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1 Precautions & description

The DuoKit uses high voltage. For your safety, and to avoid damaging the system, observe the procedures indicated in this manual, and ensure that you have the technical knowledge to use the system. If you are not sufficiently knowledgeable, ask for the help of someone with the necessary experience.

Dangerous voltages are present so be careful when carrying out work on the electronics while power is on and wait at least 2 minutes after switching off the power to allow the capacitors to discharge

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

The module has all the functionalities of a conventional tube tester but it uses a pulsed mode which guarantees a high level of security during tests.

The tests are effected with a rhythm of 0.5 seconds, and the measurement is done within a very short time of 800 μ S (0.0008 seconds).

Between tests, grid 1 is in negative potential, and the tube is in a cut-off state with zero dissipation.

With this type of functionality, little energy in high voltage is used up (plate and G2), and this helps avoid the use of heavy and costly electric supply transformers, while allowing tests with high voltage and plate current (450V/340 mA).

A PIC microcomputer clocked at 12 MHz carries out the acquisition, tests, fault management and LCD display controls.

The plate supply uses an auto-oscillating converter (Royer) controlled by a regulation loop.

A high value (47 μ F- 450V) capacitor can deliver a high pulse current during the 800 μ S test window.

This capacitor discharges slowly. It is thus practical, when the plate voltage needs to be lowered through the Vplate potentiometer, to briefly push on the DISCHARGE button.

This put on the plate supply output a discharge resistor and accelerates the process.

A SURCHARGE message (Overload) can appear on the display, but will disappear when the DISCHARGE button is released.

The G2 supply, which has a small debit, is organized around a conventional circuit: transformer, recovery/rectification, filtering and stabilization using a buffered group of zener diodes.

A mosfet power transistor controlled by a potentiometer adjusts the Vg2 voltage.

These two supplies, i.e. plate and G2, are protected by current limiters. Peripheral circuits also benefit from this type of protection.

G1 supply is designed like G2, but since the current is low enough, it is not buffered.

A neon lamp can show tube internal short circuit. This neon lights up fixedly when an excessive current runs through the tube; otherwise, it blinks or remains off.

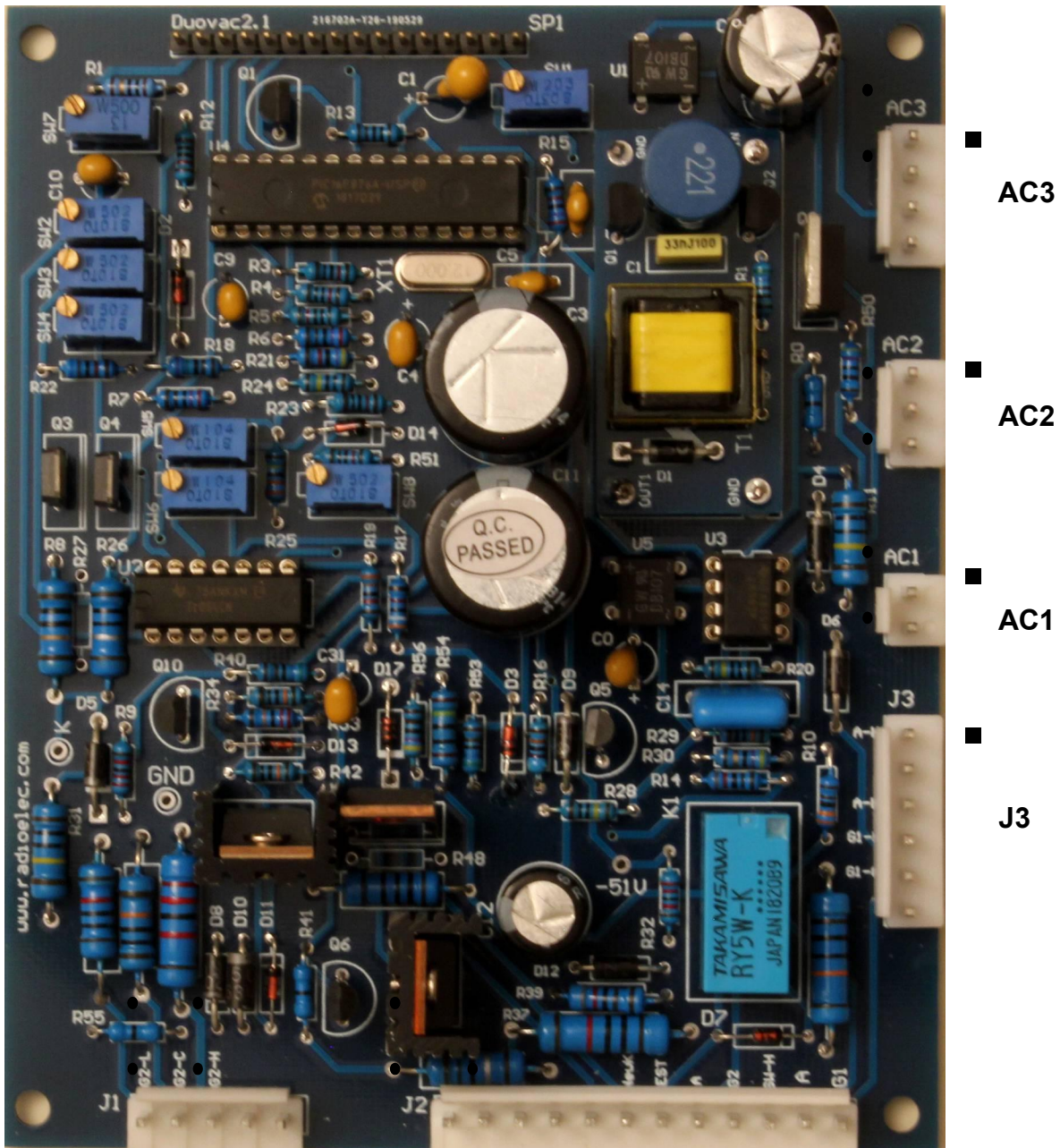
This simple circuit functions only as an aid to the test, and has limited utility. It can remain lighted up in the presence of tubes with strong power or for certain types (diodes, cathodic indicators).

Some tubes are unstable, and the connection cords make up resonating circuits so don't forget to install, near the tube, ferrite beads on G1, G2 and plate wires.

The microcomputer controls the current vs voltage of the plate supply, if the current becomes too high SURCHARGE (= overload) warning will appear on the screen, All other tests will then be suspended until the problem is resolved.

2 Connecting the module

LCD



J1

J2

View of DuoKit board and connectors

● = Pin 1

Plate (anode) voltage

Grid 2 (screen) voltage



Grid 1 voltage

Plate current

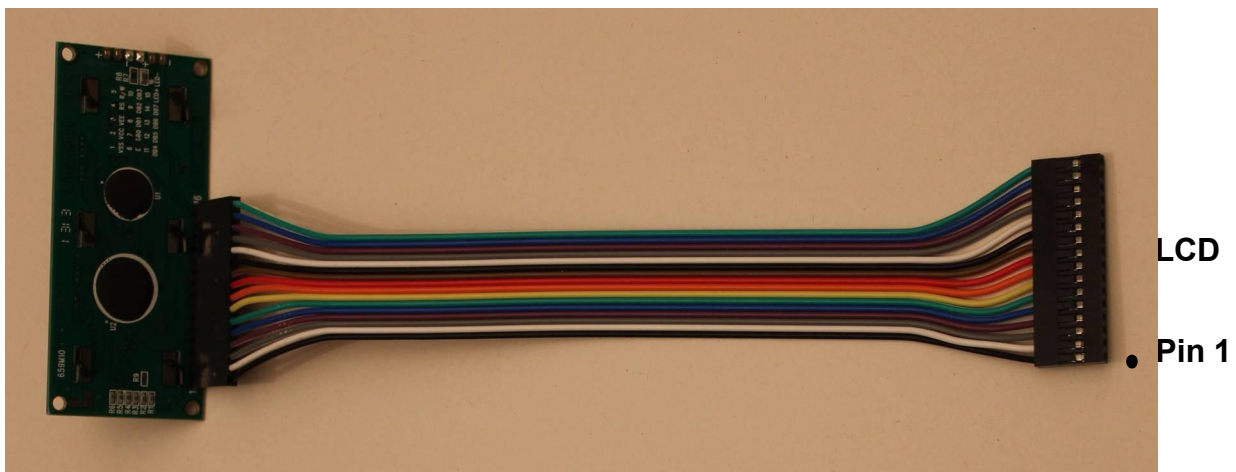
LCD display

Display: 2 lines of 16 digits.

Blue or white backlighted.

Dimensions: 70 x 25 mm

Driver: HD44780



Display (Rear view) and connection.

Total length : 20 cms

Details of connectors (the dot : • shows pin 1):

AC1:

1: 310V / a.c.

2: 310V / a.c.

AC2:

1: 120V /a.c.

2: n.c.

3: 120V /a.c.

AC3:

1: 9V d.c.

2: n.c.

3: 9V d.c.

4: n.c.

J1:

1: Potentiometer Vg2 (high) (blue)

2: Potentiometer Vg2 - wiper (yellow)

3: Potentiomètre Vg2 - low (brown)

4: n.c.

5: n.c.

J2:

1: GND (black) + switch " TEST "

2: GND (black) + switch " Discharge "

3: n.c.

4: Switch " Discharge " (yellow)

5: n.c.

6: Cathode (blue)

7: Button " TEST " (green)

8: Neon (violet)

9: Grid 2 (brown)

10: Neon (violet)

11: Plate (red)

12: Grid 1 (white)

J3:

1: Potentiometere Vplate - high (red)

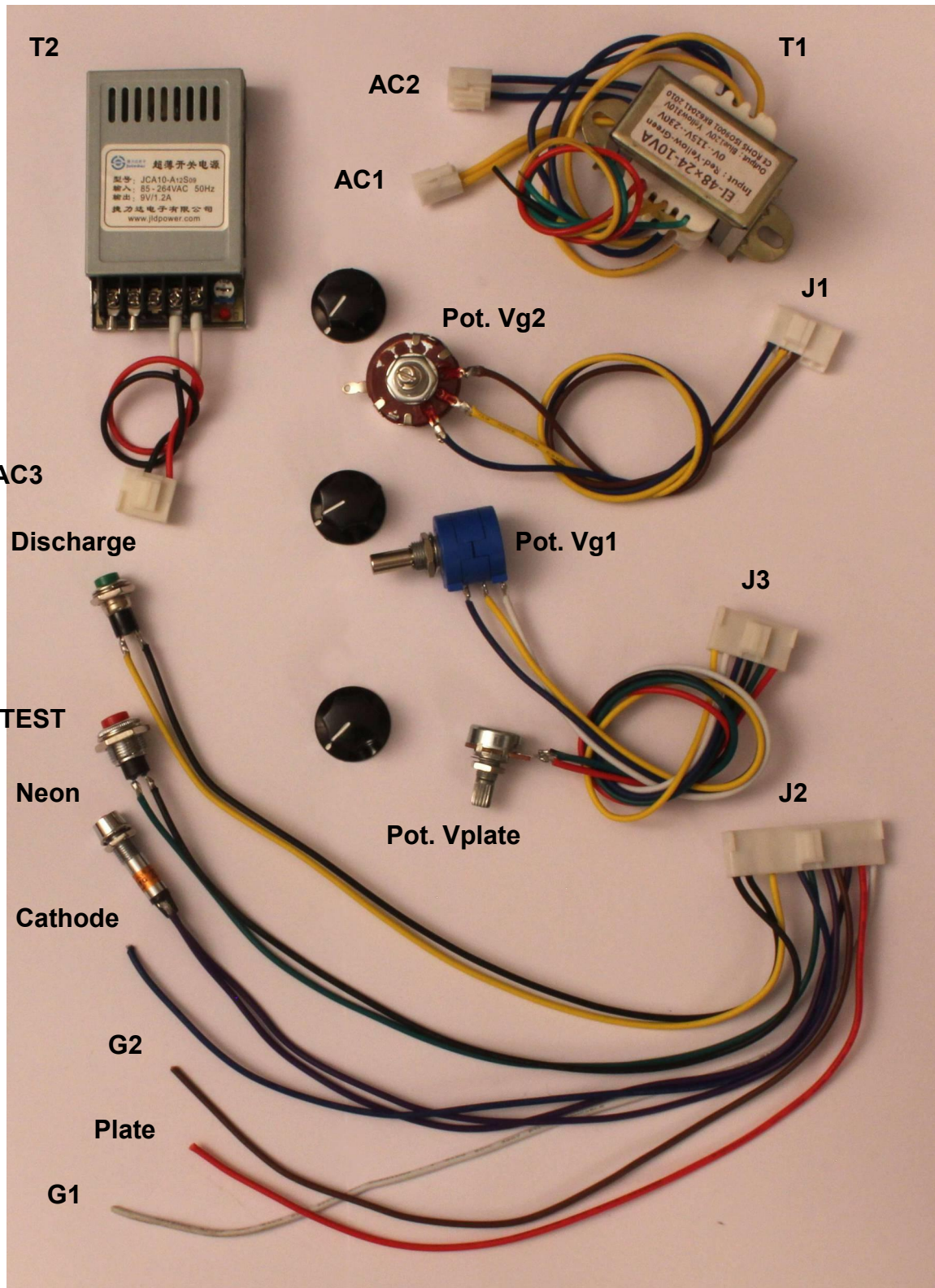
2: Potentiometer Vplate - wiper (green)

3: Potentiometer Vplate - low (black)

4: Potentiometer Vg1 - high (blue)

5: Potentiometer Vg1 - whiper (white)

6: Potentiometer Vg1 - low (yellow)



Connections Kit & supplies

T1: transfo 120 V + 310 V / Primary 110 V (red / yellow) - 230 V (red/ green)

T2: a.c. d.c. regulated converter 9V d.c. / Primary 85 V - 260 V (AC pins inputs)

3 ferrites beads are not shown but are part of the kit.

3 Getting started

As most connections are already made the kit is simple to operate:

Plug in all connectors.

Connect the mains voltage to T1 & T2 (don't forget a 1A security fuse and on/off switch)

Connect the 4 wires: Cathode, G2, Plate and G1 to appropriate socket pins according to the tube you wish to test.

Connect a heater supply or transformer (available as an option - see section 8)

Make sure that the module is properly installed on an insulating surface, that no short-circuit risks exists.

Switch on mains power.

Adjust the V_{plate} voltage (Plate)), V_{g2} (grid 2), V_{g1} (grid 1) and heating voltage depending on the characteristics of the tube to be tested.

Almost all datasheets on tubes are classified and accessible on this site:

<http://www.tubedata.org/>

Example: for the EL84 tube, the documentation indicates:

Pin 2 : G1 (grille 1)

Pin 3 : K –G3 (cathode & grid 3)

Pin 4 : F (filament)

Pin 5 : F' (filament)

Pin 7 : A (anode ou plate)

Pin 9 : G2 (screen ou grid 2)

Take a look now at the testing conditions. In the absence of indications, you can look at the manufacturer's curves.

For instance, you can choose a plate voltage of 300V, a G2 voltage of 250V, and a G1 voltage of -4.0V. Under these conditions, the nominal debit will be 90mA.

Turn the V_{plate} potentiometer until you see 300V on the screen.

Turn the V_{g2} potentiometer until you see 250V on the screen.

Turn the V_{g1} potentiometer until you see -4.0V on the screen.

Plug the tube and leave it to heat up for approximately one minute.

Check that the neon short-circuit indicator is off or blinking. For some tubes, this indicator can turn on fixedly even if there is no short circuit. In general, this phenomenon is caused by tubes with high μ , or by valves and cathodic indicators.

It is not dangerous to undertake tests even if the indicator is on.

Push " TEST " and read on the display the plate current value in mA.

For more thorough tests: transconductance, internal resistance and μ are possible and simple.

These measurements/tests are described on §6.

Release the "TEST" button. The test is finished.

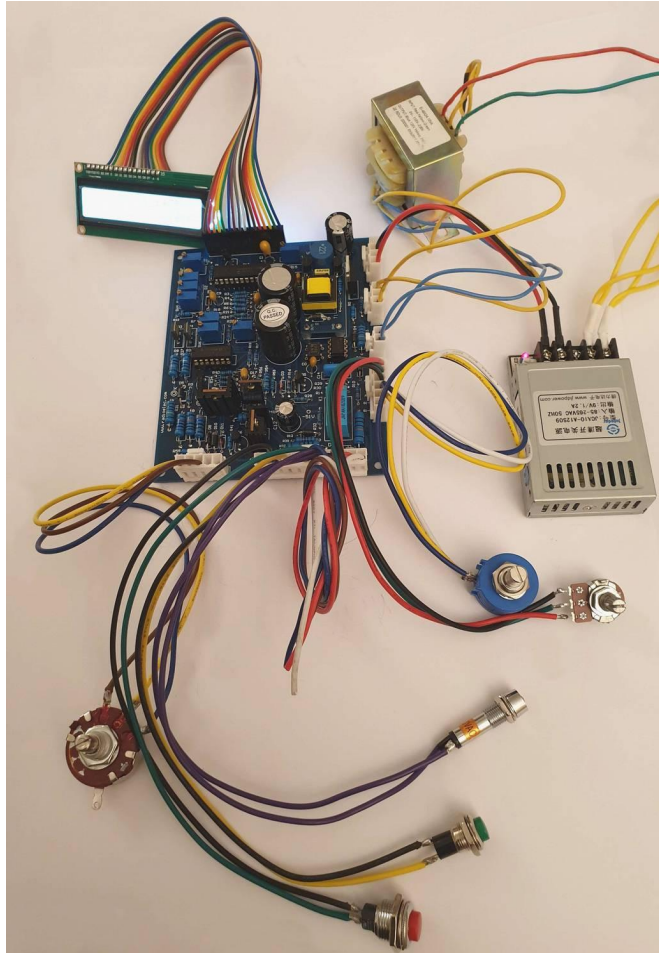
Tube matching can be done simply: just test several tubes of the same type without changing the parameters, and pair up either in twos or fours those tubes whose currents are the most similar.

For double tubes like: 12ax7, 12au7, 12at7,-6sl7, 6sn7, etc... Testing one or any of the internal triodes is done by displacing the plate pin connection on either one of the plate pins, all other electrodes (Cathode & Grid) are connected in parallel.

Testing valves, diodes and recovery diodes, cathodic indicators, gas regulators is possible, and is described on §7.

Advanced testing procedures are described in § 5.

Valves, diodes, rectifiers, regulators and cathodic indicators testing is described in §6.



The DuoKit assembled



Example of a ready to use tube tester made with the DuoKit module.

This item uses mini-banana plugs and cords for adapting the socket connections to any tube.

4 Advanced tests

With this digital tester you can directly get the plate current according to plate, G2 and G1 voltages.

You can also get 3 other important parameters in 2 successive 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 (in Volt) divided by the difference in the 2 currents (In Ampere) and is expressed in Ohm.

- **μ or voltage gain = $G_m \times R_p$**

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

5 Valves, regulators & cathodic indicators

The DuoKit allows for the testing of specific tubes like diodes, rectification valves, gas-regulating tubes, and cathodic indicators.

Diodes:

These low power tubes can be tested to a maximum current of approximately 20mA, for higher currents, observe the procedure for valves testing.

Insert a 100 KOhm resistor in series with the plate for limiting the current.

Before plugging the tube, turn the V_{plate} potentiometer fully counterclockwise, and, if needed, push the DISCHARGE button several times in order to bring the plate voltage under 20 V.

When the tube is hot, slowly turn the V_{plate} potentiometer and observe the increase in current until you reach the manufacturer testing voltage.

Valves:

Valves or rectifiers will be tested like the diodes but, as the plate current is higher, the value of the series resistor must be lower. Use a 4.7 KOhm - 2 W resistor.

The test sequence is similar to the diodes.

Gas regulator:

The test of these tubes is carried out in series with the appropriate value-limiting resistance with the anode (plate), in order to limit the current. The regulator voltage can be read directly on the screen.

Cathodic indicator:

Testing for the brightness of the cathodic indicator can be carried out simply by connecting the electrodes to the appropriate plug, and by adding the appropriate resistors according to manufacturer datasheet.

Control of the eye can be done by connecting the blue wire going to V_{g1} potentiometer to black wire of TEST button. This will block V_{g1} switching and its voltage will be linearly controlled by its potentiometer.

Remove this connection for testing other kind of tubes.

6 Specifications:

Dimensions : 146 x 133 x 28 mm (h. maxi)

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 μ S

Interval between measurements: 0.5 second

General accuracy: better than 5%

Grid 1 voltage range: 0 - 100 volts minimum

Grid 2 voltage range: 15 - 350 volts minimum

Plate voltage range: 2 to 450 volts minimum

Plate current (maximum) : 340 mA

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

Display resolution, grid 2 voltage: 1 V + / - 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): 110 V - 230 V 50/60 Hz

Tube Protection: **By automatic cut-off** between measurements (Vgrid down to - 100 V)

Tube connections: Short-circuit protected.

7 Optional accessories



Regulated heating supply.
Mains voltage: 80 to 260 V - 50/60Hz.
3 regulated output voltages (selected by a 3 ways switch):
4V / 5V / 6,3 V - 3 Amperes minimum
Dimensions: 58 x 95 x 25mm

Price: 28 Euros



Interconnection kit with 2mm female plugs & cords

Price: 16 Euros

Other accessories, sockets and components are available on request.

Contact e-mail:

triodyne@hotmail.fr
zhlhxr@hotmail.com

8 Problems & solutions

Problem	Diagnosis
The system does not light up.	Check the connection and voltages to/from the power supplies.
There is no test result.	Make sure the settings are ok then press the TEST button only.
The tube does not heat up, or the results seem wrong.	<p>Check connections to the tube and that the correct heating voltage is applied .</p> <p>Check the G1, G2, and plate values.</p> <p>Check the continuity of filament with a ohmeter.</p>
The screen displays OVERLOAD.	<p>Release the TEST button and/or DISCHARGE button, and disconnect plate and G2.</p> <p>Turn Plate potentiometer anticlockwise.</p>
When the TEST button is pressed, the screen displays indications which change rapidly and in a significant manner.	<p>The most probable cause is that the tube has started to oscillate during the test. This phenomenon is rare but could occur with high slope tubes.</p> <p>Make sure you have installed the ferrite beads.</p> <p>Contact <i>Radioelec</i> by email to receive some suggestions.</p>
The indicators on the screen are truncated or abnormal.	Remove any tube, switch off power then wait a few seconds, and turn the system back on.