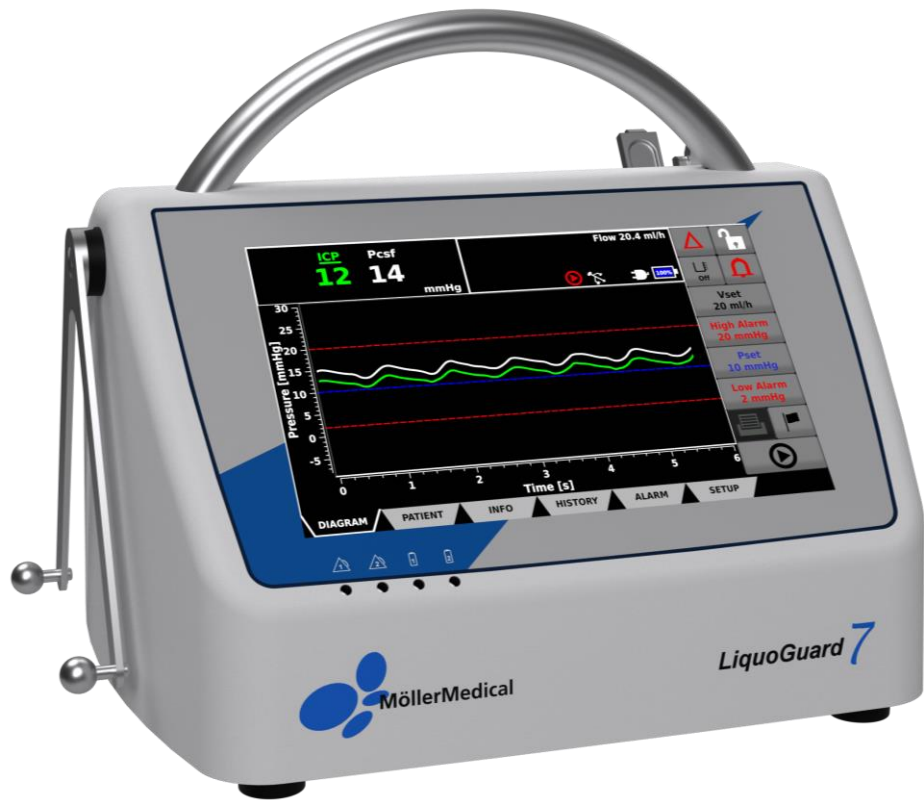


en

# Instruction Manual

# LiquoGuard<sup>®</sup>7

## CSF drainage pump



# **IMPORTANT**

**READ CAREFULLY BEFORE USE**

**KEEP THESE INSTRUCTIONS FOR FUTURE CONSULTATION**

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# 1 General safety instructions

## 1.1 Explanation of the safety symbols used

In this instruction manual, visual symbols are used to highlight important instructions. These references are prerequisites for preventing hazards to patients and operating personnel, as well for avoiding damages or malfunctioning of the device.

### 1.1.1 Symbols used in instruction manual



Caution



Information or help

### 1.1.2 Symbols appearing on the device



Type BF applied part



Defibrillation-proof type CF applied part



Medical device



Unique device identifier



Serial number (the 4 digits indicate the year and month of manufacture in YYMM format)



Follow the instructions for use



Follow instructions for use



Complies with ANSI/AAMI ES 60601-1  
CAN/CSA 22.2 No. 60601-1-08



Alternating current



Return and disposal according to WEEE Directive













Main alarm







Backup alarm

General safety instructions














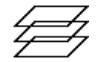





-  Main battery
-  Backup battery
-  Adapter 1 input
-  Adapter 2 input
- ICP** Parenchymal or tip sensor connection (compatible with Philips M1006B invasive pressure module connection).
-  Patient monitor output (compatible with Edwards TruWave)
-  "ON" for a part of equipment
-  "OFF" for a part of equipment
- Pcsf** Tubing set connection
- In/Out** Connection for I/O connector
-  USB host
-  RJ45 network connection
-  Connection to the nurse call system

The BF application parts (Pcsf and ICP) are specified as an application part.

**1.1.3 Symbols appearing on the LiquoGuard®7 display**

-  Pump is in Pause mode
  -  Pump is in Application running mode
  -  All alarms are displayed and emitted
  -  One or more alarms have been actively paused by the operator. Alarms are not emitted. The remaining time until the alarms are displayed again is shown.
- 10:00

## General safety instructions

-  Drainage quantity counter off
-  Drainage quantity counter active. Message when the set drainage quantity is reached.
-  All physiological alarms displayed and emitted.
-  All physiological alarms are suppressed, with the remaining time displayed until the alarm sounds again  
05:00
-  Keypad lock inactive
-  Keypad lock active
-  Main battery charge
-  Presentation mode ready
-  Softkey: press or save a screenshot  
Info bar: Printer is connected
-  Set a marker for documenting events
-  One or two USB memory sticks are connected
-  Preset is active (instead of X, the number of the preset is indicated)
-  LiquoGuard®7 is connected to the main power supply
-  Scale in/out of the time axis in HISTORY
-  Selection of curves to be displayed
-  Scaling of the axes to optimum
-  Scaling the axes to maximum
-  Clear history (plot, volume, alarms, patient data)
-  Move back and forth on the time axis in the HISTORY dialog field

## General safety instructions

## 1.1.4 Symbols indicated on the retail packaging



Follow the instructions for use



Catalogue number



Batch code



Serial number (the 4 digits indicate the year and month of manufacture in YYMM format)



Packaging unit



Use by date  
YYYY-MM-DD



Liquid outlet open



Liquid outlet closed



Sterilized using ethylene oxide



Lithium-ion battery



Non-ionising electromagnetic radiation



Not suitable for use with MRI



Not suitable for use with MRI



Limited suitability of tubing set for use with MRI. See details under symbol for the condition.



Single sterile barrier system



Single sterile barrier system with protective outer packaging



Single sterile barrier system with double protective outer packaging

General safety instructions



Do not reuse



Do not resterilise



Do not use if package is damaged



Stacking restriction, stack may consist of max. 4 packages



Keep dry



Humidity, limitation



Temperature limit



Manufacturer



Date of manufacture  
YYYY-MM-DD



Total length



Blood pressure, invasive measurement



Follow the instructions for use



Type BF applied part



Keep away from sunlight



Caution! Observe transport and storage conditions.

**Rx ONLY**

Attention: Under US Federal law, this device may be sold only to a physician or ordered by a physician.

For further information about symbols used please refer to our homepage: [www.moeller-medical.com/glossary-symbols](http://www.moeller-medical.com/glossary-symbols)

## General safety instructions

The use of the LiquoGuard®7 CSF drainage pump is subject to thorough knowledge and observance of this instruction manual which is an integral part of the delivered product. Store this instruction manual carefully. The present instructions are not a substitute for training of the owner/operator by a medical device consultant approved by the manufacturer. The device must be used only by persons who have the required training or knowledge and experience.



If components are used that do not correspond to the original equipment manufacturer parts, the performance, safety and EMC behaviour may be impaired.

### 1.2 Explanation of the conventions applied

Various typefaces are used in these instructions for easier reference.

Typeface	Application
<b><i>Bold and italics</i></b>	Buttons used in operating procedures
SMALL CAPITALS	Dialog fields and submenus in running text.
<i>Italics</i>	Device options, buttons and references to chapters and sections in running text.

### 1.3 Manufacturer's responsibility

The manufacturer is responsible for the safety, reliability and serviceability of the device in the following cases:

- Where assembly, upgrades, adjustments, changes or repairs are performed only by persons authorized by the manufacturer.
- Where the electrical installation of the area used for medical purposes complies with the applicable requirements and regulations (e.g. VDE 0100, VDE 0107 or IEC specifications).
- Where the device is used in accordance with the user manual.
- Where the regulations specific to a region or country are observed.

The manufacturer undertakes to accept returned old devices according to the Electronic Equipment Act.

## 1.4 Equipotential bonding

It is important to limit potential variances between the different parts of a system within the patient's environment. In limiting this potential variance by using a system of protective earth conductors, the quality of the connection is of utmost importance. It is, therefore, essential to avoid a failure in the protective devices in each part of the system.



In the case of failure of the protective earth conductors of a device, a potential variance can occur at the housing of the device and present a danger for the operator and the patient. Do not touch the patient and the device simultaneously.

## 1.5 Owner's duty of care

The owner of the device must accept responsibility for the proper operation of the medical device. The user is obliged to fulfil all duties in accordance with the regulatory requirements and is fully responsible for all activities when using medical devices. Only qualified personnel may operate the LiquoGuard®7. This instruction manual does not replace training of the user by the medical device consultant. The training is carried out when the product is delivered by a medical device consultant authorized by the manufacturer with the aid of all products necessary for use. The operator must ensure that staff are trained on a regular basis by a qualified person (ideally a medical device consultant authorized by the manufacturer) if the safe use of the product on the patient cannot be guaranteed due to inadequate training. Clinical application may be only according to instructions of qualified personnel.

Any modifications to the LiquoGuard®7 are prohibited. Liquids must not penetrate parts of the device which carry electrical voltage.

Ensure that no cleaning spray enters the connector socket.

Before cleaning, unplug the LiquoGuard®7 connector plug and turn the device off.

Do not turn the pump rotor opposite to the flow direction indicated if the tube is already connected to the pump. This may present a danger to the patient.

To obtain an accurate pressure measurement, do not use any other accessories except a suitable extension tube with a maximum length of 30 cm, fitted between the catheter and the tubing set.



Never attach filters (e.g. bacteria filter) between the catheter and drainage bag.

### Application on computer tomographs

The tubing set may remain attached to the patient during computer tomography (CT). The LiquoGuard®7 must be disconnected.

### Application on magnetic resonance tomographs

The tubing set may remain attached to the patient during MRI imaging exams. The LiquoGuard®7 must be disconnected and must be located outside the magnetic field (another room, screened).

## General safety instructions

It is essential to observe the further measures for use in an MRI environment from *page 132* and in the instruction manual of the respective tubing sets.

Use the device only on a mains power supply fitted with a protective earth conductor. The mains voltage must conform with the indications provided on the identification plate on the back.

Replace any connecting cable in the case of even minor damage and take care not to roll over the cables.

Keep cables away from sources of heat. This is to prevent the insulation from melting, potentially causing a fire or electrocution.

Do not force the connector plug into the socket.

Do not pull on the cable when removing the plug. If necessary, loosen the plug interlock to remove it.

Position the LiquoGuard®7 so that it can be easily disconnected from the mains power supply.

Do not subject the LiquoGuard®7 to strong heat or fire.

Do not subject the LiquoGuard®7 to strong impacts.

If heat, fumes or smoke are emitted from the LiquoGuard®7, disconnect the mains plug of the device immediately.

Do not extinguish the LiquoGuard®7 with water in the event of fire.

Also observe the safety instructions in the instruction manuals of the devices used in conjunction with the LiquoGuard®7.



Any serious incident that has occurred in relation to the device should be reported to the manufacturer and the competent authority of the Member State in which the user and/or patient is established.

### 1.6 Additional accessories

Additional accessories, which are beyond the scope of delivery of the present device and are connected to the analogue and digital interfaces of the device, must be proven to comply with the relevant IEC specifications (e.g. IEC 60601 for electrical medical devices). Furthermore, all configurations must satisfy the current version of the system requirements according to standard IEC 60601-1. Any operator connecting the additional devices is responsible for configuring the system and for ensuring that the current version of the system requirements satisfy standard IEC 60601-1.

### 1.7 Single use

The re-use of a single-use product presents a potential risk of infection for the patient or operator. Contaminated products can damage health, and cause illness or even death of the patient. Cleaning, disinfection and sterilization can adversely affect essential material properties and product parameters and thus result in product failure.

Dispose of the used single-use product according to your hygiene requirements. In order to prevent leakage from the tubing set, ensure that the stopcocks are closed when disposing of the drainage and infusion sets.

### 1.8 Declaration on DEHP

The LiquoGuard®7 tubing sets do not contain any bis (2-ethylhexyl) phthalate (DEHP).

### 1.9 Application during defibrillation and for electrosurgical devices

Do not touch the patient, table or instruments during defibrillation. The measurement accuracy can be impaired during defibrillation. The recovery time of the device is less than 10 seconds. The recovery time has no effect on patient or device safety. During defibrillation, use only accessories stated in this instruction manual.

When using electrosurgical devices, the LiquoGuard®7 and the transducers used do not include any protective measures against burning.

The LiquoGuard®7 can be used in combination with electrosurgical devices.

Nevertheless, the strong electromagnetic faults which occur in the direct vicinity of electric motors, power lines, PCs, monitors or other, possibly faulty, electrical devices can, in individual cases, impair the functionality of the device.

Consider such faults when observing inexplicable phenomena on the device. The proper operation of the device can be restored as follows:

- Position the pressure sensor housing as far away as possible from the electrosurgical electrodes.
- Set up the devices at a safe distance from each other, check their functionality and test them for plausibility.
- Make sure that the laid patient cables do not touch as electromagnetic coupling is possible during energy input via the electrosurgical device.
- Make sure that no cables are in contact with the patient.
- Take all the necessary precautions to avoid malfunctioning.
- Note the instructions and recommendations from the manufacturer of the electrosurgical device.

## Purpose

## 2 Purpose

The Möller Medical GmbH LiquoGuard®7 CSF drainage pump is a pressure-controlled peristaltic pump. The LiquoGuard®7 Drainage Set is a sterile single-use accessory designed to be used only with the LiquoGuard®7 CSF drainage pump. The LiquoGuard®7 CSF drainage pump with the LiquoGuard®7 Drainage Set are specifically designed to pump CSF from the ventricular system and the lumbar area of the patient on the basis of CSF pressure, or when the *Parenchymal/Tip sensor* and a suitable parenchymal sensor is used, from the ventricular system of the patient on the basis of parenchymal or CSF pressure. The LiquoGuard®7 Drainage Set is compatible with all conventional ventricle catheters with an internal diameter greater than/equal to 1 mm and length less than/equal to 350 mm, as well as lumbar drainage catheters with an internal diameter greater than/equal to 0.7 mm and length less than/equal to 800 mm.

The LiquoGuard®7 Infusion Test Set is a sterile single-use accessory and must be used only in conjunction with the LiquoGuard®7 CSF drainage pump. The LiquoGuard®7 CSF drainage pump, together with the LiquoGuard®7 Infusion Test Set and the Lumbar Infusion Test function, are designed to ensure the flow of up to 100 ml of infusion solution (physiological saline solution or CSF replacement fluid) at a consistent volume into the spinal canal, with simultaneous pressure measurement (see *page 115*).



The LiquoGuard®7 may be used only in monitored medical areas in hospitals. The purpose of the LiquoGuard®7 is not to form a diagnosis, but to support in forming a diagnosis.

### 2.1 Indications of temporary intrathecal CSF drainage

Generally, the LiquoGuard®7 does not change the indication for intrathecal CSF drainage in any patient, nor does it influence the therapeutic concept, type of treatment, therapy objectives, or therapy duration.

The most fundamental characteristics of the LiquoGuard®7 system are comparable with those of other CSF drainage systems on the market. Therefore, the listed indications for CSF drainage must be understood in the broadest sense, without presupposing the use of the LiquoGuard®7 system or any specific comparable CSF drainage system, as these systems are interchangeable with each other at all times without the need for a change in therapy or further surgery.

#### Communicating hydrocephalus

This condition includes all clinical pictures in which CSF production is temporarily in disproportion to CSF resorption, usually during cerebral haemorrhage (subarachnoid haemorrhage, intraventricular haemorrhage), encephalitis and cranial-cerebral injuries. In most cases, the cause is resorption dysfunction by obstruction of the Paccioni granulation. There is no alternative treatment to intrathecal CSF drainage for these clinical pictures.

**Non-communicating hydrocephalus**

CSF drainage is temporarily impaired by a partial or complete occlusion of the CSF draining paths. This case can arise with masses (tumours, cysts, haemorrhage, congenital malformation) near the foramen of Monro, of the 3rd ventricle, the aqueduct, the 4th ventricle or the foramen of Monro and the foramina of Luschka.

**Therapy-resistant cerebral swelling**

CSF drainage may be indicated in therapy-resistant cerebral swelling caused, for example, by cranial-cerebral injury, cerebral haemorrhage or subarachnoid haemorrhage or by cerebral swelling due to tumours, inflammation or hypoxia, in order to reduce intracranial pressure, and to bypass trepanation (the removal of a cranial bone).

**Forced CSF pressure reduction**

In cases of endovascular or open surgical procedures such as in aortic aneurysms, the CSF pressure is forcibly lowered so as to achieve better arterial perfusion of distal spinal segments and thus to reduce the risk of paraplegia, for example.

Lumbar CSF drainage and pressure-controlled drainage may be indicated both intra- and postoperatively.

**2.2 Indications for permanent CSF drainage**

If permanent CSF drainage is indicated (e.g. in normal-pressure hydrocephalus), temporary CSF drainage would be indicated only for diagnostic purposes (e.g. b-wave diagnostics), but not for continuous therapy. This would indicate a CSF shunt system, usually a ventriculo-peritoneal shunt or a ventriculoatrial shunt.

**2.3 Contraindications****Absolute contraindications**

- Coagulation dysfunction
- Thrombocytopenia

**Relative operative contraindications**

Superficial or deep infections of skin, bone, meninges, or brain. Especially in infections of the brain, meninges, or cerebral chambers (encephalitis, meningitis and ventriculitis), dysfunctional CSF resorption indicates relief, as does simultaneous intake of intrathecal antibiotics in the case of ventriculitis.

## Purpose

**2.4 Complications**

- Meningitis
- Encephalitis
- Ventriculitis
- Myelitis
- Nosocomial infection
- Cerebral haemorrhage
- Epidural haematoma
- Spinal cord injury
- Nerve injury
- Cone and cauda injury
- Back pain
- Cerebral swelling
- Slit ventricles
- Overdrainage
- Underdrainage
- Disconnection
- Bent tubes
- Interrupted tube flow (bent tube, occluded tube system (blood clots or detritus))
- Death

**2.5 Combination with other products, catheters and needles**

The LiquoGuard®7 may be used only with the application parts LiquoGuard®7 Drainage Set *REF. No.: 00003497 (1600 mm) or REF. No.: 00003501 (2000 mm)*, equivalent versions see Appendix 10.6 or LiquoGuard®7 Infusion Test Set *REF. No.: 00003499* of Möller Medical GmbH.

The LiquoGuard®7 Drainage Set is connected to a surgically implanted CSF draining catheter and does not come into contact with the body.



The LiquoGuard®7 Drainage Set may be connected only to a ventricle drainage catheter with internal diameter  $\geq 1$  mm and length  $\leq 350$  mm or lumbar drainage catheter with internal diameter  $\geq 0.7$  mm and length  $\leq 800$  mm.

The LiquoGuard®7 Tubing Set may be used only with the Möller Medical CSF bag provided.

To make an extension, all the usual extension tubes may be connected to the LiquoGuard®7 Drainage Set that are suitable for arterial pressure measurement (sufficient rigidity of the tube), not longer than 30 cm, and have an inner diameter greater than or equal to 2 mm.

## **2.6 Patient population & residual risk**

There are no restrictions with regard to the patient population. The device can be used on patients from any age group, with any health condition, and from any ethnic group.

The patient does not operate the device.

The LiquoGuard®7 is designed to ensure at least one alarm trigger between pressure measurement and alarm generation during an error. The residual risk for the patient exists mainly in the selection of parameters unsuitable for the patient or other application errors. The operator must be aware of this risk.

## **2.7 Essential performance**

The essential performance of LiquoGuard®7 is the measurement of the pressure of cerebrospinal fluid (CSF) and the drainage of CSF until the default pressure value (Pset) is reached.

Product description

### 3 Product description

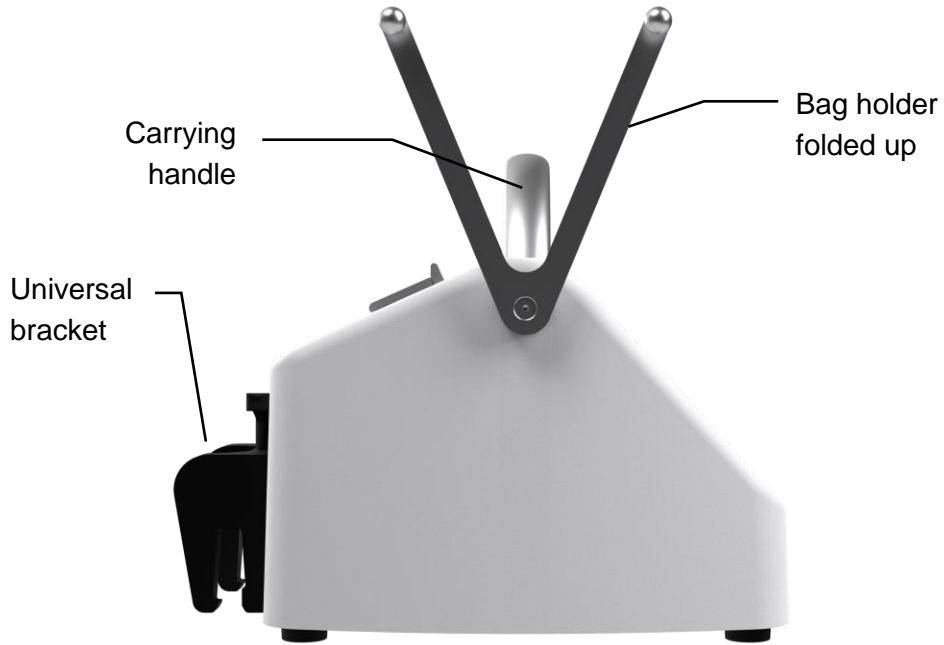


Figure 1: View of the LiquoGuard®7 from the left.

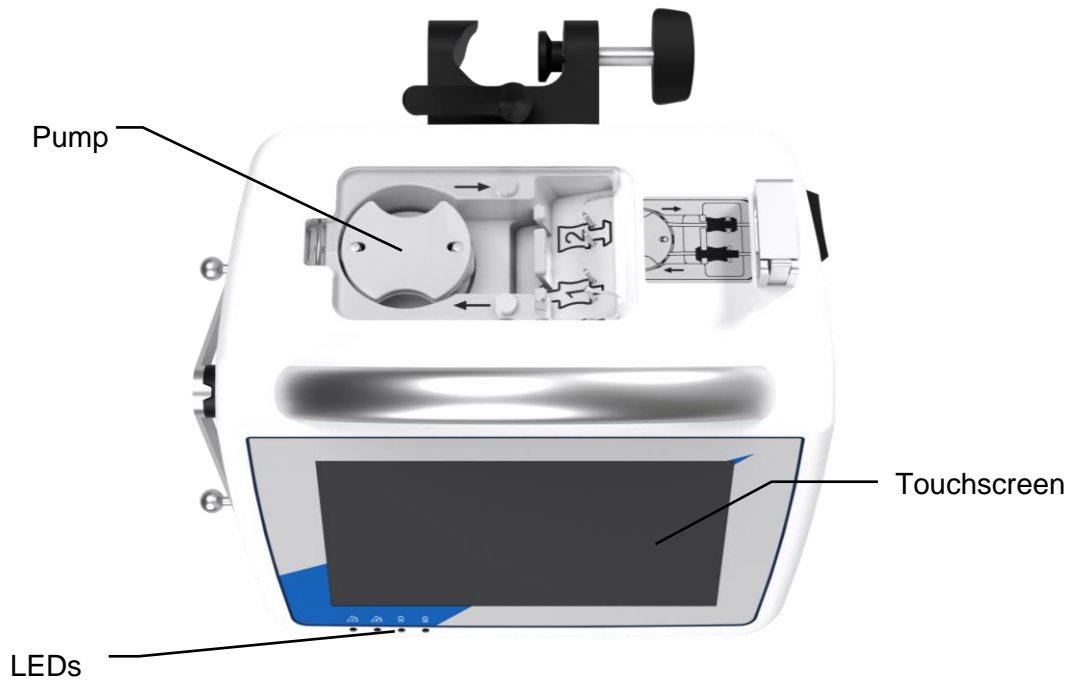


Figure 2: View of the LiquoGuard®7 from above

### **3.1 Touchscreen**

User input in the LiquoGuard®7 is performed via the touch-sensitive, resistive surface (*Touchscreen*, see Figure 2) of the display. Use a finger or suitable input pen to make entries. To select a button on the screen, apply light pressure on the touchscreen in the area of the button.

Wearing standard examination gloves does not usually limit the response of the display.

### **3.2 Bag holder**

The V-shaped holder located on the side (see *Figure 1*) is used to support the CSF drainage bag (CSF bag). Pull one of the holder ends in the direction of the display and turn upwards until the holder engages.

### **3.3 Universal bracket**

LiquoGuard®7 can be hung by means of the *universal bracket* located on the back of the device (see *Figure 1*), onto a standard rail or a bar (diameter 18 mm to 25mm).

### **3.4 Pump**

The integrated peristaltic pump located on the upper part of the LiquoGuard®7 (see Figure 2) ensures the mechanical deformation of the fitted tube, and seals it at all times, allows the flow of CSF through the tube, and the tubing is never open to the atmosphere.

## Product description

### 3.5 LEDs

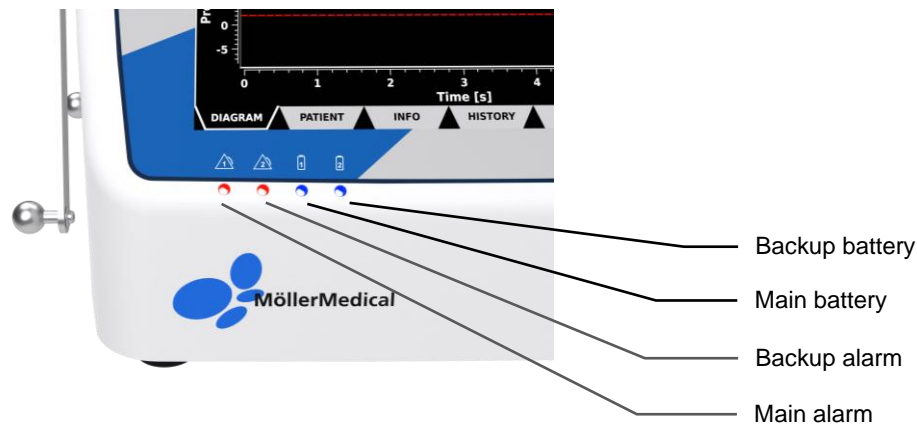


Figure 3: LEDs located on the front of the LiquoGuard®7 indicate alarm conditions and battery charge. The LEDs of the LiquoGuard®7 provide information on active alarm conditions and charge status of the internal battery (see *Figure 3*).

Symbol	Function	Description
	Main alarm	This LED flashes red as soon as an alarm condition or system failure is detected (see <i>page 72</i> ) or when the battery charge is lower than 20%. Even if <i>Alarm Pause</i> is activated, the LED indicates the presence of a valid alarm condition.
	Backup alarm	If the LiquoGuard®7 main controls cannot emit the normal alarm signal (horn) due to a fault, an alternative alarm signal will sound and the backup alarm LED will flash red.
	Main battery	The main battery supplies the LiquoGuard®7 with power when in battery operation mode. The LED lights up permanently in blue when the main battery is being charged.
	Backup battery	If the internal power supply of the LiquoGuard®7 is interrupted, the backup battery will emit an alarm signal. The LED lights up permanently in blue while the backup battery is being charged.

### 3.6 Connection options

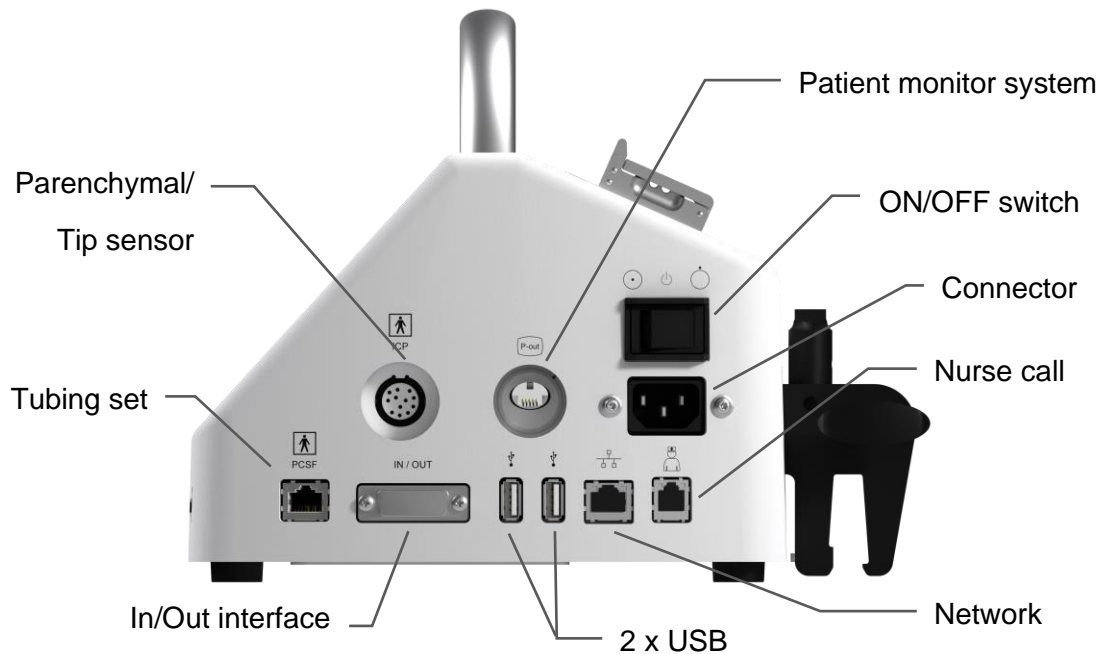


Figure 4: Connection options on the right hand side of the LiquoGuard®7.

In addition to the On/Off switch (I O), which is used to switch the LiquoGuard®7 on and off, the following connection options are also located on the right-hand side of the housing (see Figure 4):

- Parenchymal or tip sensor connection (compatible with the Philips M1006B Invasive Pressure Module connection; for connection specifications see *Input and output signals on page 127*).
- Patient monitor output (compatible with Edwards TruWave; for specifications see *Input and output signals on page 127*).
- Connector socket for three-pole mains cable Type F connected to mains power supply (mains cable must comply with standard IEC 60320).
- Tubing set connection (drainage and infusion)
- Connection for In/Out connector
- 2 x USB (host)
- RJ45 network connection (not functional in regular clinical operation, for service purposes and demonstrations only)
- Nurse call system connection (for specifications, see *page 127*).

## Product description

## 3.7 User interface

This section provides an overview of the LiquoGuard®7 user interface. Settings see *page 53*.

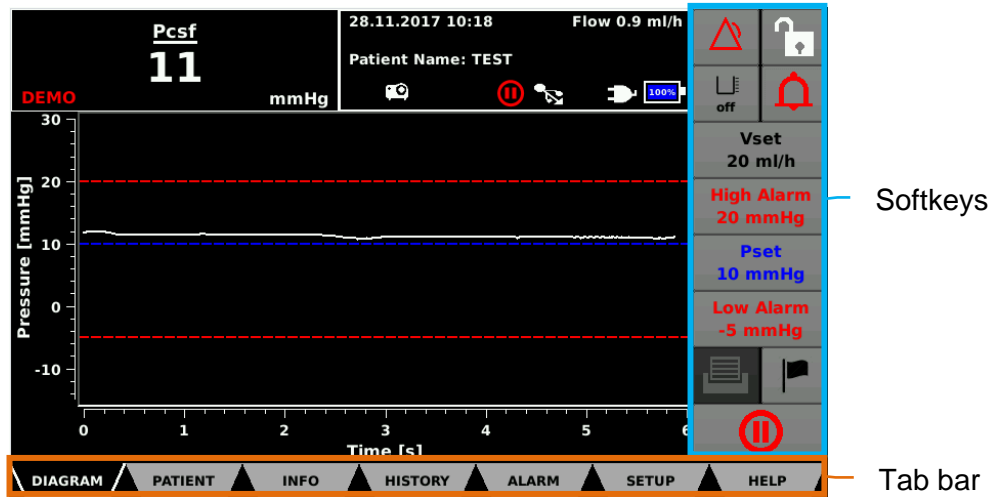


Figure 5: User interface in the DIAGRAM dialog field.

### 3.7.1 Tab bar

All information and input fields for the LiquoGuard®7 can be found under several multi-level dialog fields. Access dialog fields by selecting the relevant button on the tab bar (see *Figure 5*). The active dialog field appears in black on the tab bar. If no entry is made in the selected dialog field within one minute, the LiquoGuard®7 reverts to the standard dialog field **DIAGRAM**.

The range of functions of the LiquoGuard®7 can be extended through various device options. Therefore, not all dialog fields and submenus can be selected by the user in the standard LiquoGuard®7 configuration.

The following table provides an overview of the dialog fields, submenus and their features.

Dialog field	Features	Submenus	Page
DIAGRAM	Pressure curve of the current application Current information on drainage and the equipment Drainage settings Pressure alarms limits Drainage control	None	30
PATIENT	Patient data entry	None	98
INFO	Alarms of the current application Battery status	<ul style="list-style-type: none"> <li>• ALARMS</li> <li>• BATTERY</li> </ul>	51
HISTORY	Statistics. Pressure and flow curves of the current application in table and diagram form.	<ul style="list-style-type: none"> <li>• PLOT</li> <li>• VOLUMES</li> </ul>	101
ALARM	Alarm settings Accessories Accessories	<ul style="list-style-type: none"> <li>• GENERAL</li> <li>• FLOW</li> <li>• PULSATION</li> <li>• PARENCHYMAL / TIP SENSOR</li> <li>• MONITOR / NURSE CALL</li> </ul>	56
SETUP	Device settings	<ul style="list-style-type: none"> <li>• LANGUAGE</li> <li>• DISPLAY</li> <li>• CONFIG</li> <li>• OPERATION</li> <li>• MAINTENANCE</li> <li>• PRESETTINGS</li> <li>• NETWORK</li> </ul>	62

## Product description

### 3.7.2 Softkeys

Use the softkeys in the right-hand margin of the screen (see *Figure 5*) to change the relevant values in the **DIAGRAM** dialog field. Navigate in the other dialog fields using the softkeys provided in the submenu. When a softkey is selected and activated, it will be highlighted in white.

### 3.7.3 Keyboard screen

A keyboard screen will automatically appear as soon as an entry is required if you click on the input line. Depending on the specific field properties, the function controls on the keyboard screen will vary between alphanumeric and numeric. A calendar screen will appear to change the date.

#### 3.7.3.1 Alphanumeric keyboard screen

Letters and numbers can be entered using an alphanumeric keyboard screen (see *Figure 6*).

1. Enter the required value via the keys on the alphanumeric keyboard screen. To delete characters, press the **<=** button.
2. End and save the entry by pressing the **ENTER** button. Reject the changes by pressing the **ESC** button.

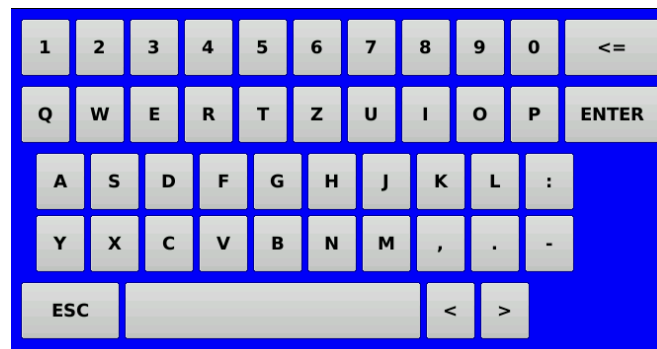


Figure 6: *Alphanumeric keyboard screen for entering letters and numbers.*

## Product description

### 3.7.3.2 Numeric keyboard screen

Use the numeric keyboard screen (see *Figure 7*) to enter numeric values. Make sure that a point is used to separate hours and minutes when entering the time.

1. Enter the required value via the digits on the numeric keyboard screen. To delete numbers, press the <= button.
2. To save the entry, press the **ENTER** button.

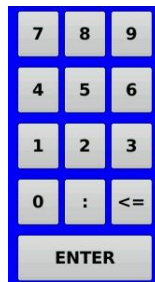


Figure 7: Numeric keyboard screen for entering number values.

### 3.7.3.3 Calendar

Dates can be changed by using the calendar screen (see *Figure 8*). The current year and month appear in the top line of the calendar. The day is shown in a yellow block. To accept changes made, select the calendar day required.

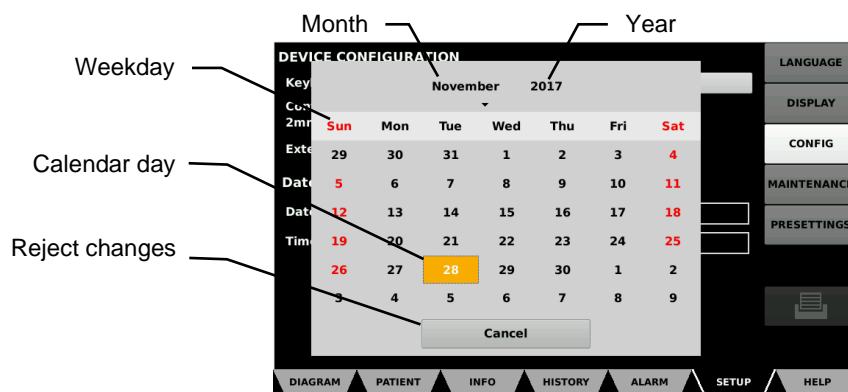


Figure 8: Calendar screen of the LiquoGuard®7 to change date.

## Product description

### Changing the year

1. Select the **Year** indicated at the top of the calendar. Two black arrows will appear next to the year (see *Figure 9*).
2. Press the **arrows** to increase or decrease the year.
3. To save the entry, select the calendar day required. To reject the changes, select **Cancel**.



Figure 9: Changing the year on the calendar.

### Changing the month

1. Select the **Month** appearing at the top of the calendar. A drop-out menu will appear on the calendar (see *Figure 10*).
2. Select the month required from the drop-out menu.
3. To save the entry, select the desired **calendar day**. To reject the changes, select **Cancel**.



Figure 10: Changing the month by opening the drop-out menu in the calendar.

### Changing the day

1. Select the required **calendar day** on the calendar.
2. Once the calendar day has been entered, the change will be accepted without needing any further confirmation.

### 3.8 Diagram dialog field

The **DIAGRAM** dialog field is the LiquoGuard®7 default screen. In addition to the diagram, this screen provides current information on drainage and the device itself. Use the softkeys to operate the LiquoGuard®7 and to enter the basic drainage settings.

#### 3.8.1 Diagram

The diagram shows the current measurement curves (see *Figure 11*)

Curve description	Curve colour	Explanation
Pcsf	White	<b>CSF pressure measured on the pressure sensor on the LiquoGuard®7 tubing set.</b>
ICP	Green	CSF pressure, measured at an additional pressure sensor
Low alarm limit	Lower red dotted line	Lower pressure alarm limit
High alarm limit	Upper red dotted line	Upper pressure alarm limit
<i>Pset</i>	Blue dotted line	Target CSF pressure that has been set



The ICP indicator is part of the *Parenchymal/Tip sensor* option. For more detailed information, see *page 110*.

## Product description

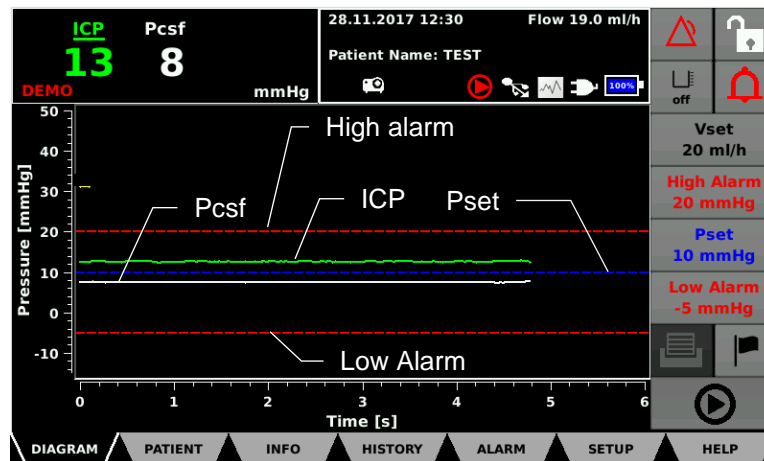


Figure 11: Limit values and curves shown in the diagram.

- Time (x-axis): Time progression of the pressure curve in seconds. The scale is set automatically.  
The scale can be adjusted as described in chapter 6.3.2.2 (page 63).
- Pressure (y-axis): Pressure expressed optionally in [mmHg] or [cmH2O]. The scale is set automatically.
- White curve: Progress of the filtered Pcsf pressure value that is measured by the pressure sensor in the tubing set of the LiquoGuard®7.
- Green curve: Progress of the ICP pressure value that was measured by an external sensor (parenchymal or catheter tip = ventricular).
- Blue dotted line: *Pset* (set pressure)  
When the CSF pressure (ICP or Pcsf) is higher than *Pset*, and the application is not paused, the pump turns (drainage) to reduce the CSF pressure to *Pset*.
- Top red dotted line: *High Alarm* (upper pressure alarm limit)  
When exceeded, an alarm is triggered.
- Lower red dotted line: *Low Alarm* (lower pressure alarm limit)  
An alarm is triggered if too low.

## Product description

### 3.8.2 Info bar

The Info Bar (see Figure 12) provides current information on drainage and the device.

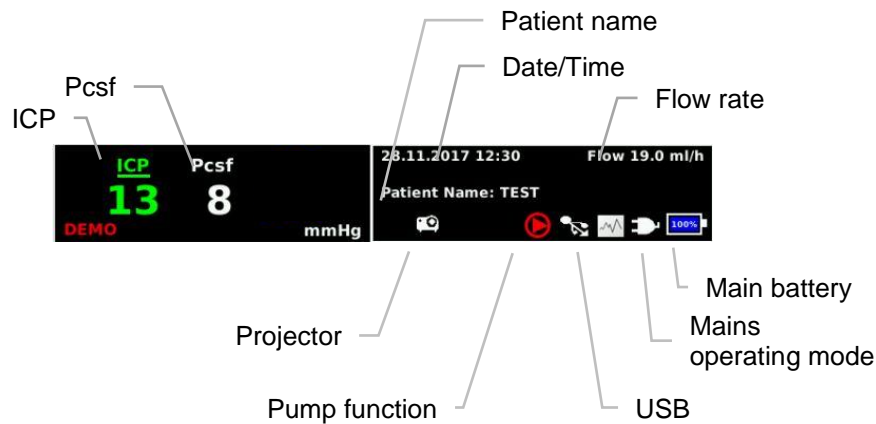


Figure 12: Elements of the Info Bar in the Diagram dialog field.

#### Pcsf (pressure of the cerebrospinal fluid)

The Pcsf field indicates the current pressure value measured by the tubing set pressure sensor. The colour of the text and flashing of the pressure value indicates whether the pressure is within or outside the pressure limits set.

Text colour	Example	Description
White		The pressure currently measured is within the pressure alarm limits set.
Red flashing		The pressure currently measured is outside the pressure alarm limits set.

If **--/--** appears in the **Pcsf/ICP** field instead of the pressure value, no pressure sensor is currently connected to the LiquoGuard®7.

#### Date/Time

This field shows the date and time set on the device.

#### USB

The USB symbol appears when a USB memory stick is connected to the LiquoGuard®7 and this was recognized correctly by the device.

#### Mains operating mode

If the LiquoGuard®7 is powered by a mains cable, the plug connector symbol confirms this operating mode.

## Product description

### Battery operating mode

The current charge state of the main battery is indicated by the bar in the battery symbol. The LiquoGuard®7 is designed to operate independently of the mains power supply via the battery for up to max. 2 hours, with a delivery rate of 20 ml/h. If the battery charge falls below 20%, the colour of the charge indicator bar will change to red. An alarm is also emitted by the device. The LiquoGuard®7 must be connected to the mains power supply at this moment at the latest, in order to prevent the device from turning off due to insufficient battery charge.



The total discharge of a battery can result in permanent damage to the battery and should therefore be avoided.

### Pump function

The pump symbol (play symbol) indicates that the pump is in operation. If the pause function of the LiquoGuard®7 is being used, this symbol will not appear. Instead, the Pause symbol appears in the same location on the display.

### Presettings

When the Presetting option on the LiquoGuard®7 is activated, the number of the current selected presetting will be shown. Information on this option can be found in the relevant section on *chapter* Presettings.

### Printer

The printer symbol appears when a printer is connected to the USB port of the LiquoGuard®7.

### Drainage volume

This shows how much volume (CSF) was drained (actual volume) and at which volume a message is issued (target volume), see *Drainage volume* on page 35.

### Flow rate

This value shows the average volume (CSF) per hour.

### 3.8.3 Softkeys

The softkeys in the right-hand margin of the screen (see *Figure 13*) are used to operate the LiquoGuard®7 and to make changes to the drainage settings. The parameters form the basis for a controlled drainage.

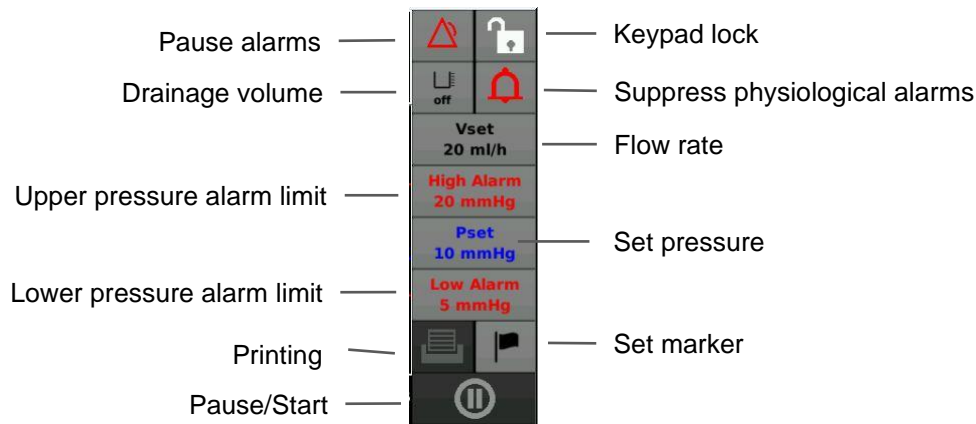


Figure 13: Softkeys in the DIAGRAM dialog field

#### Suppress physiological alarms (bell symbol)

A distinction is made between physiological alarms and technical alarms.

- Physiological alarms, for example, relate to the patient or their readings.
- Technical alarms refer to the condition of device functions.

Use the *Suppress the physiological alarms* button to suppress the audible alarm of all physiological alarms.

If alarms were suppressed, this is indicated by the crossed-out bell. The amount of time remaining before the alarms are automatically reactivated is displayed.

The displayed time is always initially 5 minutes and counts down.

This function refers only to the acoustic output of an alarm. Display of the alarm message in the display is not suppressed.

Alarm messages are shown in the display. Only the alarm sound is suppressed. This alarm suppression can for example, be used when nursing measures are carried out on patients. After 5 minutes, all pending alarms are automatically output again acoustically.

To reactivate the alarms, press the softkey again to **Suppress physiological alarms**. The bell will be shown normally again. Information on the LiquoGuard®7 alarm system can be found on page 72.

#### Pause alarm (triangular symbol)

The *An alarm was paused* button indicates that one or several alarms have been paused for the indicated period.

If an alarm is paused, this is indicated by the crossed-out symbol. The amount of time remaining before the alarm is reactivated automatically is displayed.

The displayed period of time depends on the selection made in the alarm window (see *Pause alarm signal*, page 73) and counts down.

## Product description

This function refers to the acoustic output of one or more alarms and also to the display of the alarm messages in the display.

If you would like to reactivate the alarm function before expiry of the displayed time, press the softkey **An alarm was paused**. The symbol will be shown normally again. Information on the LiquoGuard®7 alarm system can be found on page 72.

### Drainage volume

Using the Drainage volume button, set the desired amount of CSF (target volume) that the LiquoGuard®7 should deliver. Reaching the set drainage volume is indicated by a corresponding message window and an advisory tone.

Use this function to drain a defined amount of CSF and to receive feedback when the desired volume has been reached.

The drainage will NOT be interrupted when the set target volume has been reached and there is no acoustic signal. This function is for information purposes only, not for limiting the amount of drainage, and is not an alarm.

How long it takes until the set drainage volume is reached depends on the speed of the pump (see *Vset*, page 35) and how often the pump rotates. In drainage mode, the pump rotates only if the pressure (ICP or Pcsf) is above Pset (blue dotted line).

### Keypad lock

This function activates and deactivates the LiquoGuard®7 keypad lock. If the keypad lock is active, the softkey indicates a closed lock symbol and the other buttons on the display are greyed out. In this mode, all buttons other than the *Keypad Lock* softkey (and optionally, *Printing*, if available) are inactive.

### Vset

The Vset button can be used to change the delivery rate of the LiquoGuard®7 pump.

The pump always delivers (drainage or infusion, depending on the type of the connected tubing set) with the set flow rate *Vset* when the pressure is above *Pset* (blue dotted line) (drainage) or when the pressure is below the maximum pressure alarm limit (infusion). This affects the drainage quantity that is delivered per unit time.

Example: At a flow rate (*Vset*) of 20 ml/h, it may be that after an hour 20 ml has still not been drained, since the pressure (Pcsf or ICP) is not permanently above Pset.

## High Alarm

The *High Alarm* button adjusts the high alarm limit for the pressure measured. If the pressure measured exceeds the *High Alarm* limit, an alarm will be generated.

Choose expedient alarm limits by taking into consideration the degree of mobility of the patient and the nursing effort.

The more mobile the patient is, the more generous you can be in selecting the alarm limit, if necessary, since a change of position always leads to pressure fluctuations (this is physiological).

Please note that the measured pressure may be physiologically relatively high during lumbar drainage the more upright the patient lies, sits or stands.

## Pset

Use the *Pset* button to change the set pressure value.

The LiquoGuard®7 drains whenever the pressure is above *Pset*.

*Pset* cannot be lower than the low alarm limit (lower dotted red line). If necessary, lower the low alarm limit to select a lower *Pset*.

## Low Alarm

This function changes the low alarm limit of the measured pressure. If the pressure measured is below the *Low Alarm* value, an alarm will be generated.

Choose expedient alarm limits by taking into consideration the degree of mobility of the patient and the nursing effort.

The more mobile the patient is, the more generous you can be in selecting the alarm limit, if necessary, since a change of position always leads to pressure fluctuations (this is physiological).

## Printing

*Printing* is a function option. Information on this function can be found in the relevant section on *page 109*.

## Set marker

If the option *Documentation* on the LiquoGuard®7 is active, this button can be used to insert a bookmark in the saved application data. Information on this option can be found in the relevant section on *page 101*.



## Product description

### Pause/Start

This pause and restarts the drainage (*Pause* mode or *Play* mode).

If drainage is in *Pause* mode, the diagram indicates a large, flashing pause symbol for several seconds. After a few seconds, the symbol is reduced to the small flashing Pause symbol

 in the upper part of the display. The softkey *Pause/Start* also shows this symbol .

If drainage is started by selecting the softkey *Pause/Start*, the flashing symbol will go out and the softkey *Pause/Start* will show the start symbol . Similarly, the Play symbol  is displayed in the upper part of the display.

### 3.9 Battery

The LiquoGuard®7 has an internal rechargeable lithium-ion battery that powers the device during mains-independent operation. As soon as the device is connected to the mains, the battery will be charged automatically.

To get the most out of the battery, follow these guidelines:

- Charge the battery to full capacity before use.
- Charge the battery after use or when the battery level is low. To optimise performance, a fully (or almost fully) discharged battery should be charged as soon as possible.
- The service life of a lithium-ion battery depends on the frequency and duration of use as well as the environmental conditions.
- Useful life is approximately 3 years or 500 full charge/discharge cycles.
- The approximate charging time is 3 hours and can be up to 12 hours. The device can be operated during charging.

Please also note the information on storage (see chapter 5.15).



If the device shows signs of battery damage or leakage, contact the service centre immediately (see chapter 7.7). Never use a defective battery in the device.

## 4 Installation and startup



Ensure that the packaging is delivered undamaged. Check the LiquoGuard®7 for damages. In the event that the product indicates defects, it may not be used, and the supplier must be informed accordingly.

### 4.1 Transport and storage instructions

Temperature:	-10 °C to +50 °C
Humidity:	less than 90% rel. humidity
Weight with packaging:	approx. 5.3 kg
Dimension of the LiquoGuard®7 with packaging:	Width x Height x Depth 300 mm x 320 mm x 345 mm

### 4.2 Unpacking the device and inspecting delivery

The LiquoGuard®7 is supplied in a cardboard box. When unpacking the LiquoGuard®7 ensure that no parts remain in the package.

The delivery of the LiquoGuard®7 consists of (1 item each):

- LiquoGuard®7 Mains cable
- Instruction Manual



It is advisable to keep the packaging and use it again for any service required. Ship the LiquoGuard®7 only in its original packaging in order to avoid damage during transport.

The subsequent provision of transport packaging is subject to charges.

### 4.3 Operating the LiquoGuard®7

All handling of the LiquoGuard®7 is subject to precise knowledge of and compliance with this instruction manual. These instructions do not replace proper user training. Only qualified personnel may operate this unit.

Begin by removing the LiquoGuard®7 from its packaging. The LiquoGuard®7 must be prepared according to hygiene guidelines prior to first application. When cleaning, use a mild detergent/disinfectant according to the hygiene instructions on *page 92*.

The LiquoGuard®7 can be:

- set up in a suitable place.
- hung onto a standard rail.
- installed on standard infusion stands (ensure that the device is securely fastened onto the infusion stand).

The device is optimally positioned if the user can stand in front of it and view the operating interface vertically.

## Installation and startup

### When setting up the LiquoGuard®7, please ensure:

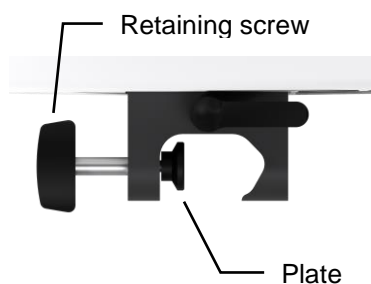


- a sufficient distance from other devices is maintained. The LiquoGuard®7 requires a space of at least 34 cm in height and width.
- the device can be turned off via the ON/OFF switch and disconnected from the mains by unplugging the mains cable.
- the LiquoGuard®7 is not operated in the direct proximity of or stacked with other devices, as this could result in faulty operation. If operation as described above cannot be avoided, monitor the LiquoGuard®7 and other devices to verify specified normal operation.

### 4.3.1 Hanging onto a standard rail

Lift the LiquoGuard®7 from its handle and hang it onto a standard rail by means of the universal bracket located on the back. Before releasing the LiquoGuard®7, check that the universal bracket is securely positioned on the rail. Activate the safety clip by turning the lever on the universal bracket by 90° (see *Figure 14*) until it engages. The safety clip prevents the LiquoGuard®7 from inadvertently being lifted off the rail.

#### Unsafe fitting of the safety clip



#### Safe fitting of the safety clip

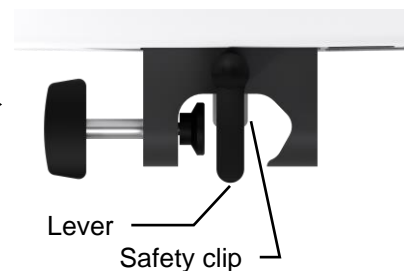


Figure 14: Unsafe and safe positioning of the safety clip.

### 4.3.2 Installation on an infusion stand

Open fully the retaining screw (see *Figure 14*) of the universal bracket. Lift the LiquoGuard®7 by its handle and place onto the infusion stand, fitting the opening of the universal bracket onto the stand. Turn the retaining screw until the LiquoGuard®7 is safely and stably installed.

Do not use the universal bracket for mounting on a stand if the plate for the retaining screw is missing, which is located between the retaining screw and stand (see *Figure 14*).

### 4.3.3 Connecting and turning the device on

Once the device has been installed in the correct place and position, connect the mains cable to the right-hand side of the housing of the LiquoGuard®7. Insert the other end of the mains cable into the power socket with a protective earth conductor. Observe the voltage indicated on the identification plate of the device. The plate is located on the back of the device. The self-test starts by placing the ON/OFF switch of the LiquoGuard®7 in the ON (☉) position. The basic functions of the electronic components are tested during the self-test. The device is ready for operation once the self-test is completed.

Testing the elements such as the LEDs on the front of the device and the built-in speaker are not subject to the self-test. In order to guarantee the functioning of these components during an alarm, ensure during the device test and particularly the self-test that both left LEDs flash red briefly and that the speaker emits an audible signal. If problems are encountered, contact the manufacturer's service team.



Use the mains cable provided to connect the LiquoGuard®7 to the mains power supply.

To avoid the risk of electrical shock, this device may be connected only to a power supply with a protective earth conductor.



To avoid false alarms, users should be familiar with the alarm concept of the LiquoGuard®7 (see *page 72*), as well as the settings (see *page 53*) before the first start-up.

To further commission the LiquoGuard®7, you need a LiquoGuard®7 Drainage Set. Observe the maximum tube length between the catheter and the LiquoGuard®7. The option *Monitor/Nurse Call* allows for the LiquoGuard®7 to be connected with a patient monitoring or nurse call system. Further information on this device option can be found on *page 95*.

## 4.4 Suitable operating environment

The LiquoGuard®7 is suitable for environments in the following areas:

- Professional healthcare facilities with specific requirements
  - Clinics (rooms in A+E, hospital rooms, intensive care, operating theatres, except for in the proximity of active facilities of electrosurgical devices or outside of the RF- shielded room for magnetic resonance imaging, first aid facilities).

The LiquoGuard®7 is not approved for use in aircraft or military applications. The appropriate EMC requirements for these environments have not been tested.

## 5 Application and operation

### 5.1 Installation and startup


Remove the LiquoGuard®7 from the packaging. Place it on an appropriate level surface or install it onto an infusion stand or rail (see *page 38*). Connect the mains cable to the LiquoGuard®7 and then to the mains power socket.



When restarted, the LiquoGuard®7 will revert to the standard settings (use the option Presettings to save the settings). For more detailed information, see *page 106*).

The LiquoGuard®7 can operate as a pressure or volume-controlled pump. The sections below describe the basic operating procedures for these two processes.

### 5.2 Switching on the LiquoGuard®7

Place the ON/OFF switch located on the side to the **ON position** (  ). The LiquoGuard®7 starts. It is possible that at the start of the boot process, the screen displays undefined patterns and colours. This is normal and does not indicate a malfunction.

LiquoGuard®7 performs a comprehensive self-test during startup. This process takes several seconds. Once completed, the LiquoGuard®7 will be in Pause mode (see *Figure 15*).



Testing the elements such as the LEDs on the front of the device and the built-in speaker are not subject to the self-test. In order to guarantee the functioning of these components during an alarm, ensure when the device starts and particularly during the self-test that both left LEDs flash red briefly and that the speaker emits an audible signal. If problems are encountered, please contact the manufacturer's service team.

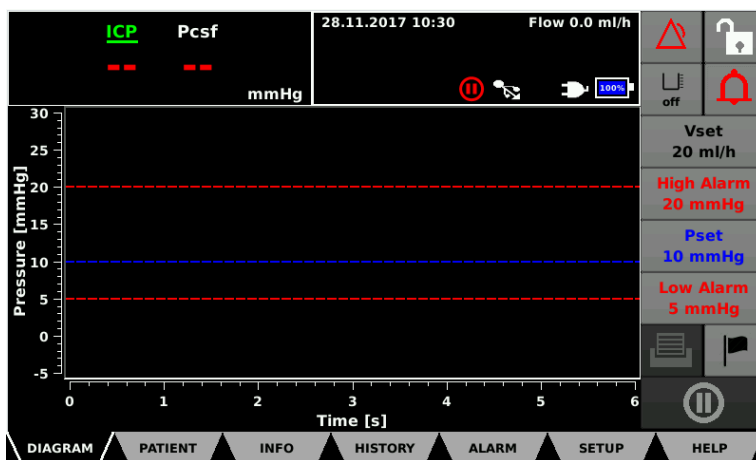


Figure 15: LiquoGuard®7 display in Pause mode

### 5.3 Preparing the tubing set

Prepare the tubing set according to the sequence described below.

1. Prepare the patient, insert the catheter (not part of this product), vent the catheter, and check that it is functioning properly.
2. Remove the tubing set from its sterile packaging in accordance with hygiene guidelines.
3. Attach the adhesive electrode to the pressure sensor housing.
4. Connect the tubing set with the CSF bag and fasten it to the bracket provided at the back of the device (see *page 21*).
5. Ensure that the stopcock is open between the tubing set and CSF bag.
6. Ensure that the outlet on the CSF bag is closed.



The bag is open when the white part is visible on the angled side. The liquid may leak out.



The bag is closed when the white part is visible on the straight side. The liquid cannot leak out.

### 5.4 Connecting the sensor cable

The sensor cable is part of the tubing set and transmits the measured signals from the pressure sensor to the LiquoGuard®7. The sensor cable connection is located on the right side of the device (see *page 24*).

1. Connect the sensor cable of the prepared tubing set to the LiquoGuard®7 (see *Figure 16*).
2. As soon as the tubing set is recognized by the LiquoGuard®7, one or several green windows will appear on the screen with the instruction to insert the tubing set.
3. Select the button **Start Application** in the message window.



Figure 16: Connecting the tubing cable set to the LiquoGuard®7

## Application and operation

### 5.5 Inserting the tube

The LiquoGuard®7 tubing set has two pump adapters: Adapter 1 and Adapter 2 (see *Figure 17*). The input points for Adapter 1 and Adapter 2 (see *Figure 18*) in the LiquoGuard®7 pump are designed so that they cannot be confused. The arrows on the adapter, as well as on the pump, indicate the direction of the CSF flow.

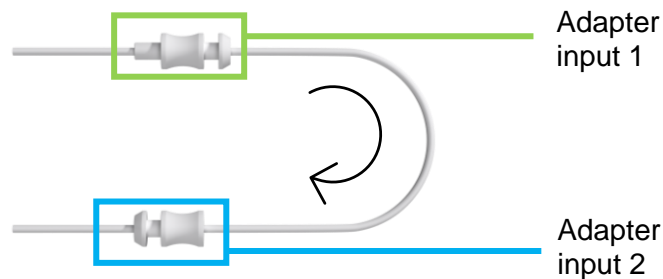


Figure 17: Adapter 1 and Adapter 2 of the LiquoGuard®7 tubing set

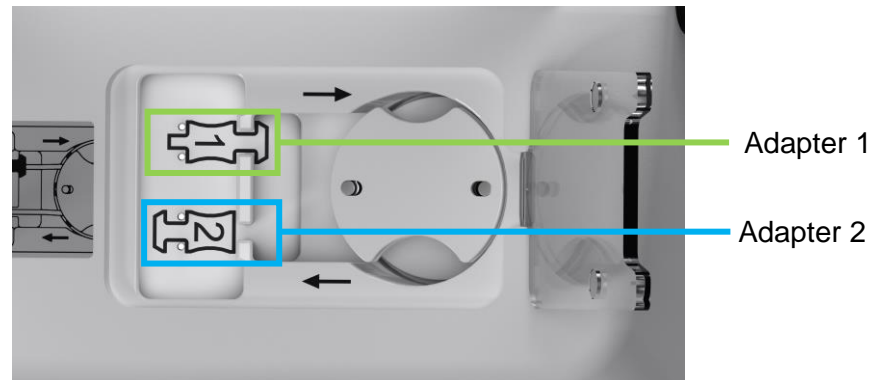


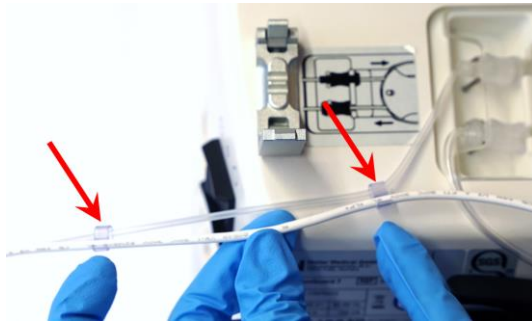
Figure 18: Adapter 1 and Adapter 2 inputs located on the pump housing. The two black arrows indicate the CSF flow direction.

1. Use your fingers to reach into the opening of the pump cover and lift until it engages.
2. The LiquoGuard®7 display indicates a green message window with the softkey Turn rotor. Use this button to turn the pump rotor and feed the tube into the pump.
3. Insert Adapter 1 into the LiquoGuard®7 Adapter 1 input.
4. Hold **Adapter 2** with one hand.
5. Select the softkey **Turn rotor** on the display and keep it pressed.
6. Feed the tube into the semi-circular opening of the rotor up to the **Adapter 2 input**.
7. Now insert **Adapter 2** into the **Adapter 2 input**.
8. Close the front cover of the pump.

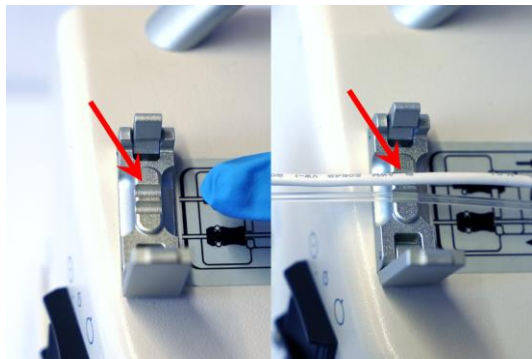
Ensure that the entire tube is inserted correctly in the pump; refit it if necessary. Do not allow the tube to be longer than 20 mm. Lay the sensor cable on the device so that it neither lies on nor is in contact with the carrying handle.

## Application and operation

### Insert the tube and cable into the clamp.



1. Open the clamp.
2. Find the point between the first and second connection point of cable and tube, starting from the rotor.



3. Insert the tube and cable into each of the two bulges of the clamp, between the two connecting pieces.



4. Close the clamp. A clicking sound must be audible.
5. Check that the clamp is securely closed.
6. Check that the cable (white) cannot move.
7. Check that the tube (transparent) can move freely inside the clamp.

If the clamp comes loose, please contact service immediately (see *chapter 0*).

## Application and operation

### 5.6 Connecting the catheter

Observe the instructions provided in the section *Combination with other products*, catheters and on page 19.

Connect the catheter to the **four-way stopcock** of the tubing system. Turn the T-handle of the four-way stopcock by 180° as shown in Figure 19 to allow drainage. In order to prevent infection, ensure here that the stopcock position does not enable any opening to the atmosphere.

Once the tube has been inserted in the pump and the catheter has been connected, the pump rotor may not turn in the direction opposite to the flow (see *Figure 18*) as this presents a danger for the patient.



The tubing set must always be sufficiently vented.

There may be no air between the patient and the pressure sensor housing.

If there is air between the patient and the pressure sensor housing, the pressure measurement may be erroneous.



To vent the tube, put the pump in Pause mode, open the pump cover, press the softkey Turn Rotor and aspirate CSF until no more air can be detected between the patient and the pressure sensor housing and no more air can be detected in the pressure sensor housing.

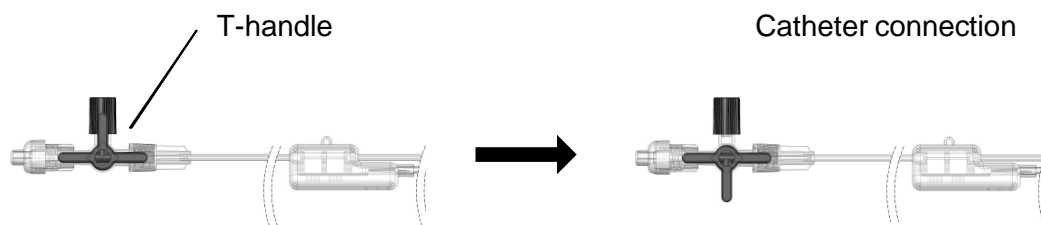


Figure 19: Tubing system four-way stopcock. The picture on the left shows the four-way stopcock in delivery mode. The picture on the right shows the four-way stopcock in operating mode.

### 5.7 Pressure sensor housing – Positioning and fastening

By selecting the sensor position, specify at what level the CSF pressure is measured. "Level" always means the height above the floor.

Literature usually indicates intracranial pressure values that are defined at the level of the foramen of Monro. The level of the pressure sensor housing above the floor should therefore always correspond to the level of the foramen of Monro, if no other levels are specifically defined.

#### Ventricular drainage

If the patient's head moves, the measured pressure values may deviate depending on head positioning. The position of the sensor on the head should, therefore, be considered when evaluating the pressure values (adjust sensor position if necessary, to always keep this at the level of the foramen of Monro).

Secure the tubing set pressure sensor housing at the level of the foramen of Monro during ventricular drainage.

#### Lumbar drainage

For the lumbar measurement, the same (level above the floor) applies, only the location of the measurement is different (spinal canal). The position of the pressure sensor housing is again obtained at the level of the foramen of Monro.

When the patient is lying down (supine or lateral position), the level of the spinal canal above the floor corresponds approximately to the level of the foramen of Monro, which allows the level of the pressure sensor housing to be easily determined (everything on the same level → exact measuring point is not primarily relevant, the important thing is at the level of the foramen of Monro).

Inquire about the patient's sleeping habits. For patients who lie on their sides, tape the pressure sensor housing on their backs; for those who lie on their backs, tape the housing on their sides. A safety cushion (available as an accessory) can be applied to avoid pressure pain (see *page 136*). If the patient moves his/her head, the measured pressure values may deviate depending on head movements. Ensure that the patient does not lie on the side on which the sensor is taped.

#### Pressure measurement in mobile patients

The LiquoGuard®7 is suitable for measuring CSF pressures in partially or completely mobilized patients and to drain CSF.



With standing, sitting or lying patients, misleading pressures can be displayed if the following principles are not observed.

## Application and operation

A patient who stands up from a lying position or is placed in an erect position can show strong CSF pressure fluctuations and the CSF pressure readings can vary greatly.

During lumbar measurements, the CSF pressure increases and may fluctuate because cerebrospinal fluid pushes into the caudal regions of the subarachnoid spaces due to gravity and induces a higher CSF pressure there.

In ventricular measurement, the CSF pressure will fall and possibly fluctuate because CSF pushes caudally and therefore less CSF remains in the ventricular system.



Depending on the patient, their degree of mobility, and medical indications, a measurement location which takes into account these circumstances is to be selected.

If applicable, the location of the pressure measurement (position of the pressure sensor housing) is to be changed according to the patient's position, so that the pressure is always measured at the level of the foramen of Monro (level of the pressure sensor above the floor).

Depending on the degree of mobility of the patient, consideration should also be given to selecting the alarm corridor accordingly to avoid frequent false alarms (pressure too high or too low).

For mobile patients, the LiquoGuard®7 must be attached to an infusion stand. The LiquoGuard®7 must always be within hearing range of trained medical staff.



If the adhesive electrode is not sufficient to firmly secure the pressure sensor, use an appropriate dressing, net bandage or adhesive tape.

Secure fixation can be crucial, especially when used with mobile patients and children. Attach the drainage catheter, the three-way stopcock, the pressure sensor, and the tubes between them securely. Otherwise, patients may damage the product.



If the position of the pressure sensor housing must be changed regularly (head turning, positioning, patient mobility), more adhesive electrodes can be used so the pressure sensor housing is always attached at the level of the foramen of Monro. In this case, stick several electrodes in the periphery of the head and attach the pressure sensor housing to the electrode located at the level of foramen of Monro (level above the floor). If an extension of the tubing set is required, only use extensions in accordance with Chapter 2.5 *Combination with other products, catheters and needles* (page 19). Ensure that the extension is firmly secured.

## 5.8 Changing drainage settings

Changes to the drainage settings can be made via the softkeys in the right-hand margin of the screen in the **DIAGRAM** dialog field. The parameters form the basis for every controlled drainage.



Inappropriate value settings for *Pset*, *High Alarm*, *Low Alarm* and *Vset* may present a danger to the patient. Ensure that the values are adjusted to the needs of the individual patient prior to each drainage procedure. Ensure that the values are adjusted to the needs of the individual patient prior to each drainage procedure.

### 5.8.1 Pressure controlled drainage

The set pressure *Pset* is the control parameter for pressure-controlled drainage.

Pressure controlled drainage means that CSF does not flow at a continuous rate and rarely at a constant volume.

- Determine the set pressure *Pset*, the *High Alarm* and *Low Alarm*, as well as the pump flow rate *Vset*.
- Determine the set pressure *Pset* so that it corresponds to the pressure that you think is appropriate for the patient.
- If the measured CSF pressure exceeds the *Pset* set value, CSF is delivered to maintain the *Pset* set pressure.
- Further information on the above and other settings can be found in the section Settings on page 53.

### 5.8.2 Volume controlled drainage

Volume controlled drainage means that CSF flows at a continuous rate and at a specific volume. The *Vset* value is the control parameter.


- Adjust the volume rate *Vset* and the *High* and *Low Alarms* to the requirements of the individual patient.
- For a continuous CSF flow, now reduce the *Pset* set pressure as far as maintainable (*Low Alarm* + 1 mmHg) to prevent the drainage from being interrupted when *Pset* is achieved.
- Also reduce the *Vset* volume flow to a sufficiently low level to prevent the patient from being overdrained.
- Further information on the above and other settings can be found in the section Settings on page 53.

## Application and operation




### 5.9 Starting the application

Check before you start using it



- that the valves on the tubing set are in the correct position (see *Figure 19*).
  - that there is no air in the tubing set (between patient and pressure sensor housing)
  - that you detect pressure fluctuations in the display when you wiggle the pressure sensor housing
  - that a pulsating pressure curve is detected when ventricular pressure is measured (pulsation is not always detectable with a lumbar or parenchymal pressure measurement)
- **Press the PAUSE/START**  softkey in the **DIAGRAM** dialog field in the right-hand margin of the screen, in order to start the application.

The pump is activated only when the application is started. An active application is shown by the following display indications:

- The flashing Pause symbol in the upper part of the diagram is replaced by the  symbol.
- The Pause/Start softkey changes from  to .

### 5.10 Pausing the application, only pressure monitoring

Only the pump is inactive in Pause mode. All pressures are still shown. All alarm conditions are active and are signalled in the case of an alarm. The Pause mode is also used for patient pressure monitoring without simultaneous CSF delivery.

- Press the softkey  to pause the application.

### 5.11 Interrupting the application

During treatment, it may be necessary to interrupt drainage for a period of time (e.g. transporting the patient, imaging exams, consultation). The procedure described below ensures that the LiquoGuard®7 settings and currently collected data are not lost due to the interruption.

1. While in application mode, remove the tubing set sensor cable from the device.
2. Press the **Interrupt Application** button in the alarm message window. The alarm will be deactivated, and the device will be set in Pause mode.
3. Close the four-way stopcock between the tubing set and the catheter.
4. Open the clamp and remove the tubing set.
5. Open the pump cover and remove **Adapter 1** from its input point.
6. Press the softkey **Turn Rotor** in the message window.
7. Feed the tube into the semi-circular rotor opening up to **Adapter 2 input**; then remove **Adapter 2** from its input.
8. Close the pump cover.



Ensure that the LiquoGuard®7 is not turned off at this stage.

9. Following the interruption, connect the tubing set to the LiquoGuard®7 as described in Points 5.4 to 0 and open the four-way stopcock between the tubing set and the catheter. When the LiquoGuard®7 recognizes the tubing set once again, the current pressure value appears on the display.
10. Press the softkey **Pause/Start** to continue the application.



Ensure that the tubing set is not disconnected from the LiquoGuard®7 for longer than 8 hours. If this period is exceeded, the LiquoGuard®7 will no longer accept the tubing set. In this case, connect a new tubing set and adjust the settings.

When the tubing set is removed from the pump or replaced, always first close the four-way stopcock between the tubing set and the catheter in order to prevent any CSF backflow.



During personal hygiene of the patient, ensure that no liquid penetrates the pressure sensor housing of the LiquoGuard®7 Tubing Set.

Showering is not permitted.

## Application and operation

### 5.12 Changing the drainage set

1. Interrupt the application as described in *Point 5.11* and remove the tubing set used. Do not switch off the LiquoGuard®7.
2. Follow the instructions in *Points 5.3 to 5.4* to prepare and connect the tubing set.
3. If the tubing set is identified as new, a green message window will appear on the display.
4. If the settings and statistical data of the previous application are to be maintained, press the **Start Application** button in the message window. If the settings and statistics of the previous application are no longer required or a new patient is being treated with the LiquoGuard®7, press the button **New Application**.
5. Follow the steps in *Points 0 to 5.9* in order to fit the tubing set and start the application.

### 5.13 Displaying drainage information

Information and statistics on the current application are found in the dialog field **Info**. Use the softkeys in the right-hand margin of the screen to access the submenus **Alarms** and **BATTERY**.



If the LiquoGuard®7 has been restarted or the power supply interrupted due to low battery charge, the data saved under the **ALARMS** submenu will be deleted.

#### 5.13.1 Alarms

A chronological list of the alarms and alarm conditions occurring during the current application, is located under the submenu **ALARMS**.

If the alarm system is paused or suppressed, all alarms occurring in the current application are still listed in the alarm list. The time of the alarm suppression or alarm pause is not documented as an entry in the alarm list.

Ten alarm entries are displayed in the alarm list. When the capacity limit is reached, the oldest alarm entry is deleted.

#### 5.13.2 Battery

The current charge of the main and backup batteries of the LiquoGuard®7 is indicated in the **BATTERY** submenu. Ensure that both batteries are fully charged when the device is disconnected from the mains power supply. Also observe the battery indicator in the **DIAGRAM** dialog field during battery operation (see *page 33*).

### 5.14 Turning off the device

The LiquoGuard®7 can be turned off via the ON/OFF switch located on the side. If the device is still connected to the mains power supply through the mains cable, the batteries will be charged. If disconnecting the device from the mains, unplug the mains cable from the mains socket.



Dispose of the used single-use product according to your hygiene requirements. In order to prevent leakage from the tubing set, ensure that the stop-cocks are closed when disposing of the drainage and infusion sets.

### 5.15 Storage

If the device is not used for more than 6 months, recharge the battery. The battery discharges over time when the device is not connected to the mains. If the battery is deeply discharged, it can no longer be charged, so it is important that the battery is always at least partially charged. The ideal state of charge of the battery for storage is 40% to 50%.

The storage location should be cool, ideally at 15°C, as storing the batteries in a cool place will slow down the ageing process. Prolonged storage of batteries at temperatures above 40°C can significantly reduce the life expectancy of the batteries.

The batteries should not be stored at a temperature below -20°C, above 60°C or in direct sunlight.

Also observe the storage conditions, see *chapter 10.1*.

The capacity display becomes inaccurate if the battery is stored for an extended period of time.

After the application, store the LiquoGuard®7 in accordance with hygiene regulations. In addition, observe the *Storage Conditions* on page 127.



The risk of battery failure increases with age when a battery is in use for more than 3 years or 500 full charge/discharge cycles.

## 6 Settings



The default values may be changed only by qualified personnel. The user must check prior to every application and on a regular basis that the current settings are suitable for a specific patient.

Particular attention should be given to the alarm parameters and that these satisfy the current requirements of the individual patient. Inappropriate and extreme values will prevent the LiquoGuard®7 alarm system from functioning.

### 6.1 Drainage

In the **DIAGRAM** dialog field, change the drainage settings of the LiquoGuard®7 by using the softkeys on the right-hand side.



Inappropriate value settings for *Pset*, *High Alarm*, *Low Alarm* and *Vset* may present a danger to the patient. Ensure that the values are adjusted to the needs of the individual patient prior to each drainage procedure.

Select the appropriate softkey to change a value. When entering a value, a **+** and **-** button will appear next to the selected softkey. Press the **+** or **-** button until the required value is shown (the softkeys can also be kept pressed). The changed values are automatically accepted without the need for confirmation. To deactivate the **+** and **-** buttons, press the highlighted softkey again or wait one minute until the buttons automatically deactivate.

### 6.1.1 Pset (set pressure value)

This setting determines the set value for the measured CSF pressure. In other words, this is the desired CSF pressure that a connected patient should have.

If the measured CSF pressure exceeds the *Pset* value, CSF will be pumped to reduce the pressure by turning the pump. The pump delivers according to the delivery rate *Vset* until the measured pressure reaches the *Pset*.



Setting the *Pset* value to < 2 mmHg can present a serious danger to the patient. For safety reasons, the system requests confirmation of the setting. To confirm, press the button *Yes, I want to set Pset < 2 mmHg*. This function can be deactivated as described in the section *Config* from page 65.

1. Tab bar **DIAGRAM** → Softkey **Pset**
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 10 mmHg
- Minimum value: limited by Low Alarm
- Maximum value: limited by High Alarm

### 6.1.2 High Alarm

Use the softkey *High Alarm* to set the high alarm limit for the CSF pressure. If the measured CSF pressure exceeds the *High Alarm* value, an alarm will be generated after a preset delay (default value = 45 seconds, see page 56).

If the High Alarm value for the period set under delay of emergency drainage (see page 59) is exceeded, the LiquoGuard®7 performs an emergency drainage. During emergency drainage the pump delivers 250 ml/h until the pressure measured by the tubing set has dropped to or below the High Alarm value.

1. Tab bar **DIAGRAM** → Softkey **High Alarm**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 20 mmHg
- Minimum value: limited by **Pset**
- Maximum value: 75 mmHg

## Settings

Choose expedient alarm limits by taking into consideration the degree of mobility of the patient and the nursing effort.



The more mobile the patient is, the more generous the selected alarm limits can be. Changes in position cause pressure fluctuations (this is physiological) and can result in more frequent unnecessary alarms.

### 6.1.3 Low Alarm

Use the softkey *Low Alarm* to set the low alarm limit. If the measured CSF pressure falls below the *Low Alarm* limit, an alarm will be generated after a preset delay (default value = 45 seconds, see *page 56*).



Setting the Low Alarm value to  $< 2$  mmHg can present a serious danger to the patient. For safety reasons, the system requests confirmation of the setting. To confirm, press the button **Yes, I want to set the Low Alarm below 2 mmHg**. This function can be deactivated as described in the section Config from *page 65*.

1. Tab bar **DIAGRAM** → Softkey **Low Alarm**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 5 mmHg
- Minimum value: -15 mmHg
- Maximum value: limited by **Pset**

Choose expedient alarm limits by taking into consideration the degree of mobility of the patient and the nursing effort.



The more mobile the patient is, the more generous the selected alarm limits can be. Changes in position cause pressure fluctuations (this is physiological) and can result in more frequent unnecessary alarms.

### 6.1.4 Vset

This setting changes the delivery rate of the LiquoGuard®7 pump. The pump delivers according to the Vset delivery rate if the measured CSF pressure exceeds the  $P_{set}$  (blue line) value. The pump delivers until the measured pressure corresponds to the  $P_{set}$  value (blue line).

1. Tab bar **DIAGRAM** → Softkey **Vset**.
2. Press the + and - buttons to change the value.

The change is accepted directly.

- Default value: 20 ml/h
- Minimum value: 1 ml/h
- Maximum value: 150 ml/h

The pump delivers whenever the CSF pressure is greater than  $P_{set}$  (blue dotted line). Often, the CSF pressure of the patient is not continuously above  $P_{set}$  (blue dotted line) but fluctuates, which is why the pump does not always have to deliver.



For example, this means that at a set flow rate of 20 ml/h, less than 20 ml was drained after one hour.

This can definitely be a physiological condition. It can be normal for the CSF pressure to fluctuate if observed over the course of a day.

If you would like to achieve an absolutely constant flow rate (e.g. 20 ml/h), carry out a volume controlled drainage (see *Volume controlled drainage*, page 48).

## 6.2 Alarm

Go to dialog field ALARM in the tab bar. The following alarm-related settings for the LiquoGuard®7 are found in the submenu.

### 6.2.1 General

#### 6.2.1.1 Alarm delay

This setting is used to determine the time period from the moment a specific physiological alarm condition occurs to the emission of an alarm signal. This avoids generating an alarm with temporary pressure fluctuations (e.g. by coughing, sneezing, patient movements or nursing measures).

An alarm delay applies only to the following alarm conditions:

- High Alarm
- Low Alarm
- ICP differs from Pcsf

## Settings

1. Tab bar **ALARM** → Softkey **GENERAL** → Subitem **Alarm delay**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 45 seconds
  - Minimum value: 5 seconds
  - Maximum value: 1 minute

### 6.2.1.2 Sound level

This function determines the volume of the acoustic alarm signal.

1. Tab bar **ALARM** → Softkey **GENERAL** → Subitem **Sound level**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 40%
  - Minimum value: 20%
  - Maximum value: 100%



Reducing the alarm volume below the surrounding volume may result in the user not hearing the alarm signals.

## 6.2.2 Flow

### 6.2.2.1 Lower Flow Alarm

This function sets the minimum time-averaged flow rate for the application. The average value is set according to the averaging time. If the average flow is lower than the *Lower Flow Alarm* value, an alarm is generated.

1. Tab bar **ALARM** → Softkey **FLOW** → Subitem **Lower Flow Alarm**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: OFF (function deactivated)
  - Minimum value: OFF (function deactivated)
  - Maximum value: 20 ml/h, limited by *Upper Flow Alarm* function

Example: You would like to be informed (alarm) if less than 5 ml CSF/h is drained.



The default value of this alarm is OFF, since it is physiologically possible that no CSF is drained over a specific period of time. Reasons are, for example, the existing auto drainage of the patient via their venous vascular bundle or a fluctuating, but not necessarily pathological CSF production rate.

### 6.2.2.2 Upper Flow Alarm

The upper flow alarm limit sets the maximum time-averaged flow rate for the application. The average value is set according to the *averaging time*. If the average flow over the *averaging time* is higher than the *Upper Flow Alarm* value, an alarm is generated.

1. Tab bar **ALARM** → Softkey **FLOW** → Subitem **Upper Flow Alarm**.
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: OFF (function deactivated), limited by *Lower Flow Alarm*
  - Minimum value: OFF (function deactivated), limited by *Lower Flow Alarm*
  - Maximum value: 150 ml/h

Example: You would like to be informed (alarm) if more CSF than 30 ml/h is drained.

Please activate the alarm “**Upper Flow Alarm**” if this is required for your application.

## Settings

**6.2.2.3 Averaging time**

This function sets the time frame for averaging the flow rate in relation to the flow alarm limits. This setting is visible only when the advanced settings are displayed. See chapter *Advanced Settings* on page 66.

1. Tab bar **ALARM** → Softkey **FLOW** → Subitem Averaging time
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 30 minutes
  - Minimum value: 5 minutes
  - Maximum value: 60 minutes



The shorter the averaging time is, the more frequently the LiquoGuard®7 checks if one of the two flow alarm limits has been exceeded.

**6.2.2.4 Delay of emergency drainage**

This value defines the time that elapses between the appearance of the *upper pressure alarm* (see page 54) and the beginning of emergency drainage. This function is typically active if the flow rate  $V_{set}$  is not sufficient for relieving the CSF pressure because the patient, for example, has developed a cerebral haemorrhage that cannot be sufficiently drained with the selected flow rate ( $V_{set}$ , see page 56), which is why the intracranial pressure steadily increases. The flow rate during emergency drainage is 250 ml/h. This maximum flow rate is maintained until the CSF pressure has dropped to or below the *High Alarm* value (see page 55).

1. Tab bar **ALARM** → Softkey **FLOW** → Subitem **Delay of emergency drainage**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: “Off”
  - Minimum value: 0 second
  - Maximum value: “Off” (no emergency drainage)

## 6.2.3 Pulsation

### 6.2.3.1 Pulsation alarm

This function changes the alarm conditions for CSF pulsation. Pulsation is a monitoring parameter intended to increase patient safety in ventricular pressure measurement. With a good connection (CSF communication) between patient and pressure sensor, the pulsation frequency corresponds to approximately the patient's pulse and is easy to identify. The poorer the communication is, the less clear the pulsation can be identified. If pulsation fails, this indicates, for example, an occlusion of the catheter.

During lumbar pressure measurement, the pulsation can be very weak, despite a good connection. In patients after craniectomy, pulsation may no longer be measurable at all.

If CSF pulsation fails or is too weak, the LiquoGuard®7 triggers an alarm.

In certain circumstances, the alarm can be deactivated (e.g. in the case of craniectomy / operative decompression (surgical removal of part of the cranium)).

Also, with continuous lumbar drainage, reliable pulsation detection is sometimes not always possible, and it may be necessary to disable the pulsations alarm.

Using the pulsation alarm, the LiquoGuard®7 recognizes whether the catheter is blocked.



Deactivating the pulsation alarm means that an alarm function for catheter occlusions or collapsed ventricles is not present.

1. Tab bar **ALARM** → Softkey **PULSATION** → Subitem **"Pulsation lost" alarm (only tested in the tubing set!)**
2. Select the required option. The selected option is indicated by a black dot in the options field .
3. To save the changes, press the **Confirm changes** button.
  - No alarm: Alarm is deactivated
  - As soon as pulsation fails: Alarm when pulsation frequency  $f \leq 30/\text{min}$  or frequency cannot be measured
  - If pulsation fails and a problem is suspected: Alarm when pulsation frequency  $f \leq 30/\text{min}$  or frequency cannot be measured, and pulsation test recognizes a problem.

## Settings

**6.2.3.2 No amplitude alarm**

This setting determines whether an alarm will be generated due to a sustained constant pressure (no pressure fluctuations = amplitude). Independently of the CSF pulsation, CSF pressure is subject to minor pressure fluctuations. If these pressure fluctuations do not occur over a specific period of time, it is possible that the tube is bent, occluded or disconnected.

1. Tab bar **ALARM** → Softkey **PULSATION** → Subitem "**Alarm "Pressure constant for too long"** (only tested in the tubing set!)
2. Select the required option. The selected option is indicated by a black dot in the options field .
3. To save the changes, press the **Confirm changes** button.
  - No plausibility test: No alarm
  - As soon as pressure amplitude seems implausible: Alarm, when the pressure fluctuations over a specific period of time are smaller than the value set under *Min. Amplitude*.
  - If there is no pressure amplitude recognized and a problem is suspected: If the CSF pressure fluctuations averaged over a specific time period are less than the value set under *Min. Amplitude* (see below), the drop-in pressure resulting from the very small quantity of CSF delivered will be tested. If the pressure drop exceeds 5 mmHg, it is possible that the tube is bent, occluded or disconnected, and an alarm will be generated.

**6.2.3.3 Minimum amplitude**

This setting is visible only when the advanced settings are displayed. See chapter *Advanced Settings* on page 66.

This function establishes the pressure difference for the setting "*Pressure constant for too long*" alarm. The CSF pressure fluctuations can vary depending on the patient and the application. If the CSF pressure fluctuation over a specific time period (see *Observation period* on page 62) is less than the value set, an alarm is generated.

1. Tab bar **ALARM** → Softkey **PULSATION** → Subitem **Min. Amplitude**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 0.5 mmHg
  - Minimum value: 0.1 mmHg
  - Maximum value: 0.5 mmHg

#### 6.2.3.4 Observation period

This setting is visible only when the advanced settings are displayed. See chapter *Advanced Settings* on page 66.

The *Observation period* setting changes the time period for the setting "*Pressure constant for too long*" alarm. If the CSF pressure fluctuation over this time period is less than the value set under *Min Amplitude*, an alarm is generated.

1. Tab bar **ALARM** → Softkey **PULSATION** → Subitem **Observation period**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 10 minutes
  - Minimum value: 2 minutes
  - Maximum value: 30 minutes

#### 6.2.4 Parenchymal/Tip sensor

The *Parenchymal/Tip sensor* option allows a parenchymal/tip sensor or a catheter with tip sensor to be connected to the LiquoGuard®7 in addition to the drainage set. Further information on this *device option* can be found on page 110.

#### 6.2.5 Monitor / Nurse Call

*Monitor/Nurse Call* is an option which allows a patient monitor and diagnostic call system to be connected to the LiquoGuard®7. Further information on this *device option* can be found on page 95.


### 6.3 Setup

Go to dialog field **SETUP** in the tab bar. The system settings for the LiquoGuard®7 can be established in the submenus of the dialog field.

#### 6.3.1 Language

##### Language settings

Select the language settings for the LiquoGuard®7 in the **LANGUAGE** submenu.

1. Tab bar **SETUP** → Softkey **LANGUAGE** → Subitem **Language Settings**
2. Select one of the languages indicated. The selected language is indicated by a black dot in the options field .
3. Press the button **Load new language** at the bottom of the screen to accept the changes.
4. Restart the LiquoGuard®7.

## Settings

## 6.3.2 Display

### 6.3.2.1 Pressure unit

Use this selection to set the unit of measure used for pressure.

1. Tab bar **SETUP** → Softkey **DISPLAY** → Subitem **Pressure unit**
2. To change, press the button indicating the unit of measure required.

The change is accepted directly.

Units of measure available:

- mmHg (default value)
- cmH<sub>2</sub>O

### 6.3.2.2 Time axis scaling

Change the value of the setting *Time Axis Scale* in accordance with the scale used on the time axis in the DIAGRAM dialog field.

1. Tab bar **SETUP** → Softkey **DISPLAY** → Subitem **Time axis scaling**
2. Press the **+** and **-** buttons to change the scale.

The change is accepted directly.

- Default value: 6 seconds
- Minimum value: 6 seconds
- Maximum value: 60 seconds

### 6.3.2.3 Timeout backlight when on battery

This function determines the period from the last time the display was touched until the background lighting is dimmed. Dimming the lighting reduces battery consumption. This function is possible only in battery operation mode. If the LiquoGuard®7 touchscreen is touched while the lighting is dimmed, full lighting will be restored.

1. Tab bar **SETUP** → Softkey **DISPLAY** → Subitem **Timeout backlight when in battery**
2. Press the **+** and **-** buttons to change the duration.

The change is accepted directly.

- Default value: 10 minutes
- Minimum value: 2 minutes
- Maximum value: ALWAYS ON

### 6.3.2.4 Display brightness

This setting adjusts the brightness of the display.

1. Tab bar **SETUP** → Softkey **DISPLAY** → Subitem **Display brightness**
2. Press the **+** and **-** buttons to change the brightness.

The change is accepted directly.

- Default value: 100%
- Minimum value: 50%
- Maximum value: 100%



The display brightness setting is limited to a minimum value so as to guarantee the operability of the LiquoGuard®7 at any setting.

### 6.3.2.5 Display contrast

This setting determines the contrast of the display.

1. Tab bar **SETUP** → Softkey **DISPLAY** → Subitem **Display contrast**
2. Press the **+** and **-** buttons to change the contrast.

The change is accepted directly.

- Default value: 100%
- Minimum value: 50%
- Maximum value: 100%

### 6.3.2.6 Date – Time format

This function sets the date and time format for the **DIAGRAM** dialog field.

1. Tab bar **SETUP** → Softkey **DISPLAY** → Subitem **Date-Time format**
2. Press repeatedly on the adjacent button until the required format is indicated.

The change is accepted directly.

Three formats are available (the examples are based the seventh day of the first month of the year 2012 at the time 15:17):

- DD.MM.YYYY HH:MM (default) (e.g. 07.01.2012 15:17)
- MM/DD/YYYY HH:MM am/pm (e.g. 01/07/2012 03:17 pm)
- YYYY-MM-DD HH:MM (e.g. 2012-01-07 15:17)

## Settings

**6.3.2.7 Display flow rate**

This function allows you to specify whether the *flow rate* is displayed in the main **DIAGRAM** window. The value indicates the average flow rate per hour and is expressed in ml/h. On delivery of the LiquoGuard®7, the display is activated, however it can be deactivated at any time.

1. Tab bar **SETUP** → Softkey **DISPLAY** → Subitem **Display flow rate**

- Flow rate visible (default value)
- Flow rate not visible

**6.3.3 Config**

The CONFIG dialog field is used to change the LiquoGuard®7 device settings.

**6.3.3.1 Keyboard format**

This setting changes the format of the keyboard screen.

1. Tab bar **SETUP** → Softkey **CONFIG** → Subitem **Keyboard format**
2. Press repeatedly on the adjacent button until the required format is indicated.

The change is accepted directly.

Formats available:

- QWERTZ (default)
 

This corresponds to keyboards (e.g. German) in which the first five keys on the top row of letters are the letters Q, W, E, R, T, Z.
- QWERTY
 

This corresponds to keyboards (e.g. English) in which the first five keys on the top row of letters are the letters Q, W, E, R, T, Y.

**6.3.3.2 Confirm Low Alarm below 2 mmHg**

This function determines whether a warning message with confirmation will appear if the user attempts to set the *Low Alarm* or *Pset* to a value less than 2 mmHg or 2 cmH<sub>2</sub>O.

Tab bar **SETUP** → Softkey **CONFIG** → Subitem **Confirm Low Alarm below 2 mmHg**

- Acknowledgement message active (default)
- Acknowledgement message deactivated

### 6.3.3.3 Advanced Settings

This function allows you to specify whether *advanced settings* are displayed. These settings are not required for normal operation and mainly intended for experts.

Tab bar **SETUP** → Softkey **CONFIG** → Subitem **Advanced settings**

- Advanced settings visible
- Advanced settings not visible (default value)

### 6.3.3.4 Date – Time settings

Use this setting to change the system time of the LiquoGuard®7.



Before changing the date and time, the tubing set must first be disconnected for safety reasons and the LiquoGuard®7 restarted.

#### Change date

1. Remove the tubing set if this has not yet been done and restart the LiquoGuard®7.
2. Tab bar **SETUP** → Softkey **CONFIG** → Subitem **Date-Time settings**
3. Select the box containing the current date.
4. Select another date in the **Screen Calendar** (see *page 28*).

The change is accepted directly.

#### Change time

1. Remove the tubing set if this has not yet been done and restart the LiquoGuard®7.
2. Tab bar **SETUP** → Softkey **CONFIG** → Subitem **Date-Time settings**
3. Press the **field** showing the current time.
4. Clear the time to be modified by pressing the button **<=** on the **numeric keypad screen** (see *page 28*) if this is not automatically deleted.
5. Enter the new time. Make sure that a double point is used to separate hours and minutes when entering the time.
6. To save the entry, press the **ENTER** button.

The change is accepted directly.

## Settings

**6.3.4 Operation**

The *OPERATION* dialog field is used to make changes to the *pump controller* of the LiquoGuard®7.

This setting is visible only when the advanced settings are displayed.

See chapter *Advanced Settings* on page 66.

**6.3.4.1 Tubing set flow resistance**

This function is used to adjust flow resistance parameters.

This setting is visible only when the advanced settings are displayed.

See chapter *Advanced Settings* on page 66.



Pressure losses occur when pumping liquids through a tube. If you want to determine the CSF pressure during drainage in the same tubing set, one must know what the pressure losses are and take them into account during the CSF delivery.

The flow resistance measurement is used to record these pressure losses.

**Repetition rate**

This setting is used to determine the interval for the automatic measurement of flow resistance.

1. Tab bar **SETUP** → Softkey **OPERATION** → Subitem **Repetition rate**
2. Press the **+** and **-** buttons to change the measurement frequency.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 30 minutes
  - Minimum value: 2 minutes
  - Maximum value: 24 hours / Manual



If the **Manual** mode is selected, the LiquoGuard®7 will not perform any The use of this mode assumes detailed knowledge of the accessories used.

**Vtest**

The parameter *Vtest* determines the flow volume which is used in the calculation of the flow resistance.

1. Tab bar **SETUP** → Softkey **OPERATION** → Subitem **Vtest**
2. Press the **+** and **-** buttons to change the *Vtest*.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 20 ml/h
  - Minimum value: 5 ml/h
  - Maximum value: 20 ml/h

**Manual**

In manual mode the user enters the flow resistance value. Changes are made by first selecting *Manual* in the frequency rate setting.

1. Tab bar **SETUP** → Softkey **OPERATION** → Subitem **Manual**
2. Press the **+** and **-** buttons to change the flow resistance.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 0.0
  - Minimum value: 0.0
  - Maximum value: 0.1

## Settings

**6.3.5 Maintenance****6.3.5.1 Registering device options (Activating the software key)**

The range of functions of the LiquoGuard®7 can be extended through various device options. For information on the available *device options*, see from *page 94*. Device options that you can already use with your LiquoGuard®7 are marked with the message **Active** (with unlimited duration) or the available remaining period (example 23 days) is displayed when using time-limited device options.

To register new device options, a valid key for the specific option and the specific LiquoGuard®7 is required. You can import the key to enable the device options via the USB interface or enter them directly via the keyboard screen.

**LOADING KEYS FROM USB**

1. Save the file containing the registration key to a USB memory stick.  
Save the file in its original condition without making any changes to it.  
Do not save the file in a subfolder but at the top level of the USB stick instead. They will otherwise not be found.
2. Connect the USB memory stick to a free USB port on the LiquoGuard®7 (see *Connection options on page 24*).
3. Tab bar **SETUP** → Softkey **MAINTENANCE**
4. Press the button **LOAD KEYS FROM USB**.

If the registration key is recognized and accepted by the device, the message *Active* will appear behind the enabled device option.

If the registration key allows time-limited access to the respective device option, the message e.g. 30 days will appear behind the enabled device option. The device will display the remaining days. The device option is disabled automatically once the remaining time has elapsed.

**ENTER KEY**

1. Tab bar **SETUP** → Softkey **MAINTENANCE**
2. Press the **ENTER KEY** button.
3. Press into the empty input field
4. Enter the key directly via the **keyboard screen**.  
Also include all the dashes with your entry.  
If the key supplied ends with "&", do not enter this.
5. Confirm your entry by using the **Enter key**.

If the registration key is recognized and accepted by the device, the message *Active* will appear behind the enabled device option.

If the registration key allows time-limited access to the respective device option, the message e.g. 30 days will appear behind the enabled device option. The device will display the remaining days. After this period, the device option is disabled automatically.

If you have problems when entering keys and these do not enable the desired device options, you can delete all the active keys first and then enable them again. It is essential to ensure with the supplier of the key beforehand that your key contains all device options to be activated (any previously activated ones and the newly activated ones)

To delete all the active keys, enter "*remove keys*" and then restart the device. All device options are now *inactive*. Now enter the key again and check that the desired device options are *active*.

It is possible to activate keys for limited periods of time. In this case, the remaining time (e.g. 12 days) will be displayed in the overview of the device options. Activation of software options is possible only once their remaining time has elapsed. A valid key will be accepted by the device before this, but the duration of the device options does not change.

The key for activating the device options can be ordered through your local LiquoGuard dealer or directly from the manufacturer:

**Möller Medical GmbH**

Wasserkuppenstrasse 29-31

36043 Fulda, Germany

Tel. +49 (0) 661 / 94 19 5 – 0

Fax +49 (0) 661 / 94 19 5 – 850

info@moeller-medical.com



Make a note of the serial number of the LiquoGuard®7 when placing an order. This can be found at:

1. Tab bar **SETUP** → Softkey **MAINTENANCE**
2. Press the button **LiquoGuard Information**.

The key applies only to the device indicated in the order and has limited validity of 30 days. If the key is not imported into the device within that time, it will no longer be accepted afterwards.

## Settings

### 6.3.5.2 LiquoGuard Information

The information on the LiquoGuard®7 described below is available under *LiquoGuard Information*.

- Device ID
- Software version installed
- Technical safety check date (date of the next device check)
- Contact information (address and contact details of the device manufacturer)

1. Tab bar **SETUP** → Softkey **MAINTENANCE**
2. Press the **LiquoGuard Information** button.

### 6.3.5.3 Reset device settings

This function resets ALL LiquoGuard®7 settings to the factory settings.

1. Tab bar **SETUP** → Softkey **MAINTENANCE**
2. Press the **Reset all device settings to factory default** button.
3. Press the button **Yes, I want to set default settings** in the green message window.

### 6.3.6 Presettings

Use the device function *Presettings* to save different application profiles on the LiquoGuard®7. The drainage settings for the tubing set are also saved. This facilitates changing between different LiquoGuard®7 devices and interrupting drainage. Further information on this device option can be found on *page 106*.

## 7 Alarm signals and corrective measures

### 7.1 Presence of an alarm condition



Figure 20: Visual alarm signals of the LiquoGuard®7, if an alarm condition exists.

#### 7.1.1 Technical and physiological alarm conditions

In the case of a technical or physiological alarm condition, the LiquoGuard®7 will generate the following alarm signals (see Figure 20):

- The main alarm LED (first from left) on the front of the housing flashes red.
- A red window indicating the alarm condition and possible causes appears on the display.
- An acoustic alarm signal (horn) is emitted by the device.
- In the case of a pressure alarm, the pressure in question is displayed in red.



If an acoustic signal cannot be emitted due to a failure of the main control unit, an alternative alarm signal will be generated and the backup LED (second from left) will flash red.

If various alarm conditions are present simultaneously, they will be displayed together in the same alarm message window. It is the responsibility of the medical personnel or physician to identify the exact cause for the alarm condition. Once the cause is eliminated, the alarm signals will deactivate automatically after a short delay.

An alarm can also be paused for a limited time in order to remedy the alarm condition.

## Alarm signals and corrective measures

Alarm signals for physiological and technical alarms are generated after a given delay. This delay period can be partly changed (see *page 56*).

### 7.1.2 Pause alarm signal

In the event of an alarm condition, the LiquoGuard®7 offers various options to pause the alarm for a limited time. It is not possible to fully deactivate the alarm.

#### Pause alarm in alarm message window

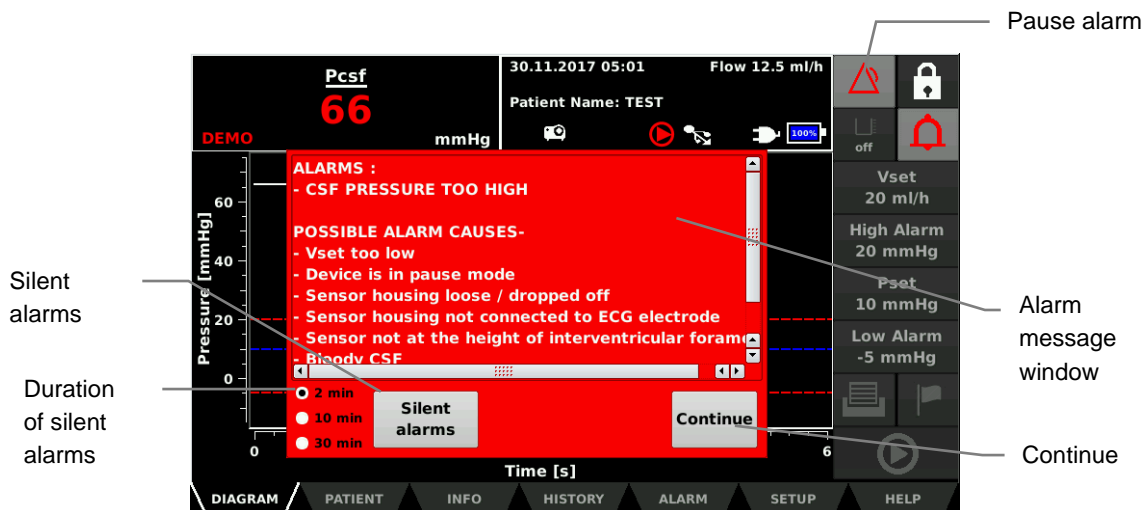


Figure 21: Configuration of the alarm message window in the presence of a technical or physiological alarm condition

The alarm can be paused for 2, 10 or 30 minutes via the alarm message window (see *Figure 21*).

1. Select the duration required from the **message window**.
2. Press the **Silent alarms** button to pause the acoustic alarm signal for the set period of time. The alarm message window remains visible until the alarm condition is removed.

or

Press the **Continue** button to pause the alarm for the required period and hide the alarm message window. Press the button **Pause alarm** to show the alarm message window once again.

#### Suppressing alarms in the DIAGRAM dialog field

The **DIAGRAM** dialog field gives you the option of suppressing physiological alarms acoustically for 5 minutes.

1. Go to the **DIAGRAM** dialog field in the tab bar.
2. Press the softkey **Suppress alarm**.



In the case of various alarm conditions occurring at different times, each individual alarm condition must be separately suppressed.

### Deactivating Suppress alarm

The crossed-through symbol indicates that an alarm has been suppressed due to an alarm condition. To reactivate the alarm, press the softkey **Suppress alarm** once again.



The removal of the cause of an alarm condition does not mean that the function *Suppress alarm* is deactivated. If the same alarm condition occurs after the cause for suppressing the alarm condition has been removed, neither the acoustic alarm signal nor the alarm message window will be activated. The only indication of an alarm will be the flashing of the red main LED.

### 7.1.3 System error

In the event of an alarm condition due to internal hardware and software tests, the LiquoGuard®7 will generate the following alarm signals:

- The main alarm LED (first from left) on the front of the housing flashes red.
- A red window with an error code will appear on the display (see *Figure 22*)
- An acoustic alarm signal (horn) is emitted by the device.



If the usual acoustic signal is not possible due to a failure of the main control unit, an alternative alarm signal will be generated and the backup LED (second from left) will flash red.

Alarms resulting from system errors cannot be deactivated or paused by the user. In this case, restart the device via the On/Off switch (see *Connection* options on page 24). If the device returns to this condition repeatedly, the device should be checked by a Service Technician.

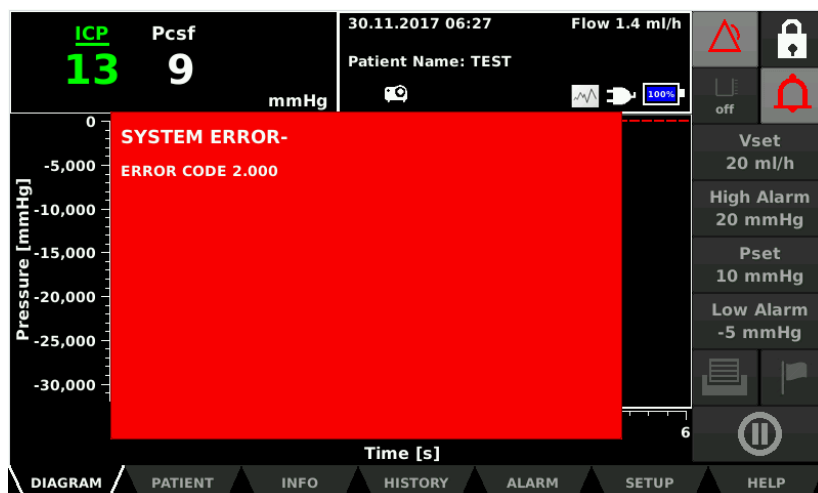


Figure 22: Configuration of the alarm message window in the event of a system error.

## Alarm signals and corrective measures

### 7.2 Testing alarm functions

When the LiquoGuard®7 is turned on via the On/Off switch, a brief alarm sound will be emitted during the self-test. A function test will also be performed. Elements such as the LEDs on the front of the device and the built-in speaker are not subject to the function test. In order to guarantee the functioning of these components during an alarm, ensure that both left LEDs flash red briefly during the device start-up and that the speaker emits an audible signal. If problems are encountered, contact the Möller Medical GmbH Service Team.

The LiquoGuard®7 alarm concept is as described below from a risk perspective. When an alarm condition occurs during proper use of the device, the user is always warned by means of visible or audible alarm signals (i.e. the user must always be within auditory and/or visual range of the device).



The LiquoGuard®7 is equipped to detect physiological and technical alarm conditions.

The alarm conditions priority is set on HIGH priority for all alarm conditions. The LiquoGuard®7 generates visible and audible alarm signals. The alarm system is designed for physiological alarm conditions with non-recurring alarms and technical alarm conditions with recurring alarms.

### 7.3 Alarm system, dual safety

The link between pressure measurement of the LiquoGuard®7 and alarm generation is designed based on the concept of dual safety. This entails two sensors in the tubing set, dual measurement value recording and processing, as well as various means of alarm emission.



If, during the start-up self-test, the monitoring system detects that the backup battery charge is below 50%, the LiquoGuard®7 will not be turned on and the battery must first be recharged.

If, during operation, the system detects a problem with the backup battery, the LiquoGuard®7 must be tested by a Service Technician and cannot be used.

The red LED (first from left) on the housing is activated by the LiquoGuard®7 main control unit. This alarm signal is supported by indications on the display. The acoustic signal of the main control unit is a horn sound.

If the monitoring system determines an error at the main control unit, it issues an acoustic alarm in the form of a rhythmic alarm sound with a fixed frequency. This condition is termed a backup alarm. Restart the device via the On/Off switch. If the device returns to this condition repeatedly, the device should be checked by a Service Technician.



The alarm system refers only to the LiquoGuard®7 itself. Any signals from an external connected system do not release the operator from the duty to promptly and appropriately react to alarm situations signalled by the LiquoGuard®7. This is also applicable when an external system does not signal an alarm condition.

## Alarm signals and corrective measures

### 7.4 Alarm system overview

#### Upper Pcsf pressure limit value exceeded

Physiological alarm condition	Measured pressure in tubing set too high
Technical alarm condition	N/A
Alarm limit	High Alarm Adjustable by user
Alarm condition delay	1 ± 0.5 second
Delay of alarm signal generation	Adjustable by user (see page 56)
Alarm signal	Audible/visible
Alarm signal description on display	CSF PRESSURE TOO HIGH
Audio paused	Yes

#### Lower Pcsf pressure limit value exceeded

Physiological alarm condition	Measured pressure in tubing set too low
Technical alarm condition	N/A
Alarm limit	Low Alarm Adjustable by user
Alarm condition delay	1 ± 0.5 second
Delay of alarm signal generation	Adjustable by user (see page 56)
Alarm signal	Audible/visible
Alarm signal description on display	CSF PRESSURE TOO LOW
Audio paused	Yes

## Alarm signals and corrective measures

### Upper ICP pressure limit value exceeded

Physiological alarm condition	Pressure measured by parenchymal or tip sensor too high
Technical alarm condition	N/A
Alarm limit	High Alarm Adjustable by user
Alarm condition delay	1 ± 0.5 second
Delay of alarm signal generation	Adjustable by user (see <i>page 56</i> )
Alarm signal	Audible/visible
Alarm signal description on display	ICP TOO HIGH
Audio paused	Yes

### Lower ICP pressure limit value exceeded

Physiological alarm condition	Pressure measured by parenchymal or tip sensor too low
Technical alarm condition	N/A
Alarm limit	Low Alarm Adjustable by user
Alarm condition delay	1 ± 0.5 second
Delay of alarm signal generation	Adjustable by user (see <i>page 56</i> )
Alarm signal	Audible/visible
Alarm signal description on display	ICP TOO LOW
Audio paused	Yes

## Alarm signals and corrective measures

### Upper flow limit value exceeded

Physiological alarm condition	Average flow volume too high
Technical alarm condition	N/A
Alarm limit	Upper Flow Alarm Adjustable by user
Alarm condition delay	1 ± 0.5 second
Delay of alarm signal generation	Adjustable by user (see <i>page 56</i> )
Alarm signal	Audible/visible
Alarm signal description on display	CSF FLOW RATE TOO HIGH
Audio paused	Yes

### Lower flow limit value exceeded

Physiological alarm condition	Average flow volume too low
Technical alarm condition	N/A
Alarm limit	Lower Flow Alarm Adjustable by user
Alarm condition delay	1 ± 0.5 second
Delay of alarm signal generation	Adjustable by user (see <i>page 58</i> )
Alarm signal	Audible/visible
Alarm signal description on display	CSF FLOW RATE TOO LOW
Audio paused	Yes

## Alarm signals and corrective measures

**Pulsation error**

Physiological alarm condition	Pulsation frequency too low
Technical alarm condition	N/A
Alarm limit	Pulsation frequency < 30/min (in the event that the function If pulsation fails and Suspicion of problem is active, the alarm is emitted only if the pressure drop due to the flow of a very small quantity of CSF is > 5 mmHg).
Alarm condition delay	30 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	PULSATION LOST
Audio paused	Yes

**Amplitude constant**

Physiological alarm condition	Measured pressure not plausible (constant)
Technical alarm condition	N/A
Alarm limit	Adjustable by user In the event that the function If pulsation fails and Suspicion of problem is active, the alarm is emitted only if the pressure drop due to the flow of a very small quantity of CSF is > 5 mmHg.
Alarm condition delay	1 ± 0.5 seconds
Delay of alarm signal generation	None Not adjustable by user
Alarm signal	Audible/visible
Alarm signal description on display	CSF PRESSURE CONSTANT FOR TOO LONG
Audio paused	Yes

## Alarm signals and corrective measures

### Pressure difference between tubing set and parenchymal or tip sensor is too great

Physiological alarm condition	Measured pressure difference too large between ICP and Pcsf
Technical alarm condition	N/A
Alarm limit	ICP differs from Pcsf Adjustable by user
Alarm condition delay	1 ± 0.5 seconds
Delay of alarm signal generation	Adjustable by user (see <i>page 56</i> )
Alarm signal	Audible/visible
Alarm signal description on display	ICP - Pcsf VALUE DIFFERENCE IS TOO HIGH
Audio paused	Yes

### Main battery charge too low

Physiological alarm condition	N/A
Technical alarm condition	Battery charge less than 20%
Alarm limit	Main battery charge < 20%
Alarm condition delay	20 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	BATTERY LOW
Audio paused	Yes

## Alarm signals and corrective measures

### End of tubing set useful life

Physiological alarm condition	N/A
Technical alarm condition	Tubing set has reached the end of its expected useful life
Alarm limit	N/A
Alarm condition delay	300 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	TUBASET USAGE LIMIT EXPIRED
Audio paused	Yes

### Tubing set disconnected

Physiological alarm condition	N/A
Technical alarm condition	Sensor cable no longer detected
Alarm limit	Internal device setting
Alarm condition delay	1 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	TUBING SET DISCONNECTED
Audio paused	Yes

### Parenchymal or tip sensor disconnected

Physiological alarm condition	N/A
Technical alarm condition	Sensor cable no longer detected
Alarm limit	Internal device setting
Alarm condition delay	1 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	PARENCHYMAL/TIP SENSOR DISCONNECTED
Audio paused	Yes

## Alarm signals and corrective measures

### Tubing set sensor difference

Physiological alarm condition	N/A
Technical alarm condition	Difference between the two sensors of the tubing set is too great
Alarm limit	Difference between the two sensors is > 4 mmHg
Alarm condition delay	10 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	TUBESET SENSOR DIFFERENCE
Audio paused	No

### Pump cover open

Physiological alarm condition	N/A
Technical alarm condition	The pump cover is open or not properly closed
Alarm limit	Internal device setting
Alarm condition delay	3 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	FLAP OPEN
Audio paused	Yes

## Alarm signals and corrective measures

### Pump fault

Physiological alarm condition	N/A
Technical alarm condition	The LiquoGuard®7 is in Application run mode but the pump does not function due to obstruction.
Alarm limit	Internal device setting
Alarm condition delay	1 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	ROTOR IS BLOCKED
Audio paused	Yes

### Tubing set defective

Physiological alarm condition	N/A
Technical alarm condition	The tubing set does not function properly
Alarm limit	N/A
Alarm condition delay	1 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	TUBESET MALFUNCTION
Audio paused	Yes

### Parenchymal or tip sensor defective

Physiological alarm condition	N/A
Technical alarm condition	Parenchymal or tip sensor not functioning properly
Alarm limit	N/A
Alarm condition delay	1 ± 0.5 seconds
Delay of alarm signal generation	1 second
Alarm signal	Audible/visible
Alarm signal description on display	ICP SENSOR MALFUNCTION
Audio paused	Yes

## Alarm signals and corrective measures

### Internal safety measures from hardware and software tests

#### -dual safety-



In the presence of the following alarm condition, restart the LiquoGuard®7 via the On/Off switch. If the same behaviour recurs, the device should be checked by a Service Technician.

Physiological alarm condition	N/A
Technical alarm condition	Internal device assessments
Alarm limit	Internal device specification
Alarm condition delay	1 - 10 seconds
Delay of alarm signal generation	Not adjustable by user Not adjustable by user Set at 3 seconds
Alarm signal	Audible/visible
Alarm signal description on display	Device error XXXX
Audio paused or audio off	Yes

## Alarm signals and corrective measures

### 7.5 Alarm system description

Terms	Definitions	Use on LiquoGuard®7	Explanation
Alarm condition	Condition of the alarm system once it has determined a possible or real threat.	<ul style="list-style-type: none"> <li>• technical alarm conditions</li> <li>• physiological alarm conditions</li> <li>• Internal safety measures from hardware and software tests</li> </ul>	
Alarm condition delay	Time between the occurrence of an alarm condition either on the patient side (PHYSIOLOGICAL ALARM CONDITION), or on the device side (TECHNICAL ALARM CONDITION), up to system determination of an existing threat.	<p>see</p> <p>Alarm system overview on <i>page 77</i></p>	
Alarm limit	Limit value used by an alarm system to determine an alarm condition.	<p>see</p> <p>Alarm system overview on <i>page 77</i></p>	Operator panel
Alarm inactive	Condition of indefinite duration in which an alarm system or a part of an alarm system does not generate alarm signals.	<p>The user can render individual alarm conditions inactive if these are not appropriate to the patient's situation. The user is responsible for consciously disabling these conditions.</p> <p>See Pulsation on <i>page 60</i></p>	
Pause alarm	Condition of limited duration, in which an alarm system or a part thereof does not issue alarm signals.	Settable to 2, 10 and 30 minutes.	
Suppress alarm	Condition of limited duration, in which an alarm system or a part thereof does not issue alarm signals.	The duration is limited to 5 minutes. Only physiological alarms are suppressed.	
Alarm preset	Set of stored configuration parameters, including the selection of algorithms and initial values for use by algorithms that can influence or modify the effect of the alarm system.	<p>See Device Options</p> <p>from <i>page 94</i></p>	

## Alarm signals and corrective measures

Terms	Definitions	Use on LiquoGuard®7	Explanation
Alarm settings	Alarm system configuration including but not restricted to: <ul style="list-style-type: none"> <li>• Alarm limits</li> <li>• Properties of all conditions of the alarm signal inactive circuit</li> <li>• Values of parameter variables that determine the function of the alarm system.</li> </ul>	Partly adjustable by the user see  Alarm system overview on <i>page 77</i>	
Alarm signal	Signal type created by the alarm system to display the existence (or the occurrence) of an alarm condition.	<ul style="list-style-type: none"> <li>• Visual alarm signal via two red LEDs on the housing</li> <li>• Visual alarm signal via alarm message window on display</li> <li>• Acoustic alarm signal, speaker is adjustable by user (see <i>page 57</i>).</li> </ul>	
Delay of alarm signal generation	Time from start of alarm condition to emittance of alarm signal.	Partly adjustable by the user see <i>Alarm delay on page 56</i> and  Alarm system overview on <i>page 77</i>	
De-escalation	Process which the alarm system uses to lower the priority of an alarm condition or the urgency of an alarm signal.	N/A	
Escalation	Process which the alarm system uses to increase the priority of an alarm condition or the urgency of an alarm signal.	N/A	
False negative alarm conditions	Lack of an alarm condition when a valid triggering event for the patient has occurred in the device or the alarm system.	Double safety measure	
False positive alarm conditions	Presence of an alarm condition when no valid triggering event for the patient has occurred in the device or the alarm system.	Results in safe condition of the device.	
Information signal	Every signal, which is not an alarm or reminder signal.	Applies.	
Recurring alarm signal	Alarm signal which continues to emit after its triggering occurrence has been eliminated, until it is stopped with a deliberate operator action.	System error	

### Alarm signals and corrective measures

Terms	Definitions	Use on LiquoGuard®7	Explanation
Non-recurring alarm signal	Alarm signal that ceases to be automatically generated when the corresponding triggering event no longer exists.	Physiological and technical alarm conditions	
Physiological alarm condition	Alarm condition originating from a monitored, patient- related variable.	Applies.	
Technical alarm condition	Alarm condition originating from a monitored alarm-system or device-related variable.	Applies.	
Alarm reset	Action performed by operator to cancel an alarm signal for which there is no currently associated alarm condition.	N/A	

## Alarm signals and corrective measures

### 7.6 Troubleshooting

This chapter identifies possible faults which may occur in connection with the LiquoGuard®7.

Several solutions may be possible for each fault. The solutions proposed should be executed in the order provided until the fault is remedied. In the case that the solutions presented below do not remedy the fault, contact the Möller Medical Service Centre.

Faults	Solution
Not functional, the display is switched off. or The LiquoGuard®7 cannot be turned on.	Start the LiquoGuard®7 via the On/Off switch. Check the power supply lead. Try a different plug connector. Check the leads. Charge the LiquoGuard®7 batteries.
The pump does not function although Pcsf (or ICP) > Pset.	Pump is in <i>Pause</i> mode. Press the softkey <b>Pause/Start</b> to start drainage. or Flow resistance measurement is being performed. or Pump functions only when the measured CSF pressure (Pcsf (or ICP)) is higher than Pset.
The touchscreen does not respond.	If you are wearing gloves, remove these and try to operate the LiquoGuard®7 again via the touchscreen. or Restart the LiquoGuard®7 via the On/Off switch. If the same behaviour recurs, the device should be checked by a Service Technician.
The incorrect fields are selected when making entries via the touchscreen.	Restart the LiquoGuard®7 via the On/Off switch. The touchscreen will then be calibrated. If the same behaviour recurs, the device should be checked by a Service Technician.
Fault due to moisture penetrating into the plug connection.	Remove mains plug. Allow plug connector to dry.
The device repeatedly emits an alarm sound with regular frequency.	Restart the LiquoGuard®7 via the On/Off switch. If the same behaviour recurs, the device should be checked by a Service Technician.



The LiquoGuard®7 must not be opened by the user.

## 7.7 Service

If you cannot resolve the fault yourself, please contact your **Möller Medical GmbH** Service Centre.

Service Centre contact details:

Tel.: +49 (0) 661 - 9 41 95 0

Fax: +49 (0) 661 - 9 41 95 850

Hotline: +49 (0) 661 - 9 41 95 82

E-mail: [service@moeller-medical.com](mailto:service@moeller-medical.com)



Whenever the LiquoGuard®7 is returned, a suitable disinfection process must be carried out in order to rule out the possible risk of infection.

Consumable materials should be disposed of in accordance with hygiene guidelines. In order to prevent leakage from the tubing set, ensure that the stopcocks are closed when disposing of the drainage and infusion sets.

Never open the appliance. Internal parts of the appliance may remain live even after disconnection from the mains. The service, upgrade or modification of the LiquoGuard®7 CSF drainage system must only be performed by Möller Medical GmbH or by a person specifically authorized by the manufacturer. Please also note the information on servicing (*see chapter 8.2 et. seq.*).

## Alarm signals and corrective measures

### System Log

In order to systematically remove a fault in the LiquoGuard®7, it is sometimes necessary to transmit data from the saved *System Log* to the Service Team.

The system log data is saved in the device's internal System Log memory. The data is retained when the device is switched off or disconnected from the power supply. The System Log memory has a capacity of 4GB.

If the alarm system is paused or suppressed, all alarms that have occurred for the current application are still saved in the System Log data.

Each time the device is restarted, the oldest System Log data are deleted until 1GB of free space is available in the System Log memory.

1. Connect a USB memory stick to your computer.
2. Go to the top directory of the USB memory stick, not in a subfolder.
3. Open the context menu by right clicking the mouse and select **New** → **Text document (.txt file)**.
4. Rename the new file to **export\_logs**.
5.
  - a. Change to the TAB "*INFO*" with the LiquoGuard®7 switched on. Connect the prepared USB memory stick into one of the LiquoGuard®7 USB connections (see *Connection options* on page 24). Press the button "Files" and wait until the file manager appears on the display.

**or**

  - b. Turn the LiquoGuard®7 off and connect the prepared USB memory stick into one of the LiquoGuard®7 USB connections (see *Connection options* on page 24). Start the LiquoGuard®7 and wait until the file manager appears on the display.
6. Go to the dialog field **System Log** in the tab bar.
7. Click on the required files to select them. The selected files will be highlighted in blue. The file name consists of the date in the format Year-Month-Day, and the time in Hours-Minutes-Seconds-Milliseconds.
8. Select the button **Copy** to transfer the data to the USB memory stick. A green message window will inform you once the data has been copied.
9. Select the **Cancel** button on the right of the screen.

You can send the system log file via e-mail to the Service Team.

## 8 Care

### 8.1 Cleaning and disinfection



No moisture must be allowed to enter into the device.

Before cleaning and disinfecting the device surfaces, disconnect the mains plug. Use a soft, lint-free cloth for cleaning and disinfecting.

Cleaning is done with a wet cloth in the form of a "scrub-wipe disinfection". Simply spraying the device is NOT suitable for cleaning. Always follow the manufacturer's instructions regarding the concentration and application time of the cleaning agent/disinfectant.

The following substances are permitted for cleaning the surfaces of the LiquoGuard®7:

Manufacturer	Product	Application time	Method
--	Isopropanol 70% aqueous solution	Until fully evaporated	Scrub-wipe
B. Braun	Meliseptol	According to manufacturer information	Scrub-wipe
B. Braun	Meliseptol rapid	According to manufacturer information	Scrub-wipe
Ecolab	Incidin Active	According to manufacturer information	Scrub-wipe
Ecolab	Incidin Liquid	According to manufacturer information	Scrub-wipe
Ecolab	Incidin Rapid	According to manufacturer information	Scrub-wipe
Ecolab	Sani-Cloth Active	According to manufacturer information	Scrub-wipe
Ecolab	Sekusept Aktiv	According to manufacturer information	Scrub-wipe
Lysoform	Lysoformin 3000	According to manufacturer information	Scrub-wipe
Metrex	CaviCide	According to manufacturer information	Scrub-wipe
Metrex	CaviCide1	According to manufacturer information	Scrub-wipe
Schülke	Acryl Des	According to manufacturer information	Scrub-wipe
Schülke	Mikrozid AF Liquid	According to manufacturer information	Scrub-wipe
Schülke	Terralin protect	According to manufacturer information	Scrub-wipe
Schülke	TPH protect	According to manufacturer information	Scrub-wipe

Ensure that the cleaning agents and disinfectants have completely evaporated before using the LiquoGuard®7.

Visual inspection: The sockets of all connections and cable plugs must be free of all dirt and moisture.

## 8.2 Maintenance



The LiquoGuard®7 will remind you of the impending date for a technical safety check during the booting process.

The service, upgrade or modification of the LiquoGuard®7 CSF drainage system must only be performed by Möller Medical GmbH or by a person specifically authorized by the manufacturer.

All correspondingly trained persons have an appropriate certificate from the manufacturer which must be valid, as the certificates do expire. Have them show the appropriate certificate if necessary.

All the work performed must be documented, signed and dated. Modifications by third parties are not permitted. A technical safety check (TSC) according to the Medical Devices Operator Ordinance must be performed at least every 12 months. Only use the LiquoGuard®7 if the device functions properly and/or is safe. In cases to the contrary, the device must be immediately repaired by the Service Centre.

## 8.3 Replacing the battery

The LiquoGuard®7 must not be opened by the user. All services, including the replacement of lithium batteries may only be carried out by staff who have received appropriate training from the manufacturer.

## 8.4 Disposal



The present device contains material which must be disposed in accordance with environmental regulations. This device is subject to the European Directive 2012/19/EEC on Waste Electric and Electronic Equipment (WEEE2). The identification plate of the device bears the symbol of the crossed through garbage bin.

Return devices that are no longer used to Möller Medical GmbH. This ensures that the device is disposed in compliance with the national requirements of the WEEE Directive.

## 9 Device options

Various useful device functions are available for extending the functional range the LiquoGuard®7. The functions are as follows:

1. Monitor/diagnostic call
  - Connecting the LiquoGuard®7 to a patient monitor system
  - Alarm transmission via diagnostic call system
2. Documentation
  - Entry of patient data (name, birth date, height/weight, other remarks)
  - Application data copied onto USB memory stick
  - Insertion of a bookmark to facilitate subsequent search for important points in time in the application data
  - Representation of the maximum and minimum pressure values and average volume flow in the HISTORY dialog field
  - Saving of screenshots and values entered in the ALARM and SETUP dialog fields, in the internal device memory (only possible in conjunction with device function *Printing*)
3. Presettings
  - Saving different user profiles on the LiquoGuard®7
  - Saving of current drainage setting of tubing set
4. Printing
  - Printing of screenshots and settings in the dialog fields ALARM and SETUP with a printer
  - Saving of screenshots and settings in the dialog fields ALARM and SETUP on a USB memory stick
5. Parenchymal/Tip sensor
  - Connecting a parenchymal pressure sensor (with or without CSF drainage channel)
  - Connecting a catheter with tip sensor (with or without CSF drainage channel)
6. Infusion test
  - Indirect measurement of the CSF absorption capability in patients suspected of or confirmed to be suffering from normal pressure hydrocephalus

## Device options

Specific device functions of the LiquoGuard®7 can be enabled if required (see 6.3.5.1), Registering device options (Activating the software key). In this case, please contact the manufacturer or a local authorized distributor.

The following sections will provide an overview and setting options of the available LiquoGuard®7 device options.

Not all device options are available in all markets.

### 9.1 Monitor/diagnostic call

The *Monitor/Nurse call* function allows you to connect the LiquoGuard®7 to a patient monitoring or diagnostic call system.

#### 9.1.1 Patient monitor system

Using an adapter cable (see *Accessories* on page 136), the LiquoGuard®7 can be connected to a patient monitor system (see *Connection options* on page 24) and transmit the pressure value indicated by the LiquoGuard®7 to the monitor system. Before connecting, first read the prerequisites under *Additional accessories* on page 15.

It is essential to check whether the patient monitoring system is compatible with the requirements of the LiquoGuard®7, as specified under Input and output signals on page 127.



The monitor system cannot be used for monitoring. Only the value indicated on the LiquoGuard®7 display is to be taken into consideration!

Operate the LiquoGuard®7 in such a manner that a response to an acoustic alarm is guaranteed at all times.

Ensure that calibration is always performed when connecting the LiquoGuard®7 to a monitor system.

## Device options

1. Connect the **Monitor cable** to the **Patient monitoring output** of the LiquoGuard®7.
2. Connect the other end of the **monitor cable** to the **analogue pressure input** of the monitor system. The LiquoGuard®7 detects the connection and displays a selection window with setting options and the calibration function.
3. **Select Simulate pressure with following values [mmHg].**
4. Select the value **0** to perform zero adjustment between the monitor system and the LiquoGuard®7.
5. Perform zero adjustment of the monitor system according to its operating manual.
6. Select the other values on the LiquoGuard®7 under **Simulate pressure with following values** and check that they are correctly displayed on the monitor system.
7. If the simulated values are indicated correctly, select on the LiquoGuard®7 the item **Tubing Set** or if available, **Parenchymal/Tip sensor** as a source for the pressure value output on the monitor system (*Parenchymal/Tip sensor* is a device function. **Further information can be found on page 110**).
8. The selected pressure value is then transmitted to the monitor system and displayed.
  - Simulate pressure with following values (default values):      -20 mmHg, 0 mmHg, 20 mmHg, 50 mmHg, 100 mmHg
  - Tubing set:      Pcsf is indicated on the patient monitor.
  - Parenchymal/Tip sensor:      ICP is indicated on the patient monitor (*Parenchymal/Tip sensor* is a device function). For more detailed information, see *page 110*).

To call up the calibration once again at a later stage, select the submenu MONITOR/NURSE call in the ALARM dialog field. Alternatively, disconnect the connecting cable and then reconnect it once again.

## Device options

### 9.1.2 Diagnostic call system

The LiquoGuard®7 can be connected to a diagnostic call system (often also referred to as nurse call) using an appropriate cable in order to transfer an alarm (see Connection options on page 24). The function of this connection must be checked and validated in each individual case. Before connecting, first read the prerequisites under Additional accessories on page 15.



It is essential to check whether the diagnostic call system is compatible with the requirements of the LiquoGuard®7, as specified under Input and output signals on page 127.



The alarm transfer does not affect the supervision of the patient. In any event, always pay attention to alarm signals of the LiquoGuard®7.

Nurse call systems in clinical facilities differ in their response to the relay circuits in the device. Identify in advance which settings are suitable for the diagnostic call system used.

If you are not certain which relay circuit your diagnostic call system uses, you can find the correct setting on your own. Proceed as described below.

1. Connect the LiquoGuard®7 to the nurse call system. The LiquoGuard®7 detects the connection and displays a selection window with setting options.
2. Under **Nurse call** select the setting **Close on alarm**.
3. Then select the button **Test nurse call**.

If the alarm is transferred via the nurse call system, keep the setting. If not, conduct the same test but this time with the setting *Open on alarm*.

- |                             |  |
|-----------------------------|--|
| ○ Close on alarm (default): | Transfer of the alarm via the nurse call system with a closed relay in the LiquoGuard®7. |
| ○ Open on alarm:            | Transfer of the alarm via the nurse call system with an open relay in the LiquoGuard®7.  |

To call up the setting once again at a later stage, select the submenu **MONITOR/DIAGNOSTIC CALL** in the Alarm dialog field. Alternatively, disconnect the connecting cable and then reconnect it once again.

## 9.2 Documentation

The device function *Documentation* provides for comprehensive records of the entire drainage process through the functions *Patient Data*, *Application Data* and *History*.

### 9.2.1 Patient data

The *Patient Data* function saves data such as name, birth date, height/weight and other remarks directly into the LiquoGuard®7. The saved patient data is displayed in the DIAGRAM dialog field.

Figure 23: Patient data

1. Go to dialog field **PATIENT** in the tab bar.
2. Select one of the fields available and enter the data via the keyboard screen (see *page 27*).
3. To save the changes, press the **Confirm changes** button.

### 9.2.2 Application data

This device function documents and saves the entire drainage process. The LiquoGuard®7 has several gigabyte of internal data memory. The recorded application data can be exported from the LiquoGuard®7 using a USB memory stick.



When the LiquoGuard®7 is started, the memory of the LiquoGuard®7 is cleared so that 500MB is always available to store patient data. This may result in the deletion of patient data if the memory becomes too full.

The function *Application Data* is also available as a function under *Infusion test* in the *Documentation* function list.

## Device options

The following *Application Data* are collected during drainage:

- TIME STAMP: Time of measurement in the format YYYY-MM-DD\_HH:MM:SS
- Pcsf: Pcsf pressure value in mmHg
- ICP: ICP pressure value in mmHg
- PSET: Set pressure entered in mmHg
- VSET: Flow rate (of the drainage pump in ml/h set in the LiquoGuard®7)
- VCURRENT: Current flow rate in ml/h
- MODE: Operating mode of the LiquoGuard®7  
0 = Pause / 20 = Operation
- FLAGS: Binary code display of the alarms
- DRAINED: Total drained CSF volume
- PMIN: Lower pressure alarm limit
- PMAX: Upper pressure alarm limit
- VMIN: Low Flow Alarm
- VMAX: Upper Flow Alarm limit

The following *Application Data* are collected during Infusion:

- TIME STAMP: Time of measurement in the format YYYY-MM-DD\_HH:MM:SS
- Pcsf: Pcsf pressure value in mmHg
- PLATEAU: Stabilized pressure value during the infusion
- PSTART: Pressure before the infusion
- ROF: Resistance to outflow
- VSET: Flow rate (of the pump in ml/h set in the LiquoGuard®7)
- VCURRENT: Current flow rate in ml/h
- VOLUME: Current infused volume
- DEVICE\_STATUS: Operating mode of the LiquoGuard®7  
0 = Pause; 20 = Operation
- ALARM\_STATUS: Binary code display of the alarms

### 9.2.2.1 Application data transferred to USB memory stick

To retrieve the saved data from the LiquoGuard®7, a USB memory stick must first be prepared.

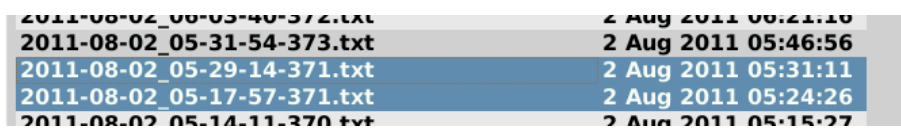
Preparation of the USB memory stick:

1. Connect the USB memory stick to a computer.
2. Now go to the top directory of the USB memory stick, not in a subfolder.
3. Open the context menu of the folder by **right clicking** the mouse and select **New → Text document (.txt file)**.
4. Rename the new file **export\_logs**.

Once the USB memory stick has been prepared, the LiquoGuard®7 file manager can be accessed and the saved data copied to the USB memory stick.

Copying data onto USB memory stick:

5. If the LiquoGuard®7 is on, turn it on.
6. Change to the TAB "INFO". Connect the prepared USB memory stick into one of the USB ports on the LiquoGuard®7 (see Connection options on page 24).
7. Press the button "Files" and wait until the file manager appears on the display.
8. Go to the History dialog field in the tab bar of the file manager.
9. Select the files to be copied by clicking on them. The selected files will be highlighted in blue (see Figure 24). The file name consists of the combined details of the patient's name (if saved in the dialog field Patient), the date and the start time of the application (Name\_Year-Month-Day\_Hours-Minutes-Seconds- Milliseconds.txt).



2011-08-02_08-03-40-372.txt	2 Aug 2011 08:21:10
2011-08-02_05-31-54-373.txt	2 Aug 2011 05:46:56
2011-08-02_05-29-14-371.txt	2 Aug 2011 05:31:11
2011-08-02_05-17-57-371.txt	2 Aug 2011 05:24:26
2011-08-02_05-14-11-370.txt	2 Aug 2011 05:15:27

Figure 24: Extract from the HISTORY dialog field.

The selected files are highlighted in blue.

10. Once the data records have been selected, press the Copy button. A green message window on the display will indicate that the data has been successfully transferred to the USB memory stick.
11. Select the Cancel button on the right of the screen to close the file manager.
12. Confirm in the green message window that you want to exit the file manager.

The data saved on the USB memory stick is stored in the folder *userlogs* → *logs*. These can now be viewed with the computer's text editor (see *Figure 25*) or imported into a spreadsheet program. Consult the software operating instructions to learn how to import the data into the spreadsheet program used.

## Device options



When data are copied from the LiquoGuard®7 in the future onto the same USB memory stick, the syslog and userlogs folders will be overwritten. The files contained on the USB memory stick will be deleted. Do not forget to back up the data on your computer.

TIMESTAMP	PCSF	ICP	cMAP	CPP	PSET	VSET	VCURRENT	MODE	FLAGS
2020-06-03_20:03:28	+0	NA	NA	NA	-3	+20	+0	20	0
2020-06-03_20:03:48	+0	NA	NA	NA	-3	+20	+0	20	0
2020-06-03_20:04:08	+0	NA	NA	NA	-3	+20	+0	20	0
2020-06-03_20:04:11	+0	NA	NA	NA	-3	+20	+0	0	0
2020-06-03_20:04:13	+0	NA	NA	NA	-3	+20	+0	0	0
2020-06-03_20:04:16	+0	NA	NA	NA	-3	+20	+0	0	0
2020-06-03_20:04:20	+0	NA	NA	NA	-3	+20	+0	0	0

Figure 25: Abstract of a text document recorded by the *Application Data* function.

### 9.2.3 Set marker

*Set marker* facilitates searches for important points in time in the application data. The inserted bookmarks are represented in the application data with *Marker: this is the name of the bookmark you entered*.

1. Tab bar **DIAGRAM**.
2. Press the softkey **SET MARKER**.
3. Access the empty field below SET MARKER AT.
4. Use the keyboard screen to enter the name of the bookmark and confirm by selecting **ENTER**.
5. Select the button **Confirm changes** to insert the bookmark. To reject the bookmark, select **Cancel**.

### 9.2.4 History



To use the *History* option, it is essential that a tubing set is connected to the LiquoGuard®7.

With the *History* function, you have the possibility to look at the progression of the pressure and flow values, as well as displaying volume balancing.

### 9.2.4.1 Plot

In the *PLOT* submenu the curves of the pressure and flow values of the current application are shown in diagram form (see *Figure 26*).

#### Pressure curve (top diagram)

- White curve: Maximum and minimum Pcsf values
- Green curve: Maximum and minimum ICP values (the green curve is displayed only if the parenchymal or tip sensor is connected.). More detailed information on this function can be found in the section Parenchymal/Tip sensor on *page 110*).
- x-axis: variable time scale in the format Days:Hours:Minutes
- y-axis: Pressure in mmHg

#### Flow curve (bottom diagram)

- White curve: average CSF quantity delivered
- x-axis: variable time scale in the format Month/Day Hours: Minutes
- y-axis: Flow in ml/h
  - Use the **forward** and **back** arrow keys to navigate the time axis.
  - Use the **scale-down** softkey to reduce the time scale (x-axis) and the **scale-up** softkey to increase it.
- Default value: 3 hours
- Minimum value: 3 hours
- Maximum value: 30 days
- The **Selection of curves to be displayed** button allows you to select or deselect the display of the different pressure measurements.
- The y-axis of the pressure curve is scaled using the softkey **Scaling of the axis to optimum**, or **Scaling of the axes to maximum**.

## Device options

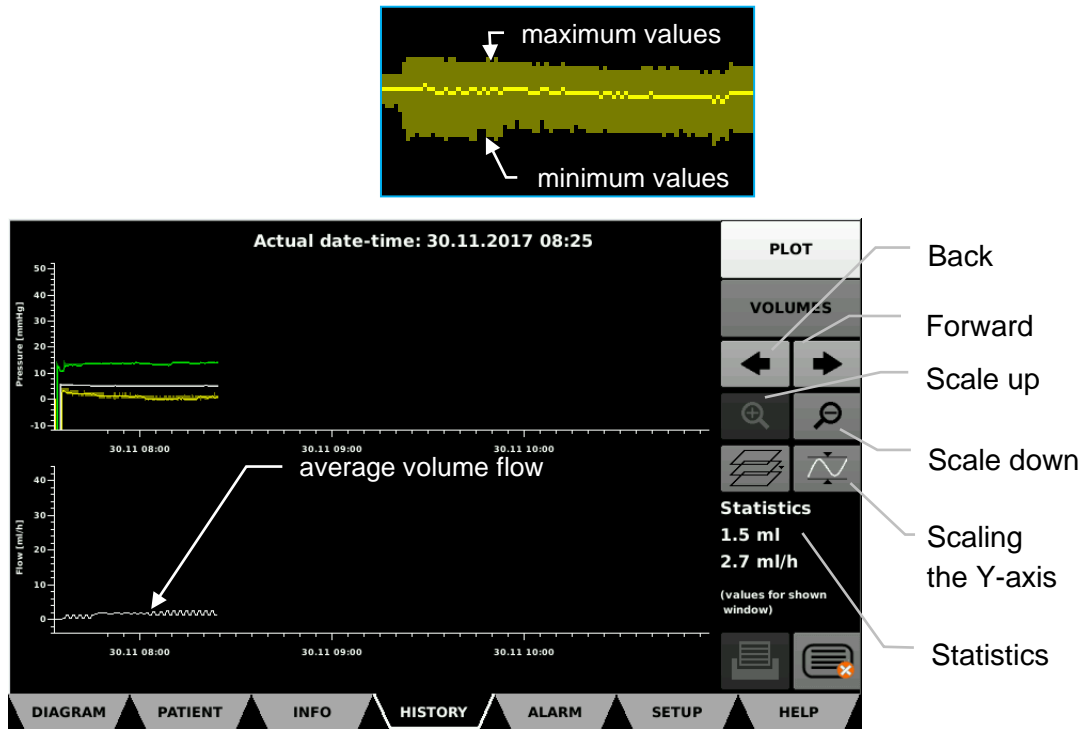


Figure 26: Diagrams in the HISTORY dialog field.

### Statistics

The volume statistics are found in the right-hand window margin of the dialog field. The volume delivered [ml] and average volume flow [ml/h] **for the set time period** are shown in the diagram.

### 9.2.4.2 Volumes

The volume balance of the current application is calculated and displayed under the sub-menu **VOLUMES** (see *Figure 27*). The values always reflect the actual volume balance for a specific time period. If the variable or fixed time periods have not yet been reached, the actual quantity delivered thus far is indicated.



In the event the tubing set is changed several times for the same patient during one application without turning the device off, the balance will be carried over to the end of the application. This means that the total drainage quantity can be read at the end of the process.

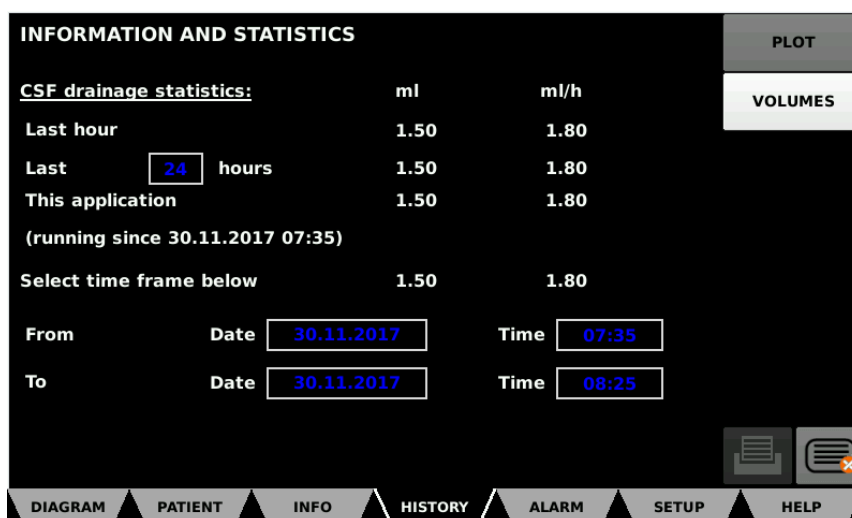


Figure 27: Overview of the *VOLUMES* submenu in the *HISTORY* dialog field.

- Last hour: Indicates the delivered volume (ml) and the average flow rate (ml/h) during the last 60 minutes.
- Last "X" hours: Access the input field and use the **numeric keyboard screen** to enter the time period in whole hours (1 - 99). The volume (ml) pumped and average flow rate (ml/h) for this time period will be calculated and displayed.
- This application: Indicates the volume delivered (ml) and the average flow rate (ml/h) of the total application.
- Select time frame below: Enter a starting time in the *FROM* field and an end time in the *TO* field. Then press the softkey **Calculate**. The volume (ml) delivered and the average flow rate (ml/h) will be calculated for this time period.

## Device options

### 9.2.4.3 Clear history

To delete the data saved in the HISTORY dialog field, select the softkey **Clear history**. In addition to the volume and flow values, the alarm history and patient data will also be deleted. Alternatively, the history of the volume and flow values will be automatically deleted when a new application is started or when the device is restarted.

### 9.2.5 Printing



This function can be used under the device function *Documentation* only if *Printing* is also enabled.

If, in addition to *Documentation*, the device function *Printing* is also activated, all screenshots and set values in the dialog fields ALARM and SETUP, will also be internally stored in the device (see *Printing* option on page 109). The screenshots and data can be transferred to a USB memory stick at a later stage.

To retrieve the saved images and data from the LiquoGuard®7, a USB memory stick must first be prepared. If the USB memory stick is already prepared for the transfer, proceed with the instruction *Copy LiquoGuard®7 data to USB memory stick*.

#### Preparation of the USB memory stick

1. Connect the USB memory stick to a computer before retrieving the data.
2. Now go to the top directory of the USB memory stick, not in a subfolder.
3. Open the context menu of the folder by **right clicking** the mouse and select **New → Text document (.txt file)**.
4. Rename the new file **export\_logs**.

Once the USB memory stick has been prepared, the LiquoGuard®7 file manager can be accessed, and the saved data copied to the USB memory stick.

#### Copy screenshots to USB memory stick

1. If the LiquoGuard®7 is on, turn it on.
2. Connect the prepared USB memory stick to one of the USB inputs on the Change to the TAB "INFO". Connect the prepared USB memory stick into one of the USB ports of the LiquoGuard®7 (see *Connection* options on page 24).
3. Press the button "Files" and wait until the file manager appears on the display.
4. Go to the **screenshots** dialog field in the tab bar of the file manager.
5. Select the files to be copied by clicking on them. The selected files will be highlighted in blue. The file name consists of the combination of date and start time of the

## Device options

application and the name of the dialog field from which the screenshot is taken (Year-Month-Day\_Hours-Minutes-Seconds- Milliseconds\_Name\_Dialogfield.png).

6. Once the data records have been selected, press the **Copy** button. A green message window on the display will indicate that the data has been successfully transferred to the USB memory stick.
7. Select the Cancel button on the right of the screen to close the file manager.
8. Confirm in the green message window that you want to exit the file manager.

The data saved on the USB memory stick can now be viewed on the computer. The files are stored in the userlogs folder → snapshot.



When data are copied from the LiquoGuard®7 in the future onto the same USB memory stick, the syslog and userlog folders will be overwritten. The files contained on the USB memory stick will be deleted. Do not forget to back up the data on your computer.

### 9.3 Presettings

Use the device function *Presettings* to save up to eight different application profiles on the LiquoGuard®7 (see *Figure 28*). The drainage settings for the tubing set are also saved. This facilitates changing between different LiquoGuard®7 devices and interrupting drainage.



Please note that the selection of presettings may affect the ability to hear the alarms due to the change in environment and its volume.

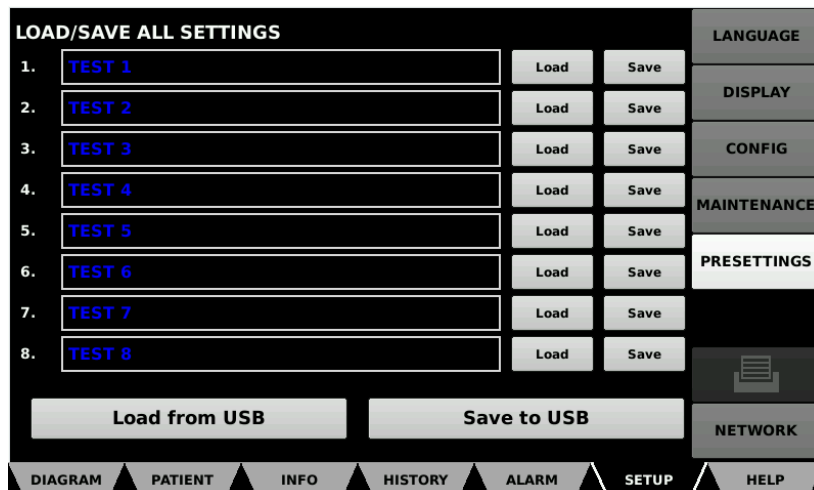


Figure 28: Screen display of Presettings function.

## Device options

For safety reasons, entering Presettings is password protected.

The password which you used when first accessing the device function *Presettings*, is valid for all functions in the Presettings dialog field.



If you forget this password and enter an incorrect one, the LiquoGuard®7 will ask whether a new password must be created. Note that when a new password is saved, all current presettings are deleted.

The presettings must be reloaded each time the LiquoGuard®7 is started or when connecting the tubing set with the enabled software option.

### 9.3.1 Editing the LiquoGuard®7 presettings

#### 9.3.1.1 Saving presettings

1. Adjust the LiquoGuard®7 settings to the requirements of the patient.
2. Go to the **SETUP** dialog field in the tab bar and open the **PRESETTINGS** submenu.
3. Access a free field and enter a name for the new configuration via the keyboard screen displayed.
4. Enter the password chosen for the presettings and confirm with **OK**. If a password has not been assigned yet for the *Presettings* option, the LiquoGuard®7 will prompt you to do so.

#### 9.3.1.2 Changing/overwriting presettings

1. Apply the required settings to the LiquoGuard®7.
2. Go to the **SETUP** dialog field in the tab bar and open the **PRESETTINGS** submenu.
3. Select the **Save** button next to the changed settings.
4. Enter the password for the presettings and confirm with **OK**.

#### 9.3.1.3 Loading the Presettings

A preset must be loaded before it is used in the current application.

Go to the **Setup** dialog field in the tab bar and open the **PRESETTINGS** submenu.

1. Click on the **Load** button next to the required preset.

Information on the presettings which are active in the current operation can be found in the Info bar of the **DIAGRAM** dialog field (see on *page 32*).

### 9.3.1.4 Saving to USB memory stick

This function allows the presets indicated in the LiquoGuard®7 submenu PRESETTINGS to be saved on a USB memory stick.

1. Connect a USB memory stick to the USB port on the LiquoGuard®7 (see *Connection options* on page 24).
2. Go to the **SETUP** dialog field in the tab bar and open the **Presettings** submenu.
3. Press the **Save to USB** button.

### 9.3.1.5 Loading from USB

Presettings saved on a USB memory stick can be transferred to a LiquoGuard®7.



Presettings loaded from a USB memory stick will replace all presettings saved on the device. To avoid this, a backup of the presettings onto another USB memory stick should be made before loading.

1. Connect a USB memory stick to the USB port on the LiquoGuard®7 (see *Connection options* on page 24).
2. Go to the **SETUP** dialog field in the tab bar and open the **PRESETTINGS** submenu.
3. Press the **Load from USB** button.
4. Enter the password for the presettings and confirm with **OK**.

## 9.3.2 Copy drainage settings to tubing set

This function allows the automatic saving of all LiquoGuard®7 settings in the connected tubing set. Following an interruption during which the tubing set is removed, reconnect the tubing set to the same LiquoGuard®7 or to another LiquoGuard®7. The option *Presettings* on the device must be enabled. The previous settings can then be restored.



Ensure that a used tubing set is not disconnected from the LiquoGuard®7 for longer than 8 hours. If this period is exceeded, the LiquoGuard®7 will no longer accept the tubing set. In this case, connect a new tubing set.

1. Reconnect the sensor cable of the tubing set previously disconnected from the LiquoGuard®7 to the LiquoGuard®7 (see *Application and operation* on page 41).
2. A green message window will signal if there are differences in patient data between the tubing set and the LiquoGuard®7 (this function is part of the *Documentation* option. For more detailed information, see page 98).
3. If you wish to transfer the patient data saved in the tubing set to the LiquoGuard®7, select the **Apply** button in the message window. If you want to keep the existing patient data in the LiquoGuard®7, press the **Cancel** button.

## Device options

- Another green message window will appear in the case of differences between the settings saved in the tubing set and the current settings of the LiquoGuard®7. Select the **Apply** button to replace the settings in the LiquoGuard®7 with the settings in the tubing set. Select the **Cancel** button if you wish to use the tubing set with the current device settings instead.

### 9.4 Printing

Use the Printing option to obtain screenshots of the current display. This function is available in all LiquoGuard®7 dialog fields. When the Printing button in the dialog fields Alarm and **SETUP** is selected, a copy of the settings will be generated in the respective dialog field, in addition to the screenshot. Depending on whether a printer or USB memory stick is connected to the LiquoGuard®7, the data will be automatically printed or saved.



Since a conventional printer is not a medical device, a USB isolator (certified according to IEC 60601-1) must be used as galvanic isolation between the printer and the LiquoGuard®7 (e.g. USB-GT MED-D Interface, manufactured by Meilhaus Electronic GmbH).

If a USB memory stick and a printer are simultaneously connected to the LiquoGuard®7, the data will be saved and printed.



If, in addition to the *Printing* option, the *Documentation* option is also activated, screenshots and settings will also be internally stored in the device and can be transferred to a USB memory stick at a later stage. More detailed information can be found under the device function *Documentation* on page 98.

#### Printer

- Connect a printer to a free USB port on the LiquoGuard®7. Information on suitable printers can be found in the Appendix on page 128.
- The printer symbol in the *Info bar* indicates that the printer has been detected by the device. The printer is now ready for operation.
- Select the softkey **Print** to print the screen content.



#### USB memory stick

- Connect a USB memory stick to a free USB port on the LiquoGuard®7.
- The USB symbol in the Info bar indicates that the USB memory stick has been detected by the device. The USB memory stick is now ready for operation.
- Select the softkey **Print** to save a screenshot of the current screen content.

## 9.5 Parenchymal/Tip sensor

Only parenchymal and tip sensors should be used which comply with the specifications provided on *page 127* under *Input and output signals*.

Since parenchymal and tip sensors are normally not fail-safe, these should be used only with a LiquoGuard®7 Drainage Set.

If you wish to use a parenchymal sensor to control drainage, a LiquoGuard®7 Drainage Set must be used. In all other cases, the parenchymal sensor may be used only for monitoring.



In the event that you disconnect the parenchymal or tip sensor from the LiquoGuard®7, but wish to continue drainage using the LiquoGuard®7 Drainage Set, first also disconnect the Drainage Set from the LiquoGuard®7. Select the **Interrupt Application** button in the alarm message window. Then reconnect the LiquoGuard®7 Drainage Set to the LiquoGuard®7 and select the **Pause/Start** softkey in the **DIAGRAM** dialog field. Drainage will now continue without the parenchymal or tip sensor.

When using the parenchymal sensor, use the LiquoGuard®7 for monitoring intraparenchymal pressure (see *Figure 29*). When using the connected tubing set, the ICP value can also be used to control drainage.

You can also connect a suitable catheter with a tip sensor to the LiquoGuard®7 for CSF drainage. Connect the catheter to the LiquoGuard®7 Drainage Set (see *Application and operation on page 41*).

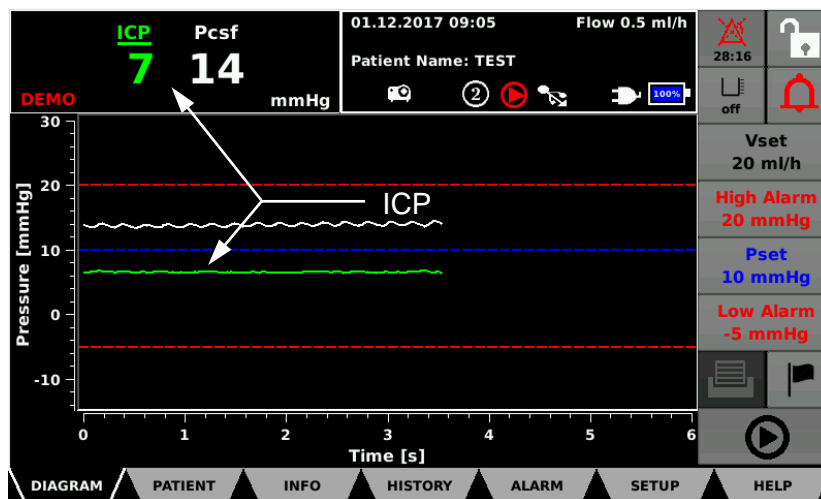


Figure 29: In the "Diagram" dialog field, the ICP is indicated as a green value in the Info bar and as a green curve in the diagram.

## Device options

The ICP indicated on the display is the filtered pressure value which is transmitted to the LiquoGuard®7 from the parenchymal or tip sensor. This value is shown only when a parenchymal or tip sensor is connected to the LiquoGuard®7. The curve progression of the pressure values is shown in green in the diagram.

- ICP pressure value is green (numerical value on the info display, not the curve directly): The currently measured value is within the alarm limits set.
- ICP pressure value flashes red: The currently measured value is outside the alarm limits set.
- ICP is underlined: The pressure at the parenchymal or tip sensor is used to control drainage.
- Pcsf is underlined: The pressure at the LiquoGuard®7 Drainage Set is used to control drainage.

If neither a LiquoGuard®7 Drainage Set nor a parenchymal or tip sensor is connected to the LiquoGuard®7, two red lines replace the pressure values.

### 9.5.1 Connecting the parenchymal/tip sensor



Use an adapter cable to connect the LiquoGuard®7 to the parenchymal or tip sensor. The LiquoGuard®7 has a socket for connecting the adapter cable (see *Connection options on page 24*).

1. Connect the end of the adapter cable to the pressure sensor cable of the parenchymal or tip sensor.
2. Connect the other end of the cable to the ICP input of the LiquoGuard®7. If the LiquoGuard®7 detects the parenchymal or tip sensor, the ICP value will appear on the display, together with a green message window with calibration setting options and sensor functions.

When measuring pressures in liquids (CSF), the level of the pressure sensor (measured from floor level) is decisive. When using two pressure sensors (for example, pressure sensor in the LiquoGuard®7 tubing set and another parenchymal pressure sensor), it is often not possible for both sensors to be at the same level. As a result, different pressures are measured regularly, even though the same patient is measured.

The same problem can arise due to the fact that measurements are taken in different compartments of the patient (e.g. CSF and brain tissue).

For this reason, you have the following options for calibrating the sensors to each other:

- **Calibrate to Pcsf:** Select this setting to calibrate the ICP currently indicated by the parenchymal or tip sensor with the Pcsf currently measured by the LiquoGuard®7 drainage set. Before performing the calibration, connect the parenchymal or tip sensor to the patient. This function can be selected only if the LiquoGuard®7 Drainage Set is connected to the LiquoGuard®7.
- **Calibrate to zero:** Select this setting to perform a zero adjustment. Ensure that the parenchymal or tip sensor is not yet connected to the patient during zero adjustment. Information on zero adjustment of the sensor with the LiquoGuard®7 can be found in the operating instructions of the parenchymal or tip sensor used.
- **Ignore calibration** (keep current values): Select this setting if you wish to keep the ICP value indicated by the parenchymal or tip sensor.

The following sensor function options are available:

- **Control CSF drainage:** Select this setting if the ICP value is to be used to control drainage while the Pcsf value (LiquoGuard®7 Drainage Set) is used for monitoring.
- **Monitor alarms:** Select this setting if the ICP value of the parenchymal or tip sensor is used for monitoring, while the Pcsf value (LiquoGuard®7 Drainage Set) is used for controlling drainage.

### 9.5.2 Settings



The default values may be changed only by qualified personnel. The user should check prior to every application that the current settings are suitable for a specific patient.

#### ICP differs from Pcsf

This function changes the permitted pressure difference between ICP (parenchymal or tip sensor) and Pcsf (LiquoGuard®7 Drainage Set). If this difference is exceeded, an alarm is emitted.

1. Tab bar **ALARM** → Softkey **PARENCHYMAL/TIP SENSOR** → Subitem **CP differs from Pcsf / alarm sensitivity**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 5 mmHg
  - Minimum value: OFF (function deactivated)
  - Maximum value: 15 mmHg

## Device options

### Use parenchymal/tip sensor (if connected)

This function establishes the settings for the parenchymal or tip sensor functions. The following options are available.

1. to control CSF drainage (default value): Select this setting if the ICP is used to control the LiquoGuard®7 pump. If the ICP exceeds the *Pset* value in the **DIAGRAM** dialog field, CSF will flow through the tubing set until the ICP is less than the *Pset*. The alarm and Pcsf data are active in this setting. The setting is possible only if the tubing set is connected.
2. for monitoring / recording / alarms only: Select this setting if the ICP value is used for monitoring and the Pcsf value for drainage. The alarm and ICP data are active in this setting.

### Pset (set pressure value)

If the parenchymal or tip sensor are selected *to control CSF drainage*, this function changes the set value of the ICP measured. If the ICP value exceeds the *Pset* value, CSF will be drawn to reduce the pressure. The threshold for exceeding the *Pset* depends on a hysteresis defined in the device. The pump delivers according to the delivery rate *Vset* until the measured ICP reaches the *Pset*.



Setting the *Pset* value to < 2 mmHg can present a serious danger to the patient. For safety reasons, the system requests confirmation of the setting. To confirm, press the button **Yes, I want to set Pset < 2 mmHg**. This function can be deactivated as described in the section *Config* from page 65.

1. Tab bar **DIAGRAM** → Softkey **Pset**
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 10 mmHg
- Minimum value: limited by **Low Alarm**
- Maximum value: limited by **High Alarm**

## High Alarm

Use the softkey *High Alarm* to set the high alarm limit. If the measured ICP exceeds the *High Alarm* value, an alarm will be generated after a preset delay (default value = 45 seconds, see page 56). If a tubing set (Pcsf) is also connected to the LiquoGuard®7, the *High Alarm* limit will apply to both values.

If the High Alarm value for the period set under

Delay of emergency drainage (see page 59) is exceeded, the LiquoGuard®7 performs an emergency drainage. During emergency drainage, the pump delivers 250 ml/h until the pressure measured by the tubing set has dropped to the High Alarm value.

1. Tab bar **DIAGRAM** → Softkey **High Alarm**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 20 mmHg
- Minimum value: limited by Pset
- Maximum value: 75 mmHg      **Low Alarm**

Use the softkey *Low Alarm* to set the low alarm limit. If the measured ICP exceeds the *Low Alarm* limit, an alarm will be generated after a preset delay (default value = 45 seconds, see page 56). If a tubing set (Pcsf) is also connected to the LiquoGuard®7, the *Low Alarm* limit will apply to both values.

1. Tab bar **DIAGRAM** → Softkey **Low Alarm**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.



Setting the *Low Alarm* value to < 2 mmHg can present a serious danger to the patient. For safety reasons, the system requests confirmation of the setting. To confirm, press the button **Yes, I want to set the Low Alarm below 2 mm Hg Pset**. This function can be deactivated as described in the *section Config* from page 65.

- Default value: 5 mmHg
- Minimum value: -15 mmHg
- Maximum value: limited by Pset

## Device options

## 9.6 Lumbar infusion test

Unlike CSF drainage, the lumbar infusion test application consists of an infusion of CSF substitute in the spinal canal.

For delivering physiological saline solution or CSF substitute, a suitable epidural needle with Tuohy-cut (not available in the Möller Medical product line) is required in addition to the lumbar infusion test set.

Möller Medical recommends:



An epidural needle with a Luer connector and Tuohy-cut incl. mandrel

- Inner diameter 18G (1.3 mm) or larger
- Length approx. 80 mm (depending on patient)



A prerequisite for the *lumbar infusion test* is that the operator is familiar with the regular use of the LiquoGuard®7, has received extensive training on the device and has read and understood the instruction manual in its entirety.

With the exception of the *Parenchymal/Tip sensor* option, all enabled device functions can also be used in *Lumbar infusion test* mode.

### 9.6.1 General description

The lumbar infusion test is an established clinical method for indirect measurement of the CSF absorption capability of patients suffering from normal pressure hydrocephalus. The procedure involves an appropriate infusion system after puncture of the intrathecal space, accompanied by pressure measurement. A fluid is pumped into the subarachnoid space of the patient through the infusion system at a specific flow rate and the CSF pressure is measured simultaneously. The user determines the flow rate and detects the initial and final liquid pressure values.

During the lumbar infusion test with the LiquoGuard®7, an infusion solution (saline solution or CSF substitute) is infused into the patient at a specific flow rate  $V_{set}$ . The pressure value prior to infusion ( $P_{start}$ ) and the stabilized pressure value during infusion (Plateau) are required to calculate the ROF (Resistance to Outflow). The ROF is calculated as follows:

$$ROF = \frac{\text{Plateau [mmHg]} - P_{start} [\text{mmHg}]}{V_{set} \left[ \frac{\text{ml}}{\text{min}} \right]}$$

This value is indicated on the LiquoGuard®7 display. The ROF dimension is [mmHg / (ml/min)]. The display indicates this in the same manner although  $V_{set}$  is expressed in [ml/h]. The patient must lie down for the duration of the application to avoid excess pressure. Qualified personnel must be present for the duration of application. The measured value depends directly on the initial pressure and the plateau pressure set by the physician. The physician is therefore directly responsible for the measurement results.



The attainment of the plateau value depends on the health of the patient. The physician must constantly monitor the patient and interrupt or stop the test via the Pause/Start softkey if the patient indicates dangerously high- pressure values. The physician alone is responsible for evaluating the pressure values. The LiquoGuard®7 is merely an aid.

The LiquoGuard®7 Lumbar Infusion test option can only be used in conjunction with the LiquoGuard®7 Infusion Test Set *REF. No.: 00003499*. Epidural needle with Tuohy-cut required for the infusion test is not included in the set and must be ordered separately.

The LiquoGuard®7 infusion test set tubing set *REF. No.: 00003499* is designed to ensure the flow of up to 100 ml of infusion solution (physiological saline solution or CSF substitute) at a consistent volume flow into the spinal canal, with simultaneous pressure measurement. Device and tubing set together have the purpose of: Performing the lumbar infusion tests.

## Device options

The appropriate location for its application includes monitored medical hospital rooms or neurosurgical practices.

Qualified personnel must stay with the device/patient for the entire duration of the application.

The LiquoGuard®7 Infusion Test Set *REF. No.: 00003499* is intended only for use in combination with and for connecting to the LiquoGuard®7 system. Separate application without the LiquoGuard®7 does not comply with the purpose of the system.



The device has been designed exclusively for the infusion of CSF-like liquid into the subarachnoid space and must not be used for the infusion of drug solutions or other constituents.

The lumbar infusion test serves only to obtain the diagnostics for the evaluation method indicated in specialist literature as the *lumbar infusion test* for normal-pressure hydrocephalus.

The withdrawal of CSF or the connection to other body systems (e.g. blood system) are incompatible with its intended use.

The lumbar infusion test must not be the only means of diagnosis resulting in measures taken on the patient.

The LiquoGuard®7 may be used specifically for the infusion of fluid (saline solution or CSF substitute) into the spinal canal. It is, however, not an infusion pump because the lumbar infusion test serves diagnostic purposes and is continuously monitored by the operator.



The LiquoGuard®7 may be used for the infusion of fluids (CSF substitute) into the spinal canal exclusively in the case of the *Lumbar Infusion Test*. The LiquoGuard®7 must not be considered as an infusion pump since the Lumbar Infusion Test option is performed for diagnostic purposes and the operator is present for the entire duration of the application.

### 9.6.2 Indications

Indications for the lumbar infusion test

The nervous system (brain, spinal cord) is surrounded by cerebrospinal fluid (CSF). The production and absorption of CSF are in a stable balance. Normal-pressure hydrocephalus disorder (hereinafter referred to as NPH) causes an imbalance between the production and absorption of CSF. Patients with this clinical picture may suffer from several symptoms. The most common are gait abnormalities (magnet gait), memory disorders and micturition disorder (incontinence). These symptoms are typical of NPH but can also be diagnosed in individuals with other cerebral disorders (such as Alzheimer's disease or other dementia disorders).

The treatment of NPH involves the continuous drainage of CSF from the ventricles of the brain into another body cavity, usually intraperitoneal (ventriculoperitoneal shunt = VP shunt) or into the blood system (usually into the atrium, i.e. ventriculoarterial shunt = VA shunt). In order to determine whether and how a shunt system can contribute towards successful therapy, meticulous diagnosis must be performed in order to ascertain whether a patient actually suffers from NPH. Besides the determination of clinical symptoms, imaging diagnosis is required in order to check for typical NPH symptoms (extension/disproportion of ventricles, effacement of the cerebral sulci, etc.). Since, however, the combination of clinical and imaging exams is not sufficient for safe diagnosis, further examination methods must be applied.

Besides continuous lumbar drainage, the lumbar infusion test represents an additional method for NPH diagnosis verification.

### 9.6.3 Contraindications

- Coagulation dysfunction
- Thrombocytopenia
- Infectious diseases
- Manifest cramp attacks
- Acute central nervous system disorders (cerebral haemorrhage, cerebral infarct, cranial-cerebral injury, subarachnoid haemorrhage)
- Tumorous disease of the central nervous system (intracranial and spinal)
- CSF obstructions (in particular, syringomyelitis, arachnopathy)
- Low CSF pressure syndrome
- Increased cerebral pressure
- Upper articular constriction (herniation)

### 9.6.4 Complications

- Meningitis, encephalitis, ventriculitis, myelitis, nosocomial infection
- CSF depletion syndrome (catheter disconnection, persistent dural defects after puncture) resulting in cerebral haemorrhage, epidural haematoma, slit ventricles, headaches
- Spinal cord injury, nerve injury, cone or cauda injury, back pain
- Increase in CSF pressure resulting in headaches, neurological disorders (impaired vision, reduced consciousness, cramp attacks, loss of consciousness)
- Interrupted tube flow (bent tube, occluded tube system (blood clots or detritus))
- Death

## Device options

**9.6.5 Combination with other products**

The LiquoGuard®7 Lumbar Infusion test option can only be used in conjunction with the LiquoGuard®7 Infusion Test Set *REF. No.: 00003499* from Möller Medical.

Accordingly, the LiquoGuard®7 Infusion Test Set *REF No.: 00003499* may be used only for the LiquoGuard®7 Lumbar Infusion Test option.

**9.6.6 Patient population**

This application is to be used exclusively on patients suspected of suffering from normal-pressure hydrocephalus (age group: mostly middle to advanced age).

**9.6.7 Residual risk**

The use of the LiquoGuard®7 with the *lumbar infusion test* option poses the following risks when carrying out this test:

- Increased CSF pressure
- Infusion of the fluid outside the subarachnoid space due to incorrect positioning of the spinal cannula
- Infection of the cerebrospinal fluid

**9.6.8 Execution of the lumbar infusion test**

The puncture of the intrathecal space is an essential element of the lumbar infusion test. The patient is usually placed in the lateral position, the skin in the centreline of the lumbar spine is disinfected, and the subarachnoid space is punctured using a large spinal needle under sterile conditions. After ensuring the CSF flow, a tubing system is connected to the positioned needle. This tubing system is in turn connected to a pressure measuring device. Using an infusion pump, sterile, CSF-like liquid can be infused via the tube system. Before starting infusion, the initial pressure is measured. Then the liquid is infused at a defined rate (in most cases 1 to 2 ml/min) while continuously measuring the pressure until a specific plateau pressure has been reached, or until a critical pressure value forces the attending physician to abort the test. If the ROF exceeds the critical value (in most cases 12-18 mmHg/ml/min), an NPH is diagnosed. However, the application of the lumbar infusion test as a single method for NPH diagnosis is neither described in expert literature nor is it found to be suitable for this specific purpose.

**9.6.8.1 Puncture of the subarachnoid space**

The subarachnoid space is punctured by means of an epidural needle with Tuohy-cut.

**9.6.8.2 Intrathecal CSF drainage**

The withdrawal of CSF requires the surgical insertion of an approved needle into the intrathecal space. This surgical intervention is indicated in case of suspicion of NPH.

### 9.6.9 Application and operation

The LiquoGuard®7 displays only the filtered pressure values. The diagram shows two horizontal green lines with which the initial and end pressures can be set. The ROF of the CSF is calculated by using these two pressure limit values and the volume rate set. In order to calculate the ROF, it is important that the measured pressure has actually reached the upper plateau.



In *Lumbar Infusion Test* mode, the pump turns off if the High Alarm limit is exceeded. If the Low Alarm limit is exceeded, further CSF substitute will flow.

The alarm "*Pressure constant for too long*" does not exist in the infusion test. Therefore, this parameter is not indicated in the menu.

As the lumbar infusion test is a diagnostic procedure during which small pressure differences are decisive, qualified personnel must stay with the patient throughout the entire process and attend the application. This is important as changes in the position of the patient would more significantly affect the measurement than the additional infiltration.

The operator must manually start and finish the procedure as the automatic mode is risky for the same reasons. In this way the operator specifies the initial pressure as well as the changed final pressure.

In order to perform the lumbar infusion test, the sensor cable of the tubing set must already be connected to the LiquoGuard®7 when the device is turned on.

#### Preparation of the tubing set

1. Firstly, remove a tubing set suitable for the *lumbar infusion test* from its packaging and connect the sensor cable to the turned off LiquoGuard®7 (see *Connection options on page 24*).
2. Restart the LiquoGuard®7 via the **On/Off switch** now.
3. As soon as the tubing set is recognized by the LiquoGuard®7, a green window will appear on the screen with the instruction to insert the tubing set.
4. Select the button **Start Application** in the message window. The device is now in lumbar infusion test mode.

#### Preparation of the lumbar infusion test

The LiquoGuard®7 supports the operator in further preparatory procedures. Each measure is indicated in the Info bar of the display. Use the arrow keys in the dialog window **DIAGRAM** to follow the installation procedure step by step.

1. Attach sticker (ECG) to the sensor housing  
Attach the adhesive electrode to the pressure sensor housing.
2. Inset tubing set into pump  
Insert tubing set into pump (see *Installation and startup on page 41*) but, after insertion, do not close the LiquoGuard®7 pump cover yet.
3. Insert spike into infusion solution

## Device options

Remove the protective cap from the spike of the tubing set and prick the container with the CSF substitute.

4. Fill tubing until completely full



Ensure that no air remains in the tubing set. This will avoid inaccurate measurements and prevent air from being pumped into the patient.

If the pump cover is closed, open it now. Remove the protective cover on the through valve. Keep the **Turn Rotor** button in the message window pressed until the CSF substitute drips from the tubing set. You can now close the pump cover.

5. Perform the puncture on the patient with an epidural needle with Tuohy-cut, wait until CSF comes out. Remove the epidural needle with Tuohy-cut from its packaging and perform the puncture on the patient. Wait for the needle to fill with CSF.
6. Connect needle and tubing  
Connect the needle to the tubing set.
7. Attach pressure sensor to patient  
Attach the pressure sensor to the patient at the level of the puncture in order to avoid inaccurate measurements.
8. Set Vset (e.g. 120 ml/h)

Press the softkey **Vset** and change the value for the infiltration flow by using the + and - buttons. The change is accepted directly. The change is accepted directly.

9. Adjust Pstart  
Check whether the current pressure (white line) is relatively constant. Align the start curve (lower green curve) to the pressure curve. Press the **Pstart** button and change the value by using the + and - buttons until the start curve lies on the pressure curve. If the pressure is not constant, check whether the sensor was attached correctly. The patient must remain still, otherwise fluctuations in pressure may occur.
10. When plateau is reached, adjust the plateau value and read ROF
11. This instruction serves only for information at this stage and can be skipped.
12. Press >(II)< to start infusion test.
13. On the LiquoGuard®7 display, press the softkey **Pause/Start** to start the lumbar infusion test.

Once preparations are completed, proceed with measurement.

**Measurement:**

1. After pressing on the softkey **Pause/Start** to activate the pump, the pressure increases until a new stable pressure plateau is reached. This constant pressure that corresponds to the set speed  $V_{set}$  of the pump is required to calculate the ROF.
2. Once it is certain that the plateau value is stable and will no longer increase, enter the plateau pressure in the LiquoGuard®7. To do this, press the softkey **Plateau** and change the value using the **+** and **-** buttons until it shows the same value as the stable  $P_{csf}$ .
3. The  $ROF$  for the application is indicated in the Info bar subject to  $P_{start}$  and the *plateau*.

The  $ROF$  is always calculated on the basis of the currently set values. If the  $V_{set}$  is changed during the application, it is necessary to wait for a new stable pressure plateau.



$$ROF = \frac{\text{Plateau [mmHg]} - P_{start} [\text{mmHg}]}{V_{set} \left[ \frac{\text{ml}}{\text{min}} \right]}$$

The start curve ( $P_{start}$ ) can be adjusted throughout the application.

If the current pressure and the start curve are identical, only the start curve will be visible.

When the LiquoGuard®7 is in pump mode, the pump operates for 8 seconds, then pauses for 2 seconds in order to measure the pressure. Then it resumes operation. After every 10 seconds, therefore, the diagram indicates the new measurement values.



In practice it is often difficult to reach a stable plateau value. The final value is subject to strong variation. It must be ensured that the pressure does not increase any further. The attending physician is responsible for setting the correct plateau pressure value.

In the event that the infusion set is disconnected from the LiquoGuard®7 during the application, the measurement curve is deleted. The indicator of the already dispensed volume is retained.

The following options are available to reset the volume counter and the measurement curve in the **DIAGRAM** dialog field:

- If the *History* device function is enabled, go to the HISTORY dialog field and press the **Clear History** button. In addition to the volume counters and measurement curves, ensure that the alarm history and patient data are deleted.
- If the *History* function is not available, the values can be reset by restarting the LiquoGuard®7.

## Device options

### 9.6.10 Settings

The setting options in *Lumber Infusion Test* mode differ only in the dialog fields **DIAGRAM** and **ALARM** from those available for drainage. The setting options for the **SETUP** dialog field can be found on *page 62*. In the *Lumbar Infusion Test* mode, you can change the unit used to show pressure (mmHg, cmH<sub>2</sub>O) only before the start of the application.

#### 9.6.10.1 Diagram

##### High Alarm

Use the *High Alarm* softkey to change the upper pressure alarm limit. If the measured pressure exceeds the *High Alarm* limit, an alarm will be generated after a preset delay (default value = 45 seconds, see *page 56*).

1. Tab bar **DIAGRAM** → Softkey **High Alarm**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 40 mmHg
- Minimum value: limited by Plateau
- Maximum value: 75 mmHg

##### Plateau

Use the softkey *Plateau* to set the plateau value at the end of the Pcsf measurement in order to determine the *ROF*.

1. Tab bar **DIAGRAM** → Softkey **Plateau**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 30 mmHg
- Minimum value: limited by Pstart
- Maximum value: limited by High Alarm

**Pstart**

Before starting measurement, press the softkey *Pstart* to adjust the value to the measured Pcsf pressure.

1. Tab bar **DIAGRAM** → Softkey **Pstart**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 12 mmHg
- Minimum value: -14 mmHg
- Maximum value: limited by Plateau

**Vset**

Using the softkey *Vset*, adjust the volume flow of the infusion solution in ml/h.

1. Tab bar **DIAGRAM** → Softkey **Vset**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 120 ml/h
- Minimum value: 0 ml/h
- Maximum value: 250 ml/h

**Low Alarm**

Use the softkey *Low Alarm* to change the lower pressure alarm limit. If the measured pressure exceeds the *Low Alarm* limit, an alarm will be generated after a preset delay (default value = 20 seconds, see page 56).

1. Tab bar **DIAGRAM** → Softkey **Low Alarm**.
2. Press the **+** and **-** buttons to change the value.

The change is accepted directly.

- Default value: 5 mmHg
- Minimum value: -15 mmHg
- Maximum value: limited by Pstart

## Device options

### 9.6.10.2 Alarm

#### Alarm delay

This setting is used to determine the time period from the moment a physiological alarm condition occurs to the emission of an alarm signal. This avoids an alarm being generated by temporary pressure fluctuations (e.g. after coughing or sneezing).

1. Tab bar **ALARM** → Softkey **GENERAL** → Subitem **Alarm delay**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 45 seconds
  - Minimum value: 5 seconds
  - Maximum value: 1 minute

#### Sound level

This function determines the volume of the acoustic alarm signal.

1. Tab bar **ALARM** → Softkey **GENERAL** → Subitem **Sound level**
2. Press the **+** and **-** buttons to change the value.
3. To save the changes, press the **Confirm changes** button.
  - Default value: 40%
  - Minimum value: 20%
  - Maximum value: 100%

### 9.6.11 Alarms

During the infusion test, alarms may be generated due to values exceeding the *High Alarm* limit or *Low Alarm* limit. *Similarly to the drainage mode, these alarms can be silenced for a set period of time (see Technical and physiological alarm conditions on page 72).*

## 10 Appendix

### 10.1 Technical Data

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#### General characteristics

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Order number REF:	00003500
Dimensions of the LiquoGuard®7:	Width x Height x Depth [mm] 238.1 x 145 x 212.8
Weight [kg]:	3.7 kg
Operating temperature application side:	42 °C at adhesive electrode
Noise pressure level Pump:	< 38 dB(A) at a flow of 30 ml/h
Noise pressure level Alarm signal:	> 85 dB (A), from speaker setting 80%
Minimum operating life:	5 years
Applicable standard:	IEC 60601-1 + A1:2012

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#### Electrical connection

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Voltage:	100 – 240 VAC (alternating voltage)
Frequency:	50 – 60 Hz
Current consumption:	1.0 – 0.4 A
Power consumption:	100 VA
Fuse:	T 3.15 A / 250 V
Protection class:	I
Protection rating:	IP 20
Li-Ion battery pack:	Art. No. 9300 7482
Li-Ion cell:	Art. No. 9300 4732
Application part BF:	LiquoGuard®7 Drainage Set REF. No. 00003497 (1600 mm) or REF. No. 00003501 (2000 mm) LiquoGuard®7 Infusion Test Set REF. No.: 00003499 <i>ICP interface to LiquoGuard®7</i>

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#### Fuses

---

F1:	Manufacturer: Littlefuse Current: 5 A Voltage: 125 VDC Tripping characteristic: Flink Breaking capacity: 50 A @ 125 VAC/ VDC
-----	--

## Appendix

F2:	Manufacturer: Littlefuse Current: 1 A Voltage: 125 VDC Tripping characteristic: Flink Breaking capacity: 50 A @ 125 VAC/ VDC
-----	--

### Transport and storage instructions

Temperature:	-10 °C to +50 °C
Humidity:	less than 90% rel. humidity
Weight with packaging:	approx. 5.3 kg
Dimensions of packaging:	Width x Height x Depth [mm] 300 x 320 x 345

### Operating conditions

Temperature:	+15 °C to +40 °C
Humidity:	30 to 75% rel. humidity
Pressure:	70 kPa - 101,3 kPa maximum operating altitude < 3000 m above sea level.

### Specific features

Delivery rate of the LiquoGuard®7:	1 ml/h to 250 ml/h
Operating pressure range:	- 75 mmHg to + 100 mmHg
Delivery rate accuracy:	± 10 % *incl. material variations of the tubing set +/- 15 %

### Input and output signals

#### Patient monitor system

Operating pressure range:	-75 mmHg to +100 mmHg
Impedance:	1.5 kOhm
Sensitivity:	5.0 µV/V/mmHg with a tolerance of: Pcsf ≥ -15 < + 20 mmHg → Tolerance: ± 2 mmHg Pcsf > +20 mmHg → Tolerance: ± 10 %
Power supply:	4 V to 10 V

#### Diagnostic call system

Output:	NO / NC
Rated voltage:	250 V/1 A

**Parenchymal/Tip sensor**

Operating pressure range:	- 75 mmHg to +100 mmHg
Impedance:	300 Ohm – 3 kOhm
Sensitivity:	5.0 $\mu\text{V}/\text{V}/\text{mmHg} \pm 1\%$
Non-linearity and hysteresis:	$\pm 1.5\%$ display accuracy or $\pm 1$ mm Hg, whereby the higher value is decisive
Operating temperature:	min. 15 °C to 40 °C
Certified sensors, catheter and devices:	Neurovent (RAUMEDIC) Neurovent-P (RAUMEDIC) Brain Pressure Monitor HDM 26.1 (Spiegelberg)

**USB**

Features:	USB 2.0 and USB 1.1 File system FAT32
Printer:	HP Deskjet 3320, HP Deskjet 3000 Printers may be used only in conjunction with a USB isolator (certified according to DIN IEC 60601-1) (e.g. USB-GT MED-D Interface, manufactured by Meilhaus Electronic GmbH).

**10.2 Electromagnetic emission**

The LiquoGuard®7 is intended for operation in the stipulated electromagnetic environment. The customer and/or operator of the LiquoGuard®7 should ensure that the LiquoGuard®7 is used in one of the electromagnetic environments described below.

Measurement of emitted interference	Conformity	Guidelines for the electromagnetic environment
Emitted high-frequency interference acc. to CISPR 11	Group 1	To satisfy its intended function, the LiquoGuard®7 must emit electromagnetic energy. Electronic devices in the vicinity could be influenced.
Emitted high-frequency interference acc. to CISPR 11	Class B	For areas of application, see <i>chapter 4.4</i>
Harmonic emission acc. to IEC 61000-3-2	Class A	
Voltage fluctuation/flicker emission acc. to IEC 61000-3-3	Complies	

## Appendix

## 10.3 Electromagnetic resistance

Immunity test	IEC 60601 – testing level	Level of conformity	Electromagnetic environment / Guidelines
Discharge of static electricity (ESD) IEC 61000-4-2	±8 kV contact discharge  ±15 kV air discharge	±8 kV contact discharge  ±15 kV air discharge	Floors should be made of wood or concrete or fitted with ceramic tiles. If the floor is provided with a synthetic material, relative humidity must be at least 30%.
Electrical fast transients/Bursts IEC 61000-4-4	±2 kV for power lines  ±1 kV for input/output lines	±2 kV for power lines  ±1 kV for input/output lines	The quality of the supply voltage should be comparable to that for a typical shop or hospital environment.
Impulse voltage (surges) IEC 61000-4-5	±1 kV normal mode voltage  ±2 kV common mode voltage	±1 kV normal mode voltage  ±2 kV common mode voltage	The quality of the supply voltage should be comparable to that for a typical shop or hospital environment.
Voltage dips, temporary interruptions and fluctuations of the supply voltage IEC 61000-4-11	< 5% $U_T$ (> 95% dip in $U_T$ ) for 1/2 period  40% $U_T$ (60% dip in $U_T$ ) for 5 periods  70% $U_T$ (30% dip in $U_T$ ) for 25 periods  < 5% $U_T$ (> 95% dip in $U_T$ ) for 5 seconds	< 5% $U_T$ (> 95% dip in $U_T$ ) for 1/2 period  40% $U_T$ (60% dip in $U_T$ ) for 5 periods  70% $U_T$ (30% dip in $U_T$ ) for 25 periods  < 5% $U_T$ (> 95% dip in $U_T$ ) for 5 seconds	The quality of the supply voltage should be comparable to that for a typical shop or hospital environment. We recommend an uninterrupted power supply or battery for operators of the product demanding continuous function even during an interrupted power supply.
Magnetic field of supply frequency (50/60 Hz) IEC 61000-4-8	30 A/m	30 A/m	Magnetic fields of the supply frequency should conform with the typical values found in commercial or hospital environments.
Magnetic fields at close range IEC 61000-4-39	9 kHz – 13.56 MHz: 134.2 kHz, 65 A/m, Pulse modulation 2.1 kHz  9 kHz – 13.56 MHz: 13.56 MHz, 7.5 A/m, Pulse modulation 50 kHz	9 kHz – 13.56 MHz: 134.2 kHz, 65 A/m, Pulse modulation 2.1 kHz  9 kHz – 13.56 MHz: 13.56 MHz, 7.5 A/m, Pulse modulation 50 kHz	Magnetic fields of appliances in the vicinity should conform with the typical values found in shops or hospital environments.
Note: $U_T$ is the alternating mains voltage prior to the application of the testing level.			

The LiquoGuard®7 satisfies all test levels in accordance with IEC60601-1-2 Edition 4 (table 4 to 9).



As a result of the presence of electromagnetic disturbances, it is possible that the key performance features of the LiquoGuard®7 are impaired. In this case there may, for example, be a temporary pressure difference. This is indicated by an alarm message from LiquoGuard®7 and control of the peristaltic pump is interrupted. For assistance with alarm messages see *chapter 7*.




Portable RF communication devices (radio devices) (including their accessories such as antenna cables and external antennas) should not be used closer than 30 cm (or 12 inches) from the parts and cables of the LiquoGuard®7 indicated by the manufacturer. Non-observance may result in a reduction of the device's performance.



Operation of the LiquoGuard®7 with additional accessories such as transducers or cables, which are not defined for the intended use with the device, may result in increased electromagnetic emissions, reduced immunity to interference or faulty operation.

The requirements for use in aviation, transportation and military fields have not been taken into account as they have not been tested.

Appendix

Immunity tests/standard	IEC 60601 testing level	Level of conformity	Electromagnetic environment / Guidelines
Conducted HF disturbances in accordance with IEC 61000-4-6	<p>3 V<sub>eff</sub> 150 kHz to 30 MHz</p> <p>6 V<sub>eff</sub> in ISM and amateur radio frequency bands between 150 kHz and 80 MHz</p>	<p>3 V<sub>eff</sub></p> <p>6 V<sub>eff</sub></p>	<p>Portable and mobile radio transmitting devices, including the cables, should be used in proximity of the LiquoGuard®7 within the recommended safety distance calculated according to the applicable transmission frequency equation.</p> <p>Recommended safety distances:</p> <p><math>d = 1,2\sqrt{P}</math> for 80 MHz to 800 MHz</p> <p><math>d = 2,3\sqrt{P}</math> for 800 MHz to 2.5 GHz</p> <p>with P as nominal transmitter power in Watt (W) according to transmitter manufacturer stipulations and d as recommended safety distance in meters (m).</p>
Conducted HF disturbances in accordance with IEC 61000-4-3	<p>3 V/m 80 MHz to 2.7 GHz</p> <p><b>Table 9 of IEC 60601-1-2 Ed. 4</b></p>	<p>3 V/m 80 MHz to 2.7 GHz</p> <p><b>Table 9 of IEC 60601-1-2 4</b></p>	<p>According to an on-site examination<sup>a)</sup>, the field intensity of stationary radio transmitters ought to be lower than the compliance level<sup>b)</sup>.</p> <p>Disturbances may occur in the environment of devices carrying the following symbol.</p> 
<p>Notes:</p> <p>NOTE 1: The higher frequency range applies to 80 MHz and 800 MHz.</p> <p>NOTE 2: These guidelines may not be applicable to all cases. The diffusion of nominal electromagnetic factors is influenced by absorption and reflection of buildings, objects and people.</p>			
<p><sup>a)</sup> The field strength of stationary emitters, such as base stations for mobile phones and mobile terrestrial radio systems, amateur radio stations, AM and FM radio and television emitters, cannot be theoretically accurately predicted. To determine the electromagnetic environment in terms of the stationary emitters, a study of the site should be considered. If the measured field strength in the location in which the LiquoGuard®7 is used exceeds the applicable RF compliance level above, the LiquoGuard®7 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the LiquoGuard®7.</p> <p><sup>b)</sup> Above the frequency range of 150 kHz to 80 MHz the field strength should be lower than 3 V/m.</p>			

## 10.4 Recommended safety distances

See *chapter 10.3*.

## 10.5 Use in a CT and MRI environment

Non-clinical testing has demonstrated the LiquoGuard®7 tubing sets are MR conditional. A patient with this tubing set can be safely scanned in an MR system meeting the following conditions:

- The tubing set (cable and tube) is NOT wound on itself. It should be elongated next to the patient without touching him/her.

Winding the cable on itself may result in heating in a concentrated area and thermal damage to the tube set cable and/or the transducer housing.

Under the scanning conditions defined above, no temperature increase above 0.4°C will be detected in the LiquoGuard®7 Drainage Set even after 15 minutes of continuous scanning.

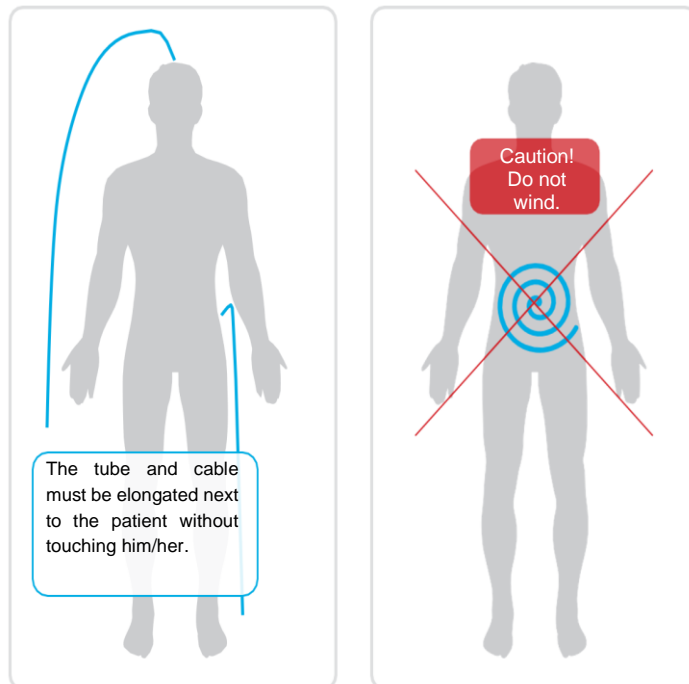


Figure 30: Positioning of the drainage set in CT and MRI environments

## Appendix

**10.5.1 Important general safety instructions:**

Some LiquoGuard®7 products may be used in an MRI environment, some not.

The LiquoGuard®7L devices (monitors) may not be used in an MRI environment. They contain ferromagnetic materials, and the device function can be disrupted by the field load. LiquoGuard®7 devices can be attracted by the magnetic field of the MRI and cause collision damage.



During the examination, place the drainage set and the bag as far away as possible from the patient on the MRI table. Do not disconnect the drainage set from the drainage catheter and make sure that the patient and the drainage set cable do not come into contact with each other during the examination.



LiquoGuard®7 tubing sets with the appropriate identification on the label of the package can be used in an MRI environment up to the maximum field strength indicated on the label of the product itself.

CSF drainage, infiltration or pressure measurements during MRI imaging are not possible.

Tubing sets may remain connected to the catheter (lumbar or ventricular) during an MRI examination. The valve between the tubing set and the catheter must be closed in order to avoid, for example, unintentional drainage.

Keeping the tubing set connected to the patient during an MRI helps to reduce the risk of infection which could be increased when the catheter or tubing lines are opened. Unnecessary disconnection or unnecessary opening of the tubing sets is to be avoided.

**Preparation before MRI imaging:**

The following safety measures must be taken by the user when using the LiquoGuard®7 tubing sets during an MRI:

Tubing sets may not be connected to the LiquoGuard®7 device (monitor) during MRI examinations.

**LiquoGuard®7 devices (monitors) must be located outside the MRI room.** They may remain switched on in order not to change settings (note the maximum allowable time that the tubing set may be separated from the device; see *page 50*), but may not be exposed at any time to the MRI's magnetic field.

Proceed as follows:

1. While in application mode, remove the tubing set sensor cable from the device.
2. Press the **Interrupt Application** button in the alarm message window. The alarm will be deactivated, and the device will be set in Pause mode.
3. Close the four-way stopcock between the tubing set and the catheter (patient protection).
4. Open the clamp and remove the tubing set.

5. Open the pump cover.
6. Remove **Adapter 1** from the pump.
7. Press the softkey **Turn Rotor** in the message window.
8. Feed the tube into the semi-circular rotor opening to **Adapter 2 input**; so that it is guided out of the rotor area.
9. Remove **Adapter 2** from the pump and close the pump cover.
10. Take the drainage bag from the bag stand but do not disconnect it from the tubing set. Do not close the 2-way stopcock between the bag and the tubing set.
11. Lay the tubing set and the drainage bag next to the patient on the MRI bed. Do not separate the tubing set from the drainage catheter.
12. Detach the pressure sensor housing from the adhesive electrode.
13. Detach the adhesive electrodes from the patient and discard them.
14. Reconnect the sensor cable of the tubing set to the LiquoGuard®7 within 8 hours (see After page 135)

### 10.5.2 Measures to avoid image artefacts in MRI

The tubing sets must not be attached with the sensor housing directly to the patient.

The tubing set and the drainage bag should not be left on or below the patient, and not lie directly next to the patient but rather should be stored as far as possible away from the patient in order to avoid artefacts in the imaging. The adhesive electrode with which the pressure sensor housing is fixed to the patient must be removed.



**Since LiquoGuard®7 devices (monitor) may not be connected to the tubing set during MRI imaging, and the tubing set attached to the patient must be closed, no intracranial pressure readings may be taken during the MRI imaging, and no drainage or infusion may take place.**

## Appendix

**10.5.3 After MRI imaging**

After MRI imaging, the patient is reconnected to the LiquoGuard®7.

To do this, proceed as follows:

1. Reconnect the sensor cable of the tubing set to the LiquoGuard®7 within 8 hours (see *Figure 16, page 42*) The unit is still in Pause mode.
2. Connect the tubing set to the pump:
  - a. Open the pump cover, use your fingers to reach into the opening of the panel and lift until the panel engages.
  - b. The LiquoGuard®7 display indicates a green message window with the softkey *Turn rotor*. Use this button to turn the pump rotor and feed the tube into the pump.
  - c. Insert **Adapter 1** into the LiquoGuard®7 **Adapter 1 input**.
  - d. Hold **Adapter 2** with one hand.
  - e. Select the softkey **Turn rotor** on the display and keep it pressed.
  - f. Feed the tube into the semi-circular opening of the rotor up to the **Adapter 2 input**.
  - g. Now insert **Adapter 2** into the **Adapter 2 input**.
3. Insert the tubing set into the clamp.
4. Attach the **drainage bag** to the holder provided on the device side (see *page 21*).
5. Clip the **pressure sensor housing** to the **adhesive electrode** and attach it to the patient (see *Pressure sensor housing – Positioning and fastening, page 45*)
6. Open the 4-way stopcock between the patient (catheter) and tubing set, but not to the atmosphere, in order to prevent infection (see *Figure 19*).
7. Check if there is air in the tubing set. If so, press the softkey **Turn rotor** and aspirate CSF until no more air can be detected between the patient and the pressure sensor housing and no more air can be detected in the pressure sensor housing.
8. Close the front cover of the pump.
9. Press the **Pause** softkey to use to start again.
10. Check the display,
  - a. whether the patient's slight head movements create print changes that are visible on the display to ensure that the pressure sensor measures CSF pressure.
  - b. whether the CSF pulsation of the patient is indicated by a pulsation of the pressure curve (often less pronounced for lumbar pressure measurement)
11. Check the device settings

Always make sure that all valves are set correctly (especially between the tubing set and drainage bag).



Always check whether the patient's movements create corresponding print changes within the pressure curve to ensure that there is a connection between the pressure sensor and CSF.

Make sure there are no air bubbles between the catheter tip and pressure sensor in the tubing set, and whether the patient's CSF pulsation can be seen on the display.

## 10.6 Accessories

### Ordering accessories:

#### Möller Medical GmbH

Wasserkuppenstraße 29-31

36043 Fulda, Germany

Tel. +49 (0) 661 / 94 19 5 – 0

Fax +49 (0) 661 / 94 19 5 – 850

E-mail: info@moeller-medical.com



Please make a note of the DEVICE ID of the LiquoGuard®7 when placing an order.

1. Tab bar **SETUP** → Softkey **MAINTENANCE**
2. Press the **LiquoGuard Information** button.

The key to enable the device functions applies only to the device indicated in the order and has a limited validity of 30 days. If the key is not imported into the device within that time, it will no longer be accepted.

Not all device options are available in all markets.

### Device options for LiquoGuard®7:

- Monitor/Nurse call  
**REF. No. 00003580**
- Documentation  
**REF. No. 00003567**
- Presettings  
**REF. No. 00003568**
- Printing  
**REF. No. 00003569**

## Appendix

- Parenchymal/Tip sensor  
**REF. No. 00003570**
- Infusion test  
**REF. No. 00003571**

**Tubing sets for LiquoGuard®7:**

- 1 x LiquoGuard®7 Drainage Set (1600 mm)  
**REF. No. 00003497**
- 1 x LiquoGuard®7 Drainage Set (2000 mm)

REF. No. CE market	MRI use	Duration of use	Shelf Life	Comment
00003501 / 1411	Yes	10 days	4 years	

REF. No. US market	MRI use	Duration of use	Shelf Life
00003501 / 2471	Yes	7 days	4 years
00003501 / 2411	Yes	10 days	4 years

- 1 x LiquoGuard®7 Infusion Test Set  
**REF. No. 00003499**

**Demonstration tubing sets for LiquoGuard®7:**

- 1 x LiquoGuard®7 Demo Drainage Set  
**REF. No. 00003553**
- 1 x LiquoGuard®7 Demo Infusion Test Set  
**REF. No. 00003554**

**Other accessories:**

- CSF Bag for the LiquoGuard® (drainage bag)  
**REF. No. 00003194**
- Safety cushion for LiquoGuard®  
**REF. No. 00002701**

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CE 0482

Order number for  
instruction manual  
REF 93006444



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