Instruction Manual

REGULATED HIGH VOLTAGE SUPPLY

Model RE-3002

Ser. No. 591

Northeast Scientific Corporation

30 Wetherbee Street

Acton, Massachusetts
I

GENERAL DESCRIPTION

The instrument consists of a high-voltage rectifier followed by a degenerative regulator arranged to supply a closely regulated source of high voltage to a load. Either side of the output may be grounded.

The supply is completely AC operated and self-contained. It is compactly housed in a ventilated cabinet designed for relay-rack or bench use. All the operating controls are mounted on the front panel. The output terminals and the input power receptacle for the power cord are located at the back of the instrument.

The power switch is arranged so that the filaments must be turned on first. The high voltage may then be turned on and off without the necessity of waiting for a warm-up period.

The high-voltage rectifier is a full-wave silicon doubler. A minimum of filter is used in order to keep the energy storage low. The AC voltage input to the rectifier is reduced as the output voltage is lowered, so that the power dissipated in the regulator is kept down.

The regulator is of the degenerative series type. The control stage is operated as a tetrode, permitting large plate voltage excursions to be applied by the rectifier. A two-stage balanced high-gain differential amplifier compares part of the output voltage with a constant reference and applies the amplified voltage difference to the control stage so that the output voltage is held within narrow limits, almost independent of output load current or input line voltage effects.

The output voltage is continuously adjustable over the entire range from 500 to 3000 volts, and it is changed by varying the feedback ratio. The ratio is changed by switching precision resistors, making the output voltage calibration about as accurate as the resistors used. These resistors are deposited carbon types that have good stability.

All the tubes used in the equipment are popular types for which there should be no replacement problem in the event of their failure.
II
OPERATING INSTRUCTIONS

The supply may be operated in any normal location, if it is adequately protected from moisture and excess dirt. If the instrument has been exposed to dampness, it should be opened and left in a warm dry place until it is thoroughly dry before being operated.

To prevent overheating, it is important that a reasonable area of the ventilated cover be exposed so that there will be adequate ventilation, especially that area over the tubes. Otherwise the heat generated by the rectifier and regulator may raise the operating temperature too high.

Although the supply has been constructed with care and all components are well supported, excessive vibration and rough handling should be avoided.

The holes at the edges of the panel are properly located for relay-rack mounting. If, on the other hand, the supply is to be used on the bench, four rubber feet are provided, which attach at the four holes at the corners of the bottom plate. Usually, the unit is shipped with these feet attached, and they should be removed, if the supply is rack mounted, so that they will not interfere with other units that may be mounted below it in the rack.

Because of the very nature of equipment of this kind, the supply should always be operated with the top cover and bottom plate in place. The warning given at the beginning of this manual is repeated:

WARNING

The output voltage and power levels from this supply are high enough to kill, or at least to cause serious and permanent injury. For this reason, the supply should only be operated when completely enclosed, i.e., all covers on, and every care should be taken to avoid personal contact with the output or load being fed by the supply during the time it is operating.

Although the supply is perfectly safe when only the filaments alone are energized, a good rule to follow is to turn off the supply completely when it is necessary to make adjustments that will require in some way bodily contact with leads at high potential.

REMEMBER

NO LIGHTS: Supply is completely OFF.

YELLOW or ONE LIGHT: Filaments only are on.

RED AND YELLOW or TWO LIGHTS: High voltage ON, BE CAREFUL.
It is suggested that the supply be placed in operation in the following steps:

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

2. Connect the load to be fed to the output terminals. If one side of the output is to be grounded, connect a jumper between that output post and the center or ground post. This post is connected internally to the chassis.

3. The output voltage can be set to the proper or some convenient value by adjusting the three right-hand controls. The operating output voltage will be the sum of the dial readings. For instance, if 1640 volts are needed, set the switches to 1500 and 100 and the vernier to 40.

4. Insert the power cord into the AC connector at the back of the unit. Plug it into some convenient outlet of 105 to 125 volts, 50 to 500 cycle AC power.

5. Advance the power switch to the "ST'D BY" or center position. The bottom or amber pilot should light, indicating that power has been applied to the filaments. Check this the first time the supply is operated after shipment by looking at the tubes through the perforations in the cover. The three 12AX7's should be quite dim, since they are operated on low voltage, but they should glow somewhat. Allow about 60 seconds for the cathodes to warm-up completely.

6. After the required warm-up time, advance the power switch to the "ON" or third position. High voltage is now on and the top or red pilot should indicate this. Both pilots are now on, indicating that power can flow to a load. If the supply is being operated for the first time or has not been operated for some months, set the output voltage to the lowest setting (500 volts) initially. After a few minutes of operation the voltage can be increased.

7. The high voltage can be adjusted, if desired, while the supply is operating, by changing the output voltage control settings. The switches shift the output voltage in 500 and 50 volt steps and the vernier gives a 0 to 60 volt variation for the voltages in between these steps.

The supply will continue to regulate the output so long as the rated load current (20 Ma.) is not exceeded and the line voltage at full-load does not fall below 105 volts. At less than full-load the regulator will continue to perform at even lower voltages. The output voltage for regulation will depend upon the output voltage setting and the load current being drawn. Generally, for any output voltage, the less the load current, the lower the line voltage can be before regulation ceases. Usually, at no-load, the supply will continue to perform at line voltages as low as 70 to 80 volts. However, the amplifier cathodes may be too cool to give the best performance, which is obtained at the rated input line voltage.
INTERLOCK BARRIER STRIP

At the back of the chassis is a two-terminal barrier strip so that the unit can be interconnected with an interlock circuit. This instrument is shipped with these two terminals connected. If it is desired to use them in an external protective circuit, remove the jumper and connect the external circuitry to them.

These two terminals are in series with the switching to the primary circuits, when the high voltage is turned on. It is necessary, therefore, to connect them together when they are not connected to an external normally closed interlock circuit, so that the unit will be turned on when desired.
**REGULATED HIGH VOLTAGE SUPPLIES**

0.5 to 3.0 Kilovolts

<table>
<thead>
<tr>
<th>Current (mA)</th>
<th>Model RE-3002</th>
<th>Model RE-3004</th>
<th>Model RE-3006</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Uses:** These supplies provide a stable and ripple-free high-voltage output over a wide range, practically independent of line voltage input or load current variations. In addition, with their ability to supply considerable current to a load of either polarity and being completely AC operated and compactly constructed, their versatility makes them particularly useful as an instrument for laboratory use and industrial application.

Typical uses include those with klystrons, traveling-wave tubes, backward-wave oscillators, cathode ray tubes, mass spectrometers, photomultipliers in scintillation counters and flying-spot scanners, and many other applications in laboratory research and development problems and in industrial control and test equipment.

**FEATURES**

- Very wide voltage range: 500 to 3000 volts.
- Either positive or negative may be grounded.
- 20, 40, or 60 mA full-load current.
- Low internal impedance: under 2 ohms at full-load.
- Excellent regulation: better than .005% no-load to full-load.
- High stability: better than .01% for 20% line voltage shift.
- Good long-term stability: .01% per hour, .1% per day.
- Standard tubes: no replacement problem.
- Compact: designed for rack or bench use.

*Northeast Scientific Corporation*
**MODEL RE-3002**
**MODEL RE-3004**
**MODEL RE-3006**

**Description**: These instruments consist of a rectifier followed by an electronic regulator. Either side of the output may be grounded.

The rectifier is a voltage doubler operating at the input line frequency and using silicon cells for simplicity and dependable performance.

The regulator is of the degenerative series type. A tetrode control stage used in conjunction with a two-stage balanced differential feedback amplifier closely regulates the output voltage so that it is practically independent of input line voltage variations or output load effects. Residual line frequency ripple is very low. Internal impedance is of the order of ohms.

With such a regulator long-term stability is determined mostly by the comparison resistors and reference tubes. For the very best performance wire-wound resistors are recommended, but for most applications, deposited carbon resistors give very good performance. The use of 5651 reference tubes strikes a good balance between performance, availability, and cost.

The output voltage is continuously variable over the entire range of 500 to 3000 volts. It is set by three front panel controls, the first a switch covering 500 to 2500 volts in 500 volt steps, a second covering 0 to 500 volts in 50 volt steps, and the third control a calibrated vernier with a continuous 0 to 60 volt range. The resulting output voltage is good to or better than $0.1\%$ of the sum of the dial readings.

These supplies are completely AC operated and self-contained. The housing is well ventilated and designed for either rack or bench use. All operating controls are mounted on the front panel. Input and output connections are made at the back. All tubes are popular types for which there will be no procurement problem.

**SPECIFICATIONS**

**Output Voltage** - 0.5 to 3.0 KV DC, ±2% continuously variable.

**Output Current** - RE-3002: 0 to 20 ma., full load.
RE-3004: 0 to 40 ma., full load.
RE-3006: 0 to 60 ma., full load.

**Polarity** - Either side of the output may be grounded.

**Ripple** - 2 mv. peak to peak maximum at line frequency.

**Regulation** - Better than .005% no load at 3 KV output.

**Internal Impedance** - 2 ohms at DC. Of the order of 0.2 ohms at AC.

**Stability** - .01% or better for input line voltage shift from 105 to 125 V AC at 3 KV.

**Long-term Stability** - .01% per hour, .01% per day after warm-up in a normal ambient temperature without sudden and wide temperature changes.

**Input** - 105 to 125 volts AC, 50 to 500 CPS.
RE-3002: 1.3 Amp. max., 130 Watts max.
RE-3004: 2.4 Amp. max., 235 Watts max.
RE-3006: 4 Amp. max., 350 Watts max.

**Terminals - Output**: Clear Plastic plate with insulated binding posts at back.

**Input**: Standard male AC chassis connector at back. A detachable all rubber molded power cord supplied with the unit.

**Tubes**: 5 5651, 3 12AX7. RE-3002: 1 6B6G-GA.
RE-3004: 2 6B6G-GA.
RE-3006: 3 6B6G-GA.

**Construction** - Ventilated cabinet mounted on rack panel suitable for rack mounting or bench use. Gray hammer-tone finish with white marking. All operating controls mounted on the front panel away from output connections at back.


**Net Weight** - RE-3002: 26 pounds.
RE-3004: 32 pounds.
RE-3006: 35 pounds.