

PHYWE Systeme GmbH & Co. KG
Robert-Bosch-Breite 10
D-37079 Göttingen

Telefon +49 (0) 551 604-0
Fax +49 (0) 551 604-107
E-mail info@phywe.de

Operating instructions


 The unit complies with the corresponding EC guidelines.



Fig. 1: 09105-40 Franck-Hertz Ne-tube with housing

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1 SAFETY PRECAUTIONS



Caution!

- Carefully read these operating instructions before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Do not start up this instrument in case of visible signs of damage to it.
- Only use the instrument for the purpose for which it was designed.
- Only use the Franck-Hertz Neon Tube with the control unit 09105-99

2 PURPOSE AND CHARACTERISTICS

The Franck-Hertz Neon Tube with housing (see Fig. 1) are instruments that have been developed specifically for use in demonstrations and practical work in the teaching of Physics in schools and colleges. The dependence of the anode current on the applied acceleration voltage proves the existence of discrete energy states of Neon atoms when free electrons collide with those atoms. The excitation energies of Ne atoms can be determined from the spectra recorded. The shell model of the atom postulated by Bohr was experimentally confirmed in 1913/14 by means of Franz- Hertz experiments (named after James Franck and Gustav Hertz).

3 FUNCTIONAL AND OPERATING ELEMENTS

3.1 Franck-Hertz Neon Tube

The Franck-Hertz Neon tube (electron collision tube) is a tube with plane, parallel electrodes (see Fig. 2): an indirectly heated oxidecoated cathode **C**, two grid-shaped accelerating electrodes **A1**, **A2** and a collecting electrode **S**. The distance between the cathode and the grid **A2**

is large compared with the mean free wavelength of the electrodes in Neon gas at the operating temperature so that the impact probability is as high as possible. In contrast, the distance between the grid **A2** and the collecting electrode is short. A protective resistance is included in the grid lead.

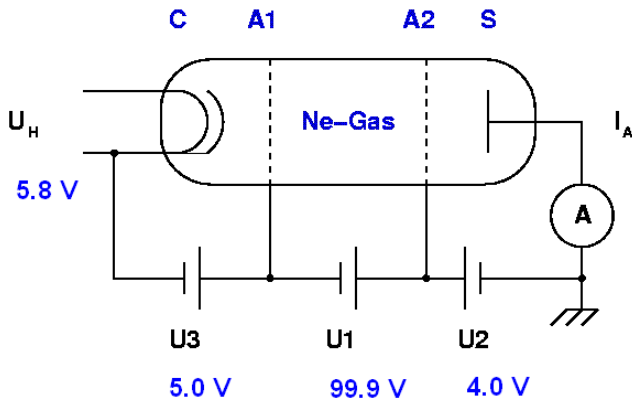


Fig 2: Schematic view of a Neon four electrodes tube

As a consequence of the Neon ions produced during the operation of the Franck-Hertz tube ignition is observed in the form of a glow discharge at a critical acceleration voltage. The collection current then suddenly increases and can exceed the highest current measurement range on the amplifier. Therefore, when the discharge occurs, the acceleration voltage should be immediately reduced until the discharge disappears. If Franck-Hertz Control Unit is used then the tube power supply is switched of automatically after 7 sec. to avoid the discharges.



Please make sure to adopt the settings at the first operation of the Franck-Hertz Neon tube. For good operation of the Franck-Hertz Neon tube, it's very important to read the instructions carefully.

Please refer to the test report enclosed with the tubes for the optimized Parameters to be set.

Don't set the heating voltage U_H too high to avoid the discharges and the damage of the Neon tube.



Fig. 3: Experimental set up of the Franck-Hertz experiment with Neon tube

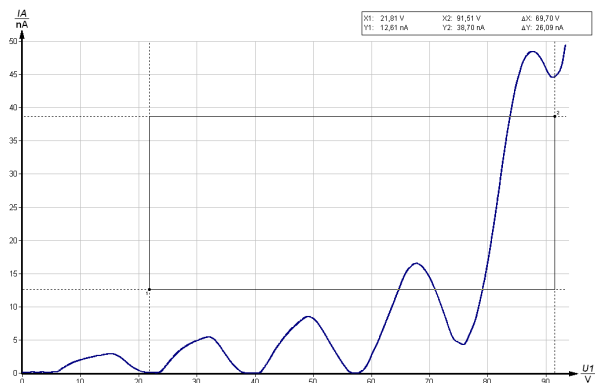


Fig. 4: Characteristic Franck-Hertz Spectrum for Neon tube

OPERATING INSTRUCTIONS

Suitable parameters can be determined by first starting the optimisation attempt with the following typical values for the Ne tube:

Start parameters $U_1 = 99.9V$ $U_2 = 8.0V$ $U_3 = 5.0V$ $U_H = 5.0V$

Optimise values by a.):

Select the 'man' menu item using the Function key. Press the 'Start' key (green LED lights up). Carefully increase U_H using the key display until a current of approx. 10 nA is shown on the display.

Optimise values using b.):

If the measured characteristic curve is too flat or the first 'maximum' is not displayed, the 'maximums' of the characteristic curve can be improved to a certain extent by increasing the voltage U_3 .

Optimise values using c.):

If the 'minima' drift into negative territory, reducing the voltage U_2 will help. If the last 'maximum' in the measured characteristic curve is not clearly defined, increasing the voltage U_2 will help.

Use with a PC

- Connect the PC to the Frank Hertz operating device.
- Start the measure programme. On the PC, select the Frank Hertz operating device under 'Function' and select the Franck Hertz experiment under 'Measuring devices'.
- Set the voltage values U1, U2, U3 and UH exactly as they were previously set in manual mode ('man.' under 'Function').
- Then select the 'PC' mode again under "Function" and click on 'Next' to start the measurement.
- Initialisation begins and is displayed on both the PC and the operating device.
- As soon as the voltage U1 has risen continuously to 99.9 V, the measurement is automatically terminated.
- The resulting diagram should correspond approximately to that shown in Figure 2. If this is not the case, the voltages UH and U3 must be adjusted accordingly.
- If the characteristic curve reaches the limit, the voltages must be reduced.
- If the curve is too small or inaccurate, the voltages must be increased. The limit values specified in the protocol must not be exceeded.

4 HANDLING

This high-quality instrument fulfils all of the technical requirements that are compiled in current EC guidelines. The characteristics of this product qualify it for the CE mark. This instrument is only to be put into operation under skilled supervision in a controlled electromagnetic environment in research, educational and training facilities (schools, universities, institutes and laboratories).

This signifies that no mobile phones etc. are to be used in the immediate vicinity of such an environment. Individual connecting leads must not be longer than 2 m. Electrostatic charges and other electromagnetic phenomena (HF, bursts, indirect discharge of lightning etc.) can have such an influence on the instrument that it no longer functions within the given technical specifications. Carry out the following measures to reduce or do away with disturbing effects:

Avoid fitted carpets; ensure potential equalization; carry out experiments on a conductive, earthed surface, use screened cables, do not operate high-frequency emitters (radios, mobile phones) in the immediate vicinity. Following a blackout failure, operate the on/off switch for a reset. The Operating Instructions for the Franck-Hertz Control Unit 09105-99 are to be carefully followed whenever this unit is used in the experiment.

5 TECHNICAL DATA

(typ. for 25°C)

Operating temperature range 5... 40°C,

Relative humidity <80 %

Franck-Hertz Neon tube

Voltage U1	99.9 V
Voltage U2	4.0 V
Voltage U3	5.0 V
Voltage U _H	4.3 V
Output current	max. 10 µA

6 LIST OF EQUIPMENT

A. Franck-Hertz Experiment with Ne-tube without PC

Franck-Hertz control unit	09105-99
Franck-Hertz Neon tube	09105-40
Connect.cord for Neon tube	09105-50
Screened cable, 75 cm	07542-11

B. Franck-Hertz Experiment with a PC

As in A. above and additionally:

RS 232 Data cable	14602-00
Software measure Franck-Hertz	14522-61

7 WASTE DISPOSAL

The packaging consists predominately of environmentally compatible materials that can be passed on for disposal by the local recycling service.



Should you no longer require this product, do not dispose of it with the household refuse.

Please return it to the address below for proper waste disposal.

PHYWE Systeme GmbH & Co. KG
Abteilung Kundendienst (Customer Service)
Robert-Bosch-Breite 10
D-37079 Göttingen

Phone +49 (0) 551 604-0
Fax +49 (0) 551 604-107