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1. Introduction

The Canberra Model 3002D is a NIM-bin-compatible high voltage power supply designed for operation with essentially all types of nuclear radiation detectors. Particularly well-suited for use with scintillation detectors, the standard double-width NIM module provides a well regulated output up to 10 mA at 0 to ±3000 V dc.

A recessed switch on the bottom panel is used to select either 115 V or 230 V ac input power furnished through a power line cord and connector. The Model 3002D can also be operated outside the NIM bin from any ac power receptacle, since it requires no power from the bin. 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 fault.

Output voltage is continuously adjustable by means of the calibrated front panel control over the full range from 0 to ±3000 V. The output voltage can also be controlled over its full range by application of an external input dc level of 0 to -6 V through a rear panel BNC connector. A 3-1/2 digit liquid crystal display meter measures output voltage with a resolution of 10 V, and output current with a resolution of 100 mA.

The output voltage is available simultaneously through two parallel-wired SHV rear panel connectors. Two high voltage outputs, with a combined load capacity of 10 mA, make the Model 3002D ideal for use with a pair of detectors having the same voltage level requirements, as long as the sum of the individual loads is within the operating limits of the power supply.

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. The polarity status is indicated by a front panel polarity indicator, which lights when the OFF/STANDBY/ON switch is in the STANDBY or ON position (polarity preview).
2. Controls And Connectors

2.1. FRONT PANEL

CAUTION: Before rewiring polarity, set voltage control to zero and wait for unit to discharge to zero volts.

OUTPUT METER - indicates output voltage 0 - 3.00 kV or output current 0 - 10.00 mA

VOLTAGE CONTROL - sets output voltage when rear panel switch is in local

POLARITY INDICATORS - indicate output polarity setting when Power Switch is in STANDBY or ON

METER SWITCH - selects current (mA) or voltage (kV) meter display

POWER SWITCH - STANDBY enables Polarity indicator; ON enables entire unit; OFF disables all input power

Figure 2.1 Front Panel Controls
2.2. REAR PANEL

REMOTE/LOCAL -
Switch to choose remote control or local (front panel) control of output voltage amplitude

CAUTION: There is ~40V p-p ac voltage present on these transistor cases

LINE FUSE -
110 V: 1A slow-blow
220 V: 1/2A slow-blow

Note: Slide switch to select ac input voltage is located on the bottom panel

Figure 2.2 Rear Panel Controls and Connectors
3. Operating Instructions

WARNING
This unit produces hazardous voltage. Do not apply line voltage input unless the power supply is adequately grounded and the high voltage output has been appropriately connected.

3.1. INSTALLATION
The Model 3002D is normally used in conjunction with the other modular electronics and may be installed in a Canberra Model 2000 Bin or equivalent. 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 3002D. The temperature of equipment operating in racks can easily exceed the recommended maximum unless precautions are taken. The Model 3002D should not be subjected to temperatures in excess of 50°C.

The Model 3002D contains all required power supplies to operate and receives input power by way of a 3-wire captive line cord with a standard NEMA outline connector. A bottom panel slide switch permits the selection of the proper input circuit for either 115 or 220 V ac nominal power input.

This power supply may be operated entirely removed from the Bin if desired, since it is totally self-contained and requires no line 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.

3.2. POLARITY SELECTION
Output polarity is selected by changing the Polarity switch on top of the unit, just behind the front panel.

Note: Before attempting to reverse the output polarity, perform the following steps to avoid permanent damage to the unit:

1. Turn off the high voltage power supply
2. Discharge the unit to ground at the output connector

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

3.3. OPERATION
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 the front panel OFF/STANDBY/ON switch to STANDBY.
4. Check the Polarity indicator LEDs for correct output polarity.
5. Connect a high-voltage cable from either of the rear panel connectors to the instrument to be powered.
6. Turn the OFF/STANDBY/ON switch to ON.
7. Set the output voltage control for the desired voltage level.

NOTE: Two instruments may be powered if their combined loads do not draw more than 10 mA maximum.

3.4. DISPLAY SELECTION
The liquid crystal display (LCD) can indicate the output voltage in kilovolts (kV) or the output current in milliamperes (mA). Select the voltage or current function with the kV/mA switch directly below the LCD display.

3.5. 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 REMOTE/LOCAL switch is set to 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 control has no effect during REMOTE reference operation.

The external reference voltage should be stable and filtered since the output is linearly proportional to this reference.

3.6. AUTOMATIC SHUTDOWN
The Model 3002D contains automatic protection against sustained overload. A sustained overload (short-circuited output) completely shuts off the high voltage. This will be clearly indicated by a zero output reading on the front panel meter. A short duration arc-over or trim-on charring transient will not cause shutdown. When the overload is removed, the preset output will resume.
Further protection is provided by the overvoltage cir-
cuitry, which shuts off the output voltage if the output
tries to go higher than the control setting. To reset the
unit, turn it OFF for approximately five seconds then back
ON.

3.7. CHANGING THE INPUT VOLTAGE
The unit's nominal input voltage can be selected for 115
V ac or 230 V ac. The selection switch is located on the
unit's bottom panel, just behind the front panel.

4. Theory of Operation

4.1. 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 voltage control 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 (ap-
proximately 20 kHz) at which all amplification, high-volt-
age 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.

4.2. 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 ground center tap rectifier circuit.
Both rectifier circuits are on the chasss. IC121 and IC122
are voltage regulators supplying the ± 12 V regulated
supplies.

4.3. INPUT VOLTAGE SELECTION
The unit's nominal input voltage can be selected for 115
V ac or 230 V ac. The selection switch is located on the
unit's bottom panel, just behind the front panel.

The output of the oscillator (IC102B) drives the Automa-
tic Gain Control (AGC) amplifier, IC105, 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 IC102A. Power transistors Q1 and Q2 are
driven directly by the opposite phase outputs of IC105.

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 recom-
meded that trouble-shooting be done only by person-
nel who are thoroughly familiar with highly regulated
high-voltage techniques.

The sensing circuit output is compared to the control
generator voltage developed at the output of IC101B.
Output voltage control is obtained by varying the refer-
ence-voltage fed to IC103A.

IC104 and CR101 provide the reference voltage for the
front panel voltage control resistors. R172 calibrates the
reference to provide 3 kV maximum output.

The front panel selection switch (S5) and control poten-
tiometer (R11) provide a linear reference at IC109A ap-
propriate for a 0 to 3000 V output.

Overload protection is provided by A107A and CR118.
When the voltage controlling the gain of IC105 exceeds
the threshold established by CR118, Q103 turns on and
sinks the oscillator output, turning off IC105. When the
overload is removed, the circuit automatically returns to
normal operation.

Overvoltage protection is provided through IC107B,
Q105 and Q103. If the output voltage exceeds the
programmed setting as dictated by the control gener-
ator, IC107B turns on Q105 which in turn inhibits the
output of IC105. Q106 also turns on Q104 which shuts
away IC105's gain voltage produced by IC102A. 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.
A.1. INPUTS
AC POWER LINE - 115/230 V ac ± 10%, 50-60 Hz; power supplied through rear panel 3-wire captive line cord with standard NEMA male connector; fully loaded input current is 0.6 A, nominal.

PROGRAM (BNC-J2) - Accepts external reference input to determine output voltage when program switch is in REMOTE; ±0.5 V input provides ±0.300 V dc output; no outputs for positive voltages; Za > 2 Megohms; ±12 V maximum; rear panel BNC connector. Remote programming is independent of selected output polarity.

A.2. OUTPUTS
HV (Regulated High Voltage Output) -0 to ±300 V dc, continuously adjustable; 0 to 10 mA output current capability; two rear panel SHV high voltage coaxial connectors.

Forced air cooling of the rear panel heat sinks may be required if the output current (I) exceeds this current (mA/voltage [KV]) relationship: I = 5 + 1.7 * Volts.

A.3. CONTROLS
POWER - Front panel 3-position switch (OFF- STANDBY-ON) for main ac power input.

METER SWITCH - Front panel rocker switch selects current or voltage display.

OUTPUT VOLTAGE - Front panel 3-turn (direct reading) locking potentiometer sets output voltage when rear panel program switch is in the local position; 0 to 3.00 KV.

LOCAL/REMOTE - Rear panel toggle switch selects local (manual) operation or remote (external) reference input to determine output voltage.

POLARITY - Top panel 2-position screwdriver switch selects either POSitive or NEGative output polarity.

115/220 V - Accessed slide switch on the bottom panel permits operation on either 115 or 220 V ac nominal input power.

A.4. INDICATORS
METER - 3½ digit LCD meter indicates output voltage (0-3.00 KV), or output current (0 to 10.00 mA).

LEDs - Polarity (POSitive or NEGative); operate in ON and STANDBY.

A.5. PERFORMANCE
RIPPLE AND NOISE - < 10 mV peak-to-peak at full load.

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

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

REGULATION - ± 0.002% variation in output voltage over load range and ± 0.001% for a ± 10% line voltage change.

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 fault.

CURRENT LIMIT - The output current will fold back to approximately 5 mA when current draw exceeds 12 mA.

DIAL ACCURACY - ± 0.5% of full scale.

METER ACCURACY - ± 0.5% of full scale output range plus 10 V or 10 mA for selected voltage or current, respectively.

A.6. CONNECTORS
INPUT POWER - Rear panel 3-wire captive ac line cord with standard NEMA male connector.

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

REMOTE CONTROL - Rear panel BNC.

A.7. POWER REQUIREMENTS
115/230 V ac, 50-60 Hz; no dc power requirements; ac power line protection via rear panel 1 A slow blow fuse (0.5 A slow blow for 230 V ac).

A.8. PHYSICAL
SIZE - 8.66 x 22.13 cm (2.70 x 9.714 in.); standard double-width NIM module per TID-20893 (rev.)

NET WEIGHT - 4.5 kg (10.0 lb)

SHIPPING WEIGHT - 5.9 kg (13 lb)