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C3

April, 2001

Part MF-9085 INSTRUCTION MANUAL

C3 Cell Stand

Bioanalytical
Systems, Inc.

2701 Kent Avenue
West Lafayette
Indiana 47906

www.bioanalytical.com

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Table of Contents

Section 1. Introduction 1
- Features 1
- Specifications 1

Section 2. General Information 2
- Technical Changes 2
- Shipping Damage 2
- Limited Warranty 2
- Service 3

Section 3. Installation 4
- Inspection of Shipment 4
- Parts of C3 Cell Stand 4
- Location of C3 Cell Stand 4
- Power Requirements 5
- Back Panel Controls and Connections 6
- Connections 7

Section 4. Operation 12
- Polarity of Remote Stir Control 12
- Front Panel Controls and Connections 12
- Remote Control 14
- Gas Purge 14
- Stir 14
- Faraday Cage 14
- Removal of Cell Lead Box 14

Section 5. Maintenance 15
- General Maintenance 15
- Troubleshooting 15
- Service Procedure 15

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Section 1. Introduction

Finite current electrochemistry is commonly used for analytical purposes. The BAS C3 Cell Stand is specifically designed to conveniently use the variety of solid electrodes and cell accessories available from BAS.

The C3 Cell Stand interfaces directly with epsilon, BAS 100 series Electrochemical Analyzers, the CV-50W and other BAS Voltammographs. The cell can be enclosed in a Faraday Cage to minimize electrical interference. A built-in gas control allows purging or blanketing of the sample prior to or during analysis. The magnetic stirrer allows for controlled agitation of the sample for experiments requiring convective mass transport of analyte to the electrode surface. The cell arm with detachable cell top allows easy access to the electrodes for rinsing, cleaning, or replacement. The stir motor/cell vial base pivots for easy removal and replacement of the cell vial.

The C3 Cell Stand is part of an Electrochemical Accessories Package. The package also includes voltammetry cells, reference electrodes (silver/silver chloride), working electrodes (glassy carbon and platinum), an electrode polishing kit, and connecting tubing.

Features

- Complete package
- “Quick-connect” input gas line connector
- Manual or remote control of gas purge/blanket
- Manual or remote on-off control of magnetic stirrer
- Manual 16-position adjustment of magnetic stirrer rate
- Small volume glass cell vials
- Mounted cell top compatible with all BAS solid working electrodes and reference electrodes
- Cell lead connects directly to all BAS electrochemical controllers (Voltammographs or Electrochemical Analyzers)
- Standard addition port
- Open architecture for easy access to cell
- Faraday Cage available for low current measurements

Specifications

Power: 100-240 VAC, 50/60 Hz, V-A 10 Watts
Main Fuse: 2.0 A Slow Blow
Inlet Gas Pressure: 5 psi maximum
Size: 7.25" (18 cm) wide x 9.25" (23 cm) deep x 11.5" (29 cm) high
Weight: 10.5 lbs (5 kg)

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Section 2. General Information

User Updates

To receive product update news and valuable information related to this and other BAS products, fill out and return the BAS Warranty Enrollment Card shipped with your C3 Cell Stand. We would like to know who you are and how we can meet your electrochemical analysis needs.

Technical Changes

BAS may make technical changes to improve the instrument. Improvements affecting use or maintenance will be described in supplementary pages to this manual.

Shipping Damage

Damage to any part of the C3 Cell Stand during shipping should be reported immediately to the freight handler and BAS Customer Service. Unless other arrangements have been made, the freight handler (shipper) is responsible for all damage or breakage to the instrument and parts. Retain the original packing box and contents for inspection by the freight handler. BAS will replace any new instrument damaged in shipping with an identical product as quickly as possible after the claim filing date. Claims not filed within seven (7) days after receipt of shipment may be invalid.

Do not return damaged goods to BAS without first contacting Customer Service for a Return Authorization Number (RA#). When a defective part is returned to BAS, the RA# immediately identifies you as the sender and describes the item being returned. BAS refuses all unauthorized return shipments.

Limited Warranty

BAS warrants equipment manufactured by the company to be free from defects in material and workmanship for a period of one year from the date of shipment, except as provided hereinafter. This warranty assumes normal usage under commonly accepted operating parameters. BAS agrees to either repair or replace, at its sole option and free of part charges to the buyer, any parts of instrumentation which, under proper and normal conditions of use, prove to be defective within one year from the date of shipment. Electrochemical cells and working electrodes are warranted for 60 days. Expendable items including but not limited to carbon paste, reference electrodes, source lights, panel lights, fuses, etc., are excluded from the warranty. This warranty and remedy are given expressly and in lieu of all other warranties, expressed or implied, including but not limited to warranties of merchantability and fitness for particular purpose, and constitute the only warranty made by BAS.

BAS neither assumes nor authorizes any person to assume for it any other liability in connection with the sale, installation, service, or use of its instruments.

All products manufactured by BAS are tested and inspected prior to shipment. Upon prompt notification by the Buyer, BAS will correct any defects in warranted equipment of its manufacture either (at our option) by return of the item to our factory or shipment of a

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repaired or replacement part. BAS is not obliged, however, to replace or repair any piece of equipment which has been abused, improperly installed, altered, damaged, or repaired by others. Defects in equipment do not include decomposition, wear, or damage by chemical action or corrosion. Shipping charges under warranty are covered only in one direction. The Buyer is responsible for the cost of shipping to the factory if return of the part is required.

BAS shall have no liability whatsoever for special, consequential, or punitive damages of any kind arising from the sale, installation, use, or servicing of its instruments.

This instrument is manufactured for research purposes only. Use in medical diagnosis is not intended, implied, or recommended by the manufacturer. Use for this purpose and accountability for the same rest entirely with the user.

Service

BAS provides a skilled service staff to solve your equipment-oriented problems. For further details, call Customer Service at (765) 463-4527 or e-mail echem@bioanalytical.com. Following discussion of your specific difficulties, an appropriate course of action will be described and the problem resolved accordingly. Do not return any products for service until you have a return authorization number (RA#). Turn-around time on service can be estimated at the time your RA# is issued, but actual service required cannot be determined until we have received your unit and verified the problem. All correspondence and shipments should be sent to:

RA#_____, Service Department
BAS
2701 Kent Avenue
West Lafayette, IN 47906

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Section 3. Installation

Inspection of Shipment

After carefully unpacking the instrument, check the contents of the packages and inspect for damage. Parts of the C3 Cell Stand are listed below. (This list is subject to change.) Please refer to the packing slip with your instrument to verify the parts. Retain the shipping box and packing material until you have fully tested the unit to be certain that no damage was incurred during shipment.

If you discover a shortage in parts, call BAS Customer Service and describe the shortage. Replacement part(s) will be sent immediately, subject to stock availability.

Parts of C3 Cell Stand

C3 Cell Stand with Faraday Cage

Stir bar

Glassy carbon voltammetry electrode

Platinum voltammetry electrode

Voltammetry cell vials

Polishing kit

Ag/AgCl reference electrodes (3)

Platinum wire auxiliary electrode

Port plug

Gas connection tubing

Cables

Instruction manual

Location of C3 Cell Stand

1. Provide a surge-free power source. Other laboratory equipment such as ovens, vortex mixers, centrifuges, and large motors may cause spikes in the power supply.

2. Ensure that all components of the system share the same ground circuit. This can best be accomplished by plugging all components into a multi-outlet power strip. Plugging the components into independent outlets can produce ground loops (current that flows between ground circuits at slightly different potentials), which can produce baseline noise.

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3. Locate the C3 Cell Stand on a stable bench. Vibrations can cause noise.

4. Select a room where temperature remains stable throughout the day. Avoid installing the C3 near windows, air ducts, ovens, and refrigerators. Diffusion coefficients can change by 3%/°C. A water-jacketed cell may be required for very precise work.

5. Place the C3 away from busy, congested areas. Remote, isolated areas are best for high-sensitivity work.

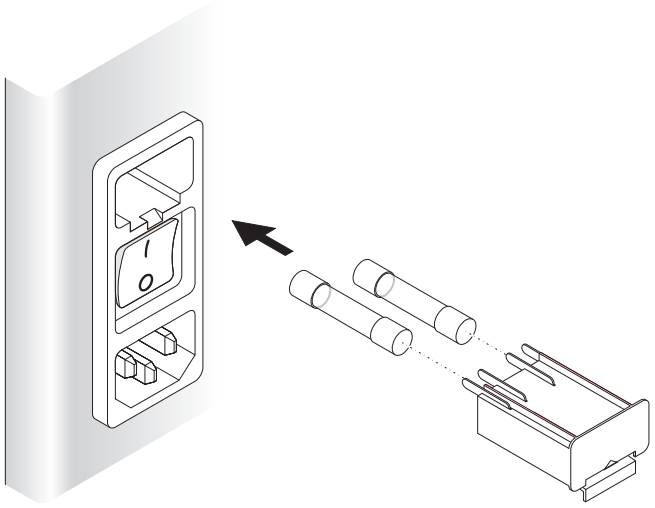
6. Avoid very dry areas and areas that are carpeted. Static electricity can affect instrument performance. Anti-static floormats and benchmats are useful if spiking caused by static charge is a problem.

7. Avoid areas where radio-frequency interference is likely. Beeper-type paging devices can be a problem in some installations.

Power Requirements

The C3 Cell Stand contains a fused, self-sensing power supply which can be powered by 100-240 V (50-60 Hz). It uses two 2 Amp fuses. Power requirements are shown on the back panel of the C3 (see Figure 2).

Figure 1. Fuse Placement

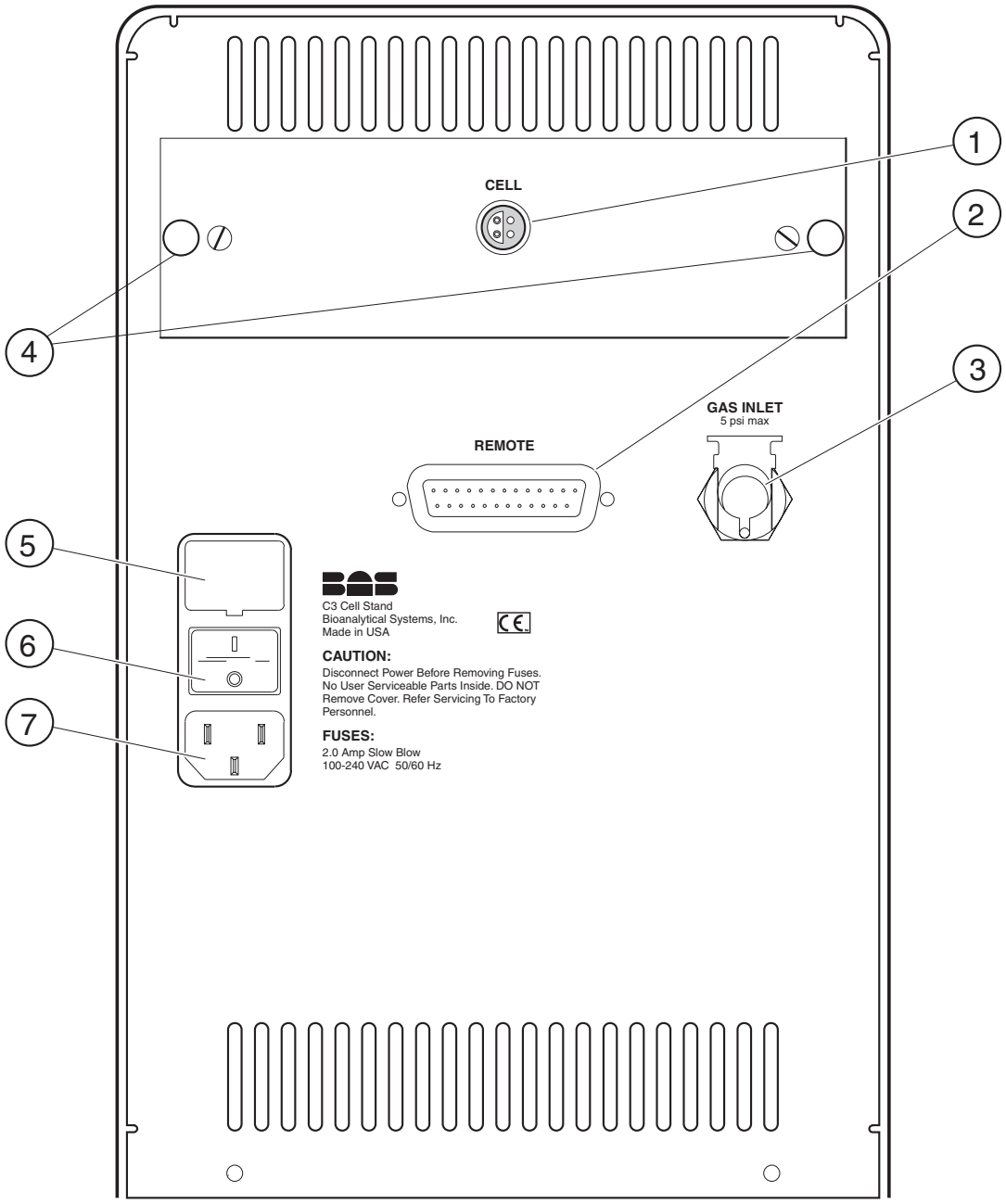


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Back Panel Controls and Connections

1. Cell Lead Connector.
2. Remote Connector. 25-pin D connector for remote control of C3
3. Gas Inlet Connector for Cell Purging. Bulkhead fitting providing connection to external gas source. **NOTE: 5 psi maximum.**
4. Thumb screws
5. Fuse Holder.
6. Power On/Off Switch.
7. Power Cord. Be sure that the 3-prong power cord is connected to a grounded circuit.

Figure 2. Back Panel



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Making Connections

Power Cord Connection

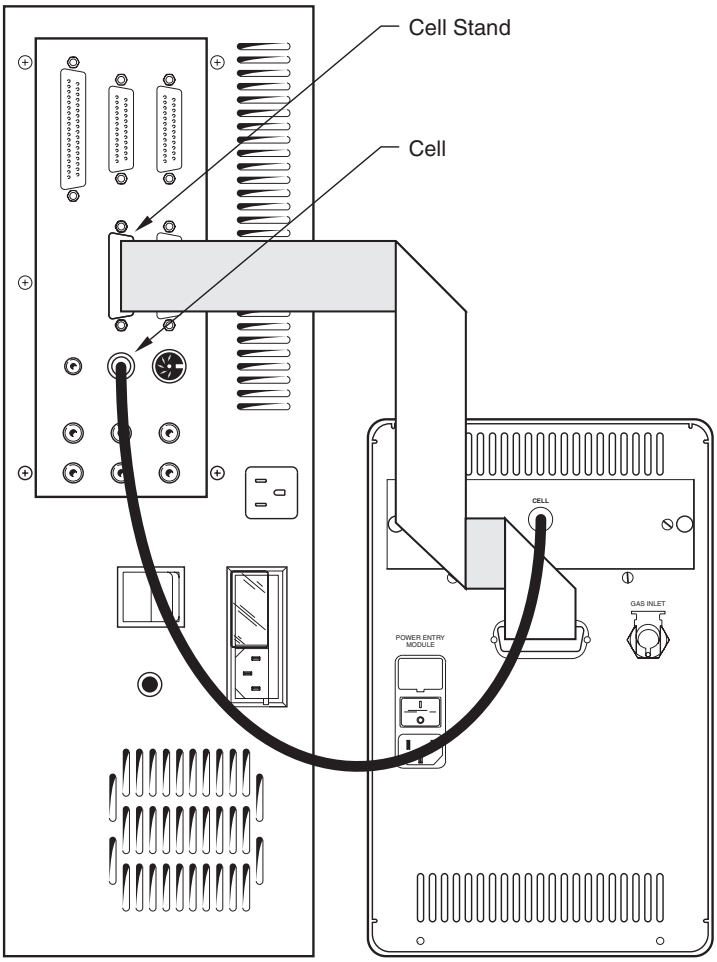
Push the socketed (female) end of the power cord into the port located in the back panel. Before making this connection, make certain that the power on/off switch is in the off position. This switch is labeled with a 0 and a 1. When 0 is pushed, the power is off and when 1 is pushed, the power is on.

C3 to BAS 100 Series Electrochemical Analyzer

Two cables are required to connect the C3 to the BAS 100 series. Stirring and purging can be automatically controlled by the BAS 100 series. The control cable is a 25-line ribbon cable (ER-9515) between the REMOTE connector (25-pin D, male) on the back of the C3 and the CELL STAND connector (25-pin D, female) on the back of the BAS 100 series. See Figure 3.

Connection of the cell lead cable is also shown in Figure 2. The cell lead cable has a stainless steel LEMO connector at each end. One end is inserted into the CELL socket on the back of the C3. The other end is inserted into the CELL socket in the back of the BAS 100 series. The ends are identical; therefore, it does not matter which end is connected to the BAS 100 series or the C3.

Figure 3. Connection of C3 to BAS 100 Electrochemical Workstation



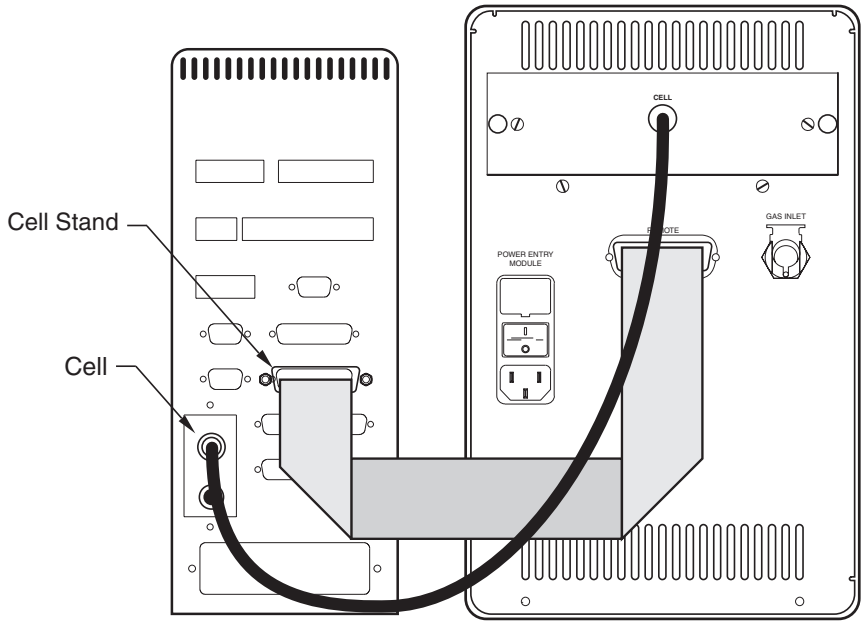
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C3 to epsilon EC

Two cables are required to connect the C3 to epsilon EC. Stirring and purging can be automatically controlled by the epsilon. The control cable is a 25-line ribbon cable (ER-9515) between the REMOTE connector (25-pin D, male) on the back of the C3 and the CELL STAND connector (25-pin D, female) on the back of the epsilon. See Figure 4.

Connection of the cell lead cable is also shown in Figure 4. The cell lead cable has a stainless steel LEMO connector at each end. One end is inserted into the CELL socket on the back of the C3. The other end is inserted into the CELL socket on the back of the epsilon. The ends are identical; therefore, it does not matter which end is connected to the epsilon or the C3.

Figure 4. Connection of C3 to epsilon



C3 to CV-1B Voltammograph

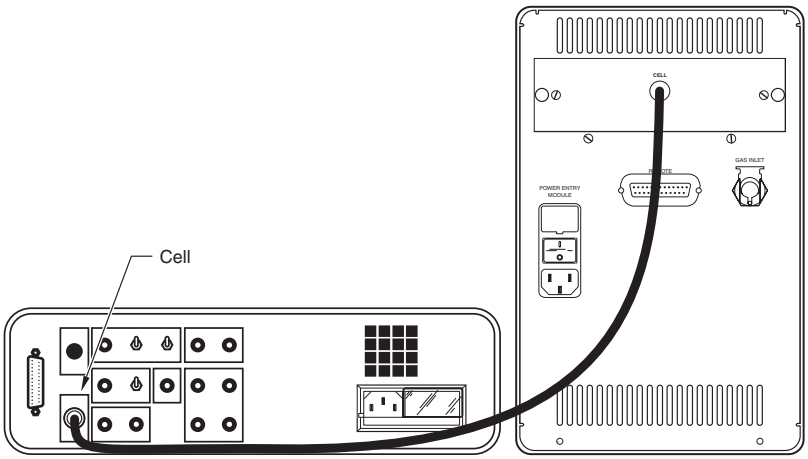
A single cable connects the C3 to the CV-1B. Stirring and purging are manually controlled. The cell lead cable has a stainless steel LEMO connector at each end. One end is inserted into the CELL socket on the back of the CV-1B. The other end is inserted into the CELL socket on the back of the C3. The ends are identical; therefore, it does not matter which end is connected to the CV-1B or the C3.

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C3 to CV-27 Voltammograph

A single cable connects the C3 to the CV-27. Stirring and purging are manually controlled. The connection of the cell lead cable is shown in Figure 5. The cell lead cable has a stainless steel LEMO connector at each end. One end is inserted into the CELL socket on the back of the C3. The other end is inserted into the CELL socket on the back of the CV-27. The ends are identical; therefore, it does not matter which end is connected to the CV-27 or the C3.

Figure 5. Connection of C3 to CV-27 Voltammograph



C3 to Non-BAS Instruments

The C3 should work, at least in the manual mode, with virtually any instrument. Cables must be custom made by the user. The CELL cable is modified by cutting off one of the LEMO connectors and attaching the appropriate connector for the particular instrument. The color code for internal wires is red (auxiliary electrode lead), white (reference electrode lead), black (working electrode lead), and bare (ground). Alternatively, if the instrument has a cell lead with alligator clips, disconnect the cell leads that are in the front panel of the C3 and connect the alligator clips directly to the electrodes. If automatic control is desired, see Section 4 for information on the pin outs of the REMOTE connector for construction of the proper cable.

Use with Low Current Module and Impedance Module

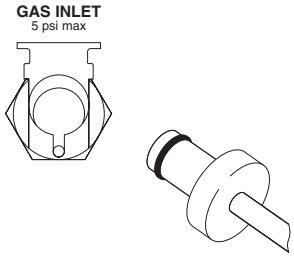
The C3 is designed to accommodate Low Current Module and Impedance Module accessories. Remove the cell lead box by loosening the two thumb screws (see Figure 2) from the back panel and sliding the cell lead box out. Slide in the appropriate module and tighten the thumb screws. It is important that the thumb screws be tight to ensure proper grounding of the case. Connection and operation of the Low Current Module and Impedance Module are described in their respective Instruction Manuals.

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Gas Inlet Connection

The C3 package contains 0.25" OD tygon tubing and a gas line fitting. One end of the gas line fitting is barbed to fit inside the tygon tubing. Push the barbed end into the tubing. The other end of the fitting connects to the GAS INLET port on the rear panel of the C3. To attach the line, simply push the connector into the port. A retaining clip will snap into place. The open end of the tygon tube is connected to a regulated gas supply. The inlet gas pressure must not exceed 5 psi. To remove the tube from the C3, squeeze the retaining ring tab against the connector, then pull the tube and connector away from the C3.

Figure 6. Gas Line Connection to C3



Cell Placement

The C3 is designed for easy cell replacement and to accommodate both regular cells and water-jacketed cells. The cell is held in place by the stir motor. Follow these instructions for initial cell placement:

1. Pivot the stir motor to the right.
2. Bring the cell up from underneath, around the electrodes, and seat on the cell top.
3. Pivot the stir motor back under the cell.
4. If required, the cell top height can be adjusted by loosening the cell height adjustment knob, sliding the cell top assembly to the desired position, and tightening the knob.
5. Four 0.25" holes are in the cell top. These holes are for the working electrode, reference electrode, auxiliary electrode, and standard addition port. Place the electrodes and port plug in the holes which are the most convenient.

Purging/Blanketing Lines

The C3 has the ability to purge or blanket the sample solution with an inert gas. The purge removes oxygen by bubbling an inert gas, typically nitrogen or argon, through the solution. The blanketing function is to maintain an inert atmosphere above the sample to keep oxygen from re-entering the sample solution.

The purge/blanket lines are the two plastic tubes coming out of the cell top support block. These two lines should be pressed into the Teflon cell top. The blanket line should extend to just beyond the bottom of the cell top. The depth of the purge tube should be near the bottom of the cell vial.

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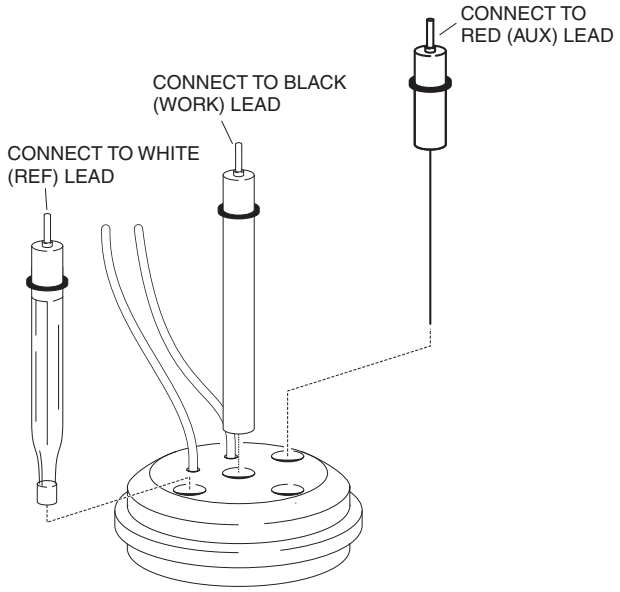
Electrode Leads

The electrode lead wires extend through the front panel. The connectors are the spring-loaded, press-on type. Simply push the connector over the corresponding pin in the electrode to make the connection (Figure 7). Each wire is color coded to the electrode it attaches. The code is:

Black . . . . . Working Electrode
White . . . . . Reference Electrode
Red . . . . . Auxiliary Electrode

Alligator clips with the appropriate pin and colored boot are included for connection to electrodes that cannot be connected to the sockets on the cell lead.

Figure 7. Electrode Lead Connections



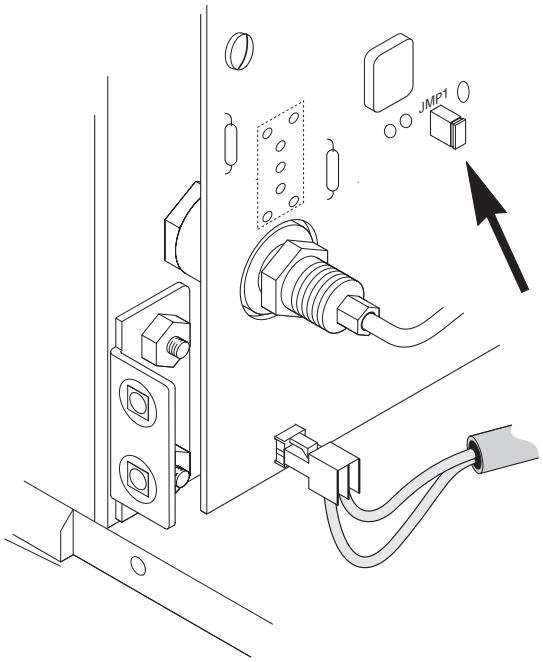
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Section 4. Operation

Polarity of Remote Stir Control

The factory-set polarity for control of the remote stir line is active low (e.g., low signal turns stir ON, high signal turns stir OFF). If opposite stir control polarity is needed (e.g., active high), then remove the jumper on the C3 printed circuit board (Figure 8) and place it on only one pin. The jumper is accessible after removing the side panel near the switches on the C3.

Figure 8. Location of Remote Stir Control Polarity Jumper

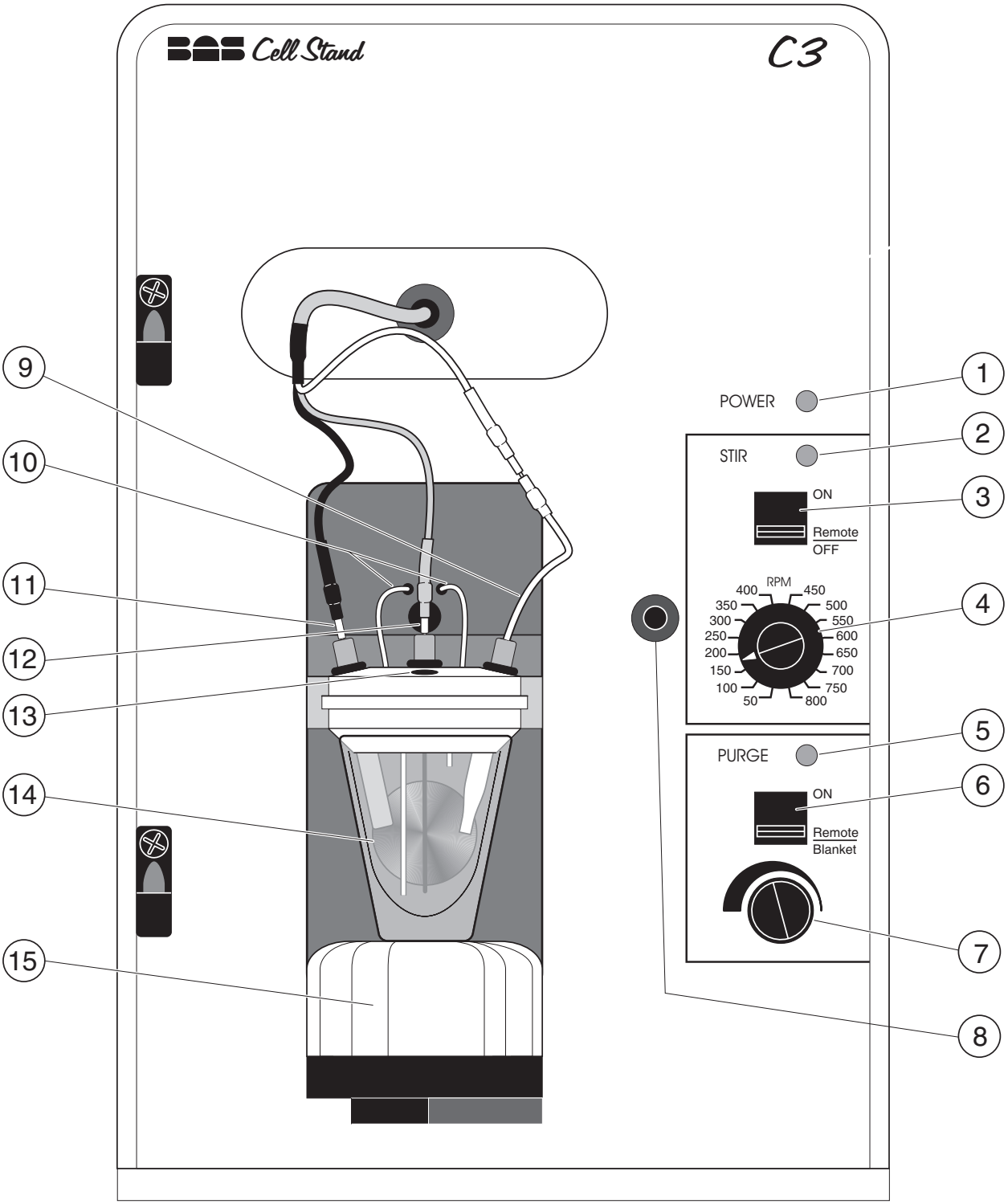


Front Panel Controls and Connections

1. Power LED. LED is lit when C3 is powered (on/off switch is located on back panel).
2. Stir-LED. LED is lit when stir is turned on, either manually or remotely.
3. Stir Control. Switch to manually control stirrer or to select remote control.
4. Stir Rate Switch. Switch for selection of one of 16 available stir rates.
5. Gas Purge LED. LED is lit when gas purge is turned on for sample vial, either manually or remotely. When LED is off the gas flows through the blanket line.
6. Gas Purge Control. Switch to manually control gas flow to purge or blanket lines or to select for remote control.
7. Gas Purge Flow Control. Needle valve control of gas flow to purge and blanket lines.
8. Latch/Ground Socket for Faraday Cage.
9. Reference Electrode Lead. White lead connected to reference electrode.
10. Gas Purge and Blanket Lines.
11. Working Electrode Lead. Black lead connected to working electrode.
12. Auxiliary Electrode Lead. Red lead connected to platinum wire auxiliary electrode.
13. Standard Addition Port.
14. Cell Top Height Adjustment Knob.
15. Stir Motor.

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Figure 9. Front Panel



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Remote Control

The remote connector of the C3 allows the stirring and gas purge functions to be controlled by an external unit. The cell stand was specifically designed to be controlled by the appropriate commands from the BAS 100 Series Electrochemical Analyzer and CV-50W. These functions can be activated by either a TTL signal or from any controller providing a contact closure to the ground. All lines are active low (negative edge triggered) and the pin designations of the remote connector are as follows:

Pin	Description
4	digital ground
7	digital ground
8	$\overline{\text{STIR}}$
21	$\overline{\text{PURGE}}$

Operation of these lines is also dependent on the setting of the stir and purge switches on the front panel.

Gas Purge

The flow rate of the gas and whether it is directed to the purge or blanket lines is controlled by a front panel knob and switch. When toggled to the ON position, the gas flow is directed to the purge line and cannot be changed by remote control. When switched to the REMOTE/BLANKET position, the gas is directed to the blanket line. It must be in this position to externally control PURGE via the REMOTE connector on the back panel. The LED is lit when the purge function is on, either manually or remotely.

Stir

The C3 has a precisely controlled magnetic stirrer. The stirrer can be controlled either by the front panel switches or remotely. When the stir switch is toggled to the ON position, the stirrer is on at the rate selected by the rate switch (50-800 RPM) and cannot be remotely controlled. The REMOTE position is required for remote control of the stirrer. The LED is lit when the stir function is turned on, either manually or remotely.

Faraday Cage

The C3 is supplied with an easily removed Faraday Cage. The Faraday Cage pivots on lift-off hinges. The latch grounds the Faraday Cage; thus, the door must be completely closed for it to be effective. For many experiments, the signal generated at the electrode is large enough that the Faraday Cage is not necessary. When small signals must be measured, the Faraday Cage will shield the cell from many electrical interferences. Unconnected wires and water lines for temperature control passing through the wall of the Faraday Cage may act as antennas and be sources of line frequency interference for small signals. For best results, remove any unconnected wires and properly ground water lines.

Removal of Cell Lead Box

Remove the cell lead box by loosening the two thumb screws from the back panel (see Figure 2) and sliding the cell lead box out. When replacing the thumb screws, tighten well to ensure proper grounding of the case.

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Section 5. Maintenance

General Maintenance

The C3 is a very rugged instrument and, with proper care, should give years of service. Following is a brief list of cautions and general maintenance considerations that will extend the lifetime of the instrument.

- Follow customary, good laboratory practices.
- Clean all spills, especially salt solutions, on or near the cabinet immediately.
- Avoid placing the unit in a corrosive atmosphere.
- Avoid dropping, shaking, or other forms of mechanical abuse to prevent loosening of components or subassemblies.
- Clean gas lines (rinse and wipe dry) after each use.
- Do not bend the auxiliary electrode (platinum wire) when removing or placing the cell vial. Repeated bending will cause the wire to break.

Troubleshooting

Symptom	Cause	Solution
saturated signal	reference tip not in contact with solution	lower reference
noisy signal	clogged reference frit	replace reference
	air bubble in reference tip	"flick" reference until bubbles are at top
	vibrations	place on pad to dampen vibration
	electrical line frequency interference	use Faraday Cage
	spikes in power line	power from a different circuit
variation in peak height	temperature variation	use water-jacketed cell

Service Procedure

There are no user-serviceable electronic parts in this unit and all service requests should be referred to BAS service personnel. In certain cases, BAS will provide electronic schematics and service procedures to qualified electronic maintenance facilities, but only upon written request and then only with the approval of the Service Coordinator.

If a problem arises and appears equipment oriented, call BAS at (765) 463-4527 and ask for Customer Service, or e-mail echem@bioanalytical.com.

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