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1 Precautions

Make sure you have enough knowledge to assemble and use this tester. If not, ask the assistance of an experienced person.

The module operates with voltages below 12 volts, but the card has a high voltage generator,. So the user must be careful when carrying out work on the electronics while power is on and must wait at least 2 minutes after switching off the power to allow the capacitors to discharge.

Follow the connections schematics in section 2. Before switching on and testing a tube, carefully check the connections, settings and value of the high voltage applied.

The Test button (see below) protects the user when not testing a tube.

This button is not essential for operation but is recommended. Any momentary contact Push button able to withstand a current of 1 A is convenient.

Before switching on the power, please check that the module is properly installed on an insulating surface, that no short-circuit risks exists. Avoid touching any part of the module while power is turned on .

2 Connecting the module

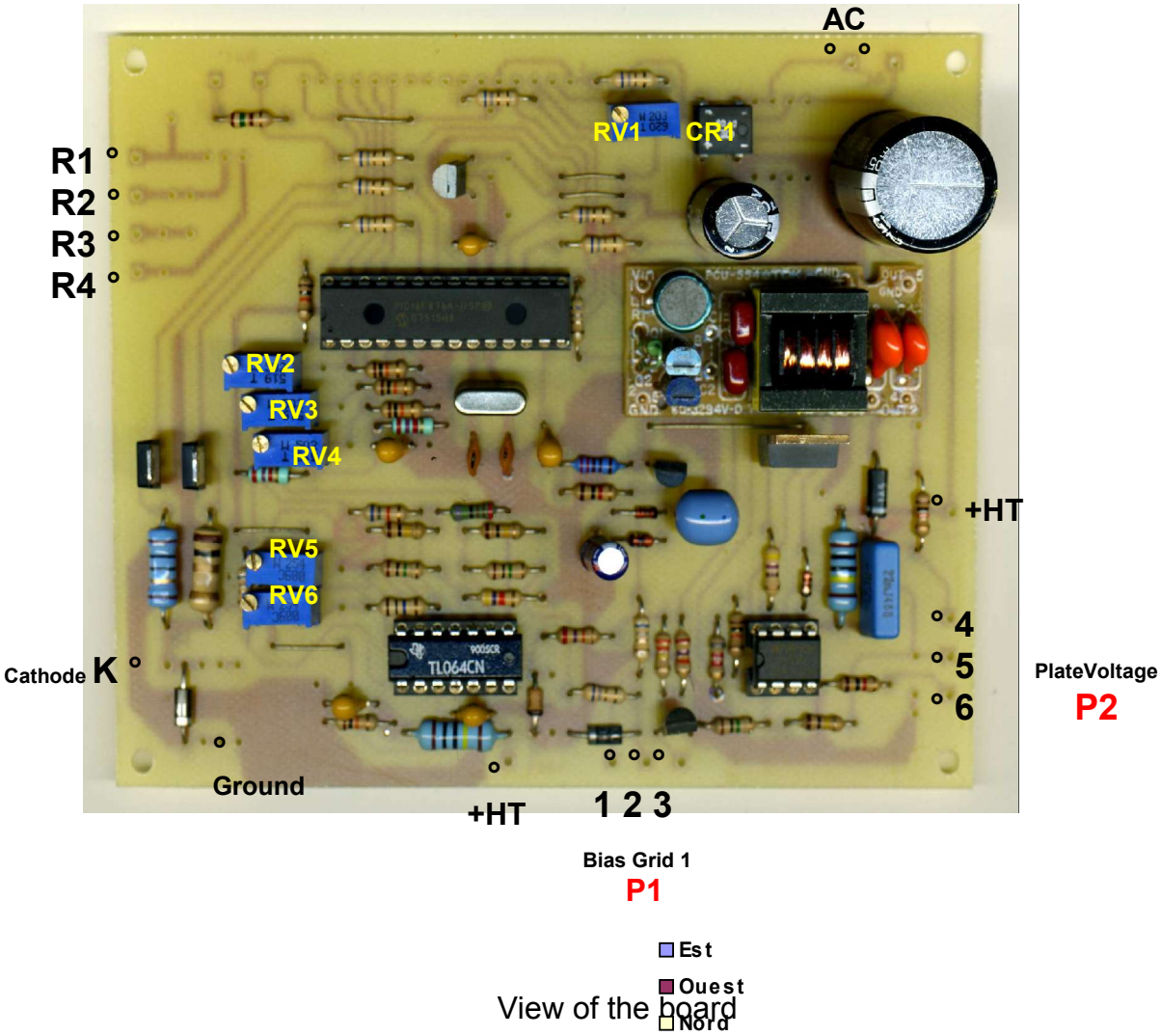
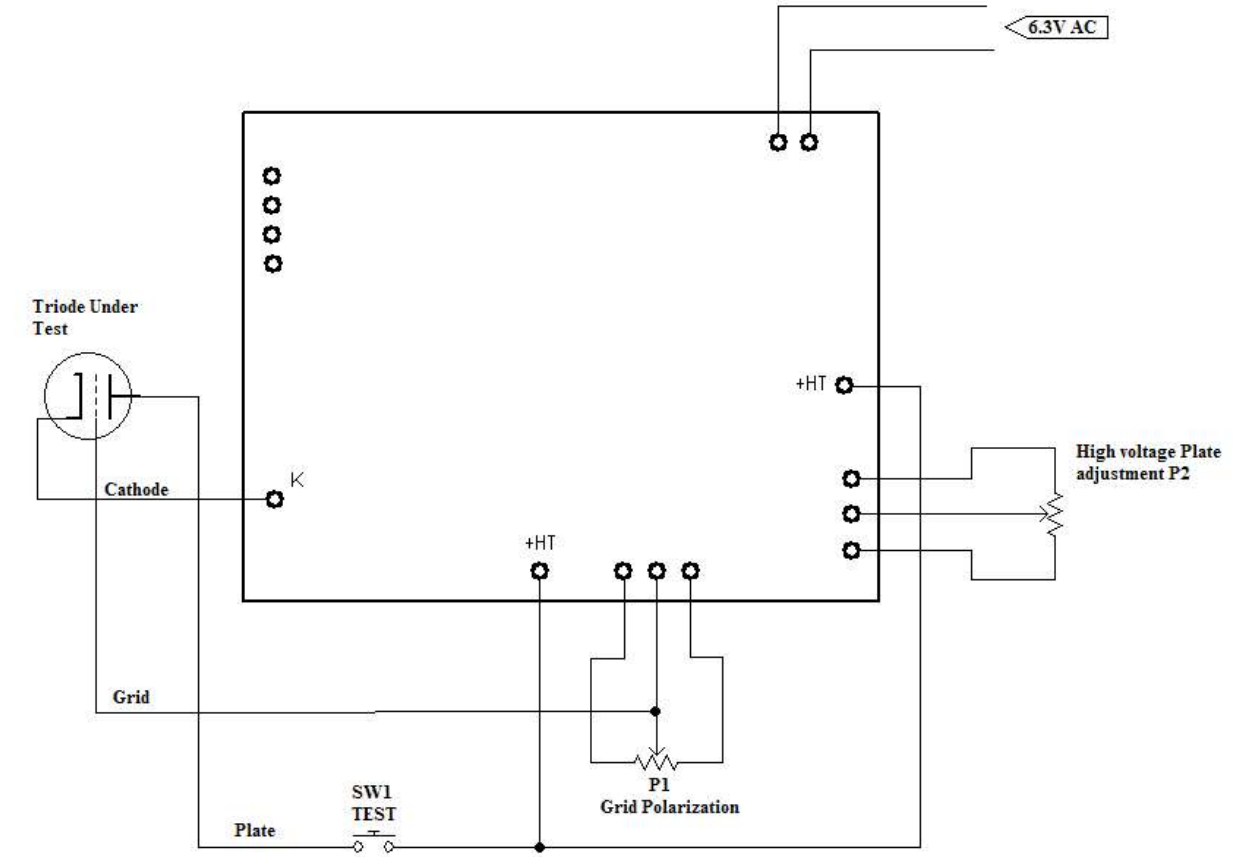
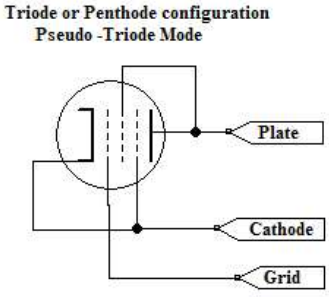


Figure 1





Board connections

Figure 2

Figure 1 shows the electronic board with its different connections plugs and settings.

Figure 2 shows a schematic of connections. Multi-grid tubes are tested in pseudo-triode mode unless an auxiliary G2 supply is provided.

There are 3 control pins between the tube and the module: the cathode, the grid (g1 for multi-grid) and the plate (plate + screen [g2] for tetrode / Pentode).

The high voltage is applied on the plate by pushing the TEST button. Do this in order to protect the user from an unexpected contact to the high voltage on the tube connection system (wire / socket).

The supply must be connected to AC pins. Polarity does not matter and you can directly connect a transformer (9 V a.c. maximum) or a d.c. power supply (9 volts to 10 volts maximum).

If you use only a battery or batteries you can eliminate losses in the bridge rectifier CR1 by directly connecting the + battery to the + of CR1 and the - battery to the – of CR1.

Dropout will be reduced by about 1 volt so the supply voltage can go down to 8.5 volts.

3 Getting Started

Fully turn both potentiometers P1 and P2 counter-clockwise. Do not plug any tube.

Turn on power. The display should indicate (from left to right):

+ 2 V (+/- 2 V)

0.0mA

- 48 V (+ /- 5 V)

Fully turn potentiometer P1 clockwise. The voltage on display becomes 0.0V. Now turn back P1 to previous setting (- 48 V).

Fully turn potentiometer P2 clockwise. 2 V becomes 450V (475 volts max.). Now turn back P2 to previous setting (approximately 2 V). The voltage drops slowly as the large capacitor acts as a tank of energy during the tube test and there is no load at the moment.

Now establish appropriate connections and plug a tube in the socket.

Set correct values for P1 and P2 test for the tube under test.

For info on tubes please visit this site where you will find datasheets for thousands of tubes.:

http://www.tubedata.org/

Press the button "Test" that you have installed. LCD display will now indicate the plate current.

You can keep this button pressed while you change the settings of the knobs. You will immediately see the results of these adjustments on the plate current.

The pulse measurement is extremely fast so the tube is safe.

If you want more flexibility and precision in the settings you can change the controls potentiometers P1 & P2 by 10 turns potentiometers. A value of 100 kohms to 220 kohms linear will be convenient for P1. P2 is a 10 Kohms, linear as well.

In case of high voltage supply overload like: short-circuit in the tube, excessive current applied, etc. :The display will show "OVERLOAD" instead of the current plate until the problem is solved. This may occur for a few seconds while increasing the plate voltage and due to high charge current of the tank capacitor.

"OVERLOAD" can also appear when V grid is set to low limit (e.g. -2 V). This will disappear when testing a tube.

4 General Functions

With this digital tester you can directly get the plate current according to plate and G1 voltages.

You can also get 3 other important parameters in 2 successives measurements. Here are the procedures:

- **Gm or Transconductance**: Make a first measurement with proper V plate and V grid. Note the corresponding current.

Change V grid by + or - 1 volt. Note the new current.

Transconductance is the difference in the 2 currents expressed in mA / V (or µS / µmhos).

- **Rp or Plate resistance**: Make a first measurement with proper V plate and V grid. Note the corresponding current.

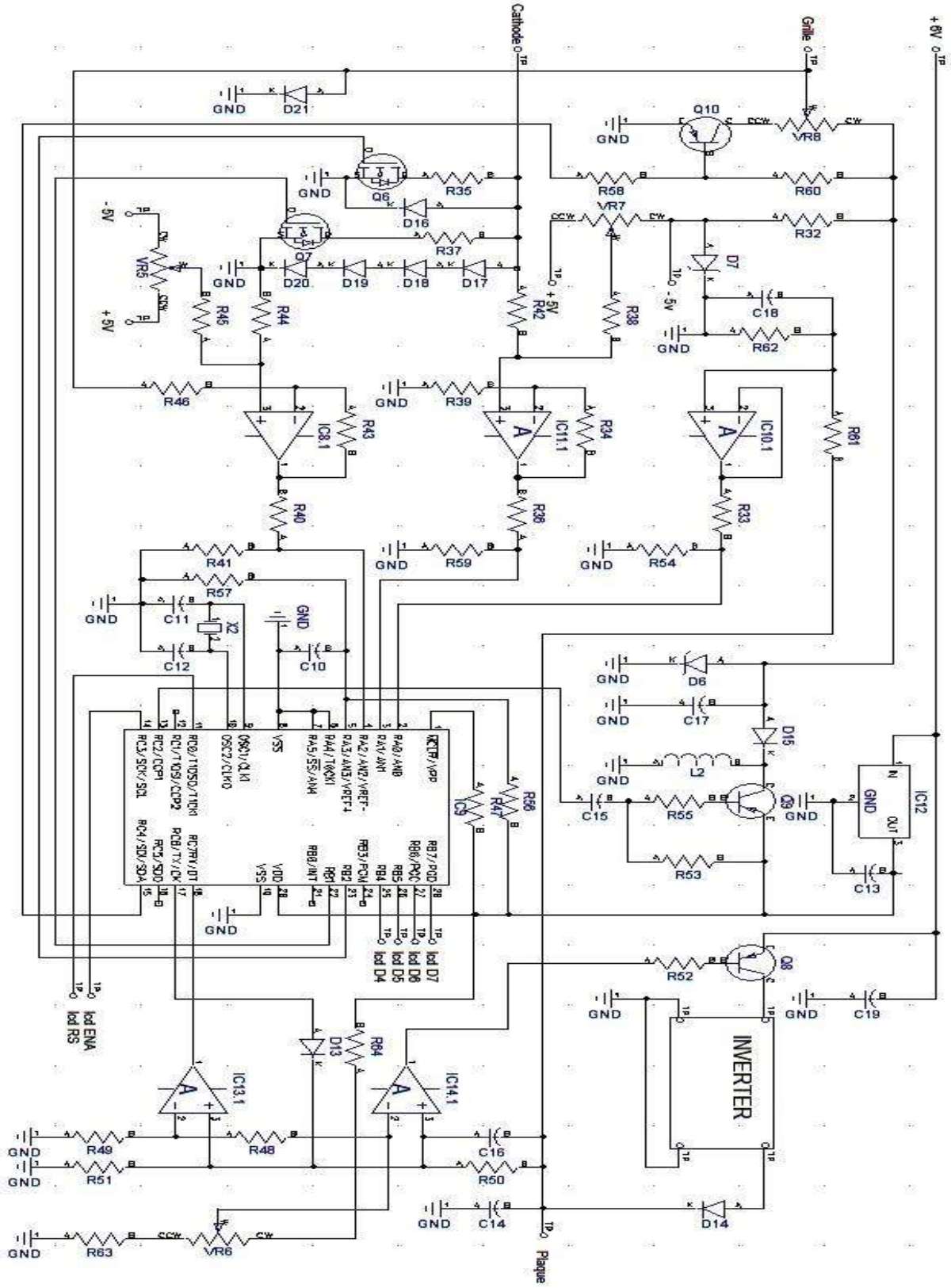
Change V plate by + or - 10 volts or more (the current must change significantly).
Note the new current.

Plate resistance is the difference between the 2 plate voltages divided by the difference in the 2 currents expressed in Ohm.

- **µ or voltage gain** = Gm x Rp

Of course you can match tubes by comparing currents under same working conditions.

5 Explanation of circuitry



Schematics of the tube tester

Figure 3

Components list:

D6 BZX36V
D7 BZX5V1
D13 1N4148
D14 BA159
D15 1N4148
D16 1N4007
D17 1N4007 – reserved
D18 1N4007 – reserved
D19 1N4007 – reserved
D20 1N4007 – reserved
D21 1N4007

IC8 TL064 ¼
IC9 16F876A
IC10 TL064 ¼
IC11 TL064 ¼
IC12 LP2950 – 5V
IC13 LM393 ½
IC14 LM393 ½

Q6 IRFU024
Q7 IRFU024
Q8 TIP32
Q9 BC307
Q10 BC307

VR5 / RV5 5Kohms
VR6 / P2 10KA

VR7 / RV6 5Kohms
VR8 / P1 100KA
VR5 / RV5 5Kohms

C11 10 pF
C12 10 pF
C13 4.7µF – 16 V
C14 22µF – 450 V
C15 4.7 µF – 16 V
C16 22nF – 400 V
C17 10 µF – 63 V
C19 1800 µF – 16 V

X2 Quartz 12 MHz

L2 Self de 6,8 mH

R32 27 Kohms
R33 / RV2 5 Kohms
R34 68 Kohms
R35 1 Ohm – 1 Watt
R36 / RV3 5KOhms
R37 10 Ohms – 1 Watt
R38 10 Mohms
R39 7.5 Kohms
R40 / RV4 5 Kohms
R41 10 Kohms
R43 100 Kohms
R46 1 Mohms
R47 10 Kohms
R48 100 Kohms
R49 1 Mohms
R50 1 Mohms – 1 Watt
R51 8,2 Kohms
R52 470 Ohms
R53 2,2 Kohms
R54 10 Kohms
R55 1 Kohms
R56 2.7 Kohms
R57 2.7 Kohms
R58 27 Kohms
R59 10 Kohms
R60 330 Kohms
R61 1 Mohms – 1 Watt
R62 10 Kohms
R63 1 Kohms
R64 10 Kohms

Main functions:

IC12: 5 volt regulator for low-power microprocessor and voltage references.

IC13 - IC14 - Q8 - P1: conversion circuit and high voltage regulation. Controls the inverter.

Q9 - L2 - D6 - D15: grid voltage generator(- 50 V)

Q10 - P1: Adjusts and controls the grid voltage.

Q6 - Q7: Sample and measurement switches.

IC10: High Voltage acquisition chain

IC11: Cathode current amplifier (plate current image)

IC8: Bias voltage acquisition chain.

Adjustment potentiometers on the board (see Figure 1):

RV1: Adjusts contrast of the screen.

RV2: Adjusts high voltage value on the display.

RV3: Adjusts plate current value on the display.

RV4: Adjusts G1 bias voltage value on the display.

RV5: Offsets trim for bias amplifier.

RV6: Offsets trim for plate current amplifier..

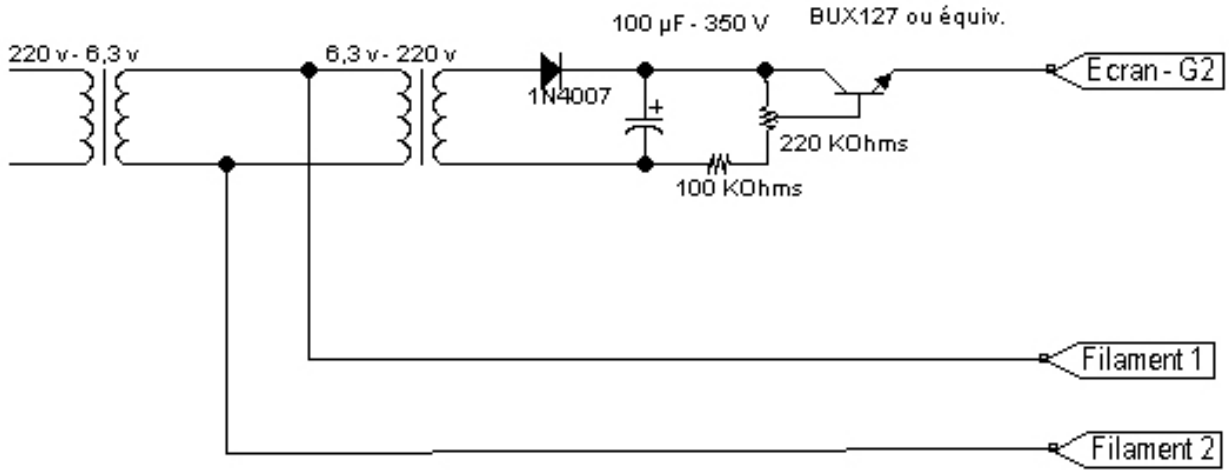
Reserve area (see Figure 1):

R1, R2, R3 and R4 are the inputs and outputs of an auxiliary low voltage regulator built around an LM317. Refer to the documentation of this component if necessary.

Test mode for tetrode and Pentode:

Although testing these tubes is simpler and equally effective in pseudo-triode mode (described above), real tetrode or Pentode mode remains possible with an auxiliary supply for g2 (screen).

The following circuit may be used:



2 Transformers are connected in reverse. A single-wave rectifier + filter provide a voltage of approximately 300 volts which is applied to a divider network. 220 kOhm potentiometer applies a variable voltage between 100 to 300 volts at the base of a high voltage Darlington transistor which buffers the voltage and can feed a few tens of mA.

The tube is automatically blocked between measurements so the screen voltage can be applied continuously without damaging the tube.

Other circuitry can be used~~,~~ t . This circuit is just a suggestion.

6 Specifications:

Measurement Mode: Pulsed, run by a 8 bits micro-computer clocked at 12 MHz

ADC sampling: 10 bit monotonous (1024 points)

Duration of the measurement window: 800 µS

Interval between measurements: 0.5 second

Measuring accuracy: better than 5%

Grid voltage range: 0 - 48 volts minimum

Plate voltage range: 2 to 450 volts minimum

Plate current (maximum) : 300 mA

Display resolution, grid voltage: 0.1 volts + / - 1 digit

Display resolution, plate voltage: 1 V + / - 1 digit

Display resolution, plate current: 0.1 mA + / - 1 digit up to 34 mA
1 mA + / - 1 digit I > 34 mA

Supply voltage (nominal): 7.5 volts a.c. or 9 volts d.c
8 volts d.c. minimum if the CR1 rectifier is removed

Supply current: 0.5 A average, 0.7 A max.

Tube Protection: By automatic cut-off between measurements (Vgrid to - 48 V)

7 Maintenance settings.

This is usually not needed except if you replace TL084 amplifier.

- Connect the input Cathode (K) to ground via a jumper.

- Connect a digital voltmeter between pin 14 of TL064 and ground and adjust the potentiometer RV6 for 0.00 V output.

- Remove the jumper between input and cathode ground.

- Connect Pin 3 (bias potentiometer) to ground by a jumper.

- Connect a digital voltmeter between pin 8 of TL064 and ground.

- Fully turn the bias potentiometer clockwise. The display shows G1 bias voltage close to or equal to 0 volts.

- Adjust trimmer RV5 to read 0.00 V on the voltmeter.

- Now connect the voltmeter between the bias potentiometer wiper (pin 2 of the board) and turn this potentiometer as to read a voltage - 40.0 volts on the voltmeter.

- Adjust trimmer RV4 - to read 40.0 V on the display.

- Remove the jumper between the pin 3 of the potentiometer P1 and ground.

- Connect the voltmeter between the output + HV and ground. Adjust the voltage to 350 V.

- Adjust trimmer RV2 in order to read +350 V on the display.

- Insert a 100 Ohms 1% resistor in series with the plate connection.

- Plug an EL84 tube on the socket with appropriate connections for pseudo-triode mode.

- Connect an oscilloscope across the 100 Ohms resistor. Ground probe to the tube plate side.

- Run the test and adjust the plate voltage around 200V and the voltage grid around – 6V to read about 30.0mA plate current.

- Set the input sensitivity (dc mode) of the oscilloscope to 0.5 volt / division and time base to 100 µS / division. Synchronize the oscilloscope on the rising edge pulse and then finely adjust the gate voltage of the tube to obtain the amplitude of 6 divisions (3 volts) pulse.

- Adjust trimmer RV3 to read 30.0 mA in the display.

- The settings are completed.