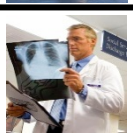
MIRION TECHNOLOGIES Health Physics Division

Technical handbook


CheckPoint:Waste™

Release measurement station

Tool&Object-Monitor (RTM606)

April 2011

D310001

RADOS

www.**mirion**.com

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All data in this manual takes place using best knowledge, but without guarantee. We reserve, in the interest of our customers, that improvements and corrections at hardware, software and documentation will be made any time without announcement.

We are grateful for suggestions and critic regarding this documentation or the RTM itself.

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Register 1	General		08.04.2011	Reg1.docx
Register 2	Technical data		08.04.2011	Reg2.docx
Register 3	Structure and description		08.04.2011	Reg3.docx
Register 4	Service		08.04.2011	Reg4.docx
Register 5	Hardware setup		08.04.2011	Reg5.docx
Register 6	Not used (OPTION)		08.04.2011	Reg6.docx
Register 7	Not used (OPTION)		08.04.2011	Reg7.docx
Register 8	Detector		08.04.2011	Reg8.docx
Register 9	Trouble shooting and repair		08.04.2011	Reg9.docx
Register 10	Maintenance		08.04.2011	Reg10.docx
Register 11	Nomenclature		08.04.2011	Reg11.docx
Register 12	Supporting documents		08.04.2011	Reg12.docx

Table of content

1 General

Figure

1.1 Health Physics Product Families

"Health physics", also known as radiation protection, is concerned with protecting people from exposure to radiation, monitoring the effects of any exposures and recording any radiation dose received by the person. The "CheckPoint" product families by Mirion Technologies (RADOS) GmbH are the virtual envelope that holds a wide range of contamination and radiation monitors for radiation safety throughout all areas of a nuclear power plant. All types of radiation important for waste management and nuclear professionals (alpha, beta, gamma and neutron) are covered by the "CheckPoint" contamination monitors in their various formats, such as contamination on people, laundry, tools or in waste.

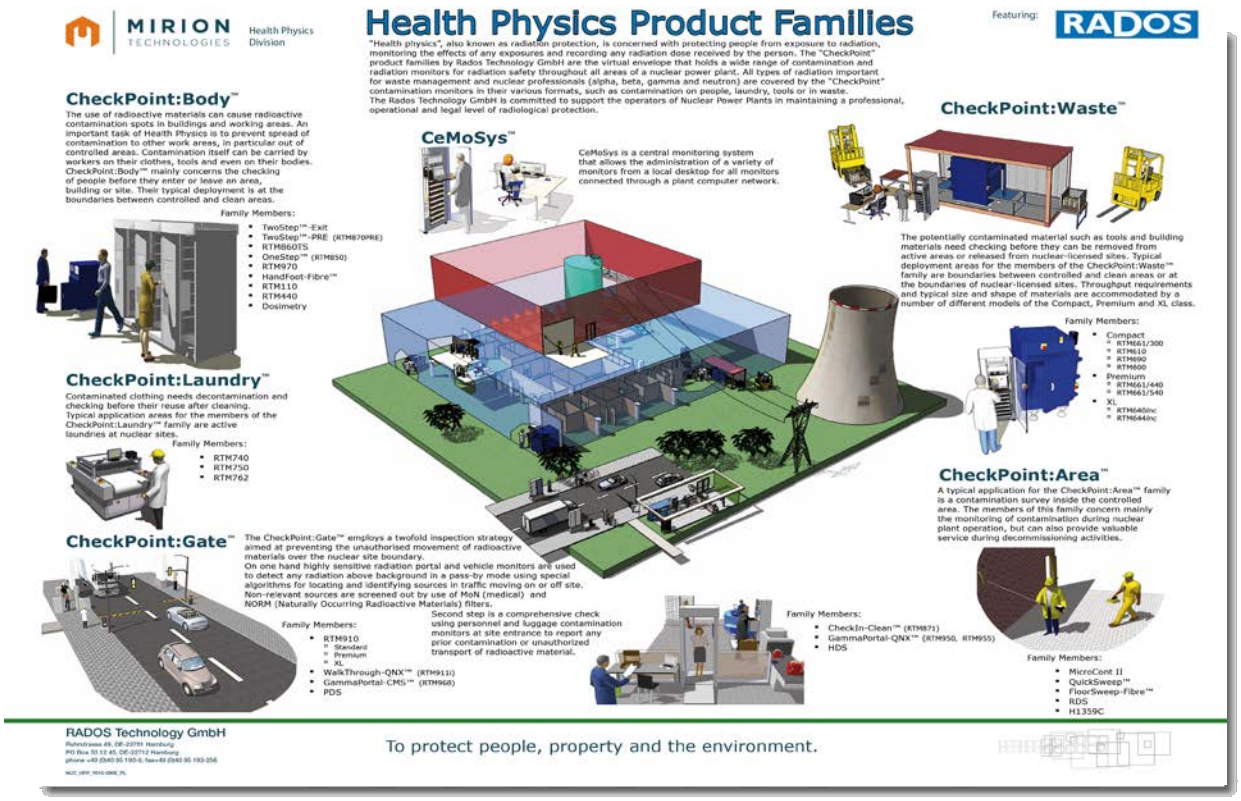


Figure 1-1: Mirion Technologies (RADOS) GmbH Health Physics product family placard

1.2 CheckPoint:Waste™ family

The use of potentially contaminated material such as tools and building materials need checking before they can be removed from active areas or released from nuclear-licensed sites. Typical deployment areas for the members of the CheckPoint:Waste™ family are boundaries between controlled and clean areas or at the boundaries of nuclear-licensed sites. Throughput requirements and typical size and shape of materials are accommodated by a number of different models of the Compact, Premium and XL class.

Additional information on the CheckPoint:Waste™ Family monitors, which are not part of this technical handbook, can be reached by the manufacturer with the address given in this handbook.

CheckPoint:Waste™ family type series members:

Compact	Premium	XL*
RTM610	RTM661/440	RTM640Inc*
RTM661/300	RTM661/540	RTM644Inc
Tool&Object-Monitor		

Figure 1-2: CheckPoint:Waste™ Premium design view

Figure 1-3: CheckPoint:Waste™ Compact design view

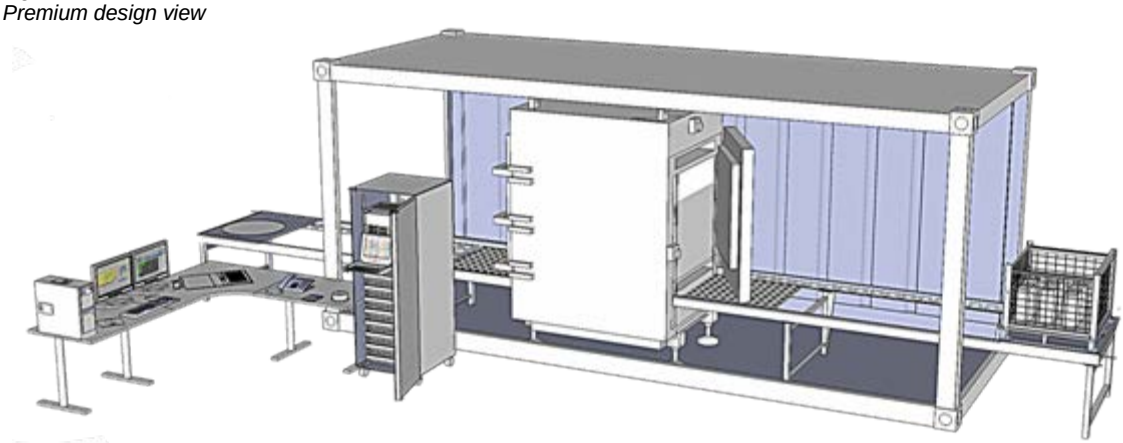


Figure 1-4: CheckPoint:Waste™ XL design view

1.2.1 Type series description

The CheckPoint:Waste™ Compact: Tool&Object-Monitor type series consists of different models, which all support waste measurements. This documentation will cover the **Tool&Object-Monitor**.

Figure 1-5: CheckPoint:Waste™ Tool&Object-Monitor view

CheckPoint:Waste™ Compact: Tool&Object-Monitor type series members:

The Mirion Technologies (RADOS) GmbH CheckPoint:Waste™ Compact: **Tool&Object-Monitor** release measurement stations are build with different measurement chamber dimensions and detector configurations:

❶	**Tool&Object-Monitor**	**measurement chamber of ˜80 litres**
➲	measurement chamber	40 x 40 x 50 cm³
➲	four to six plastic scintillation detectors	
➲	detector type RFD1600G	

Detector type list for use in CheckPoint:Waste™ family type series:

Abbr.	Name descr.	Type	Location	LxWxH (External)
RFD	RADOS Fibre Detector	RFD1600G	Measurement chamber	400x400x50

1.3 Type series options

For a general overview all options are described briefly in this documentation although they are not applicable for all monitors.
Not applicable references and text passages for all **Tool and Object Monitor Tool&Object-Monitor**. types are individually marked in this technical handbook.

The actual build of the **CheckPoint:Waste™ Compact: Tool&Object-Monitor** which is briefly described in this technical handbook, can be reached in register 2 Technical data.
For detailed information regarding an enhancement of your **CheckPoint:Waste™ Compact: Tool&Object-Monitor** with options please consult the manufacturer with the address given in this handbook.

NOTE

The update of a **CheckPoint:Waste™ Compact: Tool&Object-Monitor** with optional mechanic or software modules has no effect on the basic function as they are described in this handbook.

1.3.1 Type series technical handbook conventions

As this technical handbook is valid for all type series of the **CheckPoint:Waste™ Compact: Tool&Object-Monitor** in the following two icons are added to demonstrate that special hardware- or software-options are needed to perform the described task.

- optional hardware needed/missing

- applicable with adequate parameter setting or license only

- Additional Software license needed

1.3.2 Mechanical options

To meet the customer preferences the Tool & Object-Monitor can be supplied with one or two doors, detector and communication options.

CheckPoint:Waste™ Tool&Object-Monitor detector options:

Detector options		Number	Location
❶	Basic Version	4 Detectors	left, right, bottom, top
❷	Option 1	6 Detectors	additional front, back

CheckPoint:Waste™ Tool&Object-Monitor door options:

Door options		Number	Location
❶	Basic	2 Doors	front/back including inter-lock system (one door operation mode can activated by user software)

CheckPoint:Waste™ Tool&Object-Monitor scale options:

Scale- options		
❶	Basic Version	no scale
❷	Scale Version	integrated weight cells; measure up to 50 kg

CheckPoint:Waste™ Tool&Object-Monitor display options:

Scale- options		
❶	Basic Version	1 Touch screen display
❷	Option	additional screen at exit side

CheckPoint:Waste™ Tool&Object-Monitor lead shielding options:

Scale- options		
❶	Basic Version	25 mm
❷	Option	50 mm

1.3.3 Software options

As the technology used for release measurements is not just differentiated country to country it is also subject to substantial changes in time. Continuously changing limits and changes in the philosophy of release measurements demand flexible design of the system software to guarantee efficient use over many years.
In addition, the clearance monitor provides many optional features that are provided on top of the standard configuration.

software options:

Name		Specification
❶	Basic calibration	The basic calibration splits the efficiencies into a nuclide and a material dependent part.
❷	Nuclide vectors	A nuclide vector enpossibles of activity contributions of defined nuclides in the total activity.
❸	*System check and Detector test*	The maintenance and test program A reference measurement with a test dummy and a test source can be done for future checks of the detectors efficiencies.
❹	Scale select	Automatic parameter selection with scale measurement aid.
❺	Dose rate calculation	Algorithm to calculate in dose rates (µSvH)

NOTE

The actual build of **Tool&Object-Monitor**, which is briefly described in this technical handbook, can be reached in Register 2 Technical data.
For detailed information on an enhancement of your **Tool&Object-Monitor** with options please consult the manufacturer with the address given in this handbook.

1.4 Structure and subdivision

Text

This technical handbook has been created according to the guidelines of DIN EN 61187.

The texts are divided in up to 4 levels:

Level 1: script size of head line 22 pt, bold

Level 2: script size of headline 14 pt, bold

Level 3: script size of headline 12 pt, bold

Level 4: script size of headline 10 pt, bold

Script: Helvetica

Script size: for text 10 pt

1.4.1 Technical handbook systems and data carrier

Text- and CAD system

The text of this technical handbook is created with the word processing program Microsoft© Word© (from version 6.0) which is in common use at Mirion Technologies (RADOS) GmbH.

The drawing documents used in this technical handbook have been created with a CAD System and can be supplied in a common exchange format. These are:

- *.dwg

For creating the design drawings a CAD-system is used:

- Auto-CAD©, Mechanical Desktop

1.4.2 Data carrier for text systems

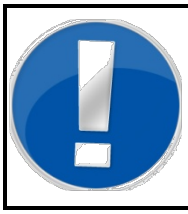
Data carrier

In future Mirion Technologies (RADOS) GmbH intends to supply the technical handbook on data carriers.

The technical handbook is saved and supplied in Adobe Acrobat in *.pdf format.

For im- and export of data a standard USB-stick is used.

1.5 Applied symbols and writing style conventions



NOTE

Hints and valuable information for the user in the course of the description.

CAUTION

Caution and safety hints have to be duly noted and complied with.

WARNING

Caution and safety hints that have to be noted and complied to prevent injuries, damages or data loss.

DANGER

Caution and safety hints that have to be noted and complied to prevent injuries, damages or death.

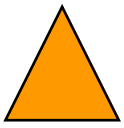
Note the operation instruction or the documentation.

Applied principles in this document is the use of the following symbols are used:

Prohibited action

Mandatory action

Warning



Example:

These symbols indicate processes or behaviours not allowed in the premises of **Tool&Object-Monitor**.

These symbols indicate special danger handling the **Tool&Object-Monitor** that presents a risk of personal injury.

These symbols indicate important instructions accompanying the **Tool&Object-Monitor** or special procedures with the monitor.

These symbols should indicate the kind of danger precisely.

Writing style conventions

• **Bold type**	indicates the name of a button to press or touch.
• Underlining	is used to emphasize a word or term.
• *Italic type*	is used to indicate names, such as the name of a chapter, or the name of a screen.
• Figure X illustration	Text referring to illustrations or screen samples are captioned underneath the image.

1.6 Product information

Product name:	Machine type: Model: Serial number Order number: Year of make:	CheckPoint:Waste™ Compact: Tool&Opject-Monitor RTM 606
Entries by customer:	Inventory-no.: location:	
Address of manufacturer:	Company name: Street: City: Telephone: Fax: E-mail:	**Mirion Technologies (RADOS) GmbH** Ruhrstrasse 49 22761 Hamburg +49 (0)40 – 85 193-0 +49 (0)40 – 85 193-256 hamburg-info@mirion.com
Orders for spares and service:	Same as above: Telephone: Fax:	 +49 (0)40 – 85 193-187 +49 (0)40 – 85 193-165
Document data:	No. of document and operating manual: Date:	D3.10.00.1 12/10

1.7 Maintenance and safety

This chapter describes procedures necessary for keeping your **Tool&Object-Monitor** operating reliably.
For troubleshooting problems, refer to the troubleshooting section of the technical handbook. Problems that cannot be solved need to be referred to your RADOS customer service.

1.7.1 Safety notices

Tool&Object-Monitor is designed and tested to meet strict safety requirements. These include safety agency approval and compliance to established environmental standards. Please read the following instructions carefully before operating the product, and refer to them as needed to ensure the continued safe operation.

CAUTION

Any unauthorized alteration, which may include the addition of new functions or connection of external devices, may impact the product certification.
Please forbear from any unauthorized alteration.

1.7.2 Calling for service

When there is a problem with **Tool&Object-Monitor** an error description and a suggested solution is displayed on the screen. Follow all steps in the suggested solutions until the problem is corrected.
If the problem still persists, call for assistance.

Follow the instructions below before calling for service.

1. Be prepared to provide a complete description of the problem to the service operator. Defining the problem accurately may help you and the operator solve the problem over the phone and minimize downtime. If the problem cannot be solved by telephone, a service representative will be dispatched to your site.
2. Record the displayed fault description.
3. Record the machine-serial number.
4. If possible, use a phone near the ***Tool&Object-Monitor*** when calling for assistance. Describe the problem and answer the questions from the service operator about the defects. Follow the instructions provided by the operator.

1.7.3 Electrical safety

Use only the power cords and cable supplied with this equipment.

- ⇨ Plug the power cords directly into a correctly grounded electrical outlet.
- ⇨ Do not use extension cords.

CAUTION

If you do not know whether or not an outlet is grounded, consult a qualified electrician.
You may incur a severe electrical shock if the outlet is not grounded correctly.

- ⇨ Do not place objects on power cords.
- ⇨ Do not override or disable electrical or mechanical interlocks.
- ⇨ If any of the following conditions occur, immediately switch off the power to the machine and disconnect the power cord from the electrical outlet.
  Call an authorized service representative to fix the problem.
- ⇨ The machine emits unusual noises or odours.
- ⇨ The power cord is damaged or frayed.
- ⇨ A wall panel circuit breaker, fuse, or other safety devices are tripped.
- ⇨ Any part of the machine is damaged.

1.7.4 Maintenance safety

- ⇨ Do not attempt any maintenance procedure that is not specifically described in the documentation supplied with your **Tool&Object-Monitor**.
- ⇨ Do not use aerosol cleaners. The use is not approved and may cause poor performance or could create a dangerous condition.

1.7.5 Operational safety

The **Tool&Object-Monitor** equipment and supplies were designed and tested to meet strict safety requirements. These include safety agency examination, approval, and compliance with established environmental standards.
Your attention to the following safety guidelines will help to ensure the continued safe operation of your **Tool&Object-Monitor**:

- ⇨ Use the materials and supplies specifically designed for your **Tool&Object-Monitor** only. The use of unsuitable materials may result in poor performance of the machine and possibly a hazardous situation.
- ⇨ Follow all warnings and instructions that are marked on or supplied with the machine.
- ⇨ Do not attempt to move any machine parts.

1.8 Disposal and recycling

1.8.1 Disposal and long term storage

The information of the section shall used whenever the operator decides to shut down the device from operation for a longer time period or for disposal.

Preparation tasks:

Task	Action
❶	Turn off the power. Secure device against accidental re-activation by a third party.
❷	Remove and store all cables from device.
❸	Do not use airtight cover on storage sides, otherwise the corrosion of various parts will be increased.

WARNING

Risk of injuries caused by cuts!

The dismantling of the device conceals the risks of injury due to sharp edges and corners of the device housing.

Therefore, it is advised to use appropriate work gloves.

1.8.2 Recycling

The sign labeled on the product indicates that it is not allowed to use customer waste sites or bins for disposal.
The operator of the device is committed to use other material disposal options. Generally this is necessary to examine the issues of prevention, product recycling and materials recycling when evaluating individual electro scrap recycling options prior to final disposal.

The disposal of electro scrap is part of the public authorities.

Some materials, parts, subassemblies can be used for another purpose than they were originally conceived (i.e. at a lower level).

The reuse is a part of the overall environmental protection. Please enquire directly to your local public waste management company for further information.

RECYCLING

In order to prevent possible environmental damage the following instructions must be carried out carefully.
Even if an approved waste management company is performing the tasks the operator must ensure the proper task execution!
The disposal of all device parts must ensure that health and environmental damages are excluded.

Recycable materials of the device:

Material	**Used in**
Copper	Cable
Plastic, rubber, PVC	Seals Hoses Cable Framework
Tin	Circuit board
Polyester	Circuit board

Special waste**:**

Material	**Used in**
liquid-crystal display (LCD)	Display
Electro scrap	Circuit board, components

1.9 Safety precautions

The consideration of this documentation is a necessity for the trouble-free operation and the execution of possible guarantee claims. Please read the documentation carefully before starting to use this monitor, in order to secure a safe operation.

The documentation contains important notes for the service work. Therefore, it should be kept close to the monitor.

NOTE

All works necessary to operate the monitor as maintenance, transportation, storage, set-up, assembly and commissioning must be carried out only by qualified personnel with strict adherence to

- circuit drawings and technical documentation
- warning and safety precaution signs
- safety notes and technical data sheets

which are given in this documentation.

CAUTION

Severe personnel and material damage may occur because of

- non- consideration of content of this documentation
- wrong installation or operation
- not permitted removal of safety features

Commissioning/Service

Operation

NOTE

The commissioning of the monitor requires qualified expert personnel or Mirion Technologies (RADOS) GmbH service personnel.

The operation of the monitor requires trained personnel.

1.9.1 Electronics

WARNING

Life Danger

If the monitor shows any errors, defects or if repairs are to be carried out, the monitor has to be disconnected from mains. Therefore the operation software has to be finished and the measurement computer has to be shut down first. (refer to register 3 chapter 3.5 for details)

Marking of dangers and dangerous areas

Danger!
High Voltage

Electric shock

Label:

- **Mains terminal**
- **Connectors**

High voltage

Application:	■ **Electric voltage in working room** **Switch room, electric distribution, detectors**
Attention!	**Dangerous electric voltage.** Work to be carried out **only** by qualified service personnel or Mirion Technologies (RADOS) GmbH service personnel.
Performance:	Works in the marked area are **only** to be carried out by: ■ Experts in electric or electro-technical trained personnel
To attach:	■ On voltage carrying components. ■ Clearly visible ■ Permanently visible
Possible consequences:	■ Danger of electric shock. ■ Death ■ Serious burnings

1.9.2 Marking by note signs

Figure 1-6: Sticking label

CAUTION

The mains connection of the monitors is marked with a sign (sticking label) "Pull mains plug before opening the monitor housing".

Following warnings are given on the label:

Squeezing area

Figure 1-7: Label at the monitor

1.9.3 Name plate

The nameplate attached to the monitor is clearly visible.

Typ	- type of monitor, e. g. **Tool&Object-Monitor**
Nr.	- serial number of the monitor
Baujahr	- year of make, date of manufacture
Teilenr.	- part number of the monitor
V + Hz	- supply voltage, e. g. 230V/50Hz
A	- power consumption

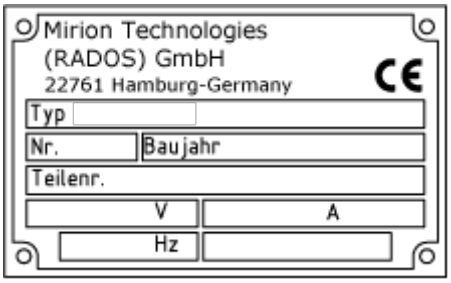


*Figure 1-8: Name plate **Tool&Object-Monitor***

Software

1.10 Operating and User Software

1.10.1 QNX 6.4x – operating system with runtime adaptation

In order to measure objects fast and reliably, many calculations of individual procedures have to run simultaneously. For instance, in order to measure the background continuously, a computer system is required that allows all operations in multi-tasking handling, in real time. For this aim the Mirion Technologies (RADOS) GmbH has been using the operating system QNX for many years to carry out the different measurement tasks. The whole system is based on a very small and thus very fast core. This core is only responsible for the exchange of messages and the distribution of the computer capacity between simultaneously running program.

All other functions of the operating system are available as independent program and thus they can be used very flexibly.
Some of these functions are:

- The “Process Manager“ for start-up, monitoring and finishing of all programs; in accordance with the POSIX standards 1003.1 and 1002.1b.
- the “File system Manager” for safe work with the different memory med ia with the file systems POSIX, DOS and ISO 9660 as well as the form of a memory med ium of various hard disks, CD-ROM, ROM and Flash memory.
- The “Device Manager” for fast work of all programs with the interfaces of the computer. These include the video monitor, terminals, modems as well as serial and parallel interfaces.
- The “Home Manager”, for addressing instance databases or special hardware.

Based on this architecture, extremely short task switches and reaction times are provided. The user surface can be realized on windows - surface capable of real time. It corresponds to the Open Look.
Network functions belong already to a standard part of the operating system. With different drivers any topologies can be used (e.g. Ethernet, Token Ring, and FDDI). The TCP/IP+NFS – protocol can also be used optionally, thus allowing for a connection to all networks and large computers.
The modular design of the operating system makes it possible to employ computers of different capacity and size, depending on the task range to be accomplished. The computer capacity of the processors is made fully available to the user with the use of the 32 bit protected mode.

Due to the strict compliance with the UNIX and POSIX guidelines the source code is compatible to the world of UNIX systems (workstation, etc.).

1.10.2 Brief introduction to QNX6

Since 1980 many manufacturers have relied on QNX real time OS (RTOS) technology to power their mission-critical applications. Everything from medical instruments and internet routers to in-car infotainment devices, nuclear-monitoring systems, and military communications has been build with the use of QNX. Small or large, simple or distributed, these systems share an unmatched reputation for operating 24 hours a day, 365 days a year, non-stop.

The QNX is, time-tested and field-proven, built on true micro kernel architecture. Under QNX every driver, application, protocol stack, and file system runs outside the kernel, in the safety of memory protected user space. Virtually any component can fail and be automatically restarted without affecting other components or the kernel. As no other commercial RTOS provides such a high level of fault containment and recovery.

But just as important, all components communicate via a single, well-defined form of communication: synchronous message passing. This message passing forms a virtual “software bus” that lets you plug in, or plug out, any component on the fly. Better yet, messages can flow transparently across processor boundaries, allowing your application to access any resource, anywhere on the network.

Engineered to the POSIX standard (1003.1-2001 POSIX.1), QNX gives you the power to port legacy and open-source UNIX, Linux, and Internet code with just a simple recompile. With standard APIs, you can reuse application code, avoid costly delays and shorten your learning curve — accelerating development cycles and reducing time to market. In addition, QNX Neutrino provides pre-integrated, out-of-the-box support for a wide range of networking protocols, from traditional TCP/IP to next-generation stacks — all based on BSD and POSIX standards and optimized for interoperability.

QNX Software Systems, a Harman International company (NYSE: HAR), is the industry leader in real time, embedded OS technology. The component-based architectures of the QNX Neutrino RTOS and QNX Momentics development suite together provide the industry's most reliable and scalable framework for building innovative, high-performance embedded systems. Global leaders, such as Cisco, Daimler Chrysler, General Electric, Lockheed Martin, and Siemens depend on QNX technology for network routers, medical instruments, vehicle telemetric units, security and defence systems, industrial robotics, and other mission or life-critical applications.

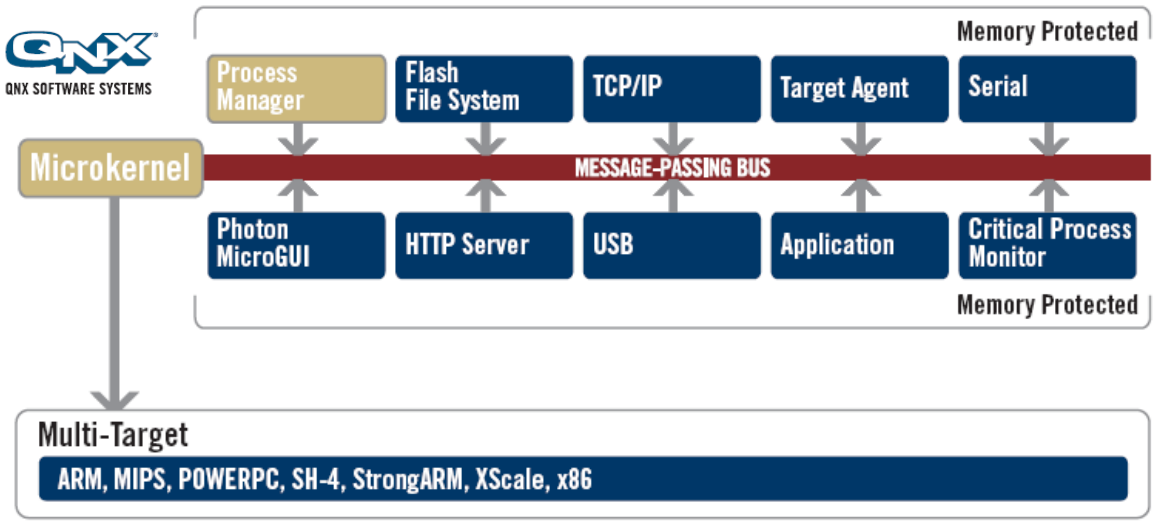


Figure 1-9: QNX RTOS system overview (picture source: QNX Software systems)

1.10.3 Operation of QNX6

The QNX provides a **G**raphical **U**ser **I**nterface for the operating system QNX. The complete operating is effected via menus and graphical symbols, so that the software- and system functions are easy to handle.

The surface provides some graphic display and input elements for communication with the user. These elements are introduced in short, and it is described how they are operated.

- Selection switch: selection of one out of several options
- Input field: input of digits or characters
- Sliding bar: display of a digit in relation to a total
- Switch: Selection out of two possible modes. Either the switched-on mode is displayed by a blue-collared rectangle or secondly as a pressed switch.
- Button: to start a specific program action
- Menu button: request to display a pull-down menu

1.10.4 General conventions of this documentation

This is a general description of the conventions, which are used in this documentation to operate in **maintenance mode**.

<key>:	Actuation of this key.
<Enter>:	Any user input (digits, letters) is acknowledged with this key.
Alt>-<letter>:	After the "Alt" key has been actuated and kept pressed down, the stated letter is entered.
<Ctrl>-<Enter>:	After the <Ctrl> key has been actuated and kept pressed down, then the <Enter> is to be activated.
Menu/Input in Menu:	An input in the menu has to be activated; for instance the meaning of *service/ measurement* status: there is a *service* menu, where the input "*measurement status*" has to be selected. (For operation of menus refer to next chapter “select menu”).
(Button):	A button with the label "*button*" is to be activated in the present window. (For operation of buttons refer to next paragraph” button”).

NOTE

For detailed information on touch screen menu operations refer to register 12 QNX-Touch screen OS.

Figure 1-10: CeMoSys™

1.10.5 CeMoSys™ Server (OPTION)

CeMoSys™ stands for Central Monitoring System for RADOS Contamination Monitors. This application supplies the owner of Mirion Technologies (RADOS) GmbH contamination monitors with a browser based monitor overview. It opens the possibility to view the measurement and the monitor status.

The following Mirion Technologies (RADOS) GmbH contamination monitors are prepared (to be activated by optional licence) to work with CeMoSys™ in the operational Software:

CheckPoint:Body™	TwoStep™–Exit, TwoStep™–Exit II OneStep™, RTM860TS, TwoStep™-PRE, RTM110, HandFoot-Fibre™, HandFoot-Fibre™ MED
CheckPoint:Laundry™	RTM750, RTM740
CheckPoint:Gate™	CheckIn-Clean™, GammaPortal-CMS™, RTM910, RTM910N, RTM911i, FastTrack-Fibre™, D&D-Portal™
CheckPoint:Waste™	RTM600*, RTM610*, **Tool&Object-Monitor***, RTM661/300*, RTM661/440*, RTM661/540*;RTM644*

*only Measurement status is embedded

More contamination monitors are planned to be embedded by the Mirion Technologies (RADOS) GmbH.

For connection to CeMoSys™, every monitor needs to have a special CeMoSys™ client.

The CeMoSys™ Client is a software module, which is implemented and operating on RADOS contamination and clearance monitors, that gathers, stores, and transfers critical data to CeMoSys™ RTM user software. The tasks of the CeMoSys™ client are:

- Identification of new measurement results, test protocols or a monitor status change.
- Processing data and data storage of the respective measurement or parameter data in a data file.
- Transfer of data file to the CeMoSys™ database server using FTP.
- Intermediate storage of data file on RTMXXX local hard disk drive (if no network connection available) and automatic transfer of the stored data as soon as the network connection is available again.

1.11 Start-up menu

The **start-up** menu is the central navigation tool for all software modules. Every software module can be reached by a mouse click. The User software should be quit before activating any other menu item because the internal parameter alteration which can be done from here is only available after restart of software.

Figure 1-11: Startup-menu

Software modules provided via the Startup**-menu**:

Start	**RTM user software** to perform contamination measurement (**Register 3** and **Register 4**)
Service	Service software module for measurement station administration.
QNX Shell	enables the user to get access to the local harddisk.
shutdown	Initiate measurement computer shutdown.

1.11.1 Software functional sequence

In this chapter the functions of the monitor in the sequence of the actual operational mode are described.

These modes are divided as follows:

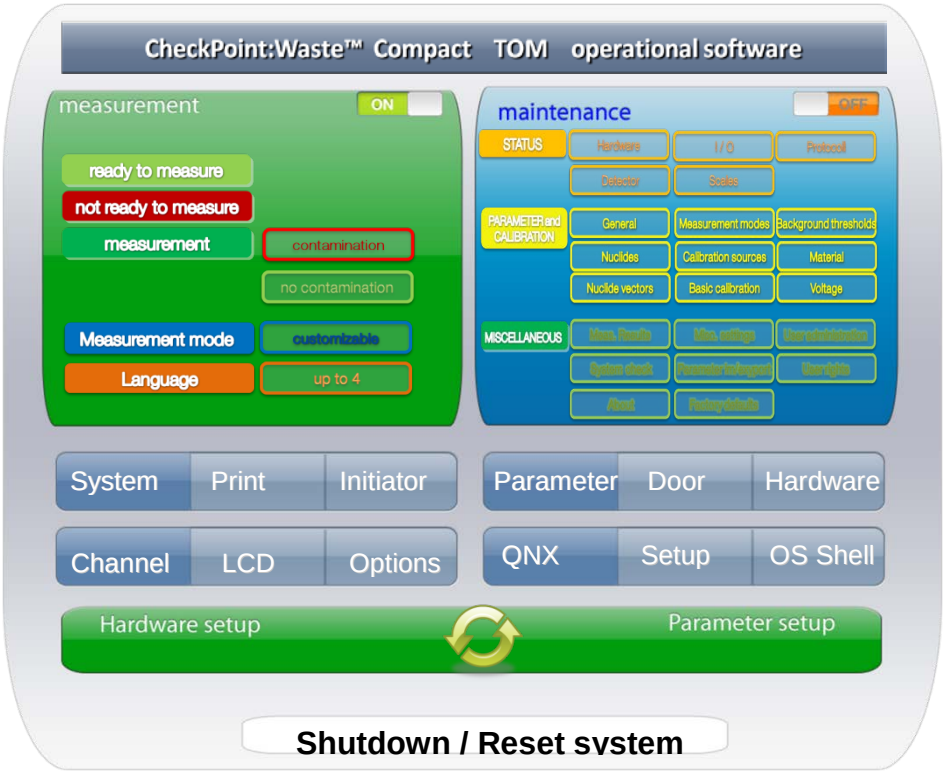


Figure 1-12: Software functional sequence

1.11.2 Operating conditions

The user software differentiates two operation conditions:

Measurement mode

The **measurement mode** is the normal operational mode.
In this mode the measurement of objects is carried out.
The measurement mode is either in state of **contamination** or **ready to measure**. The monitor uses the phase **ready to measure**, i.e. the time period between the measurements, to check the connected detectors for their proper function and to measure the background.

Service mode

The **service mode** is a very sensitive sector of the monitor and should therefore be accessible only to trained persons. This mode can only be entered via the respective button/key. In the service mode there are different sub-menus available to control the function of the monitor and to adjust all parameters influencing the measured value.

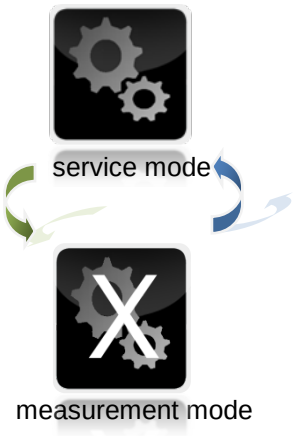


Figure 1-13: Service button

1.11.3 Operational submenu

The programmes from the operational submenu will be started in the **service mode** directly from the **start up** menu. This indicates that a **measurement operation** is not possible while performing the sub menu programmes.

QNX-Shell

The sub menu "**QNX Shell** is placed in the start up menu to enable direct file access on the monitor hard disk. This function will usually only be used by service personnel.

Figure 1-14: Pictogram “printer”

Print screenshot

The print screenshot function is functionally placed on a variety of menu screens. This enables the user to file actual displayed data even if a regarding print template is unavailable. The print screenshot function can easily be reached by the "printer" pictogram.

1.11.4 Exit user software

ATTENTION

The shutdown of the **Tool&Object-Monitor** (e.g. for maintenance) MUST follow this guideline to prevent any damages at the measurement computer or the electronic.

A damage of the **Tool&Object-Monitor** caused by ignorance of this guideline will lead to a loss of guarantee and warrantee by Mirion Technologies (RADOS) GmbH.

(1) Quit executing user software with ***close***.

(2) In the „start up- menu“ select button „***shutdown***“ to close operational software.

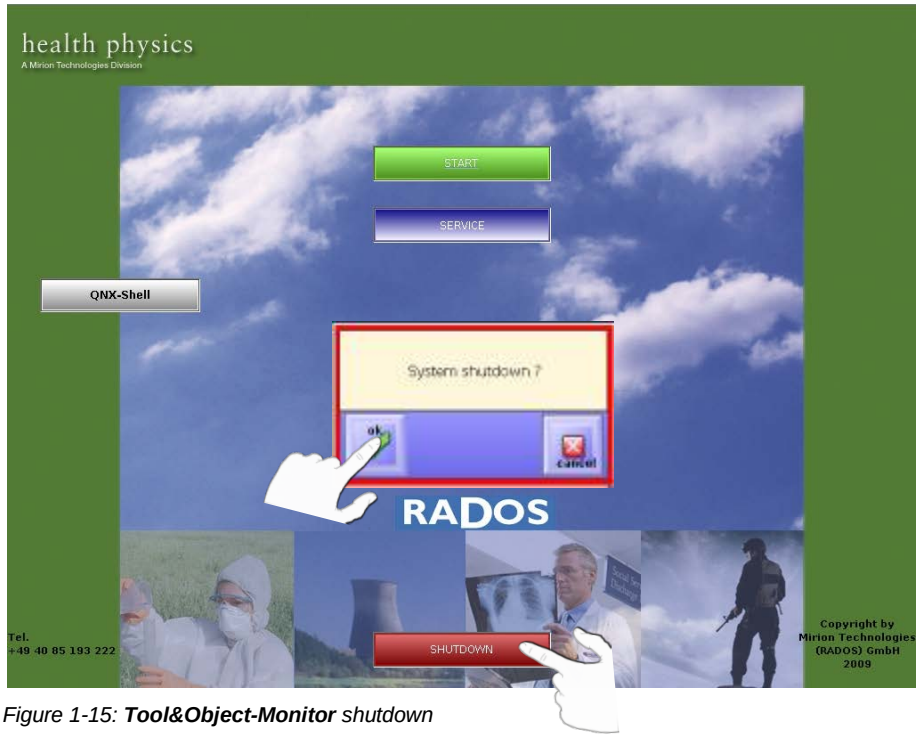


*Figure 1-15: **Tool&Object-Monitor** shutdown*

(3) After select the button „***shutdown***“ the display shows.

*Figure 1-16: **Tool&Object-Monitor** shutdown complete*

(4) Use the mains switch to shut down the monitor, after the display shows the end of the shutdown process.

1.12 Authoritative regulations and guide lines

1.12.1 Guide line for machines

Before commissioning the **Tool&Object-Monitor** monitor, this documentation must be read in order to carry out a safe operation.

Changes

CAUTION

In case of unauthorized changes or supplementations of the machine the declaration of type conformity becomes void**.**

Operation

CAUTION

The operation of the machine requires trained personnel.

1.12.2 Supporting documentation

Necessary supporting documentations are attached in register 12 of this technical handbook.

1.13 Copyright

The copyright protection claimed includes all forms and matters of copyrighted material and information now allowed by statutory or judicial law or hereinafter granted, including without limitation, material generated from the software programs that are displayed on the screen such as styles, templates, icons, screen displays, looks, etc.

All RADOS product names and product numbers mentioned in this publication are trademarks of Mirion Technologies (RADOS) GmbH. Other company brands and product names may be trademarks or registered trademarks of the respective companies and are also acknowledged.

All data provided in this manual underlies best knowledge, but comprises no guarantee. We reserve, in the interest of our customers, that improvements and corrections at hardware, software and technical handbook will be made any time without announcement.

Only with written consent from Mirion Technologies (RADOS) GmbH Germany the contents of this technical handbook may be passed on to third persons. Especially procedure descriptions and explanations are not to be passed on to third persons.

Copying or multiplying for internal use is permitted.

We are looking forward for suggestions and critics regarding this technical handbook or the RTM itself.

1.14 Default-user

Every user belongs to one of five user groups with specific authorizations (in decreasing authority order):

The authorizations of a higher user group include the ones from ones below.

In order to ease the user administration and to provide the set-up process, default users, provided with the needed authorizations for administration, have been created.

NOTE

The CheckPoint:Waste™ Tool&Object-Monitor comes with following User and passwords as factory default setting:

Level	Password
Superuser	Superuser
Master	Master
Service	Service
User	User

Explanations to the user authorizations in the individual user groups are stated in register 5.

NOTE

When entering the user name and password, please pay attention to upper and lower case letters.

NOTE

We recommend to remove this page from the documentation or create new users and to delete the users described on this page, in order of save monitor operation in the customer environment.

2 Technical data

2.1 Technical data

CheckPoint:Waste™ Tool&Object-Monitor -Type-Series

type

☑ **Tool&Object-Monitor**

Power; rated current

☐ 230V/50Hz; 0.5A
☐ 110V/50-60Hz; 1.0A

General Data		**H x W x D**
Dimensions	☐ 1450 x 800 x 845 mm	☐ 1400 x 810 x 785 mm
	with platform	with platform
Platform	☐ 272 mm	☐ 350 mm
Coated steel	RAL 7016	
Structure	IGP-622MA	matt glaze
Weight		**lead shield**
☐ **Tool&Object-Monitor**	☐ 1300 Kg	☐ 25 mm
(4 detectors)	☐ 1400 Kg	☐ 50 mm
☐ **Tool&Object-Monitor**	☐ 1810 Kg	
(6 detectors)	☐ 1950 Kg	
measurement chamber	80 litres	

Expansion Options	
Door	☐ 2D Version
Scale	☐ weight cells
2nd display	☐ for 2 -door version

PC	
Computer PC board	Soldered onboard Intel® Atom™ N270 1.6GHz CPU with 533MHz FSB
RAM	Soldered onboard 1GB DDR2-533 SDRAM
Chipset	Intel® 945GSE + ICH7M
Graphics	Integrated Intel® GMA950 GFx Core
I/O	1 x RS-232 ports with RJ-45 connector 2 x RS-232/422/485 RJ-45 connector USB Port 6 x USB 2.0 ports LAN 2 x RJ-45 ports for Gigabit Ethernet
HDD	1 x 2.5" drive bay for HDD/SSD
Monitor	10” TFT touch - display
Sound card	Audio Mic-in/Line-in/Line-out
Keyboard	by customer Specification (order)

Software	
Operating system	QNX 6.4x
User software	V: 1.xx

Extension Options		
	☐ Detector test	☐ Basic calibration
	☐ Nuclide vectors	☐ System check

Technical data (continued)

Gamma-plastic fibre-detectors

Type Dimension (mm) quantity		**location**		
☐ **RFD 1600G**	400x400x50	☐ bottom	☐ top	☐ front (door 1)
☐ 4 ☐ 6		☐ left	☐ right	☐ back (door 2)

Load cell

☐ **Type PBW**	a very low profile planar beam load cell providing optimum load cell Capacities from 12.5 lb to 240 lb Environmental Protection IP65 Calibration in mV/V/Ω for accuracy class C3 Aluminum construction

Ambient conditions

Detector housing	
temperature	-20°C up to +45°C
humidity	outdoor conditions
Electronic rack	
temperature	5°C up to +45°C
humidity	relative humidity 75 % on annual average, 95% for 5 h, no condensation

CE conformity

This contamination monitor fulfils the required guidelines for electromagnetic compatibility and protection.

2.2 Circuit drawings

Description	Drawing number
Complete monitor	3E0592A1
Computer unit PC2010	3215PC201000
Load cells connection	3E0484-3

3 Structure and description

Figures

3.1 Total view Tool&Object-Monitor

Figure 3-1: Tool&Object-Monitor: Tool&Object-Monitor View

description	drawing number
total view of the CheckPoint:Waste™	3M393…

3.2 General

This documentation has been worked out according to the DIN EN 61187 guidelines. It shall provide the user with the functioning of the CheckPoint:Waste™ and shall get him acquainted with its specific features. In this relation, a number of basic physical connections are described and explained in detail, where it is necessary.

NOTE

This documentation will explain the **maximum version** of the **Tool&Object-Monitor**.

Refer to register 1 for detailed information CheckPoint:Waste™ type series and options.

If you are interested in upgrading your **Tool&Object-Monitor** with options please feel free to contact the RADOS Service Team with the address given in register general.

A definition of terms will be given in chapter *Glossary* of the documentation, which makes it easier for users to understand this terminology which often includes more than the term given.

The RADOS team would be glad to receive your advice for further improvement of this documentation or even the monitor.

3.3 Overview of monitor components

Figure 3-2: ***Tool&Object-Monitor***

The CheckPoint:Waste™ **Tool&Object-Monitor** consists of two essential components:

❶ The measurement chamber

❷ The evaluation electronics

The individual components are described in the following, whereby no emphasis was put on a logical sequence. It was the intention to make it reference to certain detail questions. It has been assumed that it is not possible for a user, who knows the station from operation, to have easy possible to learn about such a complex system with so many variations, just from the documentation without reference to the real system.
The Mirion Technologies (RADOS) CheckPoint:Waste™ Compact: **Tool&Object-Monitor** has been developed specially for the release measurement of small items fitting into the measurement chamber.

CheckPoint:Waste™ Tool&Object-Monitor measurement chamber dimensions:

	Type	L x W x H	Ltr.
	Tool&Object-Monitor	40 x 40 x 40 cm³	50 l
Four or six gamma fibre detectors (RFD).			

Figure 3-3: ***Tool&Object-Monitor*** *operational elements*

The CheckPoint:Waste™ **Tool&Object-Monitor** is built into stable frame. Thus the system needs no special foundation. It is mobile and comes with fork lift pockets.

Operational elements on the front side:

❶ Mains switch

❷ Touchscreen display

❸ USB connection plugs
(LAN connection plug on device top)

❹ Indicator lights

❺ loudspeaker

Figure 3-4: ***Tool&Object-Monitor*** *USB/LAN connection*

The frame construction is welded to be self-supporting. However, is should be ensured that the door(s) and scale is appropriately secured when the unit is moved.

Attention

Please pay attention to the required weight load.

It is absolutely necessary to level the measurement chamber horizontally, before measurement start to ensure a correct functioning of doors and weight cells.

3.4 Overview of optional monitor components

3.4.1 2nd Door

The **Tool&Object-Monitor** is equipped with a 2nd door and an interlock system. The monitor can be set to a one door operation in the software.

The one door operation can be activated in the user- software

*Figure 3-5: **Tool&Object-Monitor** 2nd door view*

3.4.2 Functional description

The doors are equipped with computer controlled door locks and position contacts.

The initial state of the **Tool&Object-Monitor** is

Load measurement item through front door
unload failed item through front door
unload released item through back door.

3.5 Measurement computer and electronic

In the following the PC hardware applied, the operating system QNX in brief and the minimum requirements of the hardware are described. As the PC components are developed very fast nowadays, it is also possible that components with higher capacities will be employed.

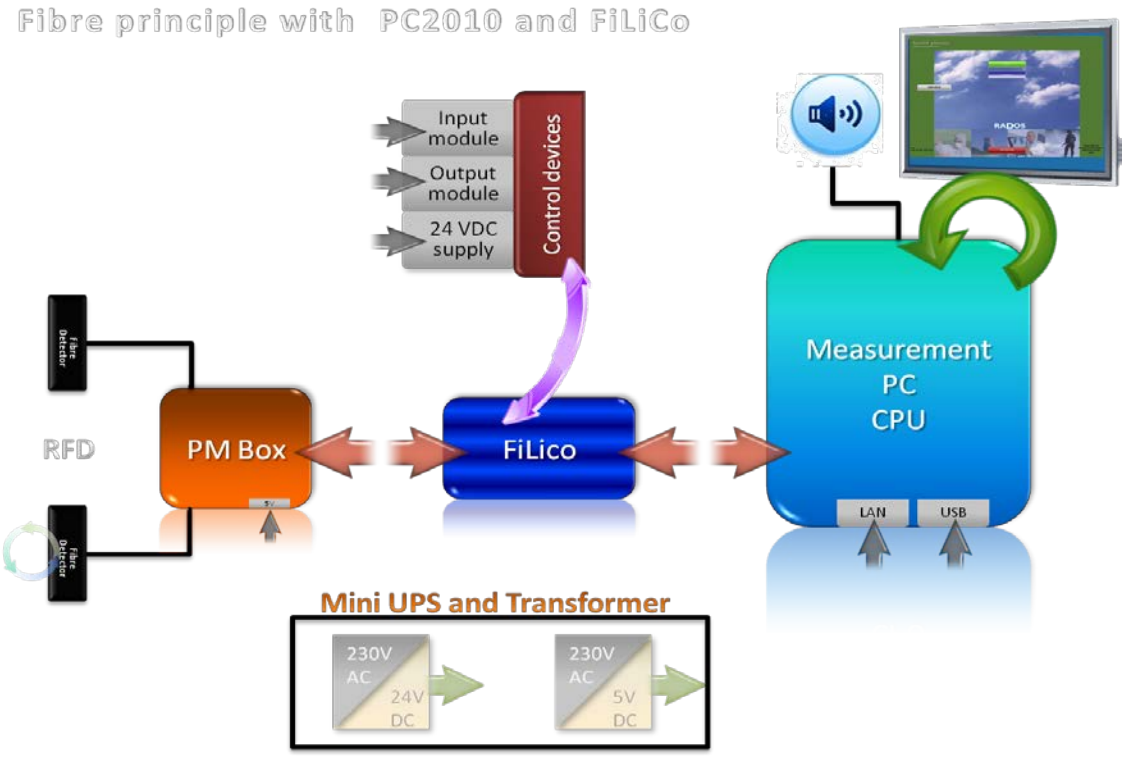


Figure 3-6: ***Tool&Object-Monitor*** *Integration of FiLiCo and extension boards*

3.5.1 Electronic location

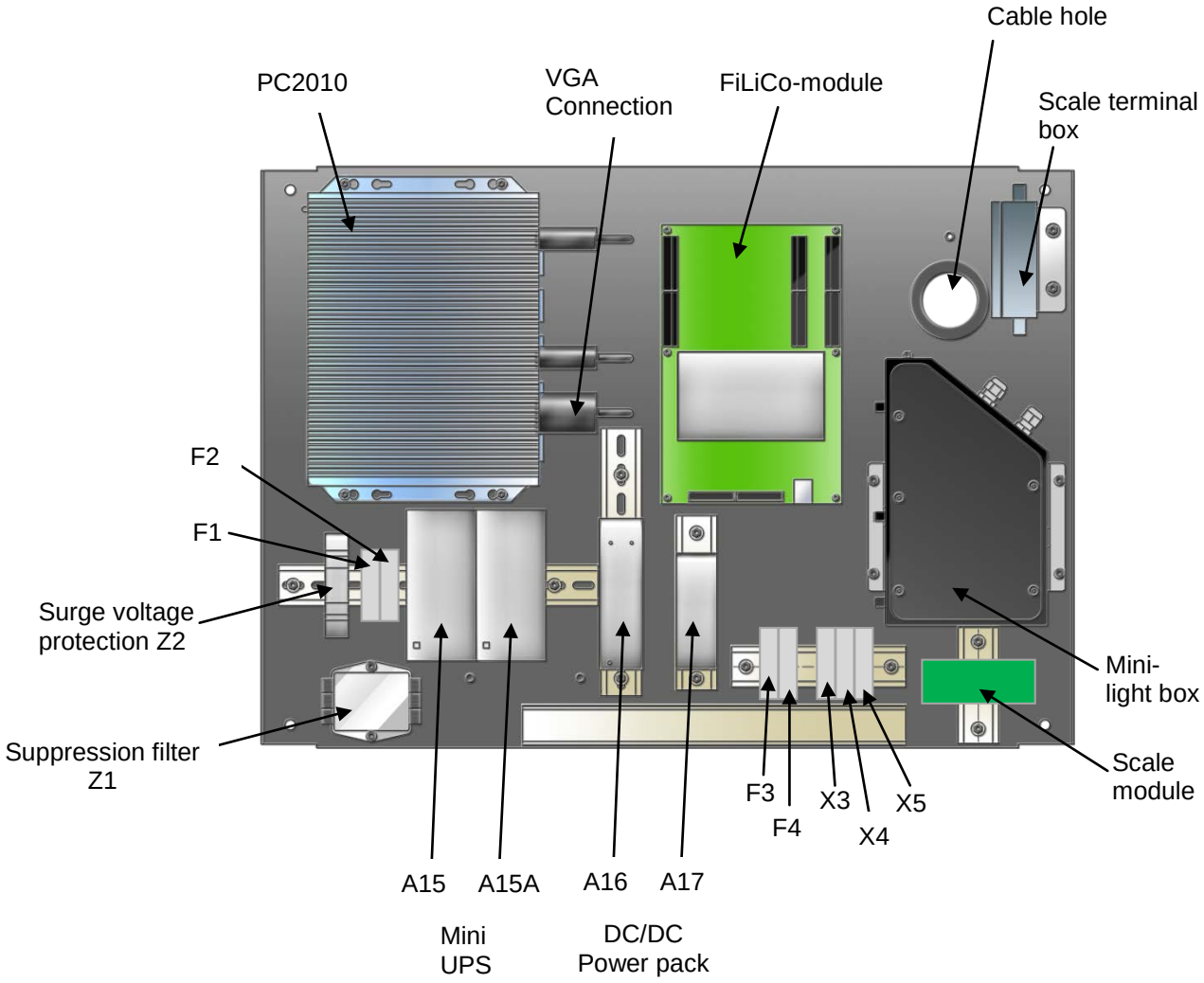


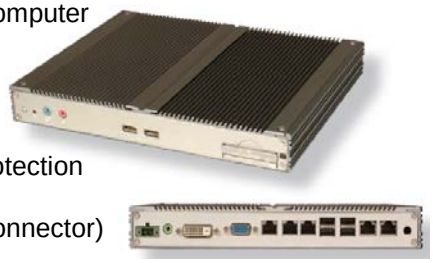
*Figure 3-7: **Tool&Object-Monitor** component view*

3.5.2 RADOS PC2010 system computer

RADOS PC2010 system computer	
CPU	Intel Atom
Cooling fan	No
Power supply	10-28 VDC
Hard disk	2.5“
USB port	6
Parallel port	0
Serial port	3
ATEWIS PCI	No
FILICO or RLC	Yes

Table 3-8: RADOS PC2010

The new industrial RADOS PC2010, with ATOM processor, is integrated in the monitor housing and includes the following features



- Ultra low power embedded system computer
- Fanless design
- Wide range DC power input
- Wide operating temperature
- Ultra low profile enclosure
- Rugged resign for shock/vibration protection
- Easy installation/maintenance
- 3 x RS-232 serial ports (over RJ45 connector)
- 6 x USB 2.0 ports
- 2x Integrated network card (one used by FiLiCo board)

The communication to the RADOS **Fi**bre **Li**ne **Co**nverter board FiLiCo is realized by a TCP/IP Network connection.

3.5.3 Operation system

In order to measure objects fast and reliably, many calculations of individual procedures have to run simultaneously. For instance, in order to measure the background continuously, a computer system is required that allows all operations in multi-tasking handling, in real time. For this aim Mirion Technologies (RADOS) GmbH has been using the operating system QNX for many years to carry out the different measurement tasks. The whole system is based on a very small and thus very fast core. This core is only responsible for the exchange of messages and the distribution of the computer capacity between simultaneously running program.

All other functions of the operating system are available as independent program and thus they can be used very flexibly.

For detailed information on the QNX operating system refer to register 1.

3.5.4 Colour touch screen display

The colour touch screen display is positioned above the front- and exit door of the monitor and is used to display following indications and functions:

- User instruction for measurement and maintenance
- Monitor status and alarm messages
- Soft- and hardware feature and parameter setting (eased through touch screen operation)
- Password secured change between measurement and maintenance mode
- Measurement result display (including last measurement recall)
- Language selection
- Schematic measurement results display with indication location and pulse rate view

3.5.5 RADOS FiLiCo- electronic

The RADOS FiLiCo electronic concept for the **Tool&Object-Monitor** was taken over from the well-established Fibre™ monitors.
At least due to the measurement task the number of in and outputs on the extension board was enhanced.
The electronic supports following functions:

- Communication port to the measurement PC
- Communication port for the PM box
- Communication ports for installed extensions (I/O port)

The RADOS FiLiCo board concept includes a wide number of customer specific in- and outputs which can be integrated on customer choice.

3.5.6 User software

In this chapter, the software functions of the monitor in the actual operational mode are briefly described. More detailed Information can found as referenced in this documentation.

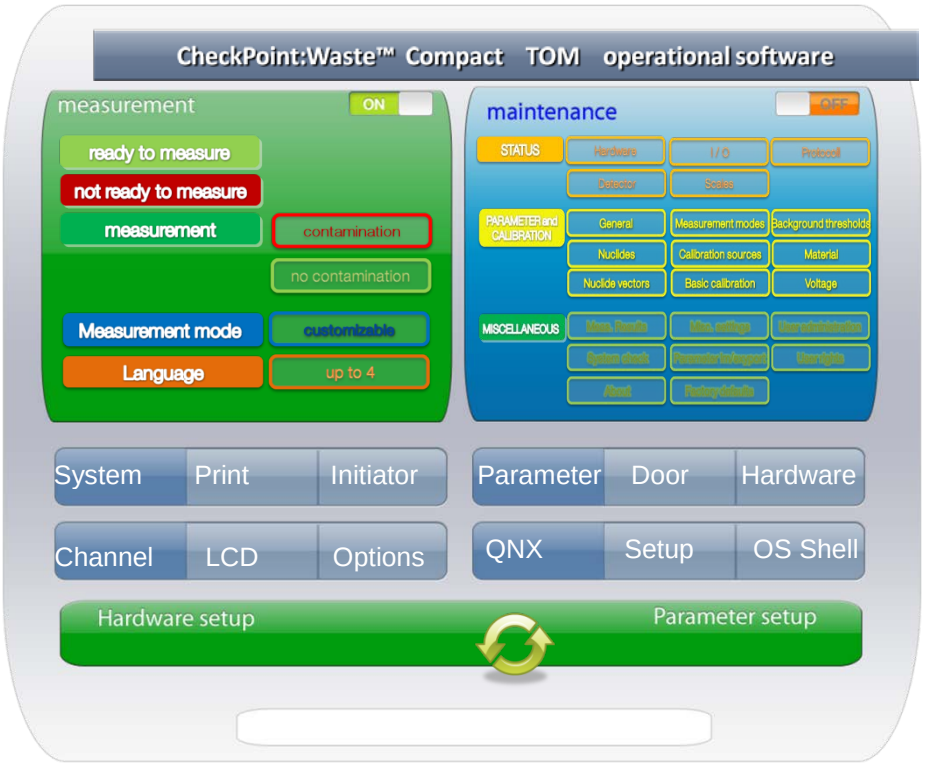


Figure 3-9: Software functional sequence

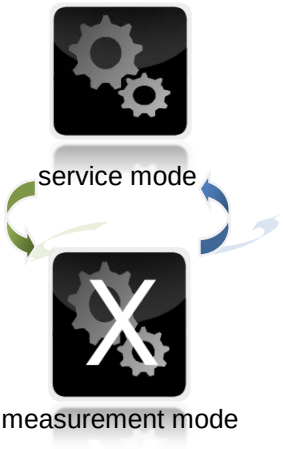


Figure 3-10: Service button

The user software differentiates two operation conditions:

Measurement mode

The **measurement mode** is the normal operational mode.
In this mode the measurement of objects is carried out.
The measurement mode is either in state of **contamination** or **ready to measure**. The monitor uses the phase **ready to measure**, i.e. the time period between the measurements, to check the connected detectors for their proper function and to measure the background.

Service mode

The **service mode** is a very sensitive sector of the monitor and should therefore be accessible only to trained persons. This mode can only be entered via the respective button/key. In the service mode there are different sub-menus available to control the function of the monitor and to adjust all parameters influencing the measured value.

3.6 User software start

The start menu is the central navigation interface for the **Tool&Object-Monitor** user software. As all modules and subroutines depend on the same internal parameter set the user software (main module) should, if not otherwise stated, be closed before entering a sub module.
New parameters are only available after restart of the main software.

Figure 3-11: Start-up menu

Main tasks of the **Startup- Menu:**

Start	**Starts RTM user-software,** to perform contamination measurements (see also **register 4**)
Service	Supporting software module for system - and detector administration respective maintenance.

3.6.1 User defined measurement modes

Different measurement modes can be set up by the administrator in the service mode. This setup will influence the measurement functions and contents of the display.

The following list will give an overview of the measurement mode setup functions. You will find a detailed description of the mode setup in the chapter “Service”.

Setup functions for the measurement modes	
Global	**Functions / characteristic** ■ Definition of the mode identification ■ Measurement time setup ■ Units (Bq or CPS)
Material selection	**Functions / characteristic** ■ Manual selection by user ■ Using default material ■ Weight based material selection (scale required)
Processing	**Functions / characteristic** ■ Expert (allow to modify parameters) ■ Easy (show parameters only) ■ Simple screen (Time-bar only) ■ Measurement start (after door closed or after input)
Result	**Functions / characteristic** ■ Save result when (clean and/or contaminated) ■ Display result when (clean and/or contaminated) ■ Show activity distribution first when (clean and/or contaminated) (6 detector version only)
Printing	**Functions / characteristic** ■ Print protocol when (clean and/or contaminated)

The measurement modes can be selected from the **Tool&Object-Monitor** main menu.

3.6.2 Background measurement procedure

When the **Tool&Object-Monitor** boots up, at first all program routines are started automatically and all functional units are checked. If there are no disturbances, the **Tool&Object-Monitor** will be ready to measure, after the current background value is measured. This is done automatically if following requirements are fulfilled:

- All routines were started correctly (automatically).
- The measurement chamber is empty. All door contacts show that the chamber is closed.
- The detector count rates are not outside of the minimum or maximum set points.

Of course, the service mode can be started without any waiting period. However a complete background measurement is often required in the service mode.

Figure 3-12: Not ready to measure

The background value is constantly updated in accordance with the settings given in the service menu. The menu is explained in the chapter of the service functions of the **Tool&Object-Monitor**.

The accuracy of the background measurement does not only depend on the statistical safety. Systematic faults are overlaying the theoretical error. These systematic faults, according to today's knowledge, cannot be avoided. In general they are of no significance, so that they can be neglected, however, e.g. an electronics that swings may have a negative influence on the quality of the measurement. For this reason some attention should be put on the background value. In the simplest case it takes 10 to 20 measurements of the background, one after the other. Then, the theoretical error resulting from the measurement time is compared to the actual error, calculated from the equation for standard

deviations for efficiencies (as given in the chapter "Detectors") If the values for a measurement time of no more than 100 seconds are similar within a factor of 1.5 to max. 2, a Gaussian distribution may be assumed. Of course the user is free to make a real significance test.

The accuracy of a theoretical, statistical error, in the following called statistical error, only depends on the duration and thus on the attained pulse sum. It is calculated in accordance to the Gaussian distribution:

Figure 3-13: Formula Gaussian distribution

or

R = rate of the measurement effect
t = measurement time

Related to the relative error this implicates:

Here it is already possible to notice that the error of the background cannot be defined by the measurement time alone. Otherwise a prolongation of the measurement time would lead to any exact results at random. Of course this is not true.

Actually it is a fact that from a certain statistical accuracy on, systematical errors plays a more important role until it becomes a decisive factor. For the RADOS detectors the experience showed that it makes no sense to measure for more than 1000 seconds in order to receive a better accuracy. From this measurement time on the systematically errors become significant.

A further conclusion from the a. m. equation is: the larger the measurement effect, the smaller the relative statistical error. However, nobody should take this to look for a high background effect in order to receive a good statistics. Of course, the ratio from useful signal to noise signals is also of importance. However for the calibration of the monitor this situation plays an important role.

If a statistical accuracy of 1 % is required for the background measurement, the a. m. equation needs to have a count rate of 10000 events for the individual detectors. The statistical error thus is:

$$\sqrt{10000} = \pm 100\,.$$

The single standard deviation of the normal distribution thus means 100 events or relatively speaking 1 %. The actual error will probably be insignificantly higher, as long as the measurement time is not significantly above 1000 seconds.

For the completion of the background measurement phase it is necessary that each detector attains this pulse sum, if this accuracy is required. Thus the detector with the smallest background pulse rate defines the duration of the background measurement.

Instead of the pulse sum a permitted error of ± percent can be pre-selected in the monitor measurement parameters. The according pulse sum is then calculated automatically.

For smaller pulse rate or higher required accuracy the measurement time for the background measurement can become very long. However it is also possible to limit it to a maximum measurement time. If the background measurement is shortened by these parameters, the measurement system will not attain the set accuracy for the background measurement.

3.6.3 Constant updating

It is advisable to update the background value obtained at the beginning from time to time during the release measurement operation. The **Tool&Object-Monitor** continuously updates the background measurement if the measurement chamber is empty and the door is closed. When such a background measurement is finished the result is automatically taken over as the current background information. However, it is also possible for the user to force an update of the background by pressing the function button “discard background” in the service menu *Status – Detector Status*. During the measurement operation the continuous background measurement is interrupted and continued afterwards.

NOTE

During constantly carried out measurements, whereby the measurement chamber is never closed when empty, it is not possible for the **Tool&Object-Monitor** to measure the background count rate. In this case the user himself has to take care, that the requirements for the background updating are effected from time to time.

The validity time parameter for the background can be set via the **Parameters>→<General Settings>→<Background>** menu in the service mode.

Background change will be checked after each measurement in case the scale is not available.

3.6.4 Calculation of measurement time

The calculation of the measurement time is carried out automatically in accordance with the regulations which are derived from the DIN 25482 part 1. In this DIN paper the calculation for the detection and the recognition limits for different measurement methods are given. From this the given safeties, background and measurement time to be expected can be derived. This is not an exact function but rather a proximity value, which however in general is very close to the true value or leads to an overestimation of the measuring time. Please note that this is also a theoretical value.

The automatically calculated measurement time is calculated from the equation for the detection limit. This assumes that the activity to be proven corresponds to the detection limit and that the expectation values of the DIN correspond to the expectation count rates. The system calculates the expectation values in the beginning of the measurement from the resulting most restrictive clearance level, whereby the current calibration for the material is used for the calculation of the count rates. Of course this can only be an approximation, and this rather leads to conservative measurement times.

The measurement time for a gross measurement effect is calculated according to:

$$t_b = \frac{t_0}{t_0 \cdot \left[\frac{2}{\kappa_\alpha + \kappa_\beta} \cdot \left(\sqrt{(R_{E0} + R_{En})} - \sqrt{R_{E0}} \right) \right]^2 - 1}$$

Figure 3-14: Formula gross measurement time

whereby

t_0 = background measurement time,
R_{E0} = expectation value of the background,
R_{En} = expectation value of the net measurement effect,
κ_α = Quantile error type I. (background effect false alarm),
κ_β = Quantile error type II (detection safety).

The confidence level defines the confidence interval of the measurement:

$$R_{En} - \kappa_{1-\gamma/2} \cdot \sqrt{\frac{R_{E0}}{t_0} + \frac{R_{Eb}}{t_b}} \leq R_{En} \leq R_{En} + \kappa_{1-\gamma/2} \cdot \sqrt{\frac{R_{E0}}{t_0} + \frac{R_{Eb}}{t_b}}$$

with

t_0 = background measurement time,
R_{E0} = expectation value of the background,
R_{En} = expectation value of the net measurement effect,
R_{Eb} = gross count rate
$\kappa_{1-\gamma/2}$ = Quantile of the confidence interval (confidence level)

In the DIN25482 part 1 the expectation values mare marked with the Greek letter ρ.

The error type I, the safety against false alarm and the error type II, the detection safety are employed as quantile of the normalized Gauss distribution. For the 5 % recommended by the SSK (Strahlen Schutz Kommission) for both kinds of error value of 1.65. In the following listing some examples for the context between error resp. detection safety and the quantiles are given. In order to explain the context between left side and right side area integral of the Gauss distribution, instead of the false alarm safety the frequency of false alarms, i. e. the opposite probability outside of the Gaussian distribution has been listed.

Frequency of false alarms	Detection safety	Quantile
0.01 %	99.99 %	3.72
0.1 %	99.9 %	3.09
0.5 %	99.5 %	2.58
1 %	99 %	2.33
2 %	98 %	2.05
3 %	97 %	1.88
4 %	96 %	1.75
5 %	95 %	1.64
6 %	94 %	1.55
7%	93 %	1.48
8 %	92 %	1.41
9 %	91 %	1.34
10 %	90 %	1.28

Figure 3-15: False alarm and detection safety

The automatic measurement time can be limited by the selection of a shortest and a longest measurement time. An exact description will follow under Software functions.

For the calculation of the measurement time it is necessary at first to define the most restrictive alarm threshold value. Therefore, the most influencing Figure for the measurement is either the total activity or one of the specific activities per surface or mass, depending on the averaging surface or the averaging mass.

NOTE

Without the option “scale” there is no mass specific values available.

This shall be explained by an example:

The total activity possible to be released is pre-set at 1.000 Bq. The detection limit for the mass-specific activity shall be 0.3 Bq/g and for the surface-related activity the detection limit shall be 0.5 Bq/cm^2. An averaging surface of 300 cm^2 and an averaging mass of 10 kg have been stipulated (the total mass is more than 10 kg). From the mass-specific detection limit an activity of 10.000 * 0.3 = 3.000 Bq results and for the surface-specific detection limit 300 * 0.5 = 150 Bq. In this case the measurement time has to be calculated for 150 Bq. However, if the averaging surface would be 5.000 cm² instead of 300 cm², then the total activity is the quantity determining the measurement time.

The CheckPoint:Waste™ independently checks for the more restrictive value and calculates the resulting measurement time based on this value.

3.6.5 Differentiation between 4 and 6 detector version

The **Tool&Object-Monitor** creates information about the activity position and activity distribution from the individual information from all 6 detectors. Having 4 detectors only, this information is not available.

Due to the activity distribution the 6 detector version needs more exact information from the single detectors.

Used detector channels for the measurement time calculation:

4 detector version:

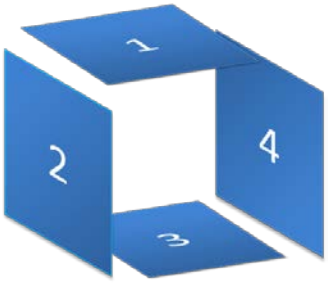


Figure 3-16: 4 detector allocation

The count rates and the efficiency from the sum channel are used for the measurement time calculation.

6 detector version:

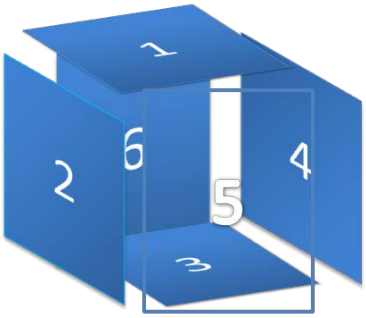


Figure 3-17: 6 detector allocation

The count rates and the efficiency from the detector channel having the worse conditions should be used for the measurement time calculation to achieve the statistical conditions from the measurement parameter to show an exact distribution picture. This can lead to inconvenient measurement times. As a sufficient compromise the **Tool&Object-Monitor** will calculate with the average efficiency from all detectors. Of course the activity calculation will be carried out using the sum channel.

3.6.6 Activity calculation

When the measurement has been completed, the **Tool&Object-Monitor** carries out the calculations for the display of the activity results. At this point only the derivation of the activity statement shall be given, as all specific activity values are calculated by dividing the value through the respective averaging parameter (surface, mass).

As the activity calculation will always base on the number of detectors used, following conventions for the channel descriptions will be used:

d → total amount of detectors (1 to six) installed, being the equivalent to the amount of channel.

d^{+1} → the sum channel (virtual channel) which will be calculated from the physical (d) channel.

Proceeding from a background effect measurement for a certain time range there are background effects for all **d** channels. The theoretical error is calculated from the measurement time and the current count rate. Propagation of this error is considered for the errors of the quantities discussed below, though not described in detail in this manual.

From the background count rates $R_{0,i}$ (i=1.. **d**) the background effect for the virtual sum channel is created:

$$R_0 = \sum_{i=1}^{d} R_{0,i}$$

$R_{0,i}$ = background count rate channel i
$R_0=R_d^{+1}$ = background count rate of the sum channel (virtual channel $\mathbf{d^{+1}}$)

In the following the virtual channel is considered as a $\mathbf{d^{+1}}^{th}$ channel, the same way as the other **d** physical channels.

When a measurement is carried out, then at first the net count rate for channel i $R_{n,i}$ rate is established from the established gross count rates $R_{g,i}$:

$$R_{n,i} = R_{g,i} - R_{0,i}$$

with

$R_{n,i}$ = net count rate for channel i
$R_{g,i}$ = gross count rate for channel i
$R_{0,i}$ = background count rate of channel I

for i=1.. $\mathbf{d^{+1}}$.

For this value the theoretical error is calculated too.

To derive the activity measured by each channel the channel specific efficiency $\eta_{i,j}$ for the measured material j has to be known:

$$\eta_{i,j} = \frac{1}{\Omega_{i,j}} = \frac{R_{g,i,j} - R_{0,i,j}}{A_{cal}^{Co60}}$$

for i=1,.. **d**[+1].

$\Omega_{i,j}$ = calibration factor channel i with material j [Bq/cps]
$\eta_{i,j}$ = efficiency channel i with material j [cps/Bq]
$R_{g,i,j}$ = gross count rate channel i with material j [cps]
$R_{0,i,j}$ = background count rate channel i with material j [cps]
A_{cal}^{Co60} = activity of the ^{60}Co calibration source

NOTE

The index i represents the sum channel (i.e. channel 7 for CheckPoint:Waste™ with 6 detectors). The index j has been introduced to show that the efficiencies are not only dependent on the nuclide (here ^{60}Co as an example) but are also dependent on the measured material due to shielding effects. This material dependent efficiencies $\eta_{i,j}$ are stored in the calibrations for each material.

Now for each detector channel i the equivalent activity A_i is calculated by dividing the net count rate $R_{n,i,j}$ by the efficiency $\eta_{i,j}$ of the measurement material related calibration.

Figure 3-18: Activity calculation

$$A_i = \frac{R_{n,i,j}}{\eta_{i,j}}$$

Only the activity of the sum channel is considered to trigger an alarm, the individual channels are needed for the evaluation of the graphically activity-distribution (6 detector version).

NOTE

The efficiency $\eta_{i,j}$ is not only dependent on the position of the channel i and the measured material j but highly dependent on the nuclide under consideration.

The formalism has been exemplarily introduced here for the nuclide ^{60}Co and applies analogously for other nuclides however resulting in different efficiencies.

For more details refer to chapter nuclide vectors.

3.6.7 Nuclide vectors (Option)

The above calculations assume that only one nuclide (here ^{60}Co) is involved. The effect of other nuclides to the measurement result will have to be considered by further calculations. This task is also performed by the software if the option nuclide vector is available.

A nuclide vector **v**= (v^1,.., v^r) gives a list of activity contributions of various nuclides to the total activity with

$$\mathbf{v} = (v^1,...,v^r), \qquad \sum_{l=1}^{r} v^l = 1.$$

This is shown in the following example:

Nuclide	Portion of nuclide l to the total activity vl	Measurable?	Efficiency of nuclide l sum channel $\eta^l_{d^{+1},j}$
Co-60	0.32	1	0.33
Cs-137	0.22	1	0.11
Eu-152	0.12	1	0.09
Sr-90	0.13	0	0.00
Y-90	0.13	0	0.00
Fe-55	0.08	0	0.00
sum:	1.00		

Table 3-19: Nuclide vectors

The system needs calibrations (efficiencies $\eta^l_{i,j}$) for all measurable nuclides l in the nuclide vector. Nuclides with zero efficiency cannot be measured directly, their portion to the total activity can be derived if their contribution v^l to the nuclide vector is known. If there is no calibration for a specific nuclide it can be considered as not measurable (zero efficiency) which will lead a conservative estimate of the real total activity.

The resulting efficiency is of the nuclide vector is given by

$$\eta_{i,j} = \sum_l v^l \eta^l_{i,j}.$$

For the given **example** it is for the sum channel $\mathbf{d^{+1}}$:

$\eta^l_{d^{+1},j}$ = 0.32 x 0.33 + 0.22 x 0.11 + 0.12 x 0.09 = 0.1406.

With this efficiency the total activity $A_{i,j}$ shown on channel i with material j can be derived:

$$A_{i,j} = \frac{R_{n,i,j}}{\eta_{i,j}} = \frac{R_{n,i,j}}{\sum_l v^l \eta_{i,j}^l} = \frac{R_{n,i,j}}{\sum_l \frac{v^l}{x} \eta_{i,j}^l} \frac{1}{x}$$

$A_{i,j}$ = Activity shown on channel i for material j [Bq]
$R_{n,i,j}$ = net count rate channel i with material j [cps]
$\eta_{i,j}$ = total efficiency channel i with material j and the given nuclide vector [cps/Bq]
$\eta_{i,j}^l$ = efficiency channel i with material j for nuclide l [cps/Bq]
v^l = portion of nuclide l to the total activity (fraction of total activity)
x = fraction of measurable activity

Now we consider the following example-situation:

Nuclide	**Activity [Bq]**	**Net count rate sum channel $R_{n, d+1,j}$ [cps]**
Co-60	2080	686.4
Cs-137	1430	157.3
Eu-152	780	70.2
Sr-90	845	0.00
Y-90	845	0.00
Fe-55	520	000
	6500	913.9

Table 3-20: Nuclide vectors example

The total activity is then reproduced from the net count rate as:

$$A_{7,j} = \frac{R_{n,7,j}}{\eta_{7,j}} = \frac{R_{n,7,j}}{\sum_l v^l \eta_{7,j}^l} = \frac{913{,}9}{0{,}1406} Bq = 6500\text{Bq}$$

The alarm levels for the surface contamination GW_{cm}^2 and the mass-specific activity GW_g of a measured item with this nuclide vector will be derived from the alarm levels of every nuclide included in the nuclide vector. The resulting alarm level is calculated with the aid of the sum formula given by the German “Strahlenschutzverordnung” (see REMARK):

$$\sum_{l=1}^{r}\frac{A^l}{GW^l}=\sum_{l=1}^{r}\frac{v^l A}{GW^l}=A\sum_{l=1}^{r}\frac{v^l}{GW^l}\le 1$$

$$A\le\frac{1}{\sum_{l=1}^{r}\frac{v^l}{GW^l}}=GW$$

A^l	= activity of nuclide l
A	= Total (specific) activity of measured item
$v^l = A^l/A$	= Portion of nuclide l in the nuclide vector
GW^l	= alarm level for nuclide l
GW	= alarm level for the total (specific) activity

In accordance to this formula the clearance levels for a nuclide vector can be derived from the clearance levels of its components

The StrlSchV (short for Strahlenschutzverordnung) is a radiation protection regulation in Germany. The Regulation on the protection from damage by ionizing rays (translation) is based on the European guidelines 96/29/EURATOM (“Euratom basic standards”) and 97/43/EURATOM (“patient protection guideline”) which were converted into German right.

3.6.8 Basic calibration and geometry factors (Option)

If the option basic calibration is available the efficiencies are split up into a detector dependent part and a material dependent part. To achieve these, a basic calibration is done with a test source of the nuclides of interest (example with ^{60}Co):

$$\Omega_i^{Co60} = \frac{A_{cal}^{Co60}}{R_{g,i} - R_{0,i}} \text{ or } \eta_i^{Co60} = \frac{1}{\Omega_i} = \frac{R_{g,i} - R_{0,i}}{A_{cal}^{Co60}}$$

Ω_i	= calibration factor channel i [Bq/cps]
η_i	= efficiency channel i [cps/Bq]
$R_{g,i}$	= gross count rate channel i [cps]
$R_{0,i}$	= background count rate channel i [cps]
A_{cal}^{Co60}	= activity of the ^{60}Co calibration test source

With additional calibrations for material j geometry factors q_{ij} are derived as follows:

$$q_{i,j} = \frac{\eta_i}{\eta_{i,j}} = \frac{\Omega_{i,j}}{\Omega_i}.$$

This means that

$$\eta_{i,j} = \frac{\eta_i}{q_{i,j}} \text{ and } \Omega_{i,j} = q_{i,j}\Omega_i,$$

or in other words, that efficiencies $\eta_{i,j}$ and calibration factors $\Omega_{i,j}$ split up into a material dependent geometry factor q_{ij} and an efficiency η_i or calibration factor Ω_i of the basic calibration depending only on the channel and the nuclide that was calibrated.

With this configuration not all calibrations have to be redone after a detector is changed or re-adjusted but only the basic calibrations.

3.6.9 Confidence level and alarm-triggering activity

As the activity measured by the clearance monitor is afflicted with an error this has to be considered when the relevant clearance levels are checked. The statistical error of the measured quantity is expressed by the standard deviation σ which represents its statistical accuracy. If an interval of increasing size around a measured value is taken into account the probability (confidence level) that the real value can be found in this confidence interval increases, too. The size of this confidence interval is given by the quantile $k_{1-\gamma/2}$ in units of the standard deviation σ. For random variables underlying an Gaussian distribution (and $A > 2\ k_{1-\gamma/2}\ \sigma$) the confidence level (probability to find the real value in the confidence interval) corresponds to the integrated probability density in the confidence interval $[A - k_{1-\gamma/2}\ \sigma, A + k_{1-\gamma/2}\ \sigma]$.

Quantile $k_{1-\gamma/2}$	**Confidence Level in %**	**Quantile $k_{1-ß}$**	**Detection Safety in %**
1 σ	68 %	1 σ	84 %
1.65 σ	90%	1.65 σ	95 %
2.05 σ	96 %	2.05 σ	98 %
2.33 σ	98 %	2.33 σ	99 %
3.09 σ	99.8 %	3.09 σ	99.9 %
3.72 σ	99.98 %	3.72 σ	99.99 %
4.26 σ	99.998 %	4.26 σ	99.999 %
4.75 σ	99.9998 %	4.75 σ	99.9999 %

Table 3-21: Confidence level and alarm-triggering activity

The table shows for example that a confidence level of 90% corresponds to a confidence interval of $[A - 1.65\sigma, A + 1.65\ \sigma]$. As the Gaussian distribution is symmetrical this results in a probability of 95% that the actual activity is larger than $A - 1.65\sigma$ or smaller than $A + 1.65\sigma$. This shows the close relationship between the confidence level and the detection safety parameterised by the quantile $k_{1-ß}$. An activity A will be detected with 95% probability if the alarm level is at $A - 1.65\sigma$.

For the triggering of an alarm the most restrictive clearance level (activity or mass/area specific activity) is compared with the measurement value of the $\mathbf{d}^{+1}$ channel, the virtual sum channel. The other individual channels respectively their activity statements are only required for the determination of the homogeneity in the graphical display of the activity distribution.

NOTE

In the service menu “General Settings – Measurement” the detection safety ($k_{1-ß}$) can be set.

The **Tool&Object-Monitor** will use the same value for the confidence level ($k_{1-\gamma}$).

Let us assume a specific activity of 0.30 Bq/g is to be detected and 0.25 Bq/g ± 10% have been determined as measurement result. The error of 10% or 0.025Bq/g is derived from the error (standard deviation) σ of the net count rates multiplied with the quantile $k_{1-\gamma/2}$ to ensure the required confidence level (that is an error of $k_{1-\gamma/2}\sigma$ or in the above example 1.65σ). This error in combination with the propagation of further involved errors is 10%.

For the triggering of an alarm this means

0.25 Bq/g <? 0.30 Bq/g - (0.25 Bq/g)*10%

0.25 Bq/g < 0.275 Bq/g

A release would be possible!

However, if the error is 25 % instead of 10 %

0.25 Bq/g <? 0.30 Bq/g - (0.25 Bq/g)*25%

0.25 Bq/g > 0.238 Bq/g

There is no possibility for release!

It is for good reason that the error is not added to the shown activity. This too, is done in order to avoid the declaration of not existing activities.

3.6.10 Alarm levels in the CPS Mode

The CPS mode is designed for measurements without calibrations. The alarm levels are given in units of standard deviations of the background count rate R_0. The standard deviation or the (absolute) error of the background count rate is

t_0 background measurement time

$R_0=R_{0,\,d+1}$ background count rate of the sum channel

The alarm level results with a given σ_{CPS} factor y in the following net count rate:

$$R_0^{GW} = y\sqrt{\frac{R_0}{t_0}}$$

NOTE

The *CPS mode* operation gives an alert in units of the standard deviation of the background effect. The effective alarm limit is changing dynamically with the background effect. The statistical accuracy does not change.

3.7 Measurement

3.7.1 General

This chapter describes the individual input possibilities of the **Tool&Object-Monitor**. All submenus, starting from the main menu are described. This shall make it possible for the user to quickly find the description for a certain menu item.

3.7.2 Prerequisites

Following conditions must be fulfilled in order to carry out a measurement:

1.) The **Tool&Object-Monitor** must have a valid background measurement value.

2.) All aggregates function properly ("*ready to measure*" state)

3.) The weigh scale transmit the current weight (Option scale only)

4.) Valid calibrations are available for the material to be measured.

5.) All necessary nuclide vectors are valid (optional)

3.7.3 Measurement modes

The **Tool&Object-Monitor** is, as mentioned before, equipped with different operation modes which can be organized by the administrator:

See also Chapter 3.6.1.

When delivered, the **Tool&Object-Monitor** is supplied with "factory default" measurement modes. They can be altered or amended by the administrator.

The measurement modes are activated by pressing the **Measurement Mode** button and selecting from the table of installed measurement modes.

3.7.4 Pre-set default modes

The pre-set default modes, delivered, depend on the layout of the **Tool&Object-Monitor** (4 or 6 detectors, scale, 2nd door).

The modes can be altered or amended by the administrator.

Measurement Mode:	Expert Mode (Bq)	Option required
Global		No
Mode Name	Expert Mode (Bq)	
Min. measurement time	5	
Max. measurement time	60	
Measurement Unit	Activity	
Material Selection		No
	User selection of material	
Processing		No
Measurement Parameters	Expert, allow user to modify	
Measurement Start	Start counting when door is closed	
Result		No
Save Result, when	Clean / Contamination	
Display Result, when	Clean / Contamination	
Show Activity distribution first, when	Contamination	6 detectors
Printing		No
Print Protocol, when	○ ○	

Measurement Mode:	Toolbox1	Option required
Global		No
Mode Name	Toolbox 1	
Min. measurement time	5	
Max. measurement time	60	
Measurement Unit	Activity	
Material Selection		No
	Default Material: Toolbox	
Processing		No
Measurement Parameters	Easy, show parameter only	
Measurement Start	Start counting when door is closed	
Result		No
Save Result, when	Clean / Contamination	
Display Result, when	Clean / Contamination	
Show Activity distribution first, when	○ ○	
Printing		No
Print Protocol, when	○ ○	

Measurement Mode:	Scale Select Mode	Option required
Measurement Mode:		**Option required**
Global		No
Mode Name	Scale Select Mode	
Min. measurement time	5	
Max. measurement time	60	
Measurement Unit	Activity	
Material Selection		Yes
	Weight based selection	Scale
Processing		No
Measurement Parameters	Simple measurement screen	
Measurement Start	Start counting when door is closed	
Result		No
Save Result, when	Clean / Contamination	
Display Result, when	Clean / Contamination	
Show Activity distribution first, when	○ ○	
Printing		No
Print Protocol, when	○ ○	

Measurement Mode:	CPS Mode	Option required
Global		No
Mode Name	CPS Mode	
Min. measurement time	5	
Max. measurement time	60	
Measurement Unit	Counts	
Material Selection		No
	○ ○ ○	
Processing		No
Measurement Parameters	Simple measurement screen	
Measurement Start	Start counting when door is closed	
Result		No
Save Result, when	○ ○	
Display Result, when	○ ○	
Show Activity distribution first, when	○ ○	
Printing		No
Print Protocol, when	○ ○	

3.7.5 Measurement process flowcharts

NOTE

The measurement process flowcharts in this chapter are used to display the basic principles.
Please be advised that the measurement process flowcharts are in detail regulated by significant user settings and options.

1.) Preparation (calibration and data input) of material database in **Tool&Object-Monitor** (see Chapter Service)

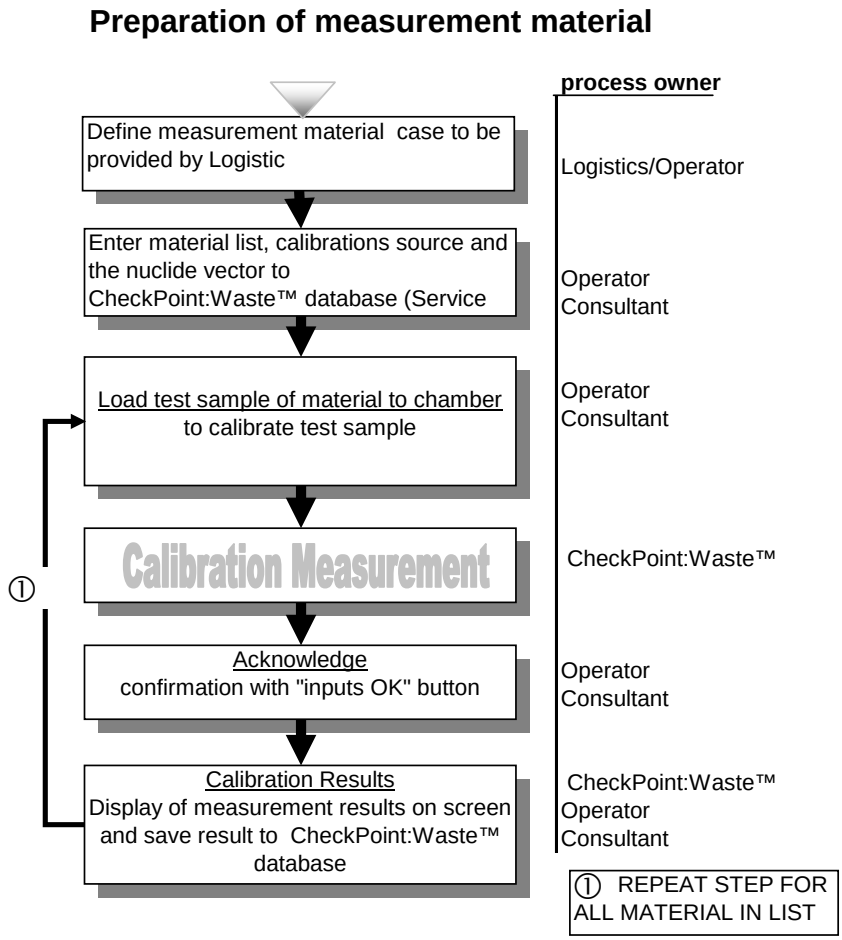


Figure 3-22: Flowchart material calibration

2.) Measurement process for defined material

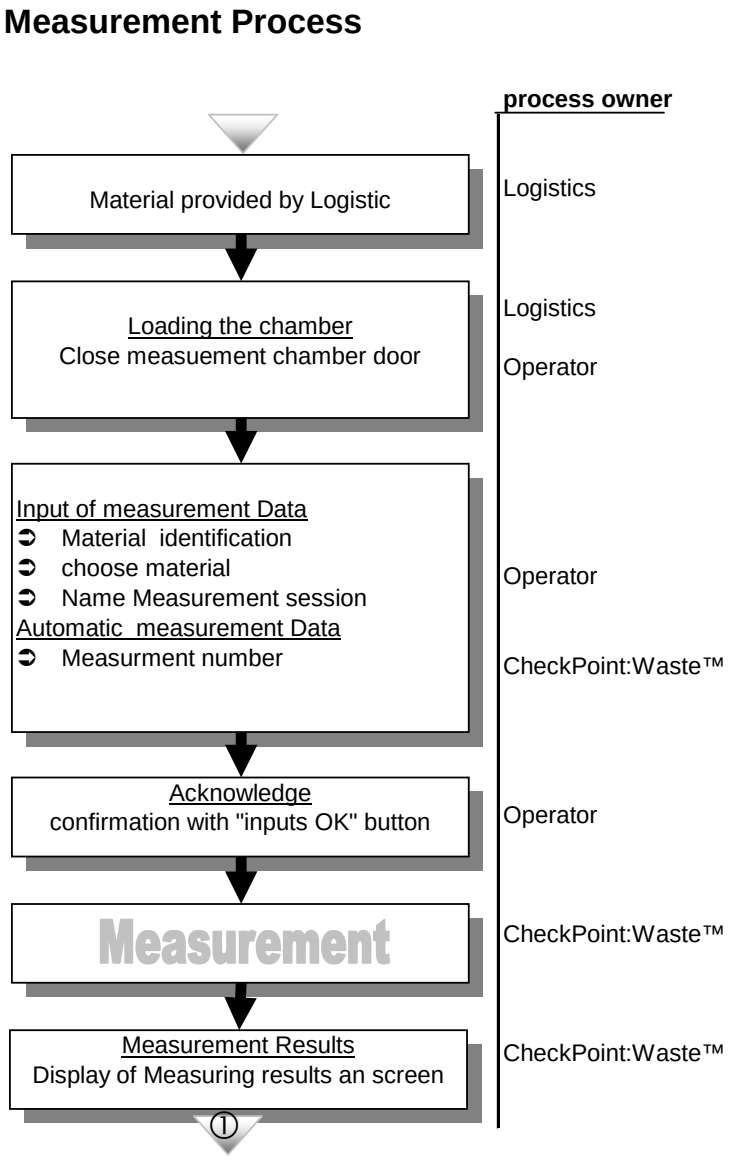


Figure 3-23: Flowchart measurement process

3.7.6 Measurement operation

Naturally, settings for the measurement operation are done from the main menu. The picture shows the screen that is shown after the monitor has been switched on, after a (background) measurement is finished and after leaving service mode.

Figure 3-24: Ready to measure

In the centre field of the screen status messages on the state of the **Tool&Object-Monitor** appear, such as “ready to measure” or “not ready to measure”. Messages as shown below may appear.

READY TO MEASURE
[Load the measurement chamber]

NOT READY TO MEASURE
[Close the measurement chamber]

or

The first message is intended to inform the user that the background effect is defined.

The measurement is initiated if all measurement conditions for the chosen measurement mode are fulfilled, for example the scale shows a weight and the chamber door is closed.

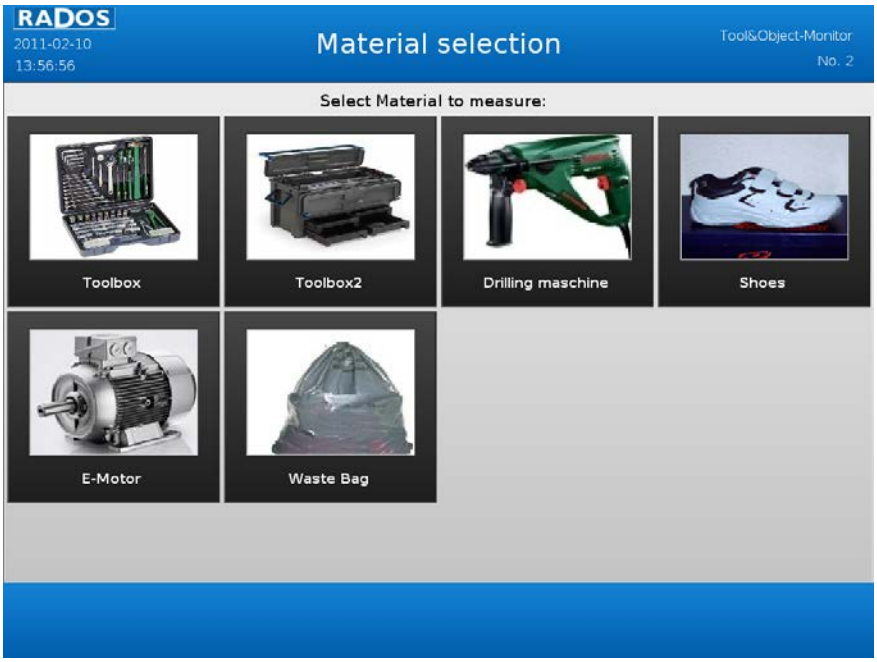


Figure 3-25: Measurement Material Selection

Mode using “user selection of material”

After loading the measurement chamber the selection menu for the material parameter-sets comes up (see Figure). After selecting the material the measurement is started.

Mode using “weight based material selection”

After loading the measurement chamber the measurement is started, using the material parameter corresponding to the weight loaded.

Mode using “default material”

After loading the measurement chamber the measurement is started, using the default material parameter.

CPS-Mode

After loading the measurement chamber the measurement is started, without using material parameter. The result is indicated in CPS$_{Net}$.

As soon as the measurement is running, it is possible to enter the parameters for the measurement, depending on the measurement mode, chosen.

Figure 3-26: Measurement Parameter Input

NOTE

Depending on the mode settings and the options available, parameter shown in the Figure, might not be available.

3.7.7 Break-off criteria

Different events may lead to the break-off of a measurement:

- The set minimum background level is not attained by one of the detectors. This may happen, if the minimum limit is set too close to the actual background. In this case the background effect must be measured again, for this purpose the measurement chamber must be emptied.
- The measurement chamber was opened during the measurement.

All break-off conditions are stated on the display, when they occur.

3.8 Measurement result

After the measurement is finished the result of the measurement is displayed:

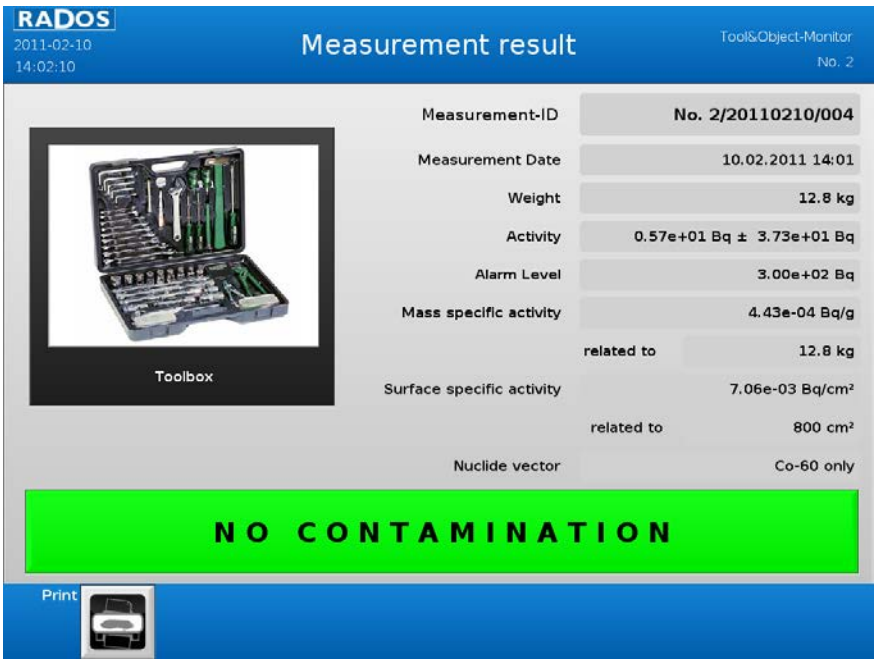


Figure 3-27: Measurement result "NO CONTAMINATION"

In the upper section all measurement related information (inputs and parameters as well as the net-weight and the measuring time) are displayed.

The activity is shown as total activity in Bq including the measurement error (except CPS-Mode). The related alarm level is displayed.

Below the alarm level for total activity the mass specific activity*[1] is shown together with the related mass*[1]. This value is the net mass or the averaging mass in case the net mass is above the averaging mass-parameter.

The surface specific activity is displayed in Bq/cm^2, related to the averaging surface. This value can be suppressed by entering "0 cm^2".

NOTE

Depending on the settings and the options available, specific activities may be suppressed.

*[1] (with scale option only)

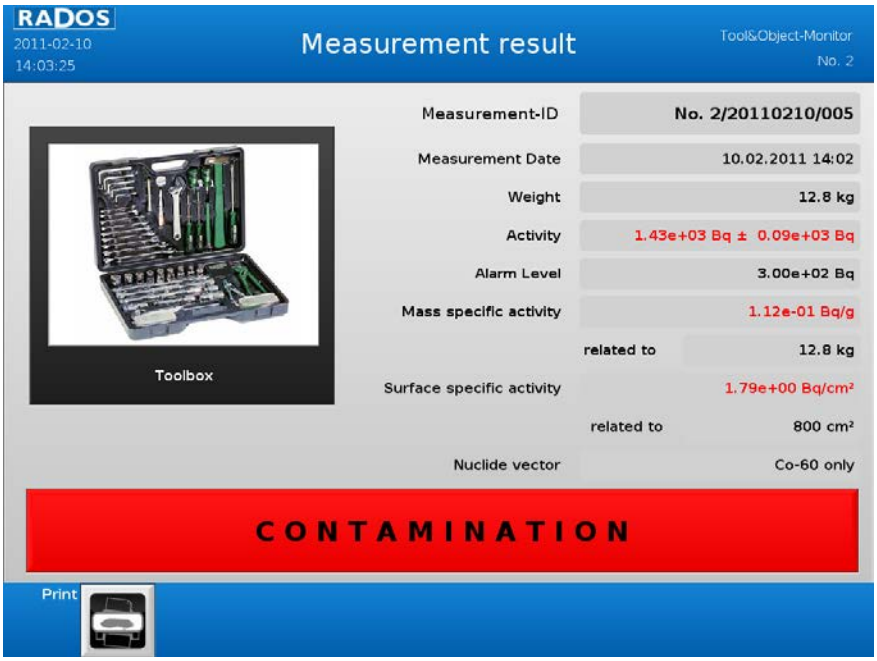


Figure 3-28: Measurement result "CONTAMINATION"

All values exceeding the alarm level are displayed in red colour!
The release decision is shown in large letters:

or

3.8.1 Distribution (optional)

CAUTION

Suitable for units equipped with 6 detectors only!

The internal chamber area, surrounded by 6 detectors, is divided into 8 cubes of same size, which fill up the complete inside of the chamber.

For each cube formalism is deposited, which has been calculated on the basis of the activity determined for each detector. With this formalism the stated activity is re-distributed to all 8 cubes, whereby about the average activity is reproduced.

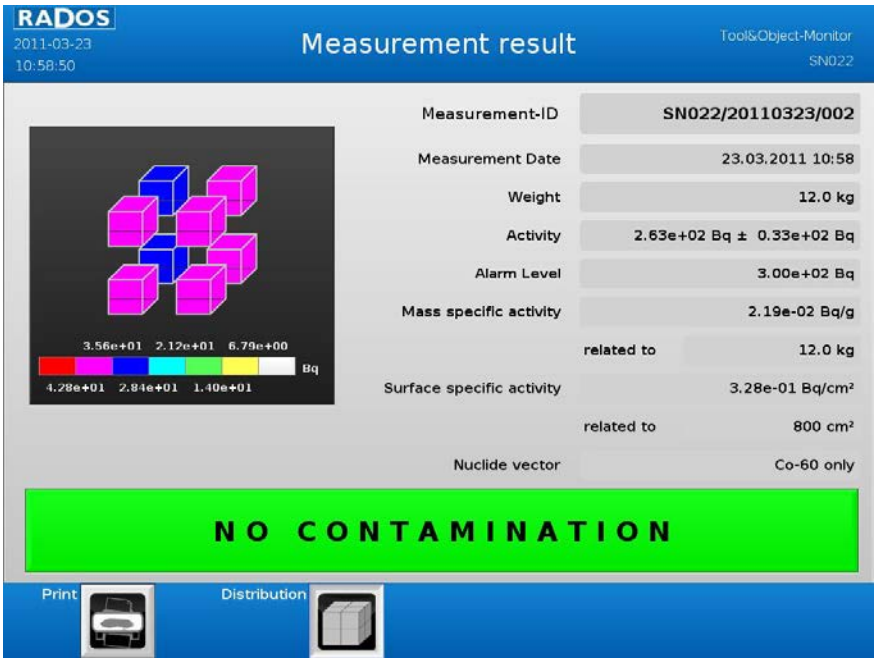


Figure 3-29: Distribution

Depending on the activity of the individual cubes, the cubes are provided with a colour, the classification of which refers to the prior defined detection limit.

A total of 7 colors are displayed:

white	below the calculated detection limit
yellow	below 1/6 of the alarm level
green	1/6 up to 2/6 of the alarm level
purple	2/6 up to 3/6 of the alarm level
blue	4/6 up to 5/6 of the alarm level
pink	5/6 up to alarm level
red	above the alarm level

Aside from the Figure of the cubes there is a three-dimensional display showing the supposed centre of the activity position. The formalism for the calculation of the activity centre is based on the goniometrical function for the measurement chamber geometry.

The display of the activity centre is done on the basis of the net count rates, i. the calibration is not considered. These way two different kinds of information are made available in the two figures. While the activity distribution gives an impression of the three-dimensional activity distribution in the measurement chamber, the activity display shows where there is the heaviest danger in the sense of dose load. For an even activity distribution the sphere will always be in the centre.

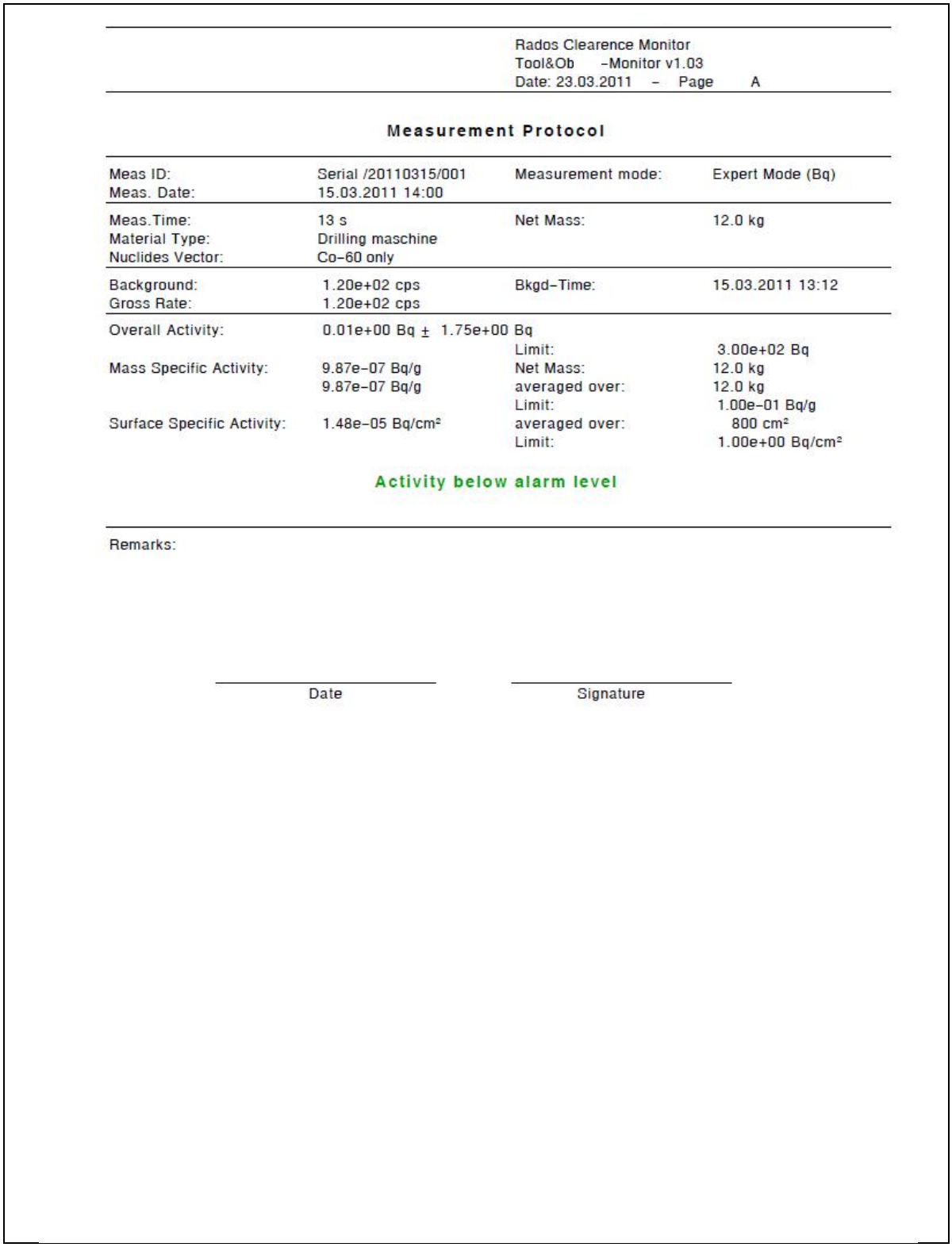
The point is marked red, if the alarm level is exceeded; otherwise it is of green colour. If, due to the statistics applied, it is not possible to calculate an activity position, the point will not be shown. There will be only the display of an empty room.

CAUTION

Due to the fact that the activity is redistributed from 6 real detector channels to 8 cubes, it may occur that there will be an alarm level exceeding of the total activity for the detector channels, and however it will not appear in the display of the cubes. It is also possible the other way around. Even if the 6 channels in the average do not show an alarm level exceeding, it may be shown in the display of the cube. This is affected by the conversion and contains two different statements.

3.8.2 Protocol printing

With a touch on the **Printer** icon in the result menu all measurement data are printed out. The measurement protocol is one page.



Rados Clearence Monitor
Tool&Ob –Monitor v1.03
Date: 23.03.2011 – Page A

Measurement Protocol

Meas ID:	Serial /20110315/001	Measurement mode:	Expert Mode (Bq)
Meas. Date:	15.03.2011 14:00		
Meas.Time:	13 s	Net Mass:	12.0 kg
Material Type:	Drilling maschine		
Nuclides Vector:	Co-60 only		
Background:	1.20e+02 cps	Bkgd-Time:	15.03.2011 13:12
Gross Rate:	1.20e+02 cps		
Overall Activity:	0.01e+00 Bq ± 1.75e+00 Bq		
		Limit:	3.00e+02 Bq
Mass Specific Activity:	9.87e-07 Bq/g	Net Mass:	12.0 kg
	9.87e-07 Bq/g	averaged over:	12.0 kg
		Limit:	1.00e-01 Bq/g
Surface Specific Activity:	1.48e-05 Bq/cm²	averaged over:	800 cm²
		Limit:	1.00e+00 Bq/cm²

Activity below alarm level

Remarks:

Date Signature

Figure 3-30: Preview of measurement result report (no activity alarm)

Rados Clearence Monitor
Tool&Ob[illegible]-Monitor v1.03
Date: 23.03.2011 – Page A

Measurement Protocol

Meas ID:	No. 2/20110210/005	Measurement mode:	
Meas. Date:	10.02.2011 14:02		
Meas.Time:	10 s	Net Mass:	12.8 kg
Material Type:	Toolbox		
Nuclides Vector:	Co-60 only		
Background:	2.42e+02 cps	Bkgd-Time:	10.02.2011 13:56
Gross Rate:	5.80e+02 cps		
Overall Activity:	1.43e+03 Bq ± 0.09e+03 Bq		
		Limit:	3.00e+02 Bq
Mass Specific Activity:	1.12e-01 Bq/g	Net Mass:	12.8 kg
	1.12e-01 Bq/g	averaged over:	12.8 kg
		Limit:	1.00e-01 Bq/g
Surface Specific Activity:	1.79e+00 Bq/cm²	averaged over:	800 cm²
		Limit:	1.00e+00 Bq/cm²

>>> ALARM LEVEL EXCEEDED <<<

Remarks:

Date Signature

Figure 3-31: Preview of measurement result report (activity alarm)

4 Service

Figure

4.1 Service

4.1.1 Prefix

The CheckPoint:Waste™ monitor family has different graphical and entry elements for the user communication. A detailed description of the operation is given in chapter "Computer system QNX…".The service mode is opened and carried out by using the button **service** (hold the button until the lock disappears) and a user login (see also the following chapter).

WARNING

To shut down the monitor it is absolutely necessary to follow the shutdown routine given in Register 3 to prevent the monitor from any damages.

Following service functions are provided in the service main menu:

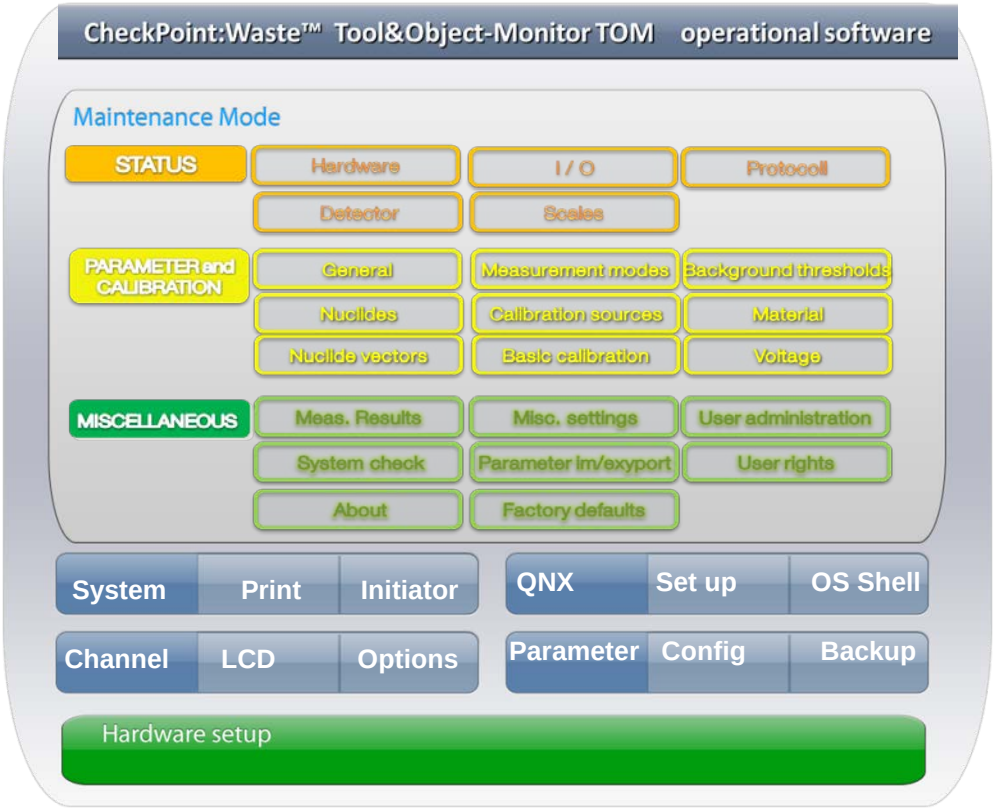


Figure 4-1: Diagram: Service functions

All service functions will be described in the following chapter. A partial repetition of the description from other chapters has been done intentionally.

4.1.2 Login to service

Figure 4-2: System check change log Log-in user icon

NOTE

To enter the service mode press the service icon for about 3 seconds until the lock disappears.

To call up the service functions a login is required.

The login provides 5 different levels of rights, linked to different functions in the service mode.

Figure 4-3: Maintenance menu - login

Every user belongs to a user group with specific authorization for the program.

- Refer to chapter user administration for detailed information.
- Refer to register 1 for pre-set user information.

4.2 Maintenance general

CAUTION

This operation mode requires qualified expert personnel or the RADOS Customer Service.

NOTE

The entries shown in white coloured fields can be edited to meet user premises. The fields coloured in grey are firmly set by the monitor software or are information only.

CAUTION

The values displayed in this documentation are simulated data that should not be compared to real measurements.

NOTE

If measurement parameters have been altered the user will be asked to save or discard the change with this query.

NOTE

The maintenance menu is password protected. Refer to register 5 for information on user administration.

4.2.1 Structure of submenu

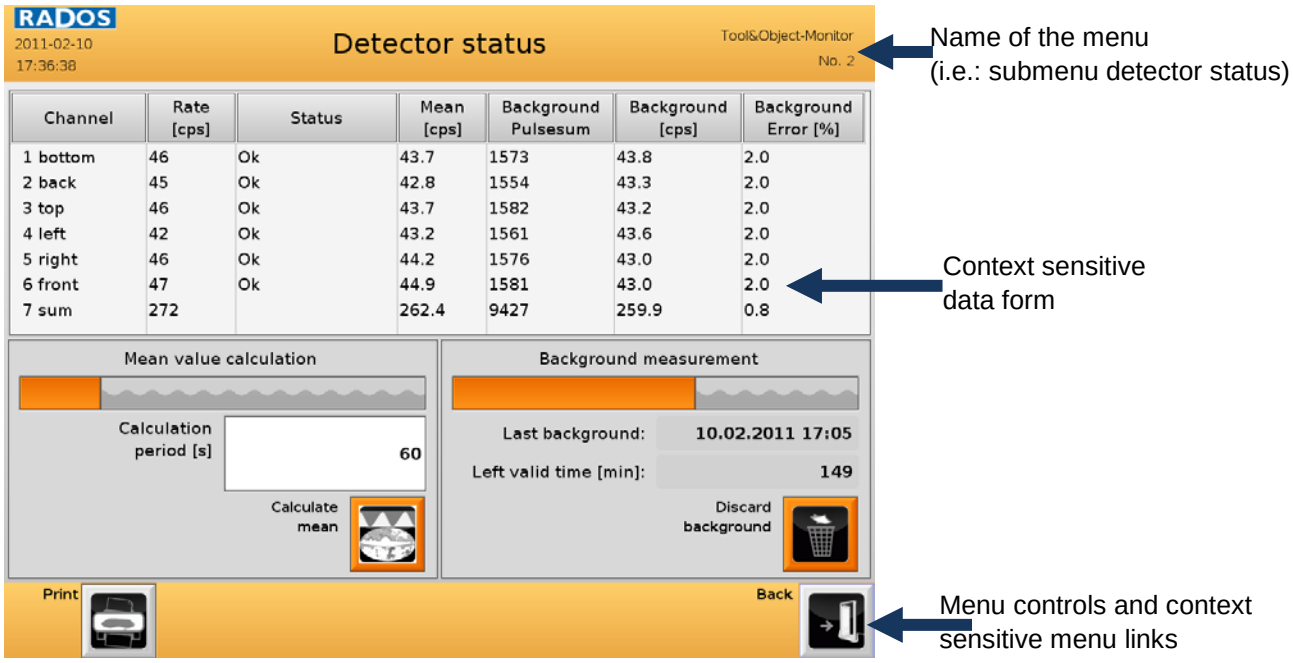


Figure 4-4: Maintenance operation - submenu structure / example

4.2.2 Touch screen keyboard

The touch screen keyboard is used to enter text and numbers, such as product location or parameter settings.
Depending on the submenu and field type, the intelligent keyboard may automatically suggest text or number keyboard as a default.

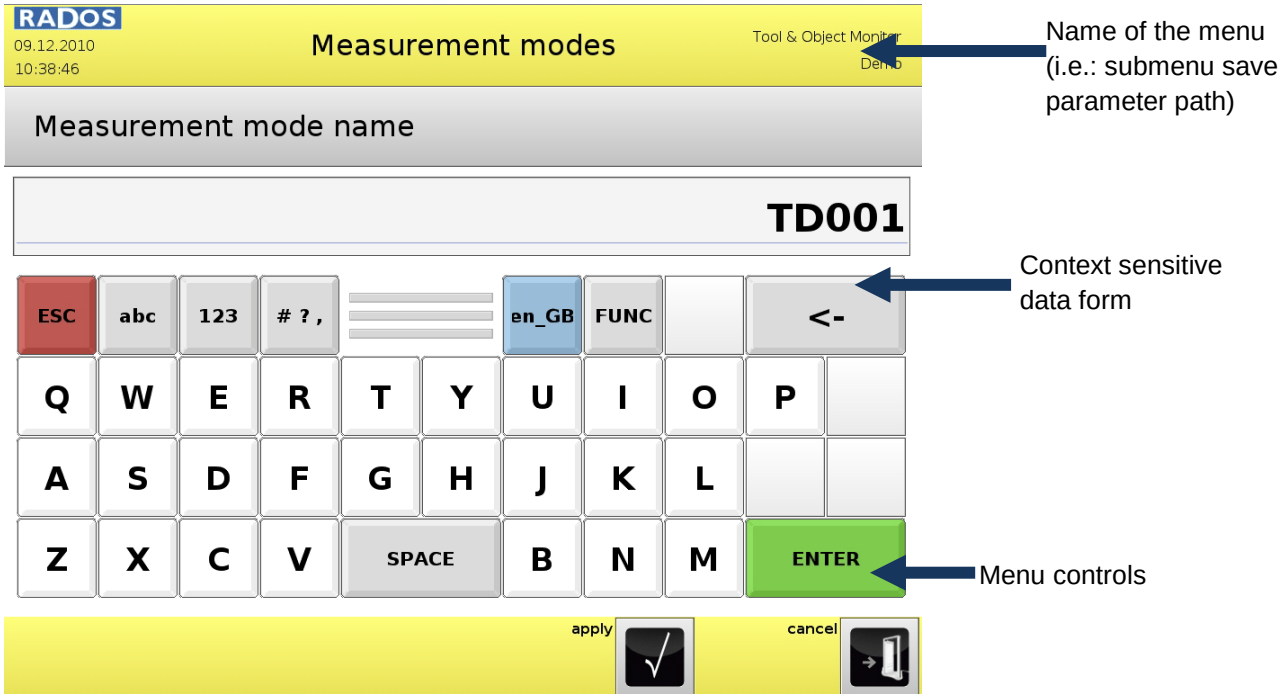


Figure 4-5: Maintenance operation - touch screen keyboard - example target directory definition

Start typing with just your index finger on the designated symbol.

If you touched the wrong key, you can use the backspace-key (**<-**) to correct the input.

The letter isn't entered until you release your finger from the key.

Functional symbols:

Symbol	Name	Function
	**Type lowercase**	Tap this key before tapping a letter in order to write in lowercase.
	**Type uppercase**	Tap this key before tapping a letter in order to write in uppercase.
	**Show numbers and punctuation**	Tap the Number key to switch to numbers and punctuation keyboard view.
	**Show symbols and signs**	Tap this key to switch to symbols and signs keyboard view.
	**Keyboard language layout**	Change keyboard layout to match your preferences.

Figure 4-6: Maintenance operation - touch screen keyboard - function keys

NOTE

For detailed information on the touch screen menu operations refer to register 12 QNX-Touch screen OS.

4.2.3 Recurrent menu controls

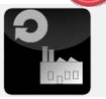
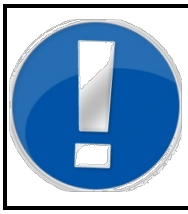
Symbol	Name	Function
	**back**	Leave the actual menu and return to maintenance main menu. (On context sensitive menu links the previous menu will be called.)
	**Back to meas. mode**	Direct switch between maintenance and measurement mode.
	**save**	The button **save** (with pulsing red bulb) will be displayed directly after parameters have been altered.
	**load**	Load factory parameter in the user software.
 	**Out of order ON/OFF**	Shut down the measurement mode usage in case of maintenance works in progress
	**Last result**	The result of the last contamination measurement will be displayed.
	**delete**	Delete a dataset.

Figure 4-7: Maintenance operation - recurrent menu controls



NOTE

For detailed information on touch screen menu operations refer to register 12 QNX-Touch screen OS.

4.3 Maintenance (enter and exit)

When the button, called **maintenance** at the bottom of the display is actuated for > 2 seconds the maintenance menu is visible and the menu items are accessible.

NOTE

The maintenance menu is password secured on user level. Refer to register 5 for closer information.

The monitor is **not** in the measurement mode any longer. By actuating the service functions, the background measurement stops. From this menu the desired service functions may be chosen.
The following submenus are available in the **maintenance** mode of the user software.

The **maintenance mode** is left actuating the button **exit service** and the button icon changes back to gears in the **measurement** mode.

The **maintenance** menu is arranged in three divisions to alter parameter and for monitor information view:

❶ **Service**
Informational section on detector and internal devices

❷ **Parameters and calibration**
Parameter and define detector operation

❸ **Miscellaneous**
Database and general information

Figure 4-8: Maintenance Mode - button

Figure 4-9: Maintenance operation – service-status

Figure 4-10: Maintenance operation - parameters and calibration

Figure 4-11: Maintenance operation - miscellaneous

4.4 Status-menu area

Figure 4-12: Chapters status menu

4.4.1 Input / Output status

All computer input and output signals are displayed in this menu. A green button means "*active*" and a grey one "*passive*". All outputs can be set by clicking them.

Figure 4-13: Icon IO state

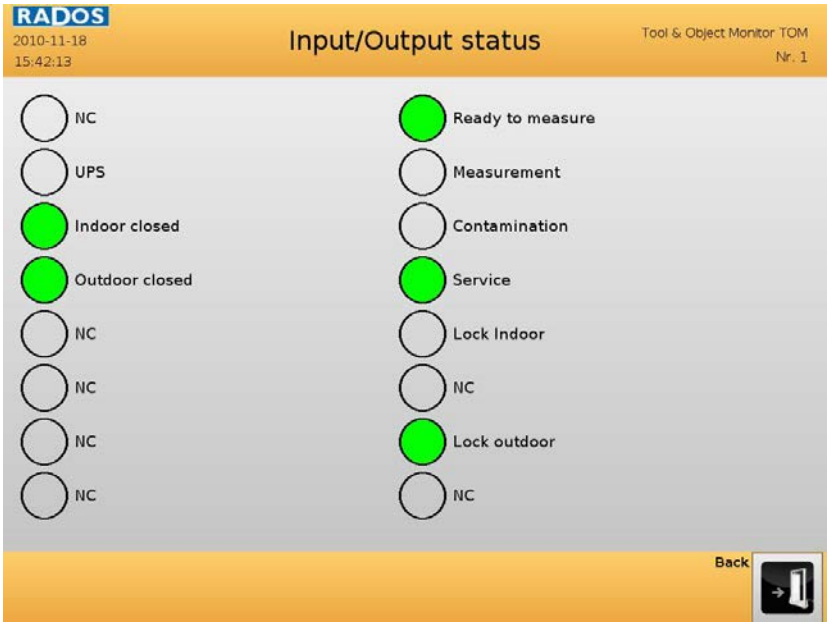


Figure 4-14: Maintenance mode – status/Input Output status

Menu controls in the Input and Output status menu:	
back Close the menu and return to maintenance menu	

4.4.2 Detector status

Figure 4-15: Icon channel status

The detector status submenu gives an overview on the present background effect. Here, information on each individual detector is displayed with its position and its consecutive numbering under various flags. The status of the background measurement is displayed as bar graph. This service menu is separated in three areas:

❶ Channel type and -details
❷ Background measurement information
❸ Calculation of mean value (timer-counter function)

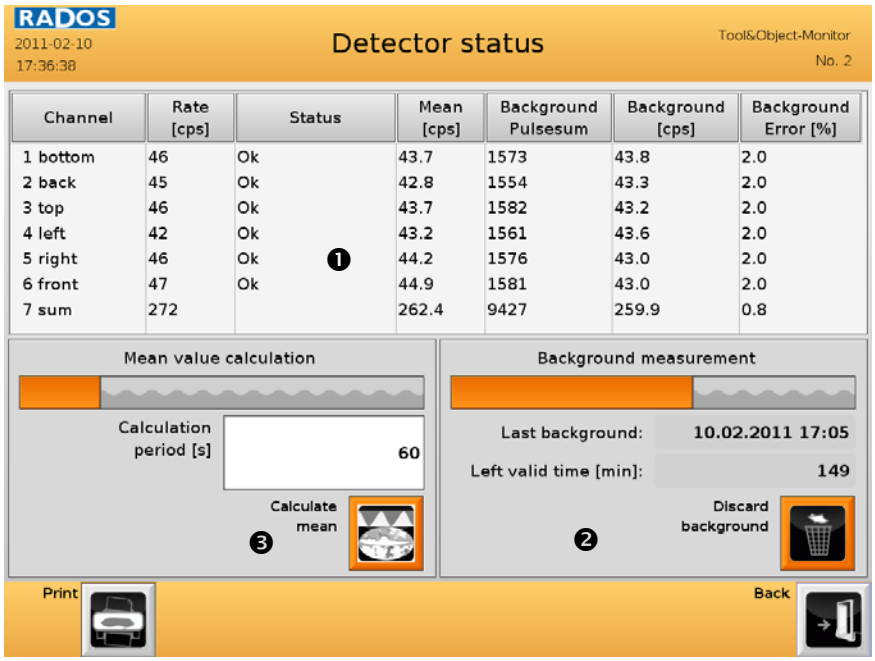


Figure 4-16: Maintenance mode – detector status

❶ Channel type and -details

The following information of the measurement channels from the detector electronics is displayed for user information and service purposes only. The information is firmly set in the electronic and cannot be changed by the user.

❶ Channel	❷ Rate [cps]	❸ Status	❹ Mean [cps]	❺ Background Pulsesum	❻ Background [cps]	❼ Background Error [%]

channel	❶	the number of the channel within the monitor
rate	❷	current count rates per second [cps]
status	❸	actual **channel status** from following possible states:
	OK	the channel is **ready to measure**
	CHG	the status has just been changed
	MIN	the value is beyond the minimum background limit
	MAX	the maximum background limit has been exceeded
mean	❹	calculated mean value [cps]
pulse sum	❺	sum of counts during one background measurement cycle
background	❻	sum of counts during one background measurement cycle
error	❼	statistically error of the background information

Background measurement information

Both, the background effect just measured (Rate [cps]) as well as the previously determined mean background effect (Background [cps]) is displayed. The stated relative error refers to the statistically determined standard deviation and therefore indicates the smallest theoretical error. A new background measurement (“Discard background”) or measurement of the mean background measurement (“Calculate mean”, timer-counter function) can be initiated.

Calculation of mean value

A new creation of the mean value is started via the button ***calculate mean***. Left of the ***calculate mean*** button the time used to measure the mean value is shown. The user can change this value at any time. The time value 0 results in a permanent mean value creation of the count rates, while 60 would stand for an averaging time of 60 seconds.

Formula 4-1: standard deviation

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Menu controls in the detector status menu:	
back Close the menu and return to maintenance menu	
Calculate mean start a new mean value calculation	
Discard background stop a background measurement	

4.4.3 Hardware status

Figure 4-17: Icon Hardware

The hardware status menu gives information about the type and version of the connected **Tool&Object-Monitor** hardware.

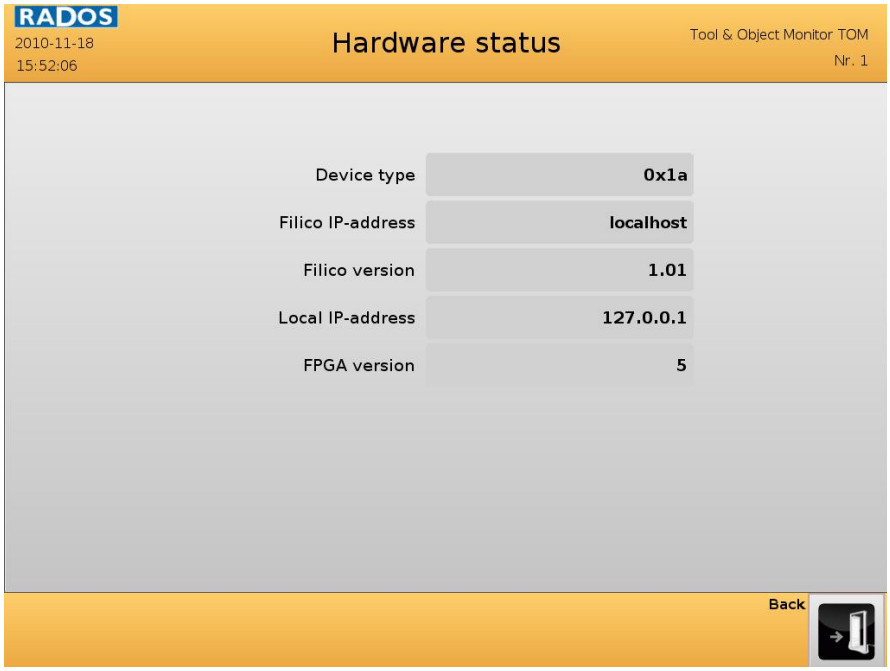


Figure 4-18: Maintenance mode – status/hardware status

Altering of the settings is not possible from this menu.

Menu controls in the hardware status menu:	
back Close the menu and return to maintenance menu	

Figure 4-19: Icon Scale

4.4.4 Scale status

The communication data to and from the *optional* scale can be displayed. In case of a communication problem it can be checked if an answer is received from the scale.

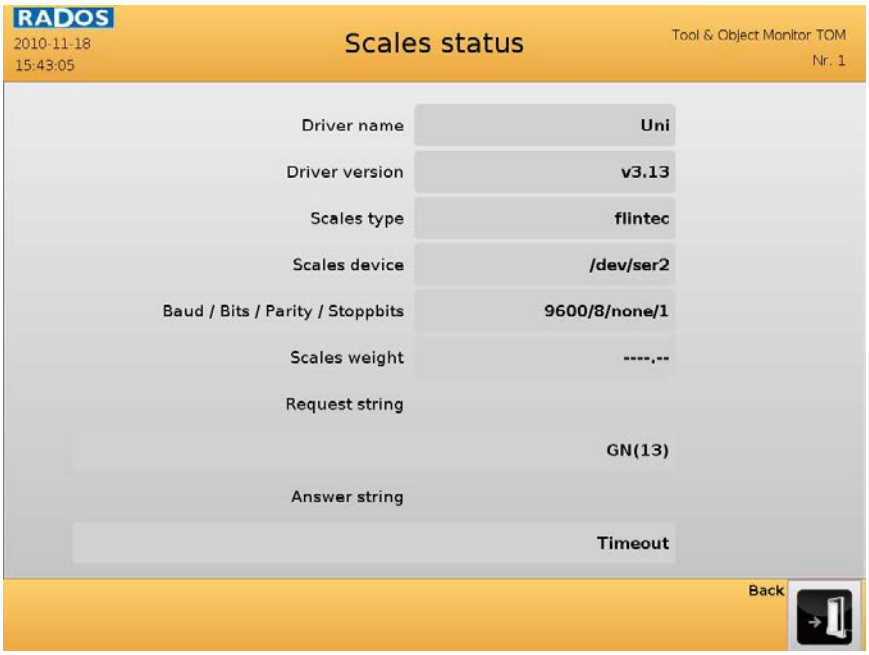


Figure 4-20: Maintenance mode – status/scale status

Additional information about the scale driver, type and communication setting are displayed.

Menu controls in the scale status menu:	
back Close the menu and return to maintenance menu	

4.4.5 Loudspeaker

The **Tool&Object-Monitor** can sound some few words as “clean” or “contamination”.

Figure 4-21: Icon Loudspeaker

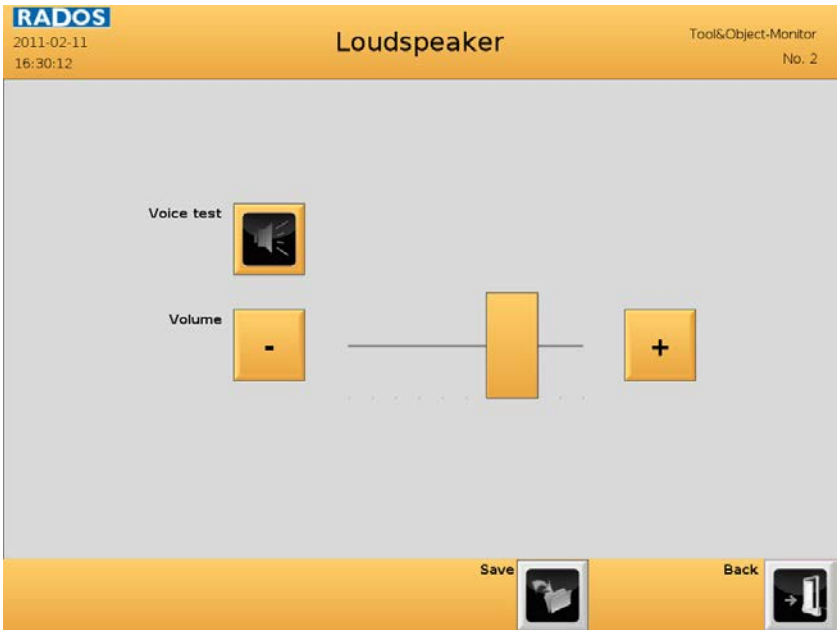
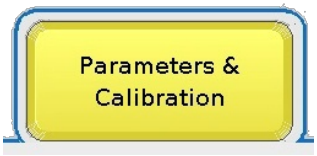


Figure 4-22: Maintenance mode – loudspeaker

The sound can be controlled by the volume setting only.



4.5 Parameter- and calibration- menu area

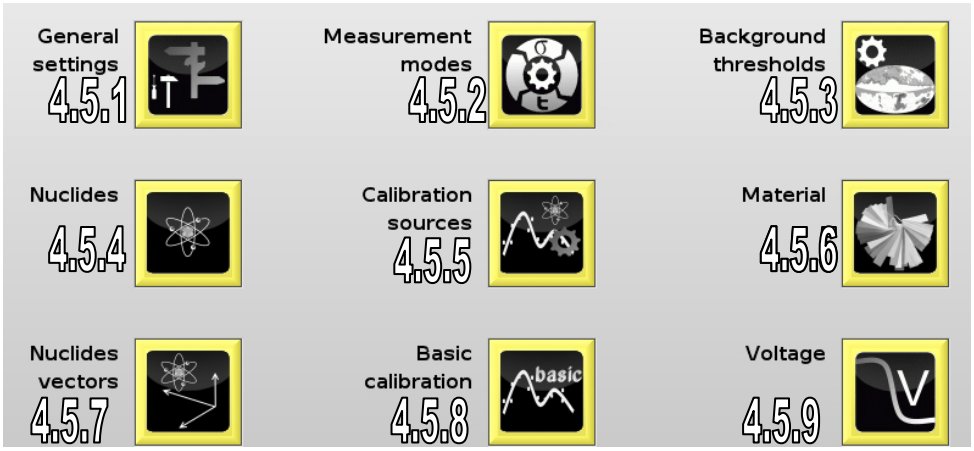


Figure 4-23: Maintenance mode - Parameter and calibration - menu area

4.5.1 General settings

Figure 4-24: Icon Hardware

In the menu **general settings** the overview of the discrete settings is shown. Sub-menus for “Processing”, “Background”, “Measurement” and “Units” can be called up from here to set parameters.

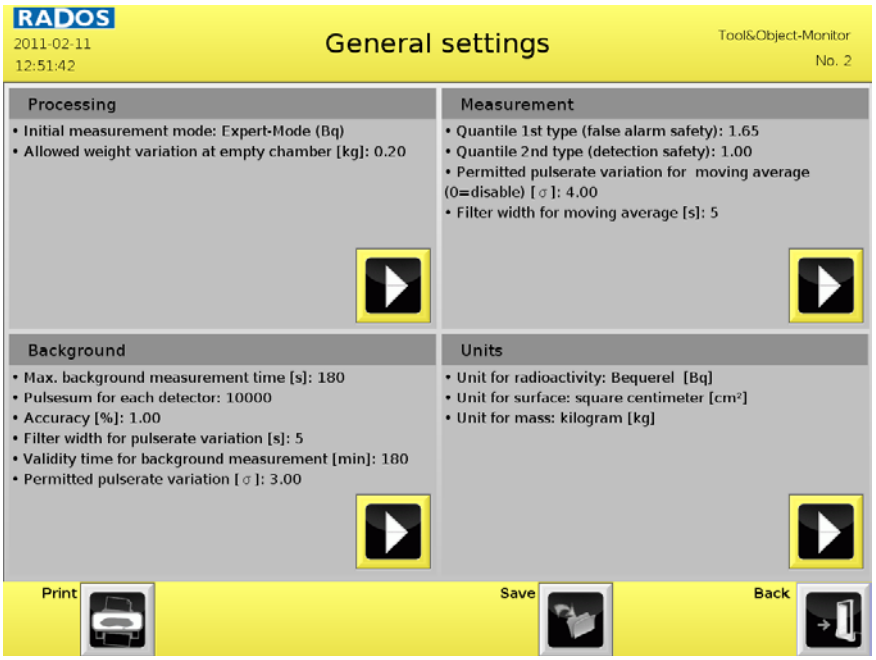


Figure 4-25: Maintenance mode - Parameter and calibration/general settings

Menu controls in the general settings menu:	
back Close the menu and return to maintenance menu	
Save The changed parameters have to be saved before leaving the menu.	

4.5.1.1 General settings – processing

In the menu “General settings-processing” the initial measurement mode will be set. The **Tool&Object-Monitor** starts up in this mode.

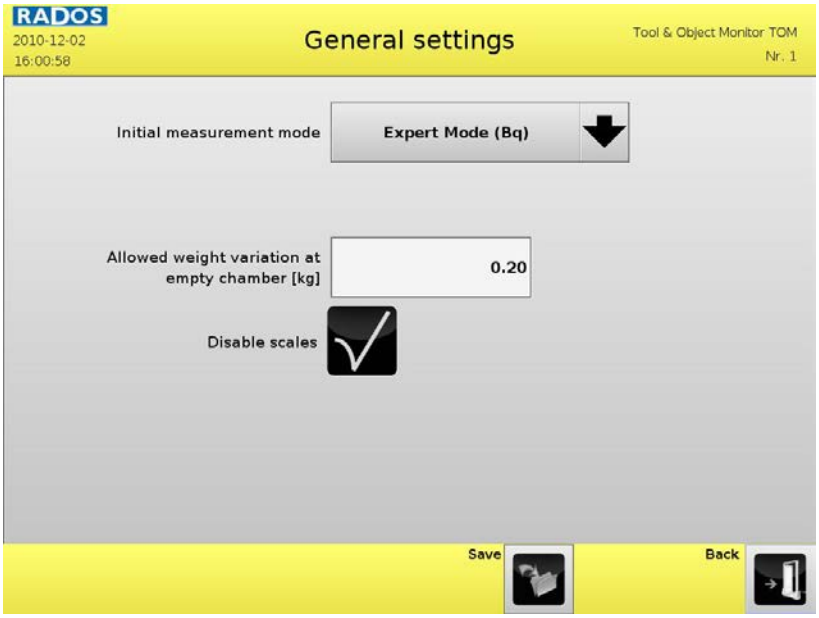


Figure 4-26: Maintenance mode - Parameter and calibration/general settings–processing

The allowed weight variation is the threshold the system indicates a weight. With a setting <0.1 kg it can happen that the system starts measurements with empty chamber in case the scale variants about the lowest digit.

With disable scale you can switch off the scale communication. A weight input field will be displayed.

NOTE

The scale parameters are available with the option scale only.

4.5.1.2 General settings – background

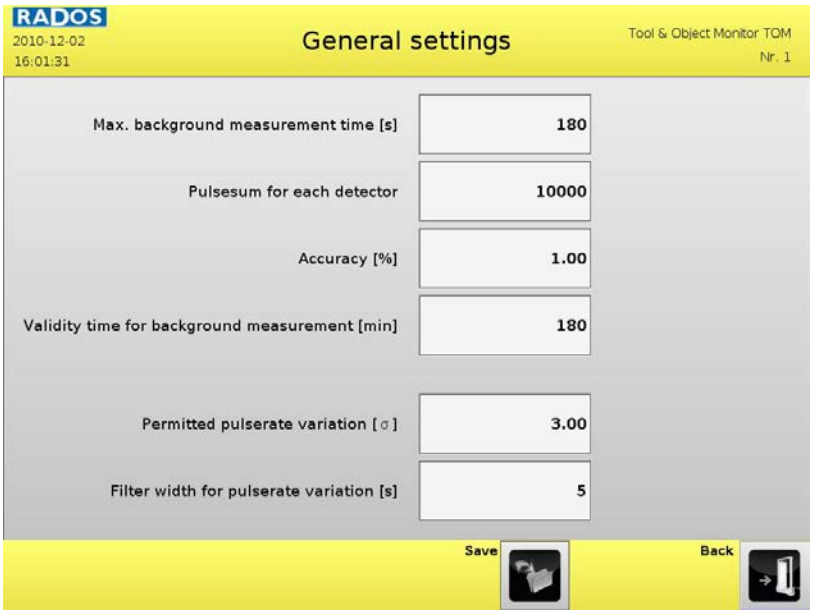


Figure 4-27: Maintenance mode - Parameter and calibration/general settings–background

The **pulse sum for each detector** in the background measurement can be set in the general settings menu. This corresponds directly to the statistical error or **accuracy** which alternatively be defined.

For the background measurement a **maximum- measurement time** can be pre-set. If the desired pulse sum is not attained within this time, the background effect measurement time is finished early. The accuracy then refers to the pulse sum of the individual detector channels attained until this time.

The system carries out a background measurement until each detector has reached the specified pulse sum or the time limit is exceeded.

The **validity time for background measurement (min)** allows to set an automatic background update interval for the **Tool&Object-Monitor**, in case the background information has not been updated in between.

The **permitted pulse rate variation** limits the deviation of the background measured in the time interval below (Filter width of pulse rate variation) from the last measured background value in standard deviations.

In case the background variation exceeds the permitted level, a new background measurement will be enforced.

4.5.1.3 General settings – measurement

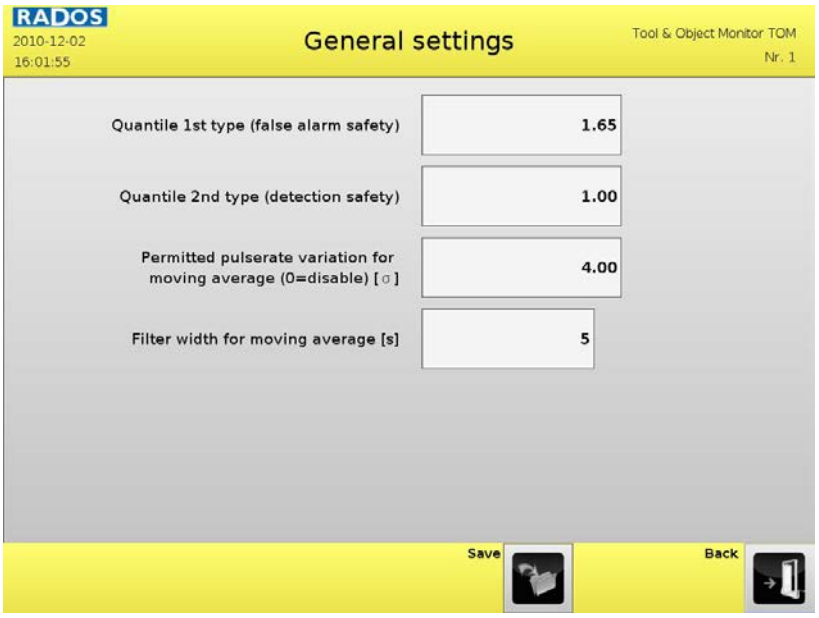


Figure 4-28: Maintenance mode - Parameter and calibration/general settings–measurement

In the menu “general settings – measurement” you will set statistically parameters for the material measurement.

The quantile 1st type will define the safety against false alarm.

The quantile 2nd type will define the detection safety.

Both parameters are used for the measurement time calculation.

The moving average monitors the background effect during the measurement phase. The effort taken is based on the fact that at the moment the measurement phase is started, at first unknown pulse rate (the gross rate) is applied. The background effect monitoring shall now monitor that this rate does not change significantly during the measurement time.

During the measurement phase, an average value over the already elapsed measurement time is created for each measurement channel. This average value becomes more and more accurate during the measurement phase.

In parallel an average value over the last x measurement cycles is created for all measurement channels. The number of measurement cycles x can be set in the field “Filter width for moving average” (default setting = 3).

A deviation from this sliding average value to the total average value for each measurement channel is calculated as standard deviation and is then compared with the parameter “permitted pulse rate variation” in each second of the measurement time.

In case the set parameter is exceeded, the measurement phase is interrupted with a respective message. In that case it has to be assumed that the background effect has been changed by external influences. The measurement must be repeated then.

If significant background changes happened it is recommended to measure background first before repeating the clearance measurement.

4.5.1.4 General settings – units

The menu "*Units"* allows the configuration of units used for calculation and printout through the **Tool&Object-Monitor** software.

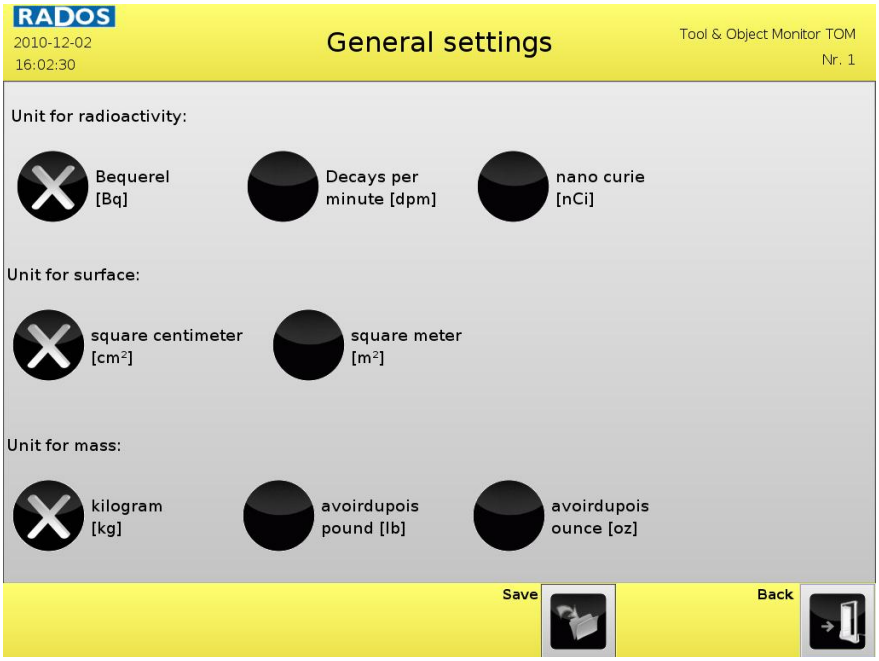


Figure 4-29: Maintenance mode - Parameter and calibration/general settings – units

You can set up units for activity and surface.

In case the option "scale" is available units for mass can be set.

4.5.2 Measurement modes

Figure 4-30: Icon measurement modes

Different measurement modes can be set up by the administrator. This setup will influence the measurement functions and contents of the display.

The following list will give an overview of the measurement mode setup functions.

Setup functions for the measurement modes

Global	**Functions / characteristic**
	■ Definition of the mode identification ■ Measurement time setup ■ Units (Bq or CPS)
Material selection	**Functions / characteristic**
	■ Manual selection by user ■ Using default material ■ Weight based material selection (scale and license required)
Processing	**Functions / characteristic**
	■ Expert (allow to modify parameters) ■ Easy (show parameters only) ■ Simple screen (Time-bar only) ■ Measurement start (after door closed or after input)
Result	**Functions / characteristic**
	■ Save result when (clean and/or contaminated) ■ Display result when (clean and/or contaminated) ■ Show activity distribution first when (clean and/or contaminated) (6 detector version only)
Protocol	**Functions / characteristic**
	■ Print protocol when (clean and/or contaminated)

The measurement modes can be selected from the **Tool&Object-Monitor** main menu.

In the top section of the main menu measurement modes you can call up the selection list of the modes available by touch at the select arrow ▼. (see 4.5.2.1 Measurement mode selection).

The menu provides several sub menus and an information status of the settings of the respectively mode.

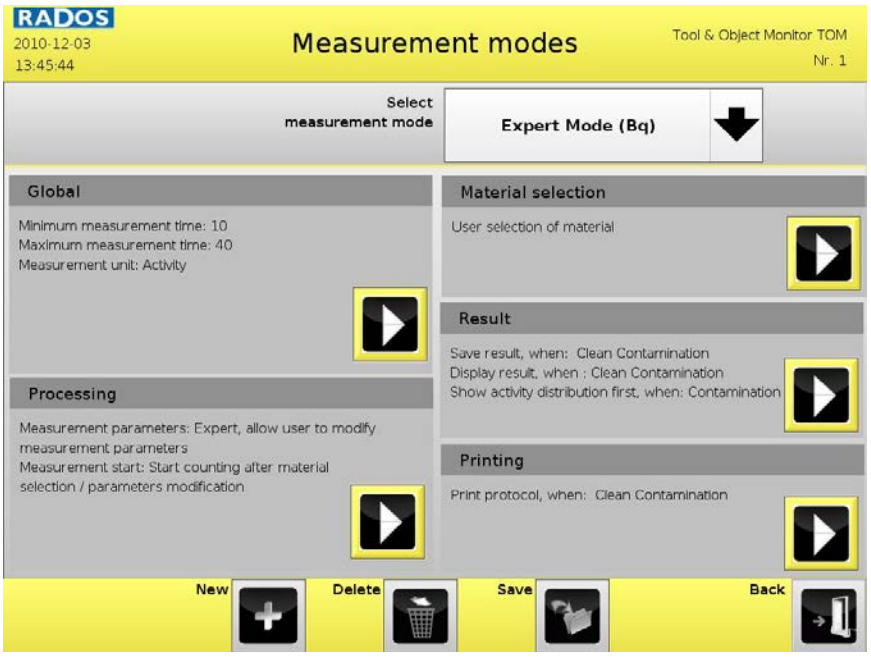


Figure 4-31: Maintenance mode - Parameter and calibration/measurement modes

By touch on “Delete” you can delete the activated measurement mode after confirming a safety query.

Touching on “New Mode” a new measurement mode will be created. Touching the empty indication field the soft-keyboard appears for input of the name of the new measurement mode.

Menu controls in the measurement modes menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
new Add new measurement mode to list	

4.5.2.1 Measurement mode selection

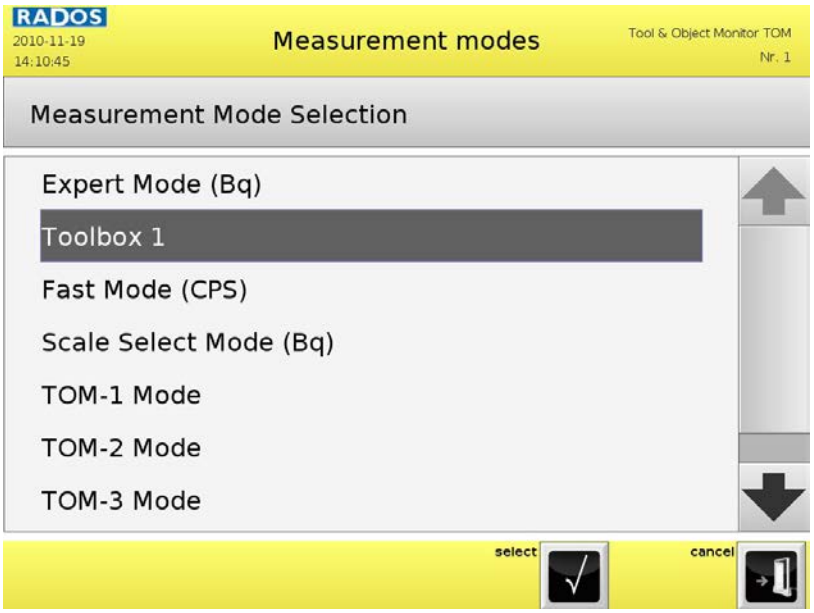


Figure 4-32: Maintenance mode - Parameter and calibration/measurement modes–selection

The measurement mode selection provides all existing modes. A scroll bar appears in case >7 modes are installed.

Menu controls in the measurement modes menu:	
back Close the menu and return to maintenance menu	
select use selected item in list	

4.5.2.2 Measurement mode - global

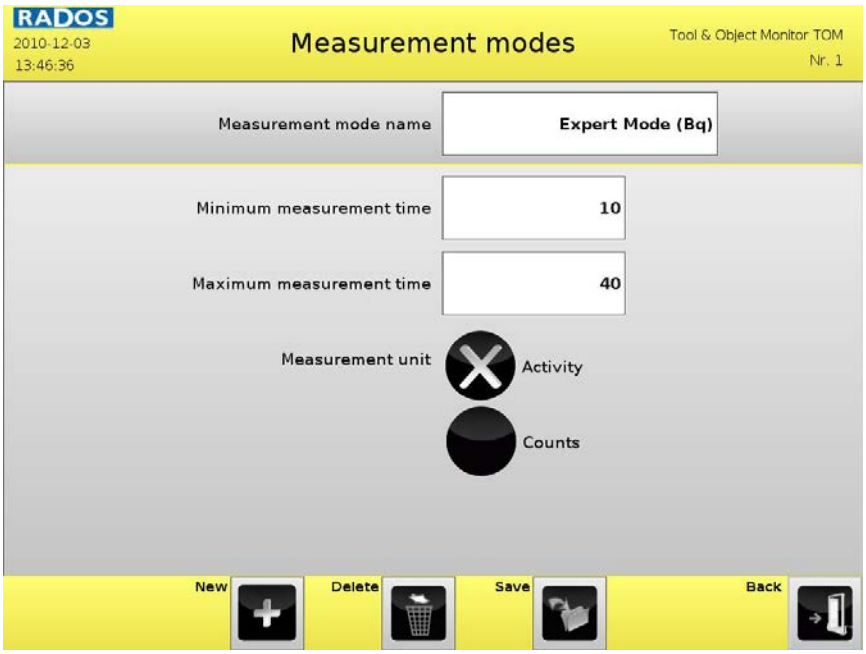


Figure 4-33: Maintenance mode - Parameter and calibration/measurement modes–global

The menu measurement mode – global provides following parameter:

- Measurement mode name

  The individual name of the measurement mode is displayed and can be altered.

- Minimum and maximum measurement time

  Here you can set the time range the automatic measurement time calculation will follow.

The quality or the statistical safety of the individual measurements is given by the errors type I and type II, by the size of the background effect and the probable measurement effect.

Menu controls in the measurement modes menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

For the probable measurement effect the most restrictive detection limit is used. This one is calculated to a net measurement effect by the efficiency values coming from the respective calibration. This value and the parameters listed above go directly into the calculation of the measurement time according to DIN25482 part 1.The equation for the measurement time has the following form:

$$t_b = \frac{t_0}{t_0 \cdot \left[\frac{2}{\kappa_{1-\alpha} + \kappa_{1-\beta}} \cdot \sqrt{(R_{E0} + R_{En})} - \sqrt{R_{E0}} \right]^2 - 1}$$

where

t_0	= background effect measurement time,
R_{E0}	= expected value for background effect,
R_{Eb}	= expected value for gross measurement effect,
R_{En}	= expected value for net measurement effect,
k_{1-a}	= quantile error 1st type, (safety against false alarm),
$k_{1-ß}$	= quantile error 2nd type, (detection safety).

The confidence level defines the accuracy of the measurement result obtained and affects the triggering of the alarm. It takes into account the statistical nature of the quantities to be measured.

A detailed description of the meaning of the quantiles of 1st and 2nd kind is given in the chapter on the evaluation procedure. You can find the parameters quantiles in the menu “*General settings / measurement*”.

- Measurement unit

Using “Activity” the indication will be in Bq. Using “Counts” the indication will be in CPS without using the calibration.

4.5.2.3 Measurement mode – material selection

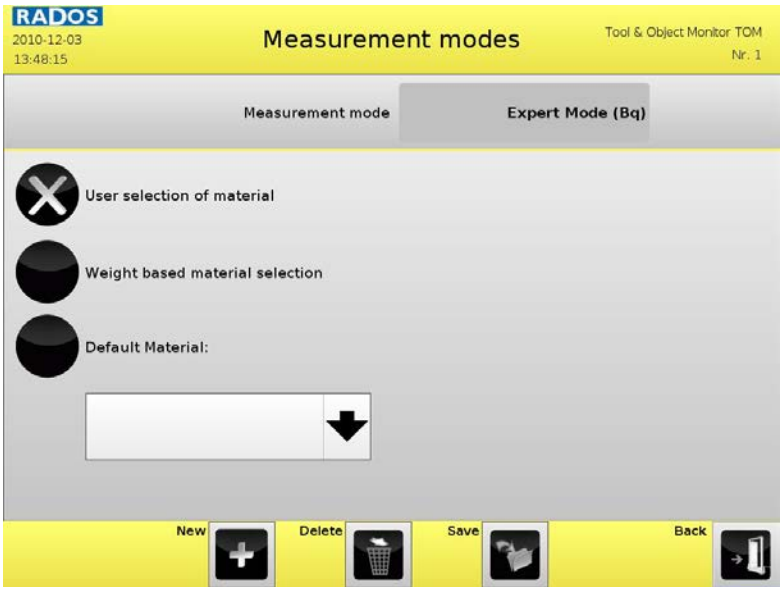


Figure 4-34: Maintenance mode - Parameter and calibration/measurement modes–material selection

In the setup for the material selection you can define how the parameter set "material" will be selected:

User selection of material

Here the operator can select the material parameter by touching one of the displayed material parameter icons.

Weight based material selection

The material selection will be done automatically depending on the weight. This mode requires weight based parameter settings in the material parameter. Of course this function is available with weight cells installed only.

Default material

In this case the selected material will be used only for measurements. No additional selection is required. Select the respectively material in the selection box below.

Menu controls in the measurement modes menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

4.5.2.4 Measurement mode – processing

In the menu “Processing” you can set effects for the user concerning measurement parameters and display contents:

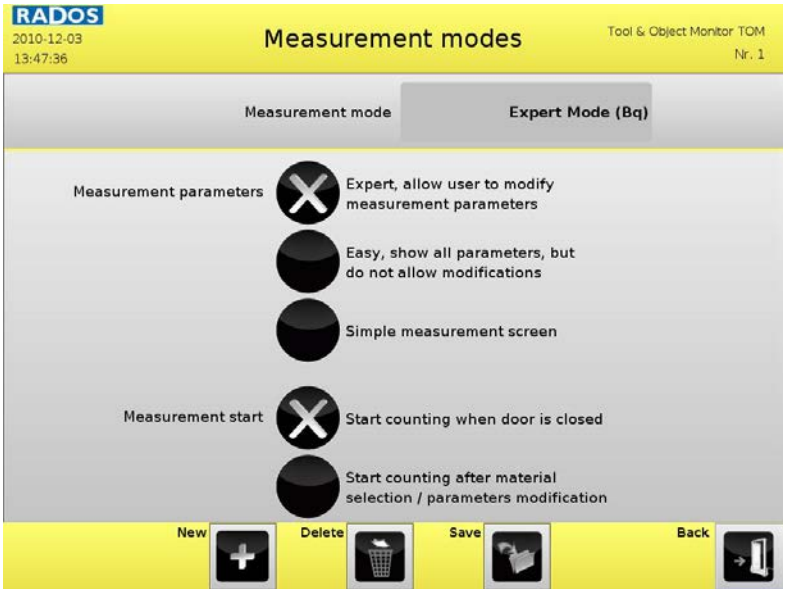


Figure 4-35: Maintenance mode - Parameter and calibration/measurement modes– processing

Measurement Parameters

Expert

The user can modify parameters in the measurement input menu.

Easy

The parameters are displayed in the measurement input menu. The user cannot modify them.

Simple measurement screen

A time-bar graph is displayed during the measurement only.

Measurement Start

Start counting when door is closed

The **Tool&Object-Monitor** starts counting after door closing with a delay of 2 seconds. This is the recommended setting.

Start counting after material selection / parameter modification

The **Tool&Object-Monitor** starts counting after the user has confirmed the inputs in the measurement menu.

Menu controls in the measurement modes menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

4.5.2.5 Measurement mode – Result

In the menu “Result” you can set effects for the display contents after the measurement phase is completed:

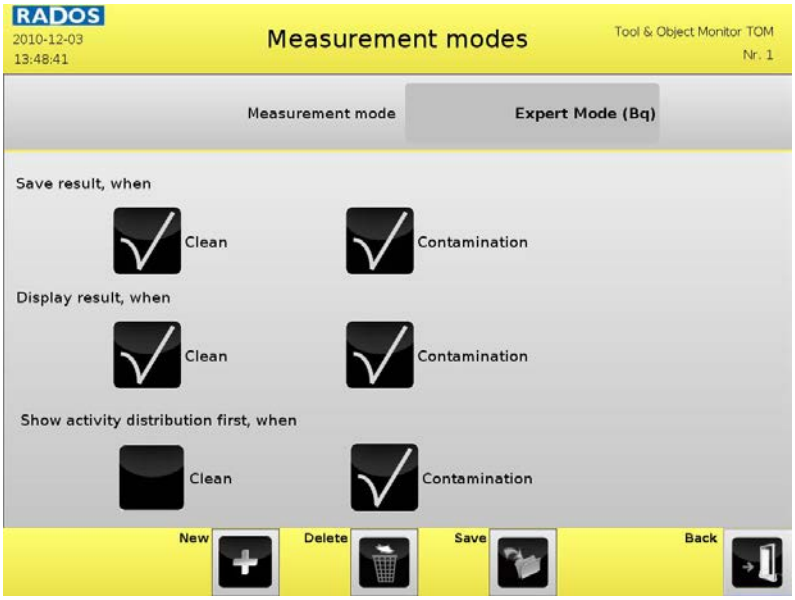


Figure 4-36: Maintenance mode - Parameter and calibration/measurement modes–results

Save result, when

The measurement result will be stored in the data base in case the respective function is activated.

Display result, when

The measurement result will be displayed in case the respective function is activated. Otherwise the **Tool&Object-Monitor** returns to the “Ready to measure status” after reloading the measurement chamber.

Show activity distribution first, when

The activity distribution picture will be displayed at once, in case the respective function is activated. Closing the activity distribution will display the result data. Otherwise the result will displayed first. You can call up the activity distribution from the result screen too.

NOTE

The activity distribution information is available in the 6 detector version only.

4.5.2.6 Measurement mode – protocol

In the menu “Protocol” you can set up the printing function for the measurement results:

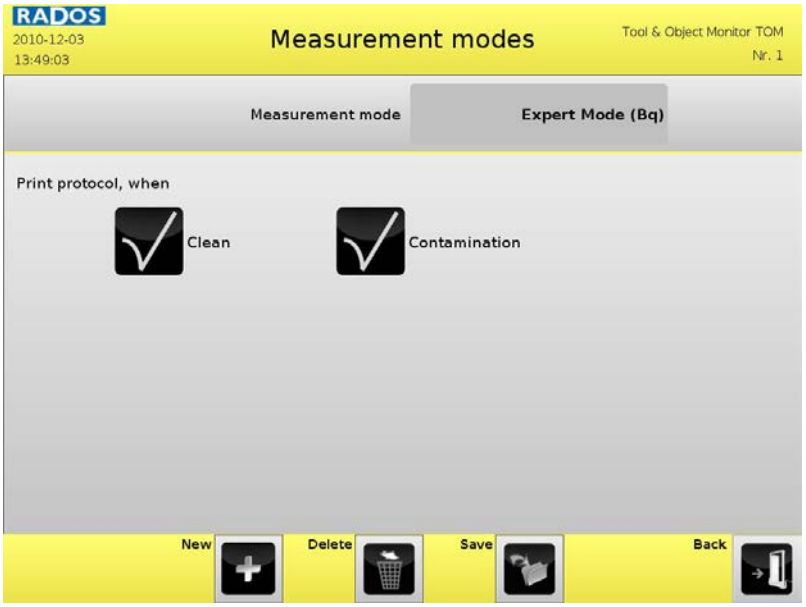


Figure 4-37: Maintenance mode - Parameter and calibration/measurement modes–protocol

Print protocol, when

The measurement protocol will be printed in case the respective function is activated.

NOTE

Please make sure that the printer and printer parameters are set up in the system configuration.

Menu controls in the Measurement modes menu:

back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

Figure 4-38: Icon background thresholds

4.5.3 Background thresholds

The background count rate corresponds with the efficiency of the detectors. It can be used for detecting efficiency loss or in worst case detector break down.

Increased background rate usually corresponds with increased background radiation in the environment of the **Tool&Object-Monitor**, or with a contamination of the measurement chamber.

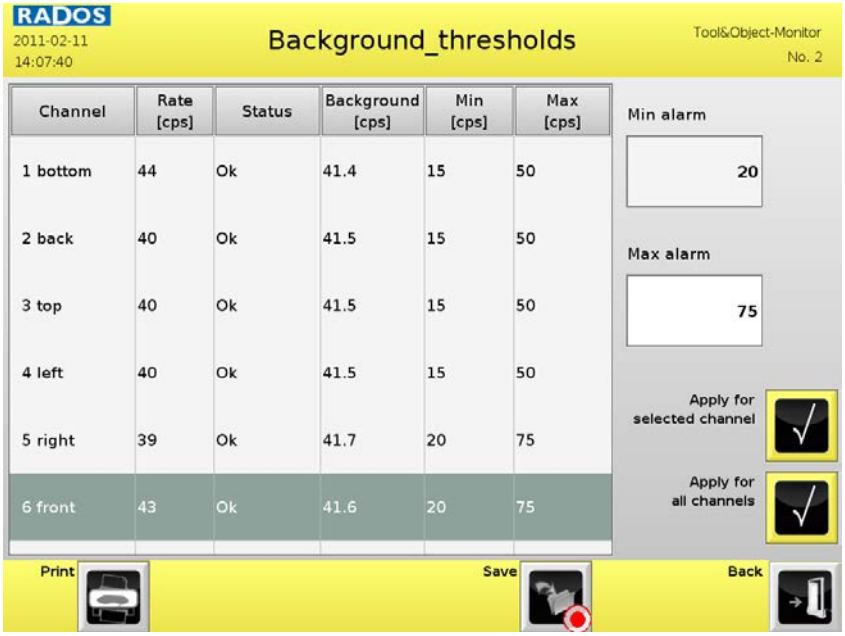


Figure 4-39: Maintenance mode - Parameter and calibration/ Background Thresholds

The menu “Background thresholds” provides thresholds for minimum and maximum alarm from the count rate, for each detector.

By setting both thresholds in the input fields you can set the thresholds for all channels (apply for all channels) or for one selected channel (apply for selected channel).

The background count rate is checked for minimum and maximum threshold during the normal background measurement in intervals of 10s.

	RECOMMENDATION
	Minimum threshold: (0.4 – 0.6) x background Maximum threshold: (1.5 – 3) x background

Menu controls in the background thresholds menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	

4.5.4 Nuclide database

Figure 4-40: Icon nuclides

The nuclides database contains up to >130 nuclides as standard. If required, you can add further nuclides to the data base (New nuclide) or delete existing nuclides (Delete nuclide).

For each nuclide the atomic number and the half life time is available, as well as clearance levels.

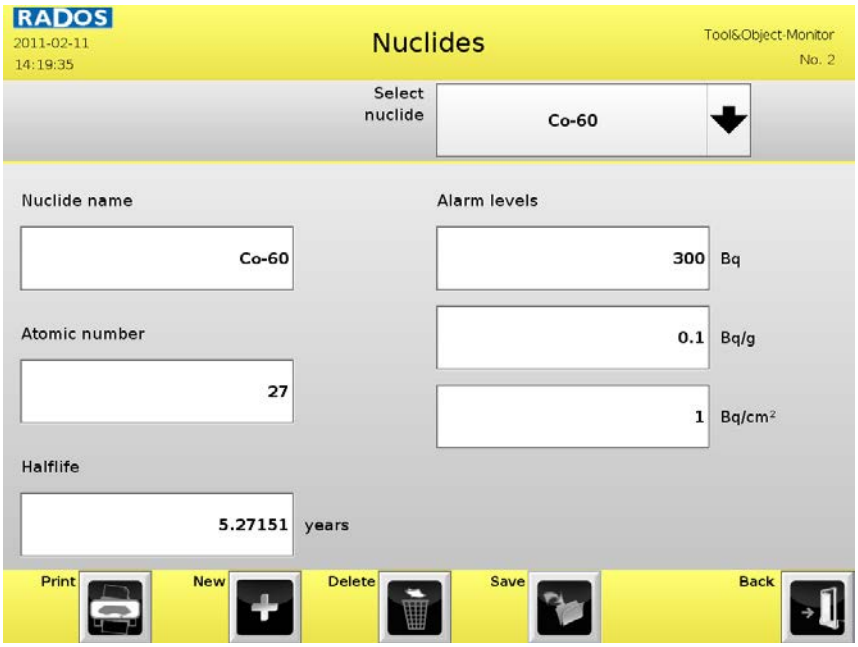
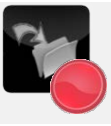


Figure 4-41: Maintenance mode - Parameter and calibration/ Nuclides

As standard, the clearance levels will be set to the German regulation. Otherwise the customer's clearance levels will be installed, if specified.

Of course the nuclide specific clearance levels can be altered by the administrator at any time.

Menu controls in the nuclides menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	

By touching the upper nuclide- button you get the list of installed nuclides for selection:

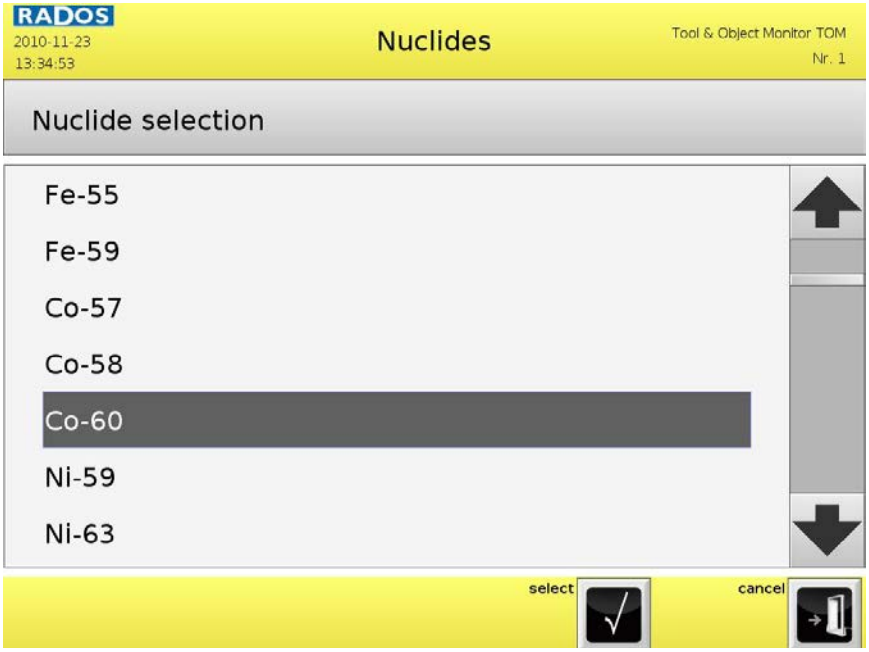


Figure 4-42: Maintenance mode - Parameter and calibration/nuclides selection

Here you can scroll the list of nuclides and select a nuclide by touch. The system returns to the nuclide data screen.

4.5.5 Calibration sources

Figure 4-43: Icon calibration sources

In this menu the local calibration sources can be entered.
The calibration sources are used for detector calibration.

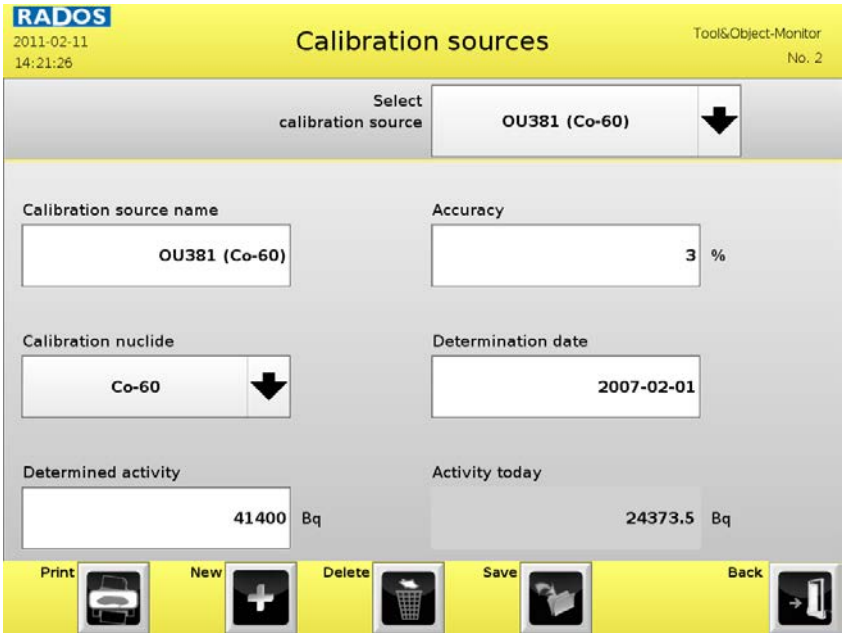


Figure 4-44: Maintenance mode - Parameter and calibration/ Nuclides selection

The pull down menu allows to change between existing calibration sources.

The input field “calibration source name” can be freely used to give each source a name.
This name will be shown in the source selection for the calibration.

After selection of a nuclide and entering the source’s activity at the determination-date the current activity is calculated by the system computer. For this reason it is necessary that the system clock has been set correctly.

Menu controls in the calibration sources menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

Figure 4-45: Icon material

4.5.6 Material

The material Parameter sets include all relevant parameters for the measurement of the respectively material chosen. In the service mode you can set up these parameters.

In the top section of the menu material you can call up the selection list of the material parameter sets available by touch at the select arrow ▼.
(see **material selection**)

Figure 4-46: Maintenance mode - Parameter and calibration/ material

By touch on “Delete” you can delete the activated parameter set after confirming a safety query.
Touching on “New Material” a new material parameter set will be created. Touching the empty indication field the soft-keyboard appears for input of the name of the new material.

material selection

Figure 4-47: Maintenance mode - Parameter and calibration/material selection

The material selection provides all existing materials.
A scroll bar appears in case >7 parameter sets are installed.

Menu controls in the material menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

4.5.6.1 Material - global

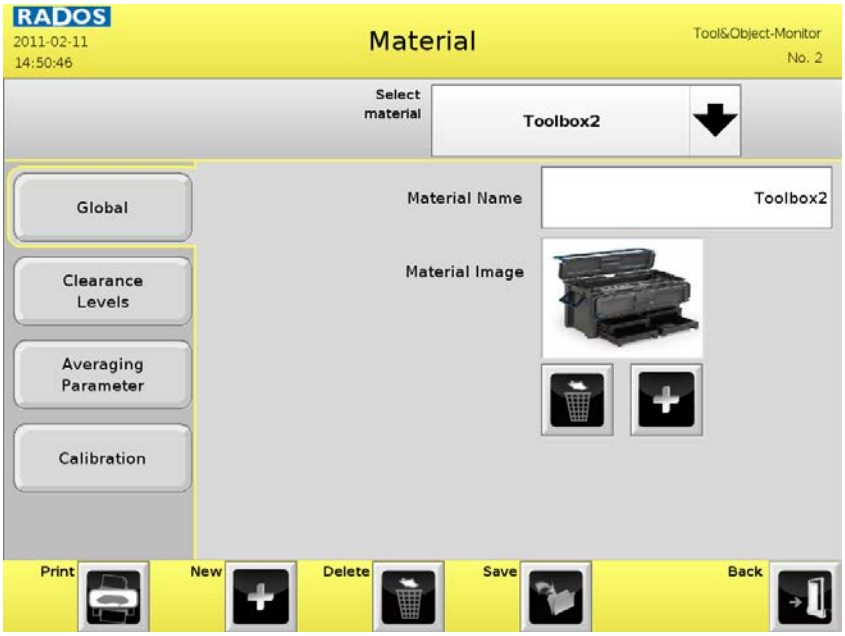


Figure 4-48: Maintenance mode - Parameter and calibration/ material global

The menu material – global provides following parameter:

Material name

The individual name of the material parameter set is displayed and can be altered.

Material image

The button *Material Image* enables the user to insert an image, illustration or picture, stored on the measurement computer or on an USB device.

NOTE

Specification for customized images:
Aspect ratio: **4:3** (i.e. 640*480 or 800*600)
File format: **JPG or PNG**

Menu controls in the material menu:

back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

4.5.6.2 Material – clearance levels

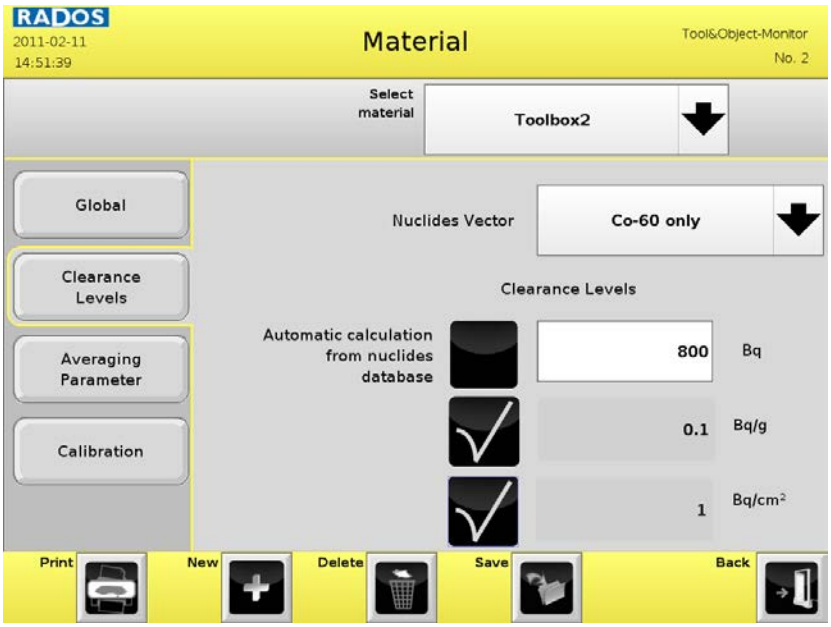


Figure 4-49: Maintenance mode - Parameter and calibration/ material clearance levels

Nuclides vector

A nuclide vector can be selected, used for this material parameter set (Option).

Calibration nuclide (without option nuclide vector only)

A nuclide for this material parameter set can be selected.

Automatic calculation / clearance levels

The clearance levels for total activity, mass specific activity and activity related to surface area are edited here. The levels are derived from the levels in the nuclide database, if exist. For nuclide vectors (OPTION) additionally the sum formula is used, calculating a resulting alarm level for the nuclides and portions. If the automatic calculation is switched off, these values can be individually adjusted.
The individual alarm values should be determined at the outset of a release measurement, either in agreement with the supervisory authorities or according to previously defined guide values.

Menu controls in the material menu:

back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new measurement mode to list	

4.5.6.3 Averaging parameter

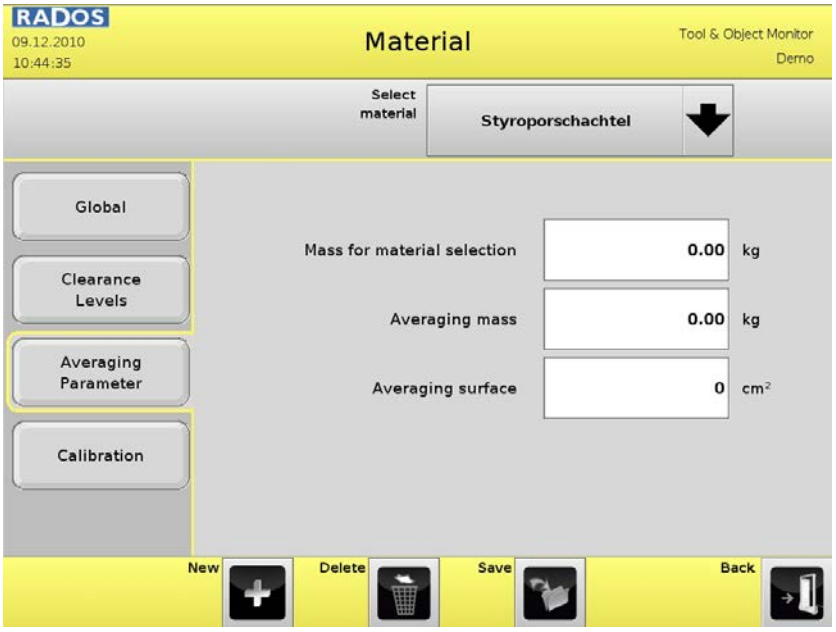


Figure 4-50: Maintenance mode - Parameter and calibration/ material averaging parameter

Averaging mass / Averaging surface

The measured total activity can be related to a mass and to a surface. The reference value can be set here. Without the option “weight scale” there is no weight values available.

Mass for material selection

In the mode “scale select” the **Tool&Object-Monitor** selects the respectively material parameter by the weight measured. This weight can be input as “mass for material selection”.

NOTE

The scale select operation mode cannot distinguish between materials with different nuclide vectors.
It is required to setup the vectors in a conservative way.

The system automatically selects the material parameters of the next higher weight level.

Example: *Material mass: 23.4 kg*

Material – parameter-no.:

1	2	3	4	5	6
5 kg	15 kg	20 kg	30 kg	0 kg	0kg

Table 4-51: Average parameter example

In the example the system will select the parameter set automatically which is **calibrated up to 30 kg.**
The material parameters 5 and 6 are set to 0 kg and not enabled for the scale select mode. They can be used in the “user selection mode”.

4.5.6.4 Material – calibration

The calibration of **Tool&Object-Monitor** is related to the measurement material parameter set.

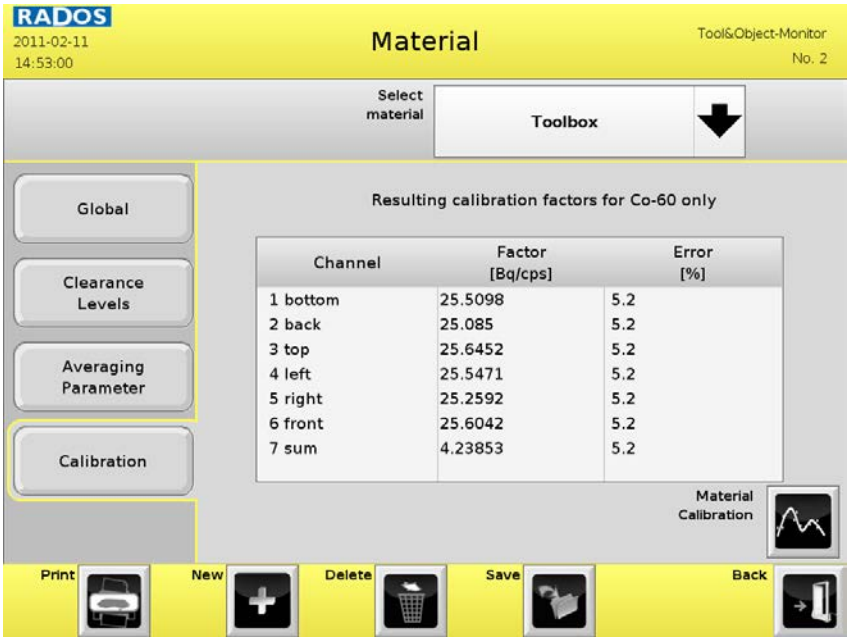


Figure 4-52: Maintenance mode - Parameter and calibration/ material calibration factors

If you call up the menu material – calibration the calibration factors for all detectors and for the sum channel are displayed.

The calibration factors are related to the nuclide of the respectively calibration or are related to the nuclide vector, in case this option is implemented.

To carry out a new material calibration with another nuclide or for a new installed material, touch on “Material calibration”.

Attention

With the option **basic calibration**:
Ensure that the respectively nuclide has been calibrated in the basic calibration before the material calibration.

The calibration parameter menu opens:

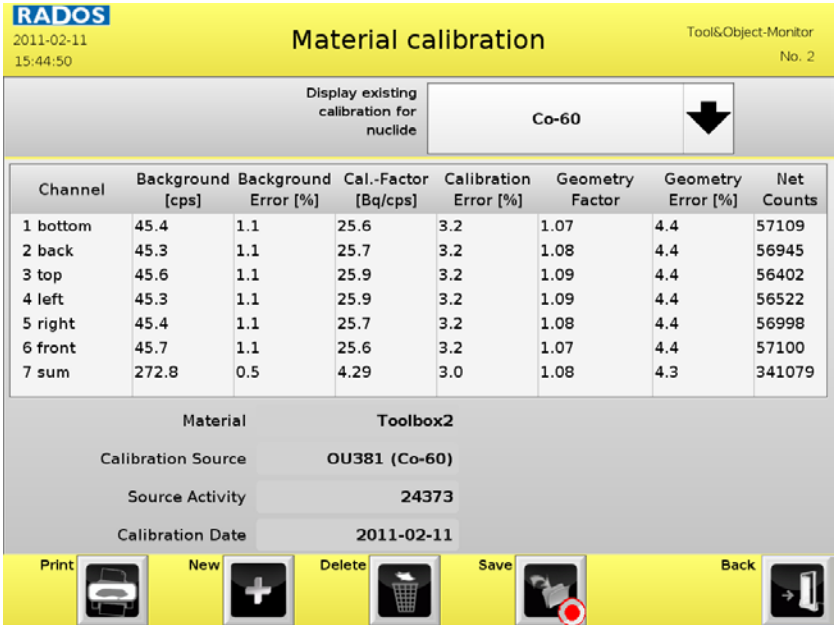


Figure 4-53: Maintenance mode - Parameter and calibration/ material calibration process I

To carry out a new material calibration actuate **new / start calibration**.

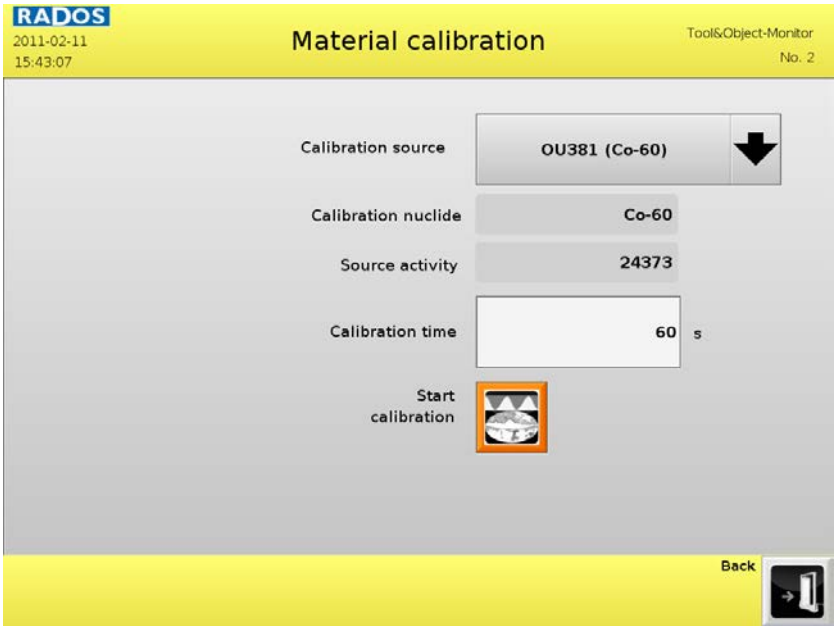


Figure 4-54: Maintenance mode - Material calibration parameter setting

The source data and the calibration measurement time are displayed.

If nuclide vectors are available a calibration for each relevant nuclide in the vector is recommended. Nuclides that have not been calibrated are considered to contribute a zero count rate (zero efficiency) and will be add by their portion in the vector to the activity result. This is a conservative approximation.

To select another calibration source touch on the calibration source button.

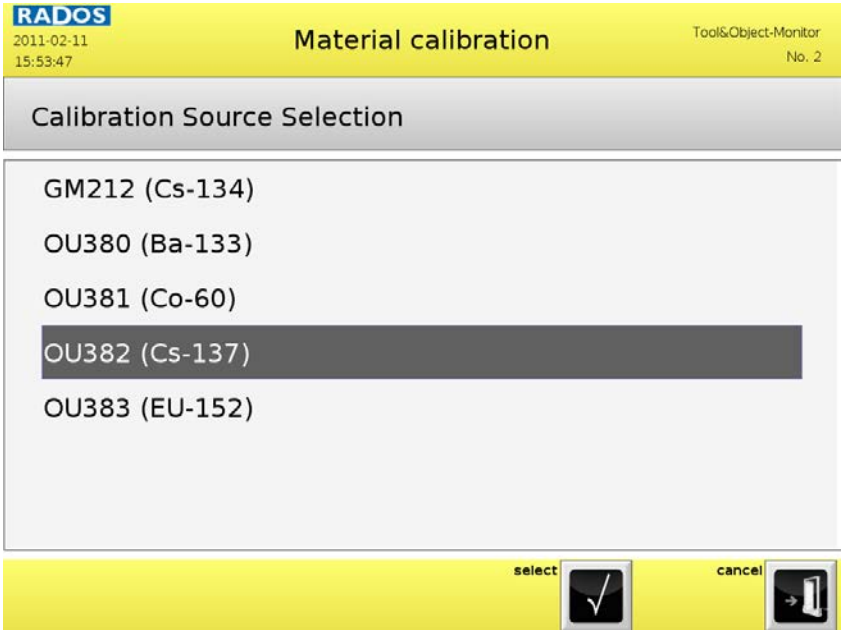


Figure 4-55: Maintenance mode - Material calibration source selection

Select the respectively source from the list and touch on “select”. The system returns to the material calibration – parameter menu.

NOTE

If the required source does not exist in the list, it must be set up in the menu "*calibration source*".

After setting the calibration measurement time, the calibration measurement will be carried out.

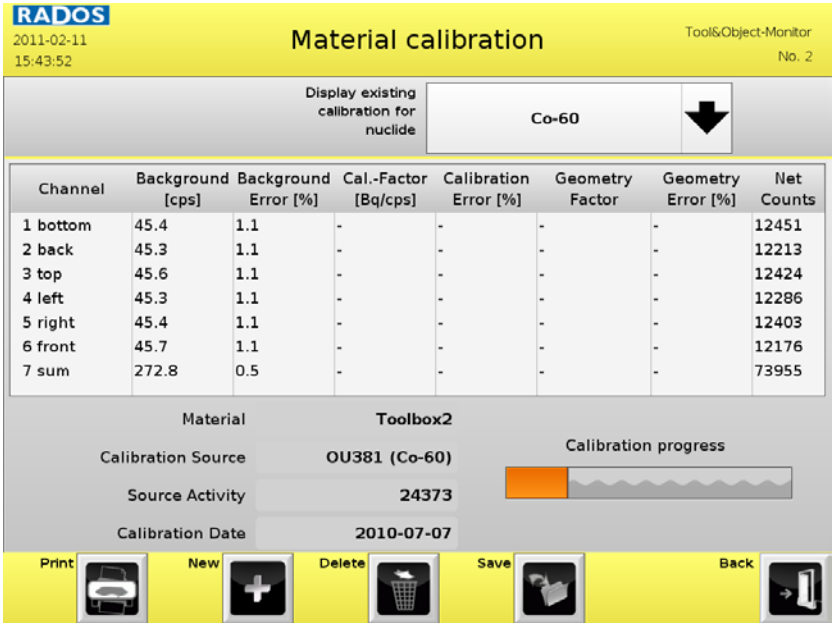


Figure 4-56: Maintenance mode – Parameter and calibration/material calibration process

If no valid background is available for the calibration, the calibration cannot be carried out. A message "*measure background first*" is displayed.

After the calibration measurement has finished the calibration factors and the error indication will be displayed.

NOTE

The calibration can be done with a source inside a calibration dummy or a clean object

Without the option “basic calibration” the material calibration will lead directly to calibration factors.

Having the option “basic calibration” the material calibration will lead to geometrically factors [ ] to the basic calibration factors [Bq/IPS].

NOTE

Do not forget to save the new material calibration!

Do not forget to backup the parameter !

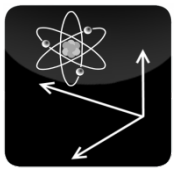


Figure 4-57: Icon nuclide vectors

4.5.7 Nuclide vectors (option)

In this menu **nuclide vectors** can be entered. The *nuclide vector* defines the specific compound of the components of a measurement type. Depending on the location the material comes from, a nuclide vector may be assumed. The individual parts refer to the total inventory.

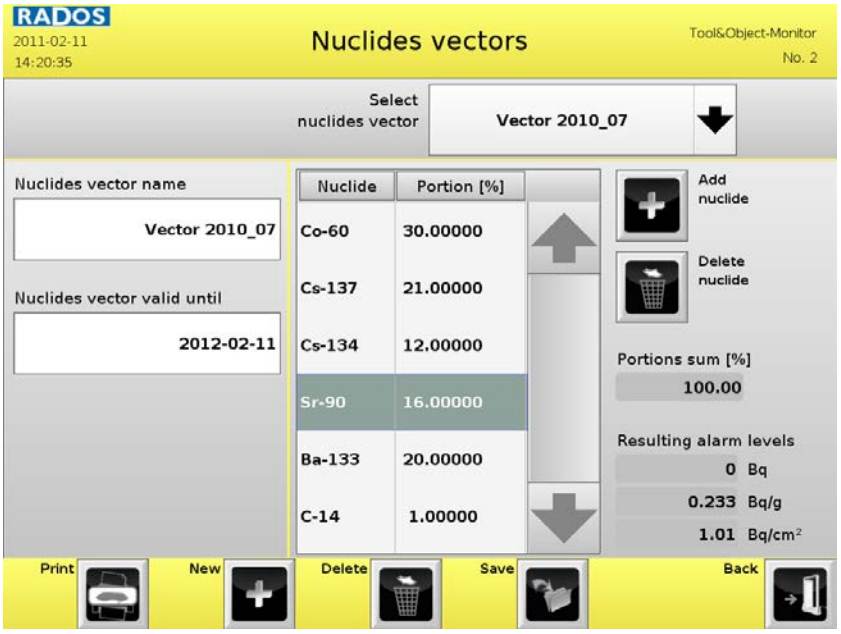


Figure 4-58: Maintenance mode - Parameter and calibration/ nuclide vectors

In the upper selection button **nuclide vectors** the name of the selected vector is displayed.

NOTE

All nuclides are set in accordance to their portion of the total nuclide composition and must be added up to 100%.

Menu controls in the material menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion measurement mode from storage.	
New Add new nuclide vector with unique *nuclide vector name* to list	

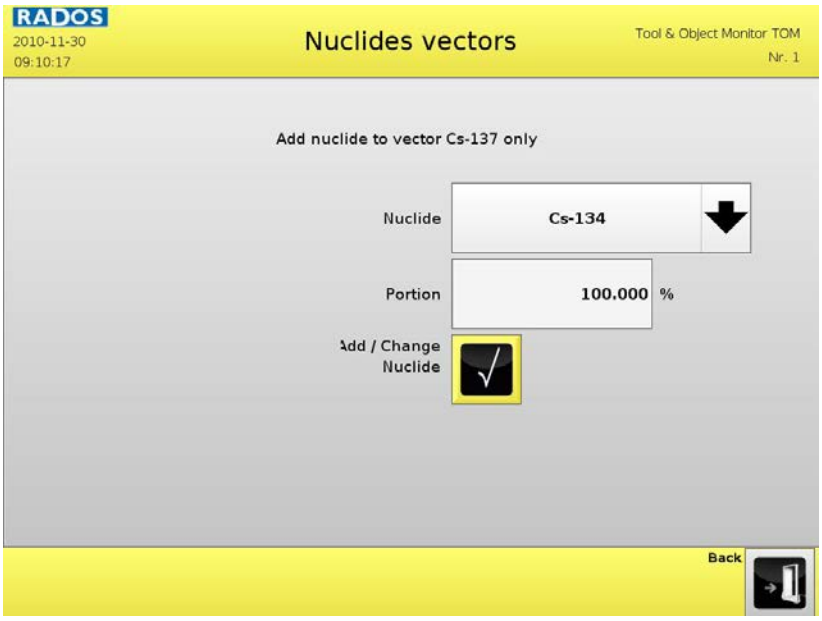


Figure 4-59: Maintenance mode - Parameter and calibration/ nuclide vectors - add nuclide and portion

Here you can set the portion for the selected nuclide of the respective vector. With “Add / Change Nuclide” you will return to the vector data. For selecting a new nuclide touch on the nuclide select field. The selection menu opens to select out of the nuclide data base:

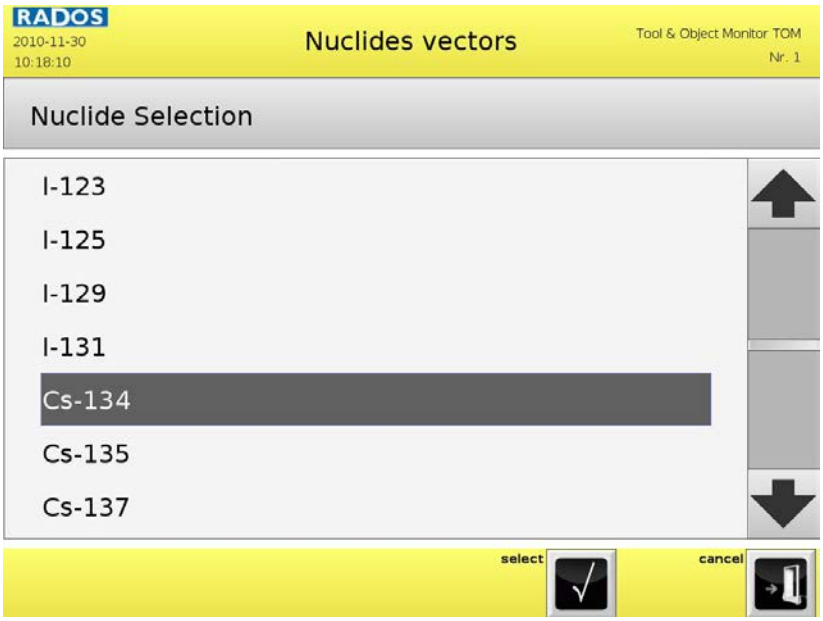


Figure 4-60: Maintenance mode - Parameter and calibration/ nuclide database selection

The selection out of the nuclide data base ensures that **Tool&Object-Monitor** will safely find the respective nuclides for calculating the clearance levels according to the sum formula.

After selecting the respective nuclide touch the “select” button. The system returns to the nuclide date to input the portion.

Figure 4-61: Icon basic calibration

4.5.8 Basic calibration (OPTION)

The optional basic calibration is used to achieve material independent calibration factors. These factors are used as basis for the material calibrations. The material calibrations will have a factor to the basic calibration for each measuring channel in this case.

The advantage, having a basic calibration, is that changing in the characteristic of one more detector(s) can be very fast re-calibrated by the basic calibration. The material calibrations must not be repeated then.

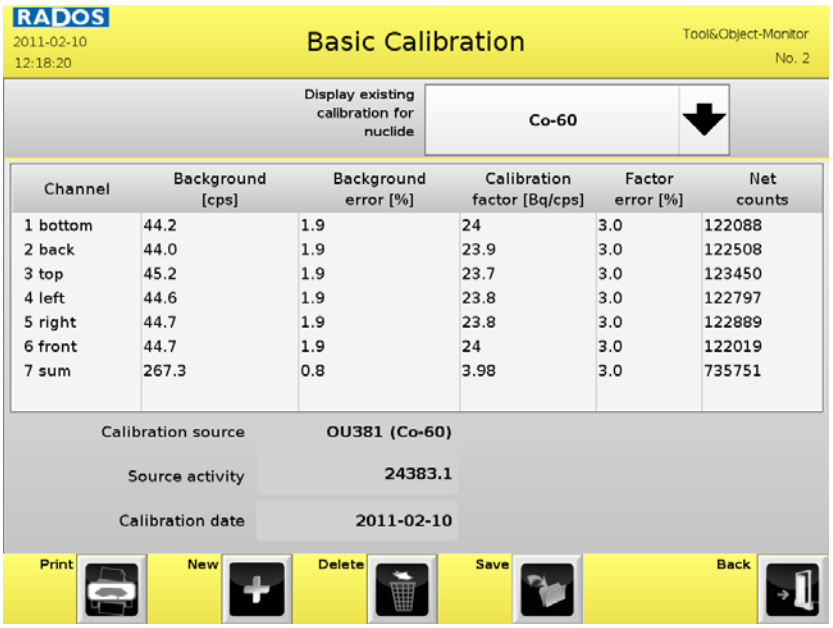


Figure 4-62: Maintenance mode - Parameter and calibration/ Basic Calibration

The calibration measurement is done with a calibration source at a defined position in the measurement chamber. It is recommended to use a source jig to centre the source in the chamber.

NOTE

The material calibrations factor will be calculated and enhanced with basic calibration data, in case this option is available.

Menu controls in the material menu:

back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	
delete This enables deletion of a basic calibration from storage.	
New Add new basic calibration with unique *name* to list	

The present used calibration source is displayed for information. The calibration is automatically associated to the nuclide of the selected source.

There can be several basic calibrations with different nuclides.

To display another basic calibration touch the nuclide button:

The “Calibration Nuclide Selection” opens:

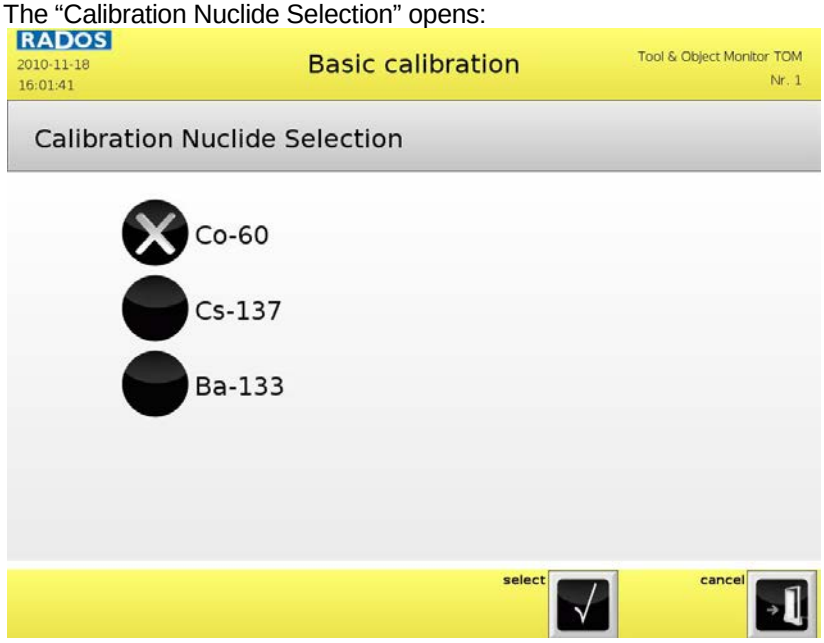


Figure 4-63: Maintenance mode - Parameter and calibration/ basic calibration - nuclide selection

After selecting the respectively calibration source and touching the “select” button the basic calibration will be displayed for the selected nuclide.

To carry out a new basic calibration touch on **“New / Start Calibration”**.

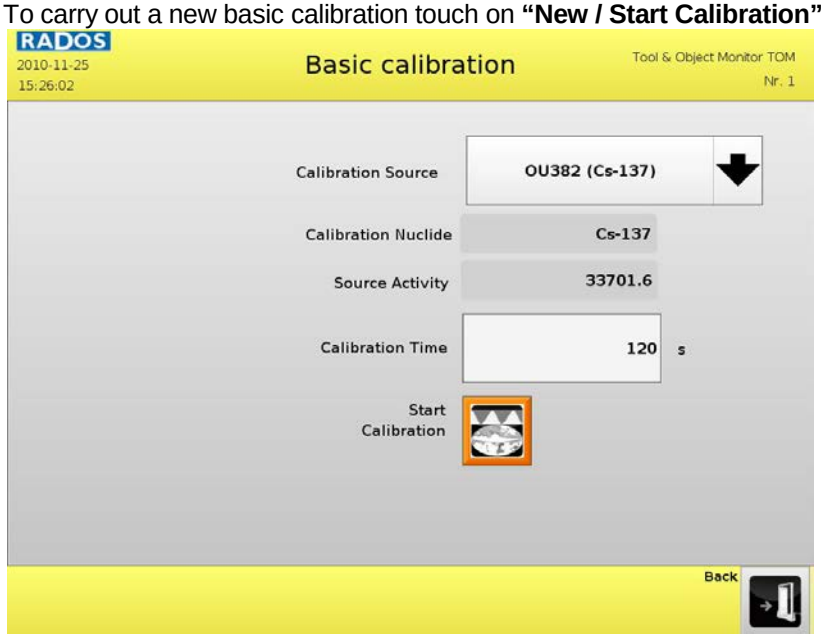


Figure 4-64: Maintenance mode - Parameter and calibration/Basic Calibration parameter

The source data and the calibration measurement time are displayed.
To select another calibration source touch on the calibration source button.
The Calibration Source Selection opens:

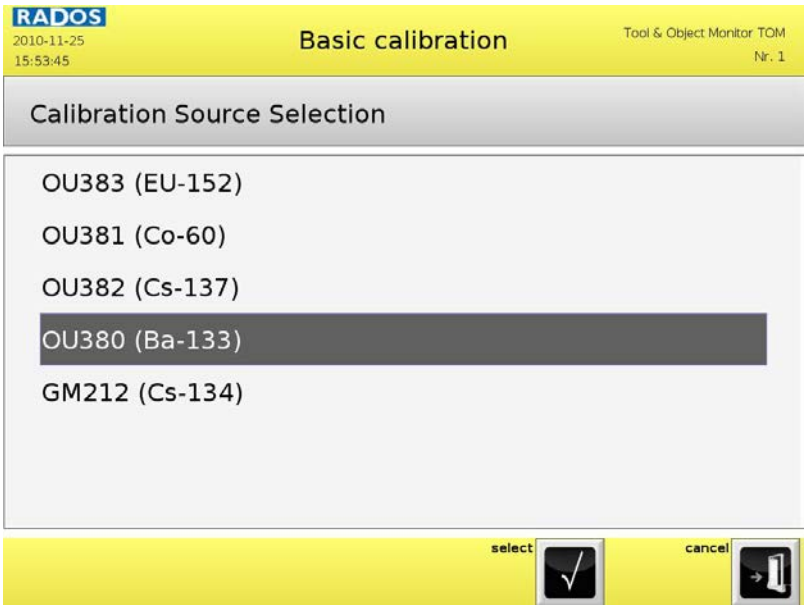


Figure 4-65: Maintenance mode - Parameter and calibration/basic calibration – source selection

Select the respectively source from the list and touch on “select”. The system returns to the basic calibration – parameter menu.

	NOTE
	If the required source does not exist in the list, it must be set up in the menu "*calibration source*".

Now the basic calibration can be carried out.

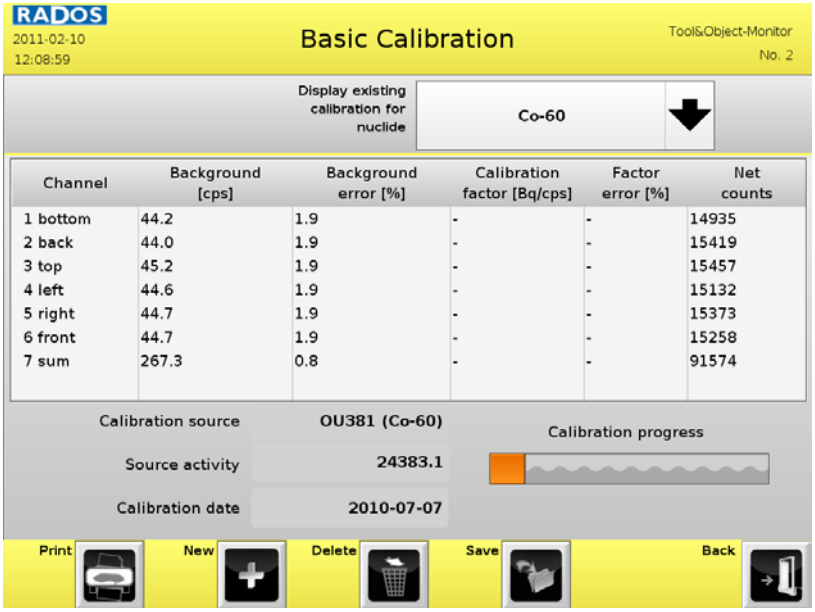


Figure 4-66: Maintenance mode - Parameter and calibration/basic calibration – calibration process

After the calibration measurement has finished the calibration factors and the error indication will be displayed.

NOTE

Do not forget to save the new material calibration!

4.5.9 Voltage

PM Box voltage can be individually configured.

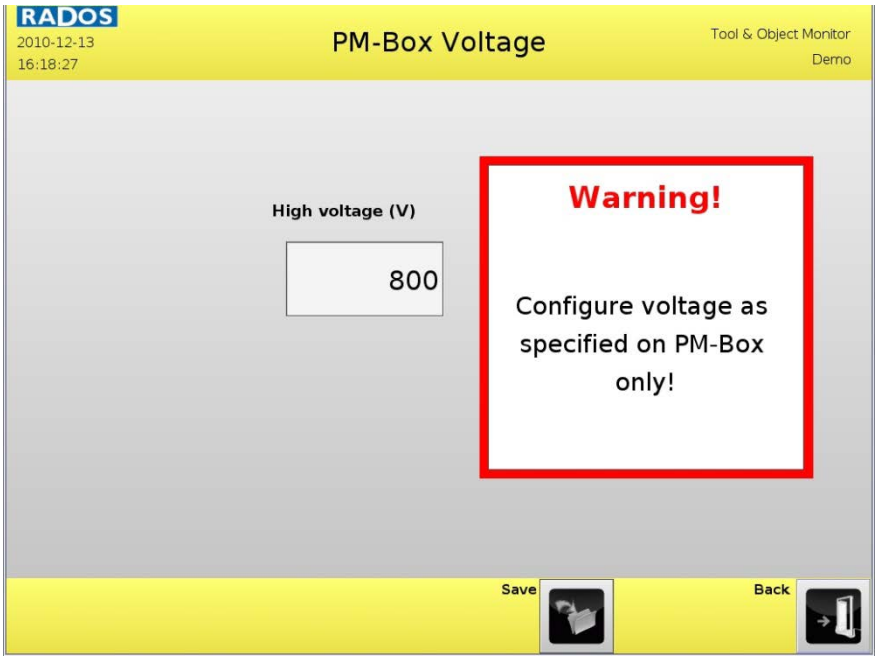


Figure 4-67: Maintenance mode - Parameter and calibration/basic calibration

CAUTION

It is only advised to use the optimized factory setting voltage, see PM box sticker, to operate the PM-Box.

Menu controls in the material menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	

4.6 Miscellaneous - menu area

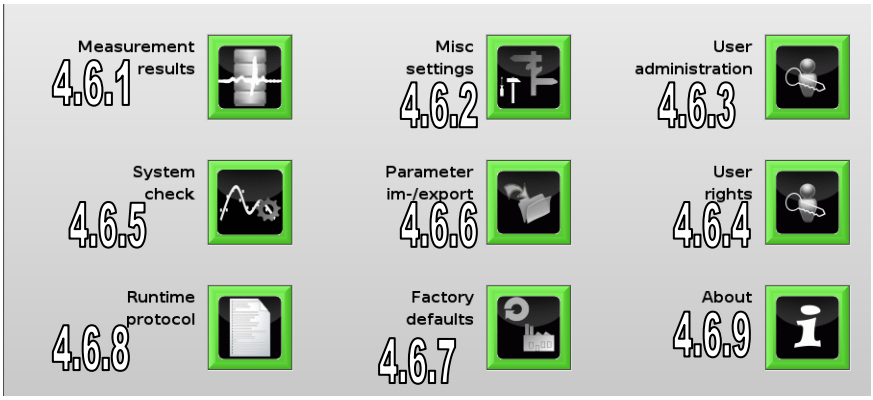


Figure 4-68: Maintenance mode - Miscellaneous

4.6.1 Measurement results

Figure 4-69: Icon measurement results

The function **measurement results** are used to later view measurement results. All result protocols are listed and can be displayed.

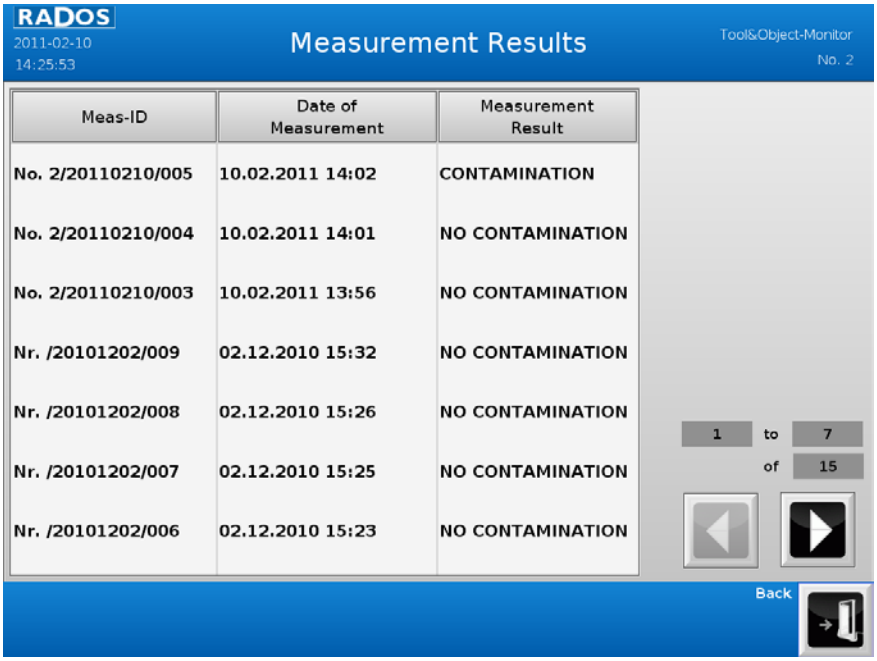


Figure 4-70: Measurement results protocols

Using the arrow button you can switch the results page by page.

CAUTION

It is not possible to modify any of these measurement protocols afterwards, as they already have the status of a document.

Menu controls in the measurement results menu:	
back Close the menu and return to maintenance menu	
Select Move selection list forward /backwards	

4.6.1.1 Measurement_results display

The details buttons displays the selected measurement result.

Figure 4-71: Measurement result – no contamination example

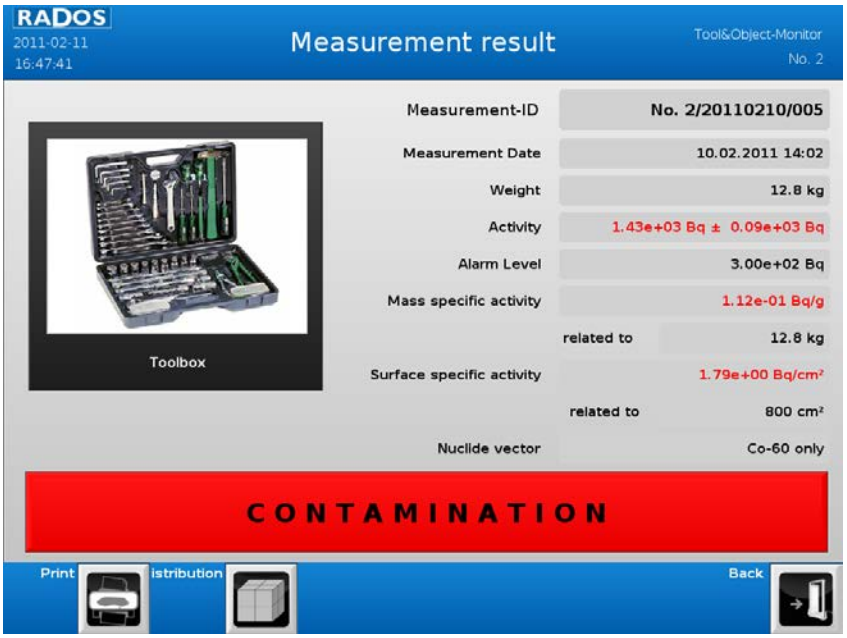


Figure 4-72: Measurement result – contamination example

4.6.1.2 Measurement results - distribution display

With the button “Distribution” you can switch to the activity distribution displayed instead of the material picture.

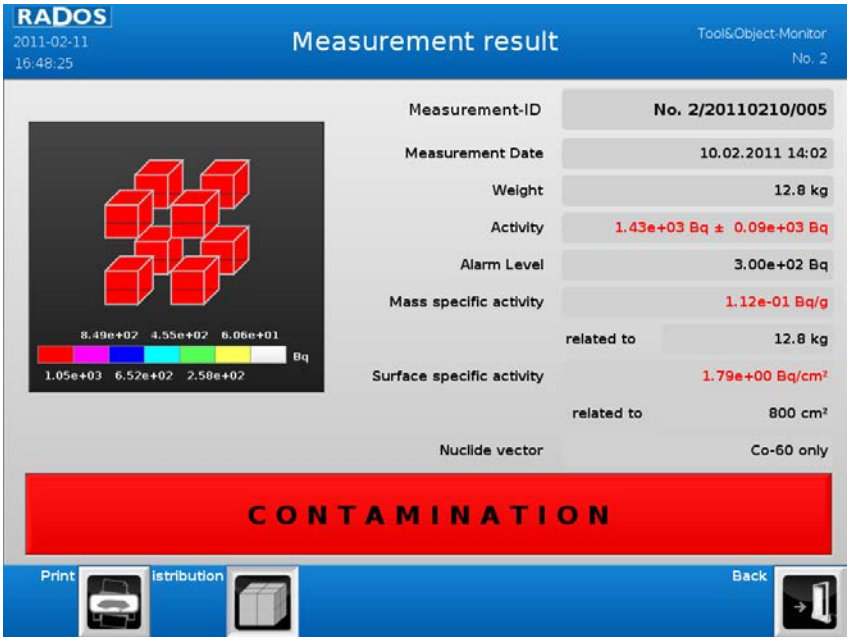


Figure 4-73: Measurement result – Distribution display

NOTE

The distribution display is available in the 6 detector-version only!

Figure 4-74: Icon misc settings

4.6.2 Misc.-settings

This point of the maintenance program displays settings to be performed by the user.

4.6.2.1 Monitor ID

Figure 4-75: Miscellaneous – Misc. settings/Monitor-ID & Location

Monitor ID

In this field an unequivocal name for the monitor can be entered (i.e. serial no.).
The entry is user defined and is used for the identification of the monitor. The monitor ID is shown on the display and on the printout of the records. It is also used for the preparation of the logbook.

Monitor location:

In this field an unequivocal location name for the monitor can be entered for local monitor differentiation.

This monitor ID information is used for the measurement protocols and for data connection to the CeMoSys™ (**Ce**ntral **Mo**nitoring **Sys**tem) server.

Menu controls in the general settings menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	

4.6.2.2 Screensaver

Figure 4-76: Miscellaneous – Misc. settings/screensaver

Screensaver

If the use of the screensaver is selected via radio button by the user the start and the refresh interval of the screensaver display can be defined here.

4.6.2.3 Language

Figure 4-77: Miscellaneous - general settings/language I

The numbers of languages to be selected and shown in the main menu are set in this menu.

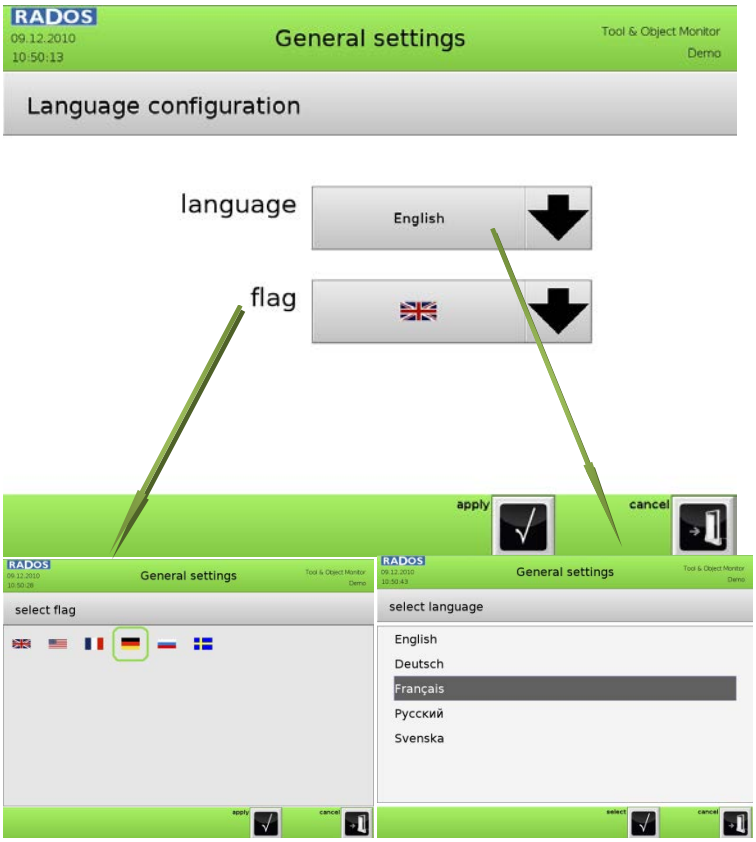


Figure 4-78: Miscellaneous - general settings/language configuration

4.6.3 User administration

In the **user administration** group authorizations for each user in different subprograms and module can be defined. With the aid of **user administration** global authorizations can be set in all User software modules.

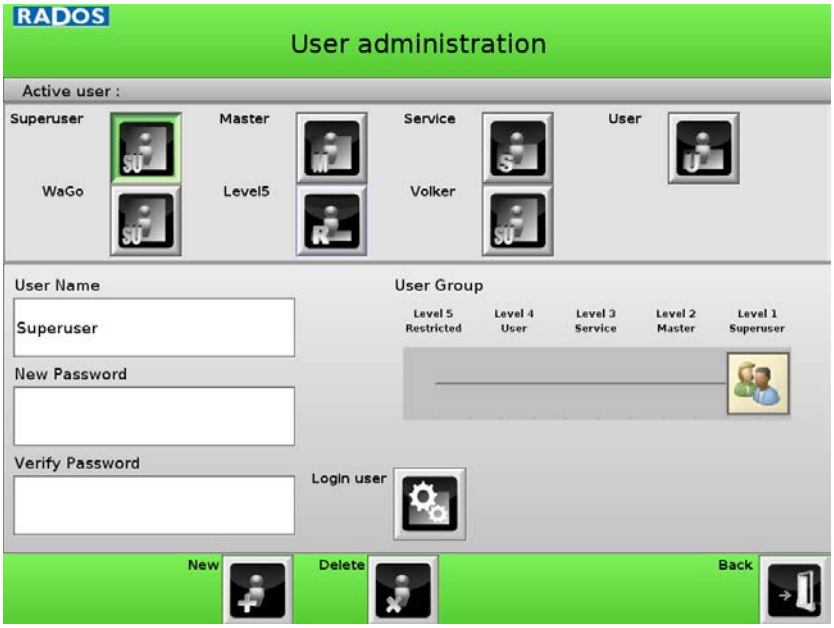


Figure 4-79: Miscellaneous - user administration

The user administration is only visible and accessible for the group authorization **Superuser**.

To simplify the first set-up user accounts for all groups are preinstalled.

NOTE

The preinstalled “Superuser” account values can be found in chapter 1 of this documentation.
This chapter is being advised to be removed from the manual, after first setup.

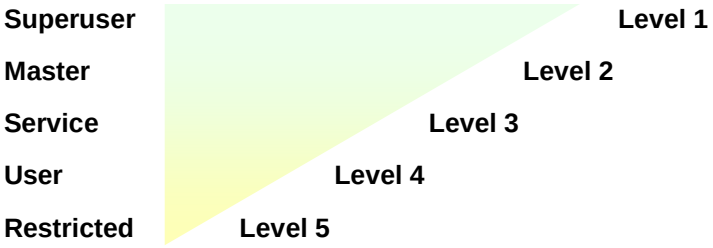
NOTE

While entering a user name and password attention has to be paid to upper and lower case.

The items in the white fields (in the running program) can be modified. However the items in the grey fields are fixed and for informational purposes only.

4.6.3.1 User groups

Every user belongs to one of six user groups with specific authorizations (in decreasing authority order):



The authorizations of a higher user group include the ones from ones below.

The Superuser is needed to edit data in the **user administration**. The user group “Restricted” is only used as a login-user in order to prevent that every user can exit the measurement mode.

If a program module is quit, the authorizations in the module will be reset.

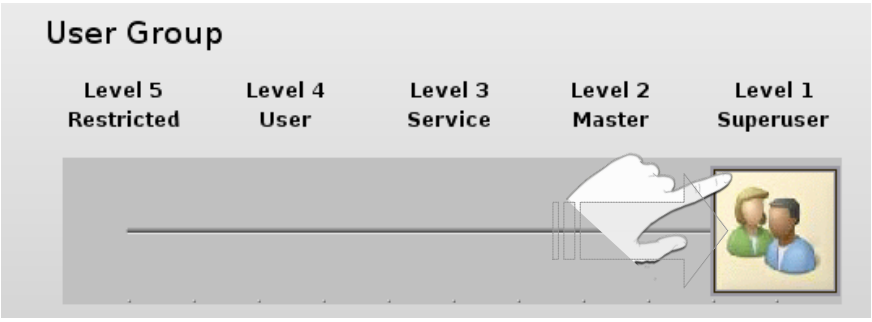


Figure 4-80: Miscellaneous - User administration - user authorization selection

4.6.3.2 Change a user profile

To change a user profile chooses an active user by clicking on the corresponding button. The user name or password can be changed directly in the corresponding white boxes.

Activate the button ***save*** 3 to store changes.

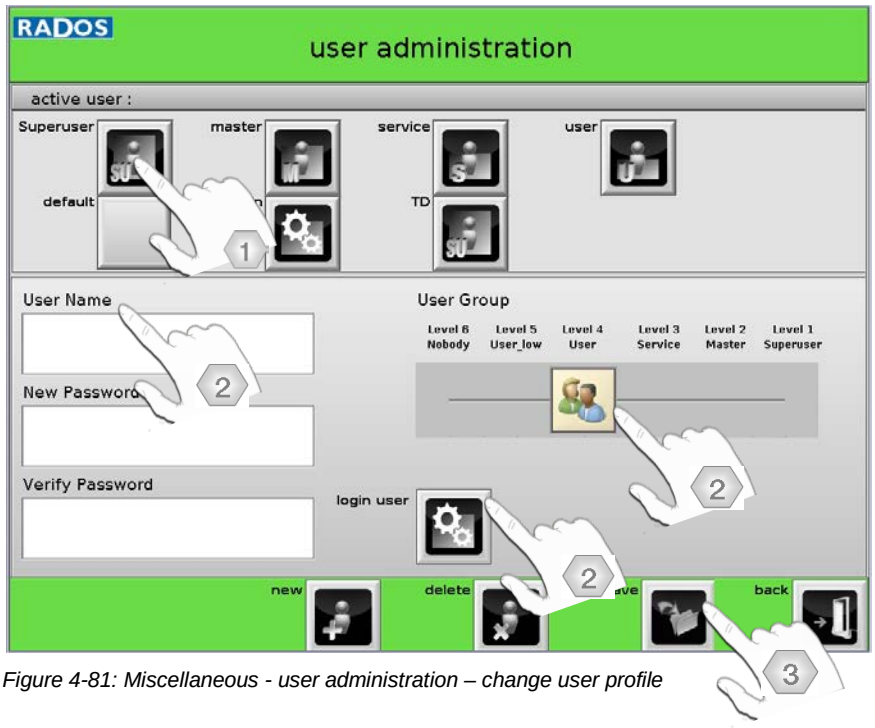


Figure 4-81: Miscellaneous - user administration – change user profile

4.6.3.3 Installation of a new user profile

Figure 4-82: NEW user

To install a new **user profile** ① you need to click on *new* at the menu panel. First of all the keypad is opened to enter the user name. Afterwards the white fields are used to define a password and the user group.

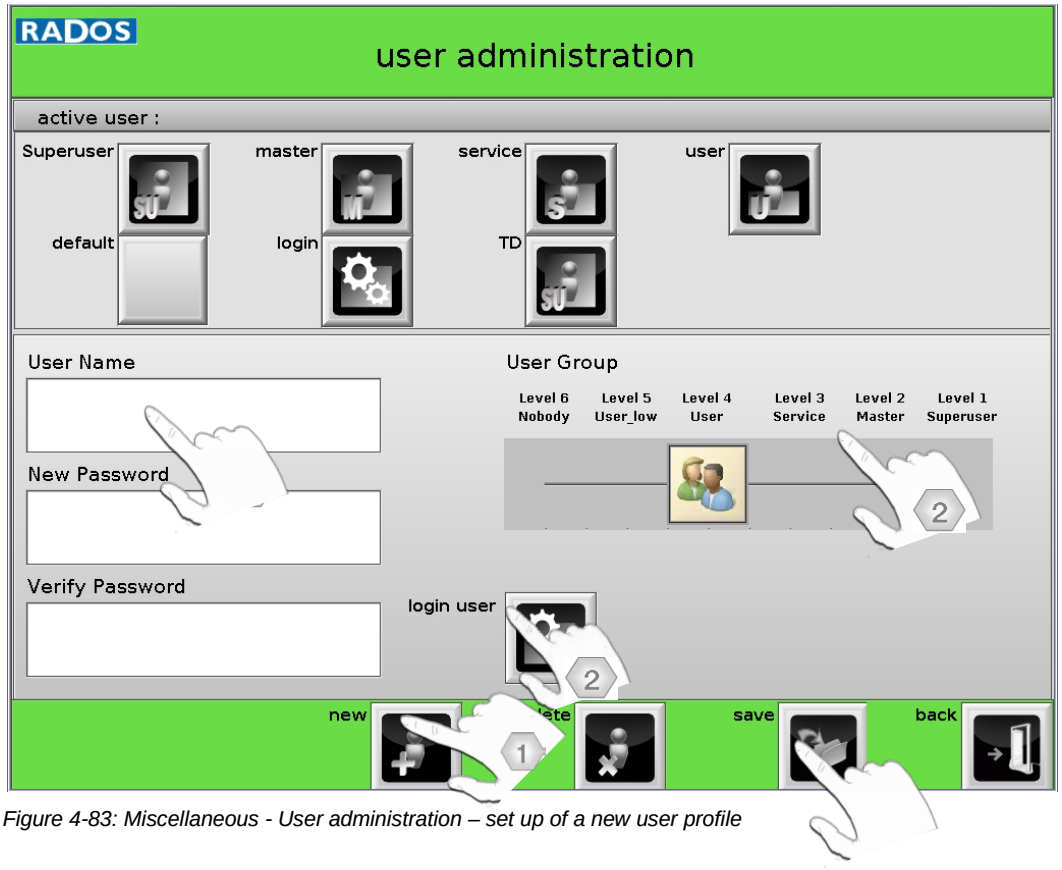


Figure 4-83: Miscellaneous - User administration – set up of a new user profile

If no password is chosen for the **user profile** no password will be requested for the login.

The new **user profile** needs to be confirmed/saved with a touch on *save* at the menu panel. Afterwards the new **user profile** is displayed in the list with the other users. The button for the new users fits the authorization chosen for this user.

Figure 4-84: Delete user

4.6.3.4 Delete a user

To delete a user the user to be deleted must be selected in the active user area (1). Initiating the delete user button (2), starts the deletion.

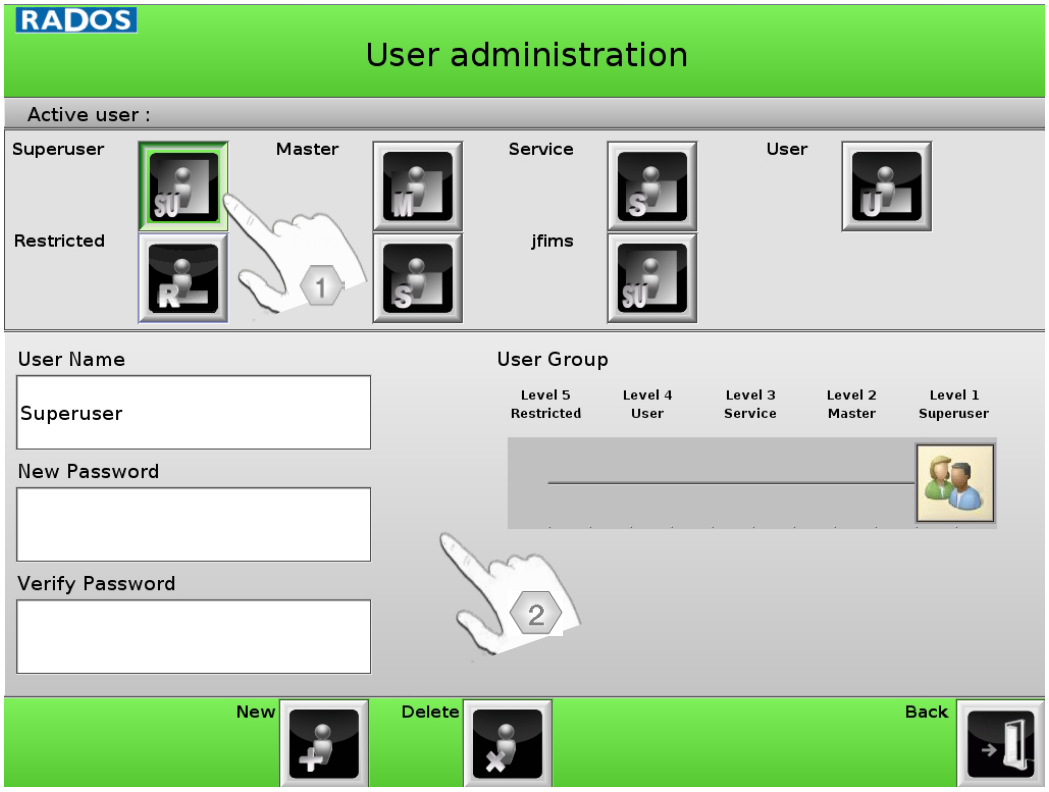


Figure 4-85: Miscellaneous - user administration – delete user profile

A second window will appear with the inquiry *"Do you really want to delete the record"*. The user is requested to confirm this step to avoid the accidental erasure of datasets.

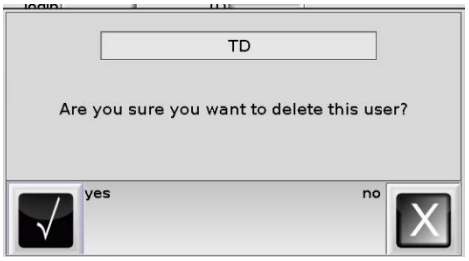


Figure 4-86: Miscellaneous - delete a user profile

4.6.4 User rights

The **User rights**, defined in the special user groups, will also organize the authorizations in the user software. With the aid of the **User rights** authorization needed to operate functions in the user software can be defined (higher authorization will cause a new password query).

Touch for the described system functions on the respectively button:

SU Superuser	**Level 1**
M Master	**Level 2**
S Service	**Level 3**
U User	**Level 4**
R Restricted	**Level 5**

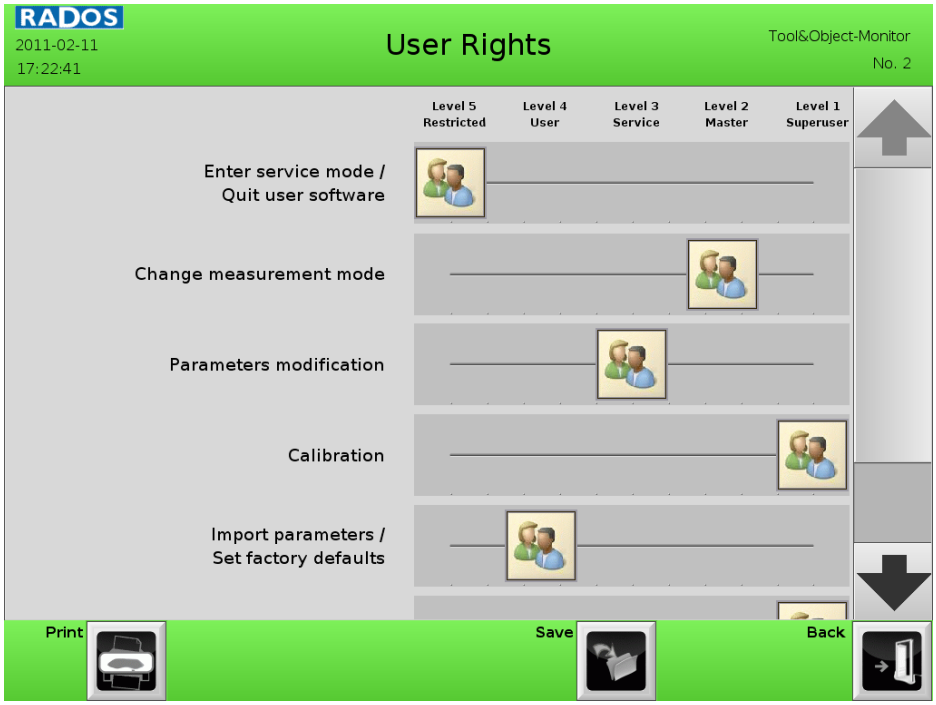


Figure 4-87: Miscellaneous - user rights

Menu controls in the general settings menu:	
back Close the menu and return to maintenance menu	
save The changed parameters have to be saved before leaving the menu.	

Figure 4-88: System check icon

4.6.5 System check

The **system check** software is used for detector testing (determination of the efficiency) and includes features as:

- Define working processes
- Carry out a working process
- System check measurement database
- Printing of results

NOTE

It is assumed from now on that the login for the system check was done under the "Master" authorization (refer to chapter 4.6.4 user administration).

4.6.5.1 System check general

It is necessary to install the nuclide to be used in the nuclide database before starting a **system check**.

The nuclide administration comprises the record, change and administration of test sources. Based on these data the efficiency of a measurement channel can be determined. If compared to a reference measurement a tendency of the physical development of a measurement channel with respect to its efficiency can be realized.

The nuclide administration comprises the record, change and administration of test sources.

For detailed Information on **nuclide administration** refer to chapter 4.5.4 nuclide database as these data is centrally used in the user software.

Based on the nuclide data the efficiency of a measurement channel can be determined. If compared to a reference measurement a tendency of the physical development of a measurement channel with respect to its efficiency can be realized.

First of all a working process needs to be defined.
Such a working process either contents a new or an update determination measurement.

An efficiency determination measurement is done with these steps:
(Some of the steps are only to be proceeded in the first use of the software).

1. Set-up of a working process for database use in the main menu can be selected
2. Perform a reference test for the working process (for over time deviation consideration)
3. Efficiency measurement with the aid of the source holder; successively measuring is possible for different types of radiation

4.6.5.2 System Check - General mathematical calculations

Different calculations are to be effected depending on the selected measurement and nuclide parameters. The applied mathematical formulas are listed and explained below.. the applied mathematical formulas are listed and explained.

4.6.5.2.1 Current activity

Based on the radioactive decay the activity of a source diminishes during increasing life.

$$A = A_0 \, e^{-\frac{\ln 2 \, \Delta t}{T\frac{1}{2}}}$$

Formula 4-2: current activity

A = current activity [Bq]

A_0 = initial activity [Bq]

$T\frac{1}{2}$ = half-life [days]

Δt = time elapsed [days]

4.6.5.2.2 Efficiency

The ratio of measured counts per gate time [cpg] and the radioactivity of the measurement source are called efficiency and are used as measure for the quality of the measurement channel.

$$\eta = \frac{N - N_0}{A}$$

Formula 4-3: efficiency

η = efficiency
N = mean gross count rate [cps] or [cpg]
N_0 = mean background count rate [cps] or [cpg]
A = current activity [Bq]

The efficiency is frequently stated as a percentage rate. In this case a multiplication with 100 has to be carried out to receive a percentage value.

4.6.5.2.3 Default deviation

The formula below is used to determine the determination of the mean deviation.

Formula 4-4: default deviation

$$\sigma_n = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2}$$

σ_n	=	default deviation
n	=	number of measurements
x_i	=	i^{th} measurement value
$\overline{x}$	=	mean value of all measurements

Considering only distribution processes this default deviation refers to the law of statistics. For nuclear decay the Poisson distribution has to be applied.

4.6.5.2.4 Error propagation net count rate

The mean net count rate is derived from the difference of the mean background count rate and the mean gross count rate. As both measurement values are subject to faults this is also true for the calculated value:

Formula 4-5: net count rate

$$\sigma\left(N - N_0\right) = \sqrt{\sigma_N{}^2 + \sigma_{N_0}{}^2}$$

$\sigma(N-N_0)$	=	error of individual measurements
σ_N	=	default deviation of the mean gross count rate [cps] or [cpg]
σ_{N0}	=	default deviation of mean background count rate [cps] or [cpg]

4.6.5.2.5 Error propagation of efficiency

The error expansion for efficiency is described as:

Formula 4-6: error propagation of efficiency

$$\sigma(\eta) = \sqrt{\frac{1}{A^2}(\sigma_N{}^2) + \frac{(N-N_0)^2}{A^4}\sigma_A{}^2 + \frac{1}{A^2}(\sigma_{N_0}{}^2)}$$

$\sigma(\eta)$	=	mean error of efficiency
A	=	current activity [Bq]
N	=	mean gross count rate [cps] or [cpg]
N_o	=	mean background count rate [cps] or [cpg]
σ_A	=	error of current activity
σ_N	=	default deviation of mean gross count rate [cps] or [cpg]
σ_{No}	=	default deviation of mean background count rate [cps] or [cpg]

4.6.5.3 Accessing the system check

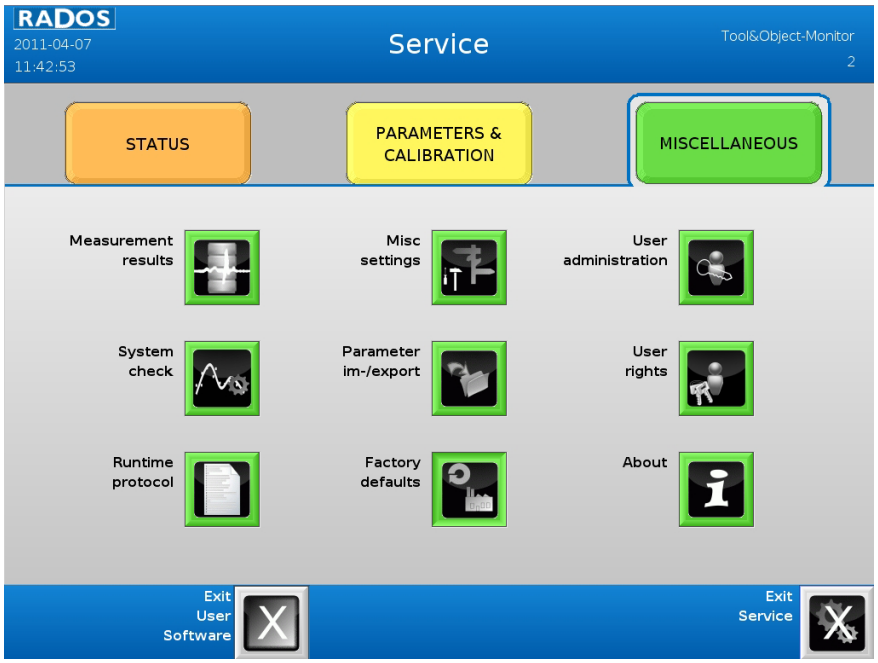


Figure 4-89: Start menu system check

Change login user

The login user and authorization can be changed all the time by touching the *change user* button in the menu control bar.

Figure 4-90: System check change log Log-in user icon

Figure 4-91: Maintenance menu - login

Every user belongs to a user group with specific authorization for the program **system check**

The start menu of the system check is shown automatically.

SYSTEM CHECK Administration

View measurement results and edit or define working processes

DETERMINATION and **REFERENCE MEASUREMENTS**

Perfrom pre-definded system check working process

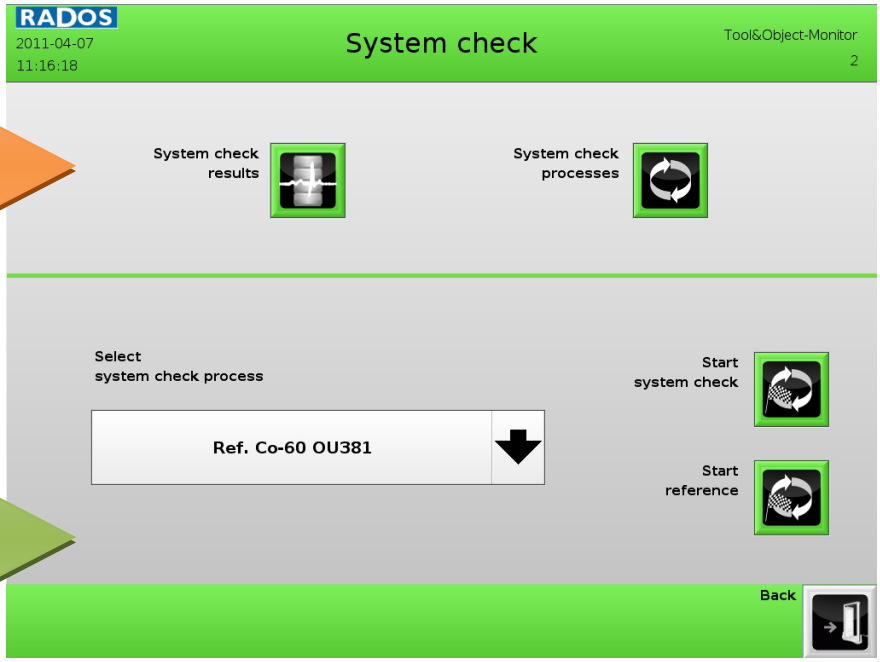


Figure 4-92: Start menu system check – function overview

NOTE

If you don't want to change any parameter or process settings, but directly want to start a predefined system calibration, than actuate the corresponding calibration process button in the Process menu area.

NOTE

The displayed calibration processes are corresponding to logged in user authorization. Please keep in mind to logon as corresponding user to perform the required calibration task.

4.6.5.4 Processes menu area

Figure 4-93: Icon System check processes

The efficiency measurement and the inspection of the binary In- and outputs will be carried out during the working processes. The installation and administration of the work processes will be done at sub menu ***system check processes.***

NOTE

Dependant on login authorization the processes administration is inaccessible and hidden in this menu. Per software default only the user authorisation *superuser* is allowed to administrate working processes.
These authorisation settings can changed in the user rights menu (see chapter 4.6.4).

The calculation of the detector efficiency is nuclide specific and specific to the kind of radiation, respectively. After selecting a working process the measurement will be done for all selected detectors and the efficiency is calculated automatically.

From the overview of all processes the detailed description of one process can be displayed selecting the process. The process can be modified after being opened *or* started.

On the calibration registry card the duration for a measurement and a background determination for the channels are defined.

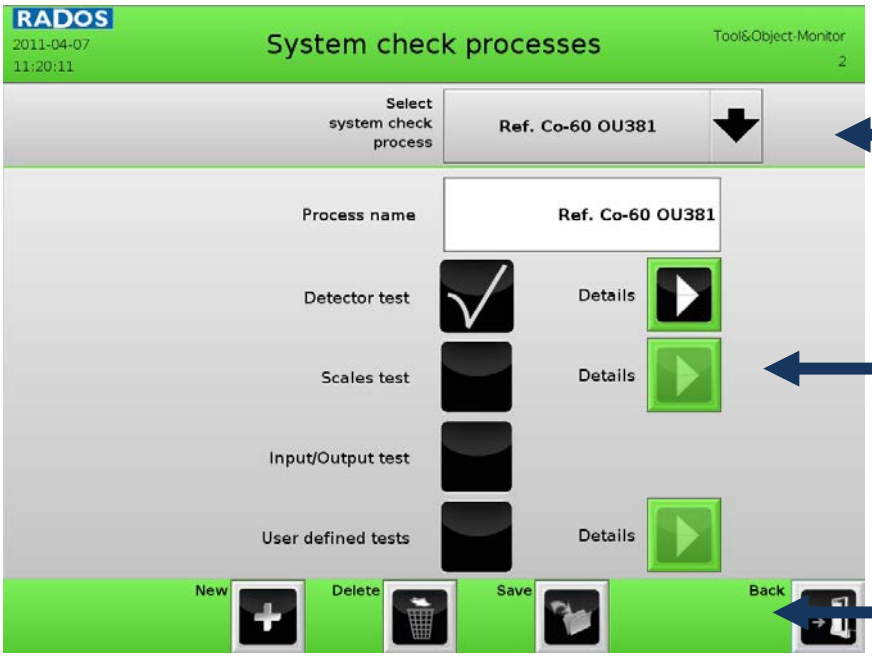


Figure 4-94: System check - process menu area

To view existing processes the process drop down menu is touched. Afterwards a detailed information view is shown.

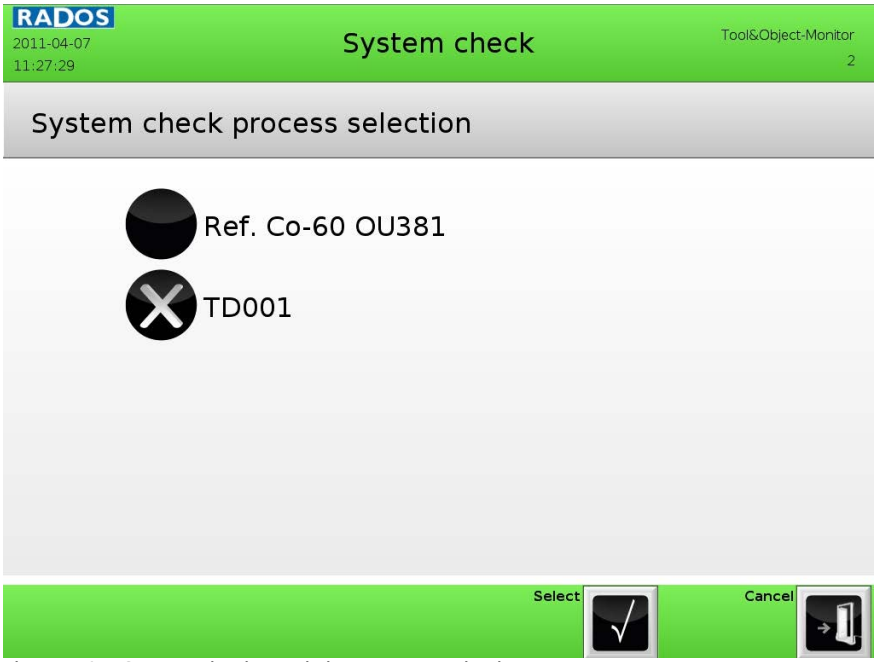


Figure 4-95: System check - Existing process selection

Figure 4-96: Icon edit process

To **add a new process** the button **new** has to be touched.

Afterwards an explicit name and the desired user group to perform the test have to be chosen. It also has to be defined if the calibration shall be used in the user software and if it is a calibration update.

Figure 4-97: Icon delete process

A process is deleted using the button **delete** at the menu panel.
Before deleting an enquiry protects against accidental loss of working processes.

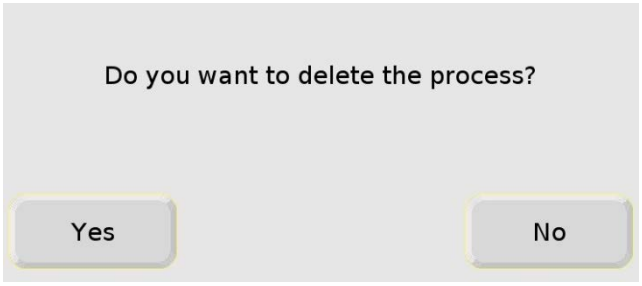


Figure 4-98: System check - Delete a process

Figure 4-99: Icon new process

To edit a system check process the authorised user can alter the settings in the process detail view and save these changes.

Working processes

Figure 4-100: System check - Process details

Each test enabled with a hook will be performed in the system check process.

❶ Detetctor test

By touching the arrow for the detector test details, the calibration source, the measurement time and the allowed deviations can be defined.
Only calibration sources which are defined in the ***calibration source*** menu are shown for selection.

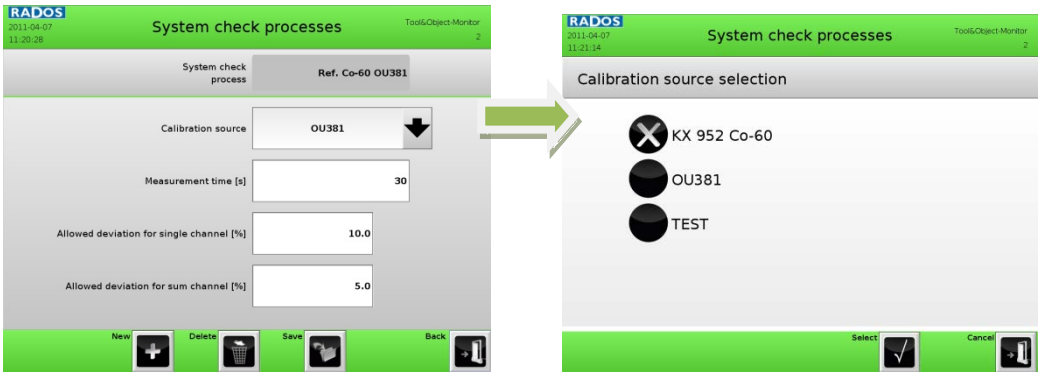


Figure 4-101: System check - Process details/detector test and calibration source selection

❷ Scale test

By touching the arrow for the scale test details, the reference mass, of the scale test dummy and the allowed deviations can be defined.

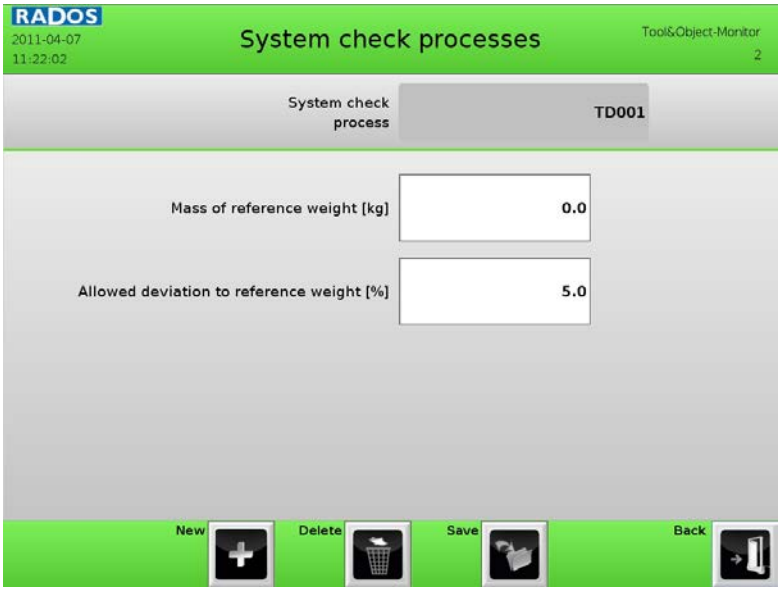


Figure 4-102: System check - Process details/scales test

❸ IO test

The I/O test is not editable, as all possible I/O must be manually checked by the system check process operator.

❹ User defined test

By touching the arrow for the user defined test details additional test like an optical conditions report, can individually be defined.

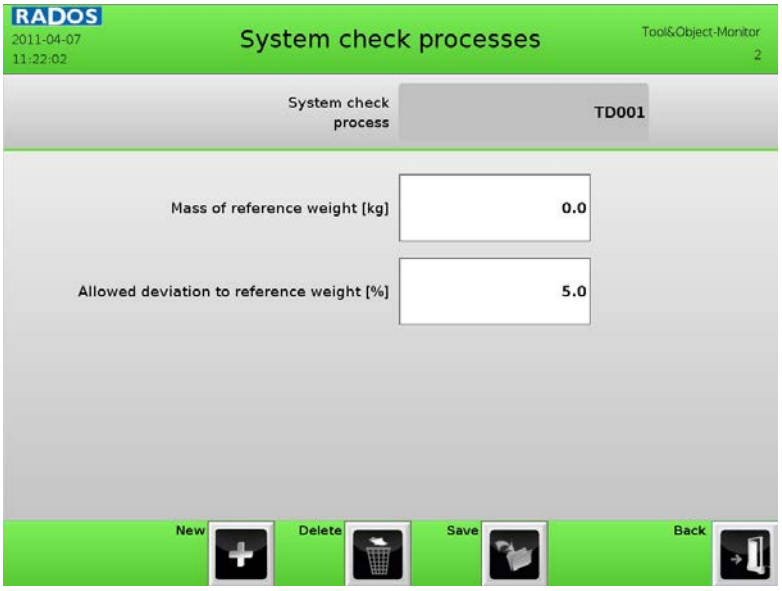


Figure 4-103: System check - Process details/user defined test

The process has to be saved before it can be used.

4.6.5.5 Results menu area

Figure 4-104: Icon System check results

The performed efficiency measurements are stored a database.
The stored data can be displayed or deleted in the ***system check results.***

NOTE

Dependant on login authorization the results administration is inaccessible and hidden in this menu. Per software default only the user authorisation *superuser* is allowed to administrate this database. These authorisation settings can change in the user rights menu (see chapter 4.6.4).

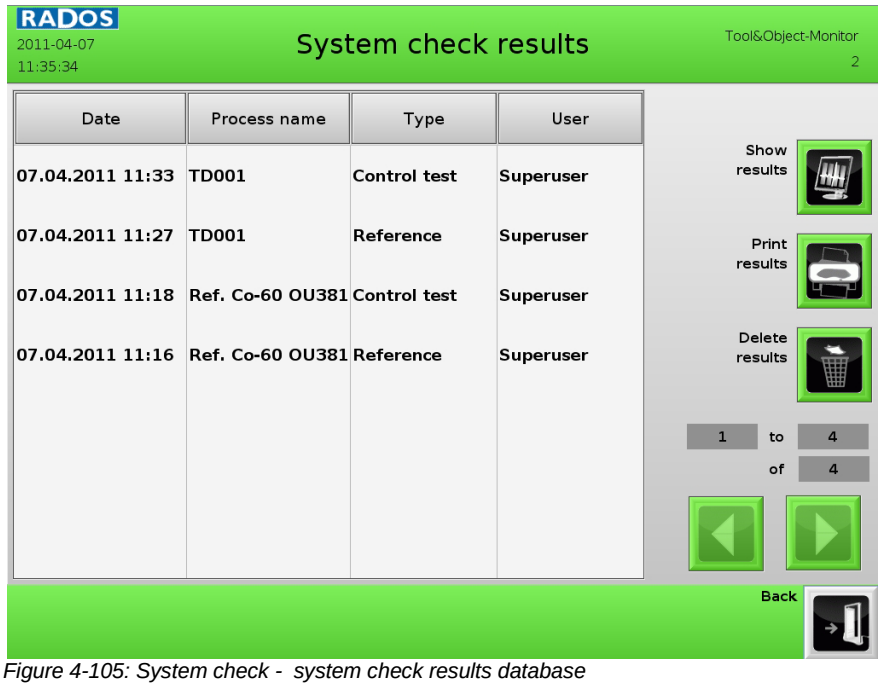


Figure 4-105: System check - system check results database

The previous system check measurement results as well as the detailed test results can be viewed a printed from this menu.

4.6.5.6 Efficiency measurement

Figure 4-106: Icon start process

CAUTION

No source should be close to the monitor (excepting the test source inside the monitor) while the efficiency measurements take place.
Please remove all sources in close proximity of the monitors.

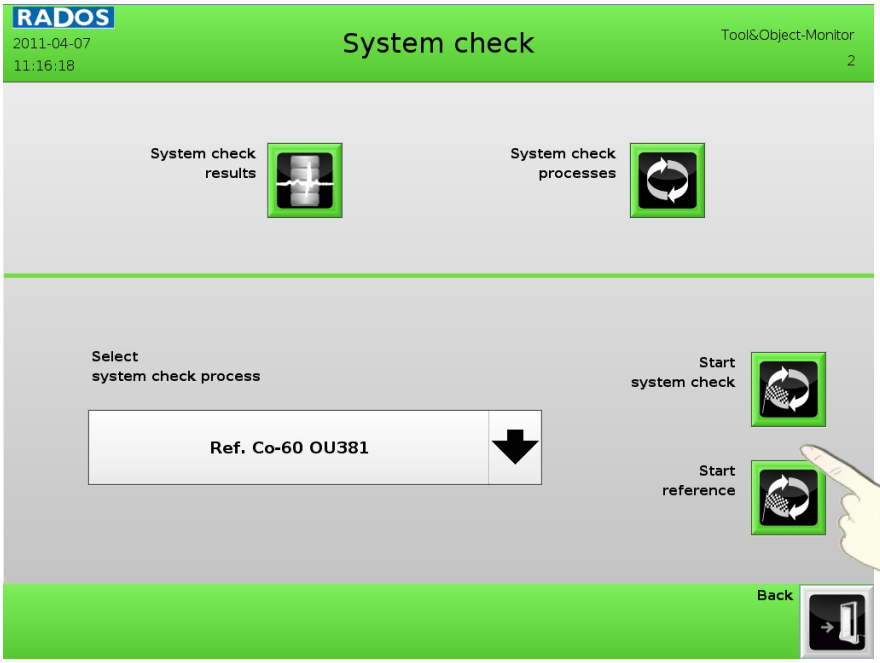
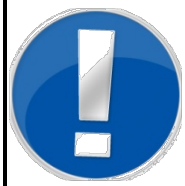


Figure 4-107: System check – Start of a process

1. Select a working process from the list of **process** drop-down menu.
2. Actuate **start** (reference or system check) button with a touch.



NOTE

Only system check processes which have been saved as reference measurement can be used for a system check measurement.

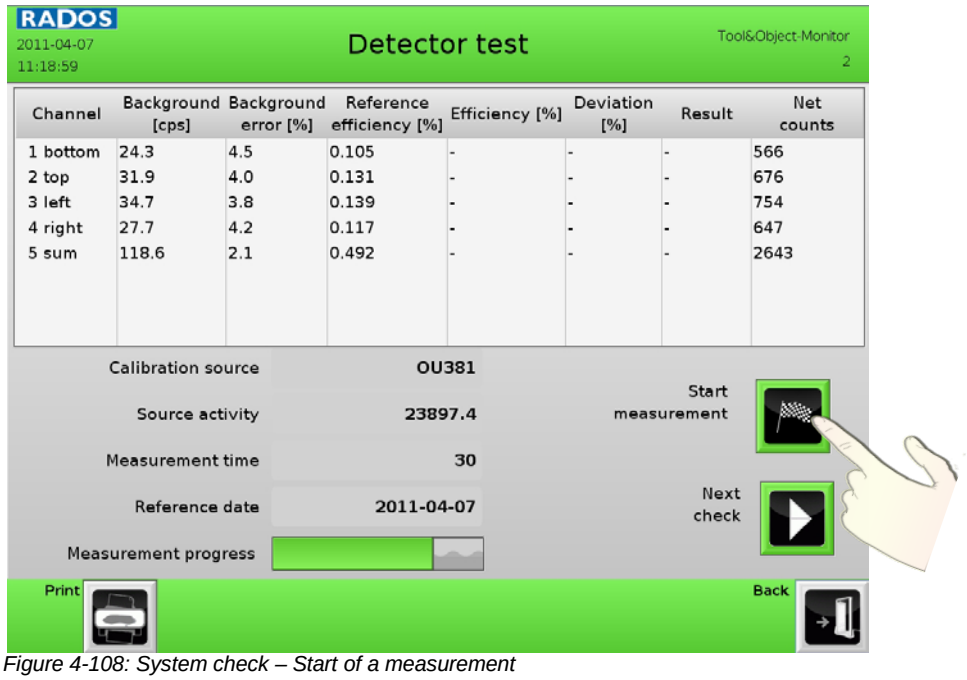


Figure 4-108: System check – Start of a measurement

3. Actuate **start measurement** button with a touch.
4. Proceed with **next check** button.

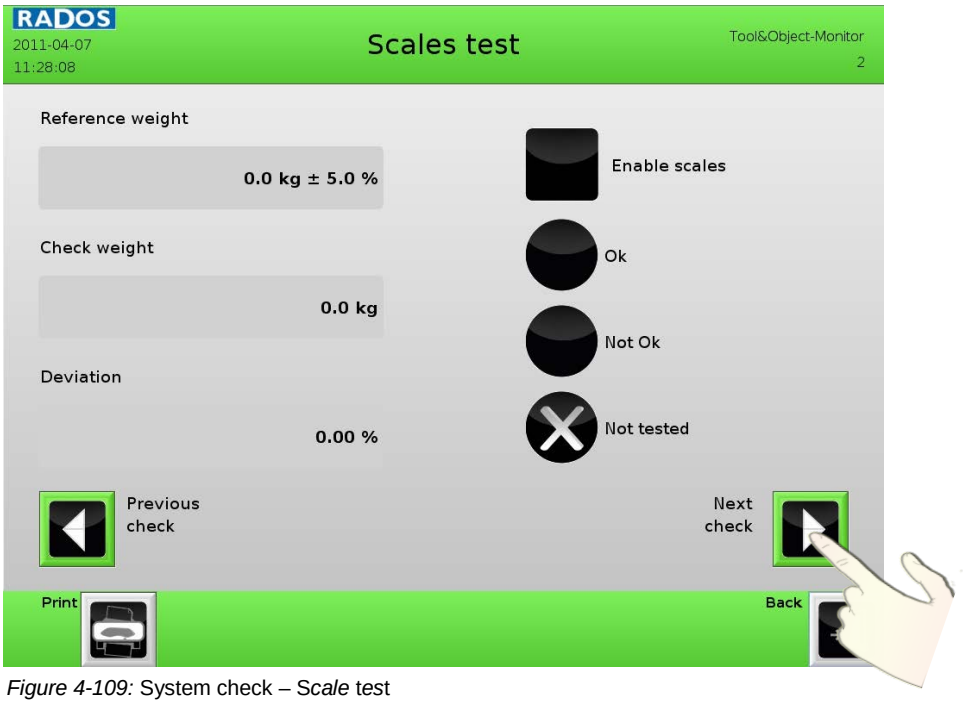


Figure 4-109: System check – *Scale test*

5. Enable scale and perform scales test with a test dummy.
   Note test results in rounded button.

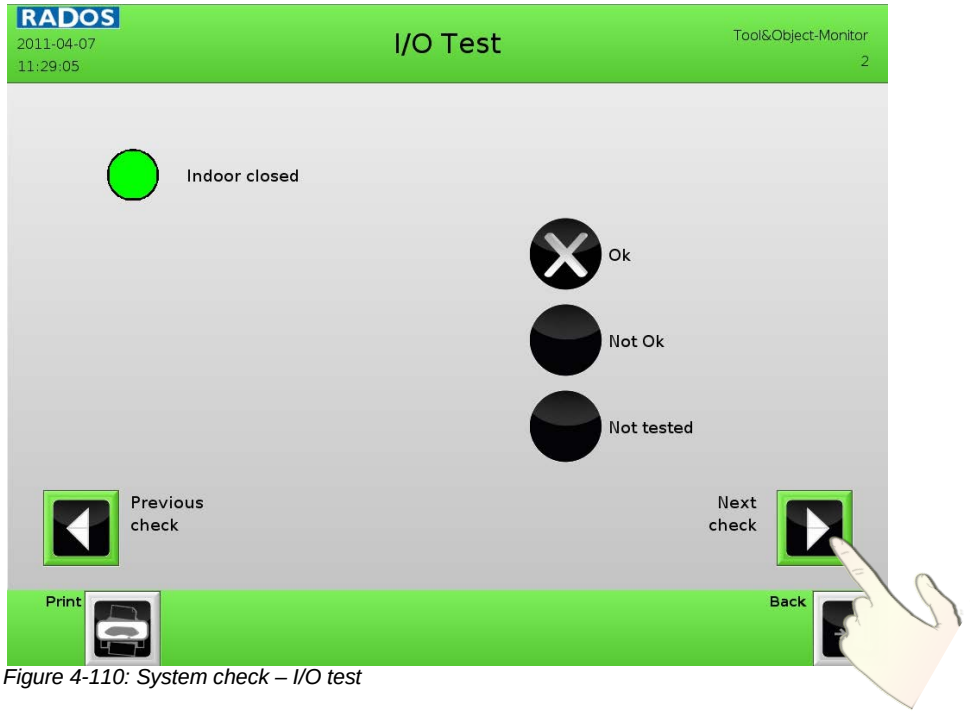


Figure 4-110: System check – I/O test

6. Perform a test for each I/O displayed during I/O-test.
(An active I/O is displayed green/inactive I/O are shown grey)

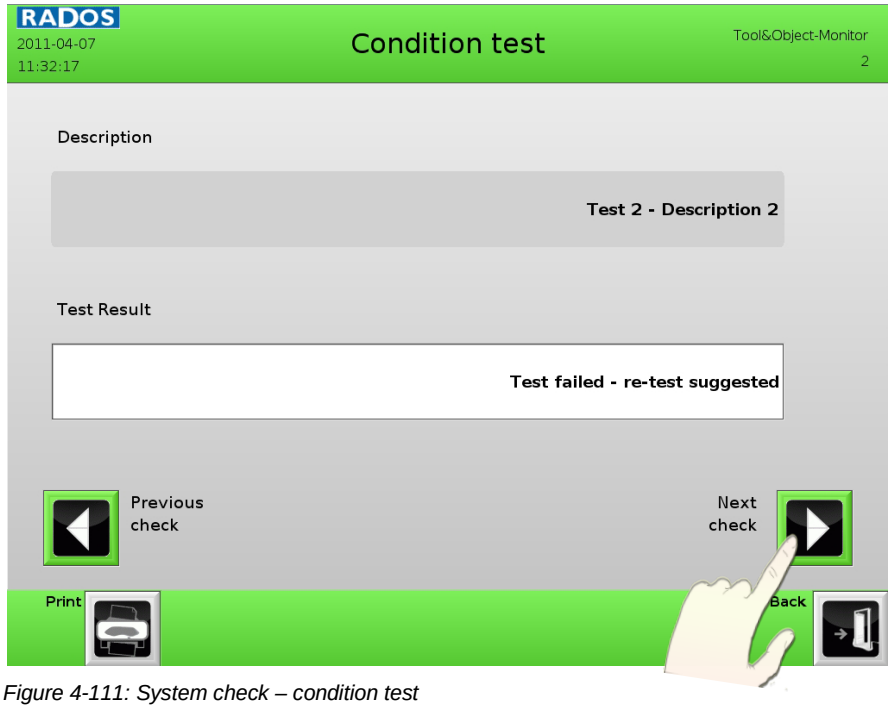


Figure 4-111: System check – condition test

7. Perform user defined test as displayed and described on screen and not test result or condition.

4.6.5.7 Test result display

After all test of the system check process have been performed a efficiency measurement result summary display is shown.

If all tested data are filed correctly this data can be stored to the database with the **save** button.

To view detailed test data actuate the **arrow** buttons.

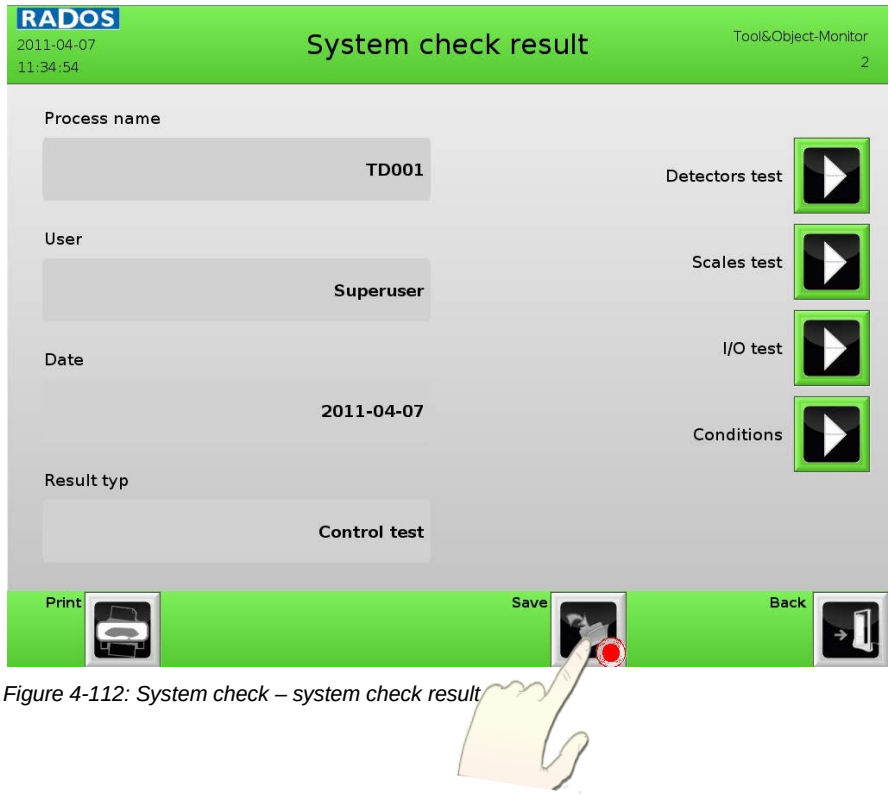


Figure 4-112: System check – system check result

Results cannot be modified. They can be retrieved in the system using the **measurement database**.

System check results can be printed as a protocol directly via a printer interface (if available).

The button ***back*** leads back to the main menu.

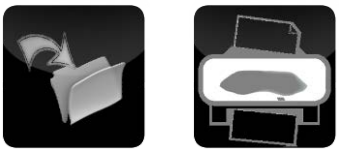


Figure 4-113: Icon save and print parameter

4.6.6 Parameter im- and export

All parameters of the clearance measurement system can be saved on a hard disk or a USB-stick. It is strongly recommended to save the parameter in regular intervals or at least after any change of parameters or performed system check. The safety data can be read back from the hard disk or a USB-stick into the system computer.
If the data are read back from the hard disk or a USB-stick, there will only be the query if the transfer of the data shall really be effected.

4.6.6.1 Save parameters

To save the configuration data of the monitor the menu button "save" ❶ has to be actuated. The actual saved data ❷, the result of the saving process❸ (serviceable in case of errors) and an overall progress bar ❹ will be displayed throughout the saving process.

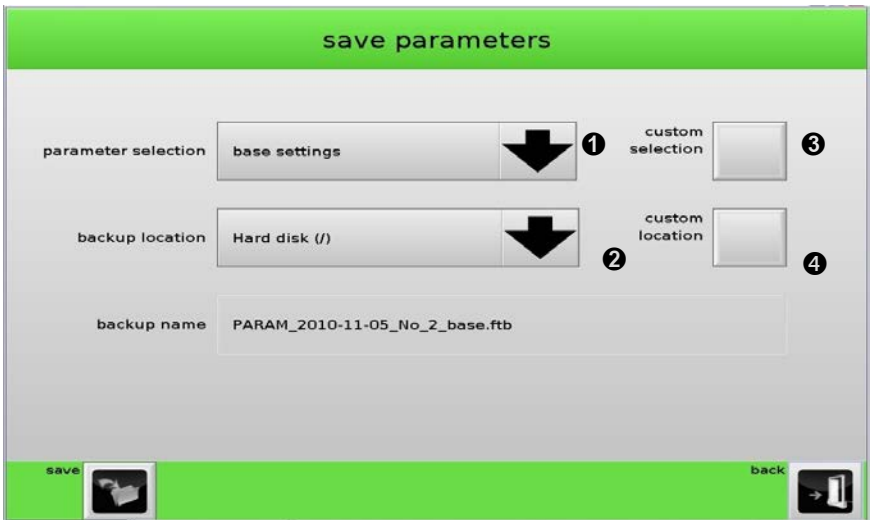


Figure 4-114: Parameter and calibration - Save configuration menu

CAUTION

Data saved in the *.csv format cannot be re-imported to Tool&Object-Monitor.

This data export format is for further processing of measurement data in spread sheet analysis only.

Figure 4-115: Parameter and calibration - save configuration/selection and save overview

4.6.6.2 Load parameters

To restore a configuration in the monitor the menu button **load** ❹ has to be actuated. The actual stored data path ❶(or the individual USB stick data path❷), and the provided data in the path ❸ (serviceable in case of errors) will be displayed throughout the *load configuration process*.

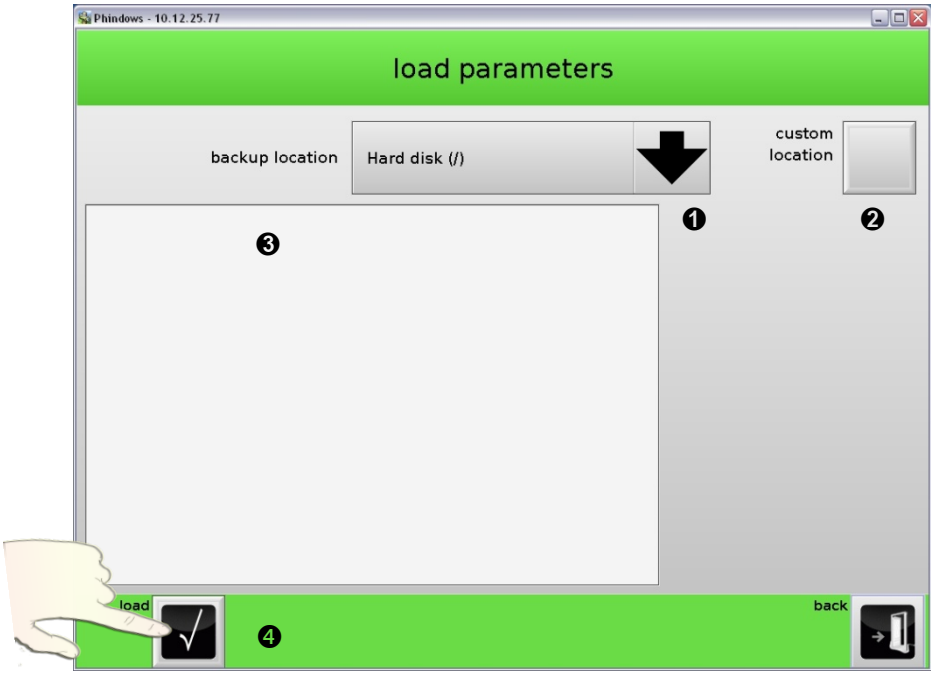


Figure 4-116: Load configuration menu

Note

The menu item **select source** is part of the save/load menu to change the path to the storage devices in the save or load menu.

4.6.6.3 Im-/export data details

Nuclides:	
Export *.csv	Exports the nuclide data base in EXCEL format. This function is for documentation of the nuclide data base only. This format cannot be imported into the clearance monitor.
Export nuclides	Exports the nuclide data base in SQL format.
Import nuclides	Imports the nuclide data base in SQL format into the clearance monitor.
Material:	
Export material	Exports the material parameter in SQL format.
Import material	Imports the material parameter in SQL format into the clearance monitor.

Parameters complete:	
Replicate	Exports all parameters via network to other RTM6xx that are connected and declared in the hardware setup. A query will appear:

For further information on this topic,
***contact RADOS customer service*.**

Export parameters	Exports ALL parameter in SQL format.
Import parameters	Imports ALL parameter in SQL format into the clearance monitor.

Measurements:

Even if the measurement results are no parameters, they can be saved from this menu.

Export	
Measurements	Exports ALL measurement results in SQL format.
Import	
Measurements	Imports ALL measurement results in SQL format into the clearance monitor. This function imports results that do not exist in the system data base only.

Figure 4-117: Icon save and print parameter

4.6.7 Factory defaults

This menu item is used to (re-) load factory parameter in the user software.

Note

After loading the factory default settings all individual parameter settings will be deleted.

To re-install the user defined settings carry out a parameter import from the actual parameter saving.

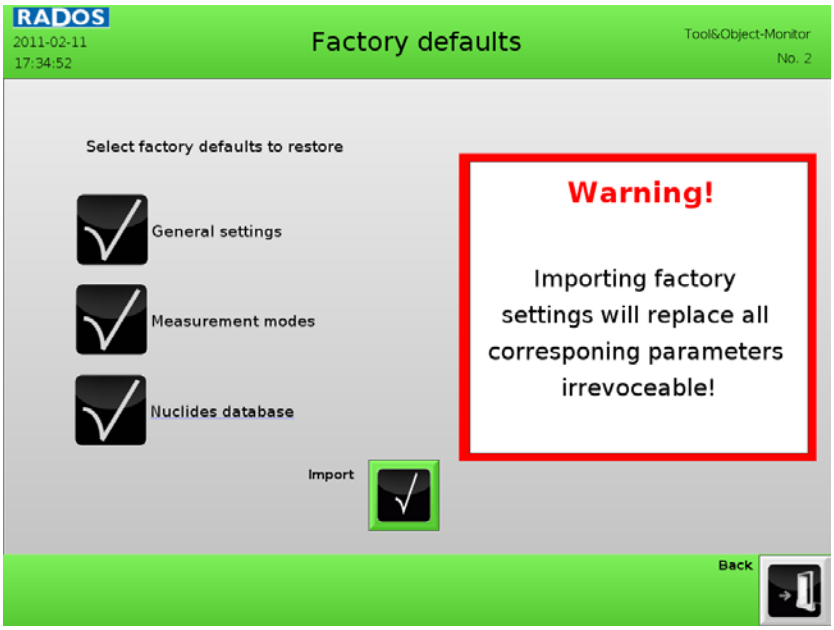


Figure 4-118: Miscellaneous – Factory default parameter

4.6.8 Runtime protocol

This menu item will display a protocol concerning the internal software messages as well as the database login.

For better differentiation actual protocols are displayed in blue and filed protocols from previous sessions are displayed in orange.

Figure 4-119: Maintenance mode – status/actual Runtime protocol

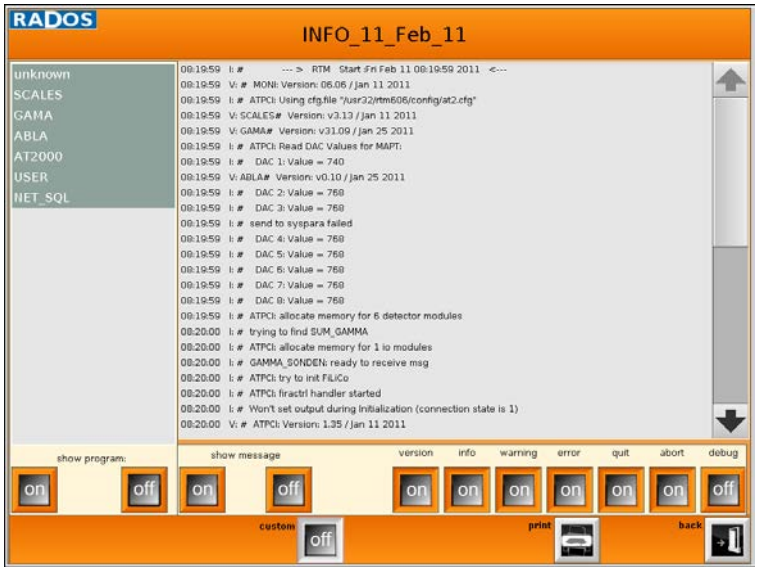


Figure 4-120: Maintenance mode – status/saved Runtime protocol custom

In case the “custom” function is activated, several filters for information can be set.

Menu controls in the protocol menu:	
back Close the menu and return to maintenance menu	
print Print actual menu selection.	

Figure 4-121: Icon info

4.6.9 About

The menu *about* offers displays the monitor name and the installed user software version.

Figure 4-122: Miscellaneous – about/version

4.7 Exit application

With the button ***exit user software*** you quit the program and return to the start menu.

Figure 4-123: Exit application

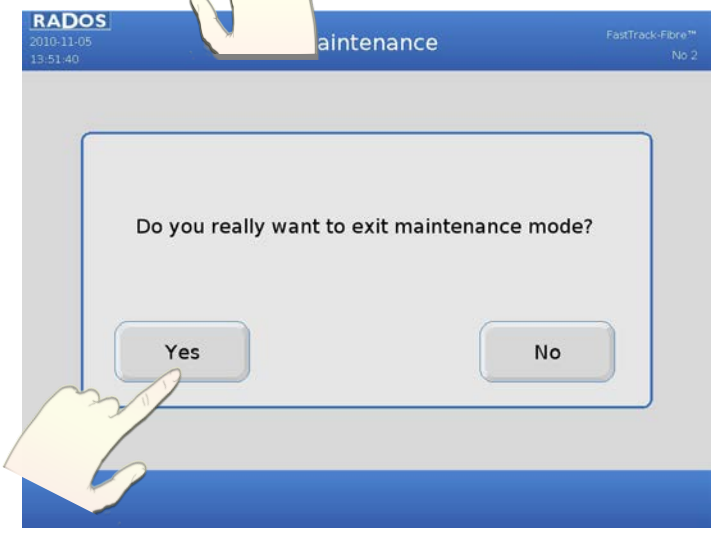


Figure 4-124: Exit application - query 1

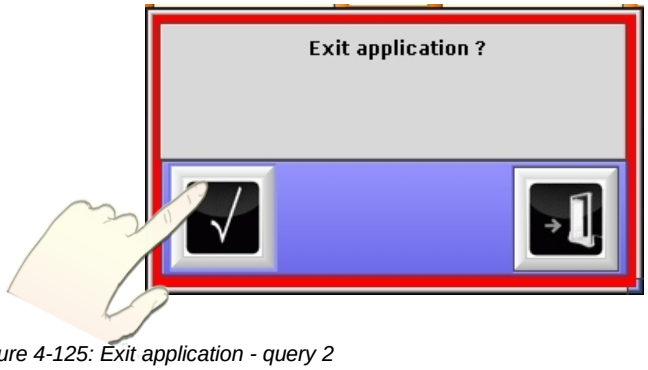


Figure 4-125: Exit application - query 2

5 Software maintenance

Figure

5.1 Software maintenance

Under normal conditions, the **Tool&Object-Monitor** monitor does not need any maintenance. Nevertheless, it is advisable to perform some small repeat tests (system checks) from time to time.

NOTE

The monitor should be cleaned at regular intervals! Contamination of the detectors has an influence on the characteristics of the measurement.

Set the **max alarm** level to level which makes sense to avoid contaminated detectors.

Furthermore, it has to be ensured that the monitor is disconnected from the power supply if any jobs at the electronics or the electrical part of the monitor are to be carried out.

DANGER

If any work on electric parts is necessary the mains switch must be in the off state.

5.2 Start-up menu

The **start-up** menu is the central navigation tool for all software modules. Every software module can be reached by a mouse click. The User software should be quit before activating any other menu item because the internal parameter alteration which can be done from here is only available after restart of software.

Figure 5-1: Start-up menu

Software modules provided via the startup**-menu**:

Start — **RTM user software** to perform contamination measurement (**Register 3** and **Register 4**)

Service — Software module for measurement station administration.

System Configuration — Enables the user to alter QNX system parameter

QNX Shell — Enables the user to get access to the local hard disk.

Runtime Protocol — this menu item will display a protocol concerning the internal software messages as well as the database login.

shutdown — Initiate measurement computer shutdown

5.4 System configuration

The menu **system configuration** enables the user to alter system internal settings.

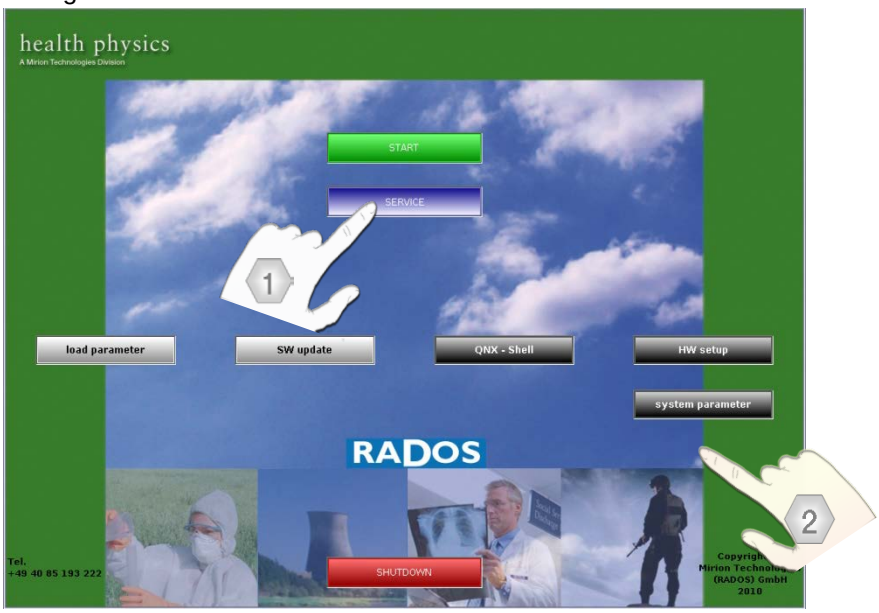


Figure 5-2: Start-up menu

program to set i.e. the timestamp and screen resolution

After actuating a service process button the ***user identification*** is started. To prevent an erroneously data changes a minimum authorization level **master** is needed.

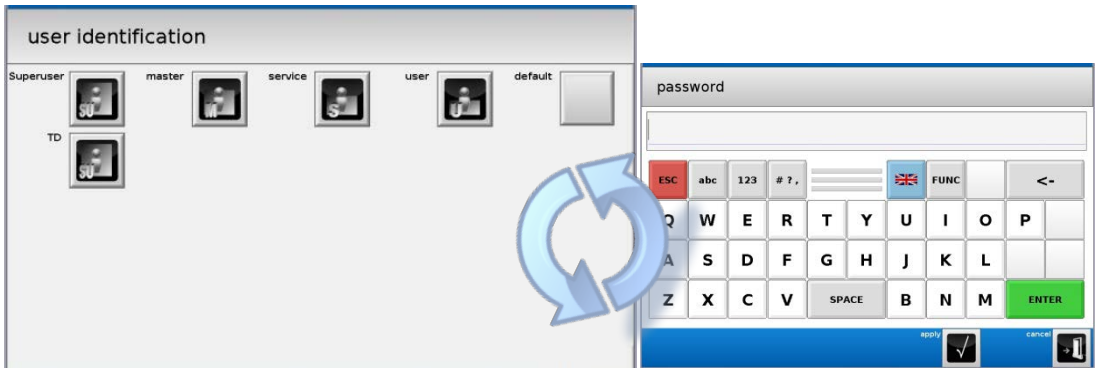


Figure 5-3: User identification parameter HW setup

In general:

- A mouse click on **<Apply>** will apply the setting and the changed data will be stored in the **Tool&Object-Monitor**
- A mouse click on **<save>** will store the settings to the **Tool&Object-Monitor**
- The monitor must be restarted to enable the settings.

NOTE

Please make sure that all monitor parameter are at hand or known prior altering system parameter. It is not advised or needed to change system parameter on monitors.

NOTE

As this part of the software is NOT touch screen optimized Mirion Technologies (RADOS) strongly recommends to use USB keyboard to perform following tasks.

5.4.1 Tab system configuration

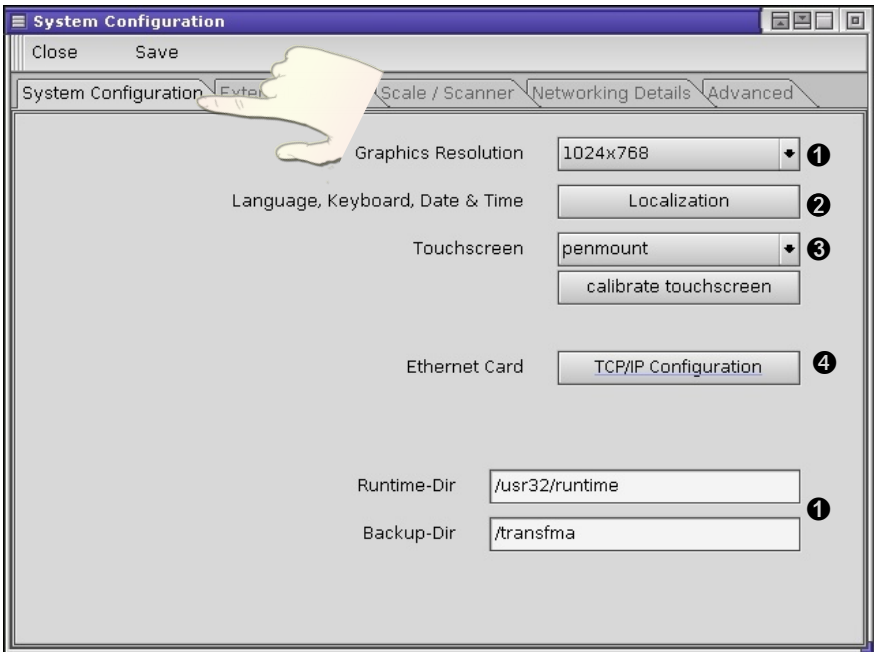


Figure 5-4: System configuration

❶ Graphics resolution and data path

The enables direct change of the screen resolution (in dependency to the used display, a resolution of 1024x768 is mandatory).
Additionally the system immanent directories can be altered to meet user premises. Please use care while changing the system directories.

❷ Localization

Select *localization* on tab *System configuration*.
The display *user configuration* starts with defining the *time zone.*

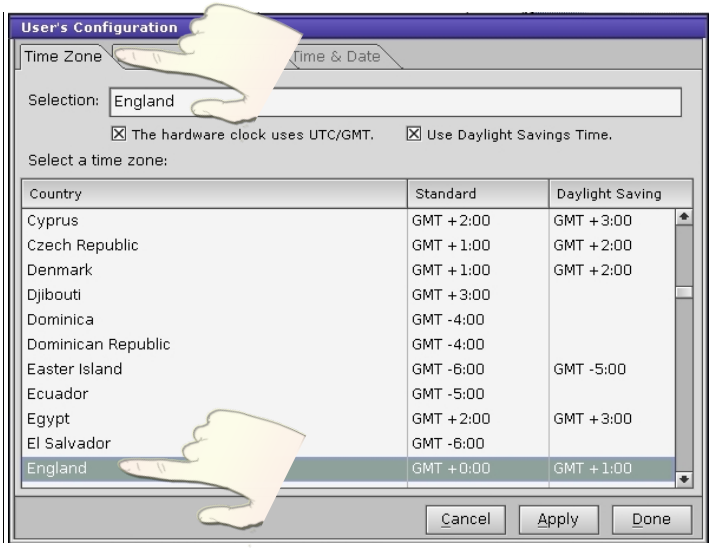


Figure 5-5: System configuration – user configuration / Localization - Time Zone

The tabs *language* and *keyboard* will define the operation system language and the keyboard layout (especially used to access German "umlaut" or other special national character)

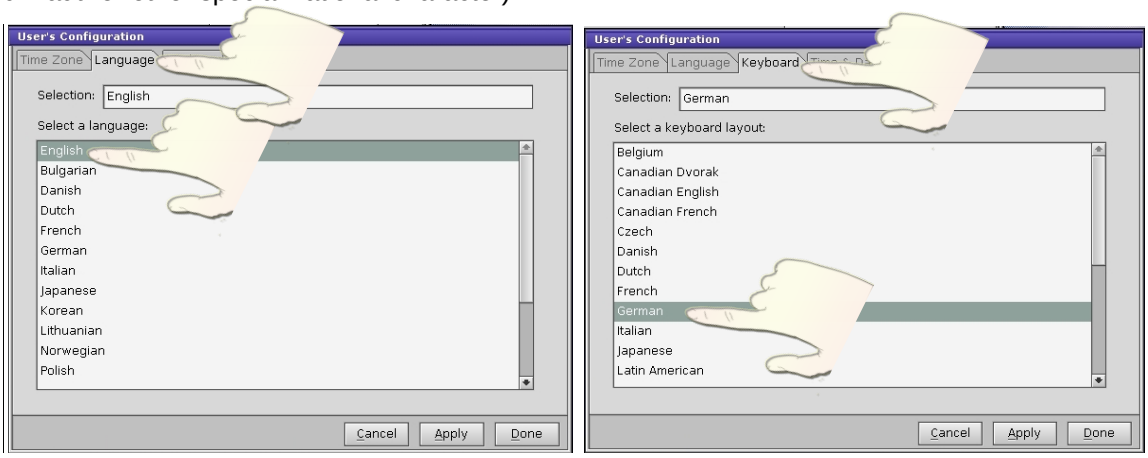


Figure 5-6: System configuration – user configuration / Localization - language and keyboard

The display to set system time and -date lets the user change the date using the six throttles for hour, minute, second and for year, month, day.

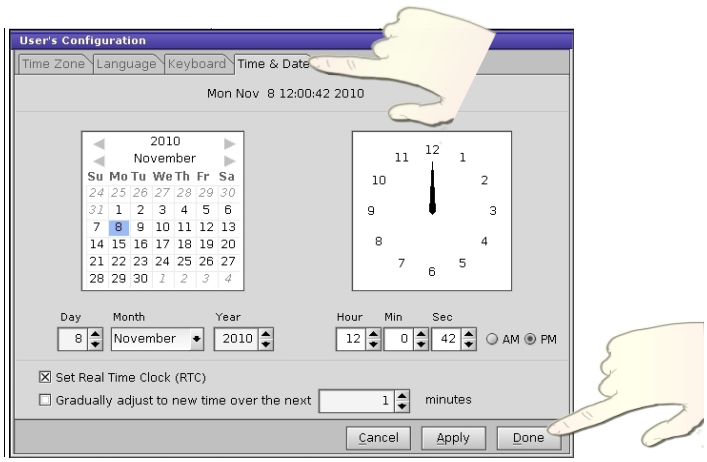


Figure 5-7: System configuration – user configuration / Localization - time

❸ Touch screen calibration

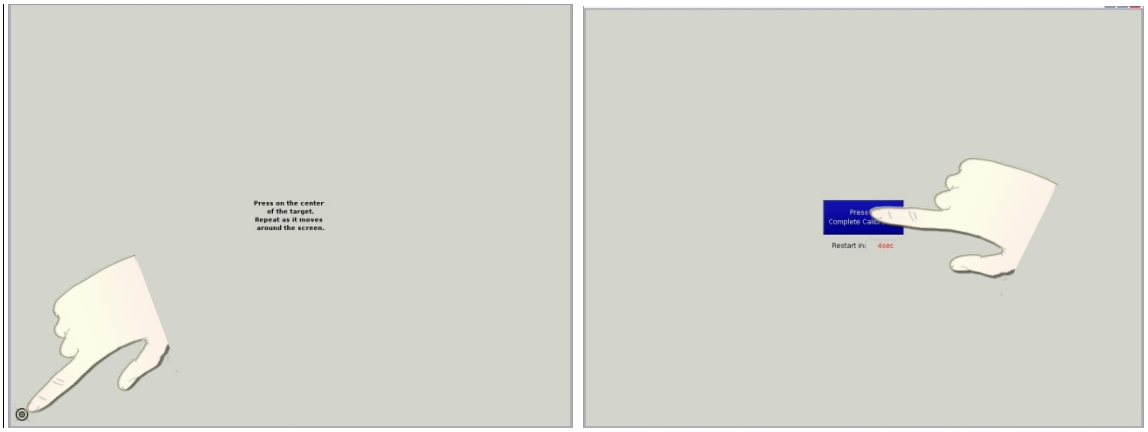


Figure 5-8: System configuration – touch screen calibration

For the **Tool&Object-Monitor** type series only pen mount touch screens are used. To calibrate the touch follow on screen instructions.

❹ TCP/IP configuration Graphics resolution and data path

Select *TCP/IP configuration* on tab *System configuration* in order to alter network settings.

The display *TCP/IP configuration* starts with defining the *global network settings* on final destination.

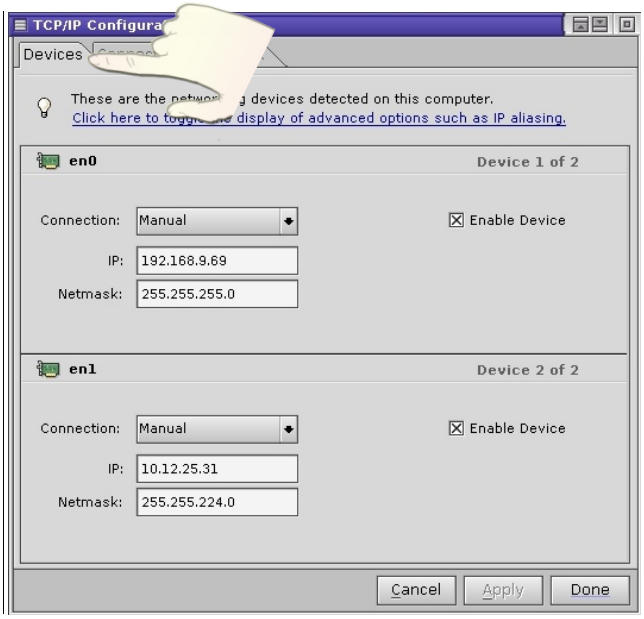


Figure 5-9: System configuration – TCP/IP configuration / Devices

The tab *connections* will display actual route connections of the device. While the tab *devices* allow the user to insert or alter network specifications like the applicable DHCP (*Dynamic Host Configuration Protocol*) Server in final network integration.

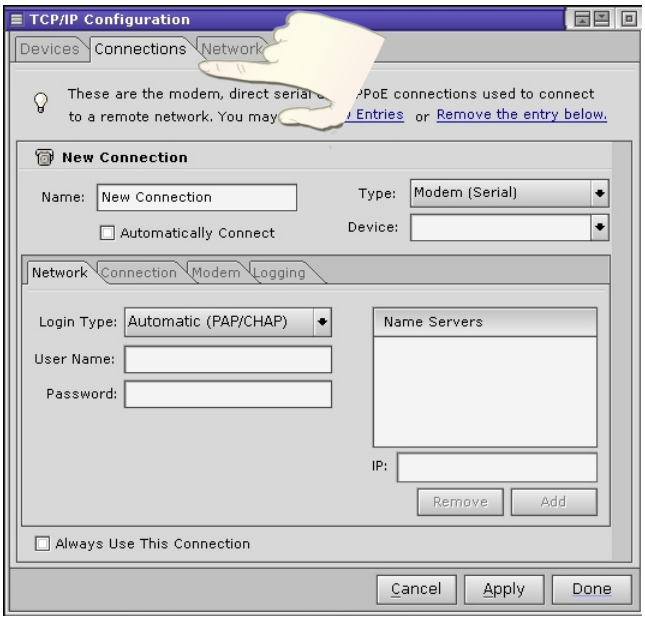


Figure 5-10: System configuration – TCP/IP configuration / Connections

There are two IP Addresses, one is default for the communication to the FILICO Board. The second one is for network communication for example to connect the monitor with CeMoSys™.

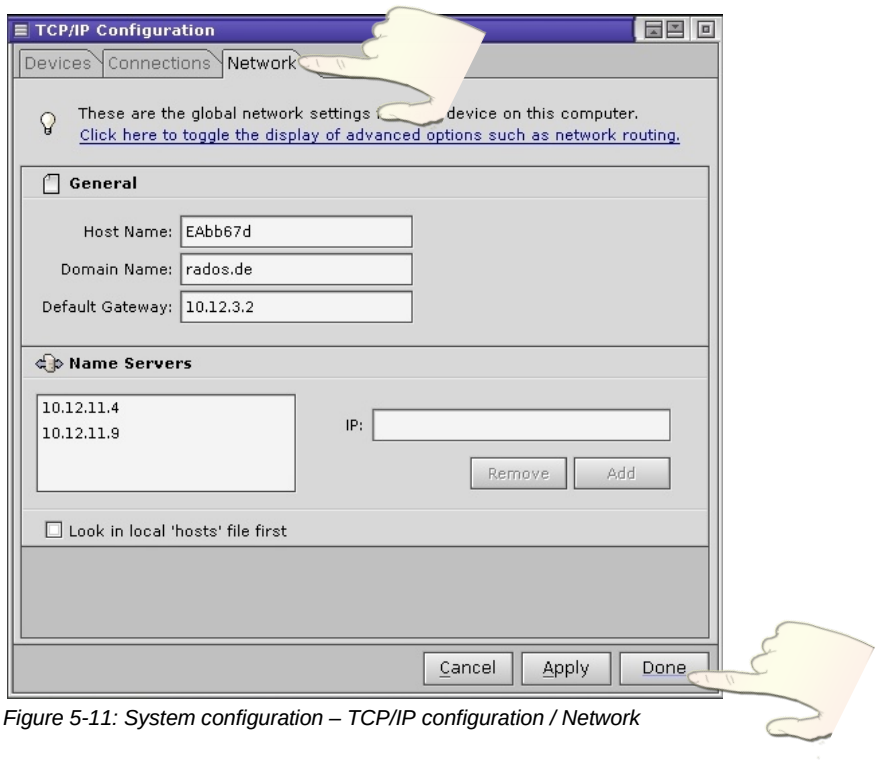


Figure 5-11: System configuration – TCP/IP configuration / Network

5.4.2 Tab external devices

The tab *External Devices* enables altering the devices connected to the **Tool&Object-Monitor** i.e. after printer change.

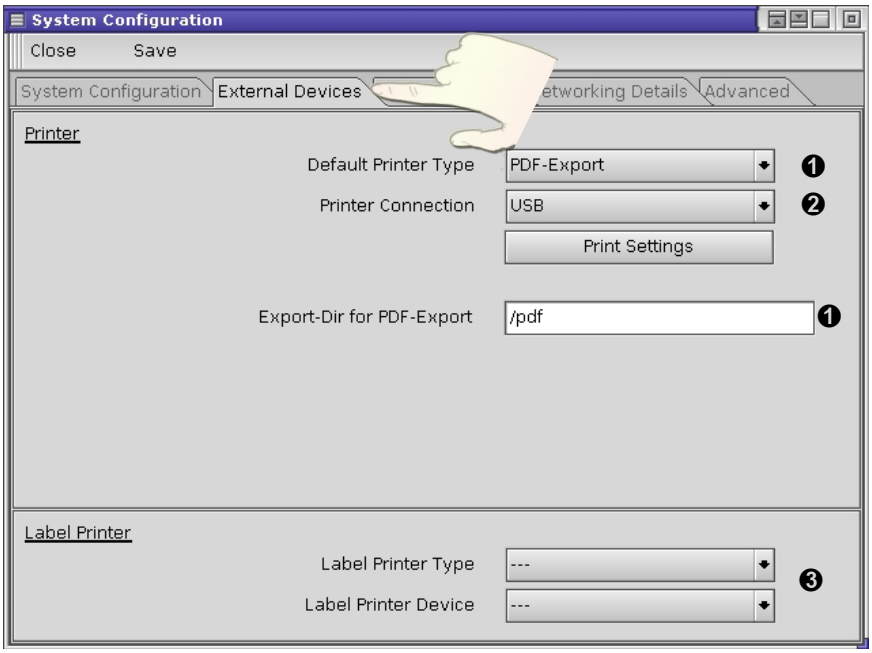


Figure 5-12: System configuration – External Devices

❶ Default printer

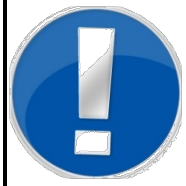
This feature is used to define the default printing device and the file location for PDF printing. For PDF or network printing additional licenses are needed.

❷ Printer connection and settings

For the **Tool&Object-Monitor** the USB Port can be used for printing only.

❸ Printer connection and settings

Contact RADOS customer service for information on label printer upgrade.



NOTE

The devices selectable are shown in the drop down menu only and represent the recommended devices, which have been approved by Mirion Technologies (RADOS) GmbH.

Regarding the case other devices should be used, please contact the RADOS customer service to ensure the device can be supported by a software driver.

5.4.3 Tab scale /scanner

The tab *scale / scanner* enables altering the devices connected to the **Tool&Object-Monitor** i.e. after weigh cell update.

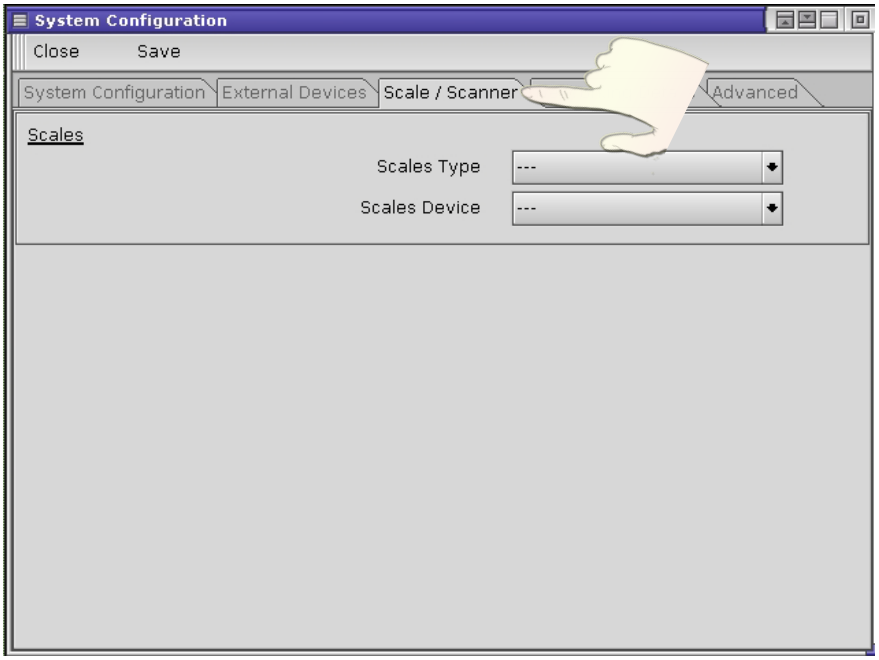


Figure 5-13: System configuration – External Devices

NOTE

The devices selectable are shown in the drop down menu only and represent the recommended devices, which have been approved by Mirion Technologies (RADOS) GmbH.

Regarding the case other devices should be used, please contact the RADOS customer service to ensure the device can be supported by a software driver.

5.4.4 Networking details

The tab *Networking Details* allows the selection of additional network service protocols as well as enabling an optional modem device.

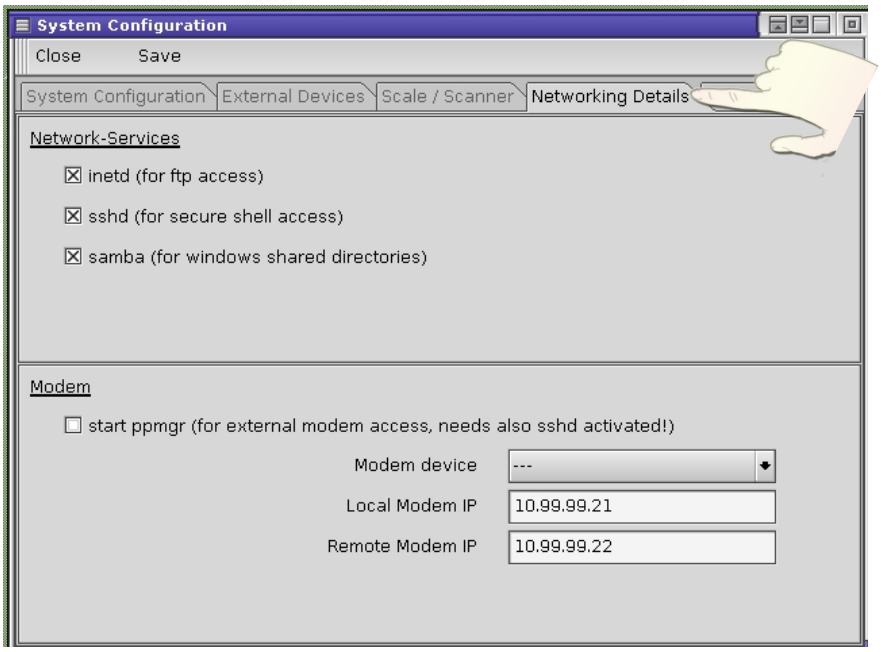


Figure 5-14: System configuration – Networking details

NOTE

The modem device selectable is shown in the drop down menu only and represents the recommended devices, which have been approved by Mirion Technologies (RADOS) GmbH.

Regarding the case other devices should be used, please contact the RADOS customer service Team to ensure the device can be supported by a software driver.

5.4.5 Advanced settings

The tab *Advanced* allows the alteration of optional QNX services for printing and database.

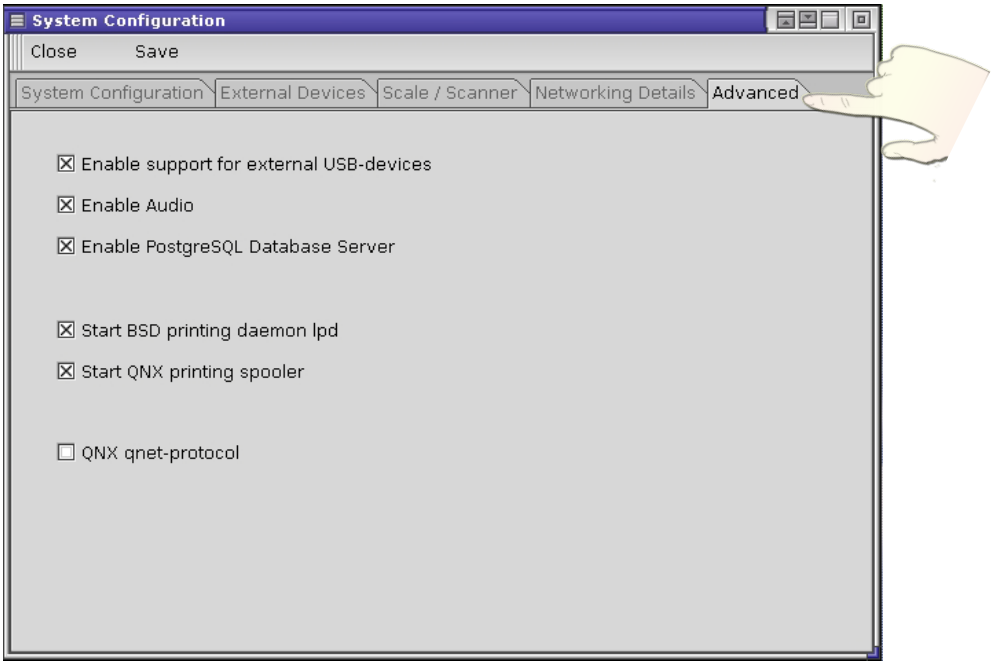


Figure 5-15: System configuration – Advanced

5.5 SW update

The start of the **SW update** for the **Tool&Object-Monitor** enables the user to apply changed or updated user software provided by Mirion Technologies (RADOS) GmbH to the device.

Figure 5-16: Start-up menu – SW update

Software modules provided via the **Start-up Menu**:

Service

SW update program to for software upgrade

After actuating a service process button the ***user identification*** is started. To prevent an erroneously data changes a minimum authorization level **Master** is needed.

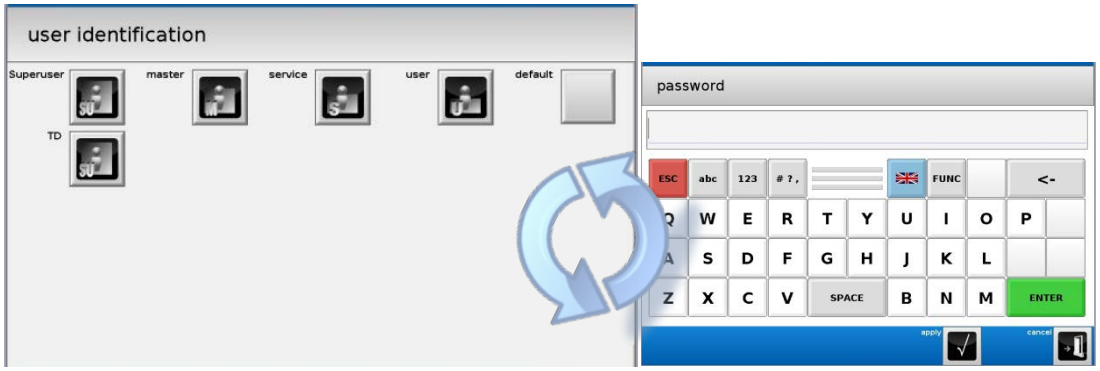


Figure 5-17: User identification parameter SW update

Figure 5-18: SW update

1. Insert **Tool&Object-Monitor** device software in USB-port in measurement computer.
   Use **Refresh** button to test if device software is acknowledged.
2. Affirm input with **Exit**.
3. Restart **Tool&Object-Monitor**

6 Not used (OPTION)

Not Used (OPTION)

7 Not used (OPTION)

Not used (OPTION)

8 Detector

Figure

8.1 Detector- and measurement electronic

For the detection of surface contaminations and covered activities as well as „Hot Spots" the new RFD-Fibre™ scintillation detectors are integrated into the **Tool&Object-Monitor**.

The detectors are connected to a multi-channel photomultiplier using coated fibre glass cables. These cables are firmly fixed to the photomultiplier and then connected to the detectors.

The photomultiplier is set into a box, the so-called mini-light box, which is connected to the FiLiCo board. This board combines different functions like analysing the I/O signals and filtering the measurement signals. The FiLiCo board transmits measurement and sensory signals to the measurement computer which calculates all necessary arithmetic operations needed for a contamination measurement.

Finally the result is shown on the display using the user software.

The following attributes are characteristic for the **RFD-Fibre™** Scintillation detector:

- Gasless operation
- Advanced detector robustness
- Increased sensitivity with Low BG and good MDA
- Less shielding required
- Operation in raised background environments
- Easy to repair with *plug and play* feature
- Almost no dead zones for detectors
- Overall reduction of used electronic components
- No electronics at detectors
- Centralized multichannel Photomultiplier
- Detector homogeneity

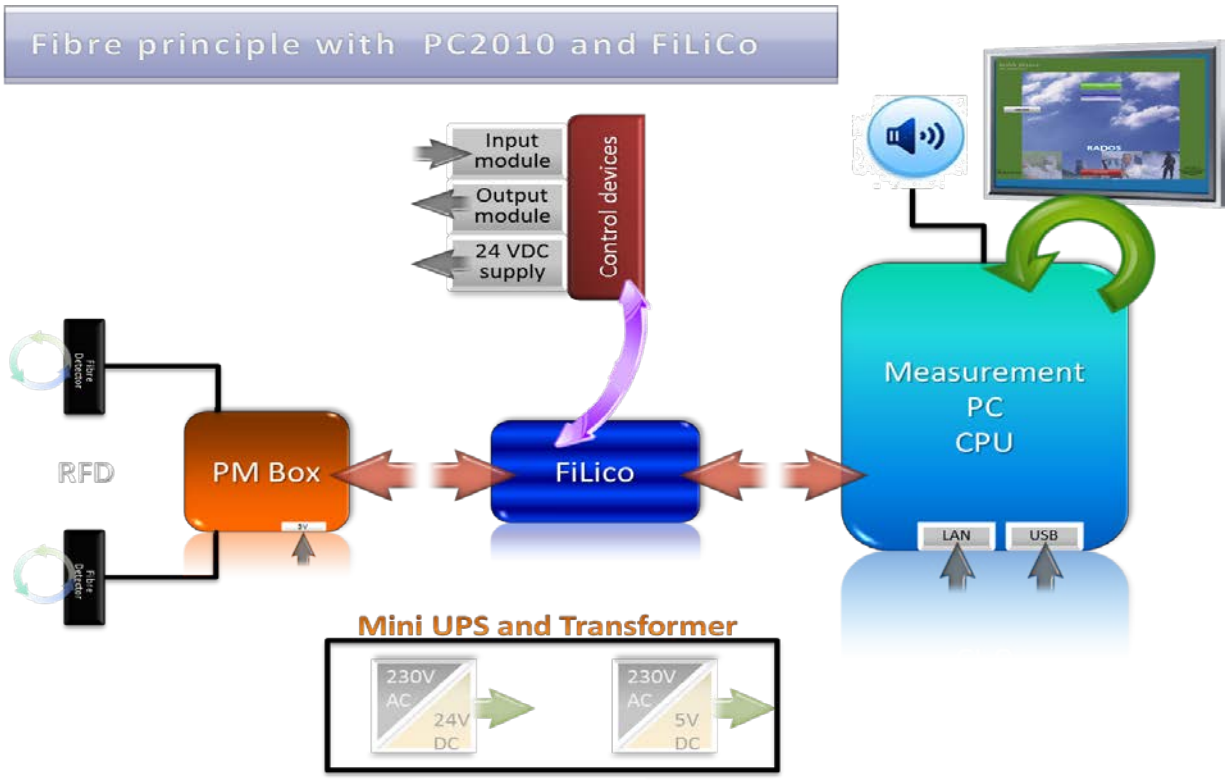


*Figure 8-1: **Fibre™** measurement electronics overview*

8.1.1 Detector unit

In the following a detector unit will be used to describe the RADOS Fibre™ scintillation detector with the light-tight cover, short RFD.

Detector type list for use in CheckPoint:Waste™ family type series:

Abbr.	Name descr.	Type	LxWxH
RFD	RADOS Fibre Detector	RFD1600G	Measurement chamber

(Refer to Register 1 and 2 for close information about type series and detectors used)

A detector unit consists of a plastic cover and a scintillator with the light wave shifter mounted to it. The detector cover is light tight and therefore it's not allowed to open it, otherwise a proper functioning of the detector is not warranted.

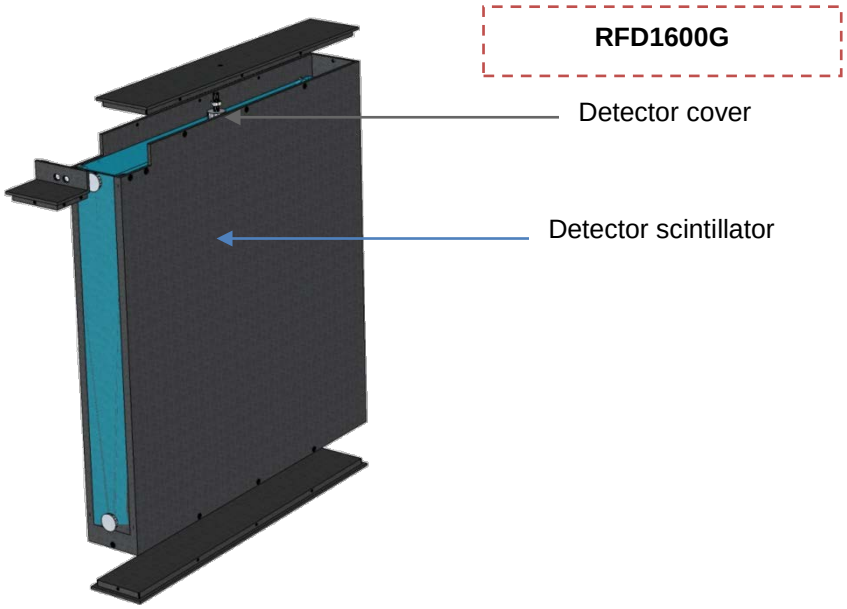


Figure 8-2: Isometric view of a RFD1600G detector

The detector housing was especially designed to enhance the stability and measurement properties on the highest level reflecting the state of the art. The measurement qualities are additional raised by moving the sensible detection area close to the detector edges.

The thickness of the scintillators is optimized for getting the best possible response of particles in the relevant energy region.

8.1.2 Mini-light box

The function of the mini-light box is similar to a camera. The setting of the working point is an adjustment process according the light conditions as it is done while taking photos, where normally the aperture is adjusted to the light conditions and the fine tuning is carried out regarding the exposure time and film quality.

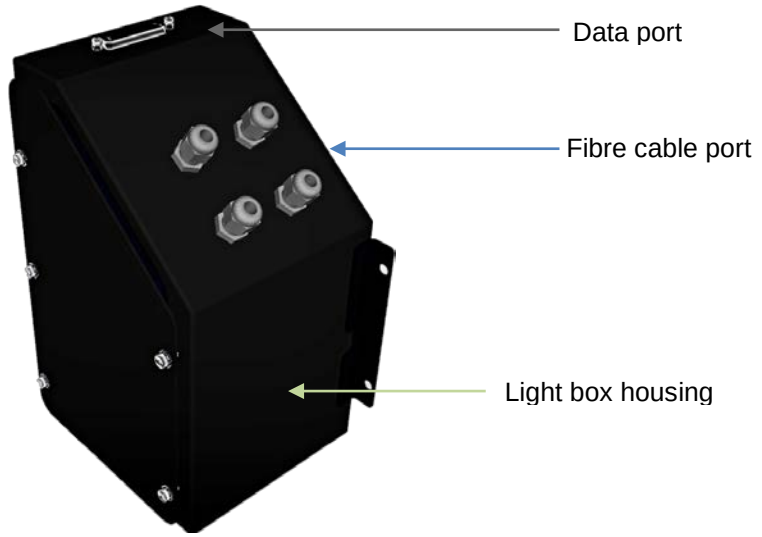


Figure 8-3: Isometric view of a mini light box

The fine tuning of the detector is carried out via the discriminator threshold and the selection of the material which is placed in front of the radiation (in this case the film material is equal to the packing of the plastic).

The mini-light box must operate linear for the expected pulse rate (quantity of light). That means the output signal for all expected activities must be proportional to these activities. In practice, this means for the photo multiplier, which keep the adjustments very stable, to choose the HV as it is recommend by the producer.

The linearity can be controlled by measuring the counting rate by means of a source (activity of approx. 10.000 Bq) subject to different distance to the surface of the plastic.

CAUTION

Please feel free to call RADOS customer service in any case regarding the exchange of detectors with different efficiencies.
In general all calibration work should only be carried out by special trained persons or the RADOS Customer Service.

8.1.3 FiLiCo board

FiLiCo is the short for the **Fi**bre-**Li**ne-**Co**mmunicator which is a digital switch board that is based on an embedded microprocessor with FPGA technology and is used to control gate times and monitor counting pulses like alpha, beta and gamma. It was especially designed to work with the new RADOS fibre detector technology and sensory.

The RADOS FiLiCo electronic concept for the **Tool&Object-Monitor** was taken over from the well-established HandFoot-Fibre™ monitor.
At least due to the measurement task the number of in and outputs on the extension board was enhanced.

The electronic supports following functions:

- Communication port to the measurement PC
- Communication port for the PM box
- Communication ports for installed extensions (I/O port)
- Voice output control

The RADOS FiLiCo board concept includes a wide number of customer specific in- and outputs which can be integrated on customer choice.

8.1.4 RADOS PC2010 system computer

The new industrial RADOS PC2010, with ATOM processor, is integrated in the monitor housing and includes the following features

- Ultra low power embedded system computer
- Fanless design
- Wide range DC power input
- Wide operating temperature
- Ultra low profile enclosure
- Rugged resign for shock/vibration protection
- Easy installation/maintenance
- 3 x RS-232 serial ports (over RJ45 connector)
- 6 x USB 2.0 ports
- 2x Integrated network card (one used by FiLiCo board)

The communication to the RADOS **Fi**bre **Li**ne **Co**nverter board FiLiCo is realized by a TCP/IP Network connection.

RADOS PC2010 system computer	
CPU	Intel Atom
Cooling fan	No
Power supply	10-28 VDC
Hard disk	2,5“
USB port	6
Parallel port	0
Serial port	3
ATEWIS PCI	No
FILICO or RLC	Yes

Table 8-4: RADOS PC2010

8.1.5 Colour touch screen display**Fehler! Textmarke nicht definiert.**

The 10” colour touch screen display is positioned at the entrance side of the monitor and is used to display following indications and functions:

- User instruction for measurement and maintenance
- Monitor status and alarm messages
- Soft- and hardware feature and parameter setting (eased through touch screen operation)
- Schematic measurement results display with indication location and pulse rate view (including last measurement recall)

The voice output language can be selected via touch screen for up to 4.

When the pulses are within the range of the set discriminator threshold they are digitised and polled by the PC.

8.2 Detector response probabilities

The detector response probability is defined as the quotient of the measured count rate to a given activity and the actual activity. If it is expressed in percentage it is also called the efficiency value.

The reaction probability of the detectors for the measurement chamber can be checked differently. On the one hand it is necessary to take a look at the individual detector channels, whereby the individual detector and the following processing electronics are considered as one unit, in order to receive information about the quality of the respective detector.

On the other hand, such a system check is much too time-consuming and in general not necessary, as significant changes are not expected within a time period of 10 years.

Thus two procedures are required which show at first the function ability of the individual detectors and in a further application only prove the total functioning of the measurement chamber. Before this procedure is described in detail, some factors shall be defined or their calculation shall be presented.

The definition integral efficiency means the ratio of net pulse sum of all detectors for a test source positioned in the centre of the chamber by deduction of the background value. The calculation formula is:

$$\eta_{int}(source) = \frac{\sum_{i=1}^{n} R_{g,i} - \sum_{i=1}^{n} R_{0,i}}{A_{(actual)}} \cdot 100,$$

with

η_{int}(source)	= integral efficiency in % for e.g. Ba-133,
$R_{g,i}$	= rate of the gross measurement effect for detector D_i,
$R_{0,i}$	= Rate of the gross measurement effect for detector D_i.
A(actual)	= actual activity
n	= number of detectors installed

Then the individual efficiency is understood as the respective ratio for a fixed source position in contact with the lining of the measurement chamber. At this point it is of no importance if the source is exactly in the geometrical centre of the respective detector or slightly staggered. It has only to be secured that the same position is selected for all comparable tests.

8.3 Detector- and measurement channel

The **Tool&Object-Monitor** is equipped with
6xRFD1600G GammaFibre™.

Name	Description	Type	LxWxH
RFD	**R**ADOS **F**ibre **D**etector	**RFD1600G**	400x400x50

No. of Detector	Position	Remark
4	Right	
3	Left	
2	top	
1	bottom	
5	Front door	optional
6	Back door	optional

8.4 Detector repair information

NOTE

There is no need addressing the detector in the **Tool&Object-Monitor** environment, the addressing will be done by hardware positioning on the PM- Box. Therefore it is important to bring a new detector in on the same position using the same connections.

CAUTION

The addressing of the detectors will depend on the plug-in position on the PM itself.

WARNING

The coated fibre glass cable should not be bended, folded or cracked during these installation tasks. Damages to the coated fibre glass cable will initiate a loss of measurement data or lead to false measurement findings.
Handle coated fibre glass cable with care, it must be carefully attended to a minimum bending radius of 6 cm.

8.4.1 Detector mounting / demounting

CAUTION

The power must be switched off before any detector is removed from the **Tool&Object-Monitor**.
Refer to register 3 concerning the shutdown process of the **Tool&Object-Monitor**.
The monitor is only to be switched on again after the work has been completed!

CAUTION

The coated fibre glass cable should not be bended, folded or cracked during these installation tasks. Damages to the coated fibre glass cable will initiate a loss of measurement data or lead to false measurement findings.
Handle coated fibre glass cable with care, it must be carefully attended to a minimum bending radius of 6 cm.

In the following the demounting and mounting of detectors in various locations is described.

To disconnect the fibre cables from the corresponding plugs, we recommend the use of the RADOS fibre connector extraction tool. This secures the optimal unlock of the cables without damaging the fibre connector.

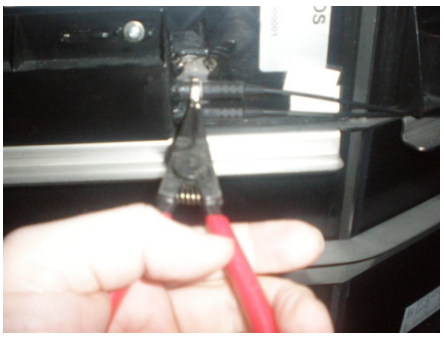


Figure 8-5: RADOS fibre connector extraction tool (Inside)

8.5 Calibration

All changed detectors should be recalibrated in the corresponding monitor by using the **system check** software module.

Refer to register 6 of this **Tool&Object-Monitor** technical handbook.

CAUTION

A detector calibration on a yearly basis seems sufficient if a functional test is performed in a three month interval.
Therefore it is advised to perform a detector alarm test on a three month basis and a system check calibration on a yearly basis.

9 Troubleshooting and repair

Figure

9.1 Repair

9.1.1 Safety precautions

When carrying out service work at the personnel monitor, the main mains supply switch must always be switched off or, where applicable, the mains plug should be removed.

 ATTENTION!	 ATTENTION!	 DANGER!
Caution!	High Voltage	Electric shock

Stick to the high tension module the detectors. Also stick at the electrical terminal.

DANGER

The main switch should be at switched-off position before opening the detector covers.

9.1.2 General safety regulations

In any case accident prevention regulations have to be maintained during maintenance and repair work.

In addition, the following is to be taken into account:

- Working on electric systems is only to be done by adequately skilled persons.
- Before working on electric systems, those parts, which undergo working, are to be switched dead.
- This applies even if the repair seems to be trivial and the de-energization affects significant parts of the electric system.

9.1.3 Safety precautions

- Switch OFF automatic circuit breakers.
- Mark individual parts before disassembling.
- For all work use proper tools, which are in perfect condition.
- Replace gaskets and seals before reassembly.
- Pay special attention to perfect restoration of earthing connections.

- Check unit after maintenance work for operational readiness.
- All operation, maintenance and repair work is to be carried out by personnel especially trained for the job.
- Before working the particular part of the electrical system must be switched dead.
- The switching place(s) must be protected against unintentional switching on.

9.1.3.1 Cables

- In case of disconnecting cables, these must be protected against breaking. The cable ends have to be prevented by wrapping with insulating tape and PVC-foil

9.1.3.2 Fuses

- It is forbidden to mend or bridge fuses and to use mended fuses.
- In case of replacing fuses only those of equal or smaller nominal current and characteristic (slow-acting, quick-acting, super-quick-acting) must be used. Replacement of fit bolts against those intended for fuses of a higher rated current is not allowed.

9.1.3.3 Plugs and sockets

- Movable electrical equipment must only be connected and operated via the provided plugs and sockets.
- Use of adapters and plugs, which fit into sockets of different voltage, is forbidden.
- Plugs and sockets must not be pulled while energized.
- When replacing plugs and sockets take care of connecting in proper phase.

9.1.3.4 Cable accessories

- Cable clamps must be secured against shaking off by means of retainer washers and spring washers.
- When reconnecting cable connections to devices and systems take care of the cable-shields grounding (by means of grounding cone) and the cable inlet's tightness (according to the protective system of the respective device).

9.2 Guideline for trouble shooting

9.2.1 Troubleshooting general

Following good practices will be recommended by Mirion Technologies (RADOS) GmbH:

- Document solution
- Prepare for failures
  - o Keep spares
  - o Keep technical handbook
  - o Keep software
  - o Keep configuration info
  - o Back up data!

9.2.2 Troubleshooting process

- Gather information
  - define the problem
  - Ask questions
- Identify the kind of problem
  - Hardware failures
  - Percussive Maintenance
  - Thermals
- Try quick fixes
  - Look at recent changes
  - Check connections
  - Reboot the computer
- Isolate the problem
- Perform the repair

9.2.3 Trouble shooting

9.2.3.1 Distinction criteria

There are following classes of faults:

a) Detector faults:
- minimum level
- maximum level

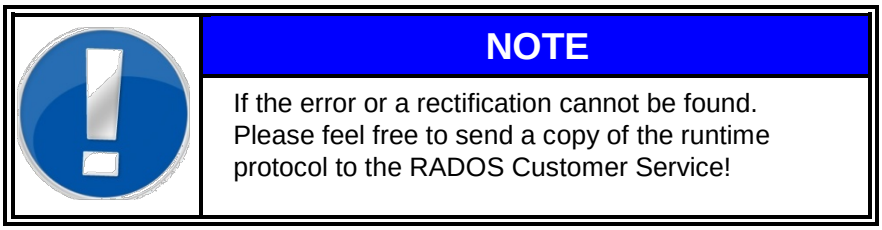
b) Sensor faults:
- sensor does not trip
- sensor is constantly tripped
- sensor is insensitive
- sensor is unstable

c) Electronic faults:
- system faults
- various fault messages

The main goal is to conclude to the correct fault origin from the observed fault symptoms.

Trouble shooting is supported by comprehensive help functions in the service menu.

Fault messages, their possible causes and their correction are described in the following section.



9.2.3.2 Trouble shooting examples

Measurement computer

Possible fault	Possible causes
Does the PC boot and start the user program?	- hard drive broken - bios settings lost - CPU battery down - no connection to main - Fuse broken - Hardware settings were cancelled - parameter settings - system check was not carried out right

Sensory

Possible fault	Possible causes
Is there dirt on the sensor?	- check the physical adjustment by sensor and I/O- menu. - pay attention for inverse sensors like nobody contact
Does the reflector exist or is there dirt	- check the cabling
LEDs: at the modules are blinking for FiLiCo	- check mains - check status of I/O‘s in the I/O menu or see runtime protocol

9.3 Detector fault messages and rectification

As an evidence for a contaminated or defective detector the in- or decrease of the minimum or maximum threshold of only one detector is to be adopted.

Rectification flowchart:

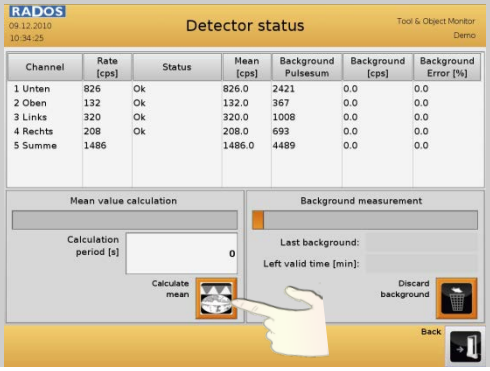
Message / fault	**Register / Chapter name**
In- or decrease of the minimum or maximum threshold of only one detector. 	**9 / Software fault messages and rectification**
Change to **maintenance mode** and select **measurement status** menu. Find faulty detector 	**4 / Detector status**
Replace faulty detector 	**8 / Detector mounting/ demounting**
Change to **maintenance mode** and select **measurement status** menu.	**4 / Detector status**
The contamination monitor switches the **measurement mode** to **ready to measure**	**4 / Detector status**
Re-calibrate the changed detector using the **System check** software.	**6 / Detector efficiency calculation**

Figure 9-1: Detector-Rectification flowchart

9.4 Software fault messages and rectification

If a reliable operation is not guaranteed, further measurements are stopped. Troubles and faults that lead to the interruption of the measurements are displayed on the screen.

Figure 9-2: Failure - not ready to measure

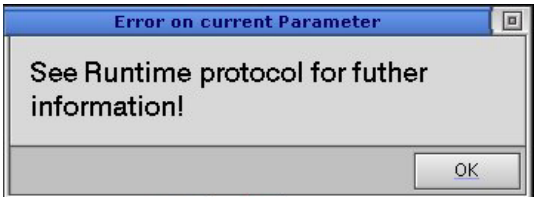


Figure 9-3: Error-message

NOTE

“Call RADOS Customer Service ”

Please refer to Register 1 chapter “call for service”, if the rectification “call RADOS Customer Service” is mentioned in the following listing.

Service phone: +49 40 85 193- 222

9.4.1 On screen fault messages

Following messages as well as the causes of the disturbance are stated.

Background

Progress of the background determination is displayed. The value states to what extend (in percentage) the currently running measurement have been completed. If no further errors are displayed, it is a complete new determination of the background. This measurement is carried out when the monitor is started or upon request in the maintenance mode.

Minimum level

At least one detector remained below the adjusted minimum threshold. The display of the measuring status (see register 4- **Service**) shows which detectors are responsible for that.

Maximum level

At least one detector has exceeded the maximum threshold set in the maintenance mode. The display of the measuring status (see register- **Service**) shows the detectors that exceeded it.

Detector fault

If more than one detector is affected, there may be a light leakages fault or a very high background. Otherwise, there may be a defect or contamination of detectors.
At least one detector may not deliver any data or delivers wrong data. The reason could be a defective wiring or damage to detector electronics. More precise information can be found in the menu - **detector status** (see Register- **Service**).

I/O fault

At least one sensor does not communicate. Sensors are affected can be identified from the display of the menu - **I/O test** (see Register- Service).

9.4.2 Hardware faults

FAULT	ORIGIN	RECTIFFICATION
Monitor does not operate	a) power supply failure - no mains supply	a) service department - check wire and fuses - check mains connection - measure low voltages
Video display is blank	a) power supply failure - no mains supply	a) service department b) check wire and fuses - check mains connection - measure low voltages c) restart the monitor again - replace the video- monitor or LC-display - adjust contrast in BIOS of CPU
Lock failure **Continual request to lock door**	a) door lock is continually active due to a tripped sensor b) the monitor cannot carry out first background measurement c) sensor is set too sensitively d) sensor defect	a) check all inputs in service menu "I/O- test" b) Without person in the monitor only the following input signals should be active: - service - exit is closed c) sensor should be cleaned - Adjusted if necessary d) replace
Minimum limit	a) background – pulse rate below minimum limit b) high voltage set too low	a) turn to service menu - measurement status, look at MIN level of channels b) check high voltage (*detector status)* c) check sensors (menu I/O-test)
Maximum limit	a) background- pulse rate above maximum limit b) high voltage set too high c) contamination of monitor d) housing damaged	a) more exact evaluation in service menu "detector-status" - check MAX-level of detectors b) check high voltage (*detector status)* c) decontaminate d) check housing for damages, - check for light tightness - remove detector and exchange

9.5 Protocol

Before entering the monitor user software a protocol manager is started. This manager records the start routine of the monitor user software.

In this protocol

- Info messages
- Warning messages
- Error messages

are recorded ❶ during the start and the program sequences.

Figure 9-4: Protocol

The left-hand window shows a listing of all available protocol files. There is an automatic delete function, so that only the protocols of the last 12 days are displayed in the list.

With the button ***print*** it is possible to make a printout of all recorded data in the selected protocol file.
With the button ***history*** it is possible to view the log-file history.
With the button ***close*** you can return to the start menu.

Should one of these errors ❶ appear during running operation, please start the monitor again or contact the RADOS customer service.

9.6 Protocol fault messages

The Software procedures and failure messages are guided by the ABLA routine (ABLA is a short in German [**ABLA**ufsteuerung] what means sequential control) which will display following messages if a failure occurs.

Below any possible messages, causes for troubles and faults, are described.

ABLA MESSAGE	ORIGIN	RECTIFFICATION
"error on I/O module"	a) at start: ABLA could not locate AT2000 and /or the LS task b) in operational mode: AT2000 could not communicate or locate with in –or output channel	a) restart the monitor b) call RADOS Customer Service a) restart the monitor b) check camera and light barrier for proper function c) call RADOS Customer Service
"error on process control"	a) ABLA application was not initiated correctly	a) restart the monitor b) call RADOS Customer Service
"error on service key"	a) ABLA could not define input on io “service key”	a) restart the monitor b) call RADOS Customer Service
"gamma min alarm"	a) minimum rates on gamma channel are to low	a) turn to service menu - measurement status - look at MIN level of channels - change detector settings b) Detector defective - change detector - call RADOS Customer Service
"… max alarm”	a) background- pulse rate above maximum limit b) contamination of monitor	a) more exact evaluation in service menu “detector-status“ - check MAX-level of detectors - change detector settings b) Source in direct detector contact during background measurement - Remove source - decontaminate detector c) Detector defective - change detector - call RADOS Customer Service
"process control not active"	a) Internal Fault of ABLA Application, data could not be retrieved	a) restart the monitor - call RADOS Customer Service
"mathematics not active"	a) Measurement data could not be retrieved during start of monitor	a) restart the monitor - call RADOS Customer Service
"i/o not active"	a) No AT2000 data received from ABLA at start	a) restart the monitor - call RADOS Customer Service

ABLA MESSAGE	ORIGIN	RECTIFFICATION
error on detector	detector data (rates) are out of range detector defective	(1) more exact evaluation in service menu “detector-status“ (2) change detector settings (3) detector defective (4) change detector call RADOS Customer Service
error on parameter setting	measurement data could not calculated	(1) more exact evaluation in service menu “parameter“ (2) - change monitor parameter to default parameter
error on light barrier	light barrier contacts are blocked or just one barrier is actuated several times	(1) remove blocking and actuate light barrier by hand (simulate measurement) (2) switch to **maintenance** mode and return to **measurement** mode to reinitialize I/O-module

9.7 Stock-keeping of spare parts / service department

Address:	**Mirion Technologies (RADOS) GmbH** Ruhrstraße 49 22761 Hamburg
Phone:	+49 - 40 85 193-222
Fax:	+49 - 40 85 193-165
e-mail:	hamburg-hotline@mirion.com

10 Maintenance

Figure

10.1 Set-up and commissioning

10.1.1 Set-up of the monitor

The monitor should be installed at a place with low background radiation to allow for low detection limits at short measurement times.
Further, fluctuations in background radiation are to be avoided.
If this cannot be arranged, adequate process instructions have to be observed, including regular measurements of the current background counts.

The monitor should not be operated in a humid or dusty environment.

CAUTION

The measurement chamber must be moved only by trained expert personnel. The relevant safety rules must be observed!

The monitor is put down on a plain surface or a foundation. Please pay attention that the measurement chamber is let down gently.

WARNING

The **Tool&Object-Monitor** has a total weight up to 2.0 t and must be lifted or moved by expert personnel with a suitable forklift or heavy-load roller only.

➲ **Refer to the safety guidelines in register 1 and to Technical data in register 2.**

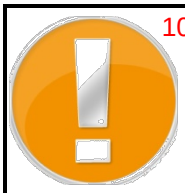
Pay attention to the markings on the monitor to find the sufficiently supporting areas!

➲ **Ensure that the allowed floor loading during transport and at the final destination is sufficient!**

10.1.2 Connection to mains

The mains connection is prepared by a cable leading directly into the monitor. If it is necessary to change the mains plug into a country specific plug the connecting has to be done in accordance to the monitor drawings.

For the connection values please refer to the technical data or to the type plate.



WARNING

The **Tool&Object-Monitor** has to be disconnected from mains prior any maintenance work.

Persons may be treated by electric shocks!

10.1.3 Transport safety features

In order to protect the measurement station against damages in transport, several components have to be equipped with transport safety features. These must be removed in the sequence on final location.

At extreme transport conditions it is recommended to remove the lead bricks from the doorframe and to remove the detectors.

10.1.4 Transport safety feature for the chamber door

After the transportation is finalized and the measurement chamber is set up, remove safety features, which are screwed, with a screw driver and remove them completely.

CAUTION

All transport safety installations are painted in orange colour and can be easily recognised.

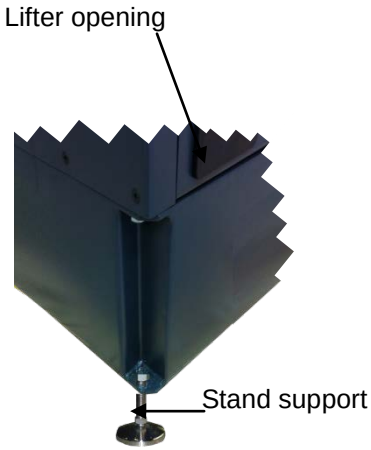


Figure 10-1: Detailed view of detector housing

10.1.5 Levelling of the station

CAUTION

To guarantee optimal performance of the **Tool&Object-Monitor** and their equipment it is absolutely necessary to level the monitor with the aid of a spirit level on the final destination.

Even if the surface, where the measurement station is to be set up, seems plain a levelling procedure has to be accomplished.

If a levelling adjustment of the monitor becomes necessary, it needs to be done with the height-adjustable stand support of the measurement chamber.

After levelling the monitor the scale has to be recalibrated.

The levelling of the weigh scales is also to be checked with a spirit level.
If an adjustment of the levelling of the weigh scales becomes necessary this is done at the holding screws of the weigh scales fixture, located at the left and right hand side on the lower frame of the measurement chamber.

In order to receive reliable measurement results it is absolutely necessary to pay attention to an even spread of the load.

Figure 10-2: Detailed view of stand support

10.1.6 Levelling procedure measurement chamber

To adjust the chamber, use the height-adjustable stand support.

1. *Loose lower nut at height-adjustable stand support*
2. *Tighten upper nut to lift the station or loose upper nut to lower the station.*
3. *Use spirit level to check levelling.*
4. *After levelling tighten lower nut on footplate to secure and arrest upper nut.*

10.1.7 Levelling procedure weight scale (Option)

To adjust the scale level with the 2 screws located in each corner of the measurement chamber.

CAUTION

Please be advised that the lower detector has to be removed from the measurement chamber to perform these tasks.

1. *Loose lower nut at height-adjustable stand support*
2. *Tighten upper nut to lift the station or loose upper nut to lower the station.*
3. *Use spirit level to check levelling.*
4. *After levelling tighten lower nut on footplate to secure and arrest upper nut*

Set-up function test

After the set-up and the preliminary preparations are done, the state of the station is:

* the main switch of the station is “ON”
* the measurement chamber is empty

Set-up function test:

1. Close measurement chamber door.
2. Switch on system computer.
3. The weigh scales terminal switches on automatically.
   The weigh scales needs to be set to „zero“, if it shows another value and has be recalibrated.
4. The system computer automatically boots into the operating system.
5. The user program of the *release measurement station* is started.
6. At first the ***Tool&Object-Monitor*** carries out its first background measurement (Status: “**not ready to measure**”) then it turns to status “**ready to measure**”.
7. Select from menu bar **Status – Detector Status** and check the displayed detector count rates for plausibility.
8. Close **Detector Status**
9. Select from menu bar **Status – I/O Status** and perform a function test of the binary in- and outputs as well as the scale.
10. An extended function test can be carried out according to the set-up record which was handed out at the delivery of the *release measurement station*.

10.2 Repetitive testing

By means of the repetitive testing the functions of the plant are to be checked and guaranteed.

The following test routine is suggested:

- Checking of the system settings
  The following system settings have to be compared with the reference data:
  - high tension settings
  - discriminator settings

- Cleaning and testing of the light barriers and the radar sensor.
  The light exit and entrance surfaces of the light barriers are to be cleaned. Caution: avoid scratches.

- Testing of binary signals
  The testing of the remaining binary inputs is carried out in the same way as regarding the already described binary inputs of the light barriers.
  The binary outputs can be set and deleted in the I/O test menu. The function of the corresponding relays or the signal units linked to them are tested.

- Check of the detector function
  First of all the background of the detectors has to be determined and compared with the reference data. Here it has to be considered that the background radiation can vary and that the backgrounds do not necessarily match with the reference data.

Then the detector efficiencies have to be determined with system check user software module (chapter 6) and compared with the reference data of the test protocol.

10.3 Cleaning

Cleaning your monitor, its components and peripherals helps to keep it in good working condition. Depending on the environment that your monitor operates in determines how often you should clean. The below lists are our recommendation and may change depending upon your environment.

10.3.1 General cleaning tips

General tips that should be taken in account when cleaning any of the components as well as tips to keep a monitor clean.

1. Never spray or squirt any type of liquid onto any monitor component. If a spray is needed, spray the liquid onto a cloth and then use that cloth to rub down the component.
2. Operators may use a vacuum to suck up dirt or dust around the monitor surface. However, do not use a vacuum for the inside of your monitor as it generates a lot of static electricity that can damage the internal components. Suck the ground area of the hand box, the foot grill, small items box, ground floor and the inside of rails where the doors are moving in from time to time.
3. Never get any component inside the monitor or any other circuit board damp or wet.
4. Be cautious when using any type of cleaning solvents.
   Some individuals may have allergic reactions to chemicals in cleaning solvents and some solvents can even damage the case.
   Always try to use water or a highly diluted solvent.
5. When cleaning, be careful not to accidentally adjust any sensors or initiators.

10.3.2 Cleaning tools

Although many products are available to help improve the process of cleaning, please use water or a highly diluted solvent to clean.

Cloth

A cloth is the best tool used when rubbing down a component; although paper towels can be used, we recommend using a cloth whenever possible.

Water or rubbing alcohol

When moistening a cloth, it is best to use water or rubbing alcohol. Other solvents may be bad for the plastics used at the monitor.

Portable Vacuum

Sucking the dust, dirt, hair and other particles out can be one of the best methods of cleaning. Over time, these items can restrict the airflow and cause circuitry to corrode.
Do not use a standard vacuum as it can generate a lot of static electricity that can damage your computer.

Cotton swabs
: cotton swaps moistened with rubbing alcohol or water are excellent tools for wiping hard to reach areas in any location.

Foam swabs
: Whenever possible, it is better to use lint-free swabs such as foam swabs.

10.3.3 Touch screen cleaning

Dirt, dust, and finger prints can cause the computer screen to be difficult to read. Unlike an old computer monitor, the touch is not made of glass, therefore requires special cleaning procedures.

When cleaning the touch screen it is important to remember to not spray any liquids onto the screen directly; do not use a paper towel as it may cause the screen to become scratched.

To clean the screen we recommend that you use a soft cotton cloth; if a dry cloth does not completely clean the screen, you can apply rubbing alcohol to the cloth and wipe the screen with the damp cloth.

10.4 Transport

Immediately after the shipment has arrived, please check the consignment for possible transportation damages. In that case please inform the Transport Company and the Mirion Technologies (RADOS) GmbH. If necessary the commissioning should be carried out.

10.5 Detector protection

In addition, all detectors should be covered with a protective cardboard.

Gamma detectors and the lead must be disassembled for transport.

Detector protection

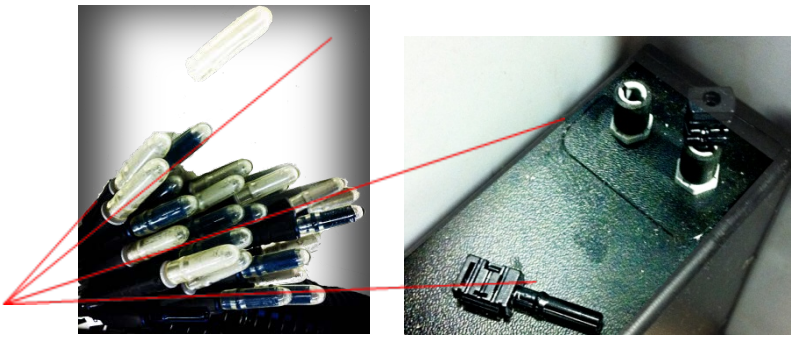


Figure 10-3: Example of detector cable cover and detector plug cover

The light fibre plugs need to be protected against dust

10.6 Storage

Storage conditions:

- 20° C up to +55° C,

Relative humidity 75 % on yearly average, 95 % over 5 hrs, no condensation.

11 Nomenclature

11.1 Index

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G

H

I

L

M

N

O

P

Q

R

S

T

U

V

W

11.2 Glossary

As different terms are used for facts of this scope and as the common ISO standards are not completely introduced presently, we would like to give a brief definition of the used terms. We tried to comply with the standards and regulations as closely as possible for the generally binding terms.

Name Abbreviation	Description, Meaning
Activity (radioactivity)	Radioactive activity complies with the decays per second of a special material. The unit is Bq. The activity alone does not say anything about the danger of radiation.
ATEWIS **AT-2000** **Atewis-2000**	Mirion Technology (RADOS) –development for personal computer with AT Technology used for RGZ, RBP and RPD detector networks.
Background	Background or also called underground radiation. Rock and other material emit radioactive radiation permanently to the environment. There is also permanent radiation penetrating from the space to the earth's surface. Naturally, this radiation is also measured by a detector. In principle, this radiation is an unwelcome effect but it also can be used to control if the detectors still measure.
Background value	Measured value of the background without additional source of radiation.
Becquerel	Measurement unit of activity. The strength of the radioactivity is proportional to the number of decays per second 1 Becquerel (Bq). Whereby 1 decay per second refers to 1 Becquerel (Bq). The old name of the unit was Curie (Ci) 1 Bq = 27 * 10-12 Ci or 1 Ci = 37 * 109 Bq.
BINOUT2000	**Bin**ary **Out**put 2000 This Mirion Technology (RADOS) –development is a binary-output channel module to provide the information of optional added devices on RTM contamination monitors (like doors, barriers)
CeMoSys™	**Ce**ntral **Mo**nitoring **Sy**stem Mirion Technology (RADOS) –development for a intranet based contamination monitor overview with a SQL database
Channels	Detector unit including the evaluating electronics and software. If channels are mentioned, the signal processing has already been completed.
CMS	**C**ontrolling **M**icroelectronic **S**ystem A very small electronic circuit components for use in an integrated circuit or sometimes for use on their own as a general electronic component without PC use.
Coincidence	Measurement of several events which happen simultaneously

Name Abbreviation	Description, Meaning
Contamination	Pollution ➔ in this case with radioactive material or substance.
Compton-effect	Physical interaction where a photon is scattered at the nucleus. A free electron emerges
Coop	Coincident circuit Mirion Technology (RADOS) –development COOP is an electronic device with one output and two (or more) inputs. The output is activated only when signals are received within a time window accepted as at the same time and in parallel at both inputs. Successor of the CTS module for the TwoStep™–Exit
Cps	Counts per second ➔ can be linked directly with activity via the efficiency factor.
CTS	**C**ross **T**alk **S**election Predecessor of the Coop- module
Decay constant	The decay constant λ of a radioactive decay is equal to the reciprocal value of the average life period τ. The following relation exists between decay constant λ, average life period τ and half-life period T: $\lambda = \tau^{-1} = T^{-1} \cdot \ln 2$
Detector	Detection medium in the original form without electronic read-out.
Detector unit	Detection medium with appropriate electronics and housing.
Discriminator	Electronic component to discriminate the output counts of the photo multiplier.
Dose	Total absorbed energy in a mass unit. Physical unit is joule / kilogram. One J/kg is equal to the amount of energy, which develops when energy of 1 J is transmitted to matter with a mass of 1 kg by means of ionising radiation. ❒ 1 J/kg = 1 Gy (Gray) ❒ 1 Gy = 100 rad (old measurement unit: Radiation Absorbed Dose). Equivalent dose in Sv = Q * energy dose in Gy, Sv (Sievert) Quality factor Q = 1 Sv / Gy, expresses the characteristic of the radiation (source) the ionization density along the way of a charged particle. For x-ray, γ, β radiation Q is = 1 Sv/Gy, for α radiation Q is = 20 Sv/Gy
Efficiency	Common abbreviation is EF. Ratio between measured count rate and activity. The efficiency can be stated as fraction or percentage (*100).
EFISYS	Special algorithm for continuous determination of the background
Fibre Detector Test rig	Measurement arrangement for RFD detector tests
FILICO	**Fi**bre **Li**ne **Co**mmunicator Mirion Technology (RADOS) –development especially used for Fibre-technology

Name Abbreviation	Description, Meaning
Gamma quantum	Energy quantum of short-wave electromagnetic radiation
Gross effect	Measurement value of background and applied radiation.
H13xxx	**H**erfurth13… A detector development by the Herfurth company , the predecessor of Mirion Technology (RADOS).
Half life	Physical: the period of time, in which half of the cores of radio nuclide decay. The half-lives are in the range of 31 magnitudes from 10^{24} to 10^{-7}.
HGZ	Herfurth Gas Zähler A gas detector development (shift detectors) by the Herfurth company , the predecessor of Mirion Technology (RADOS).
Hot spot	Small constituent with a very high activity. Possible hot spots have the same capability to jump as fleas. Therefore it is very difficult to locate them.
HS-5620	A CPU Board used with the ATEWIS cards.
IN2000	**In**put 2000 This Mirion Technology (RADOS) –development is a binary-input channel module to provide the information of optional added devices on RTM contamination monitors (like doors, barriers)
Integral efficiency local dose	Efficiency factor for the whole unit.
IO-Board	**In**put 2000 This Mirion Technology (RADOS) –development is a binary-input-output channel module to communicate with the Light box, modules and computer in fibre- technology monitors.
IRMOS	**I**ntegrated **R**adiation **Mo**nitoring **S**ystem Predecessor of CeMoSys™.
KON-R	See Atewis
light box	Converts light fluctuations into current or voltage fluctuations. In use for fibre- technology monitors, available in with 64 and 6 channel.
Inc	leading nuclide correlation
LPP	Labour Plateau Plotter Measurement arrangement for gas detector tests, Plateau detection.
MCII	MicroCont II A handheld device which carries out measurements for alpha, beta or gamma-radiation
Measuring effect	A value is measured which is significantly different from the background.
Median	The centre of a set of figures which are arranged by orders. The median separates a number set in two sub sets of equal size.

Name Abbreviation	Description, Meaning
Monitor	A device which carries out measurements independently within a period of time
MOWIN	Monitor Wirkungsgrad Nuklidverwaltung Predecessor of the System check module, the MOWIN switch is still in use for system check..
Net effect	Measured value after deduction of the background.
Nuclide	A nuclide is an atom characterised by its proton number, neutron number and its energy state. Presently more than 2500 different nuclides are known which are distributed to 109 known elements. More than 2250 of these nuclides are radioactive.
Option	Optional design of a RTM…
Partial efficiency	It's the efficiency of the individual detector.
PCI-Card	This Mirion Technology (RADOS) –development is used for computer connection is Fibre systems.
Photo multiplier	Converts light fluctuations into current or voltage fluctuations.
PIM	Person In Monitor → A Sensor to Stop the background and start personnel measurement in PCMs
Plast	Scintillation material, which is often called "plast" or "plastic" due to its material.
Operating point	Fixed setting of the high voltage at which all measurements are carried out.
Quantile	Numerical value which corresponds as multiple of a normalized standard distribution to a determined probability. In the co-ordinate system this means a value on the abscissa.
QNX **QNX4** **QNX6**	A microkernel-based, real-time, multi–tasking operating system. QNX is based on the idea of running most of the OS in the form of a number of small tasks, known as servers. This differs from the more traditional monolithic kernel, in which the operating system is a single very large program composed of a huge number of "parts" with special abilities. QNX4 – used until 2005 → QNX6 used since 2006
Radiation	Contrary to gamma radiation, which is a wave radiation, α and β radiation is a kind of particle radiation. α-particles are heavy particles. They have a very high binding energy. They are 2times loaded helium ions. In contrast to β-particles they are more difficult to measure, as they lose their starting energy rather quickly, while going through matter. α-particles ionise densely, β-particles however rather loosely. This difference is of great importance with respect to the damaging effect of the different kinds of radiation within the living tissue. β-particles are light-weight particles. They are electrons. Their average energy is by a factor 10 lower than the energy of the α-particles. (β energy lies in the range of 100 to 1000 keV, α particles in the range of 5 MeV).

Name Abbreviation	Description, Meaning
Radioactive substance	Also called radioactive source. Determined chemically unambiguous material, which emits radiation.
RadVision	Mirion Technology (RADOS) –development Truck Monitor product development.
RBP	RADOS Beta Plast Mirion Technology (RADOS) beta plast detector development
Reference nuclide	The most frequent nuclide which occurs in the plant.
RFD	RADOS Fibre Detector Mirion Technology (RADOS) Fibre™ detector development
RGZ	RADOS Gas Zähler Mirion Technology (RADOS) gas detector development
RLC	RADOS LAN Converter Mirion Technology (RADOS) –development used detector networks.
RMF-55	RADOS Mylar Fix Mirion Technology (RADOS) development glue for RFD Mylar foil
RNET	RADOS Network Mirion Technology (RADOS) for network with coaxial cable.
RPD	RADOS Plast Detektor Mirion Technology (RADOS) gamma plastic detector development
RTM	RADOS Technology Monitor Short for Mirion Technology (RADOS) contamination monitor developments.
Sensitivity	The proportion of the radiation part which reaches the detector and the actually measured counts. Often the term efficiency is also used in this respect.
Sievert	Unit name for the equivalent dose (Sv). ➔ 1 Sv = 100 rem.
Sigma factor	Multiplier of the normalized standard deviation. ➔ quantile
Solid angle	Similar to the scale of a circle, it is possible to subdivide a sphere which is described as solid angle. The unit is steradian.
System computer	PC which is used for controlling and data acquisition and preparation.
Task-switch	Procedure switching via software.
Working point	Firm setting of the high voltage, at which all measurements are carried out.

12 Supporting documents

Figure

12.1 QNX touch screen UI-overview

12.1.1 Touch screen keyboard

The touch screen keyboard is used to enter text and numbers, such as product location or parameter settings.
Depending on the submenu and field type, the intelligent keyboard may automatically suggest text or number keyboard as a default.

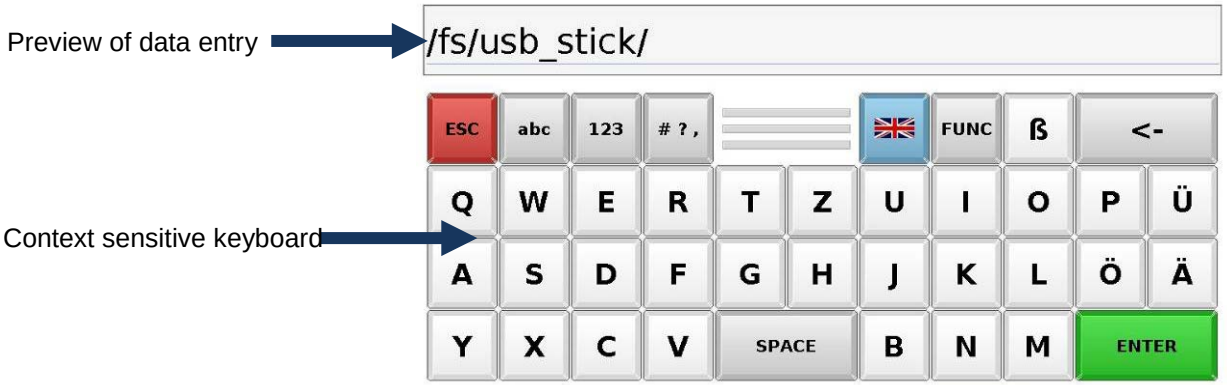


Figure 12-1: Touch screen text keyboard

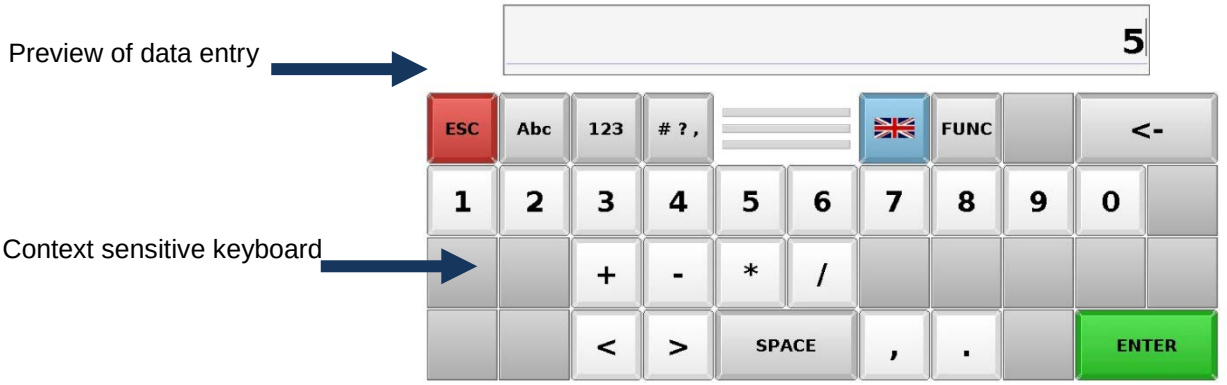


Figure 12-2: Touch screen number keyboard

Start typing just your index finger on designated symbol.
If you touch the wrong key, you can use the backspace-key(<-) to correct input. The letter isn't entered until you release your finger from the key.

Symbol	Name	Function/Description
abc	**Type lowercase**	Tap this key before tapping a letter in order to write in lower case.
Abc	**Type uppercase**	Tap this key before tapping a letter in order to write in upper case.
123	**Show numbers**	Tap the Number key to switch to number and punctuation keyboard view.
# ? ,	**Show symbols**	Tap this key to switch to symbols and signs keyboard view.
	Keyboard language layout	Change keyboard layout to match your preferences.

Table 12-3: Touch screen number keyboard

12.1.2 Touch screen menu icons

12.1.2.1 Radio button

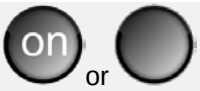
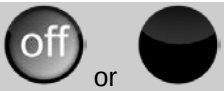
Symbol 1	Symbol 2	Description
		Radio button in software submenu → Function activated
		Radio button in software submenu → Function sustained
		Task process control step forward ←→step back

Figure 12-4: Touch screen menu icons– radio button

12.1.2.2 Recurrent menu controls

Symbol	Name	Function
	**back**	Leave the actual menu and return to maintenance main menu. (On context-sensitive menu links the previous menu will be called.)
	**Back to meas. mode**	Direct switch between maintenance and measurement mode.
	**save**	The button **save** (with pulsing red bulb) will be displayed directly after parameter have been altered.
	**save**	The button **save** (without pulsing red bulb) enables the user to save the data on a USB-Stick
	**load default**	Load factory parameter in the user software.
	**load**	Load priory saved parameter in the user software.
	**display**	The result of the last contamination measurement will be displayed.
	**delete**	Delete a dataset.
	**new**	Add new dataset
	**print**	Print actual screen display for filing.
	**user**	Change actual LogIn user
	**back**	**Back to main menu**
	**exit software**	Exit user software in case of restart, shutdown

Figure 12-5: Touch screen menu icons– recurrent menu controls

12.1.2.3 General menu controls

Symbol	Name	Description
	**accept**	Assume actual settings from menu or software module
	**adjust**	The inputs and settings in the menu or software module are accepted and saved.
	**history**	System protocol with status messages of all components and software routines
	**last result**	The last measurement result will be displayed including measurement details and place of contamination
	**select**	Select settings from sub menu or change selection filter in list display
	**service**	Switch from measurement mode to maintenance/service mode
	**Exit service**	Switch from maintenance/service mode to measurement mode
	**speaker**	Edit settings for voice support
	**reset**	Discard all changes and return to default settings (last saved settings)
	**meas. state**	Display actual measurement status, calculate mean value
	**all**	Select all channel/settings
	**all without small items**	Select all channel/settings without the small item
	**body**	Body detector channel/settings selection
	**back meas.**	Parameter setting for back measurement
	**front meas.**	Parameter setting for b front measurement
	**foot**	Parameter setting for foot measurement
	**hand**	Parameter setting for hand measurement
	**head**	Parameter setting for head measurement

Figure 12-6: Touch screen menu icons– general menu controls I

Symbol	Name	Description
	**small items**	Parameter setting for small items measurement
	**step by step**	Parameter setting step by step
	**exit door**	Start automatic exit door movement
	**entrance door**	Start automatic entrance door movement
	**head detector**	Start automatic head detector movement
	**high voltage**	Change high voltage settings on detector / PM box
	**light leakage**	Perform a software aided light leakage search
	**start/ stop**	Start / Stop contamination measurement
	**statistic**	Monitor statistic display
	**user admin**	Start user administration
	**out of service off**	Stop “out of service“ mode
	**out of service on**	Initiate “out of service“ mode
	**customer outputs**	Define customer specific outputs
	**general**	General Parameter setting
	**height sensor**	Height sensor setting
	**movement units control**	Parameter setting for movement units
	**process control**	Parameter setting for the measurement process
	**time delay**	Time delay settings
	**start mean value**	Calculation of the mean value in the selected time interval

Figure 12-7: Touch screen menu icons– general menu controls II

Symbol	Name	Function/Description
	**about**	Information about software revision and service department
	**detector alarm test**	Detector alarm test start
	**meas results**	Measurement results database
	**protocol**	System protocol with status messages of all components and software routines
	**statistic**	Monitor lifetime statistic display, since last start and overall
	**background reduction**	Background reduction parameter
	**background**	Background parameter
	**database**	Database parameter setting
	**measurement**	Measurement parameter setting
	**channel allocation**	Channel allocation display
	**detector state**	Detector state view and manual background measurement start
	**external devices**	External device status and component view
	**hardware**	Information on used hardware
	**I/ O**	In- and output status view
	**external measurement start**	call external measurement
		with key lock
		Start external measurement

Figure 12-8: Touch screen menu icons– general menu controls III

Symbol	Name	Function/Description
	**New user**	Create a new user in user administration
	**Delete user**	Delete a user in user administration
	**Login-user**	User indicator icon based on user level
	**Master**	
	**default user**	
	**Service**	
	**Superuser**	
	**User**	
	**background alarm level**	Define background alarm level
	**global**	Global system check settings
	**monitor condition**	Monitor criteria view for monitor condition report
	**edit**	Edit monitor condition criteria
	**delete**	Delete monitor condition criteria
	**new**	Add monitor condition criteria
	**export**	Export system check data
	**import**	Import system check data
	**nuclide vectors**	Call nuclide vector menu
	**Delete nuclide**	Delete a nuclide
	**New nuclide**	Add a nuclide

Figure 12-9: Touch screen menu icons–general menu controls IV

Symbol	Name	Function/Description
	**process**	View calibration processes
	**New process**	Add a calibration process
	**Delete process**	Delete a calibration process
	**start process**	Start a calibration process
	**system check**	Call system check setup
	**basic calibration**	Perform a basic calibration
	**calibration source**	Define a calibration source
	**material**	Define measurement material
	**scale status**	View scale status

Figure 12-10: Touch screen menu icons– general menu controls V

12.2 Test protocol

12.3 Software / License

12.4 Conformity documents

12.5 Third party documents