

Wide-Range Detector FHZ 621 G-L

- Measuring range: 100 nSv/h ... 100 mSv/h
- Display range: 10 nSv/h ... 10 Sv/h
(10 nSv/h ... 100 mSv/h for PTB approved versions)
- Detection of radiation anomalies (artificial gamma sources)
- Continuous self-monitoring of the detector functions
- Available for measurement of \dot{H}_x or $\dot{H}^*(10)$ energy response
- Integrated RS 232 or RS 485 interface



0. Design and Applications

For measuring networks designed to monitor the radioactivity in the environment, the setting of a warning threshold which should be as sensitive as possible is not only limited by the statistical precision of the measurements, but also by the natural fluctuation of the ambient radiation due to the weather. Increases of the dose rate with very high statistical significance up to 300 % of the "normal" background depending on the site and the weather situation - are as a rule mere consequence of natural processes in the atmosphere.

The additional use of rain sensors or the evaluation of the time decay behaviour of the radioactivity in question are well-established discrimination procedures to distinguish these impacts. The 'ordinary' rise in the dose rate due to a wash-out of radon daughter products is signalled by the rain sensor. After a few hours, the washed-out activity is characterised by a continuous decay.

A disadvantage of both methods is, however, that 'real' occurrences cannot be clearly excluded (apart from the time delay when interpreting the course of events):

a rise in the dose rate due to a wash-out of fission- and activation products occurs in correlation with rain setting in as well; in turn, radioactive masses of air moving by (e.g. inert gases) may cause time transient increases in the dose rate.

For this reason, the newly developed wide-range detector FHZ 621 G-L does not only determine the amount of the given dose rate, but does also executes a permanent search for energetic anomalies of the gamma field. This makes it possible to detect any relevant artificial gamma contribution online in a fully automatic and autonomous way and to issue an automatic alarm to a higher-level computer system even if the increases in the dose rate are considerably lower.

The applied method is based on the NBR-procedure (Natural Background Reduction) by ESM (patent pending) which has been successfully used for several years in combination with large-volume scintillation detectors. For the detector FHZ 621 G-L, this concept was further developed to be used with proportional counter tubes. In this case, the difference in the energy transmission of the gamma radiation for fission products against the ordinary cosmic and terrestrial radiation background is measured. The natural radiation is characterised by a high share of high-energy quanta (> approx. 1 MeV) as is true for the variable contribution in terms of time of washed-out radon decay products. In general, lower energies are relevant for fission products.

With a typical background of 100 nSv/h, it is, for example, possible to reliably distinguish an additional Xe-133 dose rate contribution of approx. 30 nSv/h from a wash-out due to radon decay products within 20 to 30 minutes in routine operation.

Moreover, the proportional counter tube is characterised by the detection of energies starting already at 30 keV, a fact due to which it is also possible to consider the relevant low-energy range caused by Compton scattering in air. The service life of the used counter tube is longer than 10^{12} pulses corresponding to a total dose of 25 Sv. At normal ambient level, the computed service life would consequently account for more than 30.000 years.

The following items are integrated into the detector: a threshold amplifier, a pulse shaper, a high voltage generator, a RS 232 serial interface or optionally a RS 485-interface for bus operation. The conversion into dose rate values and the evaluation of radiation anomalies are performed by a microprocessor.

The detector provided with the optional NEMP-filter is protected against electromagnetic pulses and has a protection degree of IP 67, suited for being used outdoors

0.1 Measured value data memory

When in operation, the detector is able to temporarily store 1500 data sets by means of an internal ring buffer so that the detectors need not be permanently connected with a computer for data storage purposes. With a typical measurement time of 10 minutes, a memory depth of more than 10 days is achieved this way. Apart from date and time, the following measured values are stored: 'mean dose rate of the recording interval', 'current temperature' and 'current artificial share (%)'.

0.2 Quality assurance of the measured values

A series of self-tests permanently monitors the functions of the processor and the counter tube amplification. An automatic routine can be triggered for the recording of detector characteristics.

0.3 Possibilities

0.3.1 FHZ 621 G-L in connection with FHT 6020 display unit (Ref. no. FS-0-2-0-0) or with FHT 6010 (Ref. no. 42509/01)

Photon dose equivalent rate \dot{H}_x :

Detector type	Ref. no.	Remarks
FHZ 621 G-L4	42542/02	PTB approval 23.22 Z 00.01
FHZ 621 G-L4	42542/22	freely calibratable, (Sv/h; Gy/h; R/h)

Ambient dose equivalent rate $\dot{H}^*(10)$:

Detector type	Ref. no.	Remarks
FHZ 621 G-L4-10	42542/18	PTB approval 23.71 Z 01.01
FHZ 621 G-L4-10	42542/24	freely calibratable

- Interface adapter RS 232/RS 485 required for connection to RS 232 of PC (Ref. no. 42509/2028)
- Optional: NEMP Filter (Ref. no. 42542/10) with IP 67 protection class and 6pin special connector

0.3.2 Single Detector operation with RS 232 connection to PC or modem

Photon dose equivalent rate \dot{H}_x :

Detector type	Ref. no.	Remarks
FHZ 621 G-L2	42542/03	freely calibratable (Sv/h; Gy/h; R/h)

Ambient dose equivalent rate $\dot{H}^*(10)$:

Detector type	Ref. no.	Remarks
FHZ 621 G-L2-10	42542/17	freely calibratable

- Optional: NEMP Filter (Ref. no. 42542/10) with IP 67 protection class and 6pin special connector

0.3.3 PC operation of up to 99 Detectors

Photon dose equivalent rate \dot{H}_x :

Detector type	Ref. no.	Remarks
FHZ 621 G-L4	42542/04	PTB approval 23.22 Z 00.01
FHZ 621 G-L4	42542/22	freely calibratable (Sv/h; Gy/h; R/h)

Ambient dose equivalent rate $\dot{H}^*(10)$:

Detector type	Ref. no.	Remarks
FHZ 621 G-L4-10	42542/18	PTB approval 23.71 Z 01.01
FHZ 621 G-L4-10	42542/24	freely calibratable

- Interface adapter RS 232/RS 485 required for connection to RS 232 of PC (Ref. no. 42509/2028)
- Optional: NEMP Filter (Ref. no. 42542/10) with IP 67 protection class and 6pin special connector

0.4 Operation in wide area measurement networks handling alarm call of local stations

One or more probes are connected to local PCs in distributed measurement stations (“server”). Data polling and storing is made by the program NetView. The stations are polled from a central station (“client”) by means of master-slave-concept of NetView (required programs: for client pc NetComm and NetServ for server PCs). The time of polling can be selected to be periodically or at a fixed time. The local stations are connected to central station by telephone modems.

In case of alarm, the program NetView in the server station makes an “alarm call” to the client station and sends an alarm message. As a result the central station immediately starts polling the actual values from all servers.

1. FHZ 621 G-L

Detector types

Ref. no. 42542/03	FHZ 621 G-L2	RS 232	\dot{H}_x	freely calibratable
Ref. no. 42542/04	FHZ 621 G-L4	RS485	\dot{H}_x	PTB approval
Ref. no. 42542/17	FHZ 621 G-L2-10	RS 232	$\dot{H}^*(10)$	freely calibratable
Ref. no. 42542/18	FHZ 621 G-L4-10	RS485	$\dot{H}^*(10)$	PTB approval
Ref. no. 42542/22	FHZ 621 G-L4	RS485	\dot{H}_x	freely calibratable
Ref. no. 42542/24	FHZ 621 G-L4-10	RS485	$\dot{H}^*(10)$	freely calibratable

Dimensions/weight:

Length: 340 mm
External diameter: 65 mm
Weight: 950 gr.

Electronic Data:

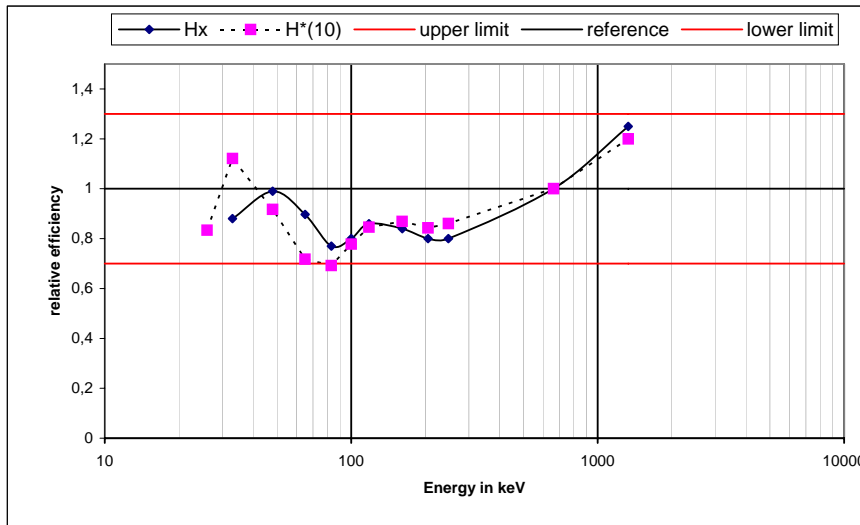
Voltage supply: 10 - 30 V DC
Power consumption: approx. 50 mA at 12 V
Initial current after switch on: approx. 120 mA
Output signals: serial interface RS 232 (optionally RS 485)

Characteristic data of the counter tube for all detector types:

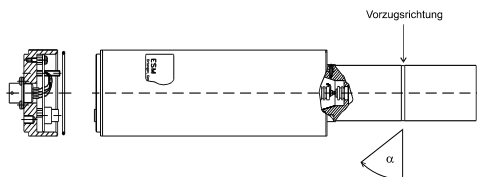
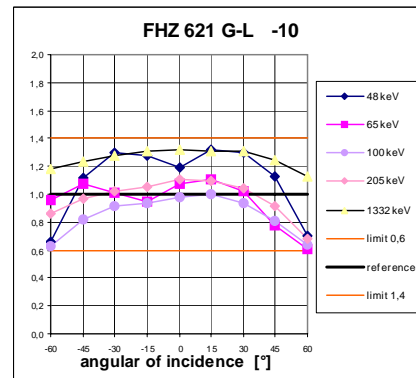
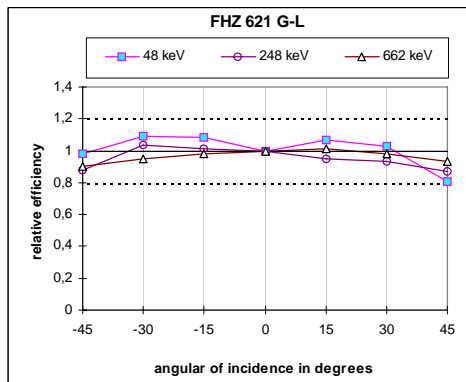
Operating voltage: 2050 V
Intrinsic background: $0.11 \text{ s}^{-1} \pm 30 \%$
Gamma response: $(9.5 \pm 0.5) \text{ s}^{-1}/(\mu\text{Sv/h})$ (individual calibration)
Deadtime: typically 1.6 μs (individual calibration)
Measuring range (PTB approved): 100 nSv/h ... 100 mSv/h
linearity < 10 % (Cs-137)
Display range: 10 nSv/h ... 10 Sv/h (... 100 mSv/h for PTB-versions)
linearity < 40 % (Cs-137)
Radiation resistance: > 50 Sv/h without a decrease of the measured value
Energy dependence: $\pm 30 \%$ in the range of 30 keV ... 1.3 MeV
Angular dependence: $\pm 20 \%$ in the range of -45° ... $+45^\circ$
reference direction: perpendicular to the cylinder axis of the counter tube
Counter gas: Ar/CO₂, permanent filling
life time > 10^{12} pulses

Ambient conditions:

Temperature range: - 30 ... + 50 °C
 Pressure of the outside air: 533 - 1060 hPa
 Type of protection: IP 52 without NEMP filter
 IP 67 with NEMP-filter

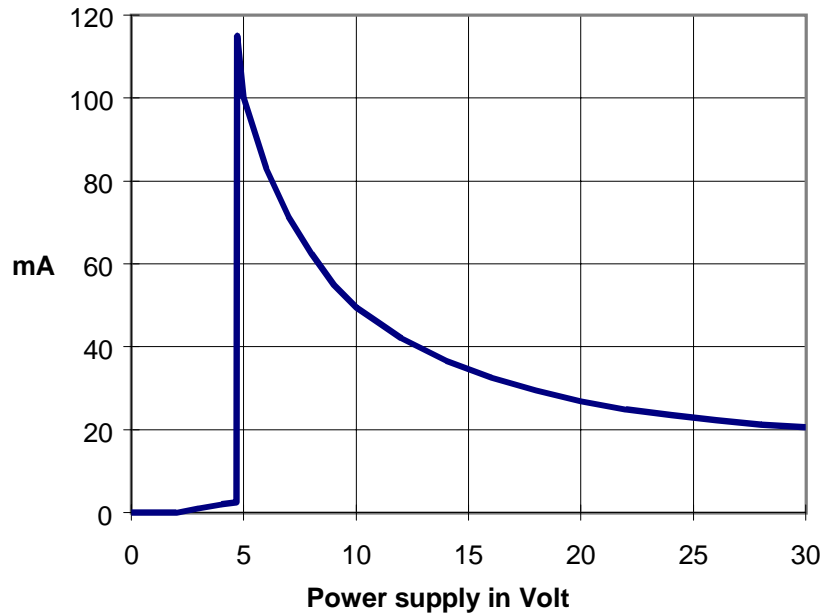


Energy response for H_x and $H^*(10)$



Angular response -45° bis + 45°

Installation hints:



Power requirement

Start-up power requirement: : app. 120 mA for the first milliseconds

Expected voltage drop for long cables during start-up:

$$U = 2 * l * R_0 * n * 120 \text{ mA}$$

l : length of cable (m)

R_0 : specific resistance ($\frac{\Omega}{\text{m}}$)

n: number of probes

In case that the probes are equally distributed along the length of the cable the calculated voltage drop can be multiplied by 0,6.

Example:

10 probes, cable AWG20 with $0,56 \text{ mm}^2 = 0,034 \Omega/\text{m}$, length 100 m: 8,1 V drop. Thus a 24 V power supply with 1,2 A short-circuit protection is sufficient but not a 15 V power supply.

Permanent power requirement during operation: 6 W (according to 25 mA for each probe); operation voltage app. 22 V at the probes, cable voltage drop 1,8 V. For greater a number of probes or longer cables another cable type with larger cross-section has to be used.

2. Accessories:

Ref. no. 42542/10

2.1 NEMP-filter

This filter is always required if the probe FHZ 621 G-L is mounted outside of a grounded enclosure (e.g. control cabinet etc.) or outdoors. The filter is inside an aluminum cylinder with the same diameter as the electronic of the dose rate probe. It is possible to plug this filter directly onto the 9-pin socket of the probe.

The external connection to a probe cable is established by means of a water-proof connector (MIL-6 pin Souriau 851-02E 10-6p 5044).

Diameter:	65 mm
Length:	plus additional 40 mm
Protective function:	NEMP (60 kV/m, rise time 10 ns, fall time 200 ns)

2.2 Holders

Ref. no. 42542/3001

Wall and Pole mount holder (for vertical installation)

Ref. No. 42542/3002

Wall mount holder for FHZ 621 G-L (2 pipe supports incl. accessories)

Incl. screws and wall plugs for wall installation. Alternatively pole installation is possible with standard screws (not incl.).

Ref. no. 42542/3004

2.3 Protection cover

The detector may be "hidden" under a grey, unspectacular PE cover if required. It additionally protects the detector from mechanical impacts and may be quickly replaced if contaminated. The protection cover is supplied together with adaption flange and can thus be directly mounted to the wall and pole holder.

Protection cover without flange: 42542/3003

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