User's Manual

C o M o 170

V20

Contamination Monitor

M|E|D

Nuklear-Medizintechnik Dresden GmbH

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subject to technical changes

Contents

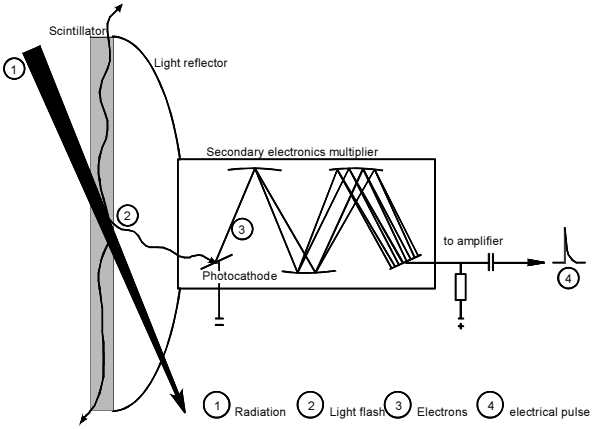
1 Use and function

Contamination may occur wherever people are working with radioactive material. A portable contamination monitor is used to detect surface contaminations by radioactive material. For this kind of detection, a large-area detector is used. The pulses measured by the detector and the electronics can be made visible as a measurement value and audible as acoustic pulses. The contamination monitor **CoMo** is a new development featuring the latest state of the art in microcontroller technology. All measured data and information for operation are shown on a large LC display. Plain text displays support less experienced users in their work with the contamination monitor.
Important functions that have to be changed quickly during the measurement are summarized in a short menu.
Essential system parameters and limit values can be set on a second, protected menu level, foreseen for service and radiation protection personnel.
In addition, the new development uses improved detector systems on scintillator basis which in practical fields do not have the mechanical drawbacks of xenon detectors and do not have to be supplied with gas like gas-flow detectors.
With the scintillation detector, α-, β- and γ-radiation can be measured.

Attention!
If alpha radiation is detected during a beta/gamma measurement, the beta/gamma value can deviate from the real value and has to be measured one more time separately, without alpha crossover. See 9.2.3.

2 Principle of measurement

The decay of radio-nuclides is accompanied by the emission of radiation, e.g. gamma rays (photons). These photons are measured by a detector which converts each photon into an electrical signal.



These signals are amplified by a preamplifier which is integrated in the probe. The signals are then transmitted to the display unit, where they are counted, processed and displayed.

3 Advantages

- innovative detector technology with plastic scintillation-detector
  - no gas-filled or gas flow detectors. Therefore, no gas supply is required. High repair costs of gas-filled detectors (xenon detectors) are avoided.
  - α-, β- and γ-contamination measurement with only one detector. No detector replacement required.
  - simultaneous, selective α- and β/γ –contamination measurement
  - The measuring system automatically detects and signals the presence of α -radiation.
- can be used to -10º C without restrictions (- 20º C on request)
- low weight, only approx. 800 g (900 g for the GM-version)
- ergonomic housing design with large illuminated graphic LCD display (128 x 64 pixels)
- nuclide-specific activity measurement (reference nuclide)
- measuring value indication of pulses, activity or area-based activity
- settings and measuring value parameters protected by pass code
- definable measuring time
- automatic background subtraction
- 26 freely programmable nuclides
  1 double nuclide (e.g. Cs-137 + Am-241)
  1 nuclide vector: selection of two nuclides e.g. Cs-137 + Co-60. Automatic calculation of efficiency by setting the relation of both nuclides to each other.
- integrated calibration menu
- acoustic alarm (approx. 80 dB in 30 cm distance), additionally optical alarm indication on display and red LED in foil keyboard.
- Vibration alarm (in hand grip) can be activated
- external earphone (accessory; see 13.2) for the acoustic alarm and the acoustic single count indication can be connected
- USB-port to connect the instrument to a PC system

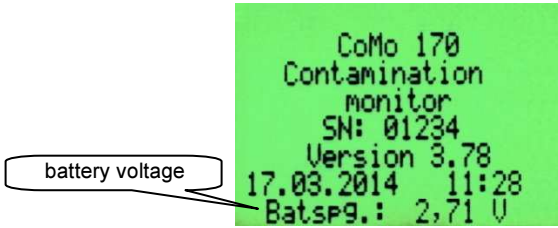
- data storage for 750 data records
- In connection with the optionally available wall station, the CoMo can be used as a stationary contamination meter.
- In connection with the optionally available smear test station, the CoMo can be used as a smear test counter.
- possibility to connect external detectors, e.g. for dose rate measurement, with automatic detector identification
- possibility to connect external display for measurement on inaccessible places. Version with buttons:
  - for data storage
  - to carry out a measurement
  - to start a background measurement
  - to switch on/off acoustic single pulses
- Version with a Geiger-Müller-counter tube for doserate measurement

4 Setup and installation

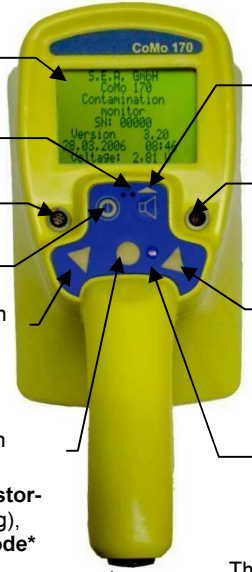
The CoMo is supplied with power by 2 standard batteries TYPE AA. With new batteries (approx. 2500 mA/h), the CoMo can be used approx. 25-30 hours.
For operation with rechargeable batteries, the instrument has an intelligent charging connection with approx. 450 mA charge current and charge conservation circuit.
All you need is a suitable charging unit/power supply and two rechargeable batteries.

4.1 Battery check

To check the charging stadium, the battery voltage is displayed after turning on the device, e.g. 3.0 V with new batteries or 2.5 V with charged batteries.
If the battery voltage is less than 2.1 V, the batteries should be replaced.
With a battery voltage less than 2.1 V, the battery symbol is shown during the measurement. If the voltage is below 1.8 V, the device is automatically turned off. If working with rechargeable batteries, the radius after falling below the 2.1 V threshold is approx. 4 hours, in case of normal batteries approx. 2 hours.
In case of stocking the instrument for a long time, the rechargeable batteries have to be removed in order to avoid total discharge. After max. 2 years, the rechargeable batteries (type AA) have to be replaced by new ones.



5 Operation of the CoMo



LCD display
128 x 64 pixels

sound exit for
internal speaker

socket for exter-
nal detectors

On/Off button
Quick menu

Menu: **Down** button
Searchmode:
Nuclide selection,
if activated

Menu: **Enter** button
Searchmode:
**Measuring value stor-
age*** (short pushing),
Measurement mode*
(long pushing),
*if activated

battery lock screw

position of the batteries
in the compartment

button **Acoustics** +
Special functions
(shown on display)

socket for RS 232
interface, mains op-
eration or charging

Menu: **Up** button
Searchmode:
Nuclide selection,
if activated

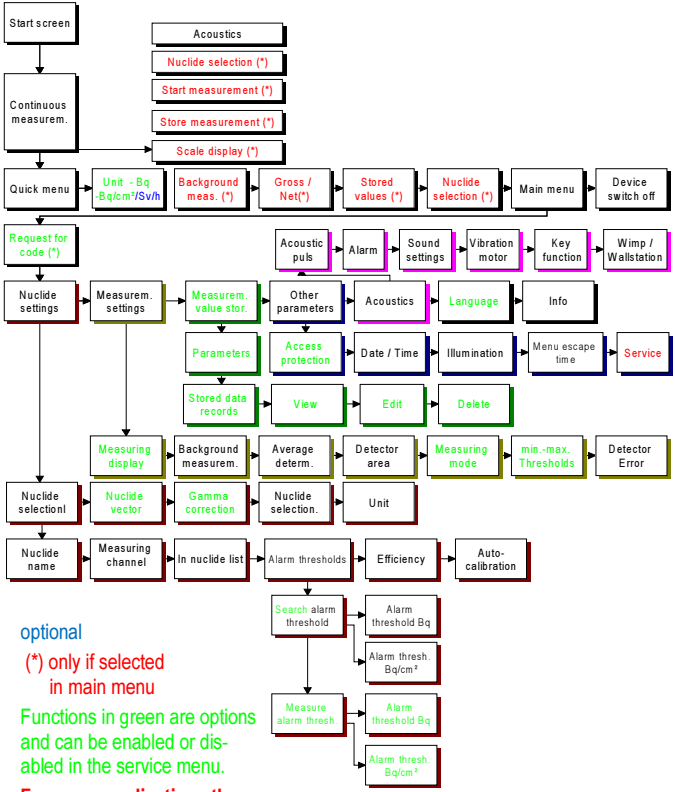
1. with rechargeable
batteries: **charging**
check light
2. burning in case of
alarms

The CoMo has a me-
chanical reverse battery
protection. If the batteries
are inserted wrongly, the
CoMo cannot be turned
on.
Remove the batteries in
case the instrument is put
on stock to avoid leak-
age/ total discharge!

5.1 Operating functions

5.1.1 Menu overview

The program structure of the CoMo as a diagram:



optional

(*) only if selected in main menu

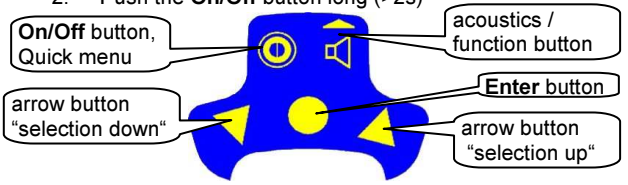
Functions in green are options and can be enabled or disabled in the service menu.

For some applications the access to the service menu is locked.

5.1.2 Turn on / off device

The CoMo is operated by means of a foil keyboard.
To turn on the device, the **On/Off** button has to be pushed until the start screen appears (approx. 2 seconds). The device can be turned off in the Quick menu. Push the **On/Off** button shortly to enter the Quick menu.
The CoMo can be turned off in two ways:

1. Choose the quick menu item **"Device switch off"** and confirm with the **Enter**- Button.
2. Push the **On/Off** button long (>2s)

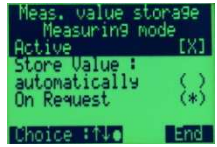


5.1.3 Button functions

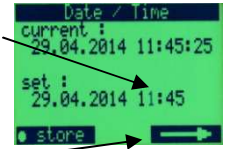
If the device is turned on, the **On/Off** button has to be pushed to enter the Quick menu. Every user has access to this menu. The number of functions in the Quick menu can be defined in the Main menu, which is protected by an access code.
The several menu items are selected with the **arrow** buttons. The selected menu item is displayed as a dark bar with light letters. If the selected menu item is confirmed with the **Enter** button, the desired submenu appears. The buttons for operation are shown left below on the LC display. The function of the **function** button is shown right below.

The parameters are set according to the following scheme:

1. Parameters which can be activated or deactivated are displayed in square brackets. If the parameter is deactivated, the position between the brackets is empty [ ]. If the parameter has been activated by the **Enter** button, a cross is shown between the brackets [X]. This kind of parameters can be activated and deactivated independently from other parameters.
2. Another kind of parameters are those meant to switch from one function to another. This means that from a list with related functions only one function can be activated at the same time. This kind of parameters are shown in round brackets ( ). If such a parameter is activated by the **Enter** button (*), all other related parameters are deactivated.



3. If a number or a description has to be changed, the first digit of the selected number starts to blink. This digit can be changed to a lower or higher level by using the **arrow** buttons. If the next digit has to be changed, it can be selected by pushing the **function** button (which belongs to the arrow right below on the display). If the setting is complete, it can be confirmed and stored by pushing the **Enter** button.

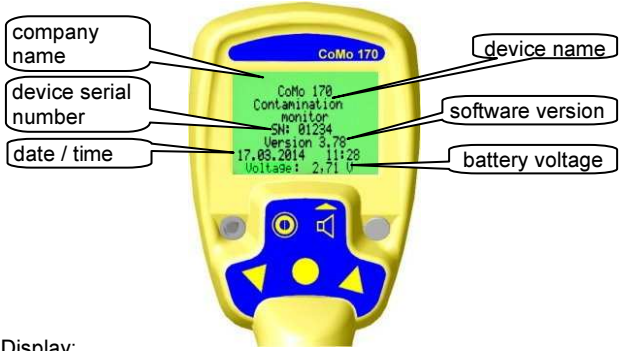


5.1.4 Menu function for external devices

In case of using external devices: external detectors, the wall station or the smear test station, individual menus adapted to the field of application are displayed (see chapter 8).

5.2 Start screen

The start screen provides an overview of the software status, the battery voltage and indicates possible system errors.



Display:

Company name
Device name
Serial number
Software version
Current date
Battery voltage

If the battery voltage is less than 2.1 Volt, a battery symbol appears during measurement

Button functions:


On button / Quick menu


short: acoustic single pulses On / Off
long: acoustics menu


no function


no function

5.3 Measurement display Numeric

After the device has been turned on and the start screen has appeared, the instrument automatically switches to the measurement mode. If net measurement is set and 'BG-request' is activated in the menu 'Measure settings | Background measurement | Further settings' (see 6.2.2.2) a background measurement (see 5.7.1) can be started immediately. The CoMo starts its measurement process using the parameters defined last time.

Display:

selected **measuring mode** or selected nuclide
Measuring channel: α, βγ, α + βγ or α / βγ
Defined **alarm threshold**
Gross / Net: measurement value with or without background subtraction
Current **measurement value** + **measuring unit** (cps, Bq or Bq/cm², with integrated GM counter tube (µ,m) Sv/h)
Analogous indication in the current unit or in % of the alarm threshold

Button functions:

short pushing: Quick menu (see 5.7)
long pushing: Turn on / off

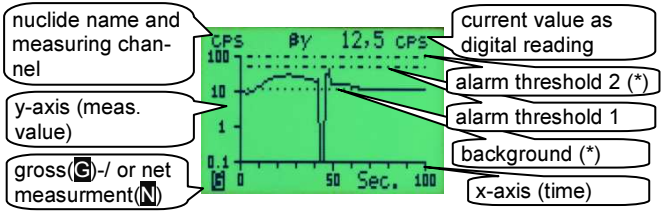
short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 5.6)

invoke the nuclide selection, if active (see 5.5).

short pushing: store measuring value, if active (see 6.3.1 and 7.2)
long pushing: start measurement, if active (see 6.2.5 and 7.3)

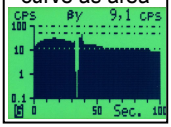
5.4 Measuring display Graphic

The graphic display can be enabled via the service menu (6.4.5.1). If a graphic display (see 6.2.1.2) is selected, the curve with the parameters defined last time appears after the start screen. If the measuring value is displayed as a graph, the dividing factor (see 5.6) is deactivated (limited processor capacity).



(*) can be enabled in service menu (see 6.4.5.1.1)

curve as area



Display:

Unit: cps, Bq or Bq/cm²
Measuring channel: α, βγ or α + βγ.
Current **measurement value + measuring unit**
Gross / Net: measurement value with or without background subtraction
Alarm threshold(s) as semicolon line (can be en(dis-)abled)
Background as dotted line (can be enabled / disabled)
The time axis can be selected 10s, 100s and 1000s

In the menu (see 6.2.1.2.1) you can change the time axis during measurement by means of the arrow buttons.

Button functions:


short pushing: Quick menu (see 5.7)
long pushing: Turn on / off

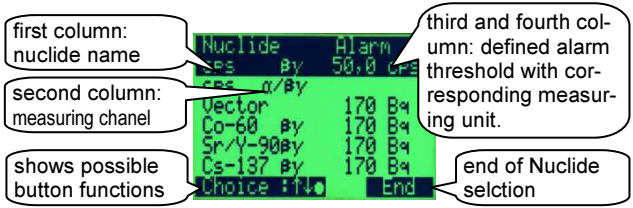

short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 5.6)


invoke the nuclide selection, if active (see 5.5).


short pushing: store measuring value, if active (see 6.3.1 and 7.2)
long pushing: start measurement, if active (see 6.2.5 and 7.3)

5.5 Nuclide selection

The CoMo contains a nuclide file with 26 nuclides, 1 double nuclide, 1 nuclide vector and 4 cps modes. In the Main menu you can define which nuclide has to be available for measurement. This reduces the nuclide list to the nuclides that are really used when selecting a nuclide for the measurement. Nuclide selection is done via one of the arrow buttons or, if enabled (see 6.1.4), via the Quick menu.



If the selected nuclide is not stored with Enter , this selection is valid only until the instrument is turned off. In that case, the previously selected nuclide appears after turning on the instrument again.

Display:

Measuring channel: α, βγ, α+βγ or α/βγ

Defined **alarm threshold**: **unit** cps, Bq or Bq/cm²

Button functions:

If no button is pushed in the nuclide selection mode, the instrument automatically returns to the measurement mode after about 2 seconds (If the parameter “Automatic menu end: **short**” is selected see 6.4.4)

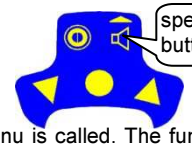
here no function

close nuclide selection

select the desired nuclide

The selected nuclide is stored as standard nuclide. It is displayed automatically after turning on the instrument.

5.6 Acoustics menu



In the search mode, the speaker is enabled. If you push the speaker button shortly, the acoustic single pulses of the active channel are turned on or off. If you push longer (> 2 s) the acoustics menu is called. The function of the Acoustics menu can be hidden except for the acoustic single pulses. However, the acoustics signalling exceeding of the warning threshold will not be disabled. The acoustic alarm in case of exceeding of a warning threshold can be acknowledge by pushing the loudspeaker key (see 6.6.4). The alarm also ends as soon as the value has dropped below the threshold again.

Display:

Acoustic **single pulses** α, βγ or GM-counter tube (option) on-/off
(also by pushing the button shortly in the search mode)

Acoustic factor: The acoustic single pulses can be reduced by the dividing factor (factor = divisor).

Submenu with further acoustics settings (see 5.6.1)

Button functions:

here no function

close acoustics menu

select desired menu item

change selected menu item; continue with a submenu item

5.6.1 Further settings acoustics menu

Display:

The following options are only displayed if these are activated in the main menu (see 6.6.5).

Alarm search: acoustic alarm in case of alarm threshold exceeding (in)active in search mode

Alarm measure: acoustic alarm in case of alarm threshold exceeding (in)active during measurement

Volume: The default volume of the CoMo can be adapted to the field of application in 7 steps. (e.g. industry = high and doctor's practice = low)

Headphone: The earphone volume can be set in 7 steps. Through the earphone the same acoustic signals as through the speaker are put out. The earphone can be ordered as an accessory (see 13.2).

Vibration motor: If the vibration motor is activated, the contamination monitor starts to vibrate in case of exceeding the alarm threshold.

The acoustics menu can be reduced to single counts (see 6.6.4).

Button functions:

here no function

close acoustics menu

select desired menu item

Reduce or increase volume

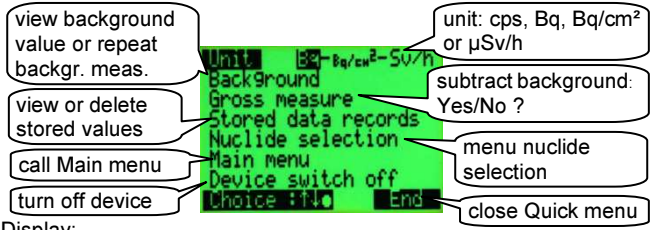
change selected menu item

confirm selected menu item (volume)

Acoustics menu reduced

5.7 Quick menu

The Quick menu contains important functions which have to be changed quickly during measurement. Push the **On/Off** button to open the Quick menu. The functions background measurement, gross/net measurement, stored data records and nuclide selection only appear if activated in the Main menu.



Display:

Unit: with the four pulse modes only cps, with all other nuclides either Bq or Bq/cm² (with integrated GM-counter tube also µSv/h)

Background measure: display of the last measured background values and start of a new measurement (see 6.2.2)

Gross/Net measure: measured values with/without background subtraction (switch with)

Stored data records: submenu to view or delete values (see 6.3.2)

Nuclide selection: (see 5.5 and 6.1.4) via arrow buttons in search mode or as an alternative via Quick menu

Main menu: access protected by a code number

Device switch off: This function is possible in the Quick menu.

Button functions:

The CoMo can also be turned off by pushing the On/Off button long.

Off button

End of Quick menu

Select the desired menu item

Change a selection or continue with a submenu item

Quick menu minimized

5.7.1 Background measurement

When measuring surface contamination, e.g. of a work bench in a laboratory, a difference has to be made between the measurement sign emitted by the contaminated object and the measurement sign coming from the radiation field in the direct area, the so called background.
The background caused by natural radioactivity which is present everywhere is for the CoMo 170 approx. 20 cps, based on a natural background radiation of approx. 100 nSv/h. Due to the location of the measurement place (mountains, rocky undersoil etc.) the background rate mentioned above can double.

To get the net measurement value of a contamination measurement, the current background at the measuring place has to be measured, stored and subtracted from the following contamination measurement. Depending on the parameter setting, the CoMo automatically subtracts the stored background value.

A background value which is not current or entered wrongly leads to incorrect measurement results.

The parameters for the background measurement are defined in the Main menu. After invoking the background measurement from the Quick menu, the last measured background is displayed and you can decide, if a new measurement has to be performed. The measurement process is started using the measuring time entered in the Main menu. The measured values are displayed separately for both channels (α and βγ). If you notice that the values do not change anymore, you may stop the background measurement prematurely by pushing the **Enter** button. The values measured up to then are stored as the new background. If you push the **End** button the measurement process is aborted and the old values are still valid.

Display:

α:	shows α - background
βγ:	shows βγ - background
Measure time:	remaining background measuring time

Button functions:

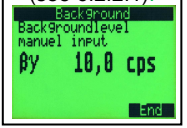

here no function


aborts the background measurement


here no function


premature termination of the background measurement (The new values are stored.)

displayed text if background was entered manually (see 6.2.2.1):



6 Main menu

Code input

The access to the main menu is protected by a 4-digit code to rule out any inadvertent modification of the system parameters. The access code can be changed in the menu 'Other parameter | Code change (or Access protection)' (see 6.4.1).

The access code upon delivery is: **0000**

Display:

Access code

Button functions:

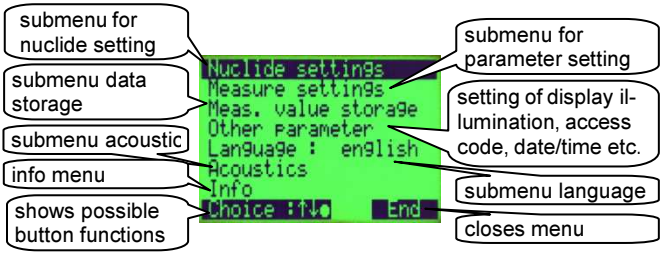
here no function

select next position

change value of selected digit 9..0 and 0..9.

confirm code

Setting of the system parameters



Display:

Nuclide settings: define parameters of the nuclide-specific data (see 6.1)

Measure settings: define device options (see 6.2)

Meas. value storage*: view the stored measurement values and set parameters of the store function (see 6.3)

Other parameter: access code to Main menu, setting of date/time and display illumination function (see 6.4)

Language*: submenu to select language (see 6.5)

Acoustics: set acoustics and vibration motor; possibility to configure the function of the speaker button (see 6.6)

Info: indication of serial number, software version, battery voltage and adjustment settings (see 6.1)

(*) can be en(dis-)abled in service menu see 6.4.5.1.1 and 6.4.5.1.2.1

Button functions:


here no function

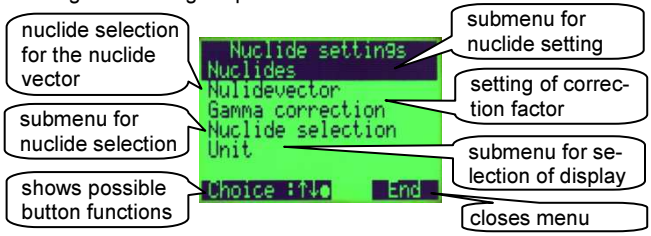

close the Main menu – return to the measurement mode


select desired menu item


continue with a submenu item

6.1 Nuclide settings

Settings of radiological parameters



Display:

Nuclides: parameter setting of nuclide-based data (see 6.1.1)

Nuclide vector*: activating the function and selection of the nuclides for the nuclide vector (see 6.1.2)

Gamma correction*: If alpha radiation is present, the gamma area is over-estimated. This can be balanced with the Gamma correction (see 6.1.3).

Nuclide selection: submenu for nuclide selection (see 6.1.4)

Unit: submenu for selection of display unit (see 6.1.5)

(*) can be en-(dis-)abled in service menu see 6.4.5.1 and 6.4.5.1.1

Button functions:

here no function

back to main menu

select desired menu item

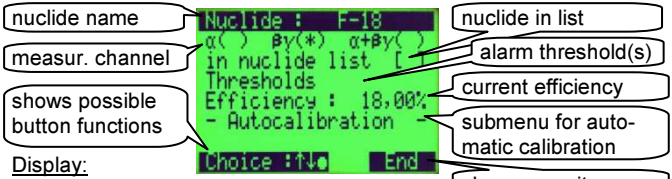
continue with a submenu item

6.1.1 Nuclide settings Bq - Bq/cm²

After nuclide selection (see 5.5) you have to define the settings of the selected nuclide. The CoMo contains a nuclide file with 32 nuclides. Some of the nuclide slots are pre-programmed with standard values. Apart from the first four positions (counts per second), all entries can be defined freely.

Caution ! Incorrect settings lead to incorrect results.

- The results of an incorrect channel selection may be that e.g. a high βγ contamination will not be detected if the α-channel has been selected.
- Incorrect alarm thresholds result in false alarms or trigger no alarm at all.
- An incorrectly defined efficiency leads to incorrect measurement.



Display:

Nuclide: nuclide name (max. 7 characters)
Measurement channel: channel which the nuclide should be measured with (α, βγ, α+βγ or α/βγ)
in nuclide list: add the nuclide to selection list for measurement
Thresholds: submenu alarm threshold(s) in Bq and Bq/cm²
Efficiency: entered or automatically determined efficiency
Autocalibration: submenu for automatic calibration of the nuclide

Button functions:


here no function


back to 'nuclide settings' (see 6.1)
in input mode: next position


select desired menu item or change selected entry

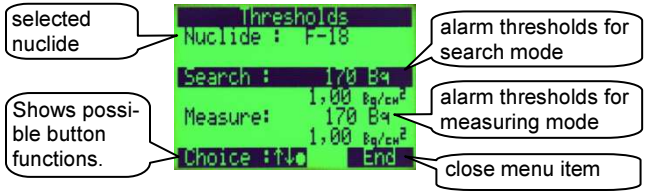

confirm entry or continue with submenu item

6.1.1.1 Alarm thresholds

Depending on the defined average determination (see 6.2.3), the display variation in the search mode can be higher than in the measuring mode. For this reason it is possible if enabled in menu restrictions (see 6.4.5.1) to define two different alarm thresholds adapted to the field of application:

1. for the search mode (continuous display)
2. for the measuring mode (measurement with measuring time or according to error limit)

For both modes you can set alarm thresholds for Bq and for Bq/cm².



Display:

Nuclide: selected nuclide for threshold setting

Search: alarm threshold setting for search mode in Bq and Bq/cm²

Measure: alarm threshold setting for measuring mode in Bq and Bq/cm²

Button functions:

here no function

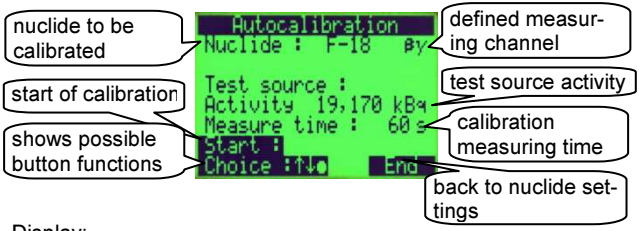
back to 'nuclide settings' (see 6.1.1)
in input mode: next position

select desired menu item or change selected entry

confirm entry

6.1.1.2 Autocalibration – Default settings

The device is equipped with an autocalibration function.
This allows you to calibrate your own nuclides with present test sources.



Display:

Nuclide: indication of nuclide to be calibrated

Measuring channel: channel which the nuclide should be calibrated with (α, βγ, α+βγ)

Test source activity: For auto-calibration you need a test source having the following properties:
- area source with approx. 100 cm² active area
- activity from 0.5 - 10 kBq

Measure time: The measuring time is dependent on the level of the source activity.
reference values: approx. 0.5 kBq: 500 seconds
from 10 kBq: 60 seconds (min. meas. time)

Start: start of calibration measurement

Button functions:


here no function

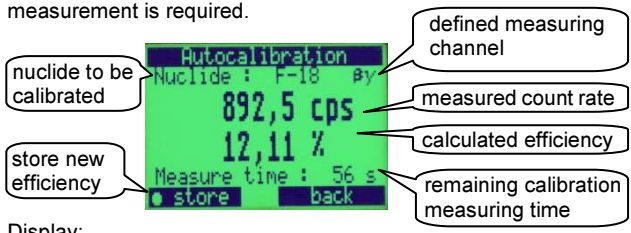

back to 'nuclide settings' (see 6.1.1)
in input mode: next position


select desired menu item or change selected entry


confirm entry or continue with submenu item

6.1.1.2.1 Autocalibration – Measurement

Before the first autocalibration (since selecting the main menu), a background measurement is made first. If you don't leave the main menu before the next autocalibration, no further background measurement is required.



Display:

Nuclide: indication of nuclide to be calibrated

Measure channel: channel which the nuclide should be calibrated with (α, βγ, α+βγ)

Measured count rate: pulses picked up in the selected measuring channel

Calculated efficiency: obtained from the test source activity and the measured count rate minus the background count rate.

Measure time: remaining calibration measuring time (The measurement can be terminated any time.)

Store: If the efficiency reading does not change any more, the measurement may be stopped and stored before the defined measuring time is over.

Button functions:

here no function

end or abort autocalibration
-> 'autocalibration – default settings' (see 6.1.1.2)

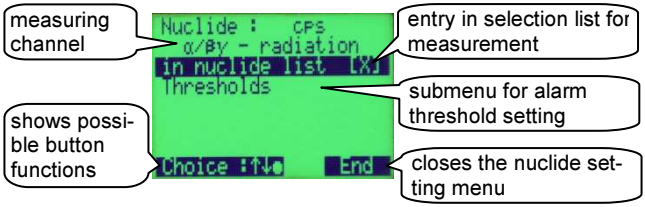
here no function

confirm new efficiency

6.1.1.3 Nuclide settings - cps mode

If you choose one of the four cps entries during nuclide selection (see 5.5) you get to the settings for counts per second. In the cps setting menu you can only change the alarm threshold and determine if the entry should be available in the nuclide selection during measurement. The four cps modes are only different with regard to the use of the measuring channels.

- α – radiation: measurement only in α channel
- βγ – radiation: measurement only in βγ channel
- α+βγ–radiation: measurement in α and βγ channel (value-added)
- α / βγ – radiation: measurement in α and in βγ channel (both channels are shown simultaneously)



Display:

Measuring channel: channel which the counts should be measured with (α, βγ, α+βγ or α/βγ)

in nuclide list: add nuclide to the selection list for the measurement

Thresholds: submenu for setting the alarm thresholds in cps (counts per second)

Button functions:


here no function

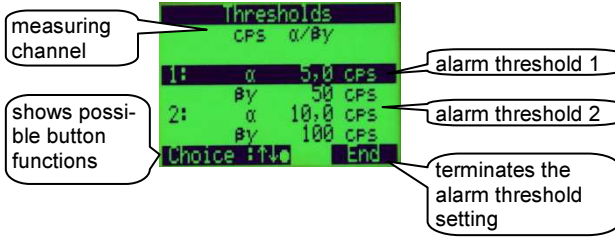

end of menu item -> 'Nuclide selection'


select desired menu item or change selected entry


confirm entry or continue with submenu item

6.1.1.3.1 Alarm thresholds – cps mode

In the counts per second mode you can activate two alarm thresholds if '2 alarm thresholds' is enabled (see 6.4.5.1). If the first alarm threshold is exceeded and quit, the second alarm threshold is activated. If the measuring value falls below the first threshold again, the first threshold is active again.



Display:

Measuring channel: channel which the counts should be measured with (α, βγ, α+βγ or α/βγ)

Threshold 1: setting alarm threshold 1 in cps (counts per second)

Threshold 2: setting alarm threshold 2 in cps (counts per second)

Button functions:

here no function

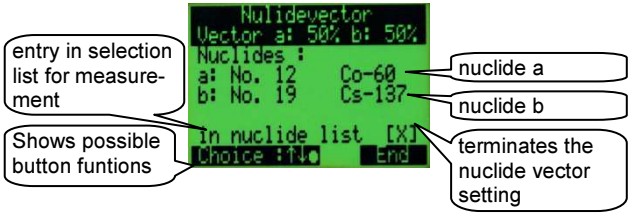
back to 'Nuclide settings - cps mode' (see 6.1.1.3)
in input mode: next position

select desired menu item or change selected entry

confirm entry

6.1.2 Nuclide vector

In areas where it is usual to work with a mix of two nuclides (e.g. in a nuclear power plant Co-60 / Cs-137 mix) you can set a so called nuclide vector. For this purpose you select both pre-calibrated nuclides from the available nuclide list and enter the relation of the nuclides according to their distribution in percent. The system now calculates the mix efficiency of both nuclides and uses it for measurement in Bq or Bq/cm². This menu item can be disabled in service menu 6.4.5.1.



Display:

Vector: relation of both nuclides to be measured. The first percent number can be changed. The second number is calculated automatically then.

a: nuclide 1 for the nuclide vector. Selection from the displayed list.

b: nuclide 2 for the nuclide vector. Selection from the displayed list.

in nuclide list: add nuclide vector to selection list for measurement

Button functions:


here no function


back to 'Nuclide settings' (see 6.1)
in input mode: next position


select desired menu item or change selected entry


confirm entry

6.1.3 Gamma correction

Due to secondary effects (see 9.2.3), present alpha radiation leads to an increased crossover from alpha into the beta/gamma channel. This influence can be balanced by calculation with the so called gamma correction. This menu item can be disabled in service menu 6.4.5.1.1.

Display:

Active: gamma correction activated

Factor: setting how many counts from the alpha channel have to be subtracted from the beta/gamma channel.
Example:
1000 counts in the alpha channel generate 100 counts in the beta-/ gamma channel. With a factor of 0.1 the system subtracts 0.1 x 1000 cps (from the alpha channel) = 100 cps in the beta-/ gamma channel.

Button functions:


here no function

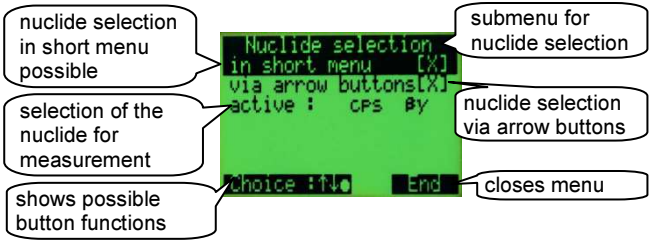

back to 'Nuclide settings' (see 6.1)
in input mode: next position


select desired menu item or change selected entry


confirm entry

6.1.4 Nuclide selection

Here the setting for the nuclide selection is defined.



Display:

Nuclide selection

In short menu: If more than one nuclide is needed, the nuclides can be selected via the short menu.

Via arrow button: If more than one nuclide is needed, the nuclides can be selected via the arrow keys during measurement operation.

Active nuclide: If no nuclide selection is enabled in the measurement operation or in the short menu, the nuclide to be measured can be enabled here. After pushing the Enter button, the nuclide list (see 5.5) to select the desired nuclide is displayed.

Button functions:

here no function

back to 'Nuclide settings' (see 6.1)

select desired menu item

change selected parameter or
continue with submenu item nuclide selection

6.1.5 Unit

Here the unit of the nuclide measurement is set.

Display:

Unit: If no selection of the unit is planned in the short menu, the unit can be selected here for the measurement.

In short menu: The nuclide unit can be selected via the short menu if this menu item is enabled.

If one of the cps modes has been selected as a nuclide, the unit is set to cps.

Button functions:

here no function

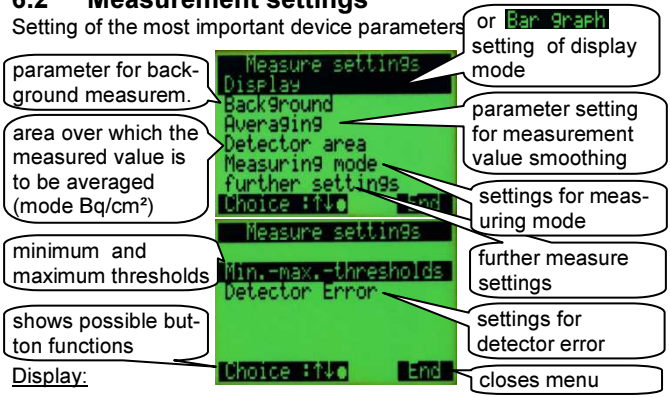
back to 'Nuclide settings' (see 6.1)

select desired menu item

change selected parameter

6.2 Measurement settings

Setting of the most important device parameters



Display:

Bar graph / (Display*): display settings in search mode (see 6.2.1)

Background: parameter setting for background measurement (see 6.2.2)

Averaging: parameter setting for average determination (see 6.2.3)

Detector area: area over which the measured value has to be determined (see 6.2.4). According to the German Radiation Protection Regulations: 100 cm² / 300 cm²

Parameter setting e.g. of measuring time for **Measuring mode*** (see 6.2.5)

Display and parameter setting of **Minimum- und Maximum thresholds*** (see 6.2.6).

Detector error: settings in case of a detector error (see 6.2.7)

(*) can be disabled in service menu 6.4.5

Button functions:

here no function

end of measurement setting -> main menu (see 6)

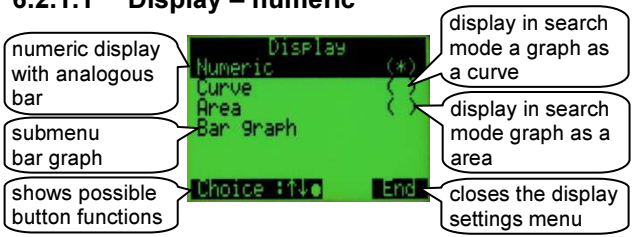
select desired menu item

continue with a submenu item

6.2.1 Bar graph - Display

With the CoMo you have the possibility to choose three different display modes for the search mode.
If the graphic function is activated in the menu item 'other parameter | service' (see 6.4.5.1), the menu item is called 'Display' and you can choose between the numeric and the curve display as a curve or an area.
If the graphic function is deactivated, the menu is called 'bar graph' and selecting the menu item directly leads to the configuration menu of the bar graph display (see 6.2.1.1.1).

6.2.1.1 Display – numeric



Display:

Numeric: display of current measuring value in big characters with analogous bar
Curve: measuring value display as a curve
Area: measuring value display as a filled area underneath the measuring value curve
Bar graph: leads to submenu (see 6.2.1.1.1) for configuration of bar graph display

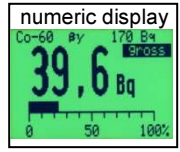
Button functions:

here no function

end of display setting

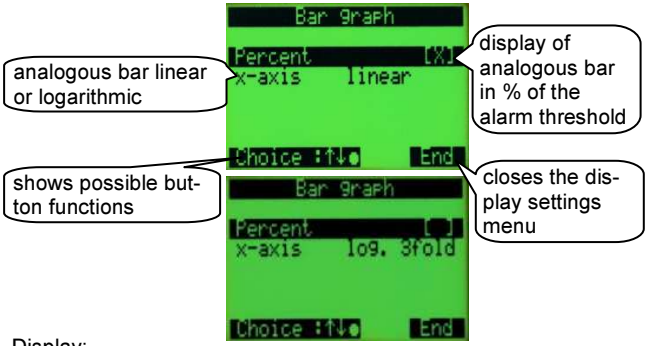
select desired menu item

change selected parameter
or continue with a submenu item



6.2.1.1.1 Bar graph

The CoMo offers the possibility to configure the analogue bar graph display.



Display:

Bar graph in percent: analogous display in % of the alarm threshold (alternative in the current unit)

X-axis: settings:

- linear (only possibility in case of display in percent based on alarm threshold)
- logarithmic (2 or 3 decades) only during display current unit

Button functions:

here no function

end of display setting
-> 'measurement settings' (see 6.2)

select desired menu item

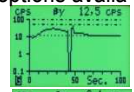
change selected parameter

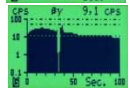
numeric display X-axis logarathmic 3 decades

6.2.1.2 Measurement display – graphic

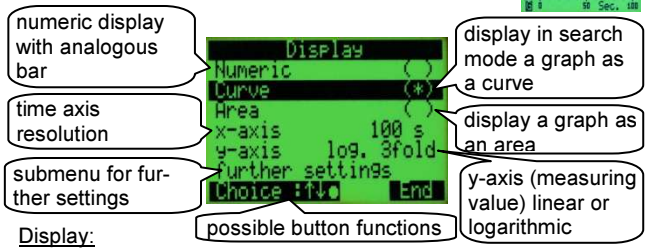
In the graphic mode (see 5.4) there are two display options available:

1. graph as a curve (background line and thresholds are better to recognise)
2. graph as an area (graph better visible)





If the measuring value is displayed as a graph, the dividing factor (see 5.6) is deactivated (limited processor capacity).



Display:

Numeric: display of current measuring value in big characters with analogous bar (see 6.2.1.1)

Curve: measuring value display as a curve

Area: measuring value display as a filled area underneath the measuring value curve

x-axis: 10s, 100s or 1000s. In case of 1000s, the resolution is 10s. Each time the highest 1-second-value is displayed

y-axis: linear or logarithmic (3 decades)

submenu **further settings**

Button functions:

here no function

end of display setting

select desired menu item

change selected parameter or continue with a submenu item

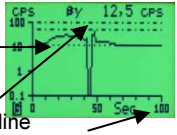
6.2.1.2.1 Measurement display – further settings

In the graphic mode it is possible to display the alarm threshold(s) and the background as lines in the curve. The alarm thresholds are displayed as a semicolon line and the background as a dotted line.

Display:

Background line: display of the last measured background as a dotted line in the curve.

Display threshold: display of the defined alarm threshold(s) as a semicolon line



Time axis changeable via arrow buttons: The scale of the X-axis can be changed via the arrow buttons into the following values: 10s, 100s, 1000s or as a numeric display (1s-value).

If the arrow buttons  were defined for nuclide selection, a warning about a change in button assignment is displayed.

Button functions:

 here no function

 end of menu item

 select desired menu item

 change selected parameter

6.2.2 Background measurement

The background subtraction can be performed in three ways.

1. Background measurement (precise measurement values but long measuring times)
2. Subtraction of a fixed entered value (see 6.2.2.1) (measurement less precise but more quickly applicable).
3. Calculate background in the active wall station and store it as current background value after taking the instrument out of the wall station.

Display:

Background measurement activated: Activating background subtraction. The menu item background measurement is added to the Quick menu. If the menu item is not activated, a gross measurement is always made.

Background:

- On Request: Background subtraction after BG measurement

- Input ...cps: Subtraction of BG entered in cps (6.2.2.1)

Measure time: defined measuring time for background measurement (2-999 seconds).

Submenu with further settings for BG measurement (6.2.2.2)

Button functions:


here no function

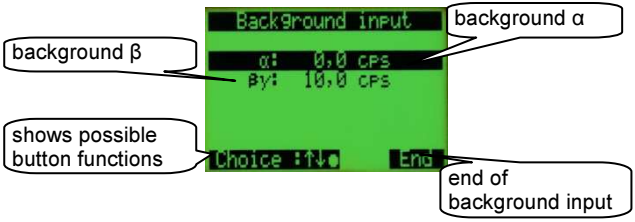

end of menu item -> 'Measurement settings' (see 6.2)
- in input mode: next position


select desired menu item or change selected entry


confirm entry or continue with a submenu item

6.2.2.1 Background Input

The subtraction of a manually entered value saves a background measurement. The CoMo can be used more quickly. But the measuring values of a net measurement are inexact. The background values which are subtracted in case of a net measurement can be entered manually in cps here.



Display:

α: α-background value in cps, to be subtracted in case of net measurement

β: β- background value in cps, to be subtracted in case of net measurement

Button functions:

here no function

end of menu item -> 'Background measurement' (6.2.2)
in input mode: next position

select desired menu item or change selected entry

confirm entry

6.2.2.2 Further settings Background measurement

Display:

Get background **from wall station** in the wall station mode.

BG-request: After turning on it is possible to start a background measurement, provided the net mode is activated.

Threshold active: The current gross measuring value is continuously compared to the valid background in the net mode. If the measuring value is lower than the valid background and the difference is higher than the „threshold“ value, an acoustic alarm is triggered and a message to remeasure the background appears. The acoustic alarm is only stopped if the background measurement is started.

Threshold: Here you enter the threshold value to determine how far the current gross value may be below the valid background.

Button functions:


here no function


end of menu item
->'Background measurement' (6.2.2)


select desired menu item


confirm entry

message for background change:

see 7.8

6.2.3 Average determination

6.2.3.1 Statistical error

Nuclear decays, i.e. transformation of nuclei are natural, randomly distributed events. If you examine e.g. a radiation source using a detector and measures the number of registered events periodically over a fixed measuring time, then you will see that an accumulation occurs in a certain area. From the size of the area of this average value you can easily infer the intensity of the source. Its true intensity, however, remains unknown, since you cannot choose an infinitely long period of observation. The average value becomes an exact value only if the period of observation is infinite. When interpreting the measured values you only have to indicate the range in which the exact intensity is expected!

The mathematical relationship between random events is described by the probability calculus, where the natural distribution, e.g. in case of nuclear decay, is expressed by a so-called Gauss distribution.

This can be presented in a simplified manner:
It is more probable to obtain measured values which come close to the exact quantity than measured values that are subject to significant deviations.
It is equally probable that measured values smaller or larger than the exact value will be obtained (symmetrical distribution).

Example:

A radioactive source of known intensity emits on average 100 particles per second which are registered by a detector in 1-second cycles.

The statistical variability for $\pm 1\ \sigma$ (sigma) is

$$\sqrt{100} = \pm 10 \text{ counts.}$$

If a large number of measuring cycles are evaluated, the following relationship becomes apparent:

Number of cycles in %	Measured values from	to	Standard deviation (± 1 σ) %
68.27	90	110	1
95.45	80	120	2
99.73	70	130	3
99.997	60	140	4
99.999943	50	150	5

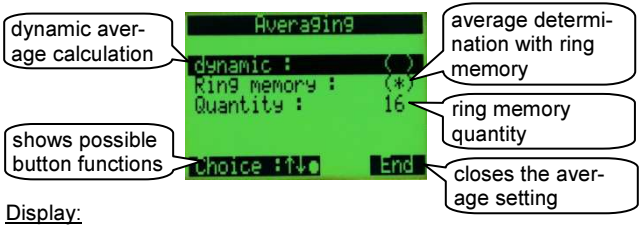
Schedule 1

This shows that it may be improbable but by no means impossible to find a measured value smaller than 50 or larger than 150; however, this probability is only approx. 1 to 1 700 000.
The purpose of this short mathematical excursion is to further the understanding of the function of the ring memory.

For the result display, an average is calculated from the number of values. The number of memory slots are defined in this menu item. A smaller value e.g. < 10 results in a higher variability of the reading but small changes are detected faster. A larger value causes a very stable reading, but small changes require a very long time and may possibly not be detected.
A general recommendation for setting cannot be given, since the setting depends on a large degree on your terms of reference.

The CoMo can also be used as a stationary contamination monitor. For this purpose, a light barrier is installed in the active wall station. This light barrier checks if an object is held in front of the detector of the monitor. In this case the CoMo switches from the background measurement to the contamination measurement with fixed measuring time.

6.2.3.2 Ring memory



Display:

dynamic: The ring memory quantity is calculated and set automatically by means of the count rates (see 6.2.3.2.1). A dynamic smoothing procedure is used:
*y = (y(old) * (smoothing factor –1)+ count rate)/ smoothing factor*
The smoothing factor is calculated with the following formula:
smoothing factor = (100 – radical (count rate)) + 1
Limits: For count rates of over 10000, the smoothing factor is 1. For low count rates (Background) approx. 100. The advantage of this is that the standard deviation is always < 1% when the measuring time is sufficiently long.

Ring memory: The counts are collected in a ring memory. The values are added and divided by the number of values (see 6.2.3.2.2). If the ring counter is full, the oldest values are overwritten (first in first out).

Quantity: The number of memory positions is definable from 2 - 99. For count rates > 2000 cps the system uses a fixed ring memory of 2.

Button functions:


here no function


end of menu item -> 'Measurement settings' (see 6.2)
in input mode: next position


change selected digit


confirm entry or change selected line

6.2.3.2.1 Dynamic average determination:

average count rate (value old): 50 cps
current count rate: a = 60 cps

$$value(new) = (value(old) * ((100 - \sqrt{a} + 1) - 1) + a) / (100 - \sqrt{a} + 1)$$

$$value(new) = (50cps * ((100 - \sqrt{60} + 1) - 1) + 60) / (100 - \sqrt{60} + 1)$$

$$value\ (new) = 50,64$$

The advantage of dynamic average determination is that the standard deviation is always < 1% if the measuring time is sufficiently long. However, old values (since the device was turned on) are always taken into account (but with decreasing influence).

6.2.3.2.2 Average determination via ring memory:

average count rage (value old): 50 cps
current count rate: **60** cps
ring memory = 16 (seconds)

is deleted from the memory

	ring memory per memory position count rate in one second																total counts	Ø [cps]
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
	78	66	48	62	45	70	64	56	62	51	42	37	26	38	28	27	800	50.00
new value >	**60**	78	66	48	62	45	70	64	56	62	51	42	37	26	38	28	833	52.06

The probability that a value with a deviation > 5 sigma is measured with a stable background radiation is < 0.01%. If the deviation of a new value (current count rate) is bigger than 5 sigma, the ring memory is erased and refilled. Advantage: fast change in case of a high probability of a (small) change in radiation.

Example:
Average value of ring memory 50 cps
5 sigma: radical from 50 cps * 5 = 35.4 cps.
Deviation bigger than 5 sigma count rate < 14.6 cps or > 85.4 cps
If the current count rate is > 85 cps, the ring memory is erased and refilled.
After 16 seconds (if the ring memory is set to 16), the ring memory if full again.
Every new value is stored. Therefore the oldest value is deleted from the ring memory.
In this way the last 16 seconds (depending on the defined ring memory quantity) are always in the ring memory and are the basis for the displayed average value.

Average determination via the ring memory has the advantage that the count rate and the calculation time for the displayed value are known and can be used for further calculations.
Time = ring memory in seconds.
Count rate display value in cps * defined ring memory.

6.2.4 Detector Area

In order to convert activities [Bq] in area-based activities [Bq/cm²] the area to be calculated has to be entered in the system.

Display:

Function explanation

Detector area: area over which the measured values have to be averaged. (Mode **Bq/cm²).** According to the German Radiation Protection Regulations: 100 cm^2/300cm^2

Button functions:


here no function

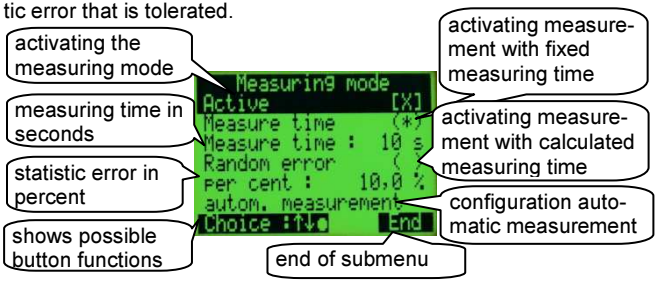

end of menu item -> 'Measurement settings' (see 6.2)
in input mode: next position


change selected digit


confirm entry

6.2.5 Measuring mode - fixed measuring time

With the CoMo, a measurement with fixed measuring time can be carried out if activated in service menu 6.4.5. For this purpose, the function has to be activated. As an alternative, the measuring time can be calculated automatically, after defining the maximum statistic error that is tolerated.



Display:

Measure mode active: activating measuring mode: After long pushing the Enter button, a measurement with fixed measuring time is started.

Measure time: measurement with fixed **measuring time**

Random error per cent: measurement with calculated measuring time based on maximum statistic error in **per cent**

Setting for **automatic measurement** (see 6.2.5.1)

Button functions:


here no function


end of menu item –>'Measurement settings' (see 6.2)
in input mode: next position


select desired menu item or change selected entry


confirm entry or change selected line

6.2.5.1 Measuring mode – automatic measurement

With the CoMo, a measurement with fixed measuring time can be carried out. Additionally a fixed time interval between the measurements can be defined. In this way you can make a serial measurement without having to push a button.

Display:

Autom. measurement active: Enabling automatic measurement in the measuring mode. After finishing a measurement, a new measurement is started automatically after the defined **Interval** time. The remaining time until a new measurement is started is displayed. This is, if activated (see 5.6.1), indicated with a short acoustic signal. Additionally, every measurement is automatically stored if the automatic store feature is activated (see 6.3.1.2). At the end of each measurement an acoustic signal (five beeps) follows, if activated (see 6.6.2).

Button functions:


here no function

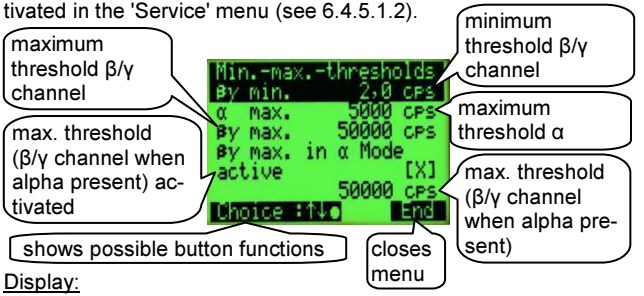

end of menu item –>'Measurement settings' (see 6.2)
in input mode: next position


select desired menu item or change selected entry


confirm entry or change selected line

6.2.6 Minimum and maximum thresholds

The CoMo warns if its maximum limits of count rates are reached. These limits are outside the linear measuring range. It is possible to set the limits also lower. This menu item is only shown if it is activated in the 'Service' menu (see 6.4.5.1.2).



Display:

- **β/γ min.:** minimum threshold for the β/γ channel. Meant to identify a detector error.
- **α max.:** measuring range limit for the α channel. Since the count widths of alpha radiation are wider than for β/γ radiation, the limit is factor 10 lower than for the β/γ channel.
- **β/γ max.:** maximum count rate for pure β/γ radiation.
- **β/γ max. in α mode:** In case of alpha radiation, the maximum count rate decreases, depending on the height of the present alpha radiation. Therefore you can set an individual threshold for the mixed operation α+β/γ.

In case of exceeding a threshold, both an acoustic and an optical alarm are triggered.

Button functions:


here no function


end of menu item –>'Measurement settings' (see 6.2)
in input mode: next position


select desired menu item or change selected entry


confirm entry or change selected line

6.2.7 Detector error

If a detector error occurs in the CoMo, i.e. no pulses are being measured, an error message is displayed after the time set below. The error is signaled visually (the display shows 'Detector Error') and acoustically (rhythmic beeping). This error message is also indicated if the minimum threshold for the β/γ channel is not reached (see 6.2.6).

Display:

Display after: The error message appears after the time (1-20 seconds) set here.

Confirm: Turn on the acknowledge mode - If the confirmation is enabled, the detector error is indicated until it is acknowledged by pushing the Acoustics key. Otherwise the measurement display will continue, as soon as pulses are measured again.

Button functions:

here no function

end of menu item –>'Measurement settings' (see 6.2)
in input mode: next position

select desired menu item or change selected entry

confirm entry or change selected line

6.3 Measuring value storage

Up to 750 datasets can be stored in the memory of the CoMo. This function can be turned on or off in the submenu **'Parameter'.**
If the memory is full, this is indicated on the display. Depending on the measuring mode, the text „memory full“ is adapted to the available space.

Display:

Parameter: parameter setting for measuring value storage (see 6.3.1)

Stored data records: view stored values in chart or in detail; delete the last value or all values (see 6.3.2)

WIMP values: display stored values made with smear test station (see 6.3.3 and 8.2), as a table or in detail; Only displayed if values from WIMP are available.

Button functions:

here no function

end of menu item (see chapter 6)

select the desired menu item

confirm selection

6.3.1 Parameter measuring value storage

The evaluation and deletion of stored data in the Quick menu can be locked. In that case, these data are only available in the Main menu. Eventually present data records do not get lost after deactivating.

Display:

Values in quick menu: Measuring values can also be viewed or deleted in the Quick menu (see 6.3.1.1).

Request remark: You can add a remark of 12 characters to each measuring point.

Storage in search mode: After pushing the enter button in the search mode, the current measuring value is stored.

Measuring mode: submenu for parameter setting of storage in the measuring mode (see 6.3.1.2)

Button functions:


here no function


back to 'Measuring value storage' (see 6.3)


select desired menu item or change selected entry


confirm entry or change selected line

6.3.1.1 Measuring value storage in Quick menu

The evaluation and deletion of stored data can be enabled in the quick menu, so that every user has access to these data.
This is only possible if the storage in the measurement and search modes (or in both modes) is enabled.

Display:

View measuring values in Quick menu: Measuring values can also be viewed in the Quick menu. Additionally you can add a remark to each measurement.

Delete measuring values in Quick menu: If this function is activated, all measurements can be deleted by everyone. This is only possible if 'View values' is enabled. If the function 'Delete values' is deactivated, a measurement can only be deleted in the Main menu, which is not accessible to everyone.

Button functions:


here no function

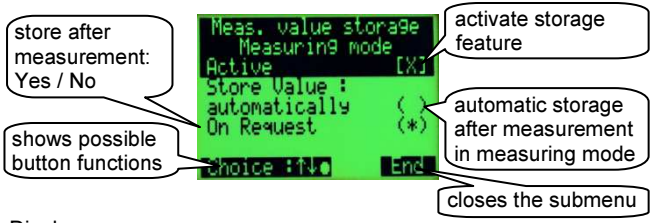

back to 'Parameter measuring value storage' (see 6.3.1)


select desired menu item


change selected line

6.3.1.2 Parameters meas. value storage in measuring mode

The storage function can be activated and it is possible to configure if the values are stored automatically or on request.



Display:

Active: activating the storage function

Store Value:

- **Automatic:** After each measurement, the measuring value is stored automatically.
- **On request:** After each measurement the system asks if the measuring values have to be stored.

Button functions:

here no function

back to 'Parameter measuring value storage' (see 6.3.1)

select desired menu item

change selected line

6.3.2 Stored data records

Up to 750 datasets can be stored in the system's memory. The function to store has to be activated in the Main menu. (see 6.3.1). To have the values also displayed in the Quick menu, the function: **Values in Quick menu** (see 6.3.1.1) has to be activated.

Display:

View data records: shows stored values (see 6.3.2.1)

Enter remark: You can add a remark of 12 characters to each measuring value. Display of stored data (see 6.3.2.2)

Last record delete: deletion of the last data record (e.g. after a false measurement (see 6.3.2.3)

All records delete: deletion of complete database (see 6.3.2.3)

Button functions:


here no function


back to 'Measuring value storage' (see 6.3)

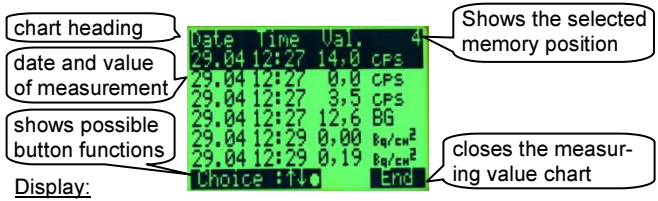

select desired menu item


continue with a submenu item

6.3.2.1 View data records

The stored measurement values are shown in a list of max. 6 measurement values.

After pushing the **Enter** button the measurement value is shown in detail.



Display:

Chart heading
Selected data record
Date, time, value and unit of the selected measurement
If the unit **BG** appears, this is the **B**ack**g**round value. It is valid for all measuring values till the next background measurement. Example: Data record 1 is (always) the first background. Data record 22 is the next measured background. The measuring values 2 – 21 are based on the background of record 1 and the measuring values 23 and up are based on the background value of record 22. The background belonging to the measuring value is also indicated in the detailed display (see 6.3.2.1.1.1).

Button functions:

here no function

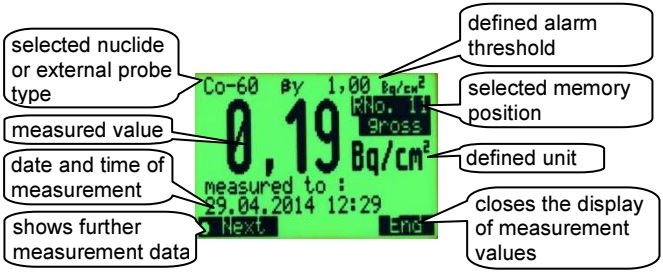
back to 'Stored data records' (see 6.3.2)

selects the measurement to be shown

The selected measurement is shown in detail.

6.3.2.1.1 Display of measurement values in detail

After being selected from the list, the stored measurement values are displayed with the following details:



Display:

Nuclide, measuring mode (CPS) or external probe type
Measuring channel: α, βγ, α+βγ or α/βγ simultaneously
Defined **alarm threshold**
Selected **memory position** (maximum 750 memory positions)
Current **measurement value** indicated digitally
Unit: cps (external probes also µSv/h)
Date and time of the stored measurement

Button functions:

here no function

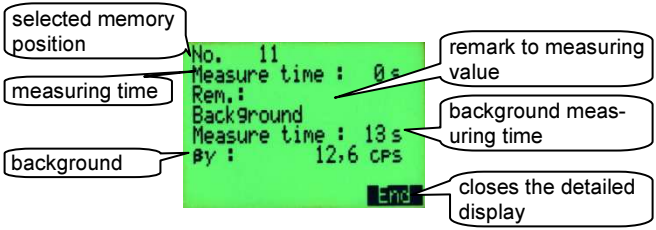
back to measurement value indication in chart format (6.3.2.1)

selects the next or the last memory position

shows further measurement data (see 6.3.2.1.1.1)

6.3.2.1.1.1 Further measurement data

After pushing the Enter button (Next), further details to the selected measuring value are displayed.



Display:

Selected **memory position** (maximum 750 memory positions)

Measuring time (0 s in search mode)

Remark: remark entered to measurement

Background **measuring time**

Background value in cps

Button functions:

here no function

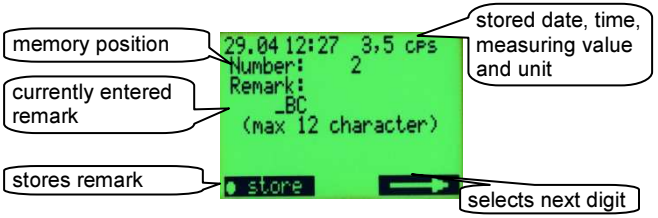
back to previous screen (see 6.3.2.1.1)

here no function

here no function

6.3.2.2 Enter remark

In order to identify measuring values also after some time, it is possible to enter a remark to every measurement.
Before adding a remark to a measurement, the measurement is selected from the list by means of the arrow buttons and confirmed with the Enter button.



Display:

Date, time and value of the stored measurement
Number of the measurement
Remark:
(empty if nothing was entered before)
Push the Enter key to start entry. The digit to be changed is flashing. You can select the desired character with the arrow buttons. (sequence: letters, numbers and then special symbols). With the right button you can select the next digit to be changed. With Enter the new remark is stored.

Button functions:

here no function

back to measurement value indication in chart format or select the next digit to be changed

change current character of remark

change current remark
store new remark

6.3.2.3 Delete data record

To avoid a loss of data, the system asks to confirm the deletion before the data are actually deleted.

Display:
Menu heading
The selected action is displayed inversely.
Security question before deletion

Button functions:


here no function


aborts deletion
back to 'stored data records' (see 6.3.2)


here no function


confirms deletion

6.3.3 Wimp values

Stored values, which were measured in the smear test station (see 8.2), are displayed as a table or in detail. This menu item is only displayed when values from WIMP are present, and has a similar structure as the menu item 'stored data records' (see 6.3.2).

Display:

View data records: shows stored values (see 6.3.2.1)

Enter remark: You can add a remark of 12 characters to each measuring value. Display of stored data (see 6.3.2.2)

Last record delete: deletion of the last data record e.g. after a false measurement (see 6.3.2.3)

All records delete: deletion of complete database (see 6.3.2.3)

Button functions:

here no function

back to 'Measuring value storage' (see 6.3)

select desired menu item

continue with a submenu item

6.4 Other parameters

Setting of the system parameters.

Display:

Access protection- Change code: The access to the Main menu is / can be protected by a 4-digit code. Input of a new code. Continue with the submenu 'Access protection – change code' (see 6.4.1)

Date / Time: setting of date and time (see 6.4.2)

Display: setting of display illumination function and contrast (see 6.4.3)

Menu Escape Time: define how long a submenu is displayed (see 6.4.4)

Service menu: special configuration of the device for the application; not available for all applications (see 6.4.5)

Button functions:

here no function

back to main menu (see chapter 6)

select desired menu item

continue with a submenu item

6.4.1 Access protection – code change

In order to allow only authorized persons (e.g. radiation protection responsible persons) to change the system parameters, the access to the main menu can be protected by a 4-digit code number. The menu item can also be called 'Code change', depending on the setting of the menu item 'Access protection' in 6.4.5.1.1

The access code upon delivery is: **0000**

Display:

active: The access to the main menu is protected by the input of a 4-digit-code number. This item can be disabled in service menu 6.4.5.1.1.

Code number: display of the current access code to the main menu

Button functions:


here no function


end of menu item -> 'Other parameters' (see 6.4)
in input mode: next position


select desired menu item or change selected entry


change selected menu item or confirm new code

6.4.2 Date/Time setting

In order to assign a correct date and time for the measurement results of the measurement value storage, the CoMo is equipped with a battery-operated clock.

The clock does not switch from summer- to wintertime and vice versa automatically. This has to be done manually.

Display:

current: display of current date and time

set: display of system time to be changed

Button functions:

here no function

end of menu item -> 'Other parameters' (see 6.4)
in input mode: next digit

change selected (flashing) digit

change current setting or store new system time

6.4.3 Display

Here the settings for display contrast are made and it is possible to enter a submenu for display illumination setting.

Display:

Illumination: Submenu item for setting of the display illumination function (see 6.4.3.1)

Contrast: The display contrast can be set between 1 (almost no contrast) and 99 (very high contrast).

Button functions:


here no function

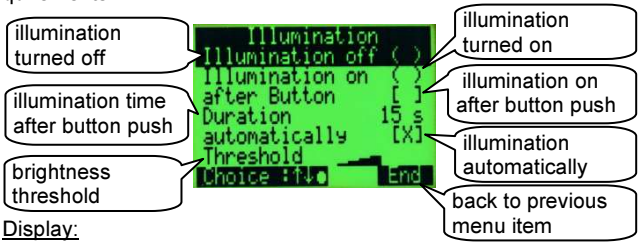

end of menu item -> 'Other parameters' (see 6.4)


select desired menu item


change selected line or confirm brightness value

6.4.3.1 Illumination

Since the illumination of the LC display requires rather much energy, the illumination can be adapted to your individual requirements.



Display:

Illumination off: The automatic illumination feature is turned off.

Illumination on: The automatic illumination feature is turned on.

after Button: If a button is pushed, the illumination is active for a definable time.

Duration: illumination time after pushing a button

automatically: In case of a light intensity of less than the adjusted light intensity, the LCD illumination is turned on automatically.

Threshold: Eight steps can be selected for the brightness threshold. At a low threshold, the background illumination is enabled already at relatively bright lighting conditions. At a high threshold, the background illumination is enabled only at a low light intensity.

Button functions:

here no function

end of menu item -> 'display' (see 6.4.3)

select desired menu item

change selected line or confirm brightness value

6.4.4 Menu escape time

In order to make the CoMo 170 faster to operate, the function **Menu escape time** was introduced. This function is only useful in the Quick menu and for nuclide selection, which is the reason why the menu escape time is very short for these functions. The significant longer escape times in the Main menu are meant to switch back a device that has been left in the Main menu to the measuring mode automatically.

Display:

Automatic return:

short: Main menu: approx. 4 min. Quick menu: without changes approx. 8 sec. After changes approx. 3 sec.

long: Main menu: approx. 8 min. Quick menu: without changes approx.16 sec. After changes approx. 6 sec.

only by button: automatic return turned off

Button functions:


here no function


end of menu item -> 'Other parameters' (see 6.4)


select desired menu item

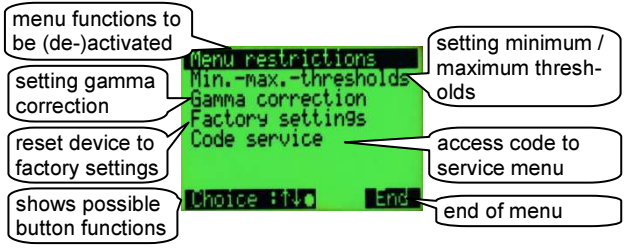

change selected line

6.4.5 Service

The CoMo is optionally available with enabled service menu.

The access code upon delivery is: 1000

The following functions can be set via the service menu:



Display:

menu restrictions: Enabling or disabling of several menu restrictions. In this way it is possible to adapt the device to different fields of application (see 6.4.5.1).

min. – max. Thresholds: Possibility to set minimum and maximum thresholds (see 6.4.5.2)

gamma correction: Possibility to set gamma correction; (if function enabled see 6.4.5.1.1 and 6.4.5.3)

factory settings: Reset device or detector to factory settings (see 6.4.5.4)

Code service: Change access code to service menu (see 6.4.5.5)

Button functions:


here no function


end of menu item -> 'Other parameters' (see 6.4)


select desired menu item


confirm entry

6.4.5.1 Menu restrictions

In order to adapt the functions of the CoMo optimally to the required field of application, the item menu restrictions was integrated. On the following 3 pages the possible parameter settings are shown.

Display:

2 alarm thresholds can be set per nuclide: one for the search mode and one for the measuring mode.

The function **Graph** as a curve or an area: enabled / disabled

Only CPS: All nuclide functions are disabled

The activity measuring range for **Bq** is enabled. All nuclide functions are activated.

The area-related activity measuring range for **Bq/cm²** is enabled. All nuclide functions are activated.

The function to measure two nuclides in a particular relation to each other (**nuclide vector**) is displayed in the list as an additional nuclide.

In the nuclide list, a mixed nuclide of an α and a β/γ nuclide (**Double nuclide**) is displayed and can be defined under the nuclides.

Button functions:


here no function

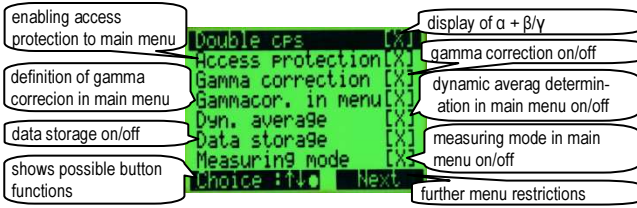

to next screen (see 6.4.5.1.1)


select desired menu item


change selected line

6.4.5.1.1 Further Menu Restrictions 1

Further possible parameter settings for the CoMo basic setting.



Display:

The **Double cps** mode is enabled in the nuclide / mode selection.

The menu function **Access protection** is displayed in the main menu and can be enabled or disabled there. If the display of this function is disabled in the main menu, the access protection to the main menu is always active.

Gamma correction function on/off

Possibility to enable / disable **Gamma correction in main menu**.

Enable possibility to select **dynamic average determination** (see 6.2.3.2.1)

Enable menu item **Data storage**

Enable **Measuring mode** in menu

Button functions:

here no function

to next screen (see 6.4.5.1.2)

select desired menu item

change selected line

6.4.5.1.2 Further Menu Restrictions 2

The last screen of possible parameter setting for the CoMo basic setting.

Display:

Setting of **Minimum and maximum thresholds** enabled **in main menu**.

The **Automatic Measurement** is listed on the menu 'Measuring Mode' (see 6.2.5.1) and can be enabled and paramterized there.

Language selection: In this submenu (see 6.4.5.1.2.1) you can configure the language selection.

Button functions:


here no function

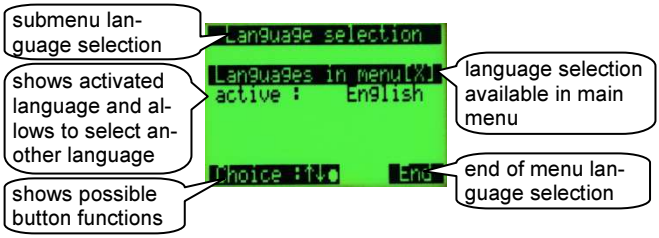

end of submenu -> 'Service' (see 6.4.5)


select desired menu item


change selected line

6.4.5.1.2.1 Language selection

Language selection settings



Display:

Language in menu: If activated, the language selection can be opened in the main menu.

active: display of the active language; If you select this menu item, the language selection menu (see 6.5) appears.

Button functions:

here no function

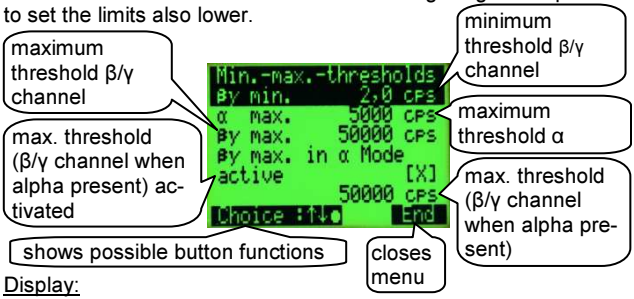
back to 'menu restriction 2' (see 6.4.5.1.2)

select desired menu item

change selected line

6.4.5.2 Minimum and maximum thresholds

The CoMo warns if its maximum limits of count rates are reached. These limits are outside the linear measuring range. It is possible to set the limits also lower.



Display:

β/γ min.: minimum threshold for the β/γ channel. Meant to identify a detector error.

α max.: measuring range limit for the α channel. Since the count widths of alpha radiation are wider than for β/γ radiation, the limit is factor 10 lower than for the β/γ channel.

β/γ max.: maximum count rate for pure β/γ radiation.

β/γ max. in α mode: In case of alpha radiation, the maximum count rate decreases, depending on the height of the present alpha radiation. Therefore you can set an individual threshold for the mixed operation α+β/γ.

Button functions:

here no function

end of menu item -> 'Service' (see 6.4.5)
in input mode: next position

select desired menu item or change selected entry

confirm entry or change selected line

6.4.5.3 Gamma correction

Due to secondary effects (see 9.2.3), present alpha radiation leads to an increased crossover from alpha into the beta/gamma channel. This influence can be balanced by calculation with the so called gamma correction. This menu item can be disabled in service menu 6.4.5.1.1.

Display:

Active: gamma correction activated

Factor: setting how many counts from the alpha channel have to be subtracted from the beta/gamma channel.
Example:
1000 counts in the alpha channel generate 100 counts in the beta-/ gamma channel. With a factor of 0.1 the system subtracts 0.1 x 1000 cps (from the alpha channel) = 100 cps in the beta-/ gamma channel.

Button functions:

here no function

back to 'Service' (see 6.4.5)
in input mode: next position

select desired menu item or change selected entry

confirm entry

6.4.5.4 Factory settings

The CoMo can be reset to its settings upon delivery. The data are stored on two different locations (in the device and in the detector) and can therefore be reset separately.

1. Only the device-specific settings (e.g. measuring mode, storage and display mode) are reset to their factory settings
2. The detector-specific data like nuclide settings with their efficiencies are reset.

The system asks to confirm before reset to their parameter settings upon delivery.

Display:

Reset all **device parameters** to their settings upon delivery
Reset all **nuclide** parameters to their settings upon delivery

After resetting the nuclide parameters, a recalibration of the nuclides is recommended!

Button functions:


here no function


aborts reset
end of menu item -> 'Service' (see 6.4.5)


select desired menu item


confirm entry

6.4.5.5 Servicecode

In order to allow only authorized persons (e.g. radiation protection officer) to change the system parameters, the access to the service menu can be protected by a 4-digit code number.

The access code upon delivery is: 1000

Display:

current access code

Button functions:

here no function

end of menu item-> 'Service' (see 6.4.5)
in input mode: next position

change selected number

confirm entry or change selected line

6.5 Language

The setting of language can be (dis)abled in service menu (see 6.4.5.1.2.1).

Display:

It is possible to select one of the currently 5 available languages:

English
German
French
Spanish
Dutch

Button functions:


here no function

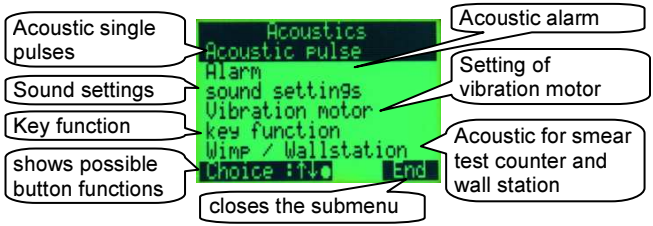

back to main menu (see chapter 6)


select desired language


setting of the selected language

6.6 Acoustics

In the submenu acoustics, the parameters for acoustic features are set.



Display:

Acoustic pulse: The acoustic single counts α, βγ or GM-counter tube (option) are turned on/off (see 6.6.1).

Alarm: The acoustic alarm in case of alarm threshold exceeding in the search / measuring mode and the beeps during measurement are (de)activated (see 6.6.2).

Sound setting: Button beep, volume and acoustic factor are set (see 6.6.3).

Vibration motor: settings of vibration motor (see 6.6.4).

Key function: Functions of the acoustic button are set (see 6.6.5).

Wimp / Wall station: The CoMo's acoustics when using in the wipe test or wall station are configured (see 6.6.6).

Button functions:

here no function

back to main menu (see chapter 6)

select desired menu item

continue with a submenu item

6.6.1 Acoustic pulse

You can activate or deactivate the acoustics for single pulses here.

Display:

Acoustic pulse α: The acoustics for single pulses α are turned on/off.

Acoustic pulse βγ: The acoustics for single pulses βγ are turned on/off.

Acoustic pulse GM: The acoustics for single pulses of the GM-counter tube (option) are turned on/off.

Probe: The acoustics for single pulses of a connected probe (see chapter 8.4) are turned on/off.

Turning on-/off the acoustics for single pulses of the currently displayed measuring channel (α and/or βγ) or GM (Sv/h) is also possible by shortly pushing the acoustics-button in the search mode.

Button functions:

here no function

end of menu item -> 'Acoustics' (see 6.6)

select desired menu item

change selected menu item

6.6.2 Alarm

The acoustic alarm for the search and measuring mode can be (de)activated.
The vibration alarm is independent from the settings made here. The acoustic alarm can also be activated/deactivated via the acoustics button (see 5.6), provided this is set in the 'Acoustics | Button function' menu (see 6.6.5).

Display:

Alarm search: acoustic alarm in case of alarm threshold exceeding in search mode active

Alarm measure: acoustic alarm in case of alarm threshold exceeding during measurement active

Beep after measurement: Acoustics indicating end of measurement are turned on/off.

Button functions:

here no function

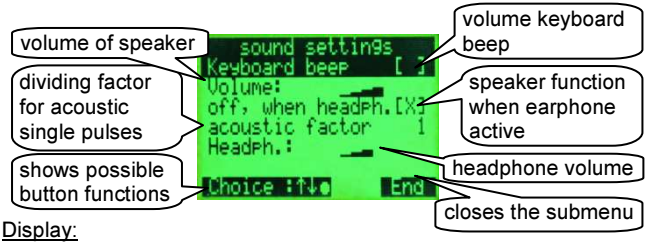
end of menu item -> 'Acoustics' (see 6.6)

select desired menu item

change selected menu item

6.6.3 Sound settings

Here you can set the parameters for keyboard beep, volume of speaker and earphone (accessory). The volume can also be set in the acoustics menu (see 5.6), provided this is configured in 6.6.5.



Display:

Keyboard beep: Low, **High** or off [ ].

To adapt the operation of the contamination monitor to different fields of application, the function **"Keyboard beep"** has been integrated. In a noisy area (e.g. industry) and eventual operation with gloves, it is useful to activate the loud mode of the keyboard beep. In other areas, this setting can be disturbing. In that case, the keyboard beep function can be switched to the quiet mode or turned off.

Volume: The default volume of the CoMo can be adapted to the field of application in 7 steps. (e.g. industry = high and doctor's practice = low)

off, when headphone: If activated, the speaker is turned off whilst the earphone is used.

Acoustic factor: The acoustic single pulses can be reduced by the dividing factor (factor = divisor).

Headphone: The earphone volume can be set.

Button functions:

here no function

end of menu item -> 'Acoustics' (see 6.6)
in input mode: next position

select desired menu item or change selected entry

change selected menu item or confirm new code

6.6.4 Vibration motor

Here you can set the parameters for the vibration motor. The vibration motor is only activated in case of exceeding an alarm threshold.

Display:

Vibration motor:

- **off:** Vibration motor is turned off.
- **always:** The vibration motor always generates a vibrating alarm in case of exceeding an alarm threshold (exception: see 'with headphone').
- **when sound off:** If the acoustic alarm is activated, no vibrating alarm is generated in case of exceeding an alarm threshold.

with headphone: If not activated, the instrument does not vibrate in case of exceeding an alarm threshold when the earphone is connected.

pulsating: The instrument's vibration is periodically interrupted.

Button functions:

here no function

end of menu item -> 'Acoustics' (see 6.6)

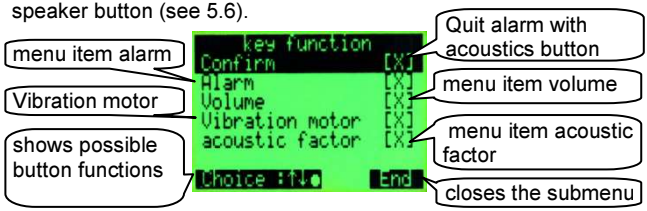
select desired menu item

change selected menu item

6.6.5 Key function

The function of the acoustics button and the menu items which are desired to be displayed in the acoustics menu are configured here.

In the search mode, the acoustics menu can be opened via the speaker button (see 5.6).



Display:

Confirm: The possibility to quit the acoustic alarm with the acoustics button can be turned on/off.

Alarm: The menu item 'Alarm' is (not) displayed in the acoustics menu.

Volume: The menu item 'Volume' is (not) displayed in the acoustics menu.

Vibration motor: The menu item 'Vibration motor' is (not) displayed in the acoustics menu.

Acoustic factor: The menu item 'Acoustic factor' is (not) displayed in the acoustics menu.

Button functions:

here no function

end of menu item -> 'Acoustics' (see 6.6)

select desired menu item

change selected menu item

6.6.6 Smear test counter / Wall station

Here you can set the parameters for acoustics, when the CoMo is placed into an active wipe test station (see 8.2). You are forwarded to the submenu 'Wall station'.

Display:

Alarm: The acoustic alarm in case of exceeding an alarm threshold is (de)activated.

Count down: During measurement, a beep is generated every second.

Volume: The acoustics volume for the wipe test station is set.

Wallstation: forward to the submenu for acoustics settings when using with the wall station.

Button functions:

here no function

end of menu item -> 'Acoustics' (see 6.6)

select desired menu item

change selected menu item
continue with a submenu item

6.6.6.1 Wall station

Here you can set the parameters for acoustics, when the CoMo is placed into an active wall station (see 8.1).

Display:

Acoustic pulse: The acoustic single pulses are turned on/off.

Acoustic factor: The acoustic single pulses can be reduced by the dividing factor (factor = divisor).

Alarm: The acoustic alarm in case of exceeding an alarm threshold is (de)activated.

Count down: During measurement, a beep is generated every second.

Volume: The acoustics volume for the wall station is set.

Button functions:


here no function

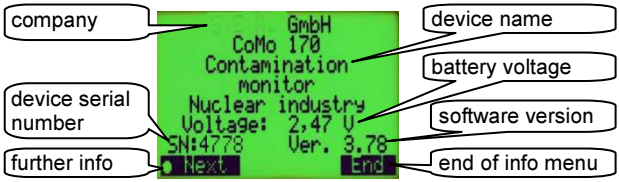

back to menu 'Smear test counter / Wall station' (see 6.6.6)


select desired menu item


change selected menu item

6.7 Info

The info screen is almost the same as the start screen and gives an overview of serial number, software version, battery voltage and eventual errors in the system.



Display:

Company name
device name
measured battery voltage
serial number of the CoMo
software version

Button functions:

no function

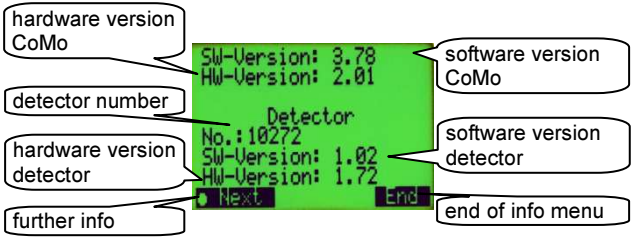
back to main menu (see chapter 6)

no function

further info (see 6.7.1)

6.7.1 Software-/ Hardware versions

For an eventually necessary diagnosis, the next screen can display further information to the versions of device and detector.



Display:

SW: software version of CoMo
HW: hardware version of CoMo
Detector number
SW: software version of detectors
HW: hardware version of detectors

Button functions:

no function

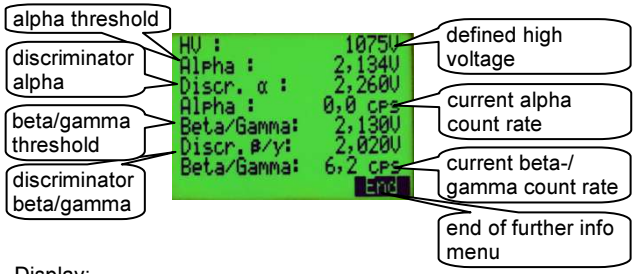
back to previous menu (see 6.7)

no function

further info (see 6.7.2)

6.7.2 Further adjustment information

For an eventually necessary diagnosis, the next screen can display further information to the state of adjustment of the device.



Display:

HV: defined high voltage
Alpha: alpha threshold
Discriminator α: defined alpha threshold
current **Alpha** count rate
Beta: beta/gamma threshold
Discriminator β: defined beta/gamma threshold
current **Beta/Gamma** count rate

Button functions:

no function

back to previous menu (see 6.7.1)

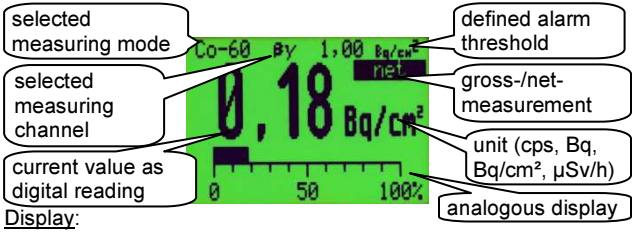
no function

no function

7 Measurement

7.1 Continuous measurement – Ratemeter mode

After the device has been turned on and the start screen has appeared, the instrument automatically switches to the measurement mode. If net measurement is set and 'BG-request' is activated in the menu 'Measure settings | Background measurement | Further settings' (see 6.2.2.2) a background measurement (see 5.7.1) can be started immediately. The CoMo starts its measurement process using the parameters defined last time.



Display:

selected **measuring mode** or selected **nuclide**

Measuring channel: α, βγ, α + βγ or α / βγ

Defined **alarm threshold**

Gross / Net: measurement value with or without background subtraction

Current **measurement value** + **measuring unit** (cps, Bq or Bq/cm², with integrated GM counter tube (µ,m) Sv/h)

Analogous indication in the current unit or in % of the alarm threshold (see 6.2.1)

Button functions:

short pushing: Quick menu (see 5.7)
long pushing: Turn on / off

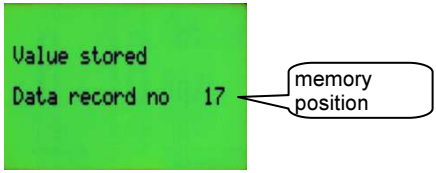
short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 5.6)

invoke the nuclide selection, if active (see 5.5).

short pushing: store measuring value, if active (see 6.3.1 and 7.2)
long pushing: start measurement, if active (see 6.2.5 and 7.3)

7.2 Measuring value storage in search mode

If the measurement value storage function has been activated in the Main menu (see 6.3.1), every currently displayed measurement value is stored after **short** pushing the **Enter** button . For this purpose, the next free memory position is used and shortly shown at the LC display after storage.



If the function 'Enter remark' is activated (see 6.3.1), the question if a remark has to be entered appears first. (This can also be done afterwards in the measuring value menu.)

Display:

memory position of last stored value or measuring result with request to enter a remark

Button functions:

during display no function

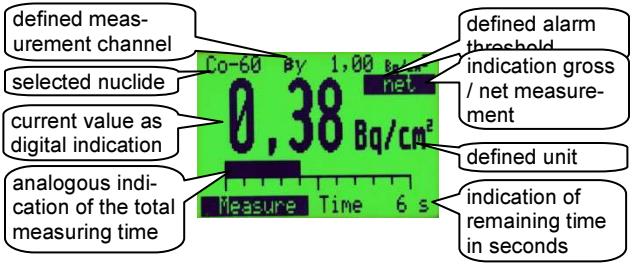
store measuring value

during display no function

submenu to enter a remark

7.3 Measurement with fixed measuring time

If the function **"Measurement with fixed measuring time"** has been activated in the Main menu (see 6.2.5), a measurement with predefined measuring time is started after pushing the **Enter** button > 2 s. This can be repeated automatically with a definable interval (see 6.2.5.1). If activated (see 6.6.2), the end of a measurement is marked with a fivefold acoustic signal.



Display:

selected **measuring mode** or selected **nuclide**
Measuring channel: α, βγ, α + βγ or α / βγ
Defined **alarm threshold**
Gross/Net: meas. value with or without background subtraction
Current **measuring value + unit**
Analogous indication of the total measuring time.
(Indication in percent of the total measuring time)
Remaining measuring time in seconds

Button functions:


no function

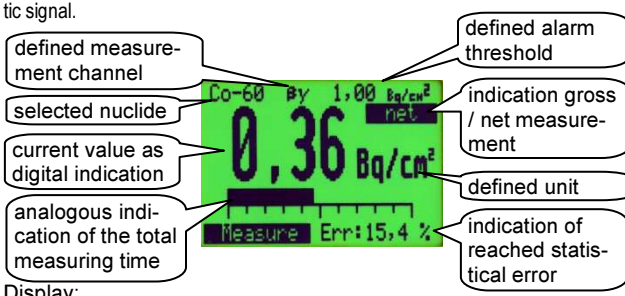

no function


no function


aborts measurement

7.4 Measurement with calculated measuring time based on error limit

If the function **Measurement with calculated measuring time based on error limit** has been activated in the Main menu (see 6.2.5), a measurement is started after pushing the Enter button (> 1 s, or automatically see 6.2.5.1). The measuring time is calculated continuously on the basis of the pulse rate and the desired maximum statistic error. With this data, the total measuring time is calculated and indicated analogically as a scale at the display. The past measuring time is shown analogically as a bar in % of the calculated total measuring time. If activated (see 6.6.2), the end of a measurement is marked with a fivefold acoustic signal.



Display:

selected **measuring mode** or selected **nuclide**
Measuring channel: α, βγ, α + βγ or α / βγ
Defined **alarm threshold**
Current **measuring value + unit**
Analogous indication of the total measuring time (Indication in percent of the total measuring time; depending on pulse rate)
Reached **statistical error** in percent

Button functions:

no function

no function

no function

aborts measurement

7.5 Storage after measurement

Depending on the setting in the submenu 'Parameter meas. value storage in measuring mode' (see 6.3.1.2) there are two options for storing. Depending on the settings, you can also add a remark (see 6.3.1).

Manual:

Automatic:

Display:

selected **measuring mode** or selected **nuclide**
Measuring channel: α, βγ, α + βγ or α / βγ
Measuring value stored as **gross or net** value
Defined **alarm threshold + unit**
Stored **measuring value + unit**
memory position of the automatically/manual stored data record
Question: **store** or **continue** without storing/

Button functions:

no function

return to measuring mode without storing

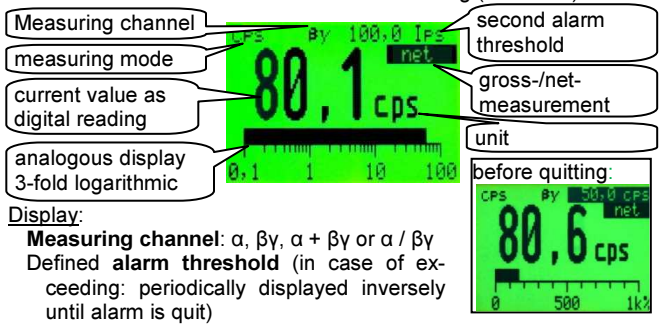
no function

store displayed measuring value/
start new measurement

7.6 Alarm threshold exceeding

The acoustic alarm in case of an alarm threshold exceeding can be quit with the speaker button, if this was activated in the main menu (see 6.6.5), or ends as soon as the values are below the threshold again. If, in one of the cps-modes, the first alarm threshold (see 6.1.1.3.1) is exceeded and the acoustic alarm is quit, the second alarm threshold is activated, provided it is defined (see 6.4.5.1).

The red LED in the foil keyboard is burning in case of alarm threshold exceeding and the defined (active) alarm threshold is periodically displayed inversely. If activated, the vibration motor is also started in case of alarm threshold exceeding (see 6.6.4).



Display:

Measuring channel: α, βγ, α + βγ or α / βγ

Defined **alarm threshold** (in case of exceeding: periodically displayed inversely until alarm is quit)

Current **measurement value** + **unit**

Analogous indication in the current unit or in % of the alarm threshold (see 6.2.1)

Button functions:

short pushing: Quick menu (see 5.7)
long pushing: Turn on / off

short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 5.6)

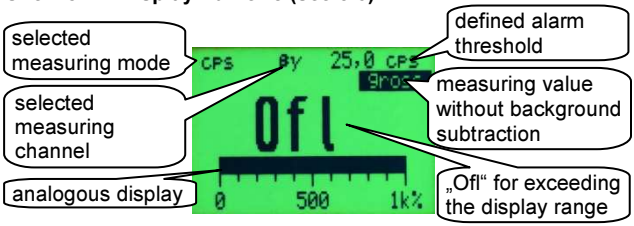
invoke the nuclide selection, if active (see 5.5).

short pushing: store measuring value, if active (see 6.3.1 and 7.2)
long pushing: start measurement, if active (see 6.2.5 and 7.3)

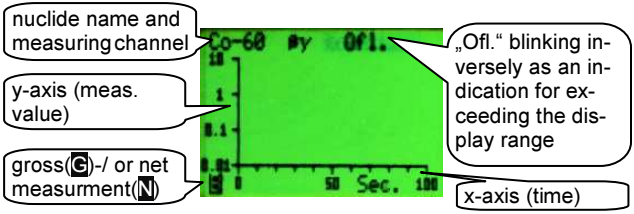
7.7 Display „Ofl“ (Overflow)

If the display range (see 9.1) is exceeded, the message „Ofl“ for Overflow is displayed.

Overflow – Display numeric (see 5.3):



Overflow – Display graphic (see 5.4):



Display: see 5.3 and 5.4

Button functions:

short pushing: Quick menu (see 5.7)
long pushing: Turn on / off

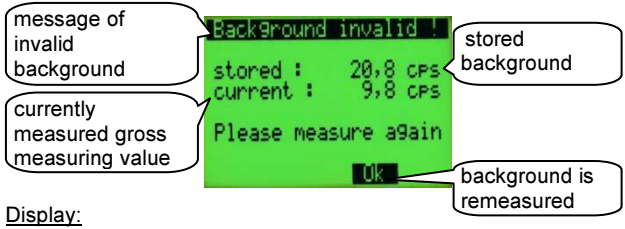
short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 5.6)

invoke the nuclide selection, if active (see 5.5).

short pushing: store measuring value, if active (see 6.3.1 and 7.2)
long pushing: start measurement, if active (see 6.2.5 and 7.3)

7.8 Background invalid

The current gross measuring value is continuously compared to the valid background in the net mode, if this is activated (see 6.2.2.2). If the measuring value is lower than the valid background and the difference is higher than the „threshold“ value, an acoustic alarm is triggered and a message to remeasure the background appears.



Display:

stored.: the stored valid background

current: the currently measured gross measured value

The acoustic alarm is only stopped if the background measurement (see 5.7.1) is started.

Button functions:

no function

Remeasure background

no function

no function

8 Optional measuring functions

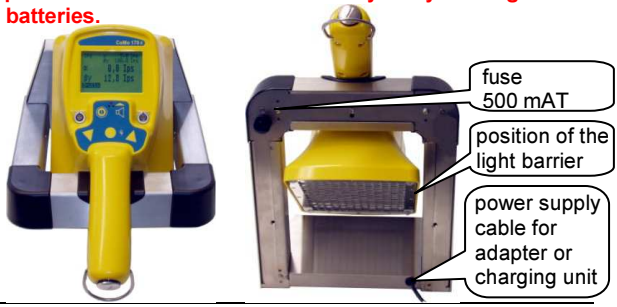
8.1 The active wall station

The CoMo can be used as a stationary contamination monitor in an active wall station. For this purpose, the device has to be placed into the wall station. Depending on the parameter setting, the device continuously measures the background and switches to contamination measurement with fixed measuring time (e.g. 5 seconds) as soon as the object to be measured is held before the detector. Thanks to a light barrier, which is mounted approx. 10 mm under the detector, the system recognizes when to switch from background to contamination measurement. For the control of the function, no additional cable connection from the wall station to the monitor is necessary. The information is transmitted through the handle by infrared rays. Additionally, if a charging unit is used, the rechargeable batteries in the CoMo are charged. The charging function is shown in the foil pad by a LED:

a. Fast blinking or continuous light means charging
b. Slow blinking means that the batteries are charged and the device switches to preservation charge.

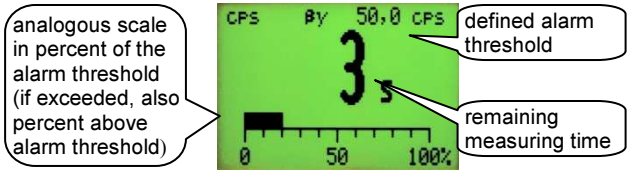
If an optionally available power supply adapter (5 Volt) is used instead of the charging adapter (9 Volt), the CoMo is supplied with power and the batteries are not charged. This is useful in case of using non-rechargeable batteries.

Attention! Never use batteries together with the charging adapter. The instrument can be destroyed by leaking or boiling batteries.



8.1.1 Measurement

The contamination monitor CoMo is a mobile measuring system equipped with large-area detectors. The available **active** wall station is designed in such way that the person being monitored holds his hands in front of the detector, which is installed at the bottom of the housing. As soon as the hands are positioned correctly, a contamination measurement starts automatically, e.g. for 10 seconds. The instructions required for performing a contamination measurement are shown at the LCD display.



Display:

Nuclide
Measuring channel: α, βγ or α+βγ
Defined alarm threshold: cps, Bq or Bq/cm²
Currently **remaining measuring time**
Analogical indication in % of the alarm threshold

Button functions:

no function

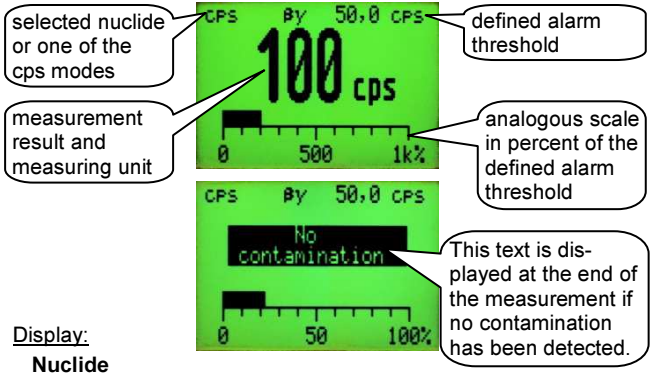
no function

no function – or nuclide selection, if activated

no function

8.1.2 Measurement result

The measurement results are displayed at the end of the measurement. If contamination is detected, the measuring values are displayed in cps, Bq or Bq/cm². If no contamination has been detected, this will be indicated in plain-language text.



Display:

Nuclide
Measuring channel: α, βγ, or α+βγ
Defined **alarm threshold**: cps, Bq or Bq/cm²
Current measuring value or note: **No contamination**
Analogical indication in % of the alarm threshold; if the warning threshold is exceeded, the display switches to k% = 1000% (0.1 k% = 100%).

Button functions:


short pushing: Quick menu (see 8.1.4)
long pushing: Turn on / off


no function


no function – or nuclide selection, if activated

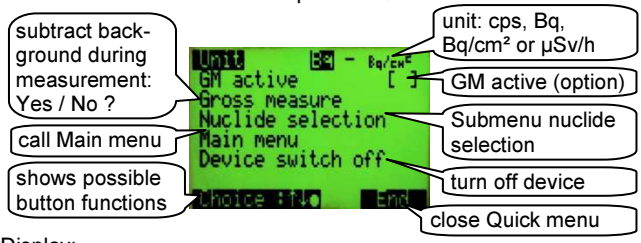

no function

8.1.3 Acoustic

No acoustic menu available. Settings are made in main menu.

8.1.4 Quick menu

The Quick menu contains important functions which have to be changed quickly during measurement (e.g. acoustic pulse on/off). Push the **On/Off** button to open the Quick menu.



Display:

Unit: with the four pulse modes only cps, with all other nuclides either Bq or Bq/cm²

GM active: en- (dis-)able GM-counter tube (option)

Gross/Net measure: measured values with/without background subtraction

Nuclide selection: via arrow buttons or as an alternative via Quick menu

Main menu: access protected by a code number

Device switch off: This function is possible in the Quick menu.

The CoMo can also be turned off by pushing the On/Off button long.

Button functions:


Off button


End of Quick menu


Select the desired menu item


Change a selection or continue with a submenu

8.1.5 Main menu active wall station

8.1.5.1 Code input

The access to the main menu is protected by a 4-digit code to rule out any inadvertent modification of the system parameters.

The access code upon delivery is: 0000

Display:

Access code

Button functions:

here no function

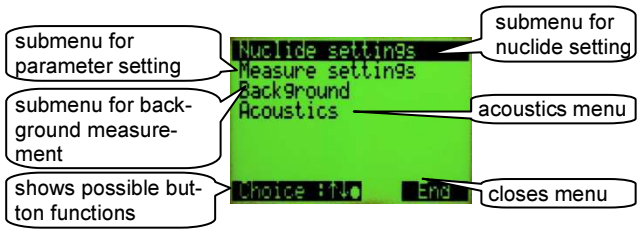
select next position

change value of selected digit 9..0 and 0..9.

confirm code

8.1.5.2 Main menu items

Setting of the system parameters



Display:

Nuclide settings: define parameters of the nuclide-specific data, as described in chapter 6.1
Measure settings: setting of measure time (see 8.1.5.3)
Background: setting background measurement (see 8.1.5.4)
acoustics: Acoustics setting as described in 6.6.

Button functions:

here no function

close the Main menu – return to the measurement mode

select desired menu item

continue with a submenu item

8.1.5.3 Measure settings

The measuring time for contamination measurement can be set here.

Display:

Measure time: contamination measurement with fixed measuring time

Button functions:


here no function


end of menu item –> Main menu (see 8.1.5.2)
in input mode: next position

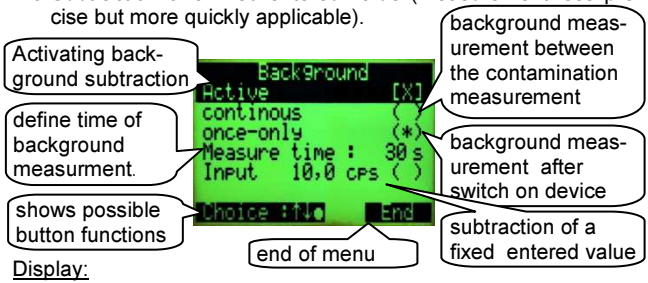

change selected entry


confirm entry or change selected line

8.1.5.4 Background measurement

The background subtraction can be performed in three ways.

1. Background measurement after turning on device
2. Background measurement, if no contamination measurement is running.
3. Subtraction of a fixed entered value (measurement less precise but more quickly applicable).



Display:

active: Activating background subtraction. The menu item background measurement is added to the Quick menu. If the menu item is not activated, a gross measurement is always made.

continuous: The background is always measured if no contamination measurement is carried out.

once-only: The background is measured only if the device is turned on.

Measure time: defined measuring time for background measurement (2-999 seconds).

Input ...cps: Subtraction of background entered in cps

Button functions:

here no function

end of menu item –> Main menu (see 8.1.5.2)
in input mode: next position

change selected entry

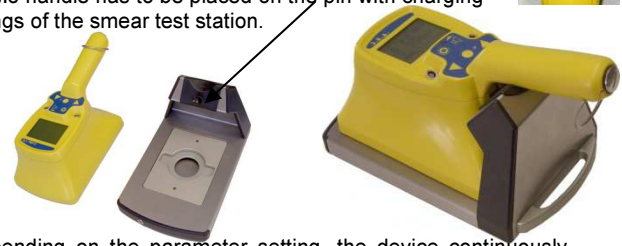
confirm entry or change selected line

8.2 The CoMo as a smear test counter

8.2.1 The active smear test counter

The CoMo can be used as a smear test counter in an active smear test station. For this purpose, the device has to be placed into the smear test station.

The opening with the charging pins in the under part of the CoMo handle has to be placed on the pin with charging fittings of the smear test station.



Depending on the parameter setting, the device continuously measures the background and switches to contamination measurement as soon as a measuring object is inserted (opening and closing the drawer). Thanks to a magnetic switch in the drawer, the system recognizes when to switch from background to contamination measurement. For the control of the function, no additional cable connection from the smear test station to the monitor is necessary. The information is transmitted through the handle by infrared rays. Additionally, if a charging unit is used, the rechargeable batteries in the CoMo are charged. The charging function is shown in the foil pad by a LED:

c. Fast blinking or continuous light means charging
d. Slow blinking means that the batteries are charged and the device switches to preservation charge.

If an optionally available power supply adapter (5 Volt) is used instead of the charging adapter (9 Volt), the CoMo is supplied with power and the batteries are not charged. This is useful in case of using non-rechargeable batteries.

Attention! Never use batteries together with the charging adapter. The instrument can be destroyed by leaking or boiling batteries.

8.2.2 Accessories smear test counter

smear test station

9 Volt charging adapter (when using rechargeable batteries) or 5 Volt power supply adapter (when using normal batteries)

adapter for using 60 mm Ø sample plates

60 mm Ø sample plates in 3 mm and 8 mm height
ring with 5 mm height for using 3mm plates

120 mm Ø sample plates in 3 mm and 8 mm height
ring with 5 mm height for using 3mm plates

8.2.3 Appropriate smear test samples

available surface of
approx. 130 x 100 mm².
use of smear test samples
including paper base or for non-
standard smear test samples

use of 120 mm Ø plates in 3mm
(with 5mm distance ring) and 8mm
height.
use e.g. for aerosol filters
Attention: effective measuring width
= 100mm

With the included adapter, a repro-
ducible geometry is created for the
standard 60 mm Ø plates.
use of standard 50 mm Ø smear
tests inserted in 60 mm Ø plates in
3mm (with 5mm distance ring) and
8mm height.

8.2.4 Measurement

The available **active** smear test counter is designed in such way that a measurement is initiated automatically as soon as the drawer is opened. After inserting the measuring object and closing the drawer, the actual measurement is made. All data required for performing a smear test measurement are shown at the LCD display.

Display:

Nuclide or **cps** mode
Measuring channel: α, βγ or α + βγ
Defined **alarm threshold**: cps, Bq or Bq/cm²
Channel and **current measurement value**
Current **remaining measuring time**
Background in α - and in βγ - channel

Button functions:

short pushing: Quick menu (see 8.2.6)
long pushing: Turn on / off

aborts measurement

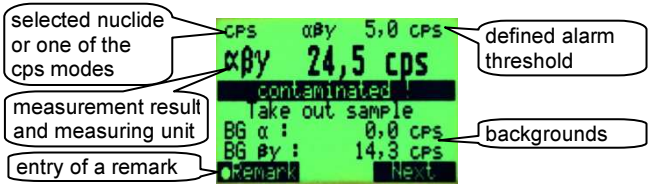
here no function

here no function

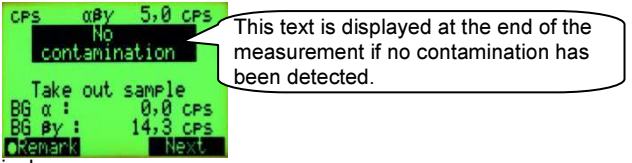
8.2.5 Measuring result

The measurement results are displayed at the end of the measurement. If contamination is detected, the measuring values (depending on setting) are displayed in cps, Bq or Bq/cm². If no contamination has been detected, this will be indicated in plain-language text.

Alarm threshold exceeding:



No alarm threshold exceeding:



Display:

Nuclide
Measuring channel: α, βγ, or α+βγ
Defined **alarm threshold**: cps, Bq or Bq/cm²
Current measuring value or note: **No contamination**
Background in α - and in βγ - channel

Button functions:

short pushing: Quick menu (see 8.2.6)
long pushing: Turn on / off

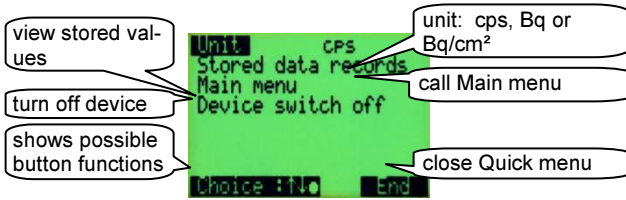
aborts measurement

no function

After confirming you can enter a remark if enabled (see 6.3.1)

8.2.6 Quick menu

The Quick menu contains important functions which have to be changed quickly during measurement (e.g. unit). Push the **On/Off** button to open the Quick menu. The function 'Stored data records' only appears if activated in the Main menu.



Display:

Unit: with the pulse mode only cps, with all other nuclides either Bq or Bq/cm²

Stored data records: submenu to view, edit or delete stored values (see 6.3.2)

Main menu: access protected by a code number

Device switch off: This function is possible in the Quick menu.

Button functions:

The CoMo can also be turned off by pushing the On/Off button

Off button

end of quick menu

select desired menu item

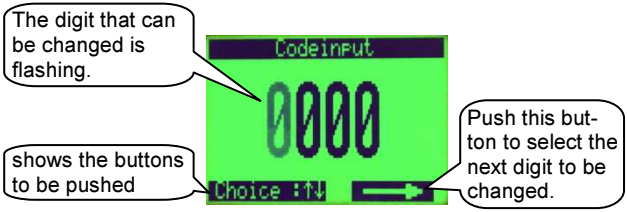
change selection or
continue with a submenu item

8.2.7 Main menu smear test measurement

8.2.7.1 Code input

The access to the main menu is protected by a 4-digit code to rule out any inadvertent modification of the system parameters.

The access code upon delivery is: 0000



Display:

Access code

Button functions:

here no function

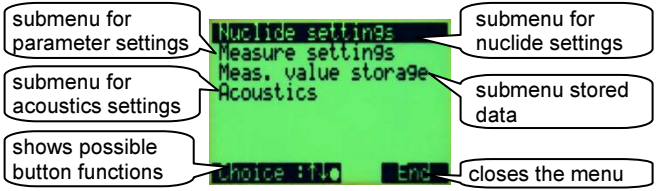
select next position

change value of selected digit 9..0 and 0..9.

confirm code

8.2.7.2 Main menu

Here you can define important system parameters.



Display:

Nuclide settings: parameter setting of measurement-specific data (see 8.2.7.3)
Measure settings: setting of device options (see 8.2.7.4)
Measuring value storage: Display of stored measurements and parameter setting of storage function (see 6.3). If the CoMo is placed in the smear test station, only the stored WIMP measurements are displayed.
Acoustics: setting of acoustics (see 6.6)

Button functions:


here no function


end of main menu – return to quick menu


select desired menu item


continue with a submenu item

8.2.7.3 Nuclide settings Bq - Bq/cm²

After nuclide selection (see 5.5) you have to define the settings of the selected nuclide. For the smear test mode, the CoMo contains an additional nuclide file with 8 nuclides. Some of the nuclide memory positions are pre-programmed with standard values. All entries, also in the cps mode, can be set freely.

Display:

Nuclide: nuclide name (max. 7 characters)

Measuring channel: channel which the counts should be measured in (α, βγ, α+βγ)

in nuclide list: nuclide added to selection list for measurement

Thresholds: submenu for alarm threshold setting (8.2.7.3.1)

Wipe factor: In case of wipe tests, the sample doesn't contain 100% of the activity. In order to take this fact into account, you can here enter a **Wipe factor** (<= 100%; usually 10% - 30%).

Area: area which has to be taken into account for measurement. (only for Bq/cm²)

Calibration: submenu for efficiency calculation (see 8.2.7.3.2)

Button functions:


here no function

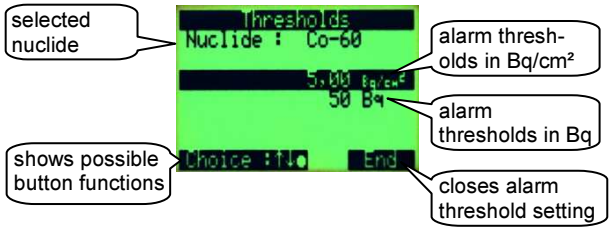

end of menu item –> back to main menu (see 8.2.7.2)
in input mode: next position


select desired menu item
in input mode: change selected entry


confirm entry

8.2.7.3.1 Alarm thresholds

Alarm thresholds for Bq and for Bq/cm² can be set.



Display:

Nuclide to be changed

Alarm threshold **Bq/cm²**: setting of alarm threshold for area-based measurement

Alarm threshold **Bq**: setting of alarm threshold for activity measurement

Button functions:

here no function

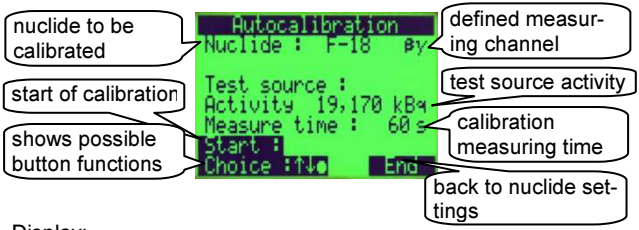
end of menu item –> back to 'nuclide settings' (8.2.7.3)
in input mode: next position

select desired menu item
in input mode: change selected entry

confirm entry

8.2.7.3.2 Autocalibration – Default settings

The device is equipped with an autocalibration function.
This makes it possible to calibrate your own nuclides with available test sources.



Display:

Nuclide: indication of nuclide to be calibrated

Measuring channel: channel which the nuclide should be calibrated with (α, βγ, α+βγ)

Test source activity: For auto-calibration you need a test source having the following properties:

- area source with approx. 100 cm² active area
- activity from 0.5 - 10 kBq

Measure time: The measuring time is dependent on the level of the source activity.
reference values: approx. 0.5 kBq: 500 seconds
from 10 kBq: 60 seconds (min. meas. time)

Start: start of calibration measurement

Button functions:


here no function

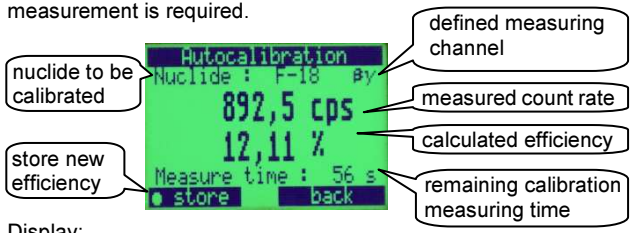

end of menu item - in input mode: next position


select desired menu item or change selected entry


confirm entry or continue with a submenu item

8.2.7.3.2.1 Autocalibration – Measurement

Before the first autocalibration (since selecting the main menu), a background measurement is made first. If you don't leave the main menu before the next autocalibration, no further background measurement is required.



Display:

Nuclide: indication of nuclide to be calibrated

Measure channel: channel which the nuclide should be calibrated with (α, βγ, α+βγ)

Measured count rate: pulses picked up in the selected measuring channel

Calculated efficiency: obtained from the test source activity and the measured count rate minus the background count rate.

Measure time: remaining calibration measuring time (The measurement can be terminated any time.)

Store: If the efficiency reading does not change any more, the measurement may be stopped and stored before the defined measuring time is over.

Button functions:

here no function

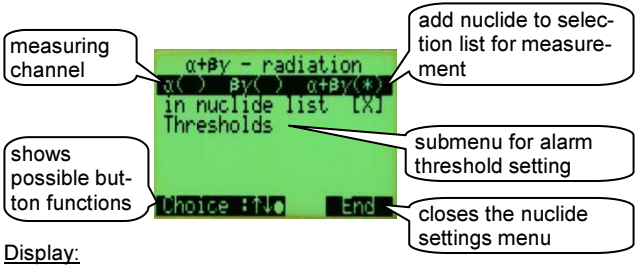
end or abort autocalibration
-> 'autocalibration – default settings' (see 8.2.7.3.2)

here no function

confirm new efficiency

8.2.7.3.3 Nuclide settings – cps mode -

If you choose one of the cps entries during nuclide selection (see 5.5), you get to the settings for counts per second - memory positions. In the cps setting menu you can only change the alarm threshold and determine if the entry should be available in the nuclide selection during measurement and which measuring channel has to be used (not in the cps mode α/βγ). Depending on which channel is selected, the designation of the cps measurement mode changes.



Display:

Measuring channel: Channel which the counts are measured in (α, βγ, α+βγ)
in nuclide list: nuclide added to selection list for measurement
Thresholds: submenu for alarm threshold setting in cps (counts per second)

Button functions:


here no function

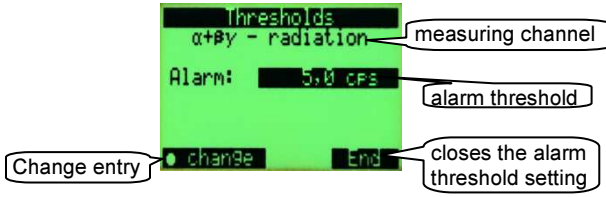

end of menu item - in input mode: next position


select desired menu item or change selected entry


confirm entry

8.2.7.3.3.1 Alarm threshold – cps mode -

The cps alarm threshold is set the same way like the setting of the nuclide alarm thresholds.



Display:

Measuring channel: channel which the counts are measured in (α, βγ, α+βγ)

Alarm threshold: setting of alarm threshold(s) in cps (counts per second)

Button functions:

here no function

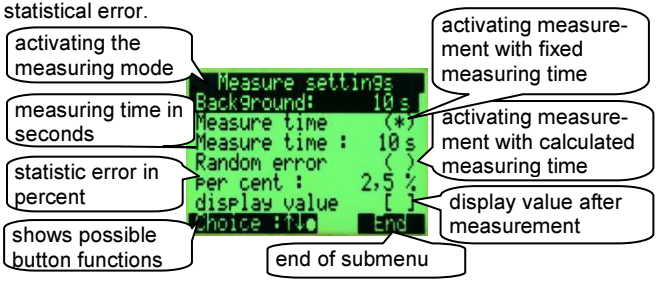
end of menu item - in input mode: next position

in input mode: change selected entry

change selected threshold
- in input mode: confirm entry

8.2.7.4 Measuring settings smear test counter

The CoMo can make a measurement as a smear test counter with fixed measuring time or, as an alternative, the measuring time can be calculated automatically, after defining the maximum desired statistical error.



Display:

Background: Here you enter the desired background measuring time. The current background is calculated each time between the measuring intervals.

Measure time: measurement with fixed measuring time

Random error: smear test measurement with calculated measuring time according to statistical error

Percent: Setting of desired maximum statistical error, in percent

Display value: If enabled, the measured value is even displayed if the alarm threshold is not exceeded; otherwise only the message 'No contamination' is displayed. In case of contamination, the measured value and a message are displayed.

Button functions:


here no function

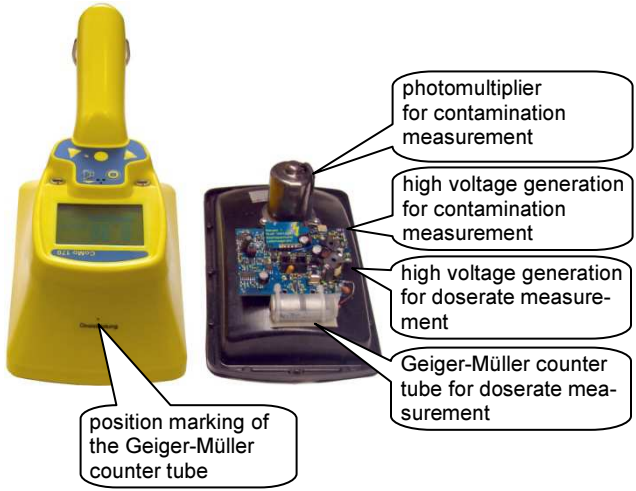

end of menu item -> back to main menu (see 8.2.7.2)
in input mode: next position


select desired menu item
in input mode: change selected entry


change selected item; confirm entry

8.3 The CoMo as a doserate meter

The CoMo can be ordered with a Geiger-Müller counter tube for dose rate measurement. In that case, an additional high voltage, an amplifier and an extension for data transmission in the CoMo are integrated and the counter tube is integrated on the detector electronics. The Geiger-Müller counter tube is mounted central on the front side of the CoMo.
The doserate measuring range is 1µSv/h – 20mSv/h



8.3.1 Measurement

The integrated Geiger-Müller counter tube gives the same measuring results as the externally connectible probe 18550 CE from Graetz. To switch from contamination measurement to doserate measurement the unit is switched from cps (or Bq) to Sv/h in the quick menu (see 8.3.2.1).

The current doserate display appears.

Display:

GM 18550 Geiger-Müller mode
Defined **alarm threshold**: in µSv/h / mSv/h
Current **measuring value** with **display unit**
Analogous bar logarithmic in 3 decades

Button functions:

short pushing: Quick menu (see 8.3.2.1)
long pushing: Turn on / off

short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 5.6)

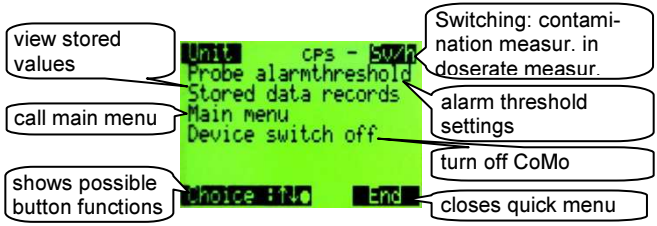
invoke the nuclide selection, if active (see 5.5).

short pushing: store measuring value, if active (see 6.3.1 and 7.2)
long pushing: start measurement, if active (see 6.2.5 and 7.3)

8.3.2 Settings doserate measurement

8.3.2.1 Quick menu

The Quick menu contains important functions which have to be changed quickly during measurement (e.g. switch between doserate and contamination measurement). Push the **On/Off** button to open the Quick menu. The function 'Stored data' records only appears if activated in the Main menu.



Display:

Unit: in doserate mode µSv/h or mSv/h, for contamination measurement depending on nuclide CPS, Bq or Bq/cm²

Probe alarm threshold: submenu to set probe alarm threshold (see 8.3.2.1.1)

Stored data records: submenu to view, edit or delete stored values (see 6.3.2)

Main menu: (access protected by a code number)

Device switch off: This function is possible in the Quick menu.

Button functions:

The CoMo can also be turned off by pushing the On/Off button long.

Off button

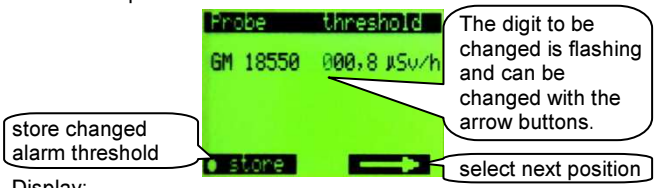
end of quick menu

select desired menu item

change selection or
continue with a submenu item

8.3.2.1.1 Alarm threshold settings doserate measurement

The alarm threshold can be set within a range from 0.1 µSv/h till 19.99 mSv/h. To switch the unit you have to select it and set the desired unit µSv/h or mSv/h with the arrow buttons.



Display:

Probe: GM 18550 (internal Geiger-Müller counter tube)
Threshold: defined threshold or threshold to be changed

Button functions:


here no function


end of menu and return to quick menu
in input mode: next position


in input mode: change flashing digit


continue with alarm threshold setting
in input mode: store alarm threshold

8.4 Utilisation of external Detectors

In order to comply with special requirements, external detectors can be connected to the CoMo, for example for dose rate measurement. The CoMo automatically recognizes if an external probe is connected. An external probe can be connected and disconnected during operation. In this case, a new start is triggered.
External detectors are connected to the left bushing of the CoMo.

If an external probe is connected, the operation of the CoMo changes depending on the type of probe. In essential points, the operation is as described in the CoMo user's manual chapter 6. Deviations are described on the following pages.

8.4.1 Dose rate probe

Here the deviations from the CoMo user's manual of the probes listed in chapter 13.1.1 are described.

8.4.1.1 Measurement display

After the device has been turned on and the start screen has appeared, the instrument automatically switches to the measurement mode. The CoMo starts its measurement process using the parameters defined last time and the parameters stored for this probe type in the CoMo.

Display:

probe type

Defined **alarm threshold**

Current **measurement value + measuring unit** (µ,m)Sv/h

Analogous indication in the current unit or in % of the alarm threshold

Button functions:

short pushing: Quick menu (see 8.4.2.3)
long pushing: Turn on / off

short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 8.4.1.2)

here no function

store measuring value, if active (see 7.2)

8.4.1.2 Acoustics menu

In the search mode, the speaker is enabled. If you push the speaker button shortly, the acoustic single pulses of the active channel are turned on or off. If you push longer (> 2 s) the acoustics menu is called (see 5.6).

8.4.1.3 Quick menu

The Quick menu contains important functions which have to be changed quickly during measurement (e.g. acoustic pulse on/off). Push the **On/Off** button to open the Quick menu (see also 5.7). The function 'Stored data records' only appears if activated in the Main menu.

Display:

Probe alarm threshold: submenu for setting the alarm threshold for probe

Stored data records: submenu to view or delete values (see 6.3.2)

Main menu: access protected by a code number

Device switch off: This function is possible in the Quick menu.

The CoMo can also be turned off by pushing the On/Off button long.

Button functions:


Off button


End of Quick menu


Select the desired menu item


Confirm a submenu item

8.4.1.3.1 Probe alarm threshold

Here you can change the alarm threshold of the external probe. The changed value is stored in the CoMo. This value will be loaded again the next time you are using this probe type.

Display:

Thresholds Settings
Probe type

Button functions:

here no function

end of menu item - > back to 'Quick menu' (see 8.4.3.3)
in input mode: next position

change selected entry

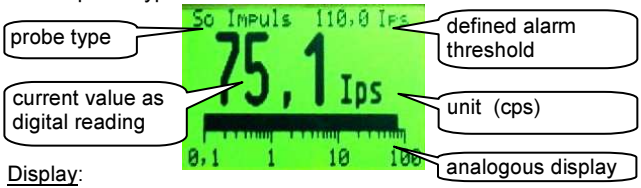
change threshold
in input mode: store new alarm threshold

8.4.2 Geiger-Müller contamination probes and special 1-channel counter probes

Here the deviations from the usual manual structure CoMo (see chapter 6) of the probes listed in the 13.1.2 are described.

8.4.2.1 Measurement display

After the device has been turned on and the start screen has appeared, the instrument automatically switches to the measurement mode. The CoMo starts its measurement process
using the parameters defined last time and the parameters stored for this probe type in the CoMo.



Display:

Probe type
Defined **alarm threshold**
Current **measurement value + measuring unit** (µ,m)Sv/h
Analogous indication in the current unit or in % of the alarm threshold

Button functions:


short pushing: Quick menu (see 8.4.1.3)
long pushing: Turn on / off


short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 8.4.2.2)


here no function


store measuring value, if active (see 7.2)

8.4.2.2 Acoustics menu

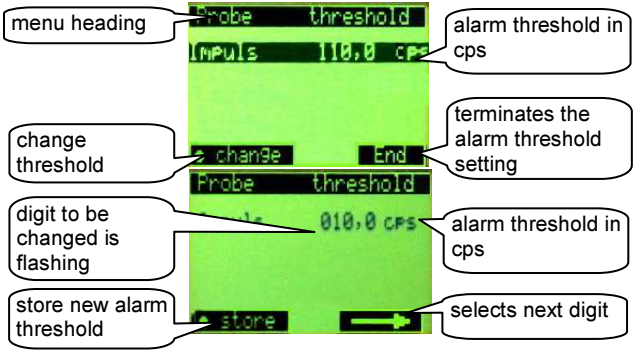
See 8.4.1.2.

8.4.2.3 Quick menu

See 8.4.1.3.

8.4.2.3.1 Probe alarm threshold

Here you can change the alarm threshold of the external probe. The changed value is stored in the CoMo. This value will be loaded again the next time you are using this probe type.



Display:
Threshold Setting

Button functions:

here no function

end of menu item
in input mode: next position

change selected entry

change threshold
in input mode: store new alarm threshold

8.4.3 Special 2-channel count probes

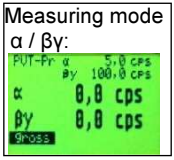
Here the deviations from the CoMo user's manual of the probes listed in the 13.1.3 are described.

8.4.3.1 Measurement display

After the device has been turned on and the start screen has appeared, the instrument automatically switches to the measurement mode. The CoMo starts its measurement process using the parameters defined last time and the parameters stored for this probe type in the CoMo.

Display:

Probe type
Measuring channel: α, βγ, α + βγ or α / βγ
Defined **alarm threshold**
Gross / Net: measurement value with or without background subtraction
Current **measurement value + measuring unit**
Analogous indication in the current unit or in % of the alarm threshold



Button functions:


short pushing: Quick menu (see 8.4.3.3)
long pushing: Turn on / off


short pushing: acoustic single pulses On / Off
long pushing: acoustics menu (see 5.6)


invoke the measuring mode, if active (see 6.1.4).

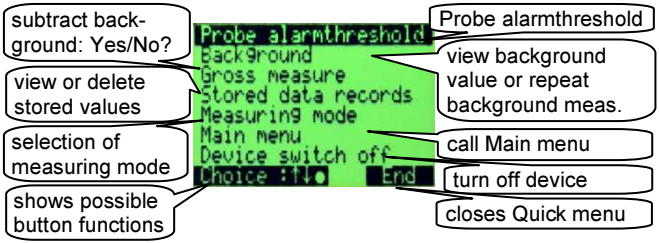

short pushing: store measuring value, if active (see 6.3.1 and 7.2)
long pushing: start measurement, if active (see 6.2.5 and 7.3)

8.4.3.2 Acoustics menu

See 8.4.1.2.

8.4.3.3 Quick menu

The Quick menu contains important functions which have to be changed quickly during measurement. Push the **On/Off** button to open the Quick menu. The functions background measurement, gross/net measurement, stored data records and nuclide selection only appear if activated in the Main menu.



Display:

Probe alarm thresholds: submenu for setting the alarm threshold (see 8.4.3.3.1)

Further description see chapter 'Quick menu' 5.7.

Button functions:

The CoMo can also be turned off by pushing the On/Off button long.


Off button


End of Quick menu


Select the desired menu item


Change a selection or continue with a submenu item

8.4.3.3.1 Probe Alarm thresholds

Here you can change the alarm thresholds of the external probe for the different measuring channels. The changed values are stored in the CoMo. These alarm thresholds are loaded again the next time you are using this probe type.

Display:

Mode: channel which the counts should be measured with
- α: threshold for measurement in α channel
- βγ: threshold for measurement in βγ channel
- α+βγ: threshold for measurement in α and βγ channel (value-added)
- α/βγ: threshold for measurement in α and in βγ channel (both channels are shown simultaneously)

Alarm: setting alarm threshold in cps (counts per second)

Button functions:


here no function


end of menu item -> back to Quick menu (8.4.3.3)
in input mode: next position

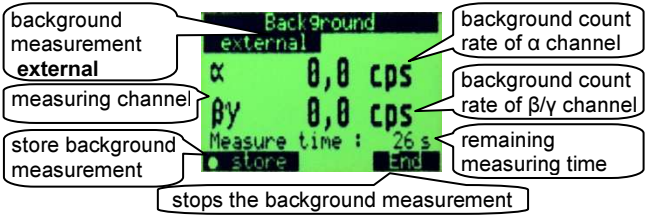

select desired menu item or change selected entry


change threshold or store new alarm threshold

8.4.3.3.2 Background measurement

Further description of background measurement see chapter 5.7.1.

The header of the menu item shows that the background measurement is carried out for the external probe.



That background value measured is stored in the CoMo for this probe type and used for calculation of the net measured value. If you will later perform a measurement without external probe, the internal background value is valid again.

Display:

α: shows α - background
βγ: shows βγ - background
Measure time: remaining background measuring time

Button functions:


here no function


aborts the background measurement


here no function


premature termination of the background measurement (The new values are stored.)

8.4.3.3.3 Measuring mode

Here the measuring channel(s) is/are set.

Display:

Mode: channel which the counts should be measured with
- α: measurement only in α channel
- βγ: measurement only in βγ channel
- α+βγ: measurement in α and βγ channel (value-added)
- α/βγ: measurement in α and in βγ channel (both channels are shown simultaneously)

Thresholds: display alarm thresholds in cps (counts per second).

Button functions:

here no function

end of menu item

select desired measuring mode

confirm entry measuring mode

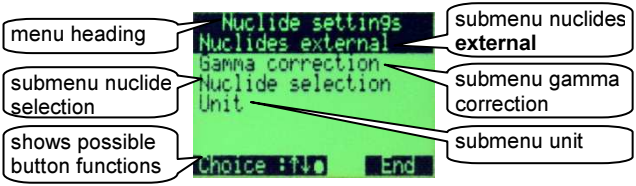
8.4.3.4 Detector area

The main menu changes when an external probe is connected only with regard to the measurement area. This entry option is missing on the menu 'Measurement settings' (see chapter 6.2).

8.4.4 1-Wire probes (intelligent probes)

With 1-wire probes, various data are stored in the probe and are selected automatically by the CoMo. In the 1-wire probe described here, for example, nuclide data are stored on the probe. A part of the stored data can be changed through entries in the CoMo menu and will then be stored changed in the probe. The various probe types can be equipped as 1-wire probes. If a dose rate probe is used as 1-wire probe, the changes in operation described in 8.4.1 apply. A 1-wire probe can be configured according to special customer requirements; therefore, it is not possible to provide a comprehensive description at this point.
Menu items or entries that concern the external probes are marked 'External' and/or 'Probe'. Based on the following two examples, we will explain how the operation menu may look like for a 1-wire probe.

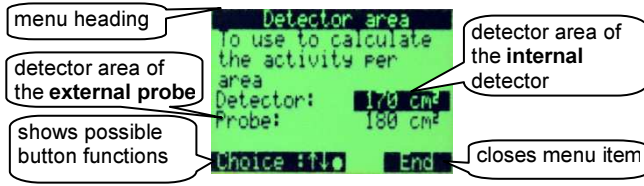
8.4.4.1 Nuclide settings



The display of the submenu 'Nuclide Setting' with connection of the 1-wire probe corresponds to the display for operation without external probe, with the exception of the supplement 'External' in 'Nuclide'.
This indicates that the nuclide data have been stored in the external probe. All settings are done as described in the CoMo manual. Changes in the nuclide data are stored in the external probe.
For 1-wire probes with nuclide data, the measuring display corresponds to that of the CoMo without external probe.

8.4.4.2 Detector Area

In order to convert activities [Bq] in area-based activities [Bq/cm²] the area to be calculated has to be entered in the system.
When using an external probe, the activity calculation refers to the measuring area of the external probe. This measuring area is stored on a 1-wire probe. Changes of the measuring area of the 1-wire probe are then stored on this probe.



Display:

Function explanation

Detector area: Area over which the measured values have to be averaged (Mode **Bq/cm²**). According to the German Radiation Protection Regulations: 100cm²/300cm²

Detector: Area of the internal detector

Probe: Area of the external probe

Button functions:

here no function

end of menu item
in input mode: next position

select desired detector area
input mode: change selected entry

confirm entry or change selected line

9 Technical specifications

9.1 Device

Detector type: large-area, thin-layer plastic scintillation detectors with ZnS coating for α- ß-γ measurements with integrated photomultiplier, high voltage generation and pulse processing.

Measuring channels:
internal: one α-channel and one ßγ-channel.
external: two pulse inputs

Start of measurement:
- continuous measurement
- measurement with fixed measuring time via start button (> 1 s)
- measurement with calculated meas. time via start button (> 1 s)

Background subtraction: with definable BG measuring time

Measuring electronics: integrated microcontroller

Keyboard: Foil keyboard:
- On-Off
- illumination-function button
- 2 arrow buttons
- Enter

Alarm: separately definable for each nuclide

Measuring value display: as desired in cps or nuclide-specific in Bq or Bq/cm², for GM-counter tube or external probes also (n/µ/m)Sv/h

Measuring range: Cs-137
- ß-γ-channel: up to 20,000 cps (Cs-137)
- α-channel: up to 2,500 cps (Am-241)

Display range:
- ß-γ-channel: up to 50,000 cps (Cs-137)
- α-channel: up to 5,000 cps (Am-241)

For other nuclides, the range (dependent from the energy) can fluctuate.

If the display range is exceeded, the display shows **"Ofl"** (Overflow; see 7.7).

Measuring time: continuous (with definable ring memory). In measuring time mode and in stationary mode definable in seconds

Display: large-area, graphic LCD display 128 x 64 pixels

Voltage: 3 Volt. 2 x batteries type: AA Mignon (LR6)

Power consumption: approx. 60 mA (at 3 V battery voltage, without illumination/acoustics, with background radiation)

Dimensions: approx. 280 x 125 x 135 mm (L (with handle) x W x H)

Weight: approx. 800 g, with GM-counter tube approx. 900 g

Housing: ergonomically shaped plastic housing

Degree of protection: IP 54

Interfaces:

- serial interface RS 232 / USB interface
  - connection to PC
- quick charging / mains operation
- probe recognition
  - Graetz counts probes and dose rate probes
  - SEA probes
- active wall station
- active smear test station

9.2 Detector Contamination measurement

Detector type: zinc sulphide coated plastic scintillator with magnetically shielded photomultiplier

Detector size: approx. 170 x 100 x 1 mm³

Cover grid:

Standard: honeycomb grid, 0.5 mm strong, maximum opening 7 mm and 78% transparency.

Optional: additional fiber glass grid for increased protection of the mylar foil; the fiber glass grid is held by the grid frame and the protection grid. The fiber glass grid reduces the efficiency (see 9.2.2.1).

Cover foil:

- thickness: 2 µm
- vaporized aluminium foil on both sides
- frame spread with double layer foil

Nominal working range for outside air pressure:
500-1300 hPa, (max. change 100 hPa/h), influence neglectable

Nominal working range of temperature:

- operation: between -10°C and 40°C, no condensation
- storage: between -20°C and 50°C
- (other temperatures on request)

Nominal working area for relative humidity:
0 - 95%, no influence (non-condensing)

Detector voltage: approx. 1200 Volt

Warning!
A long storage period can lead to a high background rate.
After having used the device for a while again, the normal background value appears again.
To check the CoMo, switch the device to gross measurement and observe the background count rate. If this is extraordinarily high (> 100 cps) a measurement should not be performed before the count rate is of an usual level (approx. 15 cps – 30 cps). Using the CoMo with a test source significantly reduces the recovery time of the photomultiplier.

9.2.1 Photomultiplier

9.2.1.1 Data sheet

For Photon Counting, Low Light Level Detection
25mm (1 Inch) Diameter, Low Noise Bialkali Photocathode
Borosilicate Glass Window, 10-Stage, Head-On Type

GENERAL

Parameter		Description/Value	Unit
Spectral Response		300 to 650	nm
Wavelength of Maximum Response		375	nm
Photocathode	Material	Low noise bialkali	—
	Minimum Effective Area	21	mm
Window Material		Borosilicate glass	—
Dynode	Structure	Circular-cage	—
	Number of Stages	10	—
Direct Interelectrode Capacitances	Anode to Last Dynode	1.0	pF
	Anode to All Other Electrodes	1.5	pF
Base		14-pin glass base	—
Suitable Socket		E678-14C (supplied)	—

MAXIMUM RATINGS (Absolute Maximum Values)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	1250	Vdc
	Between Anode and Last Dynode	250	Vdc
Average Anode Current		0.1	mA
Ambient Temperature		-80 to +50	°C

CHARACTERISTICS (at 25°C)

Parameter		Min.	Typ.	Max.	Unit
Cathode Sensitivity	Luminous (2856K)	30	50	—	μA/lm
	Radiant at 375nm	—	50	—	mA/W
	Blue (CS 5-58 filter)	—	6.5	—	μA/lm-b
Anode Sensitivity	Luminous (2856K)	20	100	—	A/lm
	Radiant at 375nm	—	1.2×10^5	—	A/W
Gain		—	2.0×10^6	—	—
Anode Dark Current (after 30min. storage in darkness)		—	0.5	4.0	nA
Anode Dark Counts		—	20	60	cps
Time Response	Anode Pulse Rise Time	—	2.0	—	ns
	Electron Transit Time	—	19	—	ns

VOLTAGE DISTRIBUTION RATIO AND SUPPLY VOLTAGE

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	Dy9	Dy10	P
Ratio	3	1	1	1	1	1	1	1	1	1	1	

Supply Voltage: 1000Vdc, K: Cathode, Dy: Dynode, P: Anode

9.2.2 Measurement-technical data

Background count rate at 50 nSv/h:

α: approx. 0.1 cps
β/γ: approx. 15 - 25 cps

9.2.2.1 Radionuclide efficiency:

Mean values from measurements with 100 cm² specimen:
Assumed background: α: 0.2 cps, β/γ: 15.0 cps

C-14	approx.	14	%	Tc-99m	approx.	3	%
F-18	approx.	18	%	In-111	approx.	10	%
P-32	approx.	25	%	Sn-113	approx.	8.5	%
P-33	approx.	12	%	I-123	approx.	7	%
S-35	approx.	12	%	I-125	approx.	12	%
Cl-36	approx.	42	%	I-129	approx.	3	%
K-40	approx.	30	%	I-131	approx.	21	%
Cr-51	approx.	0.9	%	Cs-137	approx.	35	%
Fe-55	approx.	0.8	%	Re-188	approx.	13	%
Co-57	approx.	7.5	%	Au-198	approx.	23	%
Co-58	approx.	8	%	Tl-201	approx.	7	%
Fe-59	approx.	14	%	Tl-204	approx.	43	%
Co-60	approx.	23	%	Am-241 α	approx.	18	%
Ni-63	approx.	0.5	%	Pu-238 α	approx.	18	%
Se-75	approx.	7.5	%	U-238 α	approx.	22	%
Sr-89	approx.	27	%				
Sr-90 / Y-90 (based on Sr-90)	approx.	42	%				

If the radionuclide is analysed without any doubt, the specific efficiency can be used to calculate the activity (Bq) or the area-based activity (Bq/cm²) corresponding to the count rate.

$$\text{calibration factor } w = \frac{100}{\text{radionuclide-efficiency}}$$

Efficiencies with fiber glass grid (optional; see 9.2):
C-14 approx. 8 %; Co-60 approx. 15 %; Sr-90 approx. 34 %; Cs-137 approx. 25 %; Am-241 α approx. 13 %; U-238 α approx. 24 %

9.2.2.2 Detection limits:

Calculated according to DIN ISO 11929

Detection limit in in Bq:

$$y^{\#} = \frac{2 \cdot y^{*} + k_{1-\alpha}^{2} \cdot w / t_g}{1 - k_{1-\alpha}^{2} \cdot u_{rel}^{2}(w)}$$

Decision threshold in Bq:

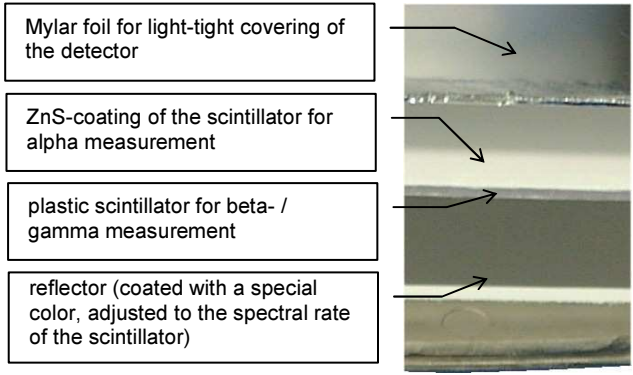
$$y^{*} = k_{1-\alpha} \cdot w \cdot \sqrt{x_2 \left(\frac{1}{t_g} + \frac{1}{t_0} \right)}$$

$y^{\#}$: detection limit
$k_{1-\alpha}$: stat. factor, depending on error probability
t_g: sample measuring time (in s = ring memory)
t_0: background measuring time in s (here: $t_0 = t_g$)
x_2: background in s^{-1} (see 9.2.2)
w: calibration factor (see 9.2.2.1)
$u_{rel}(w)$: relative standard uncertainty of w (test source)

Detection limit [Bq] for $k_{1-\alpha}$ = 1 and $u_{rel}(w)$= 6 %							
Nuclide	Measuring time			Nuclide	Measuring time		
	5 s	10 s	30 s		5 s	10 s	30 s
C-14	38.7	27.1	15.5	Sr-90 / Y-90	12.9	9	5.2
F-18	30.1	21.1	12		based on Sr-90		
P-32	21.7	15.2	8.7	Tc-99m	181	126	72.1
P-33	45.2	31.6	18	In-111	54.2	37.9	21.6
S-35	45.2	31.6	18	Sn-113	63.8	44.6	25.4
Cl-36	12.9	9	5.2	I-123	77.5	54.2	30.9
K-40	18.1	12.6	7.2	I-125	45.2	31.6	18
Cr-51	603	421	240	I-129	181	126	72.1
Fe-55	678	474	270	I-131	25.8	18.1	10.3
Co-57	72.3	50.6	28.8	Cs-137	15.5	10.8	6.2
Co-58	67.8	47.4	27	Re-188	41.7	29.2	16.6
Fe-59	38.7	27.1	15.5	Au-198	23.6	16.5	9.4
Co-60	23.6	16.5	9.4	Tl-201	77.5	54.2	30.9
Ni-63	1085	758	433	Tl-204	12.6	8.8	5
Se-75	72.3	50.6	28.8	Am-241 α	5.4	3.3	1.7
Sr-89	20.1	14	8	Pu-238 α	5.4	3.3	1.7
				U-238 α	4.4	2.7	1.4

9.2.3 Influence of alpha counts in the beta channel

Thanks to the special construction of the detector it is possible to measure alpha and beta/gamma radiation simultaneously.



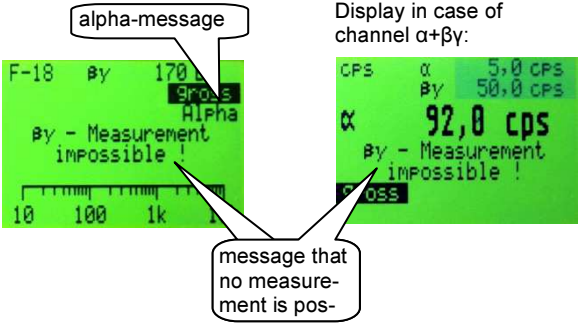
The Mylar foil is so thin, that alpha particles can penetrate it. If they hit the ZnS coating of the scintillator, this causes light flashes in the coating, which go through the scintillator and reach the photomultiplier. The photomultiplier transforms the flashes to electric pulses. Beta- and gamma radiation also cause a light flash in the scintillator. However, the light flash caused by alpha particles is much stronger. If a large number of alpha particles are present (approx. 50 cps and more), secondary effects also cause many light flashes of low intensity. These cannot be distinguished from the beta/gamma radiation and increase the beta/gamma rate significantly. By means of a special electronic switch, this influence can be reduced, but not completely eliminated.
Therefore a message about the presence of alpha radiation appears if alpha particles are detected whilst measuring in the beta/gamma channel.

- Alpha-message during beta/gamma-measurement

When the measuring channel is set to βγ-measurement, but α-radiation is detected, an alpha-message is blinking as soon as the alpha count rate is 1 cps.

- Exceeding the alpha threshold during beta/gamma-measurement

In case of high alpha radiation, the measuring values for beta/gamma radiation cannot be accepted as regular measuring values anymore. As soon as the alpha count rate is 50 cps, a message appears that no βγ-measurement is possible. At the same time, the alpha-message is blinking.



If a reliable beta/gamma value is required and alpha radiation is present, the alpha radiation has to be shielded by an appropriate material (for example a sheet of paper) between detector and measuring object.

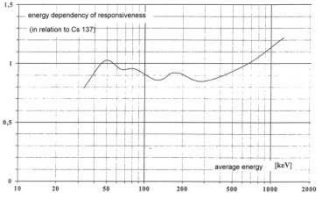
9.3 Detector Dose rate measurement (Optional)

Type of radiation: for gamma and x-ray measurement (DC installations)

Calibration: using gamma radiation, Cs 137

Measuring size: area-equivalent dose rate *H* *(10)

Nominal working range of the photon energy:
40 keV-1.3 MeV



Dose rate range (at ^{137}Cs):
1µSv/h – 20 mSv/h

Optimum direction: frontal on the front side of the CoMo; +/- 45°

Detector: Gamma counter tube 70 030 A

Detector dimensions:
internal diameter: 12 mm
effective length: 27 mm
housing thickness: 250 mg/cm²
size: 45 x 18.5 mm Ø

Position of detector in device: The detector is positioned horizontally behind the front side.

Position of reference point: identified by a dot in the center of the front side of the CoMo

Average life expectancy of the counter tube: 5×10^{10} counts

Response time: depending on measuring range 5 - 60 s

Overload capacity: > 1 Sv/h (continuous radiation)

After effect: negligible with exposure to 100 times the final reading

Warming-up time: 6 s

10 Function check

A simple function check should be performed every workday.
Since the CoMo also measures the natural radiation, which is always present, a simple function check is possible without additional tools.
A simple function check should be done once per working day. To check, select nuclide 4: α / βγ simultaneously (see 5.5). If this nuclide is not made available for use, the check can be performed in two steps, one for the α- channel and one for the βγ-channel.
The count rate in the alpha-channel should be < 0.5 cps.
The count rate in the beta/gamma-channel depends on the local background radiation and should be in the area of approx. 10 cps till 30 cps.
To check if the detector is light tight, the same background measurement should be performed twice, once with the plastic detector protection shield and once without protection shield, directed to a light source (e.g. room illumination). The count rate of both measurements should not differ too much from each other. If a significant raise of the count rate in front of a light source is noticed, a foil repair (see 12) has to be performed or the device has to be sent back for foil replacement.
A semi-annual comprehensive check can be performed using a test source. This check is performed and documented with a check protocol in chapter 15.

11 External detectors

It is possible to connect external dose rate probes to the CoMo 170. The following probes can be connected by an optionally available probe cable:

11.1 Dose rate probes

11.1.1 γ- Low dose probe NaI 25B38

Type of radiation: for gamma measurement (DC-installations)

Calibration: using gamma radiation, Cs 137

Measuring size: photon-equivalent dose rate

Nominal working range of the photon energy: 25 keV-1.3 MeV

Optimum direction: axial radiation onto the probe body.

Detector: NaI(Tl)-crystal

Detector size: 38 mm x 25 mm Ø

Position of detector in device: The detector is positioned axially in the centre of the probe

Nominal working range of atmospheric humidity: 0 - 95 %, no influence

Nominal working range for outside air pressure: 100-1300 hPa, influence negligible

Nominal working range: operation: between -20°C and +50°C
storage: between -25°C and +60°C

△t < 10° C/h

Housing: aluminium housing, black anodised, protection class IP 55

Dimensions: 32 mm Ø x 175 mm

Weight: approx. 210 g

11.1.2 γ- Low dose probe 18 550 CE

Type of radiation: for gamma and x-ray measurement (DC-installations)

Calibration: using gamma radiation, Cs 137

Measuring size: photon-equivalent dose rate

*** Nominal working range of the photon energy:** 40 keV-1.3 MeV,

Optimum direction: radial radiation onto the probe body; +/- 45°

Detector dimensions: effective length: 40 mm
housing thickness: 250 mg/cm²
size: 41 x 15 mm Ø

Position of detector in device: The detector is positioned axially in the centre of the probe.

Position of reference point: The reference point is identified by a ring-like marking on the probe housing.

*** Nominal working range of atmospheric humidity:** 0 - 95 %, no influence, the device is dust- and waterproof according to DIN 40050 (IP 67)

*** Nominal working range for outside air pressure**: 100-1300 hPa, influence negligible.

*** Nominal working range:**
operation: - 30 °C till + 60 °C
storage: - 40 °C till + 70 °C

* **Measuring range**: 10.0 µSv/h – 19.9 mSv/h

Average life expectancy of the counter tube:
5 x 10^{10} counts = at 1 mSv/h approx. 17500 h

Overload capacity: > 1 Sv/h (continuous radiation)

*** After effect**: negligible with exposure to 100 times the final reading

Housing: aluminium housing, bronze anodised, protection class IP 67

Dimensions: 40 mm Ø x 110 mm

Weight: approx. 150 g

* These values have been checked by the PTB (German physical-technical federal institute) as part of the type approval.

11.1.3 γ- Dose rate probe 18 509 CE

Type of radiation: for gamma and x-ray measurement (DC-installations)

Calibration: using gamma radiation, Cs 137

Measuring size: photon-equivalent dose rate

*** Nominal working range of the photon energy**: 55 keV-1.3 MeV

Optimum direction: radial radiation onto the probe body;+/- 45°

Detector dimensions: effective length: 17 mm
housing thickness: 80-100 mg/cm²
size: 16 x 6.2 mm Ø

Position of detector in device: The detector is positioned axially in the centre of the probe.

Position of reference point: The reference point is identified by a ring-like marking on the probe housing.

***Nominal working range of the temperature:** operation: - 30 °C till + 60 °C
storage: - 40 °C till + 70 °C

* **Measuring range:** 50 µSv/h - 999 mSv/h

Average life expectancy of the counter tube:
5×10^{10} counts = at 10 mSv/h approx. 17500 h

Overload capacity: > 50 Sv/h (continuous radiation)

***After effect**: negligible with exposure to 100 times the final reading.

Housing: aluminium housing, silver anodised protection class IP 67

Dimensions: 40 mm Ø x 110 mm

Weight: approx. 150 g

* These values have been checked by the PTB (German physical-technical federal institute) as part of the type approval.

11.1.4 γ- Dose rate probe 18 529 CE

Type of radiation: for gamma and x-ray measurement (DC-installations)

Calibration: using gamma radiation, Cs 137

Measuring size: photon-equivalent dose rate

*** Nominal working range**

of the photon energy: 70 keV-3.0 MeV

Optimum direction: radial radiation onto the probe body;+/- 45°

Detector dimensions: effective length: 7 mm
housing thickness: 80-100 mg/cm²
size: 16 x 6.2 mm Ø

Position of detector in device: The detector is positioned axially in the centre of the probe.

Position of reference point: The reference point is identified by a ring-like marking on the probe housing.

***Nominal working range of the temperature:** operation: - 30 °C till + 60 °C
storage: - 40 °C till + 70 °C

*** Measuring ranges:** 500 µSv/h – 9.99 Sv/h

Average life expectancy of the counter tube:
5×10^{10} counts = at 10mSv/h approx. 55000 h

Overload capacity: > 50 Sv/h (continuous radiation)

***After effect**: negligible with exposure to 100 times the final reading.

Housing: aluminium housing, blue anodised, protection class IP 67

Dimensions: 40 mm Ø x 110 mm

Weight: approx. 150 g

* These values have been checked by the PTB (German physical-technical federal institute) as part of the type approval.

11.2 Count probes

11.2.1 Low dose probe 18526 D

Detector: ZP 1430, window counter tube

window:	mica
thickness:	1.5 - 2 mg/cm²
effective diameter:	27.8 mm
effective surface:	6.1 cm²
shielding by protection grid:	20 %

Background: approx. 25 cpm

Counts in case of radial incident radiation (Cs 137): approx. 4 cps / µSv/h

Axial incident radiation: with cap: only γ -radiation
without cap: α-, β- and γ-radiation

Temperature range: operation: - 30 °C till + 60 °C
storage: - 40 °C till + 70 °C

Nominal working range for outside air pressure: 500-1300 hPa, influence cannot be determined in practical use. Transport in planes up to 3000 m height: Changes in air pressure have to be performed slowly.

Housing: aluminium housing, red anodised

Dimensions: 40 mm ∅ x 126 mm

Weight: approx. 150 g

11.2.2 Large-area plastic-scintillation detectors

Detector type: zinc sulphide coated plastic scintillator with magnetically shielded photomultiplier

Detector dimensions:

size 1: 240 x 140 x 1 mm³
size 2: 290 x 140 x 1 mm³

Coupling: via air - reflector

Nominal working range for outside air pressure: 100-1300 hPa, influence negligible

Nominal working range of the temperature:

operation: between 10 °C and 40 °C
storage: between 0 °C and 50 °C

Dimensions:

size 1: 380 mm x 170 mm x 65 mm (LxWxH)
size 2: 430 mm x 170 mm x 65 mm (LxWxH)

Weight: approx. 0.6 kg

Detector voltage: approx. 1100 Volt

11.2.2.1 Measuring-technical data

Background count rate at 50 nSv/h:
α: approx. 0.1 cps, β/γ: approx. 16 - 25 cps

Radionuclide-sensitivity
Average values of measurements with 100 cm² samples:

Nuclide	Efficiency	Nuclide	Efficiency
C-14:	approx. 8 %	I-131:	approx. 20 %
Cl-36:	approx. 42 %	Cs-137:	approx. 30 %
Co-60:	approx. 22 %	Pu-238 α:	approx. 12 %
Tc-99:	approx. 4 %	Am-241 α:	approx. 13 %
I-125:	approx. 12 %	Sr-90 / Y-90: (based on Sr-90)	approx. 45 %

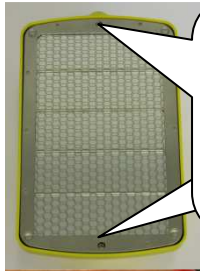
12 Foil replacement and foil repair

The foil frame is equipped with a double layer of Mylar foil on both sides. In case of small damages, it is sufficient to cover the spot which is not light tight with a small piece of foil. In case of bigger damages it is useful to replace the complete frame.

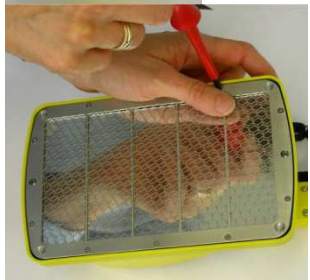
The CoMo detector contains a photo-multiplier, which transforms light into electrical signals. Replacement should take place on a dry and dust-free place. No humidity or dirt may get into the compartment. Basically, a defect foil should only be repaired or replaced in a dark room. The darker the room is, the shorter the recovery time for the photomultiplier is. After a foil repair by “daylight“, the recovery time of the photomultiplier can take several hours.

12.1 Removal of the foil

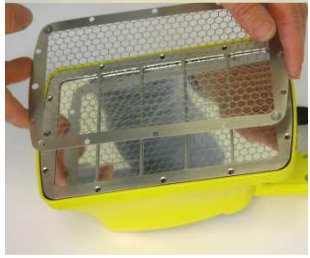
Remove the 10 countersunk head screws of the detector.



Hold the screwdriver in such way that no further damage of the foil can be caused by inadvertently slipping.



After removal of the screws, the honeycomb grid can be removed.



Then the frame with cross studs can be removed.

In case of damage at the edge of the detector, the foam rubber seal should be removed too.

In case of bigger damages, the complete frame has to be replaced.

Warning!
The detector under the foil is covered with a powder layer. This layer is not resistant to friction and should not be wept off or removed.

The detector itself should stay in the housing. However, if it has been removed, it is very important to be sure that the side covered with powder is positioned up (towards the foil).

12.2 Repair of the foil

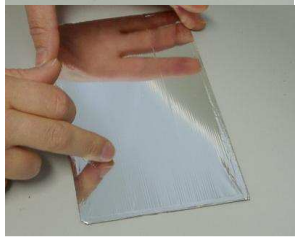
In the next 4 steps is described how to repair a foil. In case of complete replacement of the foil, these steps can be skipped.

Search the hole in the foil.

Cut a piece of foil with a sharp knife or scissors (on all sides approx. 1cm larger than the damaged spot).

Coat the cut piece of foil with a glue pen (e.g. Pritt, Uhu) on one side.

Put the coated piece of foil on the middle of the damaged spot and push it slightly.



12.3 Assembly of the detector

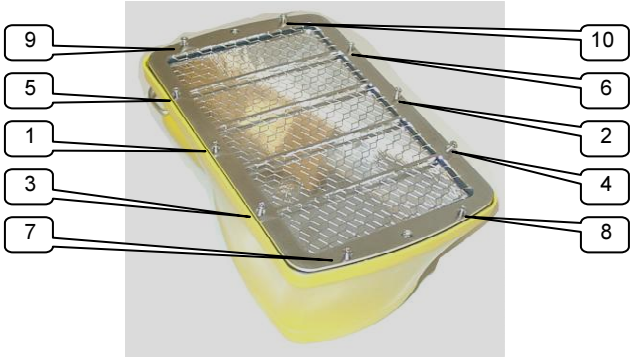
The assembly of the detector takes place in reverse order and starts with inserting a non compressed seal.
(A compressed seal expands after about 2 hours.)
Mind that the holes in the foil are above the screw holes.

The next step is to put the frame with gross studs on the detector again.

Finally, the honeycomb grid is put on the frame with cross studs.

Insert all screws through the seal in the frame. Only when all screws are inserted through the seal, the screws can be tightened.

Tighten the screws in the sequence as shown below.



Warning!
To avoid that the seal gets crushed, the screws should not be tightened too strong.

Because of the direct incidence of light which reaches the photomultiplier during the repair, the device shows much too high values at the beginning. The values return to their normal level after a while (depending on the quantity of light in the room during the repair). For this purpose, the device has to be turned on for a while. Using a test source reduces the recovery time.

Start using the instrument only after 12 hours in order to allow the phosphorescence (afterglow) to decay.

13 Accessories

Currently available accessories:

13.1 Additional probes

13.1.1 Dose rate probes

- γ-low dose rate probe NaI25D38 1”x 1.5”

- γ-low dose rate probe NaI38D50 1.5”x 2”

- γ-low dose rate probe 18 550 DE / CE

- γ-dose rate probe 18 509 DE / CE

- γ-high dose rate probe 18 529 DE / CE

The operation of the probes mentioned above is described in chapter 8.4.1.

13.1.2 Geiger-Müller contamination / smear test probes and special 1-channel count probes

- Geiger-Müller contamination / smear test probes

  - low dose probe 18526 D

- Special 1-channel count probes
  - 3“ x 3“ x 0.5“ NaI planar probe

  - 4“ x 4“ plastic scintillator

The operation of the probes mentioned above is described in chapter 8.4.2.

13.1.3 Special 2-channel count probes

- 25mm Ø α, β/γ end window probe

- 50mm Ø α, β/γ end window probe

- 43mm Ø x 150 mm, α, β/γ pipe detector

- 32mm Ø x 200 mm, α, β/γ pipe detector

- 170 cm², α, β/γ flat probe

- 4 x 170 cm² α, β/γ probe

- 375 cm² / 450 cm², α, β/γ probe

The operation of the probes mentioned above is described in chapter 8.4.3.

13.1.4 1-Wire probes (intelligent probes)

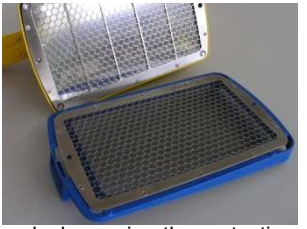
With 1-wire probes, various data are stored in the probe and are selected automatically by the CoMo. A part of the stored data can be changed through entries in the CoMo and will be stored changed in the probe.
In the 1-wire probe described in 8.4.4, for example, nuclide data will be stored on the probe. There are also 1-wire probe types that work as dose rate probes.
1-wire probes can be configured according to special customer requirements.

13.2 Miscellaneous accessories

- Charging adapter to charge rechargeable batteries with a charging current of approx. 300 mA
- Various cables:
  - serial RS 232 interface cable to computer
  - USB interface cable to computer and charging with USB-cable
  - probe cable: spiral cable (ejected approx. 2 m)
- Software:
  - **CoMo-Parameter** for parameter setting (useful for customers with several devices)
  - **CoMo-Data** for read-out and further processing of stored data
  - **CoMo-Logger** for graphic and numerical display of measuring data
- Case
- Additional display

- earphone; can be used starting with software version 3.78

- Protection cap for CoMo 170 with fiber glass grid and honeycomb grid.



This protection cap can be used to better protect the Mylar foil during a measurement (e.g. grass surface).

Caution! The efficiency is reduced when using the protection cap.
Efficiencies with fiber glass grid protection cap:
C-14 approx.6 %; Co-60 approx.12 %; Sr-90 approx.28 % (relative to Sr-90); Cs-137 approx.20 %; Am-241 α approx.10 %; U-238 α approx.14 %
We recommend to create your own nuclides with the changed efficiency for measurements with the protection cap.

- Floor bogey:
distance CoMo to floor approx. 10mm

- Single smear test counter passive or active with battery charge function

- Wall / table station
  passive or active with battery charge function, also with shielding

- Various test sources

14 Device check with test source

Unlike the simple function check (see 10) an elaborate detector check can be realised with a test source. The half-life of the test sample Am-241 is 432 years and therefore negligible during measurement. For the Sr-90 sample it is another story. This sample has a half-life of 28 years, which should be taken into account during measurement. Correcting the test source values every 5 years is sufficient. For this purpose, the new calculated activity is entered in the test protocol underneath. The count rate in the βγ- channel should be reduced by the same percentage as the calculated activity. To check, select nuclide 4 α / βγ simultaneously (see 5.5). If this nuclide is not made available for use, the check can be performed in two steps, one for the α- channel and one for the βγ-channel. To check, place the test source with the test sample to be measured (round flat side in the middle) up on a flat surface.

Years after purchase	Ref. activity (Sr-90) – x %
ca. 5 years	- 10 %
ca. 10 years	- 20 %
ca. 15 years	- 30 %
ca. 20 years	- 40 %

Make a background measurement with the device and switch to net measurement in the Quick menu. Change the nuclide selection to the cps mode. Select the alpha or beta/gamma mode, depending on the test source. Place the device (The device has to be turned on) on the test source in such way, that both surfaces (test source and detector) are positioned precisely in front of each other. Wait a moment until the value has stabilised itself and compare it with a present entry. Every half year the measured values should be entered in the protocol underneath. This measurement should be repeated with the α-test source in the same way.

15 Test protocol for test source

Test source:	No.:	Date:

Activity:	Am-241: Bq	Sr-90: Bq

Measure-ment on	α-channel [cps]	Activity Sr-90 [Bq]	βγ-channel [cps]	Signature

16 Programme update

If you turn on the CoMo, the message **BT - Loader active** is shortly displayed. During this, the CoMo checks if a PC is connected to the serial interface and an update programme was started on the PC. If this is not the case, the CoMo programme is executed normally. The procedure of update is part of the update programme and is not included in this user's manual. For update you need a special cable.

Display:
BT - Loader active: boots trap loader active
(Update search programme is active)

Button functions:


here no function


here no function


here no function


here no function

17 EC-Attestation of conformity

We hereby certify that the following product:

CoMo 170 Contamination Monitor

complies with the essential protection requirements as defined in the Council Directive on the approximation of the laws of the Member States with regard to electromagnetic compatibility (89/336/EEC).

To evaluate the product regarding electromagnetic tolerance, the following European standards have been applied:

- **Electrostatic discharge immunity test**
  Base standard: DIN EN 61000-4-2 (12.2009)
  DIN EN 61326-1; table A.1 (10.2006)
- **Electromagnetic field immunity test**
  Base standard: DIN EN 61000-4-3 (12.2006)
  DIN EN 61326-1; table A.1 (10.2006)
- **Power frequency magnetic immunity test**
  Base standard: DIN EN 61000-4-8 (11.2010)
  DIN EN 61326-1; table 2 (10.2006)
- **Radiated disturbance measurements**
  Base standard: DIN EN 55016-2-3 (08.2007)
  DIN EN 55011 clase B group 1 (11.2007)

The following additional recommendations, national standards and specifications have been applied:

- **Restriction of the use of certain hazardous substances in electrical and electronic equipment [RoHS II]**
  Directive 2011/65/EU (06.2011)

This statement is made with responsibility for the manufacturer

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Dresden, August 20th, 2014

18 Concluding remark

The CoMo has been manufactured with utmost care. Nevertheless, errors cannot be ruled out entirely. We would therefore appreciate your comments and proposals for improvements. We are happy to help you if you encounter problems in working with this instrument. Please send a letter, fax or mail to:

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