 100mA, do not connect the leads into one another for a two-terminal connection. Instead, connect the leads independent of one another to their proper terminal at the cell to prevent voltage offsets that can result from milliohms of contact resistance in a “piggy-back” connection as shown below.

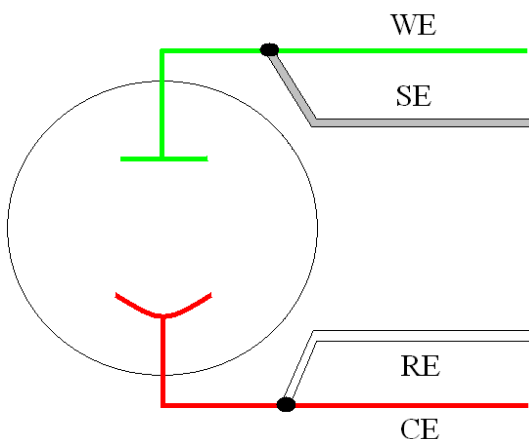


Figure 6. Two-Electrode Connection

b) General aqueous electrochemistry, corrosion experiments and most EIS experiments are connected using a three-terminal connection (Figure 7). The voltage at the working-sense is controlled relative to a stable reference electrode positioned in close proximity to the working electrode.

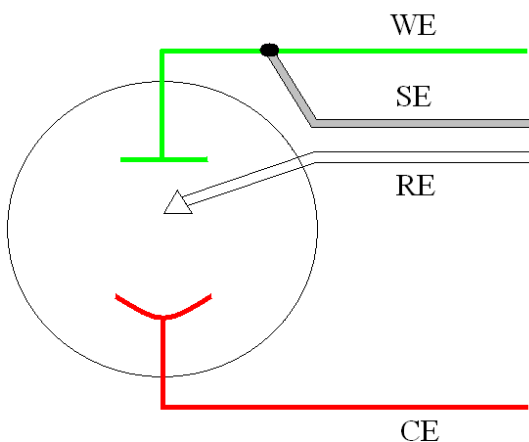


Figure 7. Three-Electrode Connection

c) There are some applications for which a four-terminal (Figure 8) connection is required. In this case, the sense electrode serves as a second reference electrode, useful for controlling the potential between the reference and sense (for instance, in controlling the potential across a membrane in a H-cell setup).

Note: Running experiments in this mode requires that the Electrometer Mode setting in the software be set to Differential for the correct potential to be applied and read.



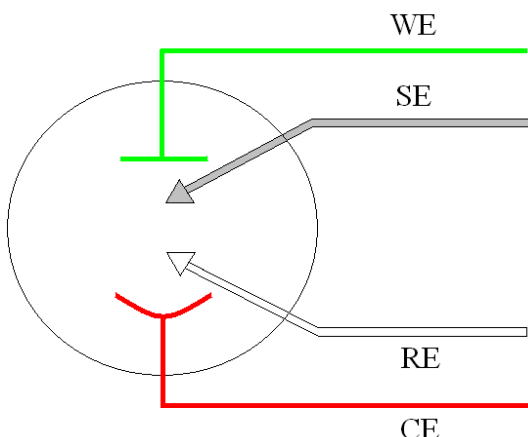


Figure 8. Four-Electrode Connection

**CAUTION:** Take care that the leads *do not accidentally short together*. Because the black ground lead is often unused, it tends to be overlooked and is more likely to accidentally short together with another lead.

The polarity of the potential at the counter electrode will be opposite the “applied potential”. This is necessary to establish the correct polarity relationship at the working electrode versus the reference electrode.

After all other connections to the PMC-1000 are made, experiments can be set up and performed.

### 3.5. Floating Operation

The PMC-1000 and PMC-1000/DC were designed to operate in either a “normal” mode or a “floating” mode. The floating mode provides the capability to operate with cells where one of the electrodes or the cell itself is at earth ground. Examples of earth grounded cells include autoclaves, strain apparatus, storage tanks and pipelines, and additional electrodes connected to a separate potentiostat that is not floating.

In floating mode, the internal ground of the PMC-1000 and PMC-1000/DC (as well as the cell leads and external connections at the rear panel) is allowed to float with respect to earth ground which allows it to operate with these grounded cells.

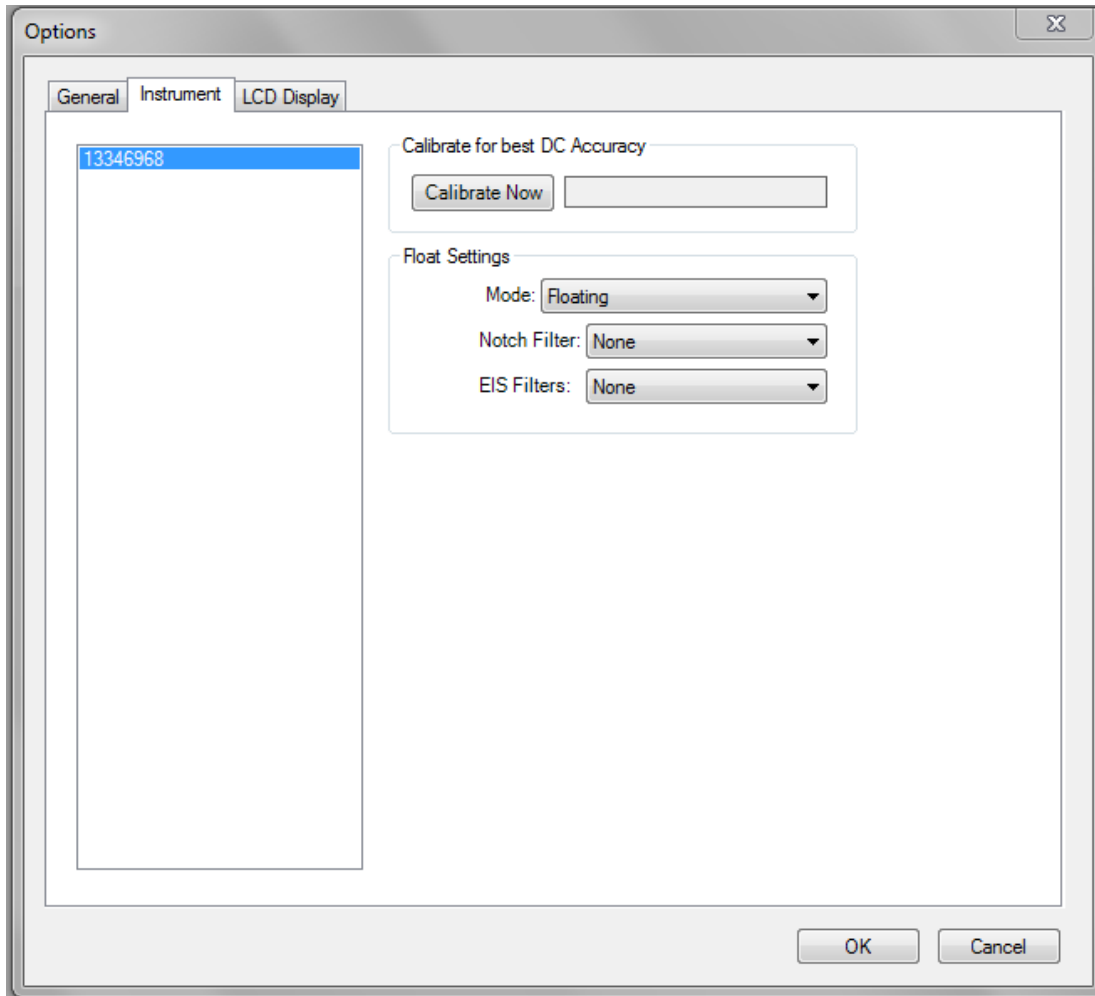
**NOTE:** Instrument performance, particularly with regards to current and voltage noise, can be substantially degraded when operating in float mode on grounded cells, the level of degradation depending on the technique and the impedance between the electrodes and ground. Therefore specifications listed in Section 5 apply only to isolated cells with the PMC-1000 set to normal mode.

The following section gives instructions on setting the PMC-1000 and PMC-1000/DC to the floating mode.

#### 3.5.1. Setting Operation Modes of Float and Normal

## PARSTAT MC Hardware Manual

The PARSTAT MC control software, VersaStudio, provides an Options menu (Tools → Options...) where the mode can be changed to either “normal” or “floating” as shown below:



**Figure 9. Changing from "Normal" operation to "Floating" operation**

It is recommended that after one changes modes, a new calibration for DC accuracy be performed by selecting the “Calibrate Now” button above the Floating Settings option.

In addition to the mode selections, the PMC-1000 and PMC-1000/DC also provides additional filters that could be required with some cells in order to enhance the signal to noise.

The “Notch Filter” is specific for those frequencies associated with line power (50/60Hz), and can reduce noise pick-up from power sources. The filter selection would depend on the line power frequency supplied to the PARSTAT MC. **Note: Notch Filters should be set to “None” if performing EIS actions.**

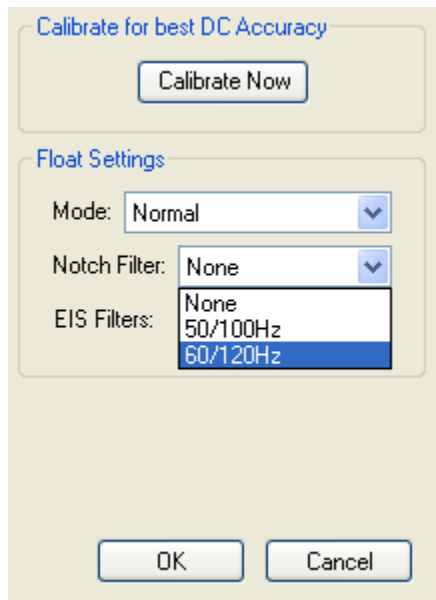


Figure 10. Selecting Notch Filters and EIS Filters.

The “EIS Filters” are specific for those systems equipped with the FRA option to perform Electrochemical Impedance Spectroscopy (EIS), and can be used when performing EIS techniques where noise pickup from additional, grounded electrodes in the cell are degrading the EIS data. The selection of “Aggressive” should be tried first, then “More Aggressive” if needed.

## 4. REPLACING MODULES OF THE PARSTAT MC CHASSIS

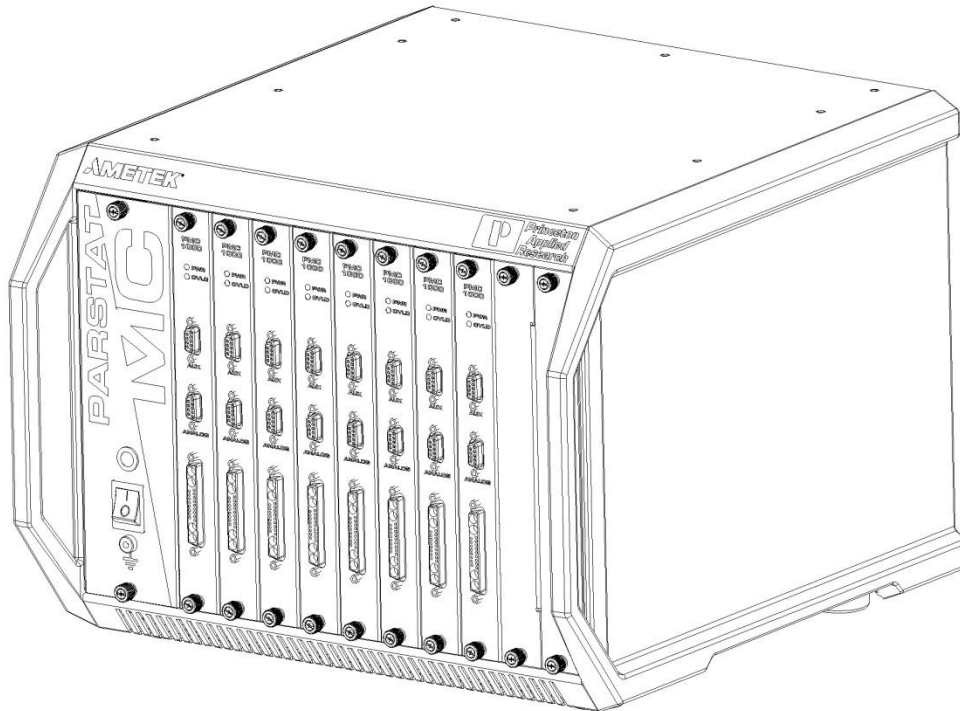


Figure 11. PARSTAT MC. 1 x PMC CHS08A and 8 x PMC-1000 channels

### 4.1. Introduction

The PARSTAT MC (PMC) is a multi-channel potentiostat system with a unique modular design.

The front of the PMC chassis has eleven slots: one dedicated power supply slot, and ten slots for up to 8 potentiostat channels. The power supply module (PMC PWR01) is always installed in the power supply slot at the far left of the chassis (PMC CHS08A). The other ten slots may have up to eight potentiostat channels installed at one time.

The rear of the PMC chassis has two modules: the fan module (PMC FAN01) and the backplane module (PMC BPLN01). These modules are protected by the rear cover. Connections for AC mains power and USB are found on the rear of the chassis.

The user may remove and replace any of these modules: the power supply, any potentiostat module, the fan module, and the backplane module. Descriptions of these modules and instructions for their removal and replacement are found in the following sections of this manual.

Please read the entire User's Manual before operating the PMC or removing any modules or panels.

### 4.1.1. Safety Information



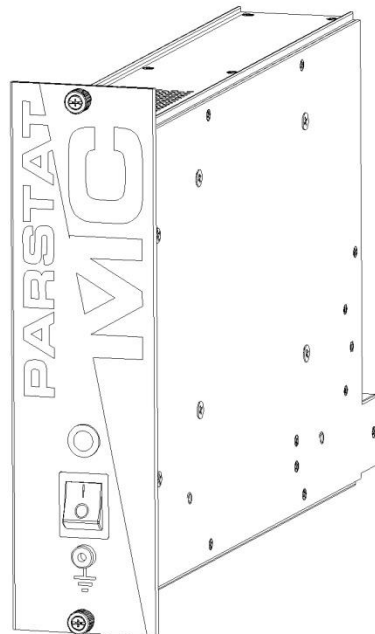
**WARNING** Within this manual, a warning message indicates the potential for injury or death to persons.



**CAUTION** Within this manual, a caution message indicates the potential for failure of or permanent damage to the instrument.

### 4.1.2. The Power Supply Module

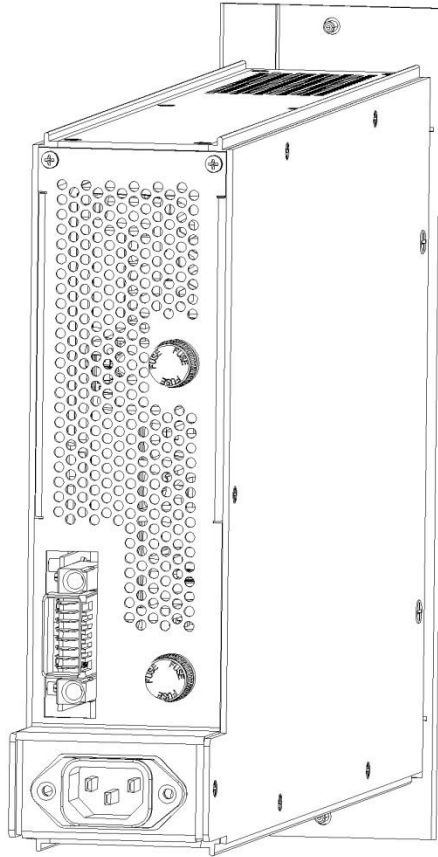
The power supply module contains the inlet for AC mains power, and provides power for all of the other modules.



**Figure 12. Power Supply module (PMC PWR01).**

On the front panel of the power supply module is the main power switch for the PMC. When the switch is toggled up (I), power is ON. When the switch is toggled down (O), power is OFF. The power indicator LED lamp is lit when power is ON and unlit when power is OFF. The ground/earth connection on the front panel is a 4mm banana jack.

There are two rails on the top and two rails on the bottom of the power supply module. These rails help to locate the module in the chassis, aligning and retaining it properly. The thumbscrews fasten the module to the front of the chassis.



**Figure 13. Back of the PWR01 after the removal from the CHS08A.**

The rear of the power supply module has the power entry for AC mains power, the locators and connector to the backplane module, and two fuse holders.



**WARNING** Do NOT connect an AC mains power cable to the power supply module when the module is not installed in the PMC chassis.



**WARNING** Do NOT remove any covers or panels from the power supply module.

### 4.1.3. The Potentiostat Module (PMC-1000)

A potentiostat channel may be installed in any chassis slot except the dedicated power supply slot. Up to eight potentiostat channels may be installed at one time. The PMC-1000 module is shown here.

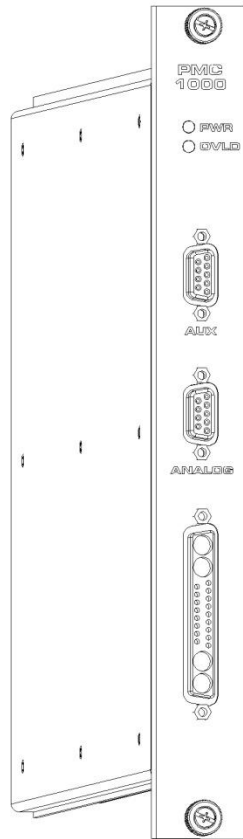


Figure 14. The PMC-1000 Potentiostat Channel

The front panel of the PMC-1000 has the cell cable connector, an analog connector, an auxiliary connector, and two LED indicators. When the PWR LED is lit, the channel is receiving power. When the OVLD LED is lit, an overload condition exists on that channel.

The PCB for the module extends outside of the case at the top and bottom of the module. These PCB edges help to locate the module in the chassis, aligning and retaining it properly. The thumbscrews fasten the module to the front of the chassis.

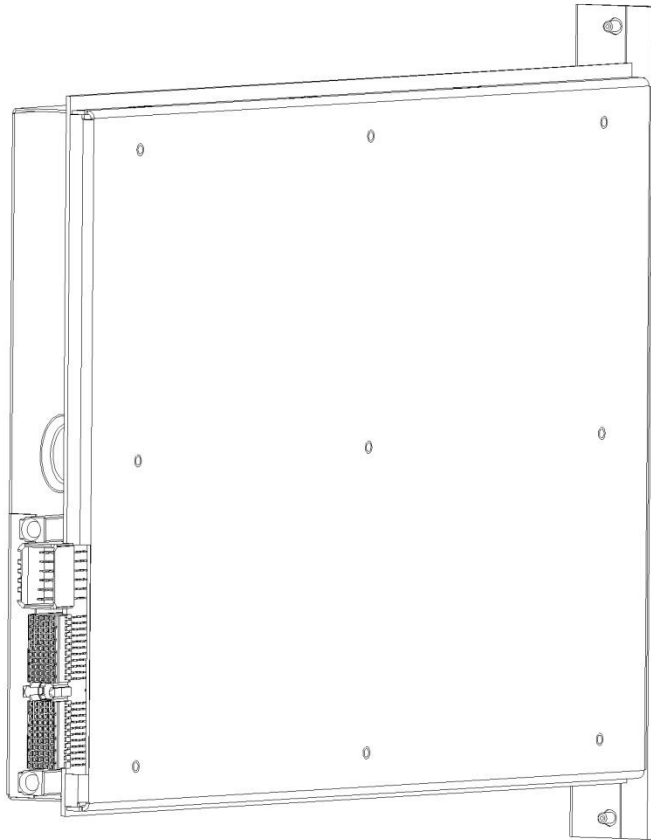


Figure 15. Back of the uninstalled PMC-1000

The back of the potentiostat channel has the locators and connections to the backplane, a signal connector and a power connector.



**CAUTION** Do not remove any covers or panels from the potentiostat module.

#### 4.1.4. The Blank Module

A blank module may be installed into any slot in the PMC chassis except the dedicated power supply module slot. It is important to have either a potentiostat module or a blank module installed in every slot when the PMC is operating. This ensures optimum air flow and cooling of the chassis.



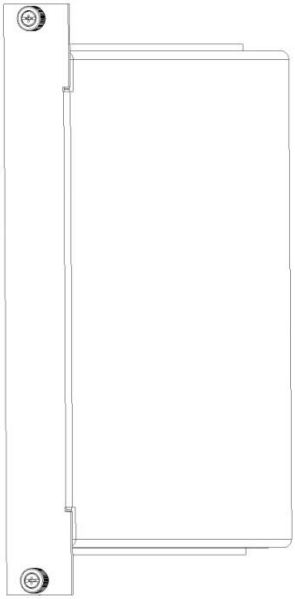


Figure 16. Front view of the Blank Module (Ametek P/N 224262).

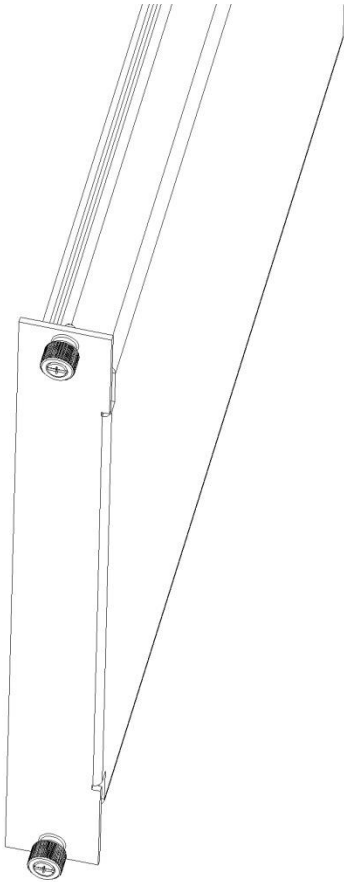


Figure 17. Angled view of the Blank Module.

The blank module has top and bottom thumbscrews that fasten the module to the front of the chassis. This module has top and bottom edges that help locate the module in the chassis, aligning and retaining it properly. The right side of the module is wider than the left side. The blank module must be installed with the correct orientation in the chassis to avoid interference with other modules.

### 4.1.5. The Fan Module (PMC FAN01)

The fan module contains three fans and associated screens all attached to one plate. Each fan is wired to a small controller card by a separate harness. The fan controller card is mounted to the backplane module.



**WARNING** Do NOT disassemble the hex-drive screws that hold the fan screens and fans to the plate.



**CAUTION** Do NOT operate the PMC without the fan module installed and working properly.

### 4.1.6. The Backplane Module (PMC BPLN01)

The backplane module contains all of the locators and connections for the power supply module, potentiostat modules, and fan module. It also contains the USB connection.

### 4.1.7. Replacing a Power Supply Module (PMC PWR01)

To replace a power supply module, first toggle the main power switch down (O) to the OFF position. THEN DISCONNECT THE AC MAINS POWER CABLE FROM THE BACK OF THE INSTRUMENT.



**WARNING** Do NOT remove the power supply module from the PMC chassis without first disconnecting the AC mains power cable from the instrument.

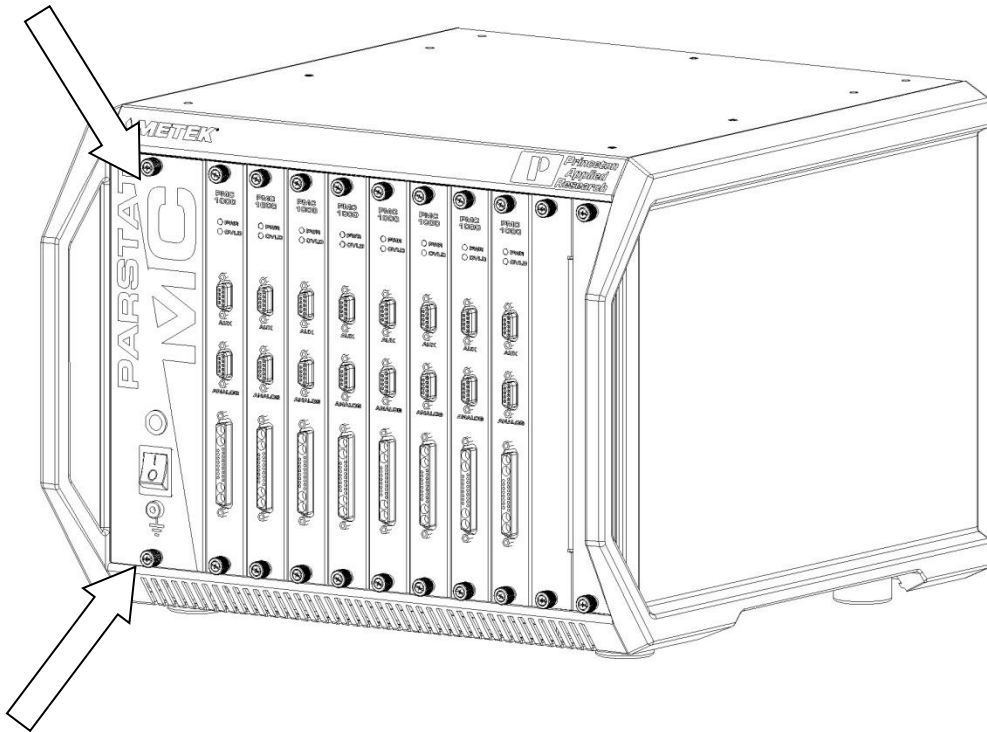


Figure 18. Front View of the PARSTAT MC.

Turn the top and bottom thumbscrews on the front of the power supply module anti-clockwise (toward the left) until the thumbscrews are disconnected from the chassis. Then pull firmly on the thumbscrews until the power supply module slides out of the chassis.

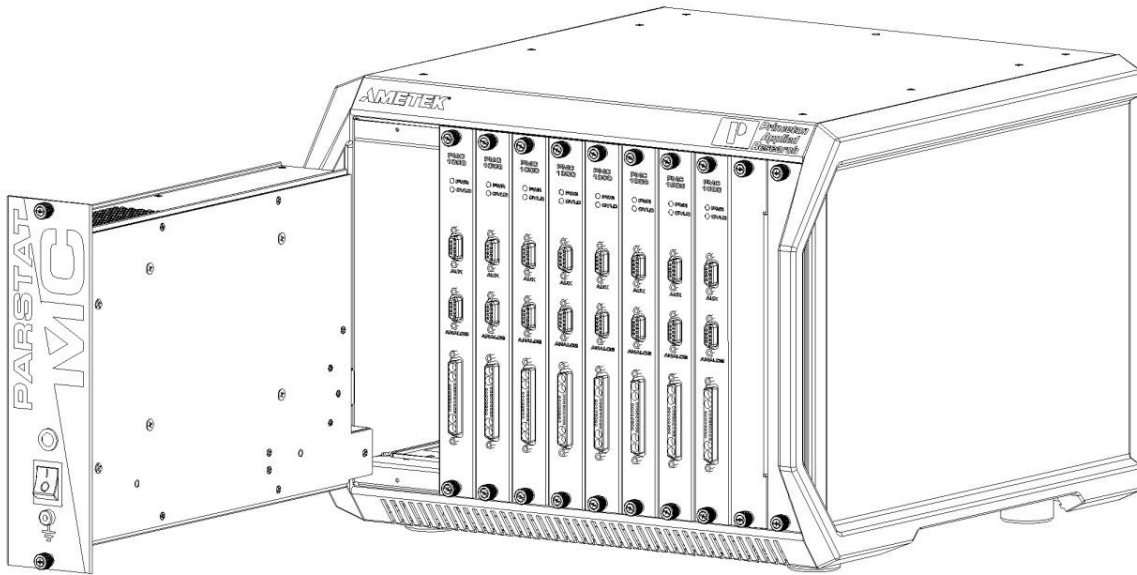


Figure 19. PARSTAT MC Chassis with PMC PWR01 being removed.

When the power supply module is removed from the chassis it may be packaged for shipment.

To install a new power supply module into the chassis, first locate the card guides for the power supply module in the chassis.

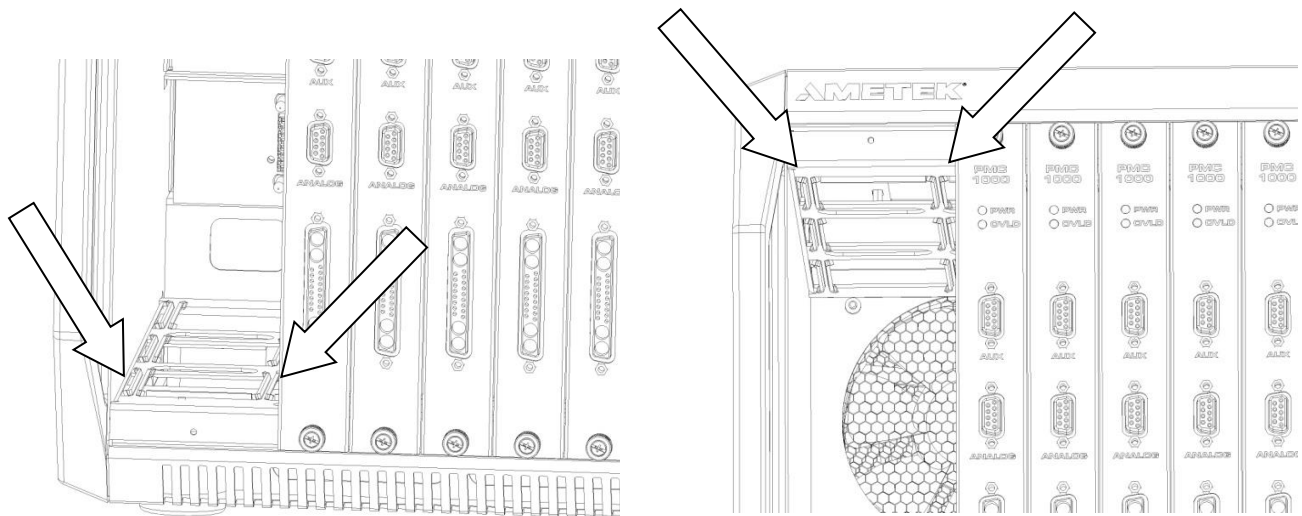


Figure 20. Dual View of card guides for PMC PWR01 replacement.

Align the top and bottom rails on the power supply module with the top and bottom card guides in the chassis.

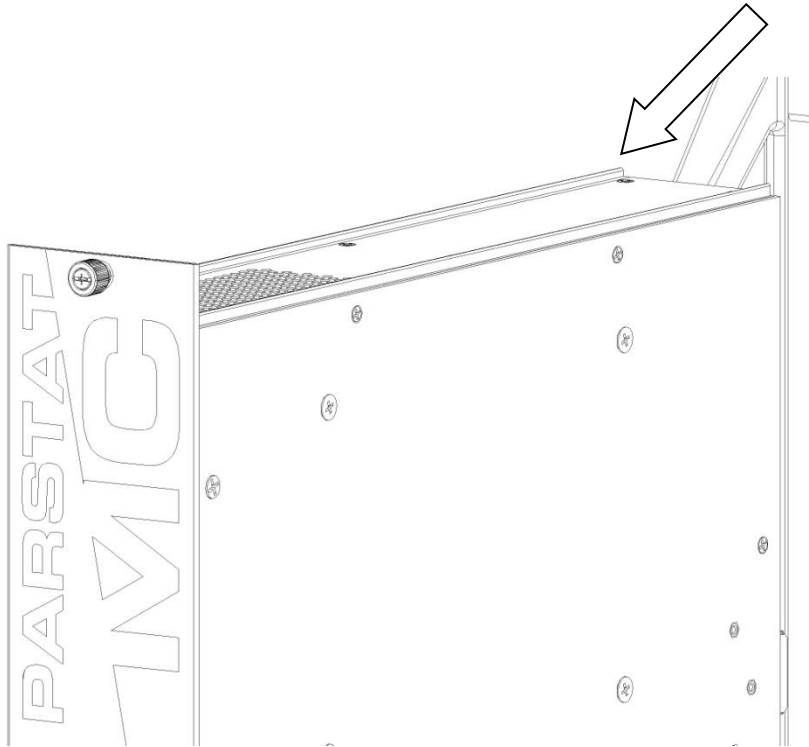


Figure 21. PMC PWR01 power supply with card guides identified.

Slide the power supply module into the chassis until the front panel of the module meets the front of the chassis. Fasten the thumbscrews to the chassis by inserting them into the threaded holes in the chassis and turning them clockwise (toward the right) until they are finger tight.

Connect the AC mains power cable to the back of the instrument and toggle the main power switch up (I) to the ON position.

#### 4.2. ***Replacing a Fuse on the Power Supply Module***

To replace a fuse on the power supply module, remove the power supply module from the instrument as shown in the section **Replacing a power supply module**.



**WARNING** Do NOT remove the power supply module from the chassis without first disconnecting the AC mains power cable from the instrument.

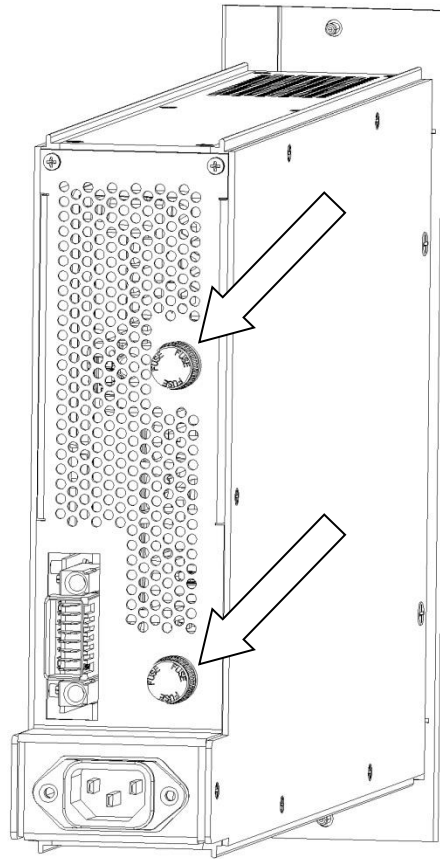


Figure 22. Rear View of the PMC PWR01 with the fuses location identified.

To remove the fuse, grasp the knob at the end of the fuse holder and turn anti-clockwise (toward the left) until the end of the holder comes loose and the fuse cartridge pulls out of the holder. Replace the fuse with the model indicated on the label on the power supply module. Return the knob and fuse cartridge to the holder, and turn clockwise (toward the right) until the fuse is connected to the fuse holder.

Replace the power supply module in the chassis as shown in the section **Replacing a power supply module**.

### 4.3. ***Installing a New Potentiostat Channel***

It is not necessary to turn off power to the instrument to install a new channel. The other channel(s) in the instrument may continue to operate normally during this procedure.

To install a new potentiostat module, first remove one of the blank modules installed in the instrument. This example shows a fifth potentiostat being installed into the fifth potentiostat slot, but installing any new potentiostat into any slot is similar.

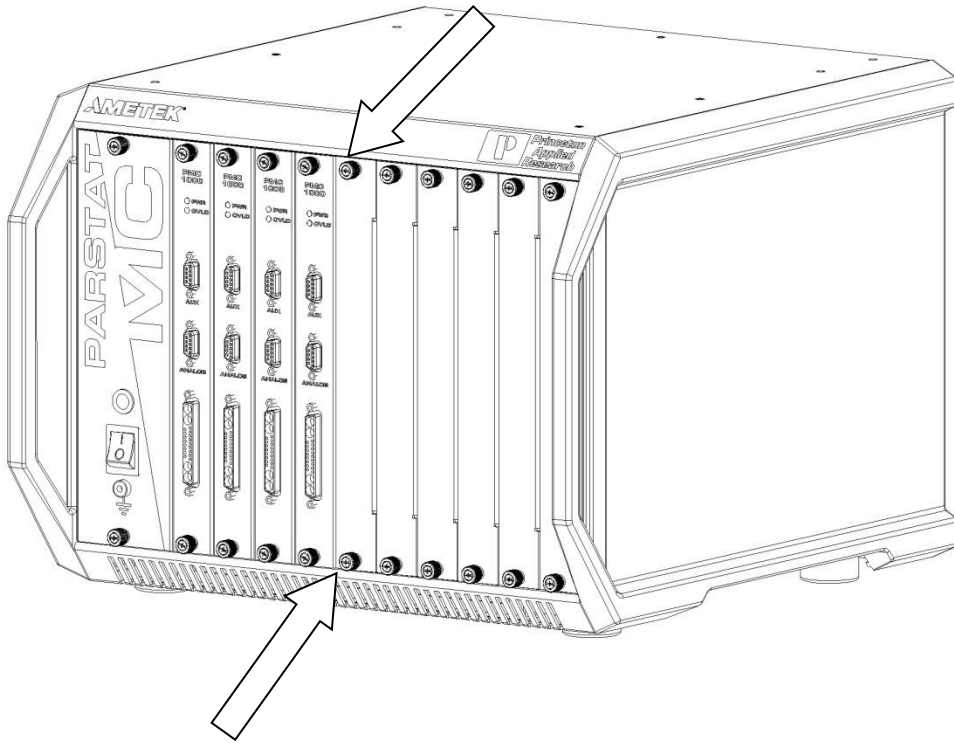


Figure 23. PARSTAT MC with the Blank Module ThumbScrews Identified

Remove the blank module by turning the top and bottom thumbscrews anti-clockwise (toward the left) until the thumbscrews are disconnected from the chassis. Then pull firmly on the thumbscrews until the blank module slides out of the chassis.

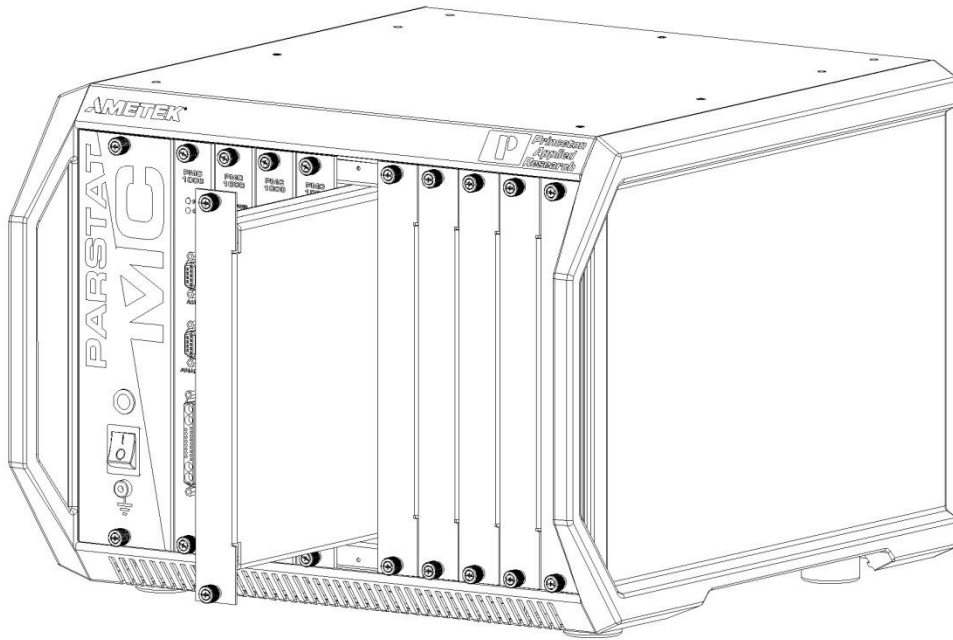


Figure 24. PARSTAT MC with a Blank Module being removed.

Set the blank module aside and unpackage the new potentiostat module.

**CAUTION** Do NOT operate the PMC with an empty slot any longer than necessary to insert another module into that slot.

Find the card guides for the potentiostat in the chassis.

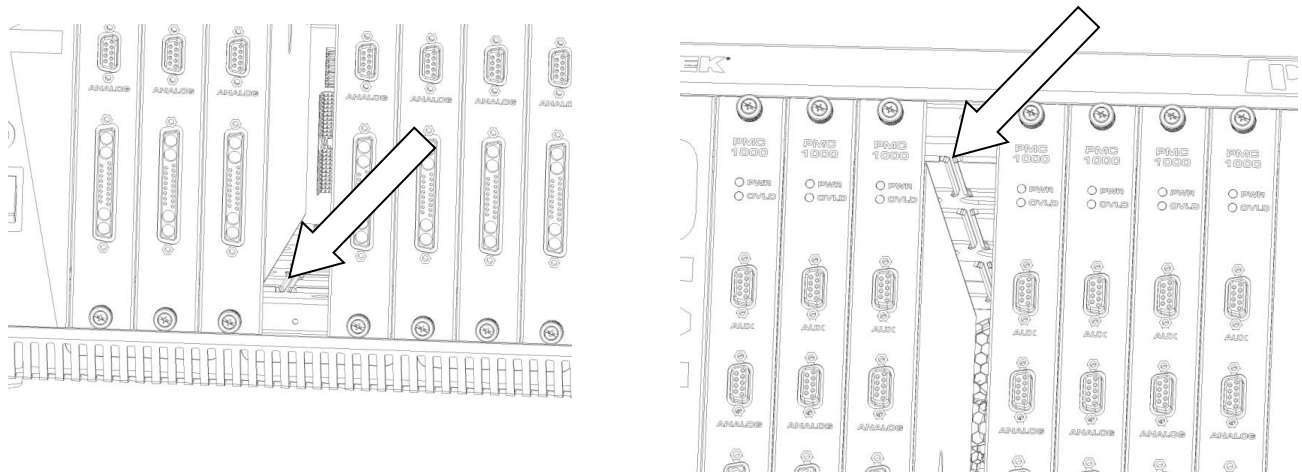


Figure 25. Card guides of PMC CHS08A identified for PMC-1000 installation



Align the top and bottom PCB edges of the potentiostat module with the top and bottom card guides in the chassis. Slide the potentiostat module into the chassis until the front panel of the module meets the front of the chassis.

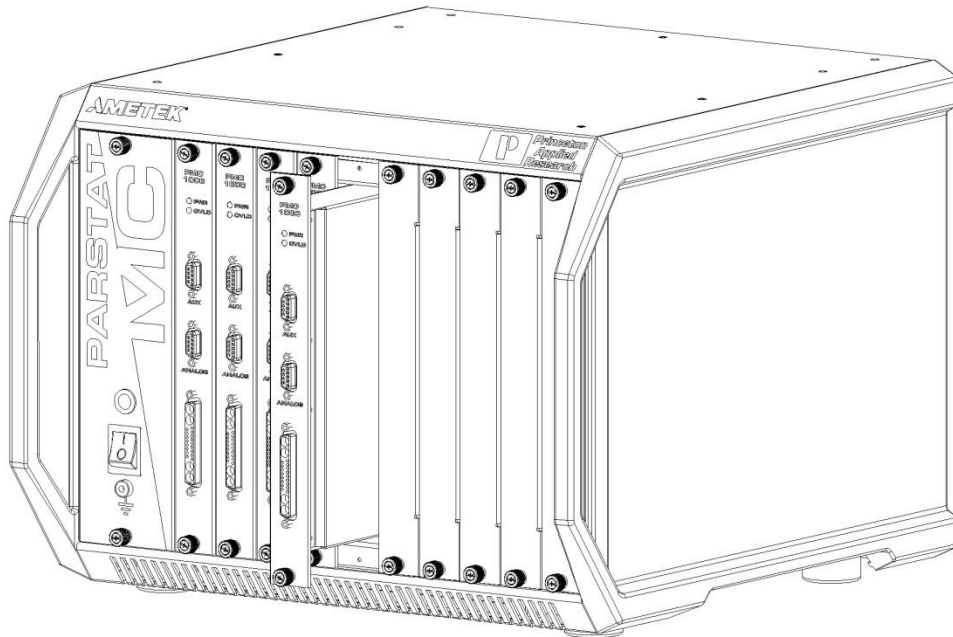


Figure 26. PARSTAT MC with a PMC-1000 being installed.

Insert the thumbscrews into the threaded holes in the chassis and turn the thumbscrews clockwise (toward the right) until they are finger tight.

#### 4.4. ***Replacing an existing potentiostat***

It is not necessary to turn off power to the instrument to replace a potentiostat channel. The other channel(s) in the instrument may continue to operate normally during this procedure.

To replace an existing potentiostat module, first remove the original potentiostat from the instrument. This example shows a fourth potentiostat being replaced in the fourth potentiostat slot, but replacing any potentiostat in any slot is similar.

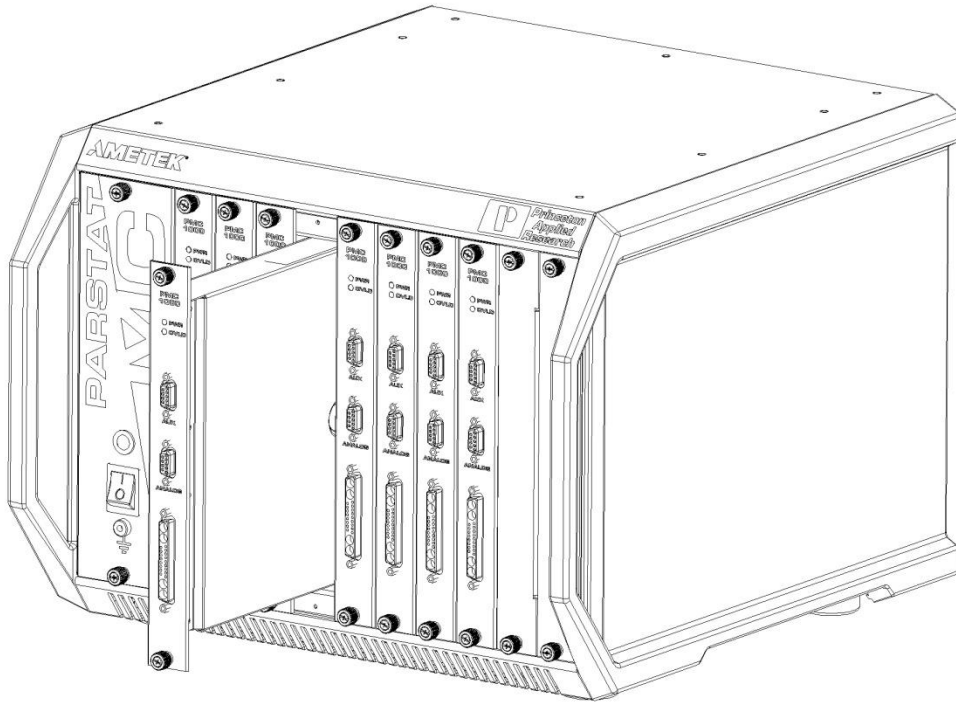


Figure 27. PARSTAT MC with PMC-1000 being removed.

Remove the potentiostat module by turning the top and bottom thumbscrews anti-clockwise (toward the left) until the thumbscrews are disconnected from the chassis. Then pull firmly on the thumbscrews until the module slides out of the chassis.

Once the original potentiostat module is removed from the chassis it may be packaged for shipment to the factory.



**CAUTION** Do NOT operate the PMC with an empty slot any longer than necessary to insert another module into that slot.

Insert the new blank module into the now empty slot by locating the card guides for this slot.

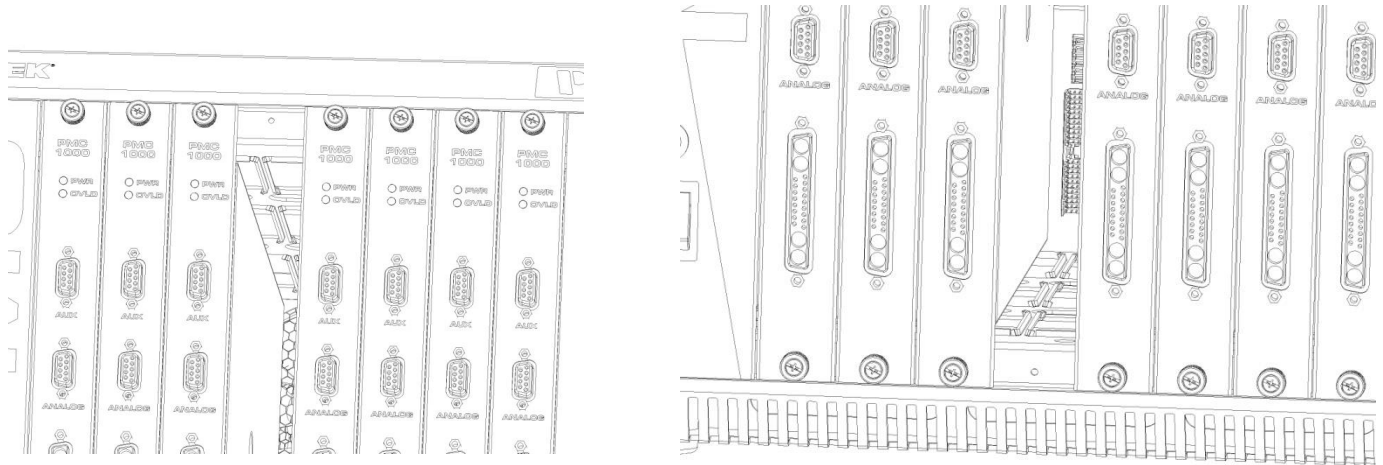


Figure 28. PMC CHS08A with card guides identified for installation of new PMC-1000

Align the top and bottom locating edges of the new blank module with the top and bottom card guides in the chassis. Slide the blank module into the chassis until the front panel of the module meets the front of the chassis.

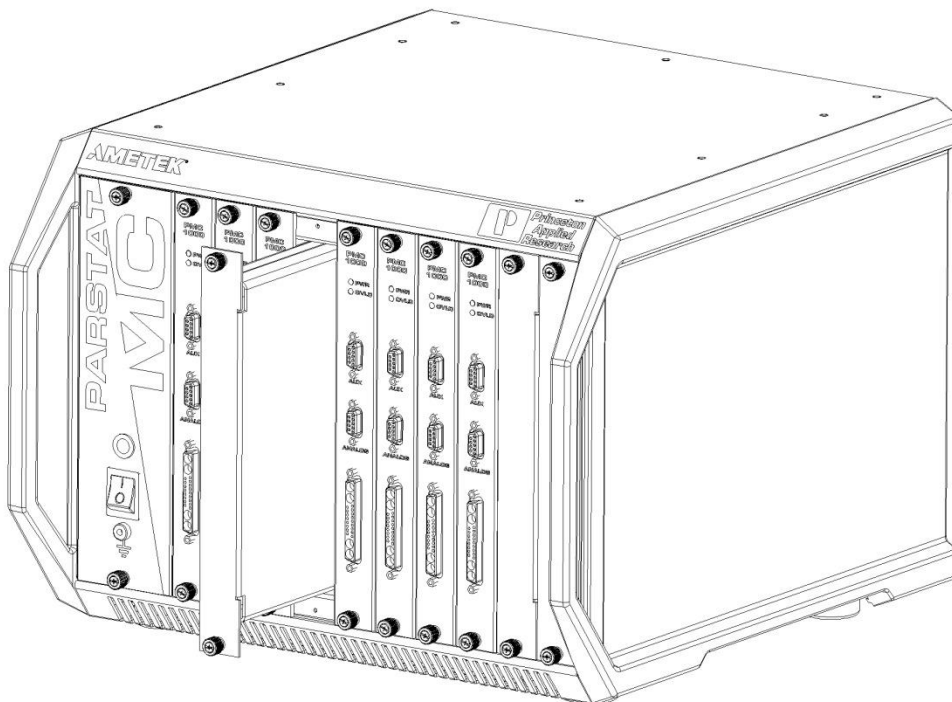


Figure 29. PMC CHS08A with a temporary Blank Module being installed .

Insert the thumbscrews into the threaded holes in the chassis and turn the thumbscrews clockwise (toward the right) until they are finger tight.

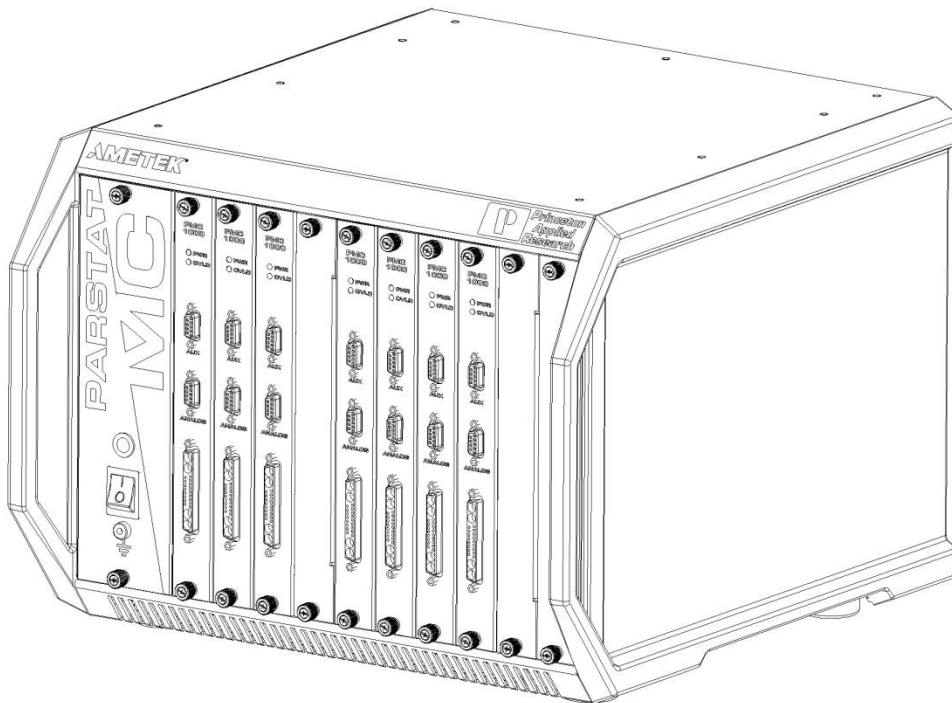


Figure 30. PMC CHS08A with a 7 x PMC-1000 and 1 x Blank Module in place.

When the replacement potentiostat module arrives, unpackage the new module and remove the blank module from the chassis.



**CAUTION** Do NOT operate the PMC with an empty slot any longer than necessary to insert another module into that slot.

Consult the Installing New Potentiostat section in the document once the new potentiostat arrives.

#### 4.5. *Replacing the Fan Module*

To replace the fan module, first toggle the main power switch down (O) to the OFF position. THEN DISCONNECT THE AC MAINS POWER CABLE FROM THE BACK OF THE INSTRUMENT.



**WARNING** Do NOT remove the rear cover from the PMC chassis without first disconnecting the AC mains power cable from the instrument.

Disconnect the USB cable from the back of the instrument. Using a suitable Phillips or cross-point screwdriver, remove the screws holding the back cover.

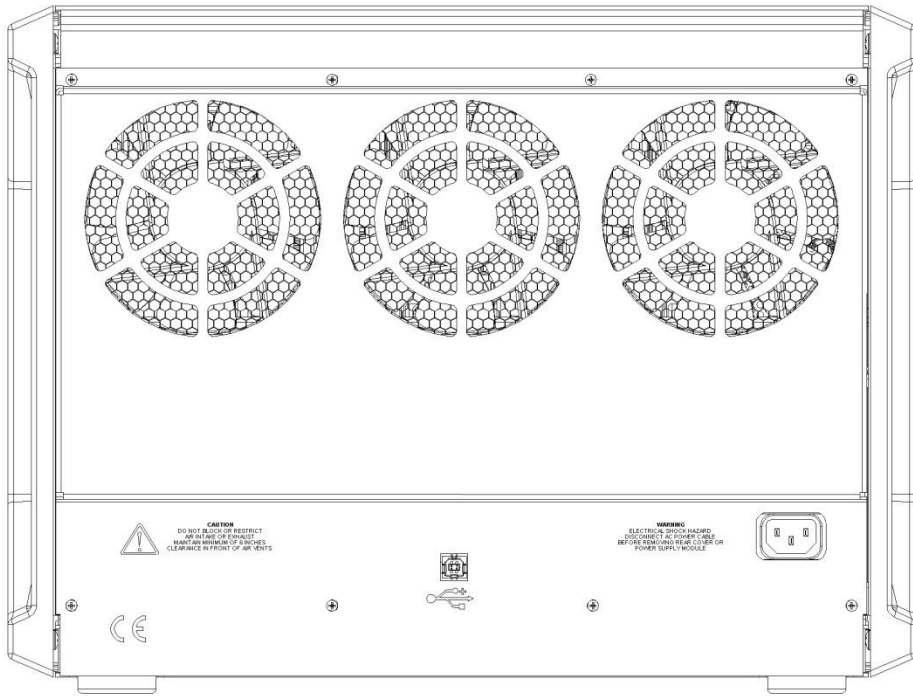
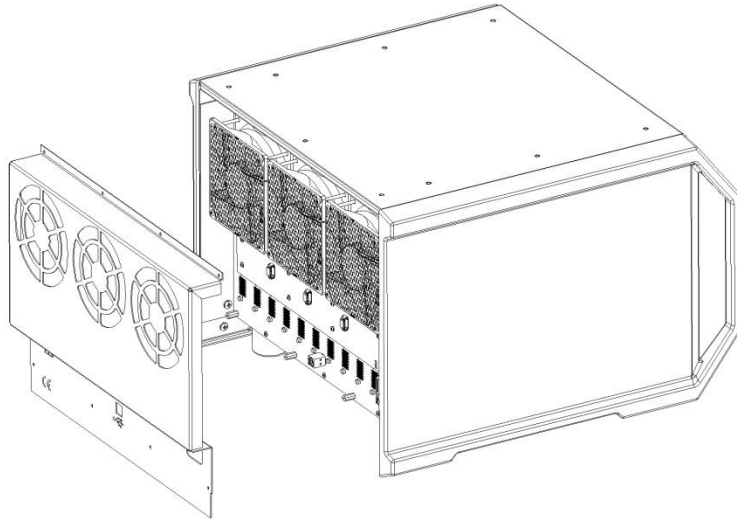


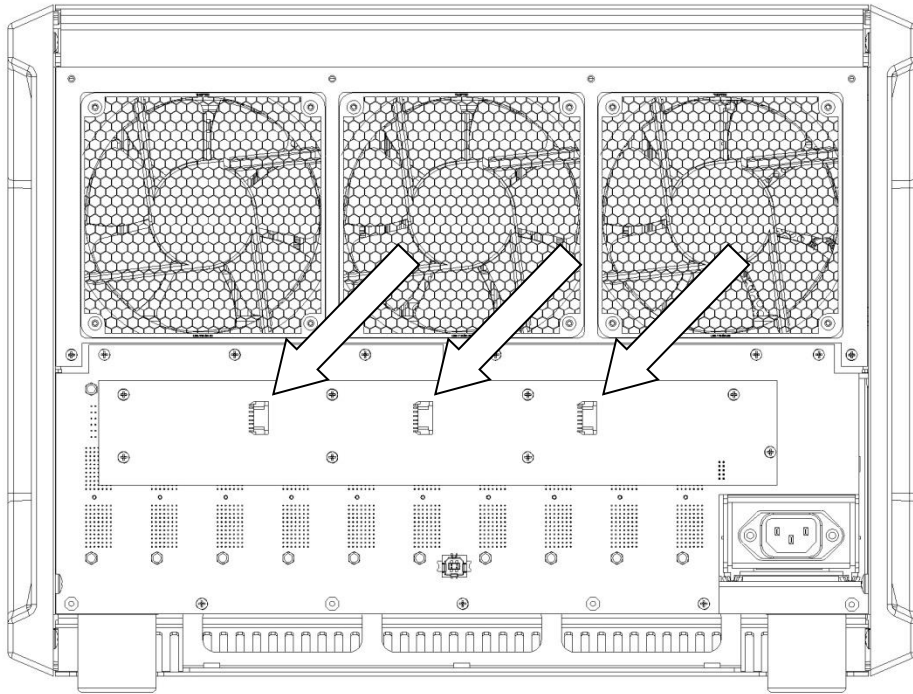
Figure 31. Rear view of a PARSTAT MC.

Remove the rear cover from the chassis and set it aside.



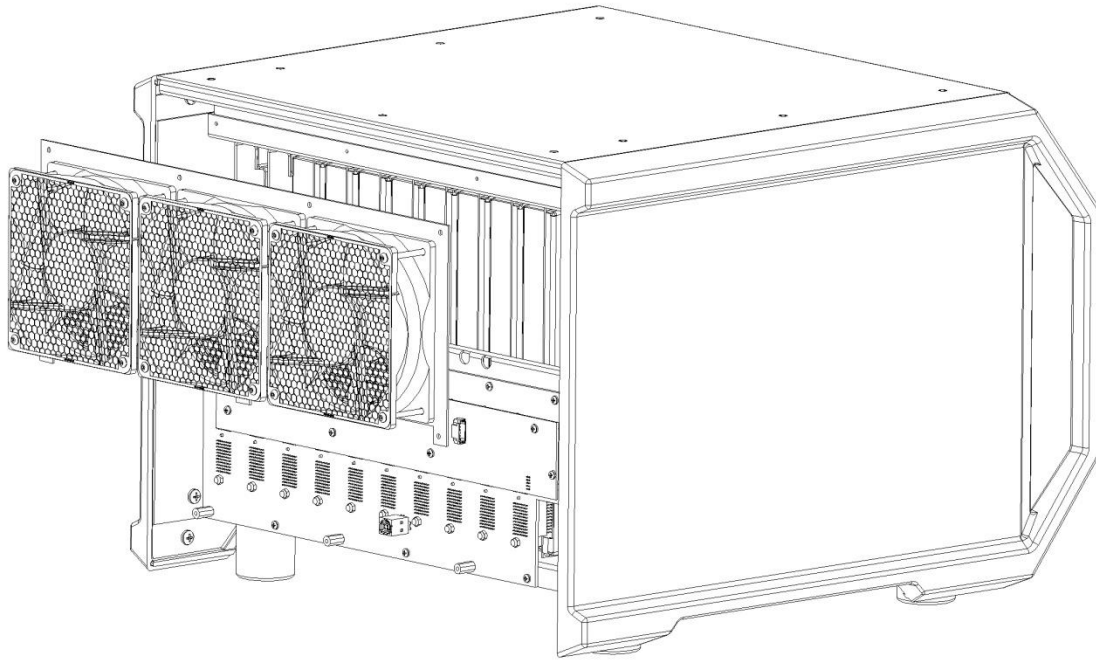
**Figure 32. PMC CHS08A with back cover removed to access PMC FAN01 for replacement.**

Disconnect the three wire harnesses that connect the fans to the fan control board.



**Figure 33. The PMC CHS08A with the 3 x wire harnesses shown as part of replacing the PMC FAN01**

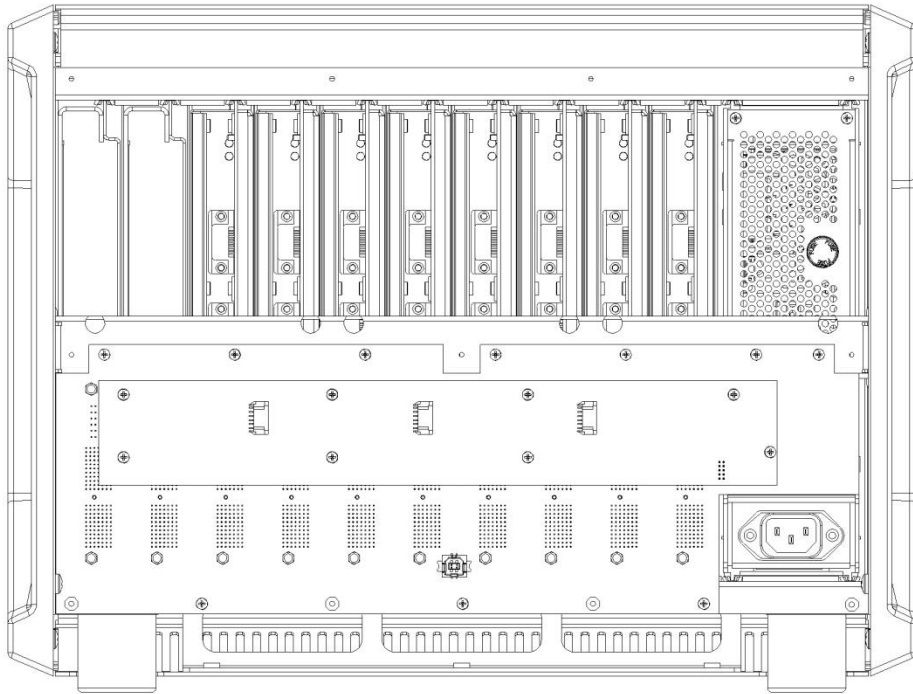
Then, unfasten the three screws across the bottom of the fan plate and remove the fan module from the chassis.



**Figure 34. PMC CHS08A showing the removal of the PMC FAN01 Fan Module.**

Remove the eight screws that hold the fan control card to the backplane.

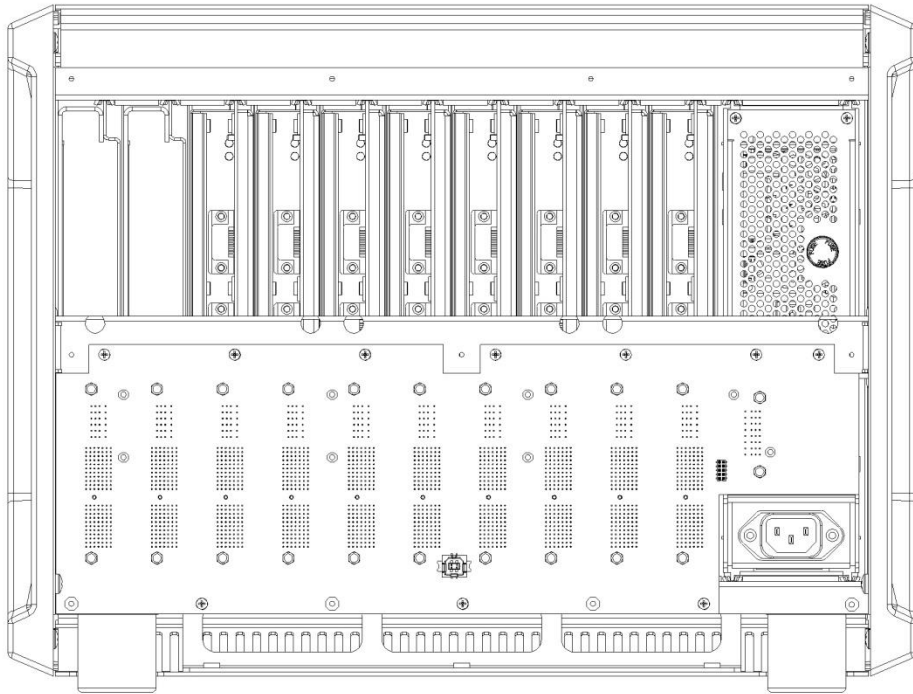




**Figure 35. PMC CHS08A shown with the PMC FAN01 removed.**

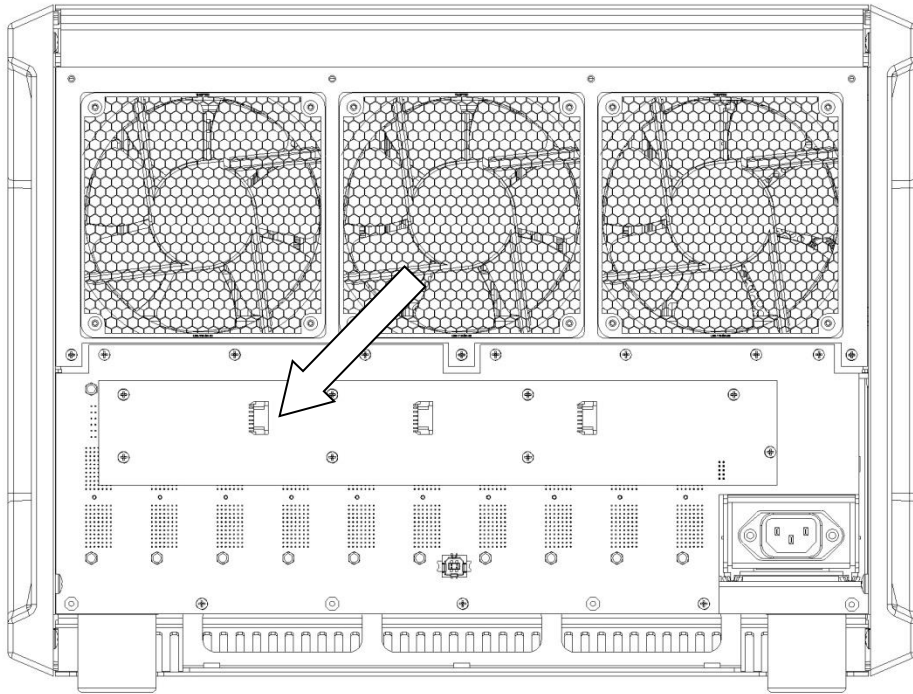
Pull the fan control card straight back from the backplane. When the fan control card is disconnected from the backplane, the fan control card and the fan module may be packaged for shipment to the factory.

To install the new fan control card, hold the card so that the side of the fan card with the three fan connectors is facing out away from the chassis, and the connector to the backplane is in the bottom right corner position. Push the fan card into the connector on the backplane, being careful that all pin positions are aligned. Then insert the eight screws that hold the fan card to the backplane.



**Figure 36. PMC CHS08A with Fan Assembly and Wire Harness Uninstalled.**

Place the fan module up to the back of the chassis with the fan plate up against the chassis. Insert three screws across the bottom of the fan plate and fasten them to the chassis.



**Figure 37. PMC CHS08A with wire fan harness (x3) identified.**

Connect a fan wire harness from the left fan to the left-most connector on the fan card, a second fan wire harness from the center fan to the center connector on the fan card, and a third fan wire harness from the right fan to the right-most connector on the fan card.

Return the rear cover to the back of the chassis, inserting and fastening the eight screws that hold the cover.

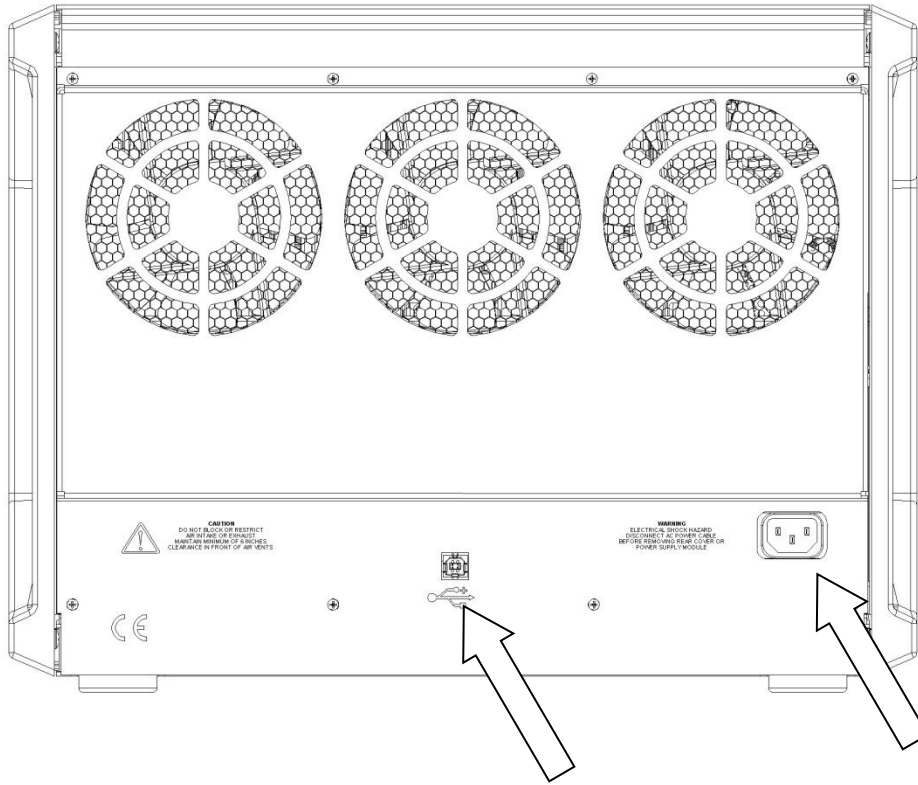


Figure 38. PMC CHS08A Rear Panel with USB and AC Power Identified.

Now the AC mains cable and USB cable may be connected and the instrument may be powered ON.

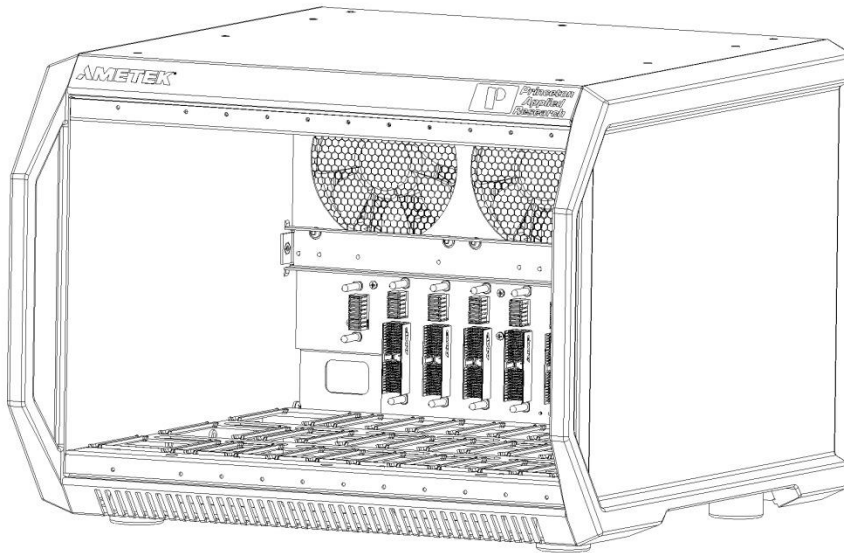
#### 4.6. *Replacing the Backplane Module*

To replace the backplane module, first toggle the main power switch down (O) to the OFF position. THEN DISCONNECT THE AC MAINS POWER CABLE FROM THE BACK OF THE INSTRUMENT.



**WARNING** Do NOT remove the power supply module or the rear cover from the PMC chassis without first disconnecting the AC mains power cable from the instrument.

Remove the power supply module and all potentiostat modules from the chassis. For instructions on removing these modules, please refer to the appropriate sections in this manual.



**Figure 39. Empty PMC CHS08A in preparation to remove PMC BPLN**

Disconnect the USB cable from the back of the instrument. Using a suitable Phillips or cross-point screwdriver, remove the screws holding the back cover.

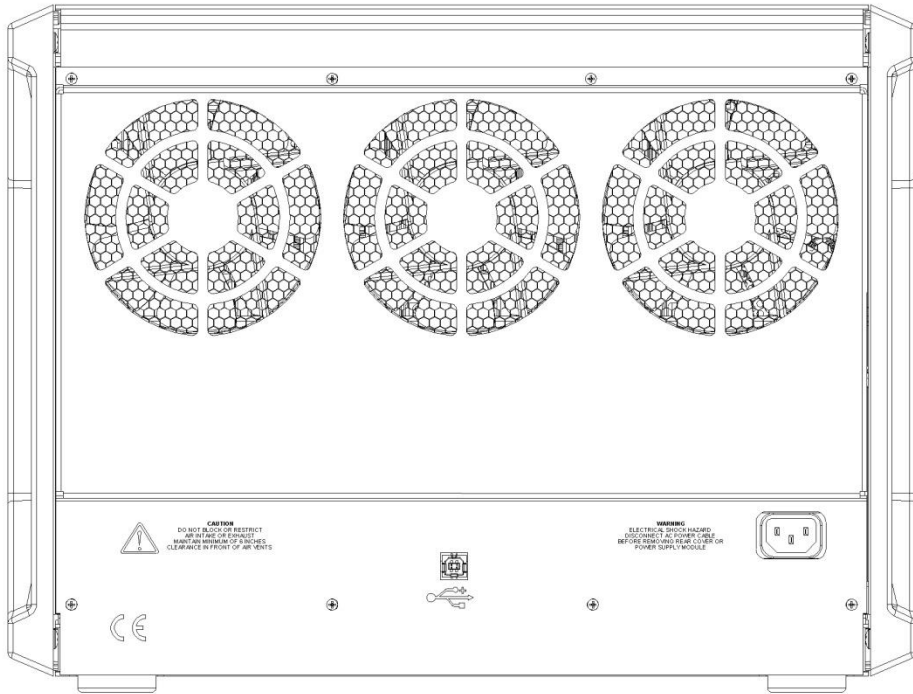
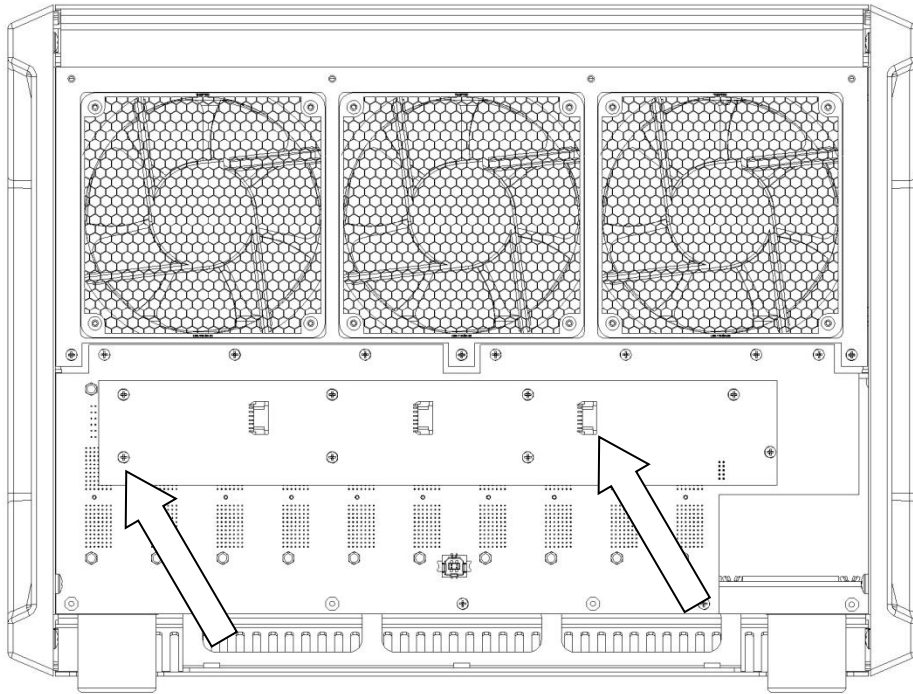


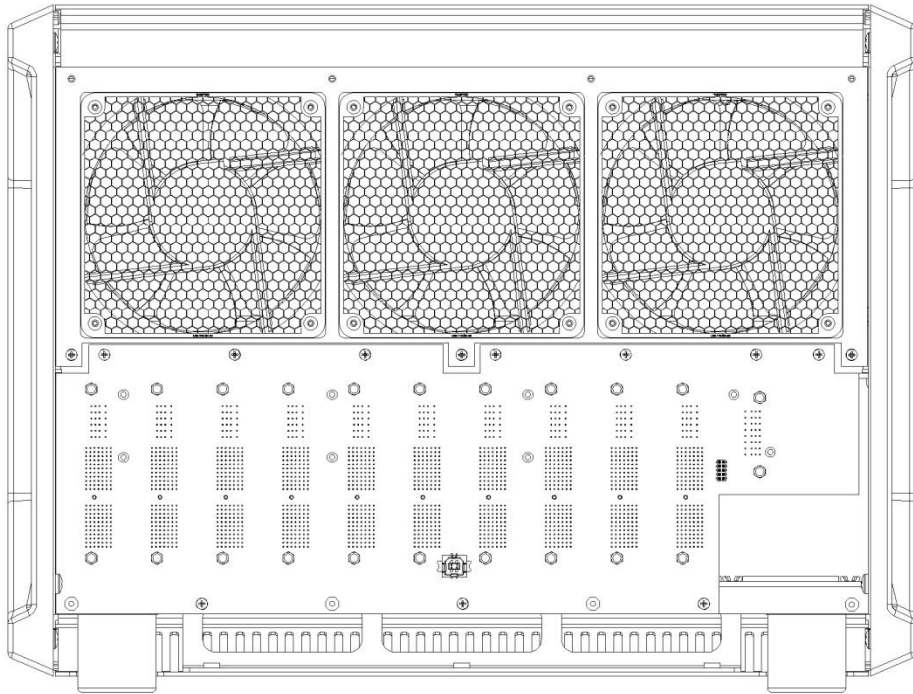
Figure 40. PMC CHS 08A identifying USB and AC cables disconnected.

Disconnect the three wire harnesses that connect the fans to the fan control board, and remove the eight screws that hold the fan control card to the backplane.



**Figure 41. PMC CHS08A showing wire harness (x3) and screws (x8) for removal.**

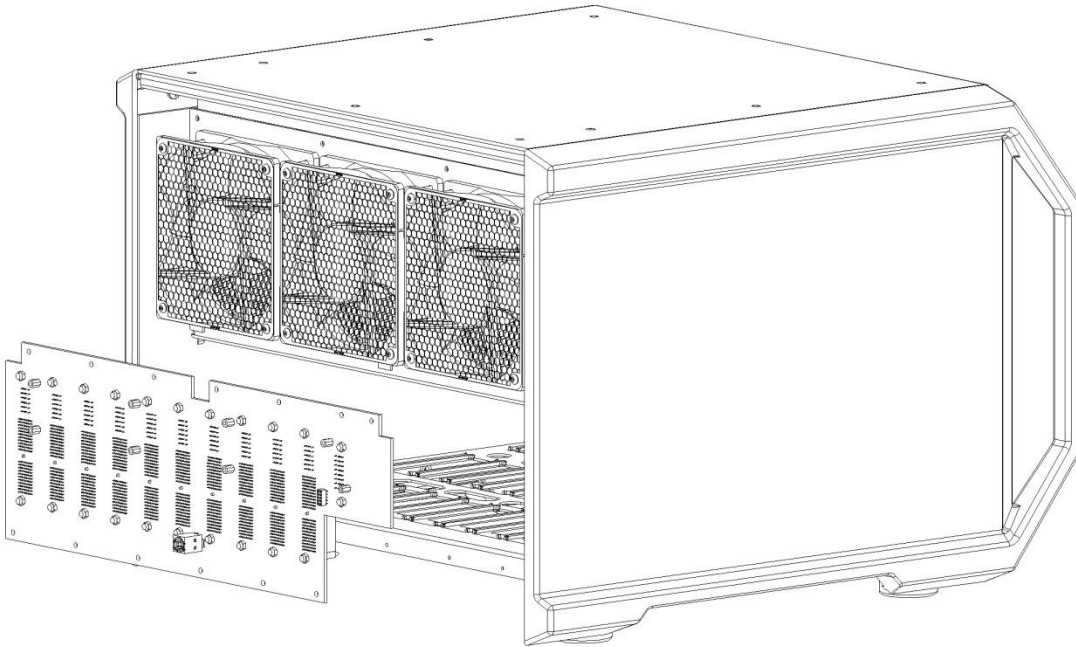
Pull the fan control card straight back from the backplane. Once the fan card is disconnected from the backplane, set it aside.



**Figure 42. PMC CHS08A with screws and standoffs for PMC BPLN removal**

Remove the ten screws holding the backplane to the chassis. Using a 1/4" nut driver, remove the three standoffs holding the backplane to the chassis and pull the backplane out.

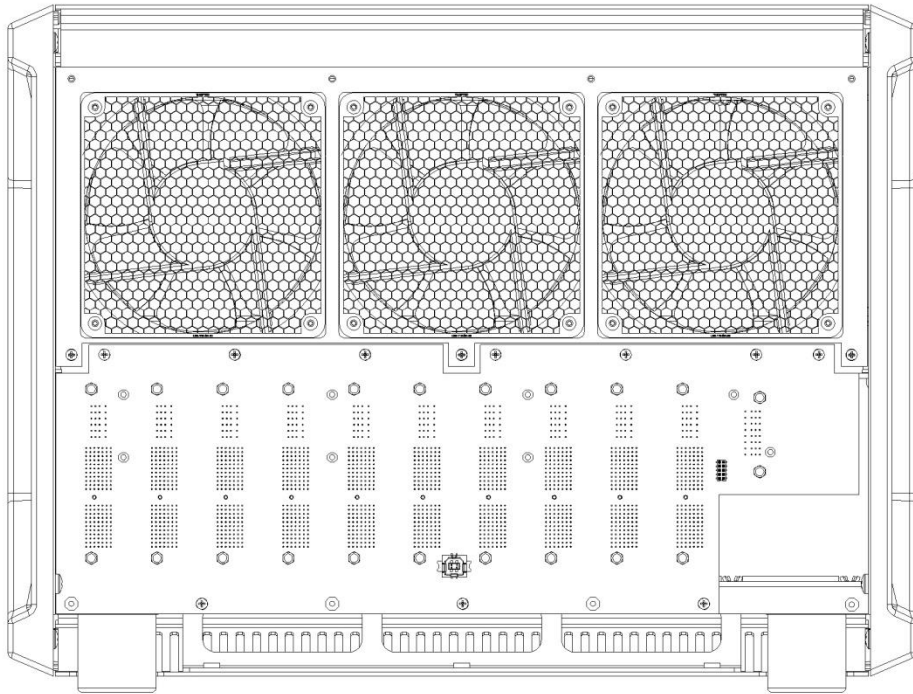




**Figure 43. The PMC CHS08A with the BackPlane (PMC BPLN) being removed.**

The backplane module may now be packaged for shipment to the factory. Be sure to keep the fan control card for use with the new backplane.

When the new backplane module arrives, install the backplane by inserting ten screws provided in the locations indicated.



**Figure 44. PMC CHS08A with the new PMC BPLN installed.**

Install three standoffs provided in the locations shown. Install the fan control card. For instructions on installing the fan control card, refer to the section Replacing the fan module.

Place the rear cover on the back of the chassis and install eight screws in the locations shown.

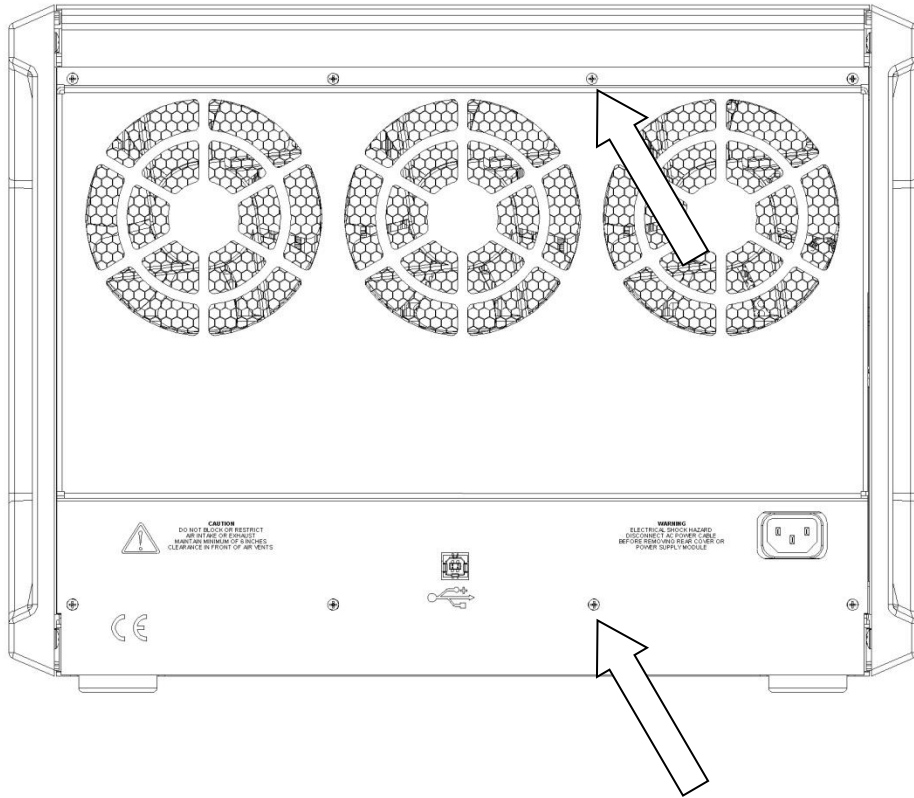



Figure 45. PMC CHS08A showing screw installation for the rear panel.

The power supply module may now be installed into the chassis. For instructions, refer to the section Replacing the power supply module.

The potentiostat and blank modules may be installed. For instructions, refer to the section Replacing a potentiostat module.

 **CAUTION** Do NOT operate the PMC with empty slots.

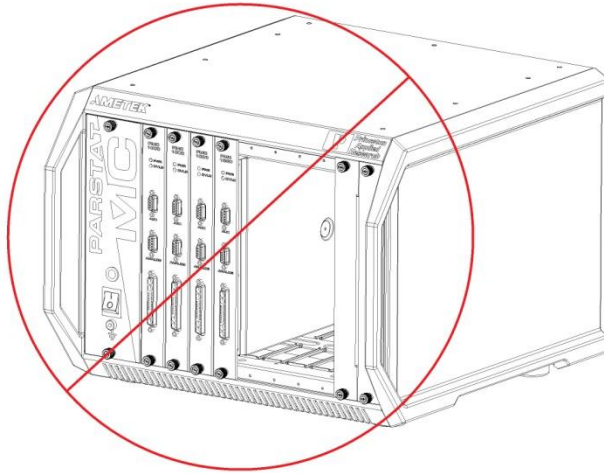
The AC mains power cable and USB cable may be connected, and the instrument may be powered ON.

#### 4.7. ***Airflow considerations***

## PARSTAT MC Hardware Manual

To ensure reliable performance and long life of the PMC, optimum airflow must be maintained during operation. The following precautions will assist in this regard:

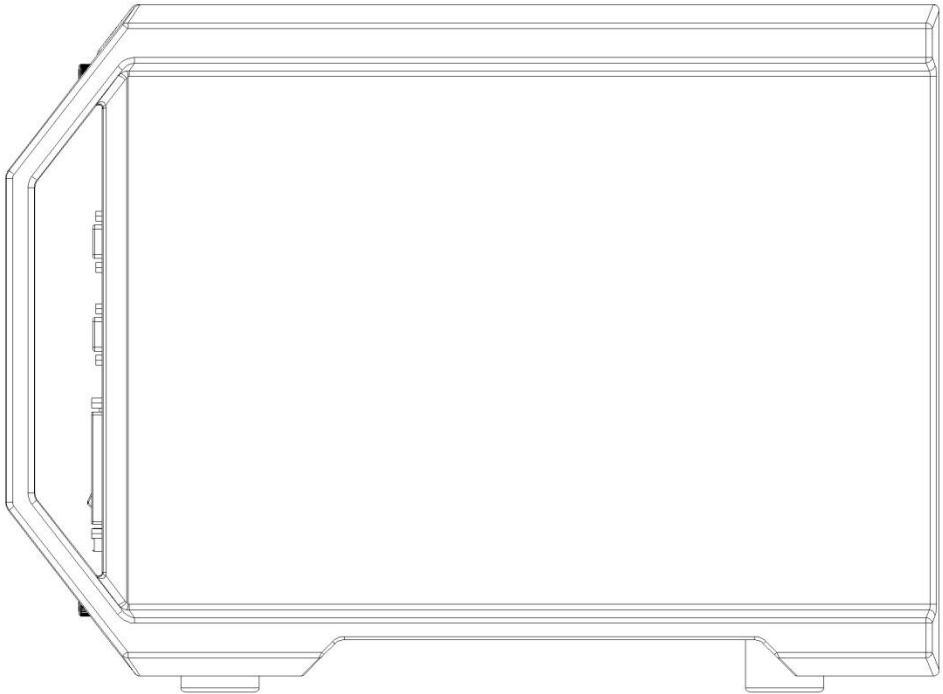
Do not operate the PMC with missing modules or empty slots.




**Figure 46. Warning against operating the PMC CHS08A with open slots.**

Occasionally it may be necessary to remove a module for replacement while the instrument is operating. This is acceptable as long as the time the instrument operates with an empty slot is minimal and the module is replaced reasonably quickly.

Air enters the PMC in the front and along the sides near the bottom of the instrument, and exhausts through the fans in the rear of the instrument. It is important not to block any intake or exhaust point on the instrument and not to place the instrument closer than six inches to any obstruction such as a wall.



 **CAUTION** Do NOT block air inlets or exhaust.

## 5. SPECIFICATIONS AND PINOUTS

### 5.1. *Electronic Specifications*

#### 5.1.1. System Performance

Minimum Time Base: 2  $\mu$ s  
 Minimum Potential Step: 1  $\mu$ V  
 Minimum Current Range: 4nA  
 Minimum Current Resolution 120fA

#### 5.1.2. Power Amplifier

Compliance Voltage  $\pm 12$  V  
 Maximum Current:  $\pm 2$ A  
 Rise Time: < 500 ns (typical)

#### 5.1.3. Voltage Control

Applied Voltage Range  $\pm 10$  V  
 Applied Voltage Resolution  
     for  $\pm 10$  mV signal = 305 nV  
     for  $\pm 100$  mV signal = 3  $\mu$ V  
     for  $\pm 1$  V signal = 30  $\mu$ V  
     for  $\pm 10$  V signal = 300  $\mu$ V

Applied Voltage Accuracy  $\pm 0.2\%$  of value  $\pm 2$ mV  
**Maximum Scan Rate** for a 25 mV step = 12500 Vs-1  
 Maximum Scan Range/Resolution  $\pm 10$  V / 300  $\mu$ V

#### 5.1.4. Current Control

Applied Current Range 0 to  $\pm 2$  A  
 Applied Current Resolution 62  $\mu$ A max; 6.1 pA min  
 Applied Current Accuracy  $\pm 0.2\%$  of reading,  $\pm 0.2\%$  of range  $\pm 200$  pA

#### 5.1.5. Differential Electrometer

Input Bias Current  $\leq 5$  pA at less than 25°C  
 Maximum Voltage Range  $\pm 10$  V maximum  
 Input Voltage Differential  $\pm 10$  V  
 Bandwidth  $\geq 10$  MHz (-3 dB)  
 Common Mode Rejection  $\geq 60$  dB at 100 kHz (typical)  
 Input Impedance  $\geq 10^{12}$   $\Omega$  in parallel with  $\leq 5$  pF (typical)

#### 5.1.6. Voltage Measurement

Voltage Range  $\pm 10$  V maximum  
 Minimum Voltage Resolution  $\pm 6$  uV  
**Voltage Accuracy**  $\pm 0.2\%$  reading,  $\pm 2$  mV

#### 5.1.7. Current Measurement

**Ranges** 10 decades, 2A to 4 nA  
**Accuracy (dc)**

- 20 nA to 2 A:  $\pm 0.2\%$  of reading,  $\pm 0.2\%$  of range

- 4 nA: <0.5%  $\pm$ 20 pA 4nA and 20nA ranges, <5%  $\pm$  50 pA

### 5.1.8. iR Compensation

**Positive Feedback Range:** 50 M $\Omega$  to 5  $\Omega$  depending on current range

**Dynamic iR :** 2s/pt rate limit (limited to Corrosion techniques)

### 5.1.9. Potential/Current Control

Digital/Analog Converters (DACs)

Bias DAC

Resolution 16 bits

Range (potentiostat)  $\pm$  10V

Range (galvanostat)  $\pm$  100% of full-scale current

Modulation DAC

Resolution 16 bits

Range (potentiostat)  $\pm$  10V

Range (galvanostat)  $\pm$  100%

### 5.1.10. Impedance Specifications, available on PMC-1000

Frequency Range 10  $\mu$ Hz – 1 MHz

Maximum AC Voltage Amplitude 1000mV RMS

Minimum AC Voltage Amplitude 0.1mV RMS

## 5.2. ***Physical and Power Specifications***

**Computer Interface** Universal Serial Bus (USB)

**Weight** 67lbs, 30.3kg, Instrument only

**Dimensions** 45 cm W x 46 cm D x 34 cm H (17.5 in W x 17.9" in D x 13.2" H)

**Power Requirements**

90Vac to 264Vac

47Hz to 63Hz 1254VA max

## 5.3. ***Standard Environmental Conditions***

This equipment is designed to meet or exceed the requirements of the following standards:

LVD: EN61010-1:1993, Amendment 2

EMC: EN61326: 1998 Emissions

EN55011:1991, Group 1, Class A

Immunity:

IEC 61000-4-2:1995, ESD

IEC 61000-4-3:1995, EM field

IEC 61000-4-4:1995, Burst

IEC 61000-4-5:1995, Surge

IEC 61000-4-6:1995, Conducted RF

Operating Temperature: 10° C to 40° C

Humidity: maximum 80% non-condensing



## 5.4. AUXILIARY INTERFACE Pinouts

### 5.4.1. Pin Numbers for PMC Auxiliary connection and Analog Connection.

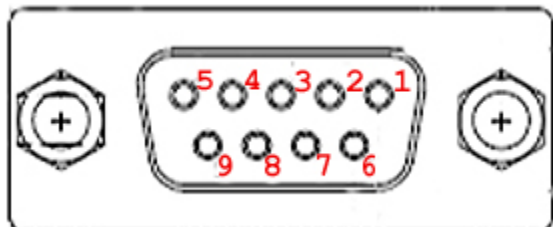


Figure 47. Labeling of Pins on DB9 connections for PMC AUX01 and PMC ALG01

### 5.4.2. Pins Outs for PMC AUX01 Cable

Table 1. PMC AUX01 Cable PinOuts

Pin	Signal	Function
1	GROUD	
2	TRIG IN	Using the VersaStudio software, an experiment can be held, waiting on this TTL trigger input signal to be read.
3	DISPENSE	When using the PMC-1000 with a Model 303 or 303A Static Mercury Drop Electrode (SMDE) via a Model 507 interface, this signal causes the electrode to perform a DISLODGE/DISPENSE operation on command from the host PC.
4	TRIG OUT	A TTL trigger output is provided on this line with the VersaStudio software
5	BIT 0 IN	Not used.
6	-	Not used.
7	BIT 0 OUT	Not used.
8	PURGE	When using a Model 303 or 303A SMDE via a Model 507 Interface, this signal controls the electrode's PURGE function in response to commands from the host PC .
9	STIR	This signal controls the Model 303 or 303A's STIR function in response to commands from an external computer. It is assumed that the electrode is being used with a Model 305 stirrer.

### 5.4.3. Pin Outs for Analog Output.

Table 2. PMC ALG01 Cable PinOuts

Pin	Signal	Function
1	I MON OUT	
2	I MON OUT GND	
3	OPEN	
4	AUX IN GND	SYNC ADC INPUT
5	AUX IN	
6	E MON OUT	
7	E MON OUT GND	
8	AUX OUT	DAC OUTPUT
9	AUX OUT GND	

#### 5.4.3.5. SYNC ADC INPUT

This BNC allows you to monitor an auxiliary signal in the  $\pm 10$  V range with 16-bit resolution. This signal is monitored synchronously with the E and I channels.

#### 5.4.3.6. DAC OUTPUT

This connection, DB9 pin or BNC with optional PMC ALG01 cable, delivers a precise DC voltage in the  $\pm 10$  V range. This output can be used to control the rotation speed of rotating disk electrodes (RDEs). **CAUTION:** The voltage at this connection will be random at power-on until the system fully boots (~ 1 min after power-on). As a result, no connection should be made until system has completely booted, or in the case of an RDE (i.e., the 616/636 systems), leave the power off on the RDE until the system is completely booted.

#### 5.4.3.7. E MON

This connection, DB9 pin or BNC with optional PMC ALG01 cable, outputs the analog of the reference voltage ( $\pm 10$ V range, 50 $\Omega$  output impedance), however, the polarity at E MON is opposite that at the cell.

#### 5.4.3.8. I MON

This connection, DB9 pin or BNC with optional PMC ALG01 cable, outputs the analog of the current with  $\pm 2$ V corresponding to  $\pm$  full scale current range, 50 $\Omega$  output impedance.

NOTE: If the PMC-1000 channel is operating in “float” mode, then all connections to the Analog Connector must be floating (isolated from ground) as well. If a grounded connection is made to any panel connectors (any non-isolated connection), then the PMC-1000 system will no longer be isolated itself, and ground loops will result in excessively noisy data.

## 5.5. *Cell Cable Pinouts*

Table 3. PMC Cell Cable Pin Outs

Pin	Signal	Function
A1	SENSE	See section 3.4.2.
A2	WORKING	See section 3.4.2.
A3	COUNTER	See section 3.4.2.
A4	REFERENCE	See section 3.4.2.
1	GROUND	See section 3.4.2.
9	GROUND	See section 3.4.2.
2-8	RESERVED	Reserved for future options
10-17	RESERVED	Reserved for future options

## 6. AVAILABLE OPTIONS

The factory installed options available for the PMC-1000 and PMC-1000/DC are as follows:

- 1.) FRA for Electrochemical Impedance Spectroscopy, with the PMC-1000.
- 2.) Auxiliary Cables
- 3.) Advanced Auxiliary Interface
- 4.) VersaSTAT LC Low Current Interface

### 6.1. *FRA, available with PMC-1000*

The FRA Option provides the hardware necessary to perform the ac-based techniques of Potentiostatic Electrochemical Impedance Spectroscopy (PEIS) and Galvanostatic Electrochemical Impedance Spectroscopy (GEIS). This function is part of the PMC-1000.

### 6.2. *Auxiliary Cables Options*

There are 2 different 9-pin connections to each PMC-1000 and PMC-1000/DC potentiostat channel.

The PMC AUX01 is a 1-meter cable that splits the DB9 connection of the Digital Ins/Outs into convenient separate BNC connections.

The PMC ALG01 is a 1-meter cable that splits the DB9 connections of the Analog Ins/Outs into convenient separate BNC connections.

Consult Chapter 5 for specific pin outs and function of the different connections.

The cell cable is provided standard with the PMC-1000.

### 6.3. *Advanced Auxiliary Interface Option*

The Advanced Auxiliary Interface (AAI) Option allows for an additional four (4) A/D inputs for the VersaStudio software to acquire along with data recorded directly from the PMC-1000 and PMC-1000/DC channels.

The AAI is an external unit that plugs directly into the same PC as that interfaced by the PMC-1000 into an available USB port. The VersaStudio auto-detects the AAI, and collects data on the additional four A/D inputs along with data directly from the PMC hardware (E, I, AUX, etc.).

The AAI is a +/-10V DC input, 12-bit unit (+/-5mV resolution) system, and is recommended for when several variables need to be collected concurrently with the electrochemical data, such a pH, temperature, etc.

### 6.4. *VersaSTAT LC Low Current Interface*

The VersaSTAT LC Low Current Interface is a plug-and-play add-on option that provides current ranges down to a minimum range of 4 pA when used with the VersaSTAT MC. Please see product brochure for additional details.

## 7. WARRANTY

### Advanced Measurement Technology, Inc.

a/k/a Princeton Applied Research, a subsidiary of AMETEK®, Inc.

## WARRANTY

Princeton Applied Research\* warrants each instrument of its own manufacture to be free of defects in material and workmanship. Obligations under this Warranty shall be limited to replacing, repairing or giving credit for the purchase price, at our option, of any instrument returned, shipment prepaid, to our Service Department for that purpose within ONE year of delivery to the original purchaser, provided prior authorization for such return has been given by an authorized representative of Princeton Applied Research.

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#### SHOULD YOUR EQUIPMENT REQUIRE SERVICE

A. Contact the Customer Service Department (865-482-4411) or your local representative to discuss the problem. In many cases it will be possible to expedite servicing by localizing the problem.

B. If it is necessary to send any equipment back for service, we need the following information.

1. Model number and serial number.
2. Your name (instrument user).
3. Your address.
4. Address to which the instrument should be returned.
5. Your telephone number and extension.
6. Symptoms (in detail, including control settings).
7. Your purchase order number for repair charges (does not apply to repairs in warranty).
8. Shipping instructions (if you wish to authorize shipment by any method other than normal surface transportation).

C. U.S. CUSTOMERS — Ship the equipment being returned to:

Advanced Measurement Technology, Inc.      PHONE: 865-482-4411  
801 S. Illinois Avenue                      FAX: 865-483-2133  
Oak Ridge, TN 37831  
ATTN: Customer Service

D. CUSTOMERS OUTSIDE OF U.S.A. — To avoid delay in customs clearance of equipment being returned, please contact the factory or the nearest factory distributor for complete shipping information.

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## 8. Appendix: Table of Figures.

Figure 1. PARSTAT MC. 1 x PMC CHS08A and 8 x PMC-1000 channels .....	5
Figure 2. Potentiostat-Mode Block Diagram .....	6
Figure 3. Galvanostat-Mode Block Diagram .....	7
Figure 4. Rear panel of PARSTAT MC (PMC CHS08A Chassis).....	13
Figure 5. Front panel of PARSTAT MC (PMC CHS08A Chassis) .....	14
Figure 6. Two-Electrode Connection .....	16
Figure 7. Three-Electrode Connection.....	16
Figure 8. Four-Electrode Connection.....	17
Figure 9. Changing from "Normal" operation to "Floating" operation .....	18
Figure 10. Selecting Notch Filters and EIS Filters. ....	19
Figure 11. PARSTAT MC. 1 x PMC CHS08A and 8 x PMC-1000 channels .....	20
Figure 12. Power Supply module (PMC PWR01). ....	21
Figure 13. Back of the PWR01 after the removal from the CHS08A. ....	22
Figure 14. The PMC-1000 Potentiostat Channel.....	23
Figure 15. Back of the uninstalled PMC-1000 .....	24
Figure 16. Front view of the Blank Module (Ametek P/N 224262).....	25
Figure 17. Angled view of the Blank Module.....	25
Figure 18. Front View of the PARSTAT MC. ....	27
Figure 19. PARSTAT MC Chassis with PMC PWR01 being removed. ....	28
Figure 20. Dual View of card guides for PMC PWR01 replacement. ....	28
Figure 21. PMC PWR01 power supply with card guides identified. ....	29
Figure 22. Rear View of the PMC PWR01 with the fuses location identified.....	30
Figure 23. PARSTAT MC with the Blank Module ThumbScrews Identified .....	31
Figure 24. PARSTAT MC with a Blank Module being removed. ....	32
Figure 25. Card guides of PMC CHS08A identified for PMC-1000 installation .....	32
Figure 26. PARSTAT MC with a PMC-1000 being installed.....	33
Figure 27. PARSTAT MC with PMC-1000 being removed. ....	34
Figure 28. PMC CHS08A with card guides identified for installation of new PMC-1000 .....	35
Figure 29. PMC CHS08A with a temporary Blank Module being installed .....	35
Figure 30. PMC CHS08A with a 7 x PMC-1000 and 1 x Blank Module in place.....	36
Figure 31. Rear view of a PARSTAT MC.....	37
Figure 32. PMC CHS08A with back cover removed to access PMC FAN01 for replacement. ....	38
Figure 33. The PMC CHS08A with the 3 x wire harnesses shown as part of replacing the PMC FAN01 .....	39
Figure 34. PMC CHS08A showing the removal of the PMC FAN01 Fan Module. ....	40
Figure 35. PMC CHS08A shown with the PMC FAN01 removed.....	41
Figure 36. PMC CHS08A with Fan Assembly and Wire Harness Uninstalled.....	42
Figure 37. PMC CHS08A with wire fan harness (x3) identified. ....	43
Figure 38. PMC CHS08A Rear Panel with USB and AC Power Identified.....	44
Figure 39. Empty PMC CHS08A in preparation to remove PMC BPLN .....	45
Figure 40. PMC CHS 08A identifying USB and AC cables disconnected. ....	46
Figure 41. PMC CHS08A showing wire harness (x3) and screws (x8) for removal. ....	47
Figure 42. PMC CHS08A with screws and standoffs for PMC BPLN removal.....	48
Figure 43. The PMC CHS08A with the BackPlane (PMC BPLN) being removed. ....	49
Figure 44. PMC CHS08A with the new PMC BPLN insalled. ....	50
Figure 45. PMC CHS08A showing screw installation for the rear panel. ....	51
Figure 46. Warning against operating the PMC CHS08A with open slots.....	52
Figure 47. Labeling of Pins on DB9 connections for PMC AUX01 and PMC ALG01 .....	57