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# Instruction Manual

## For New Radiation scanner Model 900



Coliy Technology GmbH

Version No.: J280-1

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# Introduction

It's a wise choice to use the Coliy new Radiation Scanner Model 900 (below: Model 900) which is designed totally on new standard to develop the old devices in the ways of performance, operation and manual options.

1. Comparing with old devices, Model 900 increase functions such as dose accumulating, maximum recording, hand-operated store, data transfer to PC in real-time, data analysis, etc.
2. Employed the thin film switch. One push of a button is enough to start radiation measurement and plentiful of data is available.
3. Tested precision instrument. Each Coliy Radiation Scanner Model 900 is subjected to a final test supervised by the institute of radiation protection of a government controlled university of applied technology.
4. All ray types: Model 900 can reliably measure not only  $\gamma$  rays, but  $\alpha$ 、 $\beta$  and X rays as well.
5. Model 900 increases Power on/off switch which extremely extend the battery's useful time.
6. Low power consumption: Model 900 consumes very little

## **COLIY Instruction Manual for New Radiation Scanner Model 900**

power. Due to use three AAA batteries, it's very easy to change them.

7. Large area of display: All values and settings are indicated on an extra-large display.
8. Data storage: Model 900 carries high capacity internal memory to store values. No need to keep records by hand. Furthermore it supports data storage for 1 minute after power down. You don't have to worry about losing data as changing battery.
9. Evaluation by computer: The software which comes with Model 900 enables the computer to indicate the measuring data in real-time for you to monitor remotely, to evaluate and to store data at intervals which you can set as you will.
10. Compact design: Model 900 is very compact in its dimensions, and small enough to fit a pocket.
11. Certification: Model 900 has been tested by TUV (German Technical Control Board) for device safety. It means all European CE standards as well as the "FCC 15 standards" of the USA. Model 900 may be carried on aircraft.
12. Model 900 has two models: Model 900+ and Model 900 (Simplified version). Model 900+ has functions such as

data storage, Maximum recording and communication with computer but Model 900 (simplified version) hasn' t.

# Control Panel

MODEL 900 PANEL



## MODEL 900+ PANEL



Model 900+ has functions such as data storage, Maximum recording and communication with computer but Model 900 (simplified version) hasn' t.



## Operating Instruction

### Ray selection switch:

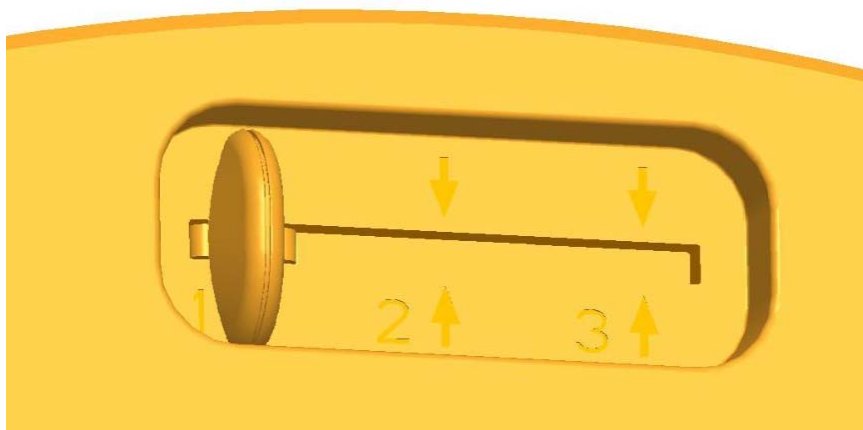
Model 900 is equipped with high degree of Geiger counter tube enabling you to detect  $\gamma$  ray but also  $\alpha$ 、 $\beta$ 、X ray.

With the ray selection switch you can limit the ray types you want to measure:

1. Set the selection to center position to detect  $\gamma$  ray.
2. Move the switch to the left to measure  $\gamma + \beta$  ray.
3. Move the switch to the right to measure  $\alpha + \gamma + \beta$  ray.
4. Put the switch to any position to detect X ray.

For normal measuring, place the ray selection switch at center position.  $\alpha$  and  $\beta$  ray are limited in ranges to a few centimeters or meters, and can therefore be detected only when very close to the radiation source.


Caution: Move switch tenderly in case of damage to sensor element.




(Image: Ray selection switch)

In standard mode, Model 900 informs you quickly and reliably about current radiation exposure.

### Indicating current radiation:

Pressing the  button puts Model 900 into standard mode, and its display show you the present radiation in microsievert per hour ( $\mu\text{Sv/h}$ ) - not only as a value but also in the form of a bar chart that varies with the displayed value. In order to visualize the volume of detected radiation, there is a bar diagram on the ground line of the display using symbols as 0.1, 1, 10, 100. Note that for a small radiation value, this bar chart appears only as a single line.

### Sv/h and Rem/h indicating unit convert


Pressing  button, the indicating unit convert between  $\mu\text{Sv/h}$  and  $\text{mR/h}$ . The converting formula as following:


$$10 \mu\text{Sv/h} = 1\text{mRem/h}$$


### Dose accumulation Sv:


Model 900 can also be used as a dose accumulator to record the accumulated radiation value during a period of time. At first the initial value is in  $\mu\text{Sv}$ . When the value is accumulated big enough






the device will convert the unit to mSv or Sv automatically on the display.

Dose accumulation Button 


Pressing  button once to switch Model 900 to the dose accumulating mode, then the display indicates “ $\mu$ Sv” icon.

Pressing  button once more to end dose accumulating, the device will respond a short ring and indicate the current accumulated dose value on the display.

Or pressing  button long for two seconds to set measure time, the display indicates two icons as “ $\mu$ Sv” and “min”. 3 digits show on the display and the default value is “060” that means 60 minutes. The Maximum time that can be set is 999 minutes. When the first digit (hundred’ s place) blinks, you can set the number directly.


- Pressing  button once to set number at tens place;
- Pressing  button once more to set number at units place;
- Pressing  button to withdraw into the previous mode;
- Pressing  button for the third time to ensure the completion of time setting, and the display indicates the current setting time;
- Pressing  button for the fourth time to enter the timing


dose accumulation mode, blinks the icon “TIME” on the top left of the display.

Pressing  or  button to adjust the displayed value.

If the measuring time was set, the device will buzz a short ring as time is up. The display indicates the accumulated dose value during the setting period while the “TIME” icon stops blinking on the display. If you press the button while the setting time is not run out, the device will enter non-timing-dose-accumulation mode. Pressing the button long to enter again the timing dose accumulation mode.

Three ways to stop measuring:

-Under non-timing measure mode, pressing  button shortly for the second time to end accumulating, the measuring value indicates on the display. During the timing measure process, pressing the button shortly to enter non-timing accumulation mode.

- Pressing  button long to enter timing mode and in the meantime the time is set as “000”. Confirm it and the measuring value is cleared. Then the default mode is to detect dose rate.


- By choosing any other operating mode, the measuring result is disappeared.



## Pulse counting


Model 900 can also be used as a normal Geiger counter, in which


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case it simply counts the number of pulse received without converting them into the sievert unit (Dose unit, 1Sv=100Rem). Model 900 indicates the received pulses on the LCD display.


Pulse counting button 


Press the  button once to switch Model 900 to the pulse count mode. The display then shows the pulse symbol. Press the  button again to end the pulse counting, And the device will show the current accumulated value and pulse symbol on the display with a short buzz.

Or press the  button long for 2 seconds, if you want to set a measuring time. The display then shows the pulse symbol. Now the display indicates 3 digits with the default value “060” that means 60 minutes. The maximum that can be set is 999 minute. When the first digit (hundred’ s place) blinks, you can set the number directly.


- Press the  button for the first time to set number at tens place;



- Press the  button for the second time to set number at units place;

- Press the  button to withdraw into the previous mode;


- Press the  button for the third time to ensure the


completion of time setting, and the display indicates the current setting time;

- Press the  button for the fourth time to start measuring the accumulated timing pulse with “TIME” symbol blinking on top left of the display. If you press the button before time is out, the device will enter non-accumulated mode. Pressing the button long to switch into time setting mode again.

Pressing  or  button to adjust the displayed value. As the measuring time was set up, the device will buzz a short ring while measuring ends. Now the display indicates the accumulated value during this process while “TIME” symbol stop blinking.


Three ways to stop measuring:

- Under non-timing measure mode, pressing  button shortly for the second time to end accumulating, the measuring value indicates on the display. During the timing measure process, pressing the button shortly to enter non-timing accumulation mode.

- Pressing  button long to enter timing mode and in the meantime the time is set as “000”. Confirm it and the measuring value is cleared. Then the default mode is to detect dose rate.

- By choosing any other operating mode, the measuring result is disappeared.



## Indicating the pulse rate: CPS/CPM

Press the  button to convert the pulse rate unit between CPS and CPM.

CPS: Pulse rate per second

CPM: Pulse rate per minute

## Setup menu : SETUP

Press the  button to switch to manu-set mode for setting DATE, TIME, ALARM LEVEL, ALARM SWITCH () AVERAGE TIME ( $\bar{T}$ ), Calibration factor.

Date : Month. Day. Year.

Time : Hour : Minute : Second





Alarm level: 1—999  $\mu$  Sv/h (default: 100)





Alarm switch: ON / OFF

AVERAGE TIME: The setting can change reaction time of the device dealing with the radioactive source. The setting scale is ranged between 8s and 120s. The device would reduce automatically the value of average time on the basis of current setting along with increasing of radiation dose rate. For example, when the value is set as “8s”, the fastest reaction time can reach to 2s in the situation of the radiation level beyond 5 $\mu$ Sv/h. The default value

is 30s.

### Calibration factor: The default value is 2.10.

Press the  button or  button to adjust value. And press the Enter  button for confirmation. Press the  button to withdraw into the previous mode.



Generally the calibration factor can't be revised, otherwise the measuring value will be inaccurate. If necessary, it must be done by professional engineer of radiation protection to calibrate the device on current calibration factor that is calculated under strict standard. When calibrating, password is obligatory. After password is entered, the device switches to calibrate factor mode: "CAL" symbol blinks and "----" shows in the middle of the display. Press "enter" and while the first "-" blinks, press  button. Then changes the first "-" to "c" and the second "-" blinks. Now press the buttons one by one: , , The display shows "ccc-" with "-" blinking. At last press the button , it shows on the display the current calibration factor (i. e. :2.10). Now the first digit blinks and you can change the value just as ways address before. Increasing it will decrease measuring radiation value and vice versa.





## Maximum record : MAX


(Note: Model 900 simplified version don't have this function)


Pressing the  button switches into maximum record mode.


Press the  button once to start maximum recording and shows "MAX" symbol on the display. Press the  button again to stop recording with a short beep. Now the maximum shows on the display with "MAX" symbol.

Pressing the  button long for 2 seconds switches the device into timing maximum record mode. Now shows 3 digits with "MAX" symbol on the display while the default value is "060" that means 60 minute. The maximum that can be set is 999 minute. When the first digit (hundred's place) blinks, you can set the number directly.


- Press the  button for the first time to set number at tens place;



- Press the  button for the second time to set number at units place;

- Press the  button to withdraw into the previous mode;

- Press the  button for the third time to ensure the


completion of time setting, and the display indicates the current setting time;

- Press the  button for the fourth time to start the timing maximum recording with “TIME” symbol blinking on top left of the display.

Pressing  or  button to adjust the displayed value.

As the measuring time was set up, the device will buzz a short ring while measuring ends. Now the display indicates the maximum value during this process while “TIME” symbol stop blinking. If you press the button before time is out, the device will enter non-timing maximum record mode. Pressing the button long to switch into time setting mode again.

Ways to stop maximum recording:


- Pressing the  button long switches into time setting mode and in the meantime the time is set as “000”. Confirm it and the measuring value is cleared.


- By choosing any other operating mode, the measuring result is disappeared.


## Data storage : SAVE


(Note: Model 900 simplified version don't have this function)


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
Pressing the  button once, the device stores the current measuring value in its internal memory. (manually operating single storage to record time and radiation value) .


Pressing the  button long for 2 seconds switches to intervallic timing storage mode with “MEM” symbol on the display that shows three digits with default value of “001” (It means that the device automatically stores once every one minute). The maximum intervals that can be set is 999 minutes. When the first digit (hundred’ s place) blinks, you can set the number directly.

- Press the  button for the first time to set number at tens place;

- Press the  button for the second time to set number at units place;

- Press the  button to withdraw into the previous mode;

- Press the  button for the third time to ensure the completion of time setting, and the display indicates the current setting time;


- Press the  button for the fourth time to start the intervallic timing storage with “TIME” symbol blinking on top left of the display.

Pressing  or  button to adjust the displayed value.

As the measuring time was set up, the device will buzz a short ring while measuring ends. Now the display indicates the maximum


value during this process while “TIME” symbol stop blinking.  
During the process of timing storage, you can still manually store an instant value immediately.


Ways to stop automatic storage function:

- Pressing the  button long for 2 seconds to enter time setting mode and in the meantime the time is set as “000”. Confirm it and the measuring value is cleared.
- Choosing other operating mode except for dosing rate and pulse counting rate, you can stop the automatic storage function.

## **Data transfer: USB**



(Note: Model 900 simplified version don't have this function)

Pressing the  button once, you were admitted to transfer data via USB port. Pressing again, this function was ceased.


Under the USB transmitting mode, the device won't response on pressing buttons. Unless press the  button shortly to close this function or Cease the USB transmitting mode via the software on the computer.

## **Clear the stored data**

(Note: Model 900 simplified version don't have this function)

Pressing the  button for 2 seconds, shows “CLEAR” on the display and blinks. Now press the enter button  to clear the data stored in the internal memory. (caution: The data can't be recovered after clear. Please be sure before pressing the enter button.) If you switch into the clear mode by mistake, press any other button to withdraw.

## **Power on / off**

Press the  button long for 2 seconds to power on or off. Once power off normally, when power on again the data stored before in internal memory still exists. While the device is powered off abnormally, it can't be sure that the stored data can be retrieved.

## **Battery**

Model 900 is powered by 3 AAA batteries that you can choose ordinary alkaline cells or rechargeable cells (AAA model).

The device can automatically detect the cell voltage. When lacking power, the battery symbol will blink on the display. It

is suggested to change battery at once. As changing battery, the device can store the data in the internal memory for a minute. When lacking power seriously, it will power off automatically and you will lose the data in memory.

## Radiation Scanner Software

Using Radiation scanner software, you can transfer the data, which Model 900+ has logged in its memory, to a computer and convert them into list or graphic form for further processing. In addition, radiation scanner software can also be used to transfer the current radiation data to the computer for displaying and analyzing.

(Note: Model 900 simplified version don't have this function)



USB cable connecting Radiation Scanner and computer

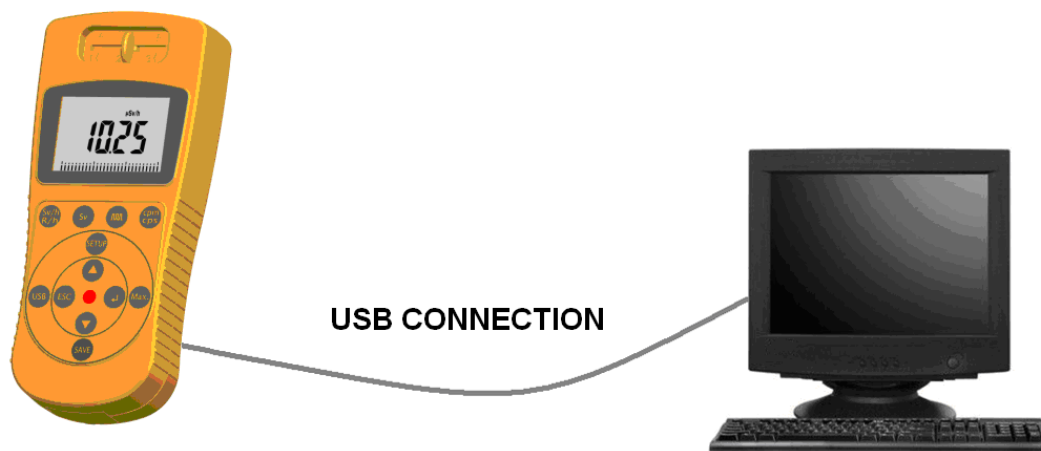


Image shows connection between Radiation Scanner and computer

When connecting the Model 900+ and computer by USB cable, you can achieve remote monitoring and saving data very easily. This function offers the best way for situations with high level radiation which requires supervising at any time.

USB cable length: Generally 1M cable is available. 5M is offered for specially request. For more length, you can use USB Extender. The maximum length can reach to 100M.

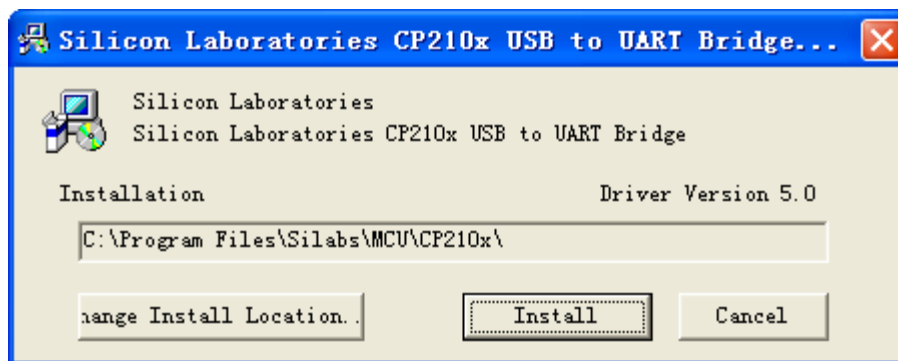
## **System requirements**

- 1、 MS-Windows PC with USB port
- 2、 CD-ROM or DVD-ROM drive for software installation
- 3、 WIN 2000、 WIN XP、 WIN VISTA

## **Software installation**

- 1、 Install USB drive: Open the folder named “Windows\_2K\_XP\_S2K3\_Vista” in CD, and execute the file “CP210xVCPInstaller”. Then the message window appears on the screen.





Click “Install” button to start installation and follow the messages prompting automatically.

2、 Install applications: Open folder “Radiation Scanner Software” in CD, and execute the file “setup”, following the prompting message during the process of installation.

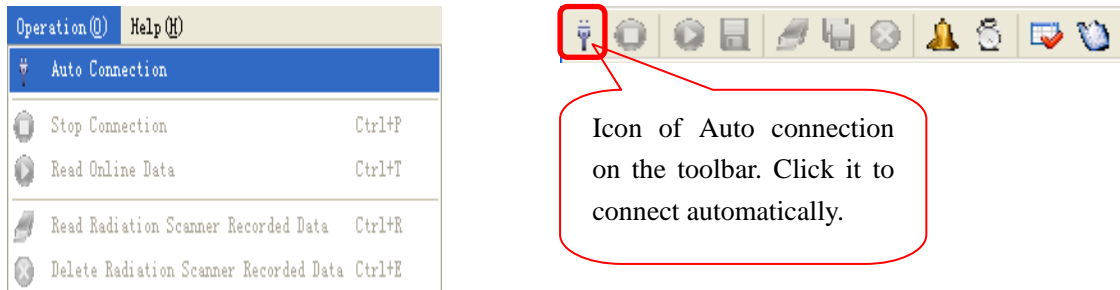
3、 Operation: After installation, you can find the Radiation Scanner software under path “Start→Program→coliy” . Click it to start the program or click the LNK on the desktop.

4、 Uninstall the software: Click “Start→Program→coliy→Uninstall Radiation”, and follow the prompt to remove the software from your computer.

## **Connecting Radiation Scanner**

Step 1: Connect the radiation scanner and computer with the USB cable and press the “USB” button on the device.

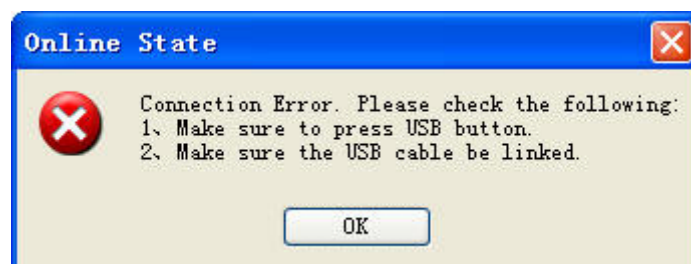
Step 2: Auto connection: Click Menu “Operation → Auto connection” or the icon of Auto connection. And the system connects the Radiation Scanner automatically.



Get connected: By the way of connecting manually or automatically, the system presents the message window as below when connection succeeded.



Fail connection: By the way of connecting manually or automatically, the system presents the message window as below when connection failed.



There are a lot of reasons for connecting failure except the 2 reasons offered on the upper message window. More offers as following for your references::

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- 1、 The installation of drivers is not complete. In this case you can update the drivers to complete the installation.
- 2、 USB cable breakdown.

If the problems mentioned above do not exist, you may close the software and restart it. Try more times, generally it may get connected.

### **Solutions to the software stallation failure**

If failed connection online after the installation of the Drive and Software, please check:

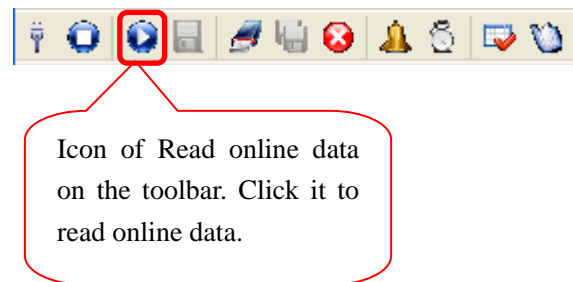
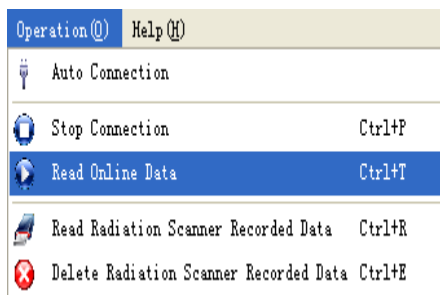
1. Check if you press the "USB" button on the Radiation Scanner; if not, then press it.


2. Open the Properties sheet (by right-clicking "My computer" and clicking "Properties") and click the "Device Manager" to check if the port status is normal. If abnormal, it shows a yellow triangle with an Exclamatory Mark in the middle. Now you need to update the Drive program. The specific procedure is to find the "SiLabs" file in the System Installation Disk (usually Disk C), then click file "C:\SiLabs\MCU\CP210x\Windows\_2K\_XP\_S2K3\_Vista" and run the "CP210xVCPInstaller" file. During the process of updating drive, please close all the other application program. After the update is finished, check the port status in "Device

Manager” to see if the yellow triangle is vanished. If so, the port can be used normally and if not, repeat the above procedures.

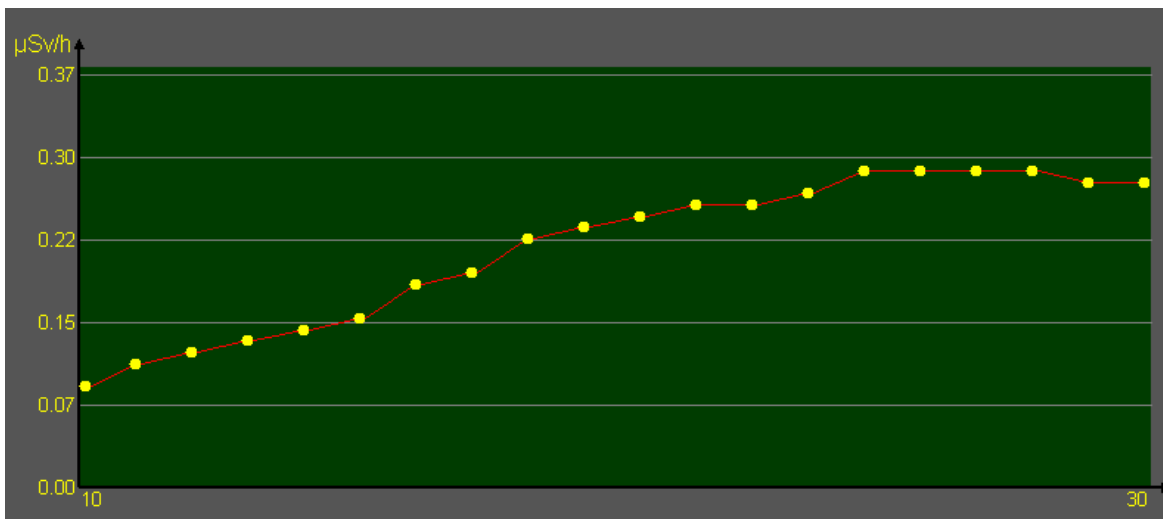
## Read online Data

After connection, you can start measuring online by clicking Menu “Operation→Read Online Data” or shortcut key “Ctrl+T” or icon of “Read Online Data” on the toolbar.




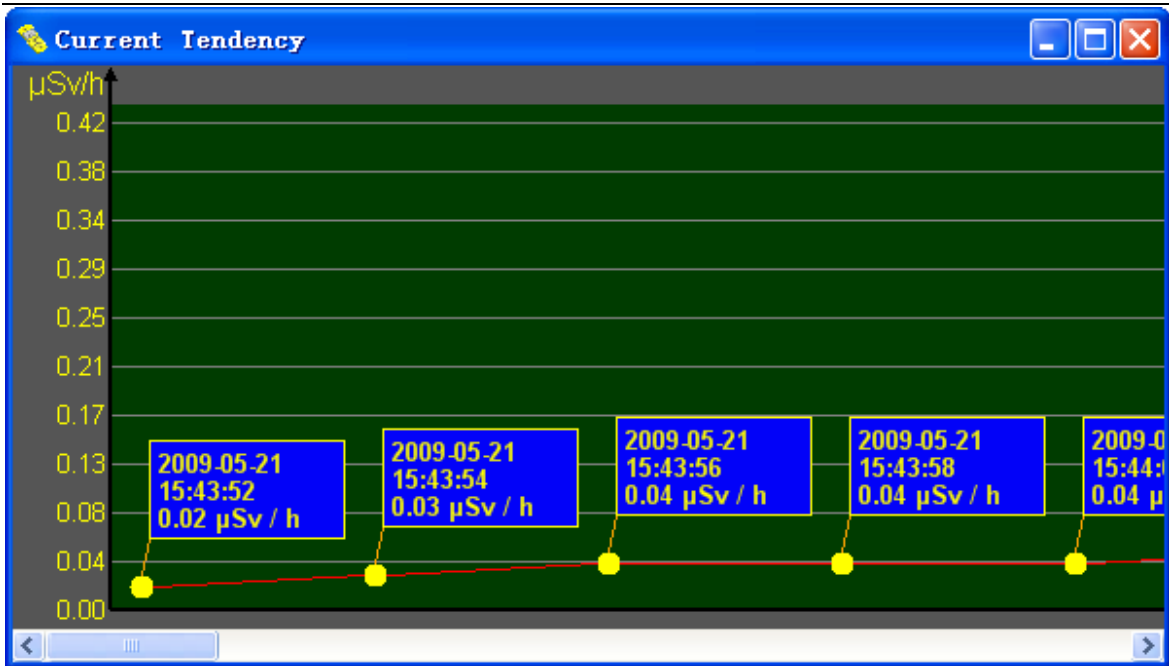
As for pause, click Menu “Operation→Pause” or the icon of pause  on the toolbar. And the system suspends reading online data.


Main interface of reading online data:

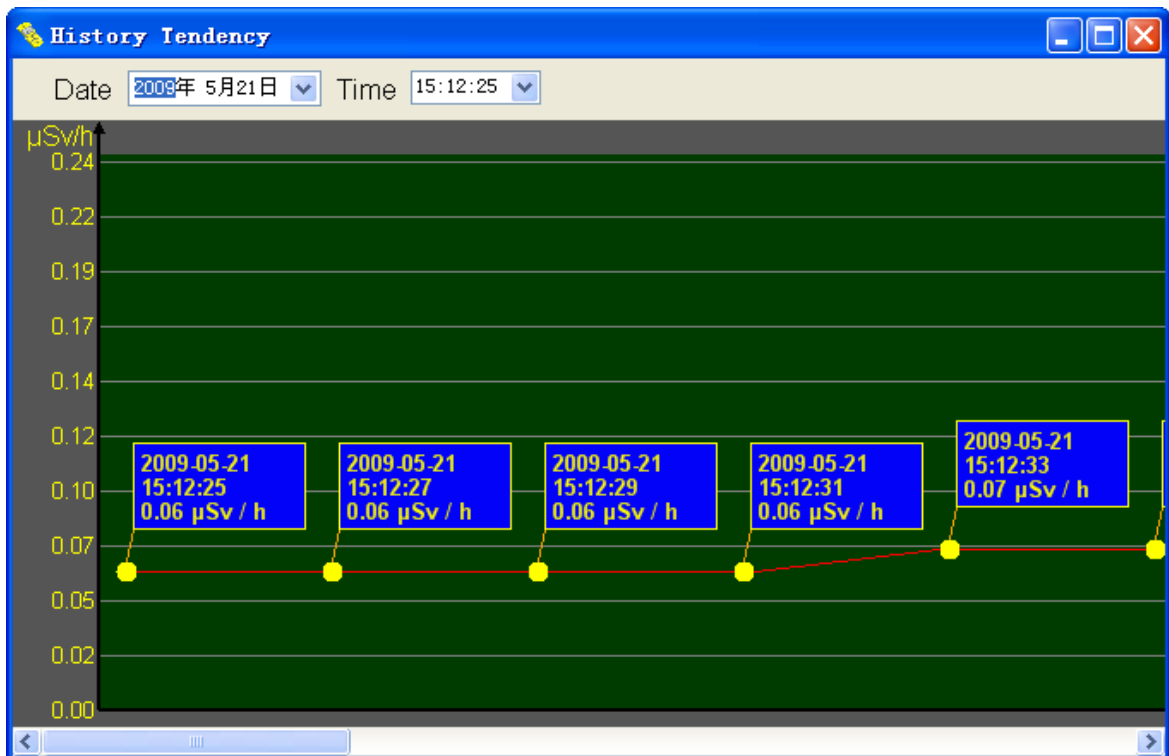


Axis Y indicates the radiation dose rate of the scale value that systems adjust automatically; Axis X indicates the quantity of the radiation dose rate. The display area of the main interface illustrates at most 20 current value of the radiation dose rate.


As to observing the foregoing value, click icon of “Current Tendency”  on the toolbar. On the tendency chart you can check all the data during a continuous measurement (there is no stop of pause in the process). Drag the scroll bar to check all the test information.




In “Current Tendency” you can only observe the tendency chart of current data. As for previous data of the tendency chart, please click the “History Tendency”  on the toolbar in which you can check all the history measuring data of the tendency chart that is not deleted.

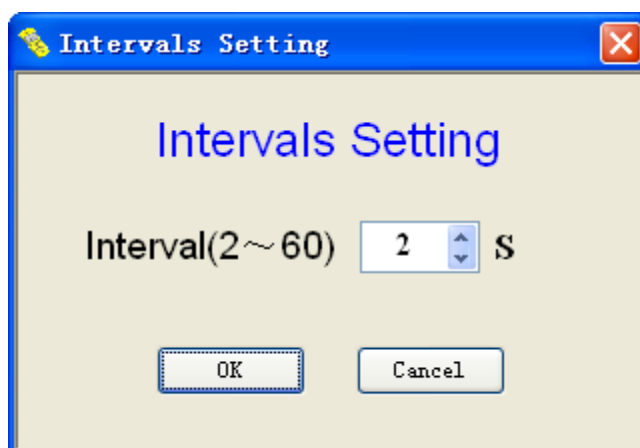



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After clicking icon , choose “Date” and “Time”. In “Time” you can check all the initial time points of measurements on a specific date. If there is no measuring on the date you choose, system shows “No Data” on the interface of the tendency chart. Drag the scroll-bar to check all the test information.

## Intervals Setting

Click Menu “Setting→Intervals Setting...” or icon  on the toolbar to open the interface of “Intervals Setting”.



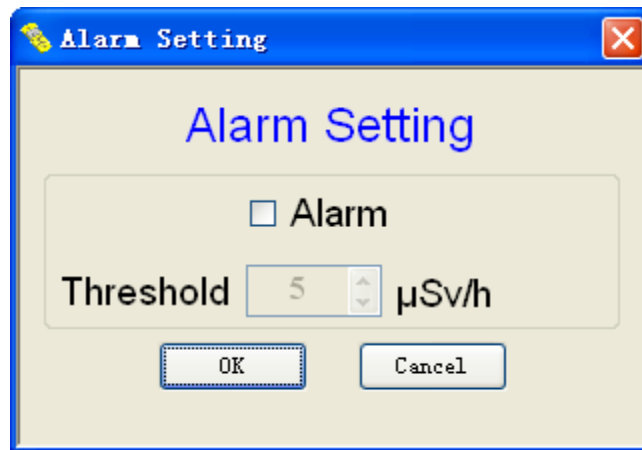
Click  to set time intervals that can be chose between 2~60S. The default value is 2 seconds. The setting value is still effective when you start the system next time.

Intervals refer to the period every which the device collects a value when reading online data.

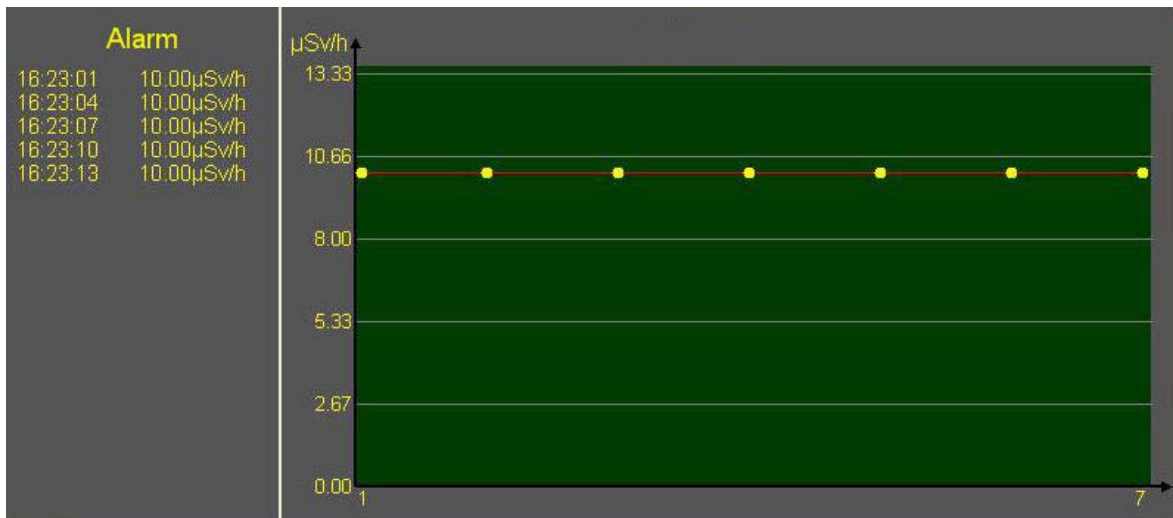
## Alarm Setting

Click Menu “Setting →Alarm Setting...” or icon  on the

toolbar to open the interface of “Alarm Setting” .



Pitch on “Alarm” to set alarming function. And then set “Threshold” . The default setting is alarm off with Threshold value of 5  $\mu\text{Sv/h}$  that can be chose between 1~1000  $\mu\text{Sv/h}$  with the increment of 1  $\mu\text{Sv/h}$ .




As alarm sets on, the device will be alarming when it detect that the radiation dose value exceeds the setting value of the alarming threshold, recording the radiation value and time point displayed on the left side of the interface. The system can record at most 255 alarming value. When the recorded data are over that, system will automatically delete the foregoing values.




## Save Online Data

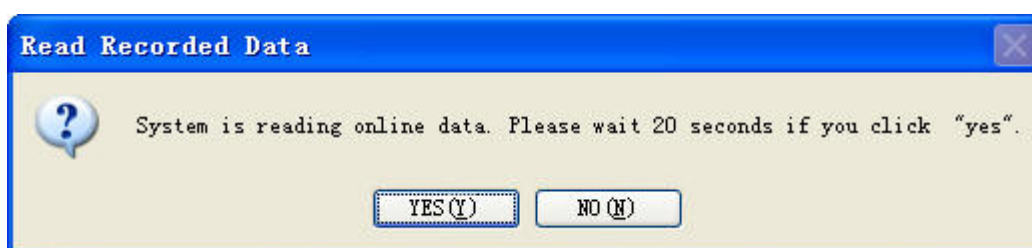
The Online data can be saved in the form of EXCEL or TEXT for further analyzing.

Click Menu “File→Save Online Data...” or icon  on the toolbar popping the window for saving.

This function is to save the data reading online continuously in the form of Excel (.xls) or Text (.txt) in your computer.

## Read Radiation Scanner Recorded Data

On connection, click Menu “Operation→Read Radiation Scanner Recorded Data” or click icon  on the toolbar to read data stored in Radiation Scanner. When you do so, if the system is reading online data, it will give a prompt as below:



Click button “YES (Y)” to start reading the recorded data while click “NO (N)” to give up. Otherwise system will read the recorded data directly.

When reading, please wait a moment for the system reaction. The reaction time depends on the data volume stored in the Radiation

Scanner. More time requires for more data, vice versa. During this process, system can't carry out other operation due to the time-lag.



On the interface system displays the “Manual Recorded Data” on top and “Auto Recorded Data” below. If there is only one kind of data stored in Radiation Scanner, the system will display the information of this kind of data on the interface and neglect the other kind of data.


Every yellow solid bar represents a value of the radiation dose rate. On top of it is its detailed information such as date, time and dose rate. Drag the scroll bar to check all the data information.

## Save Radiation Scanner Recorded Data

After system reading Radiation Scanner Recorded Data, you can

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save them in the form of Excel or Text in your computer for further analyzing.

Click Menu “File→Save Radiation Scanner Recorded Data...” or icon  on the toolbar popping the window to save both Manual recorded and Auto recorded data. Click Menu “File → Save Radiation Scanner Manual Recorded Data...” or “File→Save Radiation Scanner Auto Recorded Data...” to save one kind of the data.

When you exit the software, if the data reading from the Radiation Scanner have not been saved, system will pop a prompt asking you if to save them. Click “YES (Y) ” to save or click “NO (N)” to give up saving and exit the system.

## **Delete Radiation Scanner Recorded Data**

Radiation Scanner has limited memory so that you have to delete the data that have been saved in your computer to release the internal memory of Radiation Scanner for recording new data. And the data can’ t be retrieved after being deleted, so be care of this operation.

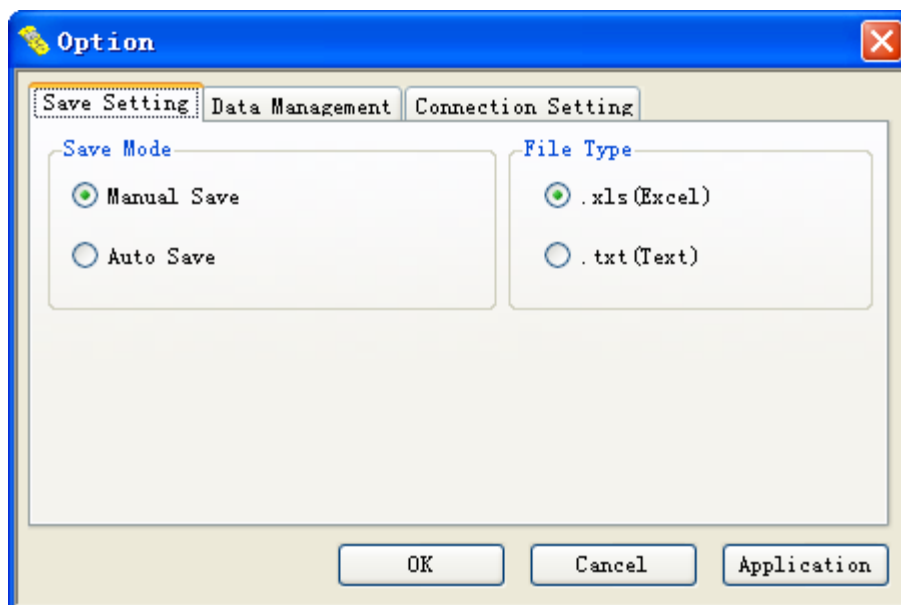
Click Menu “Operation →Delete Radiation Scanner Recorded Data” or icon  on the toolbar, system will pop a prompt window as below asking if you are sure to delete the data.



Click button “YES (Y)” to delete the data recorded in the Radiation Scanner, while click button “NO (N)” to give up. After deleted, system will give a prompt note: “erase storage data finish”

## Option

Click Menu “Setting →Option...” to open the sub-interface of option that contains of 3 module Menu: Save Setting, Data Management and Connection Setting.



### 1、 Save Setting

By the mode of Manual Save system will pop a prompt note asking if to save the data reading online when you exit the system;

## COLIY Instruction Manual for New Radiation Scanner Model 900

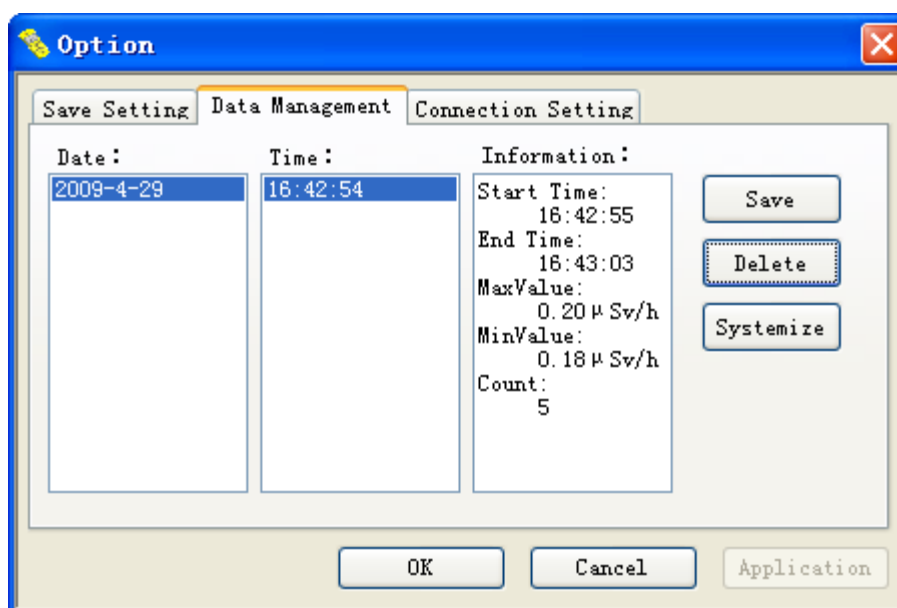
by the mode of Auto Save system will save automatically the data when exit the software.

Click radio button “Auto Save”popping a prompt window to choose a folder for saving data automatically.

Click “YSE” for system recording the folder to save data automatically while click “NO” to give up saving automatically. System will keep this folder as the default address for saving other data.

Default file type: System saves the data in Excel that is the default file type. You can change the file type by choose “.txt” in the module of File Type. Then system will save data in the type that you choose when saving automatically.

### 2、Data Management



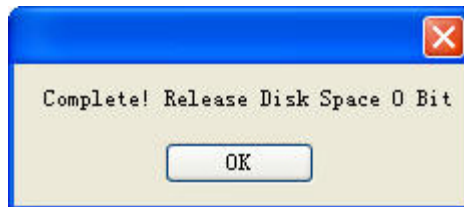
The column of Date displays all the day on which you collect radiation dose rate in your computer. Click a date value system shows all the starting time of the data detecting on that day in the column of Time and the detailed data information of a specific initial time in the column of Information such as Start Time, End Time, Max Value, Min Value and Count.

Click the starting time to make the “Save” button available. And click “save” button popping a dialog window to save the data.

Click the time of the data you want to delete and then click “Delete” button popping a dialog box as below. Click “YES(Y)” to do so while click “NO(N)” to give up.



The function of systemizing is to release the disk space. The read online data save in the disk of your computer. When you delete them, the disk space won't be released totally so that you need to click “Systemize” button to make the system clear and release it. When this has been done, system will give a prompt note as below:



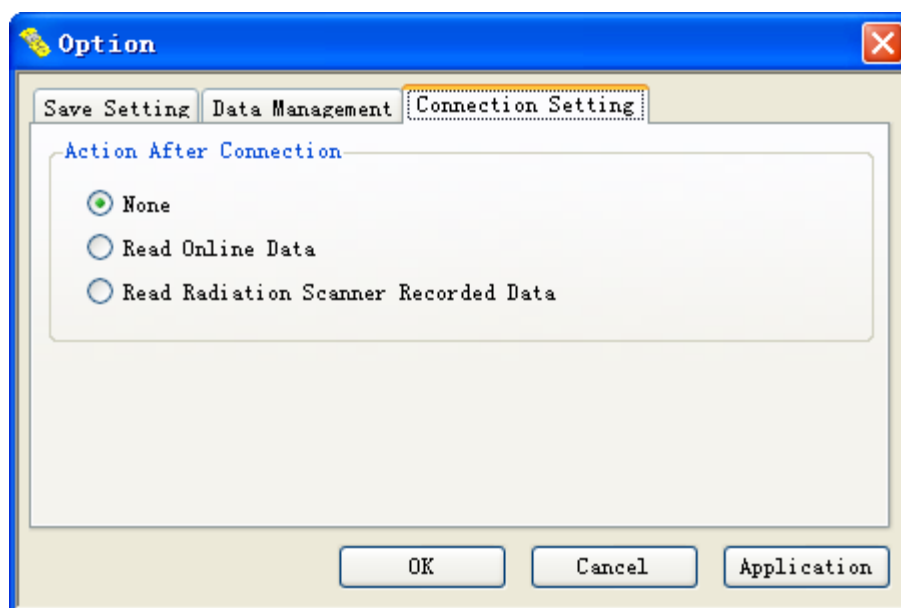
### 3、 Connection Setting

Connection setting refers to the operations after connection containing 3 sub-options:

None : System does no operation after connection, waiting for user to operate.

Read Online Data: System reads online data immediately after connection.

Read Radiation Scanner Recorded Data : System reads Radiation Scanner Recorded data immediately after connection.



## About

Click Menu “Help→About” or shortcut key “Ctrl+H”





## Technical data:

Ray types	$\alpha$ 、 $\beta$ 、 $\gamma$ and X rays
Range	Radiation dose rate: 0.01 $\mu$ Sv/h – 1000 $\mu$ Sv/h Impulse dose rate: 0–30,000cpm, 0–5,000cps Radiation dose accumulation: 0.001 $\mu$ Sv – 999999Sv Impulse dose accumulation: 0–999999
sensitivity	108pcs impulse or 1000 cpm/mR/hr in Cobalt-60 radial environment with power of 1 $\mu$ Sv/h. Alpha ray: from 4 MeV Beta ray: from 0.2 MeV Gamma ray: from 0.02 MeV X ray: from 0.02 MeV
Ray selection switch	$\alpha$ 、 $\beta$ 、 $\gamma$ and X rays selection
sensor	Halogen filled detector
Output port	USB Port (with special USB extend cable, can extend to 100M)
Display	6-digit display (LCD), numeric with all inspection data, with bar chart.

**Technical data:**

Alert	Can set alert value free, default set:5 $\mu$ Sv/hr
Accuracy	Typical 15%
Storage	Can store 2000 data automatically or by manually
Detector work tem.	-40 $^{\circ}$ C to 75 $^{\circ}$ C
weight	200g
Dimension	Length 170mmXwidth 74mmXheight 30mm
Power	3 AAA batteries
Warranty	1 year

## Warranty

Coliy technology GmbH assure you that each meter we made has no defects in materials and technics .

The length of warranty is one year after the meter was shipped to the customer.

Coliy technology GmbH reserved rights to change designs at any time.

Jan. 2009

# Appendix

## Radiation unit conversion formulas

### UNITS OF RADIATION MEASUREMENT

The curie is the number of particles per second from 1 gram of Radium =

$3.7 \times 10^{10}$  counts/second = 37 billion cps = 37 billion Becquerel.

1 Becquerel (Bq) = 1 count per second = 1 event per second

1 microcurie = 1 uCi = 37,000 Bq = 37,000 cps.

1 microcurie =  $2.22 \times 10^6$  disintegrations / minute = 2,220,000 cpm.

1 nanocurie = 1 billionth of a curie = 2,220 disintegrations / minute.

1 picocurie = 2.2 disintegrations / min.

#### Dosage units:

Gray (Gy) = 1 Joule/kg

Sievert (Sv) = Gray x QF, where QF is a "quality factor" based on the type of particle. The Sievert is a measure of biological effect.

QF for electrons, positrons, and xrays = 1 QF = 3 to 10 for neutrons, protons dependent upon the energy transferred by these heavier particles.

QF = 20 for alpha particles and fission fragments.

**Converting older units:**

1 rad = 1 centigray = 10 milligrays ( 1 rad = 1cGy = 10 mGy )

1 rem = 1 centisievert = 10 millisieverts ( 1 rem = 1cSv = 10 mSv )

1 mrad = 10  $\mu$  Gy

Nominal background radiation absorbed dose of 100 mrad/year = 1 mGy/yr.

Nominal background radiation dose biological equivalent of 1mrem/year = 10 $\mu$ Sv/yr.

Occupational whole body limit is 5 rem/yr = 50  $\mu$  sv/yr. ( Recently proposed that levels be reduced to 2 rem/yr.)

2.5 mrem/hr or 25  $\mu$ Sv/hr is maximum average working level in industry.

Exposure rate from Naturally Occurring Radioactive Material (NORM) ; an empirically derived conversion factor for Ra-226 decay series: 1.82 microR/hour = 1 picoCurie/gram.

mR/h=10  $\mu$  Sv/h

mR=10  $\mu$  Sv

sievert's meaning:

In physicals, three types of radioactive rays are know:  $\alpha$  、  $\beta$  、  $\gamma$  rays (X ray

belong to low energy scale of  $\gamma$  ray.) They differ not only in their physical characteristics but also in their effects on humans. To make these three ray types comparable in their effects on humans, a value has been created which defines the biological effects of rays: it is referred to as dose equivalent whose unit is sievert (called equivalent dose).

*sievert (Sv)*

*1 Sv=100 rem*

*rem (roentgen equivalent man )*

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