

PACKAGE INSERT INSTRUCTIONS

EC600 Constant Power Supply

BACKGROUND

Electrophoresis requiring power supplies has been known for perhaps 50 years and various types of supplies have been utilized for this purpose. Initially most power supplies were constant voltage with some being also constant current. Recently, with the advent of gel electrofocusing and nucleic acid sequencing electrophoresis gels, the function of constant power has been added to the power supplies in order to obtain mobility of the sample being separated. It has also become desirable to have automatic crossover between constant power and constant voltage and also between constant voltage or constant power to constant current.

INTENDED USES

The EC600 Power Supply is intended for use with any electrophoretic device. A series of patch cords can be provided to connect to any electrophoretic cell. DANGER HIGH VOLTAGE. This piece of equipment should be OPERATED BY TRAINED PERSONNEL ONLY.

EQUIPMENT

(1) Material Provided:

The EC600 Power Supply is complete with power cord, three (3) readout meters (volts, watts, and milliamps), On-Off Switch, Range Selector Switches, range selector indicator lights under each meter, a limit control potentiometer for each of the three (3) operating variables (volts, watts, and milliamps), Ground Leakage Detector Indicator, DC Start Button with load detector circuit, meter display buttons for output readings or setpoint readings, Circuit Breaker, and dual output terminals.

(2) Material NOT Provided, But Available if Ordered:

Appropriate patch cord for connection from the power supply to the electrophoretic cell(s).

(3) Material NOT Provided:

The electrophoretic cell with appropriate safety interlock.

ITEM LOCATION AND FUNCTION

METER READING PUSHBUTTONS: Located far left mid-panel, marked "NORM" for normal and "SET" for meter setpoints. These are pushbuttons and are functional as soon as the power supply is turned on, with or without DC output from the power supply. When in a "NORM" position the DC output is being indicated by the three meters. When in the "SET" position, the setpoints of each of the three meters are established by the individual setpoint controls ("MIN-MAX" knobs located under each readout meter). A LED above each switch indicates what reading is displayed by the meters. After actuating the "SET" Switch the meters will revert back to the "NORM" reading in one minute twelve seconds through an internal timer. When in either "SET" or "READING" position the DC output is not interrupted.

DC START SWITCH: Located left side, lower mid-panel, between "DC OFF" LED and "DC ON" LED. Upon actuation of the "POWER ON" Switch, the "DC OFF" light is illuminated. The EC600 Power Supply, as with all E-C APPARATUS' power supplies, employs a special, unique, sensing circuit whereby the power supply must be connected to an external "load" (electrophoretic cell) before the DC power may be energized. This special load detector circuit must sense a connected load and will keep the power supply energized until the load exceeds 150 million ohms. For certain high resistance gels, the Start Button must be held in until the high voltage circuit of the power supply is activated to cause engagement of the safety relay which is an audible "click".

PLEASE NOTE: Upon disconnection of the electrophoretic cell, the "DC START" Button must be reactuated after reconnecting the "load". A special memory circuit is built into the power supply to automatically reinitiate "DC ON" in the event of an external power interruption for up to three hours provided the load has not been disconnected in the meantime or the "POWER ON" switch has not been actuated.

OUTPUT TERMINALS: Two (2) sets located lower left front panel. The red terminal is positive and the black terminal is negative. At least one (1) set of terminals must be connected to an external load because of the special load detection circuit.

CAUTION: Due to the high voltages involved, handle only one lead at a time with one hand only.

VOLTAGE METER, RANGE SWITCHES, AND LIMIT CONTROL: Located left center panel. The voltage meter reads in any one of four (1 of 4) ranges as indicated by the appropriately depressed range switch located below the meter and indicated by the appropriately illuminated LED.

PLEASE NOTE: If none of the switches are actuated, the meter will read full range and none of the meter LED's will be illuminated. The "AT SETTING" LED will be illuminated and there will be no DC output.

The setpoint control for the voltage is a single turn potentiometer marked "MIN-MAX" and is a setpoint as a percentage of meter range. When the voltage set limit is in control of the power supply, the "AT SETTING" LED is illuminated. Although the set limit is set directly on the meter, the percentage of scale reading means that if setting the at limit control at 50% of scale, then at 4000 volts the power supply will be limited to 2000 volts, on the 2000 volt range the power supply will be limited to 1000 volts, on the 1000 volt range the power supply will be limited to 500 volts, and on the 500 volt range the power supply will be limited to 250 volts.

WATT METER, WATT METER RANGE SWITCHES, AND WATT METER LIMIT CONTROL: Located center front panel. The watt meter reads in two (2) ranges as indicated by the Range Selector Switches and the appropriately illuminated LED.

PLEASE NOTE: If neither of the range switches are depressed, whether the "DC ON" Button is actuated or not, the watt meter "AT SETTING" light will be illuminated. There will be no power output and the meter will read irratically which is caused by the automatic calibration circuits included with the watt meter readout.

The Watt Meter Limit Control is located below the range switches and is a single turn potentiometer which sets the limit as a percentage of the selcted range.

MILLIAMMETER, MILLIAMMETER RANGE SELECTOR SWITCHES, AND CURRENT LIMIT SET CONTROL: Located right front panel. The milliamp meter reads in any of four (4) selected ranges as indicated by the appropriately depressed button and illuminated LED.

PLEASE NOTE: If none of the range switches are depressed and none of the LED's are illuminated, the meter will read full scale, the "AT SETTING" LED will be illuminated, and there will be no power output.

The Milliamp Limit Set Control establishes the maximum milliamp output of the power supply as a percentage of scale.

GROUND LEAKAGE INDICATOR: Located mid far right front panel. If ground leakage is detected due to either an internal fault in the power supply or an external fault in the circuit connected to the power supply, the "Ground Leakage" LED indicator will be flashing. Power output will be limited to approximately 275 volts maximum and the maximum ground leakage that is permitted by the power supply depends on the internal switch setting located on the power supply power circuit boards. The low setting (shipment position) allows only 120 microamps ground leakage. The high position allows 400 microamps ground leakage which is still under the generally accepted limit of 500 microamps ground leakage. The setpoint of the switch is discussed under "Operations". Do not change the Hi-Lo Switch unless it is absolutely necessary to achieve proper operation.

POWER ON SWITCH: Located lower far right front panel. The power switch controls all power coming into the power supply. A "POWER ON" LED is illuminated upon switch actuation to the "ON" position.

CAUTION: Do not assume that electrical power is not being sent to the power supply even though the "POWER ON" LED is not illuminated. WHEN IN DOUBT..... pull the plug from the power receptacle.

CIRCUIT BREAKER: Located on the inclined portion of the bottom front panel below "POWER ON" Switch. In the event of an electrical overload, either internal in the power supply or external, the circuit breaker may actuate. This is indicated by the red stem of the circuit breaker extending approximately 1/4" beyond the silvered retaining ring. The head of the circuit breaker is white with the number of rated amps, whereas the stem, normally not visible, is red.

To re-engage the circuit breaker, turn the power supply Main Power Switch "OFF" and reinsert the circuit breaker. Because the circuit breakers are thermally actuated, it may be necessary to wait a few minutes before the circuit breaker will re-engage. After re-engaging the circuit breaker, turn the power supply "ON" and one of the set limit controls to "MINIMUM" before reactivating the DC "START" Button. After re-engaging the DC "START" Button, use the selected limit control to approach operating conditions slowly. Upon continued actuation of the circuit breaker, discontinue all use of the power supply, disconnect from the electrical receptacle, and call for service and technical information.

PROCEDURE

(1) Set-up

(a) Unpack and examine the power supply carefully. Report any damage to the transporting carrier and E-C APPARATUS CORPORATION. Be sure to save all cartons for claim purposes if damage is found.

(b) Check the operating voltage of the power supply against the line voltage. Unless otherwise stated, the unit is for 115 volt operation.

PLEASE NOTE: A 230 volts operating unit will not energize on 115 volts. No damage is done to a 230 volt unit until energized with 115 volts. A 115 volt unit IS damaged by 230 volts.

(c) Place the power supply in proximity to the electrophoretic cell with which it is to be connected. Be sure to place the power supply in a safe, dry location with the controls accessible, but with the power supply placed away from normal personnel activities.

(d) Plug the power cord into the appropriate receptacle. Unless otherwise indicated, the power supply is set up for 100 to 120VAC, 50/60Hz input. For 230V input service, see the section covering adjustments.

PLEASE NOTE: This is a three (3) wire grounded style and should NOT be used with a two (2) wire receptacle with a conversion plug. Because there are high voltages available within the power supply, the ground connection is a necessary safety precaution. Remember you are dealing with high voltage and appropriate precautions must be taken.

(e) The power supply is safety interlocked so that the appropriate patch cord must be connected into the output terminal(s) in order to energize the interlocking relay and provide output power. Also after connecting the appropriate "load" (electrophoretic cell), it is necessary to actuate the DC "START" Button to obtain output power. Initially, turn the power supply on without a "load" connected. Be sure that at least one (1) range switch of the volt meter, watt meter, and milliamp meter is appropriately depressed. Turn all the set limit controls to "MINIMUM". Note that the appropriate LED's should be illuminated, that is, the "NORM" meter reading, DC "OFF", "AT SETTING" for each of the three (3) controls, "POWER ON", and the appropriate range selector LED in accordance with the range switch for each meter appropriately depressed. Sequence through the meter range switches to be sure that each of the LED's appropriately illuminate. Engage "SET METER" readings to be sure that the appropriate LED will illuminate. While in the "SET READING" position, adjust one at a time, each of the set limit controls for volts, watts, and milliamps. The appropriate meter should come up-scale when making the adjustment and the "AT SETTING" LED for each should go out. Note that after a minute and twelve seconds, the "SET READING" LED switches back to "NORM METERS" reading.

(2) Operation

(a) If this is the first operation of the power supply with a new electrophoretic cell and/or new buffer conditions, begin by placing the volt meter on 500 volt range, watt meter on 200 watts, and the milliamp meter on 200 milliamps. With the AC Power Switch "ON", set the appropriate limits for the watts and milliamps that will be desired for those limits during the run. Do this by actuating the "SET" Reading Button and adjusting the set control under each meter. Place the volt at limit control in the "MINIMUM" condition.

(b) Connect the electrophoretic cell to the output terminals of the power supply. At this point, the "NORMAL METERS" reading LED should be illuminated, "DC OFF" LED illuminated, and the volts "AT SETTING" limit LED illuminated. Engage the Start Button above the output terminals of the power supply. An audible "click" of the safety interlock relay should be heard upon actuating the Start Button and the "DC ON" light should be illuminated.

(c) Turn the Voltage Limit Control up to either the desired setpoint or to the "MAXIMUM" on the 500 volt range. If a higher range is desired, and all conditions indicate that the power supply is operating in a stable manner, then depress the appropriate range switch for the desired voltage range in which you wish to operate. Proceed to the correct setting for your volt meter either by proceeding to the initial voltage of the run or by setting the set limit and adjusting the "AT SETTING" Control.

(d) In order to achieve 200 watts output with the power supply in all of the voltage setting ranges, it was necessary to design a circuit which includes switching of transformer windings for maximum utilization. The power supply will switch transformer windings at approximately 140 milliamps on the increasing output of milliamps. The transformer windings will be switched back at approximately 100 milliamps on decreasing current draw. In each case, the meters will momentarily depress to zero as the transformer windings are switched, but the appropriate control condition will be re-established automatically by the power supply.

(e) When the power supply is connected to an electrophoretic cell with the DC "OFF" and with the range switches at "MIN." setting, you will note that there is a small amount of voltage being applied (8 volts) and a small amount of current as indicated on the DC Milliamp Meter. This is perfectly normal and is the load sensing voltage used for the unique safety circuit of the power supply.

If re-establishing running conditions after turning the power switch "OFF" or disconnecting the electrophoretic cell thereby causing the load detection circuit to turn the DC "OFF", there will be a momentary pause after actuating the DC "START" Button before the meters will re-energize. This is the built-in power supply control circuit's normal function.

(f) If for any reason the ground leakage light is illuminated, this signals a hazardous condition may exist, either internal in the power supply or external. Typically, it has been found that the fault lies in the external circuit and most commonly with a high voltage short to the cooling water circuit. The power supply automatically limits the amount of leakage to either 120 microamps or 400 microamps depending on the internal setting in the power supply. Generally, 500 microamps has been the maximum safe limit for ground leakage as established for most electrical instruments. If continued actuation of the ground leakage circuit is noted when using the power supply and not having switched the internal setting, it is permissible to make a change in this setting. Disconnect the power cord from the receptacle, turn the power supply around for back view and remove the three (3) screws holding the cover of the power supply. Remove the cover by lifting up and back. The top circuit observed is the control circuit board and contains all low voltages necessary for function of the power supply. Immediately below the control circuit board is a protective aluminum shield and below this is view of the high voltage board which contains a switch located on the mid-rear of the board. "LO" setting (120 microamps) is to the left and "HI" setting (400 microamps) is to the right. Place the switch to the right in the "HI" condition. Replace cover and screws before reinserting the power cord into the receptacle.

(g) It should be noted that if there are other electrical devices on the same circuit as the power supply, there may be some points of control in any mode that will cause rapid fluctuations of the meter needles. This is simply a reaction of the power supply control circuits to the electronic noise generated by the other instruments on the same line. This may be overcome at any particular point by approaching the desired control point very slowly with the appropriate "AT SETTING" potentiometer.

(h) The EC600 Power Supply has been tested in temperature conditions from -10°C to $+40^{\circ}\text{C}$. It operates more favorably at lower temperature conditions, but can be operated at the higher conditions satisfactorily. At 25°C , it is normal that the cabinet temperature will reach approximately 35°C after operating for several hours at full power settings. This is normal and not injurious to the power supply.

(i) If the power supply smokes or continually activates the circuit breaker, turn off the power supply and call for further instructions. WHEN IN DOUBT....TURN OFF THE POWER.

PRECAUTIONS

Use the same precautions as with any electrical device. Do not operate without the sides and chassis fully assembled or with any possible short circuit. It must be remembered that this is a high voltage power supply and should be operated by QUALIFIED PERSONNEL ONLY. Do not operate in a damp, humid atmosphere or in a fashion where condensed moisture may short out internal electrical components. When moving the unit from either a normal room temperature condition into a cold room or vice versa, allow at least eight (8) hours for the unit to temperature equilibrate before use.

SERVICE

The EC600 Power Supply has been designed with space age computer components and technology. Only a qualified electronic technician should service this piece of equipment inasmuch as serious damage can be done if improper service techniques are used. To examine the power supply, disconnect it from the power receptacle and remove the cover.

If unable to obtain output from the power supply, there are several typical failures that can result from a rapid high voltage short of the output such as a sudden ground leakage occurrence. One typical failure will be failure of IC1 and/or IC2 located on the high voltage circuit board which is located below the main control board below the metal shield. Remove and replace these items. Also, if a high current draw was sustained for any length of time, resistors R190 and R191 on the control board may have been damaged. These are located directly behind jumper J5 in the upper right hand corner of the board when viewing the board from the front.

If the power supply exhibits "FULL ON" with the "AT SETTING" potentiometers at "MINIMUM", it is likely that one (1) of both Q1 and two (2) SCR's located on the power circuit board have failed. These are located in the rear by the power cord connection and are easily located on the U-shaped metal heatsinks. Replace one or both of these items if one is found to be shorted.

If the power supply has no output but continually actuates the circuit breaker, it is possible that the high voltage diodes D1 through D4, as well as any one of the high voltage capacitors C1 through C11, have become shorted. Typically both failures will allow the power supply to be used up to some threshold voltage after which the components will breakdown causing the meters to drop to

zero and the circuit breaker to actuate. Once the high voltage diodes have been removed, it may be necessary to test them under voltage conditions simulating the threshold voltage in order to determine if they are failing under operating conditions. Likewise, it may be necessary to test the power supply with an alternate string of capacitors in place for C1 through C11.

PLEASE NOTE: Do not operate the power supply without high voltage filter capacitors in place.

WARRANTY

The EC600 Power Supply is under warranty for one (1) year from date of shipment against defects in materials and workmanship. There is no warranty for components which fail as a result of electrical overload.

MANUFACTURER

Savant



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