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Operating instructions

CE The unit complies with the corresponding EC guidelines.

Fig. 1: Gamma detector 09101-00 with Operating unit for gamma detector 09101-93.

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1 SAFETY PRECAUTIONS

Caution!

- Carefully read these operating instructions completely before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Check that your mains supply voltage corresponds to that given on the type plate fixed to the instrument.
- Install the instrument so that the on/off switch and the mains connecting plug are easily accessible.
- Connection or disconnection of the gamma detector to or from the operating unit is only to be made when the operating unit is switched off.
- Only use the instrument in dry rooms in which there is no risk of explosion.
- Do not start up this instrument in case of visible signs of damage to it or to the line cord.
- Only use the instrument for the purpose for which it was designed.

2 PURPOSE AND CHARACTERISTICS

The gamma detector is a scintillation counter that, in connection with the operating unit, serves fundamentally for experimental investigations on gamma radiation, but also for the detection of gamma radiation.

The gamma detector

The gamma detector consists of a light-proof, encapsulated NaJ(Tl) crystal and a downstream photomultiplier that is magnetically shielded with mu-metal and is connected to the crystal by fiber-optics. Gamma quanta that are incident on the crystal generate high-energy electrons through photo or Compton effects that, for their part, generate flashes of light in the crystal whose intensity is roughly proportional to the energy of the electrons. The flashes of light generate photoelectrons in the photosensitive layer of the photomultiplier, whereupon the dynodes of the photomultplier effect a 10^6 times increase in them. In this way, a charge pulse is created at the anode which is converted to a voltage pulse at an operating impedance and is available at the output socket for further processing. The pulse height spectrum of the voltage pulse at the output of the detector corresponds to the energy spectrum of the photo or Compton electrons generated by gamma radiation in the scintillation crystal. The pulse height spectrum can be analysed by an impulse height analyser.

The operating unit
The operating unit supplies the adjustable voltage required for operation of the photomultiplier. As the amplification factor of the photomultiplier is very highly dependent on the operating voltage, this operating unit has been designed to have an extremely good voltage stability. Variation of the voltage, and so variation in the amplification factor, can be reproducibly achieved by means of a 10-step potentiometer.

3 DESCRIPTION AND HANDLING

The gamma detector is fixed on a stable base plate.
The base plate has a taped hole so the detector may be fixed on the supplied support rod.

Function elements (see Fig. 1):
1 Scintillation crystal (NaJ/Tl) in a light-proof aluminium capsule
2 Photomultiplier housing
3 Voltage divider housing
4 Connecting sockets
- BNC Signal output socket
- MHV High voltage socket, distinguished by a red ring

Caution! HV connecting cables only are to be used for connection to the MHV high voltage socket. Normal BNC cables are not approved for use at this voltage and they do not fit to this connection.
Connection and disconnection are only to be made when the operating unit is switched off.

5 HV High voltage connecting cable (article no.: 09101.10) (not included in the extent of delivery)
6 Mains switch
7 BNC Voltage output socket
8 10-Step precision potentiometer with adjusting knob and scale

The detector is sensitive to shock and so must be handled with care. Hard knocks can also, and in particular, easily cause the crystal to crack because it is very brittle. The detector is to be additionally protected against too rapid changes in temperature, e.g. do not expose it to direct sunlight. When it is not to be used for some time, we recommend that it be stored in the thermally insulating shipping container.
Use a BNC cable to connect the detector output BNC socket to the impulse height analyser input socket. Use the HV connecting cable to connect the gamma detector MHV high voltage socket (distinguished by a red ring) to the operating unit BNC output socket.
To adjust the operating voltage, first unlock the catch on the potentiometer adjusting knob.
The voltage is 600 V at the 0.00 position. It is increased by 50 V for each complete turn and reaches the highest value of 1100 V at the 10.00 scale value. The voltage increases linearly.
An operating voltage of between 700 V and 900 V is as a rule sufficient for gamma spectroscopy.
Please use the voltages specified on the test protocol for measurement.
Avoid unwanted changes to the voltage setting by re-locking the adjusting knob.

We recommend that you simultaneously observe the screen of an oscilloscope connected to a pulse height analyser while making the voltage setting.

4 NOTES ON OPERATION

This high-quality instrument fulfills 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 specialist supervision in a controlled electromagnetic environment in research, educational and training facilities (schools, universities, institutes and laboratories).
This means that in such an environment, no mobile phones etc. are to be used in the immediate vicinity. The individual connecting leads are each not to be longer than 2 m.

5 TECHNICAL SPECIFICATIONS

(Typical for 25°C)
Operating temperature range 5...40°C
Relative humidity < 80%

Gamma detector

Crystal	
Material	NaJ(Tl)
Crystal diameter	38.1 mm
Crystal height	50.8 mm
Thickness of the aluminium envelope	0.4 mm (= 0.108 g/cm^2)
Secondary electron multiplier	
Conversion quantum efficiency	approx. 22%
Photocathode material	Bialkali
Number of dynodes	10
Dynode material	CsSb
Voltage divider for multiplier	
Total resistance	6.75 MΩ
Working resistance	100 kΩ
Energy resolution (at 662keV)	≤ 7%
Maximum high voltage	1.5 kV
Output pulses	
Polarity	negative
Built up time	approx. 0.4 µs
Duration approx.	4.5 µs
Max. height	-7.5 V

Operating unit for gamma detector

Output	
Voltage (positive)	600 V – 1100 V (Negative terminal earthed)
Current intensity	max. 0.5 mA
Line stabilization	< 0.1%
Special socket	MHV (metal collar earthed)

Mains supply

Protection class	I
Connecting voltage (+6%/-10%)	see type plate
Mains frequency	50/60 Hz
Power consumption	10 VA
Housing dimensions (mm)	230 x 110 x 70 (W, D, H)
Weight	approx. 1 kg

6 EXPERIMENTAL LITERATURE

Handbook Laboratory
Experiments Physics 16502-32

7 NOTES ON THE GUARANTEE

We guarantee the instrument supplied by us for a period of 24 months within the EU, or for 12 months outside of the EU. This guarantee does not cover natural wear nor damage resulting from improper handling.
The manufacturer can only be held responsible for the function and technical safety characteristics of the instrument, when maintenance, repairs and changes to the instrument are only carried out by the manufacturer or by personnel who have been explicitly authorized by him to do so.

8 WASTE DISPOSAL

The packaging consists predominately of environmental 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.

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