RADIOLOGICAL MONITOR
MRS 110B-1

AMES d.o.o. Automatic Measuring Systems for the Environment
Jamova 39, Ljubljana, Slovenia
☎: +365 1 365 71 01, Fax: +365 1 365 71 02
info@ames.si
http://www.ames.si

CONTENTS

1. DESCRIPTION OF MRS 110B-1

Radiological monitor MRS 110B-1 is digital pocket instrument, intended to measure the exposed dose rate of roentgen, gamma and beta radiation. Detector of MRS 110B-1 is thin-wall, cylindrical halogen Geiger Mueller tube with the cross section of approximately 600 square millimetres. Since the device measures roentgen, gamma and beta radiation only, the equivalent dose rate is equal to the absorbed dose rate.

MRS 110B-1 measures the exposed dose rate in counts per minute (cpm) or in micro Sieverts per hour (µSv/h). To switch between both units, press SET, than use up or down arrows to select the desired unit and confirm the selection with pressing SET again.

It is to be mentioned that MRS 110B-1 gives the exact values of dose rate, measured in µSv/h, only for the photon energy that was used as the calibration source. For all other photon energies, the measuring error due to the energy nonlinearity of the GM tube should be taken into the consideration.

Results of measurements are, together with the selected measuring unit, shown on the liquid crystal display. Each detected pulse is heard as an audible signal. Different sounding reports, that the dose rate has exceeded the predetermined alarm level. Procedure, how to set the alarm level, is described further in this Manual.

1.1 TYPE OF DETECTED RADIATION

If the side of MRS 110B-1, where the GM tube is mounted (marked with the red dot), is close to the source, instrument detects all three sorts of radiation. Otherwise, due to the poor penetration of beta rays, only roentgen and gamma radiations are detected.

1.2 DESCRIPTION OF THE MEASURING METHOD

Geiger Mueller tube detects photons that hit it and produces an electric pulse for every detected photon. When we are measuring natural background, there are normally 15 to 20 pulses per minute, which means in average one pulse every 3 seconds. Time distribution of pulses is random. To achieve low statistical uncertainty of the measured results, one should count pulses over the longer time interval, since the relative statistical uncertainty is given with the expression $1/\sqrt{N}$ (or, in percents, with $100/\sqrt{N}$).

MRS 110B-1 uses the following measuring algorithm:

Instrument counts pulses in 2-second time intervals, storing data to the internal memory. Each 2 seconds it computes the new sum of pulses by adding the 2-seconds data from the memory, from the latest sample back (running average), until one of the two conditions is fulfilled:

- To sum 150 or more pulses
- To sum the contents of 30 intervals, this means pulses for 1 minute back.

When first or second condition is true, MRS 110B calculates new cpm value.

With the described algorithm, we achieve the following:

Under conditions, where there are only few cpm from the GM tube (background measurements), summing time is limited to 1 minute. This also defines the time response of the instrument. At 20 cpm, statistical uncertainty is equal to $1/\sqrt{20}$= 22.4%, with the response time of maximum 1 minute. When we approach the radiation source, response time is, depending on the source activity, significantly shorter (down to 2 seconds). In this case, count is limited by minimum count of N=150 pulses, that gives the statistical uncertainty $1/\sqrt{150}$= 8.2% or better. Since MRS 110B-1 works with the running average that is updated every 2 seconds, measuring is smooth and without jumps in results, caused by the random distribution of impulses.

2. USE OF MRS 110B-1

2.1 TURNING THE INSTRUMENT ON

MRS 110B-1 is switched on by pressing the "**ON"** key**.** Immediately after this, self-test is done: all segments of LCD are turned on and content of EEPROM is checked. If an error is detected in EEPROM, message "Err0" is displayed on the LCD and instrument runs with the default settings. Default values are summarized in the section »SETTING THE PARAMETERS".

After instrument being turned on, measured value slowly rises to the "real" value. Velocity of approaching the "real" value depends on the measured activity, but in all cases MRS 110 B-1 after 1 minute shows result within the declared statistical uncertainty.

2.2 WORK WITH THE INSTRUMENT

MRS 110 B-1 (after at least 1 minute from the switch-on) is carried by an operator as a personal radiation meter. Acoustic signals indicate passing of photons through the GM tube. When there is no elevated background, approximately 20 short beeps are heard each minute, MRS 110 B-1 showing aprox. 20 cpm. If we detect an increased frequency of beeps (or increased value on LCD), this means that we are approaching the source of ionising radiation.

In this case we turn the side of MRS 110 B-1, marked with the red dot (side with the GM tube), towards the source. Beeping immediately follows the radiation strength, LCD result, due to the numeric filtering, with slight delay. In any case, at latest after 1 minute, result is accurate within the statistical uncertainty.

If alarm level is exceeded, acoustic alarm is heard.

Measuring results are shown on LCD both in digital and in analogue form. Range is automatically scaled to the range of the measured value. For the analogue scale, factor in the upper right corner shows the power of 10, with which readings on the semicircular scale should be multiplied.

At extremely high dose rates, GM tube becomes saturated. MRS 110 B-1 detects it and starts emitting continuous sound. Such audible signal warns us, that radioactivity is over limits, measurable with MRS 110 B-1.

2.3 SWITCHING BETWEEN MEASURING UNITS (cpm / µSv/h)

To switch between units, press SET, than use up or down arrows to select the desired unit and confirm the selection with pressing SET again.

MRS 110B-1 gives the exact values of dose rate, measured in µSv/h, only for the photon energy that was used as the calibration source. For all other photon energies, the measuring error due to the energy nonlinearity of the GM tube must be taken into the consideration.

2.4 SETTING THE ALARM LEVEL

To set the alarm level, press **"SET"** twice. After this, current alarm level is displayed, which can be modified by pressing "up" or "down" arrows. Selection of alarm value is confirmed by pressing **"SET"** again.

As the default alarm value, we recommend to set few times the background value (e.g. 0,4 µSv/h).

If we do not confirm new value of alarm, MRS 110 B-1 after few seconds automatically returns to the measuring mode.

2.5 SERIAL NUMBER

Serial number is displayed by pressing "up" arrow when in measuring mode.

2.6 TURNING THE INSTRUMENT OFF

MRS 110B-1 is switched off by pressing **OFF** key.

3. MAINTENANCE

Battery of MRS 110 B-1 enables approximately 24 hours of continuous operation. Instead of NiCd accumulator, normal 9 V battery can be used (in this case, charging is not allowed!!!).

MRS 110 B-1 detects low battery voltage and warn us with displaying LOBAT on the LCD. If instrument is running with the accumulator battery, charger should be connected to the jack on the side of MRS. Battery charging should be continuously for 14 hours.

In case of the normal battery replace it with the new one.

4. TECHNICAL DATA

Detector:	type:	G.M. tube SBM 20
	window:	30 mg/cm^2 max.
	cross section:	aprox. 600 mm^2
	background:	aprox. 15 imp/min
Detection of:		roentgen, gamma and beta radiation
Measuring range:		0.01 µSv/h to 1 Sv/h
Display:		LC display, numeric and analogue
Alarm:		adjustable from 0 to 9999 cpm
Acoustic alarm:		Pulsed beeps when alarm level is exceeded Continuous at saturation of GM tube
Power supply:		Nicd accumulator 9V 0.11Ah (min 24 h) 9V battery 6BF22 (min. 100 h)
Dimensions:		150 x 80 x 30 mm
Mass:		250 g

5. WARRANTY

RADIOLOGICAL MONITOR MRS 110 B-1

Serial Number: Production Date:

Date of Sale: Sold by:

Customer:

Signature / Seal:

WARRANTY STATEMENT:

The device is warranted against all defects in material or labour for a period of 12 months from a date of purchase (either purchased directly from AMES or from an authorised representative).

We commit ourselves to repair without charge any defects and technical deficiencies caused under normal operation. This warranty is valid under the following conditions:

- that the device was used in accordance with the supplied instructions
- that the defect has occurred under the normal use and is not a result of any mechanical damage, atmospheric discharge, improper use or hostile operating or storage environment
- that the instrument had not been serviced by an unauthorised persons

Under the conditions stated above we accept the obligation to repair the product within thirty days.

We guarantee the availability of spare parts for a period of ten years from the date of purchase.

Manufacturer:

AMES d.o.o.
Jamova 39, SI-1000 LJUBLJANA
SLOVENIA
TEL +386 1 365 71 01
FAX +386 1 365 71 02 EMAIL: AMES@AMES.SI
http://www.ames.si