PTW

User Manual

MULTIDOS
T10004

Part 2
Application:
Dual Channel Dosimetry
Multi Channel Dosimetry
Analyzing Dynamic Fields with the Linear Array LA48
Constancy Checks with QC6Plus

firmware 2.40 or higher
from serial number 2000

Contents

Operating Manual   ☑
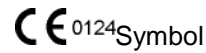
Technical Manual   ☑

Service Manual   ☑

General Information

– The product bears the CE-mark "CE-0124" in accordance with the Council Directive 93/42/EEC about Medical Devices and fulfills the essential requirements of Annex I of this directive.
The product is a class IIb device (MDD).

– Furthermore, MULTIDOS helps to fulfill the requirements of the Council Directive 97/43/EURATOM on health protection against radiation.

– **Product standard**
The product fully complies with the requirements of the following standards:
IEC 60731.

– **Electrical safety**
The product fully complies with the requirements of the following standards:
IEC 61010-1.

– **Electromagnetic immunity**
The product fully complies with the requirements of the following standards:
IEC 60601-1-2.

– The user manual is an integral part of the product. It should always be kept near the product. Observance of the manual is a prerequisite for proper product performance and correct operation.

– Operator safety, specified measuring accuracy, and interference-free operation can only be guaranteed if original products and parts are used. Furthermore, only the accessories listed in this manual are approved by PTW-Freiburg and only they or other accessories whose use has been expressly permitted by PTW-Freiburg may be used in conjunction with the product. Safe operation and proper product performance are not guaranteed if accessories or consumables from other manufacturers are used.

– PTW-Freiburg cannot be held liable for damage resulting from the use of accessories or consumables from other manufacturers or when the user ignores the instructions and information given in this manual.

– The warranty period is 1 (one) year and begins on the day of delivery.
It is unaffected by repairs covered by the warranty regulations.

– PTW-Freiburg only considers itself responsible for the safety, reliability, and performance of the product if the assembly, extension, readjustment, modification, or repair is carried out by PTW-Freiburg or by persons authorized by PTW-Freiburg, and if the product is used in compliance with the technical documentation.

– In case of any questions concerning the service, support, or warranty, please contact your supplier.

PTW

− This manual is in conformity with the product specifications and all applicable safety standards that are valid as at the printing date. All rights are reserved for devices, circuits, techniques, software, and names as referred to in the manual.

− PTW-Freiburg reserves the right to make modifications.
Please contact PTW or your local representative for the most current information concerning the products of interest.

− No part of the technical documentation may be reproduced without written permission from PTW-Freiburg.

− PTW-Freiburg is a registered manufacturer according to the ElektroG (Elektro- und Elektronikgeräte-Gesetz).
Elektro-Altgeräte-Register (EAR) Registration number DE15599992

− PTW-Freiburg works in strict accordance with a quality management system that is continuously updated according to the national and international standards.

CE 0124Symbol

Contents

Service Manual 79

List of Figures

List of Tables

Intended Use

MULTIDOS T10004 is a multi channel dosemeter that fulfills various tasks in radiotherapy.

The MULTIDOS user manual consists of two parts.

Part 1 describes the applications:

- multi channel dosemeter for patient dosimetry (In-vivo dosimetry)

- afterloading dosemeter for patient dosimetry (afterloading therapy)

Part 2 describes the applications:

- dual channel dosemeter for absolute dosimetry

- multi channel dosemeter for absolute dosimetry

- determination of the relative dose distribution (requires extender ME48 T10006)

- constancy checks in quality assurance inspections (requires measuring probe T42007)

Table 0-1 gives you a survey of the MULTIDOS applications.

MULTIDOS is a microprocessor-controlled dosemeter with up to 12 channels. Combined with the Extender ME48, it can be expanded to a total of 48 channels.

In dual channel dosimetry, MULTIDOS is used for absolute dosimetry applications with ionization chambers. It can also be used with semi-conductor detectors (M-type connector).

When used as a multi channel dosemeter, MULTIDOS employs ionization chambers or semi-conductor detectors for absolute dosimetry. The 12 measured values are displayed in two groups: channels 1 to 6 and channels 7 to 12. All 12 measured values are available at the RS232 interface.

Dynamic fields can be analyzed with the water phantom MP3/MP3-M and the Linear Array LA48 T34009 (including Extender ME48 T10006).

The QC6Plus measuring probe T42007 consisting of six detectors is used for constancy checks. For this purpose it is either directly mounted on the collimator or placed on the patient couch.

The software recommended for the application is given in Table 0-1. For changing the calibration factors you can also use the MultiCal software.

The different applications can be selected from a menu.

NOTE
Please observe the user manuals of all system components used!

	MULTIDOS applications	MULTIDOS menu item	Patient dosimetry IEC 60601*	QA-Measurement IEC 61010*		Detectors		Software
				Relative dosimetry	Absolute dosimetry	Ionization chamber	Semi-conduc-tor	
1	In-vivo dosimetry	Multi Channel	X				X	MultiSoft, VivoSoft
	Afterloading dosimetry	Afterloading	X				X	MultiSoft
2	**Dual channel dosimetry**	**Twin Dosemeter**			**X**	**X**	**X**	**MEPHYSTO mc², MultiSoft, UniSoft Edition 2000**
	Multi channel dosimetry	**Multi Channel**			**X**	**X**		**MultiSoft**
	Linear Array LA48	**Linear Array**		**X**		**X**		**BeamAdjust, MEPHYSTO mc², MLCSoft**
	Constancy checks with QC6Plus	**Constancy Check**		**X**		**X**		**QCWin**

* applicable safety standard

Table 0-1:   Recommended MULTIDOS applications

Safety Information

⚠ This is the safety alert symbol. It is used to alert the user to potential hazards. Obey all safety messages that follow this symbol to avoid possible bodily injury or equipment damage.

All safety messages consist of the following components:
– Safety alert symbol and signal word
– Type of danger
– Source of danger
– Consequence
– Measures to prevent hazards

Signal Words

> ⚠ **DANGER**
>
> Indicates an imminent hazard. If not avoided, the hazard will result in death or serious injury.

> ⚠ **WARNING**
>
> Indicates a hazard. If not avoided, the hazard can result in death or serious injury.

> ⚠ **CAUTION**
>
> Indicates a potential hazard. If not avoided, the hazard could result in minor injury or product / property damage.

> **NOTE**
>
> Provides useful information to ensure that you get the most from your equipment.

Safety Information

> ⚠ **DANGER**
>
> Operation in areas where an explosion hazard may occur or in oxygen-enriched atmospheres
>
> **Explosion Hazard!**
>
> The product is not suitable for operation in areas of risk where an **explosion** may occur. Explosion hazards may be caused by the use of combustible anaesthetics, skin-cleansing agents and disinfectants.
>
> Furthermore, the product is not suitable for application in **oxygen-enriched atmospheres.** The atmosphere is considered to be oxygen-enriched when more than 25 % of oxygen or nitrous oxide is added to the ambient air.

⚠ WARNING

Improper handling.

Patient Hazard!

The product is a medical electrical device and must only be handled by persons who are trained in the use of such equipment and are capable of applying it properly. The operator must be trained in the use of the device.

⚠ WARNING

Electricity is a source of risk, particularly when the product is not in perfect operating condition or when it is operated inappropriately.

Shock Hazard!

Strictly observe the following warnings. Failure to do so may endanger the lives of the patient, the user and other persons involved.

– Before using the product, the user must ascertain that it is in correct working order and operating condition.

– Before putting the device into operation, visually inspect all connection cables for signs of damage. Damaged cables and connectors must be replaced immediately.

– When disconnecting the device from the power line, first remove the plug from the wall outlet, then disconnect the power cord from the device.

– The product is a device of IEC 61140 protection class I. It may be put into operation only when connected to a properly installed power outlet with earthing contact.

⚠ WARNING

– Devices on which moisture condensation has developed as a result of temperature changes must not be switched on unless completely dry.

– Liquids must not enter the product. If liquids have entered the product, it must be thoroughly inspected before being used again.

– Do not use extension cords and multiple portable socket outlets (MPSO) to connect the device to the power line.

Exclusion of operation in the patient environment: Neither the product nor any peripheral devices may be operated in the patient environment (see Figure 0-1).

Exclusion of operation as a device with patient contact: The device is not intended for use in direct contact with the patient. Neither the device nor any peripheral device may have contact with the patient.

Exclusion of operation as a controlling instrument: The device is only designed for use as a measuring device. The device must not be used to control radiodiagnostic equipment or radiotherapy units.

⚠ **WARNING**

Electricity is a source of risk, particularly when the product is not in perfect operating condition or when it is operated inappropriately.

Shock Hazard!

Strictly observe the following warnings. Failure to do so may endanger the lives of the patient, the user and other persons involved.

Use of peripheral devices: Peripheral devices (PC, printer) may only be connected if they meet the requirements of IEC 60950-1 (UL 60950-1) or of standard IEC 61010-1.

Devices may be connected to other devices or to parts of systems only if it has been ascertained that this connection does not impair the safety of the patient, the operator or the environment.

If the device specifications do not contain information as to connecting the device to other equipment, you must consult the manufacturer of the other equipment or an expert about the effects of the connection on the patient, the operator or the environment. Always observe standards IEC 61010-1.

⚠ **WARNING**

Magnetic and electrical fields are capable of interfering with the proper performance of the device.

Equipment Failure!

– For this reason make sure that all external devices operated in the vicinity of the device comply with the relevant EMC requirements. X-ray equipment, MRI devices and radio systems are possible sources of interference as they may emit higher levels of electromagnetic radiation. Keep the device away from these devices and verify its performance before use.

– The use of cables longer than specified may impair the electromagnetic compatibility characteristics of the device.

– The device should not be used in the immediate vicinity of or placed on top of or below other equipment. However, if the application requires an arrangement of devices as described above, the device should be watched to ensure its proper functioning in the specific arrangement.

– The customer or user of the device should assure that it is used in an electromagnetic environment as described in IEC 60601-1-2.

⚠ WARNING

Use of the product without observing the user manual.

Bodily Injury! Equipment Damage!

No modification of this equipment is allowed.

Do not modify this equipment without authorization from the manufacturer.

If this equipment is modified, appropriate inspection and testing must be conducted to ensure continued safe use of the equipment.

⚠ WARNING

Use of the product without observing the user manual.

Patient Hazard! Shock Hazard!

In all applications, connect only the detectors needed for the application.

⚠ WARNING

Hazards originating from other system components.

Patient Hazard! Equipment Damage!

Follow the safety information provided in the user manuals of all system components.

⚠ CAUTION

Use of the product without observing the user manual.

Bodily Injury! Equipment Damage!

Always use the product in compliance with the user manual. Otherwise the intended protection can be reduced.

Use the product only in conjunction with the products approved for this purpose by PTW and/or the products listed in the section "Intended Use".

Handle the product with care to avoid equipment damage.

⚠ CAUTION

Operation or storage in radiation

Equipment Damage!

MULTIDOS is a sensitive measurement device.

– Do not expose MULTIDOS to direct or scattered radiation.

– Do not store MULTIDOS in the treatment room.

– Make sure that MULTIDOS is maintained regularly according to section 16.

⚠ CAUTION

Improper handling.

Equipment damage!

Always use the supplied caps to cover connectors not used for the application.

⚠ CAUTION

Operation under inadequate ambient conditions.

Equipment Damage!

Before connecting the device to the power line, make sure that line voltage and frequency are equivalent to the ratings indicated on the nameplate of the device. Check whether the device is set to the voltage of your power line (refer to section 17).

Set up the device in a location which affords sufficient ventilation.

Always observe the ambient conditions as indicated in the `Technical Specifications`.

⚠ CAUTION

Improper handling.

Equipment damage! Cable damage!

The cables T26024-x and T26011-x are super-sensitive dosimetry cables! In order to avoid damage to the cables, you have to observe the following points.

− Do not kink the cables. Observe the minimum bending radius of 85 mm. Never exert pressure on the cables. Do not step on the cables. Do not roll trolleys over the cables. Do not pull or twist the cables.

− Disconnect the cables from the devices during transport and when the devices are not in use. Do not let the cables hang down unrestrained.

− The connectors must always be clean. Do not allow the connectors to lie on the floor. Always protect connectors when pulling them through cable conduits.

NOTE

Please observe the user manuals of all system components used!

NOTE

Set up the device so that the operator has a clear, unobstructed view of the control panel.

NOTE

Do not set up the device in a position in which the disconnecting device is difficult to operate.
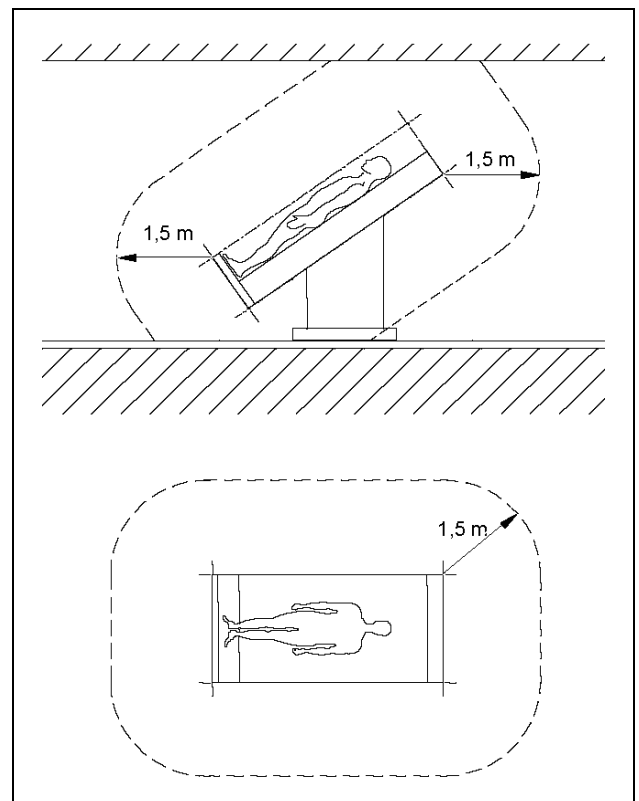
Figure 0-1:   Definition of patient environment

Symbols on the Nameplate

Symbol	Description
	Follow the user manual.
	Please refer to the user manual!
CE 0124	The product bears the CE-mark.
ETL CLASSIFIED Intertek	The product is certified by ETL (Electrical Testing Laboratories) for both the U.S. and Canadian markets, to the applicable U.S. and Canadian standards.
	Device Type BF according to IEC 60601-1
	Manufacturer and date of manufacture
REF	Reference number
SN	Serial number
	Separate collection for electrical and electronic equipment! (refer also to section "Disposal of the Product")
	Labeling according to "Administration on the Control of the Pollution caused by Electronic Information Products (ACPEIP)" (China RoHS)

For a description of additional symbols, if applicable, please refer to the equipment description.

Operating Manual

1 Description of the Device
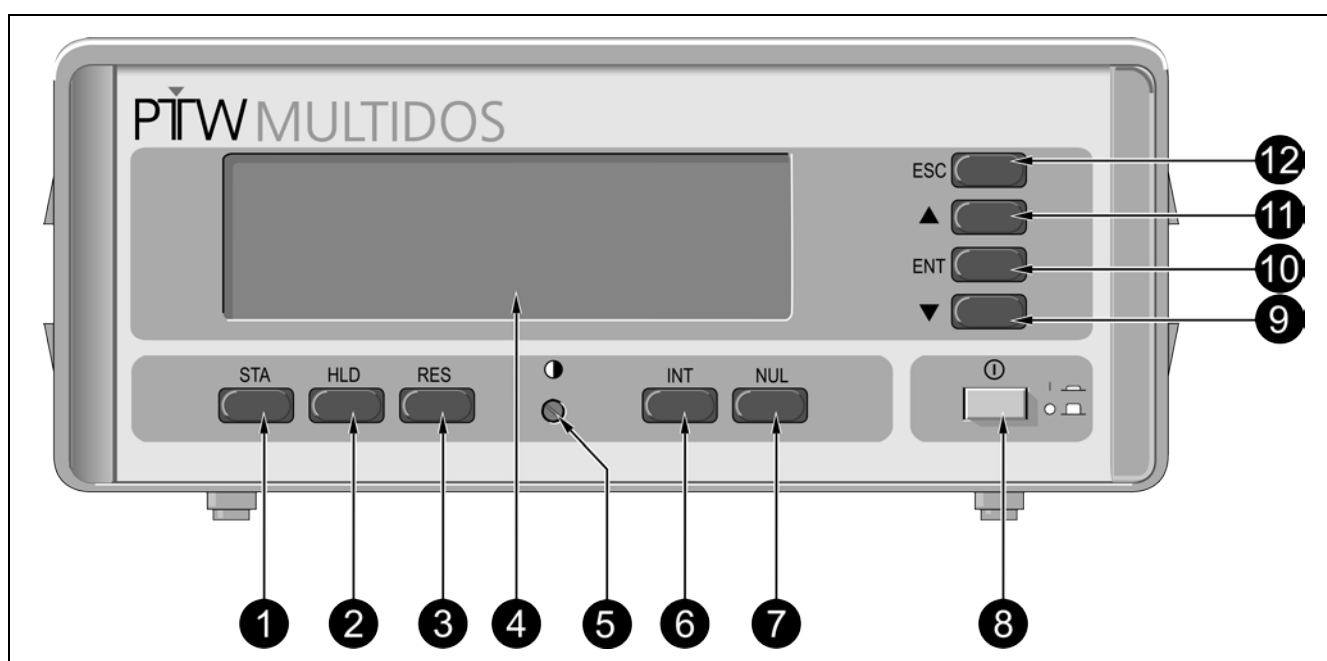
Figure 1-1:   Front panel of MULTIDOS

Controls and indicators	Symbol
1 Key to initiate a measurement	STA
2 Key to freeze the display (without interrupting measurement)	HLD
3 Key to terminate a measurement, resetting the display to zero	RES
4 Liquid-crystal display	none
5 Contrast adjustment	◑
6 Key to initiate a dose measurement for a preset interval (at the end of the interval the readings remain on display)	INT

	Symbol
7 Key to initiate the automatic zero adjustment	NUL
8 Key to turn the unit on and off - power switch -	⏽
9 Cursor control and key to decrease numeric values	▼
10 Key to confirm entries	ENT
11 Cursor control and key to increase numeric values	▲
12 Key to clear menus without saving entries or selections	ESC
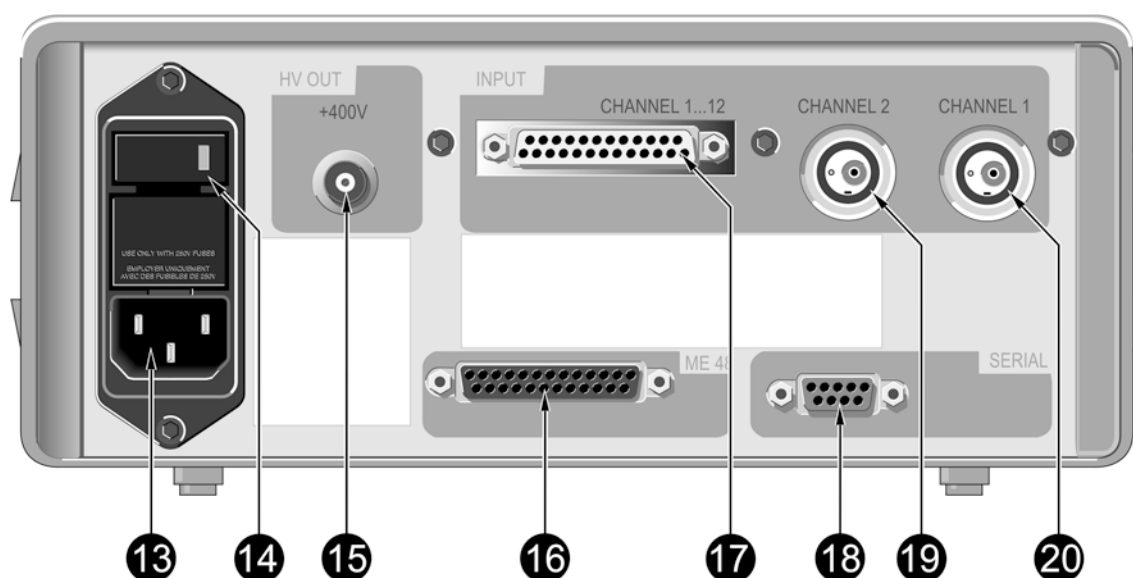
Figure 1-2:   Rear panel of MULTIDOS

Controls and indicators	Symbol
13 *Power input*	none
14 *Line voltage selector, instrument fuses*	none
15 *High-voltage output for the QC6Plus measuring plate or ionization chambers with detector connection box*	HV OUT +400V
16 *Port for connection of the extender ME48 (connecting cable T10006.1.003)*	ME48
17 *Signal inputs for channels 1 to 12 (with detector connection box)*	CHANNEL 1…12
18 *Serial port for connection of a PC (with PTW software)*	SERIAL
19 *Signal input for channel 2 (dual channel dosimetry)*	CHANNEL 2
20 *Signal input for channel 1 (dual channel dosimetry)*	CHANNEL 1
Fuse	⊟

2 Putting MULTIDOS Into Operation

> ⚠ **WARNING**
>
> Use of the product without observing the user manual.
>
> **Patient Hazard! Equipment Damage!**
>
> Follow the safety information provided in the section "Safety Information" and in the user manuals of the detectors.

> ⚠ **WARNING**
>
> Use of the product without observing the user manual.
>
> **Patient Hazard! Shock Hazard!**
>
> In all application, connect only these detectors which are needed for the application.

> ⚠ **CAUTION**
>
> Operation or storage in radiation
>
> **Equipment Damage!**
>
> MULTIDOS is a sensitive measurement device.
>
> – Do not expose MULTIDOS to direct or scattered radiation.
>
> – Do not store MULTIDOS in the treatment room.
>
> – Make sure that MULTIDOS is maintained regularly according to section 16.

- Check whether the device is set to the voltage of your power line. Refer to section 17.

- Connect MULTIDOS to the power line.

- Push the power switch to turn on MULTIDOS (Figure 2-1).
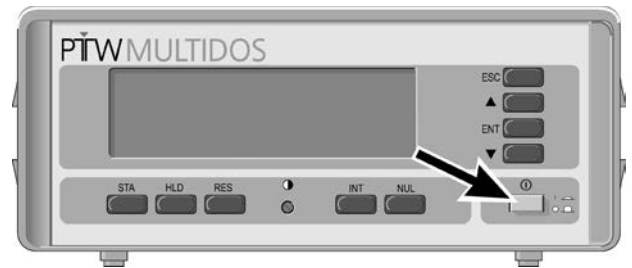
Figure 2-1:   Power switch

MULTIDOS will briefly show the start-up screen (Figure 2-2) and then the measuring screen. After power up and during operation MULTIDOS runs automatic self-tests.
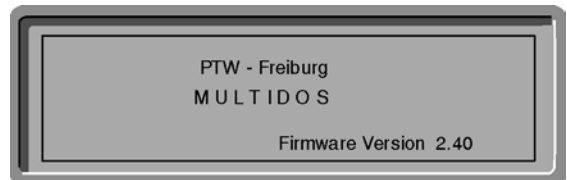
Figure 2-2:   Start-up screen

If the screen texts are in German, please refer to section 3.1 for instructions how to select the English language.

When turned on, MULTIDOS will always reactivate the last application mode. Please refer to section 3.2 for instructions how to change the application mode.

The measuring setup depends on the application and is described in the corresponding sections.

3 General System Settings

3.1 Setting the Language

The screen texts may be displayed in English or German.

- Position the cursor with ▲ and ▼ on "Setup..." (Figure 3-1) and press ENT.

```
Linear Array                        Calib...

min (24) = 0.000              Reference
max (24) = 0.000              0.000mGy
Center   = 0.000              RES        0.0s

Dose                                 Setup...
```
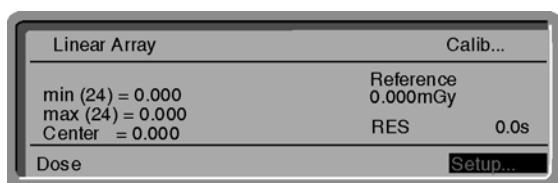
Figure 3-1:   Cursor on "Setup..."

The setup menu of the selected application will be displayed, e.g.:

```
Linear Array  -  Setup
■Reference         Chamber
■Interval Time     0010 s
■Unit              Gy/min
■Language          English
■RS232...
■More...
```
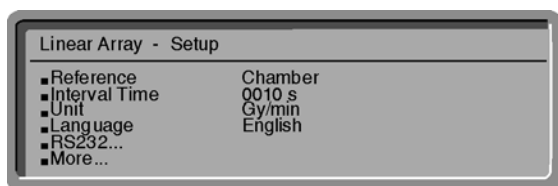
Figure 3-2:   Setup menu Linear-Array

- Using the cursor keys, position the cursor on "Language" and press ENT.

- Select the language. Then press ENT to confirm the selection.

- Press ESC to quit the setup menu.

3.2 Setting an Application

If MULTIDOS does not display the measuring screen of the application you wish to use, proceed as follows:

- Using the cursor keys ▲ and ▼ position the cursor on the application label (for instance, on "Multi Channel" Figure 3-3).

```
Multi Channel      SetMC2  CorrOff      Calib...
1: 0.000m          4: 0.000m            Unit:
2: 0.000m          5: 0.000m            Gy
3: 0.000m          6: 0.000m
                              RES        0.0s
Dose               1-6       Low        Setup...
```
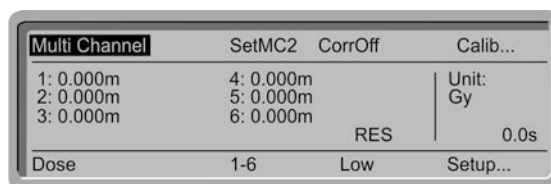
Figure 3-3:   Cursor on "Multi Channel"

- Press ENT.

The application menu will be displayed.

```
Multi ⬚ Twin Dosemeter                  Calib...
1: 0.0 Multi Channel Dosemeter
2: 0.0 Afterloading                     Unit:
3: 0.0 Constancy Check                  Gy
       Linear Array
                                        0.0s
Dose               1-6       Low        Setup...
```
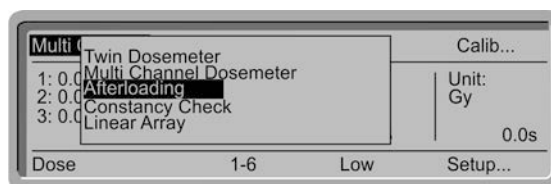
Figure 3-4:   Box to select the application menu

- Using the cursor keys again, select another application ("Afterloading", for instance) and confirm your selection with ENT.

MULTIDOS will briefly show the start-up screen.

- The application menu can be aborted with ESC. In this case, the device continues with the application unchanged.

3.3 Selecting the Unit of Measurement

> **⚠ CAUTION**
>
> Improper handling.
>
> **Malfunction!**
>
> If you choose the measurement unit "A"
>
> – all radiological factors will be ignored
>
> – on the measuring screen "Charge" will be displayed instead of "Dose" and "Current" instead of "Doserate".

Table 3-1 shows the available units of measurement for Dual Channel Dosimetry, Multi Channel Dosimetry, Afterloading Dosimetry and Linear Array.

Setting	Unit for charge / dose measurement	Unit for current / dose rate measurement
A	C (Coulomb)	A (Ampere)
Gy/s	Gy (Gray)	Gy/s (Gray per second)
Gy/min	Gy (Gray)	Gy/min (Gray per minute)
Gy/h	Gy (Gray)	Gy/h (Gray per hour)

Table 3-1: *Available units of measurement for Dual Channel Dosimetry, Multi Channel Dosimetry, Afterloading Dosimetry and Linear Array*

Table 3-2 shows the available units of measurement for Constancy Check.

Setting	Unit for charge / dose measurement	Unit for current / dose rate measurement
A	C (Coulomb)	A (Ampere)
Gy/s	Gy (Gray)	Gy/s (Gray per second)
Gy/min	Gy (Gray)	Gy/min (Gray per minute)
Gy/h	Gy (Gray)	Gy/h (Gray per hour)
%	% (for channel 5)	% (for channel 5)

Table 3-2: *Available units of measurement for Constancy Check*

Proceed as follows to select the unit of measurement:

- Position the cursor with ▲ and ▼ on "Setup..." (Figure 3-5) and press ENT.
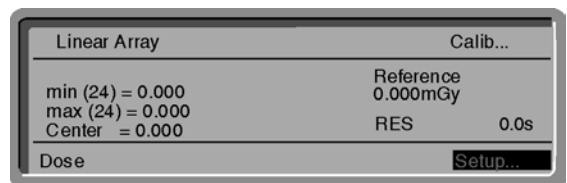
Figure 3-5: *Cursor on "Setup..."*

The setup menu of the selected application will be displayed, e.g.:
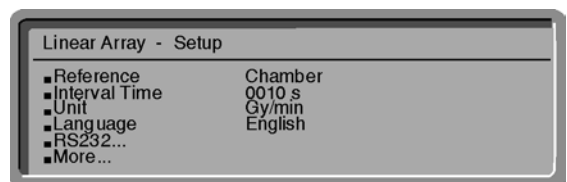
Figure 3-6: *Linear Array - setup menu*

- Using the cursor keys, position the cursor on "Unit" and press ENT.

- Select the unit of measurement with the cursor keys. Then press ENT to confirm the selection.

- Press ESC to quit the setup menu.

NOTE
If the values are measured in "A" (Ampere), the set selection window / correction menu will not be displayed in the applications.

3.4 Setting Up the RS232 Interface

- Position the cursor with ▲ and ▼ on "Setup..." and press ENT.

- Using the cursor keys, position the cursor on "RS232..." and press ENT.

The cursor flashes on the baud rate. To select another baud rate

- Press ENT and select the appropriate baud rate (4800, 9600, 19200 or 38400) with one of the cursor keys.

Now you can either quit the menu with ESC or position the cursor on "Handshake".

- Press ENT and select the handshake protocol (RTS / CTS) or "None".

- Confirm your selection with ENT, then quit the menu with ESC.

3.5   Testing the LCD

- Select the "Twin Dosemeter", "Linear Array" or "Multi Channel Dosemeter" application.

- Position the cursor with ▲ and ▼ on "Setup..." and press ENT.

- Using the cursor keys, position the cursor on "More..." and press ENT.

The cursor flashes on "Display Test":

```
Multi Channel  -  More

▪Display Test

Multidos S/N          000032
Firmware Version      2.40
Hardware Revision     B02
```
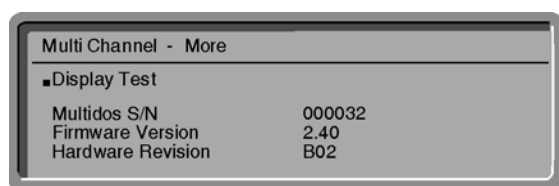
Figure 3-7:   "More" in - setup menu

- Press ENT to initiate the display test.

The test is fully automatic.

For each channel that can be displayed on the screen MULTIDOS consecutively shows the possible digits, units, and general error messages. The display test allows you to check all characters for integrity.

- Quit the menu with ESC.

4   Measurement Control Functions

4.1   Setting the Measuring Mode

You can toggle between the dose and dose rate measuring modes. Both measurements are performed simultaneously, but their status is not necessarily the same. The dose rate measurement, for instance, may be active ("RUN"), while the dose measurement is inactive ("RES"). The dose measuring values are obtained by numeric integration of the dose rate values.

• Position the cursor on the measuring mode label, for instance, on "Doserate" (Figure 4-1).

• With ENT you can now toggle between the two modes, dose and dose rate.

Figure 4-1:   Cursor on "Doserate"

Figure 4-2:   "Dose" measuring mode selected

4.2   Measurement Controls

Measurements are controlled with the keys STA, HLD, RES, INT and NUL (Figure 4-3).
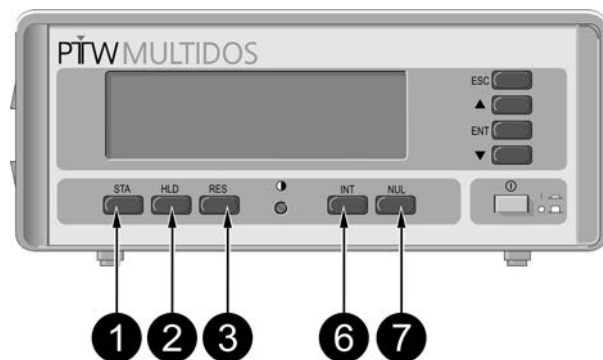
Figure 4-3:   Measurement controls

1 STA key to initiate a measurement

2 HLD key to hold a measurement without interrupting it

3 RES key to terminate a measurement, resetting the display to zero

6 INT key to initiate a dose measurement for a preset interval (at the end of the interval the readings remain on display)

7 NUL key to initiate the automatic zero balancing

4.2.1 Dose Measurement

> ⚠ **CAUTION**
>
> Improper handling.
>
> **Malfunction!**
>
> If you choose the unit of measurement "A" (refer to section 3.3), all radiological factors will be ignored and on the measuring screen "Charge" will be displayed instead of "Dose" and "Current" instead of "Doserate".

Select the "Dose" measuring mode as described above.

STA This key initiates the measurement. The displayed values and the measuring time are reset to zero. The status flag reads "STA".

HLD The displayed values and measurement timer are frozen, while the actual measurement continues. The status flag reads "HLD". Pressing HLD again will unfreeze the display and update the values.

INT This key initiates an interval measurement. The status flag reads "INT". An interval measurement is a dose measurement that changes to the HLD (hold) status after the interval time entered in the Setup menu has elapsed. When the measurement starts, the interval time is briefly displayed in the timer window. The display indicates the value measured since the start of the measurement, and the elapsed time.

RES This key terminates the measurement. The measured values and the timer are reset to zero.

NUL Adjusts the measuring system to zero. The status flag reads "NUL". The zero balancing can be performed if no radiation is applied to the connected detector. The adjustment takes about 30 seconds. Allow for a warm-up and stabilization time of about 15 minutes before initiating the zero balancing. The procedure can be aborted with the RES key.

4.2.2 Dose Rate Measurement

The dose rate measurement starts as soon as you select this mode (status flag "RUN"). The keys STA, INT and RES are disabled. Each time a dose measurement is initiated, the timer is reset to zero (synchronized).

HLD The displayed values and measurement timer are frozen, while the actual measurement continues. The status flag reads "HLD". Pressing HLD again will unfreeze the display and update the values.

NUL Adjusts the measuring system to zero. The status flag reads "NUL". The zero balancing can be performed if no radiation is applied to the connected detector. The zero balancing takes about 30 seconds. Allow for a warm-up and stabilization time of about 15 minutes before initiating the zero balancing. The procedure can be aborted with the RES key.

4.2.3 Entering the Interval Time

• Position the cursor on "Setup..." and press ENT.

The setup menu will be displayed.

• Using the cursor keys, position the cursor on "Interval time" and press ENT.

The cursor flashes on the first digit.

• Increase the digit with ▲ or decrease it with ▼. Then press ENT to confirm the new digit.

The cursor moves to the next digit.

• Proceed in the same manner for all digits to be changed. When you have entered the last digit, press ESC to quit the menu.

You can abort entry of a new value at any time by pressing ESC. In this case the system would continue with the previously entered time.
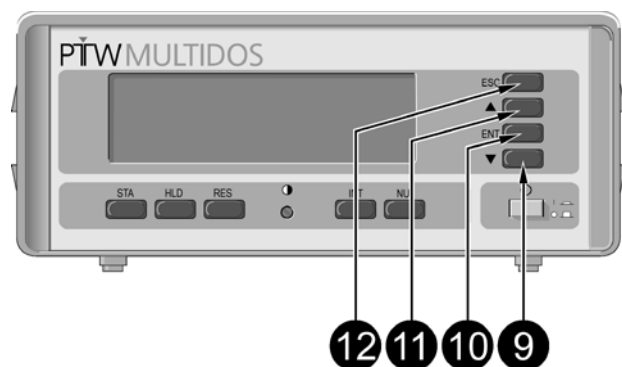
Figure 4-4:   Keys ENT, ESC, ▲ and ▼

9 *Cursor control ▼ and key to decrease numeric values*

10 *ENT key to confirm entries*

11 *Cursor control ▲ and key to increase numeric values*

12 *ESC key to clear menus without saving entries or selections*

5 Brief Operating Instructions

- Connect all system components needed for the measurement (refer to the corresponding application).

- Turn on the system.

- Select the application (section 3.2).

- Check the interface configuration (section 3.4).

- Select the unit of measurement (section 3.3).

- Select the appropriate measuring quantity (dose, dose rate, current, charge).

- Select the detector set. Check the calibration data. Check the consistence of entered and used detectors (serial numbers).

- For vented detectors:
  Enable air density correction and verify the values for ambient temperature and atmospheric pressure.

- For Linear Array LA48 measurements against reference:
  Select the reference unit (chamber, monitor).

- Select a measuring range.

- Additional step for interval measurements:
  Select the interval time (section 4.2.3).

- Start the device, then wait about 15 minutes before zero balancing.

- Press STA to initiate the measurement (section 4.2.1).
  For interval measurements: Press INT to initiate the measurement.

6 Dual Channel Dosimetry

6.1 The Basics

> ⚠ **WARNING**
>
> Use of the product without observing the user manual.
>
> **Patient Hazard! Equipment Damage!**
>
> Follow the safety information provided in the section "Safety Information" and in the user manuals of the detectors.

> ⚠ **WARNING**
>
> Improper handling.
>
> **Shock Hazard! Erroneous Measurement!**
>
> When used in dual channel dosimetry, no detector connection box must be connected to port *17*.

> ⚠ **CAUTION**
>
> Operation with radiation.
>
> **Erroneous Measurement!**
>
> In all applications with ionization chambers, MULTIDOS has to be protected against scattered radiation.

In dual channel dosimetry, MULTIDOS is used for absolute dosimetry applications with ionization chambers. It is a field class therapy dosemeter according to IEC 60731.

It can also be used with semi-conductor detectors (M-type connector).

When using MULTIDOS for dual channel dosimetry, we recommend using the MEPHYSTO mc², UniSoft Edition 2000, or MultiSoft software as well. For changing the calibration factors, you can use the MultiCal software.

6.2 Connecting MULTIDOS and Putting It Into Operation
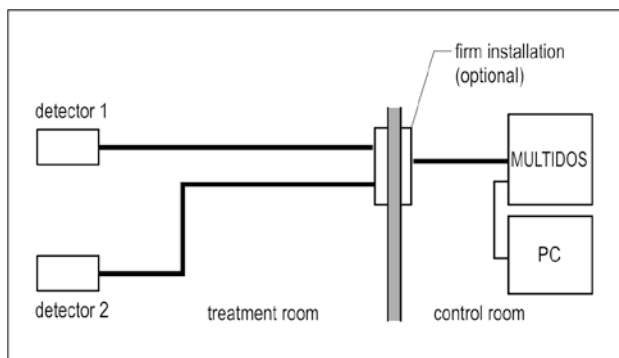
Figure 6-1: *Installation of the system components in the treatment room and in the control room*
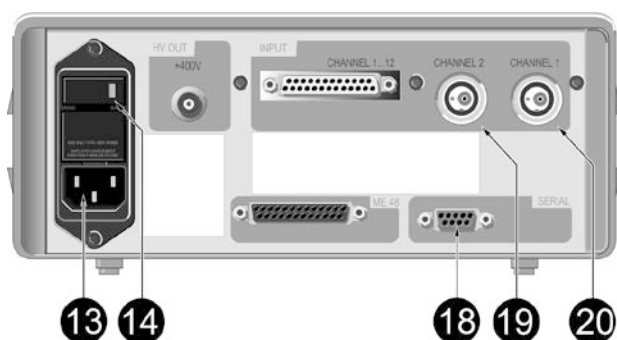
Figure 6-2: *Rear panel of MULTIDOS*

13 *Power input*

14 *Voltage selector, instrument fuses*

18 *SERIAL port for connection of a PC*

19 *Port for ionization chamber or semi-conductor detector (M-type connector), channel 2*

20 *Port for ionization chamber or semi-conductor detector (M-type connector), channel 1*

- Connect the ionization chambers or semi-conductor detectors (M-type connector) to inputs *19* and *20* of MULTIDOS.

- If you also use a PC (with PTW software), connect the PC to the serial port *18* of MULTIDOS.

- Check that the voltage selector *14* is set to the rating of the local power line. If the setting is not correct, refer to section 17 for instructions how to set MULTIDOS to another line voltage.

- Connect MULTIDOS to the power line (power input *13*).

- Push the power switch to turn on MULTIDOS.

MULTIDOS will briefly show the start-up screen and then the measuring screen (Figure 6-3). After power up and during operation MULTIDOS runs automatic self-tests.

When turned on, MULTIDOS will always reactivate the last application mode. Please refer to section 3.2 for instructions how to change the application.

6.3 Measuring Screen

The measuring screen Figure 6-3 presents informa-tion and controls. Menus for changing the settings are callable via the control.
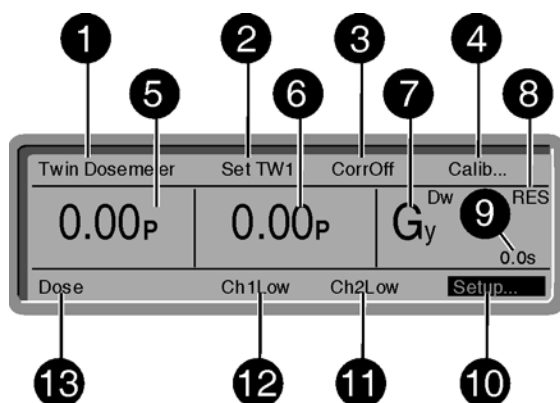
Figure 6-3:   *Measuring screen for Dual Channel Dosimetry (dose measurement, ab-solute values)*

1 *Selected application, refer to section 3.2*

2 *Selected set of radiological calibration factors, refer to section 6.4.1. You can choose among 5 sets labelled SetTW1 to SetTW5.*

3 *Selected correction, switched on/off; refer to section 6.4.2*

4 *Displays the calibration menu, refer to sec-tion 6.4.3*

5 *Display measured value channel 1*

6 *Display measured value channel 2*

7 *Display unit of measurement, If the measuring device is not calibrated for the selected unit of measurement, the message "uncalibrated" flashes below the measuring value of channel 1 (5, Figure 6-3). When set up for radiological units, the measuring quantity to which the two calibration factors of the selected set apply (D_w = absorbed dose to water, K_a = air kerma) is dis-played. Refer to section 3.3*

8 *Status flag; refer to section 4.2*

9 *Dose measurement time, During interval meas-urements the interval time is briefly displayed in this field. RES will reset the clock to zero.*

10 *Displays the setup menu*

11 *Selected measuring range channel 2 (low / high); refer to section 6.4.7*

12 *Selected measuring range channel 1 (low / high); refer to section 6.4.7*

13 *Display measuring quantity (dose, dose rate); refer to section 4.1. You can choose either dose or dose rate measurements and charge or cur-rent measurement.*

Explanation to display of measured value for channel 1 and 2

The measuring values of channels 1 and 2 (**5** and **6**, Figure 6-3); the system can display the absolute values or the ratio obtained by dividing the value of channel 2 by the value of channel 1 (given in %) (**1**, Figure 6-4).
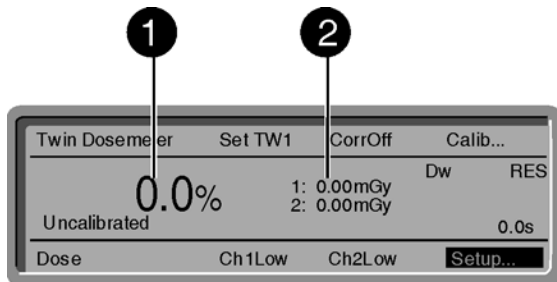
Figure 6-4:   *Measuring screen for Dual Channel Dosimetry (dose measurement, relative values)*

1   *Relative value*

$$\frac{\text{measuring value channel 2}}{\text{measuring value channel 1}} \times 100\ \%$$

2   *Absolute values of channels 1 and 2*

Furthermore, the display will show the signal strength of each channel above the measuring value (or to the left of the absolute values if the relative values are indicated):

     ** flashing on display
     The displayed measuring value is based on a measurement with a resolution below 1 %, meaning that the display is less than 100 times the resolution.

     * flashing on display
     The displayed measuring value is based on a measurement with a resolution below 0.5 % meaning that the display is less than 200 times the resolution.

     nothing flashing on display
     The resolution of the displayed measuring value is 0.5 % or better.

Relative values between 0.0% and ±9999.9% can be displayed (resolution 0.1%). When the values exceeds the display range, ####.# will appear.

Caution:
Details on the Signal Strength Indication

In integral measurements both the numeric resolution of the integral measuring value as well as the signal strength of the instantaneous measuring value on which the integral measuring value was based are taken into account. Thus the signal strength of an integral measuring value can never exceed that of the underlying instantaneous measuring value.

Since the values calculated by MULTIDOS are much more accurate than the displayed values, in borderline situations one and the same value might be annotated with ** or * (or with * or no *).

If, in the course of a measurement, a menu is activated or a window for the selection of a set or measuring range is opened, the signal strength control will be interrupted for this period of time.

There is no signal strength control while the integral value calculation is set to RES.

6.4 Settings

NOTE
If the values are measured in "A" (Ampere), the set selection window and the correction window will not be displayed.
To change the unit, refer to section 3.3.

6.4.1 Selecting the Calibration Set

⚠ CAUTION
Use of the product without observing the user manual.
Erroneous Measurement!
Before running a measurement, always check whether the selected set of calibration factors matches the detectors. The calibration factors can be viewed and edited from the calibration menu.

In dual channel dosimetry applications MULTIDOS handles 5 sets of calibration factors. This means that up to 5 different detector sets can be used in conjunction with MULTIDOS, if used as a stand-alone unit.

To view the existing sets and select another one:

- Using the cursor keys, position the cursor on "Set TWx" (**2**, Figure 6-3) and confirm the selection with ENT.

This opens a window showing all calibrated sets (Figure 6-5).
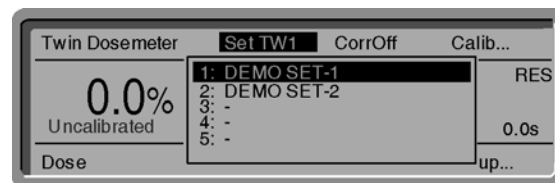
Figure 6-5:   Set selection window

The currently selected set is displayed in reverse video. To select another set:

- Use the cursor keys to position the cursor on the new set and confirm your selection with ENT.

Selecting a new set in the course of a measurement will abort that measurement. If you decide to continue with the current set, press ESC.

6.4.2 Enabling / Disabling the Correction Function

NOTE

If you change any of the settings in this menu while a measurement is in progress, the measurement will be aborted when you quit the menu.

The correction factors ("k") entered here will be cleared when MULTIDOS is turned off. During a reset, however, (press RES while holding ESC down) they are retained.

If measuring in electrical units, the measuring device will not display the menu item "CorrOff" or "CorrON". Corrections will not affect the electrical measuring values.

"CorrOff"/"CorrOn" (Figure 6-6) will display the correction menu.
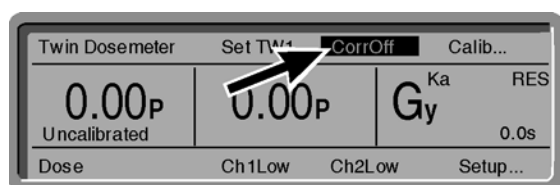
Figure 6-6: *"CorrOff"/"CorrOn" to display the correction menu*

If the display indicates "CorrOn", the correction function is enabled. If the display indicates "CorrOff", the correction function is disabled.

⚠ CAUTION

Improper handling.

Erroneous Measurement!

If using semi-conductor detectors, disable the air density correction.

The correction can be changed as follows:

- Using the cursor keys, position the cursor on "CorrOn" / "CorrOff" and press ENT.

The correction menu will appear with the cursor flashing on "Correction" (Figure 6-7).
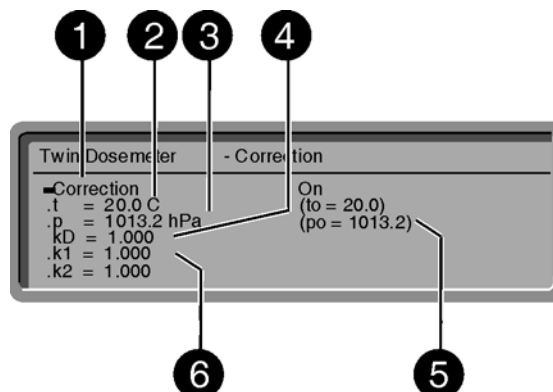
Figure 6-7: *Correction menu*

1 Air density correction on/off
2 Ambient temperature
3 Atmospheric pressure
4 Air density correction factor k_D derived from 2 , 3 and 5
5 Display of reference temperature and air pressure
6 Overall correction factor "k"

- Press ENT. Select the correction function with one of the cursor keys to "On" / "Off".

- Confirm the selection with ENT.

→ If the display indicates "Air density correction: Off" the correction function is disabled.
   Press ESC to quit the menu.

→ If the display indicates "Air density correction: On" the correction function is enabled. The current values for correction are displayed (Figure 6-7).
   You can now change the values in this window. Otherwise press ESC to quit the menu.

NOTE

When toggling the correction function on "CorrOn"), you will have to change any of the parameters t, p, k1 or k2 or to confirm one of the parameters with ENT for the switchover to become effective. Otherwise the "CorrOff" message continues to be displayed and the values will not be corrected.

If the correction function is enabled, you can enter the ambient temperature and atmospheric pressure in the correction menu (Figure 6-7).

- Position the cursor on the parameter to be changed ("t", for instance) and press ENT.

The cursor flashes on the first digit.

- Increase the digit with ▲ or decrease it with ▼. Press ENT to confirm the new digit.

The cursor moves to the next digit.

- Proceed in the same manner for all digits to be changed. Confirm the new temperature value with ENT.

- Now you have two options: quit the menu with ESC or change the atmospheric pressure value "p". This value can be changed as described above.

The admissible ambient temperature range extends from 10.0 °C to 40.0 °C, the atmospheric pressure range from 500.0 hPa to 1300.0 hPa. The values entered here are also used in the multi channel dosimetry and constancy check applications.

The factory-set reference temperature (**5**,. Figure 6-7) may be 20 °C or 22 °C. Please verify that the entered calibration factors apply to the set reference temperature.

The device automatically calculates the resulting air density correction factor "k_D". This factor is applied to both measuring values. The correction factor is calculated after the following formula:

$$k_D = \frac{p_0 * (t + 273.2)}{p * (t_0 + 273.2)}$$

t_0 20 °C oder 22 °C
p_0 1013.2 hPa

Furthermore, you can enter an additional special correction factor "k" for dual channel dosimetry for each of the two channels. Any value between 0.500 and 2.000 can be entered for the correction factor "k" (**6**, Figure 6-7). You can enter different values for the two channels.

6.4.3 Displaying the Calibration Factors

- Position the cursor on "Calib..." (**4**, Figure 6-3) and press ENT.

The calibration menu for the selected set will appear (Figure 6-8).

The calibration menu allows you to review the calibration factors of all sets. It is not necessary to load the set to be reviewed.

To view the data of other sets, proceed as follows:

- Position the cursor on "Set" and press ENT. Using the cursor keys to choose a set.

- Press ENT to display the data of the selected set or press ESC to return to the main menu.
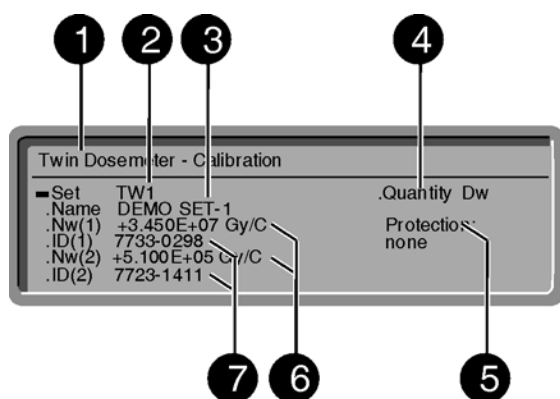
Figure 6-8:   Calibration menu

1   Selected application

2   ID of the displayed set (here: SetTW1)

3   Name of selected set

4   Measuring quantity to which the calibration factors applies

5   Protection level

6   Radiological calibration factors N for channels 1 and 2

7   Channel IDs for channels 1 and 2

6.4.4 Entering or Editing the Set Name or Channel ID

A set name may consist of up to 19 characters. You should specify different channel IDs for the individual channels. The maximum length of an ID is 15 characters. The ID may be the type and the serial number of the connected detector.

Follow the instructions to enter or edit a set name or channel ID:

- Using the cursor keys, position the cursor on "Name" or "ID" and press ENT.

The cursor flashes on the first entry position. First of all you determine the kind of character to be used (small or capital letter, numeral or blank), then you proceed to choosing the actual character to be entered. You confirm an entry with ENT and the cursor will move to the next entry position.

- To enter a capital letter, press STA ("A" will be displayed).

- To enter a small letter, press INT ("a" will be displayed).

- To enter a numeral, press NUL ("0" will be displayed).

- To enter a blank, press RES.

- To repeat the character entered last, press HLD.

- Then select the character to be entered, using the cursor keys (ASCII assignment) and confirm your selection with ENT.

As soon as you reach the last entry position, the entered name or ID will be saved and the window clears.

- You can press ESC if you wish to clear the window without saving the entered name.

6.4.5 Modifying Calibration Factors

NOTE
– Calibration factors can also be edited with the MultiCal software. – If a measuring quantity or calibration factor is changed while a measurement is running in the background, the system will abort the measurement when the menu has been cleared. – If the message "uncalibrated" flashes on the measuring screen, the calibration factors registered in MULTIDOS are incorrect. If this message appears while you are measuring in electrical units, the system will have to be returned to PTW-Freiburg.

Calibration factors can be modified as follows:

- Using the cursor keys, position the cursor on the appropriate menu item "N" and confirm with ENT.

The cursor flashes below the algebraic sign.

- Choose the algebraic sign (+ or -) and confirm with ENT.

The cursor moves to the first place of the factor value.

- Increase or decrease the numeral with the cursor keys (or press NUL to enter a "0").

The absolute value of the factor must be between 1.0×10^2 and 1.0×10^{12}. The value 0.0 is also possible. If 0.0 is entered for both calibration factors, the message "uncalibrated" will appear on the display.

- Confirm the entry with ENT.

As soon as you reach the last entry position, the entered factor will be saved and the window clears.

- You can press ESC if you wish to clear the window without saving the new factor.

6.4.6 Modifying the Measuring Quantity

On MULTIDOS systems set up for measurements in Gray, you can choose among two measuring quantities (**7**, Figure 6-3): either "D_w" (absorbed dose to water) or "K_a" (air kerma):

- Using the cursor keys, position the cursor on "Quantity" and confirm the entry with ENT.

- Again using the cursor keys, choose "D_w" (absorbed dose to water) or "K_a" (air kerma) and confirm the entry with ENT.

- Press ESC to clear the window.

6.4.7 Setting the Measuring Range

```
NOTE

− Please note that even for the measuring
  quantity "dose" the final values of the dose
  rate measurement will be displayed, since the
  integral values are obtained by numeric inte-
  gration and the maximum measurable dose
  rate determines the measurable dose.

− If you change the measuring range while a
  measurement is in progress, the measure-
  ment will be aborted when you quit the menu.
```

For both channels you can choose between the two measuring ranges "Low" and "High". The chosen range is displayed separately for the channels (Figure 6-9, arrow shows: channel 2 range Low).
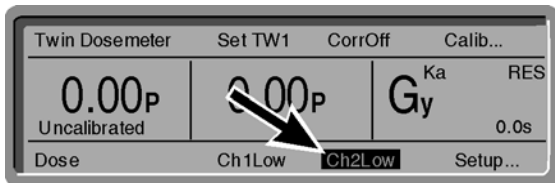
Figure 6-9: Chosen range of channel 2

- To change the measuring range, position the cursor on the channel (example "Ch2Low", Figure 6-9) and press ENT.

This opens a window (Figure 6-10) with the measuring ranges with its maximum values.
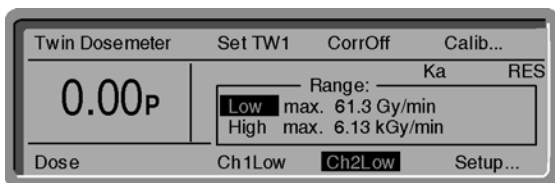
Figure 6-10: Window for changing the measuring range

The selected range is displayed in reverse video. To select the other range:

- Position the cursor on the range label and press ENT.

If you prefer to continue with the same range, clear the window with ESC.

6.4.8 Toggling Between Absolute and Relative Readings

- Using the cursor keys, position the cursor on "Setup..." and press ENT.

This opens the setup menu (Figure 6-11).
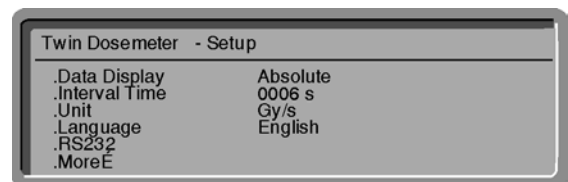
Figure 6-11: Setup menu

The cursor flashes on "Data Display".

- Press ENT and choose display of absolute values ("Absolute") or of relative values ("Channel 2 / Channel 1") with the cursor keys.

- Confirm your selection with ENT and press ESC to quit the setup menu.

6.4.9   Protecting Calibration Data

In the dual channel dosimetry mode, MULTIDOS offers two methods of protecting the calibration data of sets SetTW1 through SetTW4 from modification.

- By means of a DIL switch in the unit.
  The dots in front of the calibration menu items disappear and the protection mode (*5*, Figure 6-8) is indicated as "Hardware".

- By means of a password.
  The dots in front of the calibration menu items disappear and the protection mode (*5*, Figure 6-8) is indicated as "Password".

It is not possible to protect the data of SetTW5.

Password Protection

To enter the password:

- Using the cursor keys, position the cursor on "Setup..." and press ENT.

This opens the setup menu (Figure 6-11).

- Position the cursor on "More..." and press ENT.

This opens Figure 6-12. The cursor flashes on "Set password".
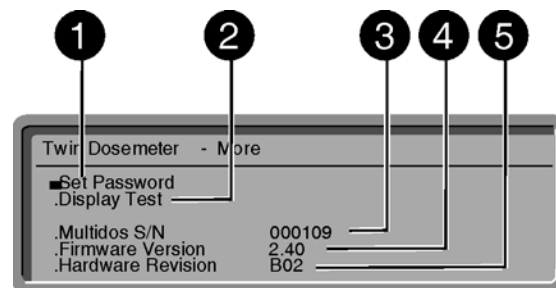
Figure 6-12:   "More" menu

1 *Allows entry of a password*
2 *Activates the display test*
3 *MULTIDOS serial number*
4 *Firmware version*
5 *Hardware revision*

- Press ENT to open the dialog box.

This opens the dialog box:
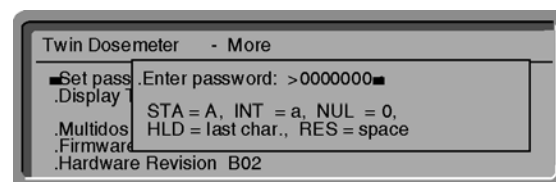
Figure 6-13:   Dialog box Password

The password is a combination of the letter M and the MULTIDOS serial number (*3*, Figure 6-12) shown on the "More..." menu. In our example the password is "M000109".

The cursor flashes on the first entry position.

- Press STA ("A" will be displayed), then press ▲ until the letter "M" appears.

- Confirm the first character with ENT.

The cursor moves to the next entry position.

- Now enter the numerals with the cursor keys (▲ increases the numeral, ▼ decreases it).

- Press ENT to clear the dialog box.

This completes the entry of the password and the menu item changes to "Clear password".

- To clear the password protection, repeat the entry as described above and press ENT to confirm the action.

As soon as you have entered the password as described above, "Password" will be displayed in the calibration menu (**5**, Figure 6-8) and it will not be possible to modify the data, unless the correct password is entered.

7 Multi Channel Dosimetry

7.1 The Basics

<table>
<tr><td>⚠ WARNING</td></tr>
</table>

Use of the product without observing the user manual.

Patient Hazard! Equipment Damage!

Follow the safety information provided in the section "Safety Information" and in the user manuals of the detectors.

<table>
<tr><td>⚠ WARNING</td></tr>
</table>

Improper handling.

Erroneous Measurement!

In the Multi Channel Dosimetry application, do not connect detectors to the single-chamber connections (CHANNEL 1 and CHANNEL 2).

<table>
<tr><td>⚠ CAUTION</td></tr>
</table>

Operation with radiation.

Erroneous Measurement!

In all applications with ionization chambers, MULTIDOS and the detector connection box have to be protected against scattered radiation.

In Multi Channel Dosimetry applications, it is only possible to perform measurements with ionization chambers (**not for patient dosimetry!**).

When using MULTIDOS for Multi Channel Dosimetry, we recommend using the MultiSoft software as well. For changing the calibration factors you can use the MultiCal software.

7.2 Connecting MULTIDOS and Putting It Into Operation

Figure 7-1 shows the layout of the medically used room and of the control room. The detector connection box T16009 is installed in the treatment room. MULTIDOS and the PC, if used, are set up in the control room.
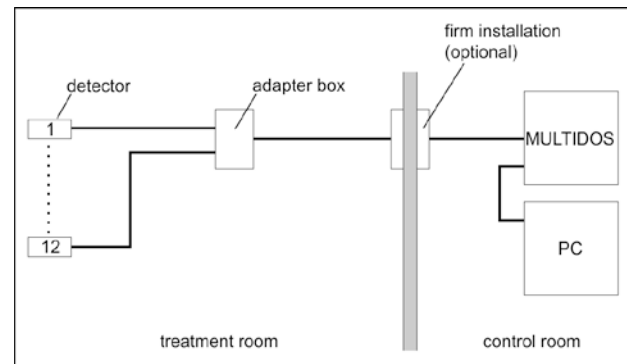
Figure 7-1:   Installation of the system components in the medically used room and in the control room
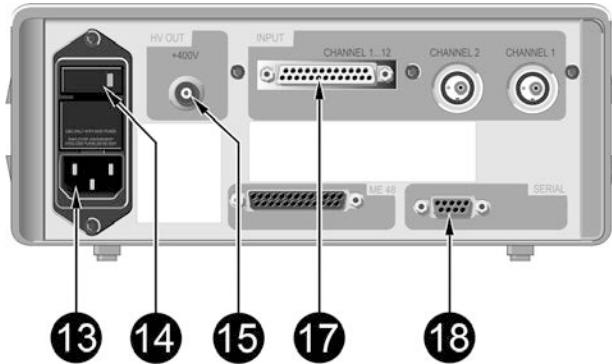
Figure 7-2:   Rear panel of MULTIDOS

13 Power input

14 Voltage selector, instrument fuses

15 HV OUT connector, high-voltage output for ionization chambers with detector connection box

17 CHANNEL 1…12, signal inputs for channels 1 to 12 (with detector connection box)

18 SERIAL port, serial interface for connection of a PC

- Connect the ionization chambers via the detector connection box T16007 or T16013 with the cable T26011-x to MULTIDOS (input **17** and HV-connector **15**).

- If you also use a PC (with PTW software), connect the PC to the serial port **18** of MULTIDOS.

- Check that the voltage selector **14** is set to the rating of the local power line. If the setting is not correct, refer to section 17 for instructions how to set MULTIDOS to another line voltage.

- Connect MULTIDOS to the power line (input **13**).

- Push the power switch to turn on MULTIDOS.

MULTIDOS will briefly show the start-up screen and then the measuring screen (Figure 7-3). After power up and during operation MULTIDOS runs automatic self-tests.

When turned on, MULTIDOS will always reactivate the last application mode. Please refer to section 3.2 for instructions how to change the application.

7.3 Measuring Screen

The measuring screen Figure 7-3 presents informa-tion and controls. Menus for changing the settings are callable via the control.
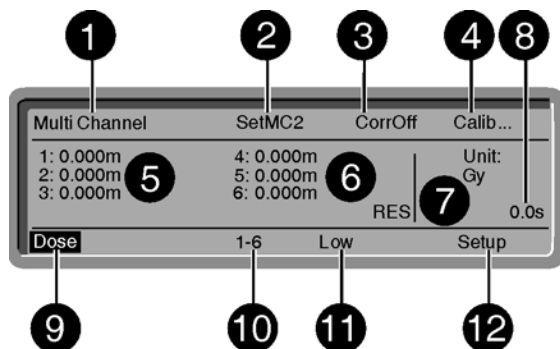
Figure 7-3: *Measuring screen for Multi Channel Dosimetry*

1 *Selected application, refer to section 3.2.*

2 *Selected set of calibration factors, refer to sec-tion 7.4.1. You can choose among 5 sets la-beled SetMC1 to SetMC5.*

3 *Selected correction switched on/off; refer to section 7.4.2.*

4 *Displays the calibration menu, refer to sec-tion 7.4.3.*

5 *Display of measured values, channels 1 to 6 or 7 to 12, The values are displayed in two groups of 6 values each. You can toggle between the groups with button 10. The maximum value of a group is marked with "<", the maximum value of both groups with "<<". All 12 values are availa-ble at the serial interface.*

6 *Display of status flag, refer to section 4.2.*

7 *Display unit of measurement, If the measuring device is not calibrated for the selected unit of measurement, the message "uncalibrated" flashes above the measuring mode* **9**.

8 *Display of dose measurement time, During in-terval measurements the interval time is briefly displayed in this field. RES will reset the clock to zero.*

9 *Selected measuring mode (dose, dose rate) You can choose either dose or dose rate measure-ments. refer to section 4.1.*

10 *Control to toggle the measured-value display (channel 1 to 6 or 7 to 12).*

11 *Selected measuring range (low/high), refer to section 7.4.4.*

12 *Displays the setup menu.*

7.4 Settings

NOTE

If the values are measured in "A" (Ampere), the set selection window and the correction menu will not be displayed.

To change the unit, refer to section 3.3.

7.4.1 Selecting the Calibration Set

⚠ CAUTION

Use of the product without observing the user manual.

Erroneous Measurement!

Before running a measurement, always check whether the selected set of calibration factors matches the detectors.

In Multi Channel Dosimetry applications MULTIDOS handles 5 sets of calibration factors. This means that up to 5 different detector sets can be used in conjunction with MULTIDOS, if used as a stand-alone unit.

To view the existing sets and select another one:

- Using the cursor keys, position the cursor on "Set MCx" and confirm the selection with ENT.

This opens a window showing all calibrated sets Figure 7-4).
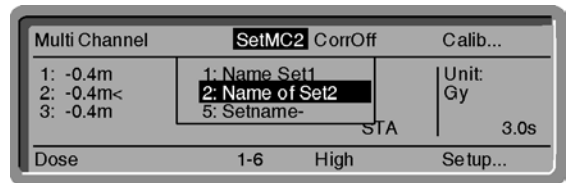
Figure 7-4: Set selection window

The currently selected set is displayed in reverse video. To select another set:

- Use the cursor keys to position the cursor on the new set and confirm your selection with ENT.

Selecting a new set in the course of a measurement will abort that measurement. If you decide to continue with the current set, press ESC.

7.4.2 Enabling/Disabling the Correction Function

NOTE
If you change any of the settings in this menu while a measurement is in progress, the measurement will be aborted when you quit the menu. If measuring in electrical units, the measuring device will not display the menu item "CorrOff" or "CorrON". Corrections will not affect the electrical measuring values.

"CorrOff"/"CorrOn" (Figure 7-5) will display the correction menu.
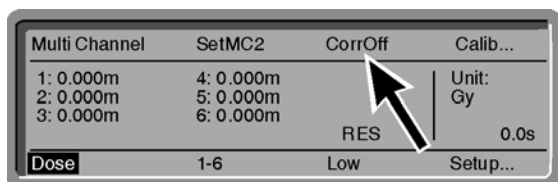
Figure 7-5:   *"CorrOff"/"CorrOn" to call the correction menu*

If the display indicates "CorrOn", the correction function is enabled. If the display indicates "CorrOff", the correction function is disabled.

The correction can be changed as follows:

- Using the cursor keys, position the cursor on "CorrOn" / "CorrOff" and press ENT.

The correction menu will appear (Figure 7-6). The cursor is flashing on "Air density correction".
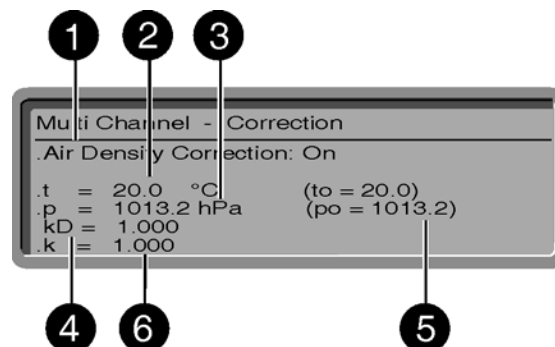
Figure 7-6:   *Correction menu for correction "on"*

1   Air density correction on/off

2   Ambient temperature

3   Atmospheric pressure

4   Air density correction factor "k_D" derived from 2, 3 and 5

5   Reference temperature and pressure

6   Overall correction factor "k"

- Press ENT. Select the correction function with one of the cursor keys to "On" / "Off".

- Confirm the selection with ENT.

→ If the display indicates "Air density correction: Off" the correction function is disabled. Press ESC to quit the menu.

→ If the display indicates "Air density correction: On" the correction function is enabled. The current values for correction are displayed (Figure 7-6).
  You can now change the values in this window. Otherwise press ESC to quit the menu.

If the correction function is enabled, you can enter the ambient temperature and atmospheric pressure in the correction menu (Figure 7-6).

- Position the cursor on the parameter to be changed ("t", for instance) and press ENT.

The cursor flashes on the first digit.

- Increase the digit with ▲ or decrease it with ▼. Press ENT to confirm the new digit.

The cursor moves to the next digit.

- Proceed in the same manner for all digits to be changed. Confirm the new temperature value with ENT.

- Now you have two options: quit the menu with ESC or change the atmospheric pressure value "p". This value can be changed as described above.

The admissible ambient temperature range extends from 10.0 °C to 40.0 °C, the atmospheric pressure range from 500.0 hPa to 1300.0 hPa. The values entered here are also used in the dual channel dosimetry and constancy check applications.

The factory-set reference temperature (**5**,. Figure 7-6) may be 20 °C or 22 °C. Please verify that the entered calibration factors apply to the set reference temperature.

The device automatically calculates the resulting air density correction factor "k_D". This factor is applied to all 12 measuring values. The correction factor is calculated after the following formula:

$$k_D = \frac{p_0 * (t + 273.2)}{p * (t_0 + 273.2)}$$

t_0 20 °C oder 22 °C
p_0 1013.2 hPa

Furthermore, you can enter an additional, overall correction factor "k" can be entered. Any value between 0.500 and 2.000 can be entered for the correction factor "k" (**6**, Figure 7-6). This factor is applied to all 12 measuring values.

7.4.3 Displaying the calibration factors

⚠ CAUTION
Use of the product without observing the user manual.
Erroneous Measurement
If the message "uncalibrated" flashes on the measuring screen, the calibration factors registered in MULTIDOS are incorrect.
If the message "uncalibrated" is displayed when measuring in electrical units, the device must be returned to PTW-Freiburg for inspection.

The calibration menu only acts as display. The MultiSoft or MultiCal software is required, if you wish to edit the calibration data.

Each set comprises 12 calibration factors. These are displayed in groups of 3 (1 to 3, 4 to 6, 7 to 9, 10 to 12).

The calibration menu allows you to verify the calibration factors of all sets. It is not necessary to load the set to be reviewed for the measurement.

- Position the cursor on "Calib..." and press ENT.

The calibration menu for the selected set will appear, showing the first group of three calibration factors (Figure 7-7).
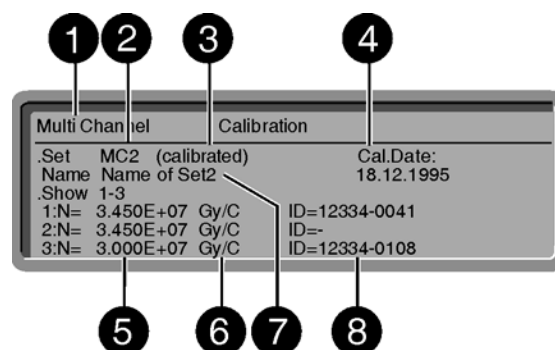
Figure 7-7:   Calibration menu

1   Selected application

2   ID of the displayed set (here: SetMC2)

3   Calibration status of the set (calibrated, uncalibrated)

4   Calibration date of the set

5   Radiological calibration factors of the displayed group

6   Unit of the calibration factors

7   Name of selected set

8   Channel IDs

- To view the data of the other sets, position the cursor on "Set" and press ENT.

- Use the cursor keys to select the set to be displayed and press ENT.

It appears the first group of three calibration factors for the selected set.

● To view the other groups of calibration factors, position the cursor on "Show" and press ENT.

● Use the cursor keys to select the group to be displayed.

● Compare the displayed values with the data on the calibration certificate of the measuring device.

● Press ESC to quit the calibration menu.

For details on the calibration of detectors, please refer to the user manuals of the detectors in question or of the software.

NOTE

In field *2* (Figure 7-7) you can display the selected calibration set. This will not change the calibration set used in the measurement.

NOTE

The MultiCal or MultiSoft software is required, if you wish to change the radiological calibration factors.

7.4.4 Setting the Measuring Range

MULTIDOS offers two measuring ranges: "Low" with a current resolution of 50 fA and "High" with a current resolution of 5 pA. Affecting the radiological calibration factor, the current resolution also determines the radiological resolution.

● To change the measuring range, position the cursor on "Low" or "High" (Figure 7-8) and press ENT.
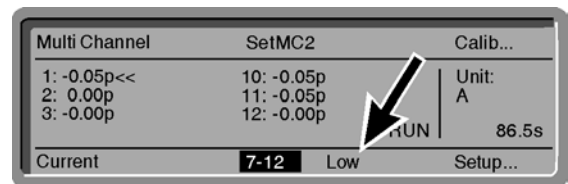
Figure 7-8:   *"Low"/"High" for adjustment of the measuring range*

This brings up a window with the measuring range menu (Figure 7-9). The selected range is displayed in reverse video.
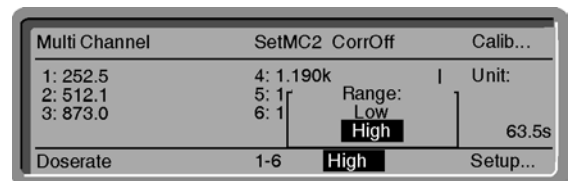
Figure 7-9:   *Measuring range menu*

● To select the other range, position the cursor on the range label and press ENT.

● If you prefer to continue with the same range, clear the window with ESC.

8 Analyzing Dynamic Fields with the Linear Array LA48

8.1 The Basics

⚠ WARNING
Use of the product without observing the user manual. **Patient Hazard! Equipment Damage!** Follow the safety information provided in the section "Safety Information" and in the user manuals of the detectors.

⚠ WARNING
Use of the product without observing the user manual. **Shock Hazard! Patient Hazard!** Do not connect semi-conductor detectors to MULTIDOS when using the Linear Array LA48.

⚠ CAUTION
Improper handling **Equipment damage!** Strictly observe the mounting and using instructions given in the user manual of Linear Array LA48.

The Linear Array LA48 consists of 47 fluid-filled ionization chambers. It is used to determine the relative dose distributions of high-energy photons and electrons. It is particularly suitable for the analysis of dynamic fields.

Measurements with the Linear Array LA48 require the extender ME48 T10006 which, in turn, is connected to MULTIDOS, upgrading it to a 48-channel dosemeter. The last component for creation of a full-fledged measuring system is the water phantom MP3/MP3-M, enabling measurements to be easily performed at various water depths.

We also recommend using the BeamAdjust, MEPHYSTO mc², or MLCSoft software which supports the acquisition and evaluation of measurements performed with the Linear Array LA48.

During measurements with the Linear Array LA48 three of the available 47 measuring channels are displayed at a time: the minimum measured value, the maximum measured value and the value of the measuring channel at the center.

NOTE
The evaluation of all 47 measuring channels of the Linear Array LA48 is possible only in conjunction with the appropriate PTW software. Without this software, MULTIDOS will only display the smallest and largest absolute values as well as the value measured at the center of the Linear Array LA48.

8.2 Connecting MULTIDOS and Linear Array LA48 and Putting Them Into Operation

⚠ **CAUTION**

Improper handling

Equipment damage!

Execute the entire installation only in the switched off condition of all devices.

For instructions on how to mount the Linear Array LA48 to the water phantom, please refer to the user manual of the Linear Array LA48.
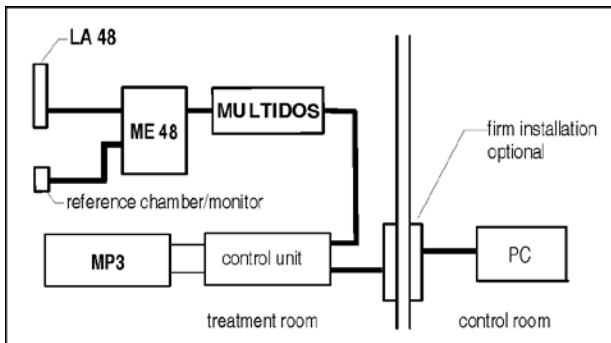
Figure 8-1: *Installation of the system components in the treatment room and in the control room*
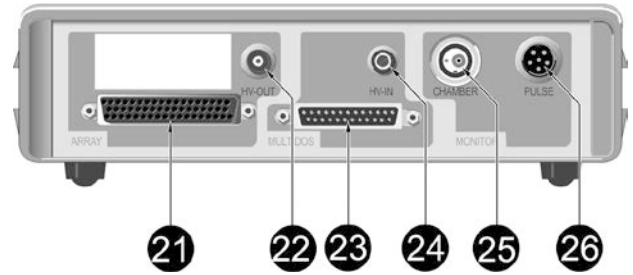
Figure 8-2: *Rear panel of the extender ME48*

21 *ARRAY connector for the Linear Array LA48*

22 *HV OUT connector, high-voltage output to the Linear Array LA48*

23 *MULTIDOS port for connection of MULTIDOS*

24 *HV IN connector, high-voltage input from MULTIDOS*

25 *CHAMBER connector for the reference chamber*

26 *PULSE connector for the pulse output of a linear accelerator (used as reference)*

- Connect port **16** of MULTIDOS to port **23** of the extender ME48, using the connection cable T10006.1.002 (Figure 8-3).

- Connect the Linear Array LA48 to connectors **21** and **22** of the extender ME48.

- If you intend to perform measurements with reference chambers, connect port **15** of MULTIDOS to port **24** of the extender ME48, using the connection cable T10006.1.003. Connect the reference chamber to port **25**.

- Monitor chambers used as a reference are to be connected to port **26**.
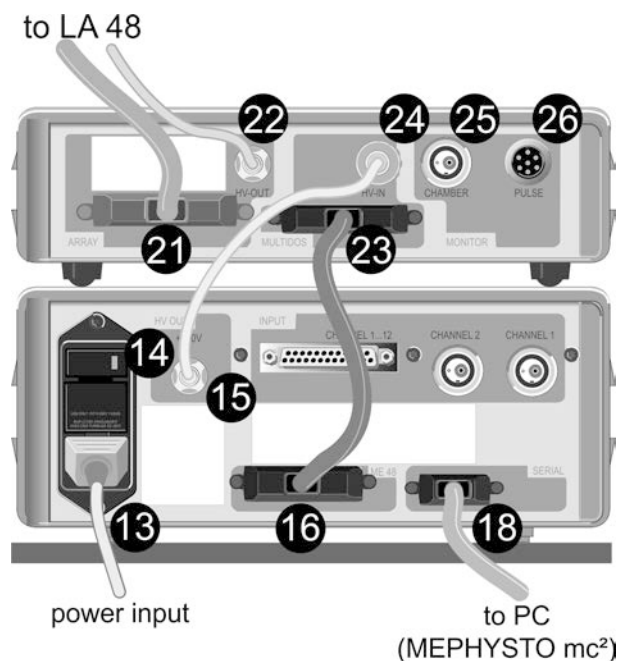
Figure 8-3:   Cable connections of MULTIDOS and extender ME48

13 *Power input*

14 *Line voltage selector*

15 *High-voltage output*

16 *ME48 port*

18 *PC port*

21 *Linear Array LA48 port*

22 *Linear Array LA48 port*

23 *MULTIDOS port*

24 *MULTIDOS port*

25 *Connector for reference chamber*

26 *Connector for accelerator pulse output*

- If you also use a PC (with PTW software), connect the PC to the serial port *18* of MULTIDOS.

- If there is only one free RS232 interface on your PC, connect MULTIDOS via cable T25015-2 to the TBA control unit. Then connect the TBA control unit to PC (RS232 interface). Perform following settings: baud rate 9600, other communication-test-commands T-PTW or T-SER. Refer to user manual of the TBA control unit.

- Check that the voltage selector *14* is set to the rating of the local power line. If the setting is not correct, refer to section 17 for instructions how to set MULTIDOS to another line voltage.

- Connect MULTIDOS to the power line (power input *13*).

- Push the power switch to turn on MULTIDOS.

Powered from MULTIDOS, the extender ME48 does not have to be turned on separately (green "POWER" indicator).

MULTIDOS will briefly show the start-up screen and then the measuring screen (Figure 8-4). After power up and during operation MULTIDOS runs automatic self-tests.

When turned on, MULTIDOS will always reactivate the last application mode. Please refer to section 3.2 for instructions how to change the application mode.

8.3   Measuring Screen

The measuring screen Figure 8-4 presents infor-
mation and controls. Menus for changing the set-
tings are callable via the control.
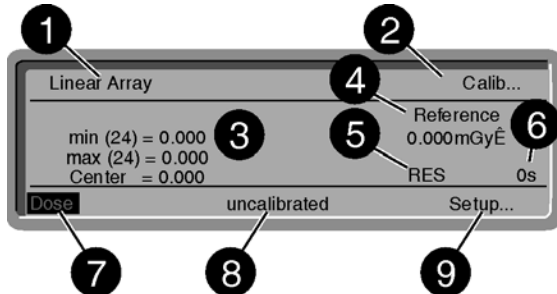
Figure 8-4:   Measuring screen Linear Array

1   *Selected application, refer to section 3.2*

2   *Control to call for the calibration menu, refer to section 8.4.2*

3   *Measuring values (min., max., center). Only three of the 47 values measured by the Linear Array LA48 are displayed here:*
the smallest absolute value (corresponding channel number in parentheses)
the largest absolute value (corresponding channel number in parentheses) and
the value measured at the center of the Linear Array LA48 (All measured values are available at the serial interface **18**.)

4   *Field specifying the measurement (against measurement, against monitor), refer to section 8.4.3*

5   *Status flag, refer to section 4.2*

6   *Dose measurement time. During interval measurements the interval time is briefly displayed in this field. RES will reset the clock to zero.*

7   *Measuring mode (dose, dose rate or current, charge) and unit. refer to section 4.1. You can choose between dose and dose rate measurement. The unit is displayed while a measurement is in progress.*

8   *Message alerting to uncalibrated device, refer to section 8.4.2*

9   *Displays the setup menu*

8.4   Settings

8.4.1   Selecting the Unit

> **⚠ CAUTION**
>
> Use of the product without observing the user manual.
>
> **Patient Hazard!**
>
> Values measured in "Gy" give you only a rough idea of the energy dose. Do not use these values for absolute dosimetry.

To change the unit, refer to section 3.3.

8.4.2   Calibration of MULTIDOS

> **⚠ CAUTION**
>
> Use of the product without observing the user manual.
>
> **Erroneous Measurement!**
>
> Prior to each measurement it is absolutely necessary to check whether the registered calibration factors are correct and whether you are actually using the devices (refer to nameplate) shown in the calibration menu.
>
> To do so, compare the serial numbers and dates indicated on the nameplates with the data in the calibration menu. They must be the same.

> **⚠ CAUTION**
>
> Use of the product without observing the user manual.
>
> **Erroneous Measurement!**
>
> If the message "uncalibrated" flashes at the bottom of the measuring screen, the values registered in MULTIDOS are incorrect.
>
> If the message is displayed when measuring in electrical units, the device must be returned to PTW-Freiburg for inspection.
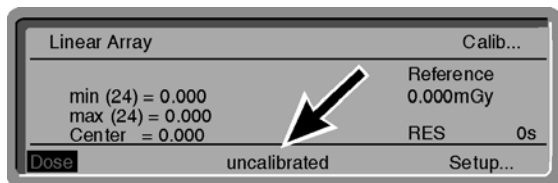
Figure 8-5:   Message "uncalibrated" flashing on the measuring screen

To open the calibration menu:

• Position the cursor on "Calib..." and press ENT.

The calibration menu will appear:
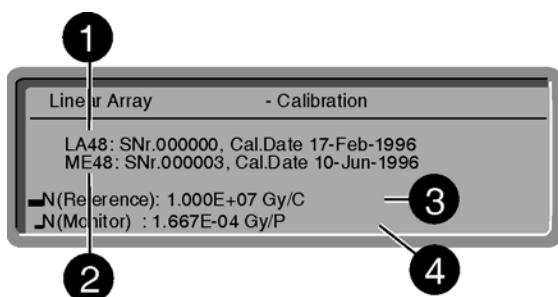
Figure 8-6:   Calibration menu

1 Serial number of the Linear Array LA48 for which MULTIDOS is radiologically calibrated, calibration date

2 Serial number of the extender ME48 for which MULTIDOS is electrically calibrated, calibration date

3 Radiological calibration factor of the reference chamber

4 Radiological calibration factor of the monitor chamber

• Compare the values displayed at *1* and *2* with the data on the calibration certificate of the measuring devices. They must be the same.

• Also compare the radiological calibration factor of the reference chamber *3* or of the monitor chamber *4* with the data of the chamber used. They, too, must be the same.

The radiological factors *3* and *4* can be corrected as follows:

• Using the cursor keys ▲ and ▼, position the cursor on the factor to be changed and press ENT.

The cursor flashes on the first digit.

• Increase the digit with ▲ or decrease it with ▼. Then press ENT to confirm the new digit.

The cursor moves to the next digit.

• Proceed in the same manner for all digits to be changed. Confirm the new value with ENT. Then quit the menu with ESC. The entry of a new value can be aborted any time with ESC. In this case, the program continues with the value unchanged.

Factor	Lower limit	Upper limit
Reference chamber	1.0E+00 Gy/C	1.0E+12 Gy/C
Monitor chamber	8.3E-5 Gy/P	2.5E-4 Gy/P

Table 8-1:   Available calibration factor ranges

(The unit Gy/P represents Gray/pulse and is identical with (Gy/s)/Hz)

• Press ESC to quit the calibration menu.

8.4.3 Measurements Against Reference

Values measured with the Linear Array LA48 can be referred either to a measuring unit or to values measured with a detector connected to the extender ME48 .

● Connect the reference chamber to port *25* (Figure 8-7) of the extender ME48 , the monitor signal to port *26*.
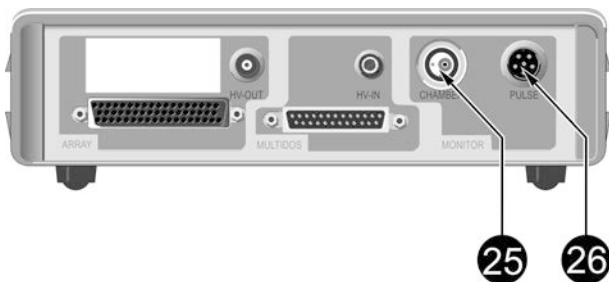
Figure 8-7:   *Reference chamber* **25** *and pulse signal (accelerator)* **26** *ports*

● Position the cursor on "Setup..." (*9*, Figure 8-4) and press ENT.

The setup menu will be displayed.
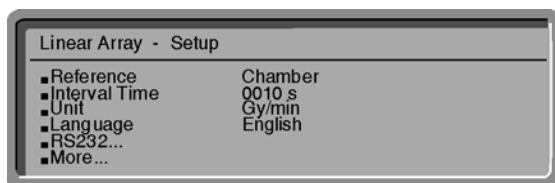
Figure 8-8:   *Setup menu*

● Using the cursor keys, position the cursor on "Reference" and press ENT.

● Using the cursor keys, select

   – **None** if you wish to display the measuring values referred to a specific measuring unit.

   – **Chamber** if you wish to refer the measuring values to the value measured with a reference chamber. The reference chamber has to be a therapy chamber according to IEC 60731 with an M-type connector. It will be supplied with 400 V from MULTIDOS. The measuring value of the reference chamber will be displayed as an absolute value.

   – **Pulse** if you wish to refer the measuring values to the pulses of the monitor of the linear accelerator. The measuring value of the monitor will be displayed as an absolute value.

● Press ENT to confirm the new selection, or press ESC to retain the current selection.

● Press ESC to quit the setup menu.

The corresponding display appears:
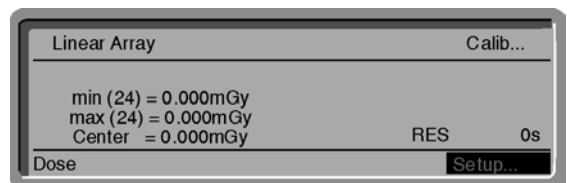
Figure 8-9:   *Measuring screen for dose measurement (absolute values)*
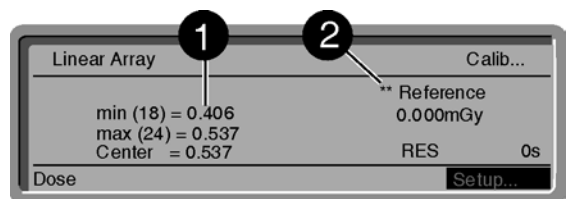
Figure 8-10:   *Measuring screen for dose measurement against a reference chamber*
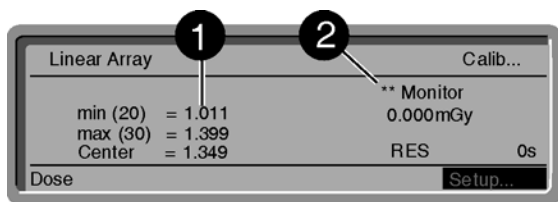
Figure 8-11: *Measuring screen for dose measurement against the monitor of the linear accelerator*

Figure 8-10 — Explanations
Reference = Chamber

❶	Ratio
	The values can range from +/- 0.000 to +/ 999.9.
	For ratios between 0.000 and 0.0005, the display shows "<5E-4".
	For ratios > 1000, the display shows "> = 1000".
❷	Signal strength for reference chamber
	a) "**" flashing on display
	The displayed measuring value is based on a measurement with a resolution below 1 %, meaning that the display is less than 100 times the resolution.
	b) "*" flashing on display
	The displayed measuring value is based on a measurement with a resolution below 0.5 % meaning that the display is less than 200 times the resolution.
	c) no flashing display
	The resolution of the displayed measuring value is 0.5 % or better.

The signal strength is indicated for identification of measurements with an inadequate reference signal. You do not obtain meaningful results by referring measuring values to inadequate reference signals, as the variation between ratios would be excessive.

Figure 8-10 shows small ratios although the reference value is 0.000 mGy. This is because ratios are calculated on the basis of the actually measured values, whereas the resolution of the measuring channel is taken into account in the displayed absolute value. The reference value is not equal to 0.000 mGy but below the resolution limit.

Figure 8-11 — Explanations
Reference = Monitor

❶	Ratio
	(see comments for Figure 8-10)
❷	Signal strength for monitor chamber

If the monitor channel of the extender ME48 is not within its measuring range, two asterisks "**" are flashing on the display. The asterisks disappear when the channel returns to its measuring range.

NOTE
The evaluation of all 47 measuring channels of the Linear Array LA48 is possible only in conjunction with the appropriate PTW software. Without this software, MULTIDOS will only display the smallest and largest absolute values as well as the value measured at the center of the Linear Array LA48.

9   Constancy Checks with QC6Plus

9.1   The Basics

NOTE
The following section is only valid for users that have available a QC6Plus T42007. The QC6Plus T42007 was replaced by the QUICKCHECK*webline* T42031.

⚠ WARNING
Use of the product without observing the user manual. **Patient Hazard! Equipment Damage!** Follow the safety information provided in the section "Safety Information" and in the user manuals of the detectors.

In the course of quality assurance measures, constancy checks are used to verify accelerators for

− homogeneity

− symmetry

− energy stability.

Constancy checks are performed with the QC6Plus T42007 measuring probe which comprises 6 detectors. With a special holding device, the measuring probe can be mounted on the collimator.
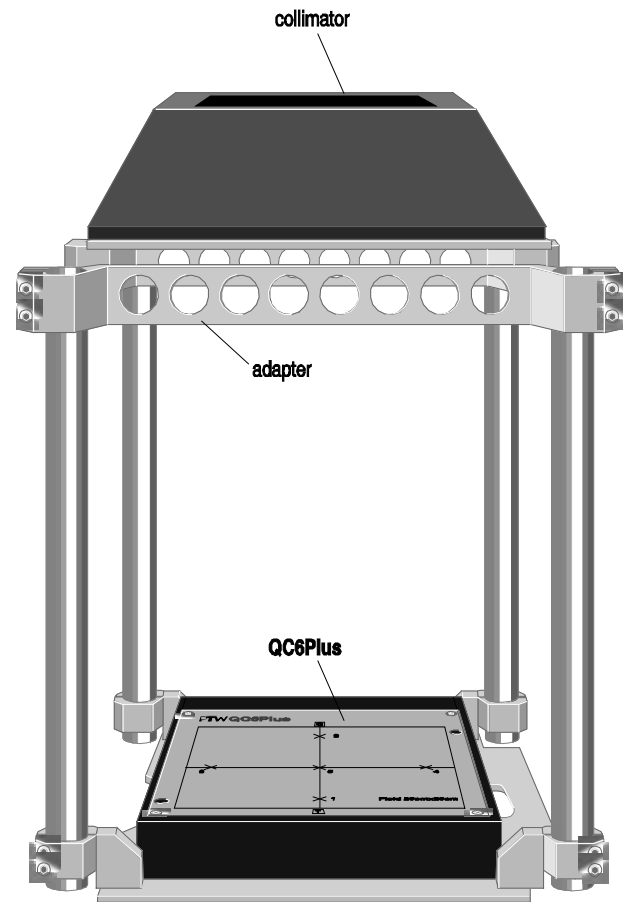
Figure 9-1:   Position of adapter and QC6Plus measuring probe with respect to the collimator

All 6 measuring values are displayed during constancy checks with QC6Plus measuring probe.

The arrangement of the 6 detectors is marked at the top of the QC6Plus measuring probe. Detector number 6 is at the center, below detector 5. There is a PMMA slide on one side of the QC6Plus measuring probe which is placed between detectors 5 and 6. This slide has a lead insert at one end. For measurements with photons, the lead insert must be positioned between detectors 5 and 6. For measurements with electrons, the slide is to be inserted the other way round (PMMA between the detectors 5 and 6).

Additional PMMA plates (PTW order no. T42007.1.009) can be placed on top of the measuring probe in order to achieve an optimal measuring depth in dependence of the quality of radiation. The plate thickness should be chosen so as to position detector 5 at least at the depth of maximum dose. The thickness must be adequate to permit build-up of the maximum dose. A point to be considered is that the ionization chamber in the measuring plate is at a depth of 5 mm PMMA.

9.2 Connecting MULTIDOS and Putting It Into Operation and Installing QC6Plus
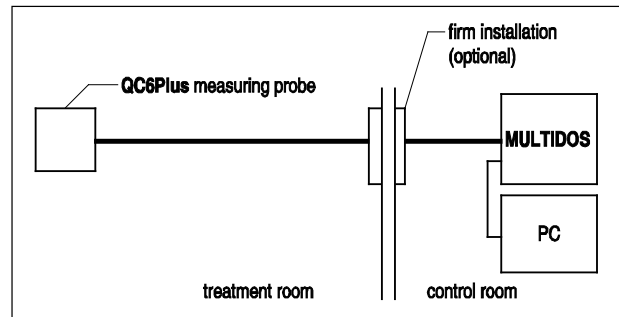
Figure 9-2: *Installation of the system components in the treatment room and in the control room*

For constancy checks with MULTIDOS we recommend using the QCWin software as well.

NOTE
When using the QC6Plus measuring probe, do not connect other detectors to MULTIDOS.

- Mount the top board of the QC6Plus measuring probe holding device to the collimator of the accelerator.

For fixation of the QC6Plus measuring probe, there are two screws in the bottom board of the holding device (Figure 9-3). The corresponding threaded holes are in the QC6Plus measuring probe.
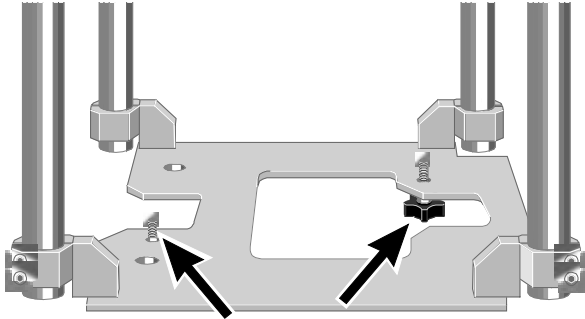
Figure 9-3:   *Screws for fixation of the QC6Plus measuring probe*

Build-up plates can be attached by means of the two threaded holes at the top of the QC6Plus measuring probe (Figure 9-4).
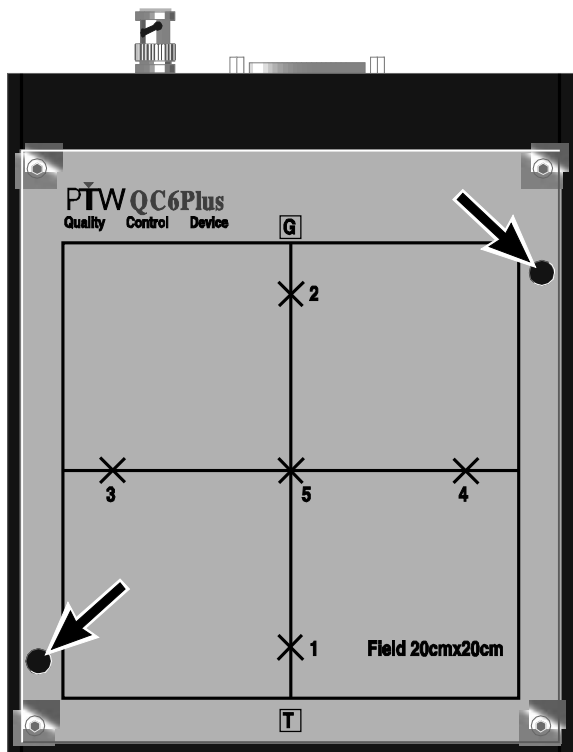
Figure 9-4:   *Threaded holes in the QC6Plus measuring probe for fixation*

● Place the QC6Plus measuring probe in the holding device as shown in Figure 9-5 and tighten the two screws from below.
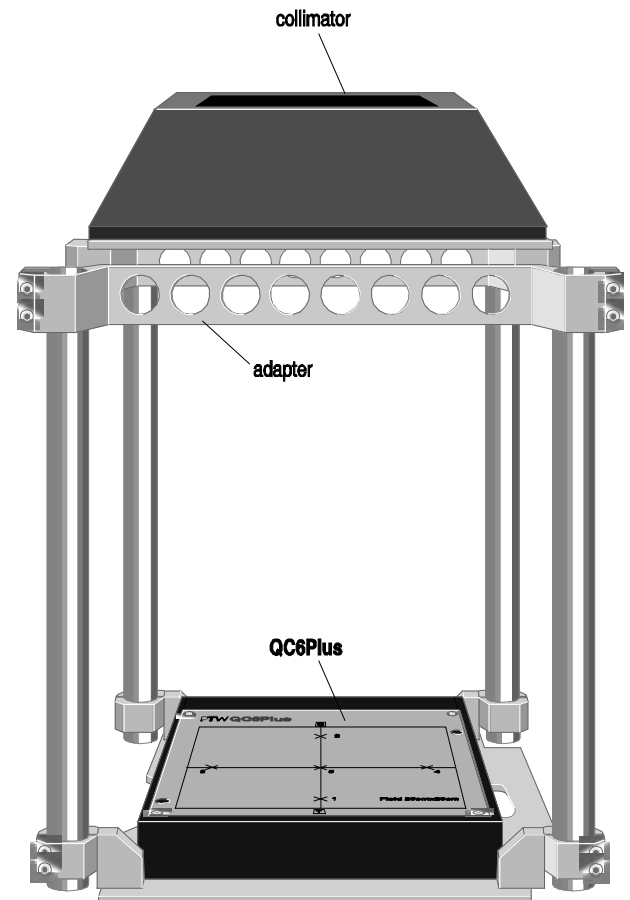
Figure 9-5:   *Installing the QC6Plus measuring probe in the holding device*

- Connect the QC6Plus measuring probe to MULTIDOS (connectors *17* (signal) and *15* (high voltage), Figure 9-6), using the connection cable T26011-x.
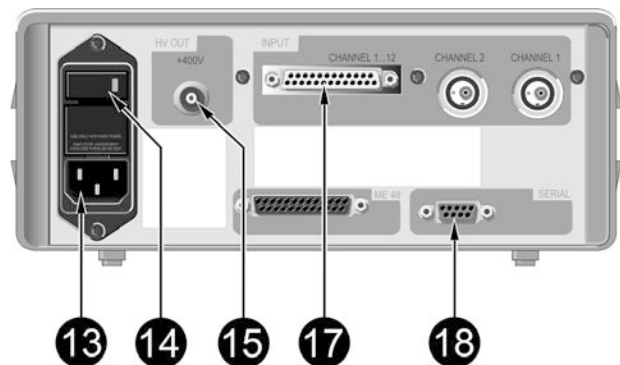
Figure 9-6:   Rear panel of MULTIDOS

13 Power input

14 Line voltage selector, instrument fuses

15 HV OUT connector, high-voltage output for the QC6Plus measuring probe

17 CHANNEL 1…12, signal inputs for the QC6Plus measuring probe

18 SERIAL port, serial interface for connection of a PC

- If you also use a PC (with PTW software), connect the PC to port *18* of MULTIDOS.

- Check that the voltage selector *14* is set to the rating of the local power line. If the setting is not correct, refer to section 17 for instructions how to set MULTIDOS to another line voltage.

- Connect MULTIDOS to the power line (power input *13*).

Installing the Measuring Plate on the Patient Couch

It is also possible to install the measuring plate on the patient couch for constancy checks. This test setup is suitable only for vertical irradiation. It is of particular importance for constancy checks with this test setup that the distance between focus and measuring plate is always the same.

Accelerator Adjustment and Test Setup

These are the adjustments required for constancy checks:

−   field size 20 cm x 20 cm

−   radiation quality

−   number of monitor units

−   orientation of the measuring plate with respect to the accelerator axes

−   distance between focus and measuring plate

−   thickness of the build-up material

- Push the power switch to turn on MULTIDOS.

MULTIDOS will briefly show the start-up screen and then the measuring screen (Figure 9-7). After power up and during operation MULTIDOS runs automatic self-tests.

When turned on, MULTIDOS will always reactivate the last application mode. Please refer to section 3.2 for instructions how to change the application mode.

9.3 Measuring Screen

The measuring screen (Figure 9-7) presents infor-
mation and controls.

Menus for changing the settings are callable via the
control.
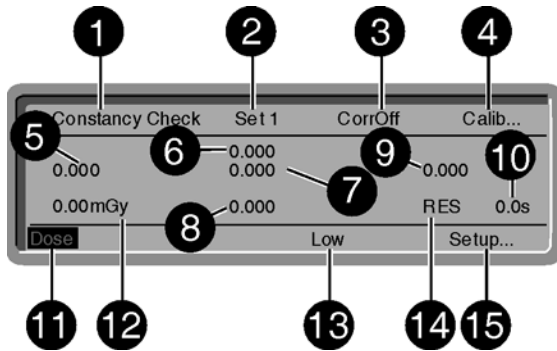
Figure 9-7: Measuring screen Constancy Check

1 *Selected application, refer to section 3.2 to change over*

2 *Selected set of calibration factors, refer to section 9.4.1 to change over*

3 *Selected correction , switched on/off, refer to section 9.4.2 to change over*

4 *Control to call for the calibration menu, refer to section 9.4.3*

5 *Measuring value detector 3, The measuring values are arranged in the same way as the detectors in the measuring plate. Detector 5 determines the decimal point and exponent. If a detector measures a value that is too large to be displayed, # signs appear instead of numbers.*

6 *Display measuring value detector 2*

7 *Display measuring value detector 5*

8 *Display measuring value detector 1*

9 *Display measuring value, detector 4*

10 *Dose measurement time*

11 *Measuring mode (dose, dose rate) You can choose between dose and dose rate measurements. refer to section 4.1*

12 *Display measuring value detector 6*

13 *Measuring range (low/high), refer to section 9.4.1*

14 *Status flag, refer to section 4.2*

15 *Displays the setup menu*

9.4 Settings

NOTE
If the values are measured in "A" (Ampere), the set selection window and the correction window will not be displayed.
To change the unit, refer to section 3.3.

9.4.1 Selecting the Calibration Set

⚠ CAUTION
Use of the product without observing the user manual.
Erroneous Measurement!
Before running a measurement, always check whether the selected set of calibration factors matches the detectors.

In constancy check applications MULTIDOS handles 5 sets of calibration factors. This means that up to 5 different detector sets can be used in conjunction with MULTIDOS, if used as a stand-alone unit.

To view the existing sets and select another one:

• Using the cursor keys, position the cursor on "Set X" (Figure 9-7)and confirm the selection with ENT.

This opens a window showing all calibrated sets:
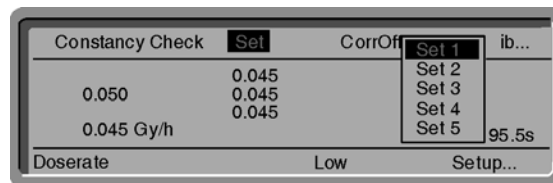
Figure 9-8:   *Set selection window*

The currently selected set is displayed in reverse video. To select another set,

• Use the cursor keys to position the cursor on the new set and confirm your selection with ENT.

You can clear the menu with ESC, if you decide to continue with the same calibration set.

9.4.2 Enabling / Disabling the Correction Function

NOTE

If measuring in electrical units, the measuring device will not display the menu item "CorrOff" or "CorrOn". Corrections will not affect the electrical measuring values.

"CorrOff"/"CorrOn" (Figure 9-9) will display the correction menu.

Constancy Check	Set 1	CorrOff	Calib...
	0.000		
0.000	0.000	0.000	
	0.000		
0.000mGy		RES	0.0s
Dose		Low	Setup...
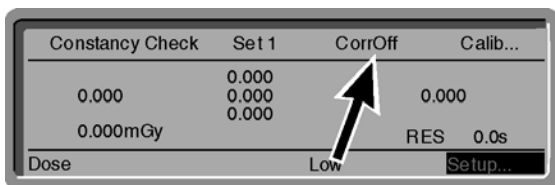
Figure 9-9: "CorrOff"/"CorrOn" to display the correction menu

If the display indicates "CorrOn", the correction function is enabled. If the display indicates "CorrOff", the correction function is disabled.

The correction can be changed as follows:

- Using the cursor keys, position the cursor on "CorrOn" / "CorrOff" and press ENT.

The correction menu will appear (Figure 9-10). The cursor is flashing on "Air density correction".
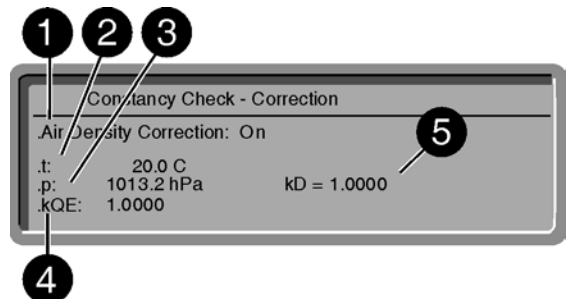
Figure 9-10: Correction menu for correction "on"

1. *Air density correction on/off*
2. *Ambient temperature*
3. *Atmospheric pressure*
4. *Correction factor "k_{QE}" for electron energy or radiation quality of photons*
5. *Air density correction factor "k_D" derived from 2 and 3*

- Press ENT. Select the correction function with one of the cursor keys to "On" / "Off".

- Confirm the selection with ENT.

- If the display indicates "Air density correction: Off" the correction function is disabled. Press ESC to quit the menu.

- If the display indicates "Air density correction: On" the correction function is enabled. The current values for correction are displayed (Figure 9-10).
  You can now change the values in this window. Otherwise press ESC to quit the menu.

If the correction function is enabled, you can enter the ambient temperature and atmospheric pressure in the correction menu (Figure 9-10).

- Position the cursor on the parameter to be changed ("t", for instance) and press ENT.

The cursor flashes on the first digit.

- Increase the digit with ▲ or decrease it with ▼. Press ENT to confirm the new digit.

The cursor moves to the next digit.

- Proceed in the same manner for all digits to be changed. Confirm the new temperature value with ENT.

- Now you have two options: quit the menu with ESC or change the atmospheric pressure value "p". This value can be changed as described above.

The admissible ambient temperature range extends from 10.0 °C to 40.0 °C, the atmospheric pressure range from 500.0 hPa to 1300.0 hPa. The values entered here are also used in the dual channel dosimetry and multi channel dosimetry applications.

The device automatically calculates the resulting air density correction factor "k_D". The correction factor is calculated after the following formula:

$$k_D = \frac{p_0 * (t + 273.2)}{p * (t_0 + 273.2)}$$

t_0 20 °C oder 22 °C
p_0 1013.2 hPa

Furthermore a second correction factor "k_{QE}" can be entered for the electron energy or the radiation quality of photons. Any value between 0.0001 and 2.000 can be entered for the correction factor "k_{QE}" (*4*, Figure 9-10).

9.4.3 Displaying the Calibration Factors

In the calibration menu the calibration factors can only be viewed. The MultiCal or QCWin software is required to edit the calibration data.

- Position the cursor on "Calib..." (*4*, Figure 9-7) and press ENT.

The calibration menu for the selected set will appear:
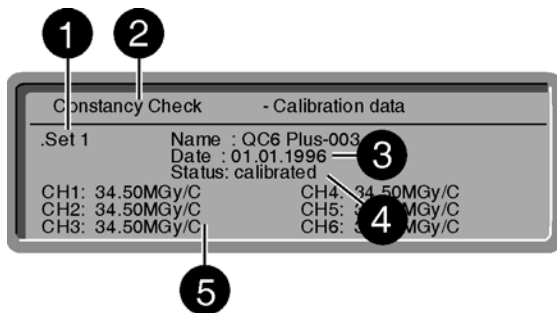
Figure 9-11:   Calibration menu

1   Number of the displayed set

2   Selected application

3   Calibration date

4   Set status (calibrated/uncalibrated)

5   Radiological calibration factors of channel 1 to 6

The cursor flashes on *1* (number of the displayed set).

- Using the cursor keys, display the required set.

- Press ESC to quit the calibration menu.

<div>
NOTE

The MultiCal or QCWin software is required, if you wish to change the radiological calibration factors. The detectors are calibrated one after the other. The detector to be calibrated is positioned in the central beam and irradiated at a field size of 7 cm x 7 cm. Further measurement hints are given in the QCWin instruction manual.
</div>

9.4.4 Setting the Measuring Range

MULTIDOS offers two measuring ranges: "Low" with a current resolution of 50 fA and "High" with a current resolution of 5 pA. Affecting the radiological calibration factor, the current resolution also determines the radiological resolution.

- To change the measuring range, position the cursor on "Low" or "High" (Figure 9-12) and press ENT.
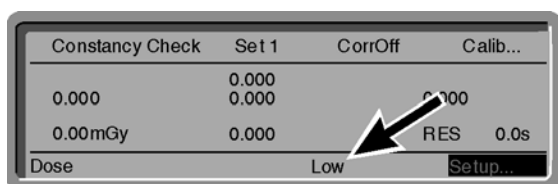
Figure 9-12: "Low"/"High" for adjustment of the measuring range

This opens a window with the measuring range menu.

Figure 9-13: Window for selection of the measuring range

The selected range is displayed in reverse video. To select the other range

- Position the cursor on the range label and press ENT.

- If you prefer to continue with the same range, clear the window with ESC.

10 Error Messages

Message	Cause	Remedy
Message "uncalibrat-ed"	The radiological calibration factors registered in the MULTIDOS calibration menu are incorrect or the electrical calibration is erroneous.	– Verify the calibration as described in the respective sections concerning the calibration factors. – Return the device to PTW.
Flashing measuring values	One or multiple channels are out of range. Note: – During dose rate measurements the values are flashing only while the channels are out of range. – During dose measurements the values start flashing as soon as the channels overrange and continue flashing until the end of the dose measurement (even if the dose rate returns to the admissible range). This approach allows the identification of dose measuring values obtained by numeric integration of values acquired under inappropriate conditions.	
Message "HVError"	High voltage generated by MULTIDOS is incorrect (e.g. due to a short-circuit)	– Check connection cable. – Notify Service.
Message "900V?" (for linear array applications only)	The high voltage generated for the Linear Array LA48 in the extender ME48 is outside the admissible range.	Notify Service
Message "400V?" (for linear array applications only)	The reference chamber supply voltage of 400 V is outside the admissible range.	The voltage is transferred from MULTIDOS to the extender ME48 via a connection cable. First of all check the cable and connections. If the message persists, notify Service.
Flashing message "ME 48!"	Multi channel or afterloading application is selected and extender ME48 is connected. Extender ME48 must not be connected to MULTIDOS for patient dosimetry.	Switch of MULTIDOS. Disconnect extender ME48 from MULTIDOS.

Technical Manual

11 Technical Specifications

Only values with specified tolerances or limits are guaranteed. Values without tolerances are for information only.

Please refer to the corresponding user manual for technical data of the in-vivo semi-conductor probes.

11.1 MULTIDOS

Device designation	**MULTIDOS T10004** **Field class therapy dosemeter acc. to IEC 60731**
Manufacturer	PTW-Freiburg
Intended use	dose and dose rate measurement in radiation therapy: quality assurance, field analysis charge and current measurement
Mode of operation	continuous operation
Electrical safety class	IEC 61010-1
Protection class	I
Power supply	115 V / 230 V; 50 / 60 Hz; -12 % to + 10 % of the rated value
Power consumption from mains	52 mA at 230 VAC 106 mA at 115 VAC
Overvoltage category	II
Degree of polution	1
Degree of protection against ingress of water	IPX0 to IEC 60529
Measuring quantities and units	dose [Gy] dose rate [Gy/s] charge [C] current [A] exposure [R], exposure rate [R/s]

Device designation	MULTIDOS T10004 Field class therapy dosemeter acc. to IEC 60731
Measuring ranges for current measurement with a resolution of 0.5 %	Low: (0.01 … 10) nA; High: (0.001 … 1) µA
Measuring ranges for dose rate measurement with a resolution of 0.5 and use of ion chamber type 31010	Low: (0.14 … 140) Gy/min; High: (0.04 ... 40) Gy/min
Resolution	Low: 50 fA; High: 5 pA
with QC6Plus	Low: 0.2 mGy/min (dose rate), 2 µGy (dose) High: 20 mGy/min (dose rate), 0.2 mGy (dose)
with Linear Array LA48	0.2 mGy/min (dose rate) 3 µGy (dose)
Repeatability	< ±0,5 %
Time constant for current and dose rate measurement	< 0.5 s
Accuracy of current and charge measurements (relative deviation)	< ±0.5 %
Number of measuring channels	12 maximum
Stabilization time	< 15 min
Settling time	< 1.5 s
Stability deviation	< ±0.5 % per year
Linearity deviation	< ±0.5 % acc. to IEC 60731
Integration time	0.5 s to 18 h
Interval time	(6 ... 9999) s
Rated ranges of use (0.5 % resolution) input current / channel	Low: (0.01 … 10) nA High: (0.001 … 1) µA
for dose rate measurement with QC6Plus	Low: (0.1 ... 10) Gy/min High: (4 ... 20) Gy/min
for dose rate measurement with Linear Array LA48	50 mGy/min ... 5 Gy/min
Rated range of use	
Temperature	(+10 ... +40) °C / (+50 … +104) °F
Relative humidity	(10 ... 80) % no condensation (max. 20 g/m³ absolute humidity)
Atmospheric pressure	(700 … 1060) hPa
Max. operation altitude	3000 m above sea level

Device designation	MULTIDOS T10004 Field class therapy dosemeter acc. to IEC 60731
Zero balancing	automatic, within approx. 35 seconds after starting the zero balancing
Zero drift dose/dose rate (leakage current) [1]	$\leq \pm 50$ fA in the "Low" range $\leq \pm 5 \cdot$ pA in the "High" range

with QC6Plus	Low: $\leq \pm 5 \cdot$ pA before zero balancing and
	        $\leq \pm 0.3 \cdot$ pA after zero balancing,
	        corr. $\leq 1\%$ of the initial value of measuring range
	High: $\leq \pm 5 \cdot$ pA before zero balancing and
	        $\leq \pm 5 \cdot$ pA after zero balancing,
	        corr. ≤ 1 display count (resolution)

with Linear Array LA48	$\leq \pm 3 \cdot$ pA before zero balancing und $\leq \pm 0.3 \cdot$ pA after zero balancing, corr. $\leq 1\%$ of the initial value of measuring range [1] IEC 60731 demands that the leakage current of dose rate meters must not exceed $\pm$ 1 % of the initial value of the measuring range over a period of 10 minutes.
Zero shift dose/dose rate	$< \pm 1$ %
Environmental conditions for transport and storage	
Temperature	(-20 ... +60) °C / (-4 … +140) °F
Relative humidity	(10 ... 85) % no condensation (max. 20 g/m³ absolute humidity)
Atmospheric pressure	(600 ... 1200) hPa
Chamber voltage	+400 V $\pm$2 %
Current limitation of high voltage source	< 400 µA through combined active and passive current limitation
Weight	5.1 kg
Dimensions	width 25.9 cm height 11.5 cm depth 32.6 cm
Bending radius of the cable T26024-x	> 8.5 cm

11.2 Extender ME 48

Device designation	Extender ME48 T10006 for PTW-MULTIDOS
Intended use	field analysis using the Linear Array LA48
Manufacturer	PTW-Freiburg
Electrical safety class	IEC 61010-1
Number of channels	48 (including one reference channel)
Sampling rate	100 Hz
Warm-up time	< 15 min
Settling time	< 1.5 s
Accuracy of current measurement (relative deviation)	±1 %
Stability deviation	±0.5 % per year
Linearity deviation	±0.5 % acc. to IEC 60731
Measuring range for current measurement with a minimum resolution of 0.5 %	(0.02 … 10) nA
Measuring range for dose rate measurement with a resolution of 0.5 % with Linear Array LA48	20 mGy/min ... 6 Gy/min
Resolution for frequency measurement with Extender ME48 monitor channel	0.1 Hz
Measuring range of the monitor channel	(50 … 500) Hz
Overall accuracy of the frequency measurement	< 5 %
Pulse width of the monitor signal	1 ms (+10 / -30) %
Time constant for current and dose rate measurement	< 0.5 s
Rated range of use	
Temperature	(+10 ... +40) °C / (+50 … +104) °F
Relative humidity	(10 ... 80) % no condensation (max. 20 g/m³ absolute humidity)
Atmospheric pressure	(700 … 1060) hPa
Max. operation altitude	3000 m above sea level
Leakage current (zero drift)	≤ 0.2 pA
Power supply	+(26 ... 40) V DC, ±7 V DC (powered by MULTIDOS)
Weight	3.2 kg
Dimensions (without desktop stand)	width 25.5 cm height 8.0 cm depth 32.5 cm

Environmental conditions for transport and storage	
Temperature	(-20 ... +60) °C / (-4 … +140) °F
Relative humidity	(10 ... 85) % no condensation (max. 20 g/m³ absolute humidity)
Atmospheric pressure	(600 ... 1200) hPa

11.3 Consequence of Influence Quantities according to IEC 60731

Influence quantity	Rated range of influence quantity	Device characteristic	Limits of variation
Stabilization time	15 min...6 h	response	≤ ±0.5 % of display
Range changing	all ranges	response	≤ ±0.5 % of display
Temperature	(+10... +40) °C	response	≤ ±1 % of display
		zero drift	≤ ±1% (lower limit of the measuring range)
		zero shift	≤ ±1% (lower limit of the measuring range)
Air humidity	(10 ... 80) % rel. humidity; max. 20 g/m³	response	≤ ±1% (lower limit of the measuring range)
		zero drift	≤ ±1% (lower limit of the measuring range)
		zero shift	≤ ±1% (lower limit of the measuring range)
Stray radiation effect	(0...0.2) mSv/h	response	≤ ±1% (lower limit of the measuring range)
Mains voltage variation, static	-12 % … +10 % of rated value (115 V / 230 V)	response	≤ ±0.5 % of display
Mains voltage variation, dynamic	-12 % … +10 % of rated value (115 V / 230 V)	indicated value	≤ ±0.5 % of display
Electromagnetic compatibility	according to IEC 60601-1-2	response	≤ ±1% (lower limit of the measuring range)

12 Definition of Polarity

The polarity of the chamber voltage of PTW dose-meters is defined by the potential of the outer electrode with respect to the guard electrode. Both positive and negative chamber voltages are shown in Figure 12-1.

Connecting system M

The collecting electrode and the guard electrode are connected to ground potential.
For positive high voltage (HV), the outer electrode (= outer shield = external chamber wall) is positive with respect to ground potential.

By this definition, with connecting system M, negative ions generated in the ionization chamber will be attracted by the chamber wall, when a positive chamber voltage is applied.
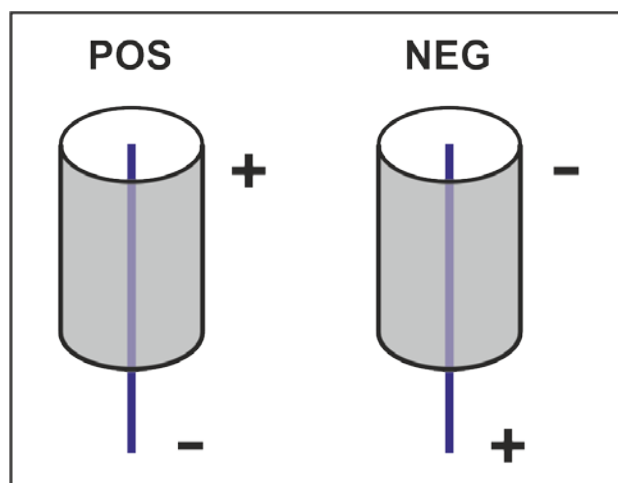

Figure 12-1:   Positive and negative polarizing voltage

13 Electromagnetic Compatibility (EMC) according to IEC 60601-1-2

The following declarations are valid for MULTIDOS T10004. We will refer to MULTIDOS as "product" in the following declarations.

> ⚠ **WARNING**
>
> Magnetic and electrical fields are capable of interfering with the proper performance of the product.
>
> **Product Failure!**
>
> Do not use cables longer than specified. This might impair the electromagnetic compatibility characteristics of the product.

> ⚠ **WARNING**
>
> Magnetic and electrical fields are capable of interfering with the proper performance of the product.
>
> **Product Failure!**
>
> Do not use the product in the immediate vicinity or placed on top of or below other equipment. However, if the application requires an arrangement of devices as described above, the product should be monitored in order to ensure its proper functioning in the specific arrangement.

Guidance and Manufacturer's Declaration – Electromagnetic Emissions		
The product is intended for use in the electromagnetic environment specified below. The customer or the user of the product should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment – guidance**
RF emissions IEC/CISPR 11	Group 1	The product uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions IEC/CISPR 11	Class B	The product is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes. [1]
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

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[1] The product fulfils the requirements of IEC/CISPR 11 Class B. However, it is not intended for use in domestic establishments.

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The product is intended for use in the electromagnetic environment specified below.			
The customer or the user of the product should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment – guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ±1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surges IEC 61000-4-5	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	± 1 kV line(s) to line(s) (symmetrical) ± 2 kV line(s) to earth (unsymmetrical)	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5 % U_T (> 95 % dip in U_T) for ½ cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (> 95 % dip in U_T) for 5 s	< 5 % U_T (> 95 % dip in U_T) for ½ cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (> 95 % dip in U_T) for 5 s	Mains power quality should be that of a typical commercial or hospital environment. If the user of the product requires continued operation during power mains interruptions, it is recommended that the product be powered from an uninterruptible power supply or a battery.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment – guidance
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The product is intended for use in the electromagnetic environment specified below.			
The customer or the user of the product should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment – guidance**
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	U_1 = 3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the product, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = \dfrac{3,5}{U_1}\sqrt{P} = 1.2\ \sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	E_1 = 3 V/m	$d = \dfrac{3,5}{E_1}\sqrt{P} = 1.2\ \sqrt{P}$ 80 MHz to 800 MHz $d = \dfrac{7}{E_1}\sqrt{P} = 2.3\ \sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey [a], should be less than the compliance level in each frequency range. [b] Interference may occur in the vicinity of equipment marked with the following symbol:
NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.			
NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the product is used exceeds the applicable RF compliance level above, the product should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the product.			
[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than [U_1] V/m = 3 V/m.			

Recommended separation distances between portable and mobile RF communications equipment and the product

The product is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the product can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the product as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150 kHz to 80 MHz $d = \dfrac{3{,}5}{U_1}\sqrt{P} = 1.2\ \sqrt{P}$	**80 MHz to 800 MHz** $d = \dfrac{3{,}5}{E_1}\sqrt{P} = 1.2\ \sqrt{P}$	**800 MHz to 2.5 GHz** $d = \dfrac{7}{E_1}\sqrt{P} = 2.3\ \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1:   At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2:   These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

14 Accessories and Spare Parts

MULTIDOS	T10004
Detector connection box 12 x M	T16007
Detector connection box 12 x B	T16013
Cable for detector connection box T16007 / T16013 available in: 5 m, 6 m, 10 m, 15 m, 20 m, 30 m, 40 m	T26011-x
RS232 cable, 2 m, 9/9 pin, f/m	L178012
RS232 cable, 2 m, 9/9 pin, f/m	L178026
Linear Array LA48	T34009
Extender ME48	T10006
Signal cable	T10006.1.002
High-voltage cable MULTIDOS - ME48	T10006.1.003
MultiSoft	S090002
MEPHYSTO mc²	S080045
UniSoft Edition 2000	S100009
BeamAdjust	S080032
MLCSoft	S070014
MultiCal	S070008
Fuse T 200 mAH, 250 V	L251044
Fuse T 400 mAH, 250 V	L251045
Detectors	on request

Service Manual

⚠ WARNING

Improper execution of service tasks.

Hazards to Persons! Equipment Damage!

Ensure that the service tasks described below are only performed by specialized staff.

In addition, ensure that all other service tasks are only performed by PTW-Freiburg or by a person authorized by PTW-Freiburg.

⚠ WARNING

Improper execution of service tasks.

Hazards to Persons! Equipment Damage!

Before carrying out any service tasks on the MULTIDOS, de-energize the device.

Do not open the housing of the MULTIDOS.

15 Cleaning

General Information on Cleaning

⚠ WARNING

Liquids have entered the device.

Shock Hazard, Erroneous Measurement!

The device must be thoroughly inspected by service personnel before being used again.

⚠ CAUTION

Disinfection of the surface with disinfectants on a phenol base or peroxide compounds.

Equipment Damage!

Do **not** use disinfectants on a phenol base or peroxide compounds to disinfect the surface.

Due to the device geometry, a thorough disinfection of the MULTIDOS and the extender ME48 is not possible. The devices cannot be sterilized.

Clean the product simply by wiping it down with a dry or slightly moistened cloth. Use water or a mild soap solution.

Alternatively, you can use a common disinfection agent for medical instruments which is specified in the list of disinfectants of your national hygiene institute (e.g., VAH in Germany).

If your country does not provide such a list, we recommend either a solution on an aldehyde base or a solution with a quaternary ammonium compound.

Device Surfaces

- Before cleaning the device surfaces, turn off the VIVODOS and disconnect it from the power line by removing the power cord from the wall outlet.

- Wipe the product down. Liquids must not be allowed to enter the product. Do **not** apply spray to the product or the connectors.

- The sockets must not be cleaned. Protect them with the supplied covers.

Connection Cables

Clean the cables as described below:

- Disconnect the cables from the devices (always pull on the connectors, not on the cables!).

- Wipe the cables down.

- Do not immerse the cables in liquids!

16 Maintenance

In the following you will find a list of the maintenance measures and inspections necessary for the product.

Check before each use

- Before each use, visually inspect the product and the cables for signs of mechanical damage.

- After power up and during operation MULTIDOS runs automatic self-tests. If the display shows the measuring screen, you can be sure that the unit will function correctly in the selected measuring mode. If it detects a malfunction, the screen displays an error message (refer to section 10).

- You can also run a test of the LCD (section 3.5 "Testing the LCD").

- Semi-conductor detectors should be checked and/or calibrated before each use.

- If damages or malfunctions are identified, the product must be repaired before it is used again.

Repair

Repairs may only be carried out by PTW-Freiburg or by persons / companies authorized by PTW-Freiburg.

Safety Inspections

Only regularly inspected products are fail-safe. To preserve the functional security and operational safety, a safety inspections are to be executed at regular intervals according to national regulations.

These inspections must only be performed by independent persons with adequate training and experience.

It is recommended to execute the safety inspections every 2 years.

Technical Inspections of the Measuring System

The product must be inspected at regular intervals according to national regulations. It is recommended to perform technical inspections of the measuring system every 2 years at PTW-Freiburg or a qualified calibration laboratory.

Inspections must also be performed after repairs or after each influence which may have changed the behavior of the product.

Calibration

The exact calibration factor and supplementary data are included in the calibration certificate.

It is recommended to have the product calibrated every 2 years at PTW-Freiburg or by specially trained staff on site.

17 Setting the System to the Local Line Voltage

> ⚠ **CAUTION**
>
> Improper handling
>
> **Equipment damage!**
>
> Pay attention to the correct insert of the fuse holder.
>
> Use only the following fuse types:
> – 230 V: 2 x T 200 mAH, 250 V
> – 115 V: 2 x T 400 mAH, 250 V
>
> Each of the fuses must guarantee a breaking capacity of at least 1500 A.

You can set MULTIDOS to the voltage of your local power line (115 V or 230 V) by reversing the fuse holder. Thereby you have to change the fuses according to the new line voltage.

- Using a small screwdriver, carefully raise the tab of the fuse holder. Then remove the fuse holder from its compartment (Figure 17-1).

Figure 17-1:   Unlocking the fuse holder

- Remove the fuse insert (labelled 115 V / 230 V) (Figure 17-2), reverse it and reinsert it with the correct voltage rating shown at the rear of the fuse holder (Figure 17-3).

- Replace the fuses with fuses of the appropriate ratings (refer to fuse specifications on the rear panel of MULTIDOS).
  Approved fuses are available from PTW:
  – L251044: T 200 mAH, 250 V
  – L251045: T 400 mAH, 250 V
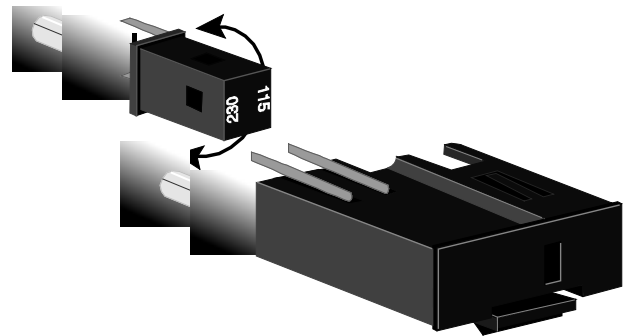
Figure 17-2:   Reversing the fuse holder

- Reinsert the fuse holder.
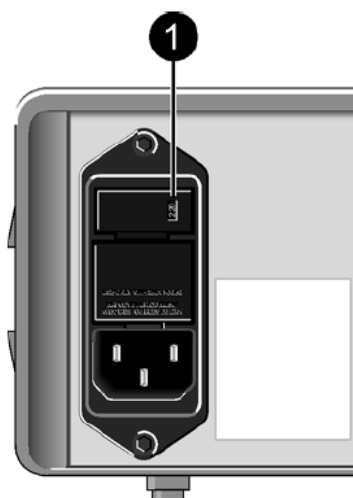
Figure 17-3:   Selected line voltage 1

18 Changing the Fuses

> ⚠ **CAUTION**
>
> Improper handling
>
> **Equipment damage!**
>
> Insert the fuse holder with the proper orientation when you replace the fuse without changing the line voltage!
>
> Use only the following fuse types:
> – 230 V: 2 x T 200 mAH, 250 V
> – 115 V: 2 x T 400 mAH, 250 V
>
> Each of the fuses must guarantee a breaking capacity of at least 1500 A.

MULTIDOS uses 2 fuses which are accessible from the back of the device.

To replace the fuses proceed as follows:

* Switch MULTIDOS off.

* Disconnect MULTIDOS from the power line.

* Using a small screwdriver, carefully raise the tab of the fuse holder. Then remove the fuse holder from its compartment (Figure 17-1). Do not re-move the fuse insert from the fuse holder.

* Replace the fuses with fuses of the appropriate ratings (refer to fuse specifications on the rear panel of MULTIDOS).
  Approved fuses are available from PTW:
  – L251044: T 200 mAH, 250 V
  – L251045: T 400 mAH, 250 V

* Reinsert the fuse holder.

19 Electrical Safety

The device meets protection class I (IEC 61140) requirements. The enclosure and all exposed metal parts of MULTIDOS are connected to the non-fused earthed conductor. For the high voltage (400 V), the current is limited to 0.5 mA max. in single-fault condition; this means that in the event of a damaged detector cable and contact with the conductor under high voltage, not more than 0.5 mA will flow to the non-fused earthed conductor or ground.

MULTIDOS is connected to the power line by means of an IEC-standard, 3-pole connector, a power cord which is usually supplied with the device, and a wall outlet with a non-fused earthed wire.

MULTIDOS may only be opened by PTW-Freiburg or by persons authorized by PTW-Freiburg. Before opening the enclosure, turn off MULTIDOS with the Power switch and disconnect it from the power line, because you may come in contact with live parts when the device is opened.

Observe the ambient conditions stated in section 11.1 when operating the device.

20 Disposal of the Product

The typical lifetime of MULTIDOS and extender ME48 s about 10 years.

At the end of the product life the components must be disposed of in compliance with the applicable waste control regulations. The different materials must be separated and recycled as appropriate.

MULTIDOS and extender ME48 do not contain hazardous materials.

The electronic components must be recycled according to local regulations.

Literature

[1] Council Directive 93/42/EEC concerning medical devices (Medical Device Directive - MDD)

[2] Council Directive 97/43/EURATOM on health protection of individuals against the dangers of ionizing radiation in relation to medical exposure

[3] IEC 60731
Medical electrical equipment
Dosimeters with ionization chambers as used in radiotherapy

[4] IEC 60601-1-2
Medical electrical equipment
Part 1-2: General requirements for basic safety and essential performance -
Collateral Standard: Electromagnetic compatibility - Requirements and tests

[5] IEC/CISPR 11
Industrial, scientific and medical equipment -
Radio-frequency disturbance characteristics - Limits and methods of measurement.

[6] IEC 60529
Degrees of protection provided by enclosures (IP Code)

[7] IEC 60950-1
Information technology equipment - Safety
Part 1: General requirements

[8] IEC 61010-1
Safety requirements for electrical equipment for measurement, control and laboratory use;
Part 1: General requirement

[9] IEC 61000-3-2
Electromagnetic compatibility (EMC) -
Part 3-2: Limits -
Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

[10] IEC 61000-3-3
Electromagnetic compatibility (EMC) -
Part 3-3: Limits -
Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection

[11] IEC 61000-4-2
Electromagnetic compatibility (EMC) -
Part 4-2: Testing and measurement techniques -
Electrostatic discharge immunity test

[12] IEC 61000-4-3
Electromagnetic compatibility (EMC) -
Part 4-3: Testing and measurement techniques -
Radiated, radio-frequency, electromagnetic field immunity test

[13] IEC 61000-4-4
Electromagnetic compatibility (EMC) -
Part 4-4: Testing and measurement techniques -
Electrical fast transient/burst immunity test

[14] IEC 61000-4-5
Electromagnetic compatibility (EMC) -
Part 4-5: Testing and measurement techniques -
Surge immunity test

[15] IEC 61000-4-6
Electromagnetic compatibility (EMC) -
Part 4-6: Testing and measurement techniques -
Immunity to conducted disturbances, induced by radio-frequency fields

[16] IEC 61000-4-8
Electromagnetic compatibility (EMC) -
Part 4-8: Testing and measurement techniques -
Power frequency magnetic field immunity test

[17] IEC 61000-4-11
Electromagnetic compatibility (EMC) -
Part 4-11: Testing and measurement techniques -
Voltage dips, short interruptions and voltage variations immunity tests

Appendix A: China Electronic Industry Standard Compliance

附录：中华人民共和国电子产业标准

This Supplement concerns China Electronic Industry Standard Compliance
此附录涉及中华人民共和国电子产业标准的相关规定

The following product pollution control information is provided according to SJ/T11364-2006 *Marking for Control of Pollution caused by Electronic Information Products*.

根据SJ/T11364-2006标准规定的《电子信息产品污染控制标识要求》特提供以下有关产品污染控制方面的信息。

1. Explanation of Pollution Control Label
    污染控制标识说明

This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese standard SJ/T11363-2006 *Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products*. The number in the symbol is the Environment-friendly Use Period (EFUP), which indicates the period during which the toxic or hazardous substances or elements contained in electronic information products will not leak or mutate under normal operating conditions so that the use of such electronic information products will not result in any severe environmental pollution, any bodily injury or damage to any assets. The unit of the period is "Year".

In order to maintain the declared EFUP, the product shall be operated normally according to the instructions and environmental conditions as defined in the product manual, and periodic maintenance schedules specified in Product Maintenance Procedures shall be followed strictly.

Consumables or certain parts may have their own label with an EFUP value less than the product. Periodic replacement of those consumables or parts to maintain the declared EFUP shall be done in accordance with the Product Maintenance Procedures.

This product must not be disposed of as unsorted municipal waste, and must be collected separately and handled properly after decommissioning.

该标识表明本产品含有的有毒有害物质超出SJ/T11363-2006标准规定的《电子信息产品中有毒有害物质的限量要求》。标识中的数字为本产品的环保使用期限（EFUP），表明在正常使用的条件下，电子信息产品内含的有毒有害物质或元素不会发生外泄或突变，用户使用该电子信息产品不会对环境造成任何严重污染或对人身、财产造成任何严重损害的期限。单位为年。

为保证所声明的环保使用期限，应按产品手册中所规定的指示和环境条件进行正常使用，并严格遵守产品维护程序中规定的定期维护和保养日程。

产品中的耗件或某些零部件可能具有单独的标识，其环保使用期限有可能短于产品本身的环保使用期限。应按产品维护程序定期更换这些耗件或零部件，以保证所声明的整个产品的环保使用期限。

本产品在使用寿命结束后不可作为普通生活垃圾处理，必须另行收集并作妥善处理。

2. Name and Concentration of Hazardous Substances
有毒有害物质的名称及含量

Table 1 - Hazardous substances name and concentration.
表1 - 有毒有害物质的名称及含量

Component Name 部件名称	Hazardous substances name 有毒有害物质的名称					
	(Pb)（铅）	(Hg)（汞）	(Cd)（镉）	(Cr(VI))（六价铬）	(PBB)（多溴联苯）	(PBDE)（多溴二苯醚）
Display 显示设备	X	X	X	X	X	X
Others 其它	X	O	X	X	X	X

O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006

• Data listed in the table represents best information available at the time of publication.

• This table shows where these substances may be found in the supply chain of PTW electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求。

• 此表所列数据为直至发布时所能获得的最全面信息。

• 此表表明自本产品销售之日起在PTW电子信息产品的供应链上何处可能找到以上所述有毒有害物质。请注意，以上所列的部件类型中的一些可能不属于本产品。

Index

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