# AT1117M Radiation Monitor

***Dosimetry of γ-, x- and n-radiation in wide dose rate and energy range***

***Radiometry of α-, β-, γ- and n-radiation***

## Application

- Radiation protective measures in case of nuclear disasters
- Radiation monitoring during decontamination operations
- Radioecology
- Sanitary and epidemiological inspection
- Nuclear industry
- Emergency rescue service
- Civil protection
- Research activities
- Customs control
- Search X-ray apparatus

## Features

- Multiple functions
- High sensitivity and wide measurement range
- Quick accommodation to changes in radiation level
- Search for X-ray, gamma, alpha, beta and neutron radiation sources
- Search for X-ray, gamma, alpha, beta and neutron radiation sources
- Compensation of intrinsic Geiger-Muller counter tubes background
- Wide choice of accessories: Telescopic bars, tripods, alarm units, sealed containers, etc.

Portable combined multi-purpose instrument, which can be equipped with different external detection units for various applications as applicable.

Depending on available set of detection units the radiation monitor can be used for measurement of:

- Ambient dose equivalent and ambient dose equivalent rate of X-ray, gamma and neutron radiation
- Air kerma and air kerma rate of X-ray and gamma radiation
- Directional dose equivalent and directional dose equivalent rate of X-ray and gamma radiation
- Flux density and fluence of alpha and beta particles from contaminated surfaces
- Flux density and fluence of neutrons with known energy distribution
- Surface activity and disintegrations of $^{239}Pu$ and $^{90}Sr + ^{90}Y$
- On-line search for sources of ionizing radiation and radioactive materials.

Processing unit (PU/PU2/PU4) or desktop computer can be used for operation and indication.

**1) PU / PU2**

Detection unit sends data over dedicated communication cable to processing unit, where the data is displayed on LCD screen.

PU and PU2 has recording and memory option for up to 999 measurement results, which can further be uploaded to a PC via dedicated application software. Sound and visual alarms activate in case user-adjustable threshold levels are exceeded.

Operation algorithm provides measurement continuity and real-time statistical processing of measurement results. PU and PU2 units feature integrated detection modules, allowing in situ dose and dose rate measurement of gamma radiation.


**2) PU4** is a hand-held PC (HPC) with integrated detection module, providing in situ measurement of gamma radiation dose and dose rate. Operation algorithm provides measurement continuity and real time statistical processing of measurement results.

Data from detection unit into PU4 can transferred in two ways:

- Bluetooth interface by BT-DU4 adapter
- Direct cable connection to PU4

PU4 has the following functions:

- Processing and display of measurement data
- GPS referencing of measurement results
- Automatic recording and storing over 10,000 measurements with GPS referencing
- Sound and visual alarm when threshold level are exceeded
- Indication of battery charge level in PU4 and BT-DU4 adapter
- Loading data to PC for further analysis and processing in professional *"GARM"* software (*Option*)
- Automatic data transfer to a remote server by *"ARMS"* software [over FTP server; integrated 3G modem or connection to a Wi-Fi network shall be available] (*Option*).

**3) Personal computer.** "Atexch" software with dedicated kit for connection (*Option*) provides the following:

- Indication of dose and radiation measurement values, as well as writing into file and reading previously stored data
- Response when measured value thresholds are exceeded
- Error indication by instrument, message analysis and display in case of error conditions
- Multiple instances of program can be run in case more than one instrument is connected to different PC ports.

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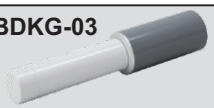
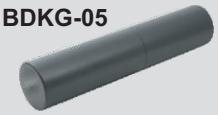
## Processing units

| Illustration | Detector | Ambient radiation dose rate equivalent measurement range | Ambient radiation dose equivalent measurement range | Energy range | Energy dependence relative to 662 keV ($^{137}$Cs) | Typical sensitivity to $^{137}$Cs gamma radiation cps/(μSv·h$^{-1}$) | Response time for dose rate change | Overall dimensions, mm weight, kg |
|---|---|---|---|---|---|---|---|---|
| PU  | Geiger-Mueller counter tube | 1 μSv/h – 100 mSv/h | 1 μSv – 1 Sv | 60 keV – 3 MeV | -25% to +35% | 1 | ≤≤2 s (for dose rate change from 10 to 100 μSv/h) | 177x85x124 1.2 |
|  PU2 PU4 | Geiger-Mueller counter tube | 1 μSv/h – 100 mSv/h | 1 μSv – 1 Sv | 60 keV – 3 MeV | -25% to +35% | 1 | ≤≤2 s (for dose rate change from 10 to 100 μSv/h) | 210x88x36 0.6 |
| | Geiger-Mueller counter tube | 1 μSv/h – 100 mSv/h | 1 μSv – 100 Sv | 60 keV – 3 MeV | -25% to +35% | 0.33 | ≤≤7 s (for dose rate change from 10 to 100 μSv/h) | 265x90x40 0.6 |

## X and gamma radiation detection units

| Illustration | Detector | Ambient radiation dose rate equivalent measurement range | Ambient radiation dose equivalent measurement range | Energy range | Energy dependence relative to 662 keV ($^{137}$Cs) | Typical sensitivity to $^{137}$Cs gamma radiation cps/(μSv·h$^{-1}$) | Response time for dose rate change | Overall dimensions, mm weight, kg |
|---|---|---|---|---|---|---|---|---|
| BDKG-01  | Geiger-Mueller counter tube | 0.1 μSv/h – 10 Sv/h | 0.1 μSv – 10 Sv | 60 keV – 3 MeV | -25% to +35% | 4 | ≤≤3 s (for dose rate change from 1 to 10 μSv/h) | Ø54x256 0.5 |
| BDKG-03  | Scintillation NaI(Tl), Ø25x40 mm | 0.03 – 300 μSv/h | 0.03 μSv – 1 Sv | 50 keV – 3 MeV | ±20% | 350 | ≤≤2 s (for dose rate change from 0.1 to 1 μSv/h) | Ø60x299 0.6 |
| BDKG-04  | Scintillation plastic, Ø30x15 mm | 0.05 μSv/h – 10 Sv/h | 0.7 nSv – 100 Sv | 15 keV – 10 MeV | ±25% (15 keV – 3 MeV) ±40% (3 – 10 MeV) | 70 | ≤≤2 s (for dose rate change from 0.1 to 1 μSv/h) | Ø60x200, 0.46 |
| BDKG-05  | Scintillation NaI(Tl), Ø40x40 mm | 0.03 – 300 μSv/h | 0.03 μSv – 0.3 Sv | 50 keV – 3 MeV | ±20% | 760 | ≤2 s (for dose rate change from 0.1 to 1 μSv/h) | Ø60x290 1.2 |
| BDKG-11  | Scintillation NaI(Tl), Ø63x63 mm | 0.03 – 100 μSv/h | 0.01 μSv – 10 mSv | 50 keV – 3 MeV | ±20% | 2200 | ≤2 s (for dose rate change from 0.1 to 1 μSv/h) | Ø76x320 1.9 |
| BDKG-17  | Geiger-Mueller counter tube | 1 mSv/h – 100 Sv/h | 1 mSv – 100 Sv | 60 keV – 3 MeV | -25% to +35% | 0.005 | | Ø54x167 0.28 |
| BDKG-24  | Scintillation plastic, Ø50x40 mm | 30 nSv/h – 1 Sv/h | 0.1 nSv – 100 Sv | 25 keV – 10 MeV | ±25% (25 keV – 3 MeV) ±40% (3 – 10 MeV) | 530 | ≤≤2 s (for dose rate change from 0.1 to 1 μSv/h) | Ø60x205 0.5 |
| BDKG-30  | Scintillation plastic, Ø50x40 mm | 30 nGy/h – 1 Gy/h (Measurement range of air kerma rate) | 0.1 nGy – 100 Gy (Measurement range of air kerma) | 50 keV – 10 MeV | ±25% (50 keV – 3 MeV) ±40% (3 – 10 MeV) | 600 cps/(μGy·h$^{-1}$) | ≤≤2 s (for dose rate change from 0.1 to 1 μGy/h) | Ø60x207 0.6 |
| BDKG-32  | Scintillation plastic, Ø70x80 mm | 30 nSv/h – 0.5 Sv/h | 0.1 nSv – 100 Sv | 40 keV – 10 MeV | ±25% (40 keV – 3 MeV) ±40% (3 – 10 MeV) | 1660 | ≤≤2 s (for dose rate change from 0.1 to 1 μSv/h) | Ø80x245 0.78 |

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## X and gamma radiation detection units

| Illustration | Detector | Ambient radiation dose rate equivalent measurement range | Ambient radiation dose equivalent measurement range | Energy range | Energy dependence relative to 662 keV ($^{137}$Cs) | Typical sensitivity to $^{137}$Cs gamma radiation cps/(μSv·h$^{-1}$) | Response time for dose rate change | Overall dimensions, mm **weight**, kg |
|---|---|---|---|---|---|---|---|---|
| **BDKR-01**  | Scintillation NaI(Tl), Ø9x2 mm | 0.05 – 100 μSv/h (Measurement range of directional dose equivalent rate) | 0.05 μSv – 5 mSv (Measurement range of directional dose equivalent) | 5 keV – 160 keV | Energy dependence relative to 59.5 keV ±35% (5 - 60 keV) ±30% (60 - 160 keV) | 400 (to $^{241}$Am gamma radiation) | ≤≤2 s (for dose rate change from 1 to 10 μSv/h) | Ø60x261 0.55 |
| **BDPS-02**  | Geiger-Mueller counter tube | 0.1 μSv/h– 30 mSv/h | 0.1 μSv – 1 Sv | 20 keV – 3 MeV | ±30% | 6.6 | ≤≤3 s (for dose rate change from 1 to 10 μSv/h) | 138x86x60 0.33 |

## Alpha radiation detection units

| Illustration | Detector | Alpha particles flux density measurement range | $^{239}$Pu surface activity measurement range | Energy range | Typical sensitivity to $^{239}$Pu source, cps/(particle·min$^{-1}$·cm$^{-2}$) | Overall dimensions, mm **weight**, kg |
|---|---|---|---|---|---|---|
| **BDPA-01**  | Scintillation ZnS(Ag), 30 cm$^2$ | $0.1 – 10^5$ particle·min$^{-1}$·cm$^{-2}$ | $3.4·10^{-3} – 3.4·10^3$ Bq·cm$^{-2}$ | 4 – 7 MeV | 0.15 | Ø85x200 0.5 |
| **BDPA-02**  | Scintillation ZnS(Ag), 100 cm$^2$ | $0.05 – 5·10^4$ particle·min$^{-1}$·cm$^{-2}$ | $1.7·10^{-3} – 1.7·10^3$ Bq·cm$^{-2}$ | 4 – 7 MeV | 0.7 | Ø137x230 0.7 |
| **BDPA-03**  | Scintillation ZnS(Ag), 300 cm$^2$ | $0.05 – 2·10^4$ particle·min$^{-1}$·cm$^{-2}$ | $1.7·10^{-3} – 0.68·10^3$ Bq·cm$^{-2}$ | 4 – 7 MeV | 2.5 | Ø222x277 1.4 |
| **BDPS-02**  | Geiger-Mueller counter tube | 2.4 – 30 particle·min$^{-1}$·cm$^{-2}$ (Limits of intrinsic relative measurement error ±30%) 30 – $10^6$ particle·min$^{-1}$·cm$^{-2}$ (Limits of intrinsic relative measurement error ±20%) | – | 4 – 7 MeV | 0.045 | 138x86x60 0.33 |

## Beta radiation detection units

| Illustration | Detector | Beta particles flux density measurement range | $^{90}$Sr + $^{90}$Y surface activity measurement range | Energy range | Typical sensitivity to $^{90}$Sr + $^{90}$Y source, cps/(particle·min$^{-1}$·cm$^{-2}$) | Overall dimensions,mm **weight**, kg |
|---|---|---|---|---|---|---|
| **BDPB-01**  | Scintillation plastic, 30 cm$^2$ | $1 – 5·10^5$ particle·min$^{-1}$·cm$^{-2}$ | $4.4·10^{-2} – 2.2·10^4$ Bq·cm$^{-2}$ | 155 keV – 3.5 MeV | 0.3 | Ø85x205 0.55 |
| **BDPB-02**  | Scintillation plastic, 100 cm$^2$ | $0.5 – 1.5·10^5$ particle·min$^{-1}$·cm$^{-2}$ | $2.2·10^{-2} – 0.66·10^4$ Bq·cm$^{-2}$ | 155 keV – 3.5 MeV | 0.9 | Ø137x235 0.87 |
| **BDPB-03**  | Scintillation plastic, 300 cm$^2$ | $0.5 – 0.5·10^5$ particle·min$^{-1}$·cm$^{-2}$ | $2.2·10^{-2} – 0.22·10^4$ Bq·cm$^{-2}$ | 155 keV – 3.5 MeV | 2.4 | Ø222x281 1.8 |
| **BDPS-02**  | Geiger-Mueller counter tube | $6 – 10^6$ particle·min$^{-1}$·cm$^{-2}$ | – | 155 keV – 3.5 MeV | 0.12 | 138x86x60 0.33 |

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## Neutron radiation detection units

| Illustration | Detector | Ambient radiation dose rate equivalent measurement range | Ambient radiation dose equivalent measurement range | Neutron flux density measurement range | Energy range | Typical sensitivity to Pu-Be source | | Overall dimensions, mm<br>weight, kg |
|---|---|---|---|---|---|---|---|---|
| | | | | | | In flux density measurement mode | In dose rate measurement mode | |
| **BDKN-01**  | He-3 counter in a polyethylene moderator | 0.1 μSv/h – 10 mSv/h<br>(Limits of intrinsic relative measurement error ±35%)* | 0.1 μSv – 10 Sv<br>(Limits of intrinsic relative measurement error ±35%)* | 0.1 – $10^4$ neutron·$s^{-1}$·$cm^{-2}$ | 0.025 eV – 14 MeV | 0.5 cps/(neutron·$s^{-1}$·$cm^{-2}$) | 0.355 cps/(μSv·$h^{-1}$) | Ø90x260<br>2.0 |
| **BDKN-03**  | He-3 counter in a polyethylene moderator | 0.1 μSv/h – 10 mSv/h | 0.1 μSv – 10 Sv | 0.1 – $10^4$ neutron·$s^{-1}$·$cm^{-2}$<br>(Limits of intrinsic relative measurement error ±30%)* | 0.025 eV – 14 MeV | 0.5 cps/(neutron·$s^{-1}$·$cm^{-2}$) | 0.355 cps/(μSv·$h^{-1}$) | 314x220x264<br>8 |
| **BDKN-05**  | Two He-3 counters in polyethylene moderator | – | – | 0.1 – $2·10^3$ neutron·$s^{-1}$·$cm^{-2}$ | 0.025 eV – 14 MeV | 10 cps/(neutron·$s^{-1}$·$cm^{-2}$) | – | 105x115x380<br>3.5 |
| **BDKN-06**   | He-3 counter in a polyethylene moderator | 0.1 μSv/h – 30 mSv/h | 0.1 μSv – 10 Sv | – | 0.025 eV – 16 MeV | 1 cps/(neutron·$s^{-1}$·$cm^{-2}$) | 0.7 cps/(μSv·$h^{-1}$) | (w/o tripod)<br>550x254x254<br>10 |

* for Pu-Be sources

## AT1117M Radiation monitor: General parameters

| | | |
|---|---|---|
| **Limits of tolerable intrinsic relative error** | | ±20% |
| **Power supply** | - Detection unit (DU) | By PU/PU2/PU4/BT-DU4/PC |
| | - PU/PU2/PU4/BT-DU4 | 1) By integrated rechargeable battery pack<br>2) By external 12 VDC power source<br>3) By external +230 VAC 50 Hz power source<br>4) By external battery |
| **Continuous operation time** | | ≥24 h |
| | | ≥8 h - PU4 power supply |
| **Interface** | - DU to PU/PU2 | RS232 |
| | - DU to PC | USB |
| | - DU to PU4 | RS232, Bluetooth (via adapter BT-DU4) |
| **Protection class** | | IP64 |
| **Operation temperature range** | | -40°C to +50°C |
| | | -30°C to +50°C (PU4) |
| | | -50°C to +50°C (BDKG-04/-24/-30/-32) |
| | | 0 to +40°C (BDKR-01) |
| **Relative air humidity** | | ≤95% (with air temperature ≤35°C without condensation) |

The radiation monitor complies with: GOST 27451-87, Safety requirements of IEC 61010-1:2010, EMC requirements of EN 55011:2009, IEC 61000-4-2:2008, IEC 61000-4-3:2008

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## TYPICAL SOLUTIONS

### Remote measurements

**Components:**

- Detection unit (BDKG-01, BDKG-03, BDKG-04, BDKG-05, BDKG-17, BDKG-24, BDKG-30, BDKG-32, BDKR-01, BDPA-01, BDPA-02, BDPA-03, BDPB-01, BDPB-02, BDPB-03)
- PU / PU2 / PU4
- Telescopic bar (1.7 m/3.2 m)
- Holder (For attaching detection unit to telescopic bar)
- Holder (For attaching PU2/HPC to telescopic bar)
- Cable

### Monitoring of hand and coat contamination by alpha/beta particles

**Components:**

- Detection unit (BDPA-02, BDPA-03, BDPB-02, BDPB-03)
- PU2
- Wall bracket
- Cable

### Handle for ease of measurement

**Components:**

- Detection unit (except BDKN-03, BDKN-05, BDKN-06)
- PU2
- Handle (For attaching PU2 to smart probe)
- Cable

### Transportable dosimetric monitoring stations

**Components:**

- Detection unit (except BDKN-03, BDKN-05)
- PU2 / PU4 with BT-DU4 adapter
- Cable
- Tripod
- Mounting bracket (For mounting detection unit and PU2/PU4 on the bar)

### Measurements with GPS-mapping

**Components:**

- PU4
- Detection unit (any)
- BT-DU4 Adapter
- Handle
- Cable

### Neutron dosimeter

**Components:**

- BDKN-03
- PU2 / PU4 with BT-DU4 adapter
- Cable
- Holder (For attaching PU2 to BDKN-03)

### Alarm units operation

**Components:**

- PU/PU2
- Detection unit (any)
- Alarm unit (With horizontal or vertical mounting bracket)
- Cables

### General control of pollution by radioactive materials in impulse count rate mode

**Components:**

- BDPS-02
- PU
- Cable

### Measurements in water, wells, etc.

**Components:**

- Detection unit (BDKG-01, BDKG-03, BDKG-04, BDKG-05, BDKG-17, BDKG-24, BDKG-30)
- PU/PU2
- Wire cable
- Cable (Up to 30 m)
- Cable spool


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