Datex Ohmeda

Centiva /5

Service Manual

Software rev. 2.1n

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9 Schematics and Diagrams

1 Introduction

In this section

1.1 What this manual includes

This manual covers the service information for the

Centiva / 5 ICU ventilator
Release 2.1n.

Special notice

Some information in this manual can possibly point the reader to electronic troubleshooting and component repair / replacement level of service. This information, when supplied, is only supplied to add clarity to service or troubleshooting statements. Datex-Ohmeda Service Personnel are mandated by Company Policy to service electronic equipment to a board replacement level only.

- Read completely through each step in every procedure before starting the procedure; any exceptions can result in a failure to properly and safely complete the attempted procedure.
- Unless otherwise specified, values in this manual are nominal.
- Sections in this manual begin on odd numbered or right-hand pages. If there is no text on the preceding, backup even numbered page, it is labeled “Notes” for your use if you wish.
- Figures that require more than one page have the title and main text on the left (even numbered) page. Additional figure information is on the facing (odd numbered) page.

1.1.1 Software versions

The revision level is displayed on the ventilator power-up test menu and on the system test menu.
This manual includes test and calibration procedures for

Release 2.1n software.

1.2 Standard service procedures

1.2.1 Operation manuals

You must have, and be familiar with, the Operation manual for this product. Study the Centiva /5 ICU Ventilator Operation manual if you need further information about the operation of the system.

1.2.2 Ventilator tests

Service calibration functions let Datex-Ohmeda trained service personnel perform ventilator setup functions , tests, measurements and calibrations from the front panel display.

Normal operational tests, calibrations and troubleshooting can be performed on the Centiva /5 ICU Ventilator without opening the system's cabinet.

Repair will require opening the system's cabinet.
Calibration of the following parameters requires opening the system's cabinet:

- Inspiratory O2 flow
- Inspiratory Air flow
- Expiratory flow
- Airway pressure
- Battery charging voltage

WARNING After the Centiva /5 ICU Ventilator has been serviced, you must perform "Post Service Checkout" to verify the system is properly functioning before the system can be returned to clinical use.

WARNING Do not perform testing or maintenance on this instrument while it is being used to ventilate a patient, possible injury may result.

1.3 Symbols used in this manual or on the equipment

⚠Warnings and ⚠Cautions tell you about dangerous conditions that can occur if you do not follow all instructions in this manual.

⚠ WARNING — Warnings tell about a condition that can cause injury to the operator or the patient.

⚠ CAUTION — Cautions tell about a condition that can cause damage to the equipment. Read and follow all warnings and cautions.

Alarm silence touch key

Menu touch key

Earth ground

Protective earth ground

Equipotential

Type B equipment

Systems with this mark agree with the European Council Directive (93/42/EEC) for Medical Devices when they are used as specified in their Operation and Maintenance Manuals. The “0123” is the certification number of the Notified Body used by Salvia Lifetec’s Quality Systems.

1.4 Abbreviations used in this manual or on the equipment

Vent. mode	Ventilation mode
CMV	Controlled, volume constant ventilation
SIMV	Synchronized intermittent controlled volume constant ventilation
Bi-Level	Bi Level pressure controlled ventilation
ASB	Assisted spontaneous breathing
CPAP	Continuous positive airway pressure
ASB / Apnea	ASB with apnea (Bi-Level back up ventilation)
ASR	Automatic suction routine
ARC	Airway resistance compensation
Endot.tube	Endotracheal tube
Trach.tube	Tracheal tube
P_{max}	Safety pressure setting
P_{limit}	Pressure limit setting
P_{insp}	Inspiratory pressure setting
P_{ASB}	Assisted spontaneous breathing pressure setting
P_{peak}	Highest airway pressure, measured within last breath
P_{min}	Lowest airway pressure, measured within last breath
P_{PEEP}	Positive end expiratory pressure setting
P_{aw}	Airway pressure in general
Rate	Breaths per minute
I:E	Inspiratory to Expiratory time ratio
Ramp	Ramp time between lower and upper Bi-level
ASB ramp	Ramp time between lower Bi-level and ASB pressure level
Time window	Trigger time window
t	Time in general
Vt	Tidal volume setting
TV	Tidal volume, measured
MV	Minute volume, measured
I-Flow	Inspiratory flow setting
Trigg.	Trigger flow
Byflow	Bypass flow
Flow	Flow in general
Fi-O2	Inspiratory O2 concentration setting
O2	Inspiratory O2 concentration, measured

I	On (Power), line supply
O	Off (Power), line supply
AC	Alternating current, line supply
DC	Direct current, DC main supply
Ref	Stock number
SN	Serial number

2 Theory of Operation

In this section

2.1 General description

The Centiva/5 ICU ventilator is a microprocessor based, electronically controlled, pneumatically driven ventilator with built-in monitoring capabilities for

- inspired oxygen concentration
- airway pressure
- exhaled volume.

The ventilator is intended to be used in general ventilation and ICU ventilation for patients age 1 year up to adults.

The ventilator compensates for

- system compliance
- inspiratory and expiratory resistance
- leakage

The ventilator allows

- invasive ventilation
- non-invasive ventilation

The ventilator is capable of the following ventilation modes

- CMV
- SIMV / ASB
- Bi-Level / ASB
- ASB / CPAP
- ASB / Apnea

2.2 Centiva/5 ICU Ventilator features

- On-board diagnostic software to ease servicing.
- Ventilator hardware is tested during the initial power-up system test.
- PEEP is generated electronically
- An exhalation valve modulates the patient's pressure pattern.
- The exhalation valve assembly is electronically locked and can be autoclaved .
- Double stage inspiration valves per gas modulate the patient's flow pattern.
- Sensors in the breathing circuit are used to control and monitor patient ventilation and measure inspired oxygen concentration.
- User settings and microprocessor calculations control breathing patterns.
- An RS 232 serial digital communication port connects to and communicates with external devices.

2.2.1 Safety features

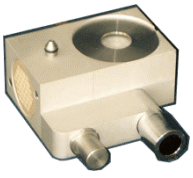
- Dual redundant airway overpressure protection
- Electronically controlled (active) overpressure protection linked to P max.
- Passive overpressure relief valve, set at fixed value (75 mbar)
- Sub atmospheric pressure relief valve (free breathing valve)
- Single gas operation capability
- Back-up battery supply for minimum 30 minutes operation

2.3 Centiva/5 ICU ventilator main assemblies

The Centiva/5 ICU ventilator has three (3) user accessible main assemblies

- The main engine
- The control panel
- The expiration valve

These three assemblies can be separated by he user without using any tools.

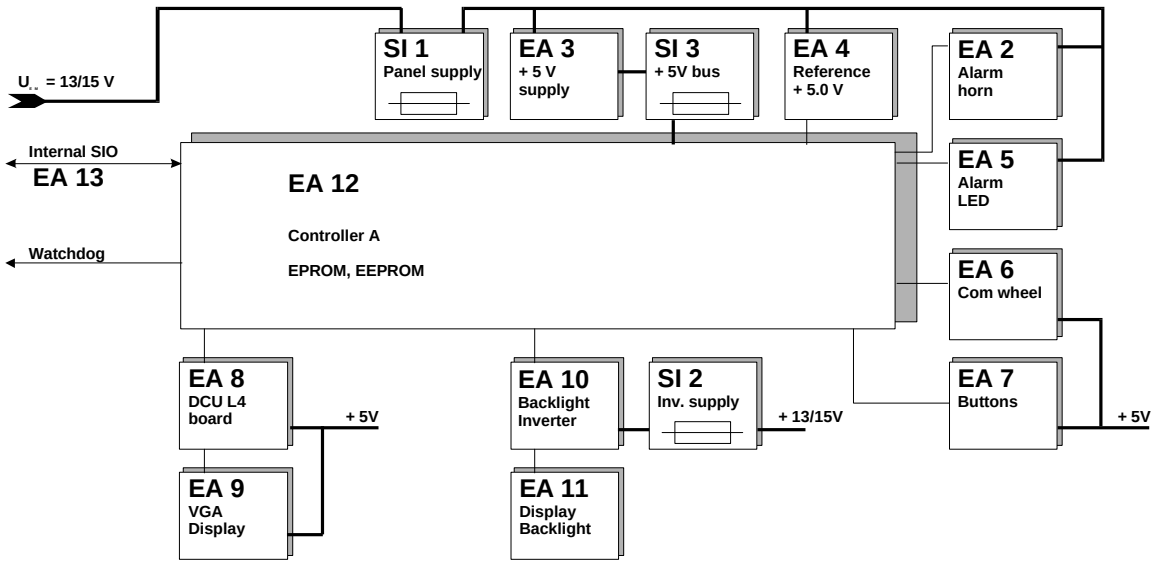


2.4 The control panel

The control panel of the Centiva/5 ICU ventilator is equipped with a 6.5" full color LCD screen with backlight illumination, buttons for selecting different parameters (hotkeys, menu, alarm silence) and a com wheel.

The control panel has a serial connection to the main engine with a power supply line (+13/15V), ground and two serial com lines.

The control panel is equipped with a microprocessor (A) that controls alarms, settings and monitoring data.



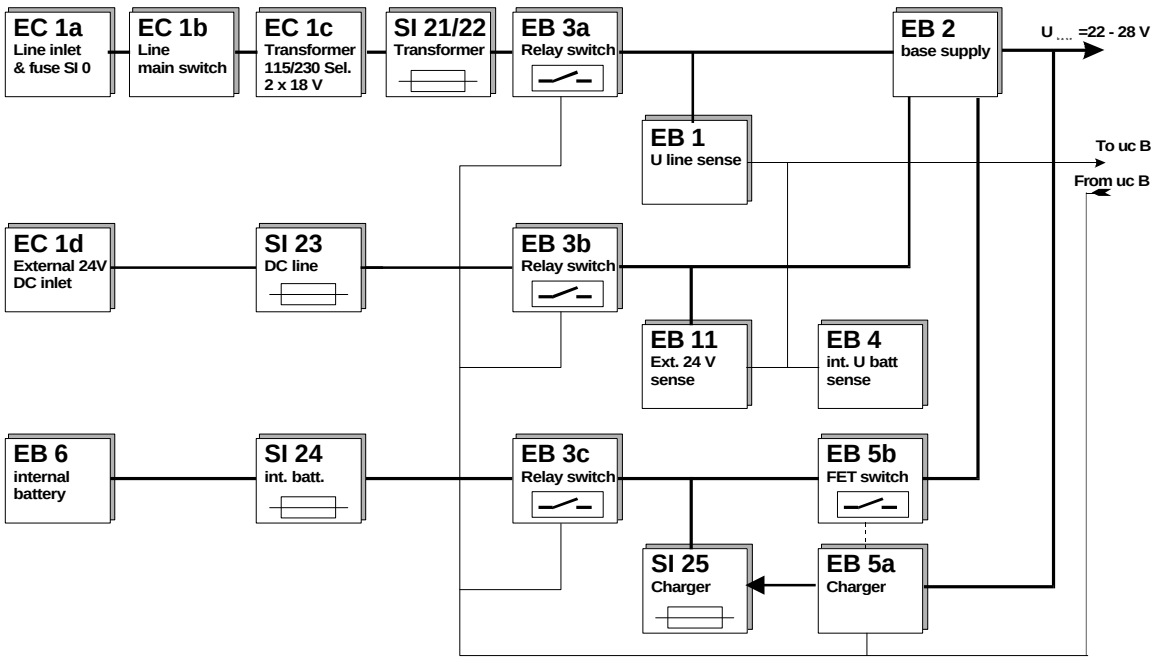
Panel block diagram

2.5 Main engine

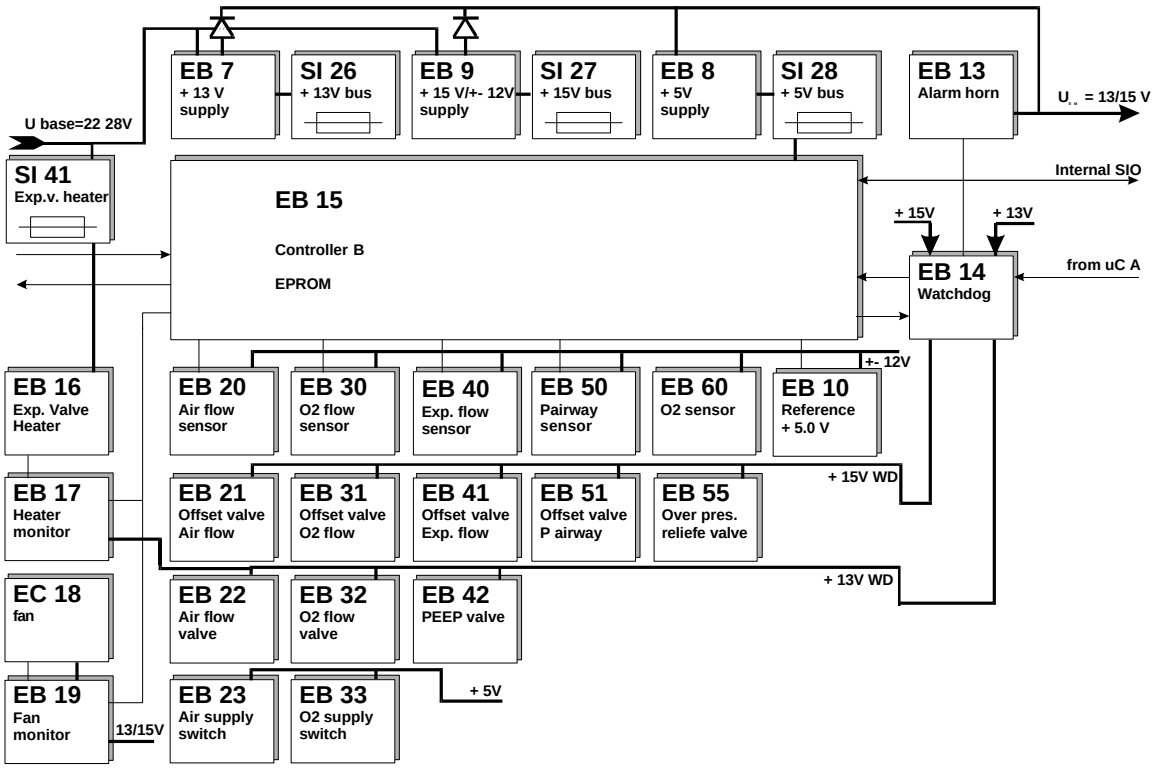
The main engine of the Centiva/5 ICU ventilator carries all the pneumatics, the power supply and the main PC board (B) . This microprocessor B controls the two (2) inspiratory gas inlet valve blocks of double staged proportional valves, the expiration (PEEP) valve and all support functions. Microprocessor B communicates with microprocessor A on the panel board via the serial connector.

The watchdog for both microprocessors is located on the main board within the main engine.

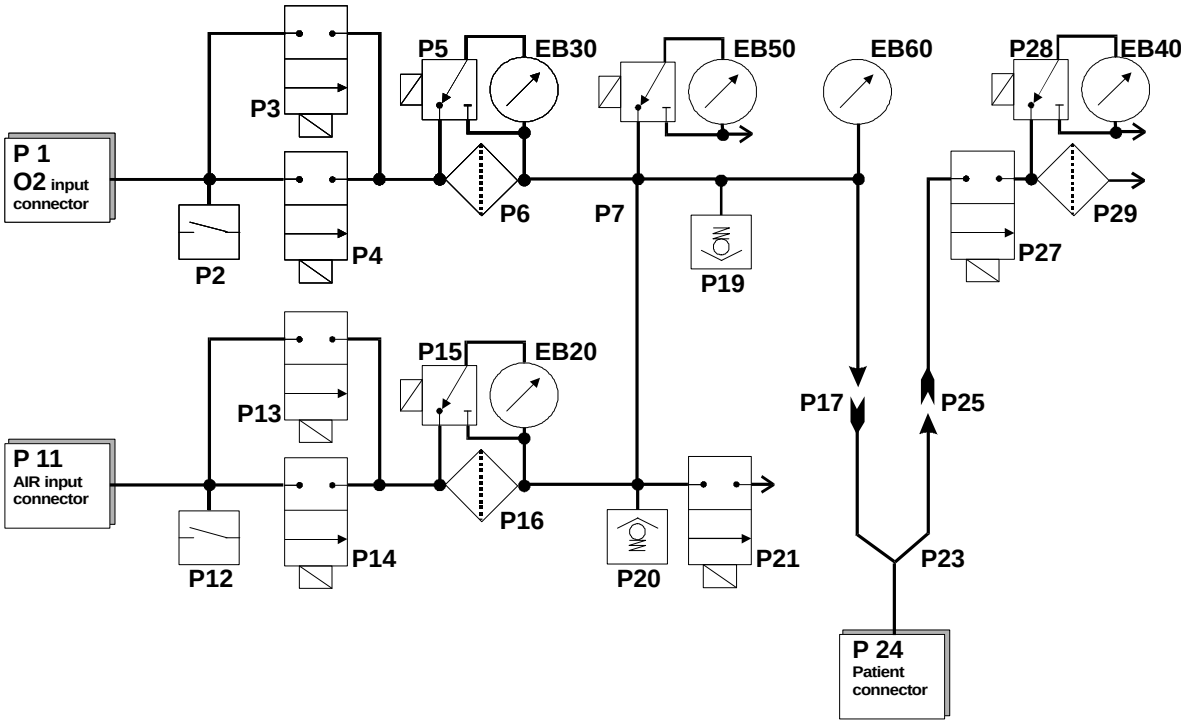
Power supply block diagram, electrical



Main board B block diagram, electrical



Main engine pneumatic diagram



For more details please refer to section 9.

3 Post-service Checkout

In this section

3.1 Post-service checkout

After servicing the Centiva /5 ICU Ventilator, perform the following test sequence:

- Power-up test (section 4.1.1)
- O_2 sensor calibration (section 4.7.1)
- Service mode check (section 4.4)
- System test (section 4.1.2)
- Test lung test (section 4.2)

WARNING You must perform all post-service checks after maintenance or service of the Centiva /5 ICU Ventilator. Failure to do so may result in patient injury.

WARNING All components and accessories must be connected correctly. All hoses and cables must be properly connected before returning the ventilator to clinical use. Failure to do so may result in patient injury.

4 Tests and Calibration

In this section

4.1 Self tests

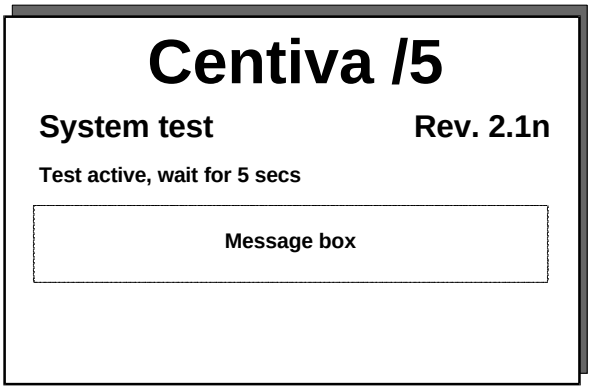
The Centiva/5 ICU Ventilator software includes self tests that determine if the operating software is functioning properly and if the electronic and pneumatic circuits are functional .

The self test include:

- Power-up test
- System test
- In-operation test

4.1.1 Power-up test

The power-up test is started automatically when the system is turned ON. The following screen is displayed:



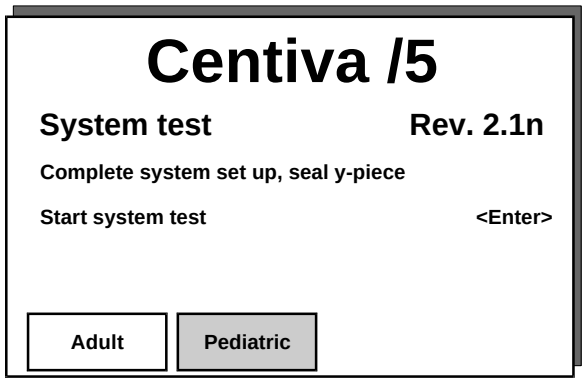
This power-up test takes at least 5 secs. The remaining test time counts down in the screen. During this power-up test, Centiva/5 will check proper function of :

- Microprocessor A and B
- Watchdog
- RAMs and ROMs
- Matching software versions in EPROM A and B
- External power supply
- Internal battery back-up
- Fan
- Heater
- Expiration valve locking system
- Audible alarm system

If a malfunction is identified during this power up test, the corresponding message appears in the message box area. For details of error messages refer to section

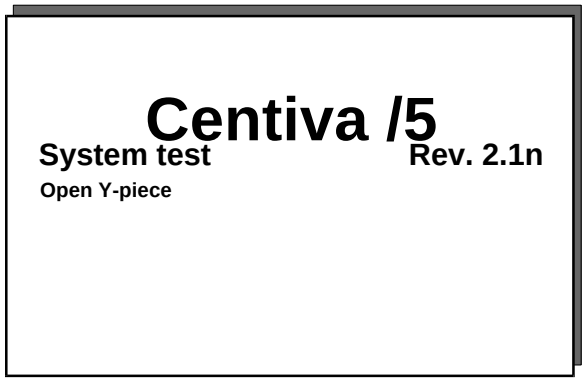
5. 3.1 Messages in power-up test.

After having passed the power-up test, the Centiva/5 ICU Ventilator prompts with a short audible sound and moves to the “Start system test” screen:



4.1.2 System test

Connect the Centiva/5 ICU Ventilator to a breathing circuit and seal the open end of the y-piece by pushing it onto the sealer located on the expiratory valve block . Rotate the com wheel to select <Enter> and then push to start the system test. The Centiva/5 ICU Ventilator displays the following screen:



This system test takes at least 40 secs. The remaining test time counts down in the screen.

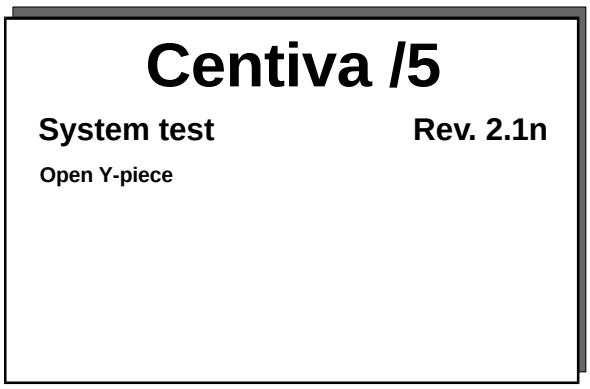
During the system test, the system will check proper function of:

- O_2 gas supply
- O_2 flow valves
- O_2 flow sensor
- AIR gas supply
- AIR flow valves
- AIR flow sensor
- Pressure sensors
- Expiration valve
- Safety valve
- Exp. flow sensor
- O_2 sensor

If any malfunction is identified during this system test, the corresponding message appears in the message box area. For details of error messages refer to section

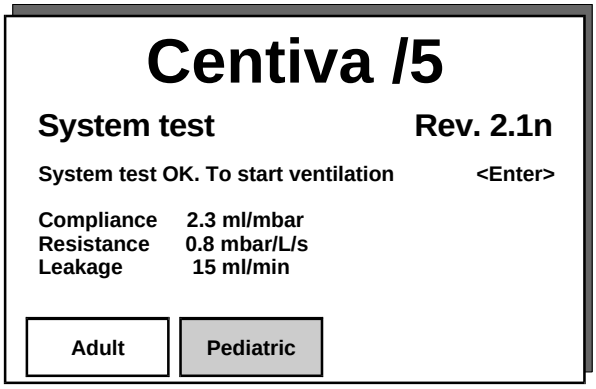
5. 3. 2 Messages in system test.

After having passed the system test, the system prompts the user to open the y-piece, to allow testing for inspiratory resistance. Disconnect the y-piece from the sealer.



The system will recognize opening the y-piece automatically and then proceeds with the test.

After calculating the inspiratory resistance, the Centiva/5 ICU Ventilator will display the following screen:



Values for compliance, resistance and leakage depend upon the breathing circuit used.

The compliance and leakage values represent the entire system (breathing circuit and ventilator).

The resistance value represents the inspiratory resistance of breathing circuit and ventilator up to the y-piece.

Filters and HMEs may significantly increase the resistance values.

Other breathing circuit designs, such as co-axial systems, may significantly increase the resistance values.

4.1.3 In-operation test

During operation the Centiva/5 ICU Ventilator continuously (200 times a second) checks the following safety relevant functions and parameters:

- Inspiratory flow sensors
- Expiratory flow sensor
- Inspiratory pressure sensor
- O2 sensor
- AIR gas supply
- O2 gas supply
- Line power supply
- Battery charging status
- Internal power supply
- Fan
- Heater
- Buttons and Com wheel
- Microprocessor A and B
- Watchdog
- Checksums of all safety relevant data

If a malfunction is identified, the system will display alarms or messages on the screen. For details of error messages refer to section

5. 3.4 Messages during operation.

4.2 Test lung test

The Test lung test is used to verify the overall functionality of the ventilator and to observe the results of the continuous in-operation tests. The power-up test and the system test of the Centiva/5 ICU Ventilator verify all safety relevant functions.

Perform the power-up test and the system test with a standard disposable breathing circuit with:

- 22 mm corrugated dual lumen tube
- 70" length

At the end of the system test

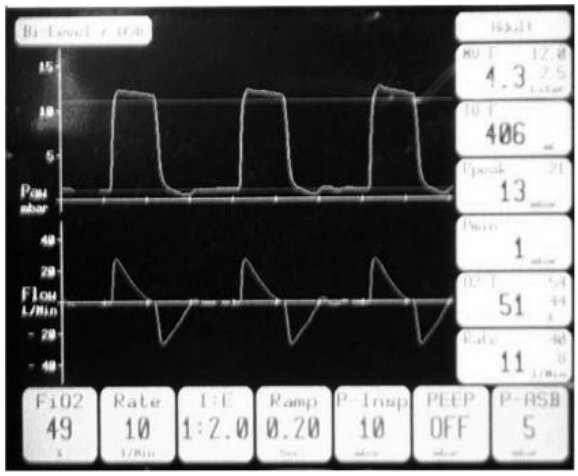
1. Connect the test lung (ST 3) to the y-piece.

Note: Test lung must have minimum airway resistance of 5mbar/l/s.

2. Select patient type "Adult".

3. Push the com wheel to start ventilation.

The following screen will appear with the "Adult default settings"



Default ventilator settings

Verify the following ventilator settings:

- Ventilation mode = Bi-Level / ASB
- Patient type = Adult
- Hotkey Fi O2 = 50 %
- Hotkey Rate = 10 /min
- Hotkey I:E = 1 : 2
- Hotkey Ramp = 0.2 s
- Hotkey P-Insp = 10 mbar
- Hotkey PEEP = Off
- Hotkey P-ASB = 5 mbar
- Parameter menu ASB Ramp = 0.2 s
- Parameter menu Trigg. = 3.0 L/m
- Parameter menu ByFlow = 3.0 L/m
- Parameter menu Time window = 60%
- Parameter menu ASB endflow = 25%
- Parameter menu Buzzer = 50%

Default alarm settings

Verify the following alarm settings (red figures) :

- Patient data MV E max = 12 L
- Patient data MV E min = 2.5 L
- Patient data Ppeak (max) = 21 mbar
- Patient data O2-I max = 55 %
- Patient data O2-I min = 45 %
- Patient data Rate max = 40/Min
- Patient data Rate min = 8/Min
- Alarm limits Leakage = 25 %
- Alarm limits Apn.del. = 20 Sec

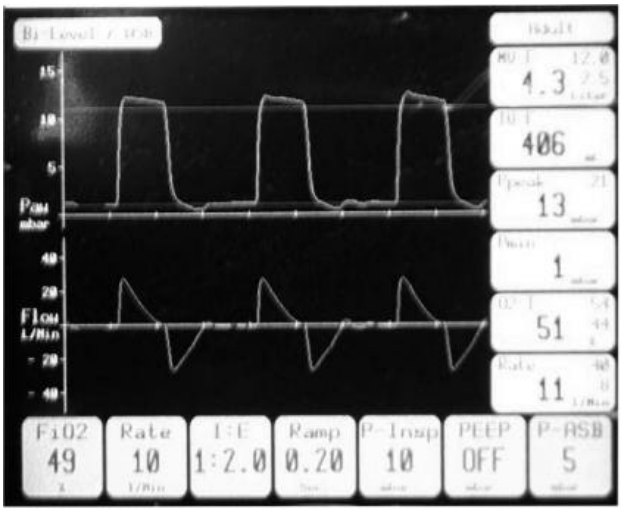
Test lung numeric data

The measured data will vary with the breathing circuit and test lung used. Verify the data to be in the following range of values:

- MV E = 3.5 – 4.5 L
- TV E = 350 – 450 mL
- Ppeak = 11 – 13 mbar
- Pmin = 1 – 3 mbar
- O2-I = 45 – 55 %
- Rate = 9 – 11 /Min

Test lung graphs

The graphical data will vary with the breathing circuit and test lung used. Verify that the quality of the graphics is comparable to that shown on the screen below:



In-operation error message or alarm

Verify that no in-operation error messages are displayed. If a malfunction is identified during operation, the corresponding message or alarm appears on the screen. For details of error messages and alarms refer to section

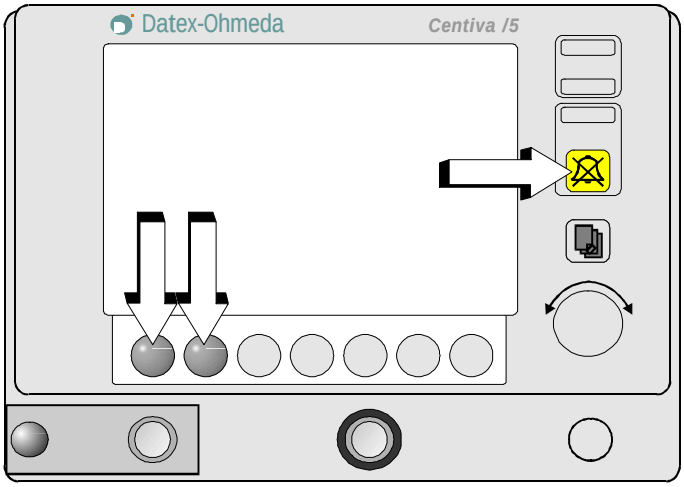
5. 3.4 Messages during operation.

4.3 Service mode

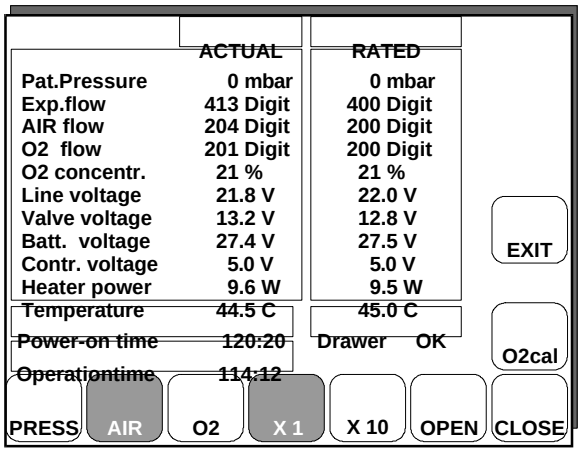
The Service Mode is used to test or troubleshoot the major components of the Centiva/5 ICU Ventilator.

For safety reasons the service mode is not accessible during the regular operation mode. The service mode is only accessible during and at the end of the power-up test or the system test.

To enter the service mode push the following three buttons simultaneously while in the power-up or the system test phase.



The system will prompt with the following screen:



Pushing the “EXIT” button returns the system to normal operation.

The service mode allows for verification of proper operation of the following functions:

- Pat. Pressure = airway pressure measurement
- Exp. flow = expiratory flow measurement
- AIR flow = inspiratory AIR flow setting
- O_2 flow = inspiratory O_2 flow setting
- O_2 concentr. = inspiratory O_2 concentration measurement.

The service mode allows for verification of the following internal values of the system:

- Line voltage = main bus supply voltage
- Valve voltage = valve supply voltage
- Batt. voltage = internal back-up battery voltage
- Contr. voltage = microprocessor supply voltage
- Heater power = expiratory valve heater power dissipation
- Temperature = expiratory valve heater temperature.

The service mode allows for verification of proper operation of the expiratory valve locking mechanism.

- Open = unlock the expiratory valve assembly
- Close = lock the expiratory valve assembly
- Drawer = detected status of locking mechanism
- Valve voltage = valve supply voltage .

The service mode allows the following calibration to be initialized:

- O_2cal = O_2 sensor calibration.

The service mode displays the following elapsed times:

- Power-on time = total time supplied with line power
- Operation time = total time in ventilation mode.

4.4 Service mode check

To identify possible malfunctions displayed as a result of the system test, the following sequence should be used to verify proper gas supply and operation of the inspiratory and expiratory valves.

1. Ensure proper O2, AIR and line supplies are connected before turning ON the system.
2. Wait for the power-up test to complete, then start the service mode according to 4.3.
3. Connect the inspiratory and expiratory ports with one tube.
4. Verify proper AIR flow function by selecting “AIR” and “x 10” and increasing the flow by use of the com wheel.
5. Use the com wheel to verify that the AIR flow can be returned to zero.
6. Verify proper O2 flow function by selecting “O2 ” and “x 10” and increasing the flow by use of the com wheel.
7. Use the com wheel to verify that the O2 flow can be returned to zero.
8. Verify proper expiratory flow function by comparing the data displayed with the set O2 flow.
9. Remove the tube from the expiratory port and seal the open end of the tube with the 22 mm sealer.
10. Select “AIR”, “x 1” and adjust the com wheel for an AIR flow of 20 L/Min.
11. Verify that the pressure limiting function of the over pressure relief valve is properly limiting “Pat.pressure” at 75 ± 2 mbar.
12. Verify proper O_2 concentration while changing Air and O2 flows.

4.5 Software version

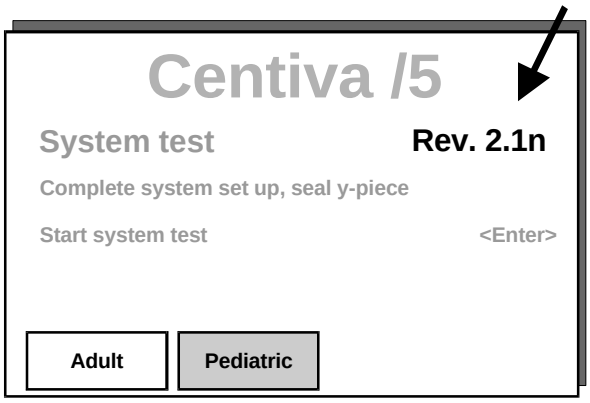
The Centiva/5 ICU Ventilator's software is stored in two independent EPROMs:

- The A EPROM is located on the control panel board (PC board A)
- The B EPROM is located on the main board (PC board B).

The A EPROM contains the language and may be changed to match the users needs.

Both EPROMs need to be the same revision level or version. During the power-up test, the system compares the software revisions in both EPROMs. If they do not match, an error message is displayed in the message box.

The current software version is displayed in the top right of the screen as "Rev.x.yy" during power-up and on the system test menu.



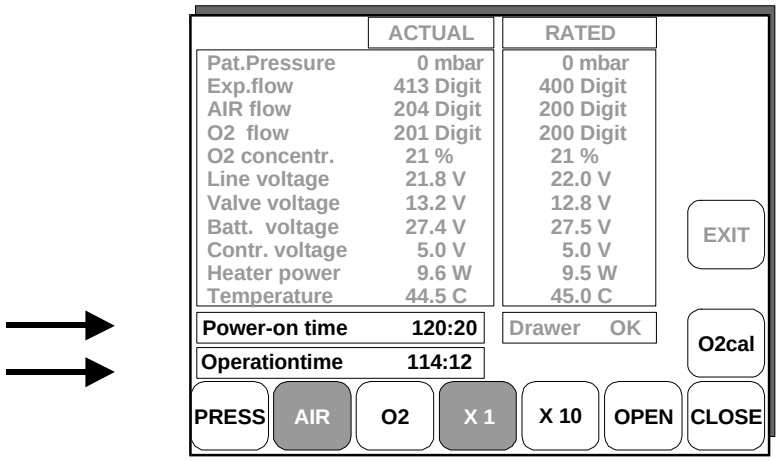
4.6 Ventilator “on-time”

The Centiva/5 ICU ventilator’s software stores two “on times”.

- Power-on time
- Operation time.

The power-on time recognizes the total time that the system is connected to line power supply and is witched ON, no matter in what mode.
The operation time only counts the total time, the system is in any ventilation mode.

Both times are displayed in the Service mode screen.



4.7 Calibrations

In the Centiva/5 ICU Ventilator the following components may be calibrated during service:

- O_2 concentration sensor
- AIR flow sensor
- Expiratory flow sensor
- O_2 flow sensor
- Airway pressure sensor
- Battery charging end voltage.

These procedures may be performed in any order. However, the procedures are presented in a logical sequence to minimize the amount of disassembly and reassembly required. This sequence also ensures best matching of inspiratory and expiratory flow and volume data.

When performing the O2 calibration you do not need to open the system's housing.

For all other calibrations open the main engine housing first, according to section 7.2.4.

Important note

If you have an external flowmeter calibrated for AIR only, perform the flow calibration in the following sequence:

- Calibrate the AIR flow sensor with the AIR external flowmeter
- Calibrate the expiratory flow sensor with the calibrated AIR flow sensor
- Calibrate the O_2 flow sensor with the calibrated expiratory flow sensor.

4.7.1 O_2 sensor calibration

The Centiva/5 ICU Ventilator performs an automatic calibration of the O_2 sensor during the O_2 calibration routine. This routine uses the built-in O2 gas supply.
The calibration routine performs the 100% (gain) calibration only.

Special notice

To ensure proper gas mixture at the O2 sensor, connect a tube to the inspiratory connector.

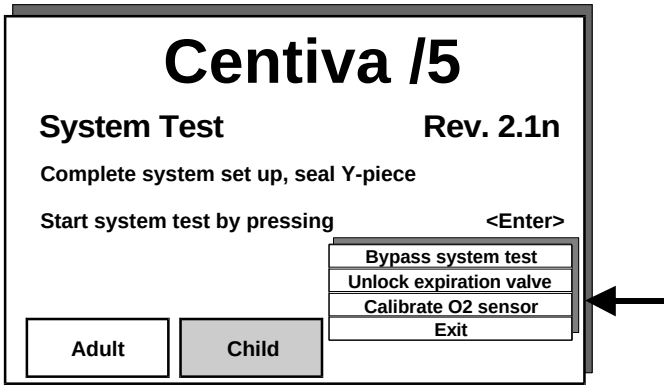
There are two ways to access the O2 calibration routine:

- In the user tech menu.
- In the service mode.

The calibration routines are identical.

Access in user tech menu

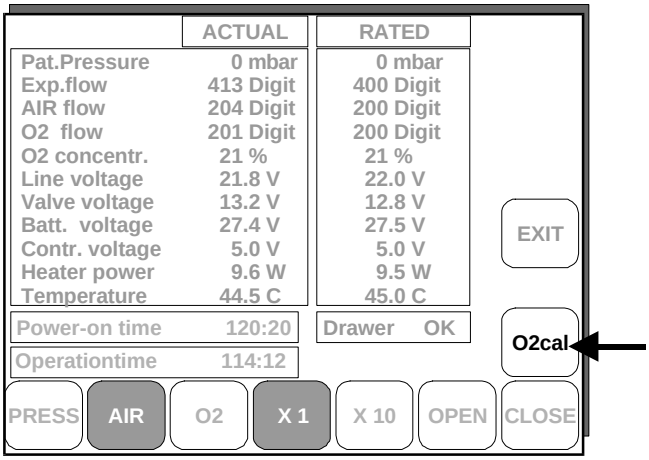
Push the Menu button after completion of the power-up test to access the user tech menu. The system will prompt with the following screen:



- Use the Com wheel to select “Calibrate O2 sensor”
- Push the Com wheel to confirm selection.
- O2 calibration starts

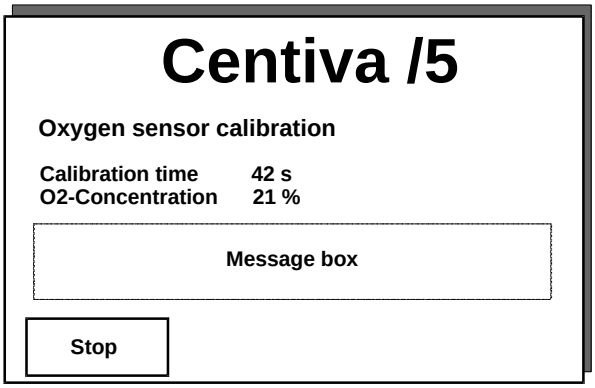
Access in service mode

From the service mode the O2 calibration is started by pushing the "O2cal" button.



O_2 cal Procedure

The procedure starts with the following screen:



This calibration procedure takes at least 60 secs. The remaining test time counts down on the screen. During this time the measured concentration is displayed. If any malfunction is identified during this procedure , the corresponding message appears in the message box area. For details of error messages refer to section:

5. 3.3 Messages in O2 sensor test.

Pushing the "Stop" button stops the calibration procedure and retains the former calibration data. The system returns to the menu it started from.

4.7.2 AIR flow sensor calibration

The AIR flow sensor calibration is divided into two parts

- The offset calibration
- The gain calibration.

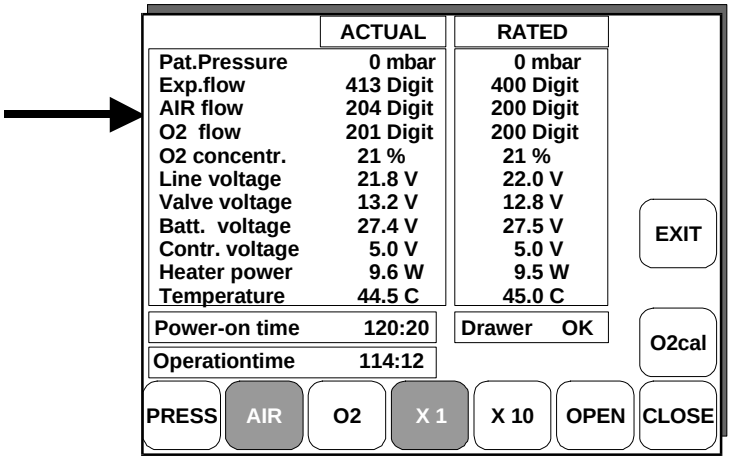
The Offset calibration is performed with the use of the service mode only. The gain calibration is performed by using an external flow measurement device.

To calibrate the AIR flow sensor follow this preparation sequence :

1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Remove internal back-up battery according to section 7.9.1.
4. Re-insert exp. valve assembly.
5. Connect line power and gas supply and turn ON the system.
6. Verify that the system performs the power-up test.
7. Start the service mode according to section 4.3.
8. Use a 10” 22 mm tube to connect the external flow measurement device to the inspiratory connection.
9. Verify that the direction of flow is correct for the measurement device.
10. Turn on the flow measurement device and let it warm up according to manufacturers instructions.
11. Select AIR for the measured gas on the flow measurement device.

Offset correction

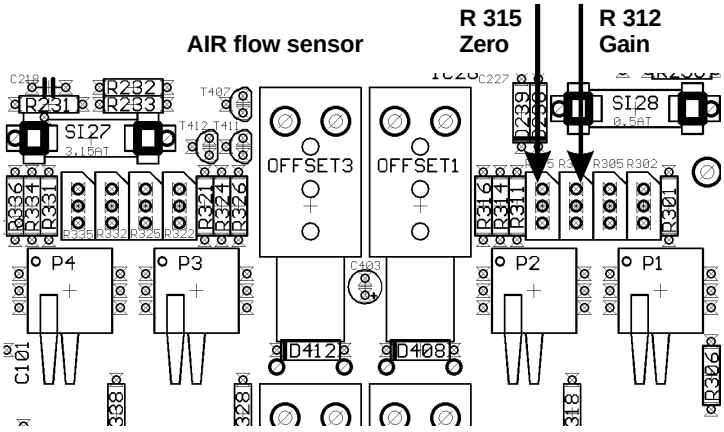
12. Select the “AIR” and “x 1” button.



13. Verify the flow to be 0 L/Min on the external flow measurement device .

14. Check the “AIR flow” “Actual” to be at 200 ± 25 digits.

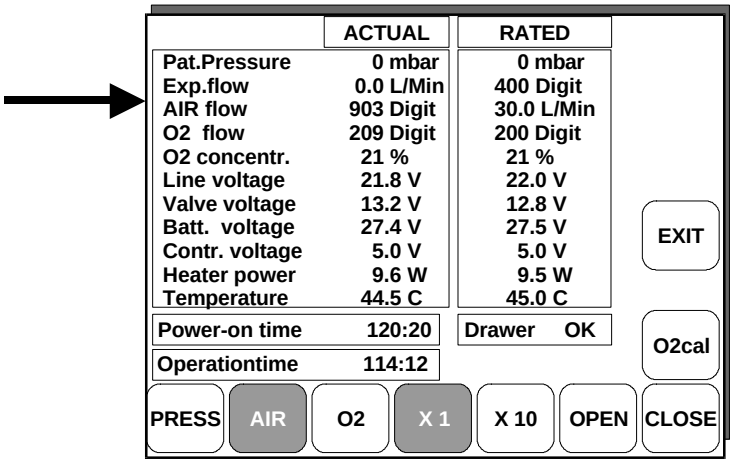
15. If not, readjust the “Zero” for the AIR flow sensor with R 315 on the main board to read 200 ± 5 digits.



Gain correction

Use the com wheel to increase the AIR flow to read 30.0 L/min on “AIR flow” “Rated”. The unit in the service menu change from digits to L/Min.

16.



17. Verify that the external flow measurement device reads 30 ± 0.5 L/Min.

18. If not, readjust the “Gain” for the AIR flow sensor with R 312 on the main board to read 30 ± 0.5 L/Min on the external flow measurement device.

19. Use the com wheel to decrease the AIR flow to read 0 L/Min.

20. Check the “AIR flow” “Actual” to be at 200 ± 25 digits.

21. If not, readjust the “Zero” for the AIR flow sensor with R 315 on the main board to read 200 ± 5 digits.

22. Repeat steps 16 to 21 with a set flow of 10.0 L/Min and a reading on the external flow measurement device of 10 ± 0.5 L/Min.

23. Repeat steps 16 to 21 with a set flow of 60.0 L/Min and a reading on the external flow measurement device of 60 ± 3 L/Min.

24. Repeat steps 16 to 23 until the readings for 10 L/min, 30 L/Min, and 60 L/Min are within tolerances.

4.7.3 Expiratory flow sensor calibration

The Expiratory flow sensor calibration is divided into two parts

- The offset calibration
- The gain calibration.

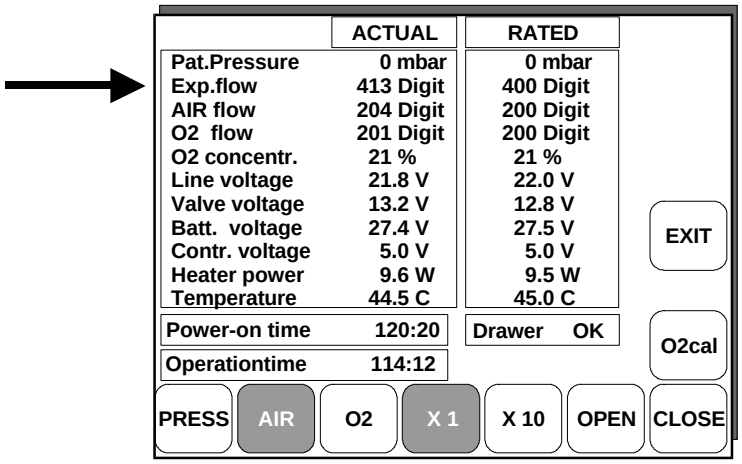
The Offset calibration is performed with the use of the service mode only. The gain calibration is performed by using the calibrated AIR flow system (refer to section 4.7.2.).

To calibrate the expiratory flow sensor follow this preparation sequence:

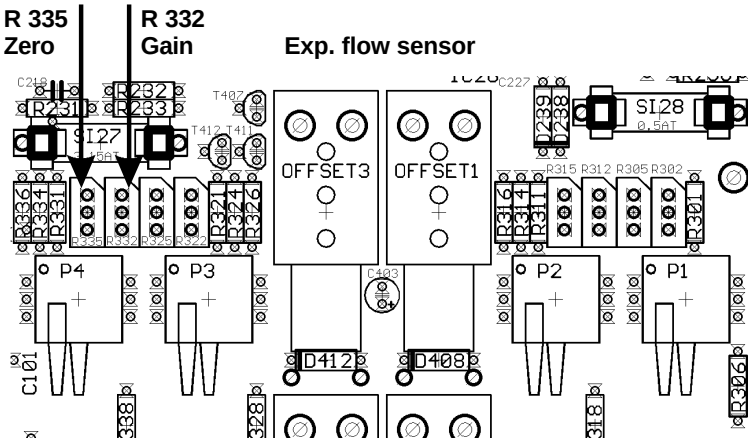
1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Remove internal back-up battery according to section 7.9.1.
4. Re-insert exp. valve assembly.
5. Connect line power and gas supply and turn ON the system.
6. Verify that the system performs the power-up test.
7. Start the service mode according to section 4.3.
8. Use a 10” 22 mm tube to connect the inspiratory and expiratory ports.

Offset correction

9. Select the “AIR” and “x 1” button.

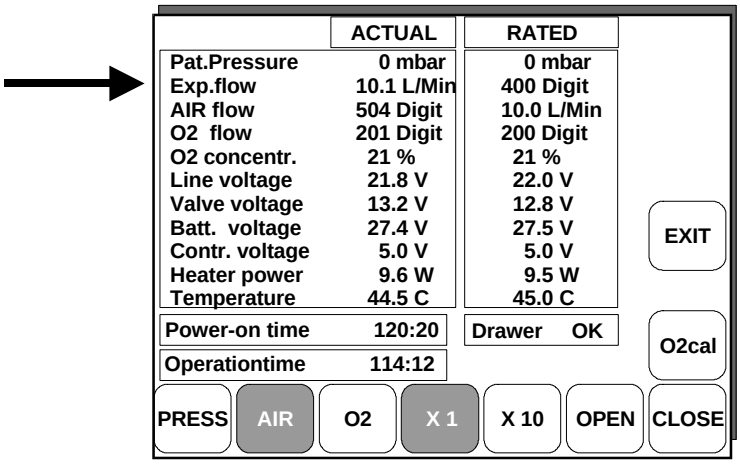


10. Verify the flow to be 0 L/Min on the “AIR flow” ” Actual” line.
11. Check the “Exp. flow” “Actual” to be at 400 ± 100 digits.
12. If not, readjust the “Zero” for the Exp. flow sensor with R 335 on the main board to read 400 ± 50 digits.



Gain correction

13. Use the com wheel to increase the AIR flow to read 10.0 L/min on the “AIR flow” “Rated” line if the AIR flow has been calibrated. The units in the service menu change from Digits to L/Min.



14. Check the “Exp. flow” “Actual” to be at 10 ± 0.2 L/Min.

15. If not, readjust the “Gain” for the Exp. flow sensor with R 332on the main board to read 10 ± 0.2 L/Min.

16. Use the com wheel to decrease the Exp. flow to read 0 L/min.

17. Check the “Exp. flow” “Actual” to be at 400 ± 100 digits.

18. If not, readjust the “Zero” for the Exp. flow sensor with R 335 on the main board to read 400 ± 50 digits.

19. Repeat steps 13 to 18 with a set flow of 30.0 L/Min on the “AIR flow” ”Rated” line and a reading for the “Exp. flow” ”Actual” of 30 ± 1.5 L/Min.

20. Repeat steps 13 to 18 with a set flow of 60.0 L/min on the “AIR flow” ”Rated” line and a reading for the “Exp. flow” ”Actual” of 60 ± 3 L/Min.

21. Repeat steps 13 to 20 until the readings for 10 L/Min, 30 L/Min, and 60 L/Min are within tolerances.

4.7.4 O_2 flow sensor calibration

The O_2 flow sensor calibration is divided into two parts

- The offset calibration
- The gain calibration.

The Offset calibration is performed with the use of the service mode only. The gain calibration is performed by using an external flow measurement device or the calibrated exp. flow system (refer to section 4.7.3.).

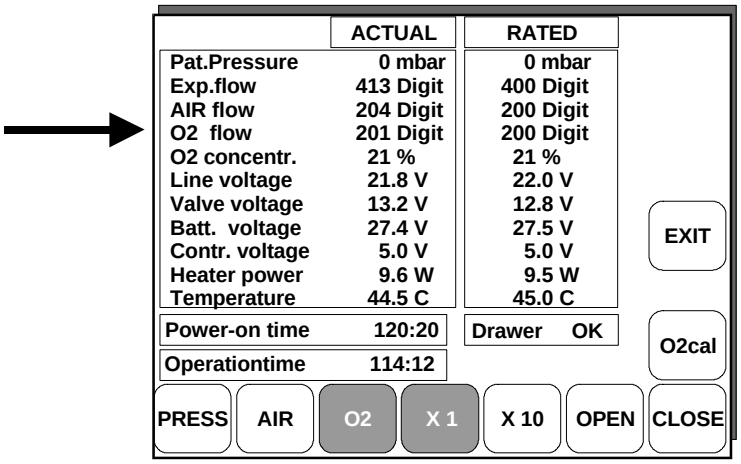
Setup with external flow measurement device

To calibrate the O_2 flow sensor using an external flow measurement device, follow this preparation sequence :

1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Remove internal back-up battery according to section 7.9.1.
4. Re-insert exp. valve assembly.
5. Connect line power and gas supply and turn ON the system.
6. Verify that the system performs the power-up test.
7. Start the service mode according to section 4.3.
8. Connect the external flow measurement device to the inspiratory port.
9. Verify that the direction of flow is correct for the measurement device.
10. Turn on the flow measurement device and let it warm up according to manufacturers instructions.
11. Select O2 for the measured gas on the flow measurement device.

Offset correction

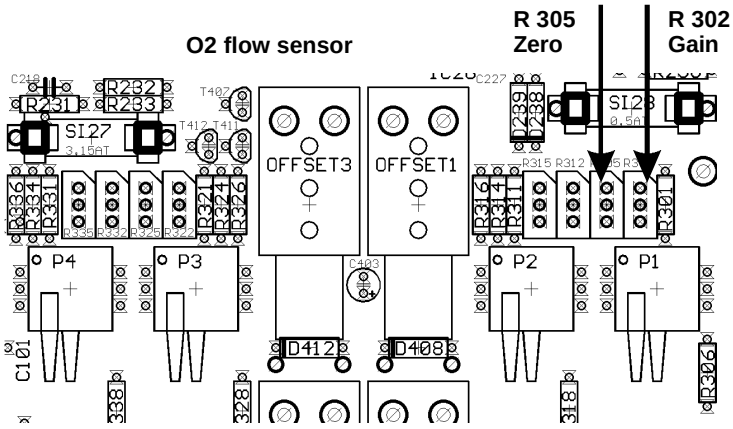
12. Select the “O2” and “ x 1 “ button.



13. Verify the flow to be 0 L/Min on the external flow measurement device.

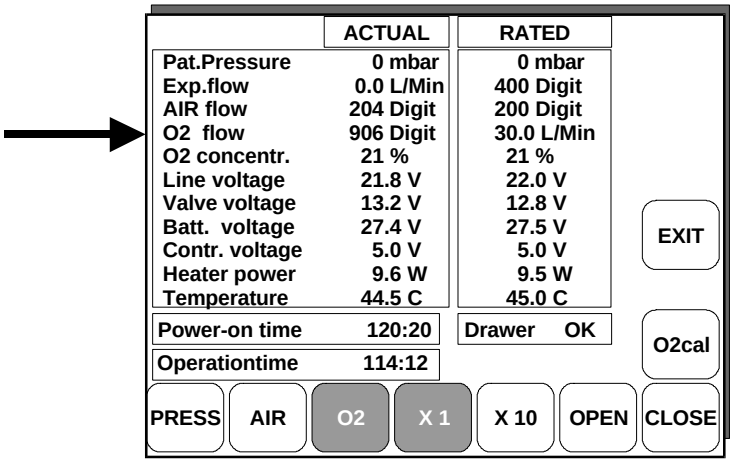
14. Check the “O2 flow” “Actual” to be at 200 ± 25 digits.

15. If not, readjust the “Zero” for the O2 flow sensor with R 305 on the main board to read 200 ± 5 digits.



Gain correction

16. Use the com wheel to increase the O2 flow to read 30.0 L/min on the “O2 flow” “ Rated”. The units in the service menu change from Digits to L/Min.



17. Verify that the external flow measurement device (or the “Exp.flow” “ Actual” line) reads 30 ± 0.5 L/Min.

18. If not, readjust the “Gain” for the O2 flow sensor with R 302on the main board to read 30 ± 0.5 L/Min on the external flow measurement device.

19. Use the com wheel to decrease the O2 flow to read 0 L/min.

20. Check the “O2 flow” “Actual” to be at 200 ± 25 digits.

21. If not, readjust the “Zero” for the O2 flow sensor with R 305 on the main board to read 200 ± 5 digits.

22. Repeat steps 16 to 21 with a set flow of 10.0 L/Min and a reading on the ext. flow measurement device of 10 ± 0.5 L/Min.

23. Repeat steps 16 to 21 with a set flow of 60.0 L/Min and a reading on the ext. flow measurement device of 60 ± 3 L/Min.

24. Repeat steps 16 to 23 until the readings for 10 L/Min, 30L/Min, and 60 L/Min are within tolerances.

O_2 flow sensor calibration

The O_2 flow sensor calibration is divided into two parts

- The offset calibration
- The gain calibration.

The Offset calibration is performed with the use of the service mode only. The gain calibration is performed by using the calibrated exp. flow system (refer to section 4.7.3).

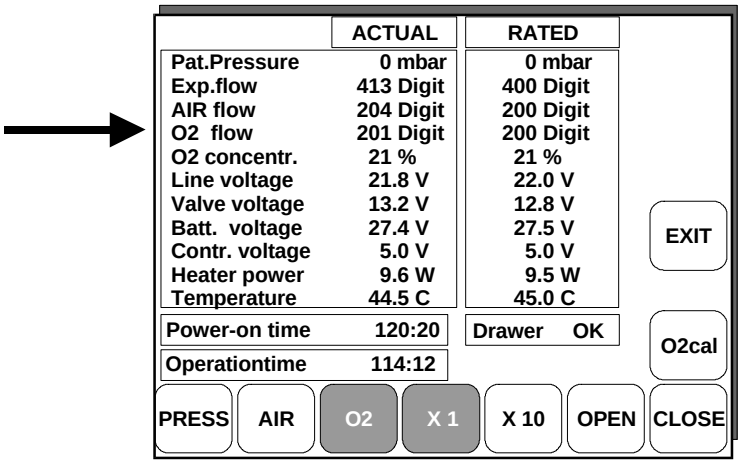
Setup with cal. Exp. flow sensor

To calibrate the O_2 flow sensor using the calibrated expiratory flow sensor, follow this preparation sequence :

1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Remove internal back-up battery according to section 7.9.1.
4. Re-insert exp. valve assembly.
5. Connect line power and gas supply and turn ON the system.
6. Verify that the system performs the power-up test.
7. Start the service mode according to section 4.3.
8. Use a 10” 22 mm tube to connect the inspiratory and expiratory ports.

Offset correction

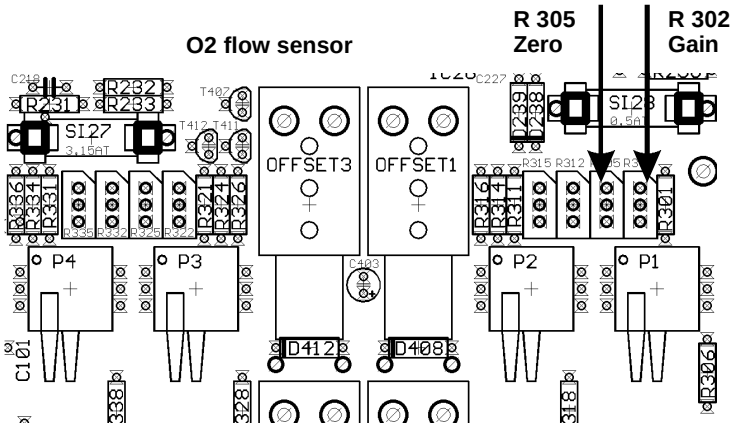
9. Select the “O2” and “ x 1 “ button.



10. Verify the flow to be 0 L/Min on the “Exp.flow” ”Actual” line. This is indicated by “Exp.flow” Actual reading the offset value .

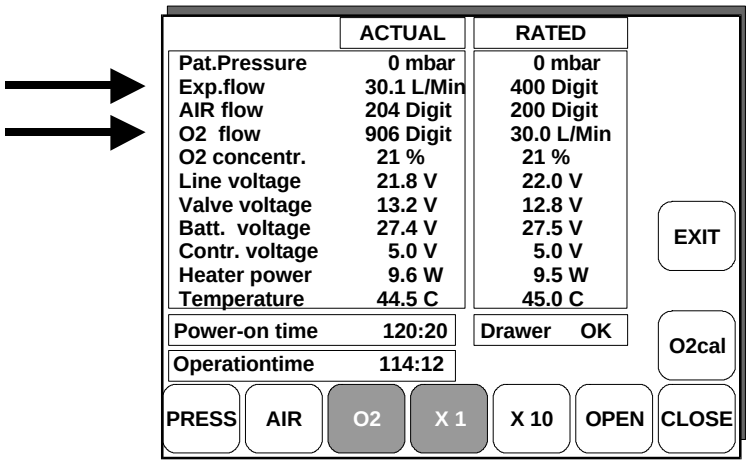
11. Check the “O2 flow” “Actual” to be at 200 ± 25 digits.

12. If not, readjust the “Zero” for the O2 flow sensor with R 305 on the main board to read 200 ± 5 digits.



Gain correction

13. Use the com wheel to increase the O2 flow to read 30.0 L/min on the “O2 flow” “ Rated”. The units in the service menu change from Digits to L/Min.



14. Verify that the “Exp.flow” “ Actual” line reads 30 ± 0.5 L/Min.

15. If not, readjust the “Gain” for the O2 flow sensor with R 302on the main board to read 30 ± 0.5 L/Min on the “Exp.flow” “Actual” line.

16. Use the com wheel to decrease the O2 flow to read 0 L/min.

17. Check the “O2 flow” “Actual” to be at 200 ± 25 digits.

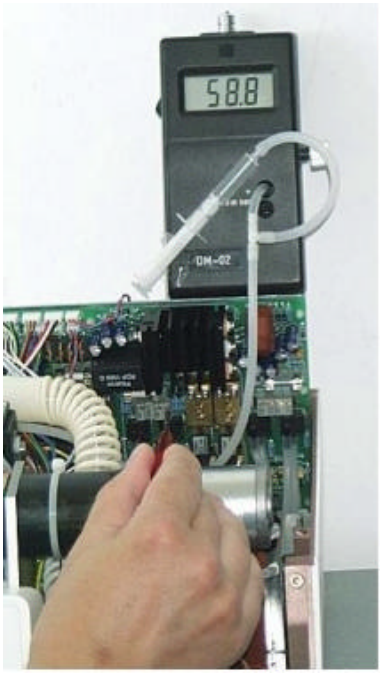
18. If not, readjust the “Zero” for the O2 flow sensor with R 305 on the main board to read 200 ± 5 digits.

19. Repeat steps 13 to 18 with a set flow of 10.0 L/Min and a reading on the “Exp. flow” “Actual” of 10 ± 0.5 L/Min.

20. Repeat steps 13 to 18 with a set flow of 60.0 L/Min and a reading on the “Exp. flow” ”Actual” of 60 ± 3 L/Min.

21. Repeat steps 13 to 20 until the readings for 10 L/Min, 30L/Min, and 60 L/Min are within tolerances.

4.7.5 Airway pressure sensor calibration

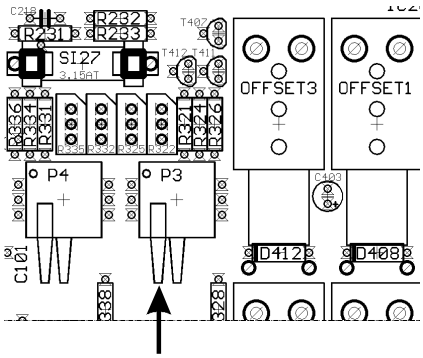


The Airway pressure sensor calibration is divided into two parts

- The offset calibration
- The gain calibration.

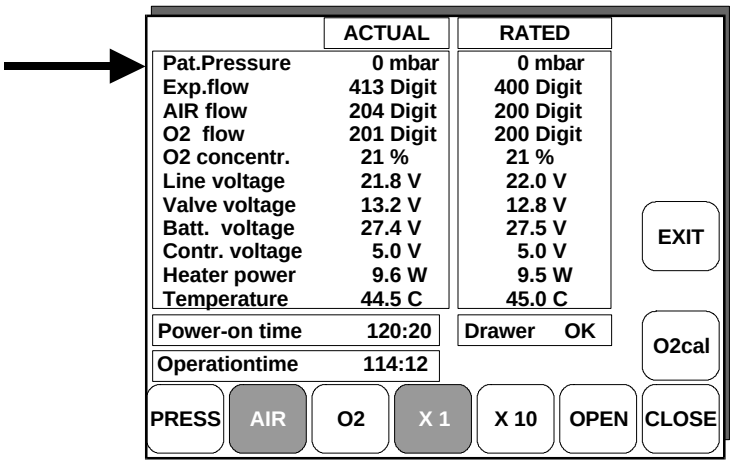
The Offset calibration is performed with the use of the service mode only. The gain calibration is performed by using an external pressure measurement device. To calibrate the airway pressure sensor :

1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Remove internal back-up battery according to section 7.9.1.
4. Re-insert exp. valve assembly.
5. Connect line power and gas supply and turn ON the system.
6. Verify that the system performs the power-up test.
7. Start the service mode according to section 4.3.
8. Disconnect the airway pressure tube from the upper port of the pressure sensor P3.
9. Connect the open end of the pressure measurement device to the upper port of the pressure sensor P3.
10. Turn on the pressure measurement device and let it warm up according to manufacturers instructions.

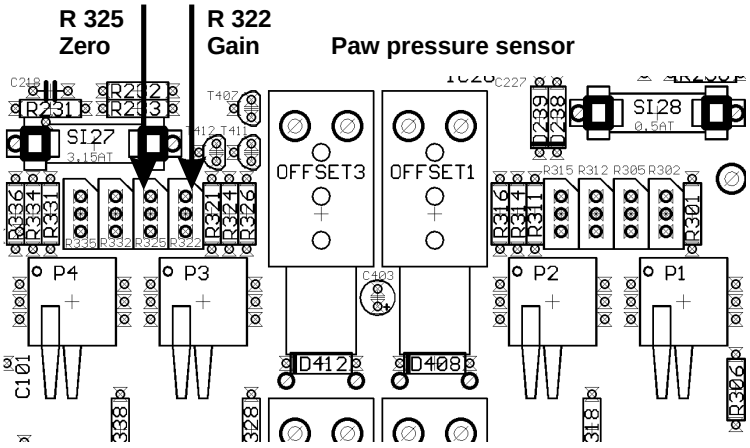


Offset correction

11. Select the “PRESS” button.

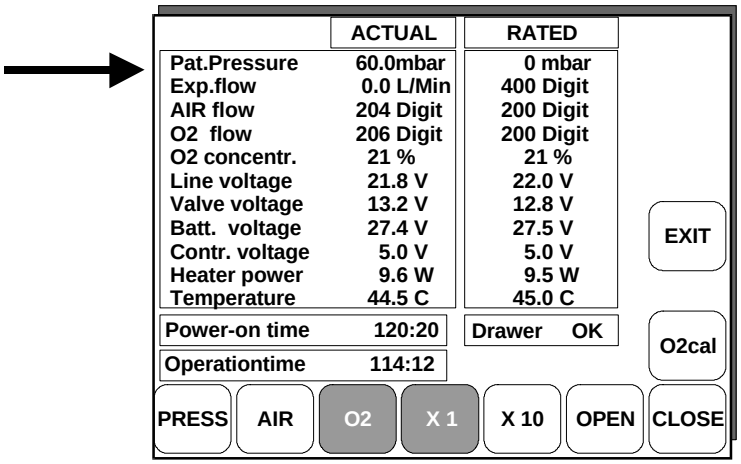


12. Verify the pressure to be 0 mbar on the ext. pressure meter.
13. Check the “Pat.Pressure” “Actual” to be at 0 ± 0.1 mbar.
14. If not, readjust the “Zero” for the Airway pressure sensor with R 325 on the main board to read 0 ± 0.1 mbar.



Gain correction

15. Use a syringe to increase the airway pressure to read 60.0 mbar on the external pressure measurement device.



16. Check the “Pat.Pressure ” “Actual” to be at 60 ± 0.6 mbar.
17. If not, readjust the “Gain” for the Airway pressure sensor with R 322on the main board to read 60 ± 0.6 mbar.
18. Remove the test pressure.
19. Verify the pressure to be 0 mbar on the ext. pressure meter.
20. Check the “Pat.Pressure” “Actual” to be at 0 ± 0.1 mbar.
21. If not, readjust the “Zero” for the Airway pressure sensor with R 325 on the main board to read 0 ± 0.1 mbar.

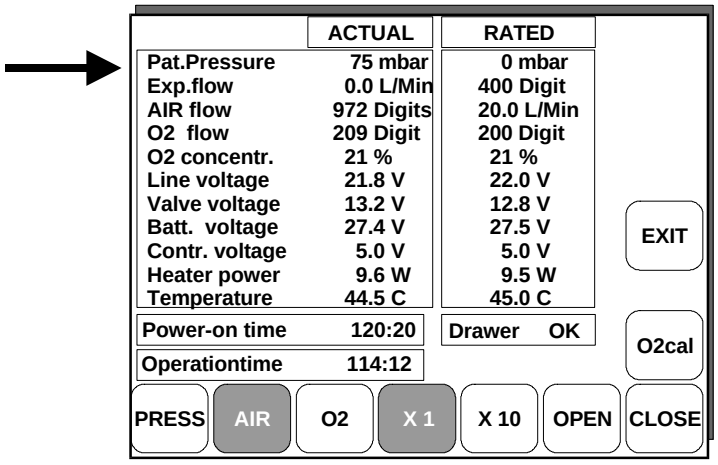
4.7.6 Overpressure relief valve calibration

The overpressure relief valve calibration is performed with the use of the service mode and uses the pressure control process of the PEEP valve.

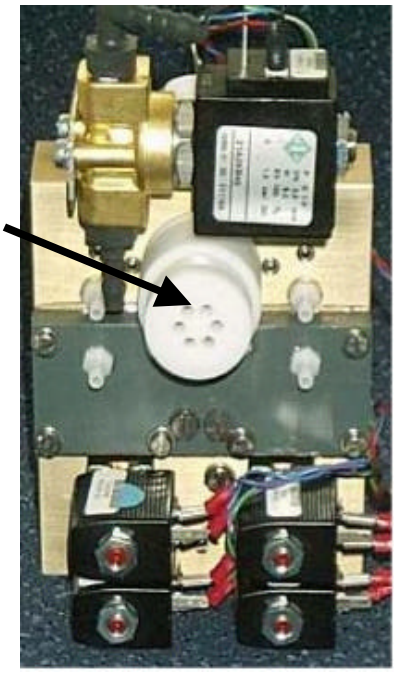
To calibrate the overpressure relief valve:

1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Re-insert exp. valve assembly.
4. Connect line power and gas supply and turn ON the system.
5. Verify that the system performs the power-up test.
6. Start the service mode according to section 4.3.
7. Connect one tube to the inspiratory port.
8. Seal the open end of the tube with the 22 mm sealer.
9. Select the “Air” and “x 1” button.
10. Use the com wheel to increase the AIR flow to read 20 ± 0.5 L/Min.
11. Watch the “Pat.Pressure” increase and stabilize at a certain pressure level.

12. Check the “Pat.pressure” “Actual” to be at 75 ± 2 mbar.



13. If not, readjust the overpressure relief valve by turning the valve cap until “Pat.pressure” “Actual“ reads 75 ± 2 mbar. Turning clockwise increases pressure, counterclockwise lowers pressure.

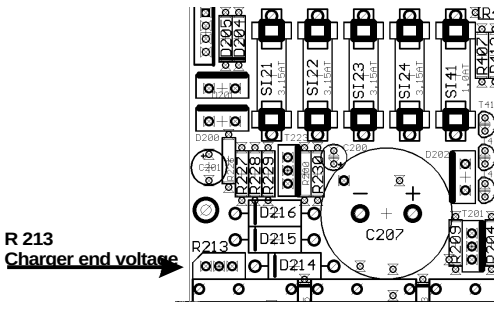


4.7.7 Battery charging voltage calibration

The internal battery is recharged whenever the Centiva /5 ICU ventilator is supplied by a main power supply (line power or 24 V DC external supply). To ensure proper recharging of the sealed lead acid battery, the charger's maximum voltage needs to be adjusted whenever the battery is exchanged. The voltage calibration is performed by using an external voltmeter device.

To calibrate the maximum charging voltage:

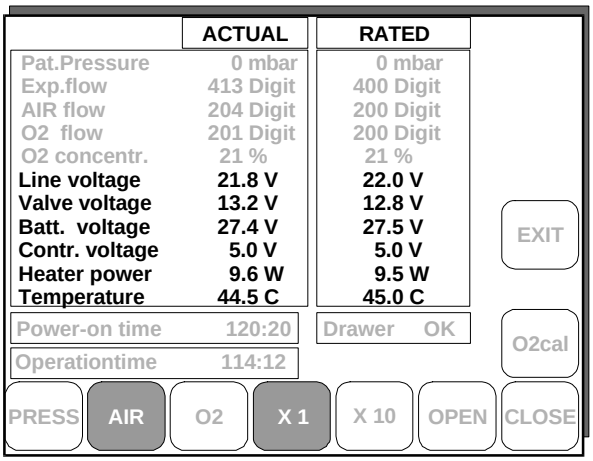
1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Re-insert exp. valve assembly.
4. Connect line power and gas supply and turn ON the system.
5. Verify that the system performs the power-up test.
6. Start the service mode according to section 4.3.
7. Disconnect X 23, battery supply connector on main board.
8. Connect the negative voltmeter lead to ground at the electric mounting plate.
9. Connect the positive voltmeter lead to Pin 7 (+) on X23 on the main B board.
10. Verify that the voltage is 27.4 ± 0.1 V.
11. If not, adjust R 213 until the voltmeter displays 27.4 ± 0.1 V.



4.8 Diagnostic tests

The Centiva/5 ICU Ventilator software has diagnostic tests built-in to ease servicing.

When in service mode these diagnostic routines are active. Start the service mode and the system will display the following screen:



Line voltage

The line voltage is measured at the base supply line and represents

- the secondary transformer voltage when connected to AC line supply
- the external DC voltage when powered by DC line supply.

Accepted voltage range is 21 – 28 V which represents the following line supply voltages

- 98 - 132 V_{AC} at 115 V_{AC} (50-60 Hz)
- 198 – 263 V_{AC} at 230 V_{AC} (50-60 Hz)
- 21 – 28 V_{DC} at 24 V_{DC} .

Valve voltage

The valve voltage is measured at the main bus 13 V WD (WD = watchdog controlled bus). Accepted voltage range is 12.3 – 15.0 V.

Batt. voltage

The battery voltage measures the internal back-up battery voltage. Accepted voltage range is 23.5 – 27.5 V. Additional data:

- U_{batt} < 22.5 V = Battery low alarm
- U_{batt} < 22.0 V = Battery depleted alarm
- U_{batt} > 29.0 V = Battery failure alarm

Contr. voltage	The contr. voltage measures the microprocessor supply bus. Acceptable voltage range is 4.7 – 5.5 V.
Heater power	The heater power measures the power dissipation of the expiratory flow sensor heating system. Acceptable power dissipation is < 12.0 W.
Temperature	The temperature measures the expiratory flow sensor temperature. Acceptable temperature is 5 - 48 °C.
Drawer	“OK” indicates proper locking of the expiratory valve.

Notes

5 Troubleshooting

⚠ WARNING Post-Service checkout is required after you have completed this section. You must perform Section "3/Post-Service Checkout" after performing maintenance, service or repair. Failure to do so may result in patient injury.

In this section

5.1 Troubleshooting instructions

The Centiva /5 ICU Ventilator software includes self test capability to identify problems or malfunctions of the system. However, some ventilator problems may not generate any message or alarm, even though the ventilator may not be functioning correctly.

The self tests include:

- Power-up test
- System test
- In-operation test.

Additional self test capabilities are within the:

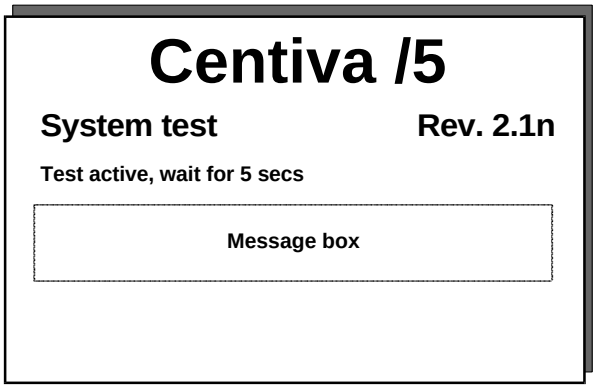
- O_2 sensor calibration.

User related alarms and messages will be displayed in the user selected language to allow the operator to react, either by correcting the problem or by calling an authorized service specialist.

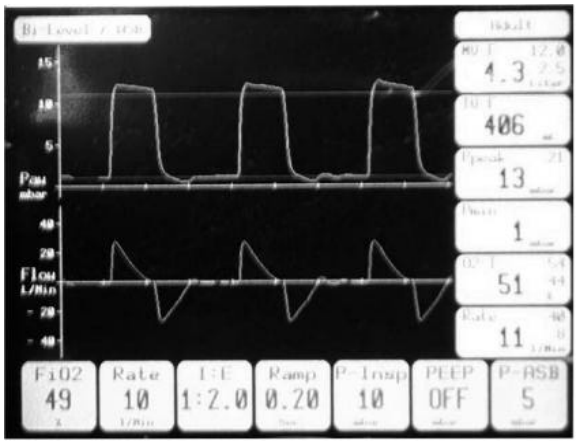
Technical service messages will always be displayed in English.

The identified problem or malfunction will be displayed with either an alarm or a message on the screen.

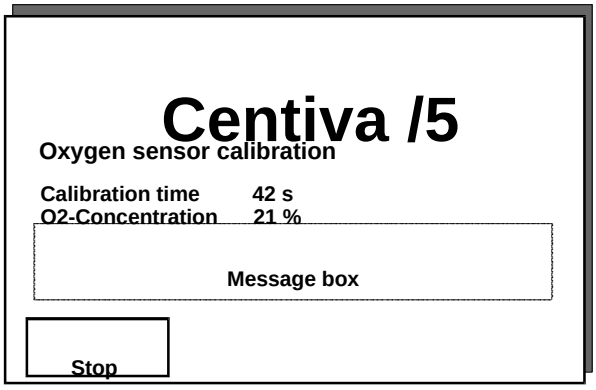
While in power-up test and system test the messages will appear in the message box:



While in operation, the messages will appear in the operation screen.



While in O2 sensor calibration, the messages will appear in the message box:



5.2 Alarms

No.	Alarm	Priority	Set condition	Action	Reset condition
1	"Pressure high"	High	In all modes: If $P_{peak} \geq P_{max}$ for more than 10 msec	High priority alarm. End inspiration (set inspiratory flow to zero) and start expiration (set expiratory valve to PEEP)	In all modes: Within the following breath If $P_{peak} < (P_{max} – 2mbar)$ And inspiratory safety valve is closed.
			Sequence #2 to follow: If $P_{peak} > (P_{max} + 2$ mbar)	In addition to the above: Open inspiratory safety valve	
2	"Pressure low"	High	CMV mode: If $P_{peak} < (P_{PEEP} + 5$ mbar) after 15 sec from start of insp.	High priority alarm.	CMV mode: If $P_{peak} \geq (P_{PEEP} + 5$ mbar) within the following breath
			SIMV / ASB mode: If $P_{peak} < (P_{PEEP} + 2$ mbar) after 15 sec from start of insp.		SIMV / ASB mode: If $P_{peak} \geq (P_{PEEP} + 2$ mbar) within the following breath
			Bi-Level / ASB mode: If $P_{peak} < ((P_{insp} + P_{PEEP}) / 2) –$ 0.5 mbar after 15 sec from start of insp.		Bi-Level / ASB mode: If $P_{peak} \geq ((P_{insp} + P_{PEEP}) / 2) – 0.5$ mbar within the following breath.
			In all modes: If $P_{airway} < 0$ mbar for more than 0.5 sec	High priority alarm. Open sub atmospheric pressure relief valve	And for all modes: If $P_{airway} \geq 0$ mbar
3	"Pressure sustained"	High	In all modes: If Pmin > (PPEEP + 2 mbar) within one breath	High priority alarm. End inspiration (set inspiratory flow to zero) and start expiration (set expiratory valve to PEEP)	In all modes: If Pmin < (PPEEP + 2 mbar) within the following breath And Inspiratory safety valve is closed
			In all modes: If $P_{airway} > (P_{set} + 5$mbar) within 0.5 sec	Additional to the above: Open inspiratory safety valve	

No.	Alarm	Priority	Set condition	Action	Reset condition
4	"Apnea"	High	CMV, SIMV/ASB, Bi-Level/ASB, ASB/CPAP mode: System open (see messages) for longer than Apnea time	High priority alarm.	CMV, SIMV/ASB, Bi-Level/ASB, ASB/CPAP Mode: Next expiration is detected And Rate > 3 bpm
			ASB Apnea mode: Since the last expiration no breath is detected in set apnea time Or measured rate < 4 bpm	High priority alarm. In ASB Apnea mode, Apnea Bi-Level mode is started. Apnea time displayed in screen. After 5 min flashing visual alarm and audible alarm is turned OFF and message remains in screen.	ASB Apnea mode: Restart ASB Apnea mode or start any other mode And Next expiration is detected And Rate > 3 bpm.
5	"Leakage"	High	In all modes: If $((V_{insp}-V_{exp}) / V_{insp}) * 100 >$ set leakage (5% - 95%) over a rolling average of 4 consecutive breaths	High priority alarm.	In all modes: If $((Vi_{inspi}-V_{exp}) / V_{insp}) * 100 \leq$ set leakage (5% - 95%) within one breath
6	"Vt not delivered"	High	CMV, SIMV/ASB modes: If $P_{peak} \geq P_{limit}$ And Vt measured $\leq$ Vt set * 0.8 after 15 sec from start of inspiration	High priority alarm	CMV, SIMV/ASB modes: If $P_{peak} < P_{limit}$ And Vt measured > Vt set x 0.8 at the end of inspiratory time

No.	Alarm	Priority	Set condition	Action	Reset condition
7	“MV low”	High	In all modes: If calculated MV over 61 seconds or over the 10 breaths (which ever is smaller) < set MV limit (0.5 – 50 L/min	High priority alarm.	In all modes: If calculated MV > set MV limit (0.5 – 50 L/min
8	“MV high”	High	In all modes: If calculated MV over 61 seconds or over the 10 breaths (which ever is greater) > set MV limit (0.5 – 50 L/min	High priority alarm.	In all modes: If calculated MV < set MV limit (0.5 – 50 L/min

No.	Alarm	Priority	Set condition	Action	Reset condition
9	"Sensor failure"	High	In all modes: If any of the three flow sensors fail to reach zero range Or If the insp. Flow sensor reads > 120 L/min for more than 0.5 sec Or If the insp. Flow sensor reads ≤-5 L/min for more than 0.5 sec Or If the exp. Flow sensor reads > 140 L/min for more than 0.5 sec Or If the exp. Flow sensor reads ≤-5 L/min for more than 0.5 sec Or If the insp. pressure sensor fails to reach zero range Or If the insp. pressure sensor reads ≤ –9 mbar for more than 0.5 sec Or If the insp. pressure sensor reads > 80 mbar for more than 0.5 sec Or If $[(V_{insp}-V_{exp})/V_{insp}]*100 \leq$ -25%	High priority alarm.	In all modes: All of the three flow sensors reaches zero range And the inspiratory flow sensor reads > 5 L/Min and < 120 L/min for more than 0.5 sec And the expiratory flow sensor reads > - 5 L/Min and ≤ 140 L/min for more than 0.5 sec And the inspiratory pressure sensor reaches zero range And the inspiratory pressure sensor reads > -9 mbar for more than 0.5 sec And the inspiratory pressure sensor reads < 80 mbar for more than 0.5 sec And $[(V_{insp}-V_{exp})/V_{insp}]*100 >$ -25%
10	"Battery failure"	High	In all modes: If sensed battery voltage > 29 V for more than 1 sec.	High priority alarm	In all modes: Unit must be turned OFF
11	"Battery low"	High	In all modes: If sensed battery voltage < 22.5 V for more than 1 sec.	High priority alarm	In all modes: If sensed battery voltage > 24 V

No.	Alarm	Priority	Set condition	Action	Reset condition
12	"Line supply fail"	Low	In all modes: If line supply voltage < 95 V_{AC} (200 V_{AC}) for more than 0.1 sec And If external battery voltage < 22.5 V for more than 0.1 sec Or If line supply voltage > 135 V_{AC} (255 V_{AC}) Or Internal main bus 13v < 12 V	Low priority alarm	In all modes: If 95 V_{AC} (200 V_{AC}) ≤ line supply voltage ≤ 135 V_{AC} (255 V_{AC}) Or If 24 V ≤ external battery voltage ≤ 29 V And Internal main bus 13v > 12.2 V
13	"Fan failure"	High	In all modes : If sensed fan rotation is < 1,600 rpm for more than 0.6 sec Or If sensed fan rotation > 2,600 rpm for more than 0.6 sec	High priority alarm	In all modes: If 1,600 rpm ≤ sensed fan rotation ≤ 2,600 rpm
14	"Heater failure"	Low	In all modes: If the heater temp is < 5° C Or if the heater temp is > 60 °C Or if the heater current is > 700 mA Or if heater power is >15 VA Or if the heater temp is < 42°C or > 48°C for more than 60 sec	Low priority alarm	In all modes: If the heater temp is > 5° C And if the heater temp is < 60 °C And if the heater current is < 700 mA And if heater power is <15 VA And if the heater temp is > 42°C and < 48°C

No.	Alarm	Priority	Set condition	Action	Reset condition
15	"O2 supply fail"	High	In all modes: If FiO_2 set > 0.21 And If the O_2 pressure control switch (2 bar, 29 PSI) is not closed for more than 0.2 sec Or If 0.5V > $V_{valveO2}$ > 11.5 V	High priority alarm	In all modes: If FiO_2 set = 0.21 Or If the O_2 pressure control switch (2 bar, 29 PSI) is closed And If 0.5V < $V_{valveO2}$ < 11.5 V
16	"AIR supply fail"	High	In all modes: If FiO_2 set < 1.0 And If the AIR pressure control switch (2 bar, 29 PSI) is not closed for more than 0.2 sec Or If 0.5V > $V_{valveAIR}$ > 11.5 V	High priority alarm	In all modes: If FiO_2 set = 1.0 Or If the AIR pressure control switch (2 bar, 29 PSI) is closed And If 0.5V < $V_{valveAIR}$ < 11.5 V
17	"Rate low"	High	In all modes: If measured rate < set rate low limit for more than 0.5 sec	High priority alarm	In all modes: If measured rate ≥ set rate low limit
18	"Rate high"	High	In all modes: If measured rate > set rate high limit for more than 0.5 sec	High priority alarm	In all modes: If measured rate ≤ set rate high limit
19	"Power PCB fail"	High	In all modes: If main bus 13v > 15 V for more than 0.2 sec Or If main bus 15v < 13 V for more than 0.2 sec Or If main bus 15v > 17 V for more than 0.2 sec	High priority alarm	In all modes: If main bus 13v ≤ 15 V And If main bus 15v ≥ 13 V And If main bus 15v ≤ 17 V

No.	Alarm	Priority	Set condition	Action	Reset condition
20	“Display failure”	High	In all modes: If CPU handshake fails for more than 2 sec Or If display back light inverter supply < 12 V for more than 2 sec	High priority alarm	In all modes: If CPU handshake is OK And If display back light supply ≥ 12 V
21	“O2 sensor fail”	High	In all modes: If O_2 measured value ≤ 10 % Or If O_2 measured value ≥ 120 %	High priority alarm	In all modes: If 10% < O_2 measured value < 120 %
22	“O2 concentr. low”	High	In all modes: If O_2 measured value < set O_2 low limit	High priority alarm	In all modes: If O_2 measured value ≥ set O_2 low limit
23	“O2 concentr. high”	High	In all modes: If O_2 measured value > set O_2 high limit	High priority alarm	In all modes: If O_2 measured value ≤ set O_2 high limit
24	“P limit reached”	Low	CMV, SIMV/ASB modes: If $P_{peak} \geq P_{limit}$ for more than 10 msec	Low priority alarm	CMV, SIMV/ASB modes: If $P_{peak} < P_{limit}$ at the end of inspiratory time
25	“Button Failure”	Low	In all modes: If a button sense is active for more than 5 sec		

5.3 Messages

5.3.1. Messages during power-up test

No	Message	Type	Set condition	Action	Reset condition
1	“No line supply”	Advice	Line power supply fails Or external DC power supply fails	System is supplied with power from internal battery.	If line power supply is restored Or If external DC power supply is reconnected
2	“Test active, wait for xx secs”	Advice	System is in test procedure for at least xx seconds	System performs automatic test procedure.	If test is successfully finished Or If test has identified any system shutdown errors
3	“Controller B no function”	System shut down error	Controller problems are identified	Replace B board	
4	“Watchdog controller A (or B) does not open (or close).”	System shut down error	Watchdog problems are identified	Replace A (B) board	
5	“No line supply, check power cord and fuse”	System shut down error	Line power supply fails	Check power cord and fuses in line connector and on B board	If line power supply is restored
6	“External DC power supply failure, DC voltage too high, check external DC power supply”	System shut down error	External DC power supply voltage is too high	Check external battery supply	If external DC power supply voltage is in the proper voltage range
7	“Internal power supply failure. System may not be operated”	System shut down error	Internal power supply fails.	Replace B board	

No	Message	Type	Set condition	Action	Reset condition
8	”Battery depleted (voltage < 22V) System not ready for operation. If this message appears for more than 10 min, battery needs replacement”	System shut down error	The internal back up battery is depleted.	Recharge battery while system is supplied with line power or external DC power. If not successful replace battery	Battery has reached sufficient voltage level within 10 minutes of recharging.
9	“Battery is empty (voltage < 23.5V) If 24.0 V are not reached in 20 min, battery needs replacement.”	System shut down error	The internal back up battery is empty. The battery voltage is x V.	Recharge battery while system is supplied with line power or external DC power prior to operation. If not successful replace battery	Battery has reached 24.0 V within 20 minutes.
10	“Battery or recharger defective. Call service specialist	System shut down error	The internal back up battery is depleted Or The charger for the internal back up battery is defective.	Readjust charger voltage. If not successful replace battery or B board	
11	“Battery cannot be switched on ! Call service specialist	System shut down error	The internal back up battery is not operable.	Check battery fuse. If not successful replace battery	
12	“Fan failure. Call service specialist	System shut down error	The internal fan is not operable.	Replace fan	
13	“Watchdog does not turn off heater. Call service specialist.”	System shut down error	The heater is not operable.	Replace B board	

No	Message	Type	Set condition	Action	Reset condition
14	“Exp. Flow sensor heater cannot be switched on. Call service specialist.”	System shut down error	Expiratory flow sensor heater fails.	Replace expiration valve locking system	
15	”Heater or heater current limiter failure. Call service specialist.”	System shut down error	Expiratory flow sensor heater current limiter fails.	Replace expiration valve locking system	
16	”Heater temperature sensor malfunction. Call service specialist.”	System shut down error	Expiratory flow sensor heater temperature sensor malfunction or defective.	Replace expiration valve locking system	
17	”Expiration valve missing or not in proper position.”	System shut down error	Expiration valve is not inserted Or Expiration valve is not properly assembled Or Expiration valve is not properly inserted	Insert expiration valve assembly and let lock	Insert expiration valve into valve lock Or assemble expiration valve properly and reinsert into valve lock
18	“Expiration valve unlocked. Ready to be removed from device”	Caution	Expiration valve locking mechanism was operated to unlock the expiration valve	Remove expiration valve from valve lock	Insert expiration valve into valve lock Or assemble expiration valve properly and reinsert into valve lock
19	”Malfunction of locking mechanism of expiration valve. Call service specialist.”	System shut down error	Expiratory flow sensor valve lock malfunction or defective.	Replace expiration valve locking system	Unlock, remove and reinsert expiration valve

No	Message	Type	Set condition	Action	Reset condition
20	“Expiration valve not properly locked. Turn off system and restart device.”	System shut down error	Expiration valve was not properly locked	Repeat insertion of expiration valve assembly. Check mechanical slide mechanism. If not successful replace expiratory valve locking system	Turn off the system and restart the power-up test by turning on the system again.
21	“EPROM versions do not match. Check software rev. no. of panel and main engine”	System shut down error	Panel EPROM version and internal main board EPROM versions do not match.	Check EPROM versions between A and B board. Verify that the EPROMs are properly inserted	Exchange entire panel with a matching version
22	“Controller or RAM on main PCB defective. Call service specialist”	System shut down error	Controller or RAM problems are identified on main PC board	Replace B board	
23	“Controller or RAM on front PCB defective. Call service specialist”	System shut down error	Controller or RAM problems are identified on panel PC board	Replace A board	
24	“EPROM on main PCB defective. Call service specialist”	System shut down error	EPROM problems are identified on main PC board	Replace B EPROM	
25	“EPROM on front PCB defective. Call service specialist”	System shut down error	EPROM problems are identified on panel PC board	Replace A EPROM	
26	“EE PROM on main PCB defective. Call service specialist”	System shut down error	EEPROM problems are identified on main PC board	Replace B board	

No	Message	Type	Set condition	Action	Reset condition
27	“EEPROM on front PCB defective. Call service specialist”	System shut down error	EEPROM problems are identified on panel PC board	Replace A board	
28	“Button defective or permanently pressed. Release button or call service specialist	System shut down error	Any front panel button is defective Or Any button is permanently activated	Replace front film with buttons	Check for permanently activated button on front panel
29	“Buzzer on main PCB defective. Call service specialist”	System shut down error	Buzzer problems are identified on main PC board	Replace main alarm system	
27	“Buzzer on front PCB defective. Call service specialist”	System shut down error	Buzzer problems are identified on panel PC board	Replace buzzer in control panel or replace A board	

5.3.2.Messages during system test

No	Message	Type	Set condition	Action	Reset condition
1	“Complete system set up. Seal y-piece. Start system test by pressing <Enter>”	Advice	System has successfully passed power up test and is ready to start system test	Complete system set up with breathing system and airway management components intended to be used upon following breathing mode. Seal y-piece by plugging y-piece onto the sealer at the expiration valve block	Proceed with system test by pushing <Enter>
2	“No O2 gas supply. Check O2 gas supply or for single gas AIR-supply press <Enter>”	Advice	Insufficient O2 supply pressure	Check for proper O2 gas supply	O2 supply pressure exceeding 2 bar (28 PSI) Or Proceed with system test by pushing <Enter>
3	“No AIR gas supply. Check AIR gas supply or for single O2-supply press <Enter>”	Advice	Insufficient Air supply pressure	Check for proper Air gas supply	AIR supply pressure exceeding 2 bar (28 PSI) Or Proceed with system test by pushing <Enter>
4	“Oxygen flow sensor miscalibrated or defective. Measured offset out of range. Call service specialist <Enter>.”	Advice	O2 flow sensor is miscalibrated Or O2 flow sensor is defective	Recalibrate O2 flow line	O2 flow sensor signal within proper offset range Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
5	“Oxygen flow valves do not open or no signal from oxygen flow sensor. Check O2 supply and press <Enter>.”	Advice	Insufficient O2 supply pressure	Check for proper O2 gas supply	O2 supply pressure exceeding 2 bar (28 PSI) Or Proceed with system test by pushing <Enter>
6	“Oxygen flow offset valve does not react. Call service specialist Press <Enter>.”	Advice	O2 flow sensor offset valve problem identified	Replace B board	O2 flow offset valve operates properly Or Proceed with system test by pushing <Enter>
7	“Oxygen valves do not properly close. Check O2 gas supply or Call service specialist. Press <Enter>.”	Advice	O2 valves do not properly close Or O2 gas supply pressure too high Or O2 valve seat dirty.	Replace pneumatic assembly	O2 valves operate properly Or Proceed with system test by pushing <Enter>
8	“2. oxygen flow valve does not react. Call service specialist. Press <Enter>.”	Advice	O2 flow valve problem identified	Replace pneumatic assembly	Proceed with system test by pushing <Enter>
9	“Malfunction at oxygen valve testing. Test takes too long, repeat test or call service specialist Press <Enter>.”	Advice	O2 flow valve problem identified	Restart the system test	Proceed with system test by pushing <Enter> Or Contact Datex-Ohmeda Technical Support

No	Message	Type	Set condition	Action	Reset condition
10	“Air flow sensor miscalibrated or defective. Measured offset out of range. Call service specialist Press <Enter>.”	Advice	Air flow sensor is miscalibrated Or Air flow sensor is defective	Recalibrate AIR flow line	Air flow sensor signal within proper offset range Or Proceed with system test by pushing <Enter>
11	“Air flow valve do not open or no signal from oxygen flow sensor. Check Air supply and Press <Enter>.”	Advice	Insufficient Air supply pressure	Check for proper Air gas supply	Air supply pressure exceeding 2 bar (28 PSI) Or Proceed with system test by pushing <Enter>
12	“Air flow offset valve does not react. Call service specialist Press <Enter>.”	Advice	Air flow sensor offset valve problem identified	Replace B board	Air flow offset valve operates properly Or Proceed with system test by pushing <Enter>
13	“Air valves do not properly close. Check AIR gas supply or Call service specialist Press <Enter>.”	Advice	Air valves do not properly close Or Air gas supply pressure too high Or Air valve seat dirty.	Replace pneumatic assembly	Air valves operate properly Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
14	“2. Air flow valve does not react. Call service specialist Press <Enter>.”	Advice	Air flow valve problem identified	Replace pneumatic assembly	Proceed with system test by pushing <Enter>
15	“Malfunction at AIR valve testing. Test takes too long, repeat test or call service specialist Press <Enter>.”	Advice	AIR flow valve problem identified	Replace pneumatic assembly	Proceed with system test by pushing <Enter>
16	“Pressure sensor miscalibrated or defective. Measured offset out of range. call service specialist Press <Enter>.”	Advice	Pressure sensor is miscalibrated Or Pressure sensor is defective	Recalibrate pressure sensor	Pressure sensor signal within proper offset range Or Proceed with system test by pushing <Enter>
17	“No pressure increase in breathing circuit. Check breathing circuit and expiration valve for leaks. Press <Enter>.”	Advice	No pressure increase measured up to 50 mbar within 5 secs caused by a non-sealed y-piece Or A leak in the breathing circuit Or A leak in the expiration valve	Replace PEEP membrane	Pressure increase is measured in the breathing circuit Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
18	“Pressure sensor offset valve does not react. call service specialist Press <Enter>.”	Advice	Pressure sensor offset valve problem identified	Replace B board	Pressure sensor offset valve operates properly Or Proceed with system test by pushing <Enter>
19	“Pressure sensor malfunction. Leakage, check expiration valve. call service specialist Press <Enter>.”	Advice	Low pressure increase measured caused by a pressure sensor malfunction Or A leak in the breathing circuit Or A leak in the expiration valve	Check the breathing circuit for leaks and check the expiration valve for proper function And restart the system test.	Pressure increase is measured in the breathing circuit Or Proceed with system test by pushing <Enter>
20	“Electronic pressure safety valve in inspiratory line does not open. Call service specialist Press <Enter>.”	Advice	Electronic over pressure relief valve in inspiration line does not react Or Pressure release too slow	Replace pneumatic assembly	Electronic pressure safety valve opens properly Or Proceed with system test by pushing <Enter>
21	“<No pressure increase in system. Seal y-piece and check breathing circuit for leaks. Press <Enter>.”	Advice	No pressure increase measured caused by a non-sealed y-piece Or A leak in the breathing circuit	Check the breathing circuit for leaks and seal y-piece	Pressure increase is measured in the breathing circuit Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
22	“Leakage in breathing circuit too high. Check breathing circuit and expiration valve for leaks Press <Enter>.”	Advice	Leakage in breathing circuit exceeds 1 L/min.	Check the breathing circuit for leaks	Seal leaks Or Proceed with system test by pushing <Enter>
23	“Operational valve malfunction. Call service specialist Press <Enter>.”	Advice	Pressure increase measured with sealed valves	Do not squeeze breathing circuit components while in system test	Proper pressure increase is measured in the breathing circuit Or Proceed with system test by pushing <Enter>
24	“Expiratory resistance too high. Check breathing circuit and expiratory valve for resistance. Press <Enter>.”	Advice	Expiratory resistance exceeding 20 mbar/L/s	Check breathing circuit for kinked hoses or components causing high resistance and check expiratory valve assembly	Expiratory resistance below 20 mbar/L/s Or Proceed with system test by pushing <Enter>
25	“Expiratory valve control time too long. Check proper assembly of expiration valve or breathing circuit. Press <Enter>.”	Advice	Expiratory valve control time too long	Check expiratory valve for proper assembly and check breathing circuit for kinked hoses or components causing high resistance	Expiratory valve control time in proper range Or Proceed with system test by pushing <Enter>
26	“Expiratory valve data not matching. Check breathing circuit Press <Enter>.”	Advice	Expiratory valve data do not match with resistance and compliance data	Check breathing circuit for kinked hoses or components causing high resistance	Expiratory valve data in proper range Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
27	“Expiration valve cannot control P < 4 mbar. Call service specialist Press <Enter>.”	Advice	Expiration valve cannot control pressure < 4 mbar.	Check breathing circuit for leaks and check expiratory valve for proper assembly and check breathing circuit for kinked hoses or components causing high resistance	Expiration valve can control pressure < 4 mbar Or Proceed with system test by pushing <Enter>
28	“Over pressure relief valve P < 65 mbar. Call service specialist Press <Enter>	Advice	Over pressure relief valve reacts on pressure < 65 mbar	Restart the system test or replace pneumatic assembly	Over pressure relief valve operates between 65 and 85 mbar Or Proceed with system test by pushing <Enter>
29	“Over pressure relief valve P > 85 mbar. Call service specialist Press <Enter>	Advice	Over pressure relief valve reacts on pressure > 85 mbar	Restart the system test or replace pneumatic assembly	Over pressure relief valve operates between 65 and 85 mbar Or Proceed with system test by pushing <Enter>
30	“Expiratory flow sensor miscalibrated or defective. Measured offset out of range. Call service specialist Press <Enter>.”	Advice	Expiratory flow sensor is miscalibrated Or Flow sensor is defective	Recalibrate expiration flow sensor	Expiratory flow sensor signal within proper offset range Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
31	“Expiration flow offset valve does not react or wrong signal from expiration flow sensor. System may not be operated Call service specialist Press <Enter>.”	Caution	Expiration flow sensor offset valve problem identified	Replace B board	Expiration flow offset valve operates properly Or Proceed with system test by pushing <Enter>
32	“Exp. flow sensor value too high with AIR flow. Call service specialist Press <Enter>.”	Advice	Expiration flow sensor value too high with Air flow.	Remove expiration valve from lock, reassemble and reinsert prior to restart the system test or recalibrate Air flow line or replace pneumatic assembly	Expiration flow sensor signal in proper range Or Proceed with system test by pushing <Enter>
33	“Exp. flow sensor value too low with AIR flow. Call service specialist Press <Enter>.”	Advice	Expiration flow sensor value too low with Air flow.	Remove expiration valve from lock, reassemble and reinsert prior to restart the system test or recalibrate Air flow line or replace pneumatic assembly	Expiration flow sensor signal in proper range Or Proceed with system test by pushing <Enter>
34	“Exp. flow sensor value too high with O2 flow. Call service specialist Press <Enter>.”	Advice	Expiration flow sensor value too high with O2r flow.	Remove expiration valve from lock, reassemble and reinsert prior to restart the system test or recalibrate Air flow line or replace pneumatic assembly	Expiration flow sensor signal in proper range Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
35	“Exp. flow sensor value too low with O2 flow. Call service specialist Press <Enter>.”	Advice	Expiration flow sensor value too low with O2 flow.	Remove expiration valve from lock, reassemble and reinsert prior to restart the system test or recalibrate O2 flow line or replace pneumatic assembly	Expiration flow sensor signal in proper range Or Proceed with system test by pushing <Enter>
36	“Oxygen sensor value too low Re-calibrate sensor Press <Enter>.”	Advice	Oxygen sensor value below 19% at 21% setting.	Verify proper O2 supply and re-calibrate the oxygen sensor	Oxygen sensor values in proper range Or Proceed with system test by pushing <Enter>
37	“Oxygen sensor value too high. Re-calibrate sensor Press <Enter>.”	Advice	Oxygen sensor above 24% at 21% setting.	Verify proper Air supply and re-calibrate the oxygen sensor	Oxygen sensor values in proper range Or Proceed with system test by pushing <Enter>
38	“Open y – piece.”	Advice	The test sequence requires opening the y-piece to measure the inspiratory resistance	Open y-piece or remove y-piece from sealer of expiration block	Opened y-piece.
39	“Measured inspiratory resistance too high. Check breathing circuit Press <Enter>.”	Advice	Inspiratory resistance exceeding 5 mbar/L/s.	Check breathing circuit for kinked hoses or components causing high resistance	Inspiratory resistance in proper range Or Proceed with system test by pushing <Enter>
40	“Measured resistance out of range. Check breathing circuit Press <Enter>.”	Advice	Breathing circuit resistance above 40 mbar/L/s Or Resistance could not be detected properly	Check breathing circuit for kinked hoses or components causing high resistance And check expiration valve for proper assembly and do not manipulate on breathing system while in test	Breathing circuit resistance below 40 mbar/L/s Or Resistance could be detected properly Or Proceed with system test by pushing <Enter>

No	Message	Type	Set condition	Action	Reset condition
41	“System test OK. To start ventilation <Enter>. Compliance xx ml/mbar Resistance xx mbar/L/s Leakage x mL/min	Advice	System test is finished. Total Compliance, insp. resistance and total leakage data of used breathing circuit are identified and will be used for compensation during following ventilation	Connect y-piece to patient and start ventilation by pushing <Enter>	n/a

5.3.3 Messages during O2 sensor calibration

No	Message	Type	Set condition	Action	Reset condition
1	“No signal: wrong gas or sensor defective”	Advice	If sensor signal does not exceed 40% at calibration with 99% O2	Ensure proper O2 gas supply Or Replace sensor	Sensor signal exceeds 40%at calibration with 99% O2
2	“Signal low: sensor used-up or sensor failure”	Advice	If sensor signal does not reach minimum data sheet value at 99% Or 21% O2	Ensure proper O2 gas supply Or Ensure proper Air gas supply Or Replace sensor	If sensor signal is in between minimum and maximum data sheet values at 21% with Air And 99% with O2
3	“Signal high: sensor failure or PCB failure”	Advice	If sensor signal exceeds maximum data sheet value at 99% Or 21% O2	Ensure proper O2 gas supply Or Ensure proper Air supply Or Replace sensor Or B board	If sensor signal is in between minimum and maximum data sheet values at 21% with Air And 99% with O2
4	“Calibration successfully finished”	Advice	If calibration settles properly at 21% with Air and 99% with O2	Finish the calibration procedure	n/a

5.3.4 Messages during operation

No.	Message	Type	Set condition	Meaning	Reset condition
1	"Battery xx Min"	Advice	In all modes: If line power supply fails Or If external DC power supply fails Or If internal battery is charging	System power supply from internal back up battery. Remaining operating time on battery is "xx Min"	In all modes: If line power is reconnected Or If external DC power supply is reconnected Or If internal battery is fully charged
2	"a, xx, yy%"	Advice	In all modes: If Airway resistance compensation ARC is used	ARC is active for a type of tube with xx mm diameter and yy % compensation	In all modes: If ARC is turned off
3	"No test"	Advice	In all modes: If system test had not been performed	System test to identify breathing circuits compliance, resistance and leakage was not performed. System uses default data to compensate. Compliance compensation therefore may not be appropriate	Perform system test
4	"Only O2"	Advice	In all modes: If during system test single gas operation for O2 only was confirmed	Only O2 gas supply with setting FiO2 default to 100% in all modes	Perform system test with AIR gas supply
5	"Only AIR"	Advice	In all modes: If during system test single gas operation for AIR only was confirmed	Only AIR gas supply with setting FiO2 default to 21% in all modes	Perform system test with O2 gas supply
6	"Adult"	Advice	In all modes: System is in "adult mode"	For all system settings adult mode default values are used	Select "pediatric" to change
7	"Pedia"	Advice	In all modes: System is in "pediatric mode"	For all system settings pediatric mode default values are used	Select "Adult" to change
8	"Standby"	Advice	System was moved into standby mode	System starts By-flow after 15 secs to identify reconnection of a patient (APD). All alarms are silenced	Connect a patient to the y-piece Or Activate the On/Off button for more than 3 secs to turn off the system

No.	Message	Type	Set condition	Meaning	Reset condition
9	"Apnea xx"	Caution	No breathing action is been detected within the last apnea time delay.	Patient has stopped breathing for more than the apnea delay time. Elapsed time is xx secs	Perform breathing activities
10	"Apnea vent."	Caution	No breathing action is been detected within the last apnea time delay.	Patient has stopped breathing for more than the apnea delay time. System has started apnea back up ventilation mode	Activate any ventilation mode in the vent. mode menu
11	"Pre oxygen xx."	Advice	Automatic suction routine ASR activated. 1st phase	Preoyxgenation phase of automatic suction routine is in operation for at least xx .	Deactivate automatic suction routine ASR Or Disconnect patient
12	"Suction xx."	Advice	Automatic suction routine ASR activated. 2nd. phase	System releases pressure to zero, silences all alarms and stops and waits for the patient to be disconnected for bronchial suction. Phase is in process for at least xx	Deactivate automatic suction routine ASR Or Reconnect patient
13	"Post oxygen xx."	Advice	Automatic suction routine ASR activated. 3rd phase	Postoxygenation phase of automatic suction routine is in operation for at least xx .	Deactivate automatic suction routine ASR
14	"Freeze"	Advice	Graphic freeze function was activated	Graphics in screen are frozen in place for better analysis.	Deactivate freeze function
15	"System open ?"	Advice	Pressure below PEEP Or patient disconnected	System cannot detect sufficient pressure increase.	Reconnect patient Or Activate the On/Off button for more than 3 secs to turn off the system
16	"Switch Off Centiva /5 ? Yes: Enter, No: any button"	Advice	System in Standby Or System open ? And On/Off button activated for more than 3 secs	Software will switch Centiva /5 Off if the <Enter> button is pushed.	Push any button to return to normal operation
17	"System shutdown error xx"	Caution	Any System shutdown error detected during permanent system check	Replace B board and B EPROM or A board and A EPROM	Shut down system, restart and perform power up test

6 Maintenance

In this section

6.1 General instructions

⚠ WARNING Do not perform testing or maintenance on the Centiva /5 ICU Ventilator while it is being used to ventilate a patient . Possible injury can result.

⚠ WARNING Items can be contaminated due to infectious patients. Wear sterile rubber gloves to protect against the spread of infectious agents to you and others.

⚠ WARNING Obey infection control and safety procedures. Used equipment may contain blood and other body fluids.

6.2 Maintenance schedule

Perform the user maintenance from the procedures and schedules in the Centiva /5 ICU Ventilator operation manual.

6.2.1. Every twelve (12) months

Perform the following every twelve months:

1. Remove all user level breathing system assemblies and components from the breathing system.
2. Remove the expiration valve form the main engine.
3. Open the main engine according to section 7.2.4 .
4. Inspect the Centiva /5 ICU Ventilator and the removed components for distortion, deterioration and/or cracks.
5. Replace the following parts in the expiration valve according to section 7.9.3, using the PEEP PM kit:
   - PEEP membrane assembly
   - O-ring , flow port
   - O-ring screen port
   - Flow screen
6. Replace the O2 sensor according to section 7.9.7.
7. Reassemble the main engine.
8. Replace O-ring on NIST connector (if applicable) for AIR and O2.
9. Perform Air flow sensor calibration according to section 4.7.2.
10. Perform Expiratory flow sensor calibration according to section 4.7.3.
11. Perform O_2 flow sensor calibration according to section 4.7.4.
12. Perform Airway pressure sensor calibration according to section 4.7.5.
13. Perform Overpressure relief valve calibration according to section 4.7.6.

14. Perform Battery charging voltage calibration according to section 4.7.7.
15. Close the main engine.
16. Perform the Post-service checkout according to section 3.1.
17. Perform the electrical safety test for
    - Ground resistance (< 0.2 E)
    - Leakage current (< 500uA)
    - Insulation resistance (> 10 ME).

6.2.1. Every twenty four (24) months

In addition to the 12 month requirements, perform the following every twenty-four months:

1. Replace the internal back up battery according to section 7.9.1.
2. Replace the free breathing valve according to section 7.9.6.

7 Repair procedures

In this section

See next page for more

In this section (cont.)

7.1 General instructions

⚠ WARNING Post-Service Checkout is required after you complete this section. You must perform Section 3, “Post-Service Checkout”, after performing any maintenance, service or repair. Failure to do so may result in patient injury.

⚠ WARNING When servicing the Centiva /5 ICU Ventilator, extreme care must be taken to avoid introducing foreign debris, particularly metal chips generated by screw threads, into the pneumatic flow passages of the ventilator. Failure to do so may result in patient injury and damage to the flow valve.

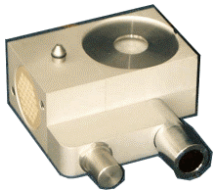
7.2 Open the System

The Centiva /5 ICU ventilator has three (3) user accessible main assemblies

- The main engine

- The control panel

- The expiration valve



These three assemblies can be separated by the user without using any tools.

To be able to open the system remove the expiration valve assembly first, to gain access to all the three body screws.

Removing the control panel is necessary to gain access to the main engine from the front side.

7.2.1 Remove the exp. valve

The following procedures describe how to remove the expiration valve assembly of the Centiva /5 ICU ventilator when:

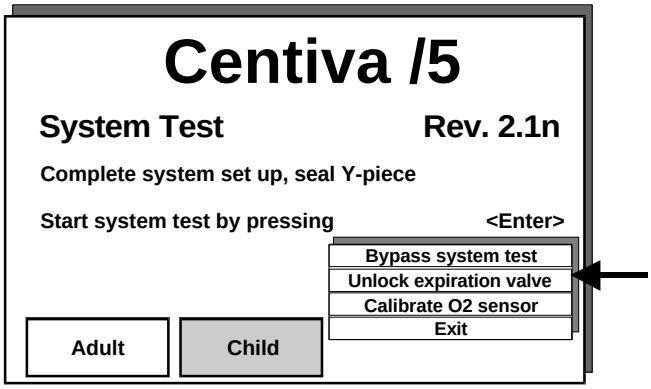
a. external power supply is available and the ventilator is able to control the expiration valve locking mechanism.

b. no external power supply is available, but the ventilator is still able to control the expiration valve locking mechanism.

c. there is no power available or the ventilator is no longer able to control the expiration valve locking mechanism.

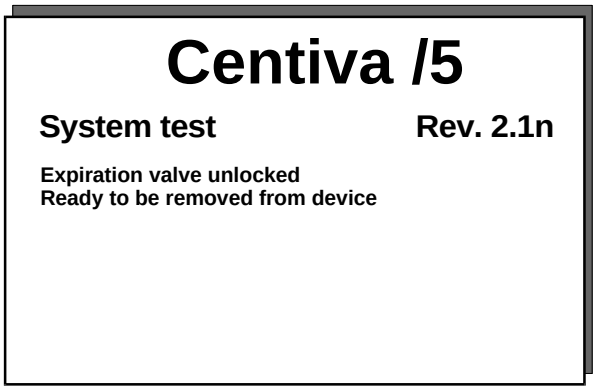
a) Ext. power supply is available and exp. valve control is working

1. Connect the system to line power.
2. Turn ON the system.
3. Wait for the automatic power-up test to finish.
4. Press the menu button.
5. The system prompts with the following screen.



6. Use the Com wheel to select “unlock expiration valve”.
7. Push the Com wheel to confirm selection.

8. The locking mechanism releases the expiration valve assembly and prompts with the following screen.



9. The expiration valve can be removed from the system.

10. When re-inserting the expiration valve, the system automatically locks the valve assembly upon proper insertion and performs a power-up test.

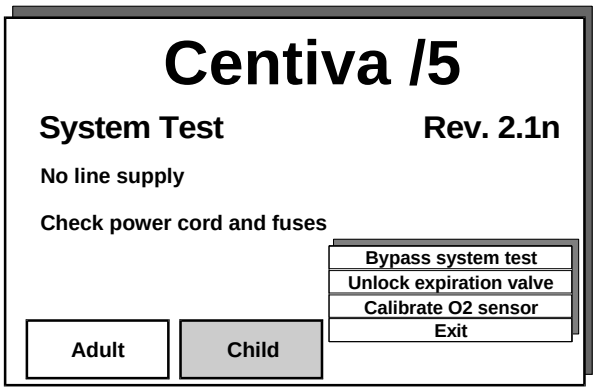
Special notice

Note: The re-locking of the expiration valve after re-insertion only works with an appropriate external power supply (line or DC) connected.

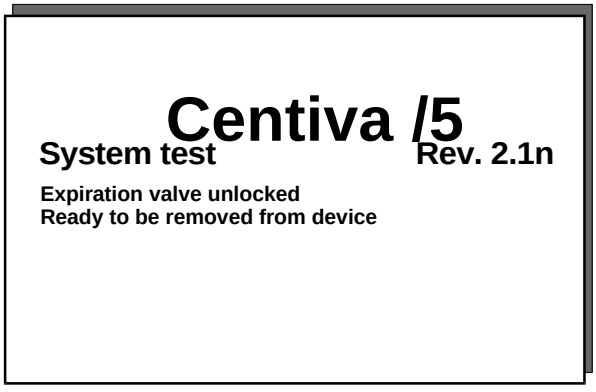
b) Ext. power supply is not available, but exp. valve control is working

Operate the system with the internal back-Up battery

1. Turn ON the system.
2. The system will prompt with an alarm message indicating that line supply is missing . Press the menu button.
3. The system prompts with the following screen.



4. Use the Com wheel to select “unlock expiration valve”.
5. Push the Com wheel to confirm selection.
6. The locking mechanism releases the expiration valve assembly and prompts with the following screen.

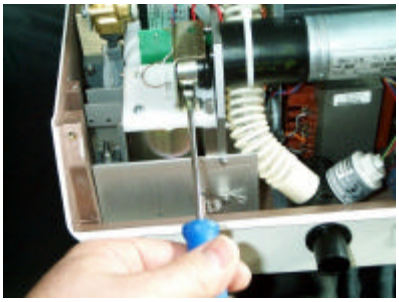


7. The expiration valve can be removed from the system.

d. No power supply available or exp. valve control is not working anymore

Under normal conditions, the expiratory valve assembly can be removed by selecting an option in the service menu or the system test menu. If this software function is no longer available or the locking mechanism is not functioning properly, use the following procedure to remove the expiratory valve assembly and gain access to the one housing screw.

(Emergency case)



1. Remove the panel according to section 7.2.2.
2. Remove the panel mounting plate according to section 7.9.2.
3. Use a screwdriver to move up the locking mechanism of the expiratory valve by inserting it into the screw hole of the motor assembly and rotating upward. Be careful not to damage the motor or the gearbox.
4. Remove the expiratory valve.

Note: Picture shows the upper housing removed for better visibility.

7.2.2 Remove the control panel

To remove the control panel assembly of the Centiva /5 ICU ventilator follow this sequence

1. Turn OFF the system.
2. Move the panel forward to access the panel bracket.
3. Move the two locking pins towards each other by gripping with thumb and index finger and unlock the bracket.

4. Move the panel bracket forward out of the engine and lift the entire assembly to remove it from the button hinge.

5. Disconnect the panel connector from the main engine by pulling back the locking collar.

7.2.3 Open the control panel

To open the control panel of the Centiva /5 ICU ventilator follow this sequence

1. Disconnect the panel connector from the main engine.
2. Remove the two bracket screws.

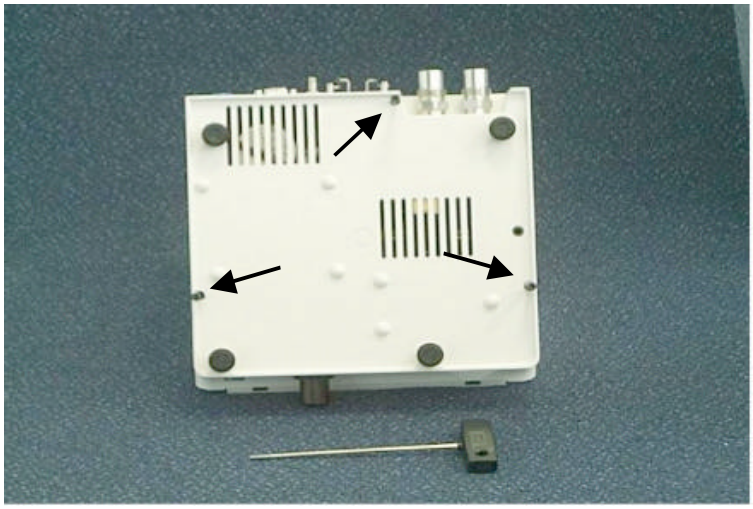
3. Remove the bracket from the panel's back.
4. Remove the four screws securing the back cover and carefully remove the back cover.

5. Pay attention to the serial cable in the back cover.

7.2.4. Open the main engine

To open the main engine of the Centiva /5 ICU ventilator follow this sequence:

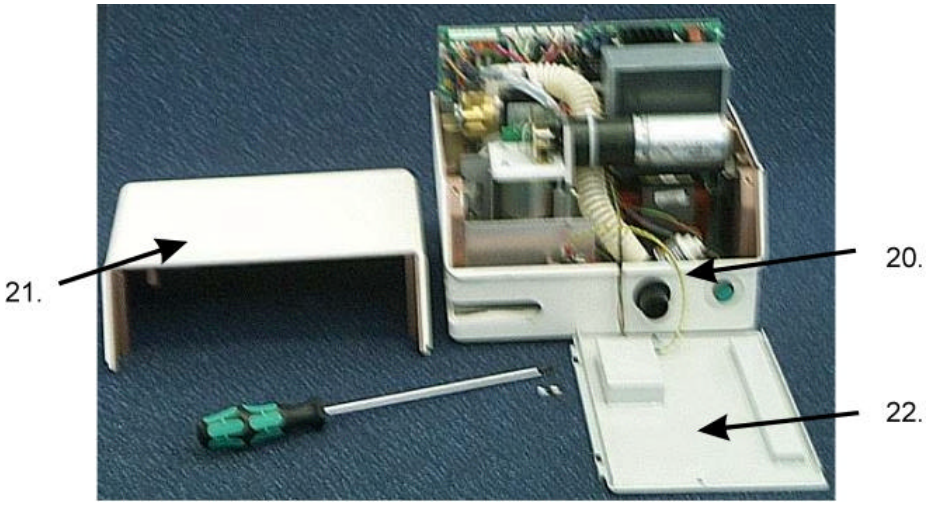
1. Turn ON the system.
2. Remove the expiration valve according to section 7.2.1.
3. Turn OFF the system.
4. Disconnect the line power supply.
5. Disconnect the gas supplies.

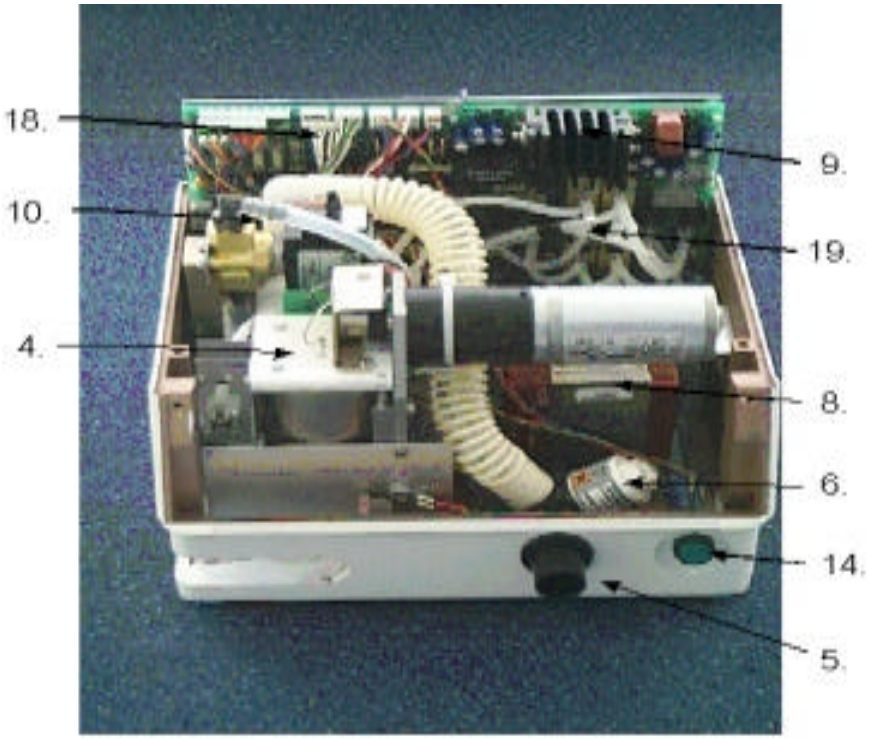


6. Turn the main engine upside down.
7. Use a 3 mm hex wrench to remove the three (3) screws in the bottom.
8. Turn main engine back on its feet.
9. Remove upper housing cover by lifting it up and back.
10. To improve accessibility to internal components, remove the control panel according to section 7.2.2 and the panel mounting plate according to section 7.9.2.
11. Remove panel mounting plate on main engine by removing the two (2) screws in front according to section 7.9.2.

7.2.5 Main engine internals

The open main engine of the Centiva /5 ICU ventilator :





7.2.6 Legend to internals

4. Expiratory valve control assembly.
5. Patient connection assembly.
6. O2 sensor.
7. Lead acid battery assembly (photo on page 7-17).
8. Transformer assembly.
9. PC Board “B” assembly.
10. Pneumatic assembly.
11. Fan assembly (not shown).
12. Alarm system (not shown).
13. Line connector assembly (photo on page 7-20).
14. ON-OFF switch assembly.
15. DC main connector assembly (photo on page 7-20) .
16. Ground stud assembly (photo on page 7-20).
17. Serial data connection assembly (photo on page 7-20).
18. Lower housing.
19. Upper housing.
20. Control panel mounting plate.

7.3 Service assemblies

The following are the service assemblies of the Centiva /5 ICU ventilator:

1. Control Panel.
2. Panel bracket.
3. Expiratory valve assembly.
4. Expiratory valve control assembly.
5. Patient connection assembly.
6. O2 sensor.
7. Lead acid battery assembly.
8. Transformer assembly.
9. PC Board “B” assembly.
10. Pneumatic assembly.
11. Fan assembly .
12. Alarm system.
13. Line connector assembly.
14. ON-OFF switch assembly.
15. DC main connector assembly.
16. Ground stud assembly.
17. Serial data connection assembly.
18. Tubing set.
19. Lower housing.
20. Upper housing
21. Panel mounting plate

Control Panel

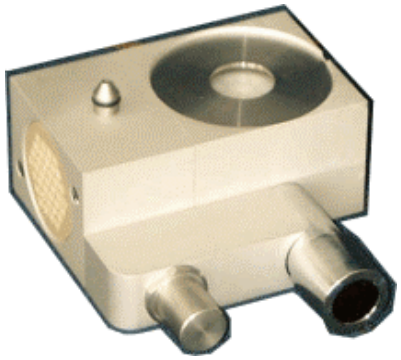
See description in section 2.4. The control panel comes without the bracket and without the A EPROM. When replacing either move the A EPROM or order the latest set of EPROMs in the desired language.

Control Panel bracket

The control panel bracket allows the angle of the panel to be adjusted. The two (2) screws on the side of the panel are used to control the force required to adjust the panel.

Expiratory valve assembly

The expiratory valve assembly contains the PEEP membrane and the expiratory flow sensor (pneumatic). The assembly has a built-in magnet which activates a magnetic sensitive switch when inserted into the expiratory control assembly.



Expiratory valve control assembly

The expiratory valve control receives the expiratory valve and locks it with a motor driven mechanism to ensure proper and tight seating. The assembly contains the PEEP valve's magnetic coil, the coil driving circuits and a plunger which transfers the coil force to the PEEP membrane.

Pos. 4 on page 13.

Patient connection assembly

At the patient connection the gas flowing from the pneumatic assembly block is brought into an inspiratory connector. The O2 sensor is located in this assembly, as well as the airway pressure port , the sub atmospheric pressure relief valve and the connection to the overpressure relief valves. The patient connection comes without the patient tube and without the O2 sensor.

Pos. 5 on page 13.

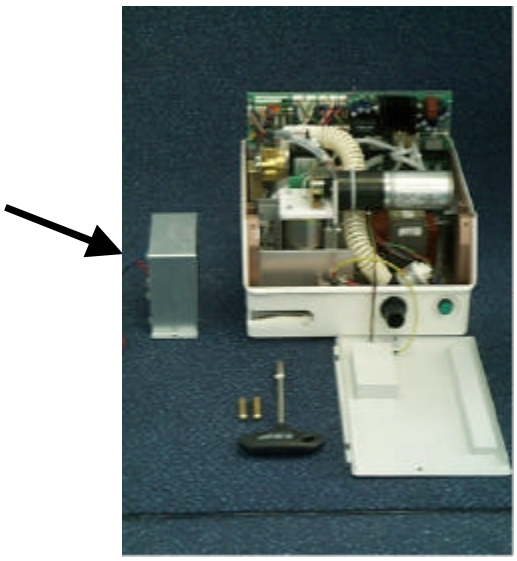
O2 sensor

The O2 sensor is a fuel cell and is attached to the patient connection.

Pos. 6 on page 13.

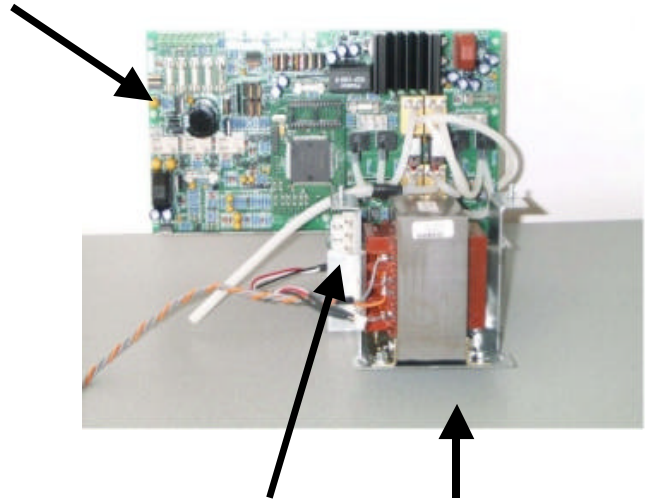
Back-up battery assembly

The internal battery is a 24 V sealed lead acid battery. The battery is mounted on top of the transformer.



PC board B assembly

PC board B carries most of the power supply systems, the sensors for the different pneumatics, (see pneumatic block diagram) , the controls and drivers and associated electrical connections.



Transformer assembly

The transformer is designed to operate with 230 V or 115 V , depending on the pin connection of the transformer plug. To change line supply voltage refer to section 7.4.

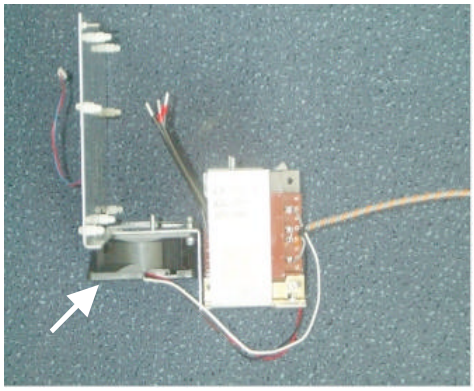
Pneumatic assembly

The pneumatic assembly contains most of the components from the pneumatic block diagram, except the PEEP valve.

.

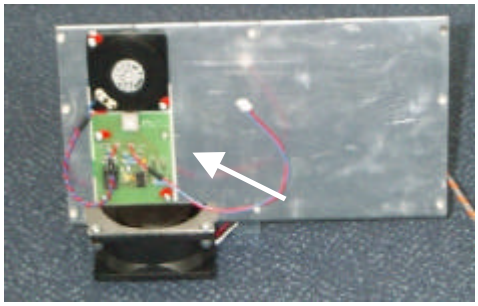
Fan assembly

The fan is designed to dilute possible increased oxygen concentrations within the main engine. The cooling of the electronic component is a (positive) side effect, only .



Alarm system

The audible alarm system uses a metal membrane loudspeaker. The module is located on the back of the sub chassis.



ON / OFF switch assembly

This button controls the software ON / OFF function. When pressed for more than 3 secs in any non-ventilation mode the message “Turn OFF device ?” is displayed. Confirming by Com wheel then turns OFF the system.
Pos. 14 on page 13.

Line connector assembly

The IEC standard line connection has two built in primary fuses (SI 0a & b) and a dual line switch in accordance with IEC 601-1. This line switch normally remains in the ON position.

Pos. 13 below.

DC main connector assembly

The DC main connector allows the system to be supplied with 24 V DC from an emergency vehicle, a helicopter or an external battery supply system.

Pos. 15 below.

Ground stud assembly

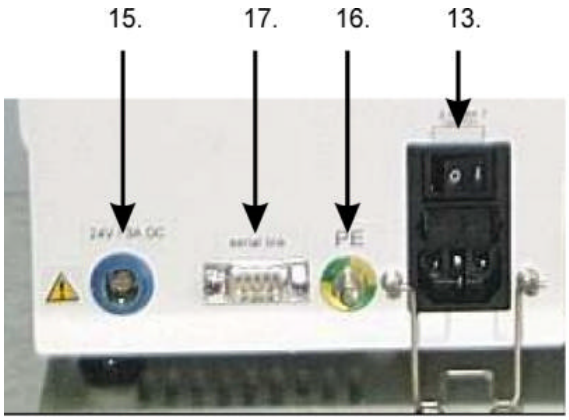
The Ground stud allows for proper electrical grounding in sensitive environments.

Pos. 16 below.

Serial data connector assembly

The serial data connection provides RS 232 protocol capabilities to communicate with other systems.

Pos. 17 below.



Tubing kit All the internal tubes are available in a set.
Pos. 19 on page 13.

Patient tube The white hose (patient tube) connecting the pneumatic assembly with the patient connection assembly has connectors on both ends.
Pos. 23 on page 13.

Lower housing The lower housing carries all the internal sub assemblies.
Pos. 20 on page 13.

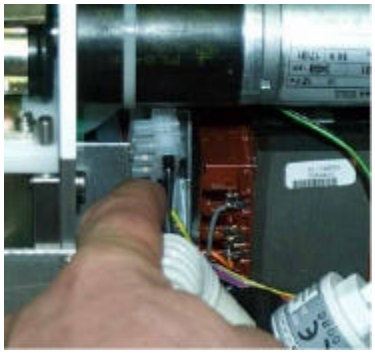
Upper housing The upper housing covers the engine.
Pos. 21. on page 13.

Panel mounting plate The panel mounting plate allows the panel bracket to be mounted to the main engine
Pos. 22 on page 13.

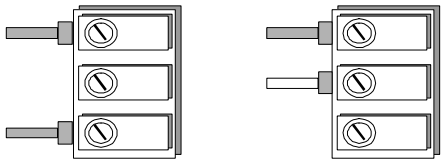
7.4 Change the line voltage

The Centiva /5 ICU ventilator is designed to run at both 230 V_{AC} and at 115V_{AC}, but requires internal switching to the appropriate line voltage. To change the line voltage, follow this sequence:

1. Open the main engine according to section 7.2.4.
2. Ensure that the line power supply is disconnected.
3. Ensure that the line switch is turned OFF.
4. Disconnect the main tube at the pneumatic assembly and carefully pull it forward through the space under the expiratory valve locking assembly.



5. Pull the three position line power connector forward to disconnect it from the transformer.
6. Change the line supply connector to the desired voltage according to the following connection diagram and then reconnect it to the transformer. Be sure align the connector so that all three pins are engaged.



Special notice

7. Change the line supply fuses SI 0 a & b inside the line connector according to the line supply voltage used:
   - 2 x 1.6 A slow blow at 115 V_{AC} line voltage
   - 2 x 0.8 A slow blow at 230 V_{AC} line voltage

   For details refer to section 7.7.1.
8. Verify proper insertion of fuses and installation of the internal connector to the transformer prior to re-assembly.

7.5 Software replacement

The Centiva /5 ICU Ventilator's software is stored in two independent EPROMs:

- The A EPROM is located on the panel board (PC board A).
- The B EPROM is located on the main board (PC board B).

When installing a new software release or version, verify that both EPROMs, the A and the B, are from the same release version. During the power-up test, the system compares the software revisions in both EPROMs. If they do not match, a system shutdown error message is displayed in the message box.

Special notice

The A EPROM contains the different languages and may be changed to match the users needs. Verify that the new A EPROM matches the users language needs.

7.5.1 Change the language (A) EPROM

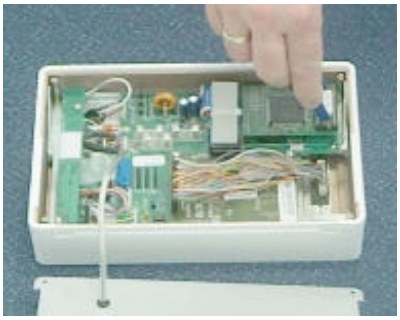
The Centiva /5 ICU Ventilator's software is available in the following languages:

a) English
b) French *
c) German
d) Italian *
e) Polish *
f) Portuguese *
g) Spanish *

(* translation in progress at time of publication)

Special notice

Contact Datex-Ohmeda to inquire concerning the availability of additional languages.



The language part of the software is stored in the A EPROM. If the language needs to be changed the A EPROM will need to be replaced. Be sure to replace the A EPROM with the same software version.

To replace the A EPROM:

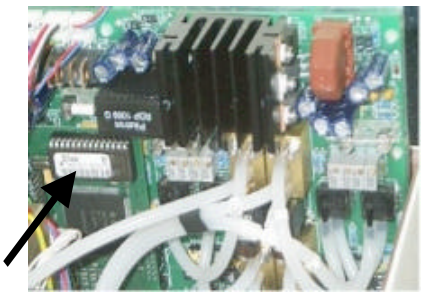
1. Ensure that the system is turned OFF and line power is disconnected.
2. Remove panel from main engine according to section 7.2.2.
3. Open panel according to section 7.2.3.
4. Use a chip extractor to remove the current A EPROM.
5. Insert the new A EPROM (mark facing the panel housing).
6. Verify that the EPROM is properly inserted.

To verify proper function, turn ON the system and perform the power-up test. Verify that the desired language is displayed.

7.5.2 Change the main (B) EPROM

To replace the B EPROM follow this sequence:

1. Ensure that the system is turned OFF and line power is disconnected.
2. Open main engine according to section 7.2.4.
3. Remove internal back-up battery according to section 7.9.1.
4. Remove the current B EPROM.
5. Insert the new B EPROM (mark toward the left side).
6. Verify that the EPROM is properly inserted.



After reassembly, verify proper function by turning ON the system and allowing it to perform the power-up test.

7.6 Change the units of measure

The Centiva /5 ICU Ventilator's software is capable of displaying pressure in the following units of measure:

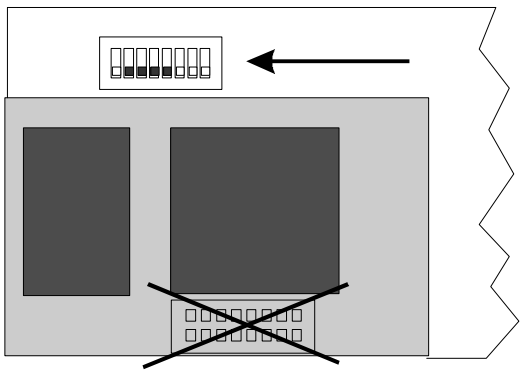
- mbar (default).
- cmH_2O.
- hPa.

This units of measure are selectable by setting DIP switches No. 2 and No. 3 on the panel's A board according to the following logic:

Dip switch No. 2	Dip switch No. 3	Units of measure
OFF	OFF	mbar
ON	OFF	cmH_2O
OFF	ON	cmH_2O
ON	ON	hPa

To change the units of measure follow this sequence:

1. Ensure that the system is turned OFF and line power is disconnected.
2. Remove panel from main engine according to section 7.2.2.
3. Open panel according to section 7.2.3.
4. Change DIP switch setting according to desired units of measure.



To verify proper function, turn ON the system and perform the power-up test. Verify that the desired units of measure are displayed.

7.7 Change fuses

The Centiva /5 ICU Ventilator's electronic system is protected by several fuses, indicated in the overview diagrams. The fuses are located:

a. in the line connector (SI O a and b)

b. on PC board A (SI 1 – SI 3)

c. on PC board B (SI 21 - 28, SI 41).

Always use the identical type and rating when replacing a fuse. For details see list of fuses in section 9.7.

7.7.1 Change the line fuses

To replace the line fuses inside the line connector, located on the back side of the main engine, follow this sequence:

1. Ensure that the system is turned OFF and line power is disconnected.
2. Remove line power cord from line connector.
3. Using a small screwdriver open the two clamps of the fuse compartment and carefully pull it out. The fuses are located in a spring loaded mechanism for easy replacement.
4. Replace fuses according to the line voltage used
   - 2 x 1.6 A slow blow at 115 V_{AC} line voltage.
   - 2 x 0.8 A slow blow at 230 V_{AC} line voltage.
5. Reinsert fuse compartment with the black nose facing downwards and apply gentle pressure until both clamps lock in place.
6. Verify proper function by connecting the system to line supply, turning the mains switch to ON, and confirming that the green ON-OFF button on the front of the unit is illuminated.
7. If the fuse blows again, analyze the reason prior to another replacement of fuses.

7.7.2 Change the control panel fuses

The Centiva /5 ICU Ventilator's control panel is protected by the following fuses:

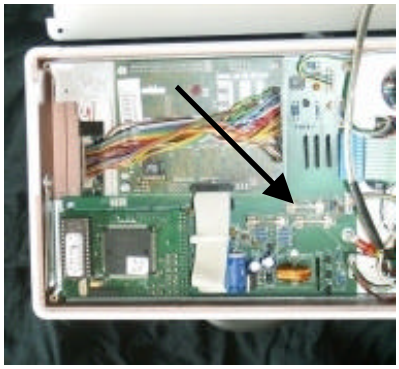
a) SI 1 = Panel supply = 0.8 A slow blow.

b) SI 2 = LCD Backlight supply = 0.8 A slow blow.

c) SI 3 = + 5V controller voltage supply = 0.8 A slow blow.

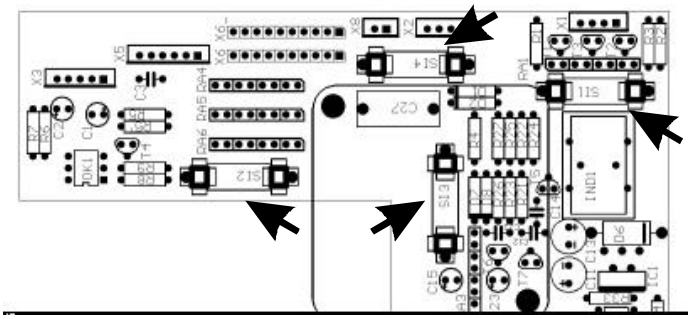
d) SI 4 = buzzer supply = 0.315 A slow blow.

Always use the identical type and rating when replacing a fuse. For details see list of fuses in section 9.7.



To replace the fuses inside the panel follow this sequence:

1. Ensure that the system is turned OFF and line power is disconnected.
2. Remove panel from main engine according to section 2.3.2.
3. Open the panel according to section 7.2.1.
4. Replace fuse.

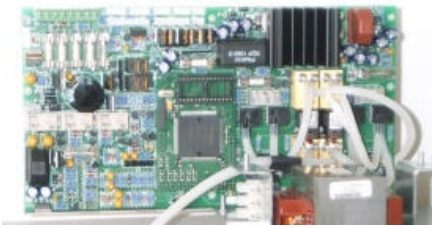


5. Verify proper function after reassembly by performing a power-up test.
6. In case the fuse blows again, analyze the reason prior to another replacement of fuses.

7.7.3 Change the main engine fuses

The Centiva /5 ICU Ventilator's main engine is protected by the following fuses, that are all located on the PC board B:

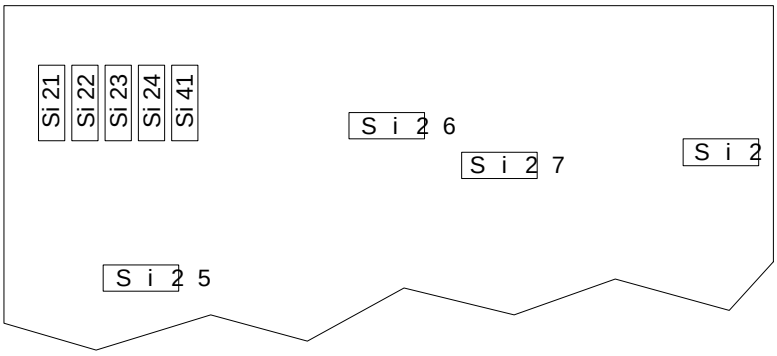
- SI 21 = Transformer secondary 1 = 3.15 A slow blow.
- SI 22 = Transformer secondary 2 = 3.15 A slow blow.
- SI 23 = Line 24 V DC inlet = 3.15 A slow blow.
- SI 24 = Back-up battery = 3.15 A slow blow.
- SI 25 = Battery charger = 0.5 A slow blow.
- SI 26 = + 13 V bus = 3.15 A slow blow.
- SI 27 = + 15 V bus = 3.15 A slow blow.
- SI 28 = + 5 V bus = 0.5 A slow blow.
- SI 41 = Exp. Valve heater = 1.0 A slow blow.



Always use the identical type and rating when replacing a fuse. For details see list of fuses in section 9.7.

To replace the fuses on the PC board B inside the main engine follow this sequence:

1. Open the main engine according to section 7.2.4
2. Disconnect the back-up battery connector X23.
3. Replace fuse.



4. Verify proper function after reassembly by performing a power-up test.

5. If the fuse blows again, analyze the reason prior to another replacement of fuses.

Special notice

It may be necessary to remove the battery according to section 9.7.1 to access SI 27. Replacement of SI 25 without removing additional components requires the use of long nose pliers.

7.8 Repair control panel components

7.8.1 Replace com wheel encoder

To replace the control panel's com wheel follow this sequence:

1. Remove the control panel according to section 7.2.2.
2. Open the panel according to section 7.2.3.
3. Remove the com wheel knob.
4. Remove the two mounting screws on the inverter PC board inside the panel (above the com wheel encoder).
5. Move the inverter PC board out of the way.
6. Unplug the com wheel encoder connector X 5.
7. Use a 14 mm wrench to remove the com wheel nut.
8. Remove the com wheel encoder from the panel.
9. Insert the new com wheel encoder and reassemble.
10. Verify proper function after reassembly by performing a power-up test.

7.8.2 Replace front label with keypad

To replace the front label and integrated keypad, follow this sequence:

1. Remove the control panel according to section 7.2.2.
2. Open the panel according to section 7.2.3.
3. Remove the com wheel knob.
4. Unplug keypad connector X 6.
5. Use a knife to lift one side of the adhesive label and then peel it off completely and pass the keypad connector through the slot in the panel body.
6. Remove all remaining adhesive on the panel body with window cleaner (alcohol based).
7. Clean LCD display surface with window cleaner (alcohol based).
8. Remove the adhesive cover of the new front label.
9. Move the keypad connector of the new front label though the slot in the panel body.
10. Align the front label inside the panel frame and then gently press the film into place.
11. Plug in keypad connector X 6.
12. Install the com wheel button.
13. Close panel.
14. Verify proper function after reassembly by performing a power-up test.

7.9 Repair main engine components

7.9.1 Remove back-up battery

The Centiva /5 ICU Ventilator is equipped with a built-in back-up battery that is designed to provide a minimum of 30 minutes of battery operation. To remove or replace the battery follow this sequence:

1. Open the main engine according to section 7.2.4.
2. Use a 7 mm nut driver to remove the two hex nuts left and right of the battery.
3. Remove the battery from the transformer assembly.
4. If replacing the back-up battery disconnect X 23.
5. For some calibration procedures, the back-up battery is removed to allow better access to PC board B. In those cases, the back-up battery must stay connected to PC board B.

7.9.2 Remove panel mounting plate

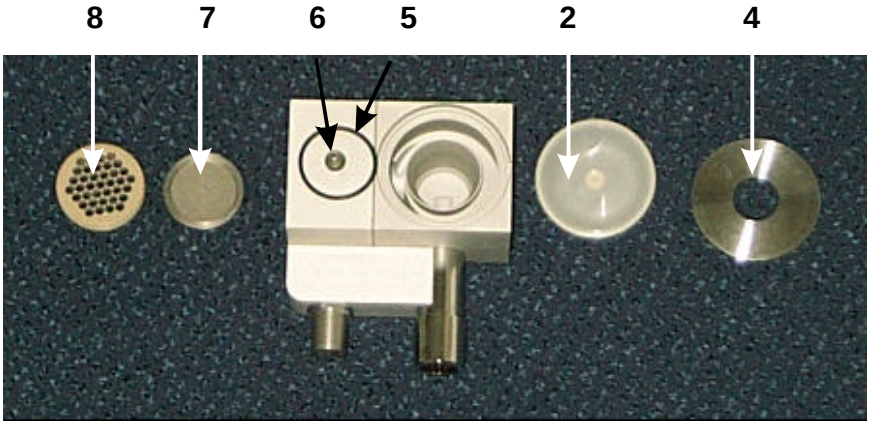
To gain better access to internal assemblies of the Centiva /5 ICU Ventilator remove the panel mounting plate. To remove the panel mounting plate follow this sequence:

1. Remove the control panel according to section 7.2.2.
2. Unscrew the two screws on the panel mounting plate.
3. Disconnect ground connection at the expiration valve locking assembly.

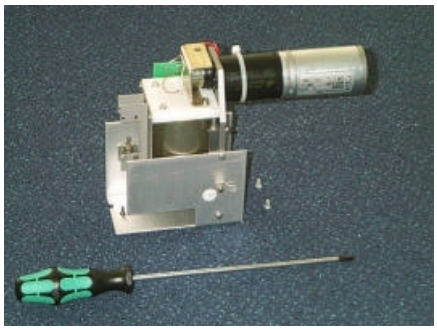
7.9.3 Repair expiratory valve

The Centiva /5 ICU ventilator is equipped with an expiration valve locking mechanism, that uses a motor driven locking system to properly fix the expiration valve inside the system. To repair and maintain according to section 6.2.1. :

1. Remove the expiration valve according to section 7.2.1.
2. Remove membrane plate (4) to gain access to the PEEP membrane assembly.
3. Remove the PEEP membrane assembly from the center plate. Note that both membranes are fixed in place by a silicon lock. To unlock the two membranes move the bottom membrane away from the top membrane.
4. To lock the PEEP membrane assembly together, insert the silicon lock at the center of the larger diameter membrane through the center plate and then through the smaller diameter membrane. Pull on the lock until the locking lip is fully engaged. Insert the PEEP membrane assembly into the expiration valve with the smaller diameter membrane facing down. The side of the larger diameter membrane marked “top” should be facing the top.
5. Replace o-ring 5 x 1.5 (6) at flow measurement port .
6. Use a small pliers to remove the flow screen retainer (8) by turning counterclockwise.
7. Carefully remove the flow screen (7) and o-ring 30 x 2 (5).

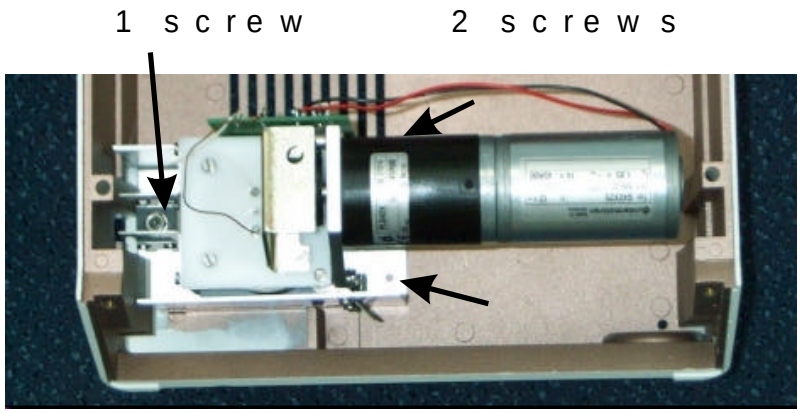


7.9.4 Repair expiratory valve locking assembly



The Centiva /5 ICU ventilator is equipped with an expiration valve locking mechanism, that uses a motor driven locking system to properly fix the expiration valve inside the system. To remove the expiration valve locking assembly:

1. Remove the expiration valve according to section 7.2.1.
2. Remove the control panel according to section 7.2.2.
3. Remove the panel mounting plate according to section 7.9.2
4. Open the main engine according to section 7.2.4.
5. Disconnect X 42 on PC board B.
6. Disconnect the ground connection at the front of the assembly.
7. Disconnect tube A from the expiration valve locking assembly (left side).
8. Unscrew three screws at he bottom of the assembly, one on the left side, two on the right side.

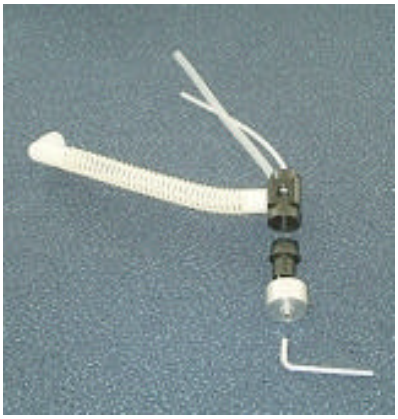


9. Remove the entire assembly by lifting it up and to the right .
10. When inserting the assembly place the three screws into the assembly before placing it into the system.

7.9.5 Repair inspiratory connection

The inspiratory connection assembly includes the O2 sensor, the free breathing valve, the connection to the pneumatic assembly, the connection to the overpressure relief valve and the connection to the pressure measuring port. To replace the inspiratory connection assembly:

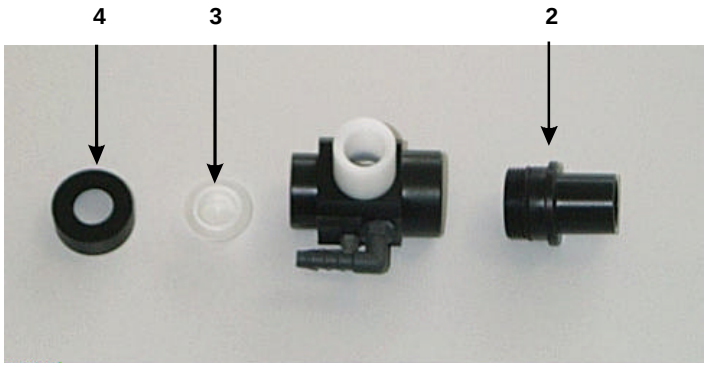
1. Remove the control panel according to section 7.2.2.
2. Open the main engine according to section 7.2.4.
3. Remove the panel mounting plate according to section 7.9.2.
4. Disconnect X 14 at the PC board B and move away panel mounting plate.
5. Disconnect cable X 31 at the O2 sensor connection.
6. Disconnect tube at over pressure relief valve.
7. Disconnect patient tube on pneumatic assembly and unscrew the patient tube from the inspiratory connection.
8. Use special tool from ST 5 to unscrew the black front nut of the inspiratory connection.
9. Remove the inspiratory connection from the housing.
10. Disconnect tube B (patient pressure line) from the inspiratory connection at PC board B.
11. When replacing the assembly, be careful not to kink or damage the white main tube.



7.9.6 Replace free breathing valve

The free breathing valve is located within the inspiratory connection assembly. To replace the free breathing valve:

1. Remove the inspiratory connection according to section 7.9.5.
2. Remove the black cap (4) at the back of the assembly by pulling and twisting (friction fit). Note: Wrapping a piece of silicone tubing around the cap makes it easier to grip.
3. Remove the free breathing valve (3).
4. Insert the free breathing valve into the inspiratory assembly and install the black cap to fix it in place. Use a narrow, blunt tool such as a hex wrench to verify that the valve move freely.
5. Install the inspiratory connection using section 7.9.5 as a guide.



7.9.7 Replace O2 sensor

The O2 sensor is located within the inspiratory connection assembly. To replace the O2 sensor:

1. Remove the control panel according to section 7.2.2.
2. Remove the panel mounting plate according to section 7.9.2.
3. Disconnect X 31 at the O2 sensor connection.
4. Remove the O2 sensor from the inspiratory connection assembly by turning it counterclockwise.

5. Replace the O2 sensor and verify that the red seal is properly positioned between the O2 sensor and the inspiratory connection. Do not use a tool, only make hand tight.
6. Allow the new O2 sensor to stabilize for approximately 5 minutes in room air prior to calibration.
7. After reassembly, perform an O2 calibration according to section 4.7.1.

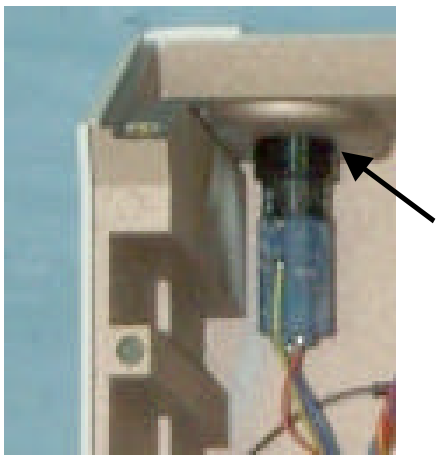
7.9.8 Repair ON-OFF switch

The ON-OFF switch is located on the right lower side of the front.

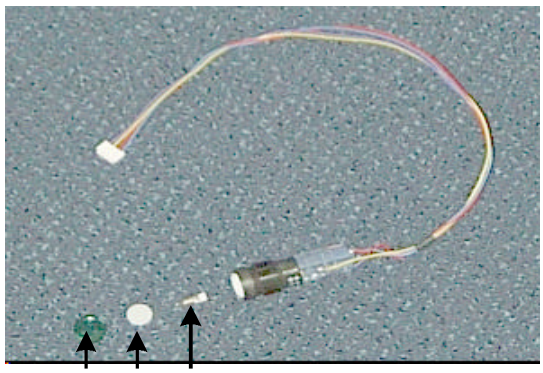
The ON-OFF switch is illuminated whenever the system is supplied by mains power and the line switch on the back of the unit is turned ON. To repair the bulb or the cover:

1. Turn OFF the system.
2. Remove the green cover (2) by inserting a small screwdriver into the cover slot and pulling forward.
3. Remove the white diffuser (3) with a small screwdriver.
4. Remove the bulb (4) with a 2 mm silicon tube or small pliers.
5. Replace bulb and reinsert white diffuser (3) and green cover (2).

To replace the entire ON-OFF switch:



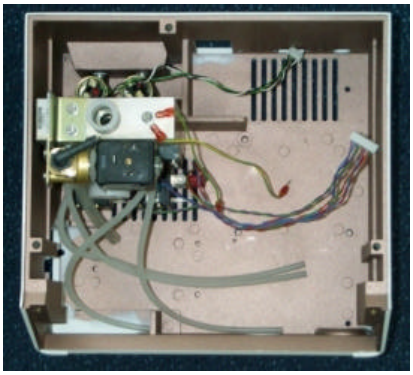
1. Remove the control panel according to section 7.2.2.
2. Open the main engine according to section 7.2.4.
3. Remove the panel mounting plate according to section 7.9.2.
4. Disconnect X 24 at PC board B.
5. Unscrew the plastic nut on the inside of the housing. Note that the slotted end of the nut is toward the front.
6. Slide the nut over the switch body, cable and connector.
7. Pull the ON-OFF switch out from the front and replace.



7.9.9 Replace pneumatic assembly

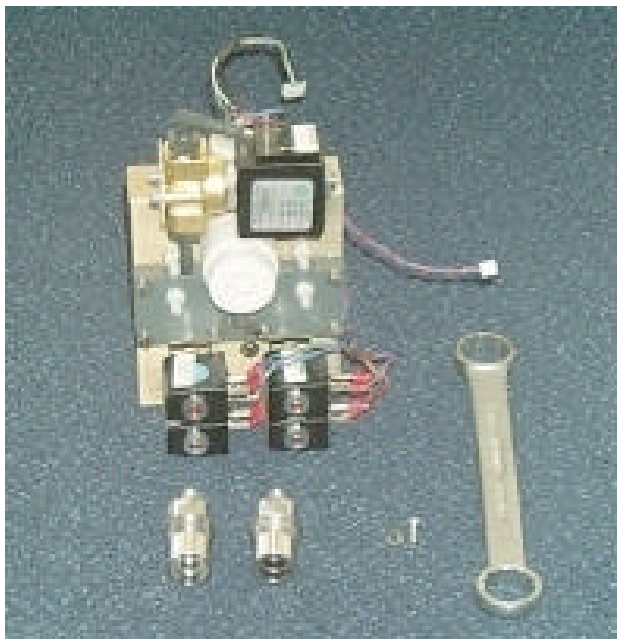
The pneumatic assembly contains the four inspiratory valves, the flow control for O2 and AIR, the gas supply pressure switches, the passive over pressure relieve valve and the active over pressure relieve valve.

To remove the pneumatic assembly :



1. Remove the control panel according to section 7.2.2.
2. Open the main engine according to section 7.2.4.
3. Remove the panel mounting plate according to section 7.9.2.
4. Remove the back-up battery according to section 7.9.1.
5. Remove expiratory valve locking assembly according to section 7.9.4
6. Disconnect the patient tube from the top of the assembly.
7. Disconnect X 41 (prop. valve control).
8. Disconnect X 43 (safety valve control).
9. Disconnect X 12 (pressure switches).
10. Use a screwdriver to remove the ground connection from the top of the assembly.
11. Disconnect tube set C at PC board B and the tee connection to tube CCC.
12. Disconnect tube set D at PC board B and the tee connection to tube DDD.
13. Disconnect the tube from the bottom (outlet) of the overpressure relief valve.
14. Use a wrench to remove the O2 and AIR gas inlet connectors and then remove the pneumatic assembly.

15. If replacing the assembly, tube sets C and D and the gas inlet connectors must be transferred to the replacement assembly. Use Teflon tape to seal the threads of the gas inlet connectors.

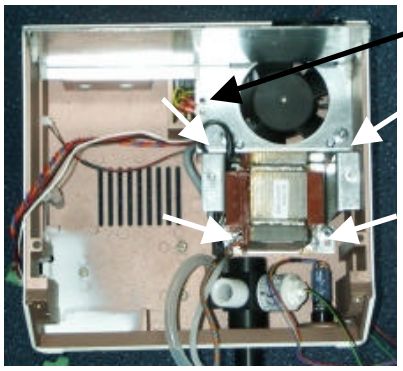


7.9.10 Remove sub chassis

The sub chassis contains the PC board B, the alarm system, the transformer assembly and the fan. To replace any of these assemblies, the sub chassis must be removed. The sub chassis must also be removed to gain access to the back side connectors (AC mains connector, DC mains connector, ground connector, serial connector).

To remove the sub chassis:

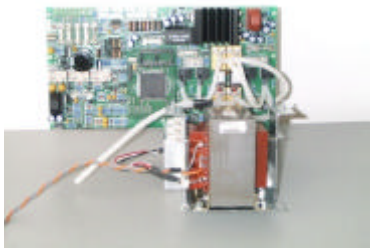
1. Remove the control panel according to section 7.2.2.
2. Open the main engine according to section 7.2.4.
3. Remove the panel mounting plate according to section 7.9.2
4. Remove the back-up battery according to section 7.9.1.
5. Remove the expiratory valve locking assembly according to section 7.9.4.
6. Disconnect all electrical connectors from the PC board B (X21, X22, X23, X24, X14, X12, X31, X15, X16, X41, X 42, X43.
7. Disconnect the line power connector from the transformer.
8. Disconnect pneumatic tubes A and B from PC board B.
9. Disconnect tube set C at PC board B and the tee connection to CCC.
10. Disconnect tube set D at PC board B and the tee connection to DDD.
11. Use a 7 mm nut driver to remove the central ground and disconnect all ground lines from the sub chassis.



12. Use a 7 mm nut driver to remove the two nuts left and right of the transformer and the two nuts left and right behind the transformer.
13. Lift the back of the sub chassis and move it up and forward.
14. When reinserting the sub chassis place the ferrite block of the line cable into the left corner behind the AC mains connector.

7.9.11 Replace transformer

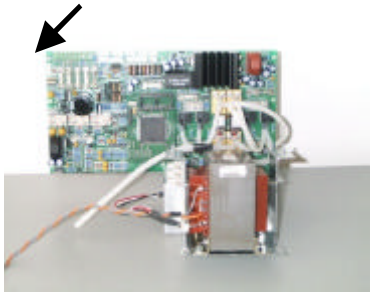
The transformer is located on the sub chassis. To replace the transformer the sub chassis must be removed.



1. Remove the sub chassis according to section 7.9.10.
2. Disconnect the primary wires at the line connector.
3. Use a 7 mm nut driver to remove the three transformer nuts (two in front one in the back).
4. Replace the transformer.
5. When mounting the transformer pay attention to have the cables on the proper side (left side seen from the front).
6. Connect the primary wires with the black lead in the center position.

7.9.12 Replace PC board B

PC board B is located on the sub chassis. To replace the PC board B the sub chassis must be removed.

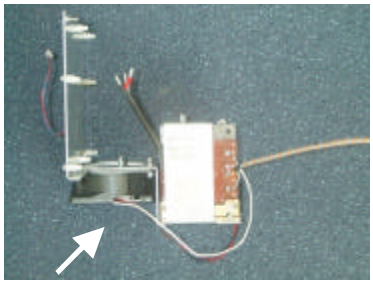


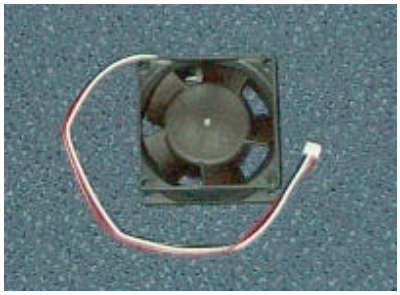
1. Remove the sub chassis according to section 7.9.10.
2. Disconnect X16.
3. Loose the seven (7) plastic PC board mounting fixtures from the back side of the sub chassis.
4. Use a 5 mm nut driver to remove the PC board ground connection at the top left corner.
5. Remove PC board B from the sub chassis and then disconnect X15.
6. Transfer the plastic mounting fixtures and required tubing to the replacement PC board B.
7. When mounting the PC board B be sure to have the grounding at the proper spot (top left as viewed from the front).

7.9.13 Replace fan

The fan is located on the sub chassis. To replace the fan the sub chassis must be removed.

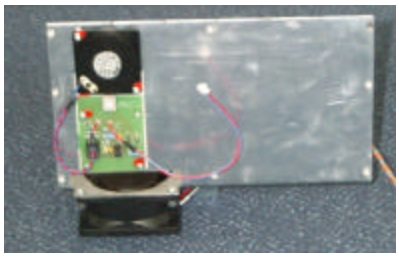
1. Remove the sub chassis according to section 7.9.10.
2. Remove the four (4) 7mm nuts and screws.
3. Replace the fan.
4. When mounting the fan be sure to have the cable on the proper side (towards the inside) and the airflow indicator arrow on the fan pointing down.





7.9.14 Replace alarm system

The alarm system is located on the sub chassis. To replace the alarm system the sub chassis must be removed.

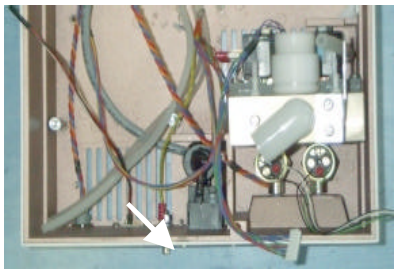


1. Remove the sub chassis according to section 7.9.10.
2. Disconnect the X16 connector at PC board B.
3. Use a screwdriver to remove the four (4) screws.
4. Replace the alarm system.
5. When mounting the alarm system be sure to place the speaker above the circuit board and to verify that all four (4) of the plastic spacers are in place between the alarm system and the sub chassis.

7.9.15 Replace line connector

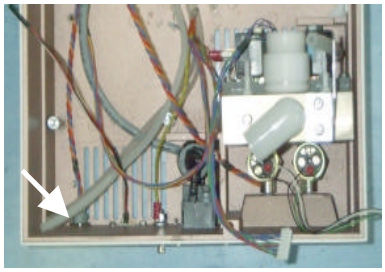
The line connector is located on the back side of the main engine. To replace the line connector the sub chassis must be removed.

1. Remove the sub chassis according to section 7.9.10.
2. Bend the top and bottom plastic locks together.
3. Remove the line connector to the outside.
4. Replace the line connector.
5. When replacing the line connector be sure to have the switch at the top and remember to insert the proper line fuses according to the selected line voltage.

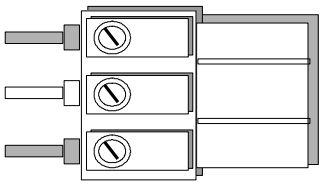


7.9.16 Replace DC mains connector

The DC mains connector is located on the back side of the main engine. To replace the DC mains connector the sub chassis must be removed.



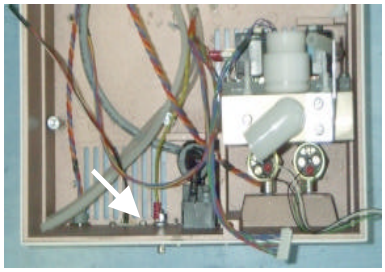
1. Remove the sub chassis according to section 7.9.10.
2. Disconnect the wires from connector X22.
3. Use a 17 mm wrench to remove the nut from the connector on the inside of the housing.
4. Remove the DC mains connector to the outside.
5. Replace the DC mains connector.
6. When replacing the DC mains connector be sure to reconnect the wires to connector X 22 in the proper order.



7.9.17 Replace ground connector

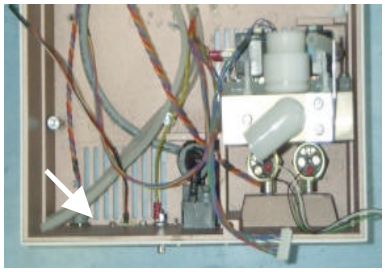
The ground connector is located on the back side of the main engine. To replace the ground connector the sub chassis must be removed.

1. Remove the sub chassis according to section 7.9.10.
2. Use a 10 mm wrench to remove the nut from the connector.
3. Remove the ground connector to the outside.
4. Replace the ground connector.
5. When replacing the ground connector, be sure to properly mount the outside label prior to reinsertion.



7.9.18 Replace serial data connector

The serial data connector is located on the back side of the main engine. To replace the serial data connector the sub chassis must be removed.



1. Remove the sub chassis according to section 7.9.10.
2. Use a 5 mm nut driver to remove the nuts from the serial data connector.
3. Remove the serial data connector to the outside.
4. Replace the serial data connector.

8 Illustrated Parts

In this section

8.1 Special instructions

Apply a thin coat of oxygen-use-approved lubricant to o-rings prior to installation (unless otherwise noted). Use a lubricant such as:

- Gleitmo 591, 60 gr.
  Order number: XY 909196

Some screws and fittings require an anti-loosing bond. Use a thread locker such as:

- Loctite 27041 screw lock
  Order number: XY 909199

When replacing fittings, position the barb end in the same direction as the original fitting to make the routing and connection of tubing easier.

8.2 Service tools

8.2.1 Calibration accessories kit, ST 2

The calibration accessories kit (order number: AZ-880007) consists of

- Syringe 2 ml
- Tubing set with T- piece
- 2 x 22 mm corrugated tube, 15".

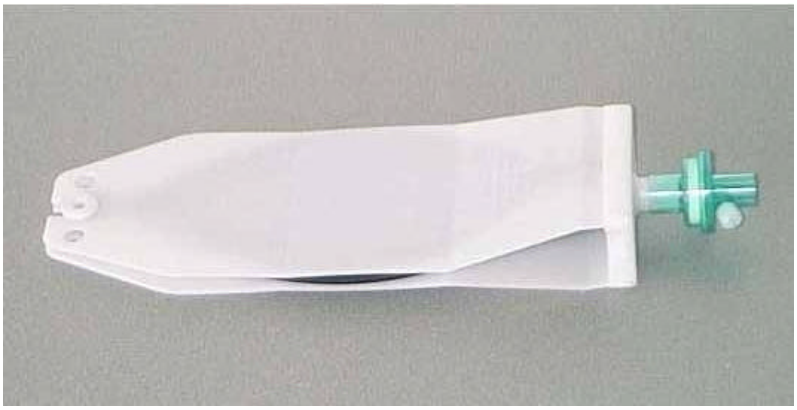
8.2.2 Test lung kit ST 3

The test lung kit (order number AZ-880004) consist of

- Test lung, range 50 – 500 ml, Compliance 60 ml/mbar
- Filter and resistor, resistance 20 mbar/l/s.

This test lung kit is designed for field service. Other test lungs with different compliance and resistance characteristics may be used. Be aware of the fact, that test lung related data in this service manual may not match with this test lung.

Always ensure a minimum resistance of 5 mbar/l/s.

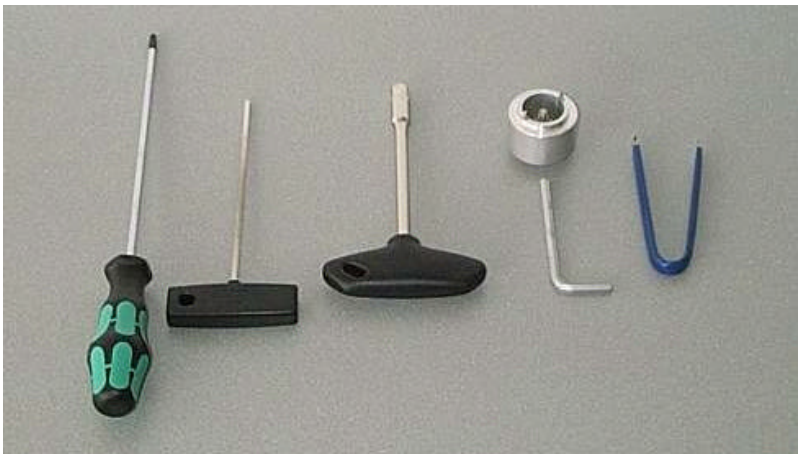


8.2.3 Tool kit ST 4

The tool kit (order number: AZ-880005) consist of

- EPROM grip
- Pozidrive, screw driver, size 2, l = 180 mm
- Inbus driver, size M3, l = 150 mm
- Inbus driver, size M5, standard
- Nut driver, size M 7, l = 120 mm
- Inspiration connection nut
- Seal 22 mm

This tool kit is designed for field service. Other tools can be used as long as their sizes and lengths match the above.



8.2.4 Test equipment specifications

Instrumentation used to service the Centiva /5 ICU Ventilator must meet or exceed the following specifications:

- Pressure meter, range 0 – 90 mbar, accuracy ± 0.1 mbar
- Flowmeter, 0 – 120 L/Min, AIR & O2, accuracy ± 0.05 L/Min or 2% of reading, (whatever is greater)
- Multimeter, standard multimeter accuracy (± 1%).

8.3 Centiva /5 ICU Ventilator parts

Control Panel

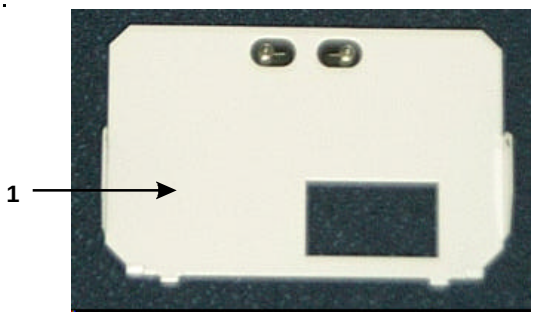
Pos.	Order Number	Description
1	BE-120099	Control Panel complete, without A-EPROM
2	ES-760290	Encoder for Com wheel
3	CM-528091	Front film “Centiva/5”
4	CW-769160	Com wheel button
5	DB-452322	Screw, M3 x 8 (not shown, 4 required)
6	EF-761079	Fuse 0.8 A slow blow, 5 x 20 mm (not shown)
7	EF-761080	Fuse 0.5 A slow blow, 5 x 20 mm (not shown)
8	EF-761078	Fuse 0.315 A slow blow, 5 x 20 mm (not shown)

A EPROM

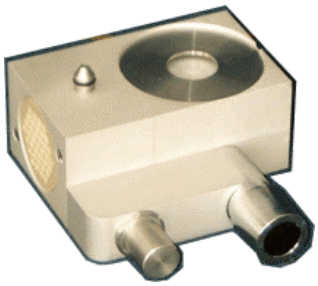
Pos.	Order Number	Description
	MA-620217	A-EPROM, German
	MA-620218	A-EPROM, English
	MA-620220	A-EPROM, Spanish
	MA-620221	A-EPROM, Portuguese
	MA-620227	A-EPROM, Polish
	MA-620228	A-EPROM, French
	MA-620229	A-EPROM, Italian

Control Panel bracket

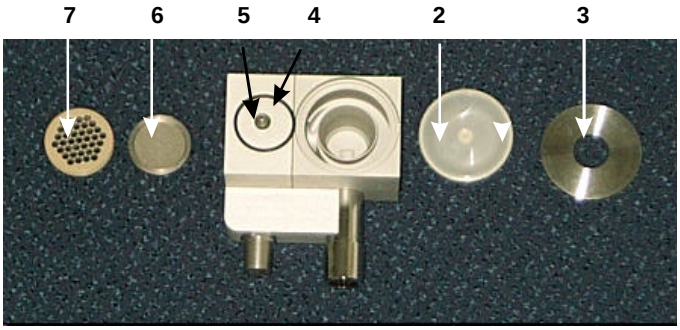
Pos.	Order Number	Description
1	CM-510162	Control panel mounting bracket
2	DB-449133	Screw M5 x 10 (not shown, 2 required)



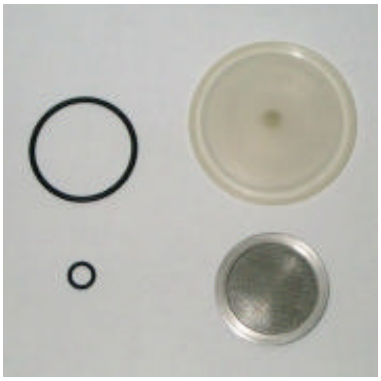
Expiratory valve assembly



Pos.	Order Number	Description
1	BM-352385	Expiration valve assembly, complete
2	BM-352386	PEEP membrane assembly
3	CM-510130	Stainless steel plate for PEEP membrane
4	DO-628232	O-ring 30 x 2
5	DO-628204	O-ring for flow measurement port
6	CM-523034	Flow screen
7	CM-510133	Retainer for flow screen



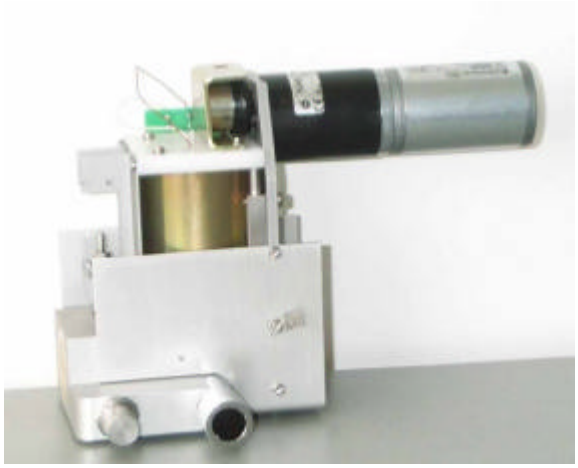
PEEP valve PM kit



Pos.	Order Number	Description
1	MA-640000	PEEP valve PM kit, consisting of - PEEP membrane assembly - O-ring 30 x 2 - O-ring 5 x 1.5 - Flow screen

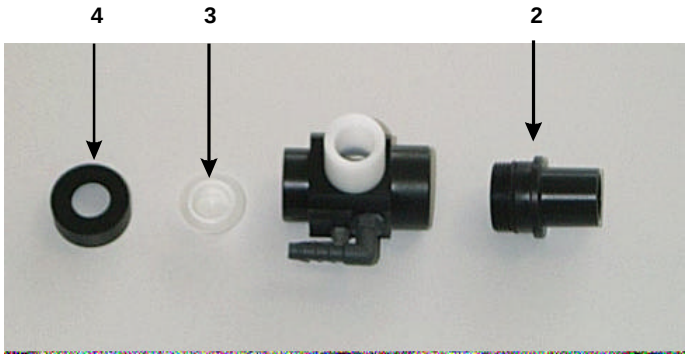
Expiratory valve control assembly

Pos.	Order Number	Description
1	BM-352383	Expiration valve control assembly (without expiration valve assembly)
2	DB-452322	Screw M3 x 8 (not shown, 2 required)
3	DH-473704	Washer, 3,2 (not shown, 2 required)
4	DA-444201	Screw M3 x 6 (not shown, 1 required)
5	CE-126092	Cable to B board



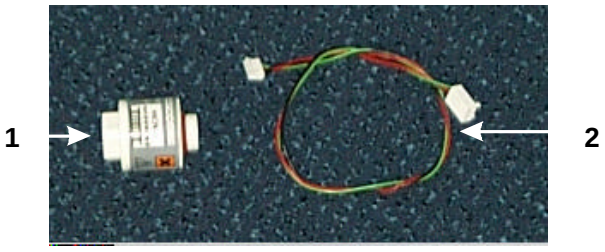
Patient connection assembly

Pos.	Order Number	Description
1	MA-640001	Patient connection assembly, without O2 sensor, without patient tube
2	CM-510137	Front cone
3	DO-626000	Free breathing valve
4	DO-626001	Retainer to free breathing valve



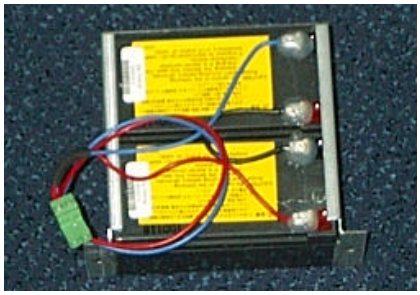
O2 sensor

Pos.	Order Number	Description
1	EB-758190	O2 sensor
2	CE-126096	Cable to O2 sensor



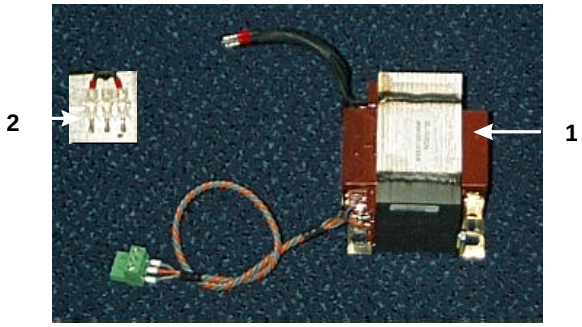
Back-up battery assembly

Pos.	Order Number	Description
1	BE-120093	Battery pack, 24 V, complete
2	CM-510139	Bold to battery pack (not shown, 2 required)



Transformer

Pos.	Order Number	Description
1	BE-120088	Transformer
2	EX-744350	Transformer line switch terminal
3	DE-490460	Nut, M4 with washer (not shown, 3 required)



PC board B assembly

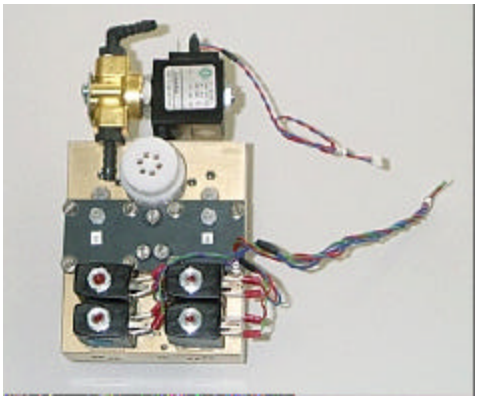
Pos.	Order Number	Description
1	BE-120081	PC Board B, without B EPROM
2	EF-761080	Fuse 0.5 A slow blow, 5 x 20 mm (not shown)
3	EF-761079	Fuse 0.8 A slow blow, 5 x 20 mm (not shown)
4	EF-761083	Fuse 1.0 A slow blow, 5 x 20 mm (not shown)
5	EF-761090	Fuse 3.15 A slow blow, 5 x 20 mm (not shown)

PC board B - EPROM

Pos.	Order Number	Description
1	MA-620239	B - EPROM

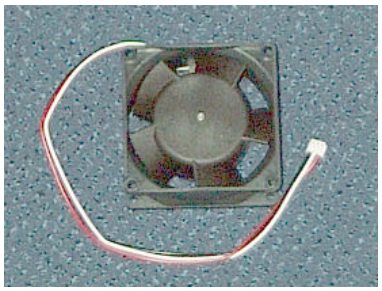
Pneumatic assembly

Pos.	Order Number	Description
1	BM-352382	Pneumatic assembly, complete



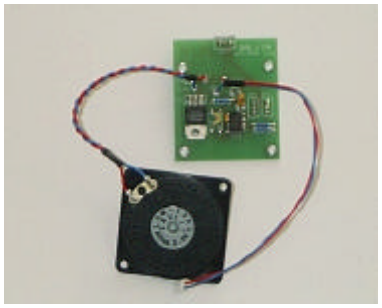
Fan assembly

Pos.	Order Number	Description
1	EM-777213	Fan, complete
2	DA-444224	Screw, M4 x 12 (not shown, 4 required)
3	DG-468506	Washer 4,2 (not shown, 4 required)
4	DG-463013	Nut, M4 self secure (not shown, 4 required)



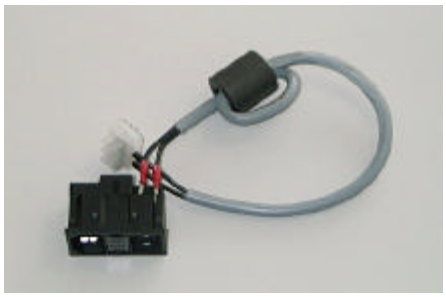
Alarm system

Pos.	Order Number	Description
1	BE-120090	Alarm system, complete
2	DA-444201	Screw, M3 x 6, (not shown 4 required)
3	DI-502810	Spacer, 3,2 (not shown 4 required)



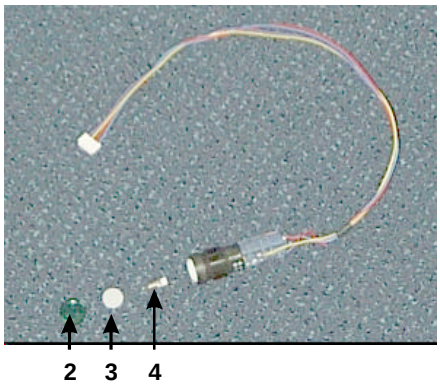
Line connector assembly

Pos.	Order Number	Description
1	BE-133434	Line connector assembly, complete
2	EF-761079	Fuse 0.8 A slow blow, 5 x 20 mm, (for 230 V line voltage) (not shown,. 2 required)
3	EF-761086	Fuse 1.6 A slow blow, 5 x 20 mm, (for 115 V line voltage) (not shown,. 2 required)



ON / OFF switch assembly

Pos.	Order Number	Description
1	BE-120086	ON / OFF switch assembly, complete
2	ES-754476	Green cap
3	ES-754477	White inlay
4	EU-748291	Bulb 24 V

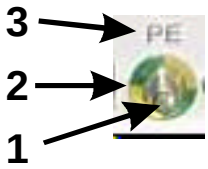


DC main connector assembly

Pos.	Order Number	Description
1	BE-120095	DC Main connector assembly, complete

Ground stud assembly

Pos.	Order Number	Description
1	EY-750840	Ground stud
2	EY-750842	Color code plate
3	CM-919026	Label
4	DG-463008	Nut M6 (not shown, 1 required)
5	BE-473008	Cable to common ground (not shown, 1 required)
6	DH-473763	Washer, contact M6/8 2-A4 (not shown, 1 required)
7	DH-473707	Washer, spring A 6.5 (not shown, 1 required)



Serial data connector assembly

Pos.	Order Number	Description
1	BE-120094	Serial data connection assembly, complete
2	DA-444201	Screw M3 x 6, (not shown, 2 required)

Sub chassis

Pos.	Order Number	Description
1	DE-490460	Nut M4 with washer (not shown, 4 required)

Tubing kit

Pos.	Order Number	Description
1	MA-640002	Tubing kit, consisting of - tube set A - tube set B - tube set C - tube set D

Patient tube

Pos.	Order Number	Description
1	BM-352209	Patient tube with connectors

Lower housing

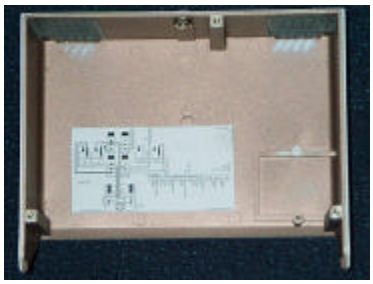
Pos.	Order Number	Description
1	CM-510157	Lower housing without assemblies
2	CM-510124	Housing feet (not shown, 4 required)
3	DG-460336	Screw, M4 x 70 mm (not shown, 1 required)
4	DG-460337	Screw, M4 x 110 mm (not shown , 2 required)

Labels

Pos.	Order Number	Description
1	CM-919029	Serial number plate, without s/n
2	MA-640003	Labeling kit, 115V
3	MA-640005	Labeling kit, 230 V

Upper housing

Pos.	Order Number	Description
1	BM-352408	Upper housing



Nuts and bolds kit

Pos.	Order Number	Description
1	MA-640006	Nuts and bolds, all of Centiva /5

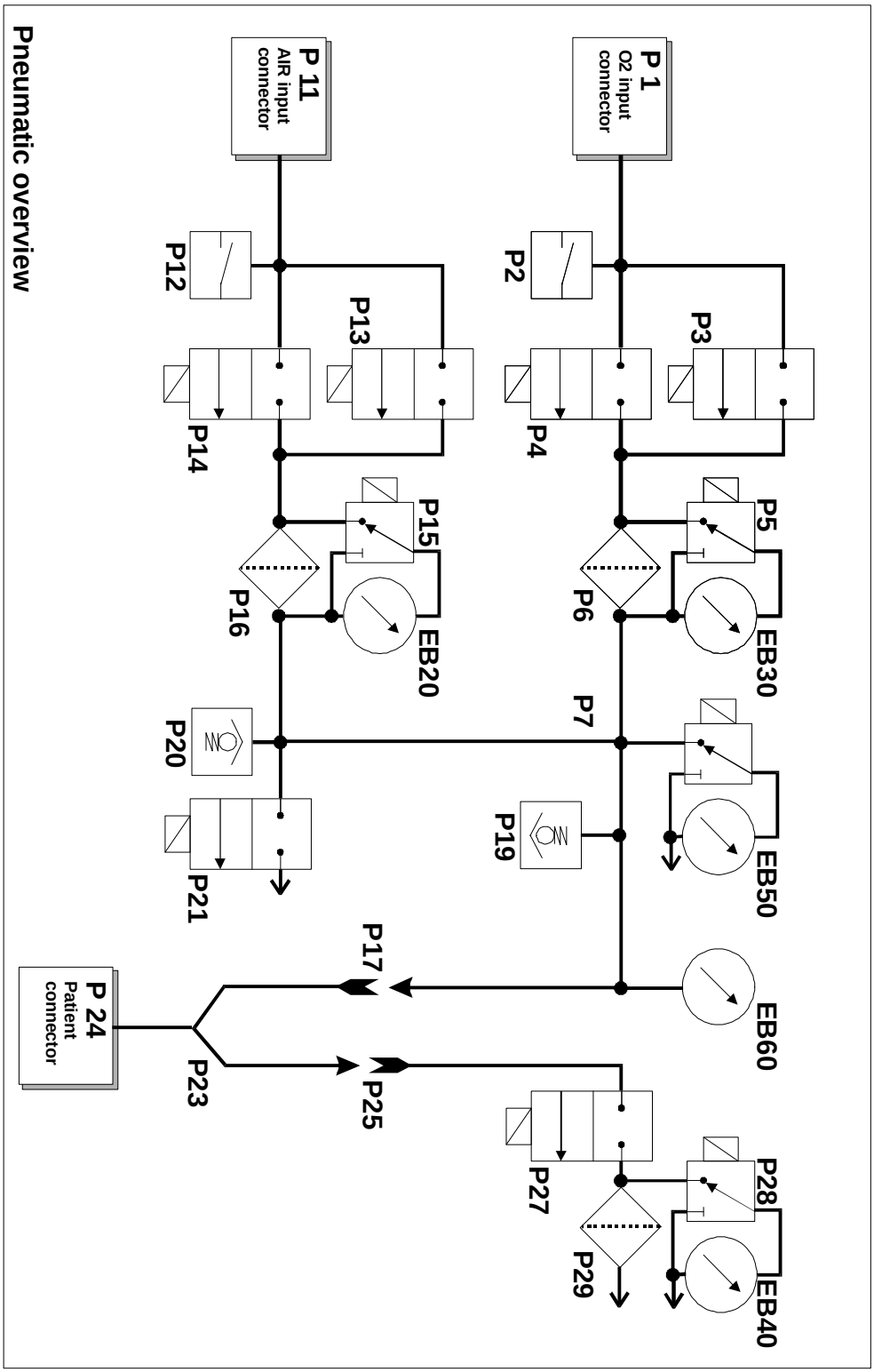
Service tools

Pos.	Order Number	Description
1	AZ-880004	Test lung kit, ST3
2	AZ-880005	Tool kit., ST4
3	AZ-880007	Calibration accessories kit, ST2

9 Schematics and Diagrams

In this section

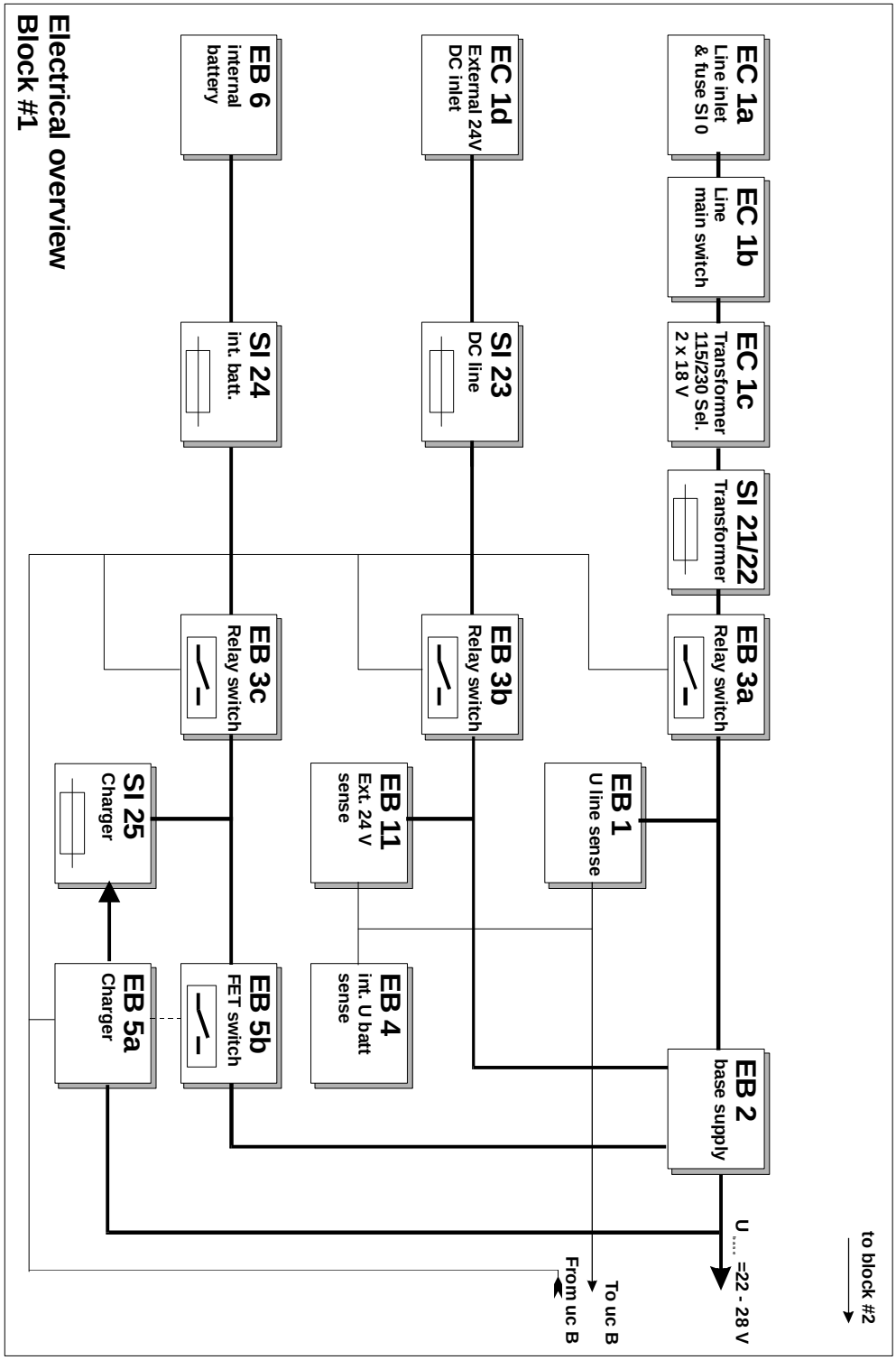
9.1 Pneumatic diagram



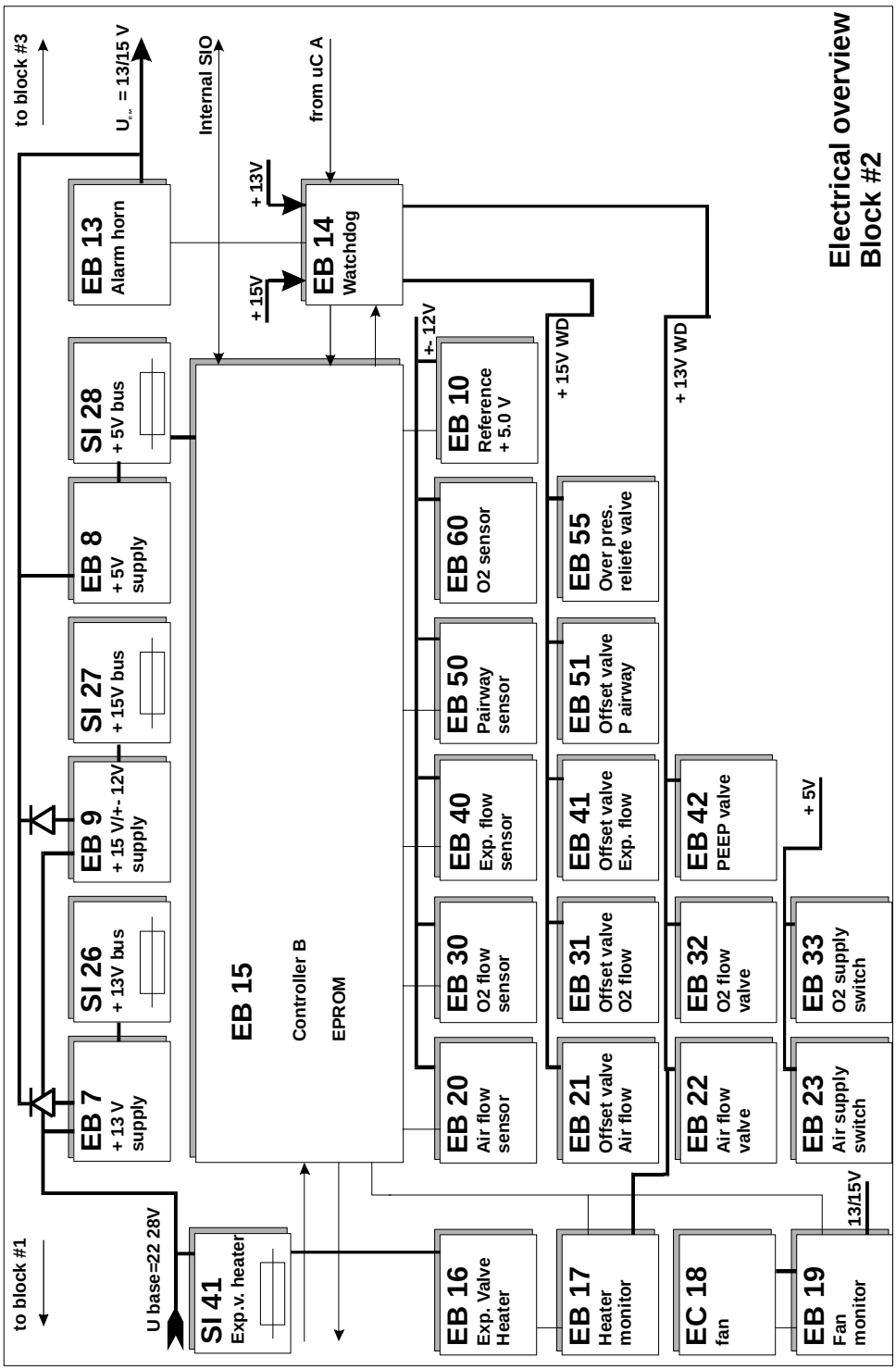
Identifier	Description
P 1	Oxygen input
P 2	Oxygen supply pressure switch
P 3	Proportional solenoid, Oxygen , flow # 1
P 4	Proportional solenoid, Oxygen , flow # 2
P 5	Offset solenoid Oxygen flow
P 6	Flow transducer Oxygen flow
P 7	Internal hoses
P 11	AIR input
P 12	AIR supply pressure switch
P 13	Proportional solenoid, AIR , flow # 1
P 14	Proportional solenoid, AIR , flow # 2
P 15	Offset solenoid AIR flow
P 16	Flow transducer AIR flow
P 17	Inspiratory connector (patient connection)
P 19	Spontaneous breathing valve (free breathing valve)
P 20	Overpressure relief vale (passive)
P 21	Pressure limiting solenoid (active)
P 22	Offset solenoid airway pressure
P 23	Breathing circuit
P 24	y-piece
P 25	Expiratory connector
P 27	Expiratory (PEEP) valve
P 28	Offset solenoid expiratory flow
P 29	Flow transducer expiratory flow
P 8, P 9, P 10, P 18, P 26	Not applicable
EB 20	AIR flow sensor
EB 30	Oxygen flow sensor
EB 40	Expiratory flow sensor
EB 50	Airway pressure sensor
EB 60	Oxygen concentration sensor

9.2 Electrical diagram

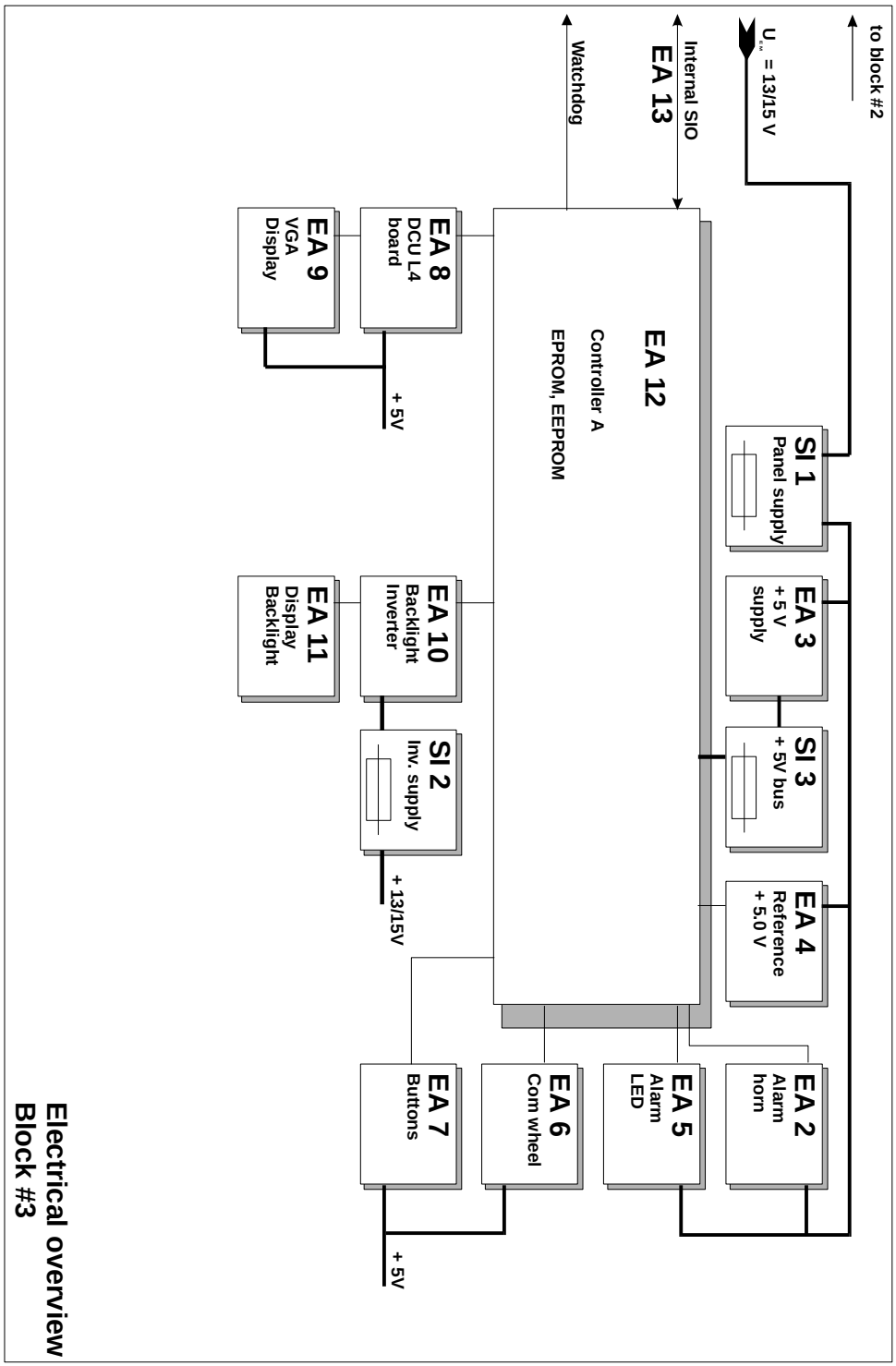
Power supply system



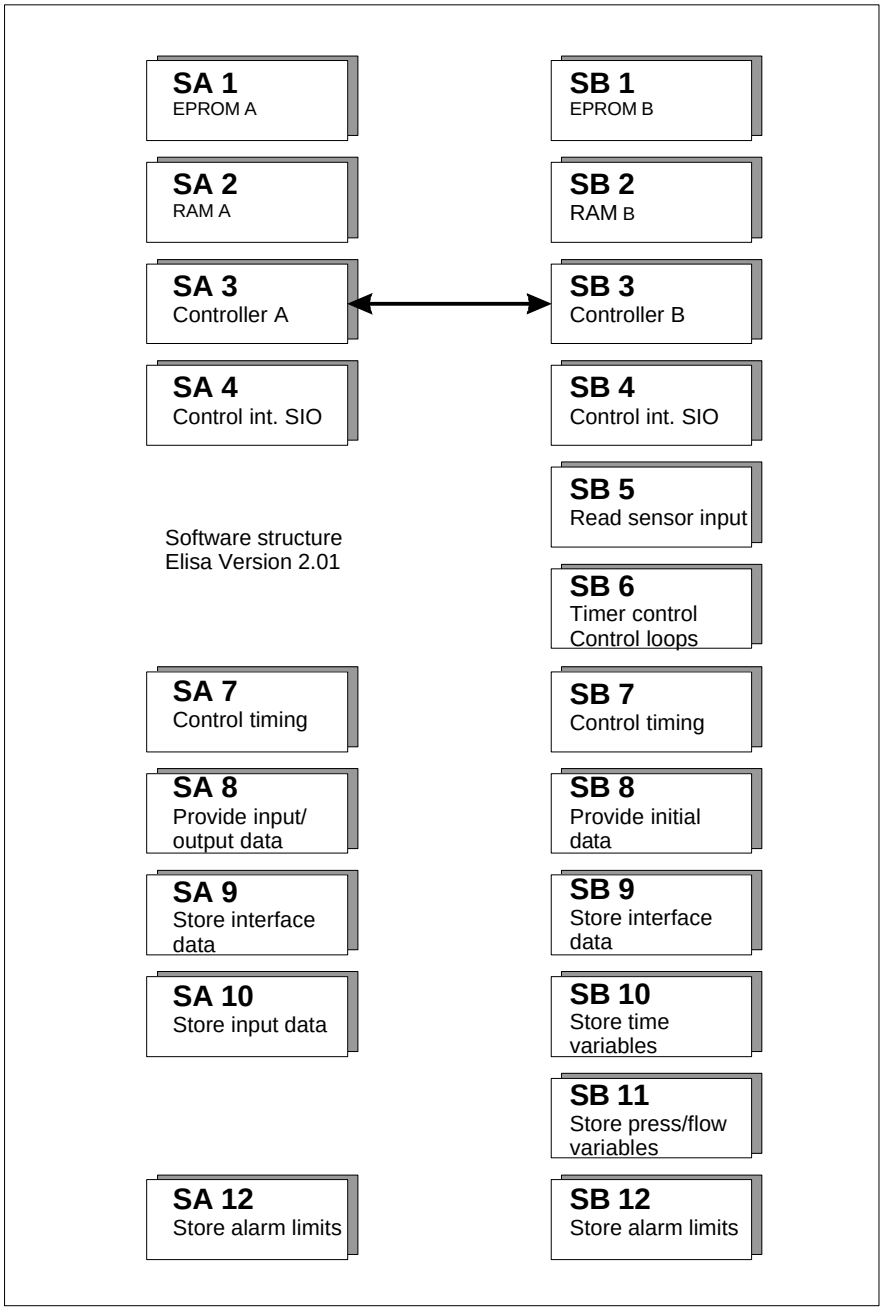
Main PC board B system



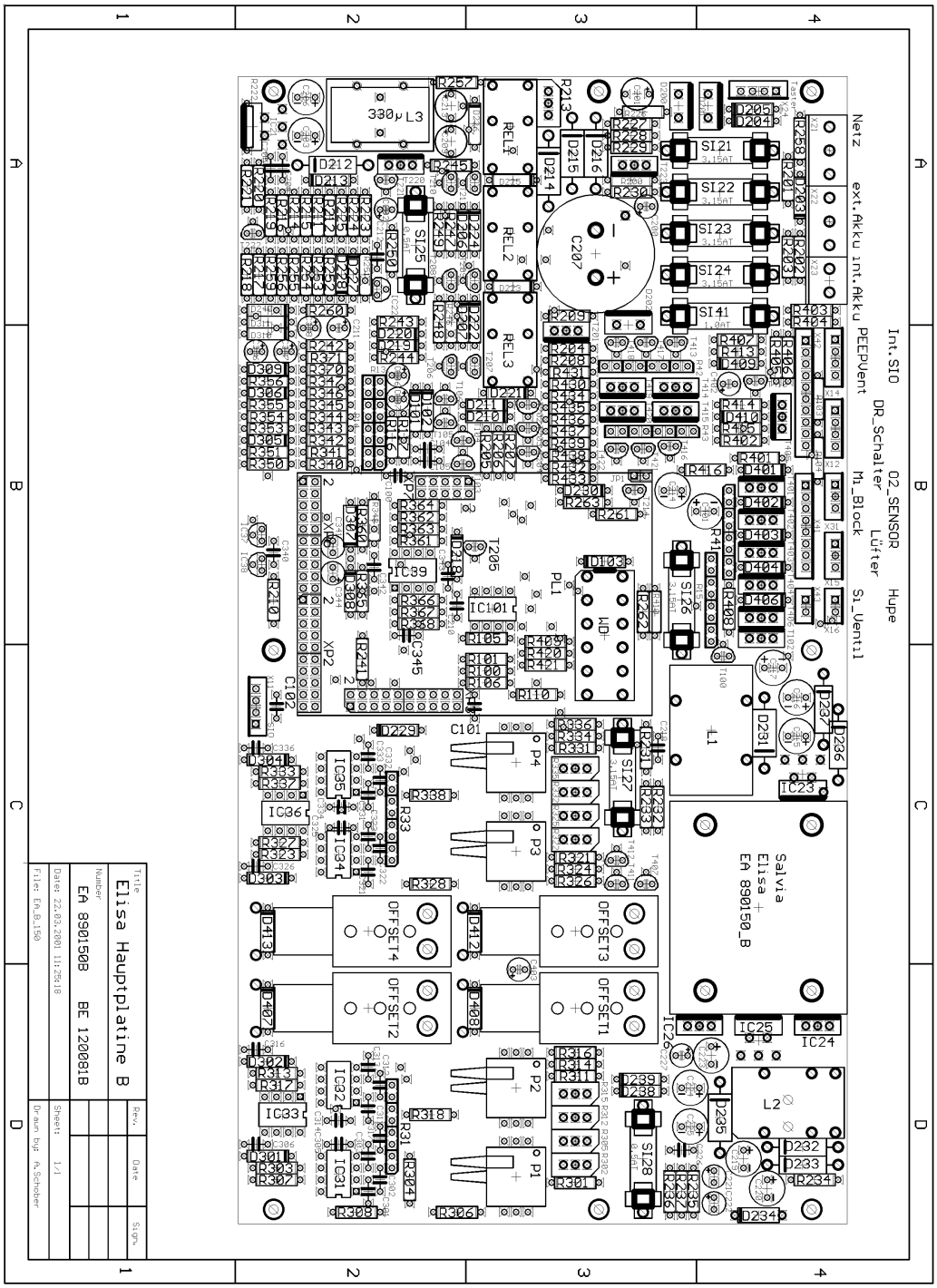
Panel PC board A system



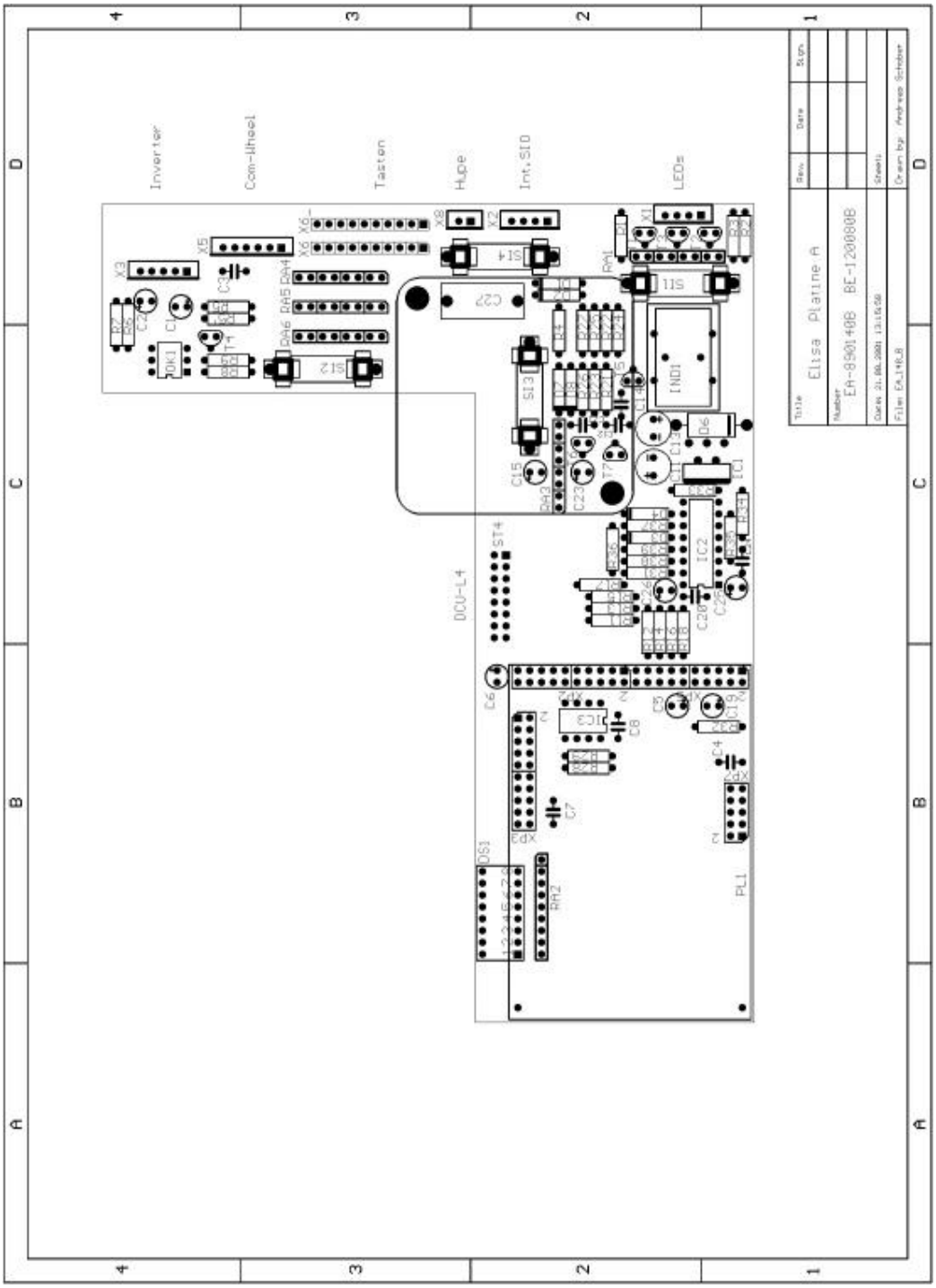
9.3 Software structure



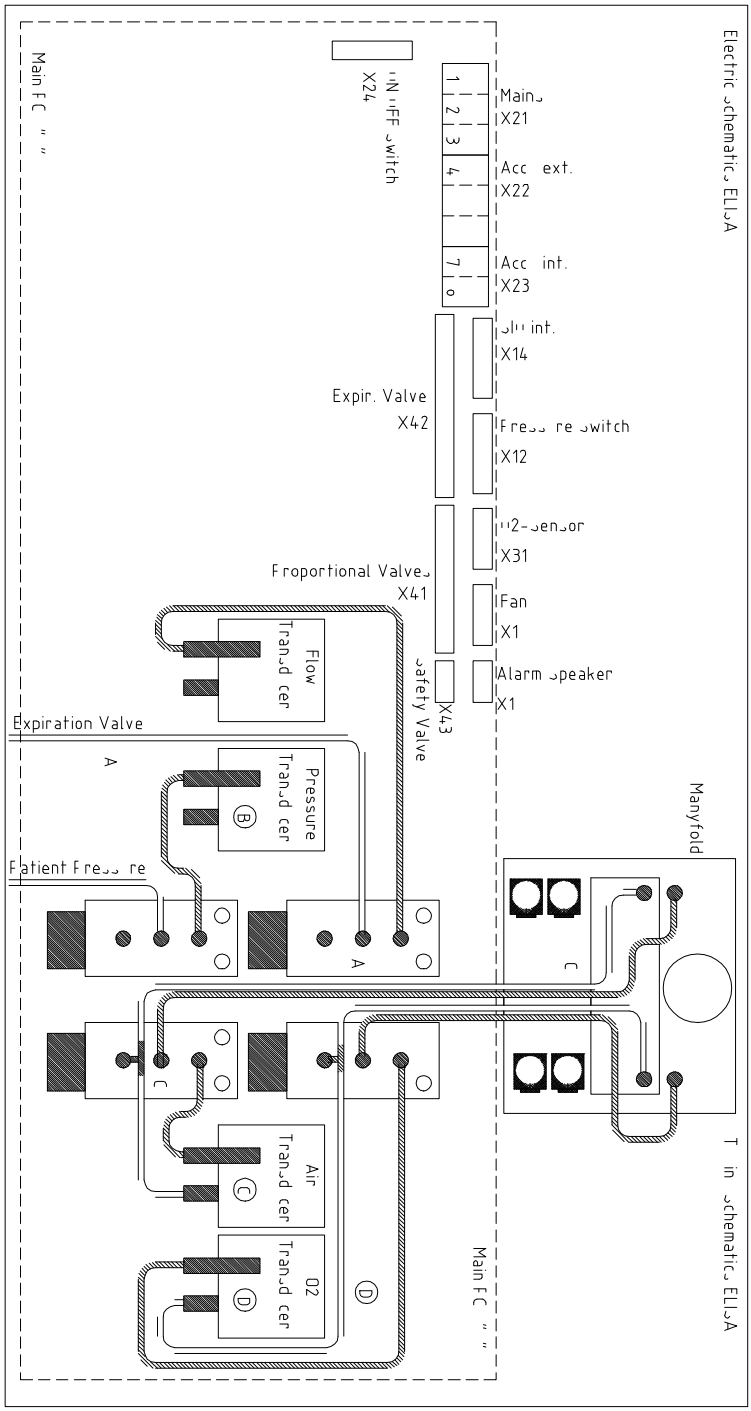
9.4 Component layout main PC board B



9.5 Component layout panel PC board A



9.6 Tubes and connectors



9.7 List of fuses

230 V line voltage

Identifier	Where located	To secure	Type	Value
SI 0 a	Line inlet connector	Line supply	5 x 20 mm	0.8 A slow blow
SI 0 b	Line inlet connector	Line supply	5 x 20 mm	0.8 A slow blow

115 V line voltage

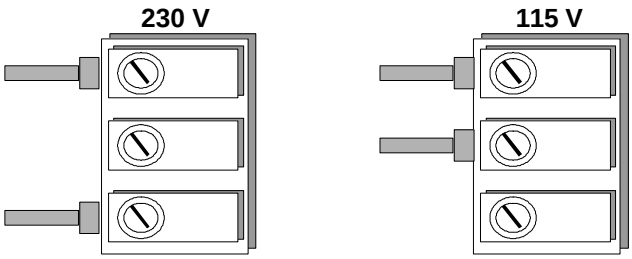
Identifier	Where located	To secure	Type	Value
SI 0 a	Line inlet connector	Line supply	5 x 20 mm	1.6 A slow blow
SI 0 b	Line inlet connector	Line supply	5 x 20 mm	1.6 A slow blow

Internal fuses

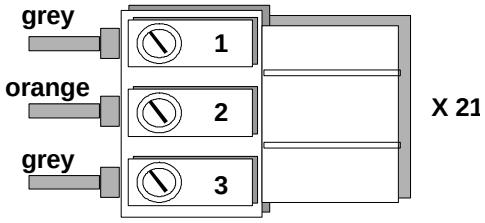
Identifier	Where located	To secure	Type	Value
SI 1	Panel PC board A	Panel supply	5 x 20 mm	0.8 A slow blow
SI 2	Panel PC board A	LCD backlight	5 x 20 mm	0.8 A slow blow
SI 3	Panel PC board A	+ 5 V bus	5 x 20 mm	0.5 A slow blow
SI 4	Panel PC board A	Buzzer supply	5 x 20 mm	0.315 A slow blow
SI 21	Main PC board B	Transformer sec. 1	5 x 20 mm	3.15 A slow blow
SI 22	Main PC board B	Transformer sec. 2	5 x 20 mm	3.15 A slow blow
SI 23	Main PC board B	Line DC inlet	5 x 20 mm	3.15 A slow blow
SI 24	Main PC board B	Back-up battery	5 x 20 mm	3.15 A slow blow
SI 25	Main PC board B	Battery charger	5 x 20 mm	0.5 A slow blow
SI 26	Main PC board B	+ 13 V bus	5 x 20 mm	3.15 A slow blow
SI 27	Main PC board B	+ 15 V bus	5 x 20 mm	3.15 A slow blow
SI 28	Main PC board B	+ 5 V bus	5 x 20 mm	0.5 A slow blow
SI 41	Main PC board B	Exp. Valve heater	5 x 20 mm	1.0 A slow blow

9.8 Screw Connectors

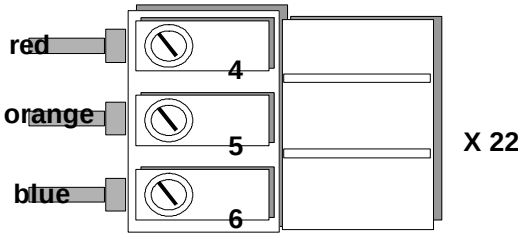
Line connector



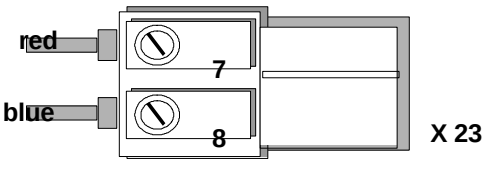
Transformer connector



External DC connector



Internal battery connector



9.9 List of voltages

On Main PC board B

$U_{line\ AC}$	95 – 135 V_{AC}, 60 Hz
$U_{line\ DC}$	22 – 28 V_{DC}
U_{Batt}	22 – 28 V_{DC}
U_{base}	22 – 28 V
13 V bus	+ 13.0 V
15 V bus	+ 15.0 V
U_{EM}	+ 13/15 V
5 V bus	+ 5.0 V
13 V WD	+ 13.0 V, controlled by watchdog
15 V WD	+ 15.0 V, controlled by watchdog
± 12 V bus	± 12.0 V
U_{REF}	+ 5.0 V reference voltage

On panel PC board A

U_{EM}	+ 13/15 V
5 V bus	+ 5.0 V
U_{REF}	+ 5.0 V reference voltage

At line supply

Line voltage	115 V_{AC} or 230 V_{AC}

DC supply voltage	At 24 DC Supply
	22 – 28 V_{DC}

Notes