



Contents

- 1 Important**
- 2 Introduction**
- 3 Description of functions**
- 4 Disassembling and assembling**
- 5 Service procedures**
- 6 Troubleshooting**
- 7 Preventive maintenance**
- 8 Index**
- 9 Revision history**
- 10 Diagrams**

1 Important

1.1 General

The information in this Service Manual is based on the SERVO-U/SERVO-n Ventilator System of System version 2.1. Unless otherwise stated, the Service Manual is valid also for System versions below 2.1.

Maquet Critical Care AB, part of Getinge, is the legal manufacturer of the SERVO ventilator systems.

Service documentation for the SERVO-U/SERVO-n Ventilator System consists of:

- User's Manual including Cleaning and Maintenance manual. The User's Manual is an indispensable complement to the Service Manual for proper servicing.
- Service Manual
- Installation Instructions
- Spare parts information
- Documentation for optional equipment included in the system.
- Product End-of-Life - Disassembly Instructions (Disassembly and Disposal Instructions)

The SERVO-U/SERVO-n Ventilator System is referred to as 'the system' in this document.

The User's Manual for the SERVO-U/SERVO-n Ventilator System is referred to as 'the User's Manual' in this document.

Maquet Headquarter Support Center is referred to as 'MCC HSC' in this document. Note that MCC HSC is available only for the Getinge service organization. For other service organizations, for example hospital biomedical departments, technical support is provided by the local Getinge representative.

In addition to the Important information given here and in the related documents, always pay attention to applicable local and national regulations.

Responsibility for the safe functioning of the equipment reverts to the owner or user in all cases in which service or repair has been done by a non-professional or by persons who are not employed by or authorized by Getinge, and when the equipment is used for other than its intended purpose.

The system complies with standards and requirements as stated in the User's Manual.



WARNING! Do not modify this equipment without authorization of the manufacturer.

System version and System software version

The *System version* number can be found in the **SYSTEM STATUS** window on the User interface. Make sure that the version of the User's Manual corresponds to the *System version*.

The *System SW version* number can be found in the **SYSTEM STATUS** window on the User interface. For functionality enhancement, the latest released *System SW version* is always recommended.

Serial number

There are two serial number labels on the unit:

- One label is attached to the Patient unit. The serial number stated on this label is the ID number of the Patient unit. The serial number is also stored in the software memory as the 'System ID'.
- One label is attached to the rear side of the User interface. The serial number stated on this label is the ID number of the User interface.

1.2 Symbols used in this manual



WARNING! Indicates critical information about a potential serious outcome to the patient or the user.



CAUTION: Indicates instructions that must be followed in order to ensure the proper operation of the equipment.



Note: ESD sensitive components. When handling ESD-sensitive devices, established procedures must be observed to prevent damage.



Note: Special waste. This product contains electronic and electrical components. Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.



Note: Recyclable material. Recycling must be performed in accordance with appropriate industrial and environmental standards.



Note: Trained and authorized personnel. Only personnel trained and authorized by Getinge shall be permitted to perform installation, service or maintenance of the system.

Note: Text inside a box is used to highlight important information.

1.3 Hazard notices

Before disassembling or assembling the system, make sure that:

- The On/Off switch is set to Off.
- Mains power cable is disconnected.
- External +12 V DC supply is disconnected.
- Backup battery modules are disconnected. Note that the backup battery modules supply power to parts of the system also when the system is switched Off.
- Gas supply is disconnected, central gas supply and backup gas supply.
- The system, including all gas conveying parts, is cleaned. Refer to instructions in the User's Manual.



WARNING! With gas supply connected to the system, there are pressurized components inside the unit. All personnel must exercise extreme caution if fault tracing or adjustments are performed with gas supply connected and with covers removed.



WARNING! With power supply connected to the system, there are energized electrical components inside the unit. All personnel must exercise extreme caution if fault tracing or adjustments are performed with power supply connected and with covers removed.



CAUTION: Do not expose the batteries to water, fire or excessive heat. Do not crush, disassemble, puncture or short circuit the connector terminals.

1.4 Installation



Note: Trained and authorized personnel. Only personnel trained and authorized by Getinge shall be permitted to install the system. The installation and handing-over procedures are described in the Installation instructions.



Note: Recyclable material. Recycling must be performed in accordance with appropriate industrial and environmental standards.

1.5 Functional check

After any installation, maintenance or service intervention in the system, perform a Pre-use check according to instructions in the User's Manual.

1.6 Service



WARNING! The system must not be serviced or maintained while in use with a patient.



Note: ESD sensitive components.

When working with ESD sensitive components, always use a grounded wrist band and a grounded work surface. Adequate service tools must always be used.



Note: ESD sensitive components.

PC boards (spare parts) must always be kept in a package for sensitive electronic devices. Maquet will not otherwise assume responsibility for the materials used, the work performed or any possible consequences of same.



Note: Special waste. This system contains electronic and electrical components. Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.



Note: Trained and authorized personnel. The system must be serviced at regular intervals by personnel trained and authorized by Getinge. It is recommended that service and maintenance is done as a part of a service contract. Any maintenance or service must be noted in a log book.

Maintenance of the system must be performed by Getinge authorized personnel with the following intervals:

- Preventive maintenance at least once a year, or every 5000 hours of operation, whichever comes first.
- The Battery modules shall be replaced after two and a half years from their manufacturing date.
- The Memory backup batteries shall be replaced every five years.

Only original spare parts from Maquet must be used in the system.

1.7 To the responsible service personnel



Note: Trained and authorized personnel. Only personnel trained and authorized by Getinge shall be permitted to perform installation, service or maintenance of the system.

The contents of this document are not binding. If any significant difference is found between the system and this document, please contact Getinge for further information.

We reserve the right to modify the system without amending this document or advising the user.

1.8 Environmental declaration

1.8.1 Purpose

This environmental declaration is for a SERVO-U/SERVO-n basic system including the Mobile cart and two batteries.

1.8.2 Components with special environmental concern

Components listed below shall be disposed of in accordance with appropriate industrial and environmental standards.

Printed circuit boards

- PC 1781 Pressure transducer, 2 pcs
- PC 1785 Expiratory channel connector
- PC 1990 Main back-plane
- PC 1991 Control, including battery
- PC 1992 Monitoring, including battery
- PC 1993 Ethernet switch
- PC 1994 Nebulizer
- PC 1995 Plug & Play back-plane
- PC 1998 DC/DC & Standard connectors
- PC 1999 LED board
- PC 2000 Pneumatic back-plane
- PC 2004/PC 2024 Expiratory channel
- B732 I/O (User interface)
- B733 Touch button (User interface)
- B734 Light bar (User interface)
- B735 Touch controller (User interface)
- B739 Ambient light sensor (User interface)
- B740 CPU (User interface)

Other electronics

- LCD display
- Touch screen (glass)
- O₂ cell, containing caustic lime and lead (Pb)
- O₂ sensor, containing PC boards

- Gas module Air, containing multiple PC boards
- Gas module O₂, containing multiple PC boards
- Expiratory cassette, containing PC board and other electronics.
- Expiratory valve coil
- Safety valve pull magnet
- AC/DC converter, containing PC boards
- Battery modules Nickel-Metal Hydride
- CO₂ analyzer module, containing PC boards
- Edi module, containing PC boards
- Y sensor module, containing PC boards
- Mains power supply connector
- Fans, 2 pcs
- Loudspeaker, 2 pcs
- Cable harness (handle as electronic waste).

1.8.3 Construction materials

The construction materials used in the system, in % of the total weight.

Metal – total 76%

- Aluminium 68%
- Steel, zink, brass 8%

Polymeric material – total 10%

- PA (Polyamide)
- POM (Polyoxymethylene)
- SI (Silicone)
- TPE (Thermoplastic elastomer)
- PUR (Polyurethane)
- ABS (Acrylonitrilebutadienstyrene)
- EPDM (Ethylenepropylenedienemonomer)
- PTFE (Polytetrafluoroethylene)
- FPM (Fluororubber)
- NBR (Nitrilerubber)
- PP (Polypropylene)
- PVC (Polyvinyl chloride)

- PS (Polystyrene)

Electronics – total 14%

- Battery modules Nickel-Metal Hydride
- Printed circuit boards, cables etc.

Others – very small amounts

- Filter paper of fiberglass

1.8.4 Articles of consumption

1. Bacteria filter
2. Filters for the gas modules
3. Filter for the inspiration pressure transducer
4. Nozzle units for the gas modules
5. Battery modules
6. Memory backup batteries
7. Expiratory cassette
8. Expiratory cassette membrane
9. O₂ cell (if applicable)

Item 1: Consumption approximately 250 pcs/year.

Items 2 – 4: Replaced once a year or every 5000 hours of operation, whichever comes first.

Item 5: Replaced two and a half years from manufacturing date.

Item 6: Replaced every five years.

Items 7 – 9: Replaced when needed.

Articles related to clinical applications, for example patient tubing, Y Sensors, nebulizer medication cups and NAVA catheters, not included in the list above.

1.8.5 Power consumption

The power consumption depends on the operating mode and whether the internal batteries are being fast or trickle charged.

- Typical minimum power consumption (no optional modules, no ongoing battery charging, normal panel backlight): 100 VA, 40 W at 230 V or 75 VA, 40 W at 110 V.
- Typical maximum power consumption (with CO₂, Edi and Y sensor modules, ongoing battery charging, maximum panel backlight): 200 VA, 80 W at 230 V or 170 VA, 80 W at 110 V.

1.8.6 Noise level

A-weighted sound pressure level (L_{pA}): <40 dB, measured at a distance of 1 m.

A-weighted sound power level (L_{WA}): <51 dB.

1.8.7 Packaging material

Materials for packing:

- Loading pallet.
- Corrugated cardboard.
- Shock-absorbing material of expanded polypropylene, EPP.

Materials added when packing for tropical climatic conditions:

- Plywood container with metal reinforcements.
- Plastic wrapping.
- Desiccant (humidity absorber).

The packaging material complies with the demands stated by the International Plant Protection Convention (IPPC).

1.8.8 Product End-of-Life

For disassembly and disposal (scrapping) information, refer to the document SERVO-U/SERVO-n Product End-of-Life Disassembly Instructions.

| 1 | *Important* |

2 Introduction

Table of Contents

2.1	Main units	2 - 2
2.2	Patient unit	2 - 4
2.3	User interface	2 - 8
2.4	Software structure	2 -10
2.5	Internal communication	2 -12

2.1 Main units

The system is configured for different patient categories:

- Neonatal
- Pediatric
- Adult (SERVO-U only).

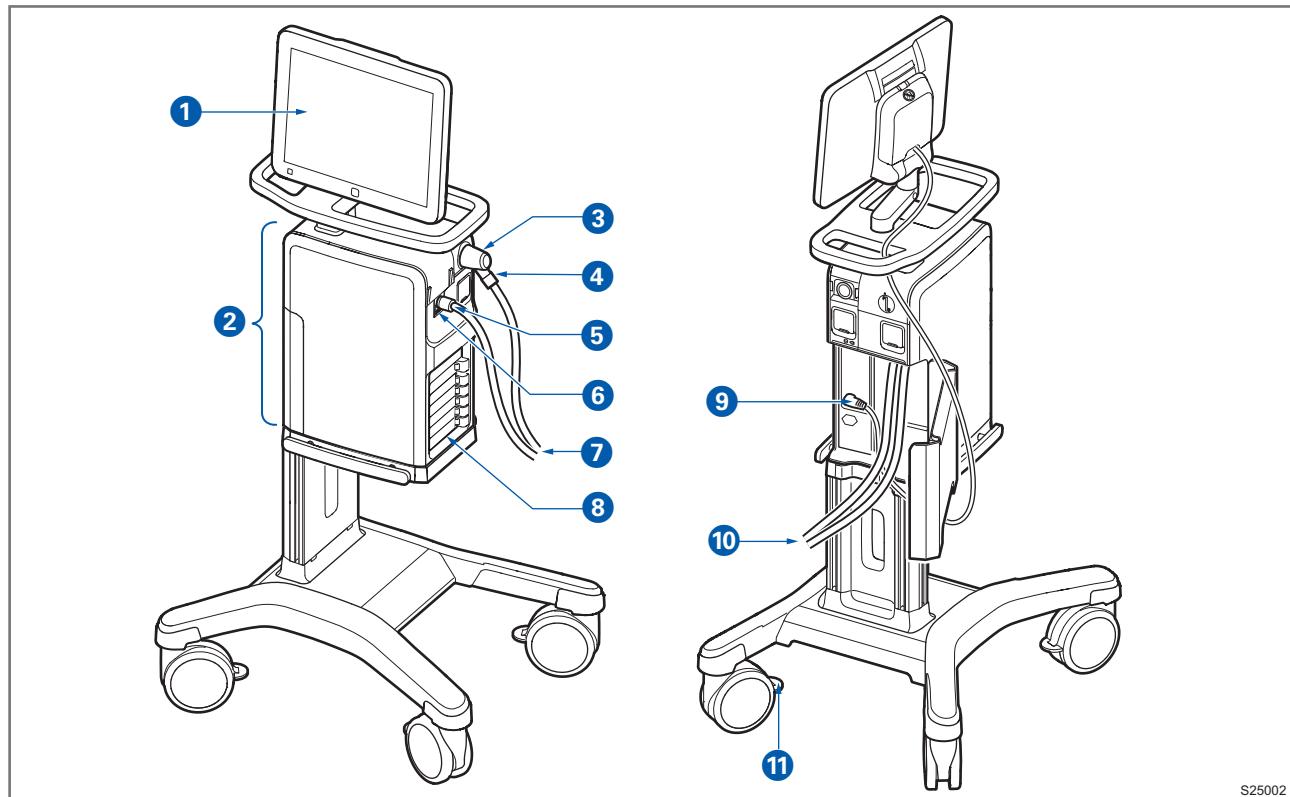
These patient categories are as standard equipped with a number of ventilation modes suitable for each category. Additional ventilation modes can be installed via a Software option installation.

The system consists of the following main units:

- **Patient unit.** The Patient unit contains pneumatics and electronics for gas supply to the patient. Power supply and battery backup is also contained in the Patient unit.
- **User interface.** The User interface contains all controls used to set the ventilation and monitoring parameters. Ventilation parameters as well as other important information are shown on the User interface display.

The Control cable connects the User interface and the Patient unit.

2.1.1 System mounted on optional Mobile cart



S25002

- | | |
|-------------------------|-----------------------------------|
| 1. User interface | 7. Patient circuit |
| 2. Patient unit | 8. Module compartment |
| 3. Moisture trap | 9. User interface control cable |
| 4. Expiratory inlet | 10. Air and O ₂ supply |
| 5. Inspiratory outlet | 11. Wheel lock |
| 6. Emergency air intake | |

2.1.2 Optional modules and accessories

A number of optional modules can be added to the system:

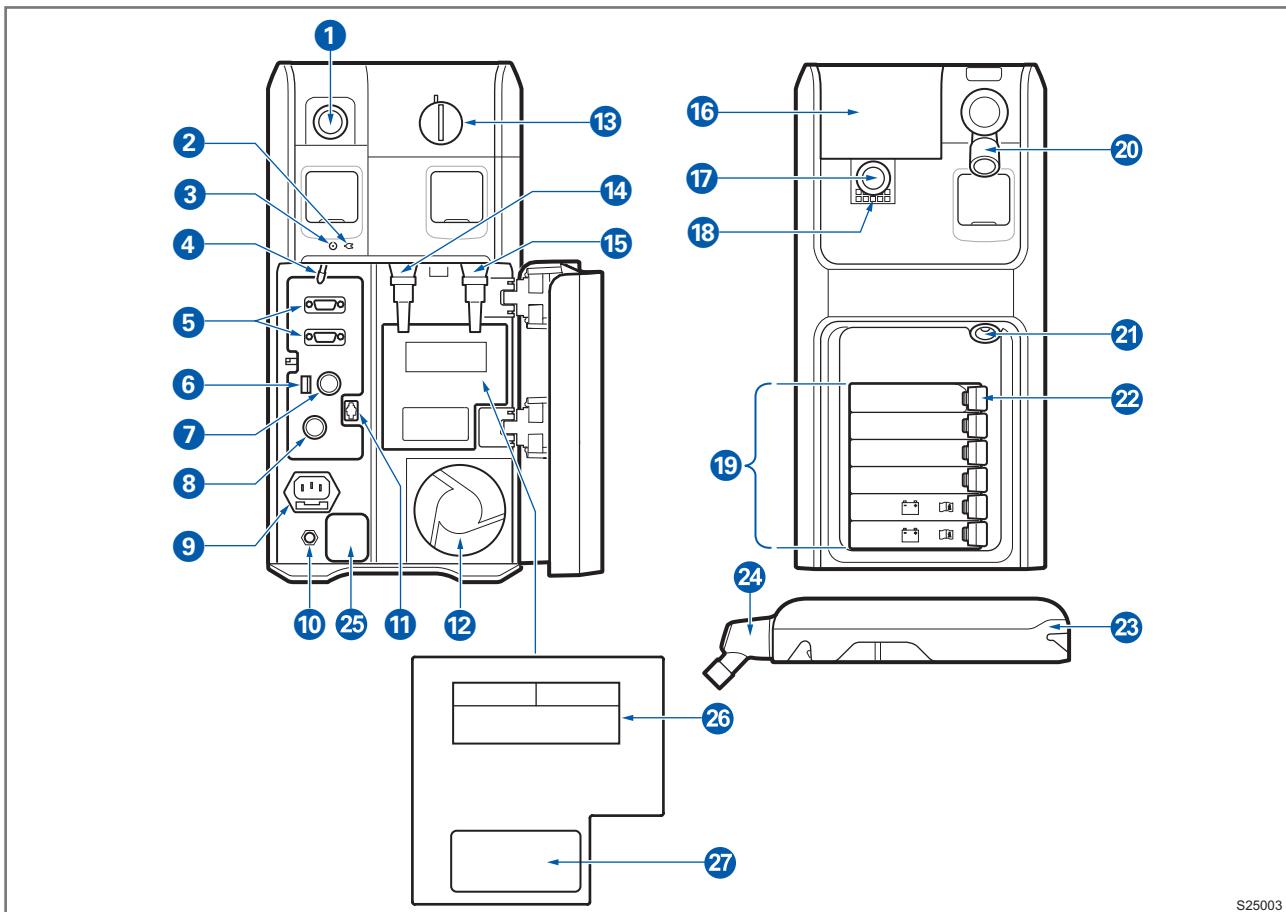
- Edi module (NAVA)
- Y sensor module
- CO₂ analyzer module
- Battery module (extra)

There are also several accessories to be used with the system, for example:

- Alarm output
- Compressor Mini
- Mounting kit for Compressor Mini on Mobile cart
- Mobile cart
- Drawer for Mobile cart
- Pendant/bed holder
- Shelf base
- Handle
- User interface holder
- Gas cylinder restrainer kit
- Support Arm 178
- Y piece holder and hook
- Cable holder
- Aerogen Pro/Aerogen Solo nebulizers
- Humidifier and Humidifier holder
- Waterbag/IV pole
- Expiratory heater, Servo DuoGuard
- MSync (adapter for HL7 communication)

For further information regarding accessories, contact your Getinge representative.

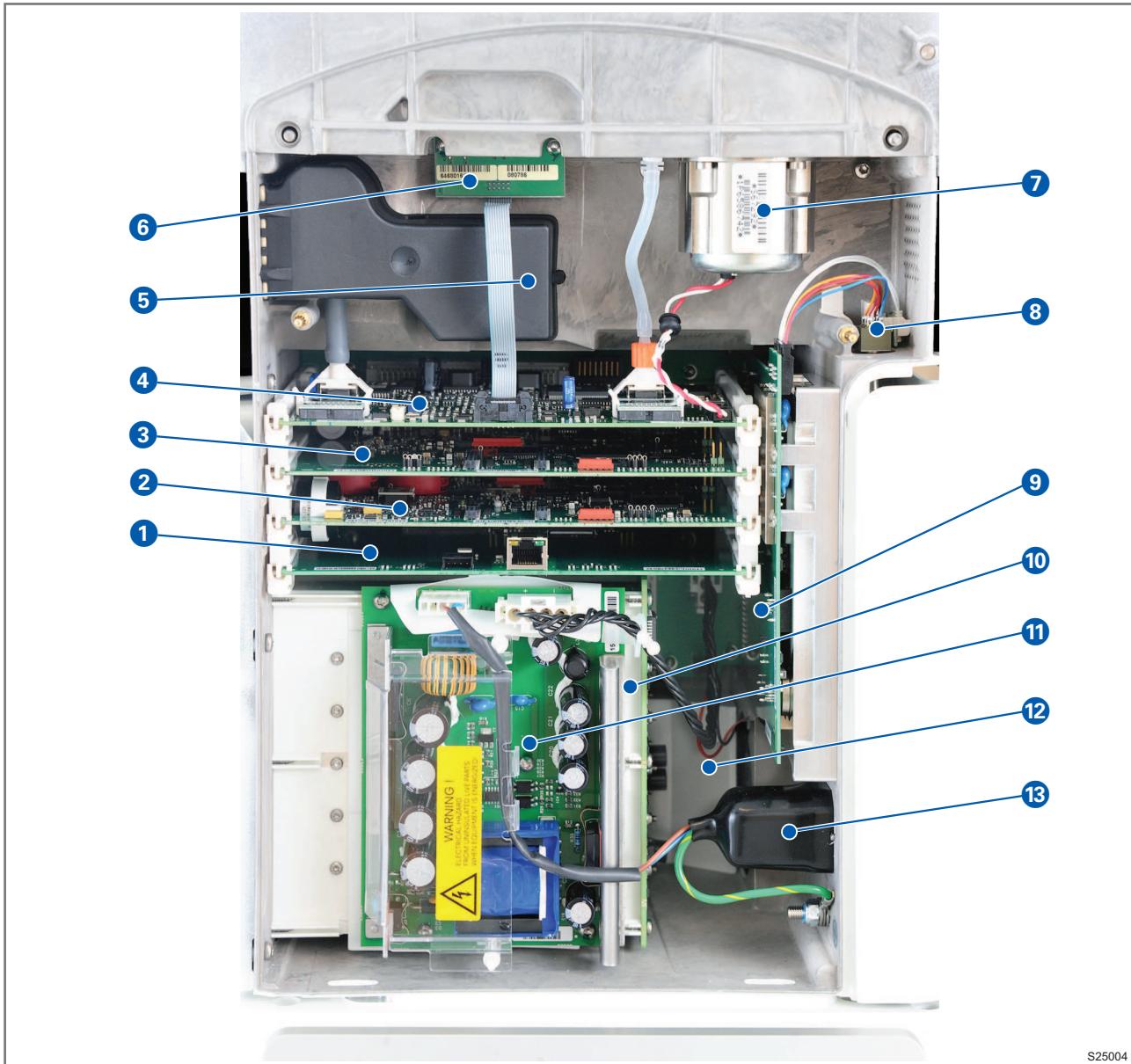
2.2 Patient unit



S25003

- 1. Expiratory outlet
- 2. AC mains power LED, blue
- 3. Power On LED, green
- 4. On/Off switch
- 5. RS-232 connectors (#1 upper and #2 lower)
- 6. Fuse for external DC power
- 7. External +12V DC inlet
- 8. User interface control cable connector
- 9. AC mains power supply connector with fuse
- 10. Potential equalization terminal
- 11. Alarm output connector
- 12. Fan 1 Patient unit, with filter
- 13. Lock for inspiratory channel cover
- 14. Gas inlet for air
- 15. Gas inlet for O₂
- 16. Inspiratory channel cover
- 17. Inspiratory outlet
- 18. Emergency air intake
- 19. Module compartment
- 20. Expiratory inlet
- 21. Nebulizer connector
- 22. Module release levers
- 23. Expiratory cassette
- 24. Expiratory inlet with moisture trap
- 25. Fuse, power label:
 - Fuse label
 - AC mains power voltage
 - Potential equalization terminal information
- 26. Gases and gas inlet pressure label:
 - Air
 - O₂
 - Allowed gas inlet pressures
- 27. Serial number label

2.2.1 Patient unit - front cover removed



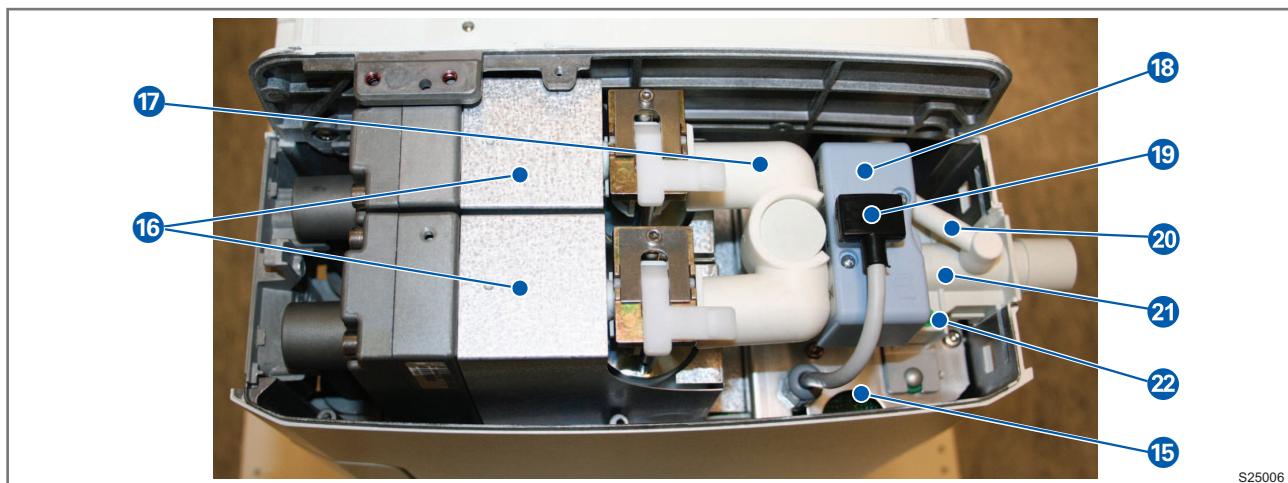
1. PC 1993 Ethernet switch
2. PC 1992 Monitoring
3. PC 1991 Control
4. PC 2004/PC 2024 Expiratory channel with the two connected PC 1781 Inspiratory and Expiratory Pressure Transducers. PC 2024 replaces PC 2004. Introduced in production Q3 2016.
5. Fan 2 Inspiratory section (behind funnel)
6. PC 1785 Expiratory channel connector
7. Expiratory valve coil
8. PC 1999 LED board and Power On/Off switch
9. PC 1998 DC/DC & Standard connectors
10. Module compartment including PC 1995 Plug & Play back-plane
11. AC/DC converter
12. Fan 1 Patient unit
13. Mains power supply inlet

14. PC 1990 Main back-plane. The PC boards, as listed above are directly or indirectly connected to the PC 1990 Main back-plane.



S25005

2.2.2 Inspiratory and Expiratory section



S25006

The upper part of the Patient unit contains the Inspiratory and the Expiratory section. The main parts in the Inspiratory section are the:

- 15. PC 2000 Pneumatic back-plane (behind metal plate). The gas modules, the O₂ sensor/cell and the safety valve pull magnet are connected to the PC 2000 Pneumatic back-plane.
- 16. Two gas modules, Air and O₂, for regulation of the inspiratory gas.
- 17. Connector muff.
- 18. O₂ sensor. The O₂ cell (incl. bacteria filter) is an alternative to the O₂ sensor for oxygen concentration measurement. The O₂ cell is not shown in the image.
- 19. Temperature sensor (inside the connector).
- 20. Inspiratory pressure transducer tube including bacteria filter, to connect the inspiratory pressure transducer.
- 21. Inspiratory pipe with housings for the O₂ sensor/cell and for the Safety valve.
- 22. Safety valve.

The Expiratory cassette (23) is a complete unit containing the following parts:

- Expiratory inlet with Moisture trap
- PC 1786 Expiratory channel cassette
- Ultrasonic flowmeter
- Heating foil to avoid condensation in the Ultrasonic flowmeter
- Pressure transducer connection, including bacteria filter, to connect the Expiratory pressure transducer
- Expiratory valve including Valve membrane.

The Expiratory valve coil, mounted under the Expiratory cassette compartment, controls the Valve membrane in the cassette.

PC 1786 Expiratory channel cassette inside the Expiratory cassette is electrically connected to PC 2004/PC 2024 Expiratory channel via PC 1785 Expiratory channel connector (6).



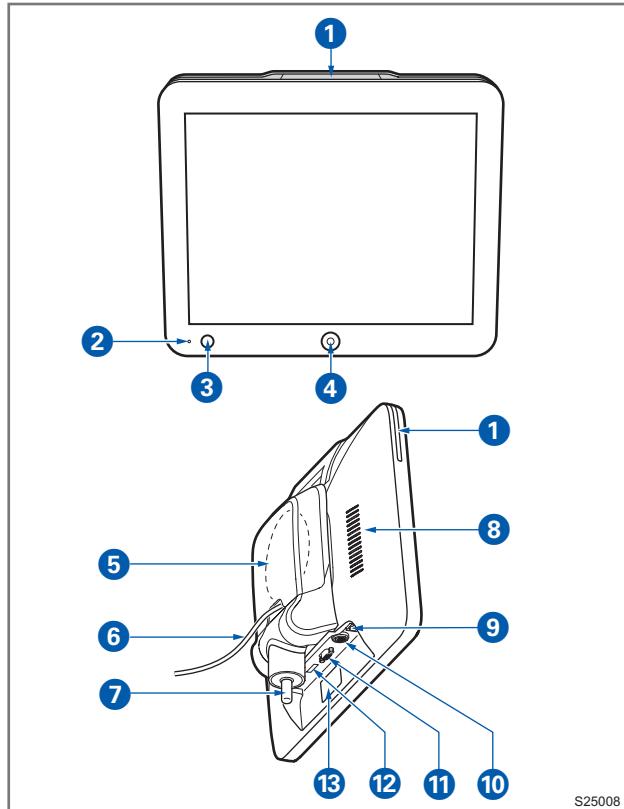
S25007

2.3 User interface

The User interface can be mounted onto the Patient unit but can also easily be mounted on a rail, table or shelf. The User interface can be rotated and tilted into a suitable position.

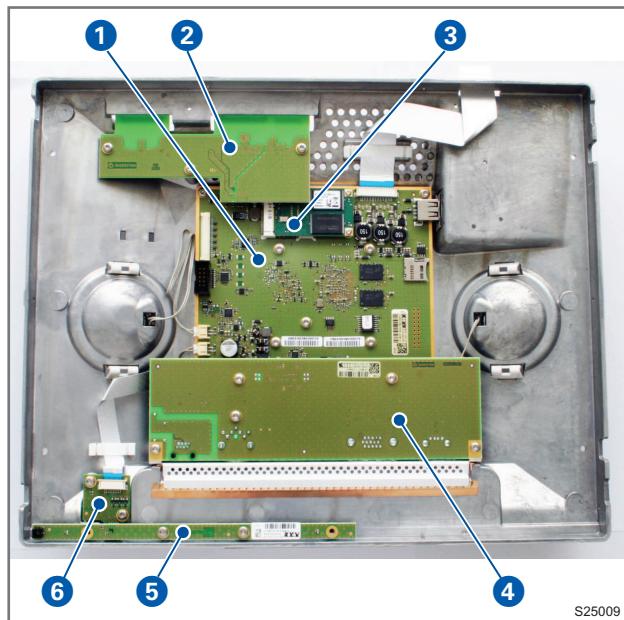
1. Alarm indicator, light bar
2. Luminescence detector for automatic adjustment of screen brightness
3. User interface lock to prevent accidental changes during cleaning or transport
4. Extended menu/quick menu toggle
5. Cable reel for the control cable
6. Control cable (2.9 m)
7. User interface stand
8. Loudspeaker
9. Network cable port (Ethernet)
10. Control cable port
11. VGA port
12. USB port
13. Serial number label

For information regarding operation of the User interface, refer to the User's Manual.

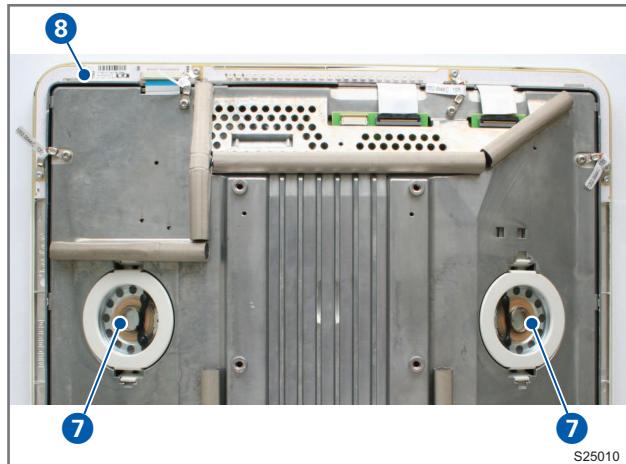


The User interface main parts are:

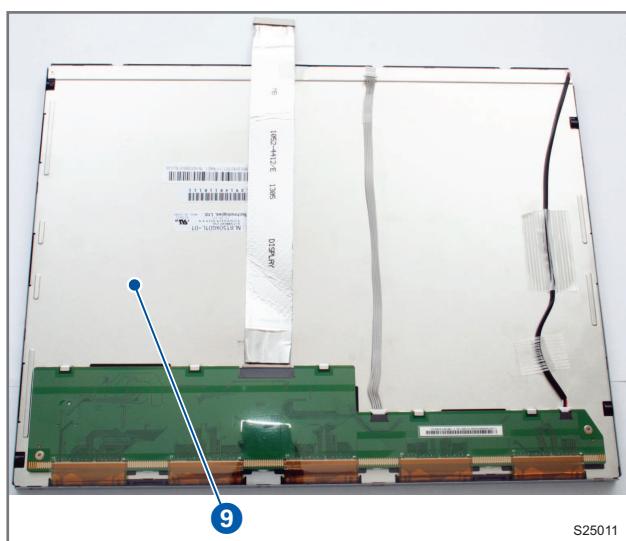
1. B740 CPU board
2. B735 Touch controller board
3. Memory card
4. B732 I/O board
5. B739 Ambient light sensor board
6. B733 Touch button board



7. Loudspeakers
8. B734 Light bar



9. LCD Display including the LED backlight board
10. Touch screen with frame (not shown in the image).
This is a complete unit with front glass and touch foil mounted into the metal frame.



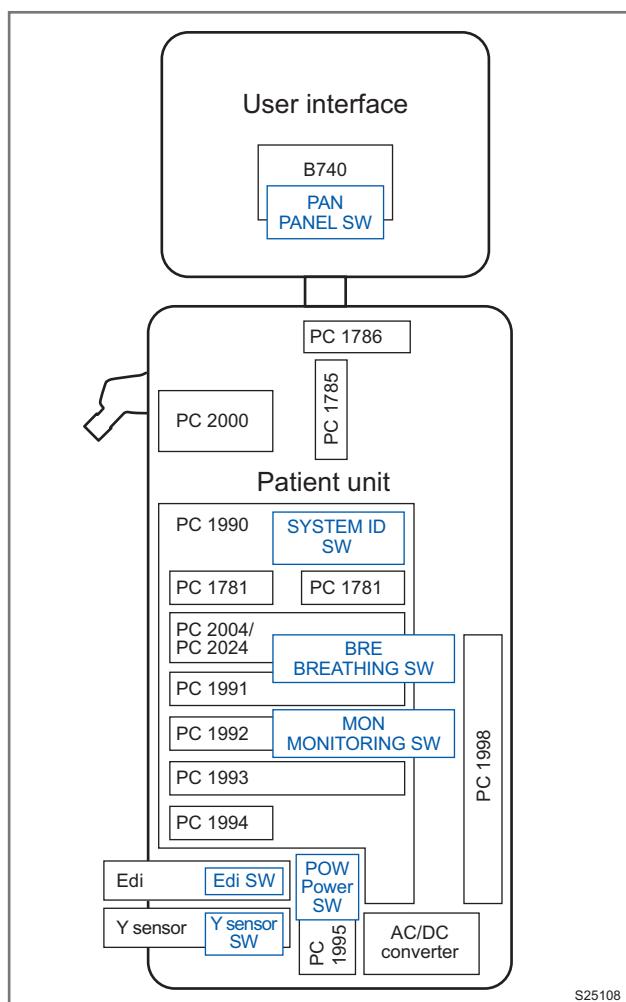
2.4 Software structure

2.4.1 General

The System software contains all available system functionality. The software is distributed across the subsystems. The installation procedure ensures that all subsystems are properly updated.

The System software contains the following main subsystems:

- Breathing BRE
- Monitoring MON
- Panel PAN
- Power POW
- System ID
- Edi
- Y sensor



2.4.2 Breathing BRE

The main function of the Breathing subsystem is the patient treatment, that is, how to regulate and measure the inspiratory and expiratory gas flow:

- Controls all ventilation modes, ventilator settings and delivery of gas mixtures.
- Controls the expiratory cassette handling including flow measurement performed by the flowmeter in the cassette.
- Nebulizer control. Controls the Nebulizer function.
- Controls Pre-use check operations on the Breathing subsystem
- Maintain a persistent data storage area used to save parameter settings.
- Controls some of the system settings, such as, storing default patient category and mode of ventilation. The system settings are stored in persistent memory.

The Breathing software is stored on PC 1991 Control and PC 2004/PC 2024 Expiratory Channel. The System software must be re-installed if PC 1991 or PC 2004/PC 2024 is replaced.

The Breathing software is executed by the microprocessors on PC 1991 and PC 2004/PC 2024.

2.4.3 Monitoring MON

The main functions of the Monitoring subsystem are alarm and monitoring, including trends of measured values:

- Detects and handles alarms. Contains a backup sound buzzer.
- Monitors the system behavior.
- Maintains a persistent data storage area to save Alarm settings.
- Monitors some of the system settings, for example default alarm limits.
- CAN communication with Expiratory channel.
- Battery module and power source supervision.
- Controls Pre-use check operations on the Monitoring subsystem.

- External communication protocol SCI (SERVO Communication Interface).
- Optional functionality such as ventilation mode and other features. All options are stored in the persistent memory.

The Monitoring software is stored on PC 1992 Monitoring. The System software must be re-installed if PC 1992 is replaced. Software related to Monitoring is also stored in the O₂ sensor.

The Monitoring software is executed by the microprocessor on PC 1992.

2.4.4 Panel PAN

The Panel subsystem controls all user interaction, for example:

- Presentation and changes of ventilator settings.
- Presentation of metrics, for example real-time values from the Monitoring subsystem.
- Presentation of alarms and their corresponding alarm sounds from all subsystem.

The Panel software is stored on B740 CPU board. The System software must be re-installed if B740 is replaced.

The Panel software is executed by the microprocessor on B740.

2.4.5 Power POW

The Power subsystem has the following main responsibilities:

- Communication with plug-in battery modules to determine battery status.
- Controlling charging/discharging of plug-in battery modules.
- Selection of power source to be used for the system.
- Control of Fan 1 Patient unit.

The Power software is stored on PC 1995 Plug & Play back-plane. The System software must be re-installed if PC 1995 is replaced.

The Power software is executed by the microprocessor on PC 1995.

2.4.6 System ID

The System ID is stored on PC 1990 Main back-plane and is unique for each system.

When installing software options, the System ID is used to verify that the option is valid for that system.

When replacing PC 1990 Main back-plane, the replacement (spare part) must be factory programmed with the correct System ID to ensure proper ventilation performance, compatibility with future updates and correct options configuration.

2.4.7 Edi

The Edi software processes and filters the signals from the Edi catheter, and transmits Edi and leads data to the system.

The Edi software is stored in the Edi module. New software can be installed via a System software installation. If an Edi module is part of the system, make sure that this module is connected during System software installation.

The Edi software is executed by the microprocessor in the Edi module.

2.4.8 Y sensor

The Y sensor software processes and filters the signals from the Y sensor (electrical signals) and the Y-piece (pressure).

The Y sensor software is stored in the Y sensor module. New software can be installed via a System software installation. If a Y sensor module is part of the system, make sure that this module is connected during System software installation.

The Y sensor software is executed by the microprocessor in the Y sensor module.

2.5 Internal communication

The internal communication is separated into different communication protocols:

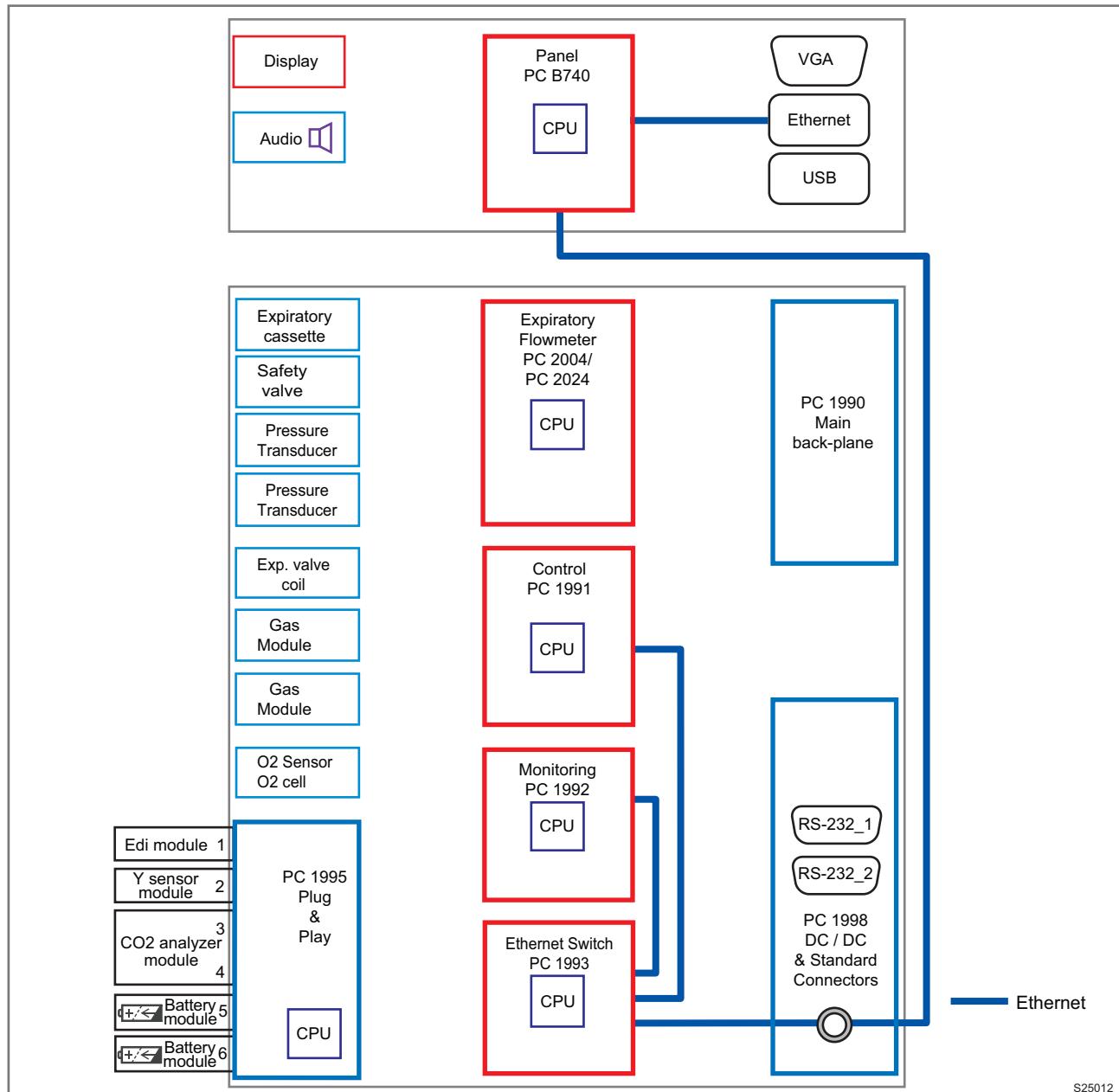
- ETHERNET bus
- CAN bus
- I²C bus
- Digital and analogue point-to-point signals.

The internal communication is described in the diagrams below.

2.5.1 ETHERNET bus

ETHERNET bus using TCP/IP running at 100 Mbit/s.

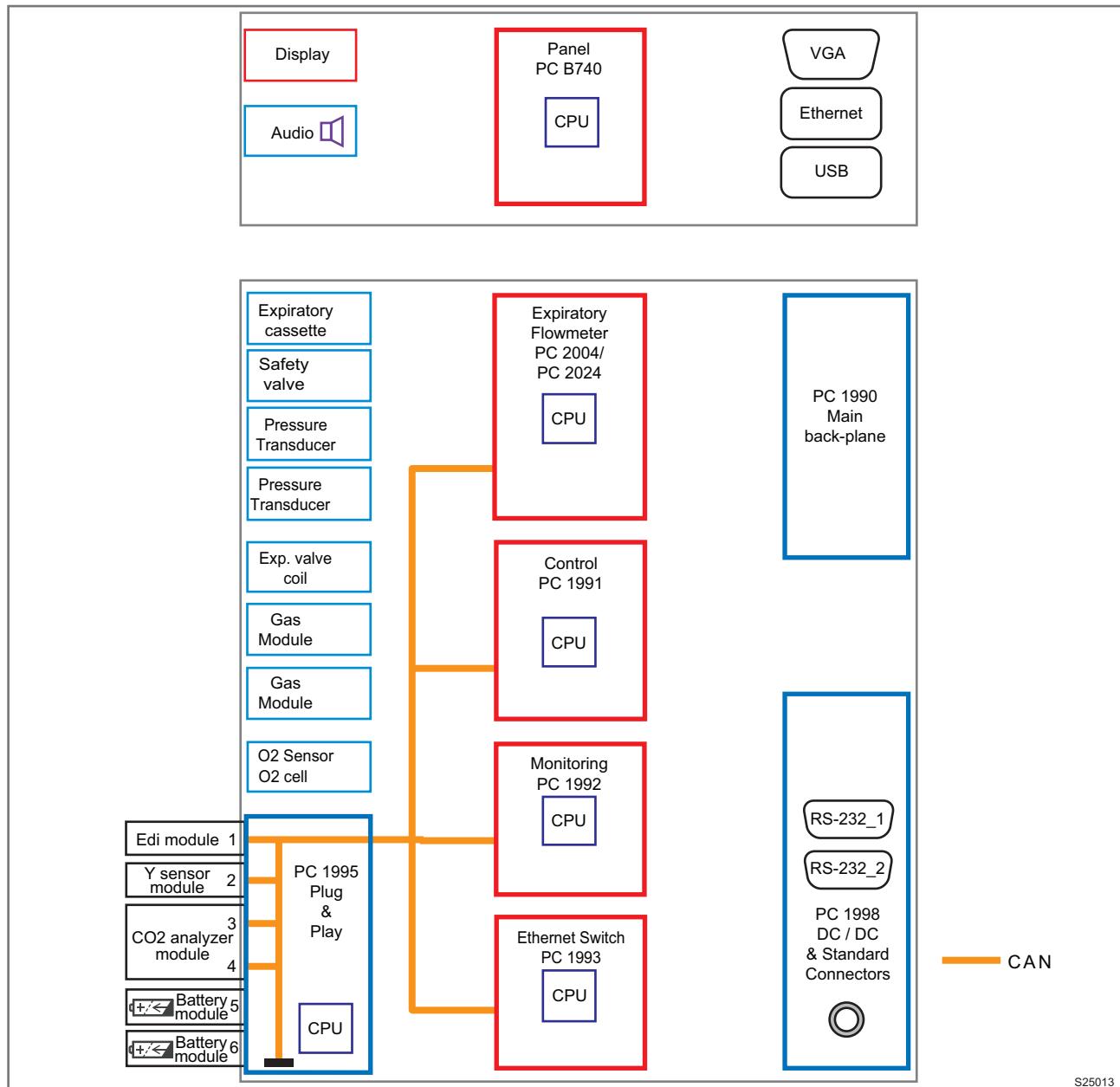
ETHERNET connects the main subsystems BRE, MON and PAN using the Ethernet switch.



2.5.2 CAN bus

CAN bus (Controller Area Network) running at 500 kbit/s. The CAN is primarily used for:

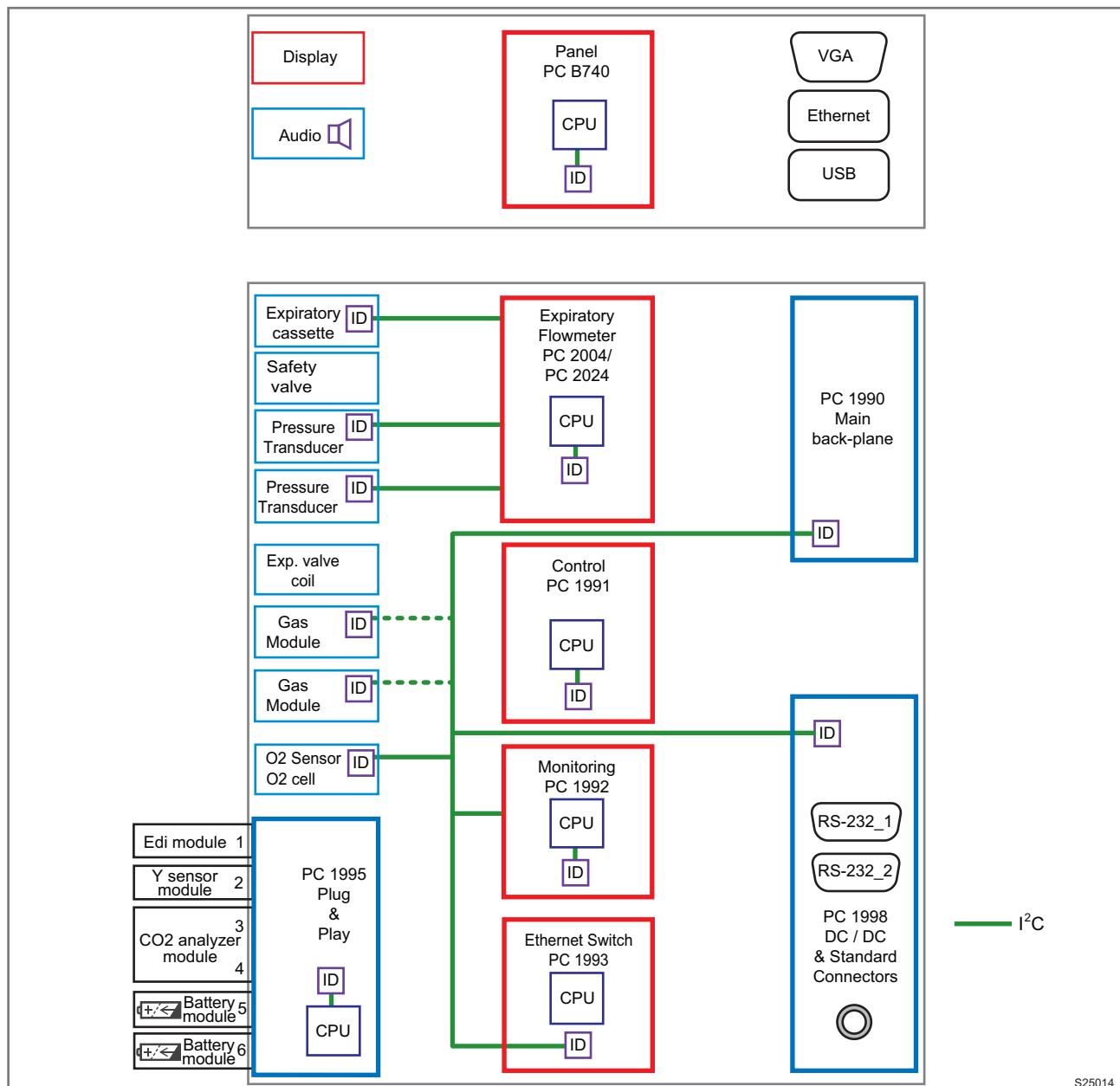
- Expiratory flowmeter
- Edi module, Y sensor module and CO₂ analyzer module.



S25013

2.5.3 I²C bus

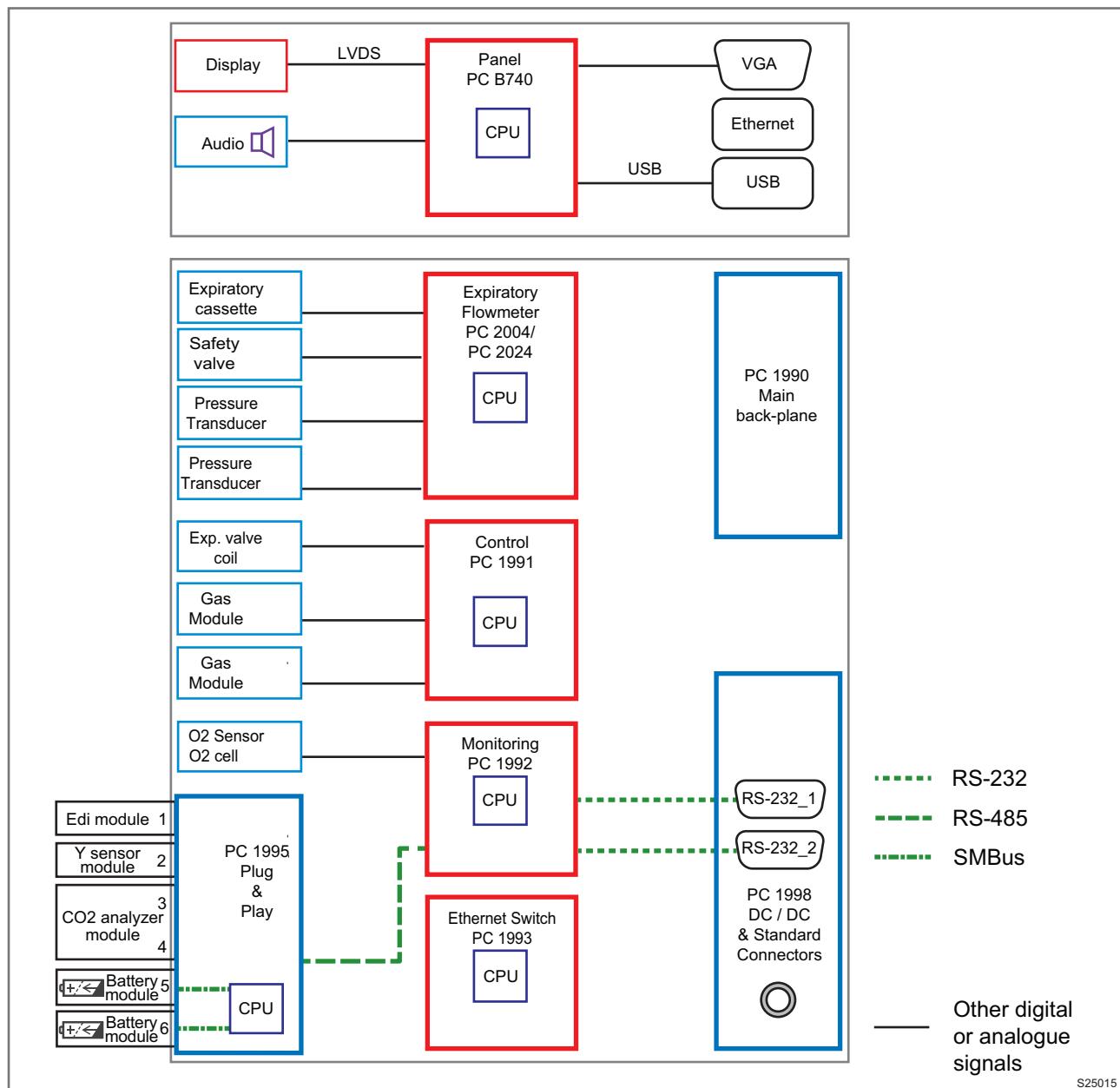
The I²C bus (Inter-Integrated Circuit) is primarily used for communication with local EEPROMS, the O₂ sensor/O₂ cell and the Expiratory cassette.



2.5.4 Other digital and analogue signals

There are several digital and analogue point-to-point signals connecting the subsystems and components, for example:

- The RS-232 is used for the SERVO Communication Interface SCI.
- The RS-485 is used for communication between the power and the monitoring subsystems.
- The SMBus (System Management Bus) is used for communication with the power subsystem and the battery modules.



3 Description of functions

Table of Contents

3.1	Gas modules - Air and O ₂ (1)	3 - 4
3.2	Connector muff (2)	3 - 5
3.3	Inspiratory pipe (3)	3 - 6
3.4	O ₂ sensor (4)	3 - 6
3.5	O ₂ cell (5)	3 - 6
3.6	Temperature sensor (6)	3 - 7
3.7	Inspiratory pressure tube (7)	3 - 7
3.8	Safety valve including pull magnet (8)	3 - 7
3.9	Inspiratory outlet (9)	3 - 8
3.10	Fan 2 Inspiratory section (10)	3 - 8
3.11	PC 2000 Pneumatic back-plane (11)	3 - 8
3.12	Expiratory cassette (12)	3 - 8
3.13	Expiratory valve (13)	3 - 9
3.14	Expiratory valve coil (14)	3 - 10
3.15	Expiratory outlet (15)	3 - 10
3.16	PC 1786 Expiratory channel cassette (16)	3 - 10
3.17	PC 1785 Expiratory channel connector (17)	3 - 10
3.18	PC 1990 Main back-plane (18)	3 - 10
3.19	PC 1781 Inspiratory pressure transducer (19)	3 - 10
3.20	PC 1781 Expiratory pressure transducer (20)	3 - 10
3.21	PC 2004/PC 2024 Expiratory channel (21)	3 - 11
3.22	PC 1991 Control (22)	3 - 11
3.23	PC 1992 Monitoring (23)	3 - 12
3.24	PC 1993 Ethernet switch (24)	3 - 13
3.25	PC 1994 Nebulizer (25)	3 - 13
3.26	Mains inlet (26)	3 - 13
3.27	AC/DC converter (27)	3 - 13
3.28	PC 1998 DC/DC & Standard connectors (28)	3 - 14
3.29	On/Off switch (29)	3 - 15
3.30	PC 1999 LED board (30)	3 - 15
3.31	PC 1995 Plug & play back-plane (31)	3 - 16
3.32	Module compartment (32)	3 - 17
3.33	Fan 1 Patient unit (33)	3 - 17
3.34	Battery module (34)	3 - 18
3.35	Control cable (35)	3 - 18
3.36	Touch screen (36)	3 - 18

3.37	LCD Display (37)	3 -19
3.38	B735 Touch controller board (38)	3 -19
3.39	B732 I/O board (39)	3 -19
3.40	B740 CPU board (40)	3 -19
3.41	B733 Touch button board (41)	3 -19
3.42	B739 Ambient light sensor board (42)	3 -19
3.43	B734 Light bar board (43)	3 -20
3.44	Loudspeakers (44)	3 -20
3.45	Optional equipment	3 -20

About this chapter

The information in this chapter refers to the System overview in chapter Diagrams. Note that the number in each heading (in brackets) represents the position number in the System overview.

Main blocks

The information in this chapter is divided into main blocks:

The **Inspiratory section** conveys the breathing gas from the gas inlets to the patient breathing system. The Inspiratory section contains the following main components:

1. Gas modules – Air and O₂
2. Connector muff
3. Inspiratory pipe
4. O₂ sensor
5. O₂ cell (alternative to O₂ sensor)
6. Temperature sensor
7. Inspiratory pressure tube
8. Safety valve including pull magnet
9. Inspiratory outlet
10. Fan 2 Inspiratory section
11. PC 2000 Pneumatic back-plane

The **Expiratory section** conveys the breathing gas from the patient breathing system to the Expiratory outlet. The Expiratory section contains the following main components:

12. Expiratory cassette
13. Expiratory valve
14. Expiratory valve coil
15. Expiratory outlet
16. PC 1786 Expiratory channel cassette (integrated into the Expiratory cassette)
17. PC 1785 Expiratory channel connector

The **System electronics** contains all PC boards and electrical components that are not included in the other main blocks:

18. PC 1990 Main back-plane
19. PC 1781 Inspiratory pressure transducer
20. PC 1781 Expiratory pressure transducer
21. PC 2004/PC 2024 Expiratory channel
22. PC 1991 Control
23. PC 1992 Monitoring
24. PC 1993 Ethernet switch
25. PC 1994 Nebulizer
26. Mains inlet
27. AC/DC converter
28. PC 1998 DC/DC & Standard connectors
29. On/Off switch
30. PC 1999 LED board
31. PC 1995 Plug & play back-plane
32. Module compartment
33. Fan 1 Patient unit
34. Battery module
35. Control cable

The **User interface** is the main user interface during operation of the system. The User interface contains the following main components:

36. Touch screen. Capacitive touch screen with multi-touch functionality.
37. LCD Display, 15" TFT display with LED backlight.
38. B735 Touch controller board for control of the touch screen
39. B732 I/O board with all external connectors
40. B740 CPU board that controls the PAN subsystem
41. B739 Ambient light sensor board with DIM sensor and LEDs to illuminate the Panel lock and Main menu buttons
42. B733 Touch button board for control of the Panel lock and Main menu buttons
43. B734 Light bar board. Illuminated alarm bar on top of the User interface frame.
44. Two Loudspeakers.

The User interface is adapted for the VESA 100 standard mounting interface.

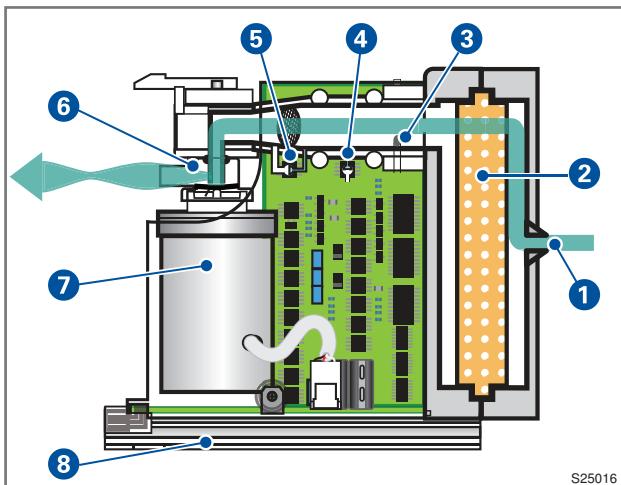
Memory types used in the system

There are five different memory types used in the system:

- **Flash memory.** For System software storage. Present on PC 1991, PC 1992, PC 1995, PC 2004/PC 2024, B740 and in the O₂ sensor, CO₂ module, Edi module and Y sensor module. The System software can be re-installed/updated using a System software installation.
- **RAM.** For temporary storage of software and data. Present on PC 1991, PC 1992, PC 1995, PC 2004/PC 2024, B740 and in the O₂ sensor, CO₂ module, Edi module and Y sensor module.
- **F-RAM.** Non-volatile memory for storage of calibration data in the Y sensor module.
- **RAM with battery backup.** For settings, trends and logs. Present on PC 1991 and PC 1992.
- **EEPROM.** For information such as PC board data, configuration and calibration data. Present on almost all PC boards and in the O₂ cell, CO₂ module, Edi module and Y sensor module. In the O₂ sensor, an EEPROM is emulated by the Flash memory.

3.1 Gas modules - Air and O₂ (1)

The Air and O₂ gas modules regulate the inspiratory gas flow and gas mixture.



1. Gas inlet
2. Filter
3. Inspiratory valve temperature sensor
4. Supply pressure transducer
5. Flow transducer (Delta pressure transducer and net)
6. Nozzle unit with valve diaphragm
7. Inspiratory solenoid
8. Gas module key

Note: The gas modules are factory calibrated. Each gas module must not be disassembled further than described in chapter Preventive maintenance.

3.1.1 Gas inlet

Gas supply is connected to the gas inlet nipples of the system. The design of the gas inlet nipples varies according to the standard chosen.

Gas is to be connected from hospital central gas supply or from gas cylinders. The Air supply may be connected from a compressor for medical air.

Refer to Technical data in the User's Manual for gas quality specifications.

3.1.2 Filter

The Filter protects the system from particles in the gas delivered to the gas modules. The filter must be replaced during the Preventive maintenance.

The filter housing and the filter cover have matching guide pins. The guide pins prevent from mounting the filter cover with the gas inlet nipple on the wrong module.

A non-return valve for the gas inlet is located in the filter cover. The non-return valve suppresses short pressure drops in the gas supply.

The non-return valve is also designed to slowly evacuate compressed gas from the module, if the gas supply to the module is disconnected.

3.1.3 Inspiratory valve temperature sensor

The temperature of the supplied gas is measured by the Inspiratory valve temperature sensor. This sensor is situated in the gas flow.

The output signal from this sensor is used to compensate for the gas density variations due to temperature.

3.1.4 Supply pressure transducer

The pressure of the supplied gas is measured by the Supply pressure transducer.

The output signal from this transducer is amplified. It is then used to calculate the absolute pressure of the gas to compensate for gas density variations due to pressure.

3.1.5 Flow transducer

The gas flows through a wire mesh (resistance) which causes a pressure drop. The pressure is measured on both sides of the net and the differential pressure value is then amplified.

3.1.6 Nozzle unit

The plastic Nozzle unit contains a valve diaphragm. The valve diaphragm, controlled by the Inspiratory solenoid, regulates the gas flow through the gas module.

The complete plastic nozzle unit must be replaced during Preventive maintenance. After replacement, allow the diaphragm to adapt to the valve seat by the spring tension during approximately 10 minutes before gas pressure is connected to the gas module.

3.1.7 Inspiratory solenoid

The gas flow through the gas module is regulated by the Inspiratory solenoid via the Nozzle unit.

The current supplied to the solenoid is regulated so that the gas module delivers a gas flow according to the settings on the User interface.

3.1.8 Gas module key

The gas modules are provided with a mechanical key to prevent that the module is mounted in the wrong slot.

The key consists of a plastic guide mounted underneath the module and a corresponding guide mounted in the Patient unit.

3.1.9 ID PROM

Each gas module is provided with an ID-PROM. The ID information can be read by the system.

3.2 Connector muff (2)

The Connector muff connects the gas module outlets to the Inspiratory pipe inlet.

3.3 Inspiratory pipe (3)

The Inspiratory pipe leads the gas from the Connector muff to the Inspiratory outlet.

The Inspiratory pipe comprises:

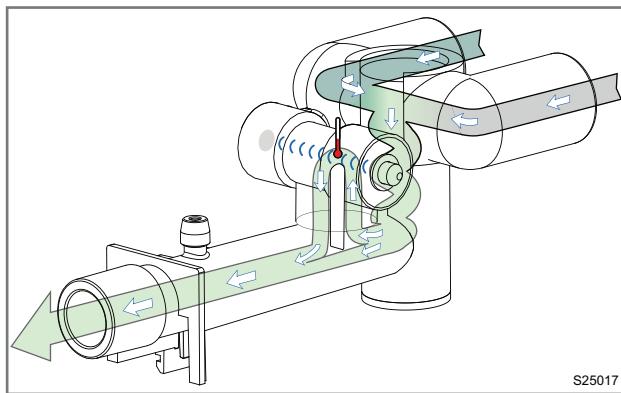
- Housing for the O₂ sensor as well as housing and locking lever for the O₂ cell with bacteria filter.
- Housing for the Safety valve.
- Connection for measurement of inspiratory pressure.

The pipe is provided with internal flanges with the purpose to improve mixing of O₂ and Air.

3.4 O₂ sensor (4)

The O₂ concentration can be measured either by an O₂ sensor or by an O₂ cell. The O₂ cell is described in section O₂ cell (5) below.

The O₂ sensor is mounted in a housing on the Inspiratory pipe.



The O₂ sensor is a measuring device for the inspired oxygen concentration, using ultrasound technique with two ultrasonic transducers/receivers.

The sound velocity in oxygen is lower than in air. By measuring the sound velocity in a binary gas mix where the two gases air and oxygen are known, the ratio between the gases can be calculated, giving the O₂ concentration.

The technical function of the O₂ sensor is similar to the one in the expiratory cassette. One transducer transmits an ultrasonic pulse through the gas and the

other transducer receives the pulse. The measured time difference between the transmission and the reception of the pulse is used for calculating the sound velocity. The calculated sound velocity is then used for calculating the O₂ concentration.

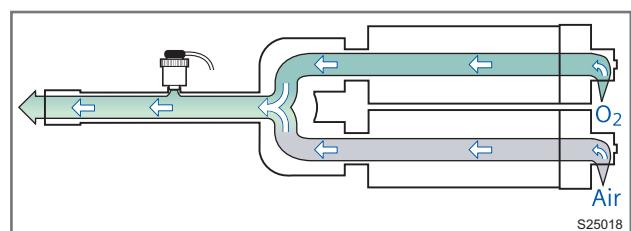
A temperature sensor inside the O₂ sensor measures the gas temperature and this measurement is used when calculating the O₂ concentration.

The O₂ sensor is provided with an ID-PROM. The ID information can be read by the system.

3.5 O₂ cell (5)

The O₂ concentration can be measured either by an O₂ cell or by an O₂ sensor. The O₂ sensor is described in section O₂ sensor (4) above.

The O₂ cell is mounted in a housing on the Inspiratory pipe and is protected by a bacteria filter.



The O₂ cell gives an output voltage proportional to the partial pressure of oxygen inside the Inspiratory pipe. At constant ambient pressure this output is proportional to the O₂ concentration in percent.

The life time of the cell is affected by the O₂ concentration. With a concentration (at the cell) in % and expected cell life time in hours the following applies at 25 °C (77 °F):

$$\text{Expected cell life time} = \text{O}_2 \text{ Conc} (\%) \times \text{Time (h)} \\ = 500\,000 \text{ (%hours)}$$

The O₂ cell is automatically calibrated each time a Pre-use check is performed (if O₂ is connected to the system).

If the system has been in use for a long time continuously, the measured O₂ concentration may drop due to normal degradation of the O₂ cell. This activates a nuisance alarm. For further information, refer to the User's Manual.

An ID PROM is integrated into each O₂ cell. The ID information and remaining lifetime can be read by the system.

For maintenance instructions, including replacing the bacteria filter, refer to the User's Manual.

Note: Pre-use check is recommended to use to calibrate the O₂ cell.

3.6 Temperature sensor (6)

A Temperature sensor is integrated into the connector on top of the O₂ sensor/cell. The Temperature sensor measures the temperature inside the Inspiratory section.

The output signal, corresponding to the temperature in the Inspiratory section, is used for regulating Fan 2 Inspiratory section. The electronics for this regulation is located on PC 1991 Control.

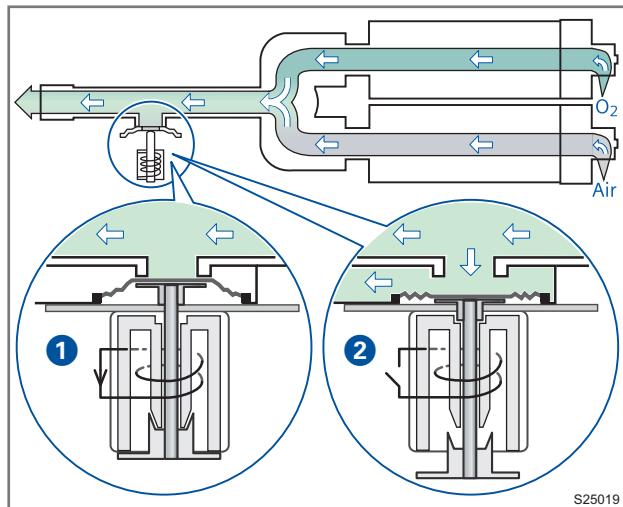
3.7 Inspiratory pressure tube (7)

The Inspiratory pressure tube connects the Inspiratory pipe with the Inspiratory pressure transducer. A bacteria filter protects the Pressure transducer on PC 1781 Pressure Transducer from contamination.

For maintenance instructions, including exchange of bacteria filter, refer to the User's manual. The bacteria filter must also be replaced during Preventive maintenance.

3.8 Safety valve including pull magnet (8)

The Safety valve including pull magnet is located in the Inspiratory pipe. The movable axis of the pull magnet closes or opens the safety valve membrane. The pull magnet is controlled by PC 2004/PC 2024 Expiratory channel.



1. During startup, the pull magnet is electrically activated and the pull magnet axis is pushed up, creating a clicking sound. The Safety valve is now closed. This is the normal operating mode, when the pull magnet is electrically activated and the safety valve membrane is closed.
2. When the Safety valve is not electrically activated, the weight of the pull magnet axis combined with the design of the valve membrane causes the pull magnet axis to be pulled down to the bottom position. When the pull magnet axis is in the bottom position, the Safety valve is open and the inspiratory gas is released from the Inspiratory pipe via the Emergency air intake resulting in decreased inspiratory pressure. The procedure described is a normal safety (pop-off) function.

The Safety valve is opened when:

- The ventilator is switched Off or to Standby.
- The pressure inside the inspiratory pipe is 5 cmH₂O above the preset Upper pressure alarm limit. This condition is controlled by the Monitoring subsystem.
- The pressure inside the inspiratory pipe is 7 cmH₂O above the preset Upper pressure alarm limit. This condition is controlled by the Breathing subsystem.

- The pressure inside the inspiratory pipe is above $117 \pm 7 \text{ cmH}_2\text{O}$. This is an extra safety function and this situation does not normally occur.
- The safety valve also opens by other alarms, for example the Out of gas-alarm.

The safety valve opening pressure is calibrated to $117 \pm 3 \text{ cmH}_2\text{O}$ during each Pre-use check.

The Emergency air intake (Safety valve outlet) is covered by a plastic grid. The Emergency air intake must be checked for obstructions during the Preventive maintenance.

3.9 Inspiratory outlet (9)

A 22 mm/15 mm tube connector for the inspiratory tube of the patient breathing system.

3.10 Fan 2 Inspiratory section (10)

Fan 2 Inspiratory section forces cooling air through the Inspiratory section. The cooling air flow inside the Inspiratory section is indicated in the System overview.

The air inlet is located below the expiratory inlet. The air outlet is located above the gas inlets.

Fan 2 Inspiratory section is controlled by the Temperature sensor in the O₂ sensor/cell connector via electronics on PC 1991 Control.

The fan starts at half effect at approximately 33 °C (91 °F) and at full effect at approximately 43 °C (109 °F). When the temperature drops below approximately 37 °C (99 °F), the fan switches to half effect and when the temperature drops below approximately 27 °C (81 °F), the fan stops.

The air inlet and outlet are protected by filters that must be cleaned or replaced during the Preventive maintenance.

3.11 PC 2000 Pneumatic back-plane (11)

Interconnecting board including connectors for

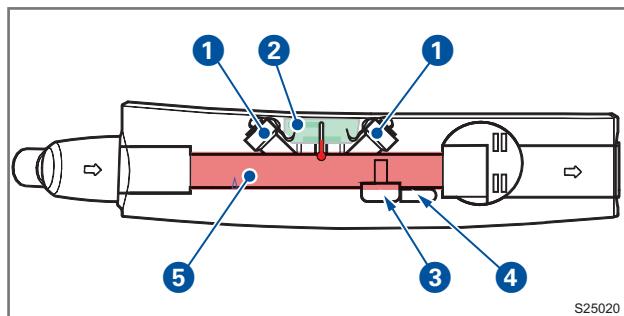
- Gas modules
- Safety valve
- O₂ sensor/cell
- Fan 2

PC 2000 Pneumatic back-plane is also connected to PC 1990 Main back-plane for communication with components in the lower part of the Patient unit.

3.12 Expiratory cassette (12)

The expiratory gas conveying parts and PC 1786 Expiratory Channel Cassette are integrated into one part – the Expiratory Cassette – which can be easily removed for cleaning or exchange, see the User's Manual.

The Expiratory cassette can be interchanged between different systems. A Pre-use check is always required after exchanging the Expiratory cassette.



- Ultrasonic transducer
- PC 1786 Expiratory channel cassette
- Bacteria filter
- Expiratory pressure tube connector
- Heating foil

3.12.1 Expiratory inlet

A 22 mm/15 mm tube connector for the expiratory tube of the patient breathing system. The expiratory inlet is designed to drain off the condensed water and

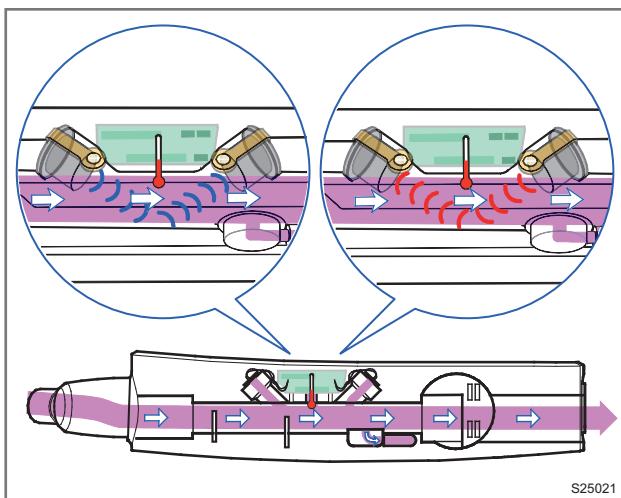
enables attaching a water trap to collect the condensed water. To protect the cassette from contamination an expiratory inlet bacteria filter can be connected.

3.12.2 Heating foil

An electrical Heating foil is applied on the outside of the Expiratory pipe where the Ultrasonic flowmeter is situated. The purpose of the Heating foil is to reduce condensation and maintain a stable temperature in the expiratory gas.

3.12.3 Ultrasonic flowmeter

The Ultrasonic flowmeter (expiratory flow transducer) is a measuring device for the expiratory gas flow, using ultrasound technique with two ultrasonic transducers/receivers. The measuring process is controlled from PC 2004/PC 2024 Expiratory channel.



The left hand side transducer is sending out an ultrasonic sound that is reflected against the inner wall of the Expiratory channel. The ultrasonic sound is received by the right hand side transducer now acting as a receiver. The time from sending to receiving ultrasonic sound in downstream expiratory gas flow is measured.

Then the right hand side transducer (earlier receiving) is sending out ultrasonic sound upstream the expiratory gas flow. The ultrasonic sound is received by the left hand side transducer now acting as a receiver. The time from sending to receiving ultrasonic sound in upstream expiratory gas flow is measured.

The time difference between the downstream and the upstream time measurements provides flow information.

A temperature sensor inside the cassette measures the expiratory gas temperature. This temperature measurement is also used when calculating the expiratory flow.

3.12.4 Bacteria filter

The Bacteria filter protects the transducer on PC 1781 Pressure transducer from contamination. The filter is an integrated part of the Expiratory cassette.

3.12.5 Expiratory pressure tube

The Expiratory pressure tube connects the Expiratory cassette to the Expiratory pressure transducer. The Expiratory pressure tube is an integrated part of the Expiratory cassette.

3.13 Expiratory valve (13)

The Expiratory valve consists of a membrane in the cassette that is operated by the axis of the Expiratory valve coil. The valve is fully open as long as no power is supplied to the coil.

Operating capacity for the membrane is estimated to 10 000 000 breathing cycles. When this limit is passed or if the membrane for some reason has become defective, it must be replaced. Refer to instructions in chapter Disassembling and assembling.

Membrane capacity (counter) can be shown in the System status window. Select **SYSTEM STATUS > Expiratory cassette** to check **Membrane capacity**. The operating capacity meter must be reset after replacement of the membrane. Note that the reset function is not implemented in System version 1.0.

3.14 Expiratory valve coil (14)

The movable axis of the Expiratory valve coil controls the opening of the Expiratory valve by pushing the valve membrane into desired position. The power supply to the coil is regulated so that the remaining pressure in the patient system, towards the end of the expiration time, is kept on the PEEP level according to User interface setting.

3.15 Expiratory outlet (15)

The gas from the patient system leaves the system via this Expiratory outlet. A thermo sleeve can be attached to the outlet to reduce condensation.

3.16 PC 1786 Expiratory channel cassette (16)

PC 1786 Expiratory channel cassette is a connection board, integrated into the Expiratory cassette, for the Ultrasonic flowmeter and for the Heating foil. It connects to PC 1785 mounted in the expiratory cassette compartment.

Includes an ID PROM. The ID information can be read by the system.

3.17 PC 1785 Expiratory channel connector (17)

PC 1785 Expiratory channel connector is a connector board including signal filters that is mounted in the expiratory cassette compartment. It connects to PC 1786 mounted in the Expiratory cassette when the cassette is docked to the expiratory cassette compartment.

3.18 PC 1990 Main back-plane (18)

Interconnection board for PC boards and components in the lower part of the Patient unit. PC 1990 Main back-plane is also connected to PC 2000 Pneumatic back-plane for communication with components in the Inspiratory section.

A temperature sensor on PC 1990 measures the temperature in the lower part of the Patient unit. The temperature sensor controls Fan 1 Patient unit via fan drive electronics on PC 1995 Plug & play back-plane.

The System ID (Serial No.) and the operating time are stored in an EEPROM on PC 1990. When replacing PC 1990, a spare part that is factory programmed for the concerned system must be used.

The preventive maintenance time stamp is lost when replacing PC 1990, therefore a new time stamp must be set. There are two alternatives to set the time stamp:

- Perform Preventive maintenance on the system and report completed Preventive maintenance in Service & Settings.

or

- If correct value (hours) until next Preventive maintenance is known, enter this value in Service & Settings.

3.19 PC 1781 Inspiratory pressure transducer (19)

The pressure, conveyed via the pressure tube, connected to PC 1781 Inspiratory pressure transducer, is led to and measured by the differential pressure transducer. With differential reference to the ambient pressure, the output signal is proportional to the measured pressure thus giving a linear measurement in the range -40 cmH₂O to +160 cmH₂O.

Technical limitation: Pressures exceeding ±400 cmH₂O must be avoided.

Includes an ID PROM. The ID information can be read by the system.

3.20 PC 1781 Expiratory pressure transducer (20)

Function identical to PC 1781 Inspiratory pressure transducer.

3.21 PC 2004/PC 2024 Expiratory channel (21)

Note: PC 2024 replaces PC 2004. Introduced in production in Q3 2016.

PC 2004/PC 2024 Expiratory channel is part of subsystem Breathing BRE. The main functions are expiratory flow measurement and expiratory cassette handling. Expiratory flow measurement is performed by the flowmeter in the cassette. PC 2004/PC 2024 is connected to the cassette via PC 1785 Expiratory channel connector.

PC 2004/PC 2024 Expiratory channel contains electronics including microprocessor for handling of:

- Expiratory flow measurement performed by the flowmeter inside the cassette. The output signal Exp. Flow is used in sub-systems Control and Monitoring.
 - All electronic connections to and from the cassette.
 - Measurement of Inspiratory and Expiratory pressure via pressure transducer boards PC 1781.
- PC 2004/PC 2024 contains holders and electrical connectors for these pressure transducer boards.
- Expiratory valve control (with input from Control).
 - Safety valve control (with input from other subsystems).

A thermistor on PC 2004/PC 2024 monitors the temperature inside the Patient unit. An alarm is activated if the temperature is $77 \pm 5^\circ\text{C}$ ($170 \pm 9^\circ\text{F}$) or higher.

Includes an ID PROM. The ID information can be read by the system.

For software and hardware requirements and compatibility, see the Compatibility chart in chapter Revision history.

Note: The System software must be re-installed if PC 2004/PC 2024 is replaced.

3.22 PC 1991 Control (22)

PC 1991 Control is a part of the subsystem Breathing BRE. The main responsibilities for PC 1991 Control are patient treatment functions, that is, how to regulate the inspiratory and expiratory gas flow.

PC 1991 Control comprises electronics including microprocessors for handling of:

- Gas modules, Air and O_2 .
- Airway pressure control with input from values measured by the Inspiratory and Expiratory pressure transducer.
- Nebulizer control.

Regulation of Fan 2 Inspiratory section is also performed by PC 1991. The temperature sensor used is located in O_2 sensor/cell connector.

A Memory backup battery on PC 1991 power supplies the internal memory on the PC board. If the battery on PC 1991 is disconnected or if the battery voltage is too low, startup ventilation configurations made via the Service & Settings may be erased. The Memory backup batteries must be replaced after five years.

Includes an ID PROM. The ID information can be read by the system.

For software and hardware requirements and compatibility, see the Compatibility chart in chapter Revision history.

Note: The System software must be re-installed if PC 1991 is replaced.

3.23 PC 1992 Monitoring (23)

PC 1992 Monitoring is a part of the subsystem Monitoring MON. The Monitoring subsystem features alarm and monitoring functions, calculations, trending of measured values and is also the CAN-bus master.

PC 1992 Monitoring comprises electronics including microprocessor for handling of:

- Controlling that all alarms are displayed on the User interface and that the alarm sound is generated. In case of malfunction in the loudspeakers in the User interface, a backup sound generating device, a buzzer, on PC 1992 is activated. The backup buzzer is monitored by a microphone and tested at startup and during the Pre-use check.
- Monitoring of alarm limits. Activates pressure reducing mechanisms, including activation of the safety valve, in case of excessive breathing system pressure.
- Supervision of delivered pressure and flow.
- Calculation of parameters. Providing the system with different measured data.
- Communication with the optional Plug & play modules. Monitors battery module status and communicates measured values from other modules that are used by other subsystems.
- Barometric pressure. PC 1992 contains a barometric transducer and the measured barometric pressure is supplied to the other sub-units in the system.
- Real time clock, RTC.
- Temperature monitoring. A thermistor on PC 1992 monitors the temperature inside the Patient unit. An alarm is activated if the temperature is $77 \pm 5^\circ\text{C}$ ($170 \pm 9^\circ\text{F}$) or higher.

- System voltage monitoring: The following voltages are supervised:

+24 V

+12 V

-12 V

+5 V

+3.3 V

The buzzer on PC 1992 generates the alarm signal in case of +5 V or +3.3 V power failures. The buzzer and +5 V/+3.3 V failure logic is powered by backup capacitors in case of power failure.

- Maintains a persistent data storage area to save logs. The logs are saved once per minute.
- RS-232 communication. The system is equipped with two RS-232 ports. The RS-232 communication is handled by PC 1992. The communication protocol SCI (SERVO Communication Interface) is described in the SERVO Communication Interface – Reference Manual.
- Alarm output function. The Alarm output connector is available on PC 1998 DC/DC & Standard connectors. The alarm signal used by this option is generated on PC 1992.

A Memory backup battery on PC 1992 power supplies the internal memory on the PC board. If the battery on PC 1992 is disconnected or if the battery voltage is too low, startup alarm configurations made in the Service & Settings menu, all logs, Pre-use check results, date and time setting, and service reports are erased. The Memory backup batteries must be replaced after five years.

Includes an ID PROM. The ID information can be read by the system.

For software and hardware requirements and compatibility, see the Compatibility chart in chapter Revision history.

Note: The System software must be re-installed if PC 1992 is replaced.

3.24 PC 1993 Ethernet switch (24)

PC 1993 Ethernet switch controls the Ethernet communication in the system. Ethernet is used by the PAN, BRE and MON subsystems.

Includes an ID PROM. The ID information can be read by the system.

3.25 PC 1994 Nebulizer (25)

PC 1994 Nebulizer is the integrated interface for connection of the Aerogen® Nebulizer Systems, Aerogen Pro and Aerogen Solo. PC 1994 Nebulizer contains electronics required to control the nebulizer units.

For electrical safety test of the Nebulizer connector, refer to section Safety inspection in chapter Preventive maintenance.

3.26 Mains inlet (26)

Inlet for mains power supply including grounding connection.

The system automatically adjusts to the connected mains power if the mains power is within the specified range. No voltage or frequency setting is required.

The mains inlet is equipped with two mains power fuses, F11 and F12, rated 4 A. Refer to the label attached at the mains inlet.

3.27 AC/DC converter (27)

The AC/DC converter is a complete unit adapted for the system. The AC/DC converter converts the connected AC Power (mains power) to the internal DC supply voltage +12V_AC-DC.

Mains power is supplied to the AC/DC converter via the Mains inlet.

3.28 PC 1998 DC/DC & Standard connectors (28)

The main responsibilities for PC 1998 DC/DC & Standard connectors are to:

- Convert and supply required internal voltages.
- Hold a number of standard connectors.
- Control switching between mains power supply and external 12 V DC power supply.
- Connect the On/Off switch and PC 1999 LED Board.

Includes an ID PROM. The ID information can be read by the system.

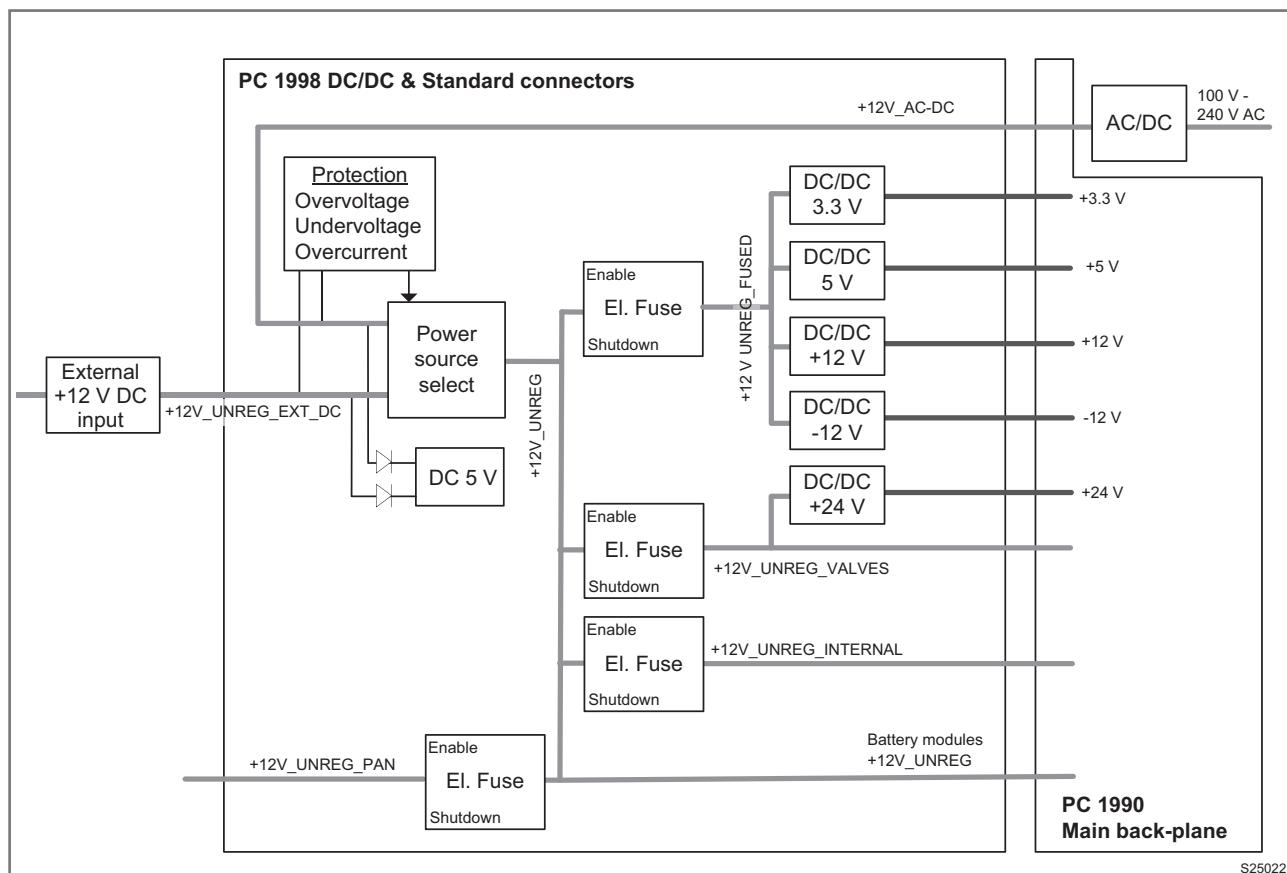
PC 1998 converts the power supply voltages into the following internal DC supply voltages:

- +24 V
- +12 V UNREG_INTERNAL
- +12 V UNREG_VALVES
- +12 V
- -12 V
- +5 V
- +3.3 V

3.28.1 Internal voltages

There are three power supply voltages to the system:

- +12V_AC-DC from the AC/DC converter.
- +12V_UNREG_EXT_DC from the External +12 V DC power supply input.
- +12V_UNREG from the Battery modules.



3.28.2 Standard connectors

All standard connectors are located on PC 1998:

- N26 – External +12 V DC power supply input. The connector is equipped with a fuse F1, rated 10 A. There are no alarms indicating power supply failure related to the External +12 V DC supply. Thus, when the External +12 V DC supply is used, backup Battery modules must be installed to ensure proper operation.
- N28 – Control cable. Connects the User interface.
- N29 – RS-232 (1). Isolated RS-232 connector. This RS-232 port is identical to port N30.
- N30 – RS-232 (2). Isolated RS-232 connector. This RS-232 port is identical to port N29.
- N67 – Alarm output. Isolated alarm output connector. The Alarm output software option is required to enable the Alarm output function. For a technical description of the function Alarm output, refer to section Alarm output later in this chapter.

Pin configuration and signal names can be found in section Connectors, chapter Diagrams.

3.29 On/Off switch (29)

Switch to Power up or Power down the system. Refer to section Power supply selection .

3.30 PC 1999 LED board (30)

PC 1999 LED board has two LEDs that are visible for the operator:

- A blue mains LED that is lit when mains power is connected.
- A green power on LED that is lit when the On/Off switch is On.

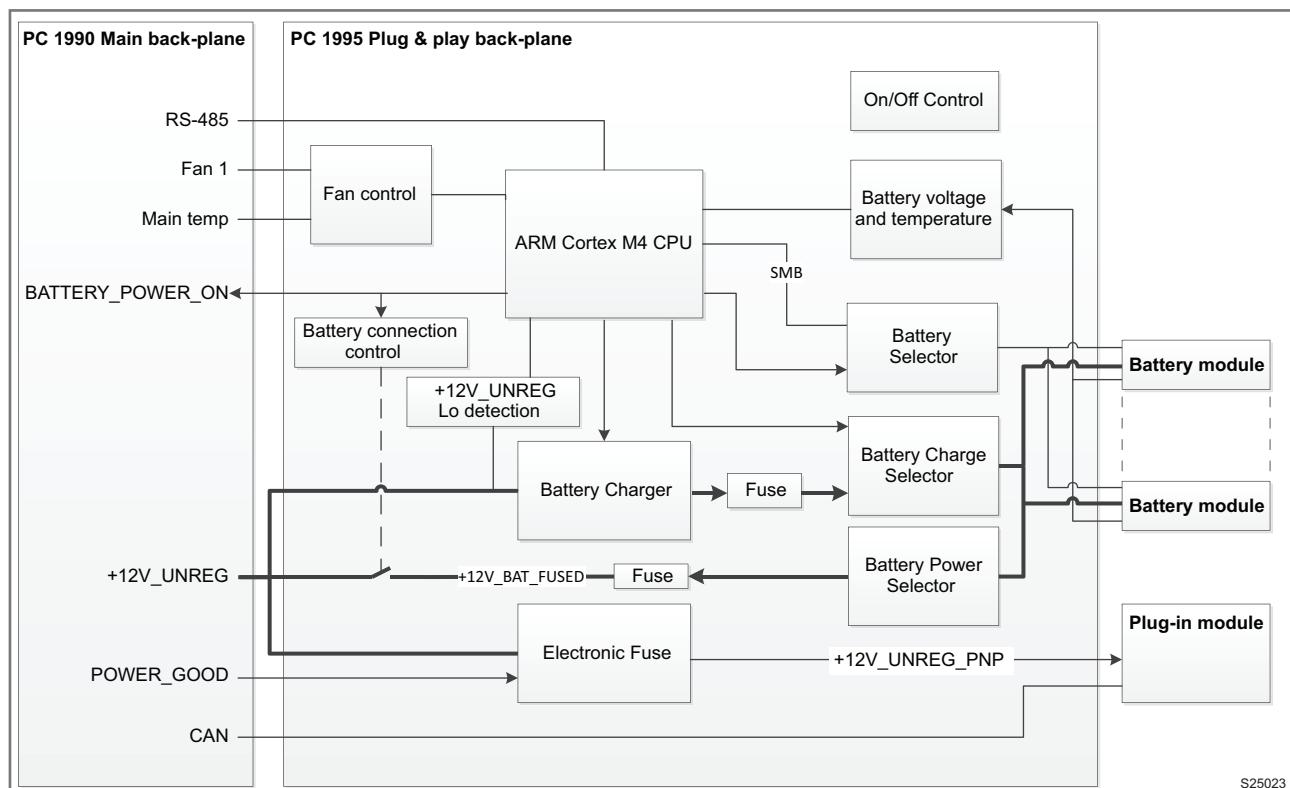
3.31 PC 1995 Plug & play back-plane (31)

The main functions for PC 1995 Plug & play back-plane are:

- On/Off control.
- Connect the optional modules that are inserted in the Module unit.
- Control charging/discharging of the Battery modules.
- Switch to battery power supply when Mains power/External 12 V DC supply is lost.
- Control of Fan 1 Patient unit using input signals from the temperature sensor on PC 1990 Main back-plane.

The ID information is stored in flash memory in the CPU and can be read by the system.

Note: The System software must be re-installed if PC 1995 is replaced.



3.31.1 On/Off control

The power modes in the system are:

- At Power up, when the On/Off switch is set to On, all internal voltages are enabled.
- At Power down, the Power supply system deactivates the hardware signal Power_Good.H, and at the same time keeps the internal voltages +5 V and +3.3 V for at least 1 ms, to let the different subsystems save their current settings in non-volatile memory. Power down can be caused by:
 - Setting the On/Off switch to Off.
 - Mains failure resulting in a switch to battery, where the backup battery voltage is too low for proper operation of the system or if there is no backup battery connected.
 - Automatic power down when the battery voltage becomes too low for proper operation of the system.

In the Off mode, only charging of Battery modules is enabled (if the system is connected to mains). To allow adequate cooling during battery charging, the Fan 1 Patient unit can operate also in Off mode. All other circuitry is un-powered.

3.31.2 Power supply selection

If the internal DC supply voltage +12V_UNREG drops below 10 V due to power supply failure, the power supply source automatically switches. The following power supply source priority is used:

1. Mains power
2. External +12 V DC supply (if connected)
3. Battery modules.

Power supply selection is managed by:

- PC 1998 – Between Mains power and External +12 V DC power supply.
- PC 1995 – Between Mains power/External +12 V DC and Battery module power supply.

3.32 Module compartment (32)

Connection slots for six optional modules, such as Battery modules, CO₂ analyzer module, Edi module and Y sensor module.

3.33 Fan 1 Patient unit (33)

Fan 1 Patient unit is the main fan that forces cooling air through the lower part of the Patient unit. The cooling air flow inside the Patient unit is indicated in the System overview.

The air inlet is located adjacent to the mains power supply connector. One third of the cooling air is routed through the Module compartment. The outlets are located in the module compartment and the air thus also cools connected modules, including battery modules. Two thirds of the cooling air is routed up to cool the PC boards. This air outlet is located below the expiratory outlet.

Fan 1 Patient unit is controlled by a temperature sensor on PC 1990 Main back-plane. The fan drive electronics is located on PC 1995 Plug & play back-plane.

The fan starts at half effect at approximately 33 °C (91 °F) and at full effect at approximately 43 °C (109 °F). When the temperature drops below approximately 37 °C (99 °F), the fan switches to half effect and when the temperature drops below approximately 27 °C (81 °F), the fan stops.

The air inlet and upper outlet are protected by filters that must be cleaned or replaced during the Preventive maintenance.

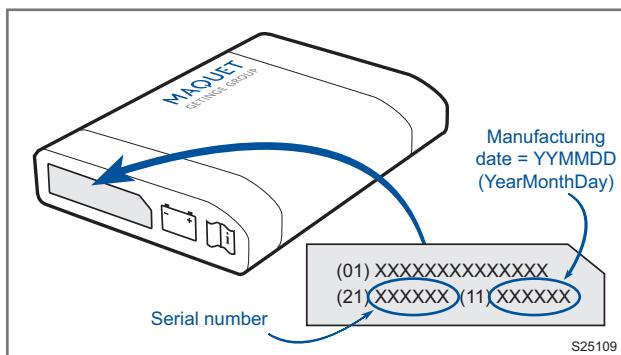
3.34 Battery module (34)

The Battery module is a 12 V/3.5 Ah Nickel-Metal Hydride rechargeable 'smart battery'. Up to six backup Battery modules can be connected to the Module compartment. To guarantee safe battery backup, always use at least two batteries.

To calculate the status of the battery, an internal highly accurate voltmeter, an amperemeter and a time clock, measure the actual charge in and out of the battery. In addition, there are algorithms to compensate for the effects of discharge rate, discharge temperature, self-discharge and charging efficiency and so forth.

Even with this technology, the only time at which the battery charge status is absolutely reliable is when the battery is either completely full or completely empty. If the battery only sees partial charges and discharges during the application, the battery charge status may not get the benefit of a 'full' or 'empty' reference point for some time, and must eventually rely on the calculated result.

The life span for the Battery module is calculated to two and a half years from manufacturing date. Normal time for logistics and storage are included in the life span calculation. The calculation corresponds to an estimated operational time of two years. Manufacturing date (YearMonthDay) is printed on the battery label.



Among other things, the system monitors:

- Expiration date.
- If the operational capacity is too poor for continued usage.

In both cases, information about battery replacement is shown on the User interface.

Select **SYSTEM STATUS > Batteries** on the User interface to check battery status. For more information, refer to section **Battery modules** in chapter **Service procedures**.

Recharge time for a discharged battery is approximately three hours per battery. If a battery is completely discharged, for example due to long storage time, the battery may require up to 12 hours charging time.

Each battery includes an ID PROM. The ID information can be read by the system.

3.35 Control cable (35)

The Control cable connects the Patient unit and the User interface. The cable can be partly wound up on a bobbin under the cover on the back of the User interface.

Note: The Control cable must only be connected or disconnected when the system is switched Off.

3.36 Touch screen (36)

The projected capacitive touch screen (ITO foil) implements the touch function of the User interface screen and is interactive with information displayed on the LCD Display.

The touch screen is automatically calibrated during operation on:

- SERVO-U S/N 20001–20777 with Touch panel calibration SW installed.
- SERVO-n S/N 1002–1077 with Touch panel calibration SW installed.
- SERVO-U S/N 20778 or higher
- SERVO-n S/N 1078 or higher

Note: The Touch panel calibration SW was introduced in Service Measure MCC/15/005/SM.

The touch screen for the LCD Display area is a transparent ITO based multi-touch sensor laminated to the inside of the front glass.

The touch button function on the panel is obtained by the touch button sensor, ITO foil, glued to the inside of the front glass. Finger guides in the glass represent the positions of the touch button sensors.

3.37 LCD Display (37)

The LCD Display is a 15" 4:3 TFT XGA display with LED backlight for display of picture- and alphanumeric data.

The screen brightness is automatically adjusted. It is estimated that the LCD Display maintains an acceptable brightness level during the lifetime of the system. Using Service & Settings, a backlight time meter can be shown.

3.38 B735 Touch controller board (38)

B735 Touch controller board controls the LCD Display area on the Touch screen.

3.39 B732 I/O board (39)

Connectors located on the B732 I/O board are:

- J1 – VGA port. For connection of an external display. Non-isolated connector. 15 pin D-Sub. For System version 1.0 the VGA port must be enabled in Service & Settings after each startup of the system.
- J2 – Network cable port (Ethernet). For connection of Remote Services. Isolated connector. Unshielded RJ45.
- J3 – USB port. For connection of a USB memory stick. Non-isolated connector. USB 2.0 Type A.
- J4 – Panel cable port. For connection of the Control cable.

3.40 B740 CPU board (40)

The B740 CPU board is part of subsystem Panel PAN.

The Panel sub-system controls all user interaction.

Other functions handled by this subsystem are:

- Software update of all subsystems via the USB interface.
- Responsible for execution of the Pre-use check.

- Responsible for the Service & Settings functions.
- Maintains a persistent data storage area to save application data, panel settings, screen shots and trend data.

The persistent memory is located on a memory card (SSD card mSATA) connected to B740. If the memory card must be replaced, the replacement card must be factory configured to match the ventilator System SW version.

The Panel software is stored on B740 CPU board and executed by the microprocessor on B740.

Note: The System software must be re-installed if B740 is replaced.

3.41 B733 Touch button board (41)

The B733 Touch button board controls two capacitive touch buttons on the Touch screen:

- Panel lock button. Tap and hold to lock or unlock.
 - Main menu button. Tap to go to the Main menu.
- Ambient light sensor signals and touch button illumination signals are routed through B733.

3.42 B739 Ambient light sensor board (42)

The B739 Ambient light sensor (ALS) board contains a DIM sensor that measures the ambient light and automatically adjusts the screen brightness.

The B739 also contains two green LEDs to illuminate the Panel lock and Main menu buttons.

3.43 B734 Light bar board (43)

The B734 Light bar board is visible on the upper part of the User interface frame. The Light bar contains a number of multicolor LEDs that flash when an alarm is triggered in the system.

- Blue LED – Low priority alarm
- Yellow LED – Medium priority alarm
- Red LED – High priority alarm.

3.44 Loudspeakers (44)

Loudspeakers for example for alarm sound. Connected to the B740 CPU board.

There are two loudspeakers in each User interface. The User interface is mechanically designed to achieve a good sound output.

The loudspeakers generate different tones with individual sound volumes. At startup and during Pre-use check the function of the loudspeakers are monitored by a microphone on the B740 board. During operation they are continuously monitored.

3.45 Optional equipment

3.45.1 Edi module (45)

The Edi module is an optional accessory used during NAVA ventilation. The Edi module requires one free slot in the Module compartment.

NAVA is based on measuring of the electrical activity of the diaphragm (Edi) and then use this information to control the ventilation. The signals from the Edi catheter can also be used for monitoring purposes.

To enable NAVA, the following parts are required:

- Edi module including Edi cable with connectors and Edi test plug. The test plug is used to verify proper operation of the Edi cable and Edi module before use.
- NAVA software. The NAVA software is installed as default on all systems.

- Single-use Edi catheter. The catheter is a feeding tube with measuring electrodes. Available in different sizes.

The Edi catheter is placed into the esophagus to the gastric ventricle. The catheter detects the signals from the diaphragm excitation. The Edi module filters the signals and passes them to system which uses the signals for monitoring and regulation. It also displays the Edi signal as a waveform on the User interface.

The Edi module is available in a 50 Hz and a 60 Hz version (to be used in 50 Hz alt. 60 Hz environment). A built-in filter removes interference from surrounding equipment.

If an Edi module is part of the system, make sure that this module is connected during System software installation. Software stored in the module is checked/updated during the System software installation.

If the Edi module is exposed to rough handling, for example if dropped on the floor, an electrical safety test of the module must be performed. For description of the electrical safety test of the module, refer to section Safety inspection in chapter Preventive maintenance.

3.45.2 Y sensor module (46)

The Y sensor module is an optional accessory. The Y sensor module requires one free slot in the Module compartment.

The Y sensor flow measuring is based on hot wire anemometer technology. The pressure is measured via a pressure line connected to patient Y piece. This allows the pressure and flow to be measured as close as possible to the patient's airway. The Y sensor can be used in all ventilation modes and improves ventilator performance for neonates.

To enable Y sensor measuring, the following is required:

- The Y sensor module including sensor cable.

- The Y sensor software option. The software option is individually created for each system and can only be installed on this system. The Y sensor function must be enabled in the configuration software.
- The Y sensor, the Y-piece and the pressure line. The Y sensor is available as disposable or reusable.

If a Y sensor module is part of the system, make sure that this module is connected during the System software installation. Software stored in the module is checked/updated during the System software installation.

For a description of the electrical safety test of the module, refer to section Safety inspection in chapter Preventive maintenance.

3.45.3 CO₂ analyzer module (47)

The CO₂ analyzer module is an optional accessory. The CO₂ analyzer module requires two free slots in the Module compartment.

There are two versions of the CO₂ analyzer module:

- CAPNOSTAT III
- CAPNOSTAT 5.

Note: The CAPNOSTAT III was discontinued from System version 1.1.

The CO₂ analyzer option allows for continuous monitoring shown in a waveform (capnogram) or as numerics on the screen.

The CO₂ analyzer module is connected with a cable to a Capnostat sensor mounted on an airway adapter at the Y-piece. The sensor uses a solid state and IR based optical system with no movable parts. It measures the difference between a reference light beam and one filtered for CO₂ wavelength.

To enable the CO₂ analyzer function, the following parts are required:

- CO₂ analyzer module.

- CO₂ analyzer software. The CO₂ analyzer software is individually created for each specific system and can only be installed on this system. The CO₂ analyzer function must be enabled in the configuration software.
- For CAPNOSTAT III: CO₂ CAPNOSTAT III sensor kit
- For CAPNOSTAT 5: CAPNOSTAT 5 mainstream CO₂ sensor
- CO₂ airway adapters. The CO₂ airway adapter is available as disposable or reusable.

For a description of the electrical safety test of the module, refer to section Safety inspection in chapter Preventive maintenance.

For software and hardware requirements and compatibility, see the Compatibility chart in chapter Revision history.

3.45.4 MSync (48)

MSync is intended for information transfer from the Maquet devices to the hospital's information system by:

- Importing real-time clinical data from the device using its respective communication protocol.
- Converting device data to HL7 compliant data.
- Exporting device data in HL7 format to the information system.

An MSync unit is connected to each Maquet device intended to be integrated with the information system.

3.45.5 Battery module

The Module compartment allows up to six Battery modules. To guarantee safe battery backup, always use at least two batteries.

For further information, refer to section Battery module (34) earlier in this chapter.

3.45.6 Alarm output

The Alarm output connector, N67 on PC 1998 DC/DC & Standard connectors, enables connection of an external alarm signal system to the system. The alarm output signal is active as long as the alarm audio is active on the system.

Pin configuration and signal names in N67 can be found in chapter Diagrams. For further information, refer to the Alarm output connector – Reference Manual.

The two contact functions of the Alarm output connector are: NO (Normally Open) and NC (Normally Closed). In an alarm situation the open contact closes, and the closed contact opens. The contacts are independent of polarity and can be used with both AC and DC systems.

Preferably the NC contact should be used. The NC contact detects any interruption in the alarm system, or any unintentional disconnection of the cable between the system and the ventilator. Also, if both the NO- and the NC-contacts are used, an even higher safety level for unforeseen failures can be achieved. Note that, in both cases, even an intentional disconnection of the ventilator triggers the external alarm.

The Alarm output software is required to enable the Alarm output function. The Alarm output software is individually created for each specific system and can only be installed on this system. The Alarm output function must be enabled in the configuration software.

3.45.7 Compressor Mini

The Compressor Mini is designed to supply medicalgrade compressed air. The compressor has a capacity of approx. 30 l/min at a pressure of 350 - 450 kPa (50 - 64 psi).

The Compressor Mini can be placed on the Mobile cart to form a compact unit which is easy to move. It can also be used as a stand-alone unit.

The Compressor Mini is well insulated against noise and therefore does not cause disturbance when used during operations.

The Compressor Mini is equipped with a standby function. In the standby mode, the compressor starts to deliver compressed air if the hospital central gas supply fails.

For further information, refer to separate Compressor Mini documentation.

3.45.8 Mobile cart

The Mobile cart is designed for carrying the Patient unit, the User interface and all required optional equipment.

The Mobile cart is equipped with standard 10x25 mm rails to carry accessories such as Support Arm 178 and Humidifier holder. The column is designed with vertical slots for installation of Compressor Mini and Gas cylinder restrainers. The optional Drawer kit can be mounted on the Mobile cart.

3.45.9 Shelf base

The Shelf base is a mounting device for the Patient unit. It allows positioning of the Patient unit on a shelf.

3.45.10 Pendant/bed holder

The Pendant/bed holder is a mounting device for the Patient unit. The Pendant/bed holder enables positioning of the Patient unit on a pendant, bed, stretcher or standard rail.

3.45.11 Handle

The Handle enables the User interface to be mounted directly on the Patient unit.

The Cable holder and the Y piece holder and hook are intended to be attached on the Handle.

3.45.12 User interface holder

The User interface holder enables the User interface to be mounted on a rail 10x25-35 mm or a table 10-45 mm.

3.45.13 Gas cylinder restrainer kit

The Gas cylinder restrainers are mounted on each side of the Mobile cart. The Gas cylinder restrainer kit is intended for two gas cylinders, maximum volume 2x4.5 litres.

3.45.14 Support Arm 178

Support Arm 178 is equipped with a clamp intended for standard 10x25 mm rails. The support arm has a central locking mechanism that secures the selected position. A twin tube holder (15-27 mm diameter) and a filter/tube support (20/25 mm diameter) can be mounted on the support arm.

Maximum load with fully extended arm is 1 kg.

3.45.15 Aerogen nebulizers

The Aerogen® Nebulizer Systems, Aerogen Pro and Aerogen Solo, can be connected to the Nebulizer connector. PC 1994 Nebulizer contains electronics required to control the nebulizer units.

Aerogen Pro and Aerogen Solo are devices intended to aerosolize physician-prescribed medications, for inhalation, that are approved for use with a general purpose nebulizer.

- Aerogen Pro: Reusable nebulizer unit.
- Aerogen Solo: Single use nebulizer unit.

The Aerogen Pro/Aerogen Solo are designed to operate in-line with the ventilator circuit in acute and sub acute care environments. It operates without changing patient ventilator parameters.

3.45.16 Humidifier and Humidifier holder

Recommended active (heated) humidifier is Fisher & Paykel MR 850. For further information, refer to manufacturer's documentation.

The Humidifier holder is equipped with a clamp intended for standard 10x25 mm rails. Maximum load is 5 kg.

3.45.17 Waterbag/IV pole

The Waterbag/IV pole is mounted on the optional Humidifier holder. It includes two hooks. Maximum load is 1 kg.

4 Disassembling and assembling

Table of Contents

4.1	General	4 - 2
4.2	Hazard notices	4 - 2
4.3	PC boards and electrical components	4 - 2
4.4	Information stored in the system	4 - 3
4.5	Assembling guidelines	4 - 5
4.6	Inspiratory channel cover	4 - 6
4.7	Inspiratory channel	4 - 6
4.8	Safety valve membrane	4 - 8
4.9	Gas modules	4 - 9
4.10	PC 2000 Pneumatic back-plane	4 - 10
4.11	Expiratory cassette	4 - 11
4.12	Front cover	4 - 13
4.13	PC 1785 Expiratory channel connector	4 - 14
4.14	Expiratory valve coil	4 - 14
4.15	PC board rack	4 - 16
4.16	AC/DC converter	4 - 16
4.17	Module compartment frame including PC 1994 Nebulizer	4 - 17
4.18	PC 1994 Nebulizer	4 - 17
4.19	Module locking device	4 - 18
4.20	Module compartment including PC 1995 Plug & play back-plane	4 - 18
4.21	PC 1995 Plug & play back-plane	4 - 19
4.22	PC 1998 DC/DC & Standard connectors	4 - 19
4.23	Fan 1 Patient unit	4 - 21
4.24	PC 1990 Main back-plane	4 - 22
4.25	User interface	4 - 23

4.1 General

Disassembling of the system is described in this chapter. If not stated otherwise, the assembling procedure is the reverse of the described disassembling procedure.

The Spare parts list may be useful when disassembling and assembling the system.

After any installation, maintenance or service intervention in the system, perform a Pre-use check according to instructions in the User's Manual.

4.2 Hazard notices

Before disassembling or assembling the system, make sure that:

- The On/Off switch is set to Off.
- Mains power cable is disconnected.
- External +12 V DC supply is disconnected.
- Backup battery modules are disconnected. Note that the backup battery modules supply power to parts of the system also when the system is switched Off.
- Gas supply is disconnected, central gas supply and backup gas supply.
- The system, including all gas conveying parts, is cleaned. Refer to instructions in the User's Manual.



WARNING! With gas supply connected to the system, there are pressurized components inside the unit. All personnel must exercise extreme caution if fault tracing or adjustments are performed with gas supply connected and with covers removed.



WARNING! With power supply connected to the system, there are energized electrical components inside the unit. All personnel must exercise extreme caution if fault tracing or adjustments are performed with power supply connected and with covers removed.



CAUTION: Do not expose the batteries to water, fire or excessive heat. Do not crush, disassemble, puncture or short circuit the connector terminals.

4.3 PC boards and electrical components

4.3.1 Replacing electrical components

As stated in section Hazard notices, mains power and battery power supply must be disconnected and the Power button switched Off when replacing electrical components. If energized electrical components are disconnected or connected, this may interfere with the operation of the system.

After replacement of PC boards or other electrical components, it is recommended to perform an electrical safety test. For a description of the electrical safety tests, see section Safety inspection in chapter Preventive maintenance.

4.3.2 Handling PC boards

Those who come into contact with circuit boards containing sensitive components must take certain precautions to avoid damaging the components (ESD protection).

PC boards (spare parts) must always be kept in protective packaging for sensitive electronic device.

PC boards must not be inserted or removed while the mains power or battery power is applied to the PC boards.

Remove and insert the PC boards very carefully to avoid damage to the connectors.



Note: ESD sensitive components.

The PC boards contain components that are highly sensitive to static electricity. When working with ESD sensitive components, always use a grounded wrist band and a grounded work surface. Adequate service tools must always be used.

4.3.3 Replacing PC boards

The System SW is distributed to the following PC boards and modules:

- PC 1991 Control
- PC 1992 Monitoring
- PC 1995 Plug & play back-plane
- PC 2004/PC 2024 Expiratory channel
- B740 CPU (panel)
- O₂ sensor
- Edi module
- Y sensor module

Additional actions when replacing PC boards

When delivered as spare parts, these components are equipped with a *System SW version* that may differ from the version on the system to be repaired. To keep the *System SW version* used prior to the replacement, the applicable *System SW version* must be available for reinstallation purposes.

For functionality enhancement, the latest released *System SW version* is always recommended.

Before installing a new *System SW version*, ensure that the software is fully compatible with all hardware, software and mechanical components in the system. Refer to the Compatibility chart in chapter Revision history.

When replacing PC 1991 Control or PC 1992 Monitoring

turn on the unit and leave the unit on for two minutes before restart. A certain time is required for the options and settings to be transferred to the new PC board.

When replacing PC 1991 Control or PC 1992 Monitoring

the set time and date may need to be adjusted.

When replacing PC 1992 Monitoring, Technical error 25 may occur. Adjust the *Barometric pressure* in Service & Settings to solve this error (Service key required).

When replacing PC 2004/PC 2024 Expiratory channel, two Pre-use checks may be required. The first check will calibrate the Safety valve, but fail in other tests. The second check will pass.

Other technical errors may occur after a software installation. These errors disappear after restarting the system.

4.4 Information stored in the system

All electronic components equipped with an ID PROM store the information that is specific for the component, for example article number, version number and serial number.

Furthermore, some of the electronic components store information related to the complete system, for example system software, system info, configurations, logs and so forth. When replacing these components, the stored information may be lost. See table below.

Stored information	PC 1990 Main back-plane	PC 1991 Control	PC 1992 Monitoring	PC 1995 Plug & play back-plane	PC 2004/PC 2024 Expiratory channel	B740 CPU (Panel)	PC 1781 Pressure transducer	Expiratory cassette (PC 1786)	O ₂ cell O ₂ sensor	Edi module	Y sensor module
System software		X	X	X	X	X			X O ₂ sensor	X	X
System info: ▪ Serial number ▪ Installed software options ▪ Total operating and ventilation time ▪ Next preventive maintenance	X										
System info: ▪ System version			X								
Configurations ▪ Startup ventilation configuration		X									
Configurations ▪ Startup alarm configuration			X								
Configurations ▪ Units, language, date format, etc.						X					
Date and time setting			X								
Logs			X	X ²							
Trends						X					
Recordings						X					
Pre-use check results including transducer calibrations		X result		X calibration		X calibration	X calibration	X calibration	X calibration		
Barometer calibration			X								
Performed preventive maintenance			X ¹								
Replaced expiratory membrane			X ¹					X counter			
Replaced backlight			X ¹		X counter						
Backlight operating time					X						
Language					X						
Expiratory cassette: ▪ Date of first use ▪ Total operating time ▪ Remaining membrane capacity								X			
O ₂ cell/sensor: ▪ Date of first use ▪ Estimated remaining capacity (O ₂ cell)									X		

S25084

¹ Included in Service report as part of the Service log.² Copied to PC 1992 at Power On and continuously when the system is powered.

4.5 Assembling guidelines

All parts of the system assembled with screws and nuts are tightened with a specified torque. Thread locking adhesives are used if required.

In order to maintain these specifications over time, it must be ensured that after any service intervention removed parts are re-assembled and secured according to instructions. Make sure to follow the guidelines stated below.

4.5.1 Tightening torque

- Thread size M3: 0.95 Nm $\pm 15\%$
- Thread size M4: 3.1 Nm $\pm 15\%$
- Thread size M5: 5.0 Nm $\pm 15\%$
- Thread size M6: 7.0 Nm $\pm 15\%$
- Gas inlet nipples: 20 Nm $\pm 15\%$

4.5.2 Thread locking adhesives

- Electrolube Bloc'Lube BLV15ML® on threads in contact with PC boards.
- Loctite 243® on all other threads.

Note: Thread locking adhesive is not required on Heli-Coil® screw thread inserts as these screw thread-inserts have a self-locking function.

4.5.3 Special grease

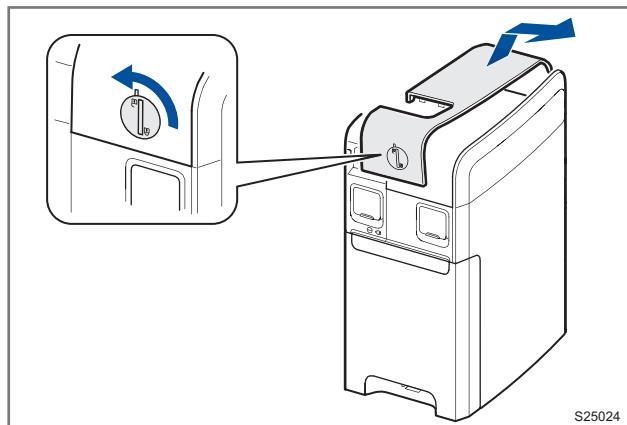
Lubricants should normally not be used when servicing the system. If lubricants must be used, use only very small amounts of grease with P/N 95 73 700. This special grease is O₂ compatible.



WARNING! Due to the increased O₂ concentration in valves and gas channels, only special grease intended for use in high O₂ concentrations, are allowed.

4.6 Inspiratory channel cover

- Turn the lock one quarter of a turn to release.
- Lift off the inspiratory channel cover.

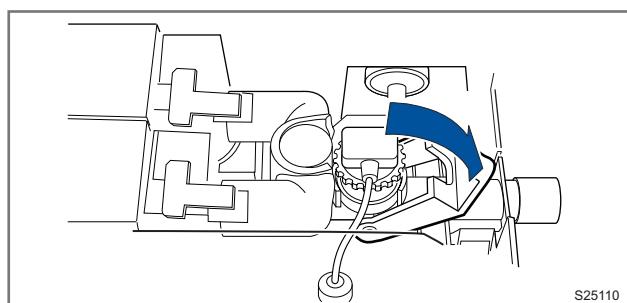


4.7 Inspiratory channel

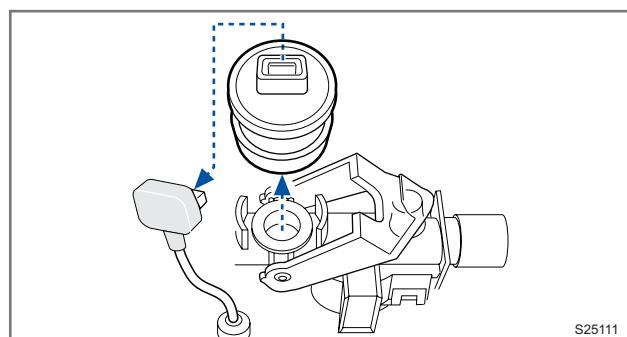
- Remove the inspiratory channel cover.

If an O₂ cell is installed:

- Lower the locking catch.

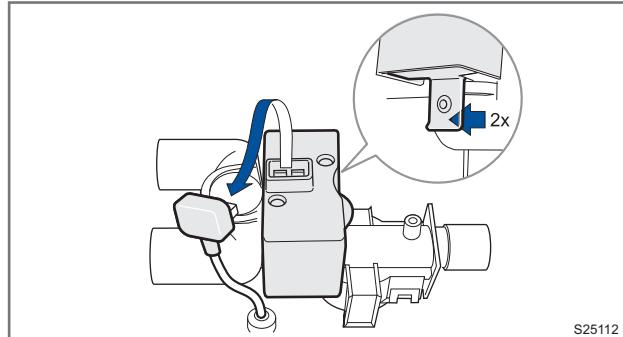


- Disconnect the O₂ cell connector and lift out the O₂ cell.

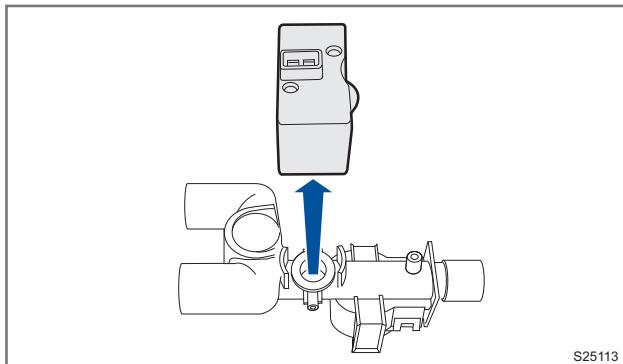


If an O₂ sensor is installed:

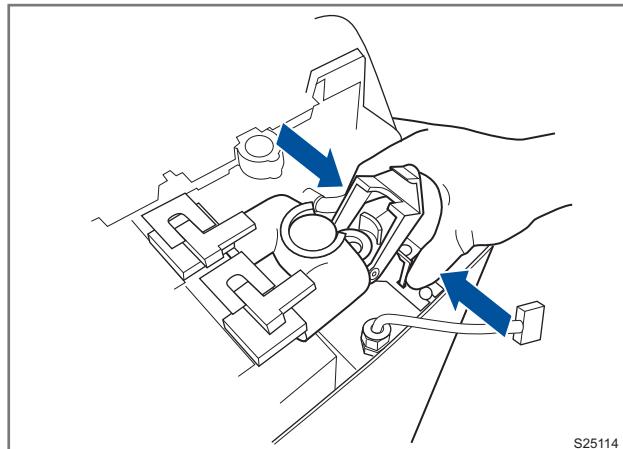
- Disconnect the O₂ sensor and carefully unlock the latches.



- Lift the O₂ sensor out of position.



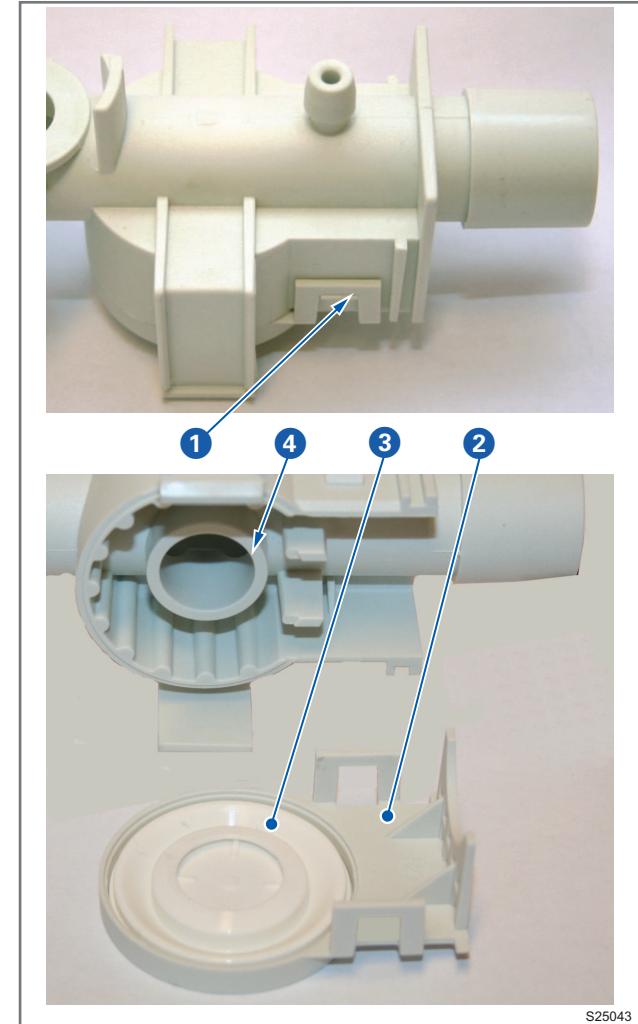
- Press the latches and lift the Inspiratory channel upwards.
- Disconnect the connector muff.
- Disconnect the inspiratory pressure tube.



4.8 Safety valve membrane

To remove the safety valve membrane:

- Remove the inspiratory channel.
- Release the latches (1), one on each side of the safety valve housing.
- Lift off the membrane holder (2).
- The membrane (3) and the valve seat (4) are now accessible, for example for inspection and cleaning.



S25043

4.9 Gas modules

To remove the gas modules:

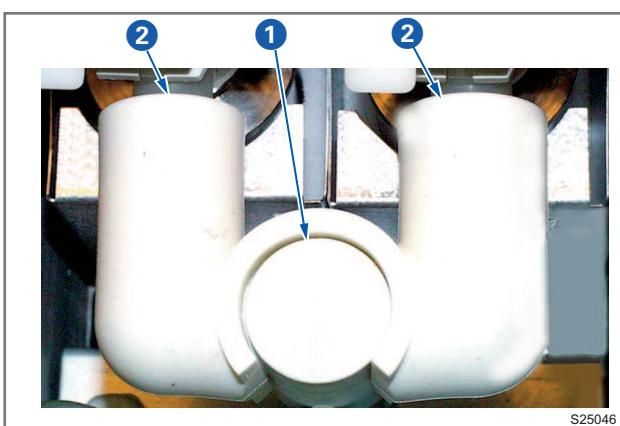
- Remove the inspiratory channel cover.
- Loosen the screw (1).
- Lift off the valve lid (2).
- Pull out and lift off the Air gas module (3).
- Pull out and lift off the O₂ gas module (4).

Notes:

- The Air gas module (3) must be removed before the O₂ gas module (4) can be removed. When assembling, start with the O₂ gas module.
- When replacing gas modules, make sure to use only SERVO-U, SERVO-n or SERVO-i gas modules. Similar gas modules intended for SERVO-s or FLOW-i Systems must not be used.



Note: When assembling, make sure that the connector muff seals properly around the inspiratory pipe (1). The connector muff must not be pushed too far onto the nozzle units (2).



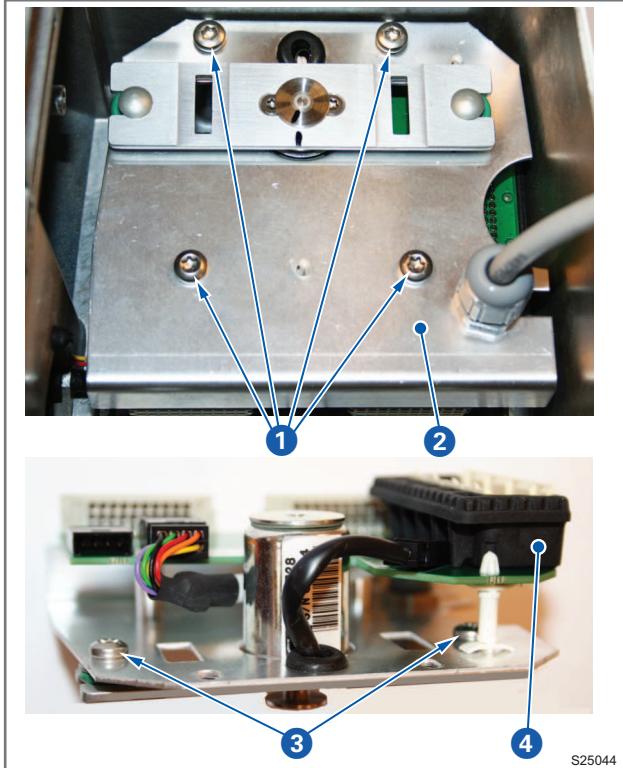
4.10 PC 2000 Pneumatic back-plane

To remove PC 2000 Pneumatic back-plane:

- Pull out the gas modules and disconnect them from PC 2000.
- Remove the inspiratory channel and the inspiratory pressure tube.
- Remove the screws (1).
- PC 2000 is secured to the mounting plate (2) with plastic studs. When removing this mounting plate assembly, grab the PC board and the mounting plate at the same time and carefully lift it to disconnect PC 2000 from PC 1990 Main back-plane.
- Disconnect Fan 2 Inspiratory section cable connector from PC 2000.
- Lift off the mounting plate assembly (2).

Notes:

- The screws (3) holding the safety valve pull magnet bracket are secured with thread locking adhesive.
- Make sure that the gasket (4) is mounted on PC 2000 when reassembling.



4.11 Expiratory cassette

Note: It is very important for the function of the expiratory valve that the valve membrane is removed and mounted correctly as described below.

The Expiratory cassette is a complete unit and must not be disassembled. The only parts that can be replaced are described below.

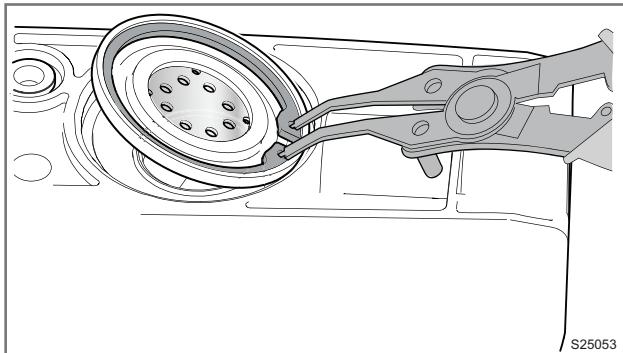
Operating capacity for the membrane is estimated to 10.000.000 breathing cycles. When this limit is passed or if the membrane for some reason has become defective, it must be replaced.

Membrane capacity (counter) can be shown in the System status window. Tap **SYSTEM STATUS > Expiratory cassette** to check **Membrane capacity**. The operating capacity meter must be reset after replacement of the membrane. Note that the reset function is not implemented in System version 1.01.03 or below.

4.11.1 Expiratory cassette valve membrane

To remove the valve membrane from the cassette

- Carefully remove the membrane including retaining ring using a suitable retaining ring pliers.

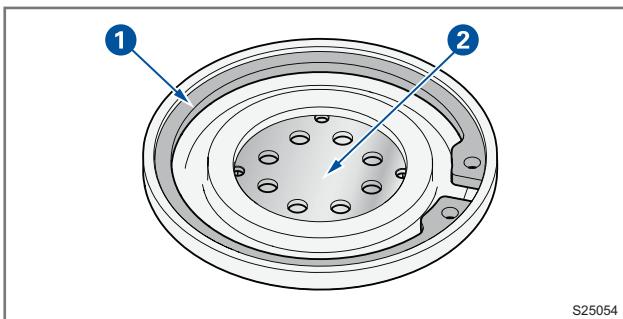


S25053

To mount the valve membrane into the cassette

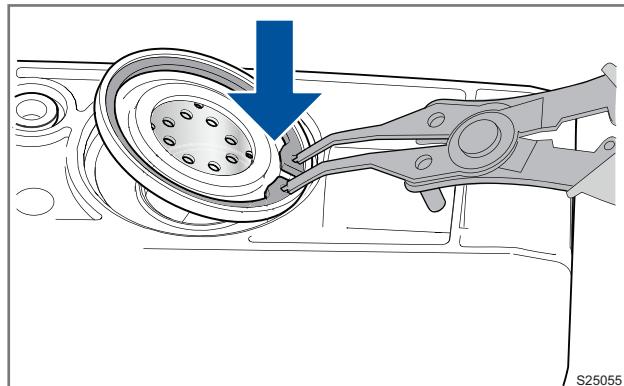
- Place the retaining ring (1) correctly into the membrane. Make sure that the retaining ring (1) and the washer (2) are correctly mounted.

Note: It is very important that the valve membrane and the membrane seat in the cassette are clean. Dirt particles can create leakage in the cassette.



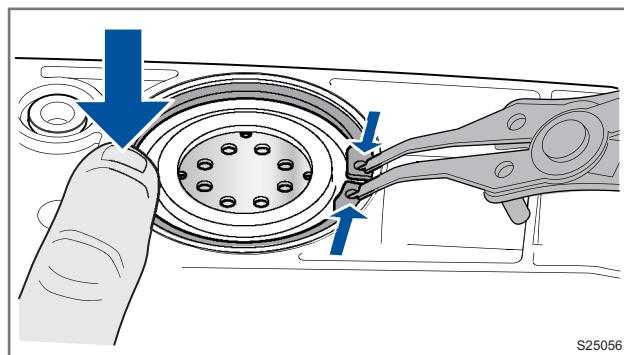
S25054

- Place the membrane onto the cassette as shown in the illustration.



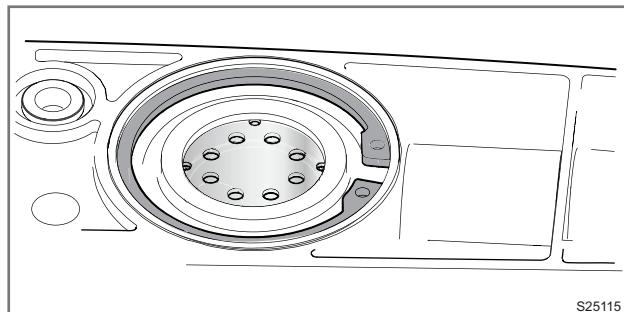
S25055

- Squeeze the retaining ring pliers and carefully press the membrane in place into the cassette as shown in the illustration.



S25056

- Carefully release and remove the pliers.
- Check that the membrane is not deformed by the retaining ring. If necessary, remove the membrane and redo the complete mounting procedure.
- Mount the expiratory cassette onto the Patient unit.
- Reset the operating capacity meter after replacement of the membrane.
- To access the reset button, tap *SERVICE & SETTINGS > SERVICE REPORT > Report replacement of exp. cassette membrane*. Note that the reset function is not implemented in System version 1.01.03 or below.

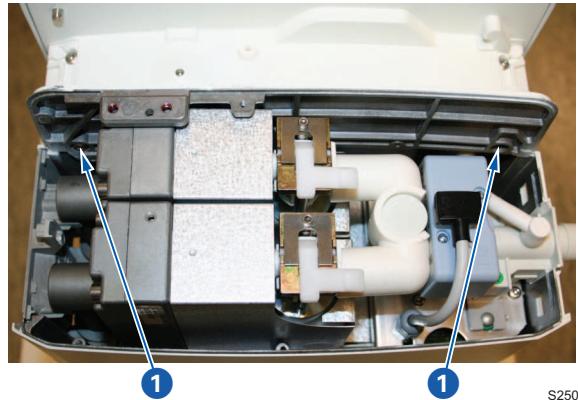


S25115

4.12 Front cover

To remove the front cover:

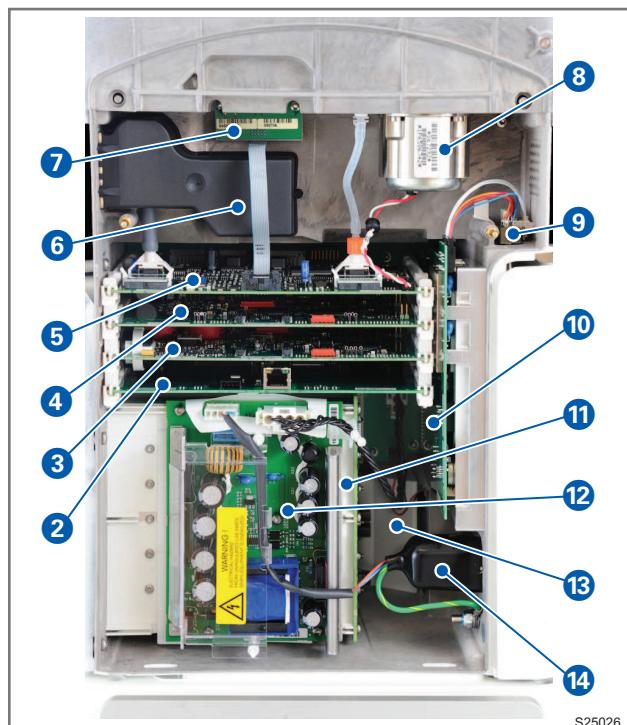
- Remove the inspiratory channel cover.
- Loosen the screws (1).
- Carefully pull out and lift off the front cover.



S25025

The following parts behind the front cover are now accessible:

- PC 1993 Ethernet switch (2)
- PC 1992 Monitoring (3)
- PC 1991 Control (4)
- PC 2004/PC 2024 Expiratory channel with the two connected PC 1781 Inspiratory and Expiratory Pressure Transducers (5)
- Fan 2 (behind funnel) (6)
- PC 1785 Expiratory channel connector (7)
- Expiratory valve coil (8)
- PC 1999 LED board and Power On/Off switch (9)
- PC 1998 DC/DC & Standard connectors (10)
- Module compartment including PC 1995 Plug & play back-plane (11)
- AC/DC converter (12)
- Fan 1 (13)
- Mains power supply inlet (14)



S25026

For software and hardware requirements and compatibility, see the Compatibility chart in chapter Revision history.

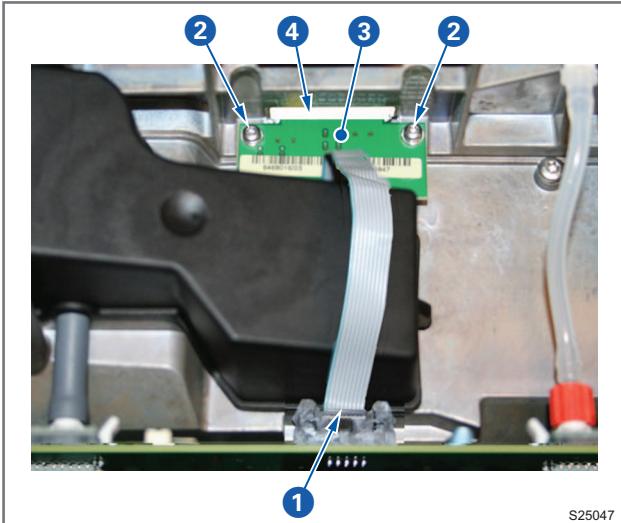
Note: Additional actions may be required after replacing PC boards. Refer to section Replacing PC boards in this chapter.

4.13 PC 1785 Expiratory channel connector

To remove PC 1785:

- Remove the front cover.
- Disconnect the PC 1785 cable connector (1).
- Remove the screws (2).
- Pull down and lift off PC 1785 (3).

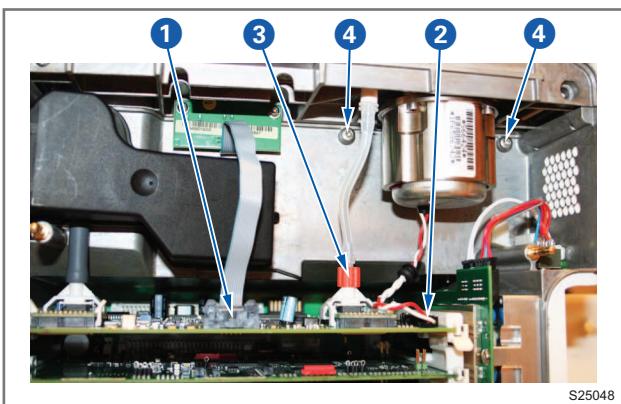
Note: When assembling, make sure that the rubber seal (4) stays in place and firmly encloses PC 1785.



4.14 Expiratory valve coil

To remove the expiratory valve coil:

- If the User interface is mounted on the Patient unit handle, release and lift off the User interface.
- Remove the expiratory cassette.
- Remove the Patient unit front cover.
- Disconnect the connectors (1 and 2) from PC 2004/PC 2024.
- Disconnect the expiratory pressure tube (3) from PC 2004/PC 2024.
- Remove the screws (4).

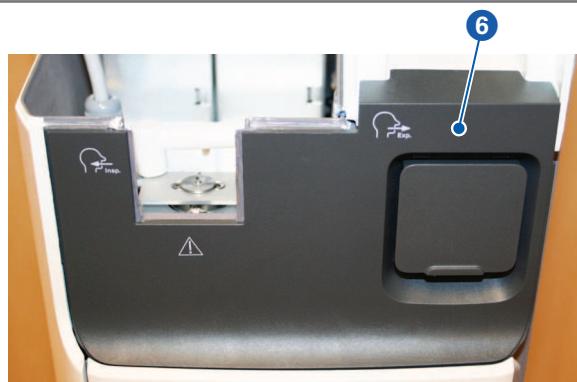


Remove the plastic side covers:

- To remove the side cover (5):
 - Remove the valve lid that secures the gas modules.
 - Carefully release the side cover using for example a small screwdriver.
 - Lift off the side cover.

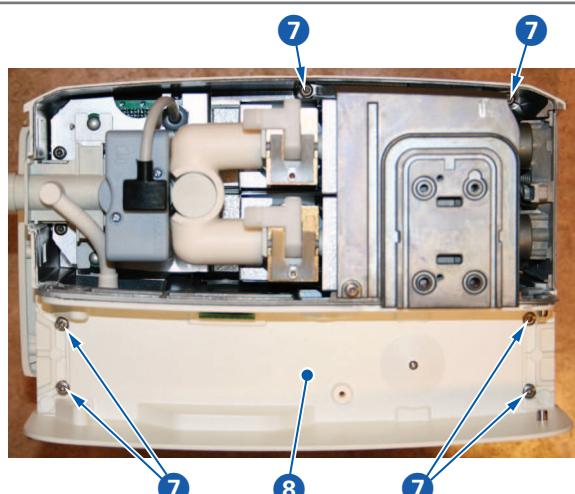


- To remove the side cover (6):
 - Lift off the inspiratory channel to access the latches securing the side cover.
 - Release the latches on the left side of the side cover.
 - Carefully release the right side of the cover using for example a small screwdriver.
 - Lift off the side cover.



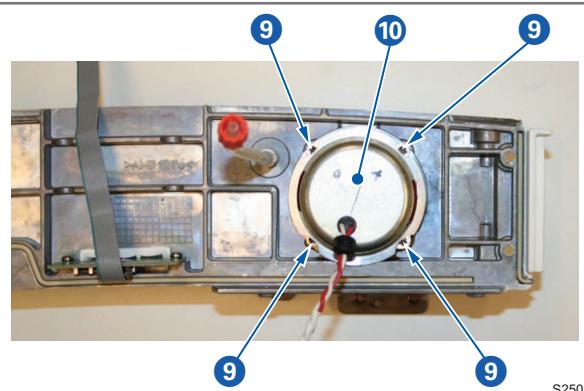
S25050

- Remove the screws (7).
- Lift off the cassette compartment assembly (8) including User interface holder. The User interface holder is not mounted on the unit in this illustration.



S25051

- Remove the screws (9).
- Lift off the expiratory valve coil (10).



S25052

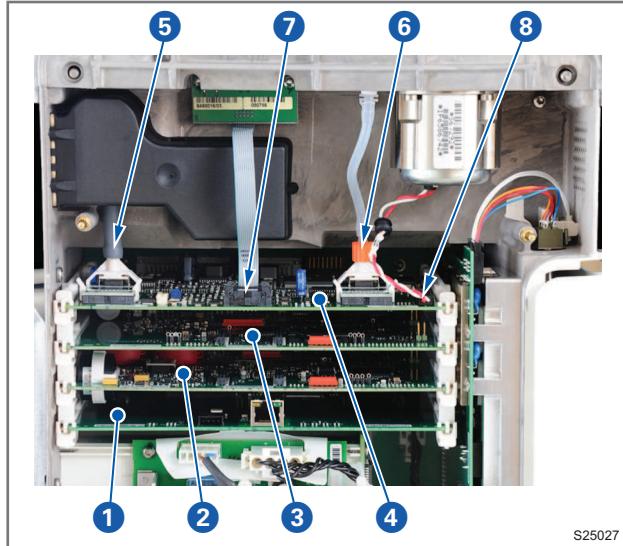
4.15 PC board rack

To remove the PC boards:

- Remove the front cover.
- Release the locks on the PC board guides.
- Carefully pull out the PC board/s:
 - PC 1993 Ethernet switch (1)
 - PC 1992 Monitoring (2)
 - PC 1991 Control (3)
- Before removing PC 2004/PC 2024:
 - Disconnect pressure transducer tubes (5 and 6).
 - Disconnect PC 1785 cable connector (7).
 - Disconnect Exp. valve coil cable connector (8).
 - Carefully pull out PC 2004/PC 2024 Expiratory channel (4).

For software and hardware requirements and compatibility, see the Compatibility chart in chapter Revision history.

Note: Additional actions may be required after replacing PC boards. Refer to section Replacing PC boards in this chapter.

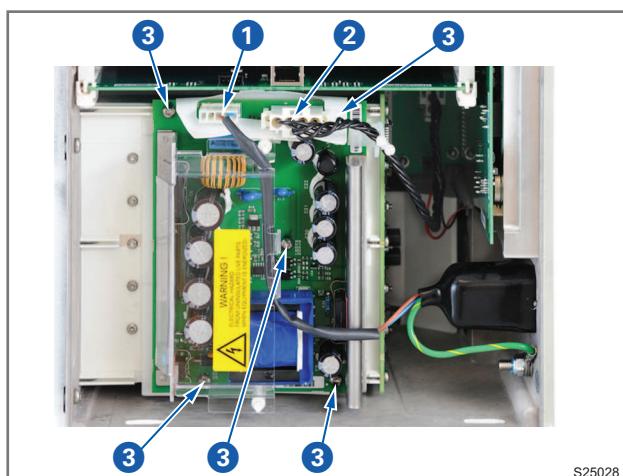


S25027

4.16 AC/DC converter

To remove the AC/DC converter:

- Remove the front cover.
- Disconnect the mains power cable connector (1).
- Disconnect the internal power cable connector (2).
- Remove the screws (3) and lift off the AC/DC converter. The upper right-hand screw is not visible in the illustration.

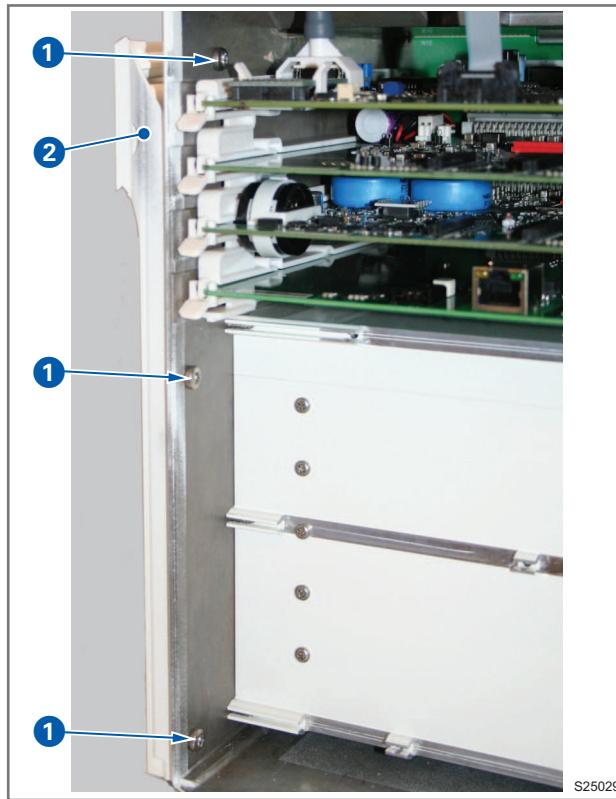


S25028

4.17 Module compartment frame including PC 1994 Nebulizer

To remove the module compartment frame:

- Remove the front cover.
- Remove the screws (1).
- Fold out and release the module compartment frame (2).
- Disconnect the nebulizer cable connector at PC 1994 Nebulizer.
- Lift off the module compartment frame (2).



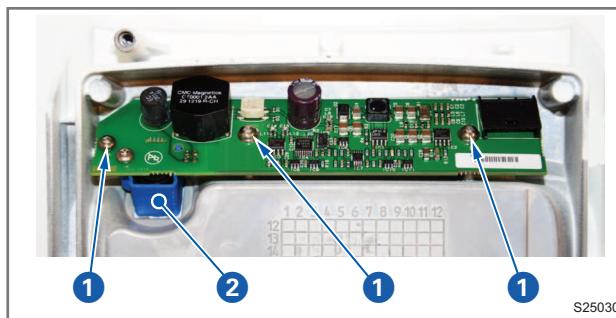
S25029

4.18 PC 1994 Nebulizer

PC 1994 Nebulizer is mounted inside the module compartment frame. To remove PC 1994 Nebulizer:

- Remove the module compartment frame.
- Remove the screws (1).
- Lift off PC 1994 Nebulizer.

Note: When mounting PC 1994, make sure the nebulizer connector (2) fits correctly into the hole in the frame.

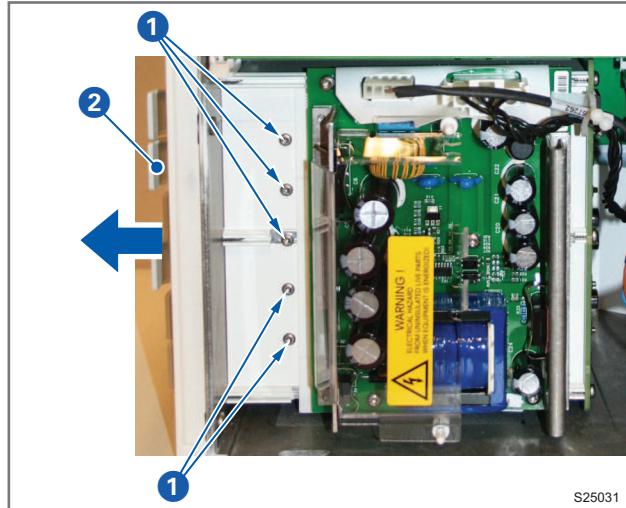


S25030

4.19 Module locking device

To remove the module locking device:

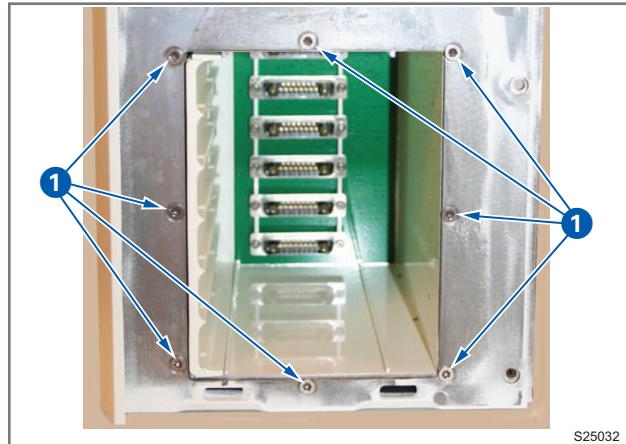
- Remove the module compartment frame.
- Remove the screws (1).
- Pull out the module locking device (2).



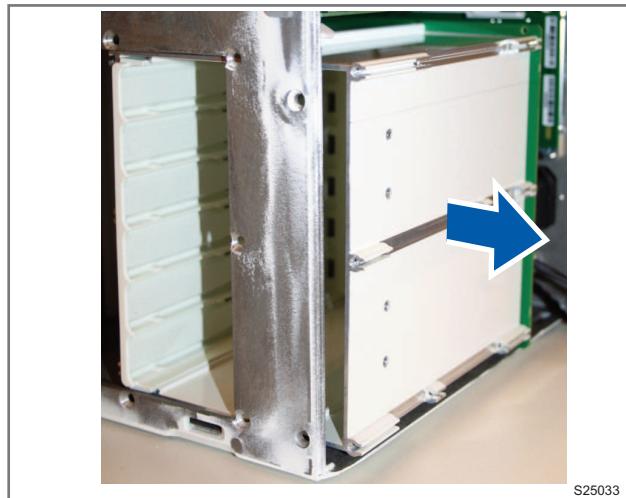
4.20 Module compartment including PC 1995 Plug & play back-plane

To remove the module compartment:

- Remove the module compartment frame.
- Remove the module locking device.
- Remove the screws (1).



- PC 1995 Plug & play back-plane is mounted on the module compartment and connected to the Main back-plane. Carefully pull out the module compartment assembly as shown in the image.

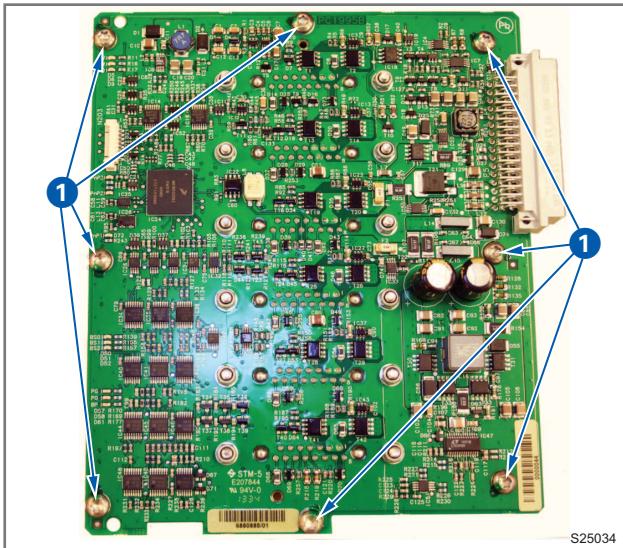


4.21 PC 1995 Plug & play back-plane

PC 1995 Plug & play back-plane is mounted on the module compartment. To remove PC 1995 Plug & play back-plane:

- Remove the module compartment.
- Remove the screws (1).
- Lift of PC 1995 Plug & play back-plane.

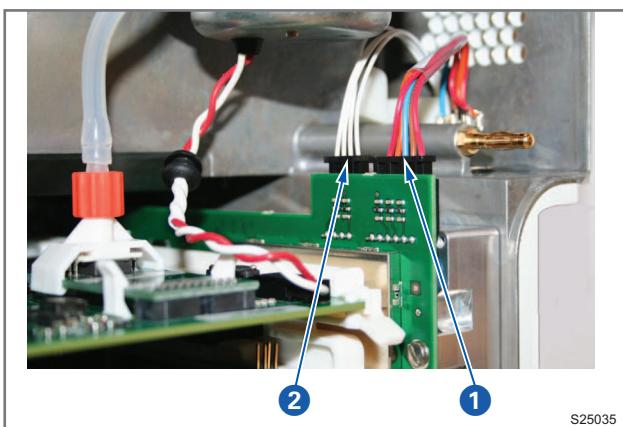
Note: Additional actions may be required after replacing PC boards. Refer to section Replacing PC boards in this chapter.



4.22 PC 1998 DC/DC & Standard connectors

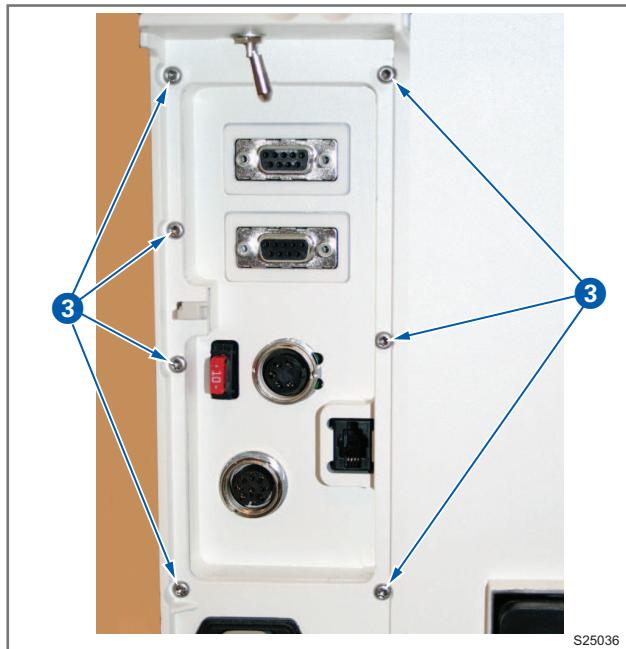
To remove PC 1998 DC/DC & Standard connectors:

- Remove the front cover.
- Disconnect the external connectors (control cable and likewise).
- Disconnect the On/Off switch cable connector (1).
- Disconnect the PC 1999 LED board cable connector (2).

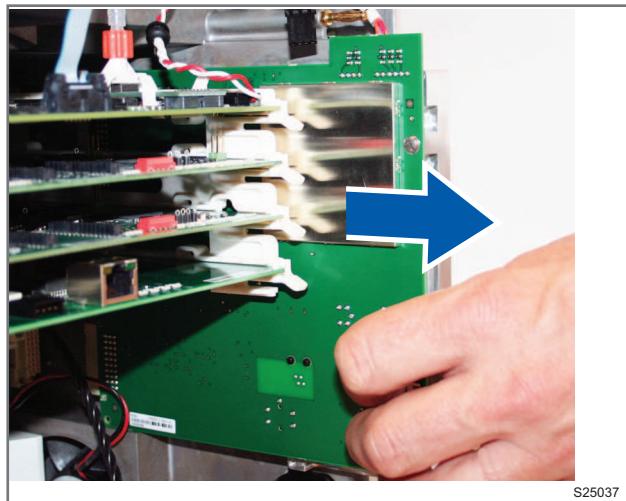


| 4 | *Disassembling and assembling* |

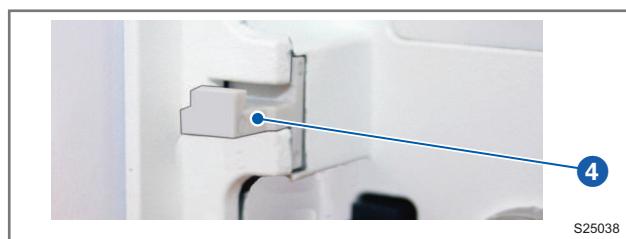
- Remove the screws (3).



- PC 1998 DC/DC & Standard connectors is connected to the Main back-plane. Carefully pull out PC 1998 as shown in the image.



Note: The catch (4) for the lid comes off when removing PC 1998. Make sure that the catch is placed in correct position when mounting PC 1998.



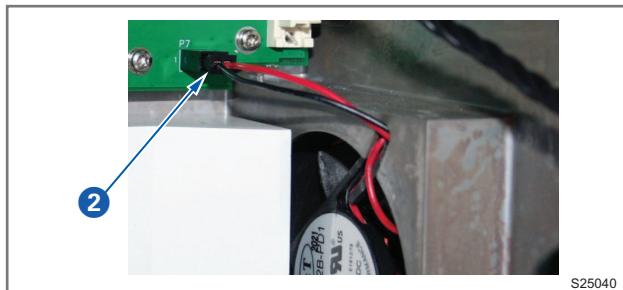
4.23 Fan 1 Patient unit

To remove Fan 1 Patient unit:

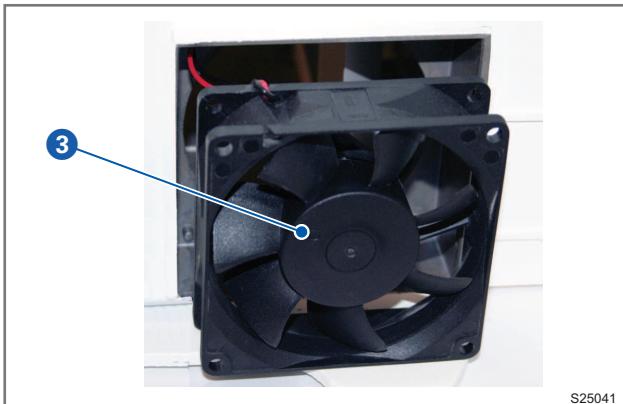
- Remove the front cover.
- Pull off the filter folder and the air inlet filter.
- Release and lift off the fan holder (1).



- Disconnect the fan cable connector (2) from the Main back-plane.



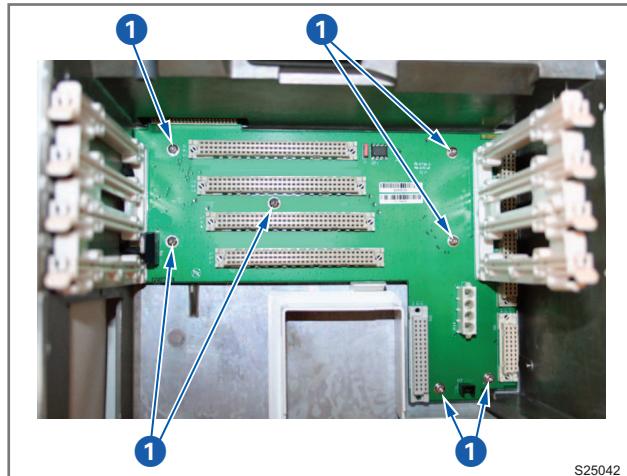
- Pull out and lift off the fan (3).



4.24 PC 1990 Main back-plane

To remove PC 1990 Main back-plane:

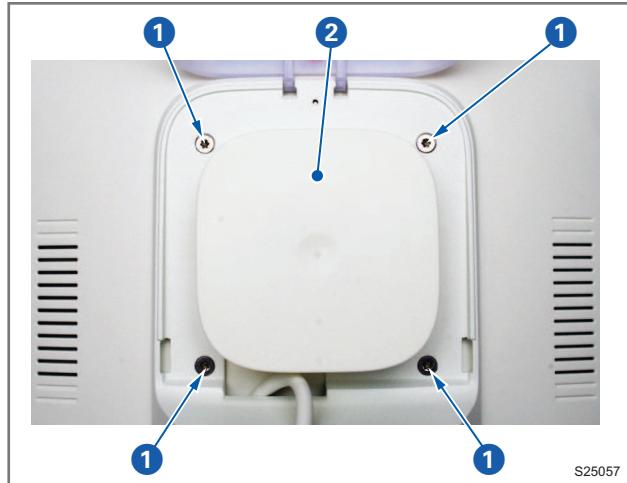
- Remove the front cover.
- Remove all four PC boards from the PC board rack.
- Remove the AC/DC converter.
- Remove the Module compartment incl. PC 1995 Plug & play back-plane.
- Remove PC 1998 DC/DC & Standard connectors.
- Remove Fan 1 Patient unit.
- Remove the screws (1).
- Carefully disconnect PC 1990 from PC 2000 Pneumatic back-plane. Lift off PC 1990.



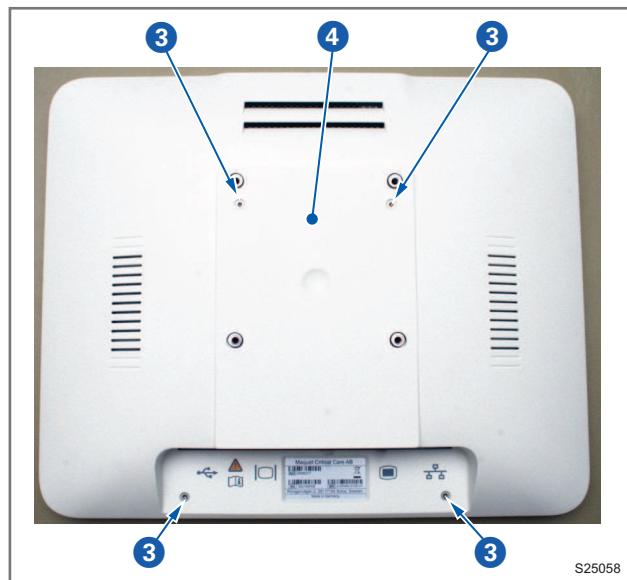
S25042

4.25 User interface

- Disconnect the Control cable from the User interface.
- Remove the User Interface from the User interface holder and place it on an ESD protected work space.
- Remove the screws (1).
- Lift off the User interface mount (2).

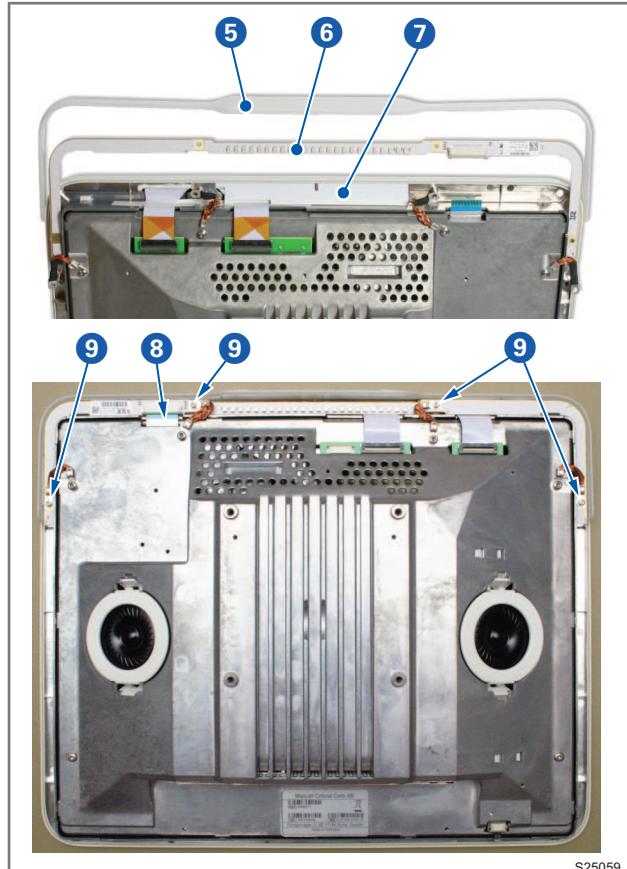


- Remove the screws (3).
- Lift off the rear cover (4).



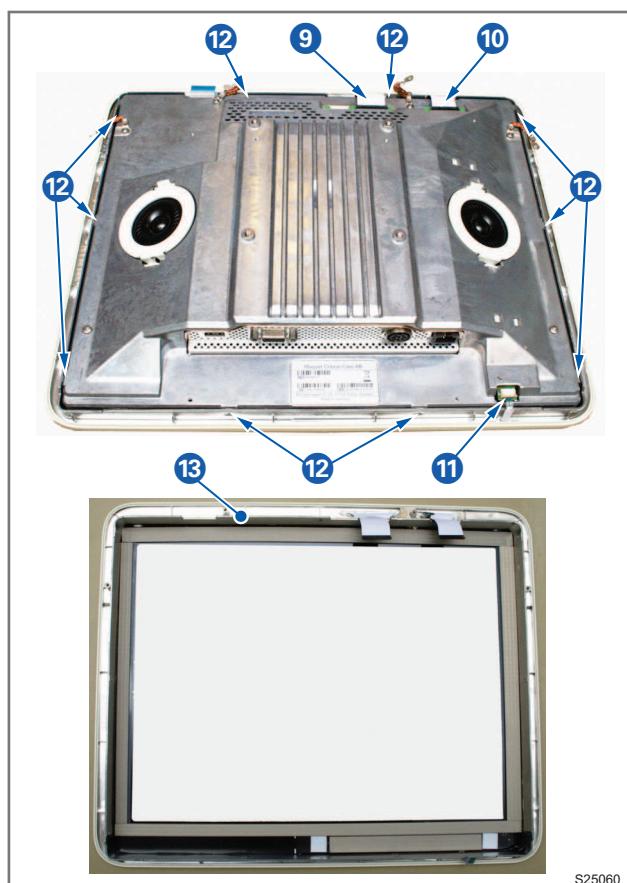
- The plastic light bar frame (5) can now be removed.
- To remove B734 Light bar (6):
 - Carefully disconnect the cable (8).
 - Remove the screws (9).
- The Light bar reflector (7) is kept in place by the B734 Light bar. To remove the Light bar reflector:
 - Remove the B734 Light bar (6).
 - Lift off the Light bar reflector.

Note: The light bar reflector and the new design of the light bar frame contribute to increased visibility of the alarm indicator. This new design was introduced in production during Q3 2015, but can be retrofitted on older systems.



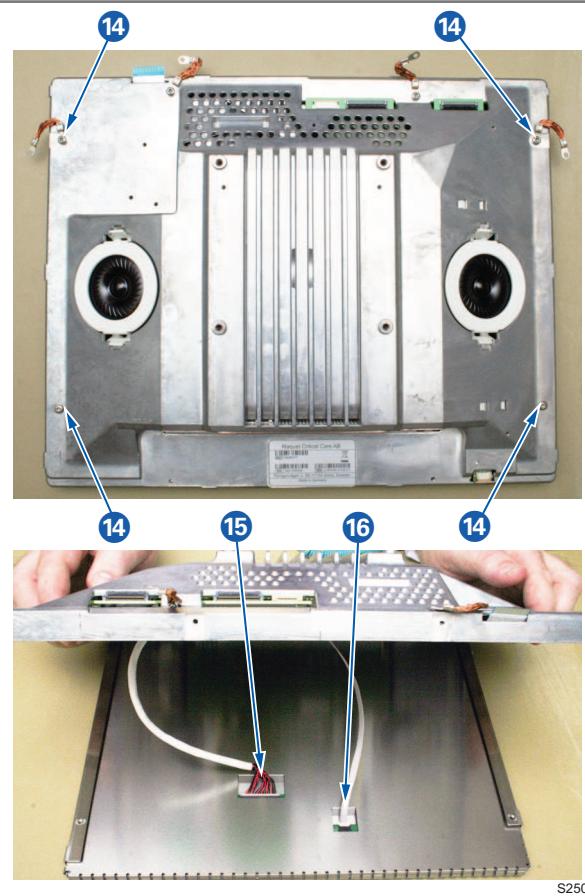
S25059

- To remove the touch screen with frame:
 - Carefully disconnect the cables (9, 10 and 11).
 - Remove the screws (12). There are ten screws in total; two on the top, two in the bottom, three on the left side and three on the right side.
 - Lift off the main assembly from the touch screen with frame (13).



S25060

- To separate the LCD Display from the main assembly:
 - Remove the screws (14).
 - Carefully lift the main assembly, as shown, to access the cable connectors (15 and 16).
 - Disconnect the cables (15 and 16).

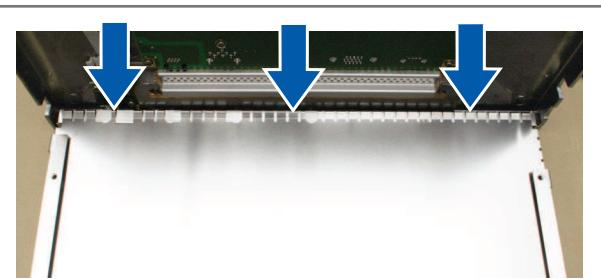


S25061

- The LCD Display shield plate is hooked onto the main assembly (at the arrows).
- Unhook and lift off the LCD Display.

Notes:

- When assembling, make sure to mount the LCD Display shield correctly on the main assembly.
- Do not remove the shield plate from the LCD Display as this is a complete unit.

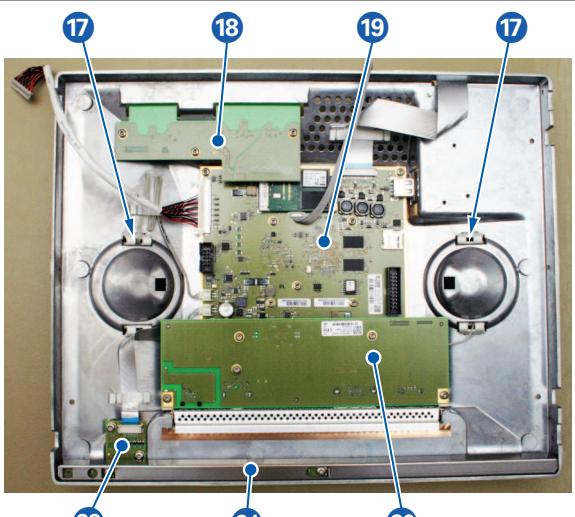


S25062

The electronics inside the main assembly is now accessible:

- Loudspeakers (17). The loudspeakers are released from the outside of the main assembly but must be disconnected on the inside.
- B735 Touch controller board (18).
- B740 CPU board (19) with its memory card.
- B732 I/O board (20).
- B739 Ambient light sensor (ALS) board (21) mounted behind the metal cover.
- B733 Touch button board (22).

Note: Additional actions may be required after replacing PC boards. Refer to section Replacing PC boards in this chapter.



5 Service procedures

Table of Contents

5.1	Service key	5 - 2
5.2	Service & Settings	5 - 2
5.3	Software installation	5 -15
5.4	Leakage detection	5 -19
5.5	Battery modules	5 -23
5.6	Memory backup batteries	5 -25

5.1 Service key

The Service key is a USB memory stick provided to personnel trained and authorized by Getinge to perform installation, service or maintenance of the system.

With the Service key it is possible to access different user levels of the built-in Service & Settings software. There are two user levels intended for Service that are described in this manual:

- Trained biomed. User level intended for hospital biomed trained and authorized by Getinge.
- Field service. User level intended for trained and authorized Getinge and Getinge partner's personnel.

The Service key, and its associated access code, are personal and must not be handed-over to anyone else. The access code is unique for each Service key.

Notes:

- When saving information, such as logs and screenshots, to a USB memory stick, allow the saving procedure to complete before removing the memory stick. Information is shown on the control panel when completed.
- Make sure to log out (tap *EXIT*) from Service & Settings when completed. If the Service key is removed while Service & Settings is open, access remains until manual exit.

5.2 Service & Settings

Service & Settings (S&S) is a built-in software provided to facilitate troubleshooting, service and maintenance of the system.

WARNING! Service & Settings must not be activated with a patient connected to the system.

Notes:

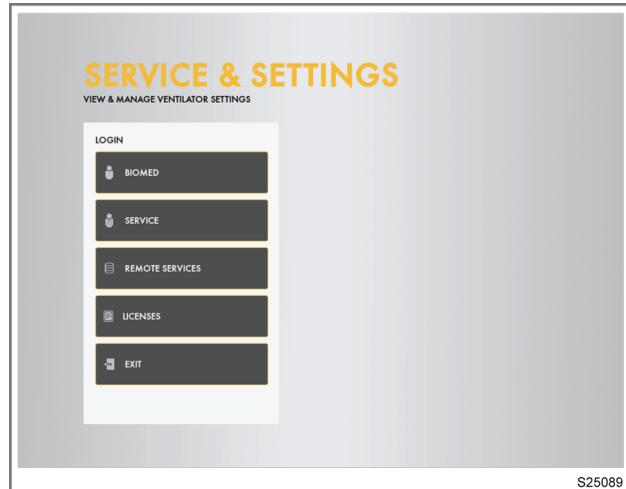
- It is only possible to access Service & Settings with the system in Standby mode.
- For an overview of the Service & Settings functions, refer to the Service & Settings menu in chapter Diagrams.

5.2.1 To access Service & Settings

- Tap **SERVICE & SETTINGS** in the extended menu.
The Service & Settings login menu is displayed.

There are five options in the login menu:

- **BIMED.** Tap **BIMED** and enter the 4 digit code 1973 (default) to access this user level. The User's Manual describes user level **BIMED**.
- **SERVICE.** Only for personnel trained and authorized by Getinge. A Service key connected to the system and the associated access code is required.
- **REMOTE SERVICES.** Remote Services start button.
- **LICENSES.** Licenses for third party software packages. Listed for legal reasons.
- **EXIT.** To exit Service & Settings.



S25089

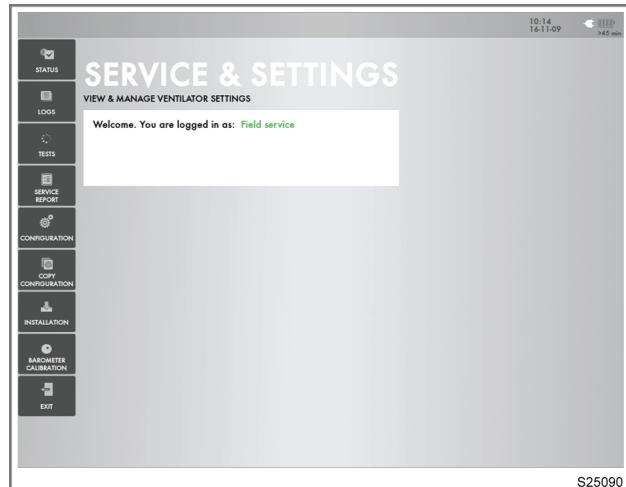
To access the SERVICE user level:

- Insert the Service key.
- Tap **SERVICE**.
- Enter the access code and verify by tapping the green check mark.
- The Service & Settings start screen is displayed.

The start screen shows the actual user level.

The following choices are available:

- **STATUS**
- **LOGS**
- **TESTS**
- **SERVICE REPORT**
- **CONFIGURATION**
- **COPY CONFIGURATION**
- **INSTALLATION**
- **BAROMETER CALIBRATION**
- **EXIT**



S25090

The Service & Settings main functions listed above are described later in this chapter.

5.2.2 Status

STATUS is used for viewing system information, installed software options and parts data.

In *System info* the following information is available:

- **SYSTEM INFORMATION**
- **O₂ CELL/SENSOR**
- **EXPIRATORY CASSETTE**
- **BATTERY STATUS**

The screenshot shows the 'System info' tab selected in the top navigation bar. The main content area displays various system parameters and their values. On the left, a vertical menu lists: STATUS, LOGS, TESTS, SERVICE REPORT, CONFIGURATION, COPY CONFIGURATION, INSTALLATION, BAROMETER CALIBRATION, and EXIT. The right side contains four main sections: 'O₂ SENSOR' (calibration date 17/03, 16-11-02; date of first use 20-02-12), 'EXPIRATORY CASSETTE' (operating time 23016 hours, accumulated use 22296274, cassette 22296274), 'BATTERY STATUS' (battery backup time 72 min, slot 1-5 details), and a summary section with total operating time (19138 hours), total validation time (5775 hours), next preventive maintenance (4483 hours), and system SW version (2.0.47905).

S25091

In *Options* the following information is available:

- **INSTALLED OPTIONS** (software options)

The screenshot shows the 'Options' tab selected in the top navigation bar. The main content area displays a list of installed software options. The left vertical menu is identical to the 'System info' screen. The right side lists the following installed options: Adult patients, Automode, BiVent/APRV mode, CO₂ analyzer, HIGH FLOW, NAVA, NIV, NIV NAVA, Neural CRAP, Neonatal patients, PRVC mode, Pediatric patients, Pressure Control mode, Pressure Support mode, Remote alarm, SERVO COMPASS, SIMV [PC] + PS mode, SIMV [PRVC] + PS mode, SIMV [VC] + PS mode, and Volume Control mode.

S25120

In *Parts data* (parts with ID-PROM) the following information is available:

- **PART** (name)
- **ARTICLE NUMBER**
- **VERSION NUMBER**
- **SERIAL NUMBER**

The screenshot shows the 'Parts data' tab selected in the top navigation bar. The main content area displays a table of parts with ID-PROM. The left vertical menu is identical to the 'System info' screen. The table has columns for PART, ARTICLE NUMBER, VERSION NUMBER, and SERIAL NUMBER. The data includes: O₂_GAS_MODULE (Article Number 0, Version 0, Serial 000000, ID NN296113); PC1781_INSPIRATION (Article Number 6467893, Version 6, Serial NN255032); PC1781_EXHALATION (Article Number 6467893, Version 6, Serial 77); PC1995 (Article Number 6880885, Version 2, Serial 000026); PC1993 (Article Number 6690437, Version 0, Serial 000122); PC1998 (Article Number 6690452, Version 2, Serial 000000); AIR_GAS_MODULE (Article Number 0, Version 0, Serial NN326029); PC2004 (Article Number 6692477, Version 3, Serial 276); PC1991 (Article Number 6689785, Version 6, Serial 8); PC1992 (Article Number 6689790, Version 3, Serial 337556011); BT40 (Article Number 6694577, Version 2-DH46-3003-01, Serial 200049); PC1786 (Article Number 6692837, Version 1, Serial 00037074); PC1873 (Article Number 6670600, Version 0, Serial 000197); and PC1990 (Article Number 6690432, Version 2, Serial 000197).

S25121

5.2.3 Logs

LOGS is used for viewing *Service logs* and *Event logs* for a certain period of time. A date interval can also be set and a search function is available.

In *Service logs* the following search filters are available:

- *Test results*
- *Test details*
- *Preventive maintenance*
- *Service report*
- *Technical alarms*
- *Installation*



In *Event logs* the following search filters are available:

- *Alarms*
- *Settings*
- *Functions*
- *Configuration*

Notes:

- Logs can be saved to a USB memory stick.
- Only a USB memory stick may be connected to the USB port.

Save logs to USB:

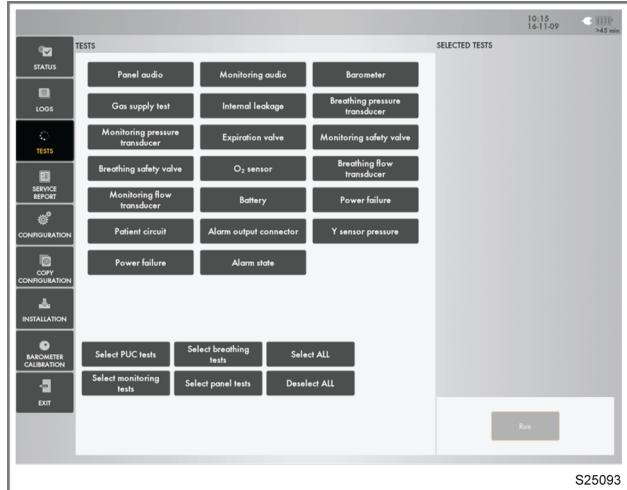
- Insert a USB memory stick.
- Tap **Save to USB**. It is not necessary to select logs before saving to USB. All required logs are copied to the USB memory stick.
- The message **SAVE LOGS TO USB** is shown during the file transfer. When completed, all log files are saved in the **ventilatorData** folder on the USB memory stick.
- Remove the USB memory stick.

5.2.4 Tests

TESTS is used to perform a Pre-use check, either the complete check, or any of the separate tests included in the Pre-use check.

- Tap *Select PUC tests* to perform a complete Pre-use check.

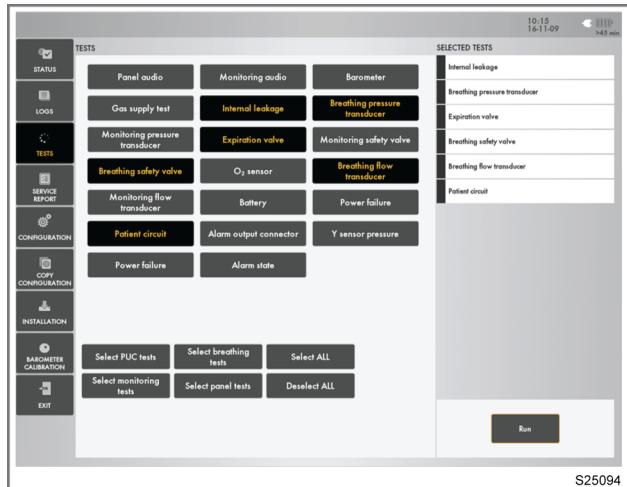
All Pre-use checks are described in section Pre-use check, chapter Troubleshooting.



The *TEST* menu also contains choices to:

- *Select breathing tests* (selected in the screenshot)
- *Select monitoring tests*
- *Select panel tests*

These tests are included in the Pre-use check, but when performed in this menu, they are limited to the function of each subsystem.



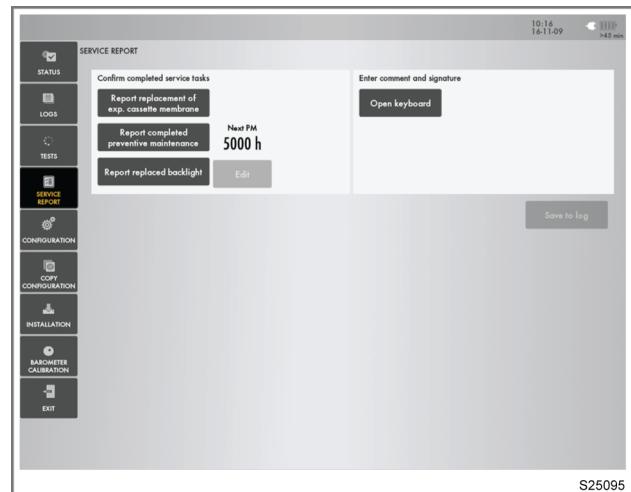
5.2.5 Service report

SERVICE REPORT is used for reporting service tasks.

The following completed service tasks can be confirmed:

- *Report replacement of exp. cassette membrane*
- *Report completed preventive maintenance*
- *Report replaced backlight*

Tap *Open keyboard* to enter comments and a signature.



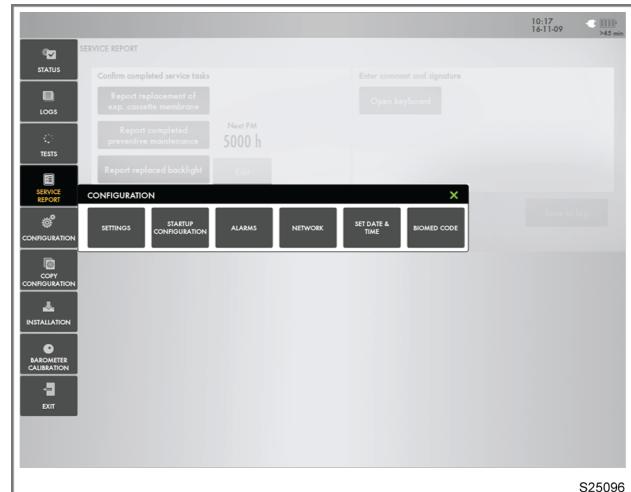
With the button *Edit*, it is possible to set a shorter time until next Preventive Maintenance. This function can be used if the time stamp for the previous Preventive Maintenance has been lost, for example after replacement of the Main back-plane.

5.2.6 Configuration

CONFIGURATION is used for viewing and editing the configuration of the system.

The following choices are available and explained below:

- *SETTINGS*
- *STARTUP CONFIGURATION*
- *ALARMS*
- *NETWORK*
- *SET DATE & TIME*
- *BIMED CODE*

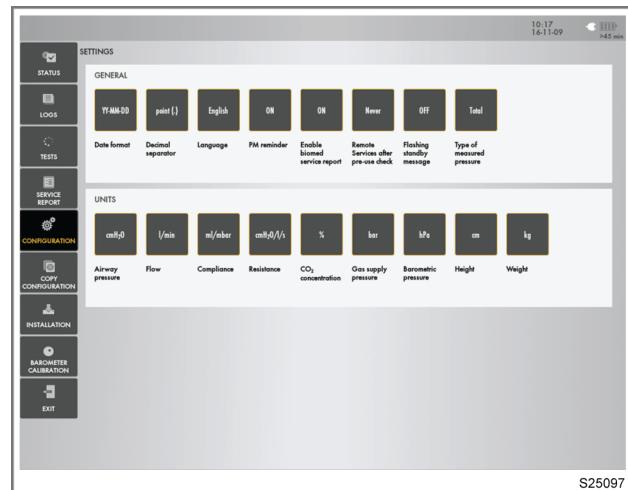


Settings

SETTINGS is divided into two sections; *GENERAL* and *UNITS*.

The following settings are available in *GENERAL*:

- *Date format*
- *Decimal separator*
- *Language*
- *PM reminder* (On/Off)
Enables/disables the *SERVICE REPORT* function in the Biomed user level. Available in Field service user level only.
- *Enable biomed service report* (On/Off).
- *Remote Services after pre-use check*. To set if log files should be sent via Remote Services after pre-use checks.
- *Flashing standby message* (On/Off)
- *Type of measured pressure* (Total/Driving).



The unit settings for the following parameters are available in *UNITS*:

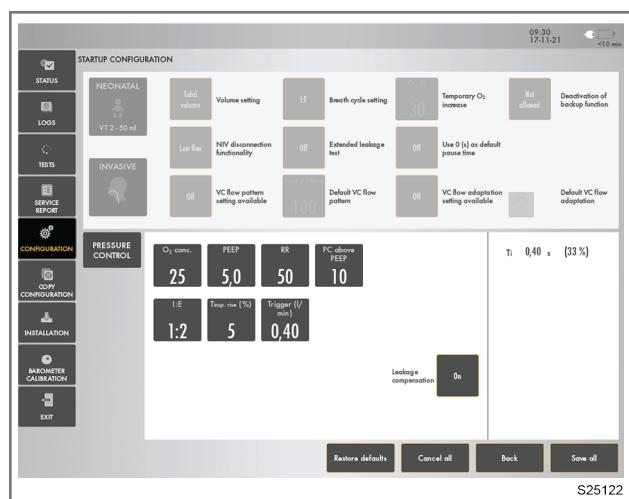
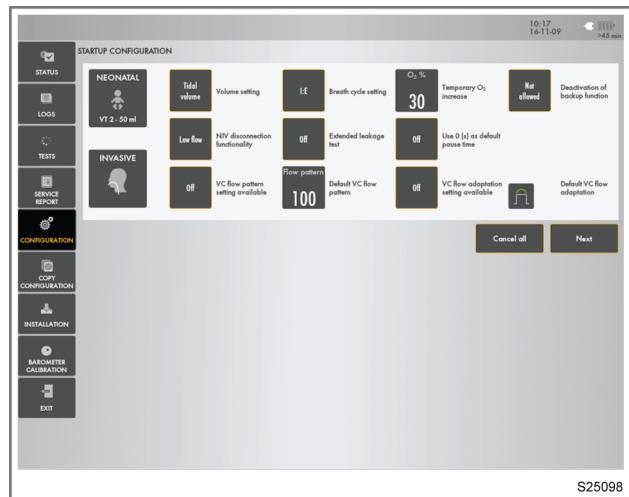
- *Airway pressure*
- *Flow*
- *Compliance*
- *Resistance*
- *CO₂ concentration*
- *Gas supply pressure*
- *Barometric pressure*
- *Height*
- *Weight*

Startup configuration

STARTUP CONFIGURATION is used for setting the startup configuration of the system.

In this menu, it is also possible to restore factory default startup configuration.

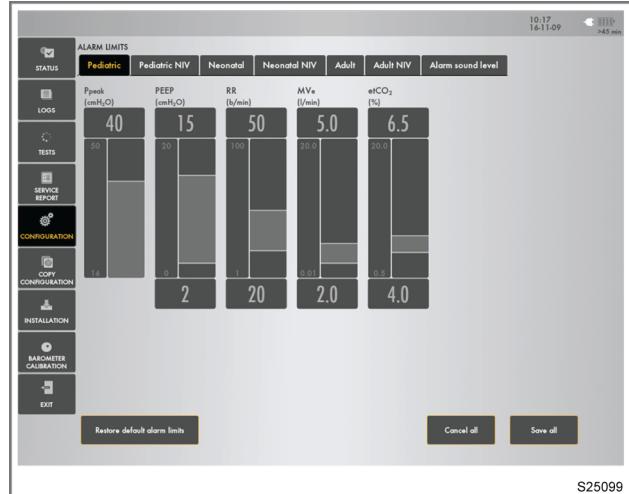
Refer to the User's Manual for information on startup configuration.



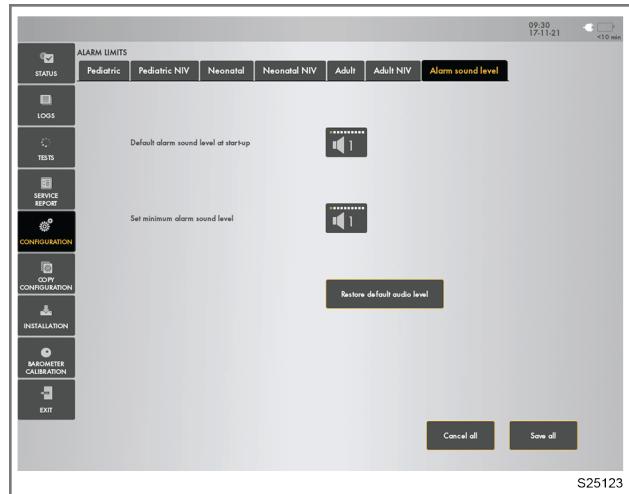
Alarms

ALARMS is used to set the system alarm limits for:

- Patient category and type of ventilation:
 - *Pediatric*
 - *Pediatric NIV*
 - *Neonatal*
 - *Neonatal NIV*
 - *Adult*
 - *Adult NIV*
- *Restore default alarm limits.*



- It is also possible to set *Alarm sound level* or *Restore default audio level*.

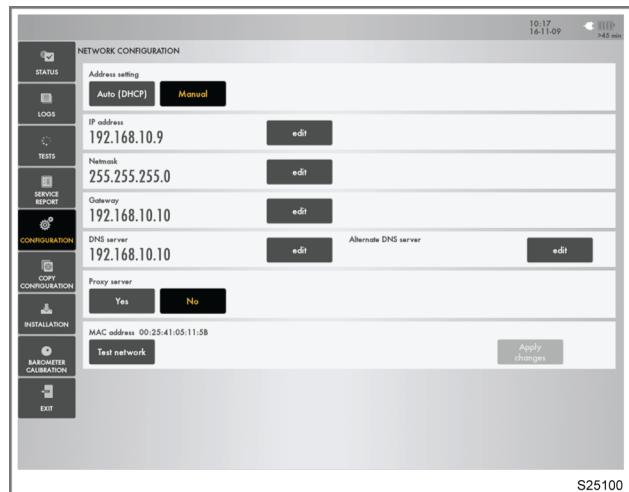


Network

NETWORK is used to display and configure network parameters when connecting the system to Remote Services.

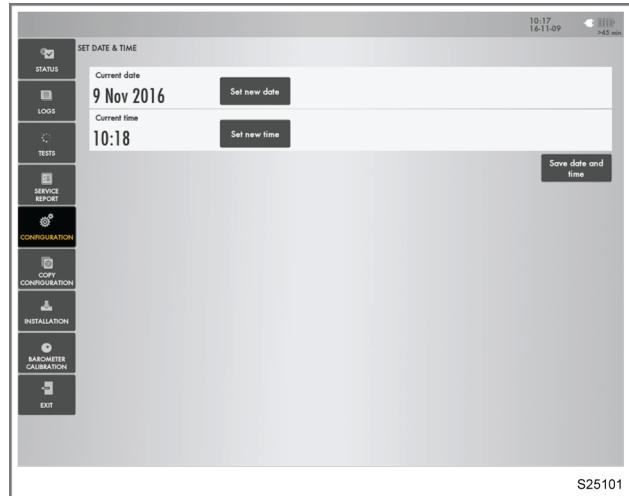
In the *Network* menu, it is possible to select *Auto (DHCP)* or *Manual* configuration.

For installation and setup instructions, refer to the Remote Services, SERVO-U/SERVO-n Ventilator System – Installation Instructions.



Set date & time

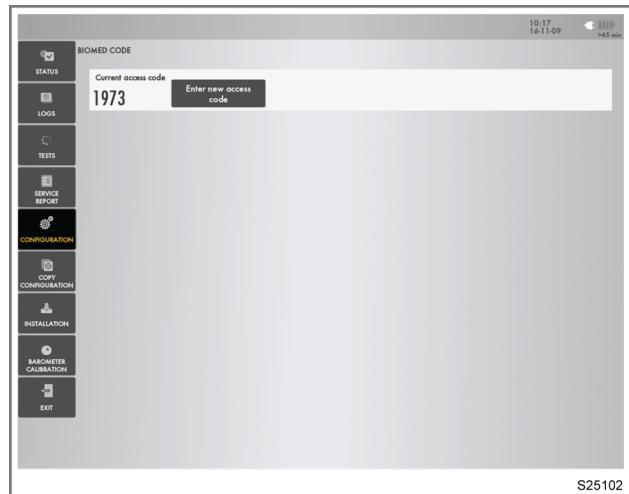
SET DATE & TIME is used to set the systems real time clock.



Biomed code

BIOMED CODE is used to set the four-digit code used to log in as Biomed to Service & Settings.

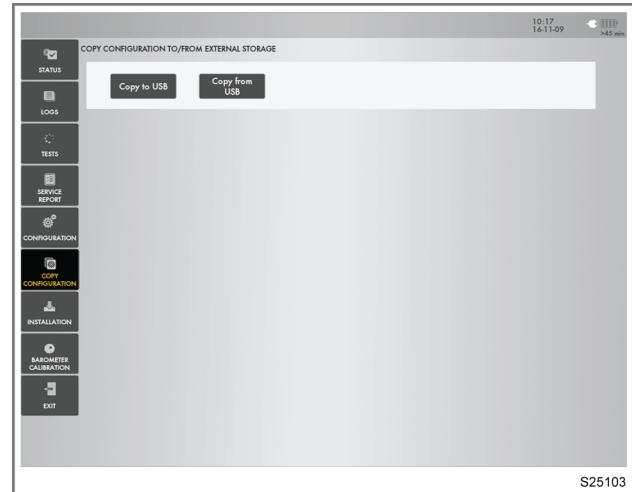
The default biomed code is 1973.



5.2.7 Copy configuration

COPY CONFIGURATION is used to export or import the systems configuration using a USB memory stick.

This function can for example be used to quickly install the same configuration to several systems.

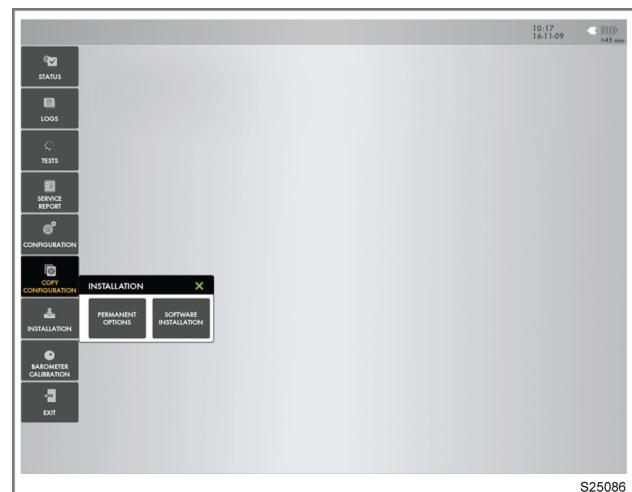


5.2.8 Installation

INSTALLATION is used for installing:

- **PERMANENT OPTIONS.** This function starts a System option installation to install Software options.
- **SOFTWARE INSTALLATION.** This function starts a System software installation to install a new System software version.

Installation is separately described in section Software installation.



5.2.9 Barometer calibration

BAROMETER CALIBRATION is used for calibrating the internal barometer. A barometer or information about the actual barometric pressure at the installation site is required.

Note: The actual barometric pressure is affected by altitude and weather. Make sure that the absolute barometric pressure at your current location and elevation is used. Do not use barometric pressure readings from a weather service as these typically report barometric pressure at sea level.

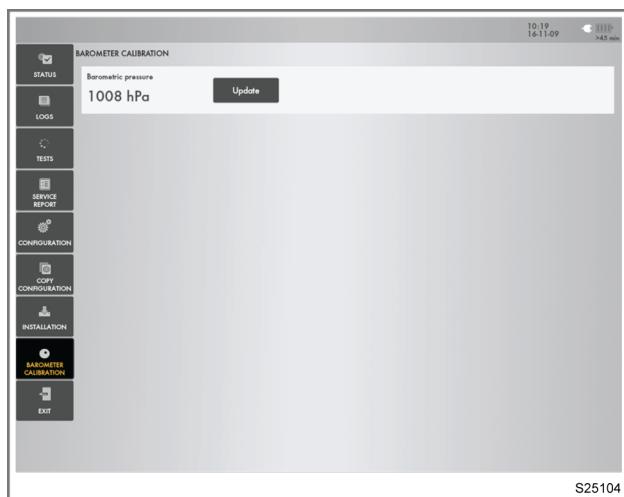
The barometer must be calibrated:

- If the Barometer test in Pre-use check fails.
- If a Technical error code indicates Barometer error.
- If the barometric pressure check performed during installation or Preventive maintenance shows that calibration is required, that is, if the *Barometric pressure* shown in the **SYSTEM STATUS > General** window differs more than ±5% from the actual barometric pressure.
- After replacement of PC 1992 Monitoring or in case of malfunction in the memory backup battery on PC 1992.

To calibrate the barometer:

- Tap **BAROMETER CALIBRATION**.
- Tap **Update**.
- Enter the actual barometric pressure and tap the **OK** button.

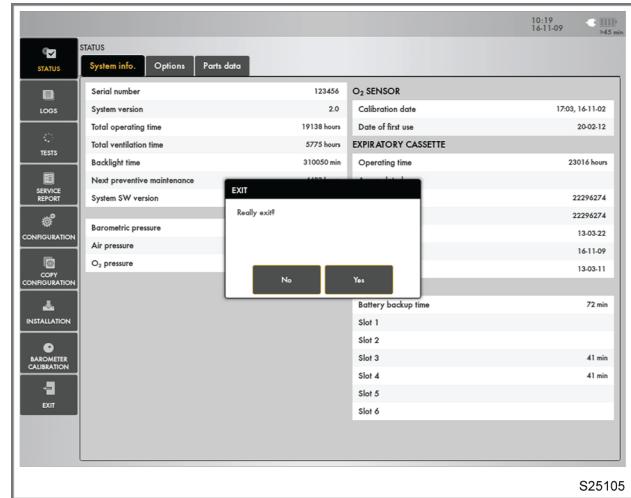
After calibration, check that the new *Barometric pressure* value corresponds to the set value. Note that the new *Barometric pressure* value may differ 1-2 hPa from the set value.



5.2.10 Exit

EXIT is used to log out from Service & Settings.

Make sure to log out (tap *EXIT*) from Service & Settings when completed. If the Service key is removed with Service & Settings open, access to Service & Settings remains.



5.3 Software installation

5.3.1 General

- This chapter describes the installation of System software and Software options.
- Only personnel trained and authorized by Getinge shall be permitted to install System software and Software options.
- Software installation is performed in Service & Settings. The Software installation function is available in *BIOMED* and *SERVICE* user levels. With *BIOMED* user level, Service key is not required.
- For functionality enhancement, the latest released System software version is always recommended.

5.3.2 Check before installation

- It is not recommended to install System software with lower version number than already installed in the system:
 - Check installed System software version, see *System SW version* in *SYSTEM STATUS > General*.
 - Check the System software version stored on the USB memory stick.
- Some parts of the configuration may be changed during the System software installation. Copy the Startup configuration to a USB memory stick prior to a software installation and reinstall the configuration afterwards.
- Make sure that the software is fully compatible with all hardware, software and mechanical components in the system. See the Compatibility chart in chapter Revision history.
- If an Edi module or Y sensor module is part of the system, software stored in the module is checked/installed during the software installation. Note that the modules must be disconnected when starting the software installation. A message in the installer window notifies when the modules should be connected.

5.3.3 Check after installation

- A software installation may change the system functionality and therefore require a new version of the User's Manual.
- After any installation, maintenance or service intervention in the system, perform a Pre-use check according to instructions in the User's Manual.



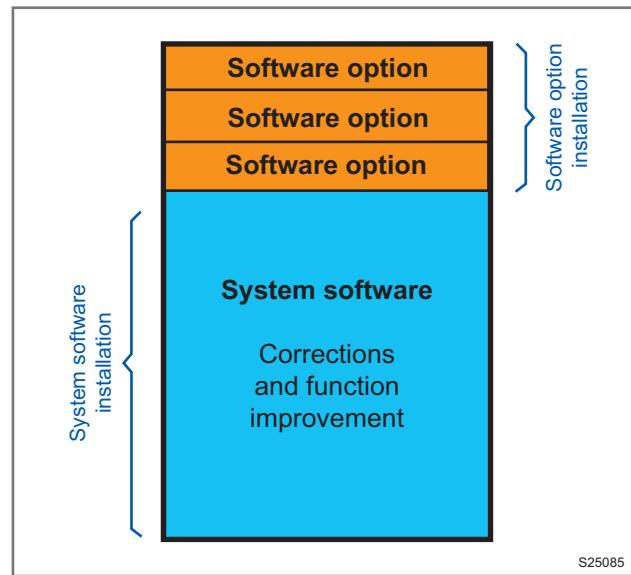
CAUTION: The system must not be switched off during the software installation process. Such interruption may cause malfunctions on PC boards.

5.3.4 Materials/documents required

- USB memory stick with the System software version/Software option to be installed. Only Maquet approved USB memory sticks must be used.
- User's Manual.
- Gas supply required for the Pre-use check.

5.3.5 Software information

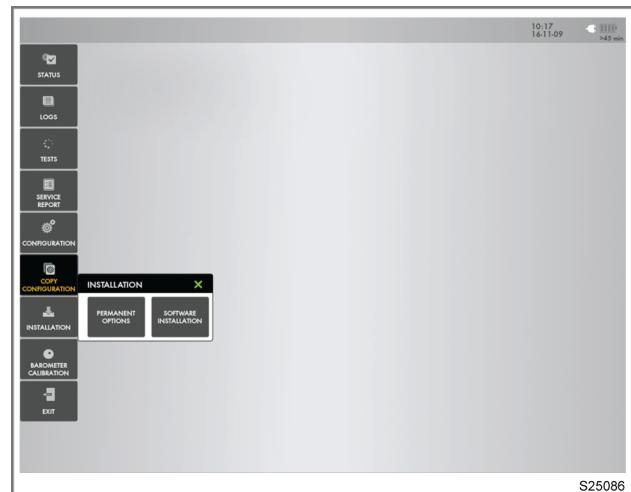
- System software:** A System software installation installs a new System software version. A System software installation is not depending on the serial number of the system and does not alter the installed Software options.
- Software option:** A Software option installation installs Software options ordered for the concerned system. A Software option is individually created for each system and can only be installed on the intended system. Serial number of the system must be stated when ordering a Software option.



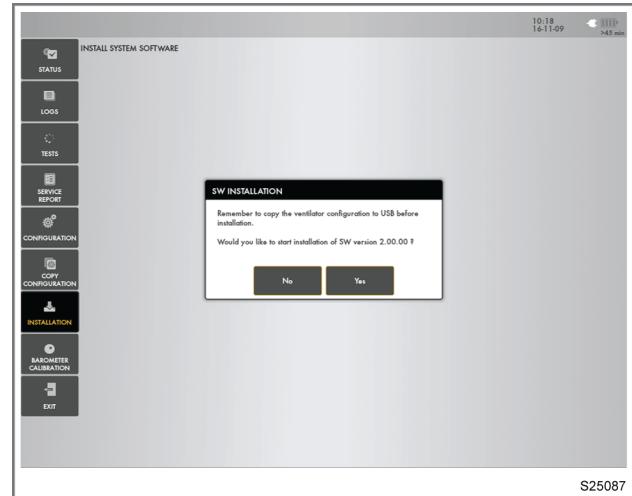
5.3.6 System software installation

To perform a System software installation:

- Set the On/Off switch to On.
- Disconnect Edi module and Y sensor module.
- Enter Service & Settings (*BIMED* or *SERVICE* user level).
- Copy the configuration to a USB memory stick.
- Connect the USB memory stick with the System software version to be installed.
- Tap *INSTALLATION*.
- Tap *SOFTWARE INSTALLATION*.



- The software installation activation box opens. Check that correct *System SW version* to be installed is stated in the box.
- Tap Yes to start the installation. The software installer screen will now open and the installation starts.
- The installer screen shows a progress bar for the installation.
- When notified on the installer screen, connect the plug-in modules (PNP modules).
- When the installation is completed (after 5–6 minutes), this is notified in the installer screen. See Note 1 and Note 2 below.
- Restart the system. See Note 3 below.
- Connect the USB memory stick containing the configuration and copy the configuration from the USB memory stick.
- Perform a Pre-use check according to instructions in the User's Manual.



Note 1: Very occasionally, it may seem that the installation is interrupted and the Service & Settings login menu appears. If the menu appears, do not cancel the installation. The installation proceeds in the background. Wait 10 minutes before restarting the system.

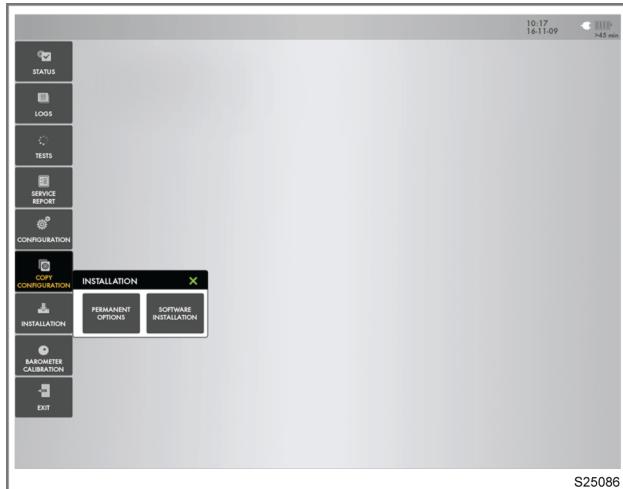
Note 2: The software installation is designed to install software in an O₂ Sensor. If the system is equipped with an O₂ cell, an error message *O₂ sensor not available or installation failed:#* may appear on the screen during the software installation. This error message can be ignored.

Note 3: After a software installation, technical alarms may be activated due to reset internal memory on the PC boards. Restart the system once more and check that no technical alarms are activated.

5.3.7 Software option installation

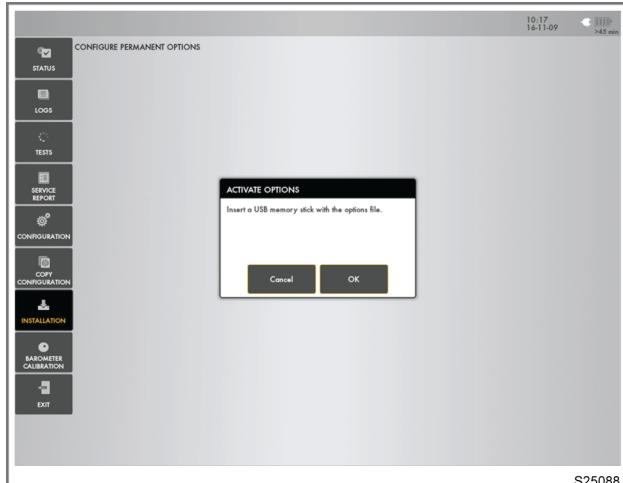
To perform a Software option installation:

- Set the On/Off switch to On.
- Enter Service & Settings (*BIOMED* or *SERVICE* user level).
- Connect the USB memory stick with the Software options to be installed.
- Tap *INSTALLATION*.
- Tap *PERMANENT OPTIONS*.



S25086

- The software installation activation box will now open. Furthermore, all software options that will be available in the system after the installation will be listed on the screen.
- Tap *Yes* to start the installation.
- When the installation is completed (after a few seconds), this is notified in the installer screen.
- Wait two minutes to allow the Service log to be updated.
- Restart the system.
- Perform a Pre-use check according to instructions in the User's Manual.



S25088

5.4 Leakage detection

5.4.1 General

When a leakage is detected in the Internal leakage test, the Pre-use check will stop and display either *Leakage* or *Excessive leakage*. To locate the leakage, the three leakage tests described below can be used.

Test equipment:

- Test tube
- Leakage detector tool, P/N 68 81 146
- Manometer, local purchase (for example, a Cuff filling measuring device with manometer)

5.4.2 Parts tested during the check

Test case 1 – Test tube:

- Test tube

Test case 2 – Expiratory channel:

- Expiratory inlet incl. moisture trap with O-ring
- Expiratory cassette
- Expiratory valve membrane
- Expiratory pressure transducer tube
- Expiratory pressure transducer
- Expiratory valve coil

Test case 3 - Inspiratory channel:

- Nozzle units in gas modules
- Silicone connector muff between gas modules and inspiratory pipe
- Inspiratory pipe
- O₂ cell bacteria filter seal/O₂ sensor seal
- Safety valve membrane
- Inspiratory pressure silicone tube
- Inspiratory pressure bacteria filter
- Inspiratory bacteria filter holder incl. tube
- Inspiratory pressure transducer.

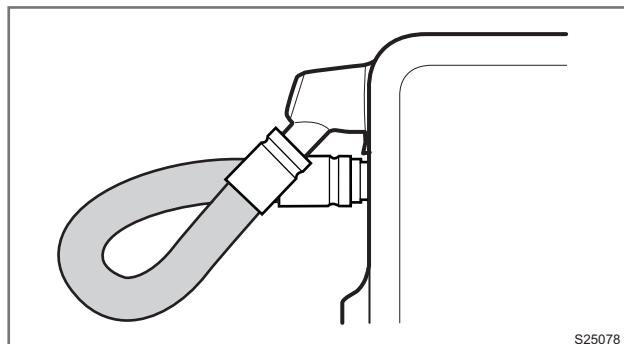
5.4.3 Starting the leakage detection

- Start the manual leakage detection when the Pre-use check has stopped during the 'Internal leakage test' and displayed either *Leakage* or *Excessive leakage*.
- Do not cancel the Pre-use check, the *Redo* function is needed during the leakage detection procedure.

5.4.4 Test case 1 - Test tube

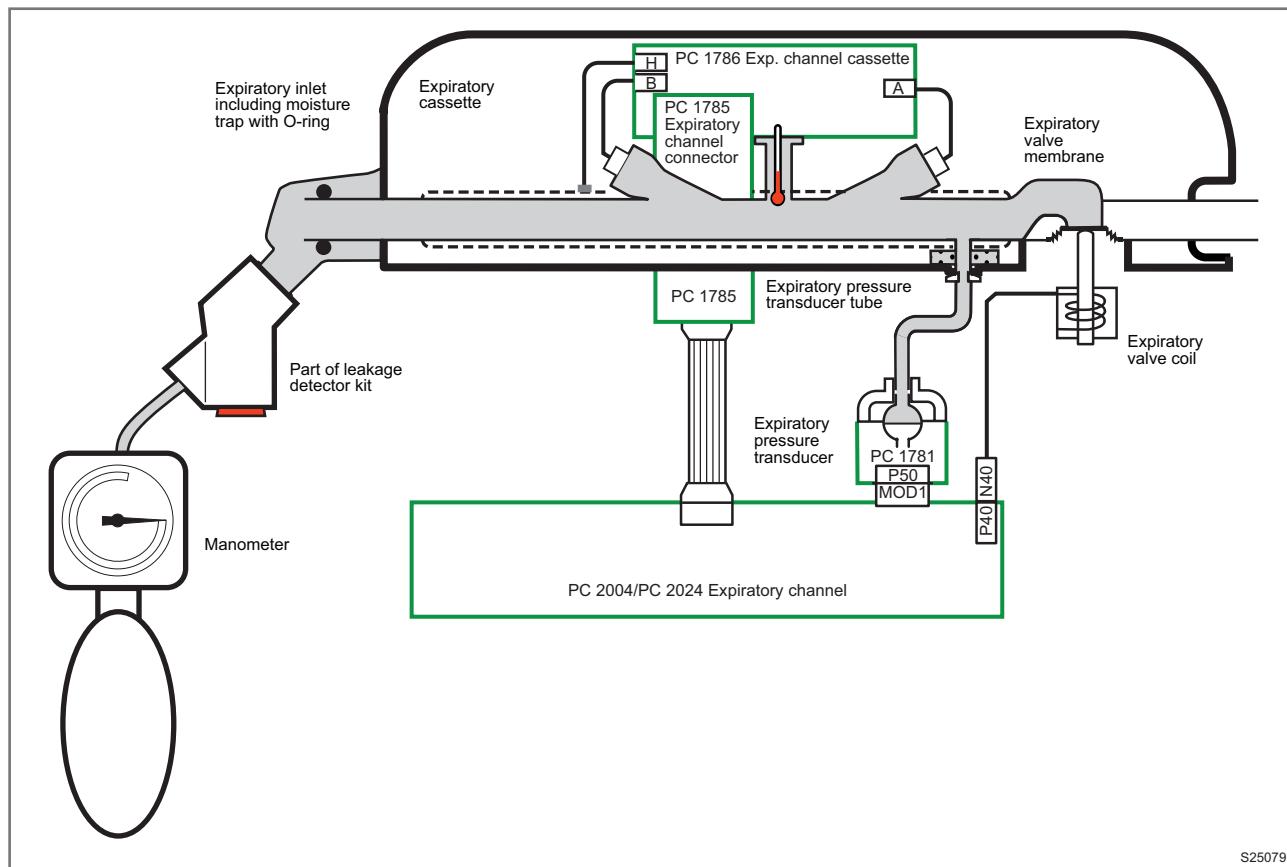
1. Check the test tube for leakage. Replace if required.
2. Reconnect the test tube properly.
3. Tap **Redo**.

If the leakage remains, continue with Test case 2.



5.4.5 Test case 2 – Expiratory channel

Expiratory channel



1. Connect the test equipment to the expiratory inlet.
2. Tap **Redo**.
3. When the expiratory valve closes, pressurize to approximately 80 cmH₂O. This must be done quickly because the expiratory valve coil is closed only for 2-3 seconds. A pressure drop indicates a leakage.

If a leakage is detected in **Expiratory channel**, continue with **Expiratory valve coil**. If not, go to Test case 3.

Expiratory valve coil

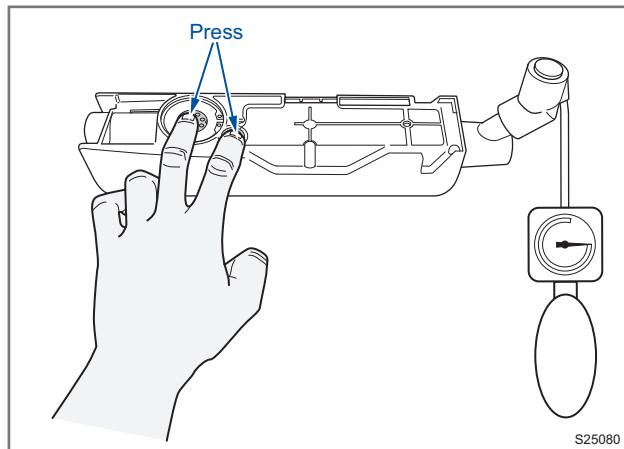
1. Remove the expiratory cassette.
2. Tap *Redo*.
3. Make sure the expiratory valve coil axis is activated (pushed up).

If the axis is activated, continue with **Expiratory cassette**. If not, check/replace the items listed below, one at a time:

- Check the expiratory valve coil including cable and connector.
- Replace PC 2004/PC 2024 Expiratory Channel.
- Replace PC 1991 Control.

Expiratory cassette

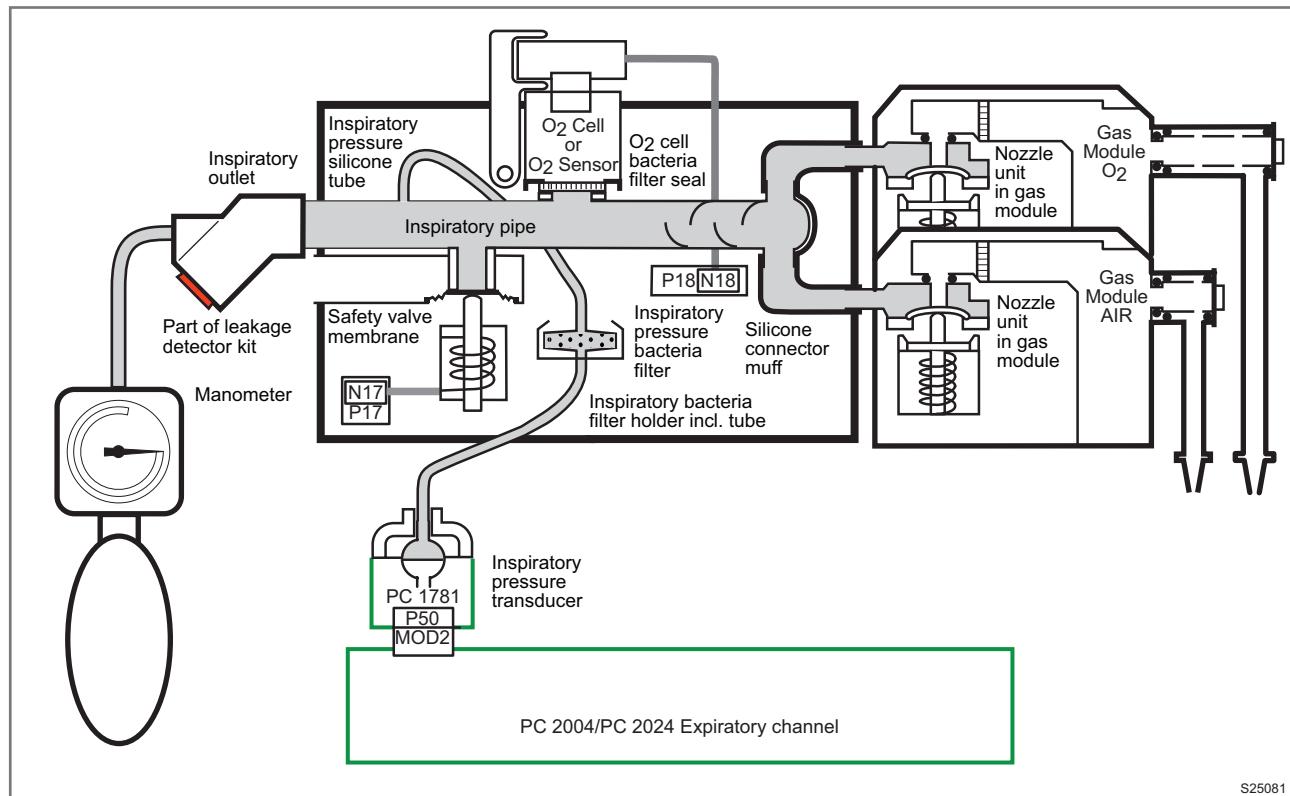
1. Connect the test equipment to the expiratory inlet (while the cassette is removed).
2. Block the expiratory pressure transducer channel hole on the cassette and close the expiratory valve by hand, see illustration.
3. Pressurize to approximately 80 cmH₂O. If a leakage is detected check/replace the following parts (one at a time):
 - Expiratory inlet incl. moisture trap with O-ring.
 - Expiratory valve membrane. The membrane may not close properly due to cleaning residues on the membranes sealing surface and/or on the corresponding sealing surface in the cassette.
 - Expiratory cassette.



Expiratory pressure transducer and tube

1. If a leakage is detected in the Expiratory channel but still remains after performed tests **Expiratory valve coil** and **Expiratory cassette**, check the Expiratory pressure transducer and Expiratory pressure transducer tube.

5.4.6 Test case 3 - Inspiratory channel



S25081

1. Connect the test equipment to the inspiratory outlet.
2. Pressurize to approximately 80 cmH₂O. A pressure drop indicates a leakage. Check/replace the following parts:
 - Silicone connector muff
 - Inspiratory pipe
 - O₂ cell bacteria filter seal/O₂ sensor seal
 - Safety valve membrane. Clean if necessary.
 - Inspiratory pressure silicone tube
 - Inspiratory pressure bacteria filter
3. Pressurize as described in step 2. If the leakage remains, check/replace:
 - Nozzle units in the gas modules
4. Pressurize as described in step 2. If the leakage remains, check/replace:
 - Inspiratory bacteria filter holder including tube.
 - Inspiratory pressure transducer.

5.4.7 Completing the Leakage detection

1. Restore the system including test tube.
2. Tap *Redo* and make sure the test passes.

5.5 Battery modules

5.5.1 General

The condition and capacity of the batteries are verified during the Pre-use check and continuously during operation of the system. No further function checks of the batteries are required.

The system software monitors:

- Expiry date. The life span for the Battery module is set to two and a half years from manufacturing date.
- If the operational capacity is too poor for continued usage.

In both cases, battery replacement information is shown on the User interface.

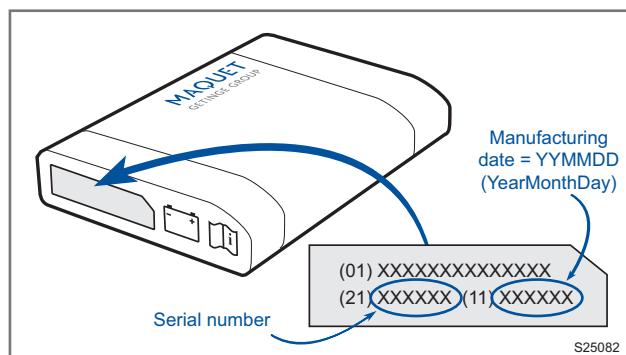
To guarantee safe battery backup, always use at least two batteries.

Recharge time for a discharged battery is approximately three hours per battery. If a battery is completely discharged, for example due to long storage time, the battery may require up to 12 hours charging time.

The battery serial number and manufacturing date is printed on the Battery label.



CAUTION: Do not expose the batteries to water, fire or excessive heat. Do not crush, disassemble, puncture or short circuit the connector terminals.



5.5.2 Battery status

Tap **SYSTEM STATUS > Batteries** to open the Battery status window.

The Battery status window shows:

- Battery capacity. Calculated as the sum of the estimated backup time for the connected Battery modules reduced with 10 minutes as an extra safety feature. This estimate may differ from the actual usable backup time during running. Usable backup time depends on set mode and selected ventilation settings.
- Slot number
- Battery module S/N
- Manufacturing date DD/MM/YY
- Remaining operating time in minutes for each battery
- Charge indicator for each battery, where:
 - 0 boxes filled = < 10% relative charge
 - 1 box filled = 10–25% relative charge
 - 2 boxes filled = 26–50% relative charge
 - 3 boxes filled = 51–75% relative charge
 - 4 boxes filled = 76–100% relative charge

An activity instruction, displayed directly next to the operating time, may show:

- *Expires soon*. Message activated if the expiry date is within 60 days.
- *Replace battery*. The battery must be replaced and discarded. Message activated if:
 - The expiry date of the battery is passed and the life span of the battery is exceeded. Due to the age of the battery, the calculated backup time may in this case not be reliable. Even if the battery indicates a significant backup time, the battery must be replaced.
or
 - The operational capacity of the battery is too poor for continued use. Caused for example by the chemical process in an aging battery.



5.6 Memory backup batteries

5.6.1 General

The Memory backup batteries must be replaced after five years. If the battery voltage level is too low, a Technical error message appears on the screen.

Always replace both batteries at the same time to keep the same replacement date for both batteries.

After any maintenance or service of the system, perform a Pre-use check. Refer to the User's Manual.



Note: ESD sensitive components.

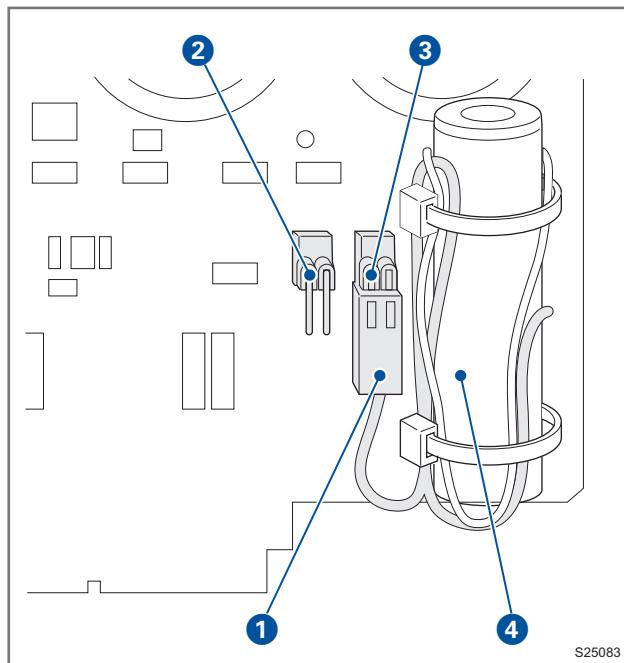
The Memory backup batteries are mounted on ESD sensitive PC boards. Refer to chapter Disassembling and assembling, section Handling PC boards for further information regarding ESD sensitive components.

5.6.2 Preparations

- Set the On/Off switch to Off.
- Disconnect the mains power cable.
- Disconnect the gas supplies (wall and/or cylinder).
- Remove patient tubing.

5.6.3 Replacing Memory backup battery

- Remove the Patient unit front cover. Refer to chapter Disassembling and assembling.
- Carefully pull out PC 1991 and PC 1992 but do not disconnect the cable connector (1). Certain information stored in the PC board memory is erased if the cable connector is disconnected:
 - The battery backup on PC 1992 supplies power to the real time clock and to the memory containing logs and settings for the last minutes, warm and cold start information. All this information is lost if disconnected.
 - The battery backup on PC 1991 supplies power to the memory containing startup ventilation configuration, which is lost at disconnection.
- There are two equal battery connectors (2 and 3) on the PC boards. Connect the new battery to the free connector. The memory functions are now secured by the new battery.
- Cut the cable ties holding the old battery (4) to the PC board.
- Disconnect and take out the old battery.
- Mount the new battery onto the PC board using new cable ties as shown in the illustration.
- Insert the PC board into the correct PC board slot and reassemble the Patient unit.



S25083

6 Troubleshooting

Table of Contents

6.1	General	6 - 2
6.2	Start-up test	6 - 2
6.3	Pre-use check	6 - 3
6.4	Other tests	6 - 5
6.5	Test logs	6 - 6
6.6	Technical error codes and messages	6 - 19

6.1 General

The information in this chapter is applicable to System version 1.0 – 2.1. For functionality enhancement, the latest System software version is recommended.

This chapter contains:

- Descriptions of the Start-up test and the Pre-use check.
- Information about how to interpret the Test log and the Technical error codes as well as recommended actions to eliminate malfunctions reported by the system.

Before starting troubleshooting, try to eliminate all possibilities of operational errors. If the malfunction remains, use the troubleshooting guides below as well as the information in chapter Description of functions to locate the faulty part. Perform actions step by step and check that the malfunction is eliminated.

When the fault is corrected, carry out a complete Pre-use check as described in the User's Manual.

The troubleshooting guides below focus on the technical problems. Information about clinically related problems can be found in the User's Manual.

Possible causes to malfunction, not mentioned in the following troubleshooting guides, that need to be considered during troubleshooting:

- Incorrectly assembled system after cleaning, maintenance or service.
- Disconnected or incorrectly connected cable connectors, PC board connectors or interconnection boards.
- Disconnected or defective gas tubes.

In the descriptions and troubleshooting guides below, the tested subsystems are referred to as:

- BRE = Breathing
- MON = Monitoring
- PAN = Panel.

6.2 Start-up test

Internal technical tests	Recommended action if the test fails
<ul style="list-style-type: none"> • Software check • Reading EEPROM • Checksum EEPROM • Audio test. (BRE + MON + PAN)	<ol style="list-style-type: none"> 1. Restart the system. Do not touch the User interface during system start-up. Interfering with the touch screen, loudspeaker grid and so forth, may affect the internal technical tests. 2. Reinstall the System software.

6.3 Pre-use check

The system requests the user to start the automatic Pre-use check at every startup of the system. It is also possible to select the Pre-use check via the Standby menu.

The User's Manual describes how to perform this Pre-use check. The Pre-use check description on the following pages gives more detailed information about the Pre-use check.

Some of the recommended actions described below refer to Service & Settings (S&S). The Service key is required to access S&S. Troubleshooting can of course be performed without access to the S&S, but for some of the recommended actions, S&S will make troubleshooting faster and easier.

Check if the fault remains after each performed service action. Re-run the complete Pre-use check or run the concerned test from S&S.

In the Standby menu it is possible to perform a separate Patient circuit test to evaluate circuit leakage and measure circuit compliance. This separate test does not replace the complete Pre-use check.

6.3.1 Internal test sequence

Panel audio test (PAN)

Checks that the loudspeakers in the User interface generate an adequate sound level. A sound level is generated and a microphone mounted nearby the loudspeakers measures the sound. PAN calculates the measured value to verify that the sound level meets the requirement.

Monitor audio test (MON)

Checks that the buzzer in the Patient unit generates an adequate sound level. A power failure is generated in order to activate the buzzer. A microphone mounted nearby the buzzer measures the sound. MON calculates the measured value to verify that the sound level meets the requirement.

Alarm output connector test (MON)

Checks that the Alarm output connector relay switches between open and closed.

Power failure test (MON)

Generates failures on different system voltages. Checks that these failures are detected.

6.3.2 Barometer test sequence

Barometer test (MON)

Checks that the barometric pressure measured by the internal barometer is within 650–1070 hPa (mbar).

Checks that the measured barometric pressure values between BRE and MON differ less than 8 hPa (mbar).

6.3.3 Gas supply test sequence

Gas supply test (MON)

The test will start with a 14 s gas flush to check that air is connected.

Checks that the Air and O₂ gas supply pressures measured by the internal gas supply pressure transducers are within 200–600 kPa (2000–6000 mbar).

Checks that the measured supply gas pressure values between MON and BRE differ less than 20 hPa (mbar).

6.3.4 Internal leakage test sequence

Internal leakage test (BRE)

Checks the internal leakage, with the test tube connected, using the inspiratory and expiratory pressure transducers.

Generates 80 cmH₂O pressure.

Checks that the measured pressure values differ less than 10 cmH₂O between inspiratory and expiratory pressure transducers.

Checks that the volume required to generate 80 cmH₂O is 0.1500–0.3500 l.

Checks that the leakage at 80 cmH₂O is maximum 0.0100 l/min.

To locate a leakage, a leakage detection test can be performed, see Leakage detection in chapter Service procedures. The Leakage detection test is a complement to the recommended actions below.

6.3.5 Pressure transducer test sequence

Breathing pressure transducer test (BRE)

Checks that the zero values for the pressure transducers do not differ more than ± 6 cmH₂O (± 0.3 V) from factory calibration.

Monitor pressure transducer test (MON)

Calibrates and checks the inspiratory and expiratory pressure transducers.

The new zero value for the pressure transducers may not differ more than ± 6 cmH₂O (± 0.3 V) from factory calibration.

With the inspiratory pressure transducers used as a reference, a new gain factor is set for the expiratory pressure transducer. The new gain factor may not differ more than $\pm 5\%$ from factory calibration.

During this test, the different concerned subsystems are compared. The difference between the subsystems must not be more than ± 1 cmH₂O at 60 cmH₂O.

Expiratory valve test (BRE)

Expiratory valve coil test. Measures offset and gain in the valve coil.

6.3.6 Safety valve test sequence

Monitor safety valve test (MON)

Checks the hardware signals related to the safety valve functions.

Breathing safety valve test (BRE)

Checks and, if necessary, adjusts the opening pressure for the safety valve to 117 ± 3 cmH₂O.

The test fails if an opening pressure of 117 cmH₂O is not reached within five attempts.

6.3.7 O₂ cell/sensor test sequence

O₂ cell/sensor test (MON)

Calibrates and checks the O₂ sensor/cell at 21% O₂ and at 100% O₂.

Checks if the O₂ cell is worn out.

As different gas mixtures are used during this test, calibration and check of the O₂ sensor/cell is not performed if one gas is missing.

The O₂ sensor/cell test requires 21% O₂ and 100% O₂. If other gas mixtures are used, for example if the O₂ supply delivers 96% O₂ instead of 100%, the O₂ cell/sensor test may fail.

6.3.8 Flow transducer test sequence

Breathing flow transducer test (BRE)

Checks that the zero values for the flow transducers are within the specified range.

Flow test (MON)

Monitoring flow transducer in the S&S Test menu.

Checks the inspiratory flow transducer. Calibrates and checks the expiratory flow transducer.

Calibrates at 60% O₂ and checks at 100% and at 21% O₂. As different gas mixtures are used during this test, calibration of the expiratory flow transducer is only performed if both gases are connected.

If only one gas supply is connected, the check using the connected gas (O₂ or Air) is performed. The Flow transducer test passes if the result of this check corresponds to the old calibration factor from the previous Pre-use check. The same expiratory cassette must be used.

The new calibration factor for the expiratory flow transducer may not differ more than -10% to +15% from factory calibration.

During this test, the different concerned subsystems are compared. The difference between the subsystems must not be more than ± 0.3 l/min.

6.3.9 Battery switch test sequence

Battery switch test (MON)

Checks that the power supply switches to battery when mains power is disconnected.

Checks that the power supply switches back to mains power when reconnected.

This test is not performed if:

- Less than 10 minutes backup time remains in the connected Battery modules.
- No Battery module is connected.

6.3.10 Patient circuit test sequence

Patient circuit test (BRE)

With the patient tubing connected, checks the patient circuit leakage, compliance and resistance using the inspiratory and expiratory pressure transducers.

Allowed leakage is 80 ml/min at 50 cmH₂O.

Allows the system to calculate a compensation for circuit compliance, if the leakage requirements are met.

Checks the patient circuit resistance, with patient tubing connected and using the inspiratory and expiratory pressure transducers.

6.3.11 Alarm state test sequence

External alarm system test (MON)

If the option Alarm output is enabled, the user can test the external alarm system.

Pin configuration and signal names in the Alarm output connector N67 can be found in chapter Diagrams. For further information, refer to the 'Alarm output connector – Reference Manual'.

Alarm state test (MON)

Checks that no Technical error alarms are active during the Pre-use check.

6.4 Other tests

6.4.1 Patient circuit test sequence

Patient circuit test (BRE)

This test performs the Patient circuit test separately, as described above.

6.4.2 Y sensor test sequence

Y sensor calibration (MON)

Y sensor pressure in the S&S Test menu.

Checks the pressure and flow measurement of the Y sensor.

This test can only be performed if a Y sensor and a Y sensor module are connected to the system.

6.5 Test logs

This section describes how to interpret the Test logs related to the Pre-use check.

6.5.1 Interpreting the Test result logs

The Pre-use check, complete test as well as separate tests, is logged in the *Service log*. Select *Test results* and *Test details* to show all test result logs. A Service key is required to access the Service log. The description below shows how to interpret the Service log.

If one or more checks within a test fail, the log will include Check Failures (CHK). All Check Failures have a unique Check Failure Identifier (CFI). Possible causes and recommended actions for tests that fail permanently or intermittently are listed in the following CFI tables.

A Check Failure occurs if a check within a test fails. When a test fails due to a user error; a Dialog Choice (DLG) appears and gives the user the choice to redo the test by choosing *Redo* or, to bypass the test by choosing *Cancel*.

Always perform recommended actions in a chronological order. A test that fails can cause subsequent tests to fail.

Test log example 1

The log example below shows an O₂ cell/sensor test sequence:

1. The test starts.
2. The test fails, indicated with CFI code 14.
3. A Dialog Choice window appears with the two options *Redo* or *Cancel*. The user selects *Cancel*.
4. Data for the O₂ sensor is shown.
5. The O₂ cell/sensor test is finished. CFI code 14 indicates that the test failed.

2016-12-16	15:54:46	[SSTA]	O2 cell/sensor test sequence
2016-12-16	15:54:48	[STA]	O2 cell/sensor test
2016-12-16	15:55:07	[CHK_STA]	Checking O2 Sensor AIR PUC Status.
2016-12-16	15:55:07	[ADD_INFO]	Status: 25
2016-12-16	15:55:07	[CHK_FIN]	FAILED : O2 Sensor AIR PUC failed. [Error Code = 14]
2016-12-16	15:55:15	[DIALOG]	Redo test? - User Choice : Cancel.
2016-12-16	15:55:20	[ADD_INFO]	O2 sensor ID: Part number = 6670600 Version = 0 Serial number = (AsciiCode 0 AsciiCode)48048-56236
2016-12-16	15:55:20	[ADD_INFO]	PC1873ID: Part number = 6570878 Version = 9 Serial number = (AsciiCode 0 AsciiCode)78079-942016
2016-12-16	15:55:20	[ADD_INFO]	Date of first PUC (YYYY-MM-DD): 2016-9-1
2016-12-16	15:55:20	[FIN]	O2 cell/sensor test FAILED - [Error Code = 14]
2016-12-16	15:55:20	[SFIN]	O2 cell/sensor test sequence FAILED

S25117

Test log example 2

The log example below shows the Expiratory valve test:

1. The test starts with the subtest 'Checking Measured Expiratory Pressure'.
2. A number of expiratory pressures are measured.
3. The measured expiratory pressures are within the specified limits and the subtest 'Checking Measured Expiratory Pressure' is passed.
4. The test continues with the subtest 'Checking that the expiratory valve constants are stored persistently'.
5. The measured 'Expiratory Valve Offset' is above the specified limits and the subtest fails, indicated with CFI code 4.
6. The Expiratory valve test is finished. CFI code 4 indicates that the test failed.

2016-12-14	14:41:30	[STA]	Expiratory valve test
2016-12-14	14:41:33	[CHK_STA]	Checking Measured Expiratory Pressure.
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 46.30 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [35.00; 65.00] (Unit : cmH2O)
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 16.67 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [5.00; 35.00] (Unit : cmH2O)
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 7.54 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [-5.00; 25.00] (Unit : cmH2O)
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 3.44 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [-10.00; 20.00] (Unit : cmH2O)
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 46.70 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [35.00; 65.00] (Unit : cmH2O)
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 17.10 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [5.00; 35.00] (Unit : cmH2O)
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 7.84 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [-5.00; 25.00] (Unit : cmH2O)
2016-12-14	14:41:33	[MEA]	Measured Expiratory Pressure = 3.67 - Tolerance Interval (Desired Expiratory Pressure +/- 15.00) = [-10.00; 20.00] (Unit : cmH2O)
2016-12-14	14:41:33	[CHK_FIN]	PASSED
2016-12-14	14:41:33	[CHK_STA]	Checking that the expiratory valve constants are stored persistently.
2016-12-14	14:41:33	[MEA]	Expiratory Valve Offset = 0.16123 - Tolerance Interval = [0.06768; 0.15684] (Unit : A)
2016-12-14	14:41:33	[MEA]	Expiratory Valve Gain = 0.00922 - Tolerance Interval = [0.00730; 0.01130] (Unit : A/cmH2O)
2016-12-14	14:41:33	[CHK_FIN]	FAILED : the expiratory valve constants were not stored persistently. [Error Code = 4]
2016-12-14	14:41:33	[FIN]	Expiratory valve test FAILED - [Error Code = 4]

S25118

6.5.2 Pre-use check

Internal test sequence

CFI	Log description	Recommended action
Panel audio test (PAN)		
-	If the test fails, the audio does not work.	<ol style="list-style-type: none"> 1. Make sure that the User interface rear cover is correctly mounted. Otherwise the audio tests may fail. 2. Replace loudspeaker. 3. Replace B740 CPU board.
Monitor audio test (MON)		
1	The buzzer is permanently on.	<ol style="list-style-type: none"> 1. Make sure that the Patient unit front cover is correctly mounted. Otherwise the audio tests may fail. 2. Replace PC 1992 Monitoring.
2	The buzzer could not be turned on.	<ol style="list-style-type: none"> 1. Make sure that the Patient unit front cover is correctly mounted. Otherwise the audio tests may fail. 2. Replace PC 1992 Monitoring.
3	The buzzer could not be turned off.	<ol style="list-style-type: none"> 1. Make sure that the Patient unit front cover is correctly mounted. Otherwise the audio tests may fail. 2. Replace PC 1992 Monitoring.
Alarm output connector test (MON)		
1	Remote Alarm is already active.	<ol style="list-style-type: none"> 1. Replace PC 1998 DC/DC & Standard connectors. 2. Replace PC 1992 Monitoring.
2	Remote Alarm has not been activated.	<ol style="list-style-type: none"> 1. Replace PC 1998 DC/DC & Standard connectors. 2. Replace PC 1992 Monitoring.
3	Remote Alarm has not been deactivated.	<ol style="list-style-type: none"> 1. Replace PC 1998 DC/DC & Standard connectors. 2. Replace PC 1992 Monitoring.
Power failure test (MON)		
1	PFA alarm is inactive.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
2	PFA alarm is inactive.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
3	PFA alarm is inactive.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
4	PFA alarm is inactive.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
5	The buzzer has not been turned on.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
6	The buzzer has not been turned off.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
7	The remote alarm is active.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
8	The remote alarm is active.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.
9	PFA alarm is active.	<ol style="list-style-type: none"> 1. Replace PC 1992 Monitoring.

Barometer test sequence

CFI	Log description	Recommended action
Barometer test (MON)		
1	Barometric Pressure (MON) is not within the accepted limits. Comment: >1070 hPa (mbar)	1. Calibrate the barometer (S&S). 2. Replace PC 1992 Monitoring. 3. Replace PC 2004/PC 2024 Expiratory channel.
2	Barometric Pressure (MON) is not within the accepted limits. Comment: <650 hPa (mbar)	1. Calibrate the barometer (S&S). 2. Replace PC 1992 Monitoring. 3. Replace PC 2004/PC 2024 Expiratory channel.
3	The difference between the values measured in BRE and MON is too high. Comment: >8 hPa (mbar)	1. Replace PC 1991 Control. 2. Replace PC 1992 Monitoring. 3. Replace PC 2004/PC 2024 Expiratory channel. 4. Replace gas modules. Replace one gas module at a time.

Gas supply test sequence

CFI	Log description	Recommended action
Gas supply test (MON)		
1	O ₂ supply pressure too high. Comment: >600 kPa (6000 mbar)	1. Check that the connected O ₂ supply pressure is within the specified range. 2. Replace gas module O ₂ .
2	O ₂ supply pressure too low. Comment: <200 kPa (2000 mbar)	1. Check that the connected O ₂ supply pressure is within the specified range. 2. Replace gas module O ₂ .
3	The difference between O ₂ supply pressure (MAX) and O ₂ supply pressure (MIN) is too large. Comment: O ₂ supply pressure variation too large, >100 hPa (mbar)	1. Check that the connected O ₂ supply pressure is stable. 2. Replace gas module O ₂ .
4	The difference between O ₂ supply pressure (MON) and O ₂ supply pressure (BRE) is too large. Comment: >20 hPa (mbar)	1. Replace PC 1991 Control. 2. Replace PC 1992 Monitoring.
5	Air supply pressure too high. Comment: >600 kPa (6000 mbar)	1. Check that the connected Air supply pressure is within the specified range. 2. Replace gas module Air.
6	Air supply pressure too low. Comment: <200 kPa (2000 mbar)	1. Check that the connected Air supply pressure is within the specified range. 2. Replace gas module Air.

CFI	Log description	Recommended action
7	The difference between Air supply pressure (MAX) and Air supply pressure (MIN) is too large. Comment: Air supply pressure variation too large, >100 hPa (mbar)	1. Check that the connected Air supply pressure is stable. 2. Replace gas module Air.
8	The difference between Air supply pressure (MON) and Air supply pressure (BRE) is too large. Comment: >20 hPa (mbar)	1. Replace PC 1991 Control. 2. Replace PC 1992 Monitoring.
9	Only AIR has been detected - O ₂ pressure too low.	1. Check that the connected O ₂ supply pressure is within the specified range. 2. Replace gas module O ₂ .
10	Only O ₂ has been detected - Air pressure too low.	1. Check that the connected Air supply pressure is within the specified range. 2. Replace gas module Air.
11	Breathing disconnected.	1. Restart the system. 2. Replace PC 1991 Control.

Internal leakage test sequence

CFI	Log description	Recommended action
Internal leakage test (BRE)		
1	The difference between InspPress and ExpPress is too high. Comment: >10 cmH ₂ O	1. Check that the pressure transducer tubes and the inspiratory filter are correctly mounted. 2. Check that both PC 1781 Pressure transducer (Insp. and Exp.) are correctly mounted. 3. If the 'Pressure transducer test' also fails, refer to the recommended actions if 'Pressure transducer test' failed.
2	The System Volume is too low. Comment: <0.1500 l	1. Replace the gas modules. Replace one gas module at a time. Moisture in the gas supply can cause gas module error. If so, this must be addressed so that the error does not recur.

CFI	Log description	Recommended action
3	<p>The System Volume is too high.</p> <p>Comment: >0.3500 l</p>	<ol style="list-style-type: none"> 1. Check that the correct test tube is used during the Pre-use check. 2. If the 'Flow transducer test' also fails, replace the gas modules. Replace one gas module at a time. Moisture in the gas supply can cause gas module error. If so, this must be addressed so that the error does not recur. 3. Check that the test tube is correctly connected. 4. Check that the expiratory cassette is correctly seated in the cassette compartment. 5. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. 6. Check that the pressure transducer tubes/filters are correctly mounted. 7. Check that the inspiratory pipe is correctly mounted in the inspiratory section. 8. Check that the safety valve membrane is clean and correctly seated in the inspiratory pipe. 9. Check that the safety valve closes properly when the Pre-use check starts (distinct clicking sound from the valve). If the safety valve not closes properly during this check: <ul style="list-style-type: none"> - Replace safety valve pull magnet. - Replace PC 2004/PC 2024 Expiratory channel.
4	<p>Inspiratory Pressure is too low.</p> <p>Comment: Excessive leakage. Required pressure 80 cmH₂O not obtained, leakage test cannot be performed.</p>	<ol style="list-style-type: none"> 1. Check that the connected gas supply pressure is within the specified range. 2. Check that the test tube is correctly connected. 3. Check that the expiratory cassette is correctly seated in the cassette compartment. 4. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. 5. Check that the inspiratory pipe is correctly mounted in the inspiratory section. 6. Check that the safety valve closes properly when the Pre-use check starts (distinct clicking sound from the valve). If the safety valve not closes properly during this check: <ul style="list-style-type: none"> - Replace safety valve pull magnet. - Replace PC 2004/PC 2024 Expiratory channel.

CFI	Log description	Recommended action
5	The Leakage Value is too high, or the safety valve is either not locked or its status could not be read. Comment: >0.0100 l/min	<ol style="list-style-type: none"> 1. Check that the test tube is correctly connected. 2. Check that the expiratory cassette is correctly seated in the cassette compartment. 3. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. 4. Check that the pressure transducer tubes/filters are correctly mounted. 5. Check that the inspiratory pipe is correctly mounted in the inspiratory section. 6. Check that the safety valve membrane is clean and correctly seated in the inspiratory pipe. 7. Check that the safety valve closes properly when the Pre-use check starts (distinct clicking sound from the valve). If the safety valve not closes properly during this check: <ul style="list-style-type: none"> - Replace safety valve pull magnet. - Replace PC 2004/PC 2024 Expiratory channel.

Pressure transducer test sequence

CFI	Log description	Recommended action
Breathing pressure transducer test (BRE)		
1	Inspiration Offset could not be stored persistently - Value out of range. Comment: >6 cmH ₂ O (± 0.3 V) from factory default.	<ol style="list-style-type: none"> 1. Replace PC 1781 Insp. 2. Replace PC 1991 Control.
Monitor pressure transducer test (MON)		
1	Inspiration offset >6 cmH ₂ O from factory default. Comment: (± 0.3 V)	<ol style="list-style-type: none"> 1. Replace PC 1781 Insp. 2. Replace PC 1992 Monitoring.
2	Expiration offset >6 cmH ₂ O from factory default. Comment: (± 0.3 V)	<ol style="list-style-type: none"> 1. Replace PC 1781 Exp. 2. Replace PC 1992 Monitoring.
3	Expiration gain >8% from factory default.	<ol style="list-style-type: none"> 1. Cancel the 'Pressure transducer test' and continue with the remaining tests (this will calibrate the safety valve). Restart the Pre-use check. 2. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. 3. Check/replace PC 1781 Pressure transducer (Insp. and Exp.). To locate the faulty pressure transducer, replace one transducer at a time.

CFI	Log description	Recommended action
4	Expiration offset is different at zero pressure and high pressure.	1. Replace PC 1781 Exp.
5	The difference between the values measured in BRE and MON is too high. Comment: >1 cmH ₂ O	1. Replace PC 1991 Control. 2. Replace PC 1992 Monitoring.
6	Inspiration pressure transducer could not be locked or is faulty.	1. Replace PC 1781 Insp.
7	Expiration pressure transducer could not be locked or is faulty.	1. Replace PC 1781 Exp.
8	Inspiratory pressure value out of bounds. Comment: 60 ±5 cmH ₂ O	1. Replace gas module Air nozzle unit.

Expiratory valve test (BRE)

1	Expiratory Pressure too high. Comment: Measures at 50, 20, 10 and 5 ±15 cmH ₂ O.	1. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. 2. Replace the Expiratory valve coil.
2	Expiratory Pressure too low. Comment: Measures at 50, 20, 10 and 5 ±15 cmH ₂ O.	1. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. 2. Replace the Expiratory valve coil.
3	Voice Coil too strong. Comment: Voice coil not within specified limits; offset 0.06768-0.15684 A, gain 0.00730-0.01130 A/cmH ₂ O.	1. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette membrane. 2. Replace the Expiratory valve coil.
4	The expiratory valve constants were not stored persistently.	1. Replace PC 2004/PC 2024 Expiratory channel.

Safety valve test sequence

CFI	Log description	Recommended action
Monitor safety valve test (MON)		
1	The Safety Valve could not be opened.	1. Replace PC 2004/PC 2024 Expiratory channel. 2. Replace PC 1992 Monitoring.
2	The Safety Valve could not be closed.	1. Replace the safety valve pull magnet. 2. Replace PC 2004/PC 2024 Expiratory channel. 3. Replace PC 1992 Monitoring.
3	The Safety Valve is open.	1. Replace the safety valve pull magnet. 2. Replace PC 2004/PC 2024 Expiratory channel. 3. Replace PC 1992 Monitoring.
4	Disable valves activation failed.	1. Replace PC 1992 Monitoring.

CFI	Log description	Recommended action
5	Disable valves deactivation failed.	1. Replace PC 1992 Monitoring.
Breathing safety valve test (BRE)		
1	Pressure superior to allowed max and valve not open.	1. Replace the safety valve pull magnet. 2. Replace PC 2004/PC 2024 Expiratory channel.
2	Pressure not rising. Timeout. Comment: Not possible to reach opening pressure 117 cmH ₂ O.	1. Check that the inspiratory pipe is correctly mounted in inspiratory section. 2. Check that the safety valve membrane is clean and correctly seated in the inspiratory pipe.
3	Calibration Impossible.	1. Replace the safety valve pull magnet. 2. Replace PC 2004/PC 2024 Expiratory channel.
4	The Safety Valve is not closed.	1. Replace the safety valve pull magnet. 2. Replace PC 2004/PC 2024 Expiratory channel. 3. Replace PC 1992 Monitoring.
5	The Safety Valve could not be disabled.	1. Replace PC 1991 Control.
6	The Safety Valve could not be enabled.	1. Replace PC 1991 Control.

O₂ cell/sensor test sequence

CFI	Log description	Recommended action
O₂ cell/sensor test (MON)		
1	No O ₂ Transducer detected.	1. Check that the O ₂ cell/sensor is connected. 2. Replace the O ₂ cell/sensor. 3. Replace the O ₂ cell/sensor cable. 4. Replace PC 1992 Monitoring.
2	O ₂ Concentration in AIR Supply too low. Comment: Error in the log text. Correct text is: O ₂ Concentration in AIR Supply too high.	1. Check that the connected gas supply pressure is within the specified range. 2. Replace the O ₂ cell.
3	O ₂ Concentration in O ₂ Supply too low.	1. Check that the connected gas supply pressure is within the specified range. 2. Replace the O ₂ cell.
4	AIR supply low.	1. Check that the connected gas supply pressure is within the specified range. 2. Replace gas module Air.
5	O ₂ supply low.	1. Check that the connected gas supply pressure is within the specified range. 2. Replace gas module O ₂ .
6	Unknown gas supply error.	1. Gas supply test not passed. Redo the Gas supply test.
7	Gas supply not approved.	1. Gas supply test not passed. Redo the Gas supply test.
8	Invalid EEPROM data.	1. Replace the O ₂ cell.

CFI	Log description	Recommended action
9	Lock failed. Comment: Lock failed, I ² C problem	1. Replace the O ₂ cell.
10	O ₂ Cell Calibration impossible.	1. Replace the O ₂ cell.
11	The O ₂ Cell needs to be replaced.	1. Replace the O ₂ cell.
13	Timeout.	1. Replace the O ₂ sensor.
14	O ₂ Sensor AIR PUC failed.	1. Check that the connected Air supply concentration is within the specified range. 2. Replace the O ₂ sensor.
15	O ₂ Sensor O ₂ PUC failed.	1. Check that the connected O ₂ supply concentration is within the specified range. 2. Replace the O ₂ sensor.
16	Unable to communicate with the O ₂ sensor.	1. Check that the O ₂ sensor is connected. 2. Replace the O ₂ sensor.

Flow transducer test sequence

CFI	Log description	Recommended action
Breathing flow transducer test (BRE)		
1	Inspiration Air Offset could not be stored persistently - Value out of range. Comment: 0.000-0.081 V	1. Replace gas module Air.
2	Inspiration O ₂ Offset could not be stored persistently - Value out of range. Comment: 0.000-0.081 V	1. Replace gas module O ₂ .
3	Expiration Offset could not be stored persistently - Value out of range. Comment: 0.093-0.142 V	1. Check that the expiratory cassette is correctly seated in the cassette compartment. 2. Replace the expiratory cassette. 3. Replace PC 2004/PC 2024 Expiratory channel.
Flow test (MON)		
1	The Inspiration Air Offset is not within the accepted limits. Comment: 0.000-0.033 V	1. Replace gas module Air.
2	The Inspiration O ₂ Offset is not within the accepted limits. Comment: 0.000-0.033 V	1. Replace gas module O ₂ .

CFI	Log description	Recommended action
3	The Expiration Offset is not within the accepted limits. Comment: 0.024-0.072 V	1. Check that the expiratory cassette is correctly seated in the cassette compartment. 2. Replace the expiratory cassette. 3. Replace PC 2004/PC 2024 Expiratory channel.
4	Expiration Gain is not within the specs. Comment: 0.90-1.15	1. Check that the connected gas supply pressure (Air and O ₂) is within the specified range. 2. Check that the cassette is correctly seated in the cassette compartment. If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. The fail with the old cassette may in this case be due to water collected inside the cassette. 3. Replace the gas modules. Replace one gas module at a time. 4. Replace PC 1785 Expiratory channel connector. 5. Replace PC 1991 Control. 6. Replace PC 1992 Monitoring. 7. Replace PC 2004/PC 2024 Expiratory channel.
5	No gas supply	1. Check that the connected gas supply pressure (Air and O ₂) is within the specified range.
6	Timeout getting Expiration Gain	1. Check that the expiratory cassette is correctly seated in the cassette compartment. 2. Replace the expiratory cassette.

Battery switch test sequence

CFI	Log description	Recommended action
Battery switch test (MON)		
1	Mains is not on.	1. Connect mains power.
2	The batteries have not been switched on. (TIMEOUT)	1. Mains power not disconnected as demanded.
3	The batteries have been switched back off without mains being back on first. (TIMEOUT)	1. Mains power not reconnected as demanded.
4	No battery operation detected by BRE.	1. Replace PC 1991 Control.
5	Remaining battery power is insufficient for the test to be performed.	1. Charge or replace battery modules.
6	No batteries attached.	1. Connect battery modules. 2. Replace PC 1995 Plug & play backplane.
7	The batteries have been switched on without mains loss first. (TIMEOUT)	1. Restart the system. 2. Replace PC 1995 Plug & play backplane.
8	The batteries have been switched back off without mains being back on first. (TIMEOUT)	1. Replace battery modules.

Patient circuit test sequence

CFI	Log description	Recommended action
Patient circuit test (BRE)		
1	InspPress is too low. Comment: <40 cmH ₂ O	1. If the internal leakage test has passed, the leakage is to be located to the patient circuit. Check for leakage or replace the patient circuit.
2	The Compressible Volume is too low. Comment: <0.00002 l/cmH ₂ O.	1. Check or replace the patient circuit.
3	The Compressible Volume is too high. Comment: >0.00600 l/cmH ₂ O	1. Check or replace the patient circuit.
4	Leakage too high, or the safety valve is either not locked or its status could not be read. Comment: >0.0800 l/min	1. If the internal leakage test has passed, the leakage is to be located to the patient circuit. Check for leakage or replace the patient circuit.
5	System Volume is too low. Comment: <0.1500 l	1. Check that the internal leakage test passed.
6	System Volume is too high. Comment: >6.0000 l	1. Check that the internal leakage test passed. 2. Improper patient circuit connected.

Alarm state test sequence

CFI	Log description	Recommended action
External alarm system test (MON) If this option is installed.		
1	Remote External Alarm is not connected.	1. Check the external alarm system. 2. Replace PC 1998 DC/DC & Standard connectors.
2	Remote External Alarm is already active.	1. Check the external alarm system. 2. Replace PC 1998 DC/DC & Standard connectors.
Alarm state test (MON)		
-	cf alarms error codes	Check Technical error alarms logs for further information.

Y sensor test sequence

CFI	Log description	Recommended action
Y sensor calibration (MON)		
1	FAILED	<ol style="list-style-type: none"> 1. Replace Y sensor. 2. Replace Y sensor module.
2	No HWAY module.	<ol style="list-style-type: none"> 1. Check that the Y sensor module is connected. 2. Replace Y sensor module. 3. Replace PC 1995 Plug & play backplane.
3	Calibration Timeout.	<ol style="list-style-type: none"> 1. Replace Y sensor. 2. Replace Y sensor module.
4	Incompatible version.	<ol style="list-style-type: none"> 1. Install System software with Y sensor module connected.
5	Invalid EEPROM.	<ol style="list-style-type: none"> 1. Replace Y sensor module.
6	Press Com Error.	<ol style="list-style-type: none"> 1. Replace Y sensor module.
7	Flow Com Error.	<ol style="list-style-type: none"> 1. Replace Y sensor module.

6.6 Technical error codes and messages

The table below shows recommended actions in case of Technical errors.

6.6.1 Monitoring

Technical error	Error message / Possible cause	Recommended action
1	Power error. -12 V too low, i.e. < -13.2 V.	1. Replace PC 1998 DC/DC & Standard connectors.
2	Power error. -12 V too high, i.e. > -10.8 V.	1. Check status of external 12 V supply (if connected). 2. Replace PC 1998 DC/DC & Standard connectors. 3. Replace PC 1995 Plug & Play back-plane.
3	Power error. +12 V too low, i.e. < +10.8 V.	1. Check status of external 12 V supply (if connected). 2. Replace PC 1998 DC/DC & Standard connectors. 3. Replace PC 1995 Plug & Play back-plane.
4	Power error. +12 V too high, i.e. > +13.2 V.	1. Replace PC 1998 DC/DC & Standard connectors.
5	Power error. +24 V too low, i.e. < 21.5 V.	1. Replace PC 1998 DC/DC & Standard connectors. 2. Replace the gas modules. Replace one gas module at a time and check that this technical error code will not appear.
6	Power error. +24 V too high, i.e. > 26.5 V.	1. Replace PC 1998 DC/DC & Standard connectors.
7	Software error. Patient category mismatch between Breathing and Monitoring subsystems.	1. Replace PC 1991 Control. 2. Replace PC 1992 Monitoring. 3. Replace the gas modules. Replace one gas module at a time and check that this technical error code will not appear.
8	Insp. pause hold time exceeded. The maximum <i>Insp. pause hold time</i> 30 seconds exceeded. The system did not return to ventilation after <i>Insp. pause hold time</i> .	1. Replace PC 1991 Control.
9	Exp. pause hold time exceeded. The maximum <i>Exp. pause hold time</i> 30 seconds exceeded. The system has not returned to ventilation after <i>Exp. pause hold time</i> .	1. Replace PC 1991 Control.

Technical error	Error message / Possible cause	Recommended action
10	Ventilation stopped. The VALVES_DISABLED signal has stopped power supply to gas modules and safety valve.	1. Replace PC 2004/PC 2024 Expiratory channel. 2. Replace PC 1991 Control. 3. Replace PC 1998 DC/DC & Standard connectors. 4. Replace PC 1992 Monitoring.
11	Safety valve open. The Safety valve is detected as open without fulfilled opening conditions.	1. Replace safety valve pull magnet. 2. Replace PC 2004/PC 2024 Expiratory channel.
16	Ventilation error. PC 2004/PC 2024 Expiratory channel failure.	1. Replace PC 2004/PC 2024 Expiratory channel.
17	Ventilation stopped. Software conflict. Two PC 2004/PC 2024 Expiratory channel detected on the CAN bus.	1. Report to MCC HSC or to your local Getinge representative for further information.
22	Backup audible alarm error. Backup alarm buzzer error.	1. Replace PC 1992 Monitoring.
24	Backup audible alarm or Remote alarm error. Error indicated in the backup alarm or remote alarm capacitor on PC 1992 Monitoring.	1. Replace PC 1992 Monitoring.
25	Communication error. Communication error between ID PROMs/EEPOTs and Monitoring subsystem. The ID # is followed by an Error # in the Technical alarm log. For Error 6, report to MCC HSC or to your local Getinge representative for further information. For all other Error #, replace the part identified by the ID #. Error # 1. CHK_SUM_ERR 2. NR_OF_BYTES_IN_CHKSUM_ERR 3. CHKSUM_FILL_BYTE_ERR 4. WRITABLE_RECORDS_FAILURE 5. WRITABLE_RECORDS_DIFFER 6. COMM_ERR 7. VALIDATION_ERR 8. WCR_VALIDATION_ERR 9. WRITE_NOT_PERMITTED 10. OTHER_ERR	Depending on ID # and Error # stated in the Technical alarm log. If repeated, replace the spare part indicated by the ID # according to the list below: ID # 0: PC 1990 Main back-plane. 1: PC 1992 Monitoring. 2: PC 1995 Plug & Play back-plane. 3: PC 1998 DC/DC & Standard connectors. 4: PC 1781 Inspiratory pressure transducer. 5: PC 1781 Expiratory pressure transducer. 6: O ₂ cell or O ₂ cell cable. 7: O ₂ sensor or O ₂ sensor cable. 32: PC 2004/PC 2024 Expiratory channel. 33: Air gas module. 34: O ₂ gas module. 35: PC 1992 Monitoring. 256: PC 1991 Control. 512: B740 CPU board. 1024: PC 2004/PC 2024 Expiratory channel. 1025: Expiratory cassette. 1026: PC 1993 Ethernet switch. Note: After replacement of PC 1992, TE 25 may occur. Adjust the barometric pressure in Service & Settings to solve this error (Service key required).

Technical error	Error message / Possible cause	Recommended action
27	Backup audible alarm error. Backup alarm buzzer error.	1. Replace PC 1992 Monitoring. Note: If the Patient unit front cover is removed, this error may be activated.
28	Audible alarm error. Loudspeaker error.	1. Replace loudspeaker. 2. Replace B740 CPU board.
29	Memory backup battery depleted. The Memory backup battery on PC 1992 Monitoring is depleted.	1. Replace Memory backup battery on PC 1992 Monitoring.
32	Software version conflict. Conflict between the software versions installed.	1. Reinstall the System software. 2. Report to MCC HSC or to your local Getinge representative for further information.
35	Ventilation disabled. Communication error or PC 2004/PC 2024 Expiratory channel failure during startup.	1. Replace PC 2004/PC 2024 Expiratory channel.
37	Software error. PC 2004/PC 2024 Expiratory channel indicates wrong patient category.	1. Replace PC 2004/PC 2024 Expiratory channel. 2. Report to MCC HSC or to your local Getinge representative for further information.
38	Barometric pressure too high. Barometric pressure above allowed limit or barometer error.	1. Calibrate barometer (S&S required). 2. Replace PC 1992 Monitoring.
39	Barometric pressure too low. Barometric pressure below allowed limit or barometer error.	1. Calibrate barometer (S&S required). 2. Replace PC 1992 Monitoring. Note: This alarm will be activated if the ambient pressure is below 650 hPa, e.g. on a high altitude.
40	Measured value invalid. Invalid measured metric detected. The invalid metric is not displayed.	1. Restart the system.
41	Real time clock error. Internal processor real time clock error.	1. Replace PC 1992 Monitoring.
42	Checksum error. Software checksum error during startup.	1. Restart the system. 2. Replace Memory backup battery on PC 1992 if together with Error code 29. 3. Replace PC 1992 Monitoring.

Technical error	Error message / Possible cause	Recommended action
43	Battery communication error. Battery module or PC 1995/PC 1992 communication error.	1. Update to System SW version 2.1.1 or higher. 2. Replace the Battery module(s). 3. Replace PC 1992 Monitoring. 4. Replace PC 1995 Plug & Play back-plane.
44	Alarm limit error. Alarm limit settings (with checksum) are stored. If the checksum is incorrect, this Technical error alarm is activated.	1. Restart the system. 2. Replace Memory backup battery on PC 1992 if together with Error code 29. 3. Replace PC 1992 Monitoring.
46	Alarm output connector error. Alarm output connector error or communication error with PC 1992.	1. Replace PC 1998 DC/DC & Standard connectors. 2. Replace PC 1992 Monitoring.
48	Pre-oxygen time exceeded. The maximum <i>Pre-oxygenation</i> time during DISCONNECTION/ SUCTION exceeded. The system did not return to ventilation using the previous settings after the <i>Preoxygenation</i> time.	1. Replace PC 1991 Control.
50	Communication error. Communication error between ID PROM on PC 1990 Main back-plane and Monitoring subsystem. System ID, configuration, operating time, etc., not available.	1. Replace PC 1992 Monitoring. 2. Replace PC 1990 Main back-plane.
51	On/Off switch error. The On/Off switch is neither in On or Off position during more than 3 seconds.	1. Replace On/Off switch including cable.
55	Communication error. This error code is an indication of one or more of: <ul style="list-style-type: none">• Internal Ethernet communication failure• Battery status erroneously repeated• Subsystem mismatch of patient category, ventilation mode, and/or ventilation setting(s)• Certain problems with the Edi module.	1. Replace Control cable. 2. Update to System SW version 1.1.2 or higher. 3. Replace battery module. 4. Replace Edi module (if present). 5. Replace PC 1992 Monitoring. 6. Replace PC 1991 Control. 7. Replace PC 1993 Ethernet Switch. 8. Report to MCC HSC or to your local Getinge representative for further information.
56	Missing SW option data.	1. Reinstall software options. 2. Replace PC 1992 Monitoring
59	SW option installation failure.	1. Reinstall software options. 2. Replace PC 1992 Monitoring

Technical error	Error message / Possible cause	Recommended action
60	<p>Charger error.</p> <p>This error code is an indication of a charger error in the power supply subsystem.</p> <p>The cause is a hardware error, for example:</p> <ul style="list-style-type: none"> • An SMB-bus MUX error which may cause estimation of remaining battery capacity to be inadequate. • A charger electronics error causing unreasonably high current consumption. 	<ol style="list-style-type: none"> 1. Replace Battery module. 2. Replace PC 1995 Plug & Play back-plane.
61	<p>Fan 1 error</p> <p>Valid only for System SW version 1.0.5 - 1.1.3.</p> <p>Power supply to Fan 1 is monitored and this error code indicates for example:</p> <ul style="list-style-type: none"> • Fan 1 error. • Error in the power supply subsystem. 	<ol style="list-style-type: none"> 1. Update to System SW version 1.1.4 or higher. 2. Replace Fan 1 Patient unit. 3. Replace PC 1995 Plug & Play back-plane.

6.6.2 Breathing

Technical error	Error message / Possible cause	Recommended action
10001	Memory backup battery depleted. The battery on PC 1991 Control is depleted.	1. Replace battery on PC 1991 Control.
10003	Ventilation stopped. Error in the internal memory detected. This technical alarm may occur after a software installation. Restart the system and check that no technical alarms are activated. If TE 10003 remains, this indicates a HW error.	1. Restart the system. 2. Replace PC 1991 Control.
10004	Missing SW option data.	1. Reinstall software options. 2. Replace PC 1991 Control.

6.6.3 Panel

Technical error	Error message / Possible cause	Recommended action
20002	Backlight error. The backlight power consumption is measured. If the power consumption is outside specified range, this technical error is activated. This error message may also be logged immediately before the <i>No battery capacity</i> alarm when the system is running in battery mode.	Check internal PC board connections and cable connections. If the display is lit, and the error code is shown on the display: 1. Replace B740 CPU board. If the display is not lit, the display is dark: 1. Replace backlight lamps. 2. Replace B740 CPU board. Note: With a failure of the backlight lamp, or likely also on B740 CPU board, the User interface display becomes dark. In this case, the error code is not visible, but is however logged.
20003	Activate all pending alarm. There is a software-related internal communications problem.	1. Report to MCC HSC or to your local Getinge representative for further information.
20004	Alarm sound level too low. The loudspeakers are checked using a microphone during startup.	1. Restart the system. Do not touch the User interface during system startup. Interfering with the Touch screen, loudspeaker grid, etc., may affect the internal technical tests. 2. Replace loudspeaker. 3. Replace B740 CPU board.

Technical error	Error message / Possible cause	Recommended action
20005	Communication error Ethernet communication failure between PAN and MON. May occur with TE 55.	<ol style="list-style-type: none"> 1. Replace Control cable. 2. Update to System SW version 1.1.4 or higher. 3. Report to MCC HSC or to your local Getinge representative for further information.
20006	Missing SW option data. If together with TE 56 or TE 10004, see recommended actions for these errors.	<ol style="list-style-type: none"> 1. Restart the system. 2. Update to latest released System SW version.

6.6.4 Expiratory flowmeter

Technical error	Error message / Possible cause	Recommended action
For systems with PC 2004 Expiratory channel		
40001	Expiratory flowmeter error. See information logged together with error code 40001 in the Service log / Technical alarms.	<p>Technical alarm <i>Expiration flow meter PC 2004</i> and <i>Exp. cassette EEPROM read/write error</i>:</p> <ol style="list-style-type: none"> 1. Replace PC 2004 Expiratory channel. <p>Technical alarm <i>Expiration flow meter PC 2004</i> and <i>Exp. cassette EEPROM checksum error</i>:</p> <ol style="list-style-type: none"> 1. Replace Expiratory cassette. <p>Technical alarm <i>Expiration flow meter PC 2004</i> and <i>PC 2004 thermistor failure</i>:</p> <ol style="list-style-type: none"> 1. Check fan operation for proper cooling. 2. Replace PC 2004 Expiratory channel. <p>Technical alarm <i>Expiration flow meter PC 2004</i> and <i>PC 2004 60 V overrange</i>:</p> <ol style="list-style-type: none"> 1. Replace PC 2004 Expiratory channel. 2. Replace PC 1998 DC/DC & Standard connectors. <p>Technical alarm <i>Expiration flow meter PC 2004</i> and <i>PC 2004 60 V underrange</i>:</p> <ol style="list-style-type: none"> 1. Replace PC 1991 Control. 2. Replace PC 1998 DC/DC & Standard connectors. 3. Replace PC 2004 Expiratory channel.

Technical error	Error message / Possible cause	Recommended action
For systems with PC 2024 Expiratory channel		
40001	Internal communication error on PC 2024.	1. Replace PC 2024 Expiratory channel.
40002	Temperature sensor error on PC 2024. Note that this error may occur if the system is running outside operating temperature range.	1. Replace PC 2024 Expiratory channel.
40003	Power error. +60 V supply voltage to the ultrasonic transducers in the Expiratory cassette too high, i.e. > +75 V.	1. Replace PC 2024 Expiratory channel.
40004	Power error. +60 V supply voltage to the ultrasonic transducers in the Expiratory cassette too low, i.e. < +45 V.	1. Replace PC 2024 Expiratory channel. 2. Replace PC 1998 DC/DC & Standard connectors
40005	Power error. +1.8 V is more than 15 % outside nominal value.	1. Replace PC 2024 Expiratory channel.
40006	Power error. +1.2 V is more than 15 % outside nominal value.	1. Replace PC 2024 Expiratory channel.
40007	Power error. +5 V is more than 15 % outside nominal value.	1. Replace PC 2024 Expiratory channel. 2. Replace PC 1998 DC/DC & Standard connectors
40008	Power error. -5 V is more than 15 % outside nominal value.	1. Replace PC 2024 Expiratory channel.
40009	Power error. +2.5 V is more than 15 % outside nominal value.	1. Replace PC 2024 Expiratory channel.
40010	Internal temperature too high, > 77 °C. The temperature is too high or temperature sensor error on PC 2024.	1. Ensure proper cooling: - Check fan operation - Check the operating temperature - Check the fan filter in the Patient unit. 2. Replace PC 2024 Expiratory channel.
40011	Multiple CPU restarts on PC 2024.	1. Restart the system. 2. Replace PC 2024 Expiratory channel.

6.6.5 Other Technical error alarms

Error message / Possible cause	Recommended action
Expiratory cassette error Technical error in Expiratory cassette or in the communication with the cassette.	1. Replace the expiratory cassette. 2. Replace PC 1785 Expiratory channel connector. 3. Replace PC 2004/PC 2024 Expiratory channel. Check the Service log / Technical alarms. If <i>Expiration flow meter Exp. cassette power failure</i> is logged together with error code <i>Technical error in Expiratory cassette</i> : 1. Replace PC 1991 Control. 2. Replace PC 1998 DC/DC & Standard connectors.
Nebulizer hardware error Technical problem with nebulizer hardware. Temperature in the nebulizer patient unit too high. Technical problem with connection cable.	1. Restart the nebulizer. 2. Replace connection cable. 3. Check internal PC board connections and cable connections. 4. Replace PC1994 Nebulizer. 5. Replace PC 1991 Control.
CO₂ module error Hardware error in the CO ₂ analyzer module.	1. Unplug and reinsert the module. 2. Replace the module. There are no spare parts available for the CO ₂ analyzer module. In case of malfunction, the module must be replaced.
CO₂ sensor error Hardware error in CO ₂ capnostat sensor. The values in the capnostat memory failed the internal test.	1. Unplug and reinsert the capnostat sensor. 2. Calibrate the capnostat sensor. 3. Replace the capnostat sensor. There are no spare parts available for the capnostat sensor. In case of malfunction, the sensor must be replaced.
Edi module error Hardware error in the Edi module.	1. Unplug and re-insert the Edi module. 2. Replace the Edi module. There are no spare parts available for the Edi module. In case of malfunction, the module must be replaced.
Y sensor module error Hardware error in the Y sensor measuring module.	1. Unplug and reinsert the module. 2. Replace the module. There are no spare parts available for the Y sensor module. In case of malfunction, the module must be replaced.

6.6.6 User interface errors

Error message / Possible cause	Recommended action
User interface lock button and Quick menu button not lit	<ol style="list-style-type: none"> 1. Check control cable. 2. Check internal PC board connections and cable connections. 3. Replace B739 ALS board.
LCD display not lit	<ol style="list-style-type: none"> 1. Check control cable. 2. Check internal PC board connections and cable connections. 3. Replace PC B740 CPU. 4. Replace LCD display.
User Interface will not start up	<ol style="list-style-type: none"> 1. Check control cable. 2. Check internal PC board connections and cable connections. 3. Replace B740 CPU board. 4. Replace memory card (mounted on B740).
User interface lock button and Quick menu button malfunction	<ol style="list-style-type: none"> 1. Check/replace touch button cable. 2. Replace B733 Touch button board. 3. Replace Touch screen including frame.
Touch screen malfunction	<ol style="list-style-type: none"> 1. Check internal PC board connections and cable connections. 2. Replace Touch screen including frame. 3. Replace B735 Touch controller board.
Ambient light sensor malfunction	<ol style="list-style-type: none"> 1. Clean glass surface. 2. Clean sensor on B739 ALS board. 3. Replace B739 ALS board.
Loudspeaker malfunction	<ol style="list-style-type: none"> 1. Check loudspeaker cable connections. Switch loudspeaker connections on B740 CPU board to check if the malfunction is related to a defect loudspeaker or defect B740 CPU board. 2. If loudspeaker(s) is defect; replace loudspeaker(s). 3. If B740 CPU board is defect; replace B740 CPU board.
Light bar malfunction	<ol style="list-style-type: none"> 1. Check/replace light bar cable. 2. Replace B734 Light bar board.
I/O ports malfunction (USB, Ethernet)	<ol style="list-style-type: none"> 1. Replace B732 I/O board. 2. Replace B740 CPU board.

7 Preventive maintenance

Table of Contents

7.1	General	7 - 2
7.2	Preventive maintenance intervals	7 - 2
7.3	Required equipment	7 - 2
7.4	Preventive maintenance calculation and notification	7 - 2
7.5	Maintenance kit 5000h	7 - 3
7.6	Performing the Preventive maintenance	7 - 3

7.1 General

It is recommended that a complete cleaning of the system should be performed before carrying out Preventive maintenance. The cleaning procedure is only permitted by personnel trained and authorized by Getinge. Refer to instructions in the User's Manual (Cleaning and maintenance).

In some parts of the Preventive maintenance, as described in this chapter, access to Service & Settings is required.

Optional equipment not covered by this Service Manual, may also demand maintenance actions. Refer to the documentation for the optional equipment.



WARNING! The system must not be serviced or maintained while in use with a patient.



Note: Trained and authorized personnel. The system must be serviced at regular intervals by personnel trained and authorized by Getinge. It is recommended that service and maintenance is done as a part of a service contract. Any maintenance or service must be noted in a log book.

7.2 Preventive maintenance intervals

- Preventive maintenance of the system must be performed once a year, or every 5000 hours of operation, whichever comes first.
- The Battery modules shall be replaced after two and a half years from manufacturing date.
- The internal Memory backup batteries on PC 1991 and PC 1992 shall be replaced every five years.

7.3 Required equipment

- Standard service tools.
- Barometer (or information about the actual barometric pressure).
- Access to Service & Settings. Recommended but not required.
- Preventive maintenance kit containing all parts needed during the maintenance.
- Isolation test cable kit, P/N 68 83 300.

7.4 Preventive maintenance calculation and notification

7.4.1 Calculation

The calculation of time until next Preventive maintenance (5000 hours) includes only operating hours, standby hours are excluded.

7.4.2 Notification

The Preventive maintenance notification (PM reminder) is shown on the User interface. The PM reminder is shown after the Pre-use check dialogue (performed or cancelled).

There are two different time limits for the PM reminder:

- The first type of PM reminder is shown when there are 200 hours or less until next Preventive maintenance.
- The second type of PM reminder is shown when there are 0 hours until next Preventive maintenance, that is, the time limit for Preventive maintenance is exceeded.

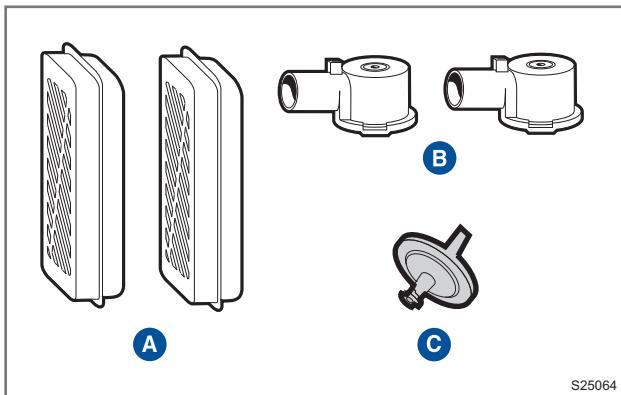
The PM reminder is active by default, but can be disabled in Service & Settings *CONFIGURATION > SETTINGS > GENERAL > PM reminder (On/Off)*.

7.5 Maintenance kit 5000h

Only original parts from the manufacturer must be used. Spare parts and maintenance kits can be ordered from your local Getinge representative.

When performing this maintenance, the Maintenance kit 5000h should be used.

The following parts, included in the Maintenance kit 5000h, shall be replaced:



S25064

Pos	Description	Remark
A	Gas module filter	For the Air and O ₂ gas modules.
B	Gas module nozzle unit	For the Air and O ₂ gas modules.
C	Bacteria filter	For the inspiratory pressure transducer.

7.6 Performing the Preventive maintenance

- Disassembling and assembling of the system is required when replacing parts included in the Maintenance kit 5000h. If not stated otherwise, refer to chapter Disassembling and assembling for instructions.
- All steps during Preventive maintenance should be documented.
- The letters **A – C** in the text below refer to the description of the Maintenance kit above.

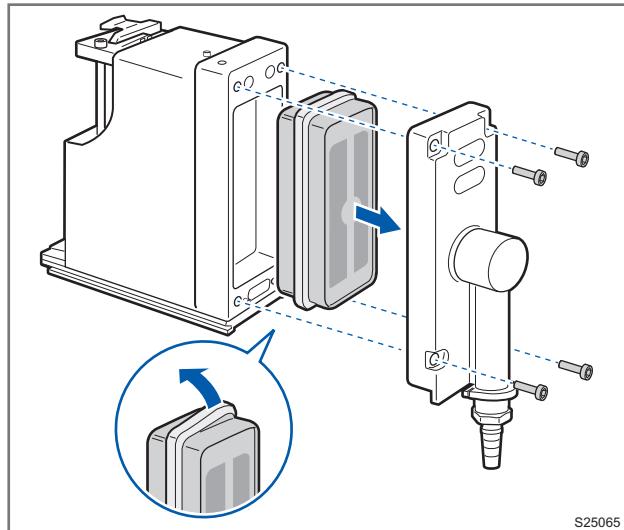
7.6.1 Preparations

- Check and note Serial number, System software version and Operating time.
- Check that a User's Manual corresponding to the installed System software version is present. Also check that operating manuals for optional equipment connected to the system are present.
- Make a general inspection/visual check of the system for external defects or damages. Replace defective or damaged parts.
- Make sure that gas supply hoses and connectors are correct.
- Check if there are any unexpected Technical alarms in the Service log available via Service & Settings.
- Perform a Pre-use check to make sure that the system work properly before the maintenance.
- Set the On/Off switch to Off.
- Disconnect the mains power cable.
- Disconnect the gas supplies (wall and/or cylinder).
- Remove patient tubing.
- If fitted, remove bacteria filter from the Expiratory inlet.

7.6.2 Gas module filters (A)

- Replace the filters in the gas modules.
 - When replacing a filter, move the rubber seal from the old to the new filter.
 - Make sure that the rubber seal is clean. Dirt particles on the rubber seal may cause leakage.

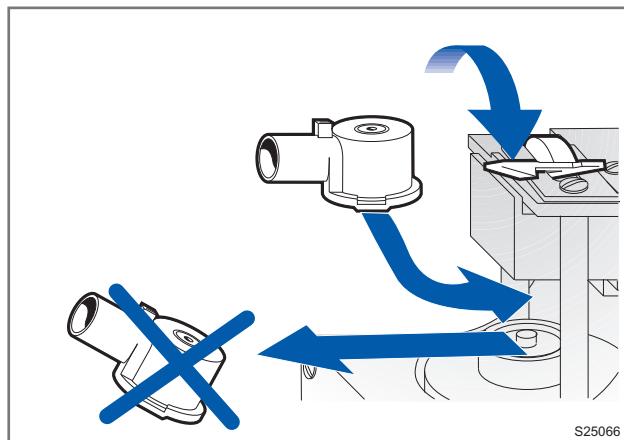
Note: Check for moisture in the gas module filter housing. If moisture is found, this may indicate too high moisture content in the gas supply. Inform the customer that gas supply must meet the requirements for medical grade gases according to applicable standards. Refer to Technical data in the User's Manual.



7.6.3 Gas module nozzle units (B)

- Replace the nozzle units in the gas modules.
 - Make sure that the O-ring on top of the nozzle unit is correctly seated and clean. Dirt particles on the nozzle unit may cause leakage.

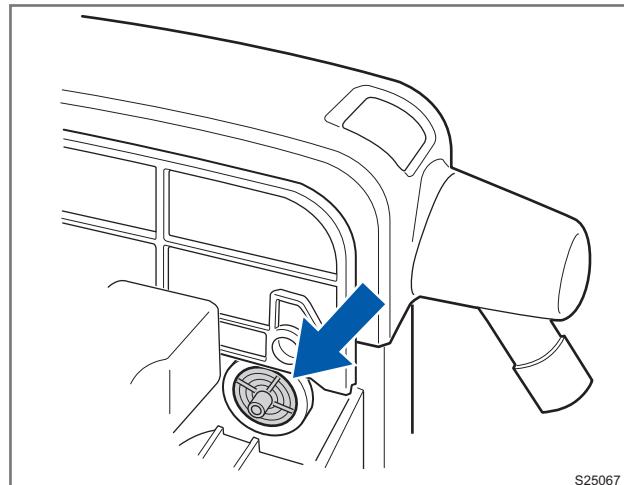
Note: After replacing the nozzle units, wait 10 minutes before applying pressure to the gas modules.



7.6.4 Inspiratory pressure transducer filter (C)

- Replace the filter for the inspiratory pressure transducer.
 - Make sure that the filter is correctly seated into the rubber ring.
 - Refer to the instructions in the User's Manual.

Note: The filter may already be replaced as a part of the Extended cleaning of the Inspiratory channel, performed prior to the Preventive maintenance.

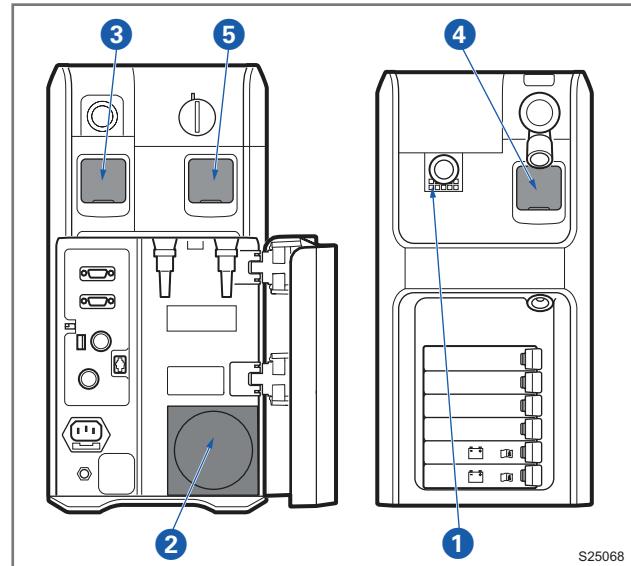


7.6.5 Emergency air intake

- Check that there are no obstructions on the Emergency air intake (1). Clean if required.

7.6.6 Fan filters

- Remove all fan filters:
 - Fan 1 inlet filter (2)
 - Fan 1 outlet filter (3)
 - Fan 2 inlet filter (4)
 - Fan 2 outlet filter (5).
- Check if the filters are damaged. Replace damaged filters.
- If not damaged, clean the filters. The filters can be rinsed in water. Shake out and make sure that the filters are free from excess water.
- Mount the new/cleaned filters.



7.6.7 Fan tests

- Check Fan 1 Patient unit (lower) and Fan 2 Inspiratory section (upper):
 - Set the On/Off switch to On.
 - Check that Fan 1 Patient unit and Fan 2 Inspiratory section start and run for a few seconds.

7.6.8 Expiratory cassette

- Operating capacity for the membrane is estimated to 10 000 000 breathing cycles. When this limit is passed or if the membrane for some reason has become defective, it must be replaced. Refer to instructions in chapter Disassembling and assembling.
- Membrane capacity (counter) can be shown in the System status window. Select **SYSTEM STATUS > Expiratory cassette** to check **Membrane capacity**.
- The operating capacity meter must be reset after replacement of the membrane. Note that the reset function is not implemented in System version 1.0 or 1.1.

7.6.9 User interface

- Check the screen readability:
 - Transparency
 - Surface
 - Brightness (backlight). The LED backlight is designed to maintain an acceptable brightness level throughout the lifetime of the system. The backlight operating time can be found in Service & Settings. If the backlight is replaced, the time meter must be reset in Service & Settings > Service report > Report replaced backlight.
 - Open a bright window, for example the Service & Settings login window, and check if pixels on the screen are defective. A few defective pixels can be accepted. Check that defective pixels are not concentrated to a small area which can reduce readability in this area.
- Check the touch functions and make sure that the software responds to these actions:
 - Tap on different parts of the touch screen.
 - Tap the Lock button.
 - Tap the Extended menu/quick menu button.

7.6.10 Barometric pressure

- Select SYSTEM STATUS > General. Check that the *Barometric pressure* value corresponds to the actual barometric pressure value at the local site. The value shown on the User interface may not differ more than $\pm 5\%$ from the actual barometric pressure.
- If the value shown on the User interface differs more than $\pm 5\%$ from the actual barometric pressure, the internal barometer must be calibrated. For further information, refer to section Barometer calibration in chapter Service procedures.

7.6.11 Gas supply pressure transducers

- Connect the Air and O₂ gas supplies.
- Select SYSTEM STATUS > General.
- Disconnect one gas supply at a time.
- Check that the corresponding Air/O₂ pressure value in the SYSTEM STATUS-window drops.

7.6.12 Battery modules

- The Battery modules shall be replaced after two and a half years from manufacturing date.
- Select SYSTEM STATUS > Batteries to check battery status. For further information, refer to section Battery modules in chapter Service procedures.

7.6.13 Memory backup batteries

- The Memory backup batteries must be replaced every five years. Check manufacturing date on the Memory backup batteries. For further information, refer to section Memory backup batteries in chapter Service procedures.

7.6.14 Safety inspection

- Check the mains power cable and control cable and their connections for damage.
- Perform an electrical safety test. Use of an Electrical Safety Tester and the Isolation test cable kit (P/N 68 83 300) is recommended.

The electrical safety test is a standard procedure according to IEC 60601-1:2005 or IEC 62353:2007 (or corresponding national standards). Allowable values and test methods are defined in the standards.

The following tests shall be performed (IEC 62353 terminology in brackets):

- A. Protective earthing (Protective earth resistance)
- B. Touch current (Equipment leakage current – direct method)
- C. Patient leakage current (Applied part leakage current – direct method)
- D. Insulation (Insulation resistance) – Measured between mains and protective earth.
- E. Insulation (Insulation resistance) – Measured between isolated connections and protective earth.

The system is classified within the standards listed above, and shall be tested according to the following:

- SERVO-U/SERVO-n base unit: Class 1, Type B. Test A, B, D.
- Nebulizer connector: Type BF. Test C, E.
- Y Sensor Module: Type BF. Test C, E.
- CO₂ Analyzer Module: Type BF. Test C, E.
- Edi Module: Type CF. Test C, E.

7.6.15 Completing the Preventive maintenance

- Perform a Pre-use check. Refer to the User's Manual.
- Reset the Preventive maintenance time counter. In Service & Settings, tap *SERVICE REPORT > Report completed preventive maintenance > Save to log*. This information is also stored in the log.
- Save system log files. Remote Services is recommended.
- Inform the customer that Preventive maintenance has been performed.

8 Index

Table of Contents

8.1	Alphabetic index	8 - 2
-----	------------------	-------

8.1 Alphabetic index

A

AC mains power LED 2-4
 AC mains power supply connector 2-4
 AC/DC converter 2-5, 3-13, 4-2, 4-13, 4-16
 Aerogen Module 3-23
 Aerogen Pro/Aerogen Solo nebulizers 2-3
 Air and O₂ supply 2-2
 Alarm indicator 2-8
 Alarm output 3-22
 Alarm output connector 2-4
 Assembling guidelines 4-5

B

B732 I/O board 2-8, 3-19, 4-23
 B733 Touch button board 2-8, 3-19, 4-23
 B734 Light bar board 2-9, 3-20
 B735 Touch controller board 2-8, 3-19, 4-23
 B739 ALS board 2-8, 3-19, 4-23
 B739 Ambient light sensor board 2-8, 3-19, 4-23
 B740 CPU board 2-8, 3-19, 4-3, 4-23
 Bacteria filter 2-6, 3-9
 Barometer calibration 5-13
 Barometric pressure 7-6
 Battery module 2-3, 3-18, 3-21, 5-23, 7-6
 Breathing BRE 2-10, 2-10, 6-24

C

Cable holder 2-3
 Cable reel 2-8
 CAN bus 2-12, 2-14
 CO₂ analyzer module 2-3, 3-21
 Communication protocols 2-12
 Compatibility chart 9-3
 Compressor Mini 2-3, 3-22
 Configuration 5-7
 Connector muff 2-6, 3-5
 Connectors 10-2
 Control cable 2-2, 2-8, 3-18, 4-23
 Control cable port 2-8
 Copy configuration 5-12

D

Digital and analogue signals 2-12, 2-16
 Drawer for Mobile cart 2-3

E

Edi 2-11, 4-3

Edi module (NAVA) 2-3, 3-20, 4-3
 EEPROM 3-4
 Electrical components 4-2
 Emergency air intake 2-2, 2-4, 7-5
 Environmental declaration 1-4
 ETHERNET bus 2-12, 2-13
 Expiratory cassette 2-4, 2-7, 3-8, 4-11, 7-5
 Expiratory cassette membrane 4-11
 Expiratory flowmeter 6-25
 Expiratory heater, Servo DuoGuard 2-3
 Expiratory inlet 2-2, 2-4, 3-8
 Expiratory inlet with moisture trap 2-4, 2-7
 Expiratory outlet 2-4, 3-10
 Expiratory pressure tube 3-9
 Expiratory section 3-3
 Expiratory valve 2-7, 3-9
 Expiratory valve coil 2-5, 3-10, 4-13, 4-14
 Extended menu/quick menu toggle 2-8
 External +12V DC inlet 2-4

F

Fan 1 Patient unit 2-4, 2-5, 3-17, 4-13, 4-21
 Fan 2 Inspiratory section 2-5, 3-8, 4-13
 Fan tests 7-5
 Filter 3-4, 3-5, 7-5
 Flash memory 3-4
 Flow transducer 3-4, 3-5
 F-RAM 3-4
 Front cover 4-13
 Functional check 1-3
 Fuse for external DC power 2-4
 Fuse, power label 2-4

G

Gas cylinder restrainer 2-3, 3-23
 Gas inlet for Air 2-4, 3-4
 Gas inlet for O₂ 2-4, 3-4
 Gas module 2-6, 3-4, 4-9
 Gas module filter 7-4
 Gas module key 3-4, 3-5
 Gas module nozzle 7-4
 Gas supply pressure transducer 7-6
 Gases and gas inlet pressure label 2-4

H

Handle 2-3, 3-22
 Hazard notices 1-2, 4-2
 Heating foil 2-7, 3-9
 Humidifier 3-23

Humidifier holder 2-3, 3-23

I

I2C bus 2-12, 2-15

Information stored 4-3

Inspiratory channel 4-6

Inspiratory channel cover 2-4, 4-6

Inspiratory outlet 2-2, 2-4, 3-8

Inspiratory pipe 2-6, 3-6

Inspiratory pressure transducer 2-6

Inspiratory pressure transducer filter 7-4

Inspiratory pressure tube 2-6, 3-7

Inspiratory section 3-3

Inspiratory solenoid 3-4, 3-5

Inspiratory valve temperature sensor 3-4, 3-5

Installation 1-3, 5-12

Internal communication 2-12

L

LCD Display 2-9, 3-19, 4-23

Leakage detection 5-19

LED backlight board 2-9

Light bar 4-23

Lock for inspiratory channel cover 2-4

Logs 5-5

Loudspeaker 2-8, 2-9, 3-20, 4-23

Luminescence detector 2-8

M

Main units 2-2

Mains inlet 3-13

Mains power supply inlet 2-5, 4-13

Maintenance kit 5000h 7-3

Memory backup batteries 5-25, 7-6

Memory card 2-8

Memory types 3-4

Mobile cart 2-2, 2-3, 3-22

Module compartment 2-2, 2-4, 2-5, 3-17, 4-13,

4-18

Module compartment frame 4-17

Module locking device 4-18

Module release levers 2-4

Moisture trap 2-2

Monitoring MON 2-10, 2-10, 6-19

Mounting kit 2-3

MSync 3-21

N

Nebulizer connector 2-4

Network cable port 2-8

Nozzle unit 3-4, 3-5

O

O2 cell 2-6, 3-6, 4-6

O2 sensor 2-6, 3-6, 4-3, 4-7

On/Off control 3-17

On/Off switch 2-4, 3-15

Optional equipment 3-20

Optional modules and accessories 2-3

Other technical error alarms 6-27

P

Panel PAN 2-10, 2-11, 6-24

Parts tested during leakage check 5-19

Patient circuit 2-2

Patient unit 2-2, 2-4

PC 1781 Expiratory pressure transducers 3-10

PC 1781 Inspiratory pressure transducers 3-10

PC 1785 Expiratory channel connector 2-5, 3-10,
4-13, 4-14

PC 1786 Expiratory channel cassette 2-7, 3-10

PC 1990 Main back-plane 2-6, 3-10, 4-22, 10-3

PC 1991 Control 2-5, 3-11, 4-3, 4-13

PC 1992 Monitoring 2-5, 3-12, 4-3, 4-13

PC 1993 Ethernet switch 2-5, 3-13, 4-13

PC 1994 Nebulizer 3-13, 4-17

PC 1995 Plug & Play back-plane 2-5, 3-16, 4-3,
4-13, 4-18, 4-19

PC 1998 DC/DC & Standard connectors 2-5, 4-13,
4-19

PC 1999 LED board 2-5, 3-15, 4-13

PC 2000 Pneumatic back-plane 2-6, 3-8, 4-10,
10-7

PC 2004 Expiratory channel 2-5, 2-7, 3-11, 4-3,
4-13

PC 2024 Expiratory channel 2-5, 2-7, 3-11, 4-3,
4-13

PC board rack 4-16

PC boards 4-2, 4-3, 4-16, 4-23

Pendant/bed holder 2-3, 3-22

Potential equalization terminal 2-4

Power 2-11

Power On LED 2-4

Power On/Off switch 2-5

Power supply selection 3-17

Pressure transducer connection 2-7

Pre-use check 4-2, 6-3, 6-8

Preventive maintenance calculation 7-2
Preventive maintenance intervals 7-2
Preventive maintenance notification 7-2

R

RAM 3-4
RAM with battery backup 3-4
RS-232 connectors 2-4

S

Safety inspection 7-7
Safety valve 2-6, 4-8
Safety valve including pull magnet 3-7
Safety valve membrane 4-8
Serial number label 1-1, 2-4, 2-8
Servers 2-10
Service 1-3
Service & Settings 5-2, 5-3, 10-9
Service key 5-2
Service report 5-7
Servo DuoGuard and Servo Guard filters 2-3
Shelf base 2-3, 3-22
Software installation 5-15
Software structure 2-10
Special grease 4-5
Standard connectors 3-15
Start-up test 6-2
Status 5-4
Supply pressure transducer 3-4, 3-5
Support Arm 178 2-3, 3-23
Symbols used 1-2
System electronics 3-3
System ID 2-11
System overview 10-10
System software version 1-1
System version 1-1

T

Technical error codes and messages 6-19
Temperature sensor 2-6, 3-7
Test case 1 5-19, 5-20
Test case 2 5-19, 5-20
Test case 3 5-19, 5-22
Tests 5-6
Thread locking adhesive 4-5
Tightening torque 4-5
To the responsible service personnel 1-3
Touch screen 3-18
Touch screen with frame 2-9, 4-23

U

Ultrasonic flowmeter 2-7, 3-9
USB port 2-8
User interface 2-2, 2-8, 3-3, 4-23, 7-6
User interface control cable 2-2
User interface control cable connector 2-4
User interface errors 6-28
User interface holder 2-3, 3-22
User interface lock 2-8
User interface stand 2-8

V

Valve membrane 2-7
VGA port 2-8

W

Waterbag/IV pole 2-3, 3-23
Wheel lock 2-2

Y

Y piece holder and hook 2-3
Y sensor 2-11
Y sensor module 2-3, 3-20, 4-3

9 Revision history

Table of Contents

9.1	SERVO-U/SERVO-n revision history	9 - 2
9.2	Service Manual revision history	9 - 4

9.1 SERVO-U/SERVO-n revision history

System version #	Status	Comments
System version 1.0	Valid	First released System version.
System version 1.1	Valid	<p>Software improvements:</p> <ul style="list-style-type: none"> • CO₂ analyzer option updated for Capnostat 5. • VGA port always active. • O₂ cell and Expiratory cassette membrane reports remaining capacity in %. • All three settings for “Remote Services after pre-use check” (Never/Always/Prompt) now works properly. • Static IP address in Remote Services now possible to set.
System version 2.0	Valid	<p>Software improvements:</p> <ul style="list-style-type: none"> • Adapted to PC 2024 Expiratory channel • Technical error: 61 Fan 1 error disabled • Now possible to reset the Expiratory cassette membrane counter in Service & Settings • SERVO Communication Interface (SCI) updated to protocol version 0004 • SERVO COMPASS • High Flow therapy.
System version 2.1	Valid	<p>Software improvements:</p> <ul style="list-style-type: none"> • Updated PRVC algorithm. • Changes in the VT/PBW presentation. • New O₂ sensor software, version aa271100. • Improvements in the communication with the O₂ sensor to reduce the occurrence of O₂ sensor failure. • Correction of SCI protocol regarding ventilation mode info for SIMV (PC) + PS. • Improvements of flow transducer test in Pre-use check. Prolonged flow zeroing of the gas modules. • Timing improvements in the internal communications between Panel and Monitoring subsystems to reduce the occurrence of Technical Error 20006. • Improvements of loudspeaker supervision to reduce the occurrence of Technical Error 20004. • Stability enhancement to reduce the occurrence of Technical Error 43. • Adjustments of triggering criteria for the alarm “Expiratory cassette error”.

9.1.1 Compatibility chart

The chart contains both software and hardware related information such as:

- Software version required to support hardware changes.
- Minimum software version required for a certain option.

To find article numbers and revision numbers of the PC boards:

- See the labels on the PC boards (part number/revision number)
- Go to *STATUS > Parts data (ARTICLE NUMBER/VERSION NUMBER)* in the Service & Settings menu. Service key required.

These article numbers cannot be used when ordering spare parts. See the Spare parts list for correct ordering information.

SERVO-U/SERVO-n System SW version	System SW version requirement for options	PC 1991 Control 66 89 785 revision #	PC 1992 Monitoring 66 89 790 revision #	PC 1995 Plug & play back-plane 68 80 885 revision #	PC 2004 Expiratory channel 66 92 477 revision #	PC 2024 Expiratory channel 68 81 702 or 68 87 462 revision #	B740 CPU 66 96 577 revision #
1.0.5 –		01 – 08 <i>Note 1</i>	01 – 09 <i>Note 1</i>	≥ 01	≥ 00	–	<i>Note 2</i>
1.1.0 –	Capnostat 5	01 – 08	01 – 09	≥ 01	≥ 00	–	<i>Note 2</i>
2.0.0 – 2.1.0	SERVO COMPASS High Flow therapy	01 – 08	01 – 09	≥ 01	≥ 00	≥ 01	<i>Note 2</i>
2.1.1 –		≥ 01	≥ 01	≥ 01	≥ 00	≥ 01	<i>Note 2</i>

S25119

Note 1: When replacing PC 1991 Control or PC 1992 Monitoring, the system must be updated to System SW version 1.1.0 or higher.

Note 2: Article number and version number shown in Service & Settings refers to the complete User Interface. PC board information is not available in Service & Settings.

9.2 Service Manual revision history

9.2.1 Revision 01

First revision.

9.2.2 Revision 02

In the table below, the following keywords are used:

A = Added. Information about new functionality added.

B = Changed. Information about changed functionality.

C = Corrected. Corrections made due to printing errors or clarifications.

A	B	C	Page	Section	Comment
	x	13-20	46. Y sensor module		Information about software installation now included.
	x	4-18	User interface		Disassembling and assembling instructions now included.
	x	5-11	Software installation		Software installation instructions revised.
	x	5-18	Test case 3 – Inspiratory channel		PC board number corrected.
	x	8-1	8. Index		Alphabetic index now included.
	x	9-2	Service Manual revision 02		Service Manual history updated.
	x	10-11	System overview		Minor corrections.

9.2.3 Revision 03

Revision 03 was not published.

9.2.4 Revision 04

In the table below, the following keywords are used:

A = Added. Information about new functionality added.

B = Changed. Information about changed functionality.

C = Corrected. Corrections made due to printing errors or clarifications.

A	B	C	Page	Section	Comment
x			1-1	General	The Service Manual is based on System version 1.1.
	x		1-5	Environmental declaration	Minor adjustments of the environmental declaration.
	x		1-5	Other electronics and throughout the Service Manual	Touch panel has changed name to touch screen.
x			1-6	Construction materials	Information regarding phthalates no longer valid and removed.
x			1-7	Articles of consumption	Filter for the O ₂ cell no longer included in the Preventive Maintenance kit.
x			2-3	Optional modules and accessories and throughout the Service Manual.	Aeroneb has changed name to Aerogen.
x			3-18	36. Touch panel	Touch panel calibration SW introduced.
x			3-21	47. CO ₂ analyzer module	Description adapted to cover also Capnostat 5.
	x		4-5	Tightening torques	Information regarding tightening torque for gas inlet nipples.
x			4-7	PC board rack	Information regarding software requirements for PC 1991 and PC 1992 (spare part boards).
x			4-19	User interface	Light bar reflector introduced.
	x		5-11	Software installation	The General information on page 5-11 restructured.
	x		5-13	System software installation	Note 3 introduced.
x			5-14	Test equipment	New P/N for Leakage detector tool.
x			5-18	General	Manufacturing date label redesigned.
x			6-16	Error code 55	Recommended action improved.
x			6-17	Error code 20005	Possible cause and recommended action improved.
	x		6-18	Error code 40001	Recommended action improved.
x			7-2	Required equipment	An Isolation test cable kit is now available. To be used during the electrical safety test.
x			7-3	Maintenance kit, 5,000 hours	Filter for the O ₂ cell no longer included in the Preventive Maintenance kit.
x			7-5	Filter for the O ₂ cell	Filter for the O ₂ cell no longer included in the Preventive Maintenance kit. Replacement instructions deleted.
x			7-7	Safety inspection	Information regarding the electrical safety test improved.
x			9-2	SERVO-U/SERVO-n revision history	SERVO-U/SERVO-n revision history introduced.

9.2.5 Revision 05

In the table below, the following keywords are used:

A = Added. Information about new functionality added.

B = Changed. Information about changed functionality.

C = Corrected. Corrections made due to printing errors or clarifications.

A	B	C	Page	Section	Comment
	x	-	All chapters in the Service Manual.	New layout.	
x		-	All chapters in the Service Manual.	PC 2024 replaces PC 2004.	
	x	-	All chapters in the Service Manual.	Fan 1 renamed to Fan 1 Patient unit. Fan 2 renamed to Fan 2 Inspiratory section.	
	x	-	1 Important	Restructured and adapted to new guidelines.	
	x	3 - 3	Main blocks	Information regarding Main blocks introduced.	
	x	3 - 7	3.8 Safety valve including pull magnet (8)	Image and information clarified.	
	x	3 - 16	3.31 PC 1995 Plug & play back-plane (31)	Note regarding system software installation after replacing PC 1995 introduced.	
	x	3 - 20	3.45 Optional equipment	Information regarding MSync, Handle, User interface holder and Aerogen module introduced.	
	x	-	4 Disassembling and assembling	Restructured chapter.	
	x	4 - 3	4.3.3 Replacing PC boards	Information about additional actions required after replacing PC boards clarified.	
	x	4 - 19	4.21 PC 1995 Plug & play back-plane	Note regarding additional actions after replacing PC boards introduced.	
x		-	5 Service procedures	User interface for version 2.0 changed. New images and descriptions.	
	x	6 - 3 to 6 - 7	6 Troubleshooting	New sections: 6.3 Pre-use check, 6.4 Other tests and 6.5 Test logs introduced. Log descriptions and recommended actions in section Pre-use check clarified.	
x		6 - 20, 6 - 22	6.6.1 Monitoring	Technical error: 25 Recommended action corrected. Technical error: 43 Recommended action corrected.	
	x	6 - 25	6.6.4 Expiratory flowmeter	PC 2004: Recommended actions corrected.	
x		6 - 25	6.6.4 Expiratory flowmeter	PC 2024: Technical error codes 40001-40011 introduced.	
	x	9 - 3	9.1.1 Compatibility chart	Compatibility chart introduced.	
x		10 - 9	10.4 Service & Settings menu	User interface for version 2.0 changed. Service & Settings menu revised.	
	x	10 - 10	10.5 System overview	Illustration revised.	

9.2.6 Revision 06

In the table below, the following keywords are used:

A = Added. Information about new functionality added.

B = Changed. Information about changed functionality.

C = Corrected. Corrections made due to printing errors or clarifications.

A	B	C	Page	Section	Comment
		x	-	All chapters in the Service Manual.	The Service Manual now states Maquet Critical Care AB as legal manufacturer but with Getinge as the local service provider.
	x		-	All chapters in the Service Manual.	The information in the Service Manual is based on System version 2.1.
		x	3 - 11	PC 2004/PC 2024 Expiratory channel (21)	Reference to the Compatibility chart clarified.
		x	3 - 11	PC 1991 Control (22)	Reference to the Compatibility chart clarified.
		x	3 - 12	PC 1992 Monitoring (23)	Reference to the Compatibility chart clarified.
		x	3 - 13	PC 1994 Nebulizer (25)	Information clarified.
		x	3 - 19	B732 I/O board (39)	Information regarding isolated/non-isolated connectors clarified.
		x	3 - 21	CO ₂ analyzer module (47)	Reference to the Compatibility chart clarified.
		x	3 - 22	Alarm output	Alarm output information corrected.
		x	4 - 13	Front cover	Reference to the Compatibility chart clarified.
		x	5 - 7	Service report	Information regarding <i>Edit</i> button clarified.
		x	5 - 17	Software option installation	Installation procedure clarified; wait two minutes for Service log to be updated.
	x		5 - 25	Replacing Memory backup battery	Function for battery on PC 1991 changed.
		x	6 - 3 to 6 - 18	Pre-use check Other tests Test logs	Names on tests and test sequences adapted to the terms used in the Service log.
		x	6 - 3 to 6 - 18	Pre-use check Test logs	Units changed to correspond to the units in the Service log
		x	6 - 10	Gas supply test sequence	CFI 7 and 8: Log description corrected. Checks Air supply pressure, not O ₂ as previously stated.
	x		6 - 11 to 6 - 12	Internal leakage test sequence	CFI 3 - 5: Recommended action corrected.
		x	6 - 14	Safety valve test sequence	CFI 3: Recommended action corrected.
		x	6 - 14	O ₂ cell/sensor test sequence	CFI 2: Log description clarified.
	x		6 - 15	O ₂ cell/sensor test sequence	CFI 13 - CFI 16: CFI number changed.
		x	6 - 20	Monitoring	TE 11: Recommended action corrected.
		x	6 - 20	Monitoring	TE 25: Recommended action clarified.
		x	6 - 21	Monitoring	TE 32: Recommended action corrected.

A	B	C	Page	Section	Comment
		x	6 - 21	Monitoring	TE 37: Error message/Possible cause and Recommended action clarified and corrected.
	x		6 - 22	Monitoring	TE 43: Recommended action changed.
	x		6 - 22	Monitoring	TE 55: Recommended action changed.
	x		6 - 23	Monitoring	TE 61: Recommended action changed.
	x		6 - 25	Panel	TE 20005: Recommended action changed.
	x		6 - 25	Panel	TE 20006: Recommended action corrected.
		x	6 - 25	Expiratory flowmeter	TE 40001: Recommended action corrected.
		x	6 - 27	Other Technical error alarms	Error message <i>Restart ventilator</i> not applicable and removed in the table.
		x	7 - 3	Preparations	Information corrected.
		x	7 - 6	Battery modules	Information clarified.
		x	7 - 7	Completing the Preventive maintenance	Information clarified.
x			9 - 2	SERVO-U/SERVO-n revision history	System version 2.1 added.
x			9 - 3	Compatibility chart	System SW version 2.1.1 added. PC 2024 Expiratory channel P/N 68 87 462 added.
		x	10 - 10	System overview	Minor corrections.

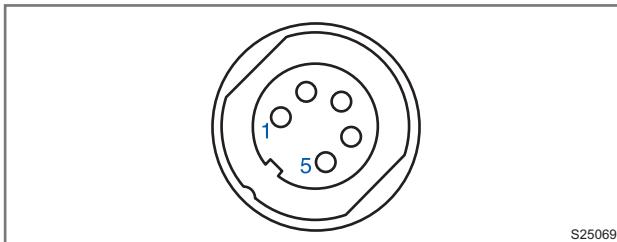
10 Diagrams

Table of Contents

10.1	Connectors	10 - 2
10.2	PC 1990 Main back-plane	10 - 3
10.3	PC 2000 Pneumatic back-plane	10 - 7
10.4	Service & Settings menu	10 - 9
10.5	System overview	10 -10

10.1 Connectors

10.1.1 N26 – External +12 V supply input



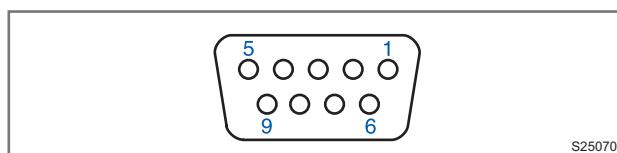
Cable connector: Amphenol C 091 A, P/N T 3360 005

1. +12V_UNREG_EXT_DC
2. +12V_UNREG_EXT_DC
3. –
4. GND
5. GND

10.1.2 N28/J4 – Control cable

User interface control cable connector. Only original spare parts from Maquet must be used in the system.

10.1.3 N29/N30 – RS-232

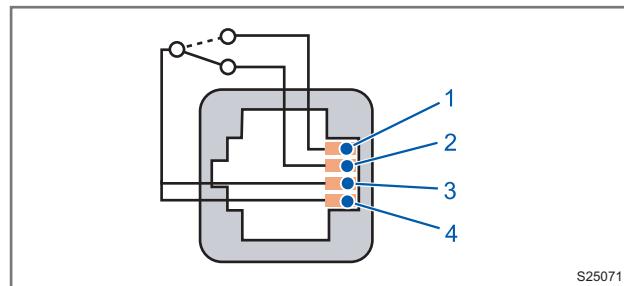


Isolated RS-232 serial ports. 9 pin D-Sub female connector.

RS-232C for data communication via the Servo Communication Interface (SCI).

1. –
2. RXD_ISO
3. TXD_ISO
4. DTR_ISO
5. GND_ISO
6. –
7. RTS_ISO
8. –
9. –

10.1.4 N67 – Alarm output



Isolated connector. Modular plug 4/4 (4P4C)
Switching capability: Max 40 V DC, Max 500 mA, Max 20 W.

1. NO – Normally Open
2. NC – Normally Closed
3. Common
4. Common

10.1.5 J1 – VGA

Non-isolated connector. 15 pin D-Sub

Resolution: 1024x768@60Hz

External monitors should be isolated from the ventilator system. This can be achieved if the connected monitor is powered via a medical grade transformer.

10.1.6 J2 – Ethernet

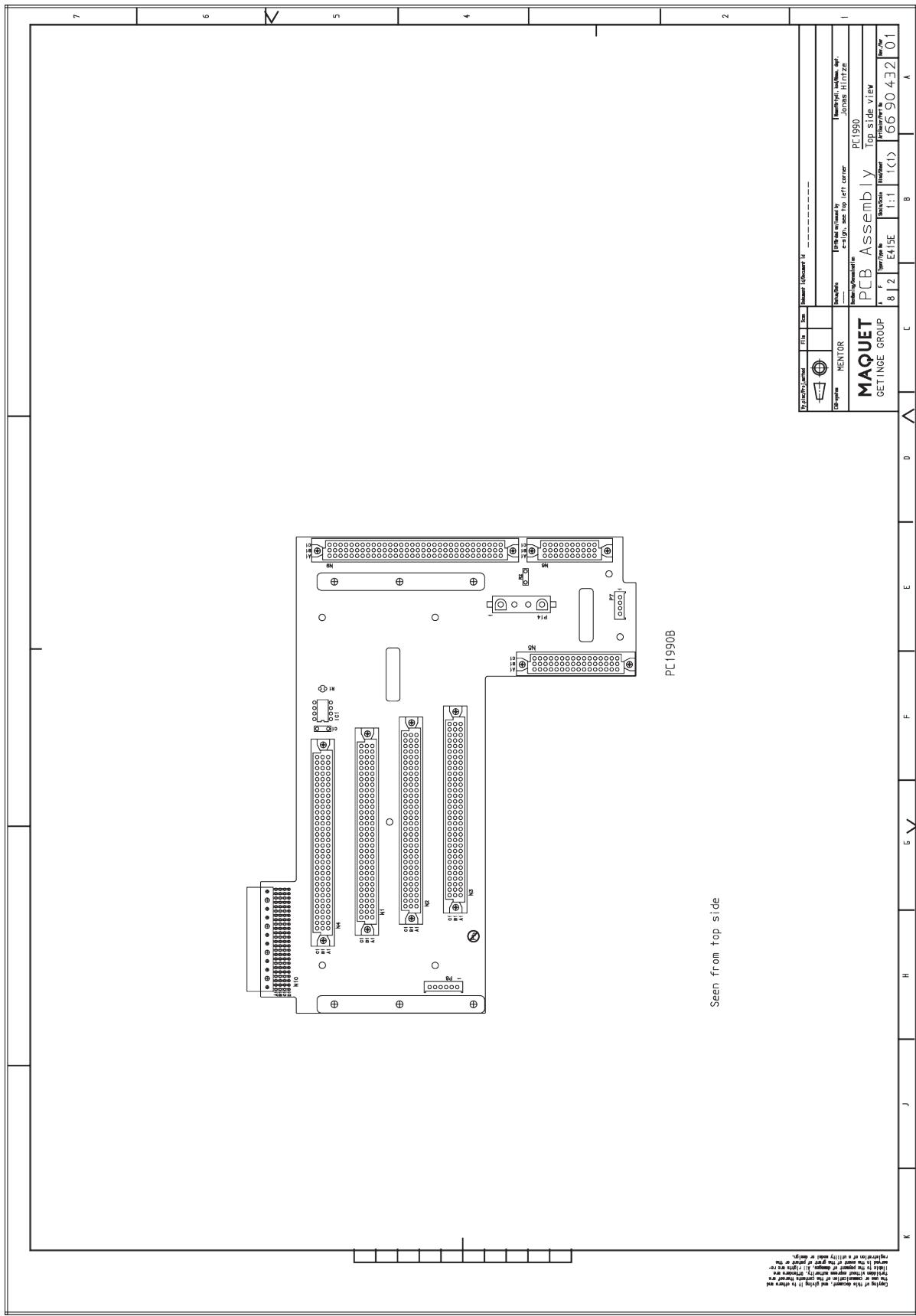
Isolated connector. Unshielded RJ45.

Speed: 10 Mbit/s.

10.1.7 J3 – USB

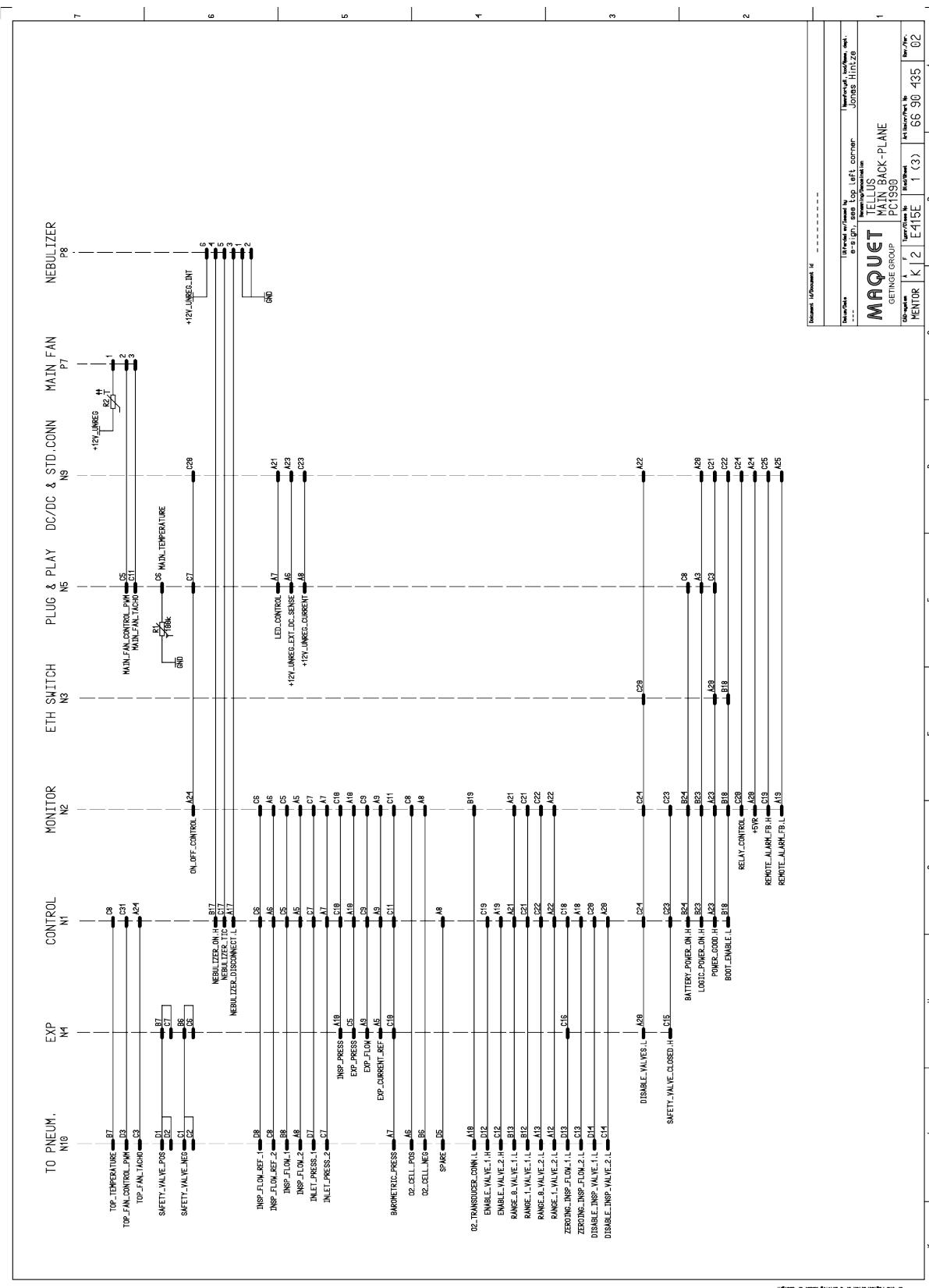
Non-isolated connector. USB 2.0 Type A.

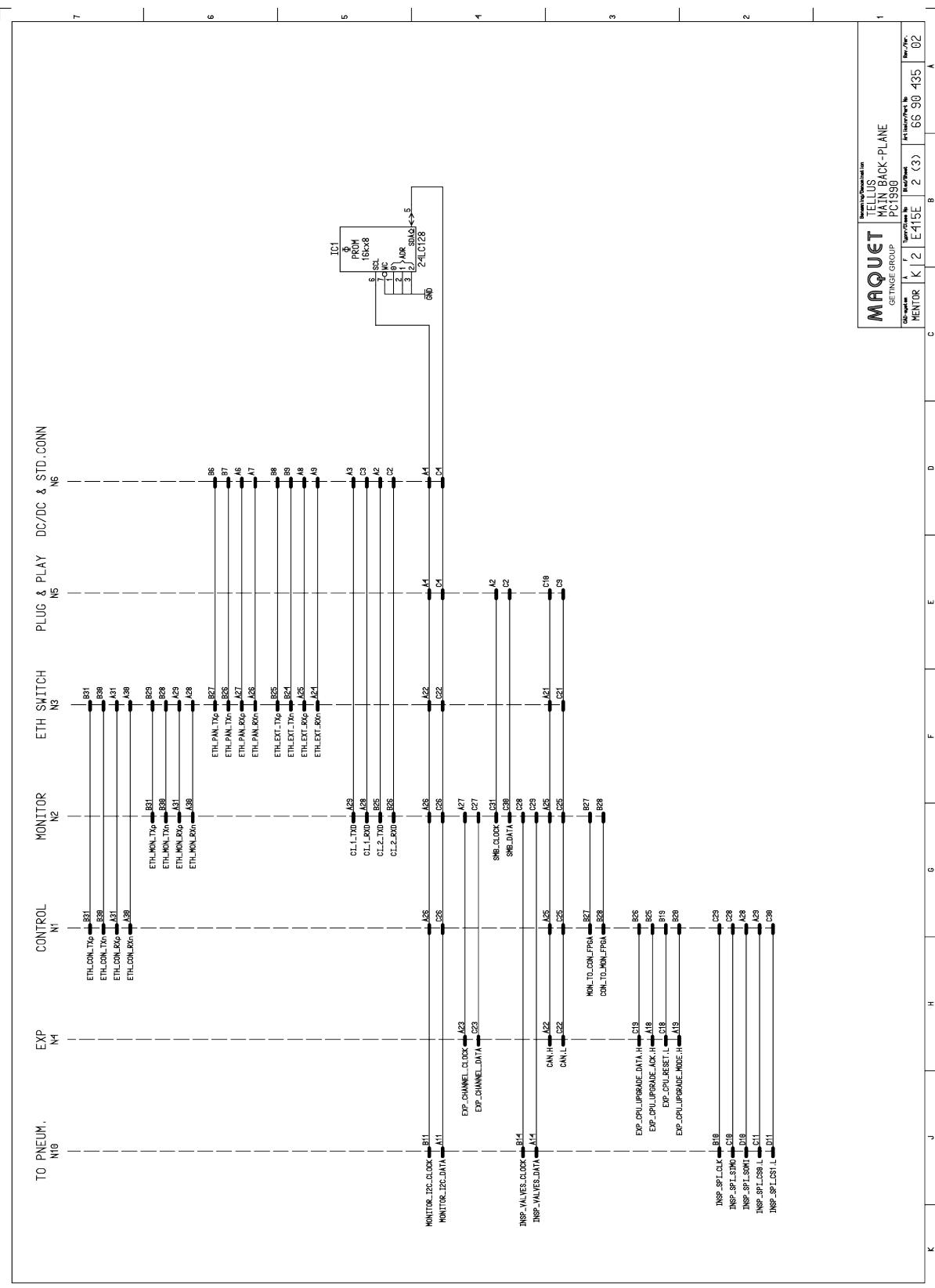
10.2 PC 1990 Main back-plane

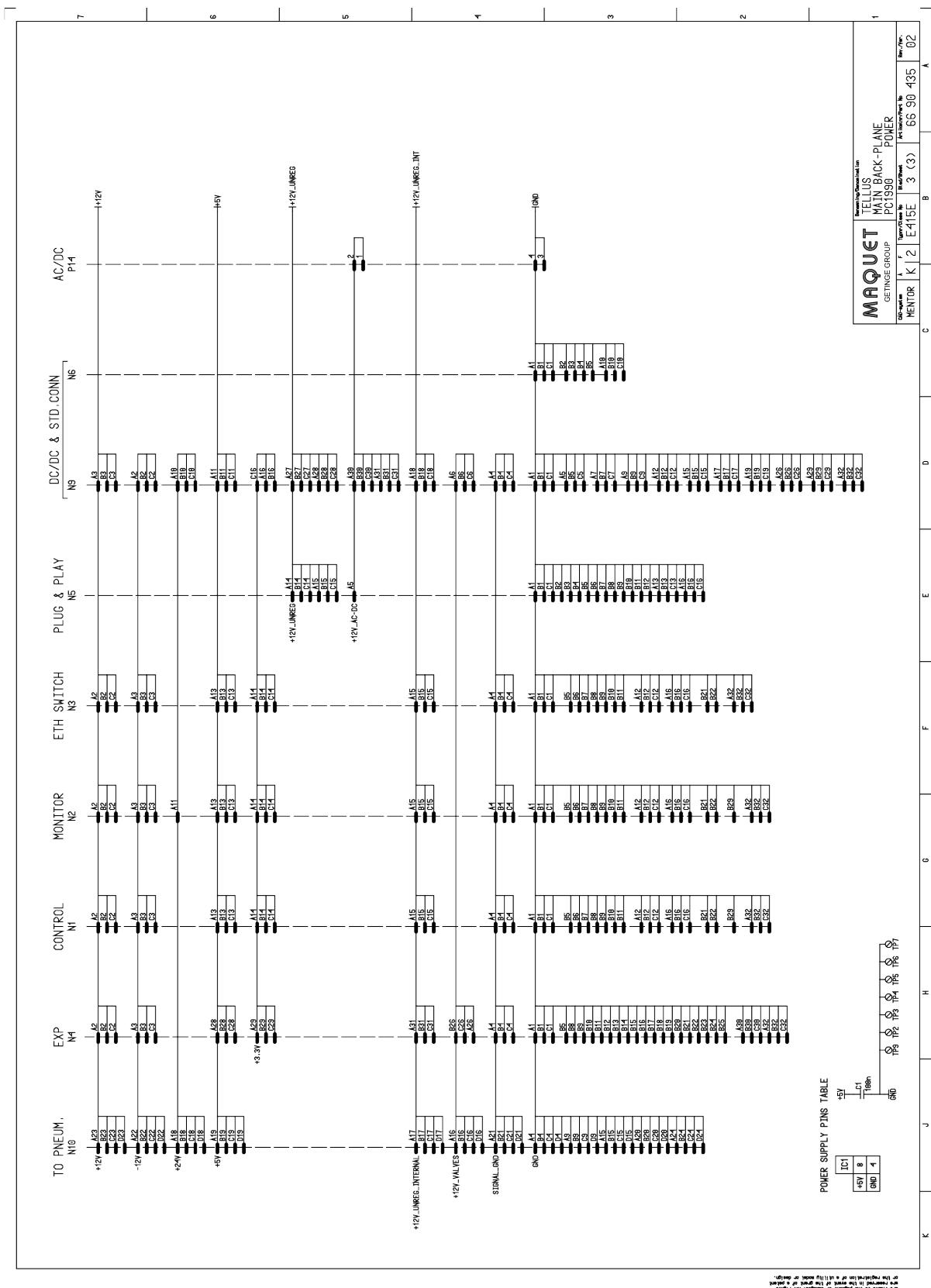


SERVO-U/SERVO-n Ventilator System, Service Manual

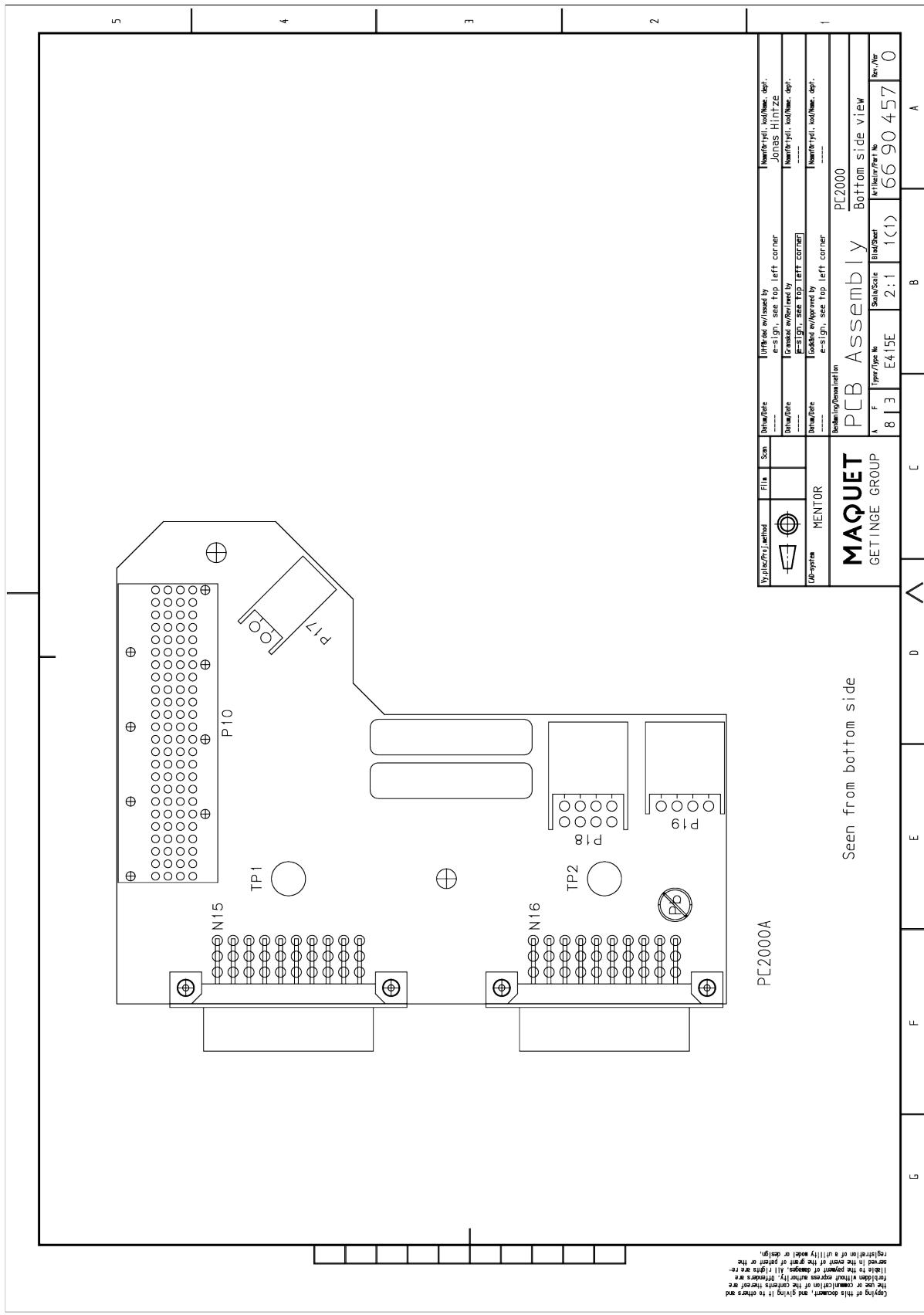
10 - 3

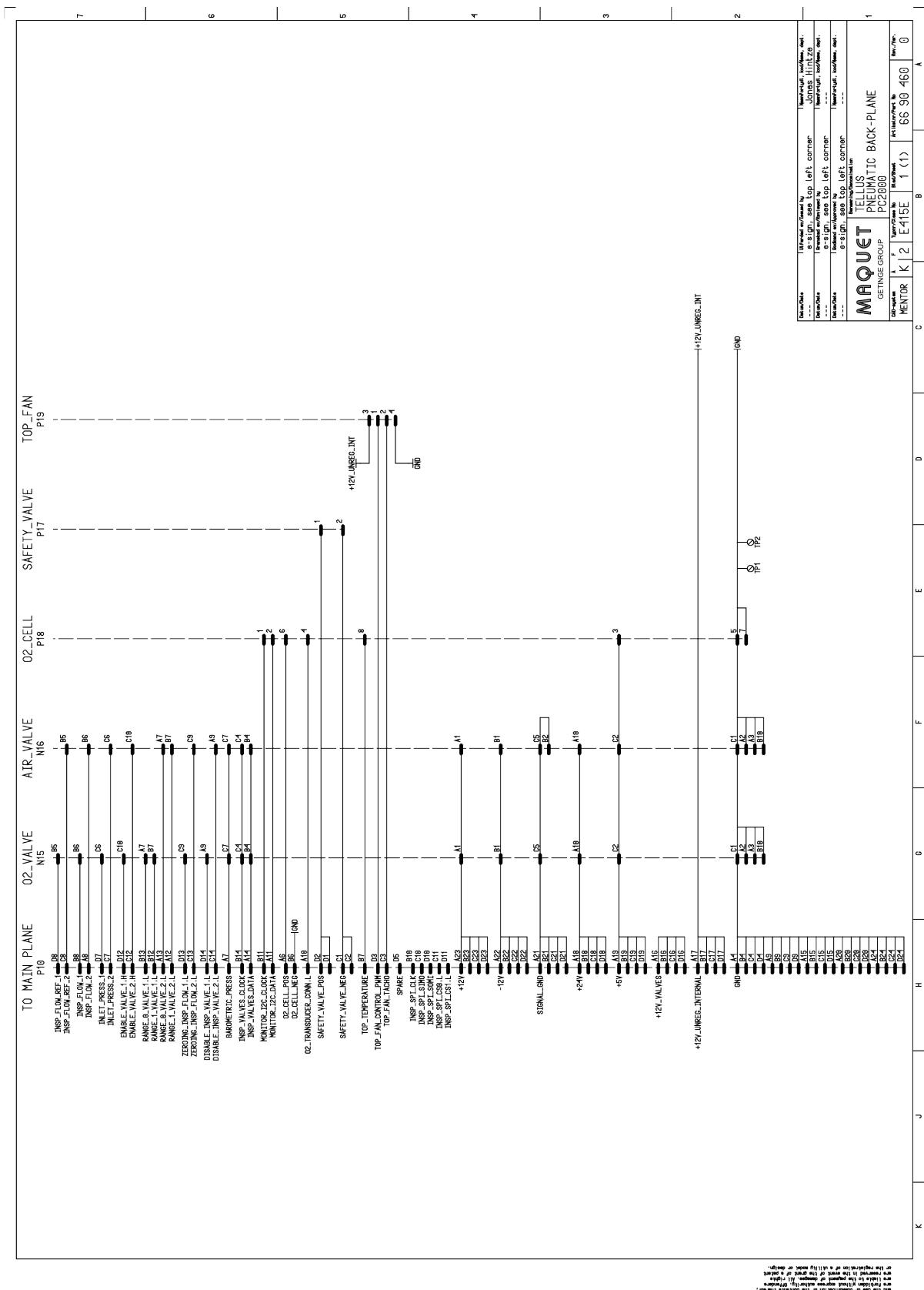




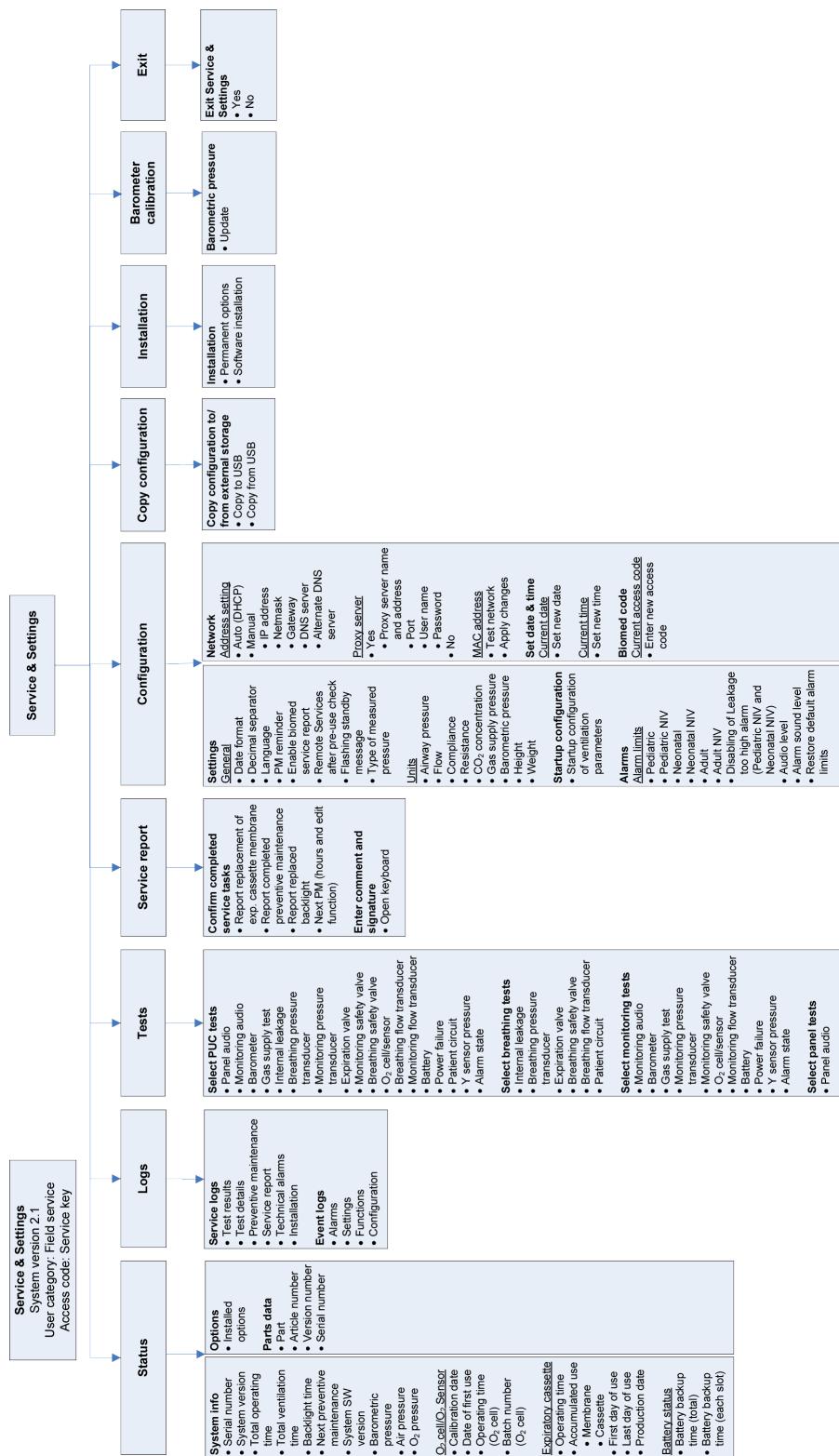


10.3 PC 2000 Pneumatic back-plane

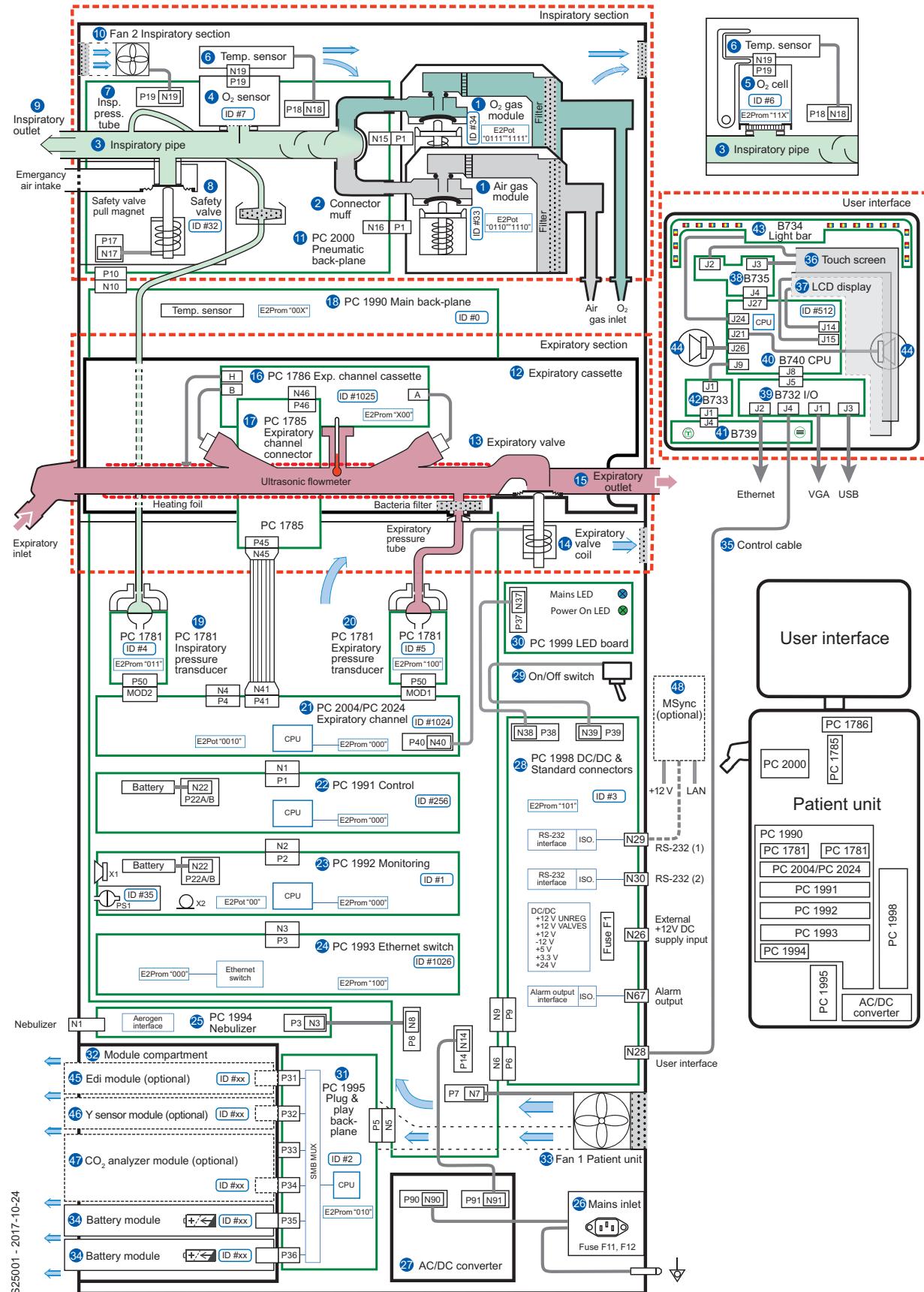




10.4 Service & Settings menu



10.5 System overview





Manufacturer: Maquet Critical Care AB
Röntgenvägen 2
SE-171 54 Solna, Sweden

For local contact:

Please visit our website
www.maquet.com

GETINGE GROUP

Getinge Group is a leading global provider of products and systems that contribute to quality enhancement and cost efficiency within healthcare and life sciences. We operate under the three brands of ArjoHuntleigh, Getinge and Maquet. ArjoHuntleigh focuses on patient mobility and wound management solutions. Getinge provides solutions for infection control within healthcare and contamination prevention within life sciences. Maquet specializes in solutions, therapies and products for surgical interventions, interventional cardiology and intensive care.