User's Manual

Model : QSF104

Portable Radiation Detector

Simple & Easy Radiation Check Solution

Functions

Survey Meter, Dosimeter,
Alarm Threshold, Total Pulse,
Power On/Off, Sound On/Off,
Light On/Sleep,
Product Information

Features

Long Life & High Sensitivity
Scintillator Sensor
2.5" Wide LCD Display with
Green, Red Color Alert
Easy One Button
(Mode Change, Power On/Off)

VER 3.0.

Components

QSF104
1ea

Plug Charging Adaptor
1ea

User Guide Manual
1ea

Simple Manual

◎ Before Getting Started

◆ Pleas wait 2 seconds to turn on the device or change mode.

◆ Pushing the button with excessive force may cause damage to the device.

◆ QSF104 has eight modes.
Survey Meter, Dosimeter,
Alarm Threshold, Total Pulse,
Power On/Off, Sound On/Off,
Light On/Sleep, Product Information

◆ The LCD backlight is turned off after 20 seconds in "Light Sleep" setting(default).
If you want to turn backlight always on, set the mode on "Light On".

◆ 3 days continuous use in one recharging.
(In condition of "Light off" mode)

◎ Basic Operation

◆ **Power On**
The device can be powered on by pressing and holding the button for more than 3 seconds and taking it off.

◆ **Switching Modes**
Measuring mode is changed when pressing the button for shorter than 1 second and taking it off.

◆ **Switching it Off**
In "Power Off" mode, the device is powered off when pressing and holding the button for more than 3 seconds.

Simple Manual

As backlight is off, temperature accuracy is improved.

Temperature error : ± 2.0 °C

Notice
The temperature display is placed inside the device. Displayed temperature may higher than external one when backlight is on or charging the battery which cause internal temperature higher.

◎ Basic Operations

◆ Use enclosed recharger or PC's USB port to recharge.

◆ It takes 4 hours to fully recharge battery.

◆ USB connector for recharge
- Use USB type 5 pin Mini-B cable to the connector for recharge.
- No data transfer function.

◆ Lamp for charge State
- Recharging : Red light
- Fully Recharged : Turned off
(When the device is power on, the Lamp is not off even the battery is fully charged because it using battery.)

◆ Battery Level
- Battery charge level is displayed graphically.
- Remaining operating time could be referred as follows.

Light On :	6 hrs.	4~8 hrs.	1~4 hrs.	~1 hr.	immediate recharge needed
Light Sleep :	3 days ~	2~3 days	2~1 days	~1 day	

Simple Manual

◎ Simple Way of Use

① Press the button to power on.

② Use “Survey Meter Mode”.

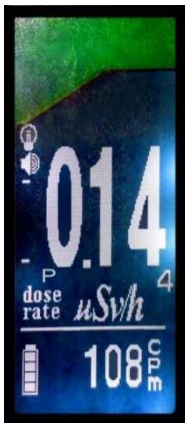
③ There is a ‘+’ mark at the back of device which scintillator sensor is located.
Place the mark as close as possible to the radioactive suspicious object.
(The radiation density is inversely proportional to the square of distance.)

④ In ‘P’ mode, measure more than 2 minutes.

⑤ When the result is higher than normal ambient value,
you may suspect the radiation contamination.
It is not absolute but usually considered above 0.4 μSv/h is danger.

Mode Guide

◎ Survey Meter Mode



- In this mode, measures dose rate, measures radiation in the environment and object.
- Place the device's back "+" mark closely to the object you want to measure.
- For accurate detection, measure more than 30 secs. ~ 2 min.
- By pressing the button(more than 3 seconds.), change the F,N,P measurement mode.

F(Fast) : fast speed, 6 seconds response time, Used for scanning. Radiation spot detection.
N(normal) : normal speed, 21 seconds response time. Used for normal detection.
P(Precision) : 2 minutes response time. Use for very precise detection.

※Changes of Value

The bars next to numbers "-" shows, the changes of measured radiation. So, as the distance of two bars is far, the changes of radiation is huge. When the distance is far, please wait until the rate is stable for more accurate detection.

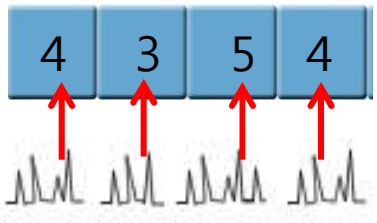
The changing value of measured radiation is big.

The changing value of measured radiation is decreasing.

The changing value of measured radiation is stable.

Mode Guide

※ QSF104 Algorithm



▪ QSF104 detects radiation every 3secs. and average the value.

▪ One unit means 3 seconds.

- F mode : 6 seconds

① 4 3 — Result : (4 + 3) / 6 = 1.17

② 4 3 5 — Result : (3 + 5) / 6 = 1.33

③ 4 3 5 4 — Result : (5 + 4)/ 6 = 1.50

① 7 is detected during 6 seconds. Average is 1.17.
② After this, add 5 which detected during 3 seconds to 3(former data), and work out an average. The result is 1.33.

- N mode : 21seconds

4 3 5 4 3 6 5 ▪Result : (4+3+5+4+3+6+5)/21=1.43

4 3 5 4 3 6 5 7 ▪Result :(3+5+4+3+6+5+7)/21= 1.57

4 3 5 4 3 6 5 7 6 ▪Result :(5+4+3+6+5+7+6)/21= 1.71

- P mode : 2 minutes

4 3 5 4 3 6 5 7 5 4 5 6 4 3 2 3 4 5 3 5 5 5 4 6 1 2 3 4 5 4 3 4 5 4 3 3 4 5 5 4

▪Result : :(4+3+5+4+3+6+5+7+5+4+5+6+4+3+2+3+4+5+3+5+
5+5+4+6+1+2+3+4+5+4+3+4+5+4+3+3+4+5+5+4) / 120 = 1.33

4 3 5 4 3 6 5 7 5 4 5 6 4 3 2 3 4 5 3 5 5 5 4 6 1 2 3 4 5 4 3 4 5 4 3 3 4 5 5 4 5

▪Result :(3+5+4+3+6+5+7+5+4+5+6+4+3+2+3+4+5+3+5+5
+5+4+6+1+2+3+4+5+4+3+4+5+4+3+3+4+5+5+4+5) / 120 = 1.38

4 3 5 4 3 6 5 7 5 4 5 6 4 3 2 3 4 5 3 5 5 5 4 6 1 2 3 4 5 4 3 4 5 4 3 3 4 5 5 4 5 4

▪Result : (5+4+3+6+5+7+5+4+5+6+4+3+2+3+4+5+3+5+5+5+
4+6+1+2+3+4+5+4+3+4+5+4+3+3+4+5+5+4+5+4) / 120 = 1.39

Mode Guide

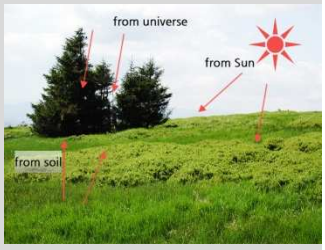
◎ Dosimeter Mode(Accumulated dose)

- Mode for displaying accumulated dose.
- Assume the device is always with user, you can check total dose of radiation exposure.
- By pressing and holding the button more than 3 seconds , accumulated dose value and time are reset to zero.
- Display the total accumulated time.
- According to the UNSCEAR report 2000, the yearly exposure of ubiquitous background radiation due to regular environment. (e.g. the solar wind. K40(potassium) inside human body) is 2.4 mSv.
  This varies between 1 mSv to 10 mSv depending on altitude.
- Allowed artificial radiation dose is under 1mSv.
- The annual allowable exposure dose is therefore, 3.4 mSv which is equivalent 0.4 µSv/h.

※Natural Background & Artificial Radiation?

Natural background radiation?
is a radiation from universe, soil, sun and other nature.

Artificial Radiation?
is a radiation from appliances like a TV, a microwave, airport security checks, X-ray in medical appliances, cancer treatment device, and nuclear power plant.



Mode Guide

◎ Alarm Threshold Mode

green　　green + red　　red

- Mode for setting alarm threshold.
- When the detected value is higher than the set value, alarm rings.

- In Survey meter mode text warning message and red LED indication is displayed.
  - over threshold : "Warning" and half red color
  - 2 times the threshold : "Danger" and all red color
- Threshold is from 0.19 to 3.30.

- By pressing and holding the button more than 3 seconds, you can change the value.

- In "Alarm Off" mode, alarm function stops.

- In "Alarm Off" mode, the text(safe, warning, danger) and red led indication is not shown.

◎ Total Pulse Mode

- Mode for displaying the measured total pulse count.
- Use this mode for precise measurement than survey meter mode.
- Display the total count of detected radioactive rays.
- Display the total measurement time. (Renew every 3 seconds)
- By pressing the button and holding more than 3 seconds, Start/Stop count.
- When it starts counting, previous data reset to zero.

※Total Pulse Mode Simple Manual

① **Detect natural background radiation first.**
Turn on the device and go to total pulse mode, put the device on radiation free place and measure count for a certain time. (30 minutes ~ 3 hours)
② **Record the detected pulses and time**.
③ Put the device on the radiation suspicious sample and measure count.
④ Compare the detected pulses.
⑤ Interpretation:
If detected value with a sample is higher than background value, you can suspect radiation exist.

Total Pulse Mode

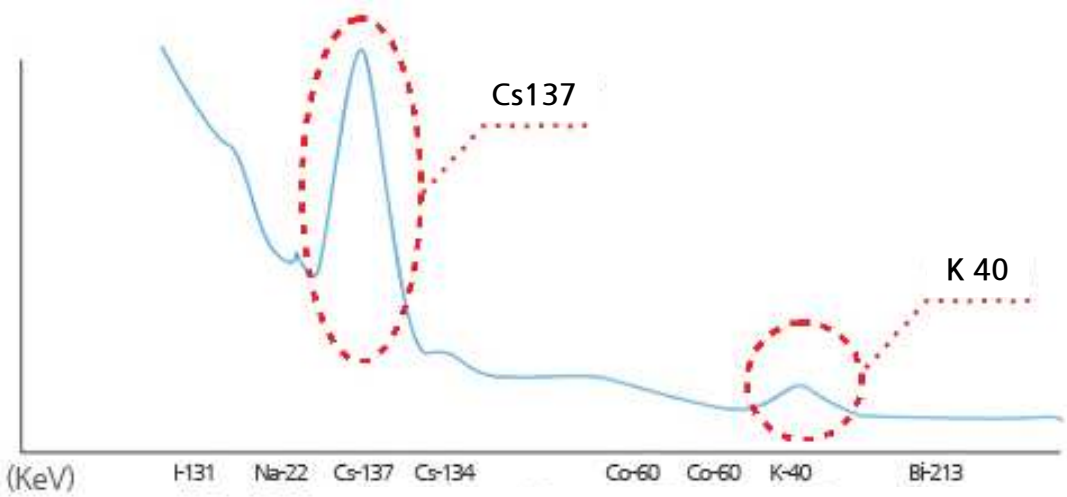
Screening Food Radioactivity Measurement

※ Simplified Food Radioactivity Measurement

Food Radioactivity Measurement is based on to check possibility of detect 100Bq/Kg(radioactivity safety standard limit-Republic of Korea). One Bq (Becquerel) is defined as the activity of a quantity of radioactive material in which one nucleus decays per second. Bq/Kg is defined as nucleus decays per one kilogram.
100 Bq/Kg means there are 100 decays per second in one kilogram of food and emit radiation.

For accurate food radioactivity measurement(on a basis of Korean Food Standards Codex - Ministry of Food and Drug Safety **)** , **radionuclide analysis function** is needed.

It is for distinguish between **Natural Background Radiation** and **Artificial Radiation**.
For example, bananas, seaweeds are full of K40 and it may detected . But K40 is natural background radiation and impossible to remove, it is not considered as radioactive contamination. So, for precise measurement, radionuclide analysis is necessary.



〈 Gamma Spectrum with Radionuclide Analysis Function 〉

QSF104 does not have a radionuclide analysis function. So, it can not distinguish radioactive element, but measure whole amount of radiation. Natural background radiation is also dangerous for human body. Radiation is always destroy DNA of cells both from Cs-137(artificial radiation) and K-40(natural background radiation).

High sensitive QSF104's food radiation analyze is
using Total Pulse Mode to detect whole amount of radiation
up to 1/10 of radioactivity safety standard limit
(basis on Republic of Korea).

Total Pulse Mode

Screening Food Radioactivity Measurement

※How to do Screening Food Radioactivity Measurement

1. Food radioactivity analysis needs a container designed for QSF104.
   (For maximize measurement sensitivity and for calibration of CRM, QSF104 only container is necessary.)
2. Measure background radiation using Total Pulse Mode.
   Fill a container with water ,put QSF104 into container.
   Check total pulses and time. (To equalize density, use water)
3. Fill a container with food, measure radiation using Total Pulse mode.
   Check total pulses and time.
4. Compare the results . For more detail read * data analyze (p13).
5. The more measure long time, detection limit is lower.
   Detection limit according to measurement time is below.

〈Container designed for QSF104〉

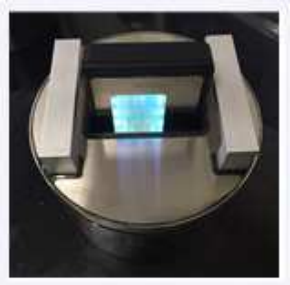
〈 QSF104 with container 〉

Normal (without lead container)	
Detection Time (min.) (Same time : background,sample)	Detection Limit(Bq/Kg)
30	150
60	100
120	75
240	50
480	32
720	25
1440	17

6. With *lead container, lower detection limit.
   *lead container : container made of lead,
   It block the natural back ground radiation to lower detection limit.

〈Lead Container designed for QSF104〉

with Lead container	
Detection Time (min.) (Same time : background, sample)	Detection Limit(Bq/Kg)
30	64
60	48
120	32
240	24
480	16
720	12
1440	8



〈QSF104 with lead container〉

7. You can buy container, lead container as an option.

Total Pulse Mode

Screening Food Radioactivity Measurement

※ Example of Simplified Food Radiation Measurement

This is **a demonstration** how to do food radiation measurement with **QSF104.**
Radioactivity safety standard limit of Republic of Korea is 100 Bq/Kg.
So,Cs-137 - 100 Bq/Kg CRM is measured as a sample at this demonstration.

Cs-137 100 Bq/Kg CRM

This is made in Authorized Inspection Agency - KRISS
(Korea Research Institute of Standards and Science).

※ 100 Bq/Kg Measurement Demonstration (with lead container)

1. Background radiation measurement using QSF104

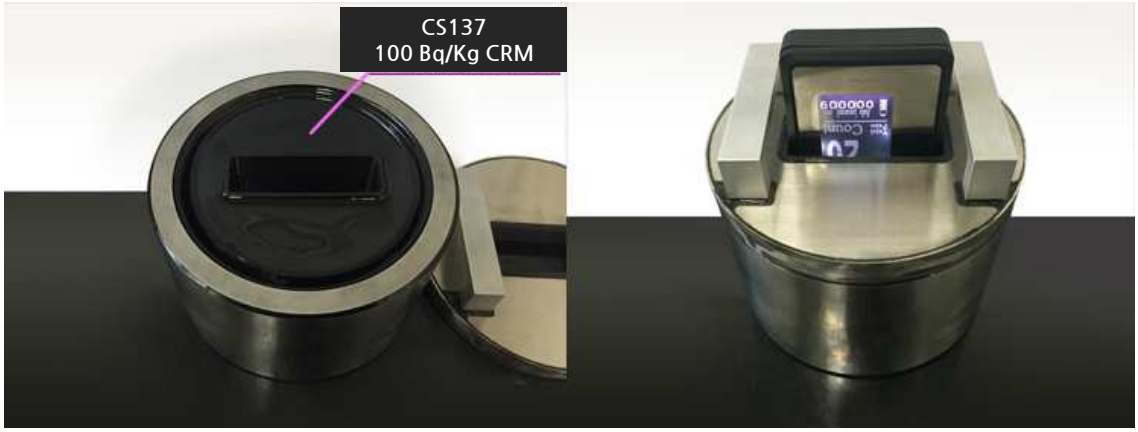
1. Use Total Pulse Mode to measure background radiation.
   Fill the container with uncontaminated thing(ex. water) and place it in the lead.
   Put QSF104 in the lead container.
2. After measurement, record total pulses and total time.
   Calculate the CPM, σ.
3. The result:
   *Total Time : 61.5 minutes *Total Pulses : 4380 count,
   *CPM = 71.2195122 *σ = 1.076123064

The 95% confidence interval value in the range is 71.21 ±2.14 CPM.

Total Pulse Mode

Screening Food Radioactivity Measurement

2. Sample(Cs137 : 100 Bq/Kg CRM) measurement using QSF104



1. Use Total Pulse Mode to measure sample's radiation.
   Put Cs137-100 Bq/Kg CRM in the empty lead container.
2. After measurement, record total pulses and total time.
   Calculate the CPM, σ.
3. The result
   *Total Time : 61.5 minutes *Total Pulses : 4890 count,
   *CPM = 79.5121951 *σ = 1.137049349

The 95% confidence interval value in the range is 79.51 ± 2.26 CPM.

The difference values of Cs137 100 Bq/Kg CRM and background radiation is

79.51(sample's CPM) - 71.21(background's CPM) = 8.3 CPM

8.3 CPM is the difference values.

8.3 CPM difference is because of 100 Bq/Kg of Cs 137.

(QSF104's sensitivity is 2200 ~ 2800 CPM/uSv/h.
So 7~9 CPM caused by 100 Bq/Kg.)

Total Pulse Mode

Analysis of measurement values

※Analysis of Total Pulse Mode's measurement values

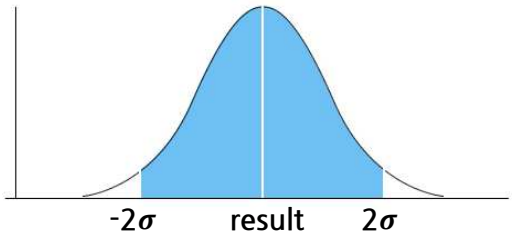
Principle of Radiation Measurement

Radiation measurement is stochastic, so it follows a probability function.
Stochastic measurement means, though you get 12000 count as a result at the first measurement, next measure's result is may different.

Than, what is the result as second, third measurement?
The results are follows discrete probability distribution function.
There is more detail below.

1. Analysis of discriminating distribution curve

▶ Graph of 95% confidence interval. It based on CPM



CPM : Counted pulse Per a Minute
How to get CPM

$$\frac{\text{Total Pulse}}{\text{Total Time(minute)}}$$

Total time(minutes) : QSF104
= hh(hour)x60 + mm(minute) +ss(second)/60

σ : standard deviation

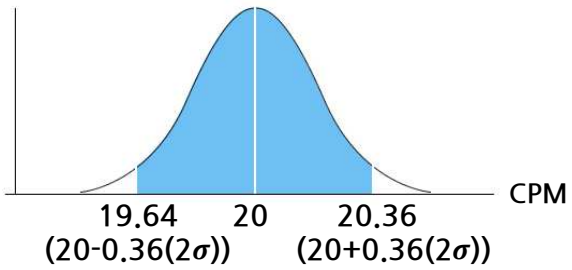
σ - 68 % confidence interval
2σ - 95 % confidence interval
3σ - 99 % confidence interval

How to get σ

$$= \frac{\sqrt{\text{TotalPulse}}}{\text{Total Time(minute)}}$$

▶ Graph of 95% confidence interval, 12000 counted during 600minutes.
Use the formula to this measurement.

A) 600minutes 12000 count measured - 95% confidence interval



CPM $\frac{\text{Total Pulse}}{\text{Total Time(minute)}}$

=12000 / 600 = 20

$\sigma = \frac{\sqrt{12000}}{600} = 0.18$, $2\sigma = 0.36$

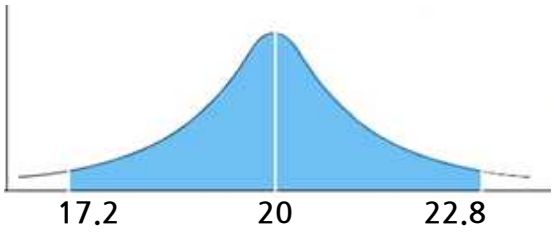
Analysis : If you measure same samples during 600minutes,
the result is 19.64 ~ 20.36 CPM on a 95% confidence interval.

Total Pulse Mode

Analysis of measurement values

▶ Graph of 95% confidence interval. same sample, different time, same CPM

B) 10minutes 200 count measured - 95% confidence interval



CPM $\frac{\text{Total Pulse}}{\text{Total Time(minute)}}$

=200 / 10 = 20

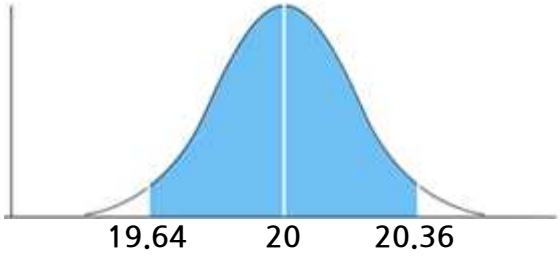
$\sigma = \frac{\sqrt{200}}{10} = 1.4$, 2 $\sigma = 2.8$

Analysis : The result is 17.2 ~ 22.8 CPM on a 95% confidence interval.

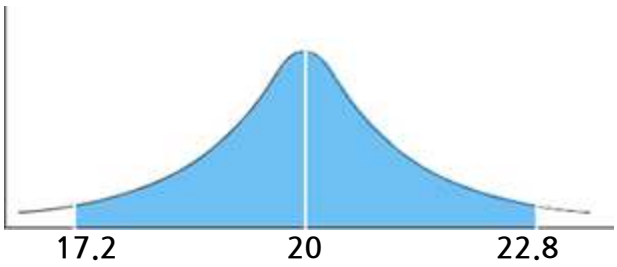
▶Compared two graphs - same samples, same CPM as a result

Time is different. It is the comparison by the time difference.

A) 600minutes 12000 count measured



B) 10minutes 200 count measured



Analysis : Even the result is same as 20 CPM,
Long time measurement is 19.64 ~ 20.36 CPM on a 95% confidence interval.
Short time measurement is 17.2 ~ 22.8 CPM on a 95% confidence interval.

So, as it measured the longer the result is precise.

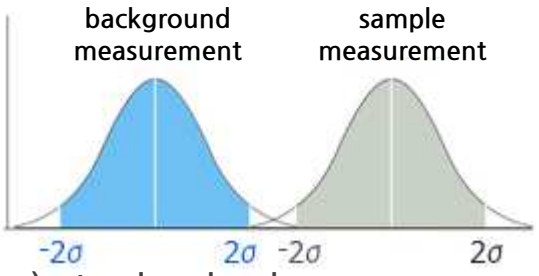
Total Pulse Mode

Analysis of measurement values

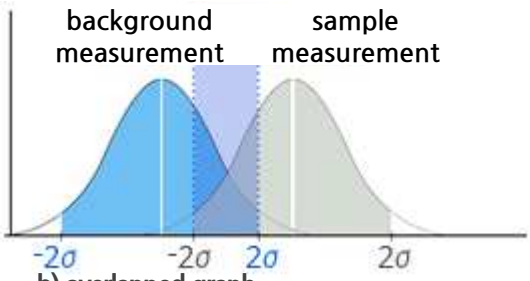
2. How to check there is radioactivity

▶How to check there is radioactivity

① Use Total Pulse Mode.
② Measure background radiation for a while. - Background radiation measurement
③ Measure Sample's radiation - Sample measurement
④ Draw and check the two graphs are overlapped or not. (on a 95% confidence interval , ±2σ)
⑤ If it is not overlapped there is radioactivity, or there is no difference between background and sample's radioactivity.



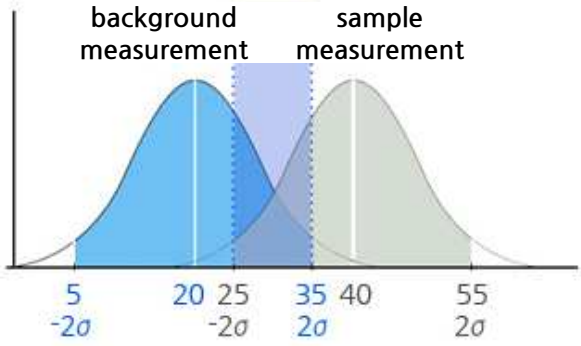
a) not overlapped graph
There is a difference between sample and background radioactivity. Sample's radioactivity is higher than background's radioactivity.



b) overlapped graph
There is no difference between sample and background radioactivity.

⑥ Overlapped graph means that results of background and sample radioactivity measurement's ranges are overlapped.
On 95% confidence interval, even sample's result is higher than background's result, if the two graphs are overlapped, there is no radioactive differences between two results. Because, sample's measurement result could in the range of background's result next time. So, it is not the result that can sure about there are radioactivity.

※Example of graphs analysis



On 95% confidence interval,
Sample measurement is 40 CPM,
Background measurement is 20 CPM.
Ranges of Sample is 5~35 CPM,
Ranges of background is 25~55 CPM.

25~35 CPM range is overlapped in this graph.
It means there is no radioactive difference between two results.

It is possible the background's measurement is 32 CPM, sample's measurement is 27 CPM in next measurement. Background is higher than sample, so there is no radioactivity.

Total Pulse Mode

Analysis of measurement values

▶Overlapped graph means the results is lower than the detection limit.

How much is the detection limit?

Check the CPM's difference when measure 100 Bq/Kg CRM(QSF104 Optional sale product).

The way to check is on ※ Example of Simplified Food Radiation Measurement(11p).

It needs a 100 Bq/Kg CRM which sale as a optional product.

If you don't have CRM, assume the value as 7~9 CPM which is an average result.

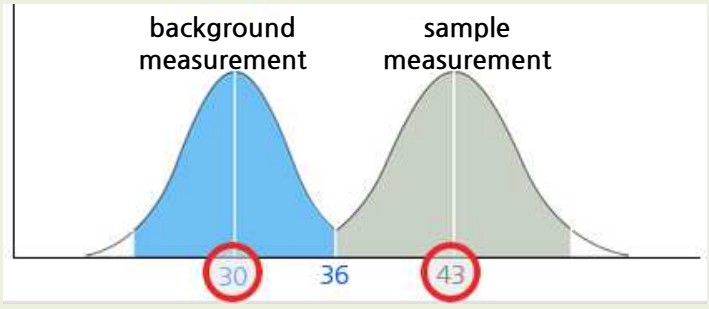
※ How to get a detection limit

Assume the value as 10 CPM which is difference of 100 Bq/Kg sample and background radioactive measurement.

The result is as below.

Background : 30 CPM , 2σ = 6
Sample : 40 CPM ', 2σ' = 7

The CPM difference is 10 . Can we sure there is 100 Bq/Kg of radioactive in the Sample? At first, we need to check a detection limit. Draw graphs using measurement result. At first, draw a background graph. Second, Draw sample's graph overlapped CPM' - 2σ' of Sample and CPM + 2σ of Background.



CPM + 2σ(6) 36 + 2σ'(7)

The difference from this graph is 43(sample)-30(background) = 13 CPM.
10 CPM converts into 100 Bq/Kg, 13 CPM converts into 130 Bq/Kg.

So, the **detection limit of this measurement is 130 Bq/Kg.**

Therefore, the result 10 CPM from the detection, convers into 100 Bq/Kg, and it is lower than 130 Bq/Kg which is the detection limit, so, it is not the result that sample's radioactivity is higher than background's radioactivity.

Total Pulse Mode

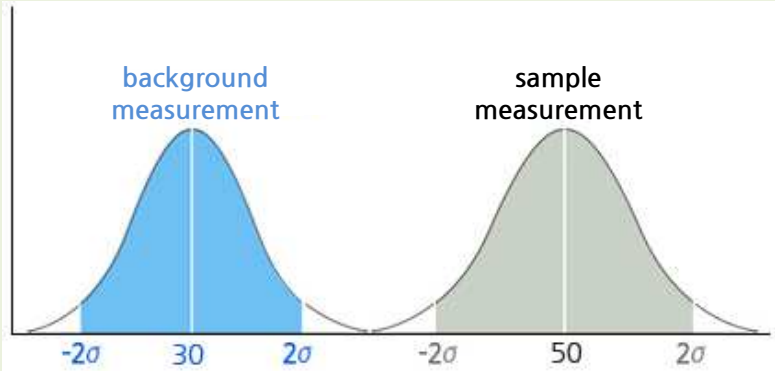
Analysis of measurement values

※ Example of quantitative measurement

The example's result is as below.

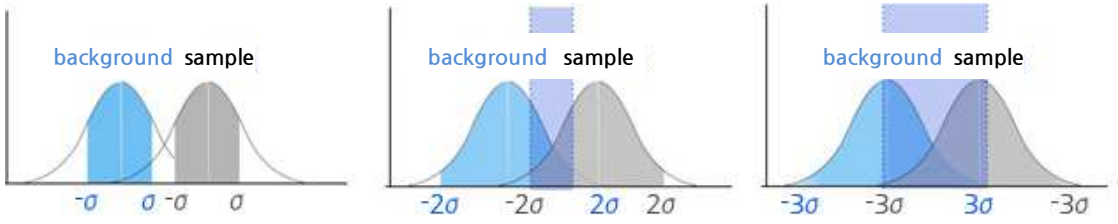
Background : 30 CPM , 2σ = 6
Sample : 50 CPM, 2σ = 7

Two graphs are not overlapped. So, this measurement is valid.
How to get quantitative measure of graph as below .
The difference of CPM is 20 CPM(50 - 30). Quantitative range is 20 CPM ± 2σ.
20 CPM convers into 200 Bq/Kg, 2σ = 7 converts into 70 Bq/Kg.
As a result, 200 ± 70 Bq/Kg is the quantitative measurement value.



▶Comparison of Graphs with different Conditions

A) Different confidence interval



a) confidence interval : 68%, σ b) confidence interval : 95%, 2σ c) confidence interval : 99%, 3σ

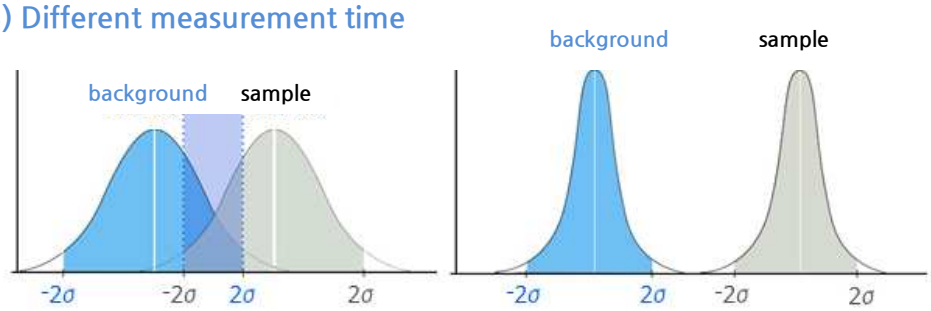
Analysis :
On 68% confidence interval, graphs are not overlapped. There is radioactive difference between sample and background, It means, sample's radioactivity is higher than background's.
On 95% confidence interval, graphs are overlapped. There is no radioactive difference.
On 99% confidence interval, graphs are overlapped. There is no radioactive difference.

It is depend on confidence interval whether the graphs is overlapped or not.

Total Pulse Mode

Analysis of measurement values

B) Different measurement time



a) 60 minutes b) 60000 minutes

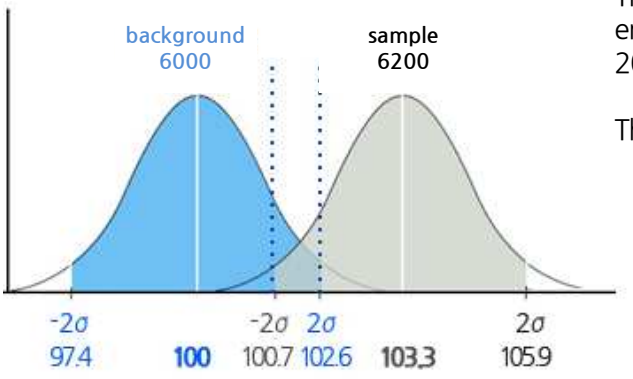
Analysis :
It is depend on measurement time whether the graphs is overlapped or not.

The longer the measurement time, the more precise the measurement .

3. For more precise radioactive measurement

▶To detect very low amount of radioactive using Total Pulse Mode?

A) At a normal environment(without lead container) - 60 minutes



This is a graph of two measurement at a normal environment. Sample's radioactive value is 200 count higher than background's.

The graphs are overlapped.

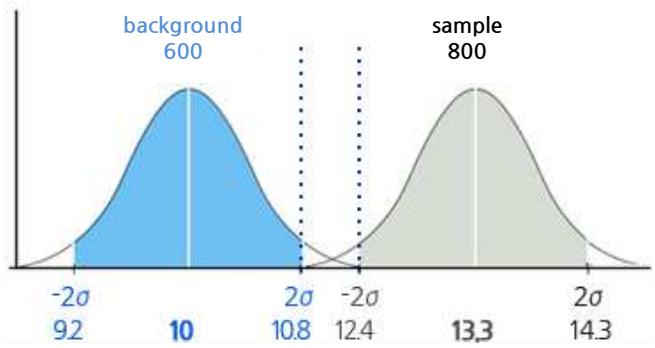
a) CPM : 100
σ : 1.3
2σ : 2.6
3σ : 3.9

b) CPM : 103.3
σ : 1.3
2σ : 2.6
3σ : 3.9

Total Pulse Mode

Analysis of measurement values

B) At a lead container - 60 minutes



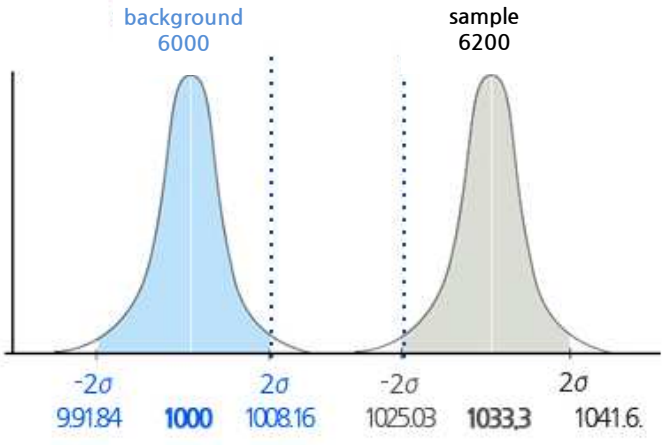
This is a graph of two measurement at a lead container.

Background's result is 1/10 of normal measurement.
Sample's radioactive value is 200 count higher than background's same as normal environment measurement.

The graphs are not overlapped and it means it can detect lower radioactivity.

a) CPM : 10	b) CPM : 13.3
σ : 0.4	σ : 0.47
2σ : 0.8	2σ : 0.94
3σ : 1.2	3σ : 1.41

C) At a normal environment(without lead) with **high sensitive detector** - 60 minutes



Measure at the same environment as A) with a high sensitivity detector.

All results are 10 times higher than A).

Graphs are not overlapped and it is possible to measure until very low radioactivity.

a) CPM : 1000	b) CPM : 1033.3
σ : 4.08	σ : 4.14
2σ : 8.16	2σ : 8.3
3σ : 12.24	3σ : 12.4

So , to measure very low radioactivity, a lead container and a high sensitive detector is needed.

Total Pulse Mode

Analysis of measurement values

4. Easy Total Pulse Mode Use

▶We simplify the steps how to use Total Pulse Mode.

STEP 1.

1. Measure background's radioactivity.

2. A(Total Pulse) : Ⓐ x Ⓔ

Ⓔ : Count : 1
kilo Count : 1000
mega Count : 1000000

ex) 55.2 X 1000 = 55200

3. T (Total Time) : Ⓑx60 + Ⓒ + Ⓓ/60

ex) 1x60 + 31 + 27/60 = 91.45

4. CPM = A(Total Pulse)/T(Total Time)

ex) 55200/91.45 = 603.6

5. Ⓖ σ = A / T

ex) σ= 2.6 2σ = 5.2 , 3σ = 7.8

6. Calculate CPM - 2σ , CPM + 2σ

ex) 603.6 - 5.2 = 598.4

603.6 + 5.2 = 608.8

7. Draw a graph.

CPM - 2σ CPM CPM + 2σ
598.4 603.5 608.8

Total Pulse Mode

Analysis of measurement values

STEP 2.

1. Measure sample's radioactivity.

2. A'(Total Pulse) : Ⓐ' x Ⓔ'

Ⓔ' : Count : 1
kilo Count : 1000
mega Count : 1000000

ex) 54.4 X 1000 = 54400

3. T' (Total Time) : Ⓑ'x60 + Ⓒ' + Ⓓ'/60

ex) 1x60 + 31 + 54/60 = 90.9

4. CPM' = A'(Total Pulse)/T'(Total Time)

ex) 54400/90.9 = 598.5

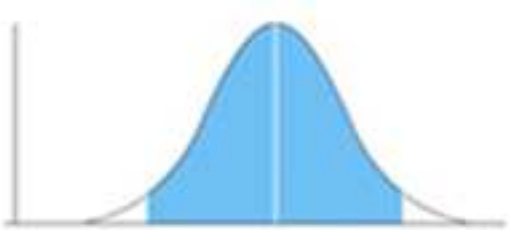
5. Ⓖ' σ' = A' / T'

ex) σ'= 2.6 2σ' = 5.2 , 3σ' = 7.8

6. Calculate CPM' - 2σ' , CPM' + 2σ'
ex) 598.5 - 5.2 = 593.3

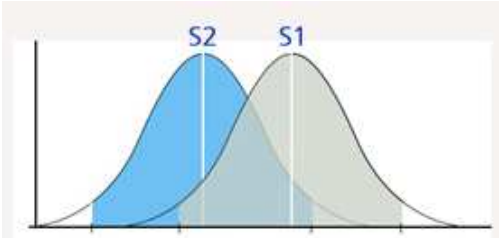
598.5 + 5.2 = 603.7

7. Draw a graph.



CPM' - 2σ' CPM' CPM' + 2σ'
593.3 598.5 603.7

STEP 3.



593.3 598.5 603.7
598.4 603.5 608.8

1. Check graphs of S1,S2 whether overlapped or not.

2. If it is overlapped, there is no radioactive difference between sample and background in 95% confidence interval.
3. If it is not overlapped, there is a radioactive difference.
ex) It is overlapped, there is no radioactive difference between sample and background.

Mode Guide

◎ Power Off Mode

- Mode for power off the device.
- By pressing the button and holding more than 3 seconds, the power is off.

◎ Sound On/Off Mode

- In “sound on” mode
  The device makes “tick” sound when the radiation is detected.

- By pressing and holding the button more than 3 seconds, sound on/off mode is changed.

Mode Guide

◎ Light On/Sleep Mode

- In “Light On” mode, the light is always on.
- Save the battery using “Light Sleep mode.
- Icon shows mode.
- By pressing the button and holding more than 3 seconds, can change the mode.
- In “Light Sleep” mode, light is turned on only short pressing the button and off after 20 secs.
- Light On Mode : 6 hours operation
  Light Sleep Mode : 70 hours operation
  (it could be shortened by frequent button operation)

◎ Product Information

- Mode for shows product information
- Date of Manufacture
- Serial Number

Troubleshooting

Case	Check List
Dose not function all.	- Check if the device is powered up. The device takes approximately 5 seconds for power up. - Check if device is discharged. Try operating after charging for at least 3 hours.
Button is not functioning.	- Check if device is discharged. Try operating after charging for at least 3 hours. - Check for any dust or debris inside the button.
Measurement value seems odd.	- The device can be affected by the following environments. Avoid these for a more accurate measure. - temperature above 50°C or under -10°C - Under strong electromagnetic interference

Specifications

Category	Measurement Sensor
Measurement	**Gamma, X-ray**
Energy Range	50 keV ~ 6 MeV
Sensor Type	**CsI(Tl) Scintillator** + Photodiode
EM protection	Aluminum Shield : 1.5mm thickness

Category	Radiation Measurement
Measurement Range	Survey Meter Mode 0.001 uSv/h ~ 100 uSv/h Dose Meter Mode 0.001 uSv ~ 999.9 mSv Total Count 0~ 999 Mcount Count Per Minute 0~99999 CPM
Measurement Error	Below 20% or 0.15 uSv/h (based on N mode, Cs-137)
Sensitivity	above 2000 CPM/uSv/h (based on Cs-137)

Category	Usage Environment
Temperature	**-10°C ~ 50°C Operational temperature** **-50°C ~ 70°C Storage temperature**
Humidity	20 ~ 90% RH (non-condensing) IP65
Vibration	2g , 10 Hz ~ 230 Hz, 15 min
Free Fall	1m onto wood
Waterproof and Dustproof rating	Above IP64

Category	Exterior
Size	95mm x 60 mm x 17mm
Weight	90g
Color	Bottom : Black Top : Black
Material	ABS resin
Surface	Tinted Resin, Urethane Coating

Category	User Interface
LCD type	Mono, Transparent
Resolution	240 x 128 dots
Warning LED	Red, Green bicolor LED
Backlight	White LED
Display Size	60mm X 30 mm
Sound	Magnetic Buzzer
Button	1 Smart Button

Category	Power
Battery	Li-Polymer, 3.7V 1200mA/h
Current Consumption	**Operation : 100 mA(Light On Mode), 12mA(Light Sleep Mode), 30uA(Standby)**
Operation Time	~6hours(Light On mode), ~3days(Light Sleep mode), ~3years(Standby)

Warranty

◎Device : _____

◎Model : _____

◎Date of Purchase : _____

◎Name : _____

◎Phone : _____

◎Store name : _____

◎Store number: _____

◎Manufacture & Service : Analog Research System

◎Address

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