

MANUAL
GAMMA DETECTOR
TYPE: RS04

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1. General description of the gamma detector, type RS04

The gamma detector, type RS04 developed and manufactured by BITT Technology, it is designed for measuring radioactivity of gamma radiation. It is calibrated in the quantity of "ambient dose equivalent rate" [$\dot{H}^*(10)$], its measuring range comprises 9 decades (from 10 nSv/h up to 10 Sv/h). This wide measuring range permits detecting minor changes in the ambient natural radioactivity as well as measuring high dosage rates. The detector is available in two versions: type RS04/H for wide measuring range and type RS04/L for low measuring range.

This robust and unique detector lends itself to an extensive range of utilizations:

- sensor in monitoring network for early warning systems covering a wide geographical area;
- hospital surveillance at radiation therapy wards;
- measuring unit in scientific institutions and development centers;
- supervision unit at borders, airports, railway stations and in aircrafts, etc.
- measuring unit in private sector, especially for owners of fallout shelters

The detector is operating at 12 V, 50 mA DC.

For the evaluation of the measured data a personal computer with a serial interface (RS232, RS485) are required. The serial interface type RS232 allows a distance between the detector and the evaluating unit of up to 500 m, while the type RS485 allows for up to 1200 m. For request the detector is available with USB interface, too.

2. Structure of the detector

- The BITT Technology detector is a proportional counter tube of type NPGD02. A large number of these counter tubes have been in operation in several European countries for many years and have set a new worldwide environmental surveillance standard. This specific model is unique as it is the only that is able to cover a 9-decade measuring range with a single detector.
- One of the major advantages is that the counter tube's sensitivity to natural ambient radiation is rather high despite its wide measuring range. The tube's durability is practically independent of the number of pulses. After a high dose irradiation the detector can be regenerated automatically by a one month refresh (out of operation).
- The signal processing unit was developed on the basis of extensive experiences gained over many years. This microprocessor processes the signals of the detector tube, converts them into the quantity of ambient dose equivalent rate [$\dot{H}^*(10)$], controls continuously the operation of the detector, stores the measured data and ensures the communication between the detector and the central unit.
- An extra stable high-voltage unit ensures the solid operation of the counter tube.
- Additionally all electric in- and outputs are equipped with special protection filters (NEMP¹) providing excellent lightning protection.
- The complete equipment of the detector is housed in a waterproof aluminum tube with a wall thickness of 2 mm. The connector is waterproof, too.

¹ Nuclear Electromagnetic Pulse

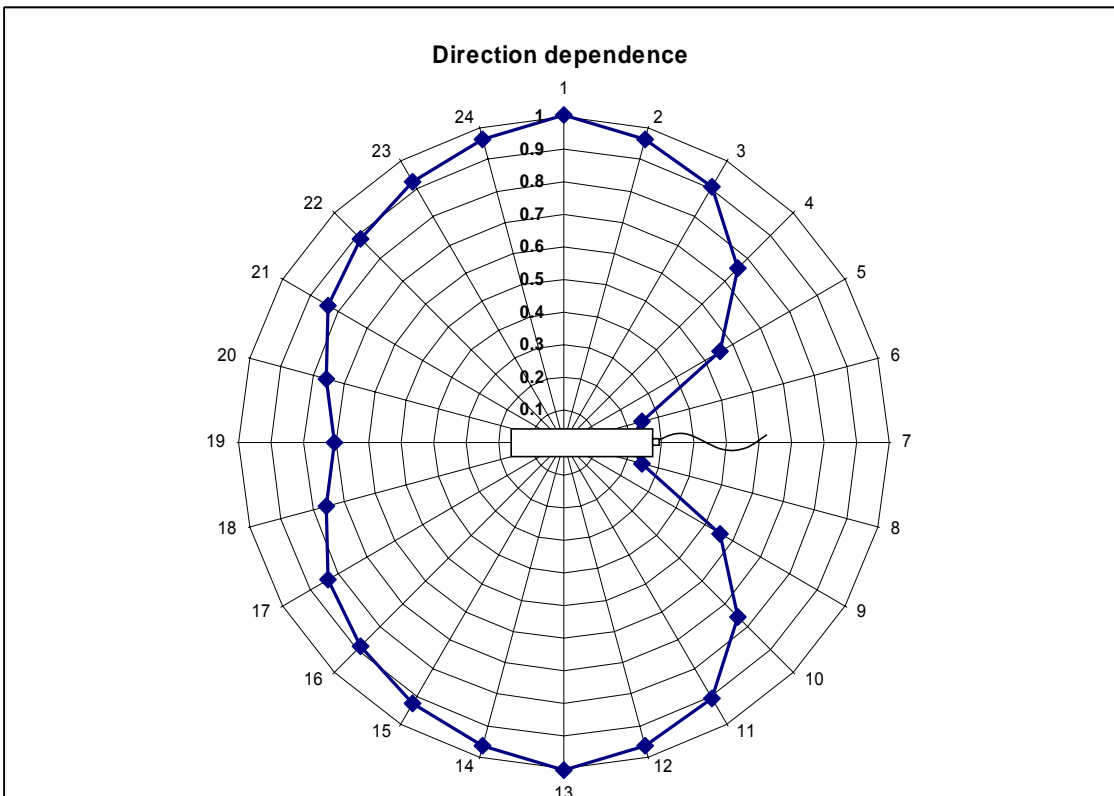
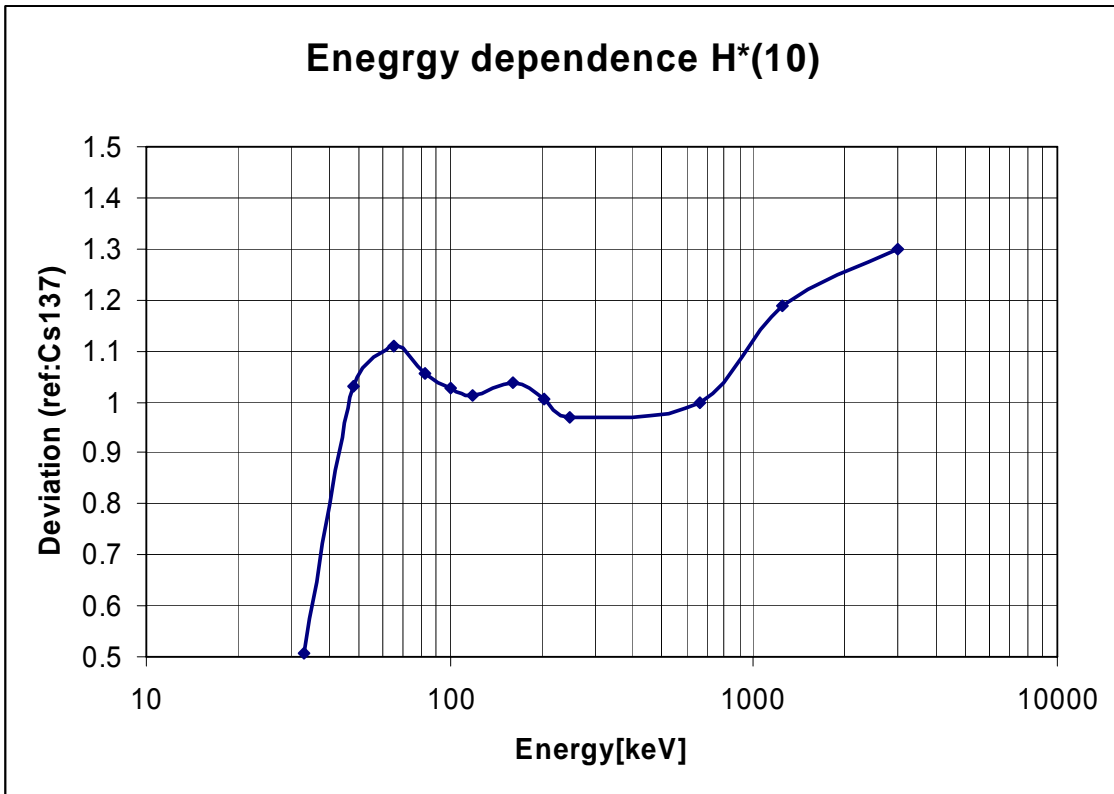
3. Technical specification

| Type | RS04H/232, RS04H/485 | RS04L/232, RS04L/485 |
|-------------------------------------|---|----------------------|
| Detector | Proportional counter, Type NPGD 02 with energy compensation (produced by BITT Technology) | |
| Microprocessor | Type C8051F022 Silicon Labs, compatible with Intel 8051 | |
| Measuring range | 10 nSv/h ÷ 10 Sv/h | 10 nSv/h ÷ 15 mSv/h |
| Energy range (±30%, ref. Cs-137) | $\dot{H}^*(10) \leq 30$ mSv/h: 40 keV ÷ 3 MeV $\dot{H}^*(10) > 30$ mSv/h: 100 keV ÷ 3MeV | 40 keV ÷ 3 MeV |
| Temperature range | -30°C ÷ +70°C | |
| Temperature dependence | less than ±5% | |
| Measuring uncertainty | $\dot{H}^*(10) \leq 1$ Sv/h: ±10% $\dot{H}^*(10) > 1$ Sv/h: ±15% | |
| Output | RS-232 or RS-485 ¹ | |
| Services | | |
| Protokoll version ² | BSN, BSS, OS€, OS@ | |
| Real time clock | Yes | |
| Data storage memory | Yes | |
| Real time data | Yes | |
| Additional software | Bittsens, Vcomtest, Bittwin, AMAR, Procomm, Terminalprogram, RS-Datalogger with Modem, BOREAS BCU | |
| Power consumption | max. 60 mA ³ (10,5V _{DC} ÷ 13,8 V _{DC}) | |
| Dimensions | Ø76 mm x 500 mm | |
| Mass | ca. 2,5 kg | |

¹ For request it is available with RS422 interface, other parameters are equivalent with the RS485-ös interface.

² BSN Bittsens protocol, it answers on all request, report is generated automatically
BSS Selectiv Bittsens protocol, it answers only on the request from the addressed and 999 addresses, none report is generated automatically.

³ Operating consumption ≤50 mA, transient current is max. 100 mA, max. 5 s.



Adjustable parameters in type RS04/232 and RS04/485:

- Date, time
- Data storage period
- History limit
- 8 alarm level with hysteresis
- Resetting (zeroing) of the accumulated dose values
- Able/disable of generating reports (in type RS485 disable is default)

Queryable data and parameters:

- Ambient dose-equivalent rate
- Accumulated dose-equivalent values at alarm levels.
- Ambient dose-equivalent values, measured in the last 10 minutes in 1 minute interval
- Ambient dose-equivalent rate values measured in the last 72 hours and in 10 minutes interval
- Reports
- Status (Power voltage/current, temperature inside, etc.)

Preset parameters

Measured values in type RS04/232 and RS04/485:

- Ambient dose-equivalent rate in Sv/h
- Status
- Input power voltage in Volt-s
- Current consumption in mA-s
- High-voltage in Volt-s
- Inside temperature in °C
- Analogue power voltage (inside) in Volt-s
- The last measured counts (pulses) normalized for 1 second.
- The last measured detector current in mA-s

Options:

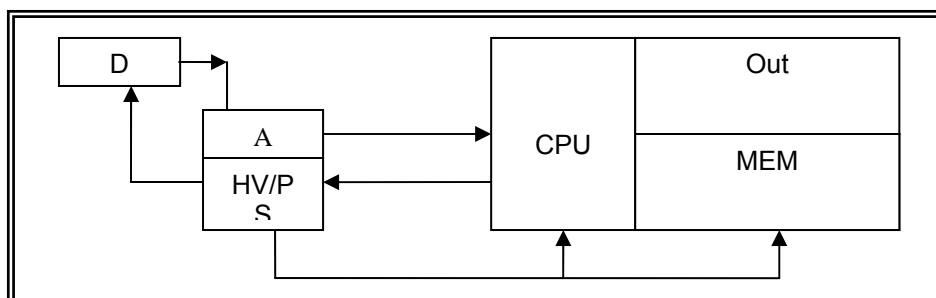
- NEMP¹ protection against overvoltage and lightning
- Backup power voltage supply against max. 72 hours power failure
- Power supply built in PC
- Cable
- Locking frame
- Stand (in accordance of request)
- Measured data processing and communication unit

¹ Nuclear Electromagnetic Pulse

4. Operation

The gamma detector consists of four main parts:

- Proportional counter, equipped with energy compensation
- Puls- and current amplifier and high-voltage unit
- Microprocessor unit
- Cover tube



| | |
|-----|---|
| D | Proportional counter tube, type NPBGD02 |
| A | Amplifier |
| PS | Power Supply |
| CPU | Central Processor Unit |
| MEM | Storage memory |
| Out | Output unit |

The proportional counter works as a pulse generator in the low dose-rate range, and as a current source (integral of the pulses) in the high dose-rate range. Both signals are processed by the microprocessor; the transition range between the two operation modes is calculated by software (see the paragraph 5.1). In the highest dose rate ranges the high voltage of the counter tube is reduced by 25% ÷ 30%.

4.1. Detector

The counter tube is a proportional tube, type NPDG-02 manufactured by BITT TECHNOLOGY. The counter tube is filled with a special gas mixture; in the tube's axle a thin anode wire is fixed. An energy compensation filter equipped with appropriate insulation is mounted on to the tube. In the RS04 detectors the counter tubes are applied to following work points: -1700V cathode voltage and 0 V anode voltage. The energy compensation filter is connected to 0V potential in order to reduce electric disturbances.

4.2. Pulse- and current amplifier

This unit forms the pulses of the counter tube and fits them to the microprocessor. If the counts of the pulses are too high, the unit reduces the high voltage on the cathode, i.e. decreases the gas-amplification. In the current mode the AD converter processes the current of the counter tube.

4.3. Microprocessor unit

This unit is based on the Silicon Labs type C8051F022 microcontroller circuit. This chip is completed with the following circuits:

- 64 kbyte EPROM (U2, 27C512)
- 32 kbyte additional RAM (U7, 51256 CMOS)
- Real time clock (U6, RTC 72421)*
- 8 bites parallel input (U1, 74HCT573)

4.4. Cover tube

All the parts are placed in a 2mm thick aluminium tube. The connector and the cover itself are dust- and waterproof.

5. Appendix

6.1. Appendix B

The additional specification of the type RS04/232

The parameters of the RS232 line:

8 data bits
1 stop bit
No parity
2400 baud

Three wires are used for the communication (The control lines DSR, DTR, etc. are not applicable).

The nominal value of the line voltage levels $\pm 12V$ in accordance with RS232 standard.

Communication messages:

At the start of operation the messages BWC and BSC are enabled, the other reports are disabled*.

Default parameters:

History limit: 1000

Warning levels:

1 120 nSv/h
2 300 nSv/h
3 1 μ Sv/h
4 10 μ Sv/h
5 100 μ Sv/h
6 1 mSv/h
7 30 mSv/h
8 300 mSv/h

Hysteresis: 10%

The nominal value of the high voltage: 1700V

Connector:

A H.V. control, it is used by the service only!!
B TXD (Transmitted Data)
C RXD (Received Data)
D N.C.
E +12V DC
F 0V

Accessories (delivered with the detector):

1pc..... connector (CANNON 7SDB)

Package:

In a paper tube of $\varnothing 100$ mm, wrapped in shock absorbing plastic foil.

6.2. Appendix C

The additional specification of the type RS04/485

This type of detector sends answer on the only message which is addressed to its own identification (set by jumpers inside, e.g H123). It doesn't generate any report automatically.

For the task of test, all the detectors answer on the address H999 (global ID), but in the answer its own ID will be sent back. In this way the ID of any detector can be identified without open the cover tube.

Connector:

- A H.V. adjustment, it is used by the service, only!!
- B RS485 A
- C RS485 B
- D N.C.
- E +12V DC
- F 0V

Accessories delivered with the detector:

- 1db Connector (CANNON 7SDB)

Package:

- In a paper tube of Ø100mm, wrapped in shock absorbing plastic foil.

Document release

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