



RxE 10k Rotating Electrode™

Operator's Manual



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If You Have Problems

Please visit our service and support page at <https://www.gamry.com/support-2/>. This page contains information on installation, software updates, and training. It also contains links to the latest available documentation. If you are unable to locate the information you need from our website, you can contact us via email using the link provided on our website. Alternatively, you can contact us in one of the following ways:

Internet	https://www.gamry.com/support-2/
Phone	(215) 682-9330 9:00 AM–5:00 PM (US Eastern Standard Time) (877) 367-4267 (Toll-free US & Canada Only)

Please have your instrument model and serial numbers available, as well as any applicable software and firmware revisions.

If you have problems with the installation or use of a system containing a RxE 10k Rotating Electrode, please try to call from a phone next to your computer, where you can type and read the screen while talking to us.

We will be happy to provide a reasonable level of free support for registered users of the RxE 10k Rotating Electrode. Reasonable support includes telephone assistance covering the normal installation, use, and simple customization of a computerized system containing a RxE 10k Rotating Electrode connected to a computer with Microsoft Windows® 10 or higher (64-bit version only).

A service contract that extends both the hardware warranty and software update period is available at an additional charge. Software updates **do not** include software enhancements offered to our customers at additional cost.

Enhancements to the RxE 10k Rotating Electrode and Gamry Instruments' standard applications software that require significant engineering time on our part can be performed on a contract basis. Contact us with your requirements.

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The information in this manual has been carefully checked and is believed to be accurate as of the time of release. However, Gamry Instruments, Inc. assumes no responsibility for errors that might appear.

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Chapter 1: Safety Considerations

Your RxE 10k Rotating Electrode has been supplied in a safe condition. This chapter of the RxE 10k Rotating Electrode Operator's Manual contains information and warnings that you must follow to ensure continued safe operation of the RxE 10k Rotating Electrode.



The safety of any system incorporating the RxE 10k Rotating Electrode is the responsibility of the assembler of the system.



If the RxE 10k Rotating Electrode is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Inspection

When you receive your RxE10k Rotating Electrode, inspect it for evidence of shipping damage. If you observe any damage, please notify Gamry Instruments Inc. and the shipping carrier immediately. Save the shipping container for possible inspection by the carrier.



An RxE 10k Rotating Electrode damaged in shipment can be a safety hazard. Do not operate a damaged apparatus until a qualified service technician has verified its safety. Tag a damaged RxE 10k system to indicate that it could be a safety hazard.

Product Safety

The RxE 10k Rotating Electrode has been designed, tested, and certified to meet the requirements of EN 61010 and EN 61326, Safety requirements for electrical equipment for measurement, control, and laboratory use. As defined in these standards, it is a Category II apparatus, with any "hazardous live voltages" protected by "reinforced insulation".

Most of the RxE 10k Rotating Electrode circuitry operates at voltages low enough to be considered safe. The RxE 10k Rotating Electrode contains a limited amount of internal circuitry that is a "hazardous live" voltage as defined in EN 61010 (the standard mentioned above). "Reinforced insulation" (again defined in EN 61010) is used to reduce the risk of electrical shock caused by this hazardous live voltage.

The majority of the RxE 10k Rotating Electrode's circuitry does not contain voltages higher than 15 V DC. Generally, input and output voltages in the RxE 10k Rotating Electrode are limited to ± 9 V. This voltage level is considered safe.

The RxE 10k Rotating Electrode is normally provided with an AC line cord suitable for your location. This AC line cord connects the AC mains to the chassis of the instrument. You must always use a line cord with a CEE 22 Standard V female connector on the instrument end of the cable. If your RxE 10k Rotating Electrode has been provided without an AC line cord, or a cord that is not compatible with your local AC mains socket, obtain a line cord certified for use in your country. Contact your local Gamry Instruments Representative or email to techsupport@gamry.com if you are uncertain what AC line cord to use.



Never operate the RxE 10k Rotating Electrode system with any cover or panel on the chassis open. Dangerous voltages may be present at several points within the Motor Controller chassis, including PC board traces. Always remove the power connection before opening the Motor Controller case.

Mechanical Safety

The RxE system has components which can rotate at speeds of up to 10500 rpm (revolutions per minute). For your safety, please wear appropriate protective equipment.



Always wear safety goggles while operating the RxE system. While extremely rare, the Rotating Electrode or allied parts can break and fly, injuring the operator's eyes.



Use extra caution when running experiments with glass cells.

Rotator shaft and electrode need to move freely. Each type of electrode has a maximum allowable speed.



Never block or restrict the motion of the rotator shaft and electrode.

Always operate the RxE system in compliance with maximum speed specifications for your electrode.

AC Mains Connection to the Power Brick

The Motor Controller does not connect directly to an AC Mains supply. Instead, the mains are connected to a desktop AC adapter (power brick), which outputs 48 V DC, which in turn powers the Motor Controller.



The Motor Controller's AC Adapter is rated for operation from 100 to 240 V AC, 47 to 63 Hz. It should therefore be useful throughout the world.



Use only Gamry Instruments-approved DC power sources with your Motor Controller. Other power sources may alter the performance and/or safety characteristics of the RxE 10k system.

If you power up the Motor Controller with an Interface 1010 power supply, the unit may work at low output currents. Operation at full power, however, is likely to cause abnormal operation; the problems may be subtle. Use only the Motor Controller's power supply with the Motor Controller.

Temperature and Ventilation

Your RxE 10k Rotating Electrode system is designed for indoor use at ambient temperatures between 0°C and 45°C.

The RxE 10k Rotating Electrode uses forced-air cooling to keep its components within their operating temperature range. The fan within the rotator housing turns on when the connected Motor Controller is turned on. The air enters the housing at the fan and exits through an array of slots on the rear side of the rotator.

The Motor Controller does not have a fan within its enclosure, convection cooling is generally sufficient. Most of the air needed to cool the Motor Controller enters the chassis through holes in its bottom. The air exits through slots on the side of the instrument.



Do not block the airflow into or out of the Motor Controller and RxE 10k rotator chassis. The circuitry is thermally protected so over-temperature will cause the system to enter a shutdown state. If shutdown occurs during data-acquisition, experimental data could be lost. Running the Motor Controller without adequate cooling could also shorten the time to failure of some of the circuitry. Custom cables with the shield connected to pin 6 of the D sub connector are preferred.

Be careful when operating the RxE 10k Rotating Electrode system in an enclosed space (such as an enclosed relay rack or NEMA enclosure). The temperature within the enclosure must not exceed 45°C. You may need to provide ventilation holes or even forced air-cooling for the enclosed space if excessive temperature rise occurs.

Defects and Abnormal Stresses

Treat your RxE 10k Rotating Electrode as potentially hazardous if any of the following is true of the unit:

- It shows visible damage,
- It does not operate properly,
- It has been stored for an extended period of time under unfavorable conditions,
- It has been dropped or subjected to severe transport stress,
- It has been subjected to environmental stress (corrosive atmosphere, fire, etc.).

Do not use your RxE 10k Rotating Electrode or any other apparatus if you think it could be hazardous. Have it checked by qualified service personnel.



If any part of the wiring, connectors, or enclosures on the RxE 10k Rotating Electrode appears physically damaged, do not use the system. Please contact your Gamry representative to discuss the next steps.

Environmental Limits

There are environmental limit conditions on the storage, shipping, and operation of this equipment. The RxE 10k Rotating Electrode has **not** been designed for outdoor use.

Table 1-1 – Environmental limits of the RxE 10k Rotating Electrode

Description	Specifications
Storage	
Temperature	-20°C to +60°C
Relative Humidity	max. 90 % non-condensing
Shipping	
Temperature	-20°C to +60°C
Acceleration	max. 30 G
Operation	
Temperature	0°C to +45°C
Relative humidity	max. 90 % non-condensing



The Motor Controller is not designed for operation in conditions where liquid water may enter the chassis, or water vapor may condense within the chassis. Operation of a Motor Controller that has water within the chassis can create a safety hazard, which could result in personal injury or death.

Cleaning

Clean the external chassis only when necessary.

Disconnect the RxE 10k Rotating Electrode from all power sources prior to cleaning.

Use a cloth, lightly dampened with either clean water or water containing a mild detergent, to clean the outside of the RxE 10k Rotating Electrode enclosure. Alternatively, you may use isopropyl alcohol. Do not use a wet rag or allow fluid to enter the RxE 10k Rotating Electrode enclosure. Do not immerse the RxE 10k Rotating Electrode in any type of cleaning fluid (including water). Do not use any abrasive cleaners.

Service

Always turn the RxE 10k Rotating Electrode system **OFF** before replacing any parts, such as the rotator shaft, electrodes, or carbon brushes.

Your RxE 10k Rotating Electrode has no user-serviceable parts inside beside electrode shaft, electrode, and carbon brushes. Refer all other service to a qualified service technician.



Never operate the RxE 10k Rotating Electrode system with any cover or panel on the chassis open. Dangerous voltages may be present at several points within the Motor Controller chassis, including PC board traces. Always remove the power connection before opening the Motor Controller case.

RF Warning

The RxE 10k Rotating Electrode has been tested for both radiated and conducted RF interference and for immunity to RF fields and has been found to be in compliance with FCC Part 18 and EU Council Directive 2014/30/EU, the EMC Directive EN 61326:2013—*Electrical equipment for measurement, control, and laboratory use—EMC Requirements*. Testing was performed in accordance with the Basic Immunity Requirements contained in Table 1 and the Emission Requirements contained in Section 7.

However, your RxE 10k Rotating Electrode still does generate some radio-frequency energy. The radiated levels are low enough that the RxE 10k Rotating Electrode should not create an interference problem in most industrial laboratory environments.

Your RxE 10k Rotating Electrode may also respond to environmental radio-frequency energy. We recommend you avoid using mobile phones and other radio-frequency equipment in the same room as an RxE 10k Rotating Electrode. The RxE 10k Rotating Electrode circuitry has been tested for operation in high-intensity RF fields and has demonstrated little response to those fields. However, there is no guarantee that the electrochemical cell and its connections will not respond to RF fields. This response most often appears as DC shifts in a cell's response caused by rectification of the RF signal.

Electrical Transient Sensitivity

Your RxE 10k Rotating Electrode system was designed to offer reasonable immunity from electrical transients, including transients on the incoming AC mains supply and electrostatic discharge. It has been tested for compliance with EN 61326:1998—*Electrical equipment for measurement, control, and laboratory use—EMC Requirements* describing acceptable limits for electrical transient susceptibility in laboratory test equipment. It should continue to operate when subject to the standard ESD and power-line events defined in EN 61326.

In severe cases involving transients beyond the limits tested in EN 61326, the RxE 10k Rotating Electrode system could still malfunction as a result of electrical transients. If you have problems in this regard, the following steps may help:

If the problem is static electricity (sparks are apparent when you touch the RxE 10k Rotating Electrode system or its cables):

Safety Considerations

- Try placing your RxE 10k Rotating Electrode system on a static-control work surface. Static-control work surfaces are now generally available from computer-supply houses and electronics-tool suppliers. An antistatic floor mat may also help, particularly if a carpet is involved in generating the static electricity.
- Air-ionizers or even simple air-humidifiers can reduce the voltage available in static discharges.

If the problem is AC power-line transients (often from large electrical motors near the RxE 10k Rotating Electrode system):

- Try plugging your RxE 10k Rotating Electrode system into a different AC power branch circuit.
- Plug your RxE 10k Rotating Electrode system into a power-line surge-suppressor. Inexpensive surge-suppressors are now generally available because of their use with computer equipment.

Contact Gamry Instruments, Inc. if these measures do not solve the problem.

CE Compliance

The European Community has instituted standards limiting radio-frequency interference emitted by electronic devices, setting limits for susceptibility of apparatus to RF energy and transient events, and mandating safety requirements. Gamry Instruments, Inc. has designed and tested the RxE 10k Rotating Electrode to comply with these standards.

The relevant CE regulations include EN 61010-1:2010/A1:2019 and EN 61326-1:2013.

RoHS Compliance

The RxE 10k Rotating Electrode is built using lead-free components and lead-free solder. It complies with the European RoHS initiative.

Chapter 2: Introduction

About this Manual

This manual covers the installation, safety, and use of the RxE 10k Rotating Electrode system with Revision 7 (and later revisions) of the Gamry Instruments Framework software. It is equally useful when setting up a newly-purchased instrument or modifying the setup of an older instrument for use with new software.

Technical material such as specifications, certificates, or optional parts can be found in the Appendices.

This manual discusses software installation or software operation in some detail. The installation is written assuming installation using Revision 7 of Gamry's Framework™ software. Installation is also described in Gamry's Quick-Start Installation Guide for USB Potentiostats.

Software support for the RxE 10k Rotating Electrode system and any potentiostat is described in the Gamry Help system.

About the RxE 10k Rotating Electrode

The RxE 10k Rotating Electrode system is a research-grade instrument.

The rotator unit is mounted on a gear rack to allow precise and stable control of the rotator height. This allows use of smaller as well as larger cells for electrochemical measurements. A protective Safety Shield can be mounted on the wide base plate to protect the user during operation.

The Motor Controller is packaged in a small, easy-to-handle case. It works particularly well in systems with other multiple potentiostats connected to a computer. It offers precise and stable control of the rotation speed using either digital or analog control.

The RxE 10k Rotating Electrode features include but are not limited to:

- Rotation rate setting from 50 to 10500 rpm
- High-precision and highly stable rotation rate control
- Digital and analog control mode
- No residual rotation

The RxE 10k Rotating Electrode requires for digital control, like all Gamry instruments, a computer for its use. The instrument to the computer through a USB connection from the Motor Controller. The USB connection has become truly universal, with USB ports found on all modern computers. Gamry Windows® based software currently supports up to 16 Gamry potentiostats connected to one computer. A system can include a mixture of RxE 10k Rotating Electrode systems, Gamry Reference and Interface Family potentiostats as well as other USB controlled Gamry devices.

During digital control, the rotation rate is controlled by reading out the motor's encoder signals. The data processor within the Motor Controller translates the output signal and changes the PI-controller parameters to adjust the motor's speed rate. This allows a very precise control and fast adaptation of the speed setting which is required for special applications where the rotation rate needs to be modulated. The rotation rate can be set either within Gamry Instruments' Framework software or manually using a rotary encoder knob at the Motor Controller's front panel. Both set speed and actual rotation rate are conveniently displayed on an LC-display at the Motor Controller. An Emergence Shutdown button turns off the motor immediately in case of any unforeseen circumstances.

Analog control of the rotation rate can be achieved using an external voltage signal applied through a User I/O connector on the Motor Controller. The connector allows an input voltage from 0 to +4.096 V and thus achieves a proportionality factor of 0.41 mV/rpm.

The RxE 10k Rotating Electrode system enables electrochemical experiments with rotating disk electrodes (RDEs), rotating cylinder electrodes (RCEs), as well as rotating ring disk electrodes (RRDEs). The electrodes can be mounted on a high-precision machined electrode shaft.

Software and Applications

The RxE 10k Rotating Electrode system supports **all** Gamry electrochemical applications software. Gamry's Framework software includes a collection of special electrochemical experiments for rotating electrode applications that require either constant or modulated rotation rates. These scripts do already include the potentiostat interface.

The RxE 10k Rotating Electrode system can also be used as a stand-alone system with any other experiment script. Separate scripts are available which allow exclusive control of only the rotator.

In addition, custom experimental sequences can be made using Gamry's Sequence Wizard within Framework software. Individual control of potentiostats and rotator scripts allow complex experiment sequences with automatic parameter adjustment.

Notational Conventions

In order to make this manual more readable we have adopted some notational conventions. These are used throughout this manual and all other Gamry Instruments manuals:

- Numbered lists. A numbered list is reserved for step-by-step procedures, with the steps always performed sequentially.
- Bulleted list. The items in a bulleted list, such as this one, are grouped together because they represent similar items. The order of items in the list is not critical.
- File names and folders. Inside paragraphs, references to computer files and Windows® folders are capitalized and placed within quotes, for example: "C:\MYGAMRYDATA\CV.DTA" and "GAMRY.INI".

Chapter 3: Installation

This chapter of the Gamry Instruments Inc. RxE 10k Rotating Electrode Operator's Manual covers all basic steps for installation of the RxE 10k Rotating Electrode system. We assume the RxE10k Rotating Electrode is installed as part of a Gamry Instruments' Framework-based electrochemical measurement system containing computer with Microsoft Windows® 10 or higher (64-bit version only).

Unpacking

When you receive your RxE 10k Rotating Electrode system, please verify that you have received the following items :

Table 3-1 – RxE 10k Rotating Electrode (992-00146)

Quantity	Part Number	Description
1	-	Power Cord, 6' to 7.5', generic (country-specific)
1	727-00013	AC-DC Desktop Power Supply, 48 VDC at 2.08 A, 100 W, 90-264 VAC with 3-pin power DIN DC-output connector
1	820-00196	Ring stand rod, 400 mm length
1	821-00016	Screwdriver Hex, 1/16" X 50mm
2	966-00006	Safety Shield
1	985-00131	USB2.0 A Male to B Male Cable Assembly, 1.8 – 2m long, 2 ferrites
1	985-00194	RxE 10k Rotating Electrode System – Motor Control Cable
1	988-00075	RxE 10k Rotating Electrode System – Operator's Manual
1	988-00084	RxE 10k Rotating Electrode System – Quick Start Guide
1	990-00497	RxE 10k Rotating Electrode – Top Assembly
1	990-00498	Motor Controller – Top Assembly

Initial Visual Inspection

After you remove your RxE 10k Rotating Electrode system from its shipping carton, check it for any signs of shipping damage. Do **not** operate the instrument with any broken or damaged components as it can pose a safety hazard. If you observe any damage, please notify Gamry Instruments, Inc., and the shipping carrier immediately. Save the shipping container for possible inspection by the carrier.



If the RxE 10k Rotating Electrode is taken from a cold location (for example outdoors in winter conditions) to a warm, humid location, water vapor may condense on the cold surfaces inside the RxE 10k Rotating Electrode, possibly creating a hazardous condition. Before connecting power to a "cold" RxE 10k Rotating Electrode, allow at least one hour to warm at room temperature.

Physical Location

Place your RxE 10k rotator and the Motor Controller on a flat workbench surface. Keep easy access to the rear of both instruments because some cable connections are made from the rear. Operation of the Motor Controller

is generally operated in a “flat” position, but other orientations are possible as long as it is ensured that air movement through the chassis is not restricted. The RxE 10k rotator may only be operated in an upright position.



Do not block the airflow into or out of both RxE 10k Rotating Electrode and Motor Controller chassis. The RxE 10k Rotating Electrode system will enter a power-down state if it becomes overheated. If this occurs during data-acquisition, you may lose experimental data.

If you place your RxE 10k Rotating Electrode system within an enclosed space, make sure that the internal temperature within that space does not exceed 45°C, the maximum ambient temperature for the rotator and Motor Controller. Be particularly careful if a computer or other heat-dissipating equipment is mounted in the same enclosure as the rotator and Motor Controller.

The RxE 10k Rotating Electrode system is **not** designed for outdoor use.

Computer Requirements

Before you connect the potentiostat connected to your RxE 10k Rotating Electrode to a computer, you must make sure that your computer meets these requirements:

- A computer based on one of the x86 family of Intel™ microprocessors or a 100%-compatible processor from another vendor.
- Microsoft Windows® 10 or higher is required with Gamry Framework™ software version 7.9.1 and above. Only the 64-bit version of these operating systems is supported. Log in to Gamry's [Client Portal](#) for the latest software version.
- A USB port that supports Full Speed (12 Mbits/second) or High Speed (480 Mbits/second) USB transfers. It must be compatible with Revision 1.1 or Revision 2.0 of the USB specification.

Quick-Start Guide for System Installation

Your shipment should have included a document entitled **Quick-Start Installation Guide**. It contains the latest instructions for installing Gamry Instruments' hardware and software onto a computer system. If this document is missing, you can find it on www.gamry.com. The documents found on the website contain the latest information concerning system installation, so the information provided below is always subject to change.

Software Installation

The RxE 10k Rotating Electrode is compatible with the Windows® Plug & Play configuration system. Like most Plug & Play hardware, it is best if you install the software for the RxE 10k Rotating Electrode **before** you install the instrument hardware.

The latest Gamry software is not provided on a DVD anymore but is now available for download as *.exe or *.iso file on Gamry Instruments' Client Portal after creating an account and registering your instrument:

<https://www.gamry.com/client-portal/my-account/>

An internet download of Gamry Instruments' software will download a self-extracting file. Running this file will extract the software and begin the installation.



Turn off your RxE 10k Rotating Electrode system and any connected potentiostat before installing or updating Gamry Instruments' Framework software.

Reboot your Computer after Software Installation

Reboot your computer after the Gamry Setup program is done. The Setup program normally offers you the opportunity to do so. USB device drivers are usually loaded when Windows boots up. Following Setup, you may not be able to use your RxE 10k Rotating Electrode until the drivers are loaded.



Device-driver installation may not occur until a while after the Windows® Desktop appears. On a slow computer, or a busy computer with lots of active applications, the delay before driver installation can be a minute or more.

First-time Device Installation in Windows®



These instructions presume you have already installed Gamry software Revision 7.10 or higher.

Running the Framework

Regardless of your electrochemical application, Gamry recommends running the Gamry Framework after you install new Framework software or add an instrument to your system. The Framework Instrument Manager allows you to:

- Rename instruments,
- Calibrate instruments,
- Manage instrument firmware,
- Authorize specific applications for use with specific instruments

Run the Gamry Framework by clicking on the icon, installed on the Windows® desktop. You can connect and power any Gamry instrument either before or after you start the Framework.

Framework Device Status Bar

By default, the Gamry Framework shows a Device Status Bar under its main menu (see Figure 3-1). If you do not see the Device Status Bar when you run the Gamry Framework, it has been disabled in the Framework **Options** menu.

Installation

Instruments that are connected to the computer appear on this bar. The round indicator associated with each device shows its status:

Green	The device is available to run experiments.
Orange	The device is currently running an experiment.
White	The device is connected to the system but is not usable. This is generally the result of a mismatch between the Framework software and the device's firmware. You can use the Gamry Instrument Manager to fix the mismatch.

The screen capture below shows a Framework screen with three USB instruments connected.

Figure 3-1
Framework with Three Potentiostats and One Running Test



The Reference 620 (**REF620-46052**) in this system is shown with a green indicator because it is installed and ready to run. The Interface 1010 labeled **IFC1010-01860** has a yellow indicator because it is recording the EIS spectrum shown on the screen. The Reference 620 labeled **REF620-chem lab** has a white indicator, showing it is plugged in but cannot be used. This is an indication of obsolete firmware.

Though no RxE 10k Rotating Electrode was used in this example, its status indicator behaves in the same manner described above.

Gamry Instrument Manager

Use Gamry's Instrument Manager (GIM) application make changes to the configuration of your RxE 10k Rotating Electrode system. Get access to this dialog box via the **Options** menu in the Gamry Framework.

Use the Instrument Manager to:

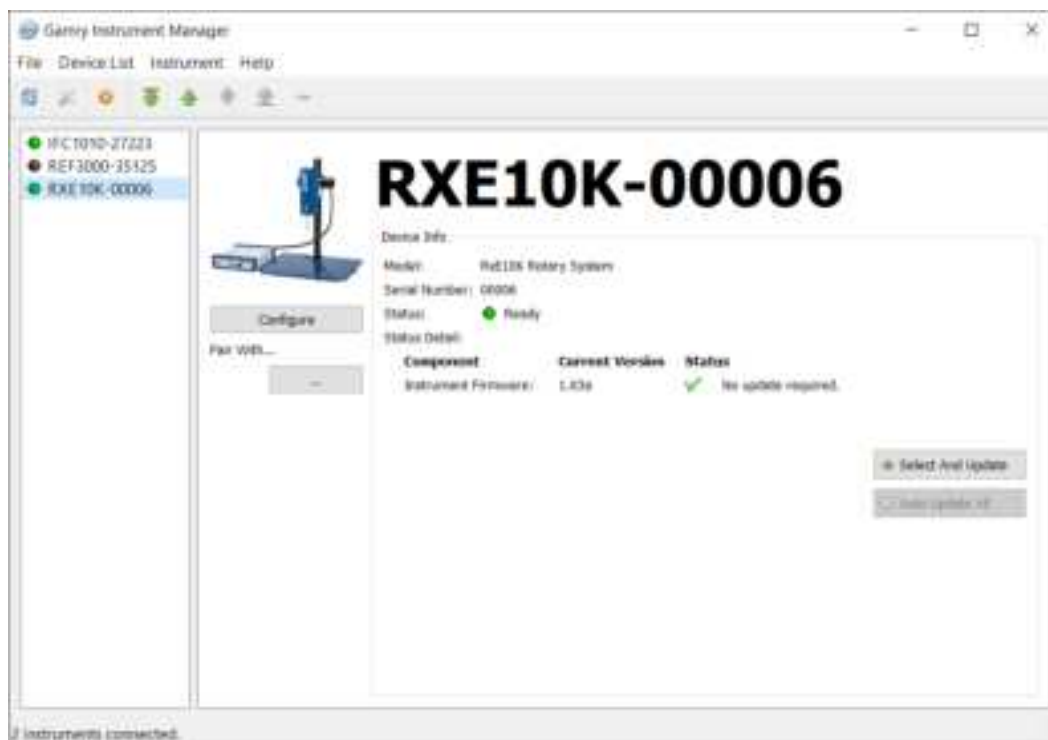
- Rename devices
- Delete devices that are not currently connected to the computer

Installation

- Select the order in which devices appear on the menus
- Update firmware within devices
- Pair your rotator with a potentiostat

Figure 3-2 shows an example of the Gamry Instrument Manager window with an RxE 10k Rotating Electrode system.

Figure 3-2
Instrument Manager Dialog Box



GIM appears automatically when a new instrument is connected to the computer. You can start GIM anytime by opening Framework and selecting **Options > Instrument Manager...**

GIM is always in its own window, separate from the Framework window.

Each Gamry device in the system appears in the list on the left. All Gamry Instruments devices that are known to the system are displayed in the **Instrument Manager**. Select an instrument by clicking on its name. Selecting an instrument that is connected and idle blinks its Power LED. After a moment, your potentiostat should appear next to **Devices Present** along with a green virtual LED. Repeat for additional devices.

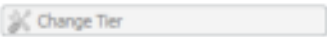
Firmware Update

Your RxE 10k Rotating Electrode was shipped with the latest version of all its firmware. From time to time, Gamry makes changes to the instrument's firmware code, and a firmware update is required to make use of the new or improved code.

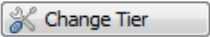
Appropriate update files (firmware images) can be obtained from the Gamry Instruments website at www.gamry.com. Download the file containing the new image and save it onto your computer's hard disk.

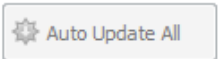
GIM automatically determines if the software and firmware are compatible. The status of compatibility is shown in the Device Info area.

If there is a conflict, this area shows the following (here using a Reference 3000 and Reference 600P as an example):

Device Info			
Model:	Reference 3000	Host Software Revision:	7.04.4758
Serial Number:	30121		
Tier:	REF3000E		
Firmware Revision:	4.00		Warning! Version 4.15 or greater required
PLD Revision:			Not supported
Comm Revision:	2.24		No update required.
Status:			Update Required

If the firmware is compatible with software version, the **Device Info** area appears as:

Device Info			
Model:	Reference 600 Plus	Host Software Revision:	7.06.5945
Serial Number:	30008		
Tier:	REF600PE		
Firmware Revision:	4.30		No update required.
PLD Revision:	Not updatable		
CTRL PLD Revision:	Not updatable		
Comm Revision:	2.24		No update required.
Status:			Ready




Auto Update All

If no updates are required to use the instrument, this tool is grayed out. When your firmware revision is incompatible, the **Auto Update All** button is active. This tool automatically selects the compatible firmware and installs it. Gamry Instruments recommends that you use this button. To use this tool, take the following steps:



Do not power off or disconnect the instrument during this process. Doing so can cause irreversible damage to the instrument.

Click the **Auto Update All** button. A window appears giving information on what version of firmware is currently installed, and what version will be installed. The installation process starts automatically. After the relevant firmware is updated, a window appears confirming the process is complete and successful. Click the **OK** button. The instrument is now ready to be used.

Select And Update

The **Select And Update** button is available at all times, even if an update is not required. Gamry recommends not altering the firmware if it is not necessary. This tool allows you to change individual firmware.



Please contact Gamry's technical support if you are unsure if firmware modification is required.

Pairing your RxE 10k rotator with a potentiostat

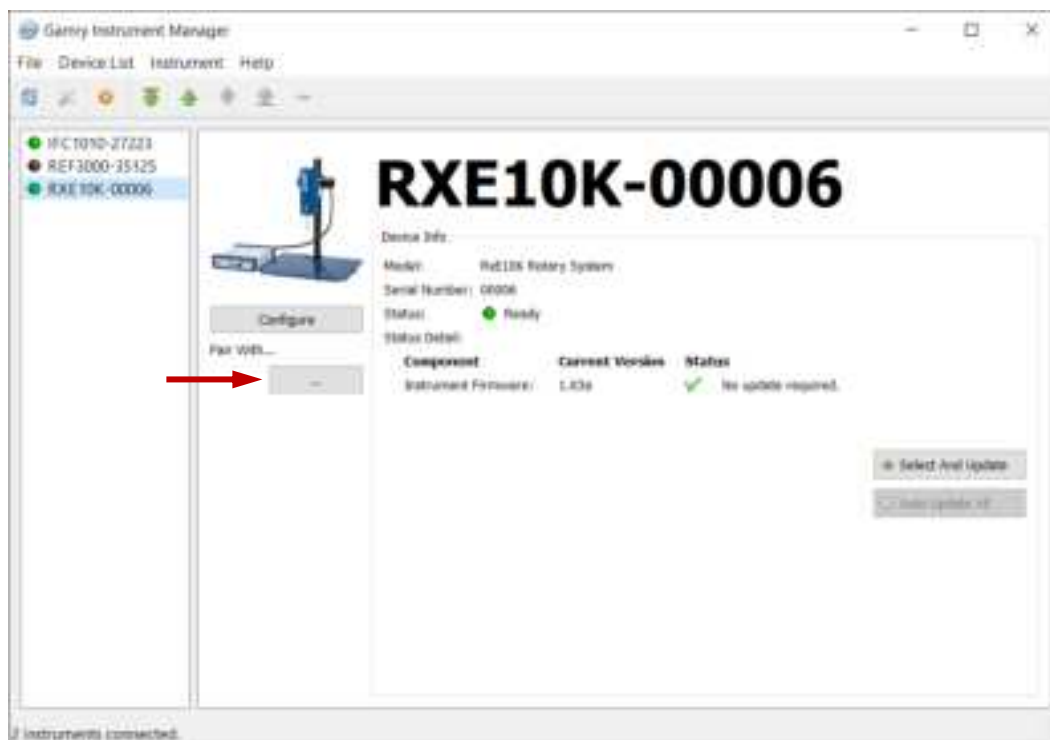
Pairing your RxE 10k rotator with one of your potentiostats is simple.

1. Be sure your host computer is on, the rotator is on, and your potentiostat is on.

Installation

2. Run the Gamry Framework software.
3. In the main menu bar, choose **Options > Instrument Manager...**

The Gamry Instrument Manager window opens.

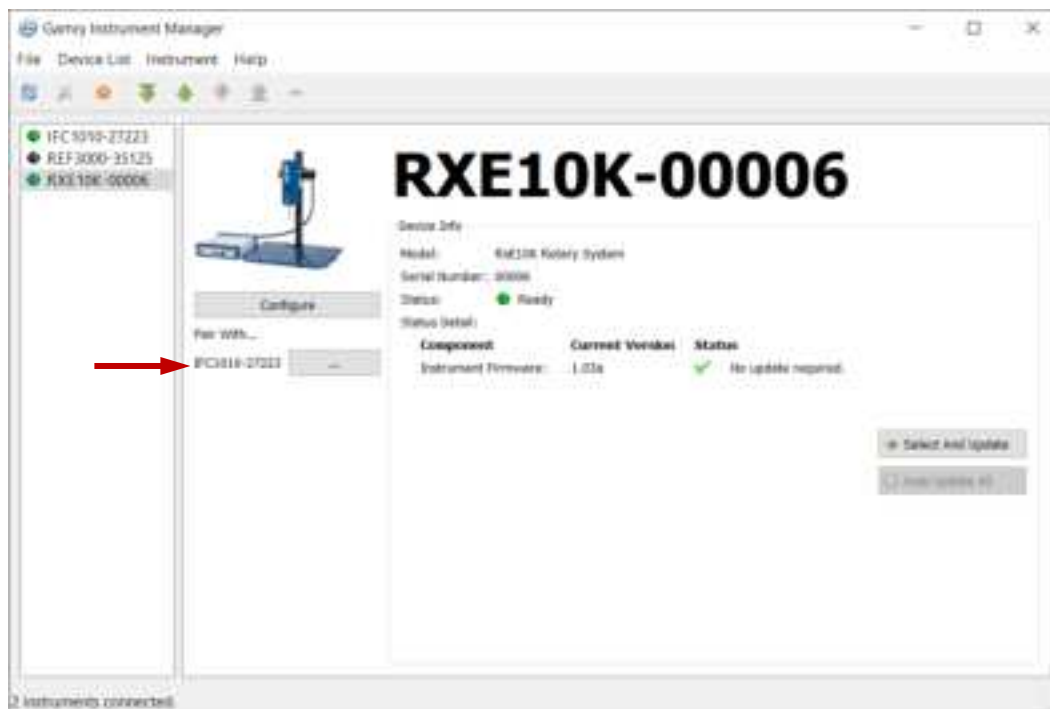


- a. Click the ... button under **Pair with...** to open the selection window.



- b. Select the potentiostat you want to pair with your RxE 10k rotator and press **OK**
The Instrument Manager now displays the potentiostat paired with your RxE 10k rotator.

Installation



Chapter 4: Rotator Setup

Setup Overview

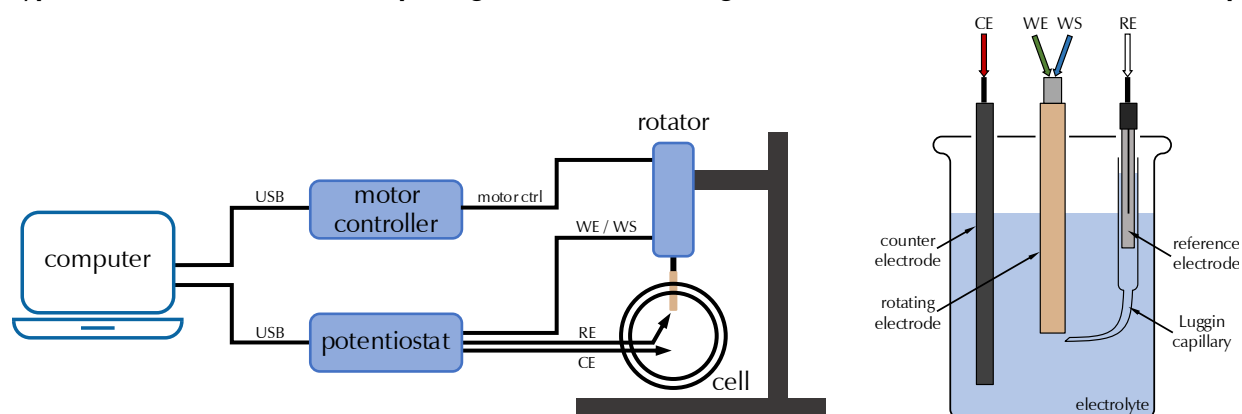
An RxE 10k Rotating Electrode experimental setup requires the following Gamry Instruments components:

- RxE 10k Rotating Electrode system
 - RxE 10k rotator unit
 - Motor Controller
 - Motor Control Cable
 - Safety Shields
- Electrode shaft (separate item)
- Rotating Electrode (RDE, RCE, or RRDE) (separate items)
- Gamry Instruments, Inc. Potentiostat/Galvanostat/ZRA (separate items)

Figure 4-1 shows a schematic outline of an electrochemical test setup using the RxE 10k Rotating Electrode.

Figure 4-1

Typical Electrochemical Test Setup using the RxE 10k Rotating Electrode and detailed view of a Cell Setup



The RxE 10k rotator unit is mounted on a focusing block which can be moved up and down on a coarse Z-axis stand. The whole setup is placed on a rigid rotator base plate made out of Polypropylene (PP). Electrode shaft and rotating electrodes can be mounted to the motor via an electrically insulating shaft adapter. Both are not included in the RxE 10k Rotating Electrode but need to be purchased separately.

The rotator is powered and controlled by the Motor Controller. Both are interconnected with a Motor Control cable (Gamry P/N 985-00194) at the matching 26-pin HD D-sub connectors at the rear side. The Motor Controller does not plug directly into the AC mains supply. Instead, the mains are connected to an external power supply, which supplies a regulated 48 V DC output. This regulated DC is then connected to the DC power input jack on the rear of the Motor Controller.

For digital control, the Motor Controller connects to a computer using a filtered High Speed USB A/B cable. A suitable cable is always shipped with your RxE 10k Rotating Electrode. The replacement cable is Gamry Part Number 985-00131. The computer controls the Motor Controller using Gamry Instruments' Framework software. The computer software and instruments are responsible for taking the measurement and storing it.

For analog control, an optional Multipurpose User I/O Cable can be connected to the Motor Controller using the 15-pin HD D-sub controller on the rear panel. The other end of the has fully customizable wires which can be connected to an external signal generator. The Gamry Part Number for a Multipurpose User I/O Cable is 985-00171.

When using a separate Gamry Instruments, Inc. potentiostat, connect its cable leads to the female banana connectors on the rear panel of the RxE 10k rotator. The upper connectors connect to the disc electrodes for RDEs and RRDEs as well as the cylinder electrode for RCEs. The lower connectors connect to the ring electrode when using RRDEs.

The Gamry Instruments, Inc. potentiostat does not plug directly into the AC mains supply. Instead, the mains are connected to an external power supply, which supplies a regulated 48 V DC output. This regulated DC is then connected to the DC power input jack on the rear of the potentiostat.

The Gamry Instruments, Inc. potentiostat connects to a computer using a filtered High Speed USB A/B cable. A suitable cable is always shipped with your potentiostat. The replacement cable is Gamry Part Number 985-00131. The computer controls the potentiostat using Gamry Instruments' Framework software. The computer software and instruments are responsible for taking the measurement and storing it.

USB Cables

The Motor Controller connects to a computer using a filtered High Speed USB A/B cable. A suitable cable is shipped with your RxE 10k Rotating Electrode system. The replacement cable is Gamry P/N 985-00131.

An A/B USB cable has different connectors on each end. The end with a wider, rectangular shaped connector plugs into a USB port on your computer (or a similar port on a USB hub). The end with a nearly square connector plugs into the USB port on the rear panel of the Motor Controller (see Figure 4-2).

Figure 4-2
USB port of the Motor Controller



The USB connection can be “hot plugged”. This means both the computer and the Motor Controller can be powered up before the USB cable is plugged in. Unlike many other instrument system connections, you do not need to power down the system before plugging in the USB.

You can also safely remove the USB cable without powering down the Motor Controller and your computer.



Be aware that removing the USB cable during an experiment may have undesirable consequences. An electrochemical experiment and data acquisition will be aborted, and any measured data may be lost.

The front panel **USB** LED provides a simple test of two aspects of normal Motor Controller USB operation. It has four normal states:

LED status	Description
Unlit	The USB cable is disconnected, or the USB connection is disabled by the host computer.
Continuous green	A valid cable connection has been made and the Motor Controller USB processor is receiving power from the USB cable.
Flashing orange	Valid USB messages are being transferred between the computer and the Motor Controller.
Continuous red	A software download or firmware update is in progress, or a USB communications error exists.

The flashing state only occurs when Gamry Instruments application software is running.

Power Cord and Power Connection

The Motor Controller does not plug in directly into the AC mains supply. Instead, the mains are connected to an external power supply which supplies a regulated 48 V DC output. This regulated DC is then connected to the DC power input jack on the rear of the Motor Controller.

The external power supply provided with the RxE 10k Rotating Electrode system is rated for operation from 90 to 264 V AC, at frequencies from 47 to 63 Hz. It should therefore be usable worldwide.

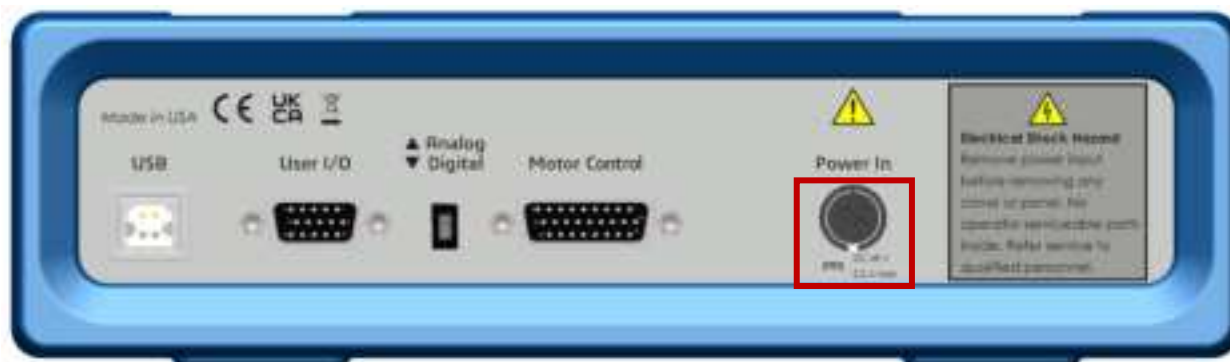
The Motor Controller external power supply is normally supplied with a line cord suitable for use in the United States. In other countries, you may have to replace the line cord with one suitable for your type of mains (electrical outlet). You must always use a line cord with a CEE 22 Standard V (IEC 320 C13) female connector on the end of the cable leading to the unit. This is the same connector used on the US standard line cord supplied with your Motor Controller.



When replacing the line cord for the power supply, always verify that it has adequate power ratings. Do not use a line cord that shows any damage or exposed wires. Contact Gamry Instruments (techsupport@gamry.com) or your local Gamry Instruments representative for additional support and replacement parts.

The DC output cord from the external power supply plugs into the DC Power In jack on the rear panel of the Motor Controller (see Figure 4-3).

Figure 4-3
Power In connector of the Motor Controller



Motor Control Cable

The RxE 10k rotator does not directly plug into the AC mains supply. Instead, it is powered and controlled by the Motor Controller. Both instruments, RxE 10k rotator and Motor Controller are interconnected by the Motor Control Cable (Gamry P/N 985-00194) using the matching 26-pin HD D-sub connectors on the Motor Controller's and rotator's rear panels (see Figure 4-4)

Figure 4-4
Motor Control connector of the Motor Controller (left) and RxE 10k rotator (right)



The Motor Control Cable has three dedicated power lines for the motor and two additional power lines for the encoder and fan.

Mounting an Electrode Shaft



Always make sure that the rotator is turned **OFF** before replacing any part on the rotator or removing the Safety Shield. Verify that the Motor Controller is turned **OFF**.

A rotating shaft is a safety hazard and complying with all necessary protection measures is crucial for your personal safety.

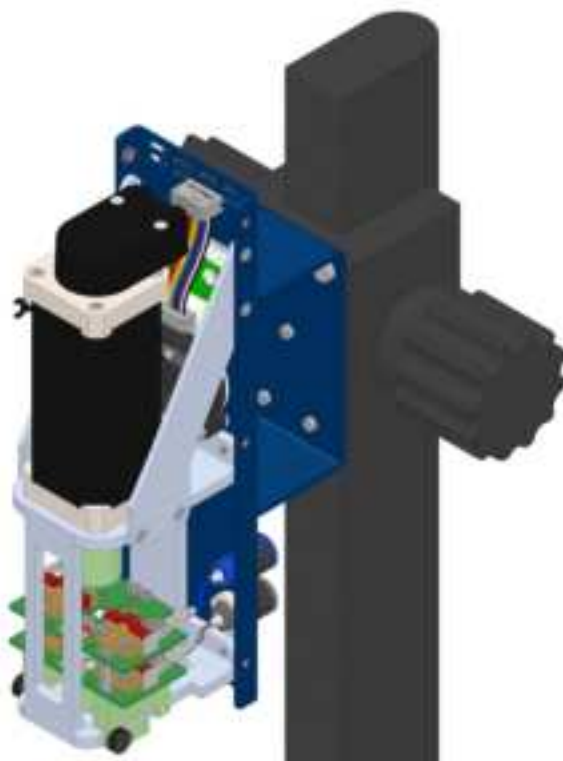
Both electrode shaft as well as electrodes (RDE, RCE, or RRDE) are not part of the RxE 10k Rotating Electrode system. Please see Appendix D: Replacement parts and Accessories for a list of additional accessories for the rotator system. Follow the instructions below for mounting an electrode shaft and electrodes:

- 1) Make sure the Motor Controller is turned **OFF** and that the motor shaft is not rotating.
- 2) Slightly unscrew the six thumb screws on the left and right side of the rotator enclosure. You do not have to remove them completely. Carefully slide off the rotator enclosure.

Rotator Setup



- 3) At the bottom are four carbon brushes with two on each side and stacked on top of each other. The top brushes make electrical contact to the disk of RDEs and RRDEs as well as the cylinder electrode of RCEs. The bottom carbon brushes make electrical contact to the ring electrode if an RRDE is mounted.

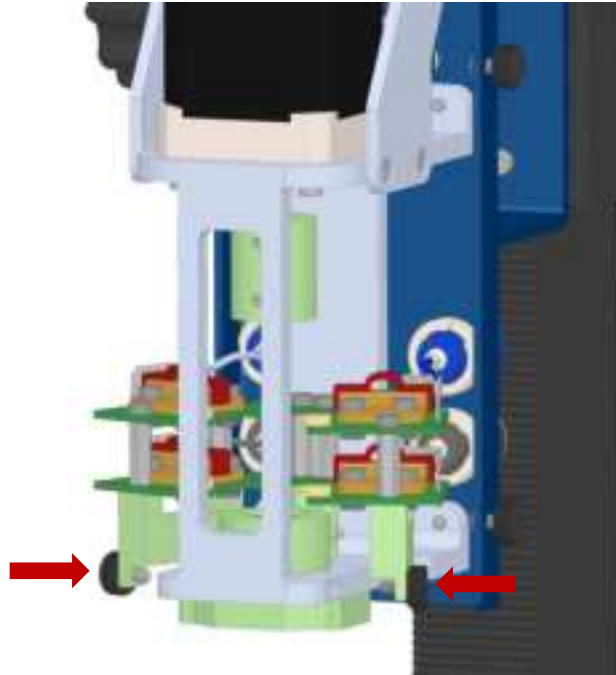


There are four wires which go from each PCB to the rotator's back side and the 4 mm banana receptacles. You can leave these wires as they are.

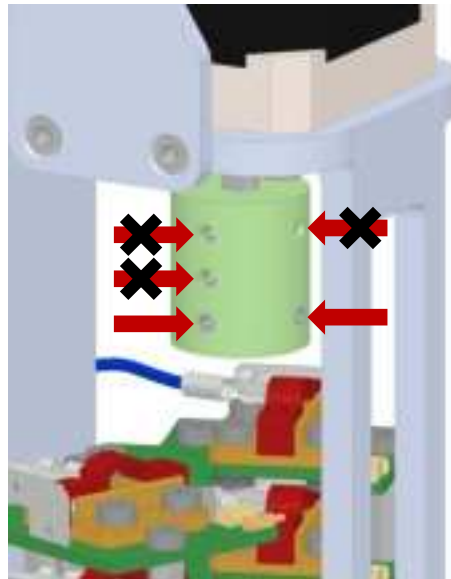
Rotator Setup

Initially, the carbon brushes are inside their metal housing and protected by red covers. Leave them on for now until the electrode shaft is installed.

- 4) Unscrew the thumb screws on both sides that hold the brush holders in place and rotate them outwards.



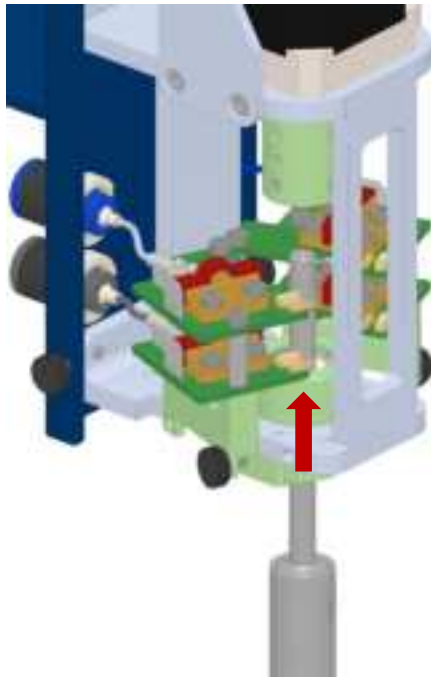
- 5) At the upper end, you can see the shaft adapter mounted onto the motor shaft. Unscrew the **bottom** two set screws which will be later used to attach the electrode shaft.



Do **not** open the top set screws that attach the shaft adapter to the motor's shaft. Do **not** remove the center set screw. It electrically separates motor shaft and electrode shaft.

- 6) Carefully guide the electrode shaft from the bottom of the rotator through the bearing housing.

Rotator Setup



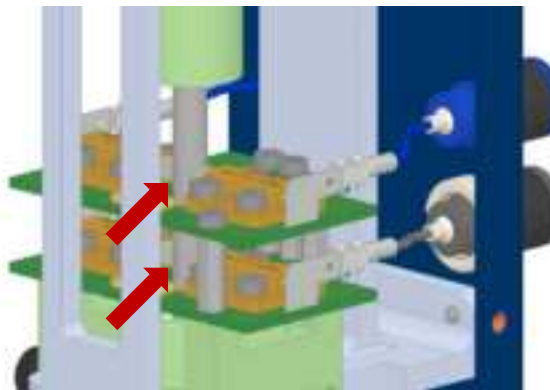
Do **not** bend the shaft sideways, tilt, or force it through the bearings. This can irreversibly damage both bearings and shaft.

- 7) Slide the electrode shaft upwards into the shaft adapter until it does not move any further. Secure the electrode shaft by tightening both set screws alternately. Do **not** overtighten the screws!



Alternate between both set screws while gradually tightening the screws. Do **not** fully tighten each set screw individually which can cause misalignment of the shaft. This can lead to vibrations and radial runout when rotating which can irreversibly damage the bearings.

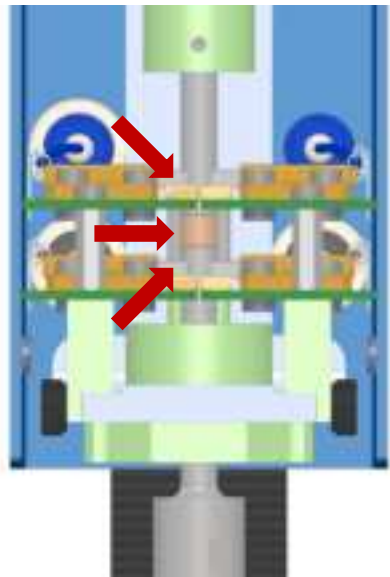
- 8) Carefully remove all four red covers from the brushes. The brushes snap outwards. Move both brush holders back to their original position and secure them again with the previously removed thumb screws.



- 9) Test the assembly by manually rotating the shaft. The electrode shaft should rotate freely without much counterforce. Make sure that all four brushes have good contact with the electrode shaft.

Rotator Setup

Upper and lower brushes are electrically insulated from each other. When using an RRDE shaft, verify that both upper brushes make contact above the RRDE shaft's PEEK insulator. The lower brushes should make contact below the shaft's PEEK insulator.



10) After verifying correct functionality, put the rotator enclosure back on and secure with the six thumb screws.



Always check the functionality of the rotator after installing an electrode shaft or after replacing the carbon brushes. Carefully follow the instructions in chapter **Rotator Test** on page 36 to verify that the rotator operates correctly.

Mounting an Electrode



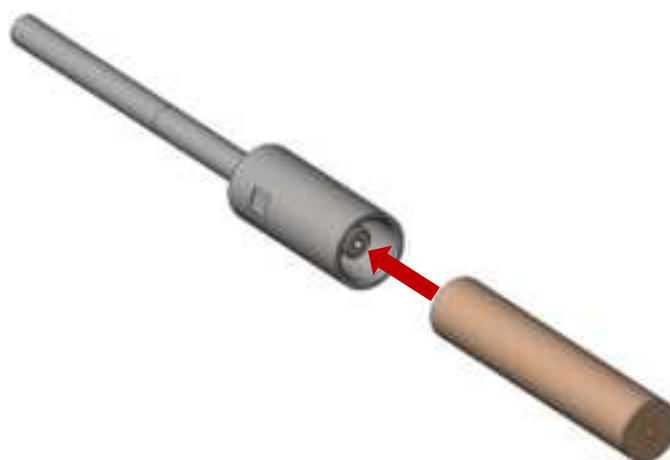
Always make sure that the rotator is turned **OFF** before replacing any part on the rotator or removing the Safety Shield. Verify that the Motor Controller is turned **OFF**.

A rotating shaft is a safety hazard and complying with all necessary protection measures is crucial for your personal safety.

Both electrode shaft as well as electrodes (RDE, RCE, or RRDE) are not part of the RxE 10k Rotating Electrode system. Please see Appendix D: Replacement parts and Accessories for a list of additional accessories for the rotator system. Follow the instructions below for mounting an electrode shaft and electrodes:

- Hold the lower part of the electrode shaft in place. Guide the electrode into the shaft's sleeve and screw on hand-tight. Do not bend the shaft sideways, otherwise the bearings, shaft, and carbon brushes could get damaged.

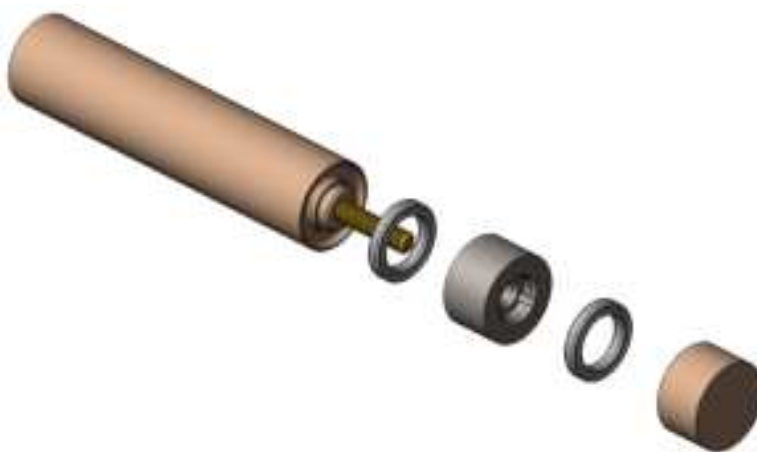
Rotator Setup



Make sure to have an RRDE shaft installed when using RRDEs. The RRDE shaft has two electrically insulated portions for the disk and the ring electrode. RDEs and RCEs should preferably be used with the RDE/RCE shaft. See Appendix D: Replacement parts and Accessories on page 67 for a list of available accessories and their Gamry part numbers.

RCE assembly

The figure below shows the general assembly of an RCE with the main body, cylinder electrode, end cap, and two O-rings on both sides of the cylinder electrode.



- 1) Place the first Viton™ O-ring into the groove of the main body.
- 2) Carefully screw on the cylinder electrode hand-tight onto the brass shaft until flush with the main body. Make sure not to wedge the O-ring between PEEK body and electrode.



You can also use the included drilled spanner tool to fully tighten the electrode. See below for further details.

- 3) Screw on the end cap with a second Viton™ in between until flush. Again, be careful not to wedge the O-ring.

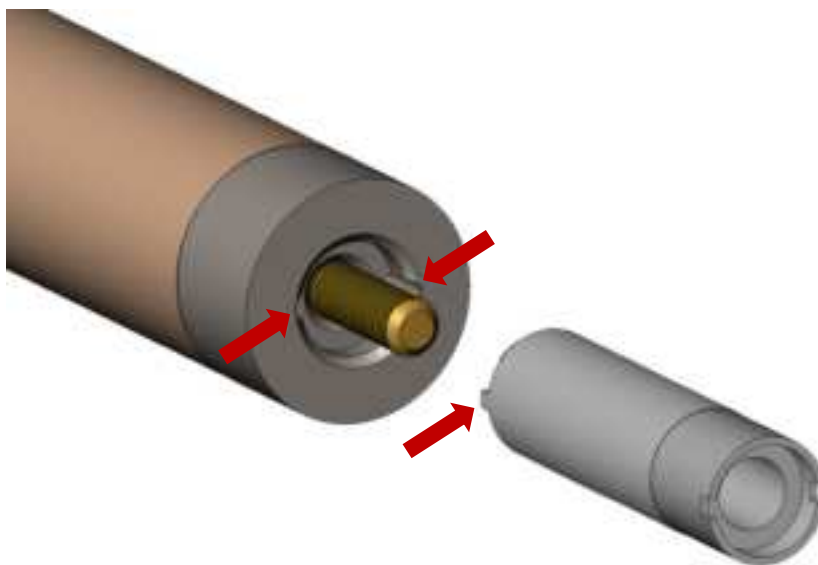


The RCE cylinders have an oil coating to prevent rust during storage. It is recommended to rinse them with an organic solvent such as methanol, ethanol, or isopropyl alcohol before usage.

Removing the cylinder electrode

If the cylinder electrode cannot be removed by hand or you do not want to touch the outer electrode surface, you can use the drilled spanner tool provided with the RCE.

- 1) Remove the end cap and the first O-ring.
- 2) Align both pins of the drilled spanner tool with the holes of the cylinder electrode.
- 3) Twist counterclockwise to loosen the electrode.



Safety Shield Installation

The Safety Shield serves as protection for the user when performing any experiments with the RxE 10k Rotating Electrode. It is made of 6 mm thick acrylic panels at the front and each side. Two of them can be mounted directly onto the rotator base plate. The Safety Shield can be removed when setting up the measurement cell or installing electrode shaft and electrode but should be installed again before starting an experiment.



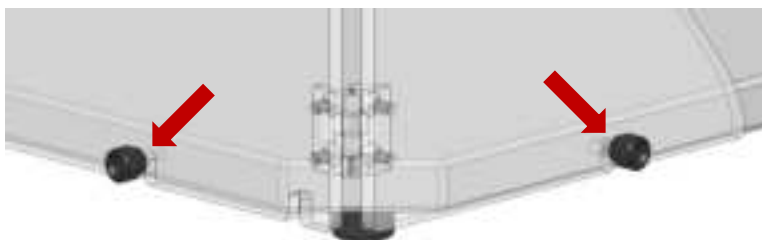
Always install the Safety Shield when running an experiment and operating the RxE system. While extremely rare, rotating shaft, electrode, or attached parts can break and fly off, injuring the operator.

- 1) Slightly unscrew the knurled knobs at the front and back of the rotator base plate. Unscrew all four M4 Torx screws on the sides using your T10 Torx key.

Rotator Setup



- 2) Unfold a Safety Shield and align the slots on the bottom side of the acrylic panels with the exposed threads of the knobs.



- 3) Push the Safety Shield fully towards the base plate to lock the side threads within the panel's L-slots.



- 4) Tighten all four knobs and screws to secure the Safety Shield. We recommend re-using the screws to secure both Safety Shields, but you can also use spare knurled knobs provided with your system.
- 5) Repeat the above steps for the second Safety Shield.



Always wear safety goggles while operating the RxE 10k system. While extremely rare, the rotating shaft, electrode, or attached parts can break and fly off, injuring the operator's eyes.



Use extra caution when running experiments with glass cells.

Power-up Test

Before you make any other connections to your RxE 10k Rotating Electrode system, check that the Motor Controller is at least nominally functional.

Attach your line cord to the power supply and connect it to the Motor Controller. Plug in the line cord to the AC mains supply.



When replacing the line cord for the power supply, always verify that it has adequate power ratings. Do not use a line cord that shows any damage or exposed wires. Contact Gamry Instruments (techsupport@gamry.com) or your local Gamry Instruments representative for additional support and replacement parts.

Turn on the **Power** switch on the front panel of the Motor Controller (Figure 4-5).

Figure 4-5
Power switch, Power LED, and LC-display of the Motor Controller



Watch the **Power** LED as the Motor Controller powers up. It flashes slowly four or five times (depending on the amount of software loading) then glows a steady blue. This process could take as long as 15 seconds. If you do not see a continuous blue color, contact technical support.

Additionally, the LC-display turns on after the Power switch is pressed. First a welcome message and then shortly after the Gamry Instruments lettering appears in white letters on a blue background. Figure 4-6 shows all display messages when powering up the Motor Controller.

Figure 4-6
LC-display messages of the Motor Controller after powering up



The status of the other LED indicators is not important at this time.



The Motor Controller is not working properly if the **Power LED** or LC-display goes on, then turns off and stays off! If this power-up test fails, contact Gamry Instruments or your local Gamry Instruments representative as soon as possible.

If the **Power LED** continues to flash after 30 seconds, the instrument could malfunction, or the instrument could be over heated. Make sure the Framework Instruments Manager is not causing the flashing (see below). Check that the air flow through the chassis is not restricted. If airflow looks okay and the **Power LED** continues to flash, contact Gamry Instruments (techsupport@gamry.com) or your local Gamry Instruments representative as soon as possible.

Rotator Test

After verifying the Motor Controller's general functionality, the RxE 10k Rotating Electrode should be tested. Make sure that the Motor Controller is turned **off** and that an electrode shaft (with or without electrode) is mounted securely to the rotator.



Always wear safety goggles while operating the RxE system. While extremely rare, the Rotating Electrode or allied parts can break and fly, injuring the operator's eyes.

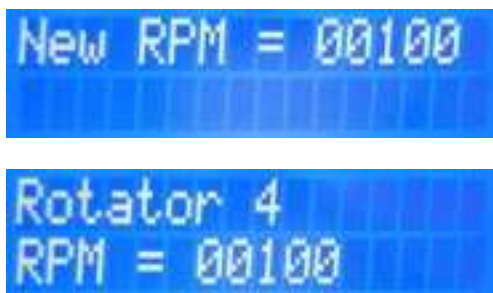


In case of any malfunctioning, immediately press the red **Emergency Shutdown** button on left side of the Motor Controller's front panel. This stops the motor abruptly and the shaft stops rotating.

Contact Gamry Instruments (techsupport@gamry.com) or your local Gamry Instruments representative as soon as possible.

Turn on the **Power** of the Motor Controller. The fan of the rotator turns on, the electrode shaft should not rotate. After the Motor Controller fully booted up, turn the **Manual** knob until the speed setting on the LC-display reads 100 rpm. Press the knob to confirm the speed setting.

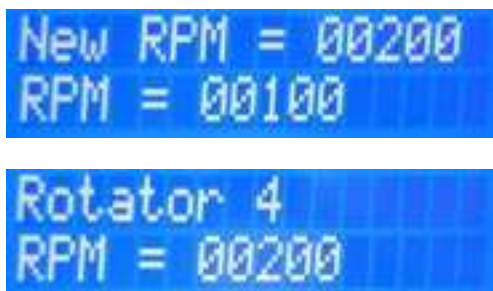
Figure 4-7
LC-display while selecting (top) and after confirming new speed (bottom)



The motor should now turn on and the electrode shaft begin accelerating to the set rotation speed. Verify that the shaft rotates smoothly.

Update the rotation speed to 200 rpm by turning the **Manual** knob clockwise and pressing it again. The rotator should speed up until it reaches its target value.

Figure 4-8
LC-display while updating (top) and after confirming new speed (bottom)



Press the **Emergency Shutdown** button on the Motor Controller's front panel to check its functionality.

Figure 4-9
Emergency Shutdown button of the Motor Controller



The motor should abruptly turn off and the electrode shaft stop rotating. System control is now fully disabled. The LC-display shows a warning message (Figure 4-10). Press the **Power** switch to re-enable the system.

Figure 4-10
LC-display when Emergency Shutdown button is pressed

The image shows a close-up of the LC-display, which is a small rectangular screen with a blue background and white text. The text on the screen reads 'SHUTDOWN - Cycle Power to Reset' in two lines.

Chapter 5: Operation

The following section discusses general operation of the RxE 10k Rotating Electrode system with a Gamry Instruments, Inc. potentiostat. Prior to operating the RxE 10k Rotating Electrode system, users should first read the previous chapters in order to avoid any mishandling leading to potential damage to the rotator system or injuries. We assume the RxE 10k Rotating Electrode is installed with a Gamry Instruments, Inc. potentiostat as part of a Gamry Instruments' Framework-based electrochemical measurement system containing a Microsoft Windows®-compatible computer.



Always wear safety goggles while operating the RxE 10k Rotating Electrode system. While extremely rare, the rotating electrode or allied parts can break and fly, injuring the operator's eyes.

Potentiostat Setup

The RxE 10k Rotating Electrode is mainly built to work with any Gamry Instruments, Inc. potentiostat, allowing digital control of the motor via Gamry's Framework software. Generally, the RxE 10k Rotating Electrode can be used with any commercially available potentiostat to perform electrochemical experiments.

Depending on the experiment, either a single potentiostat for RDE and RCE experiments or a bi-pstat setup for RRDE experiments is required. Follow the installation instructions of the potentiostats used in your setup. A current version of each manual can be downloaded on Gamry's website at <https://www.gamry.com/support/documentation-downloads/>.



Please check Gamry's website or the operator's manuals of the potentiostat for detailed information about connections, specifications, and general usage.

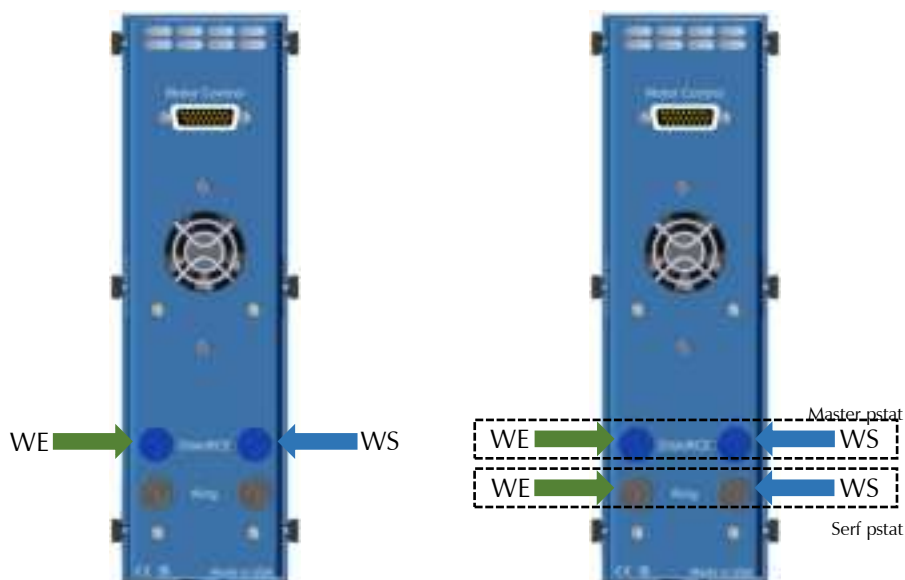
Hardware interfacing between the RxE 10k Rotating Electrode system and a Gamry potentiostat is done via the potentiostat's cell cable. Communication and synchronization between rotator and potentiostat(s) is done by Gamry's Framework software with all devices connected to the same computer via USB.



RDE/RCE experiments only require a single potentiostat while a bi-pstat setup is required for RRDE experiments.

- The cell cable connectors (4 mm female banana) of the RxE 10k rotator are located on the rear panel.
- The **Disk/RCE** connectors connect to the disk (RDE, RRDE) and cylinder (RCE) of the electrode.
- The **Ring** connectors connect to the ring electrode if an RRDE is used.

Figure 5-1
Cell cable connections for RDE/RCE (left) and RRDE experiments (right)



Cell lead connections for an RDE/RCE setup:

- Connect the green Working Electrode (WE) lead and the blue Working Sense (WS) lead of the potentiostat's cell cable to the **Disk/RCE** connectors.
- Connect the red Counter Electrode (CE) lead towards the counter electrode of your measurement setup.
- Connect the white Reference Electrode (RE) lead towards the reference electrode of your measurement setup.

Cell lead connections for an RRDE setup:

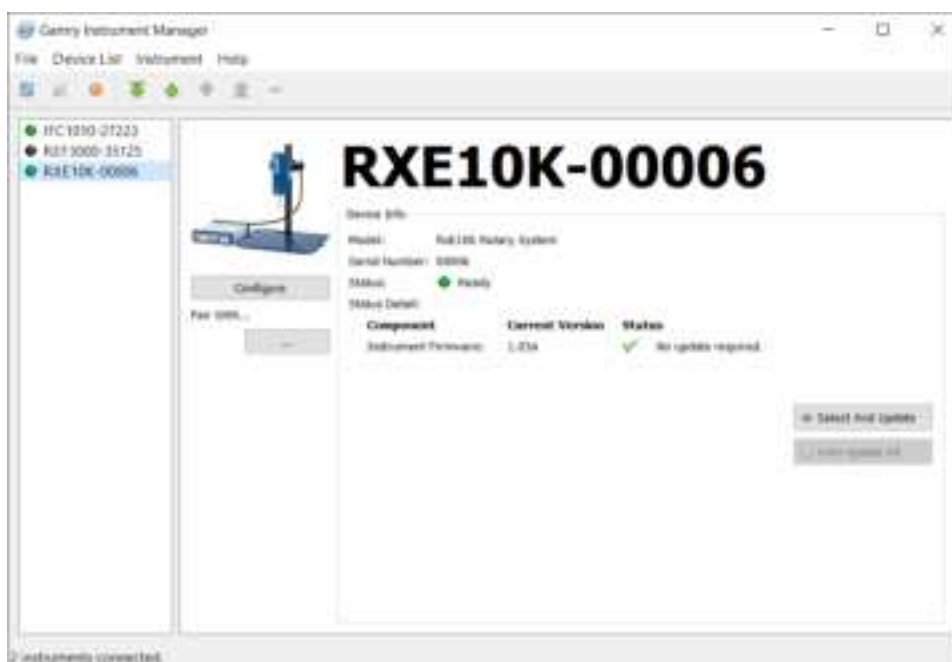
- Connect the green Working Electrode (WE) lead and the blue Working Sense (WS) lead of the **Master** potentiostat's cell cable to the **Disk/RCE** connectors.
- Connect the green Working Electrode (WE) lead and the blue Working Sense (WS) lead of the **Serf** potentiostat's cell cable to the **Ring** connectors.
- Connect the red Counter Electrode (CE) leads of both potentiostat towards the counter electrode of your measurement setup.
- Connect the white Reference Electrode (RE) leads of your potentiostats towards the reference electrode(s) of your measurement setup.

Gamry Instrument Manager

The Gamry Instrument Manager is useful in organizing the instruments in the system. You can access the Instrument Manager in Framework's **Options** menu

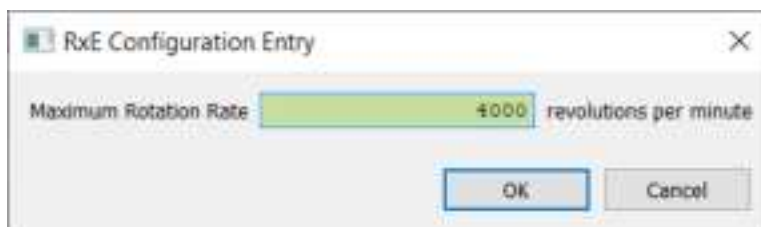
1. Ensure that your RxE 10k Rotating Electrode and potentiostat are installed.
2. Power on your Motor Controller and potentiostat and ensure that both are connected to the computer via their USB ports.
3. Start the Gamry Instrument Manager from either the Start menu or from within the Framework™ software by selecting **Option/Instrument Manager...** on the Framework Menu. From the Start menu navigate to the Gamry program group and then select the Gamry Instrument Manager from the list.

Figure 5-2
Framework's Instrument Manager



4. The left pane of the Instrument Manager shows a complete list of potentiostats and rotators that are and were previously installed. The status indicator next to the instrument's name should turn green after a device fully powered up.
5. Click on the active RxE 10k Rotating Electrode system. Detailed information about the rotator system such as model name, serial number, and status are shown in the right window. Check if any software updates are required, see also chapter *Firmware Update* for more information.
6. Press the **Configure** button to open the **RxE Configuration Entry** dialog box as shown in Figure 5-3. Set the maximum permitted rotation speed for your RxE 10k Rotating Electrode system in revolutions per minute (rpm). The maximum value is 10500 rpm. Confirm with **OK**.

Figure 5-3
RxE Configuration Entry setup window



7. The **Pair With...** function allows pairing your RxE 10k Rotating Electrode system with a specific potentiostat or check the pairing status. Press the "... " button to open the select window as shown in Figure 5-4.

Figure 5-4
Dialog window for pairing a potentiostat with your RxE 10k Rotating Electrode



8. Select the potentiostat for pairing and confirm with **OK**.
9. The selected potentiostat is then listed as paired device in the Gamry Instrument Manager

Figure 5-5
Framework's Instrument Manager with paired instrument



When performing RRDE experiments requiring a bi-pstat setup, only the **controller** potentiostat needs to be paired with the RxE 10k Rotating Electrode.

Make sure that you already set up your bi-pstat system before pairing with your RxE 10k system.

Control Mode

The RxE 10k Rotating Electrode system allows two different modes of controlling the rotation speed of the electrode. The Motor Controller has a slide switch on the rear side to either set the mode to digital control (▼ **Digital**) or analog control (▲ **Analog**). Always begin each session with the Motor Controller's power turned **OFF** before selecting the control mode. After selecting the control mode, the system can be powered up.

Figure 5-6
Analog and Digital control switch of the Motor Controller



Digital Control allows to control the motor via Gamry's Framework software. Prerequisite is to connect the Motor Controller via USB cable to a PC. Analog Control requires an external voltage signal applied through the **User I/O** connector on the Motor Controller's rear panel.



Do not change the rotation speed control mode while the Motor Controller is turned on. It can render the Motor Controller or potentiostat inoperable and measured data can get lost. The unit may have to be returned to Gamry for reprogramming. Contact Gamry before starting any return process.

Table 5-1 summarizes all available functions for both control modes.

Table 5-1 – Function overview for Digital and Analog Control Modes

Function	Digital Ctrl	Analog Ctrl
Framework control	✓	✗
Manual control	✓	✗
Connection	USB	User I/O

Digital Control

When enabled, digital control allows the user to control the motor's rotation speed via Gamry's Framework software. In addition, manual control at the front of the Motor Controller is enabled using the **Manual** knob. This feature is enabled by default but can be disabled in Framework if required.

The Motor Controller reads the output of the encoder mounted on the top end of the motor shaft during digital control. The encoder is built of a clear disk with opaque line markings attached to the rotating shaft. A light-emitting diode is focused through the disk towards a receiver. When the light reaches the receiver through the transparent sections, the receiver creates an analog signal. The analog signal is then converted into a digital signal and transmitted to the data processor within the Motor Controller. The encoder has a resolution of 2000 CPR (counts per revolution).

The data processor within the Motor Controller translates the output signal into rotation speed and compares it to the user-specified rate. Any deviations are corrected by adjusting the PI-controller parameters (proportional–integral controller) of the data processor stored in a lookup table for any given speed. The Motor Controllers then sends the adjusted signal to the motor to rotate the shaft at the user-specified rotation speed.

Analog Control

Analog Control allows the user to control the motor's rotation speed using an external voltage signal. The external signal is fed in via the **User I/O** connector on the rear panel of the Motor Controller. The applied voltage signal is proportional to the rotation rate of the motor. The Motor Controller allows an input voltage span from 0 to +4.096 V. With a maximum resolution of 13 bit, the proportionality factor is about 0.41 mV/rpm.

A detailed description of the User I/O pin layout can be found in Appendix C: User I/O Connector. Gamry Instruments offers an optional **Multipurpose User I/O cable** which can be connected to the User I/O connector.



Floating operation of the Motor Controller can be compromised by improper connections to the **User I/O** connector. We do not recommend the use of standard 15-pin shielded cables with this connector. Custom cables with the shield connected to pin 6 of the D-sub connector are preferred.

Gamry Instruments provides with P/N 985-00171 a suitable Multipurpose User I/O cable.

With analog control enabled, some functions such as speed control via Gamry's Framework software as well as manual control using the Manual knob on the Motor Controller's front panel are disabled.

Motor Stop

In order to avoid any residual rotation and non-uniform shaft movement, the motor is turned off when the rotation speed is below 50 rpm. This does not interrupt any running experiment in Framework and measured data is not lost.

The motor can be immediately stopped when pressing the **Emergency Shutdown** button on the Motor Controller's front panel. System control is disabled for 5 seconds after pressing the button. Any running rotator experiment in Framework is aborted. Re-power the rotator to enable system control.

Figure 5-7
Emergency Shutdown button of the Motor Controller



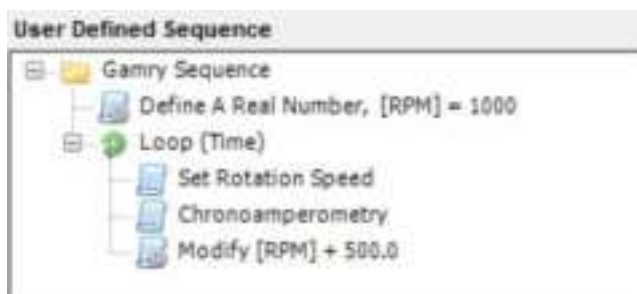
The motor can also be turned off when powering down the Motor Controller. Any running rotator experiment in Framework is aborted. However, this procedure takes longer than pressing the Emergency Shutdown button.

Running Experiments in Framework

- 1) Launch the Gamry Framework software and open the Gamry Sequence Wizard under **Experiment > Sequence Wizard**.
- 2) Create a custom experiment sequence. Select from a list of individual experiments and utilities and simply drag-and-drop them to your user-defined sequence

Figure 5-8

Example script for a rotating electrode script created in Gamry Framework's Sequence Wizard software.



Chapter 6: Motor Controller Indicators and Functions

Front Panel

Figure 6-1
Motor Controller front panel



Power Switch and Power LED

The **Power** button is on the far-right side of the Front Panel. It is a push-push switch: push once to turn the Motor Controller on and push again to turn the Motor Controller off. The switch's button latches: the button is closer to the front panel when the instrument is on than when it is off.

Generally, the **Power** LED illuminates when the Motor Controller is powered on; see the **Power** LED description below.

Normally, the DC power is connected before the **Power** button is turned ON. However, no damage occurs if this switch is already in the ON position when the cable is connected to **Power In**, or when the AC power input is connected to the external power supply.



Avoid touching the **Power** switch button during normal instrument operation. Data are lost if the instrument is accidentally powered off during an experiment.

USB LED

The **USB** LED is located just below the **Power** LED. It is a tri-color LED, able to glow green, orange, or red. The **USB** LED provides a simple test of Motor Controller USB operation. It has four normal states. The **USB** LED is unlit when:

- The Motor Controller is not powered.
- The Motor Controller does not have a USB cable plugged into its rear-panel **USB** port.
- The computer end of the USB cable is not plugged into a USB port on a computer or hub.
- The USB cable does not supply USB power to the Motor Controller.
- The computer has disabled the USB port going to the Motor Controller.

LED status	Description
Unlit	The USB cable is disconnected, or the USB connection is disabled by the host computer.
Continuous green	A valid cable connection has been made and the Motor Controller USB processor is receiving power from the USB cable.
Flashing orange	Valid USB messages are being transferred between the computer and the Motor Controller.
Continuous red	A software download or firmware update is in progress, or a USB communications error exists.

The flashing state only occurs when Gamry Instruments application software is running.

Interrupting a firmware update can cause a catastrophic failure of your system.



Do **not** interrupt a firmware update while it is in progress. An incomplete update can render the Motor Controller inoperable until it is returned to Gamry for reprogramming.

Do **not** turn off the Motor Controller, do **not** unplug the USB cable, and do **not** stop the operation of the host computer when the USB LED is a continuous red color.

LC-display

The LC-display is located at the center of the Motor Controller's front panel. It displays a maximum of 2×16 characters on a blue display with a white LED backlight.

The display shows the instruments' serial number and the current motor speed during operation, see Figure 6-2.

Figure 6-2
LC-display of the Motor Controller



Manual Control

The **Manual** knob is located to the right of the LC-display. It is a rotary encoder switch which allows manual control of the rotation speed. This function is only enabled for digital control. The rotation speed is displayed on the LC-display. The RxE 10k Rotating Electrode allows rotation speeds from 0 to 10500 rpm.

Rotate the **Manual** knob clockwise to increase rotation speed and counterclockwise to reduce the rotation speed.

After you select the rotation speed, press the knob to confirm the selected value.

The **Manual** knob allows speed-dependent step size adaptation. This means that if the knob is turned faster, speed values can be set in larger increments. If the knob is turned slowly, speed setting can be controlled more precisely by ± 1 rpm.

Emergency Shutdown and LED

The **Emergency Shutdown** is located on the left side of the Motor Controller front panel. It is a large, red push button that interrupts power and turns off the motor when pressed. The **Emergency Shutdown** LED illuminates red during the emergency shutdown period.

The LC-display shows a warning message when the button is pressed, see Figure 6-3. System control can be re-enabled by pressing the **Power** switch.

Figure 6-3
LC-display when Emergency Shutdown button is pressed



Motor LED

The **Motor** LED illuminates when the motor is running.

Remote LED

The **Remote** LED illuminates during digital control only. If illuminated, manual control is disabled by the user in Gamry's Framework software.

Rear panel

Figure 6-4
Motor Controller rear panel



USB port

The **USB** port is a Type B connector. Use a standard, shielded, Type A/B cable to connect this port to a computer's USB port or a USB hub (preferably an externally powered hub). The Rx/E 10k Rotating Electrode system is shipped with a suitable USB cable. The replacement cable is Gamry P/N 985-00131.

The two ends of a Type A/B cable are different. The more-rectangular end plugs into the computer and the more-square end plugs into the Motor Controller.

The Motor Controller is a High-Speed USB 2.0 peripheral, capable of data-transfer at 480 Mbits/s. If it is plugged into a computer port incapable of High-Speed operation it will downgrade to USB 1.1 full-speed operation (12 Mbits/s), causing slower data-transfer. The Motor Controller USB port is compatible with Revision 1.1 and 2.0 of the USB specification. It supports the Windows Plug-n-Play mechanism, including dynamic connect/reconnect.

The front panel **USB** LED should be green whenever a valid computer to Motor Controller connection is made, and both the computer and Motor Controller are fully powered.

User I/O

The **User I/O** connector contains digital signals used to connect external devices to Motor Controller. All of its signals are referenced to earth ground, so their connection does not compromise the Motor Controller ground isolation.

A full description of this connector is in Appendix C: User I/O Connector of this manual. This appendix includes details such as connector pin-out, output and input voltage levels, and full signal descriptions.

The following list is a brief description of the signals in the **User I/O** connector and their uses:

- Four digital outputs can be used to turn on external devices under control of an Explain experimental control script.
- Some of Gamry Instruments applications assign three of the digital outputs to control stirring, flow of de-aeration gas, and formation of mercury drops on a mercury-drop electrode.
- Four digital inputs that can be read in an Explain experimental control script.
- An analog output voltage. The output is generated by a 12-bit digital-to-analog converter with an output span from 0 to 4.096 V.
- This connector includes a 5 V power supply that can provide up to 50 mA of current for external circuitry.



Floating operation of the Motor Controller can be compromised by improper connections to the **User I/O** connector. We do not recommend use of standard 15-pin shielded cables with this connector. Custom cables with the shield connected to pin 6 of the D-sub connector are preferred.

Gamry Instruments provides with P/N 985-00171 a suitable Multipurpose User I/O cable.

Analog / Digital Control

The **▲ Analog / ▼ Digital** switch toggles between analog (upward) and digital control (downward). This switch determines how the motor speed is controlled.

Analog control requires an external voltage signal connected to the **User I/O** connector of the Motor Controller. The rotation speed can be set depending on the input voltage signal. The rotation direction is limited to clockwise only. Manual control by using the **Manual** knob is disabled.

Digital control allows the user to set the rotation speed via Gamry's Framework software. The Motor Controller requires USB connection to a PC that runs Gamry's Framework software. Manual control is enabled during digital control.

Motor Control

The **Motor Control** connector is a 26-pin HD D-sub connector (female) used to connect the Motor Controller to the RxE 10k rotator. Both connectors are located on the rear panel.

In order to interconnect the Motor Controller and the RxE 10k rotator, a Motor Control Cable supplied with the system is used. The cable has the Gamry part number 985-00194.

The Motor Control Cable pin layout is discussed in Appendix B: Motor Control Connector.

Power In

The **Power In** connector is a 4-pin power DIN connector. The Motor Controller derives all its power from +48 V DC input through the Power In jack. The input current is less than 1.8 A.

Always use the external power supply supplied with your Motor Controller to supply DC power to the system.

Motor Controller Indicators and Functions

The external power supply is rated for operation from 100 to 240 V AC, at frequencies from 47 to 63 Hz. It should therefore be useable worldwide.



Power input voltages less than 40 V or greater than 52 V can damage the Motor Controller's power supply.

Chapter 7: Carbon Brush Replacement



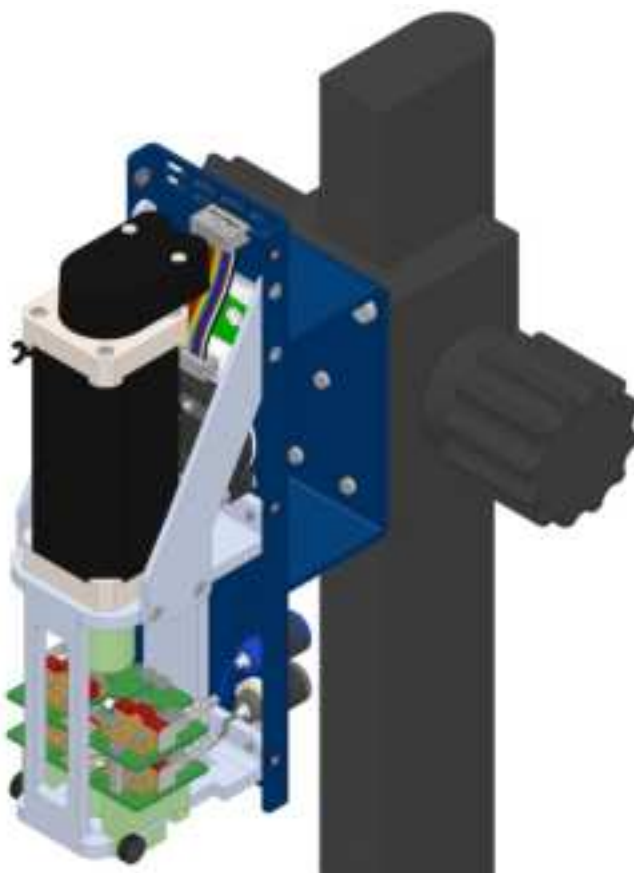
Always make sure that the rotator is turned **OFF** before replacing any part on the rotator or removing the Safety Shield. Verify that the Motor Controller is turned **OFF**.

A rotating shaft is a safety hazard and complying with all necessary protection measures is crucial for your personal safety.

The RxE 10k Rotating Electrode uses in total four carbon brushes to guarantee uninterrupted and noise-reduced electric signals between the potentiostat's cell leads and the electrode shaft. For each electrode contact (disk/cylinder and ring), two carbon brushes are mounted on opposite sides of the shaft. Each pair is electrically connected as shown in Figure 7-1. This setup allows in case of any vibrations and possible loss of electrical contact at a single carbon brush to maintain uninterrupted electrical contact with the second one.

The upper pair connects to the disk of an RDE/RRDE or cylinder of an RCE. Two blue wires lead from each PCB to the ear panel where the potentiostat's cell cables can be connected. The lower pair connects to the ring of an RRDE. Here, two gray wires make a connection to the rear panel's 4 mm banana connectors. For more information about the correct cell cable connection, see page 40.

Figure 7-1
Setup of the carbon brushes used in the RxE 10k system



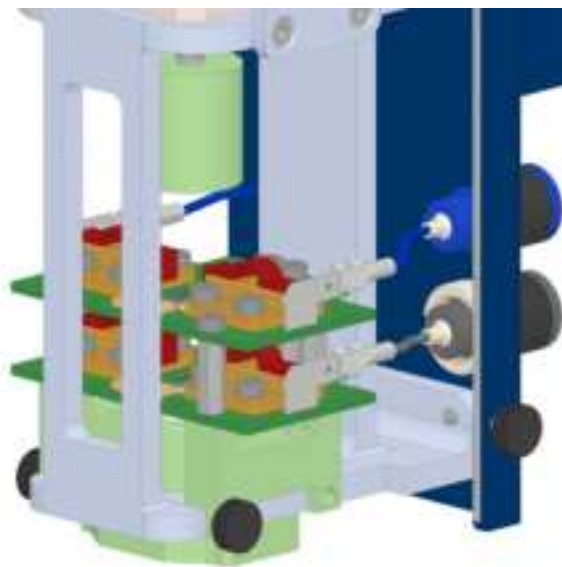
Generally, the carbon brushes should not require any replacement. Their lifetime is specified for several years. However, in certain cases the brushes might want to be replaced, i.e., after damaging them or long-term overstressing. For this, replacement parts are available as listed in Appendix D: Replacement parts and Accessories. Please follow the instructions below for replacing the carbon brushes on your RxE 10k Rotating Electrode:

Carbon Brush Replacement

- 1) Make sure the Motor Controller is turned **OFF** and that the motor shaft is not rotating.
- 2) Slightly unscrew the six thumb screws on the left and right side of the rotator enclosure using. You do not have to remove them completely. Carefully slide off the rotator enclosure.



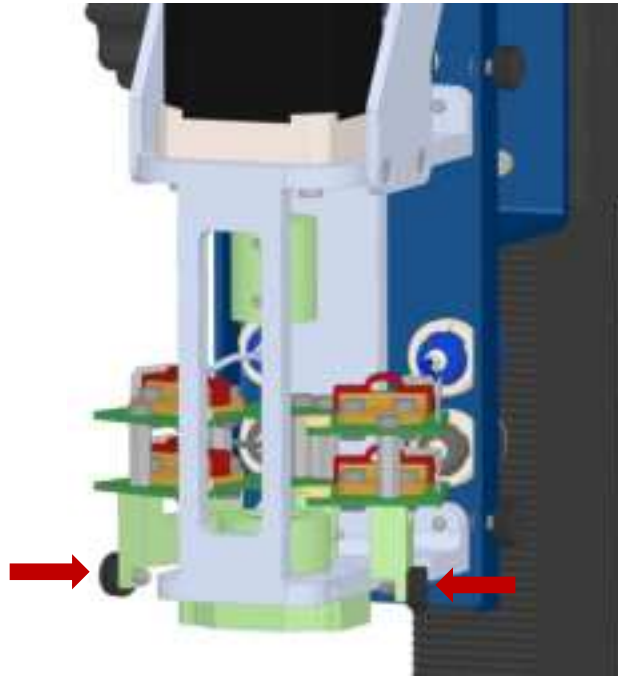
- 3) At the bottom are four carbon brushes with two on each side and pairs stacked on top of each other. The top brushes make electrical contact to the disk of RDEs and RRDEs as well as the cylinder electrode of RCEs. The bottom carbon brushes make electrical contact to the ring electrode when an RRDE is mounted.



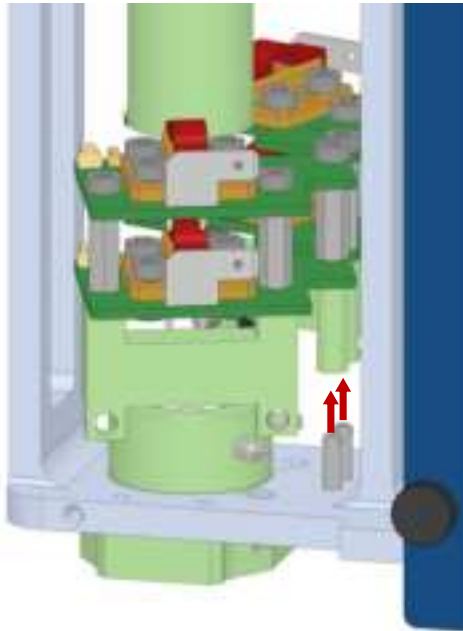
- 4) There are four wires which go from each PCB to the rotator's back side and the 4 mm banana receptacles. Carefully disconnect each wire from the PCB.

Carbon Brush Replacement

- 5) Once the wires are disconnected, unscrew the thumb screws on both sides that hold the brush holders in place and rotate them outwards.



- 6) You can now lift them upwards and remove both brush holder assemblies from the rotator.



- 7) Carefully unpack the new brush holders. Each brush holder still has the red covers attached to protect the carbon brushes. Leave them on until an electrode shaft is mounted.
- 8) Slide each brush holder onto one of the rear pins. Make sure that the wire connections are on the rear side when mounting the PCBs.
- 9) Secure the brush holders again with the thumb screw on the front.
- 10) Connect all four wires to the PCBs again.



Verify that the wires are connected to the correct brushes, see page 53.

11) Put the rotator enclosure back on and secure with the six thumb screws.



Always check the functionality of the rotator after installing an electrode shaft or after replacing the carbon brushes. Carefully follow the instructions of chapter **Rotator Test** on page 36 to verify that the rotator operates correctly.

Chapter 8: Troubleshooting Guide

Problem	Cause	Solution
Shaft vibrates when rotating.	The shaft is misaligned after installation.	Readjust the set screws on the shaft adapter. Open both lower set screws that hold the shaft. Gradually tighten each set screw while alternating between them.
Motor does not rotate.	Disconnected cables.	Verify if the rotator is properly connected to the motor controller.
		Remove the rotator enclosure and verify that the ribbon cables connectors are plugged in to the encoder and the PCB on the back.
	Motor requires tuning.	Run the Auto-tune file <code>RXE10K Auto Setup.EXP</code> in Gamry Frameworks under Experiments > Named scripts. Follow the instructions.
	Shaft might be stuck.	Check if shaft or electrode are blocked, causing the shaft not to rotate.
Measurements are noisy.	Bubbles on the electrode surface.	Carefully tap your cell and electrode to remove all the bubbles.
	Bad connection between shaft and carbon brushes.	Clean the shaft surface with a damp cloth. Verify if each pair of brush holders is interconnected by pogo pins and that the carbon brushes make proper contact to the shaft.
		Check your cell setup and cable arrangement.



Please contact Gamry's technical support or local representative if you still experience problems or require additional assistance.

Appendix A: Specifications

All specifications are subject to change without notice.

AC-DC Desktop power supply

Description	Dimensions
DC Voltage	48 V (@ 2.1 A)
AC Voltage range	100 V – 240 V
Power	max. 100.8 W
Frequency range	47 – 63 Hz

Rotator unit

Description	Dimensions
Adjustable rotation rate	50 – 10500 rpm
Rate Accuracy	± 1 rpm for 50 – 10500 rpm
Rotation Direction	Clockwise
Residual Rotation	0 rpm
Rate Display	- LC-display (2×16 characters) with blue display and white LED backlight 4 ½ digit display indicates rotation rate (RPM)
Control Mode	- Analog: User I/O port with analog input voltage connections with an input voltage span from 0 to +4.096 V - Digital: USB connector (rear panel) allowing speed control via software input or manual input via rotary encoder knob (front panel)
Motor Stop	- Emergency shutoff on front panel - Rotation rate is set below 50 rpm
Motor Protection	- Current-limited power supply - Overheat protection by temperature monitoring (NTC-thermistor) - Fan speed control - Emergency shutoff

Motor and Encoder

Description	Dimensions
Motor + Encoder	Brushless DC (BLDC) with optical encoder
DC Voltage	48 V (rated)
Current	0.8 A (no load); 3.57 A (rated); 10.71 A (peak)
Power	147 W (rated)

Specifications

Torque	0.10 Nm (rated); 0.30 Nm (peak)
Rotation Speed ¹	14000 rpm (rated); 16500 rpm (peak @ no load)
Rate Control	Closed loop servo-system temperature compensated tachometer mounted on motor shaft
Encoder Speed	max. 10800 rpm
Encoder Signal Type	Incremental
Encoder Resolution	2000 CPR (counts per revolution)

Controls

Description	Dimensions
Front Panel	• Power switch • Rotary encoder knob for manual speed control • Emergency shutoff button
Rear Panel	• USB port (type B) for digital control • 15-HD D-sub connector (female) as User I/O port for analog control • Switch to toggle between analog and digital control • Binding post (4 mm banana jack) to connect chassis ground to earth ground • 26-HD D-sub connector (female) for motor control cable • 4-pin power DIN connector

Environmental

Description	Dimensions
Storage Temperature Relative Humidity	-25°C to +75°C max. 90 % non-condensing
Shipping Temperature Acceleration	-25°C to +75°C max. 30 G
Operation Temperature Relative humidity	0°C to +45°C (Motor Controller) max. 80°C (RxE 10k Rotating Electrode) max. 90 % non-condensing

¹ Motor only.

Dimensions and Weight

Description	Dimensions	Weight
Shipping	61 cm × 51 cm × 61 cm (24 in × 20 in × 24 in)	25 kg (60 lbs)
Motor Controller	29 cm × 26 cm × 15 cm (11.4 in × 10.1 in × 5.75 in)	-
RxE 10k Rotating Electrode	48 cm × 40 cm × 54 cm (18.8 in × 15.5 in × 21 in)	-
Control Cable	60 cm	-
Power Adapter ²	14.7 cm × 6.7 cm × 3.4 cm	max. 0.45 kg

² Excluding removable line cord.

Appendix B: Motor Control Connector

This Motor Control connector contains a number of signals used to connect the Motor Controller to the RxE 10k Rotating Electrode. It is a female 26 pin HD D-sub connector and located on the rear panel of the Motor Controller and on the rear side of the RxE 10k Rotating Electrode.



The pin-layout of this connector is shown below.

Table B-1 – Pin-layout for Control Cable

Pin	Name	Pin	Name
1	Motor W	14	NTC
2	Motor Ground ³	15	-
3	-	16	-
4	ID Ground	17	Encoder A- / A\
5	ID	18	Encoder A+ / A
6	-	19	Motor U
7	-	20	-
8	Encoder B- / B\	21	Fan Ground
9	Encoder B+ / B	22	Fan Power (5 V)
10	Motor V	23	Encoder Power (+5 V)
11	-	24	Encoder Ground
12	-	25	Encoder I- / I\
13	NTC Ground	26	Encoder I+ / I

³ Only connected to rotator end of the cable and not on the Motor Controller's end.

Appendix C: User I/O Connector

The **User I/O** connector contains a number of signals used to connect the Motor Controller to external apparatus. It is the miniature 15-pin female D-sub connector on the rear panel of the Motor Controller.



The ground pin (pin 6) on this connector is earth ground and the D-sub connector shell is the Motor Controller's Floating Ground. Improper User I/O connections can damage the device that is connected to a high-energy cell containing earth-grounded terminals.

The pin-layout of this connector is shown below.

Table C-1 – Pin-layout for User I/O connector

Pin	Name	Use
1	Analog Output High	The auxiliary output signal (DAC output). The output range is 0 to +4.096 V.
2	Analog Output Low	The auxiliary output ground connection (ground).
3	-	-
4	-	-
5	-	-
6	Ground	Digital ground
7	-	-
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	-	-
15	+5 V	Power, 50 mA maximum current

Appendix D: Replacement parts and Accessories

The following chapter provides a list of available accessories for the RxE 10k Rotating Electrode system. The list includes parts already provided in the system but can be purchased in case of replacement. Others are optional parts to complete your RxE 10k Rotating Electrode system such as electrode shaft and electrodes. Due to the large variety and customizability of these parts as well as user-defined experimental setup, these parts are not included in the RxE 10k Rotating Electrode system but must be purchased separately.

All parts listed are subject to change without notice. For a complete and updated list, please see the Gamry Instruments website at www.gamry.com. Please contact Gamry Instruments or your local representative for assistance and to discuss your options.

Table 8-1 – List of replacement parts for the RxE 10k Rotating Electrode

Part Number	Description
966-00003	Brush Holder sub-assembly (with carbon brushes)

Table 8-2 – List of optional RDEs and accessories for the RxE 10k Rotating Electrode

Part Number	Description
990-00538	RDE/RCE rotating shaft
990-00539	RRDE rotating shaft
976-00001	Glassy Carbon Disk RDE (3 mm OD), PEEK body (12.7 mm OD, 65 mm long)
976-00002	Platinum Disk RDE (3 mm OD), PEEK body (12.7 mm OD, 65 mm long)
976-00003	Gold Disk RDE (3 mm OD), PEEK body (12.7 mm OD, 65 mm long)
976-00004	Nickel 270 Disk RDE (3 mm OD), PEEK body (12.7 mm OD, 65 mm long)
976-00005	Silver Disk RDE (3 mm OD), PEEK body (12.7 mm OD, 65 mm long)
976-00006	Copper C11000 Disk RDE (3 mm OD), PEEK body (12.7 mm OD, 65 mm long)

Table 8-3 – List of optional RCEs and accessories for the RxE 10k Rotating Electrode

Part Number	Description
990-00538	RDE/RCE rotating shaft
977-00010	RCE body PEEK (12.7 mm OD, 70 mm length) w/O-ring and drilled spanner
977-00102 ⁴	1018CS RCE cylinder (12.7 mm OD, 7.6 mm length) – 10 per pkg.
977-00103 ⁴	316SS RCE cylinder (12.7 mm OD, 7.6 mm length) – 10 per pkg.
977-00104 ⁴	430SS RCE cylinder (12.7 mm OD, 7.6 mm length) – 10 per pkg.

Table 8-4 – List of optional RRDEs and accessories for the RxE 10k Rotating Electrode

Part Number	Description
990-00539	RRDE rotating shaft

⁴ The RCE cylinders have an oil coating to prevent rust during storage. It is recommended to rinse them with an organic solvent such as methanol, ethanol, or isopropyl alcohol before usage.

Replacement parts and Accessories

978-00001	GC disk/Pt ring RRDE (3 mm OD disk, 5 mm ID/7 mm OD ring), PEEK body (12.7 mm OD, 65 mm long)
978-00002	GC disk/GC ring RRDE (3 mm OD disk, 5 mm ID/7 mm OD ring), PEEK body (12.7 mm OD, 65 mm long)
978-00003	Pt disk/Pt ring RRDE (3 mm OD disk, 5 mm ID/7 mm OD ring), PEEK body (12.7 mm OD, 65 mm long)
978-00004	Au disk/Au ring RRDE (3 mm OD disk, 5 mm ID/7 mm OD ring), PEEK body (12.7 mm OD, 65 mm long)

Table 8-5 – List of optional labware for the RxE 10k Rotating Electrode

Part Number	Description
820-00196	Ring stand rod (14 mm OD, 400 mm length)
985-00171	Multipurpose User I/O Cable
992-00180	1L RCE Cell Kit, jacketed

Appendix E: Certifications



Declaration of Conformity: No. DOC-2021-CE-RxE10k

According to ISO/IEC 17025

Manufacturer's Name and Location:

Gamry Instruments
734 Louis Drive
Warminster, PA 18974
USA

This declaration is for the Gamry Instruments product model: RxE 10k

The declaration is based upon compliance with the following directives:

- EMC Directive 2014/30/EU

The declaration is based upon product compliance with the following standards as defined in report number R-3474P-1 from Retlif Testing Laboratories for EMC testing and analysis and report number R-3474P-2 from Retlif Testing Laboratories for safety analysis.

EMC Standards	Title	Class/ Criteria
EN 61326-1:2013, Clause 7.2	Conducted Emissions, Radiated Emissions	B
EN 61326-1:2013, Table 1	Basic Immunity Requirements, Electrostatic Discharge, Radiated Immunity, Electrical Fast Transient	

General Safety Standard	Title
EN 61010-1:2010/A1:2019	Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General requirements

Signature

December 15, 2021

Date

Dr. Gregory A. Martinchek, PhD
Title: President

Formal signed declaration is on file at Gamry, Inc.

Certificate of Conformance



CERTIFICATE OF CONFORMANCE
EUROPEAN COMMUNITY
COUNCIL DIRECTIVE 2014/30/EU

Date of Issue: October 2021

Issued By: Retlif Testing Laboratories
3131 Detwiler Road
Harleysville, PA 19438

Issued To: Gamry Instruments
734 Louis Drive
Warminster, PA 18974

Reference: Retlif Report Number R-3474P-1

Retlif Testing Laboratories hereby acknowledges that compliance testing in accordance with the below listed standards was performed on a representative sample of the equipment listed below. Retlif Testing Laboratories further acknowledges that the test sample listed below was found to be in compliance with these standards.

This certificate is hereby issued to the above-named grantee and is valid only for the equipment identified below.

Manufacturer: Gamry Instruments
Manufacturer Address
Warminster, PA 18974

Equipment Tested: Rotator

System Model Number: RXE10K

Brand Name: Gamry Instruments

Product Type: Measurement, Control Equipment and Laboratory Use

Note(s): 1) See attached report R-3474P-1 for details and/or conditions pertaining to this certificate.
2) Conforms to the emissions requirements of:
EN 61326-1:2013; Clause 7.2, Class B
3) Conforms to the immunity requirements of:
EN 61326-1:2013; Table 1



Declaration of Conformity: No. DOC-2021-UKCA-RxE10k

According to ISO/IEC 17025

Manufacturer's Name and Location:

Gamry Instruments
734 Louis Drive
Warminster, PA 18974
USA

This declaration is for the Gamry Instruments product model: RxE 10k
The declaration is based upon compliance with the following directives:

- EMC Directive 2014/30/EU

The declaration is based upon product compliance with the following standards as defined in report number R-3474P-1 from Retlif Testing Laboratories for EMC testing and analysis and report number R-3474P-2 from Retlif Testing Laboratories for safety analysis.

EMC Standards	Title	Class/ Criteria
EN 61326-1:2013, Clause 7.2	Conducted Emissions, Radiated Emissions	B
EN 61326-1:2013, Table 1	Basic Immunity Requirements, Electrostatic Discharge, Radiated Immunity, Electrical Fast Transient	

General Safety Standard	Title
EN 61010-1:2010/A1:2019	Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General requirements

Signature

December 15, 2021

Date

Dr. Gregory A. Martinchek, PhD
Title: President

Formal signed declaration is on file at Gamry, Inc.

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