



# IG2 Operation Manual



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# Safety Notices

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The equipment manufactured by RBD Instruments, Inc. (RBD) are designed with consideration of the safety of those who come in contact with them. Towards this end, we have defined the skills and knowledge that operators and maintenance personnel must have to interact with our products.

## Authorized Personnel

Operators and maintenance personnel require specific skills to interact with RBD's products.

Operators of RBD equipment are expected to be familiar with the technical information and instructions provided in the included documentation. It is also expected that unless Operators have the skills and knowledge required by maintenance personnel, Operators will not attempt to repair or maintain the equipment without the assistance of someone who has such skill and knowledge.

Qualified and skilled maintenance personnel will have the following knowledge and experience:

- Training and experience with voltages above 2 kV.
- Familiarity with and understanding of the documentation included with the equipment
- Awareness, familiarity, and understanding of all safety notices and symbols that are included in the documentation and on the equipment

## Safety Symbols

To help you quickly recognize possible safety hazards, we have provided safety symbols below that are used elsewhere in this document as well as on the equipment itself, as applicable.



This symbol indicates hazardous voltages may be present that could cause death or serious personal injury. Service to be done by trained personnel only.



This symbol indicates a risk of death, personal injury, and/or damage to equipment exists. Service to be done by trained personnel only.



This symbol indicates that the equipment must be unplugged from its power source before any service or maintenance is performed on the equipment.

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## Procedural Warnings

When a step in a procedure presents a potential hazard or danger, we have identified the hazard or danger using the following words:

**Danger:** When an imminent hazardous situation is not avoided, serious injury, or death could result.

**Warning:** When a potentially hazardous situation is not avoided, serious injury, or death could result.

**Caution:** When a potentially hazardous situation is not avoided, minor or moderate injury to personnel or damage to equipment could result.

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## Limited Warranty

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RBD Instruments, Inc. (referred to as “Company”) warrants that the product(s) discussed in this document will perform substantially in accordance with the accompanying written materials, and will be free from defects in materials and workmanship for the period of one year from receipt by buyer. In the event applicable law imposes any implied warranties, the implied warranty period is limited to 90 days from the date of receipt. Some jurisdictions do not allow such limitations on duration of an implied warranty, so the above limitation may not apply to the buyer.

Other than as described here, there are no other expressed or implied warranties.

### Customer Remedies

The Company’s and its suppliers’ entire liability and Customer’s exclusive remedy shall be the repair or replacement of the product that does not meet this Limited Warranty. This Limited Warranty is void if failure of the product has resulted from accident, abuse, modification, or misapplication of the product(s). Any replacement product will be warranted for the remainder of the original warranty period or 90 days, whichever is longer.

### No Other Warranties

To the maximum extent permitted by applicable law, the Company and its suppliers disclaim all other warranties, either express or implied, including, but not limited to implied warranties of merchantability and fitness for a particular purpose. This limited warranty gives customer specific legal rights. Customer may have other rights depending on the jurisdiction.

### No Liability for Damages

To the maximum extent permitted by applicable law, in no event shall the Company or its suppliers be liable for any damages whatsoever (including without limitation, special, incidental, consequential, or indirect damages for personal injury, loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use of or inability to use this product, even if the Company has been advised of the possibility of such damages. In any case, the Company’s and its suppliers’ entire liability under any provision of this agreement shall be limited to the amount actually paid by the buyer.

In addition, this warranty does not cover loss, damage, or defects that result from transportation to buyer, improper care by buyer, buyer-supplied software or other components, unauthorized changes, use, or misuse (including, but not limited to, use outside of the specified environmental conditions).

### Product Service

Any claims of product failure of performance must be reported to Company within 30 days of product’s receipt by buyer. During this time, the buyer may return the product to Company for repair at Company’s

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cost and at no cost to the buyer.

The Company recognizes that expendable items may not function for the full year covered by this Limited Warranty. Expendable items, such as filaments, grids, special ceramics, and ionizers, are therefore excluded from the Limited Warranty for the specific product of which they are a part. However, each of these expendable items will have its own warranty and will be replaced or repaired in accordance with its warranty.

Buyers who purchased the product through one of the Company's international sales representatives should contact their sales representative to make arrangements for return, repair, or replacement.

## IG2 Introduction

This manual provides information about the IG2 Ion Source Package, which comprises the Model 04-165 2 kV Backfill Ion Source and the Model 32-165 Ion Source Control, as well as additional options available for the IG2.

The RBD 04-165 Ion Source is interchangeable with the PHI® 04-161 and 04-162 ion guns. The RBD 32-165 Ion Source Control is interchangeable with the PHI® 20-045 control. As a result, the RBD Model 04-165 works with the PHI 20-045, and the PHI 04-161 and 04-162 ion guns work with the RBD Model 32-165. This manual discusses the options available for the IG2, the items required to use RBD's components with corresponding PHI components, as well as differences in operation or other aspects of a component's use.

### RBD Model 04-165 2 kV Backfill Ion Source

The Model 04-165 2 kV Backfill Ion Source generates an energetic inert gas ion beam for sputter-etching solid surfaces. The source requires a static pressure of  $5 \times 10^{-5}$  torr with an inert gas such as argon. Ions are generated by electron impact within the ion source's dual filament ionization chamber and are then focused at the target with energies of up to 2 keV. The impurity content of the ion beam is minimized by using an off-axis filament geometry. A focusing lens permits high ion current density to be obtained for a given operating pressure and source-to-sample distance. A dual tungsten filament assembly permits continued operation when the first filament opens. The expected lifetime of the filament assembly is several years under normal usage at the recommended operating conditions. The filament assembly is easily replaced in the field.

The 04-165 fits on a standard 2.75" flange, which has a 1.35" ID and a 1.5" OD.

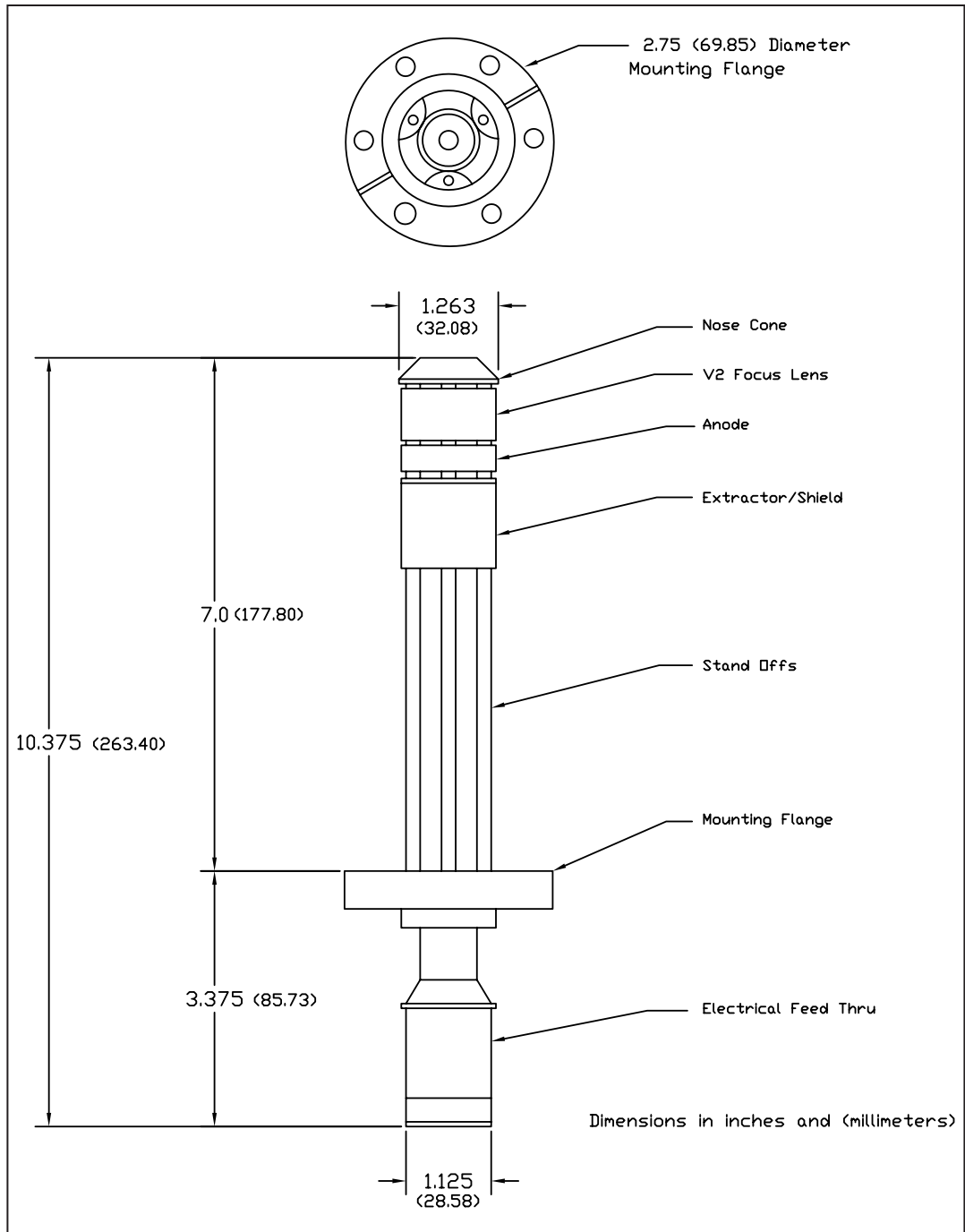
#### 04-165 Specifications

Specification	Description
<b>Source Type</b>	Hot filament electron impact (dual filament, backfill type)
<b>Beam Energy</b>	.5 kV to 2 kV
<b>Minimum Beam Diameter</b>	
» at 25 mm working distance	2.5 mm FWHM (at target)
» at 50 mm working distance	3.5 mm FWHM (at target)
<b>Maximum Total Target Current</b>	$\geq 10 \mu\text{A}$ at $V_B = 2 \text{ kV}$ .
<b>Maximum Current Density</b>	
» at 25 mm working distance	$\geq 200 \mu\text{A}/\text{cm}^2$ when $V_B = 2 \text{ kV}$
» at 50 mm working distance	$\geq 100 \mu\text{A}/\text{cm}^2$ when $V_B = 2 \text{ kV}$
<b>Mounting</b>	Standard 2.75" CF bored flange OD, 1.35" ID minimum tube required
<b>Flange to End of Optics</b>	7.00" or 9.25" (2.25" less with optional x-y aligner)
<b>Working Distance</b>	Typically 50 mm end-of-optics-to-target



### **04-165 Diagram**

The diagram below identifies the dimensions of the RBD 04-165 as well as its sections. Please note that the vertical dimensions reflect the 04-165 dimensions when the optional X-Y aligner (RBD part number IG2-EA) is not used.



*Figure 1. 04-165 Ion Source*

## Model 32-165 2 kV Ion Source Control

The Model 32-165 2 kV Ion Source Control provides all the necessary voltages and currents required to operate the Model 04-165 2 kV Backfill Ion Source or the PHI 04-161/162 ion guns. The beam voltage may be activated manually, remotely, or with the built-in timer. The focus control allows the beam size to be varied, and can be externally calibrated to optimize current density. Anode current (ion current), filament current, beam and focus voltages all can be monitored to ensure accurate resetting of sputtering conditions.

### 32-165 Specifications

Specification	Description
<b>Input Power</b>	90-264 VAC @ 47-63 Hz, Single Phase
<b>Output Voltage</b>	.5 kV to 2 kV in 500 volt increments
<b>Ripple-to-Noise</b>	≤30 mV peak-to-peak
<b>Focus Voltage</b>	Variable, 0 to 100% of the Beam Voltage
<b>Front Panel Controls</b>	
» <b>Beam Control</b>	Manual (local), Timer, Remote
» <b>Beam Voltage Control</b>	4-position switch
» <b>Focus Voltage Control</b>	5-turn potentiometer
» <b>Filament Current Control</b>	5-turn potentiometer
» <b>Timer</b>	1-turn potentiometer (0 to 60 seconds/minutes)
<b>Remote Input (on Back Panel); BNC-type connector</b>	Beam Voltage ON/OFF; TTL High=ON
<b>Emission Voltage</b>	+30 V to +200 V, adjustable at 30 mA ±5 mA measured between the beam voltage and filament common.
<b>Extractor Voltage</b>	-30 V to -200 V, adjustable
<b>Filament Control</b>	5-turn potentiometer, 2-position switch for Filament 1 or Filament 2
<b>Filament Current Limit</b>	2.5 A
<b>Filament Voltage</b>	Nominally 8 V at 2.5 A
<b>Front Panel Monitors (for emission current)</b>	
» <b>Beam Voltage</b>	0 to 2 V corresponds to 0 to 2 kV
» <b>Focus</b>	0 to 2 V corresponds to 0 to 2 kV (tracks Beam Voltage)
» <b>Filament</b>	0 to 2.5 V corresponds to 0 to 2.5 A
» <b>Anode Current</b>	0 to 100 mV corresponds to 0 to 100 μA of beam current
<b>Cooling</b>	Convection and cooling fan
<b>Dimensions</b>	19" rack mount x 14" deep x 3" high

### 32-165 Front and Rear Panel Diagrams

The following diagrams show the controls and connections, as applicable, on the front and back panels of the 32-165.

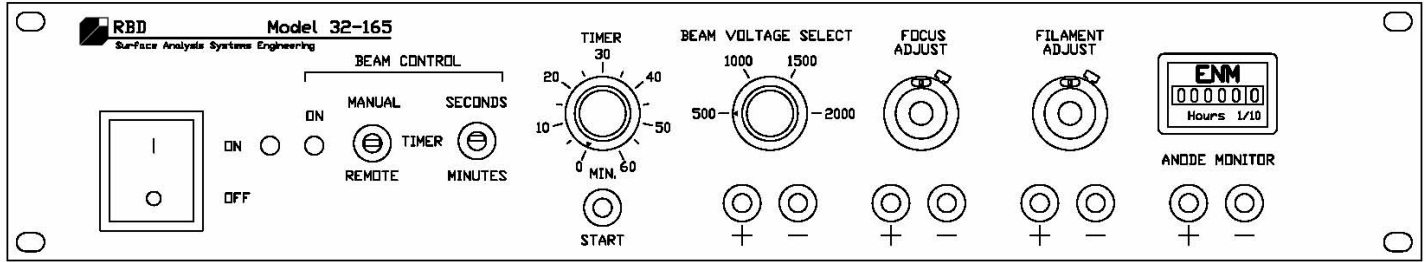


Figure 2. 32-165 Front Panel

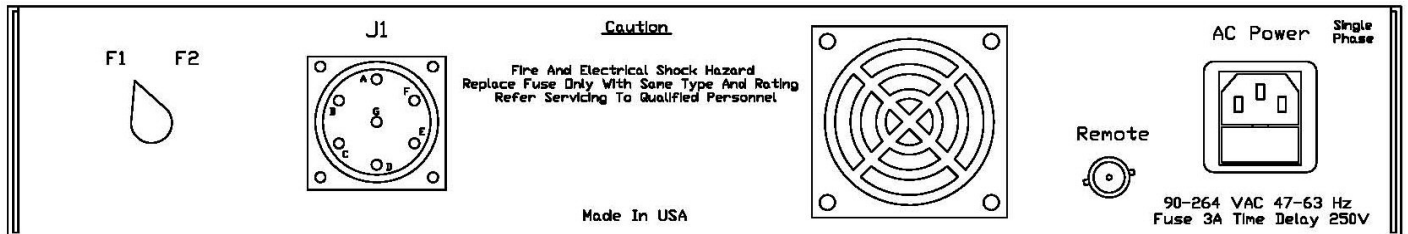


Figure 3. 32-165 Back Panel

### IG2 Options

The following components are optional and are available separately.

#### IG2-AGA Argon Gas Admission

All versions of the IG2-AGA are available for any configuration of the IG2 package.

The following table provides details about the three options available for the IG2-AGA.

IG2-AGA Option	Description
IG2-AGA	Precision manual leak valve alone
IG2-AGA-18L	Precision manual leak valve with 18 liter bottle of research-grade argon
IG2-AGA-50CC	Precision manual leak valve with 50cc bottle of research-grade argon

## **IG2-EAPR Equipment Aligner**

The IG2-EAPR Equipment Aligner provides the ability to adjust the X-Y alignment of UHV optics components that are mounted on a 2.75-inch CF flange. The IG2-EAPR increases the end-of-optics to target distance by 2.25 inches. Note that the IG2-EAPR requires a large ID tube (approximately 1.5") to work properly.

The IG2-EAPR flange, which is tapped for six ¼"-28 mounting bolts, is mounted to the vacuum chamber at the appropriate 2.75-inch CF flange on the chamber using a 2.75" **large ID** gasket. The optics unit is then mounted to the aligner with its own flange using a 2.75" **standard** gasket. The X-Y adjustment is then accomplished by adjusting the four thumb screws located around the sides at the top of the IG2-EAPR.

The IG2-EAPR is UHV compatible and fully bakeable to 200° C.

## **Cables to Connect RBD and PHI Components**

The following cables are required for the connections indicated. (Note that if you are connecting the RBD 04-165 and the RBD 32-165, you use the IG2-CA1 cable that is included with your IG2 package.)

<b>Between These Components</b>	<b>RBD Part Number</b>
<b>RBD 32-165 and PHI 04-161/04-162</b>	IG2-CA2
<b>RBD 04-165 and PHI 20-045</b>	IG2-CA3

## **System Setup**

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This chapter provides information on setting up your IG2 components. This includes:

- Information about inspecting the packaging for damage
- The tools that are included with your shipment. These are determined by the components that you are installing and setting up.
- Instructions for the unpacking and handling of the IG2 components
- Checkout procedures for the IG2 components

### **Inspecting the Packaging for Damage**

The packaging RBD Instruments uses when shipping components is designed to withstand the demands of normal shipping activities. However, once the boxes leave our facility, their treatment is out of our control. We recommend that you make a quick inspection of the boxes in the presence of the delivery person. Look for indications of mishandling such as dented corners or sides, punctures in the outer container, evidence of re-packaging, or a container that has been positioned in a direction other than that indicated by the arrows on the outside of the container.

Be sure to note any obvious shipping damage to the outer container and make the delivery driver aware of any damage. We suggest that all observations are provided to the delivery person in writing. In addition, please take photographs of damaged items whenever possible at the time of delivery.

Inspect the inner packaging and components as soon as possible so that you can report any necessary damage claims in a timely manner with the shipping company used. This is especially important when there is evidence of mishandling on the outside container.

### **Unpacking and Handling**

If you have not already done so, please follow the procedures outlined in the previous section, “Inspecting the Packaging for Damage.” Once you have confirmed that all components have arrived intact, verify that you have the following items. If any are missing, please contact RBD Instruments at 541-330-0723 or e-mail us at [tech@rbdinstruments.com](mailto:tech@rbdinstruments.com).

- 04-165 Ion source
- 32-165 Control
- IG2-CA1 Cable
- AC Power Cord
- Digital Volt Meter
- Red Banana Plug Cable
- Black Banana Plug Cable
- IG2 CD

## Installing IG2 Components

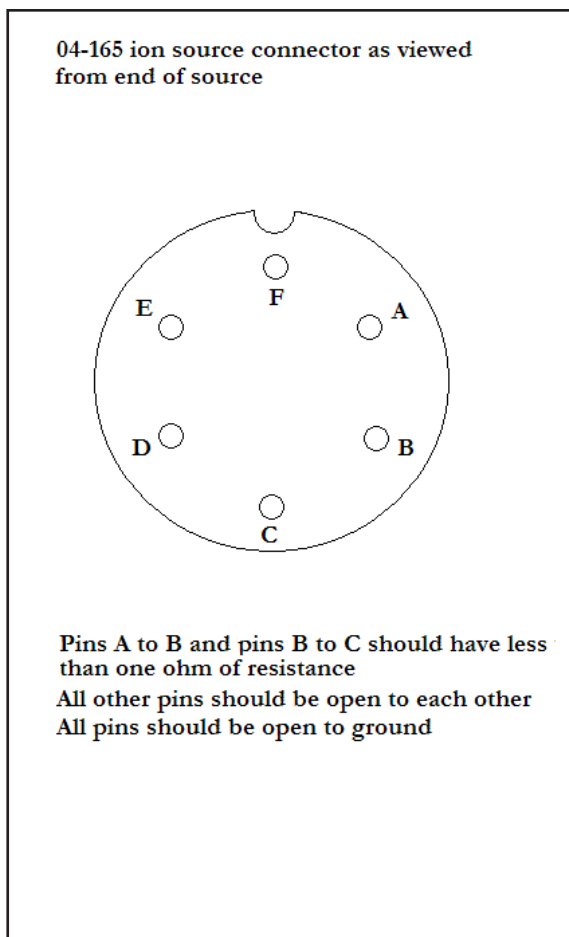
This chapter provides instructions for installing all IG2 components. This includes:

- Installing the 04-165 ion source on your vacuum chamber
- Installing the 32-165 ion source control in your system's electronics rack
- Connecting the 04-165 ion source and the 32-165 ion source control. Included in this section are instructions for connecting the RBD 04-165 ion source with a PHI 20-45 ion source control, as well as connecting the RBD 32-165 ion source control with a PHI 04-161 or 04-162 ion source.

### Installing the 04-165 Ion Source

To install the 04-165 ion source:

1. Perform a resistance check of the 04-165.
  - a. Using an ohm meter, measure the resistance of the pins on the 04-165 ion source.
  - b. The filament pins (A to B and B to C) should show less than 1 ohm of resistance.
  - c. All other pins should be open to each other.
  - d. All pins should be open to ground (the outside of the 04-165 electrical connector).



<b>A</b>	<b>Filament 1</b>
<b>B</b>	<b>Filament Com</b>
<b>C</b>	<b>Filament 2</b>
<b>D</b>	<b>Focus</b>
<b>E</b>	<b>Grid Voltage</b>
<b>F</b>	<b>Ext. Voltage</b>

2. Remove the blank flange from the vacuum chamber port into which you are installing the ion source.
3. Insert a new copper gasket between the ion source and the flange:
  - a. Place the gasket onto the open vacuum chamber flange.
  - b. Insert the ion source into the test chamber.
4. Tighten the ion source flange using the appropriate hardware.
5. Bake the system. If baking the system is not possible, use heat tape to heat the ion source. If you are unable to heat the ion source at all, the source will take much longer to outgas.

## **Installing the 32-165 Ion Source Control**

To install the 32-165 ion source control:



1. **Warning:** Ensure that the power switch on the 32-165 is set to OFF.



2. Ensure that the power cord and electron source cable are disconnected.
3. Slide the 32-165 chassis into an electronics rack. It is recommended that the source control is supported with side rails in the electronics rack, if possible.
4. Secure the control to the electronics rack by inserting screws through the four mounting holes that are provided on the front panel.

## **Connecting the 04-165 and 32-165**

To connect the 04-165 and the 32-165:



1. **Warning:** Ensure that the power switch on the 32-165 is set to OFF.
2. Screw the IG2-CA1 cable into the J1 connector on the back of the 32-165.
3. Screw the other end of the IG2-CA1 cable onto the electrical feed thru on the 04-165 ion source.



4. Plug in the 115 VAC power cable into the AC power connector on the back of the 32-165.  
**Warning:** Use caution while doing this.

Notes:

It is recommended that the 115 VAC power to the 32-165 is interlocked to your ion gauge so that the 32-165 cannot be turned on if your vacuum chamber is up to air.

If you want to use a computer to control the ion gun beam remotely, you need to connect a TTL level BNC cable to the Remote connector on the back of the 32-165. A TTL high (4 V) turns the beam voltage ON, and a TTL low (less than 0.5 V) will turn the beam voltage OFF. The Remote signal only turns the beam voltage on and off. The filament is controlled independently.

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## 32-165 Operating Procedure

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This chapter provides instructions for using the RBD 32-165 Ion Source Control.

### Getting Started with the 32-165

Before beginning to use the 32-165, confirm the following:

1. Make sure the system is under vacuum to less than  $5 \times 10^{-5}$  torr.
-  2. Make sure the 32-165 is unplugged and that the power switch on the front panel is set to Off.
3. Set the following switches and controls on the 32-165 Control front panel:
  - a. Set the Beam Control switch to Timer.
  - b. Set the Timer dial to 0.
  - c. Set the Timer switch to Seconds.
  - d. Set the Beam Voltage Select dial to 500, which is its lowest setting.
  - e. Turn the Focus Adjust dial fully counter-clockwise (set to 0).
  - f. Turn the Filament Adjust dial fully counter-clockwise (set to 0).
4. On the 32-165 Control back panel, set the Filament Select Switch (labeled F1 and F2) to the F1 position.

### Operating the 32-165 with the 04-165

You are now ready to run the 32-165. This procedure requires the following items:

- The digital volt meter (DVM) and the double-banana connectors that are included with the 32-165.
- A test sample loaded in your system. A sample mount or other conductive sample will work well.

In addition, confirm that the 04-165 (or your 04-161/04-162) is under vacuum (better than  $5 \times 10^{-5}$  torr).

1. Turn on the 32-165. The green light to the right of the ON/OFF switch is illuminated. The amber-colored ON light for the Beam Control lights for a moment then goes off again. If the light does not go off immediately, the Timer switch is set to Minutes. Change the Timer switch setting to Seconds.
2. Set the Focus Adjust dial to 4 (80%) as a nominal setting. Once you have the optimal value for this defined as it applies to your system, it can be locked in place because you won't need to change it again. (How to determine the optimal value for your system is covered in step 7, below.)
3. Using the included double-banana connectors and DVM, monitor the voltage output on the Filament Adjust dial by connecting the DVM to the +/- Filament Adjust connectors on the front panel.
4. Slowly increase the Filament Adjust voltage by turning the dial clockwise until the DVM shows 2 volts. This corresponds to 2 amps of filament current. To get this reading, you'll be at approximately 4 on the Filament Adjust dial. This is a good starting point for defining your standard operating settings for your 32-165. The filament in the 04-165 should be glowing white.
5. Backfill your vacuum system to  $5 \times 10^{-5}$  torr with argon.



Turn the Beam Voltage Select dial to 500 V.

**Tip**

*If you want to use slower sputter rates, run the ion source at 500 V.*

*If you want faster sputter rates for faster cleaning, run the ion source at 2000 V. Please note, however, that if you operate the source at 2000 V, you will get increased mixing of elements in your samples. This effect is reduced if you reduce the beam voltage being applied.*

DVM measurements at the connectors below the Beam Voltage Select switch roughly correspond to the beam voltage being applied to the ion source. For example, .5 V on the 32-165 when measured with the DVM corresponds to *approximately* 500 V of beam voltage being applied to the ion source.

For any Beam Voltage Select setting, you can optimize the Focus Adjust setting to maximize the target current. The ratio of the Focus Adjust voltage will change automatically as you reduce or increase beam voltage. The Focus Adjust value is a percentage of the beam voltage. The size of the beam remains constant regardless of the Beam Voltage Select setting.

**Tip**

*For example, when the Beam Voltage Select is set to 1000 V and the Focus Adjust dial is set to 8, this corresponds to 80% of beam voltage, resulting in 800 V of focus voltage. When the Beam Voltage Select dial is set to 2000 V, the focus voltage is 1600 V (80% of 2000 V).*

6. Connect the DVM leads to the Anode Monitor test points (which are located under the timer meter). Set the Beam Control to Manual. The Beam Control ON LED will illuminate, indicating that the beam voltage is on.

The reading shown on the DVM for the Anode Monitor corresponds to the beam current that is leaving the ion source (0 to 10 mV corresponds to 0 to 10  $\mu$ A). This is useful when the target current cannot be measured.

7. To optimize the Focus Adjust, either:
  - a. Vary its knob slightly higher and lower than the nominal setting while observing the Anode Monitor current. When the Anode Monitor current reaches its peak value, lock the Focus Adjust dial to this position.  
or
  - b. Load a piece of TaO<sub>5</sub> into the system and sputter through the oxide. You will see the crater as a blue circle that represents the edge of the oxide layer, which follows the outline of the ion beam. By moving to an un-sputtered piece of TaO<sub>5</sub> and then making slight changes to the Focus Adjust, you will be able to set the Focus Adjust to where the crater is at its smallest size and the ion beam is in focus.

If your system is equipped with a Faraday cup, you can further optimize the Focus Adjust by maximizing the ion current into the Faraday cup.

8. Fine-tune the filament:
  - a. Increase the Beam Voltage Select to 2000 V.
  - b. Confirm that your system vacuum is still at  $5 \times 10^{-5}$  torr with argon.
  - c. Increase the filament current using the Filament Adjust dial slightly until you monitor 10 millivolts on the Anode Monitor, which corresponds to 10  $\mu$ A of anode current (ions being generated by the source and accelerated to target).

**Tip**

*Improving the Filament Lifetime: Operating the filament current higher than required to get 10  $\mu$ A of target current will shorten the filament lifetime. The nominal filament current range is 2.1 to 2.3 amps. Filament current is internally limited to 2.5 amps. You can run it higher than 2.3 amps (for short periods of time), but doing so will shorten the lifetime of filament.*

Notes:

1. The meter on the front panel of the 32-165 allows you to monitor the run-time of the ion source. This helps you determine the life of your filament.
2. Even though the beam is off, the filament normally is left on to stabilize the gun. This affects the filament life. To prolong the filament life when the 32-165 is not in use:
  1. Turn the Filament Adjust dial fully counter-clockwise.
  2. Turn the power switch to Off.

## **Beam Control Switch Operation**

There are three settings available for the Beam Control:

- Manual (the switch is set to its top position). When the Beam Control is set to Manual, the beam is set to ON.
- Timer (the switch is in its center position). When the Beam Control is set to Timer, you use the Timer to determine for how long the beam is on, from a minimum of 0 seconds up to a maximum of 60 minutes. This allows for repeatable sputter times.
- Remote (the switch is set to its bottom position). When the Beam Control is set to Remote, the beam is controlled by a TTL signal, which is connected to the Remote input on the back of the 32-165. This allows you to control the beam with software such as AugerScan<sup>®</sup> to perform depth profiles.

For example, to sputter for 30 seconds:

1. Set the Timer dial to 30.
2. Set the Timer switch to seconds.
3. Press the Start button, which is under the Timer dial.

After 30 seconds, the beam turns off.

## **Special Notes for Using the 04-165 with a PHI 20-045 Control**

When you use the RBD 04-165 with a PHI 20-045 control, the 20-045 should be operated at 10 mA of emission current, not 25 mA as with the 04-161/162. The ionizer in the 04-165 is more efficient, so operating it above 10 mA will shorten the filament lifetime.

## **Using the 32-165 with a PHI 04-161 or PHI 04-162 Ion Source**

The 32-165 is used with the 04-161 or 04-162 in the same way it is used with the RBD 04-165. Please refer to the section "[Operating the 32-165 with the 04-165](#)", on page 9.

## Principles of Operation

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The RBD Model 04-165 2 kV Backfill Ion Source is used with the RBD Model 32-165 Ion Source Control. Together with the appropriate gas admission system such as the RBD IG2-AGA, these units comprise a complete system designed to sputter-etch a specimen surface using inert-gas ions. The ion gun is CF flange mounted and can be installed in standard vacuum systems. The control unit contains all the electronics and power supplies necessary for operating the ion source.

The Model RBD Model 04-165 2 kV Backfill Ion Source generates an energetic inert-gas ion beam for sputter-etching solid surfaces. In operation, the test chamber is backfilled to a static pressure of  $5 \times 10^{-5}$  torr with an inert gas such as argon. Positive ions are created by electron impact within the ion gun's ionization chamber. The ions are then extracted from the ionization chamber, accelerated through a focusing lens, and directed at a specimen with energies up to 2 keV. The impurity content of the ion beam is minimized because there is no direct line of sight from the hot filament to the target. Operating parameters are adjustable on the front panel of the Model 32-165 Ion Source Control. Focus, beam voltage selection, filament selection, and emission are all controlled by the ion gun control.

## **Appendix - Cable Diagrams**

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The cable diagram for the cable included with the IG2 is provided in this appendix. We have also included cable diagrams for the optional cables that are available to integrate the RBD 04-165 ion source with the PHI controller and the RBD 32-165 ion source control with the PHI ion guns.

# IG2 Cable #1 (IG2-CA1-A)

7-Pin Amphenol Connector  
Cable Clamp and Rubber bushings

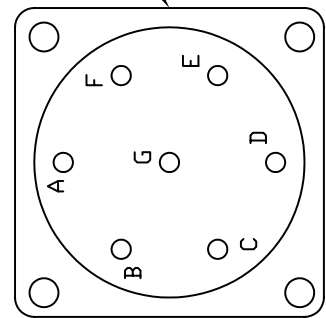
Lapp/USA  
7-Conductor, 20 AWG,  
Cable Length = 15'

6-Socket Amphenol Connector  
Cable Clamp and Rubber bushings

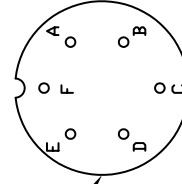
Filament 1	A
Filament Com.	B
Filament 2	C
Focus	D
Grid Voltage	E
Ext. Voltage	F
NC	G

Blk/1
Blk/2
Blk/3
Blk/4
Blk/5
Blk/6

A	Filament 1
B	Filament Com.
C	Filament 2
D	Focus
E	Grid Voltage
F	Ext. Voltage



As viewed from rear of  
32-165 Controller.



As viewed from connector  
end of 04-165 Ion Gun.

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This drawing contains proprietary information and any reproduction, disclosure or use of this drawing is expressly prohibited except as may be necessary for RBD. RBD hereby agrees to in writing.				Title	IG2 Cable 1
				RBD 32-165 TO RBD 04-165	
				DRAWING NO.	IG2-CA1-A
				SIZE	A
				SHEET	1 OF 1
				REV.	A

# IG2 Cable #2 (IG2-CA2-A)

7-Pin Amphenol Connector  
Cable Clamp and Rubber bushings

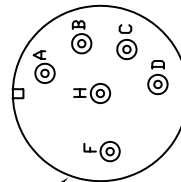
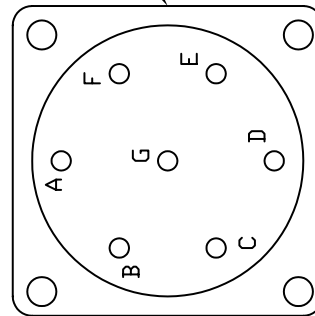
Lapp/USA  
7-Conductor, 20 AWG,  
Cable Length = 15'

8-Socket Amphenol Connector  
Cable Clamp and Rubber bushings

Filament 1	A
Filament Com.	B
Filament 2	C
Focus	D
Grid Voltage	E
Ext. Voltage	F
NC	G

Blk/1
Blk/2
Blk/3
Blk/4
Blk/5
Blk/6

B	Filament 1
C	Filament Com.
F	Filament 2
A	Focus
H	Beam Voltage
D	Shield



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	Title		
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DRAWING NO.		IG2-CA2-A	REV.
SIZE	A	SHEET	1 OF 1
			A

# IG2 Cable #3 (IG2-CA3-A)

8-Pin Amphenol Connector  
Cable Clamp and Rubber bushings

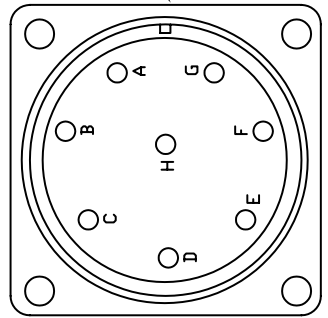
Lapp/USA  
7-Conductor, 20 AWG.  
Cable Length = 15'

6-Socket Amphenol Connector  
Cable Clamp and Rubber bushings

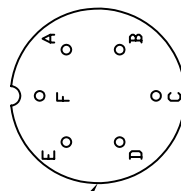
Filament 1	B
Filament Com.	C
Filament 2	F
Focus	A
Beam Voltage	H
Shield	D

Blk/1
Blk/2
Blk/3
Blk/4
Blk/5
Blk/6

A	Filament 1
B	Filament Com.
C	Filament 2
D	Focus
E	Grid Voltage
F	Ext. Voltage



As viewed from rear of  
20-045 Controller



As viewed from connector  
end of 04-165 Ion Gun.

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		Phi 20-045 TO RBD 04-165
DRAWING NO. IG2-CA3-A		REV. A
SIZE A	SHEET 1	DF 1