GammALERT SPECTRAL SYSTEM

EARLY WARNING Gamma Ray ENVIRONMENTAL RADIOACTIVITY MONITORING SYSTEM with data and alarm transmission in real-time

♦ Radioactive Monitoring Networks
♦ Supervision of borders, airports and railway stations
♦ Hospital Surveillance
♦ Nuclear Power Plants
♦ Radioactive Waste Storage
The **GammALERT SYSTEM** has been developed having in mind the importance of counting on a first quality early warning Gamma Ray Environmental Radioactivity Monitoring Solution with an extensive range of applications, such as in monitoring networks for early warning civil protection, with coverage of wide areas; hospital surveillance at radiation therapy wards; supervision at borders, airports, railway stations; accidental radiation generated by Nuclear Power Plants, storage and truck/train transportation of fusionable materials, etc.

The **GammALERT SYSTEM** can be made up of one or more **Remote Measuring Stations** that would store and transmit air levels of gamma radiation as well as alarms to a **Central Receiving Station** and/or to the Civil Protection Authorities in case of an event.

The **Remote Measuring Station** consists of two main parts:

1. The first one is a very advanced digital gamma detector Model GammaMETER-RS04 or gamma spectrum probe Model Gamma METER-GSP02.
2. The second element is the Data Acquisition and Transmission Unit Model GammaDATA-3000C. It receives the digital signal generated by the gamma detector RS04 or spectral GSP02 and stores all the measurements and calculations on its internal memory. Data and alarms, are also transmitted by the GammaData-3000C Unit to a Central Receiving Station and to the Civil Protection Authorities.

Both the GammaMETER and the GammaDATA-3000C unit that configure the Remote Radioactive Monitoring Station, are described below.

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The Gamma detector, type RS04, has been designed to measure radioactivity of gamma radiation. It is calibrated in the quantity of “ambient dose equivalent rate” \(H^\prime(10)\), its measuring range comprises 9 decades (from 10 nSv/h up to 10 Sv/h). This wide measuring range allows to detect minor changes in the ambient natural radioactivity as well as to measure high dosage rates. The detector is available in two versions: type RS04/H for wide energy range and type RS04/L for low energy range.

The **GammaMETER RS04** consists on a proportional counter tube (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 one 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 of 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 performs the following tasks: processes the signals of the detector tube, converts them into the quantity of ambient dose equivalent rate \(H^\prime(10)\), controls continuously the operation of the detector, stores the measured data and ensures the communication between the detector and Gamma Data-3000C 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 (NEMP\(^1\)) 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 as well.

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\(^1\) **Nuclear Electromagnetic Pulse**
<table>
<thead>
<tr>
<th></th>
<th><strong>RS04H/232, RS04H/485</strong></th>
<th><strong>RS04L/232, RS04L/485</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Detector</strong></td>
<td>Proportional counter, Type NPGD 02 with energy compensation</td>
<td></td>
</tr>
<tr>
<td><strong>Microprocessor</strong></td>
<td>Type C8051F022 Silicon Labs, compatible with Intel 8051</td>
<td></td>
</tr>
<tr>
<td><strong>Measuring range</strong></td>
<td>10 nSv/h ÷ 10 Sv/h</td>
<td>10 nSv/h ÷ 15 mSv/h</td>
</tr>
<tr>
<td><strong>Energy Range</strong></td>
<td>H*(10) ≤ 30 mSv/h: 40 keV ÷ 3 MeV</td>
<td>H*(10) &gt; 30 mSv/h: 100 keV ÷ 3 MeV</td>
</tr>
<tr>
<td><strong>Temperature Range</strong></td>
<td>-30°C ÷ +70°C</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature Dependence</strong></td>
<td>H*(10) ≤ 1 mSv/h: ±3%</td>
<td>H*(10) &gt; 1 mSv/h: -20%, +50%</td>
</tr>
<tr>
<td><strong>Measuring uncertainty</strong></td>
<td>H*(10) ≤ 1 Sv/h: ±10%</td>
<td>H*(10) &gt; 1 Sv/h: ±15%</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td>RS-232 or RS-485</td>
<td></td>
</tr>
<tr>
<td><strong>Real time clock</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Data Storage memory</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Real time data</strong></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Power Consumption</strong></td>
<td>max. 50 mA (10,5 VDC ÷ 13,8 VDC)</td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>Ø76 mm x 500 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>ca. 2,5 kg</td>
<td></td>
</tr>
</tbody>
</table>

**Energy dependence (relative)**

**Direction dependence (relative at 1 mSv/h)**
Adjustable parameters in type RS04/232 and RS04/485:
- Date, time
- Data storage period
- History limit
- 8 alarm level with hysteresis
- Accumulated dose values reset
- Reports generation able/disable (in type RS485 disable is default)

Available 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

THE DETECTOR

The counter tube is a proportional tube, type NPDG-02. The counter tube is filled with a special gas mixture; a thin anode wire is fixed in the tube's axle. An energy compensation filter equipped with appropriate insulation is mounted on to the tube. In the RS04 detectors the counter tubes are applied to the 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.

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.

MICROPROCESSOR UNIT

This unit is based on the Silicon Labs type C8051F022 microcontroller circuit. This chip is completed with the following circuits:
- 32 kbyte additional RAM FM25L256
- Real time clock DS3231

COVER TUBE

All the parts are placed in a 2mm thick aluminium tube. The connector and the cover itself are dust protected and waterproof.
The Gamma Spectrum Probe, model GammaMETER-GSP02 has the following main features:

▪ All in one: NaI(Ti) or LaBr3(Ce) scintillator with digitally regulated HV, amplifier, 1k MCA, continuously automatic energy calibration in full temperature range, communication by RS232/485/422, USB
▪ Measuring radioactivity of the gamma radiation in the quantity of “ambient dose equivalent rate” [H * (10)].
▪ Spectroscopic detection of gamma radiation with NaI or LaBr3
▪ In-situ isotope identification

This wide measuring range permits detecting minor changes in the ambient natural radioactivity as well as autonomous spectroscopic monitoring.

**DATA ANALYSIS**

▪ Continuous evaluation of the gamma spectra
▪ Isotope identification from an isotope library
▪ Isotope-based alarm management

### MAIN APPLICATIONS

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

▪ sensor in monitoring network for early warning system covering a wide area;
▪ hospital surveillance at radiation therapy wards;
▪ measuring unit in scientific institutions and development centres;
▪ supervision unit at borders, airports, railway stations and in aircrafts,
▪ control unit in municipal sector mainly for the instant check of accidental radiation, generated by nuclear

### Technical Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>GSP02 N-55/232, 485</th>
<th>GSP02 L-38/232, 485</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector Scintillator</td>
<td>NaI(Ti)</td>
<td>LaBr3(Ce) SGC</td>
</tr>
<tr>
<td>Detector size</td>
<td>55x55mm</td>
<td>1.5” x 1.5”</td>
</tr>
<tr>
<td>Measuring range</td>
<td>10 nSv/h ÷ 50 μSv/h</td>
<td>10 nSv/h ÷ 100 μSv/h</td>
</tr>
<tr>
<td>Energy range</td>
<td>33 keV ÷ 2 MeV</td>
<td></td>
</tr>
<tr>
<td>Dose-rate energy dependence</td>
<td>±30%, ref. Cs-137</td>
<td></td>
</tr>
<tr>
<td>Energy resolution FWHM at Cs137</td>
<td>&lt; 8%</td>
<td>&lt; 3%</td>
</tr>
<tr>
<td>Multichannel analyser</td>
<td>1024 channel</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>-30°C ÷ +60°C</td>
<td></td>
</tr>
<tr>
<td>Temperature dependence</td>
<td>less than ±3keV</td>
<td></td>
</tr>
<tr>
<td>Measuring uncertainty</td>
<td>H’10 ≤ 50 μSv/h: ±15%</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>RS-232, RS-485, RS-422, USB</td>
<td></td>
</tr>
<tr>
<td>Real time clock</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Data storage memory</td>
<td>2Gbyte µSD card</td>
<td></td>
</tr>
<tr>
<td>Real time data</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>approx. 1W</td>
<td>approx. 2W</td>
</tr>
<tr>
<td>Max. cable length between detector and evaluating unit</td>
<td>RS232 - 500m / RS485,422 - 1200m (with ext. power supply1)</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 2.5 kg</td>
<td></td>
</tr>
</tbody>
</table>

Specifications are in accordance with IEC 62327 (Radiation protection instrumentation)
Model **GammaDATA-3000C** is an automatic Data Acquisition and Transmission Unit, specially designed for outdoors installation in remote unattended areas, with the possibility of building gamma alert monitoring networks, comprising an undetermined number of field stations, and one or more Central Stations for receiving, storing, presenting and processing environmental gamma ray data and alarms generated by the Gamma Meter detector connected to this unit.

Gamma ray data and alarms can be transmitted from the Remote Measuring Station to Central Station using any of the communication options and alternative available such as:

- cellular networks GSM/GPRS/CDMA,
- point-to-point radio link,
- Ethernet connection
- via satellite (INMARSAT, GOES, IRIUM, ARGOS, etc.).

From the Central Receiving Station it is possible to manually or automatically get data and alarms in real-time from each and every one of the remote measuring stations, as well as remotely program all their functionalities.

Data transmission using TCP/IP and FTP protocols is also possible as shown in the following communication diagram:
**Inputs/Outputs (total 16, plus 4/6 serial ports):**
- 8 or 16 Analog Input channels (differential)
- 2 Digital Inputs; 4000 V galvanic insulation
- 2 Digital Outputs; 4000 V galvanic insulation
- 4 Pulse channels (16 bits) for pluviometers, anemometers and other similar sensors with impulse output.

**Communication Ports (4 standard; 6 optional):**
- Com 1: General purpose RS232 serial port
- Com 2: development (Dedicated)
- Com 3: General purpose, programmable RS232/422/485 serial port
- Com 4: Serial port for connection to modems GSM, GPRS, PTSN, etc.
- Com 5/6: Two additional optional ports

**Storage memory:**
- 64 MB internal memory.
- Optional 2GB removable SD memory card.

**Data Transmission**
Depending on the user requirements, Unit 3000CP is capable of transmitting the data to the central facility in several ways:
- Serial port RS232/422/485
- Cellular Modem GSM/GPRS/3G
- Ethernet connection - Radio link
- Fiber optic
- Wi-Fi/Bluetooth
- Satellite (INMARSAT, VSAT, etc)
- Internet

Such flexibility of the communication ports, inputs and outputs and memory capacity, allows the system to be connected to a large number of different sensors like anemometers, visibilimeters, rain gauges, etc., and also noise processors or digital cameras for image acquisition and transmission.

The Data Recording and Transmission Unit is mounted either on a IP-67 Polypropylene housing (dimensions 41x33x18cm) or on an IP-66 Metallic housing (dimensions 43x33x20cm). Batteries, charge regulator, communications modem, keyboard and visual display (optional) are also enclosed into the same cabinet.
HARDWARE
In the Central Station a typical configuration includes the following elements:
• Communications Hardware for the reception of the data transmitted by the Remote Stations (i.e. GSM modems, switching devices, Satellite Receivers)
• Communications (TELETRANS) Server: For querying data from the Remote Stations
• Database Server, that includes: Processor Power EdgeT100 or similar, including:
  - SQL Database
  - SQL License

MANAGEMENT SOFTWARE
Geonica Suite 4K is the last generation of a software package developed by GEONICA for the interaction, configuration, data presentation, data analysis and real-time data monitoring of Geonica’s data acquisition stations (METEODATA/HYDRODATA 2000/3000/4000 series).
The package, which runs under Windows (XP SP3, Windows 7 Professional, Server 2003 SP2 and Server 2008 R2, 32 and 64 bits), consists of four main applications:
• TELETRANS-W4K This application is designed for the communication between PC and stations, which allows the data recovery and other configuration commands as: date and time synchronization, station parameter setup, tests, firmware update, calibration, image requests, etc.
• DATAGRAPH-W4K This application is designed for data query, data management and real-time data monitoring. This data captured by the station is stored in the database by TELETRANS-W4K application or accessible by means of a web service.
• FLASH READER This application can convert raw data (stored by METEODATA/HYDRODATA stations in a SD card or captured through satellite systems) into a binary format that can be used by the final user (CSV or Access).
• METAR/SYNOP/BUFR Reporter. This application accesses the station database and generates encoded meteorological reports according to METAR standard (frequently used in aerodromes), SYNOP standard (widely extended in meteorology) and BUFR standard (defined by the WMO-World Meteorological Organization).

WEBPOSTING SOFTWARE
A very valuable option offered by GEONICA with the GammaALERT SYSTEM, is the possibility of WEB Posting, in such a way to provide worldwide access via INTERNET to the historical and instant values of all the parameters measured at the remote station.

Data visualization in Internet is possible thanks to WEBTRANS Ubiquitics Application. Access is granted for every user in order to remotely check any station parameter.

For a small size layout Communications SW and Database may be settled in the same Server. The Central station admits fully redundancy for both Communication Hardware and servers that gives the System maximum robustness.

WEB POSTING SOFTWARE

Battery Level (V)