HIGH VOLTAGE POWER SUPPLY
Model 3002

Operator's Manual

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FIGURE LISTING

Section 1. Introduction

The Canberra Model 3002 is a NIM-bin-compatible high voltage power supply designed for operation with essentially all types of nuclear radiation detectors. Particularly well suited to high resolution system applications, the standard two-width NIM module supplies well-regulated stable detector bias with extremely low ripple and noise content.

A recessed slide switch on the bottom panel permits operation on either 115 or 230 V ac input power, furnished through a power line cord and connector. The unit has no audible noise and therefore can be operated in close proximity to users with no irritating, unpleasant ultrasonic or audio sounds. The power supply will withstand any overload or direct output short-circuit for an indefinite period of time and provide normal output automatically upon removal of the overload. Overvoltage protection is also provided.

Two front panel controls allow continuous adjustment of the output voltage over its 0 to 3000 V range. The output voltage can also be controlled over its full range by application of an external input dc level of 0 to -5 V through a rear panel BNC connector. This feature is desirable for control applications and is standard on all units.

A polarity reversal switch provides selection of positive or negative output polarity. To prevent inadvertent polarity reversal, the switch is top panel mounted and screwdriver activated. In addition, the front panel LED indicators allow visual monitoring of the output voltage polarity for the safety and convenience of the user.

The output voltage is available simultaniously through two parallel-wired MHV rear panel connectors. Having dual outputs plus an output load capacity of 10 mA makes the Model 3002 ideal for use with a pair of detectors having the same voltage level requirements - if the sum of the individual loads are within the operating limits of the power supply.

For protection of liquid-nitrogen-cooled detectors, the Model 3002's ac supply can be controlled by the Model 1786 Liquid Nitrogen Monitor. Note: for safe operation of the Model 1786, the ac line power must be 110 volts.

Section 2. Specifications

2.1 INPUTS

REMOTE CONTROL (J2) - Accepts external reference input to determine output amplitude when LOCAL/REMOTE switch is set to REMOTE; 0 to ≈ -5 V dc input provides 0 to ± 3000 V output; Z_{in} > 5000 ohms.

2.2 OUTPUTS

REGULATED H.V. OUTPUT - 0 to 3000 V dc, continuously adjustable; 0 to 10 mA output current capability; two parallel, rear panel, SHV-type high voltage coaxial connectors.

POLARITY INDICATORS - Front panel LEDs to indicate output voltage polarity.

2.3 CONTROLS

ON/OFF - Front panel 2-position toggle switch for main ac power input.

VOLTS - Front panel controls to set output amplitude when rear panel Control switch is set at LOCAL 0-2000 V in 500 V steps; 0-1000 V with 10-turn precision potentiometer; output voltage is sum of the two control settings ± 0.25%; minimum warranted output 50 V, but satisfactory performance to 10 V, minimum.

LOCAL/REMOTE - Rear panel switch selects LOCAL controls or REMOTE reference input (J2) to determine output voltage.

POLARITY - Top panel two-position screwdriver switch selects either POSitive or NEGative output polarity.

115/230 V ac - Bottom panel two-position screwdriver slide switch permits operation on either 115 or 230 V ac nominal input power.

2.4 PERFORMANCE

RIPPLE AND NOISE - < 10 mV peak-to-peak, 5 Hz to 5 MHz

OUTPUT STABILITY - Long term drift of output voltage is < 0.01%/hr. and < 0.02%/8 hr. period, at constant input line voltage, load, and ambient temperature, after a 30 minute warmup.

REGULATION - 0.001% variation in output voltage, for line variations and 0.01% for load variations within operating range at constant ambient temperature.

TEMPERATURE COEFFICIENT - ≤ ± 50 ppm/° C after 30 minute warmup, operating range 0 to 50° C.

OVERLOAD PROTECTION - Power supply will withstand any overload, including a short-circuit, for an indefinite period, and will automatically resume normal operation upon removal of the overload; output current is limited to ≈ 12 mA.

CALIBRATION ACCURACY - Output voltage will differ by < ± 0.25% from sum of control settings plus 0.05% of maximum voltage.

RESETABILITY - Output voltage can be reset to within ± 0.2 V.

OUTPUT LOAD CAPACITY - 0 to 10 mA.

OUTPUT RANGE - 0 to 3000 V dc.

2.5 CONNECTORS

INPUT POWER - Rear panel 3-wire captive ac line cord with standard NEMA male connector.

OUTPUT VOLTAGE - Two rear panel parallel-wired SHV type female high voltage coaxial connectors.

REMOTE CONTROL - Rear panel BNC

2.6 POWER REQUIREMENTS

103-129 V ac, 206-258 V ac, 47-65 Hz, 70 W, nominal; no dc power requirements; ac power line protection via rear panel slow-blow fuse.

2.7 PHYSICAL

SIZE - Standard double-width NIM module 6.86 cm x 22.13 cm (2.70 x 8.714 inches).

WEIGHT - 4.9 kg (10.8 lbs.)

Section 3.
Controls and Connectors

3.1 FRONT PANEL

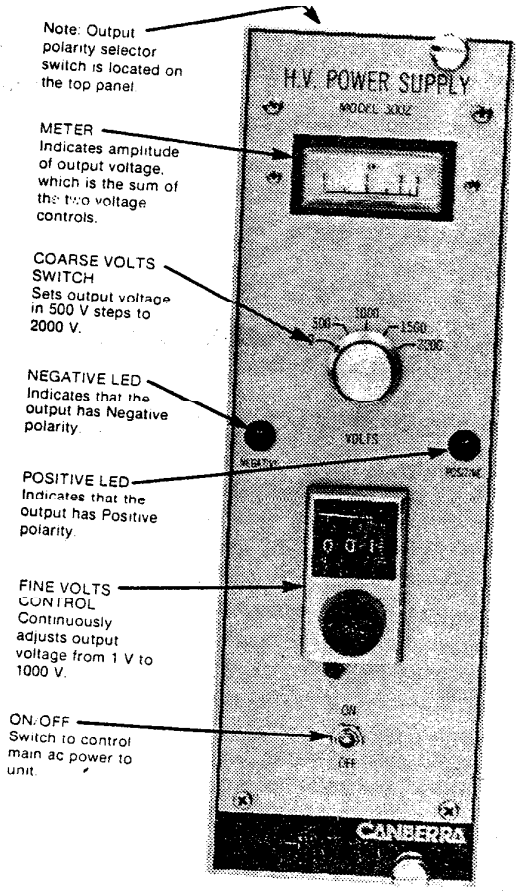

Figure 3.1
Front Panel Controls

3.2 REAR PANEL

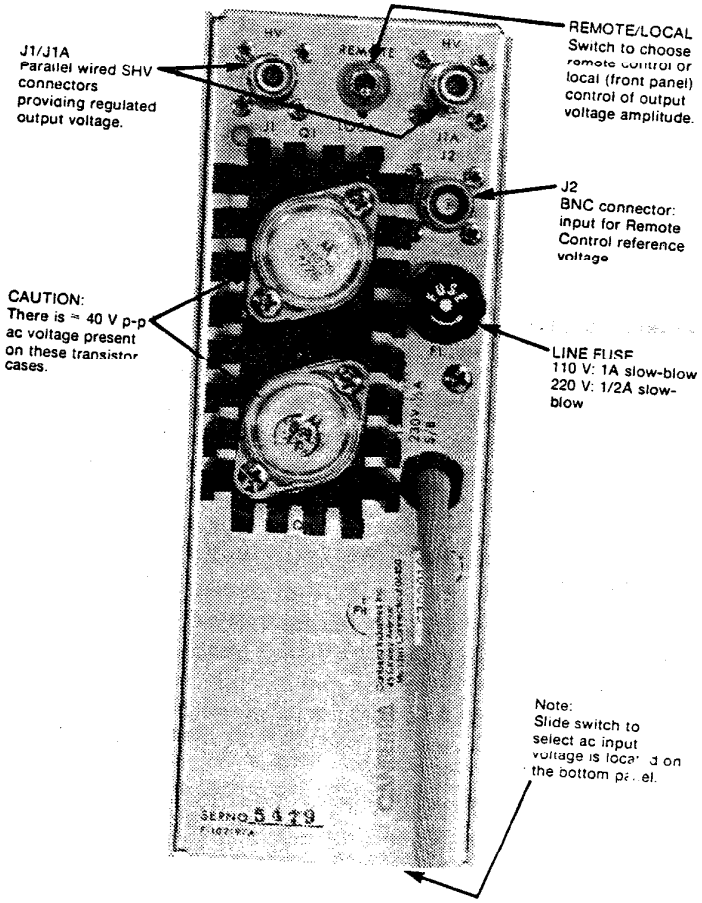

Figure 3.2
Rear Panel Controls

Section 4.
Operating Instructions

CAUTION

THIS UNIT PRODUCES HAZARDOUS VOLTAGE. DO NOT APPLY LINE VOLTAGE INPUT UNLESS ADEQUATE GROUND IS CONNECTED TO THE POWER SUPPLY AND THE HIGH VOLTAGE OUTPUT HAS BEEN APPROPRIATELY CONNECTED.

4.1 GENERAL

The purpose of this section is to familiarize the user with the installation and controls of the Model 3002 and to check that the unit is operating correctly. Since it is difficult to determine the exact system configuration in which the module will be used, explicit operating instructions cannot be given. However, if the following procedures are carried out, the user will gain sufficient familiarity with this instrument to permit its proper use in the system at hand.

4.2 INSTALLATION

The Model 3002 is normally used in conjunction with other modular electronics and may be installed in a Canberra Model 2000 Bin. As such, it can be rack mounted. Therefore any other equipment that may be installed in the same rack must be sufficiently cooled by circulating air to prevent any localized heating of the circuits in the Model 3002. The temperature of equipment operating in racks can easily exceed the recommended maximum unless precautions are taken. The Model 3002 should not be subjected to temperatures in excess of 50° C (120° F).

The Model 3002 contains all required power supplies to operate and receives input power by way of a 3-wire captive line cord with a standard NEMA male connector when connected to a suitable source. A bottom panel slide switch permits the selection of the proper input circuit for either 115 or 230 V ac nominal power input. This power supply may be operated entirely removed from a Model 2000 Bin if desired, since it is totally self-contained and requires no dc operating power levels from the Bin. However, precautions should be taken to ensure that personnel know of the shock hazard at the rear connectors, and air space should be provided at the top and bottom of the instrument.

4.3 OPERATION

Polarity selection is done by moving the Polarity switch on top of the unit, just behind the front panel.

NOTE: BEFORE ATTEMPTING TO REVERSE THE OUTPUT POLARITY,

1. TURN OFF THE HIGH VOLTAGE POWER SUPPLY
2. DISCHARGE THE UNIT TO GROUND AT THE OUTPUT CONNECTOR

This will protect both the Model 3002 and any equipment connected to it.

After selecting the Output Polarity:

1. Plug the ac power cord into the ac line supply.
2. Set the Output Voltage Controls to zero.
3. Turn on the front panel ON/OFF switch.
4. Check the Polarity indicator LEDs for correct Output Polarity.
5. Connect a high-voltage cable from either of the rear panel Output connectors to the instrument to be powered.
6. Two instruments may be powered, if their combined loads do not draw more than a maximum current of 10 mA.
7. Set the Output Voltage Controls for the desired voltage level. The Output High Voltage will be the sum of the settings of both controls.

4.4 EXTERNAL REFERENCE OPERATION

The output voltage level can be controlled by an external reference level that is furnished through the rear panel BNC connector when the Control switch is set at REMOTE. The range of input voltage is 0 to -5 V dc to provide an output level 0 to ± 3000 V. The front panel voltage level controls are ineffective for REMOTE reference operation.

For positive output the Polarity selector slide switch on the top panel is set at POSitive; for negative output the Polarity switch is set at NEGative. The external reference voltage should be stable and filtered since the output is linearly proportional to this reference.

4.5 AUTOMATIC SHUTDOWN

The Model 3002 contains automatic protection against sustained overloading (short-circuited output). A sustained overload will cause the high voltage to shut down completely. This will be clearly indicated by the zero output reading on the front panel meter whatever the voltage control settings may be. A short duration arc-over or turn-on charging transient will not cause shutdown. When the overload is removed, the preset output will resume.

Further protection is provided by the overvoltage circuitry. If the output should try to go higher than the Control settings, the overvoltage sensing circuit will shut the unit down. To reset, the unit must be turned OFF for approximately five seconds then turned back ON.

4.6 PERFORMANCE TESTS

The following test equipment is required to perform the measurements.

a. Oscilloscope
b. Digital Voltmeter (DVM).
c. High impedance, high voltage 1000:1 precision dc voltage divider with capacitive coupled ac viewing circuit.
d. High voltage load resistor, 300k ohms, 50 watts.
e. High voltage shorting stick.

Connect the high voltage output of the Model 3002 to the 1000:1 dc voltage divider. Connect the low voltage end of the divider to the DVM and the scope to the ac viewing output of the divider. Make sure a good ground is provided for all instruments.

Turn the front panel voltage controls to their maximum positions. The DVM should indicate an output of 3000 volts.

Connect one end of the load resistor to ground and the other end to the shorting stick. Then connect the load resistor to the high voltage output with the shorting stick and observe the change in output voltage. During this no-load to full-load test, the DVM reading should not change more than 0.001%.

With the load connected, measure the ac ripple on the oscilloscope. The ripple should be 10 mV peak-to-peak.

Section 5. Theory of Operation

5.1 GENERAL

This section describes the overall functional operation and circuitry of a Model 3002. The section gives background information to assist in the application and maintenance of the equipment. A complete circuit schematic is included at the rear of the manual.

5.2 FUNCTIONAL DESCRIPTION

The unit is basically a dc-dc converter which converts low voltage dc power to a high voltage dc output. This output voltage is highly regulated and filtered and can be varied either by the front panel VOLTS controls or through the REMOTE input on the rear panel.

The input to the dc-dc converter is obtained from a conventional low voltage power supply with ac line input. An oscillator determines the high frequency (approximately 20 kHz) at which all amplification, high voltage transformation, rectification, and filtering occurs. The amplification is a function of a control voltage which performs the function of control and regulation. A sample of the output is compared against a reference voltage in the sensing circuit. The sensing circuit generates the control voltage to set and maintain a fixed high voltage output.

5.3 CIRCUIT DESCRIPTION

The ac line provides the 36 V dc supply by a full-wave bridge rectifier and ± 20 V dc for the ± 12 V regulators by a dual full-wave grounded center-tap rectifier circuit. Both rectifier circuits are on the chassis. IC 121 and IC 122 are voltage regulators supplying the ±12 V regulated supplies.

The output of the oscillator (IC 102B) goes to the Automatic Gain Control (AGC) amplifier, IC 105, which has two outputs of opposite phase. The gain of the AGC amplifier is a function of the control generator voltage as seen at the output of IC 102A. Power transistors Q1 and Q2 are driven directly by the opposite phase outputs of IC 105.

The encapsulated high voltage assembly includes a high-voltage power transformer, a rectifier circuit, a ripple filter and a sampling (voltage-divider) circuit. These are all critical custom-designed components. It is recommended that trouble-shooting be avoided by personnel who are not thoroughly familiar with highly regulated high-voltage techniques.

The sensing circuit output is compared to the control generator voltage developed at the output of IC 103B. Output voltage control is obtained by varying the reference voltage fed to IC 103A.

IC 104 and CR 101 provide the reference voltage for the front panel voltage control resistors. R 172 calibrates the reference to provide 3 kV maximum output.

The front panel selection switch (S5) and control potentiometer (R 11) provide a linear reference at IC 103A appropriate for a 0 to 3000 V output.

Overload protection is provided by A107A and CR118. When the voltage controlling the gain of IC 105 exceeds the threshold established by CR118, Q103 turns on and sinks the oscillator output, turning off IC 105. When the overload is removed, the circuit automatically returns to normal operation.

Overvoltage protection is provided through IC 107B, Q105 and Q104. If the output voltage exceeds the programmed setting as dictated by the control generator, IC 107B turns on Q105 which in turn inhibits the output of IC 105. Q105 also turns on Q104 which shunts away IC 105's gain voltage produced by IC 102A. The power supply will remain in this condition until the ac power to the unit is turned off and then on again.

In the REMOTE mode, the control voltage on PCB 100 is determined by the voltage at the REMOTE input (J2). The LOCAL mode uses the internal reference voltage from the reference generator with the output voltage adjustments being controlled through S5 and R11.

3kV POWER SUPPLY
Model 3002

Instruction Manual
October, 1977

CANBERRA INDUSTRIES, INC.
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WARRANTY

Canberra-Manufactured Equipment

Equipment manufactured by Canberra Industries, Inc. is warranted against defects in materials and workmanship for a period of twelve months from date of shipment, provided that the equipment has been used in a proper manner as detailed in the instruction manuals. During the warranty period repairs or replacement will be made at Canberra's option, but the transportation cost to and from Canberra is the responsibility of the Customer. For defects discovered upon initial operation, shipping expense to Canberra is to be paid by the customer; shipping expense to return the repaired equipment will be paid by Canberra.

The customer must obtain shipping instructions, including an *Authorized Return Number* (ARN), before returning any equipment to the Canberra factory. Compliance with this provision by the customer shall be a condition of this warranty. In giving shipping instructions, Canberra shall not, therefore, assume any liability in connection with the shipment. If, upon receipt of the equipment, Canberra determines that such equipment is not defective within the terms of this warranty, the customer shall pay to Canberra upon invoice, the cost of all transportation and cost of repairs at the then prevailing Canberra repair rate.

This warranty shall not apply to equipment that has been modified or serviced by other than Canberra service personnel, or to failures caused by defective equipment not supplied by Canberra.

This warranty applies only to equipment manufactured by Canberra. On other equipment supplied by Canberra, the full warranty, and only that warranty offered by the original manufacturer, will be passed on to the customer.

WARRANTY ON EQUIPMENT NOT MANUFACTURED BY CANBERRA

Canberra's basic one-year warranty applies only to equipment manufactured by Canberra. Although Canberra may frequently supply, as part of systems, equipment manufactured by other companies, the only warranty that shall apply to such non-Canberra equipment is that warranty offered by the original manufacturer.

Canberra will, upon request, state what warranties are offered by the original manufacturers of such items as computers, teletype machines, printers, plotters, and other non-Canberra equipment which may be supplied as part of a Canberra system. In no case, however, will Canberra assume any liability for such equipment other than to pass on to its customer whatever warranty is supplied by the original manufacturer.

WARRANTY ON SOFTWARE

Canberra will warrant system operation with *Canberra Laboratory Automated Software Systems* (CLASS) only. If the customer decides to use software other than CLASS, Canberra assumes *no* responsibility. Engineering assistance, however, for non-CLASS software is available to the user and should be contracted separately if desired.

ON-SITE WARRANTY OPTION

The basic Canberra warranty applies only to equipment manufactured by Canberra which is *returned to the factory*. If equipment must be repaired at the customer's site, the actual repair labor and parts will be provided at no charge during the warranty period. However, travel expenses to and from the customer's site, and living expenses while on site, shall be paid by the customer unless an on-site warranty option has been purchased. This option may only be purchased prior to shipment of the equipment to the customer.

The on-site warranty option provides for free on-site warranty work (Canberra pays all travel and living expenses) within the first 60 days after delivery of equipment to the customer. If installation is ordered from Canberra, the 60 day period commences upon completion of the initial installation. After the 60 day period, labor and materials used on site will still be covered by the basic warranty, but the customer shall pay for all travel and living expenses incurred for any on-site service.

The on-site warranty option is available only within the contiguous forty-eight (48) United States and Canada.

After the 60 days on-site warranty period, or after initial installation of the equipment, a maintenance contract may be purchased. This is to be contracted through Canberra's Customer Service Department. Contact the factory for details concerning warranty options and maintenance contracts.

INSTALLATION

Installation of equipment purchased from Canberra shall be the sole responsibility of the customer unless it is specifically contracted for at the prevailing Canberra field service rates. To insure timely installation after receipt of equipment, it is recommended that installation be contracted for at the time the equipment is ordered.

REPAIRS

Any Canberra-manufactured instrument no longer in its warranty period may be returned, freight prepaid, to our factory for repair and realignment. When returning instruments for repair, contact the factory for shipping instructions and an *Authorized Return Number* (ARN).

All correspondence concerning repairs should include Model Number and a description of the problem observed.

Once repaired, all equipment passes through our normal pre-shipment checkout procedure, and will meet or surpass its original specifications when returned. Return shipping expense on out-of-warranty repairs will be charged to the customer.

For instruments out of warranty, the customer must supply a purchase order number for the repair before the item will be returned.

SHIPPING DAMAGE

Shipments should be carefully examined when received for evidence of damage caused by shipping. If damage is found, immediately notify Canberra and the carrier making delivery, as the carrier is normally responsible for damage caused in shipment. Carefully preserve all documentation to establish your claim. Canberra will provide all possible assistance in damage claims.

3kV POWER SUPPLY

Model 3002

CONTENTS

3kV POWER SUPPLY
Model 3002

Section 1

INTRODUCTION

The Canberra Model 3002 is a NIM bin compatible high voltage power supply designed for operation with essentially all types of nuclear radiation detectors. Particularly well suited to high resolution system applications, the standard two-width NIM module supplies well-regulated stable detector bias with extremely low ripple and noise content.

A recessed slide switch on the bottom panel permits operation on either 115 or 230VAC input power furnished through a power line cord and connector. The unit has no audible noise and therefore can be operated in close proximity to users with no irritating, unpleasant ultrasonic or audio sounds. The power supply will withstand any overload or direct output short-circuit for an indefinite period of time and provide normal output automatically upon removal of the overload.

Two front panel controls allow continuous adjustment of the output voltage over its 0 to 3000V range. The output voltage can also be controlled over its full range by application of an external input DC level of 0 to -5V through a rear panel BNC connector. This feature is desirable for control applications and is furnished standard on all units.

A polarity reversal switch provides selection of positive or negative output polarity. To prevent inadvertent polarity reversal, the switch is top panel mounted and screwdriver activated. In addition, the front panel LED indicators allow visual monitoring of the output voltage polarity for the safety and convenience of the user.

The output voltage is available simultaneously through two parallel-wired MHV rear panel connectors. Having dual outputs plus an output load capacity of 10 milliamps makes the Model 3002 ideal for use with a pair of detectors having the same voltage level requirements — the sum of the individual loads being within the operating limits of the power supply.

Section 2
SPECIFICATIONS

2.1 INPUTS

AC POWER LINE	103-129V, or 206-258V, 47-65Hz, 70W, nom; power supplied through rear panel 3-wire captive line cord with standard NEMA male connector; a rear panel fuse is provided.
REMOTE CONTROL	Accepts external reference input to determine output polarity and amplitude when INT/EXT control is set at EXT; 0 to ≈ -5VDC input provides 0 to ± 3000V output; $Z_{in} > 5000$ ohms.

2.2 OUTPUTS

REGULATED H.V. OUTPUT	0 to 3000VDC, continuously adjustable; 0 to 10mA output current capability; two rear panel type SHV high voltage coaxial connectors.
POLARITY INDICATORS	Front panel LED indicator lights for output voltage polarity.

2.3 CONTROLS

POWER	Front panel 2-position toggle switch for main AC power input.
OUTPUT VOLTAGE	Front panel controls to set output amplitude when rear panel Control switch is set at LOCAL, 0-2000V in 500V steps; 0-1000V with 10-turn precision potentiometer; output voltage is sum of the 2 control settings ± 0.25%; minimum warranted output 50V, but satisfactory performance to 10V, minimum.
CONTROL INT/EXT	Rear panel slide switch selects LOCAL operation or REMOTE reference input to determine output voltage.
POLARITY	Top panel 2-position screwdriver switch selects either POSitive or NEGative output polarity.
115/230VAC	Bottom panel 2-position screwdriver slide switch permits operation on either 115 or 230VAC nominal input power.

2.4 PERFORMANCE

RIPPLE AND NOISE	< 10mV peak-to-peak, 5Hz to 5MHz
OUTPUT STABILITY	Long term drift of output voltage is < 0.01%/hr. and < 0.02%/8 hr. period, at constant input line voltage, load, and ambient temperature, after a 30 minute warmup.

REGULATION	0.001% variation in output voltage, for line variations and 0.01% for load variations within operating range at constant ambient temperature.
TEMPERATURE COEFFICIENT	⩽ ± 50ppm/°C after 30 minute warmup, operating range 0 to 50°C.
OVERLOAD PROTECTION	Power supply will withstand any overload, including a short-circuit, for an indefinite period, and will automatically resume normal operation upon removal of the overload; output current is limited to ≈ 12mA.
CALIBRATION ACCURACY	Output voltage will differ by < ± 0.25% from sum of control settings plus 0.05% of maximum voltage.
RESETABILITY	Output voltage can be reset to within ± 0.2 volt.
OUTPUT LOAD CAPACITY	0 to 10mA.
OUTPUT RANGE	0 to 3000VDC.

2.5 CONNECTORS

INPUT POWER	Rear panel 3-wire captive AC line cord with standard NEMA male connector.
OUTPUT VOLTAGE	Two rear panel type SHV female high voltage coaxial connectors.
REMOTE CONTROL	Rear panel, BNC, UG-1094/U.

2.6 POWER REQUIREMENTS

103-129VAC 206-258VAC, 47-65Hz, 70W, nominal; no DC power requirements; AC power line protection via rear panel 1.0 amp SLO BLO fuse and holders.

2.7 PHYSICAL

SIZE	Standard double-width NIM module (2.70 x 8.714 inches) per TID-20893 (rev.).
WEIGHT	8.0 lb. (3.6 kg.).

Section 3

OPERATING INSTRUCTIONS

3.1 GENERAL

The purpose of this section is to familiarize the user with the installation and controls of the Model 3002 and to check that the unit is operating correctly. Since it is difficult to determine the exact system configuration in which the module will be used, explicit operating instructions cannot be given. However, if the following procedures are carried out, the user will gain sufficient familiarity with this instrument to permit its proper use in the system at hand.

3.2 INSTALLATION

The Model 3002 is normally used in conjunction with other modular electronics and may be installed in a Canberra Model 1400 Bin. As such, it can be rack mounted. Therefore any other equipment that may be installed in the same rack must be sufficiently cooled by circulating air to prevent any localized heating of the circuits in the Model 3002. The temperature of equipment operating in racks can easily exceed the recommended maximum unless precautions are taken. The Model 3002 should not be subjected to temperatures in excess of 50°C (120°F).

The Model 3002 contains all required power supplies to operate and receives input power by way of a 3-wire captive line cord with a standard NEMA male connector when connected to a suitable source. A bottom panel slide switch permits the selection of the proper input circuit for either 115 or 230VAC nominal power input. This power supply may be operated entirely removed from a Model 1400 Bin if desired, since it is totally self-contained and requires no dc operating power levels from the Bin. However, precautions should be taken to ensure that personnel know of the shock hazard at the rear connectors, and air space should be provided at the top and bottom of the instrument.

3.3 FIRST-TIME OPERATION

1. Check to see that the Power switch is in the OFF position.

2. Plug the AC power cord into the appropriate receptacle.

3. Check the Polarity switch on the top panel and set it for either POSitive or NEGative output polarity as required for the application.

4. Connect a high-voltage cable from either Output connector on the Model 3002 to the instrument to be powered. Use the other Output connector if a second instrument is to be operated at the same output voltage.

5. Set the front panel selector switch and potentiometer for the desired voltage level. This is normally specified with the instruments to which the voltage is to be applied. The adjusted output voltage will be the sum of the settings of both controls.

6. Turn on the power with the toggle switch on the front panel. One of the polarity indicators will light to show that input power is being applied and to indicate the output polarity.

3.4 EXTERNAL REFERENCE OPERATION

The output voltage level can be controlled by an external reference level that is furnished through the rear panel BNC connector when the Control slide switch is set at REMOTE. The range of input voltage is 0 to -5VDC to provide an output level 0 to 3000V. The front panel voltage level controls are ineffective for REMOTE reference operation.

For positive output the Polarity selector switch on the top panel is set at POSitive; for negative output the Polarity switch is set at NEGative. The external reference voltage should be stable and filtered since the output is linearly proportional to this reference.

Section 4

THEORY OF OPERATION

4.1 GENERAL

This section describes the overall functional operation and circuitry of a Model 3002. The section gives background information to assist in the application and maintenance of the equipment. Figure 4-1 is a simplified Block Diagram. A complete circuit schematic is included at the rear of the manual.

4.2 FUNCTIONAL DESCRIPTION

The unit is basically a dc-dc converter which converts low voltage dc power to a high voltage dc output. This output voltage is highly regulated and filtered and can be varied either by the front panel VOLTS controls or through the REMOTE input on the rear panel.

The input to the dc-dc converter is obtained from a conventional low voltage power supply with ac line input. An oscillator determines the high frequency (approximately 20kHz) at which all amplification, high voltage transformation, rectification, and filtering occurs. The amplification is a function of a control voltage which performs the function of control and regulation. A sample of the output is compared against a reference voltage in the sensing circuit. The sensing circuit generates the control voltage to set and maintain a fixed high voltage output.

4.3 CIRCUIT DESCRIPTION

The input ac line is connected to the B+ (35V dc) supply and regulated ± 12V low voltage power supply assembly. The B+ supply is a simple full wave bridge rectifier circuit. The regulated low voltage power supply circuits are standard regulator IC circuits (IC 107 and 108) on PCB 100. The B+ Supply is located on the chassis.

The output of the oscillator circuit (IC 104B) located on PCB100 is amplified in the AGC integrated circuit, IC106. The gain of IC106 is a function of the control voltage developed at the output of the amplifier IC104A. The output of IC106 is amplified, buffered and then employed to drive the power transistors. The amplification and buffering for both phases of drive is accomplished by IC105.

The encapsulated high voltage assembly includes a high voltage power transformer, rectifier circuit, ripple filter and sensing circuit. These are all critical custom designed and encapsulated components. It is recommended that trouble-shooting be avoided by personnel who are not thoroughly familiar with highly regulated high voltage techniques.

A sample of the high voltage dc output is fed to the sensing circuit and is compared to a reference voltage. The sensing circuit consists of differential operational amplifiers IC101. Output voltage control is obtained by varying the reference voltage fed to IC104.

IC103A and potentiometer R15 (front panel VOLTS control) provide a continuous linear reference variation appropriate for obtaining a 0 to 1000 voltage output. The front panel 500V control switch provides incremental step changes in the reference voltage appropriate for obtaining incremental output variations of 500V.

IC103B sums the effect of the voltage controls. R47 and R10 are located on PCB100 and provide adjustment of the maximum output voltage and the 0 to 1000V adjustment range respectively.

Section 5

MAINTENANCE

CAUTION

THIS UNIT PRODUCES HAZARDOUS VOLTAGE. DO NOT APPLY LINE VOLTAGE INPUT UNLESS ADEQUATE GROUND IS CONNECTED TO THE POWER SUPPLY AND THE HIGH VOLTAGE OUTPUT HAS BEEN APPROPRIATELY CONNECTED.

5.1 GENERAL

This section contains information required for the maintenance of a Model 3002. It is organized around the approved performance test procedures used to determine that the equipment is operating to specifications.

5.2 TEST EQUIPMENT REQUIRED

The test equipment required to test and maintain a Model 3002 is listed as follows (equivalents may be used):

a. Oscilloscope, Hewlett-Packard Model 1205A.
b. Digital voltmeter, Digitec Model 251/251-4.
c. Variable autotransformer, General Radio Model W2.
d. High impedance, high voltage 1000:1 precision dc voltage divider.
e. Capacitive coupled ac viewing circuit.
f. High voltage load resistor rated for maximum voltage and current of Model 3002.
g. High voltage shorting stick.

5.3 PREPARATION FOR MEASUREMENTS

Connect the HIGH VOLTAGE OUTPUT of the Model 3002 to the high voltage terminal of the dc voltage divider and to the capacitor input of the ac viewing circuit. The low voltage terminal of the dc divider should be connected to the digital voltmeter input, and the ac viewing circuit output connected to the oscilloscope input. Make sure that a good ground is connected to all instruments, viewing circuits and the Model 3002. After the ground has been checked, adequate safety precautions have been taken, and the output VOLTS controls set at zero, input power can be applied. The ac input should be applied through the variable autotransformer, which should be initially set for 115 or 230 volts output, as appropriate.

5.4 ADJUSTMENTS

With the VOLTS switch (where appropriate) set at zero, adjust the VOLTS dial to read 1000 volts. Adjust R10 on PCB100 for an output voltage of exactly 1000 volts.

With the VOLTS dial set at 1000 volts, set the VOLTS switch at maximum. Adjust R47 for an output voltage of exactly the rated maximum output voltage (3000VDC). If R47 required adjustment, reset the switch back to its zero position and repeat the adjustment of R10.

Adjusment is now complete. The following performance tests are used to determine that the unit meets all specifications.

5.5 PERFORMANCE TESTS

Check to assure that the procedures in Section 5.3 have been followed.

Turn the front panel output VOLTS controls fully clockwise until the reading on the digital voltmeter indicates maximum output from the Model 3002.

Connect one end of the high voltage load resistor to ground and the other end to the shorting stick. Then, with the shorting stick, connect the load resistor across the HIGH VOLTAGE OUTPUT and observe the change in output voltage. During this no load to full load test, the digital voltmeter reading should not change by more than 0.01%.

With the load connected as above, observe the ac ripple voltage on the oscilloscope. The ripple should be less than the specified peak-to-peak ripple under this condition of full load and maximum output voltage.

Vary the autotransformer to produce an ac line input change of ± 10% to the power supply and again observe the change in digital voltmeter reading. This change should be less than 0.001%.

Additional line and load regulation and ripple measurements may be performed at other voltage levels using the same procedure outlined above. This should not usually be necessary. Satisfactory test data at maximum output voltage and the full range of voltage control generally indicate that satisfactory test data will be obtained at all voltage levels. However, full range testing is performed at the factory on each unit prior to shipment.

5.6 TROUBLE-SHOOTING PROCEDURES

A Model 3002 High Volgage Power Supply consists of one easily replaceable plug-in printed circuit board and a main chassis assembly which includes the high voltage circuitry. The basic trouble-shooting procedure consists of determining which of these assemblies is defective. Removal of the two side covers provides access to the printed circuit board and high voltage components. The printed circuit board is secured by a supporting bracket.

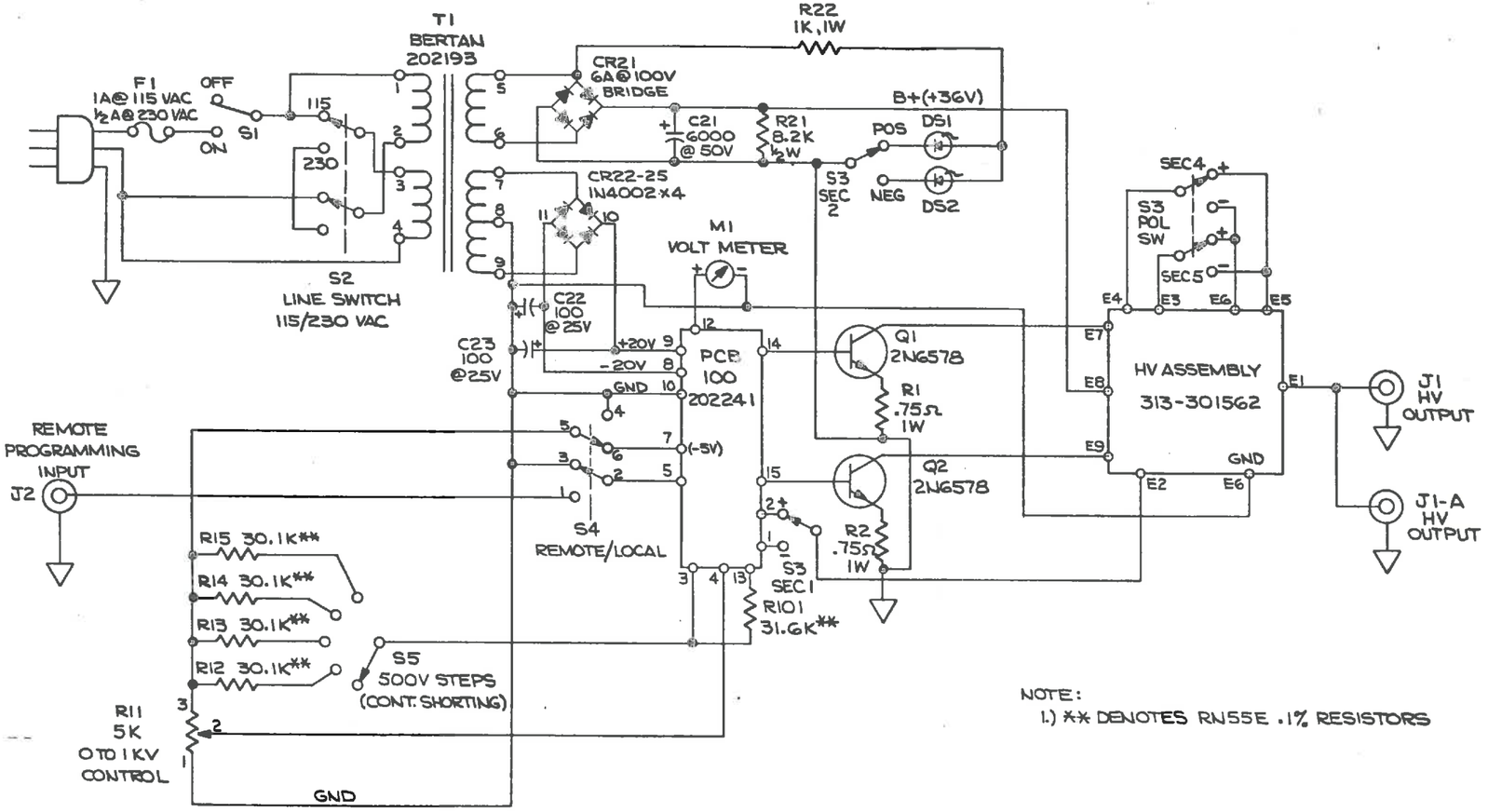
No further disassembly is required for trouble-shooting purposes. ONCE THE COVER HAS BEEN REMOVED EXTREME CAUTION MUST BE EXERCISED AS POTENTIALLY DANGEROUS VOLTAGES ARE ACCESSIBLE. Make sure all test instruments are grounded, either to the high voltage connector shield or directly to the chassis, prior to the application of input power to the unit. The following procedures should then be followed.

Remove PCB100 from the unit. This leaves only the low voltage B+ and ± 15 volt power supplies operable. Turn on ac line power and measure the dc voltage obtained at the positive terminal of capacitor C21 located on the top of the unit. This voltage should be approximately +41V dc. If this voltage differs by more than 15%, the power transformer, bridge rectifier or capacitor is probably defective.

If the B+ supply is operating properly, check for the regulated ± 15V dc output accessible at pins 7 and 8, respectively, of the PCB200 connector. The ± voltages should be of equal magnitude to within 2% and within the range of 14 to 16V dc. If the magnitude and tracking are not within the range specified, this circuitry is probably defective.

If all of the low voltage power supplies are operating properly, turn off input power, insert PCB100, turn all voltage controls to zero, follow the PREPARATION FOR MEASUREMENT procedure outlined in Section 5.3, and turn the line power back ON.

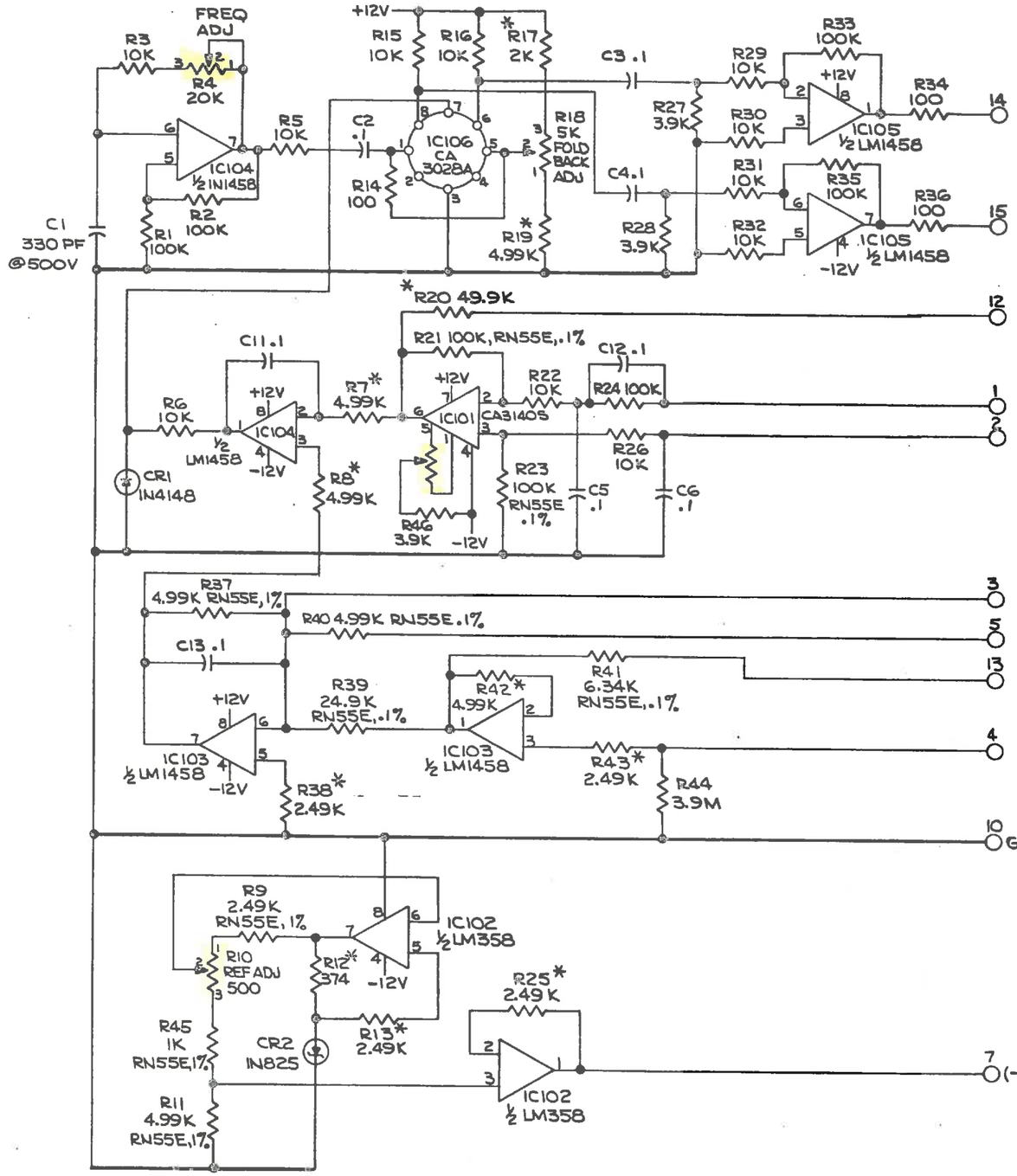
REV	CHANGE	ECN	BY	DATE	APPD
	INITIAL RELEASE	1817	RHm	4-24-78	

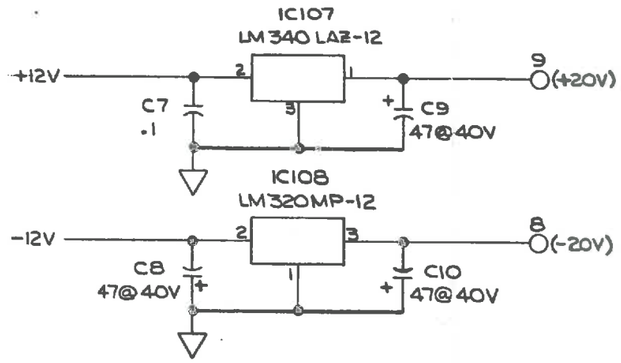


NOTE:
1.) ** DENOTES RN55E .1% RESISTORS

DRAWN D.R.WEST	DATE 9-8-77	SCHEMATIC/BLOCK DIAGRAM	CANBERRA
CHKD		MODEL 3002 HVPS	DRAWING NO. B-16894 REV.
APPD MECH		SCALE — DO NOT TEMPLATE DRAWING	SHT 1 OF 1
APPD ELEC	15 Nov 77		
NEXT ASSY			
USED ON			

REV	CHANGE	ECN	BY	DATE	APPD
	INITIAL RELEASE	1817	RAM	4-26-77	





NOTES:
1. * DENOTES RN55C 1% RESISTOR.
2. UNLESS OTHERWISE SPECIFIED:
   A. RESISTOR VALUES IN OHMS ±5%.
   B. CAPACITOR VALUES IN MF ±10% AT 250V.

USED ON	DRAWN D.WEST	DATE 9-8-77	SCHEMATIC PCB 100 MODEL 3002 HVPS
	CHKD		
	APPD MECH		
	APPD ELEC	15 Mh, T3	
	NEXT ASSY		
	SCALE —	DO NOT TEMPLATE DRAWING	DRAWING NO B-16895 REV.
			SH 1 OF 1

CANBERRA