

MANUAL
GAMMA DETECTOR
Type: RS04



BITT Technology
Wienerstraße 70
A-2104 Spillern
Tel.: 0043/ 2266/ 80216
Fax.: 0043/ 2266/ 80216 12
office@bitt.at
www.bitt.at

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GAMMA DETECTOR
Type: RS04
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Contents

| | | |
|----------|---|-----------|
| 1 | IMPORTANT BASIC INFORMATION | 5 |
| 1.1 | ITEMS SUPPLIED | 5 |
| 1.2 | ORDERING INFORMATION | 5 |
| 1.3 | QUOTE REQUEST FORM | 6 |
| 1.4 | AVAILABLE ACCESSORIES (IN EXTRACTS) | 7 |
| 1.5 | RESPONSIBILITIES | 8 |
| 1.5.1 | The manufacturer's responsibilities | 8 |
| 1.5.2 | The operating organization's responsibilities | 8 |
| 1.6 | LEGAL NOTES | 9 |
| 1.7 | SIGNIFICANCE OF THE OPERATING INSTRUCTIONS | 9 |
| 2 | SAFETY | 10 |
| 2.1 | BASIC SAFETY INSTRUCTIONS | 10 |
| 2.1.1 | Requirements on the personnel, duty to take due care | 10 |
| 2.1.2 | Electrical danger | 10 |
| 2.1.3 | Disposal | 10 |
| 2.2 | CORRECT USAGE | 11 |
| 2.2.1 | Application | 11 |
| 2.2.2 | Operating conditions | 11 |
| 2.2.3 | Connection conditions | 11 |
| 2.3 | INCORRECT USAGE | 12 |
| 2.4 | RESIDUAL HAZARDS AND PROTECTIVE MEASURES | 12 |
| 3 | TECHNICAL DATA | 13 |
| 3.1 | TECHNICAL SPECIFICATION | 13 |
| 3.1.1 | Energy dependence | 14 |
| 3.1.2 | Direction dependence | 14 |
| 3.2 | DIMENSIONS AND POSITIONS OF THE MAIN PARTS | 15 |
| 3.2.1 | RS04_/232(422; 485) | 15 |
| 3.2.2 | RS04_/232(422; 485)-R (with rain sensor) | 16 |
| 3.2.3 | RS04_/WEB | 17 |
| 3.2.4 | RS04_/WEB-R (with rain sensor) | 18 |
| 4 | LAYOUT AND FUNCTION | 19 |
| 4.1 | GENERAL DESCRIPTION OF THE GAMMA DETECTOR, TYPE RS04 | 19 |
| 4.2 | STRUCTURE OF THE DETECTOR | 19 |
| 5 | INSTALLATION CONDITIONS | 21 |
| 5.1 | AMBIENT CONDITIONS | 21 |
| 5.2 | SPACE REQUIRED | 21 |
| 5.3 | CONNECTION CONDITION | 21 |
| 5.4 | CONNECTIONS | 21 |
| 5.4.1 | Connector RS04_/232(422; 485)(-R) | 21 |
| 5.4.2 | Connector RS04_/WEB(-R) | 22 |
| 5.5 | CUSTOMER SAFETY PRECAUTIONS | 22 |
| 6 | OPERATION | 23 |
| 6.1 | MAIN PARTS | 23 |
| 6.1.1 | Detector | 24 |
| 6.1.2 | Pulse- and current amplifier | 24 |
| 6.1.3 | Microprocessor unit | 24 |
| 6.1.4 | Cover tube | 24 |
| 6.2 | SPECIAL TOOLS, EQUIPMENT, MATERIAL | 24 |
| 6.3 | PLACING IN SERVICE | 25 |
| 6.4 | ALIGNING, SETTING UP | 25 |
| 6.5 | ADJUSTABLE PARAMETERS RS04_/232(485; 422) AND RS04_/WEB | 25 |
| 6.5.1 | Query able data and parameters | 25 |
| 6.5.2 | Measured values | 26 |

| | | |
|----------|--|-----------|
| 6.6 | OPERATING..... | 26 |
| 7 | RS04_/232(485; 422) DESCRIPTION OF THE OPERATING FIRMWARE | 27 |
| 7.1 | SAVING AND EVALUATION..... | 27 |
| 7.2 | EVALUATION OF THE WARNING LEVELS | 27 |
| 7.3 | COLLECTION OF ONE-MINUTE DATA | 27 |
| 7.4 | DATA STORAGE AT FIXED INTERVALS | 28 |
| 7.5 | STORAGE OF THE AMBIENT DOSE EQUIVALENT VALUES | 28 |
| 7.6 | MISCELLANEOUS EVALUATIONS | 28 |
| 7.7 | PROCESSING OF THE MEASURED DATA | 28 |
| 7.8 | COMMUNICATION..... | 28 |
| 7.8.1 | Communication by the BSN and BSS protocols..... | 28 |
| 7.8.2 | Communication by the OS€ and OS@ protocols | 28 |
| 8 | RS04_/WEB | 28 |
| 9 | MAINTENANCE..... | 29 |
| 9.1 | SERVICE ADDRESS | 29 |
| 9.2 | DEFINITION OF MAINTENANCE INTERVALS..... | 29 |
| 9.3 | REPAIR WORK | 29 |
| 9.4 | SPARE PARTS AND CONSUMABLES..... | 29 |
| | DOCUMENT RELEASE..... | 30 |

1 Important basic information

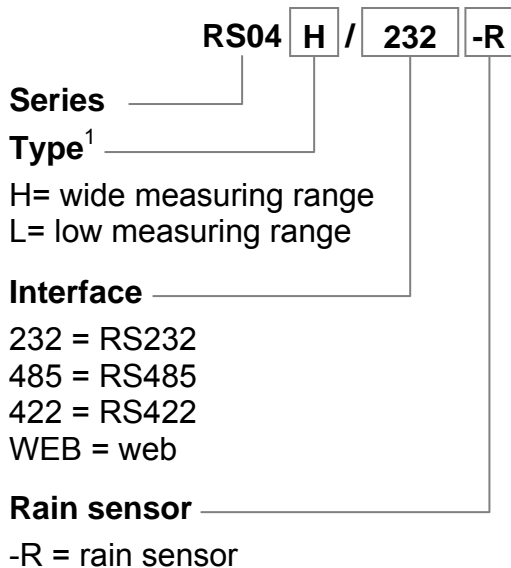
1.1 Items supplied

| Gamma Detector | RS04_/232 | RS04_/485 | RS04_/422 | RS04_/WEB |
|--------------------------|-----------|-----------|-----------|-----------|
| Internal RS232 interface | ● | -- | -- | -- |
| Internal RS485 interface | -- | ● | -- | -- |
| Internal RS422 interface | -- | -- | ● | -- |
| Internal web interface | -- | -- | -- | ● |
| Rain sensor | ○ | ○ | ○ | ○ |
| Plug male | ● | ● | ● | ● |
| Cable | ○ | ○ | ○ | ○ |
| Mounting kits | ○ | ○ | ○ | ○ |
| PoE adapter | -- | -- | -- | ○ |
| Manual RS04 | ● | ● | ● | ● |

● supplied ○ optional -- not supplied

1.2 Ordering information

Example: RS04 for wide measuring range, with RS232 interface and rain sensor



| ¹ Type | RS04H/____ | RS04L/____ |
|-------------------------------------|---|---------------------|
| 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 |

1.3 Quote request form

Base type: RS04

Measuring range: 10nSv/h -15mSv/h 10nSv/h - 10Sv/h

Adjustment: ¹³⁷Cs ⁶⁰Co ¹

Calibration: Yes No

Interface (Hardware): RS232 RS485 RS422 WEB (Ethernet/PoE)

Rain sensor: Yes No

Software factory setup² for RS232, RS485, RS422:

OS. (send a String, without ask in every 10sec)³

Record mark (first char. in String): @ [0x40] € [0x80]

or

Bittsens (handshake, send only for asking)⁴

Answers for all asking

Answers only for own address

(RS232 default)

(RS485, RS422 default)

Baud rate:

Default Baud rate for RS232 is 2400 baud; for RS485 is 9600 baud

Default or individual: _____

Software factory setup for WEB (Ethernet/PoE):

Web visualization: default adapted to customer requirements ⁵

Operating mode: data logger mode (default) direct data mode

Note:

Pieces: _____
.....

¹ Only for extra charge.

² The setup is changeable later with a special software.

³ See chapter 7.8.2 "Communication by the OS€ and OS@ protocols".

⁴ See chapter 7.8.1 "Communication by the BSN and BSS protocols".

⁵ Only for extra charge.

1.4 Available accessories (in extracts)

USB converter:



Mounting kits
(pole-, tripod-, wall mounting):



Data logger (WebDL-L, -M, -S):



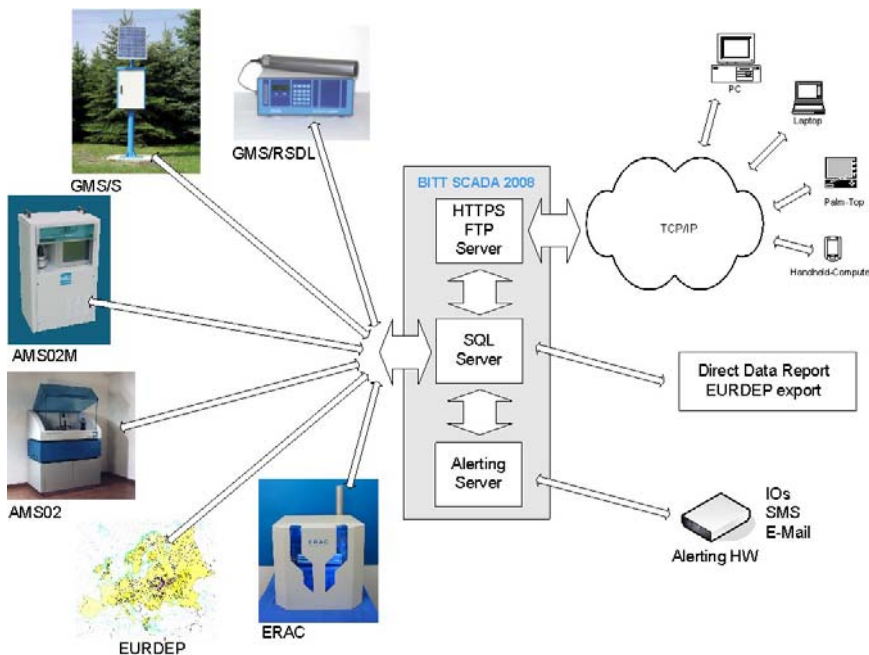
Gamma monitoring stations
(GMS, GMS Light):



External Displays:



Bitt SCADA:



For further information read respective associated manuals!

1.5 Responsibilities

1.5.1 The manufacturer's responsibilities

The RS04 and the optional equipment was designed and built on the basis of a risk analysis and is under consideration of all relevant harmonized standards as well as further national standards and technical specifications. The system thus conforms to the current level of technology and guarantees the highest possible degree of safety.

1.5.2 The operating organization's responsibilities

The highest possible degree of safety can only be achieved in practice if all necessary measures are observed in dealing with the equipment. It is therefore part of the duty of care of the operator to plan these measures and check that they are executed correctly.

In particular the operator must ensure that

- the RS04 only is used as prescribed (cf. chapter 2.2 "Correct usage"),
- the RS04 is operated only in a fault-free, operational condition and in particular the safety devices are regularly checked to ensure that those function as stipulated,
- any necessary protective equipment or apparel for the operating, maintenance and repair personnel is available and is used,
- the operating manual is always legible and is available in full at the product's location,
- the product is operated, maintained and repaired only by sufficiently qualified and authorized personnel,
- the personnel is regularly instructed in all matters relating to occupational safety and environmental protection and is familiar with the operating manual and in particular the safety instructions that it contains.

1.6 Legal notes

The operating instructions must not be electronically or mechanically reproduced, distributed, amended, transmitted, translated into other languages or used in any other way – either in full or in part – without the express written approval of Bitt Technology-A Ges.m.b.H.

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1.7 Significance of the operating instructions

The operating instructions

- are part of the product,
- must be retained and maintained for the entire service life of the product (i.e. updated as necessary),
- must be passed to any subsequent owner or user of the product.

This document shall allow the customer to put a RS04 device into operation.

Some chapters are not included in the short version of the manual. For further information see main- manual.

2 Safety

2.1 Basic safety instructions

2.1.1 Requirements on the personnel, duty to take due care

- Electrical equipment must be checked regularly: Loose connections must be made secure, damaged wires or cables must be replaced immediately.
- Never clean open electrical apparatus with water or other liquids.

The RS04 is only permitted to be operated and maintained by personnel who has reached the minimum age stipulated by law.

A suitable qualified person is everyone who is due to his/her specialist training, knowledge, and experience; as well as knowledge of the applicable stipulations, is able to assess the work assigned to him/her and can recognize possible hazards.

2.1.2 Electrical danger

When working on the equipment there is a risk of electrical danger from

- direct contact with live parts or parts which have become live due to faults,
- electrostatic processes,
- short circuits / overloading.

2.1.3 Disposal

Dispose of all components in accordance with locally applicable national regulations.

2.2 Correct usage

2.2.1 Application

The RS04 is intended exclusively for:

- Measuring radioactivity of gamma radiation in the quantity of "ambient dose equivalent rate" [$\dot{H}^*(10)$],
- data storage,
- data communication.

Correct usage also includes reading this operating manual and complying with all the instructions it contains – in particular the safety instructions. Furthermore, all inspection and maintenance work must be carried out at the stipulated intervals.

The RS04 is not designed for applications other than those listed here - this is considered as improper use!

If the RS04 is not used in accordance with these conditions, safe operation of the equipment cannot be guaranteed.

For any injury or damage to persons or property resulting from improper use, the operator, but not the manufacturer of the system will be responsible!

2.2.2 Operating conditions

For consistent quality, it is imperative that the following ambient conditions are met.

Permissible room temperature: -30 °C to 70 °C

Permissible relative atmospheric humidity: up to 95 % (IP67)

2.2.3 Connection conditions

RS04_/232(485; 422): V_{IN} max. 15V_{DC}

RS04_/WEB: V_{IN} max. 72V_{DC}

2.3 Incorrect usage

The RS04 and the peripherals are not allowed to be modified or changed without approval.

The components of the RS04 are not permitted to be integrated in other systems.

Maintenance work other than described in this manual only is permitted to be performed by Bitt technology personnel.

None of the operating conditions defined in correct usage are permitted to be changed.

2.4 Residual hazards and protective measures

- Electronic components can be damaged by electrostatic processes.
- Appropriate safety precautions must be taken by the customer.
- Prior to working on the electrical system unplug from the main or isolate the mains connection.

3 Technical data

3.1 Technical specification

| Type | RS04H/___ | RS04L/___ |
|-------------------------------------|--|---------------------|
| 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 |
| Detector | Proportional counter, Type NPGD 02 with energy compensation (produced by BITT Technology) | |
| Microprocessor | Type C8051F022 Silicon Labs, compatible with Intel 8051 | |
| 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 or RS-422 or WEB | |

| Type | RS04_/232(485; 422) | RS04_/WEB |
|--|---|---|
| Protokoll version ⁶ | BSN, BSS, OS€, OS@ | http, ftp, ssh, telnet |
| 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 | Bitt Scada, IP to COM port redirector, Bittsens SL (when using in direct dada mode), web browsers (IE, Firefox, Safari, etc.), FTP clients, SSH clients, TELNET clients |
| Power consumption ⁷ | 0,7 - 1W | 1,6 - 1,8W |
| Dimensions | Ø76 mm x 500 mm (534 mm with rain sensor) | |
| Mass | ca. 2,5 kg | |
| Max. cable length between detector and evaluating unit | RS232...500m RS485,422...1200m (with ext. power supply ⁸) | 20m |

_____ See product code in chapter 1.2 "UOrdering information"

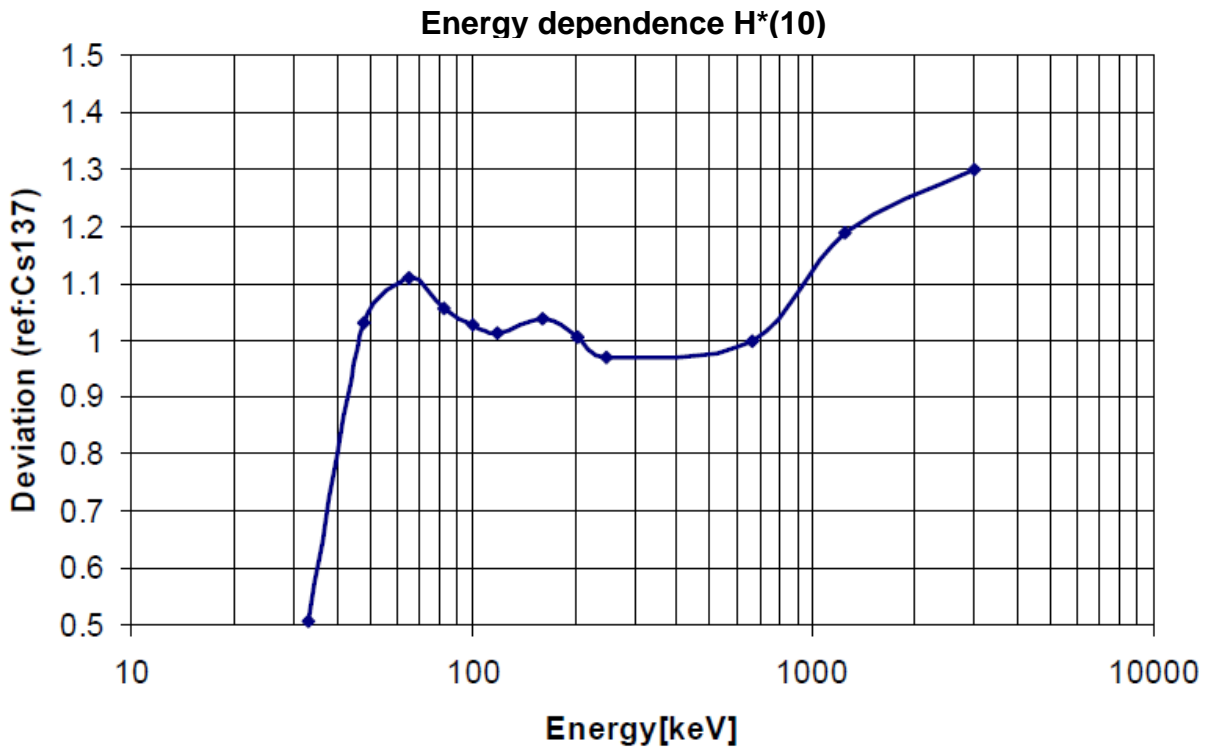
⁶ BSN Bittsens protocol, it answers on all request, report is generated automatically

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

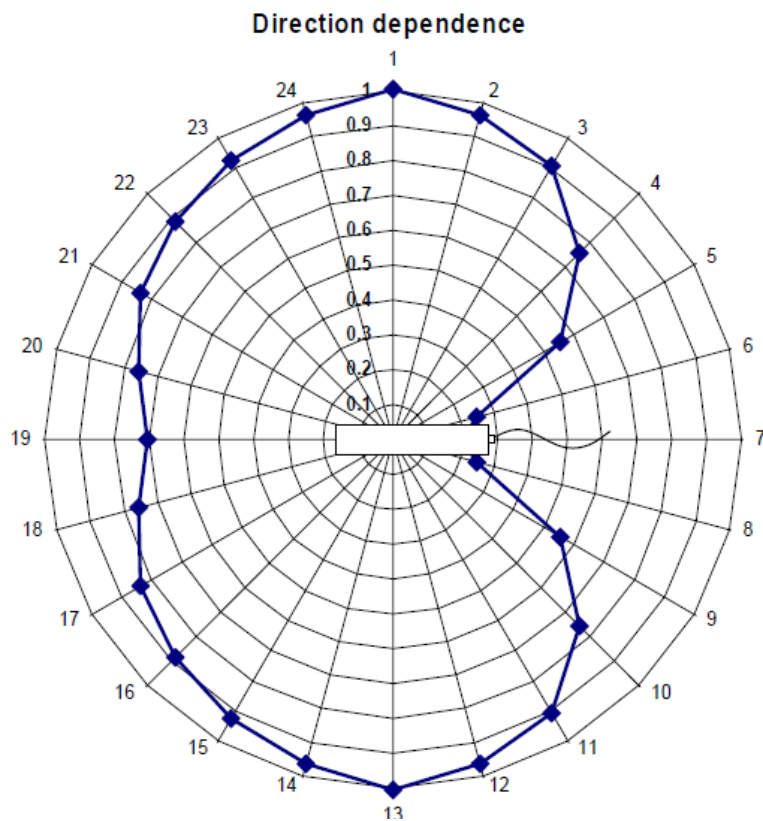
⁷ Power consumption on working point (higher on startup).

⁸ Max. 100m when using the same cable also for power supply.

3.1.1 Energy dependence

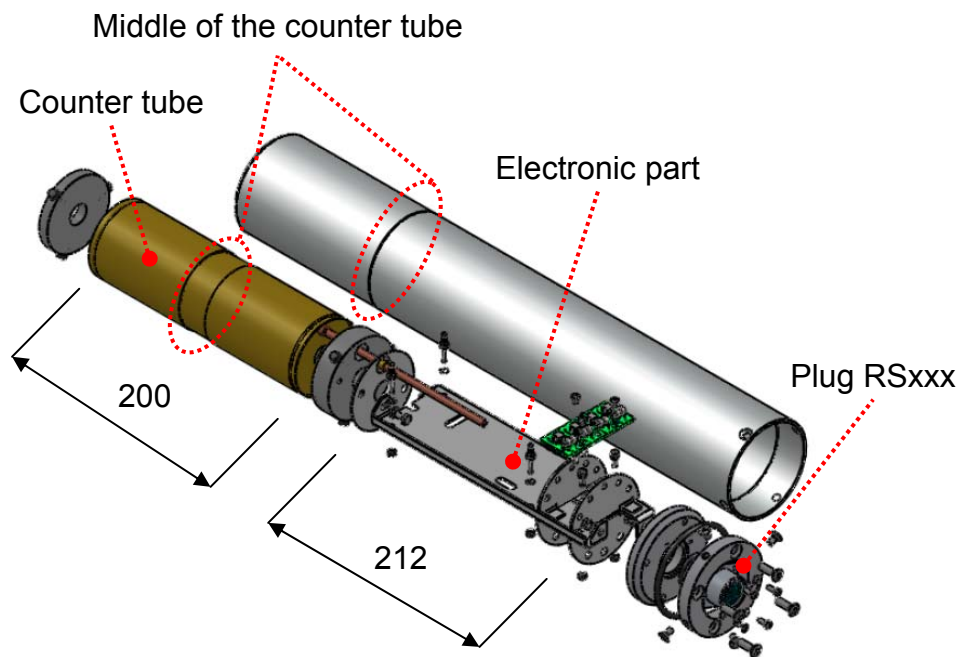
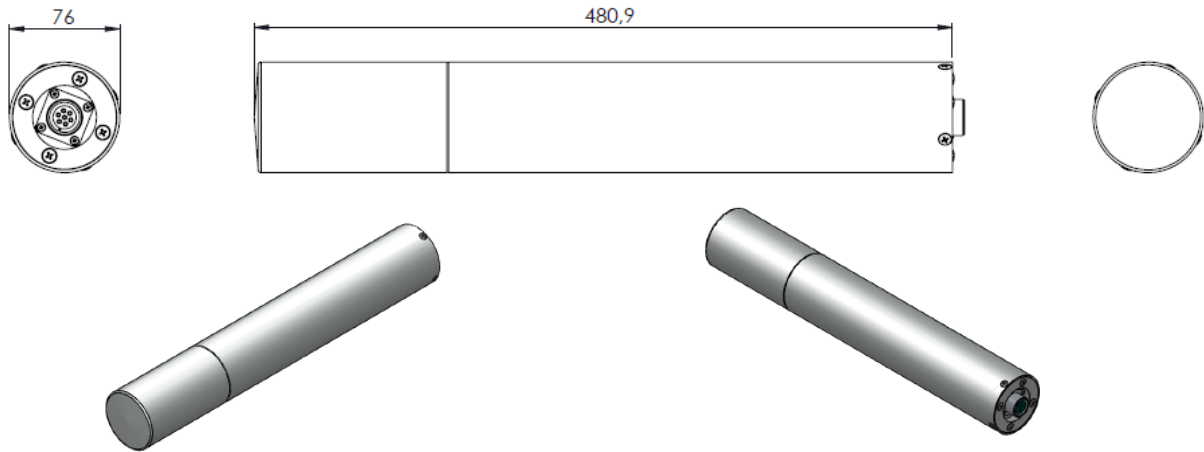


3.1.2 Direction dependence

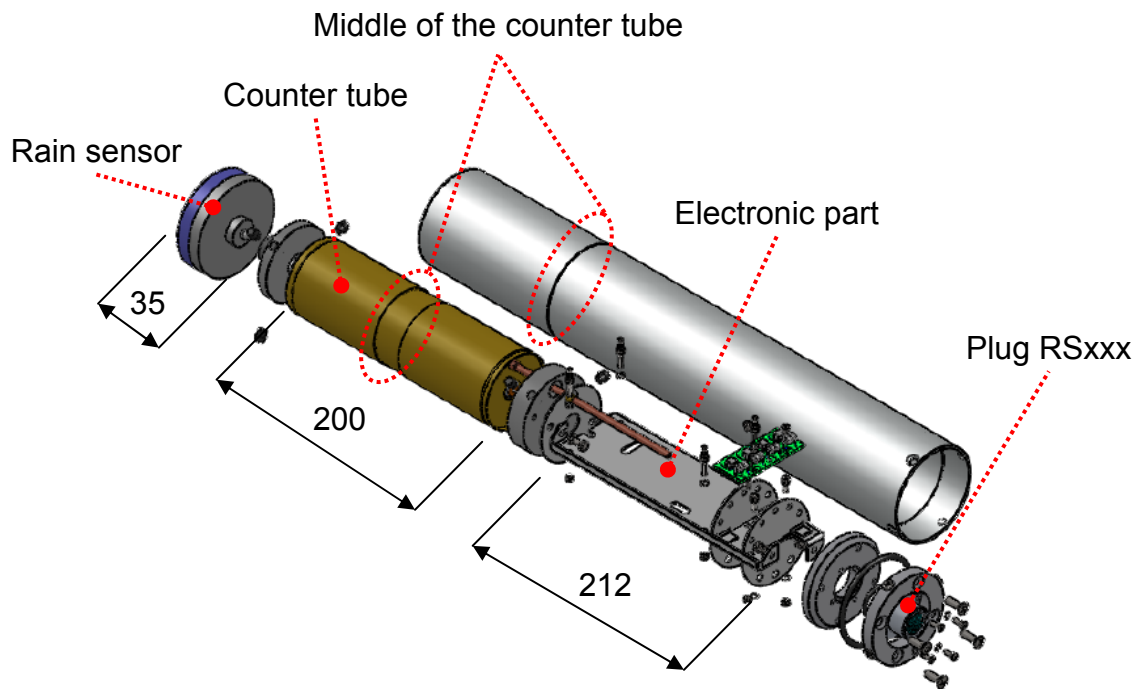
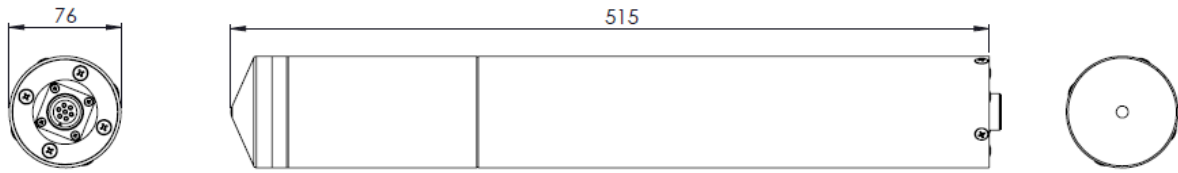


3.2 Dimensions and positions of the main parts

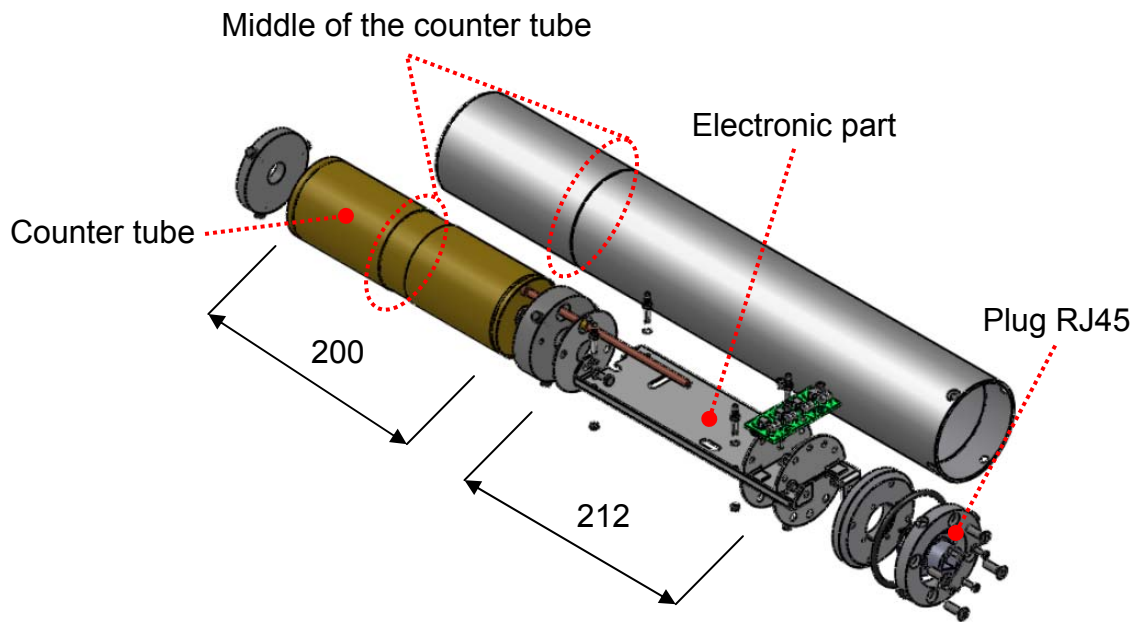
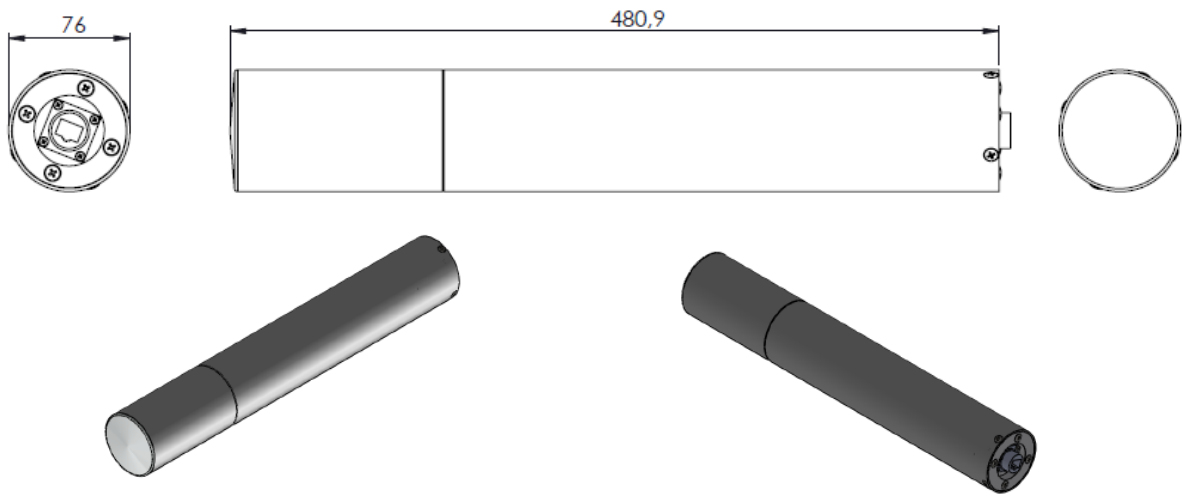
3.2.1 RS04_/232(422; 485)



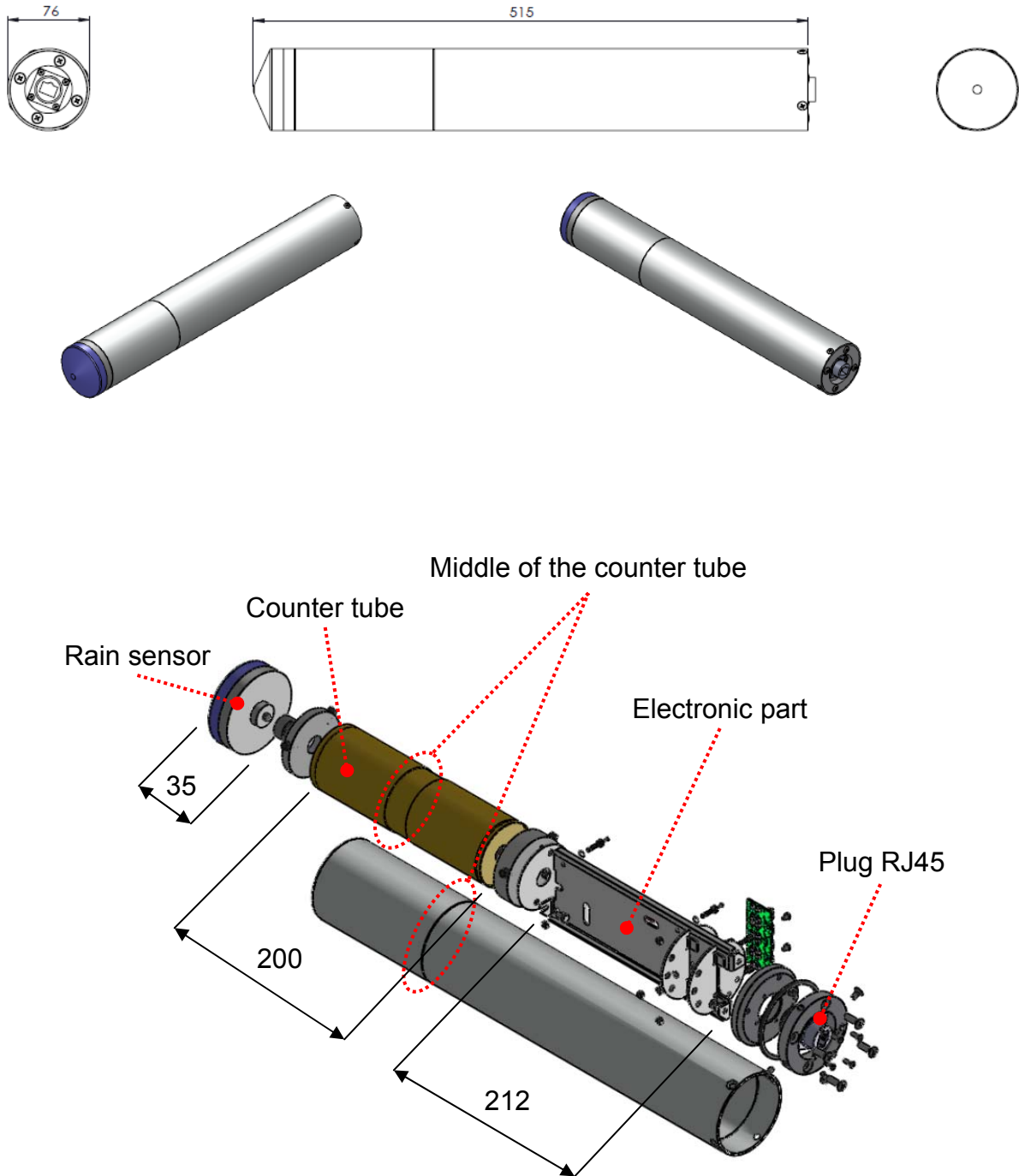
3.2.2 RS04_ /232(422; 485)-R (with rain sensor)



3.2.3 RS04_/WEB



3.2.4 RS04_/WEB-R (with rain sensor)



4 Layout and function

4.1 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

4.2 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 (nuclear electromagnetic pulse “NEMP”) providing excellent lightning protection.
- The complete equipment of the detector is housed in a waterproof aluminum tube with a wall thickness of 3 mm. The connector is waterproof (IP67), too.

5 Installation conditions

5.1 Ambient conditions

Read chapter 2.2.2 „Operating conditions“

5.2 Space required

Read chapter 3.2 “Dimensions and positions of the main parts”.

5.3 Connection condition

Read chapter 2.2.3 “Connection conditions”

5.4 Connections

5.4.1 Connector RS04_/232(422; 485)(-R)



RS232(485;422)

RS232:

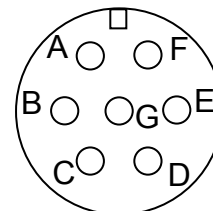
B...2.....TxD
C...3.....RxD
E...9.....VIN
F...5.....GND

RS485:

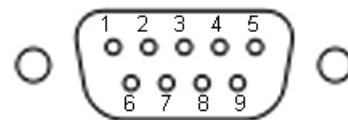
C...1.....Rx+/Tx+
B...2.....Rx-/Tx-
F...5.....GND
E...9.....VIN

RS422:

C...1.....Rx+
B...2.....Rx-
G...3.....Tx+
D...4.....Tx-
F...5.....GND
E...9.....VIN



Female



D-Sub

5.4.2 Connector RS04_/WEB(-R)



WEB (Ethernet RJ45)

IEEE 802.3af

10/100 DC on spares:

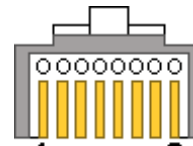
- 1.....Tx+
- 2.....Tx-
- 3.....Rx+
- 6.....Rx-
- 4, 5.....VIN+
- 7, 8.....VIN-

10/100 Mixed DC & data:

- 1.....Rx+ / VIN+
- 2.....Rx- / VIN-
- 3.....Tx+ / VIN-
- 4, 5.....unused
- 6.....Tx- / VIN-
- 7, 8.....unused



RJ45 female



RJ45 male

5.5 Customer safety precautions

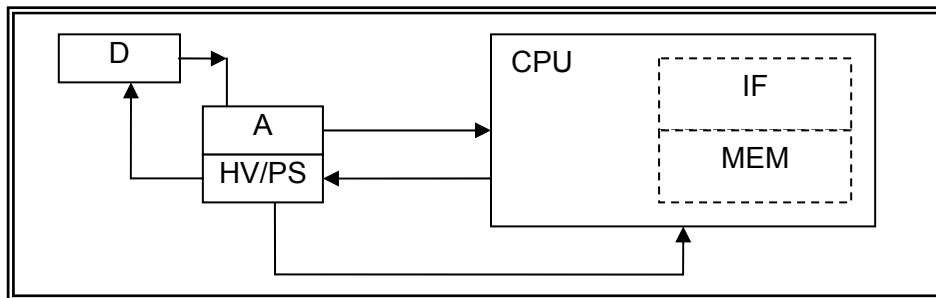
Read chapter 2 “Safety”

6 Operation

6.1 Main parts

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 NPGD02 |
| A | Amplifier |
| HV/PS | High Voltage / Power Supply |
| CPU | Central Processor Unit |
| MEM | Storage memory |
| IF | Interface |

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%.

6.1.1 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.

6.1.2 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.

6.1.3 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)

6.1.4 Cover tube

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

6.2 **Special tools, equipment, material**

Read chapter 1.1 "Items supplied" and chapter 1.4 "Available accessories (in extracts)".

6.3 Placing in service

The device (re)starts automatically after power is (re-) established.

6.4 Aligning, setting up

Read chapter 7 “RS04_/232(485; 422) description of the operating firmware” and chapter 0 “RS04_/WEB”.

6.5 Adjustable parameters RS04_/232(485; 422) and RS04_/WEB

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

6.5.1 Query able 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.)

6.5.2 Measured values

- 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

6.6 Operating

Read chapter 7 “RS04_/232(485; 422) description of the operating firmware” and chapter 8 “RS04_/WEB”

7 RS04_/232(485; 422) description of the operating firmware

The firmware of the microcontroller consists of three main parts:

- Evaluation of the measured data
- Communication
- Tables

These program modules are written in assembler and “C” languages.

7.1 Saving and evaluation

The data calculated by means of the algorithm described in paragraph 7.1 shall be evaluated according to the following criteria:

- evaluation of the warning level
- data collection during one minute
- save by defined saving periods
- ambient dose equivalent calculations
- miscellaneous evaluations

7.2 Evaluation of the warning levels

8 warning levels are defined in the gamma detector type RS04. The default values are specified in the Appendix. In case, the ambient dose equivalent rate is higher than any of the warning levels, the program-module sends a signal to the communication module. If the ambient dose equivalent rate shall have been reverted to a lower level, the module shall give an other signal too. The evaluation is hysteresis-like; the hysteresis is defined as the value of the hysteresis level (LH) in percentage.

7.3 Collection of one-minute data

The one-minute average of the ambient dose equivalent rates are placed in a FIFO-system stock where the last 10 average values are available for communications.

7.4 Data storage at fixed intervals

The average value of the ambient dose equivalent rate shall be saved at intervals fixed in parameter PS. This storage is also FIFO-like. The storage capacity equals to 2016 ambient dose equivalent rate values (i.e. collected in 14 days with 10-minute periods).

Chapters 7.2 – 7.5 only apply for Bittsens protocol!

7.5 Storage of the ambient dose equivalent values

The ambient dose equivalent can be calculated from the values of the ambient dose equivalent rates. The calculated dose is added to the total of doses and to the dose per warning level. These dose memories can be read and/or deleted through the communication lines.

7.6 Miscellaneous evaluations

In order to check the status the following items are controlled:

- supply voltage ($11,5V < U_t < 13,8V$)
- supply current ($40 \text{ mA} < I < 300 \text{ mA}$)
- "no pulse within 10 s"
- H.V. metering

If any value is out of the permitted range, the communication modul gets a warning signal.

7.7 Processing of the measured data

7.8 Communication

7.8.1 Communication by the BSN and BSS protocols

7.8.2 Communication by the OS€ and OS@ protocols

8 RS04_/WEB

These chapters and further are not included in the short version of the manual! For further information see main-manual.

9 Maintenance

9.1 Service address

BITT Technology
Wienerstraße 70
A-2104 Spillern

Tel.: 0043/ 2266/ 80216
Fax.: 0043/ 2266/ 80216 12

office@bitt.at
www.bitt.at

9.2 Definition of maintenance intervals

| description | quarterly (online) | semi-annually (onsite) | annually (onsite) | Every two years(factory) | minute | action |
|---|-----------------------|---------------------------|----------------------|-----------------------------|--------|----------------------------|
| Check of wire between the probe and the data collector unit | | | X | | 10 | If needed change the cable |
| Check of supply voltage and current drain at the probe | X | | X | | 10 | |
| Control of the status messages of the probe | X | | X | | | |
| Recommended adjustment period | | | | X | | |

9.3 Repair work

Factory provided only.

9.4 Spare parts and consumables

Read chapter 1.1 "Items supplied" and chapter 1.4 "Available accessories (in extracts)".

Document release

| | | |
|---------------|--|------------------|
| provided by: | Martin Frühstück | date: 24.02.2011 |
| for contents: | DI Karoly Kautny DI Matthias Rötzer | date: 28.02.2011 |
| Released by: | Ing. Günter Kemminger | date: 29.02.2011 |