

ION TECH, INC.

INSTRUCTION MANUAL

RFB-1200 POWER SUPPLY

SERIAL NUMBER RFB12 92004

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Section 1

PERSONNEL SAFETY REQUIREMENTS

WARNING

ALL POWER OUTPUTS CAN BE LETHAL

This equipment utilizes high voltage at an amperage sufficient to be dangerous. Because of this potential hazard, only qualified personnel, using established safety procedures, should be involved in any maintenance, checkout, and programming procedures for the RFB-1200.

Complete ion beam systems purchased through Ion Tech are equipped with interlocks that prevent operation of the electrical system with the vacuum system at atmosphere or with the rear cover removed on the electronics cabinet. The external interlock prevents operation of the RFB-1200 while areas at high voltage can be touched. The internal interlock will shut down all power outputs if the facility power is disrupted.

Customers purchasing incomplete systems for retrofit into existing pumping stations are urged to use the external interlocking strategy for the safety of their personnel.

EXPLANATION OF COMMENTS

WARNING

WARNINGS ARE USED WHENEVER CONDITIONS OR PROCEDURES COULD RESULT IN INJURY TO PERSONNEL. WARNINGS MUST BE OBSERVED.

CAUTION

Cautions are used whenever conditions or procedures could result in damage to equipment. Cautions Should Be Observed.

NOTES: Notes supply additional information that may be useful in installing or operating the equipment.

Section 2

GENERAL DESCRIPTION

The RFB-1200, with the RF Plasma Products RF5S RF Generator, is a power supply system, specifically designed and optimized to power and control ION TECH's RF Ion Beam Sources. The built-in microprocessor provides the utmost in reliability and flexibility to the user. Each time the system is turned on, the microprocessor automatically checks each of the power supplies. When the RFB-1200 is operating an Ion Source and an unsatisfactory condition is encountered, an error code will appear on the display of whichever power supply is being affected by the problem. By checking the error code on the list provided in this manual, often the user can determine the cause of and the solution to the problem.

Programmable limits on several of the power supplies allow the users to adjust the system to best suit their particular needs. On the NEUTRALIZER power supply, for example, the filament current limit might be adjusted upward or downward as required, depending upon the size and type of filament wire being used.

The RFB-1200 is designed to operate in the following modes:

MANUAL - Each of the individual power supplies is controlled from the front panel. The parameters are changed by selecting a power supply with the MODULE select switch, selecting a parameter with the FUNCTION select switch, and then turning the ADJUST knob to reach the desired value.

Also, complete operating conditions can be stored in or recalled from one of two, nonvolatile memories. The SOURCE and BEAM switches can be turned on and off at the front panel.

LOCAL - In LOCAL mode the following parameters can be adjusted from the front panel: beam voltage and current, accelerator voltage and A/B ratio, PBN filament current, emission ratio, and RF power limit. Recalling or storing two complete sets of operating conditions in the two, nonvolatile memories is possible in the LOCAL mode. The SOURCE and BEAM switches can be turned on and off at the front panel.

LOCAL RESTRICTED - No adjustments can be made to any parameters from the front panel. The operator can recall operating conditions from either of the memories but cannot store conditions in memory. The SOURCE and BEAM switches can be turned on and off at the front panel.

REMOTE - The operator cannot use the front panel to adjust any parameter, cannot store conditions in memory, and cannot recall conditions from memory in the REMOTE mode. By means of an RS-232C interface, a computer can have control of the various power supplies and can recall conditions from memory. The SOURCE, BEAM, and MEMORY switches also can be controlled with remote switches. The MEMORY select, MODULE select, and FUNCTION select

switches are nonfunctional in REMOTE mode. The SOURCE and BEAM switches can be turned off, but cannot be turned on at the front panel.

The KEYLOCK switch can "lock" the power supply into any of the above modes. When in the DISABLE position, the mode cannot be changed.

Section 2 contains brief descriptions of some of the features of the RFB-1200 power supply and is intended to serve as an introduction only. Detailed explanations of each of these features will be found in later sections of this manual.

Section 3

SPECIFICATIONS

POWER REQUIREMENTS: 200-220 VAC Line Voltage, 50/60 Hz, 20 Amperes, 1 0 (single phase).

A. RFB-1200

Beam Voltage Supply

- 50-1200 Volts DC
- 300 mA maximum
- 300 Watts maximum
- Overvoltage protection
- Current limit protection
- Accuracy $\pm 0.1\%$ to 1000 Volts
- Voltage and current readouts
- Thermal protection

Accelerator Voltage Supply

- 0-1000 Volts DC
- 30 Watts maximum
- 100 mA maximum
- Overvoltage protection
- Current limit protection
- Programmable accelerator current-to-beam current (A/B) ratio limit
- Voltage and current readouts
- Thermal protection

Plasma Bridge Neutralizer (PBN) Current Supply

- 0-10 Amp AC Filament Supply
- 0-600 mA DC Emission Supply
- 400 mA DC Body Supply
- Programmable filament current limit
- Programmable emission-to-beam current ratio
- Soft start
- Current limit protection
- Filament current and emission current readouts
- Body voltage readout
- Thermal protection

Probe Supply

- 30 Volts bias
- 40 mA maximum
- Current readout

B. PROGRAMMED LIMIT VALUES

<u>Parameter</u>	<u>Default Value</u>
A/B RATIO LIMIT	10%
PLASMA BRIDGE NEUTRALIZER FILAMENT CURRENT LIMIT	6.5 A
RF POWER LIMIT	225 W

The above limits are programmed into the power supplies at the factory. The preset A/B ratio limit is the recommended value for operation of all ion sources. The PBN filament current limit is set for tungsten wire, 0.010 inch. An RF power limit of 225 W is recommended for the Ion Tech 3 cm RF ion source. Although the

above are the recommended limits programmed into the RFB-1200, the limits can be changed. New values will be stored along with the operating parameters in one of the two nonvolatile memories.

Section 4

INSTALLATION

WARNING

READ ALL INSTRUCTIONS BEFORE CONNECTING POWER

Inspection:

Every effort has been made to package and ship the RFB-1200 as carefully as possible. However, to insure that the system has arrived intact, unpack and inspect it carefully for any damage. If any damage is noted, immediately notify Ion Tech, Inc. at (303) 221-1807 and notify the shipping company.

Assembly of the RFB-1200:

The RFB-1200 is designed for either bench or rack mount. Normally, it is shipped with the rack mount brackets attached.

1. Install the RFB-1200 in the desired location. If cabinet installation is desired, use the four holes in the rack mount brackets to attach the RFB-1200 to a cabinet.

CAUTION

Do not obstruct the cooling ports on the RFB-1200. The cooling air ports are located in the sides and rear of the chassis, and the cooling fan port is located in the rear panel of the chassis. An insufficient supply of cooling air will result in overheating of the RFB-1200, causing a thermal shutdown and possible damage.

2. Connect the 7 pin male connector of the SOURCE/BEAM cable to the SOURCE/BEAM connector (P33) on the back panel.
3. Connect the 4 pin male connector of the NEUTRALIZER cable to the NEUTRALIZER connector (P32) on the back panel.

NOTE: In some installations the SOURCE/BEAM and the NEUTRALIZER conductors are contained in a single multi-conductor cable which splits to two connectors at the power supply end and terminates with a single SOURCE/BEAM/NEUTRALIZER connector at the source end.

4. Connect the SOURCE/BEAM cable to the RF Ion Beam Source as shown in Figure 4-1.
5. Connect the NEUTRALIZER cable to the RF Ion Beam Source as shown in Figure 4-1.

WARNING

INSURE THAT THE SHIELD AND THE GROUND CONDUCTOR IN THE SOURCE CABLE IS ATTACHED TO FACILITY GROUND WITH A LOW IMPEDANCE CONNECTION. FAILURE TO DO SO MAY RESULT IN PORTIONS OF THE POWER SUPPLY AND THE FACILITY FLOATING AT HIGH VOLTAGE.

6. If a probe is to be used, attach the PROBE cable to the probe connector (P32) on the back panel and then make the following connections at the vacuum system.

If the PROBE cable terminates in lugs, the "A" lug connects to the single-pin electrical feedthrough on the vacuum chamber. The "GND" lug connects to facility or earth ground.

If the PROBE cable terminates in a connector, attach the cable to the "PROBE" connector at the vacuum chamber.

7. Connect the INTERLOCK cable to the INTERLOCK connector (P31) on the back panel.
8. Connect the INTERLOCK cable to the series-connected, external interlock circuitry.

NOTE: a. When all series switches are closed, the external interlock conditions are met.

- b. The INTERLOCK cable is connected to the RF5S ANALOG INTERFACE cable via a 3 foot long jumper (hardwired without a connector). This jumper provides interlock protection which turns off the RF output of the RF5S generator whenever the RFB-1200 interlock circuit is open or the RFB-1200 power is turned off.

CAUTION

The external interlock circuit must be wired per figure 4-1. Connection to a powered circuit will result in damage to the RFB-1200 and the RF5S.

9. Verify that the POWER ON/OFF switch is in the OFF (0) position and that the rear circuit breaker is in the ON (1) position.
10. Connect the line cord to a power source capable of 200-220 VAC, 50-60 Hz, 20 A, single phase.
- a) If connecting to a three-wire, 200- to 220-volt power service with two hot lines and facility ground, the RFB-1200 power cord is wired as follows:

<u>Service</u>	<u>RFB-1200</u>
Hot	Blue (White)
Hot	Brown (Black)
Ground	Green (Green)

b) If connecting to a three-wire, 200- to 220-volt power service with one hot line, a neutral line, and facility ground, the RFB-1200 power cord is wired as follows:

<u>Service</u>	<u>RFB-1200</u>
Hot	Brown (Black)
Neutral	Blue (White)
Ground	Green (Green)

11. This completes installation of a single RFB-1200 Ion Source Power Supply.

Assembly of the RF Generator and Matching Network:

The following summary of installation and electrical connections for the RF5S RF generator and AM-5 matching network is provided here for the user's convenience, and because it contains information specific to an RF ion source installation. It is recommended that the user read carefully the INSTALLATION sections of the RF5S and the AM-5 Operator's Manuals before proceeding.

1. Install the RF5S generator and the AMPS-2A controller for the matching network in the desired location. It is recommended that they be installed in close proximity to the RFB-1200 for ease of connection and operation. Both of these units are provided with rack mount hardware.

2. Mount the AM-5 matching network near or on the vacuum chamber within 18" of the RF power feedthrough for the ion source.
3. Make the following connections between components as shown in Figure 4-1.
 - (a) Connect one of the 18" long RG-8 cables between the AM-5 (connector J3-1) and the RF power feedthrough (connector labeled #1).
 - (b) Connect the other 18" long RG-8 cable between the AM-5 (connector J3-2) and the RF power feedthrough (connector labeled #2).

NOTE: The two 18" long RG-8 cables are tie-wrapped together when shipped. If it is necessary to remove these ties during installation, it is important that they are replaced prior to operation. It is also important for proper operation that the cable length not be modified. Both the cable length and parallel routing are necessary for proper tuning of the matching network.

- (c) Connect the RS-232 INTERFACE* cable between the RS-232C port on the RF5S and port labeled "TO RF5S" on the RFB-1200.

* Designations refer to printed labels on interface cables.

- (d) Connect the ANALOG INTERFACE* cable to the ANALOG INTERFACE port on the RS5S generator, the P7 connector on the AM-5 matching network, and the J2 connector on the AMPS-2A controller.

NOTE: The ANALOG INTERFACE cable is connected to the RFB-1200 external INTERLOCK cable via a 3 foot long jumper (hardwired without a connector). This jumper provides interlock protection which turns off the RF output of the RF5S generator whenever the RFB-1200 interlock circuit is open or the RFB-1200 power is turned off.

- (e) Connect the controller interface AMPS-2A cable from connector J1 on the AMPS-2A controller to P6 on the AM-5 matching network.

NOTE: The AM-5 matching network has an interlock switch on its chassis cover. The connections for this switch are on the small two pin connector attached to the CONTROLLER INTERFACE cable* with red and white wires. It is recommended that this interlock switch be wired into the RFB-1200 series interlock circuit.

* Designations refer to printed labels on interface cables.

- (f) Connect the 12 foot long RG-213 cable between the RF OUTPUT connector J1 on the RF5S generator and the RF INPUT connector J2 on the AM-5 matching network.
 - (g) Ground the chassis of the AM-5 to the vacuum chamber and the chamber to an earth ground with low impedance connections. Braided or solid copper strap is recommended.
4. Connect the AC line cord on the RF5S generator to the facility power source according to the instructions in the RF5S Operator's Manual.
 5. Connect the AC line cord on the AMPS-2A controller to a 115 VAC facility power source.
 6. This completes installation of the RF generator, matching network and controller.

Section 5

CONTROLS

A. FRONT PANEL CONTROLS - (see Figure 5-1)

1. POWER - ON/OFF - controls the AC power to the RFB-1200.

When the power switch is turned on, power is applied to the CONTROLLER board and to all the displays on the display board, and the test program is initiated. After approximately six (6) seconds, the main contactor is energized. As each power supply is checked, the letter "P" will be visible on the upper display of that power supply. The POWER switch is controllable in all modes of operation.

2. SOURCE - ON/OFF - turns on the RF power at the RF5S RF generator and ramps the RF power to the target value entered in the RFB-1200. It also applies power from the NEUTRALIZER power supplies to the appropriate pins of the NEUTRALIZER connector (P32), located on the rear panel of the RFB-1200. Illumination of the word "SOURCE" above the switch indicates that the SOURCE switch has been selected. When SOURCE is ON the accelerator output will be clamped at ground and the Neutralizer emission current will rise to 300 mA and remain there until an ion source discharge is sensed. After

the source discharge has ignited, the neutralizer emission current will ramp to its target value.

3. BEAM - ON/OFF - applies power from the BEAM and ACCELERATOR power supplies to the appropriate pins of the SOURCE connector (P33) located on the rear panel of the RFB-1200. When the BEAM switch has been selected, the word "BEAM" will illuminate above the switch.
4. KEYLOCK - enables or disables the MODE switch. In the DISABLE position, the MODE switch will not function, and whichever mode is active will be locked in. To change the mode of operation, the KEYLOCK switch must be in the ENABLE position.
5. MODE - selects the mode in which the power supply will operate. To change from one mode to another, the KEYLOCK switch must be in the ENABLE position. See Section 6 through Section 9 for detailed descriptions of each mode.

MANUAL: All parameters, except beam current, can be adjusted from the front panel. Operating conditions can be stored in or recalled from memory. All switches on the front panel are active in this mode. The illumination of the word "MANUAL" indicates that the MANUAL mode has been selected.

LOCAL: Only the following parameters can be adjusted: beam voltage, beam current, accelerator voltage, A/B ratio, PBN Filament limit, RF Power limit and emission current ratio. All remaining parameters cannot be changed from the front panel. The microprocessor will control the nonadjustable parameters to obtain the requested values. Operating conditions can be stored in or recalled from memory. All the front panel switches are active in this mode. The illumination of the word "LOCAL" above the MODE switch indicates that LOCAL mode has been selected.

LOCAL RESTRICTED: No parameter can be adjusted in this mode. However, parameters can be recalled from memory. When in LOCAL Restricted mode, the enunciators above the FUNCTION (8) and MODULE (7) switches will blank, while the words "LOC RES" will illuminate above the MODE switch. All switches, except the FUNCTION and MODULE switches, are active in this mode.

REMOTE: allows the RFB-1200 to be controlled by a computer or by remote switches. The computer can select the REMOTE mode, recall conditions from either memory, and turn on or turn off the SOURCE and BEAM switches. All adjustable parameters can be changed via the controlling computer. If remote switches are used, they can turn on or turn

off the SOURCE and BEAM switches and can select either MEMORY 1 or MEMORY 2. In REMOTE mode, the SOURCE and BEAM switches can be turned off but cannot be turned on at the front panel. The KEYLOCK (4), MODE (5), POWER (1), and PROBE (19) switches are fully functional, while the MEMORY (6), MODULE (7), and FUNCTION (8) switches are not functional. The word "REMOTE" will illuminate above the MODE switch when the REMOTE mode has been selected.

6. MEMORY - selects one of the two sets of parameters that are stored in memory.

MEM 1: When "1" is illuminated above the MEMORY switch, the power supply will operate from memory location one (1). When any parameter is changed, the new value will be stored automatically in MEMORY (1).

RCL: When RECALL has been selected, the parameters will be displayed from the memory location not being used. While the parameters are being recalled from a memory location, the letters "RCL" will illuminate above the MEMORY switch. After approximately four (4) seconds, the displays will return to their previous readings. The running conditions will not be affected by selecting RECALL.

MEM 2: When "2" is illuminated above the MEMORY switch, the power supply will operate from memory location two (2). When any parameter is changed, the new value will be stored automatically in MEMORY 2.

7. MODULE - selects which power supply can have changes made to its parameters.

BEAM: The word "BEAM" will illuminate above the MODULE switch when the BEAM power supply has been selected. Beam voltage is the only parameter that can be adjusted in MANUAL.

ACCEL: When the letters "ACCEL" are illuminated above the MODULE switch, the ACCELERATOR power supply has been selected. Both the accelerator voltage and the A/B ratio are adjustable.

NEUT: The letters "NEUT" will illuminate above the MODULE switch when the NEUTRALIZER power supply has been selected. The filament current limit is the only adjustable parameter.

EMISS: The letters "EMISS" will illuminate above the MODULE switch when the neutralizer EMISSION power supply has been selected. The EMISSION current and limit are the only adjustable parameters.

RF: The letters "RF" will illuminate above the MODULE switch when the RF power supply has been selected. The FORWARD POWER and POWER LIMIT are the only adjustable parameters.

8. FUNCTION - selects which parameter is to be adjusted.

VOLTAGE: Voltage is adjustable only for the BEAM and ACCELERATOR power supplies. When voltage has been selected, the word "VOLTAGE" will illuminate above the FUNCTION switch.

CURRENT: Current is adjustable when the neutralizer EMISSION power supply has been selected in MANUAL mode or when the BEAM power supply has been selected in LOCAL mode. If current has been selected, the word "CURRENT" will illuminate above the FUNCTION switch.

A/B: The A/B RATIO (Accelerator-to-Beam Current Ratio) can be adjusted only when the ACCELERATOR power supply has been selected. "A/B" will illuminate above the FUNCTION switch when the A/B RATIO has been selected.

LIMIT: The limit is adjustable when the NEUTRALIZER power supply, RF power supply, or Emission supply has been selected. When limit has been selected, the word "LIMIT" will illuminate above the FUNCTION switch.

POWER: The power is adjustable only when the RF power supply has been selected. When selected, the word "POWER" will illuminate.

9. ADJUST - The ADJUST knob is used to change the value of a selected parameter. Turning the knob clockwise increases the value of the parameter, while counterclockwise turns decrease the value. If the selected power supply is off, the target parameter will be changed by turning the ADJUST knob, and changes can be viewed on the appropriate display. When the selected power supply is operating and the ADJUST knob is turned, the target parameter will be changed, but the power supply will react to the new parameter immediately. Target parameters are displayed while the knob is being turned; actual values are displayed when the knob is not being turned. Anytime the knob is turned, the new value is stored automatically in the selected memory.
10. FORWARD POWER - indicates the amount of RF power being supplied to the RF source.
11. REFLECTED POWER - indicates the amount of RF power being reflected back to the RF generator.
12. BEAM CURRENT DISPLAY - displays the amount of ion current being extracted from the ion source.

13. BEAM VOLTAGE DISPLAY - displays the amount of voltage (positive with respect to facility ground) applied to the ion source discharge.

NOTE: The final directed energy of the beam ions is equal to the potential difference between the discharge chamber ions and facility ground. This potential is the BEAM VOLTAGE displayed by the RFB-1200 power supply. It is equal to the positive voltage applied to the screen grid by the BEAM power supply, plus the discharge chamber plasma potential. Because the ions in the discharge chamber have a self-bias (or plasma) potential about 25 volts positive of the screen grid during normal operation, the ion beam energy is equal to the potential applied to the screen plus 25 volts. The RFB-1200 power supply compensates for this 25 volt self-bias, so that the displayed BEAM VOLTAGE is equal to the actual ION BEAM ENERGY.

14. ACCELERATOR CURRENT DISPLAY - indicates the amount of current being collected by the accelerator (downstream) extraction grid.

15. ACCELERATOR VOLTAGE DISPLAY - indicates the amount of voltage (negative with respect to facility ground) applied to the accelerator (downstream) extraction grid.

16. NEUTRALIZER EMISSION CURRENT DISPLAY - indicates the amount of electron emission current being supplied by the NEUTRALIZER power supply into the ion beam.
 17. CURRENT/VOLTAGE - indicates the amount of current being supplied by the NEUTRALIZER power supply for heating of the neutralizer filament or the voltage difference between the body and the filament.
 18. PROBE - The PROBE switch applies the output of an internal probe supply to the appropriate pin of the PROBE connector (P30) on the rear panel of the RFB-1200. If the probe cable is attached to a functional probe, the collected ion current will be visible on the PROBE display. When the switch is in the off (0) position, the display will be blank.
- B. REAR PANEL - (see Figure 5-2)
1. POWER LINE INPUT - provides connection points for attaching the power line cord to the RFB-1200.
 2. SOURCE/BEAM CONNECTOR (P33) - output connector for the BEAM and ACCELERATOR power supplies and the SOURCE cable.
 3. NEUTRALIZER CONNECTOR (P32) - output connector for the NEUTRALIZER power supply and the NEUTRALIZER cable.

4. CIRCUIT BREAKER (CB1) - primary circuit breaker for the input power.
5. FUSE (F9) - This fuse is not active in the RFB-1200.
6. COOLING FAN - circulates air through the entire chassis of the RFB-1200.
7. RS-232 INTERFACE CONNECTOR (J28) - connector for RS-232 interface.
8. FLOW CONNECTOR (P29) - Not applicable.
9. FUSE (F10) - the probe fuse: protects circuitry in the probe power supply.
10. PROBE CONNECTOR (P30) - output cable connection for the probe supply.
11. INTERLOCK CONNECTOR (P31) - output cable connection of the external interlock circuit.
12. EMISSION FUSE (F8) - protects the neutralizer emission circuitry.
13. RF5S INTERFACE (TO RF5S) - connector for RS-232 interface with the RF5S.

C. CONTROLLER BOARD SWITCH DEFINITIONS - (see Figure 5-3)

The RFB-1200 is designed to allow the user to select different operating options. The options are selected and programmed into the power supply by the appropriate posi-

tioning of switches located on the CONTROLLER board. These switches can be located by using Figure 5-3. To change switch settings refer to Section 8-E.

Using the following definitions, select the options desired. The "ON" position indicates that the switch is toward the top, and the "OFF" position indicates that the switch is toward the bottom of the board.

1. SWITCH SETTINGS FOR SWITCH BANK #1:

SW1 1 thru 4, 7, 8 - for factory use only. Do not change the positions of these switches.

SW1-5, SW1-6 - selects the baud rate. Baud rate represents the speed with which the RFB-1200 will communicate to an external computer via an RS-232 interface.

<u>BAUD RATE</u>	<u>SW1-5</u>	<u>SW1-6</u>
9600	ON	OFF
4800	OFF	ON
2400	ON	ON
1200	OFF	OFF

The baud rate is factory preset to 1200 bps.

2. FACTORY-SET POSITIONS FOR SWITCH BANK #1:

FACTORY SWITCH SETTINGS FOR SWITCH BANK #1

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
* <u>OFF</u>	<u>OFF</u>	<u>OFF</u>	<u>OFF</u>	OFF	OFF	<u>OFF</u>	<u>OFF</u>

*The underlined switch settings are for factory use only.

All switches will be set in the factory.

3. SWITCH SETTINGS FOR SWITCH BANK #2:

SW2-1 - Not used.

SW2-2 - CONTROLLER Board Alarm Switch

ON - In the "ON" position, the CONTROLLER board alarm will sound when a FATAL error has been detected and will sound at power-up of the RFB-1200.

OFF - In the "OFF" position, the CONTROLLER board alarm will not sound when a FATAL error has been detected and will not sound at power-up of the RFB-1200.

4. FACTORY-SET POSITIONS FOR SWITCH BANK #2:

FACTORY SWITCH SETTINGS FOR SWITCH BANK #2

SW1	SW2
OFF	ON

Section 6

MANUAL OPERATION: RFB-1200

Your RFB-1200 power supply was used for the preshipment check out of your ion source. At that time, typical operating conditions were programmed into its memory registers. These operating parameters are indicated on the checkout data sheet shipped with the source. After installation in your vacuum system, it is recommended that you use the simplified start up instructions in the OPERATION section of the Ion Source Manual to verify proper operation of your ion source and power supply. This will provide a quick and easy way to become familiar with your equipment. The RFB-1200 OPERATION sections below (Sections 6 through 9) provide more detailed instructions on operation and parameter adjustment for the various RFB-1200 operating modes.

Prior to any operation of the RFB-1200, insure that:

- (1) The appropriate RF ion beam source has been properly installed in the vacuum system, according to instructions in the ion source manual.
- (2) Sufficient gas flow is being introduced into the ion beam source and the PBN for proper operation. Refer to the ion source manual for approximate gas flow levels.
- (3) The pressure within the vacuum system is 5×10^{-4} Torr or lower with the ion source and PBN gas flowing.

(4) The RS-232 cable is connected between the connector labeled "TO RF5S" on the RFB-1200 and the RS-232C connector on the RF5S RF Generator.

(5) All connections are made from the RF5S RF Generator to the source and tuning network. See Figure 4-1.

A. START-UP

1. POWER switch ON.

(a) The fan will start.

(b) Random displays will come on, and the audio alarm will sound. This condition will last for approximately one second.

(c) The CONTROLLER will self-test each of the power supplies. A power supply has been tested when "P" appears in the top display. Testing of each of the supplies will proceed from right to left.

(d) After approximately 6 seconds, a click will be heard when the main contactor energizes.

(e) After each of the power supplies has been tested, the RFB-1200 is ready to operate an ion source.

Selecting Manual Mode:

2. If the RFB-1200 is to operate in MANUAL mode, use the following steps:

- (a) Turn the KEYLOCK switch (4) to the MODE ENABLE position.
- (b) Select MANUAL using the MODE switch (5). The word "MANUAL" will illuminate above the MODE switch when MANUAL mode has been selected.
- (c) If the user desires to "lock" the power supply in MANUAL mode, turn the KEYLOCK switch (4) to the DISABLE position and remove the key.

Selecting Memory:

- 3. With MEMORY switch (6), select which memory location the RFB-1200 will use to store parameters. The number of the selected memory will illuminate above the MEMORY switch.

Selecting the PBN Filament Current Limit:

- 4. (a) Select the NEUT power supply with the MODULE switch (7) and the LIMIT with the FUNCTION switch (8). The letters "NEUT" will illuminate above the MODULE switch and the word "LIMIT" will illuminate above the FUNCTION switch.
- (b) Adjust the current limit upwards or downwards as needed. The value will be visible on the CURRENT/VOLTAGE display (17).

NOTE: Different sizes and different types of filament wire may require adjustments to the PBN filament current limit.

NOTE: PBN current limit will be factory-set at 6.5A. This value is recommended for a 0.010 inch (.25 mm) diameter tungsten filament.

- (c) The final selected value is stored automatically in whichever memory is indicated above the MEMORY switch (6).

Selecting the PBN Emission Current:

5. Select an emission current that will be greater than the expected beam current.
 - (a) Select the EMISSION power supply with the MODULE switch (7), and CURRENT with the FUNCTION switch (8). "EMISS" and "CURRENT" should illuminate above the appropriate switches.
 - (b) Enter the desired value by turning the ADJUST knob (9). The value will be visible on the NEUTRALIZER EMISSION CURRENT display (16).
 - (c) As the ADJUST knob (9) is turned, the PBN emission current is entered automatically into the selected memory location.

Selecting the RF Forward Power Limit:

6. (a) Select the RF power supply with the MODULE switch (7) and LIMIT with the FUNCTION switch (8). The words "RF" and "LIMIT" will illuminate above the appropriate switches.
- (b) Adjust the limit upwards or downwards as needed. The RF forward power cannot be adjusted above the limit value. The limit value will be visible on the FORWARD POWER display (10).

Selecting the RF Forward Power:

7. For ease of starting, select a value between 60 and 80 Watts.
 - (a) Select the RF power supply with the MODULE switch (7) and POWER with the FUNCTION switch (8). The words "RF" and "POWER" will illuminate above the appropriate switches.
 - (b) Enter the desired value by turning the ADJUST knob (9). The value will be visible on the FORWARD POWER display (10).
 - (c) As the ADJUST knob (9) is turned, the RF forward power is entered into the selected memory location.

Applying Power to the Source:

WARNING

ALL POWER OUTPUTS CAN BE LETHAL

8. Turn on the front panel power switches to the RF5S generator and the AMPS-2A matching network controller, and set the AMPS-2A TUNE and LOAD toggle switches to REMOTE.
9. Press the SOURCE ON/OFF switch (2). The word "SOURCE" will illuminate above the SOURCE switch.

When the SOURCE switch is activated, several changes will be observed on the front panel:

- (a) The RFB-1200 will turn the RF power "on" and the red RF ON indicator will light on the RF5S generator. This will take about 5 seconds. The RF power level will then ramp to a target value and the automatic matching network will tune the system to a few watts of reflected power. This will also take a few seconds.

NOTE: The AM-5 matching network and AMPS-2A controller were set up at the factory to automatically tune to a reflected power level which provides good discharge stability. The reflected power will range

from zero to approximately 15 Watts depending on the forward power level. Call Ion Tech for assistance if the reflected power does not drop below 15 Watts after tuning.

- (b) The PBN filament current (NEUTRALIZER CURRENT) will increase until the BODY VOLTAGE has dropped to between 20 V and 25 V.

NOTE: The PBN filament current will not increase beyond the NEUTRALIZER LIMIT value. If the PBN BODY VOLTAGE does not drop below 25 V, either the NEUTRALIZER LIMIT value or the gas flow rate probably needs to be increased.

- (c) The NEUTRALIZER EMISSION current will increase to 300 mA and remain there until the RFB-1200 determines that the ion source discharge has been started. Once the source discharge has started, the emission current will ramp to the requested value.

NOTE: If the NEUTRALIZER EMISSION does not rise to 300 mA, increase the PBN gas flow rate. A zero emission current probably indicates a zero target value. Go to MANUAL mode and set a non-zero emission current target value.

(d) When the SOURCE switch is turned on, the above steps sequence automatically and are visible on the RFB-1200 front panel. In addition, the beam voltage is cycled on and off automatically to aid in starting the source discharge. This beam voltage pulsing is not evident from the front panel but is usually visible in the plasma discharge in front of the ion source. This pulsing cycle raises the beam voltage to 1000 V for one second then turns it off for four seconds. This sequence begins after the RF power reaches the target value and will continue until the power supply senses that the discharge has started. Normally the discharge will start on the first voltage pulse. If this does not happen then the source gas flow rate is probably too low and should be increased.

NOTE: In some applications substrates may be damage-sensitive to the small flux of 1000 eV ions generated during the one second beam pulse. If such substrates cannot be protected by use of a shutter during ion source start up, special software with lower beam start up voltages (down to 100 V) can be provided. Operation of sources with this software will require higher source gas flow rates

for starting (up to 6.0 SCCM with argon and up to 10.0 SCCM with oxygen). Please contact Ion Tech, Inc., if your application requires this type of software.

- (e) If the BEAM button is pressed before the discharge has started an error message E-72 will be displayed until the discharge starts.

Selecting the Beam Voltage:

10. For initial start-up purposes, a value of 1000V can be used.

- (a) Select the BEAM power supply with the MODULE switch (7). The words "BEAM" and "VOLTAGE" will be illuminated above the appropriate switches.
- (b) Enter the desired voltage by turning the ADJUST knob (9). The changing values will be visible on the BEAM VOLTAGE display (13).
- (c) As the ADJUST knob (9) is turned, the beam voltage is entered automatically into the selected memory.

Setting the A/B Ratio:

11. The recommended A/B ratio is 10% for all sources. The A/B ratio is factory-set for 10%.

- (a) Select the ACCELERATOR power supply with the MODULE switch (7). The letters "ACCEL" will illuminate above the MODULE switch.

- (b) Select the A/B RATIO with the FUNCTION switch (8). "A/B" will illuminate above the FUNCTION switch.
- (c) With the ADJUST knob (9), select the accelerator-current-to-beam-current ratio. The A/B ratio will be visible in the ACCELERATOR VOLTAGE display (15).
- (d) The final selected ratio is stored automatically in whichever memory is indicated above the MEMORY switch (6).

Selecting the Accelerator Voltage:

12. For initial start-up purposes, a value of 250 V can be used.

- (a) Select the ACCELERATOR power supply with the MODULE switch (7) and VOLTAGE with the FUNCTION switch (8). "ACCEL" and "VOLTAGE" should be illuminated above the appropriate switches.
- (b) Enter the desired voltage by turning the ADJUST knob (9). The changing value will be visible on the ACCELERATOR VOLTAGE display (15).
- (c) As the ADJUST knob (9) is turned, the accelerator voltage is entered automatically into the selected memory.

Starting the Ion Beam:

WARNING

ALL POWER OUTPUTS CAN BE LETHAL

Verify that the source discharge has started by observing the neutralizer emission current. Prior to starting, the emission current will be set at 300 mA. When the discharge starts the emission current will ramp to its operating target value.

13. After the source discharge has started, press the BEAM ON/OFF switch (3). The word "BEAM" will illuminate above the BEAM switch.

NOTE: If the BEAM button is pressed before the discharge has started an error message E-72 will be displayed until the discharge starts.

Some value of beam current should be visible on the BEAM CURRENT display (12), and some value of accelerator current should be visible on the ACCELERATOR CURRENT display (14). The actual current values depend on other parameters, such as: source size, RF power, gas flow, and beam and accelerator voltage requests.

NOTE: At this point, the ion source should be operating and extracting an ion beam. Adjust the system to the desired operating conditions, by using the following procedures:

Adjusting Beam Current:

14. Select the desired beam voltage as described in Section 6-10 (a through c).
15. Adjust the RF power to obtain the desired beam current as described in Section 6-7 (a through c).

Adjusting for a Minimum Accelerator Current:

16. Adjust the accelerator voltage, as described in Section 6-12 (a through c), to minimize the accelerator current.

Normally, the accelerator current should be no more than 10% of the beam current. Excessive accelerator currents could be an indication of too high of a system pressure, coated grid insulators, or misaligned grids. Consult the ion source manual for troubleshooting accelerator system problems.

Often the excessive accelerator current can be lowered by adjusting the operating conditions and/or gas flow rate to bring the A/B ratio within the recommended limits.

NOTE: When the accelerator-current-to-beam-current ratio exceeds the programmed A/B ratio value, an audio alarm will sound, if enabled, and an error message ("E-25") will appear on the ACCELERATOR CURRENT display.

CAUTION

Running the ion source with a high accelerator current could cause damage to the grids or rapid coating of the quartz discharge chamber with material back-sputtered from the grids.

Adjusting Neutralizer Emission Current:

17. Adjust the PBN emission current until the value is approximately 110%-125% of the beam current. See Section 6-5 (a through c).

When the PBN emission current is satisfactory, the RFB-1200 should be completely adjusted for operation.

B. STORING OPERATING CONDITIONS

All adjustable operating conditions are stored automatically in the selected memory location when the ADJUST knob (9) is turned. This is the only method of storing parameters.

C. RECALLING OPERATING CONDITIONS

Selecting RCL with the MEMORY switch (6), allows viewing of the operating conditions stored in the unused memory location. After approximately four (4) seconds, the original parameters will be displayed.

Section 7

LOCAL OPERATION

Often operating conditions must be maintained over long periods of time without constant operator attention. The RFB-1200 incorporates a LOCAL or automatic mode of operation: the internal microprocessor monitors and controls several parameters. The accelerator-current-to-beam-current ratio (A/B ratio) is monitored. If the value exceeds the limit programmed into the A/B ratio, an error message ("E-25") will be visible on the ACCELERATOR CURRENT display (15), and a continuous audio signal will be heard if the audio alarm is enabled.

With the RFB-1200 in the LOCAL mode, the internal microprocessor constantly monitors the beam current and maintains it at the requested value by making adjustments to the RF5S forward power. The microprocessor also monitors the neutralizer emission current and adjusts the supply as required to keep the emission-current-to-beam-current (E/B) ratio at the requested value. (This value is displayed in percentage as the EMISS LIMIT.)

In LOCAL mode, stored values can be recalled from the memories, and switches and the ADJUST knob on the front panel can be used to make changes in beam voltage, beam current, accelerator voltage, A/B ratio, E/B ratio, neutralizer limit, and RF forward power limit.

Use the following procedures for operation in this mode:

1. POWER ON/OFF switch to ON position. Wait for completion of the self-test procedure.
2. Select the LOCAL mode with the MODE switch (5). The word "LOCAL" will illuminate above the MODE switch.
3. Select the desired memory with the MEMORY switch (6). The parameters stored in the selected memory location will be displayed immediately on the front panels and can be verified.
4. Insure that the chamber pressure and ion source gas flow rate are adequate for the requested conditions.
5. Press the SOURCE switch (2). The word "SOURCE" should illuminate above the switch.

WARNING

ALL POWER OUTPUTS CAN BE LETHAL

When the SOURCE switch is pressed, the following should occur:

- (a) The PBN filament current will increase until the body voltage has dropped to between 20 V and 25 V. However, the PBN filament current will not increase beyond the limit.

- (b) The neutralizer emission current will be set at 300 mA until the RFB-1200 determines that the ion source discharge has been started. Once the source discharge has started, the emission current will ramp to its requested value.
- (c) The RF power on the RF5S will turn on and go to 80 Watts. Once the RFB-1200 has determined that a discharge has been ignited the RF power will ramp to give the requested beam current. Forward and reflected power will be shown on the appropriate displays of the RFB-1200.
6. Press the BEAM switch (3). The word "BEAM" should illuminate above the MODULE switch (7).

WARNING

ALL POWER OUTPUTS CAN BE LETHAL

The beam current, beam voltage, and accelerator voltage should ramp to their requested values.

NOTE: (a) An error message E-71 indicates the beam current has dropped to zero, i.e. the discharge has extinguished. If this happens shortly after the BEAM is turned on, the source may need a longer warm up

period. Press SOURCE to restart the discharge and allow a few minutes for the source to warm up.

- (b) When changing from MANUAL mode to LOCAL mode, the displayed beam current in MANUAL mode will become the new beam current target for LOCAL mode. This value will be stored in whichever memory location is being used.

Adjusting Beam Current:

- 7. (a) Select the Beam supply with the MODULE switch and CURRENT with the FUNCTION switch. The words "BEAM" and "CURRENT" should be illuminated above the appropriate switches.
- (b) Enter the desired value by turning the ADJUST knob (9). The changing target value will be displayed in the BEAM CURRENT window (12).
- (c) The RFB-1200 will adjust the power on the RF5S until the desired Beam current is reached.

Adjusting (E/B) Emission-to-Beam Current Ratio:

- 8. (a) Select the Emission supply with the MODULE switch (7) and LIMIT with the FUNCTION switch (8). The words "EMISS" and "LIMIT" should be illuminated above the appropriate switches.

(b) Enter the desired (E/B) emission-to-beam current ratio by turning the ADJUST knob (9). The value will be visible on the EMISSION CURRENT display (16) as a percentage. When the Source and Beam are on, the RFB-1200 will automatically adjust the neutralizer emission current supply to obtain the requested E/B ratio.

(c) As the ADJUST knob (9) is turned, the emission-to-beam current ratio is entered into the selected memory location.

Changing Memory Locations:

9. Operating conditions that are stored in the unused memory location can be viewed by selecting RCL with the MEMORY switch (6).
10. To change to the other memory location, use the MEMORY switch (6). The power supply will ramp to the new parameters as soon as the memory location is changed.

Section 8

LOCAL RESTRICTED OPERATION

In LOCAL restricted mode, operation is limited to conditions recalled from memory. The operator cannot change any parameters, and the ADJUST knob (9) is nonfunctional. All switches are active, except the MODULE (7) and FUNCTION (8) switches.

The LOCAL restricted mode of operation is useful when limited operator intervention is desired. Parameters must be stored in the memory locations in advance. First, select the desired operating conditions in MANUAL or LOCAL mode; second, select the LOC RES mode with the MODE switch (5); and finally, turn the KEYLOCK switch (4) to the DISABLE position and remove the key. The operator can turn on/off the SOURCE (2) or BEAM (3) switches and change from one memory location to the other. The RFB-1200 will function as if it were in LOCAL mode.

Section 9

REMOTE OPERATION

The RFB-1200 can be controlled remotely, by a computer, through an RS-232C interface or by remote switches. To operate by remote switches the RFB-1200 must be in REMOTE mode.

The only front panel switches that are functional in the REMOTE mode are the MODE (5) and the SOURCE (3) and BEAM (2) OFF switches.

Section 10

SERIAL COMMUNICATIONS

The RS-232C interface standard¹ establishes electrical and mechanical interface requirements but does not define the exact function of all the signals that are used by various manufacturers of data communications equipment and serial I/O devices. Consequently, when the serial interface is plugged into an RS-232 connector, there is no guarantee the device can communicate unless the user has configured optional parameters to match the requirements of the computing device.

A manual accompanying the computing device should describe electrical and mechanical interfacing, setting the interface format, and the data transfers. The following information is needed for connection of the computing device to the RFB-1200:

1. The serial communication (baud) rate is selected on the CONTROLLER board with SW1-5 and SW1-6. Various baud rates may be selected (see Section 5-D, Controller Board Switch Definitions). The factory setting is 1200 baud.
2. The RFB-1200 CONTROLLER is set to receive data with 1 start bit, 8 data bits, 2 stop bits, and no parity.
3. For the RS-232C connector pinout, see Figure 11-1.

¹ RS-232C is a data communication standard established and published by the Electronic Industries Association (EIA). Copies of the standard are available from the association at 2001 Eye Street, N.W., Washington, DC 20006. The equivalent for European applications is CCITT V. 24.

A command is executed when a carriage return <cr> is received. All characters are echoed by the RFB-1200. Two commands per second will be accepted, commands received at a faster rate are placed in a 250 character buffer. When this buffer is filled, additional characters will be lost.

The RS-232 communications are active in all modes.

RESPONSES:

UNLESS STATED OTHERWISE ALL COMMANDS THAT ARE ACCEPTED WILL RESPOND WITH:

<lf><cr>OK<lf><cr><eot>

IF THE COMMAND IS NOT ACCEPTED THE RESPONSE WILL BE:

<lf><cr>?<lf><cr><eot>

A. COMMAND SUMMARY TABLE

<u>COMMAND</u>	<u>DESCRIPTION</u>
A	ATTENTION
AB	SET A/B RATIO
AD	ENABLE/DISABLE AUTO DATA LOGGING
AE	ENABLE/DISABLE AUTO ERROR LOGGING
AV	SET ACCELERATOR VOLTAGE
B	TURN BEAM SUPPLIES ON/OFF
BE	SET BEAM CURRENT TOLERANCE
BI	SET BEAM CURRENT
BV	SET BEAM VOLTAGE
EB	SET E/B RATIO

M SET POWER SUPPLY MODE

NE ENABLE/DISABLE E/B RATIO ERROR
NI SET NEUTRALIZER CURRENT
NK ENABLE/DISABLE FRONT PANEL
NL SET NEUTRALIZER LIMIT

PF SET FORWARD POWER
PL SET FORWARD POWER LIMIT

R RECALL MEMORY
RC REQUEST RUNNING CONDITIONS, CONDENSED FORMAT
RH MANUAL DATA LOG REQUEST, NO HEADER
RN REQUEST TARGET PARAMETERS, CONDENSED FORMAT
RP REQUEST TARGET PARAMETERS
RS MANUAL DATA LOG REQUEST
RST RESET RFB-1200

S TURN SOURCE SUPPLIES ON/OFF

T SET AUTO DATA LOGGING INTERVAL

V REQUEST POWER SUPPLY VERSION
VI REQUEST POWER SUPPLY VERSION, CONDENSED FORMAT

B. DETAILED COMMAND DESCRIPTION

COMMAND NAME: ATTENTION

SYNTAX: A<cr>

UNITS: N/A

RANGE: N/A

DESCRIPTION: THIS COMMAND IS USED TO PUT THE RFB-1200 INTO REMOTE MODE.

COMMAND NAME: SET ACCELERATOR TO BEAM CURRENT RATIO LIMIT
(A/B RATIO)

SYNTAX: AB[n]<cr>

UNITS: %

RANGE: n = 0 - 99

DESCRIPTION: SETS THE VALUE FOR THE ACCELERATOR CURRENT TO BEAM CURRENT RATIO LIMIT. IF THIS LIMIT IS EXCEEDED THE ERROR MESSAGE "E-25" WILL BE DISPLAYED IN THE ACCELERATOR CURRENT WINDOW.

EXAMPLE:

TO SET THE A/B RATIO LIMIT TO 15% SEND THE FOLLOWING
COMMAND:

AB15<cr>

COMMAND NAME: AUTOMATIC DATA LOGGING

SYNTAX: AD[N]<cr>

UNITS: N/A

RANGE: n = 0 or 1

DESCRIPTION: THIS COMMAND IS USED TO ENABLE (AD1) OR DISABLE (AD0) AUTOMATIC DATA LOGGING.

WHEN ENABLED, THE RFB-1200 WILL TRANSMIT ITS ACTUAL RUNNING CONDITIONS AT THE TIME INTERVAL SPECIFIED BY THE "T<n>" COMMAND.

LOGGING WILL BEGIN WHEN THE SOURCE IS TURNED ON AND WILL END WHEN THE SOURCE IS TURNED OFF. SEE FIGURE 10-2 FOR SAMPLE PRINT OUT.

EXAMPLE:

TO DISABLE AUTO DATA LOGGING SEND THE RFB-1200 THE FOLLOWING COMMAND:

AD0<cr>

COMMAND NAME: AUTOMATIC ERROR LOGGING

SYNTAX: AE[n]<cr>

UNITS: N/A

RANGE: n = 0 or 1

DESCRIPTION: THIS COMMAND IS USED TO ENABLE (AE1) OR DISABLE (AE0) AUTOMATIC ERROR LOGGING.

WHEN ENABLED, THE RFB-1200 WILL TRANSMIT ANY ERROR CONDITIONS THAT OCCUR WHILE THE SOURCE AND BEAM ARE ON.

SEE FIGURES 10-5 AND 10-6 FOR SAMPLE PRINT OUTS.

EXAMPLE:

TO ENABLE AUTO ERROR LOGGING SEND THE RFB-1200 THE FOLLOWING COMMAND:

AE1<cr>

COMMAND NAME: SET ACCELERATOR VOLTAGE

SYNTAX: AV[n]<cr>

UNITS: VOLTS

RANGE: n = 0 - 1023

DESCRIPTION: SETS THE TARGET VALUE FOR THE ACCELERATOR VOLTAGE. WHEN THE BEAM IS ON THE ACCELERATOR VOLTAGE WILL RAMP TO THIS VALUE.

EXAMPLE:

TO SET THE ACCELERATOR VOLTAGE TO 400 VOLTS SEND THE FOLLOWING COMMAND:

AV400<cr>

COMMAND NAME: BEAM ON/OFF

SYNTAX: B[n]<cr>

UNITS: N/A

RANGE: n = 1 or 0

DESCRIPTION: USED TO TURN THE BEAM SUPPLY ON (B1) OR OFF (B0).

EXAMPLE:

TO TURN THE BEAM SUPPLY ON SEND THE COMMAND:

B1<cr>

COMMAND NAME: SET BEAM CURRENT TOLERANCE LIMIT

SYNTAX: BE[n]<cr>

UNITS: %

RANGE: n = 0 - 99

DESCRIPTION: SETS THE BEAM CURRENT TOLERANCE LIMIT. WHEN THE BEAM IS ON AND THE RFB-1200 IS NOT IN MANUAL MODE THE BEAM CURRENT WILL BE CHECKED TO SEE IF IT REMAINS WITHIN THE SPECIFIED LIMIT. IF IT IS OUT OF TOLERANCE FOR MORE THAN 1 SECOND, THE BEAM WILL BE SHUT OFF AND

AN E-13 DISPLAYED IN THE BEAM CURRENT WINDOW.
TO DISABLE THIS FEATURE SEND "BE0<cr>" TO THE
RFB-1200.

EXAMPLE:

TO SET THE BEAM CURRENT TOLERANCE LIMIT TO 5% SEND THE
FOLLOWING COMMAND:

BE5<cr>

COMMAND NAME: SET BEAM CURRENT

SYNTAX: BI[n]<cr>

UNITS: mA

RANGE: n = 0 - 300

DESCRIPTION: SETS THE TARGET VALUE FOR THE BEAM CURRENT.
WHEN THE BEAM IS ON AND THE RFB-1200 IS NOT
IN MANUAL MODE, THE BEAM CURRENT WILL RAMP TO
THIS VALUE.

EXAMPLE:

TO SET THE BEAM CURRENT TO 200 mA SEND THE FOLLOWING
COMMAND:

BI200<cr>

COMMAND NAME: SET BEAM VOLTAGE

SYNTAX: BV[n]<cr>

UNITS: VOLTS

RANGE: n = 50 - 1200

DESCRIPTION: SETS THE TARGET VALUE FOR THE BEAM VOLTAGE.
WHEN THE BEAM IS ON, THE BEAM VOLTAGE WILL
RAMP TO THIS VALUE.

EXAMPLE:

TO SET THE BEAM VOLTAGE TO 1000 VOLTS SEND THE FOLLOWING
COMMAND:

BV1000<cr>

COMMAND NAME: SET EMISSION TO BEAM CURRENT RATIO

SYNTAX: EB[n]<cr>

UNITS: %

RANGE: 100-255

DESCRIPTION: SETS THE VALUE FOR THE EMISSION TO BEAM CURRENT RATIO (E/B). WHEN THE RFB-1200 IS NOT IN MANUAL MODE, THE EMISSION CURRENT TARGET WILL BE CALCULATED AS FOLLOWS: $(BI_{targ} \times E/B) = EI_{TARG}$.

COMMAND NAME: SET MODE

SYNTAX: M[n]<cr>

UNITS: N/A

RANGE: n = 0, 1, 2, OR 3

DESCRIPTION: USED TO SET THE OPERATING MODE OF THE RFB-1200.

<u>n</u>	<u>MODE</u>
0	MANUAL
1	LOCAL
2	LOCAL RESTRICTED
3	REMOTE

EXAMPLE:

TO PUT THE RFB-1200 IN LOCAL MODE SEND THE COMMAND:

M1<cr>

COMMAND NAME: DISABLE E/B RATIO ERROR

SYNTAX: NE[n]<cr>

UNITS: N/A

RANGE: n = 0 or 1

DESCRIPTION: WHEN DISABLED (NE1) THE E/B RATIO ERROR (E-24) WILL NOT BE ACTIVATED IF THE EMISSION CURRENT DROPS BELOW THE BEAM CURRENT. IN ALL MODES BUT MANUAL THE EMISSION CURRENT WILL STILL AUTOMATICALLY SERVO TO THE REQUESTED EMISSION TO BEAM CURRENT RATIO.

WHEN ENABLED (NE0) THE E/B RATIO ERROR WILL FUNCTION NORMALLY.

THE VALUE OF THE NE COMMAND IS STORED IN NON-VOLATILE RAM AND STAYS IN EFFECT UNTIL IT IS CHANGED.

EXAMPLE:

TO DISABLE THE E/B RATIO ERROR SEND THE FOLLOWING COMMAND:

NE1<cr>

COMMAND NAME: SET EMISSION CURRENT

SYNTAX: NI[n]<cr>

UNITS: mA

RANGE: 0 - 600

DESCRIPTION: USED TO SET THE EMISSION CURRENT TARGET. THE EMISSION CURRENT WILL RAMP TO THIS VALUE WHEN

THE RFB-1200 IS IN MANUAL MODE. IN ALL OTHER MODES THIS COMMAND HAS NO EFFECT, BUT IS STILL ACCEPTED.

EXAMPLE:

TO SET THE EMISSION CURRENT TO 250 mA SEND THE FOLLOWING COMMAND:

NI250<cr>

COMMAND NAME: LOCKOUT FRONT PANEL SWITCHES

SYNTAX: NK[n]<cr>

UNITS: N/A

RANGE: n = 0 or 1

DESCRIPTION: WHEN ENABLED (NK1) ALL OF THE SWITCHES ON THE FRONT PANEL OF THE RFB-1200 WILL NOT FUNCTION. ALSO, THE ALARM WILL NOT SOUND ON ANY FATAL OR NON-FATAL ERROR.

WHEN DISABLED (NK0) ALL SWITCHES AND THE BUZZER ACT NORMALLY.

THE VALUE OF THE NK COMMAND IS STORED IN NON-VOLATILE RAM AND STAYS IN EFFECT UNTIL IT IS CHANGED.

EXAMPLE:

TO LOCKOUT THE FRONT PANEL SWITCHES SEND THE FOLLOWING COMMAND:

NK1<cr>

COMMAND NAME: SET NEUTRALIZER LIMIT

SYNTAX: NL[n]<cr>

UNITS: AMPS

RANGE: 0.00 - 10.23

DESCRIPTION: USED TO SET THE PBN FILAMENT CURRENT'S SOFTWARE LIMIT. THE ACTUAL FILAMENT CURRENT WILL NOT RAMP ABOVE THIS VALUE.

EXAMPLE:

TO SET THE NEUTRALIZER LIMIT TO 5.50 AMPS SEND THE FOLLOWING COMMAND:

NL5.50<cr>

COMMAND NAME: RECALL TARGETS FROM MEMORY

SYNTAX: R[n]<cr>

UNITS: N/A

RANGE: n = 1, 2

DESCRIPTION: RECALLS THE TARGET PARAMETERS FROM THE SELECTED MEMORY. THE RECALLED VALUES WILL BE THE NEW RUNNING PARAMETERS.

EXAMPLE:

TO RECALL MEMORY 1 SEND THE FOLLOWING COMMAND:

R1<cr>

COMMAND NAME: REQUEST RUNNING CONDITIONS, COMPRESSED FORMAT

SYNTAX: RC<cr>

UNITS: N/A

RANGE: N/A

RESPONSE:

```
<lf><cr>  
AA.AA, BB.BB, ^^^^^, ^DDDD, ^EEEE, ^FFFF, ^GGGG, ^HHHH, II.II,  
^^^^^, ^KKKK, ^LLLL, M,  
<lf><cr><eot>
```

WHERE:

<u>PARAMETER</u>	<u>UNITS</u>
AA.AA - FORWARD POWER	WATTS
BB.BB - REFLECTED POWER	WATTS
DDDD - BEAM CURRENT	mA
EEEE - BEAM VOLTAGE	VOLTS
FFFF - ACCELERATOR CURRENT	mA
GGGG - ACCELERATOR VOLTAGE	VOLTS
HHHH - EMISSION CURRENT	mA
II.II - PBN FILAMENT CURRENT	AMPS
KKKK - PBN BODY VOLTAGE	VOLTS
LLLL - FATAL ERROR CODE	N/A
M - POWER SUPPLY MODE	N/A
0 = MANUAL	
1 = LOCAL	
2 = LOCAL RESTRICTED	
3 = REMOTE	
^ - ASCII BLANK SPACE (32).	

DESCRIPTION: USED TO REQUEST THE POWER SUPPLY'S RUNNING CONDITIONS. ALL OF THE ABOVE PARAMETERS WILL BE TRANSMITTED. IF A VALUE IS OFF ITS VALUE IS REPLACED WITH ASCII BLANK SPACES (32).

COMMAND NAME: MANUAL DATA LOG REQUEST WITHOUT HEADER

SYNTAX: RH<c>

UNITS: N/A

RANGE: N/A

RESPONSE:

WITH SOURCE AND/OR BEAM ON:

```
<cr><lf>^^^^^^AA:BB:CC^^^DDDD^^EEEE^^^FFFF^^^GGGG^^^HHHH
^^^IIII^^^JJJJ^^^KK.KK
<lf><cr><eot>
```

WHERE:

PARAMETER	UNITS
AA:BB:CC - TIME SINCE SOURCE WAS TURNED ON	HOURS/MINUTES/SECONDS
DDDD - RF FORWARD POWER	WATTS
EEEE - RF REFLECTED POWER	WATTS
FFFF - BEAM CURRENT	mA
GGGG - BEAM VOLTAGE	VOLTS
HHHH - ACCELERATOR VOLTAGE	VOLTS
IIII - ACCELERATOR CURRENT	mA
JJJJ - EMISSION CURRENT	mA
KK.KK - PBN FILAMENT CURRENT	AMPS
^	- ASCII BLANK SPACE (32)

WITH SOURCE AND BEAM OFF:

```
<lf><cr>^^^^^^^^^^^^^^^^^^^^^SOURCE^&^BEAM^ARE^OFF^DDDD
<lf><cr><eot>
```

WHERE:

- DDDD - FATAL ERROR MESSAGE. IF THERE IS NO FATAL ERROR MESSAGE WHEN THE RH COMMAND IS RECEIVED, DDDD = BLANK SPACE (32).
- ^ - ASCII BLANK SPACE (32)

DESCRIPTION: USED TO REQUEST DATA LOGGING PARAMETERS WITHOUT HEADER INFORMATION. IF A VALUE IS OFF IT WILL BE REPLACED WITH ASCII BLANK SPACES (32).

COMMAND NAME: REQUEST TARGET PARAMETERS WITH HEADER

SYNTAX: RP[n]<cr>

UNITS: N/A

RANGE: n = 1, 2

RESPONSE:

```
<lf><cr>MEM^X^PARAMETERS: <lf><cr>
BEAM^V^^^BEAM^I^^^ACCEL^V^^^A/B^^^PWR^LIM^^^PWR^^^N^LIM
^^^E/B
<lf><cr>
XXXX^V^^^XXX^mA^^^XXXX^V^^^XX^%^^XXXX^W^^^XXXX^W^^XX.XX
^A^XXX%
<lf><cr><eot>
```

^ - ASCII BLANK SPACE (32)

DESCRIPTION: THIS COMMAND IS USED TO REQUEST THE ABOVE TARGET VALUES, WITH HEADER INFORMATION, FOR THE SELECTED MEMORY.

EXAMPLE:

TO REQUEST THE TARGET PARAMETERS STORED IN MEMORY 2 SEND THE FOLLOWING COMMAND:

RP2<cr>

COMMAND NAME: REQUEST ALL TARGET PARAMETERS IN COMPRESSED FORMAT

SYNTAX: RN[n]<cr>

UNITS: N/A

RANGE: n = 1, 2

RESPONSE:

```
<lf><cr>^AAAA,^BBBB,^CCCC,^^^DD,EEEE,FFFF,GGGG,
HHHH,^^^,JJJJ,KKKK,
<lf><cr><eot>
```

WHERE:

<u>PARAMETER</u>	<u>UNITS</u>
AAAAA - BEAM VOLTAGE	VOLTS
BBBBB - BEAM CURRENT	mA
CCCCC - ACCELERATOR VOLTAGE	VOLTS
DDDDD - A/B RATIO	%
EEEEE - RF FORWARD POWER LIMIT	WATTS
FFFFF - PBN FILAMENT LIMIT	AMPS
GGGGG - EMISSION TO BEAM CURRENT RATIO	%
HHHHH - BEAM CURRENT TOLERANCE	%
JJJJJ - RF FORWARD POWER	WATTS
KKKKK - EMISSION CURRENT	mA

DESCRIPTION: USED TO REQUEST ALL TARGET VALUES, IN THE COMPRESSED FORMAT, FROM THE SELECTED MEMORY. IF THE VALUE IS NOT REPORTED FOR A PARTICULAR MODEL IT IS REPLACED WITH ASCII BLANK SPACES (32).

EXAMPLE:

TO REQUEST ALL THE TARGET PARAMETERS STORED IN MEMORY 1
SEND THE FOLLOWING COMMAND:

RN1<cr>

COMMAND NAME: MANUAL DATA LOG REQUEST

SYNTAX: RS<cr>

UNITS: N/A

RANGE: N/A

RESPONSE:

IF SOURCE AND/OR BEAM ARE ON:

```
<lf><cr>^^^^^^^TIME^^^^^^FWD^^REF^^BI^^BV^^AV
^^^^^AI^^^^^EI^^^^^NI
<lf><cr>
^^^^^HH:MM:SS^^^^^W^^^^^W^^^^^mA^^VOLTS^^VOLTS^^mA
^^^^^mA^^^AMPS
<cr>
<cr><lf>^^^^^XX:XX:XX^^^^^XXX^^^XXX^^^XXXX^^^XXXX^^^XXXX
^^^XXX^^^XXX^^^XX.XX
<cr><lf><eot>
```

IF SOURCE AND BEAM ARE OFF:

```
<lf><cr>^^^^^^^SOURCE^&^BEAM^ARE^OFF^DDDD
<lf><cr><eot>
```

WHERE:

DDDD - FATAL ERROR MESSAGE. IF THERE IS NO FATAL ERROR MESSAGE WHEN THE RS COMMAND IS RECEIVED, DDDD = BLANK SPACES (32).

^ - ASCII BLANK SPACE (32)

DESCRIPTION: THIS COMMAND IS USED TO REQUEST DATA LOGGING PARAMETERS. IT IS ONLY VALID WHEN AUTOMATIC DATA LOGGING IS DISABLED.

COMMAND NAME: RESET RFB-1200

SYNTAX: RST<cr>

UNITS: N/A

RANGE: N/A

DESCRIPTION: THIS COMMAND IS USED TO RESET THE RFB-1200.

COMMAND NAME: SOURCE ON/OFF

SYNTAX: S[n]<cr>

UNITS: N/A

RANGE: n = 1 or 0

DESCRIPTION: USED TO TURN THE SOURCE SUPPLIES ON (S1) OR
OFF (S0).

EXAMPLE:

TO TURN THE SOURCE SUPPLIES ON SEND THE COMMAND:

S1<cr>

COMMAND NAME: SET AUTOMATIC DATA LOG TIME INTERVAL

SYNTAX: T[n]<CR>

UNITS: N/A

RANGE: n = 0 - 9

DESCRIPTION: USED TO SET THE TIME INTERVAL AT WHICH THE
RFB-1200 WILL TRANSMIT DATA WHEN AUTOMATIC
DATA LOGGING IS ENABLED.

T0 - 2 SECOND INTERVAL

T1 - 10 SECOND INTERVAL

T2 - 20 SECOND INTERVAL

T3 - 30 SECOND INTERVAL

T4 - 1 MINUTE INTERVAL

T5 - 2 MINUTE INTERVAL

T6 - 5 MINUTE INTERVAL

T7 - 10 MINUTE INTERVAL

T8 - 30 MINUTE INTERVAL

T9 - 1 HOUR INTERVAL

EXAMPLE:

TO SET THE AUTO DATA LOG TIME INTERVAL TO 1 MINUTE SEND
THE COMMAND:

T4<cr>

COMMAND NAME: REQUEST POWER SUPPLY TYPE

SYNTAX: V<cr>

UNITS: N/A

RANGE: N/A

RESPONSE:

<lf><cr>RFB-1200 #x<lf><cr><eot>

WHERE: x = ID NUMBER 1 - 4

DESCRIPTION: USED TO REQUEST THE TYPE OF POWER SUPPLY.

EXAMPLE: N/A

COMMAND NAME: REQUEST POWER SUPPLY MODEL & MODULE TYPES

SYNTAX: V1<cr>

UNITS: N/A

RANGE: N/A

RESPONSE:

<lf><cr>ABCDEF<lf><cr><eot>

WHERE:

A - POWER SUPPLY MODEL: 2 = RFB-1200

B - CATHODE TYPE: 2 = RF

C - BEAM TYPE: 0 = NORMAL

D - NEUTRALIZER TYPE: 2 = PBN

E - DISCHARGE TYPE: 2 = RF

F - ACCELERATOR TYPE: 0 = NORMAL

DESCRIPTION: USED TO REQUEST THE POWER SUPPLY MODEL.

EXAMPLE: N/A

Section 11

CONTROL BY REMOTE SWITCHES

Some RFB-1200 and Ion Source operating conditions require precise control of the SOURCE (2) and BEAM (3) switches by a timer or another sensing device. The RS-232 connector (J28) on the rear panel of the RFB-1200 has four pins that allow a remote contact closure to control the SOURCE, BEAM, and MEMORY switches. The RFB-1200 must be in the REMOTE mode for the remote switches to function.

The memory location can be changed at any time. However, when a new memory location is selected, the power supply will operate immediately from the new parameters. The KEYLOCK (4), MODE (5), POWER (1), and PROBE (19) switches are fully functional in this mode. The SOURCE (2) and BEAM (3) switches can be turned off with the respective front panel switches but cannot be turned on. Use the following table as a guide for remote switch control.

Remote Switch	Source	Beam	Memory
<u>Position Change</u>	<u>Switch</u>	<u>Switch</u>	<u>Switch</u>
<u>Open to closed</u>	<u>on</u>	<u>on</u>	<u>2</u>
<u>Closed to open</u>	<u>off</u>	<u>off</u>	<u>1</u>

Remote SOURCE/BEAM - Pin Designations on J28 (see Figure 11-1):

1. J28-25 Remote Source - Shorting J28-25 to J28-7 will allow power from the NEUTRALIZER and RF (RF5S) power supplies to the Ion Source (equivalent to pressing the SOURCE switch). When the contacts go from closed to open, all outputs will be off.

2. J28-18 Remote Beam - Shorting J28-18 to J28-7 will allow power from the BEAM and ACCELERATOR power supplies to the Ion Source, but only if the SOURCE switch is on (equivalent to pressing the BEAM switch). When the contacts go from closed to open, the output of the BEAM and ACCELERATOR power supplies will be off.

3. J28-11 Remote Memory - Shorting J28-11 to J28-7 selects memory two (2). If the connection is left open, memory one (1) will be selected.

TROUBLESHOOTING

WARNING

HIGH VOLTAGE IS PRESENT WITHIN THE SYSTEM ENCLOSURES,
AND ALL POWER OUTPUTS ARE LETHAL.

THE FOLLOWING TROUBLESHOOTING PROCEDURES ARE INTENDED
ONLY TO IDENTIFY THE MOST GENERAL PROBLEMS. IN THE
CASE OF DAMAGED BOARDS OR FAULTY COMPONENTS WITHIN
THE SYSTEM, THE ENTIRE POWER SUPPLY SHOULD BE RETURNED
TO ION TECH, INC. FOR REPAIR.

Symptoms

Front panel displays will not
light, fan will not start.

Probable Cause

Power cord is not plugged in.

Circuit breaker on rear panel
of RFB-1200 has been tripped.

Power plug is wired
incorrectly.

Front panel displays light.
Fan starts. "E-20" flashes
on all upper displays.

External interlock string is
not complete.

E-23 is displayed on the
NEUTRALIZER module:

PBN filament is open.

Cable is not connected.

The Ion Source discharge
will not start.

The Body Fuse (F9) is open.
Replace the fuse with the
correctly rated fuse, and
check to assure that the source
body is not grounded through
cable connections or internal
connections.

CONTROLLER fails to retain
stored parameters in memory.

Battery is low.

Internal circuitry or a com-
ponent is damaged. Contact
Ion Tech, Inc.

A. ERROR CODE DEFINITIONS

<u>ERROR CODE</u>	<u>DEFINITION</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED REMEDY</u>
E-03	The operating value is low and is unable to increase to meet the requested target.	Power into the RFB-1200 is low. A power supply fuse has failed. Facility voltage is low.	Recycle the power. Check the appropriate fuse on the POWER Board. Refer to Section 11 for fuse replacement. Raise facility voltage.
E-04	The operating parameter is high and cannot be reduced to the requested target value.	If the error message is on the NEUTRALIZER, the neutralizer filament could be open. (When SW1-4 is in the ON position on the CONTROLLER board, an open filament is not a FATAL error.) Requested target value is below operational limits.	Replace the neutralizer filament. Increase the target value.

*NOTE 1: A FATAL error will cause shutdown of the power supply until the problem is corrected. Power must be recycled (switch 1 on the front panel).

NOTE 2: If an error message persists, and the problem cannot be found, call Ion Tech, Inc.

<u>ERROR CODE</u>	<u>DEFINITION</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED REMEDY</u>
E-05	Current limit	Requested target value is above the maximum current capability of the power supply. The output is shorted.	Reduce the requested target value. Check ion beam source and cable connections. (See Ion Beam Source manual, Troubleshooting section.) Factory service.
E-06	Thermal shutdown FATAL*	Blockage of air flow. Defective fan.	Remove the blockage and recycle the power. Factory service.
E-07	Clock Fault	Defective component.	Factory service.
E-20	External interlock failure	External interlock circuit is incomplete.	Complete the external interlock circuit.
E-21	Internal interlock failure FATAL*	Voltage is low from the internal line conditioner. Facility voltage is low. Power plug is wired incorrectly.	Recycle the power. Raise facility voltage. Rewire power plug.

*NOTE 1: A FATAL error will cause shutdown of the power supply until the problem is corrected. Power must be recycled (switch 1 on the front panel).

NOTE 2: If an error message persists, and the problem cannot be found, call Ion Tech, Inc.

<u>ERROR CODE</u>	<u>DEFINITION</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED REMEDY</u>
E-23	Neutralizer filament FATAL*: SW1-4 is ON (CONTROLLER board) MPS-3000 FC or MPS-3000 PBN	Broken neutralizer filament. Cable is disconnected.	Replace filament. Connect cable.
E-24	Emission-current-to-beam-current ratio is less than 100%. The error will occur only in LOCAL, LOCAL restricted, or REMOTE mode and only when SW1-4 is OFF (CONTROLLER board).	Low neutralizer filament current is causing the emission current to be less than 100% of the beam current. (Filament neutralizer)	Go to MANUAL mode, and raise the filament current. Return to LOCAL, LOCAL restricted, or REMOTE mode.
E-25	Accelerator-current-to-beam-current ratio exceeds the programmed A/B ratio.	Accelerator voltage is not set to minimize accelerator current. System pressure exceeds 3×10^{-4} Torr. Excessive gas flow. Requested A/B ratio is too low. Extraction grids are misaligned. A low impedance is present between the extraction grids (accompanied by E-05 on the BEAM).	Adjust accelerator voltage. Reduce system pressure. Reduce gas flow. Adjust A/B ratio. Realign ion extraction grids. (See Ion Beam Source manual for procedures.) Check the ion extraction grids for a low impedance connection.

*NOTE 1: A fatal error will cause shutdown of the power supply until the problem is corrected. Power must be recycled (switch 1 on the front panel).

NOTE 2: If an error message persists, and the problem cannot be found, call Ion Tech, Inc.

ERROR CODE DEFINITION PROBABLE CAUSE SUGGESTED REMEDY

E-70 RFB-1200 cannot communicate with the RF5S via the RS232 link.
RS232 cable is not installed between the RFB-1200 and RF5S.
RS232 driver/receiver defective in RFB-1200 or RF5S.
Install RS232 cable.
Contact Ion Tech, Inc.

E-71 The RFB-1200 detected that the RF discharge went out while the BEAM switch was on.
This error will turn off both SOURCE and BEAM.
Gas flow too low.
Insufficient warm up before turning on BEAM.
Improper grounding of RF5S or AM-5 matching network.
Increase gas flow.
Warm up longer.
Correct grounding.

E-72 The BEAM switch was pressed before the RF DISCHARGE has started.
NOTE: The E-72 error message will be cleared from the display when the RF discharge starts.
Wait for the RF DISCHARGE to start before pressing the BEAM switch.

E-80 Reflected power limit met on RF5S. *

* Consult the RF5S Users Manual for further information.

*NOTE 1: A fatal error will cause shutdown of the power supply until the problem is corrected. Power must be recycled (switch 1 on the front panel).

NOTE 2: If an error message persists, and the problem cannot be found, call Ion Tech, Inc.

<u>ERROR CODE</u>	<u>DEFINITION</u>	<u>PROBABLE CAUSE</u>	<u>SUGGESTED REMEDY</u>
E-81	Max power limit met on RF5S.	Power limit set too low. *	Increase limit. (May require cycling RF5S main power switch to clear error.)
E-82	Power amp limit met on RF5S.	*	*
E-83	Over temperature on RF5S.	Running too high a power on RF5S. Fan blocked on RF5S.	Decrease power. Remove obstructions from fan.
		Reflected power is not being tuned to 0. *	Contact Ion Tech, Inc. *
E-84	Cover interlock is broken on the RF5S.	Top or bottom cover to the RF5S is not on properly.	Secure top/bottom cover.
E-85	External interlock is broken on RF5S.	Interlock string has been opened.	Close interlock string.
E-86	Line power to the RF5S is too high.	Facility power is greater than specified for the RF5S. *	*

* Consult the RF5S Users Manual for further information.

*NOTE 1: A fatal error will cause shutdown of the power supply until the problem is corrected. Power must be recycled (switch 1 on the front panel).

*NOTE 2: If an error message persists, and the problem cannot be found, call Ion Tech, Inc.

Section 13

MAINTENANCE

A. GENERAL INFORMATION

1. Observe all warnings, all applicable cautions, and all labels.
2. There are no operator serviceable parts inside, except fuses. Refer servicing to qualified personnel at Ion Tech, Inc.

B. FUSE LISTING FOR THE RFB-1200

1. RFB-1200

Power Board

F3 Plasma Bridge Neutralizer	5 Amp
F4 Beam	5 Amp
F5 Accelerator	2 Amp
F6 Power Input	2 Amp, Slo Blo
F7 Logic Supply	2 Amp, Slo Blo
F11 PBN Emission	2 Amp Picofuse
F12 PBN Body	1 Amp Picofuse

Rear Panel

F9 Body (Not Used)*
F10 Probe 1/32 Amp

* Note: Fuse holder F9 is not active in the RFB-1200.

A spare part kit, containing extra fuses, is included with your RFB-1200. Use Ion Tech, Inc. part number 6290-002 when reordering an RFB-1200 spare part kit.

C. FUSE CHANGING PROCEDURE FOR THE RFB-1200

WARNING

MAKE SURE THAT THE POWER SWITCH AND CIRCUIT BREAKER (CB1) ARE IN THE OFF POSITION (0) AND THAT THE POWER CORD HAS BEEN REMOVED FROM ITS POWER RECEPTACLE. FAILURE TO DO ALL THE ABOVE COULD RESULT IN INJURY OR DEATH TO PERSONNEL.

1. If F8 or F10 need to be replaced, locate them on the rear panel of the RFB-1200.
 - (a) Remove the correct fuse holder and fuse.
 - (b) Replace the fuse (see Section 13-B for the correct rating of the fuse).
 - (c) Insert the fuse holder into the appropriate location on the rear panel.

2. If F1 through F7 require replacement, use the following procedures:
 - (a) Remove the 26 screws holding the top cover and mounting ears to the chassis, and then remove the top cover.
 - (b) Locate the proper fuse holder.
 - (c) Remove the fuse holder and the fuse.
 - (d) Replace the fuse (see Section 13-B for the correct rating of the fuse).

- (e) Insert the fuse holder into the appropriate location.
- (f) Replace the top cover, the mounting ears (if applicable), and the screws.
- (g) Reconnect to power, and verify that the RFB-1200 operates correctly. If problems persist, contact Ion Tech, Inc. at (303) 221-1807.

D. SOFTWARE UPDATING PROCEDURE FOR RFB-1200

To update software on the RFB-1200, a single PROM needs to be changed. Updated PROM versions are sent in static-protected bags.

CAUTION

Handling of the PROM should be performed at a static station to insure damage is not incurred.

WARNING

MAKE SURE THAT THE POWER SWITCH AND CIRCUIT BREAKER (CB1) ARE IN THE OFF POSITION (0) AND THAT THE POWER CORD HAS BEEN REMOVED FROM ITS POWER RECEPTACLE. FAILURE TO DO ALL THE ABOVE COULD RESULT IN INJURY OR DEATH TO PERSONNEL.

1. Remove the 26 screws holding the top cover and mounting ears to the chassis, and then remove the top cover.
2. Locate XU9 on Figure 5-3 from the RFB-1200 manual. The PROM to be replaced is in this socket.

3. Use a small screwdriver to pry the PROM upwards carefully until it is loosened.
4. Remove the old PROM from the socket.
5. Orient the new PROM with the notched end toward the inside of the CONTROLLER board (note position of the notched end in Figure 5-3), and insert it into the socket.
6. Apply equal pressure across the PROM, insuring that all the legs continue to enter straight into the socket. (The legs may have to be formed before inserting the PROM.) Continue applying pressure until the PROM is firmly and evenly seated.
7. Inspect to insure that the PROM is fully seated and that all pins are in the socket. Also verify that the notch on the PROM is in the same direction as shown in Figure 5-3.
8. Replace the top cover, the mounting ears (if applicable), and the screws.
9. Reconnect to power, and verify that the RFB-1200 operates correctly. If the RFB-1200 does not complete the self-test sequence, recheck the seating and the orientation of the PROM. If problems persist, contact Ion Tech, Inc. at (303) 221-1807.

E. RETURNING AN RFB-1200

1. Seal the RFB-1200 power supply in a plastic bag.
2. Pack the RFB-1200, using the original foam packing material and the original shipping box.
3. If the original packing material is not available, surround and cover the RFB-1200 with foam, and ship in a double-walled box.

TIME HH:MM:SS	FWD W	REF W	BI mA	BV Volts	AI mA	AV Volts	EI mA	NI Amps
00:00:00	0	0	0	0	0	0	0	0.00
00:00:10	18	12	100	1196	49	499	117	2.35
00:00:20	40	0	100	1200	50	500	125	2.51
00:00:24	60	0					125	2.51
00:00:30	80	0					125	2.51
00:00:38	80	0	0	0	0	0	125	2.51
00:00:40	80	1	100	1200	50	500	125	2.51
00:00:46	SOURCE & BEAM ARE OFF							

Fig. 10-2 - Sample Automatic Data Logging: T = 10 Seconds; No Errors Detected

TIME HH:MM:SS	FWD W	REF W	BI mA	BV Volts	AI mA	AV Volts	EI mA	NI Amps
00:00:00	0	0	0	0	0	0	0	0.00
00:00:10	18	12	100	1200	50	500	118	2.37
00:00:20	40	0	E-05	975	50	500	125	2.51
00:00:30	60	0	100	1198	E-05	485	125	2.51
00:00:34	SOURCE & BEAM ARE OFF							

Fig. 10-3 - Sample Automatic Data Logging: T = 10 Seconds; Errors Detected

TIME HH:MM:SS	FWD W	REF W	BI mA	BV Volts	AI mA	AV Volts	EI mA	NI Amps
00:00:06	10	14	100	1194	49	498	141	2.81
00:00:20	40	0	E-05	1075	50	500	125	2.51
00:00:33	60	1	100	1200	50	500	125	2.51

Fig. 10-4 - Sample Manual Data Logging: Error Reported

TIME HH:MM:SS	FWD W	REF W	BI mA	BV Volts	AI mA	AV Volts	EI mA	NI Amps
00:00:00	0	0	0	0	0	0	0	0.00
00:00:07			E-05					
00:00:10	18	12	E-05	1090	50	500	119	2.38
00:00:12			OK					
00:00:16					E-05			
00:00:20	40	0	100	1200	E-05	442	125	2.51
00:00:23					OK			
00:00:30	60	1	100	1200	50	500	125	2.51
00:00:32		E-70						
00:00:35		OK						
00:00:40	80	0	100	1200	50	500	125	2.51
00:00:45	SOURCE & BEAM ARE OFF							

Fig. 10-5 - Sample Automatic Data Logging and Automatic Error Logging: T = 10 Seconds; Errors Reported

TIME HH:MM:SS	FWD W	REF W	BI mA	BV Volts	AI mA	AV Volts	EI mA	NI Amps
00:00:10	18	12	100	1200	50	500	119	2.38
00:00:23	18	12	100	1200	50	500	125	2.51
00:00:28	FATAL ERROR: E-20							

Fig. 10-6 - Sample Manual Data Logging: Automatic Error Logging Enabled; FATAL Error Reported

LIMITED WARRANTY STATEMENT

ION TECH, INC.

2330 E. Prospect, Fort Collins, CO 80525, 303-221-1807

Supercedes All Previous Limited Warranty Statements

WARRANTY

Products manufactured by seller are warranted against defects in materials and workmanship for twelve (12) months from date of shipment thereof to customer, and seller's liability under valid warranty claims is limited, at the option of seller, to repair, replacement, or refund of an equitable portion of the purchase price of the product. Items expendable in normal use are not covered by this warranty. All warranty replacement or repairs of parts shall be limited to equipment malfunctions which, in the sole opinion of seller, are due or traceable to defects in original materials of workmanship. All obligations of seller under this warranty shall cease in the event of abuse, accident, alteration, misuse or neglect of the equipment. In-warranty repaired or replacement parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced parts. After expiration of the applicable warranty period, customer shall be charged at the then current prices for parts, labor, and transportation.

Reasonable care must be used to avoid hazards. Seller expressly disclaims responsibility for loss or damage caused by use of its products. Except as stated herein, seller makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except as stated herein, seller shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise. Statements made by any person, including representatives of seller, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon seller unless reduced to writing and approved by an officer of seller.

WARRANTY REPLACEMENT AND ADJUSTMENT

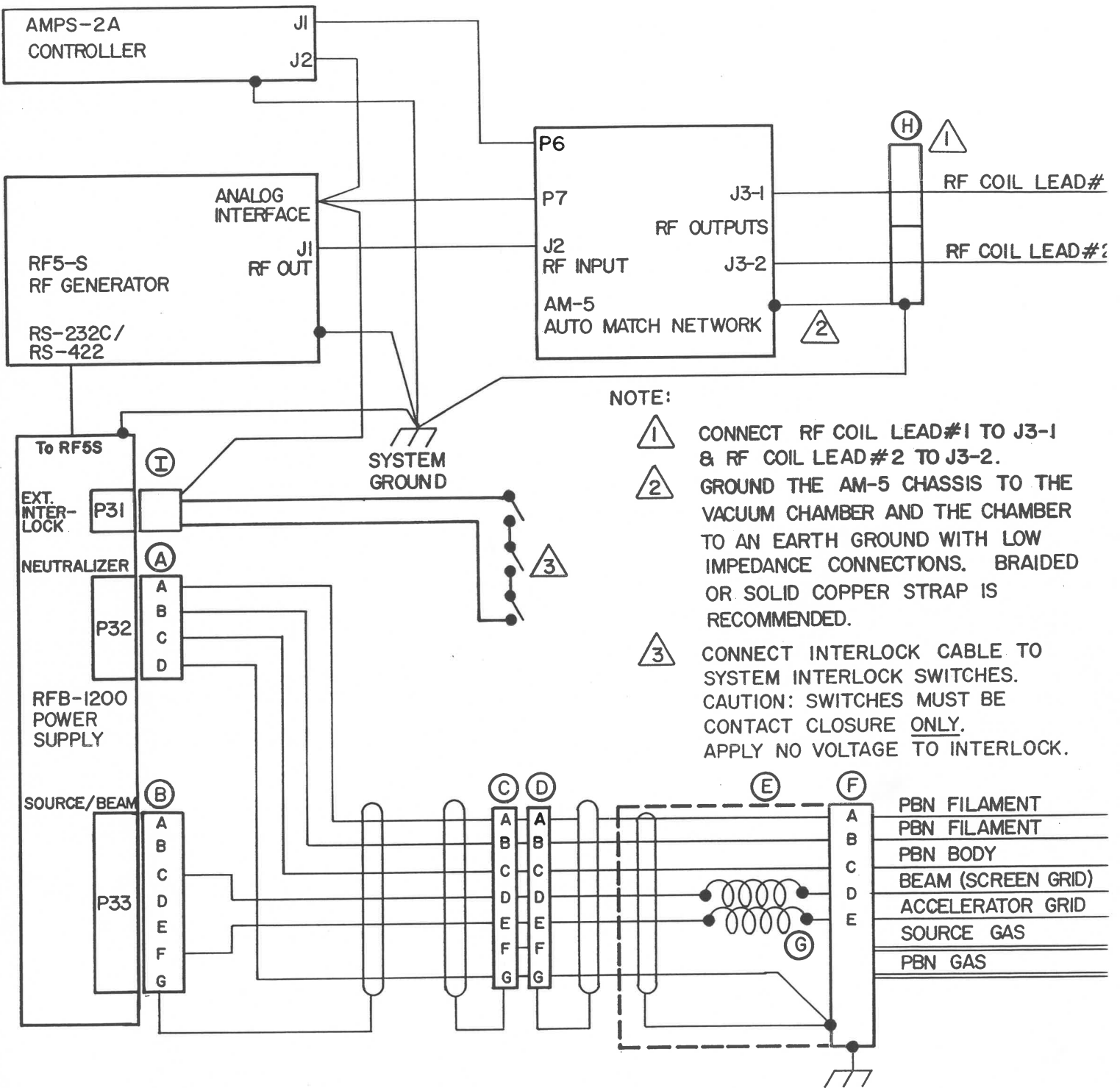
All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto, and must be received within the applicable warranty period by seller or its authorized representative. Such claims should include the product serial number when available, the date of ship-

ment, and a full description of the circumstances giving rise to the claim. Before any products are returned for repair and/or adjustment, written authorization from seller or its authorized representative for the return and instructions as to how and where these products should be returned must be obtained. Any product returned to seller for examination shall be sent prepaid via the means of transportation indicated as acceptable by seller. Seller reserves the right to reject any warranty claim not promptly reported and any warranty claim on any item that has been altered or has been returned by non-acceptable means of transportation. When any product is returned for examination and inspection, or for any other reason, customer shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect or nonconformity in the product. In all cases seller has sole responsibility for determining the cause and nature of failure, and seller's determination with regard thereto shall be final.

If it is found that seller's product has been returned without cause and is still serviceable, customer will be notified and the product returned at customer's expense; in addition, a charge for testing and examination may be made on products so returned.

DAMAGES AND LIABILITY

Seller's liability for damages shall not exceed the amount seller actually receives for the product furnished or to be furnished, or service rendered, or to be rendered, as the case may be, which is the subject of claim or dispute, and in no event shall seller be liable for incidental, consequential or special damages. Liability to third parties for bodily injury, including death from seller's performance shall be determined in accordance to law and the total liability limitation stated above shall not be construed as a limitation on seller for damages for any such bodily injury, including death.

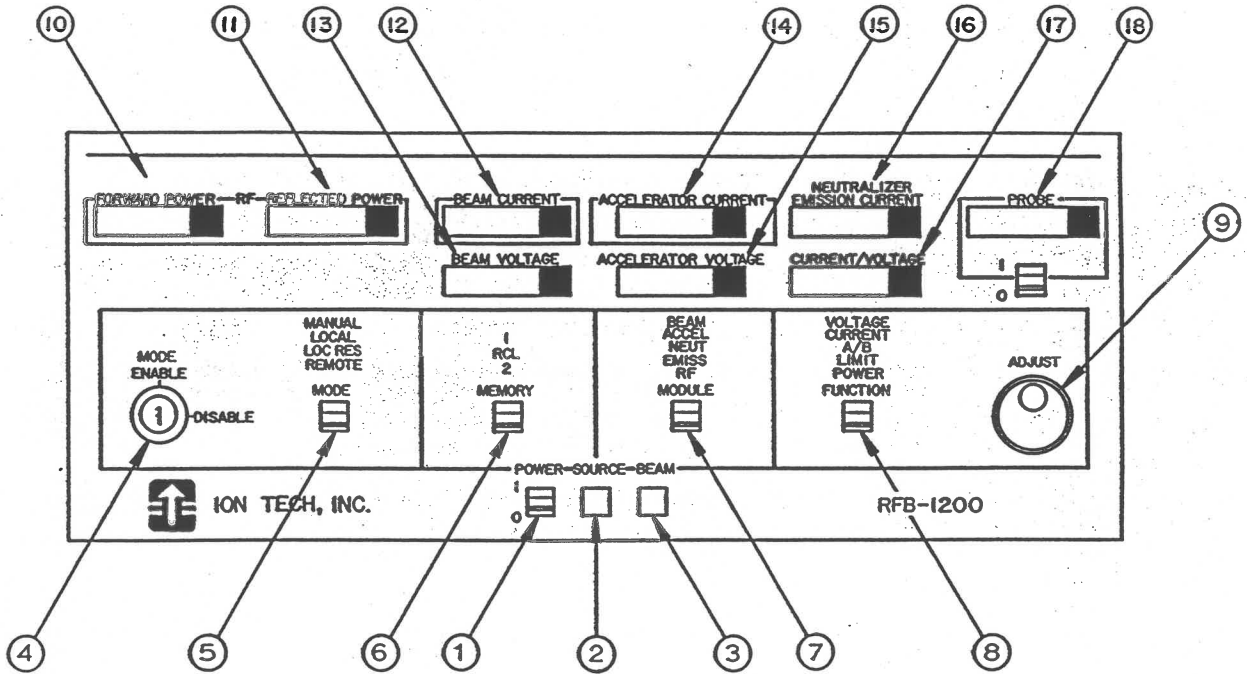


NOTE:

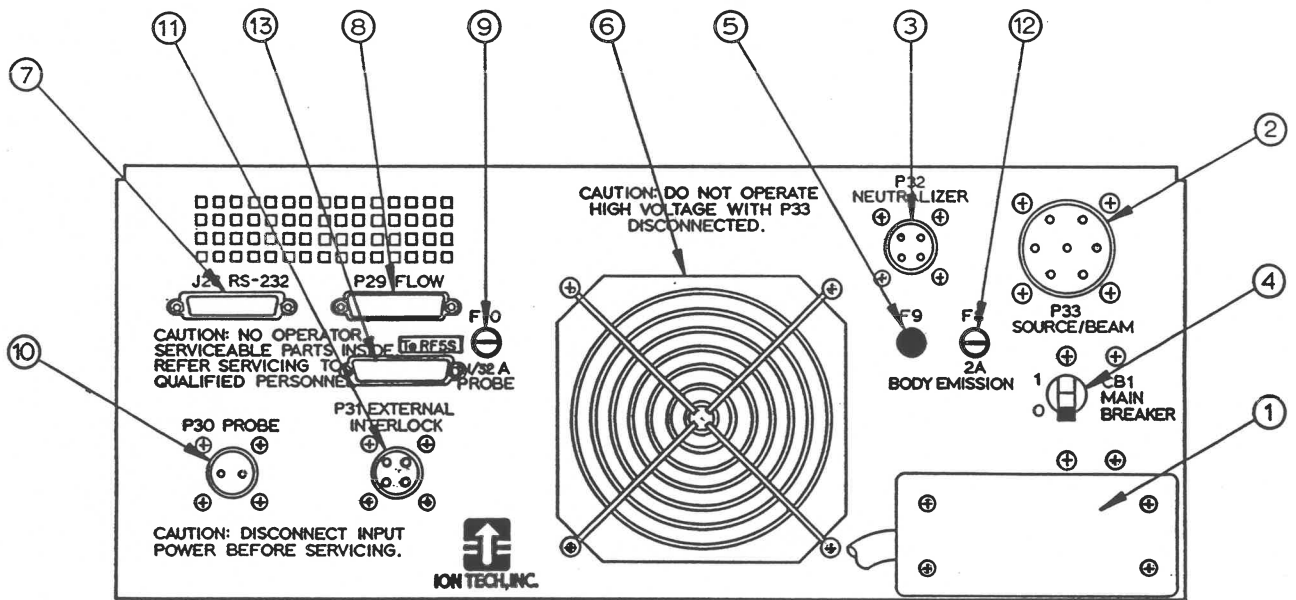
- ① CONNECT RF COIL LEAD#1 TO J3-1 & RF COIL LEAD#2 TO J3-2.
- ② GROUND THE AM-5 CHASSIS TO THE VACUUM CHAMBER AND THE CHAMBER TO AN EARTH GROUND WITH LOW IMPEDANCE CONNECTIONS. BRAIDED OR SOLID COPPER STRAP IS RECOMMENDED.
- ③ CONNECT INTERLOCK CABLE TO SYSTEM INTERLOCK SWITCHES. CAUTION: SWITCHES MUST BE CONTACT CLOSURE ONLY. APPLY NO VOLTAGE TO INTERLOCK.

- (A) MALE CABLE CONNECTOR, 4-PIN.
- (B) MALE CABLE CONNECTOR, 7-PIN.
- (C) FEMALE CABLE CONNECTOR, 7-PIN.
- (D) HVC MALE CABLE CONNECTOR, 7-PIN.
- (E) HIGH VOLTAGE COVER (HVC).
- (F) 5 ELEC/2 GAS PIN FEEDTHROUGH.
- (G) RF CHOKES.
- (H) RF FEEDTHROUGHS.
- (I) MALE CABLE CONNECTOR, 4-PIN.

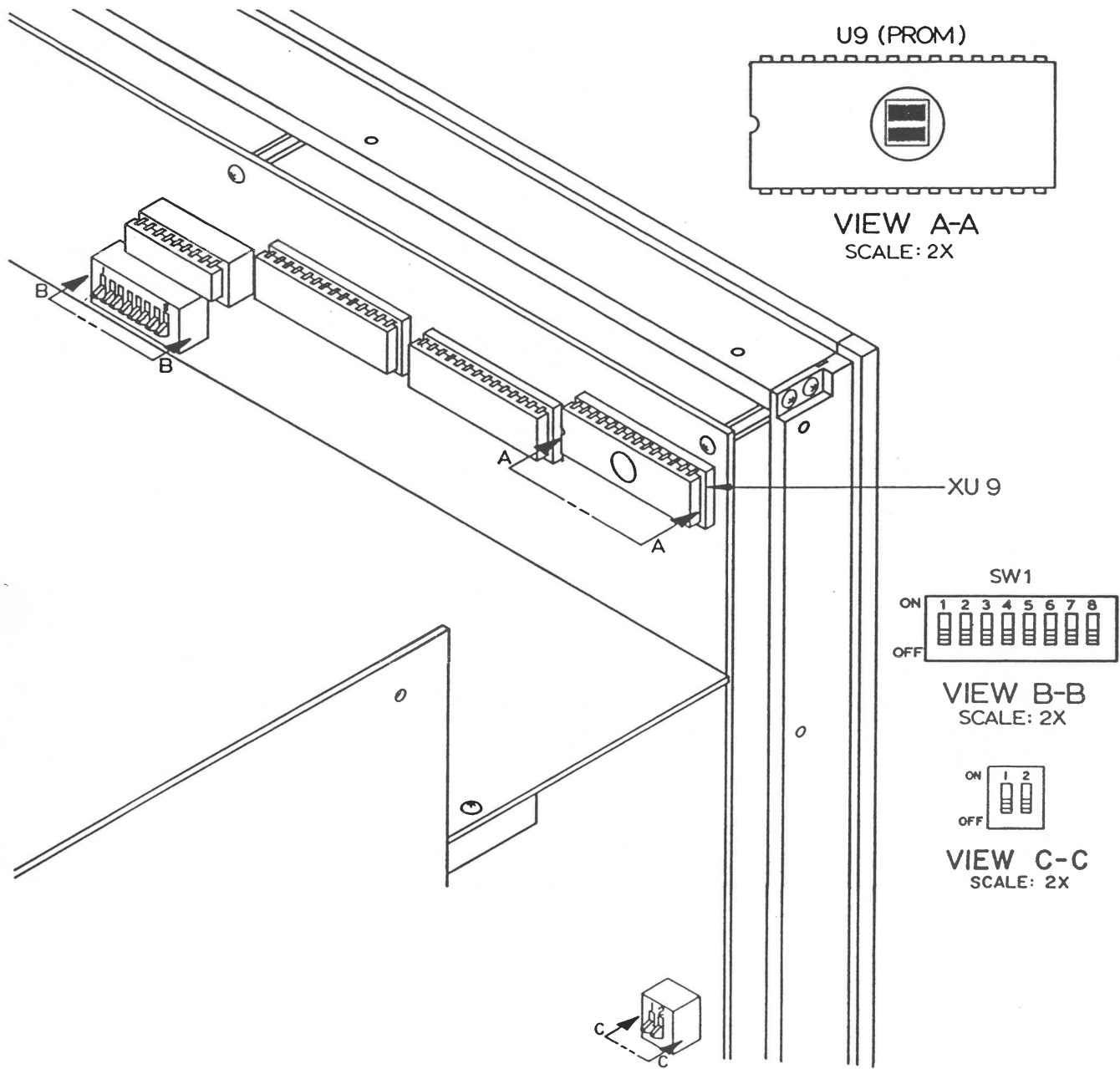
POWER SUPPLIES TO SOURCE CONNECTIONS
FIG. 4-1



FRONT PANEL: RFB-1200
FIG. 5-1



REAR PANEL: RFB-1200
 FIG. 5-2



**PROM and SWITCHES LOCATION
FIG. 5-3**



