

Model 616 Rotating Disk Electrode

Instruction Manual

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

WARRANTY

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

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SHOULD YOUR EQUIPMENT REQUIRE SERVICE

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

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

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

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

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

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

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1. INTRODUCTION

1.1. Overview

The Princeton Applied Research Model 616 Rotating Disk Electrode (RDE) and its accessories have been designed to provide reliable and convenient operation for a wide variety of electrochemical experiments.

1.2. Characteristics

The Model 616 features remote activation, front-panel and external speed control, and speed read-out, allowing for automatic operation when used with other Princeton Applied Research electrochemical instrumentation. Experiments such as voltammetry, stripping voltammetry, cyclic stripping voltammetry, and Levich Plots can be run automatically using the Model 616 RDE.

1.3. Electrodes

A large selection of electrode elements are available to permit both classical rotating disk experiments and rotating cylinder configurations. Electrode materials are available for most applications, and the Quick-Change electrode assemblies allow you to conveniently use other electrode materials. This feature is especially useful in corrosion measurement applications, where virtually any type of conductive solid may be tested.

2. INSTALLATION

2.1. Unpacking

After unpacking the instrument, check the contents against the packing list. The following items should be present:

- One assembled Model 616 with these components:
 - One Frame (with base, column, and hexscrew)
 - One Electronic Control Unit/Motor-Tach Assembly
 - One Cell Platform Assembly
 - Three Adjustable Stops
- One Instruction Manual
- One Inspection Sheet
- Electrodes (Optional—See Packing List)
- Cell Top (Optional—See Packing List)
- Polishing Kit (Optional—See Packing List).

2.2. Inspection

Inspect all components of the rotating disk assembly for any damage, especially if there has been damage to the packing case. Notify the carrier and Princeton Applied Research if there are any.

2.3. Assembly

You may wish to disassemble the Model 616 for storage or shipping and then reassemble it later. The following paragraphs describe the procedure for inserting the parts onto the frame.

- 1) Attach the column to the frame base with the hexscrew supplied with the unit.
- 2) Insert a stop about one inch from the collar at the bottom of the column and tighten the knob.
- 3) Insert the cell platform assembly on top of the stop and tighten the knob.
- 4) Insert a second stop high enough to prevent the electrode from contacting the cell and tighten the knob.
- 5) Insert the Control Unit/Motor-Tach Assembly on top of the second stop and tighten the knob. Make sure that there is room to install an electrode without contacting the cell.
- 6) Insert the third stop onto the column and tighten the knob.
- 7) When you're ready to begin operations, screw electrode onto the teflon-covered support at the bottom of the bearing assembly. When using disposable electrodes with the RDE001 Quick Change Electrode Holder, make sure the spring remains in the threaded recess.

This completes the assembly procedure.

2.4. Jumpering The Motor Stop Line

The MOTOR STOP line is factory-jumpered to allow a TTL high level to stop the motor. However, not every controller supplies a TTL high level. For example, the Princeton Applied Research Model 264 Polarographic Analyzer supplies a TTL low level. Thus, there must be a way to jumper the MOTOR STOP line to allow a TTL low to stop the motor. If your controller supplies a TTL low level, perform the following procedure to change the jumper setting.

WARNING This procedure should be performed only by a trained service person and then only with the instrument completely disconnected from the power source. Performing the procedure with power on could result in serious or lethal electrical shock.

- 1) Remove the instrument from the power source by removing the power cord from the wall socket and the instrument.
- 2) Remove the cover from the control unit by removing the four screws from the side panels and lifting the cover off.
- 3) Position the instrument so that you are facing the component side of the circuit board. Observe that there is a white wire attached at the point labeled "1" near the left edge of the board. The other end of the wire is attached to a pin slightly above and to the left of the component labeled "Q3".
- 4) To change the jumper to allow a TTL low level to stop the motor, carefully remove the wire from the pin (so as not to loosen the pin from the board) and attach it to the pin below and to the right of the component labeled "Q4". The jumper can only slide onto the pin about a quarter inch, so don't try to force it all the way in.
- 5) You're now jumpered to allow a TTL low to stop the motor. Replace the cover, reconnect the instrument to power, and test by applying a TTL low to the MOTOR STOP jack while the motor is running. This completes the procedure.

3. OPERATION

3.1. Overview

The Model 616 RDE is a solid-state-controlled servo-system capable of rotating an electrode at speeds from 100 RPM to 8,000 RPM. You can set the speed manually using the push button controls on the front panel. The speed is calibrated to within 3% for the entire range.

3.2. Applying External Waveforms

An important feature of the Model 616 is its ability to accelerate and decelerate very rapidly, allowing you to apply rotational speed waveforms. The inputs from front-panel controls and the input jack are added electronically in the control box to produce the electrode rotational speed. This feature permits the operator to modulate the electrode speed around a set speed.

Applying an external signal to the rotator increases the electrode speed 4,000 RPM for each volt applied. A positive voltage produces counter-clockwise rotation (observing from the electrode end of the rotator); a negative voltage slows down the clockwise rotation, although the electrode will never rotate clockwise. Thus the actual speed at any moment will be the sum of the front-panel setting and the externally applied signal, with 0 rpm the minimum.

4. ELECTRONIC CONTROL UNIT

4.1. Overview

The control unit contains the drive circuitry, power supply, and control circuitry. This section describes the front and rear panels of the control unit.

4.2. Front Panel

POWER SWITCH	Labeled for on-off; power is on when the bright red coating is visible.
RPM	Push button switches set potentiometer speed (set rotational speed when no external input is present; when there is an external input, the rotational speed is the sum of the switch settings and the input, with zero the minimum).

4.3. Rear Panel

OUTPUT JACK	The voltage at this jack indicates the rotator speed; 1 volt per 1000 RPM. The output impedance is about 600 ohms.
COMMON JACK	This jack is connected to the DC common and used as a common ground for measuring the rotator speed output and for applying an external input (see INPUT JACK).
INPUT JACK	An external voltage applied to this jack causes the rotator to turn at a rate of 4,000 RPM per volt applied. The voltage is summed with the front-panel potentiometer setting—for example, if you set the speed to 1,000 RPM on the front panel and then apply +1 VDC to the input jack, the rotational speed at the electrode will be 5,000 RPM. The input impedance is 50K ohms.
MOTOR STOP	A TTL level of user-selected polarity (factory-set for positive, can be jumpered for negative) applied to this jack will stop the rotator motor.
GROUND JACK	Provides a ground connection to a controller when excessive noise is present.
AC POWER JACK	With supplied power cord, connects to 3-prong 115V 50/60Hz AC outlet with effective earth ground (factory-wired 230V model available).

5. MECHANICAL COMPONENTS

5.1. Overview

The Model 616 consists of a base, a frame, and a motor-tachometer assembly. The motor and spindle bearings are housed with the motor-tach assembly and can only be replaced at the factory. This chapter describes the major assemblies.

5.2. Major Assemblies

The following paragraphs describe the major assemblies of the Model 616 RDE.

MOTOR-TACH	The DC motor and DC tachometer is an integral unit.
FRAME	The frame supports the motor-tach, the bearings, and the cell holder. The cell holder and motor-tach section can be adjusted up and down on the column.
BASE	The base supports the frame and is made of chemical-resistant material.
PICK-UP BRUSH	The brush contacts the electrode spindle for electrical pickup.

6. TROUBLESHOOTING

6.1. Overview

The Model 616 RDE isn't designed to be repaired by the user. However, in this chapter we provide some troubleshooting hints that may help you fix a problem or provide more information when you contact the factory.

6.2. Major Assemblies

The following list offers some troubleshooting suggestions in case the Model 616 isn't working correctly.

PROBLEM	CAUSE/ACTION
Motor fails to rotate	Make sure the motor shaft and spindle rotate freely when you try to turn it by hand at the teflon-covered part of the electrode. If it doesn't turn freely, contact the factory. Make sure the unit is connected to a live outlet of the proper voltage and that the power switch is on. Make sure the front-panel speed setting is not "0". Faulty connection or wire—contact factory. Faulty circuitry or motor—contact factory.
Motor runs at high speed at any dial setting	Faulty connection or wire—contact factory. Faulty circuitry—contact factory.
Excessive audible noise	Spindle bearings are worn—contact factory. Motor bearings are worn—contact factory.
Excessive electrical noise in system	Connect the DC Common to the Ground Jack; use only one point in the system as the common; eliminate ground loops. CAUTION: Take great care when making the connections to ground. Make this connection only on a "floating" system. Contact the factory for more information. Use shielded cables as connections to the brushes. Clean the surface where the brush contacts the rotating ring.

APPENDIX A. SPECIFICATIONS

POWER	115 VAC or 230 VAC, 50/60 Hz, factory connected.
WEIGHT	14 lbs.
OPERATING TEMP.	10 Deg. C to 40 Deg. C
DIMENSIONS	Control Unit: 11 3/8" W x 10 1/8" D x 5 3.4" H Base: 11" x 15" x 3/4"
MOTOR	Permanent magnet DC, ironless rotor
MOTOR POWER SUPPLY	+24 V DC Nominal
SPEED CONTROL	Closed loop servo-system; temperature compensated tach generator mounted on motor shaft (provides rotational speed information)
SPEED RANGE	100 RPM to 8,000 RPM
PRECISION	Better than $\pm 1\%$
ACCURACY	Better than $\pm 3\%$ of dial setting
CONTROLS	On-Off switch. Push button potentiostat to control speed.
MOTOR STOP	Motor stopped by TTL level of user-selected polarity (factory jumpered for positive—see INSTALLATION to change)

APPENDIX B. ACCESSORIES

PERMANENT DISK ELECTRODES (4.0mm diameter permanently sealed in Teflon):

ELECTRODE TYPE	ORDER NUMBER
Platinum	RDE004
Gold	RDE005
Palladium	RDE006
Silver	RDE007
Glassy Carbon	RDE008
Pyrolytic Graphite	RDE009

QUICK CHANGE ELECTRODES (Disk Electrodes 0.444 in. diameter, 1 cm² surface area; the material adjacent to electrode surface is Teflon; the electrode body is Kel-F.

ITEM	ORDER NUMBER
Disk Electrode Assembly (including 430 SS disk)	RDE001
Disk Installation Tool	RDE002

CYLINDER ELECTRODES (0.472 in. diameter, 0.349 square in. (3.00 cm²) surface area)

ITEM	ORDER NUMBER
Cylinder Electrode Assembly (including a 430 SS cylinder)	RDE011
Cylinder electrode assembly only	RDE012

CELL TOP (for the Princeton Applied Research K-0060, K0062 and K0064—all bottoms): Order Number RDE010

POLISHING KIT (for polishing of all electrodes): Oder Number K0015

