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1 Introduction

This chapter gives an overview of the Vivo 50/60 ventilator and this service manual.



WARNING!

This product must be:

- **Subjected to regular service, maintenance and control and any applicable upgrades, in accordance with Breas service instructions.**
- **Repaired and/or modified in accordance with Breas service manuals, technical bulletins, and any special service instructions, by service technicians that have been authorised after the Breas Vivo 50/60 service training.**

Deviation from these service instructions may lead to risk of personal injury!

1.1 About the Vivo 50/60 Ventilator

1.1.1 Function

The Vivo 50/60 is a pressure and volume ventilator capable of delivering continuous or intermittent ventilatory support for patients who require invasive or non-invasive mechanical ventilation.

The Vivo 50/60 can be operated in 13 different modes:

- PSV – Pressure Support Ventilation
- PSV(TgV) – Pressure Support Ventilation with Target volume
- PCV – Pressure Controlled Ventilation
- PCV(TgV) – Pressure Controlled Ventilation with Target volume
- PCV(A) – Assisted Pressure Controlled Ventilation
- PCV(A+TgV) – Assisted Pressure Controlled Ventilation with Target volume
- PCV-SIMV – Pressure Controlled Ventilation with Synchronized Intermittent Mandatory Ventilation
- PCV-MPV – Pressure Controlled Ventilation with MouthPiece Ventilation
- VCV – Volume Controlled Ventilation
- VCV(A) – Assisted Volume Controlled Ventilation
- VCV-SIMV – Volume Controlled Ventilation with Synchronized Intermittent Mandatory Ventilation
- VCV-MPV – Volume Controlled Ventilation with MouthPiece Ventilation
- CPAP – Continuous Positive Airway Pressure

The Vivo 50 can be used with a leakage circuit, circuit with active exhalation valve or circuit with mouthpiece interface.

The Vivo 60 can be used with the following patient circuit configurations:

- Dual limb circuit (adult or paediatric), connected to an integrated active exhalation valve, for internal measurement of expired volume, pressure and flow.
- Single limb circuit with external leakage port or external active exhalation valve.
- Circuit with mouthpiece interface.

The internal memory data of the Vivo 50/60 can be downloaded to a PC, printed out, and analysed via the Vivo 50/60 PC Software. For more information about the Vivo 50/60 PC Software, please contact your Breas representative.

1.1.2 Intended Use



For a detailed description on intended use, refer to the Vivo 50 or Vivo 60 operating manual.

1.1.3 Design

The Vivo 50/60 is designed around a blower assembly that delivers air to the patient.

The main processor monitors sensors for pressure, flow etcetera and controls the blower to meet treatment settings and make breathing comfortable for the patient.

A number of various internal sensor readings are monitored to ensure that the Vivo 50/60 functions correctly. Some of them are checked at power up, some at treatment start and some of them are monitored continuously.

1.1.4 Service Personnel's Training Requirements

Service personnel working with the Vivo 50/60 shall have medical/technical training and a good knowledge of the construction and function of respiratory devices. Authorisation by Breas after Vivo 50/60 service training is mandatory.



Always contact your Breas representative if you have any questions or if training is required.

1.2 About this Manual

1.2.1 Scope

This manual describes all the routine maintenance checks and the additional service actions for the Vivo 50/60. The manual contains all the documentation that is required for the maintenance and the service of the ventilator, such as replacement parts lists, exploded drawings, cabling diagrams, component location guides and more.

Breas Medical AB reserves the right to make changes to the products and/or the contents of this manual without any prior notice.



The service manual is to be used in conjunction with the Vivo 50 and Vivo 60 operating manual.

1.2.2 Intended Audience

This service manual is intended for service technicians who have medical/technical training and who have a good knowledge of the construction and function of respiratory devices. Authorisation by Breas after Vivo 50/60 service training is mandatory.



Always contact your Breas representative if you have any questions or if training is required.



The service manual is not intended for clinical personnel or patients, who will find all the information they need in the Vivo 50 or Vivo 60 operating manual.

1.2.3 Icons

In this manual, icons are used to highlight specific information. The meaning of each icon is explained in the table below.

ICON	EXPLANATION
A black square icon containing a white triangle with an exclamation mark inside, used to denote a warning.	Warning! Risk of death and serious personal injury.
A black square icon containing a white hand with fingers spread, used to denote a caution.	Caution! Risk of minor or moderate injury. Risk of equipment damage, loss of data, extra work, or unexpected results.
A black square icon containing a white lowercase letter 'i', used to denote a note.	Note Information that may be valuable but is not of critical importance, tips.
A black square icon containing a white arrow pointing downwards and to the right, used to denote a reference.	Reference Reference to other manuals with additional information on a specific topic.

2 Maintenance Instructions

This chapter describes all the routine maintenance checks and additional service instructions for the Vivo 50/60.



WARNING!

This product must be:

- **Subjected to regular service, maintenance and control and any applicable upgrades, in accordance with Breas service instructions.**
- **Repaired and/or modified in accordance with Breas service manuals, technical bulletins, and any special service instructions, by service technicians that have been authorized after Breas Vivo 50/60 service training.**

Deviation from these service instructions may lead to risk of personal injury!



The patient and care provider should follow the checks that are described in the Vivo 50 or Vivo 60 operating manual.

2.1 Purpose

The Vivo 50/60 is designed to give users many years of trouble-free breathing assistance, provided that the preventive maintenance is carried out at the intervals specified in this manual. Well-performed maintenance services will ensure the performance during its lifetime.

It is also important that any peripheral equipment is checked at the same time as the services are carried out.

2.2 Service Schedule

The maintenance service includes all the checks listed in the schedule below.



A complete maintenance service (as described in this chapter) must be carried out at least every 12 months.

INTERVAL	SERVICE CHECK	CHAPTER
Every 12 months	Perform an external inspection	2.5
	Change the cooling air filter	5.2
	Perform a complete function test	2.8
	Perform the CO ₂ Gas Span Check (if a CO ₂ sensor is used with the Vivo 50/60)	2.9
Every 3 years	Change the internal battery	5.1
	Check the power failure alarm.	2.7
Every 5 years	Change the clock battery.	5.12
	Change the alarm batteries.	5.14
	Perform an internal inspection.	2.6
Every 20 000 hours of device operating time	Change the complete blower assembly.	5.4
	Perform an internal inspection.	2.6

2.3 Introduction

Before you start a maintenance service, read the safety precautions and make sure you have a new service record and all the necessary equipment, tools, and replacement parts at hand.

2.3.1 Safety Precautions



Follow the safety precautions below when working with the Vivo 50/60:

- Do not work on the ventilator with the casing removed and the power supply connected, unless the instructions in this manual, or other special service instructions sent out by Breas, clearly says so.
- Always use extreme caution when working with the ventilator connected to the mains or any other power source and the casing removed.
- Do not use explosive gases and/or fluids near the ventilator.
- Make sure that all precautions to prevent electrostatic discharge (ESD) have been taken. Follow all regulations regarding ESD.



The Vivo 50 and Vivo 60 operating manual contains extended lists of safety precautions.

2.3.2 Service Record

The Breas service record is found in chapter 9 “Appendices”.

Copy the service record and use it for noting the service checks while performing the yearly service.

2.3.3 Inspection Equipment and Tools

Before starting the service of the Vivo 50/60, make sure you have the following equipment at hand:

- Test lung (for example Breas part no 001917)
- Ventilator tester (Fluke VT Plus or IMT PF-300)
Or:
 - Flow meter
 - Pressure manometer
 - Measuring instrument for tidal volume and minute volume/rate
- Torque screwdrivers:
 - Torx TX 10
 - Torx TX 20
 - Phillips PH1
 - Socket 5.5 mm
- Vivo to PC communication cable, Breas part no 004886
- Vivo 50/60 Service Software (compatible with Fluke VT Plus and IMT PF-300), available for download from Breas Extranet. Contact Breas technical support for more information.
- Test connector kit, Breas part no 004829 (connectors and leakage ports used when testing)

2.3.4 Replacement Parts

The following replacement parts should be available when servicing the ventilator:

DESCRIPTION	PART No.
Patient air inlet filter, grey, washable	004909 (5 pcs)
Patient air inlet filter, white, disposable	004910 (10 pcs)
Cooling air filter	004911 (5 pcs)
If required:	
Internal battery kit	004554
Alarm batteries, NiMH 4.8 V, 500 mAh (2 pcs)	005058
Clock battery, CR 2032	
Blower assembly kit	004558

2.4 Preparing for Inspection

2.4.1 Initial Recording

- 1 Copy a new service record (see “Service Record Vivo 50/60” on page 83).
- 2 Identify the Vivo 50 or Vivo 60.
- 3 Note the model and serial number and any inventory number on the service record.
- 4 Check any comments recorded on the previous service records.
- 5 Document the current patient settings.

2.4.2 Checking additional services

- 1 Note the number of device operating hours on the service record.



The operating hours are found at the “Device information” screen. Access the “Device information” using the menu as described in the Vivo 50 or Vivo 60 operating manual.

- 2 Check the service schedule to see whether the alarm/clock batteries, the internal battery kit, or the complete blower assembly needs to be replaced.

2.4.3 Inspecting the Markings

Make sure that all markings on the ventilator’s information labels can be read:

- Model description, serial number
- Warning texts
- Any inventory marking
- Any other texts

2.4.4 Information from the Patient/User

Check the following with the patient:

- Has the ventilator functioned without any problems? If not, what were they?
- How does the patient/care provider check the function of the ventilator? How often?
- How often is the filter replaced?
- How many filters will be required until the next service?
- Other observations?

2.4.5 Validity of the Documentation

- 1 Check the validity of the operating manual enclosed with the ventilator.
- 2 Check if any modification or upgrading of the ventilator needs to be done at the same time as the service.

2.5 External Inspection

2.5.1 Visual Inspection for External Damage and Wear

- 1 Clean the outside of the ventilator using a mild soap solution.
- 2 Check for any visible damage to the casing and the other components.
- 3 Check that nothing has become loose.
- 4 Check the oxygen low pressure/bleed-in inlet.
- 5 Remove and inspect the patient circuit insert (Vivo 60 only).

2.5.2 Checking the Power Connection

- 1 Check the plugs on the power cord, the cord itself, and the ventilator's power socket.
- 2 Make sure that the restraining clip for the power cord is not damaged or missing.
- 3 Inspect the external battery cable, if used.
- 4 Check the external battery socket in the ventilator.
- 5 Check the click-on battery connector and make sure that the protection cover is not damaged or missing.

2.5.3 Inspecting the Patient Circuit

Inspect the patient circuit and replace it if necessary.

2.5.4 Inspecting the Ventilator Accessories

Check any other accessories that are used with the ventilator.

2.5.5 Changing/Washing the Patient Filters

- 1 Change the white air filter.
- 2 Change the grey filter, if necessary.
- 3 Make sure the patient has enough filters to last until the next service.

2.5.6 Minimum Function Check

- 1 Connect the power cord.
- 2 Connect the patient circuit.
- 3 Switch on the ventilator and make sure it operates normally.

2.6 Internal Inspection



Make sure to disconnect the power supply before opening the casing of the ventilator.



Always perform an internal inspection after having opened the Vivo 50/60.

2.6.1 Cleaning the Inside of the Ventilator

- 1 Open the casing. See “Opening the Vivo 50/60 and Replacing the Main Components” on page 33 for instructions.
- 2 Remove any dirt or dust that has collected in the ventilator.

2.6.2 Checking the Cables

Inspect all the cables and their connectors. Make sure that the cables and the wires are not pinched or kinked.

2.6.3 Checking the Fastening of Components

- 1 Make sure that all the components, such as the pneumatic block, the circuit boards and the connectors are securely fastened.
- 2 Check that the blower assembly is placed correctly and that the vibration dampening pads are properly in place.
- 3 Check that the cooling fan is placed correctly.
- 4 Make sure that all tubes are properly fastened and not pinched or kinked. Do not forget the air inlet and outlet of the blower assembly.

2.6.4 Checking the Power Supply

- 1 Make sure that the power connectors are undamaged and that they are securely in place.
- 2 Check the cables to the CPU and PTU boards.

2.6.5 Reassembling the Casing

See “Opening the Vivo 50/60 and Replacing the Main Components” on page 33 for instructions.

2.7 Power Failure Test

2.7.1 Checking the Power Failure Alarm



The “Low Alarm Battery” alarm shall not be active prior to the test.

- 1 Remove the internal battery as in section 5.1.
- 2 Connect the Vivo 50/60 to mains.
- 3 Turn the Vivo 50/60 on and start treatment.
- 4 Disconnect mains power supply.
- 5 Make sure that the Vivo 50/60 gives the power failure alarm.

The power fail alarm is given with an audible signal and the red alarm LED flashing. The alarm shall be given for, at least, two minutes. If the power fail alarm stops within two minutes, change the alarm batteries (See section 5.14).

- 6 Reconnect the internal battery as in section 5.1.

2.8 Complete Function Test



To perform the complete function test you need the Vivo 50/60 Service Software, which can be downloaded from the Breas extranet.

Contact Breas technical support for more information.

2.9 CO₂ Sensor Gas Span Check

If a CO₂ sensor is used with the Vivo 50/60 it shall be checked once a year to verify the sensor readings.

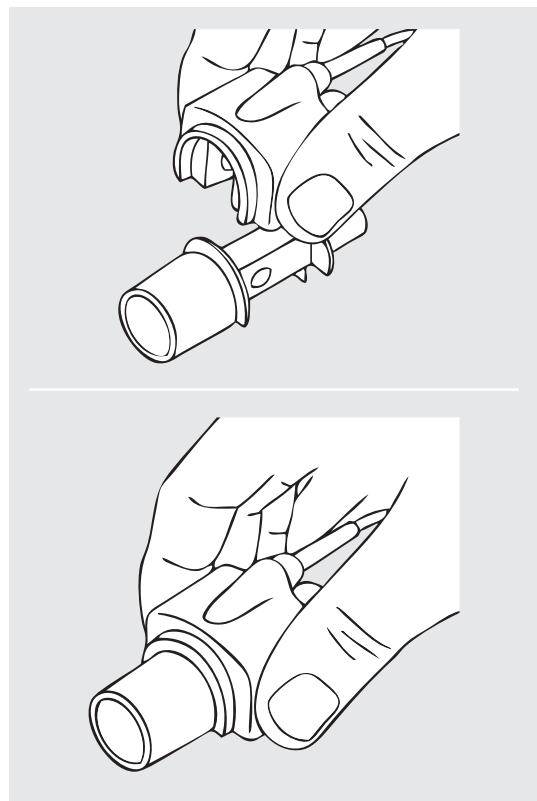
To perform the CO₂ gas span check you need a CO₂ calibration gas; Breas part no 005341 or a similar gas consisting of:

- 5% CO₂ (carbon dioxide)
- 21% O₂ (oxygen)
- 74% N₂ (nitrogen)

You also need a gas regulator; Breas part no 005371 (fits to 005341).

2.9.1 How to perform the CO₂ Gas Span Check

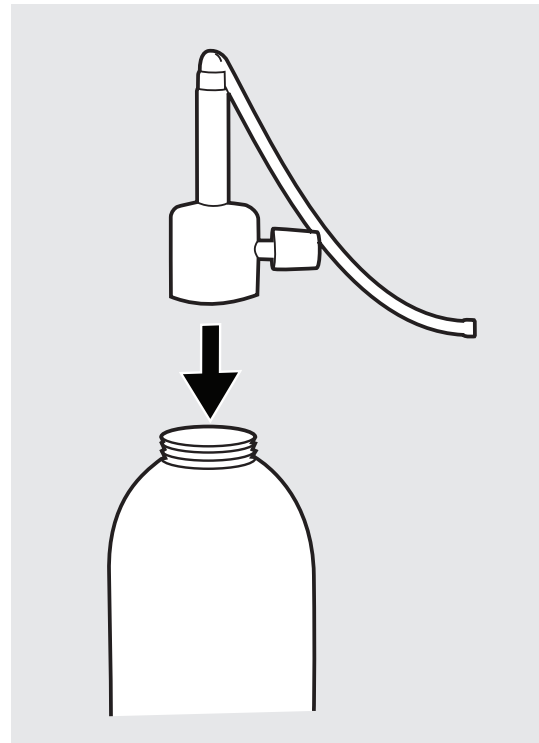
1 Snap on a new airway adapter to the CO₂ sensor probe.



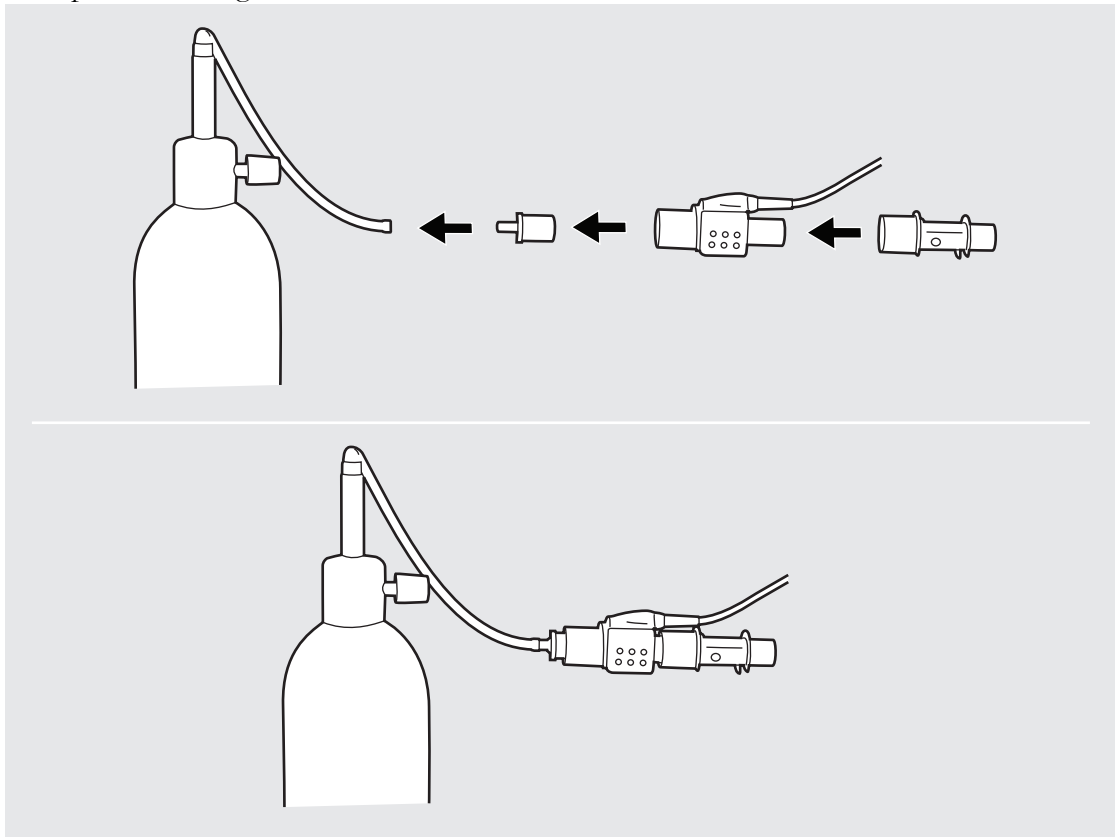
2 Perform a CO₂ zeroing procedure. You find the zeroing procedure under “FiO₂/CO₂ Calibration” in the “Others” section.

FiO ₂ /CO ₂ Calibration	11:10
Start FiO ₂ Calibration	
Start CO ₂ Zeroing	
CO ₂ Momentary	0 mmHg

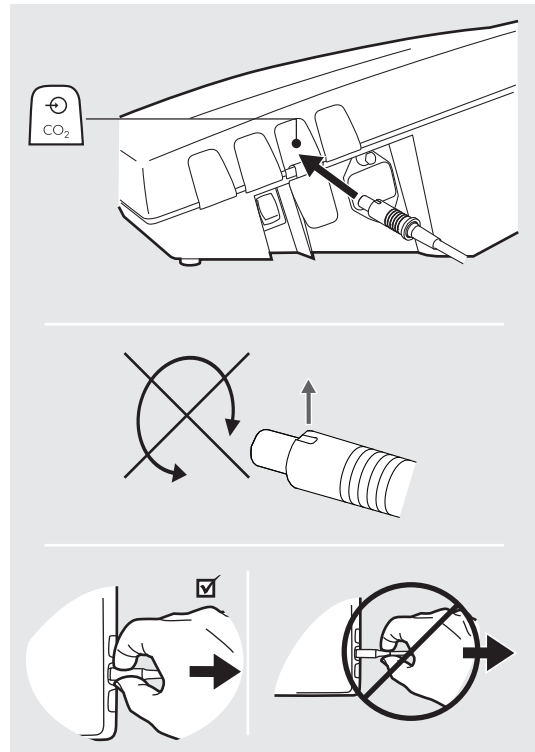
- 3** Mount the gas regulator on the gas bottle.
Be careful not to damage the thread on the bottle.
Make sure that the pressure indicator is not within the red mark.



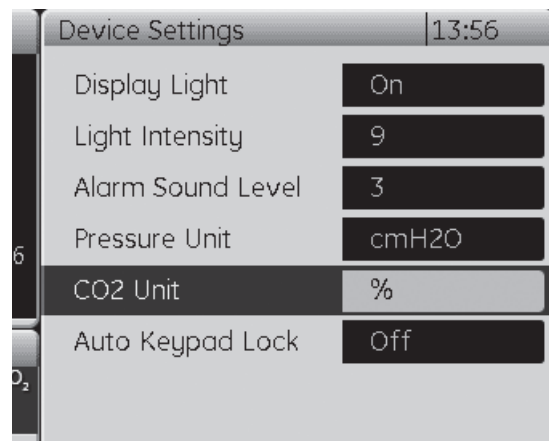
- 4** Connect the CO₂ sensor to the CO₂ calibration gas as below.
The extra airway adapter mounted behind the CO₂ sensor is to make sure that no ambient air is present during the check.



5 Connect the CO₂ sensor to the Vivo 50/60.

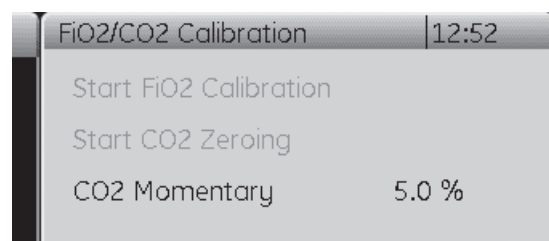


6 Change the Vivo 50/60 device settings so that the CO₂ unit is set to percent (%).



7 Open the gas valve and adjust the flow so that the float of the rotameter lies above the first line (or 0.5 l/min if other equipment is used) and let it flow for 30 seconds. The gas bottle must be in an upright position when performing the gas span check.

8 Check the “CO₂ Momentary” reading on the Vivo 50/60. You find the reading under “FiO₂/CO₂ Calibration” in the “Others” section. The CO₂ Momentary value shall be between 4.5-5.5%.



If the Momentary value is not between 4.5-5.5%:

- Be absolutely sure that the CO₂ sensor is in ambient air and perform the CO₂ zeroing procedure again.
- Check the expiration date of the gas bottle and that the pressure indicator is not within the red mark.
- Make sure that you have attached an extra airway adapter behind the CO₂ sensor and that the output from the second adapter is unconnected out in ambient air.
- Check that the luer lock plug on the side of the gas regulator is tightly connected.
- Do not use a sensor that fails the gas span check.

2.10 Electrical Safety Precautions

Electrical safety measurements must be made in accordance with IEC 601.

Use an automatic electrical safety tester to make the measurements. All tests must be performed in accordance with class II type BF.

Supply Voltage

Note the power voltage reading.

The voltage must be noted at each service check, as the currents measured are directly in relation to the supply voltage. This allows all measurements made on the same ventilator to be compared with measurements made on different occasions.

Insulation

The insulation resistance is measured using a 500 V DC power supply. The most suitable method is to connect the plus lead to the two ventilator power socket pins, and the minus lead to the casing or the patient air connector. The measurements made during the delivery inspection can be used as reference values for measurements made during future services. If no reference values are available, the value for the insulation resistance should be $>20 \text{ M}\Omega$.

Leakage Currents



The leakage current test is optional.

The leakage current test is not necessary to ensure safe use of the Vivo 50/60.

The leakage currents are measured at different parts of the ventilator using an RC circuit to earth.

Make the measurements partly at normal case (NC) and at the single fault condition (SFC). Reverse the polarity of the power supply and note the highest value.

Leakage currents to earth must not exceed the stated limit values.

Leakage Currents from the Casing

The leakage current of the casing is measured at an unpainted point, for example, the head of a screw.

Limit values: NC $<0.1 \text{ mA}$

SFC $<0.5 \text{ mA}$

Break neutral for SFC.

Patient Leakage Currents

The patient leakage current is measured between the patient connector and earth.

Limit values: NC $<0.1 \text{ mA}$

SFC $<0.5 \text{ mA}$

Break neutral for SFC.

Leakage Currents with Mains Power Supply at the Patient-connected Part

This test must be done using an automatic electrical safety tester with this function. See the safety instructions for the tester.

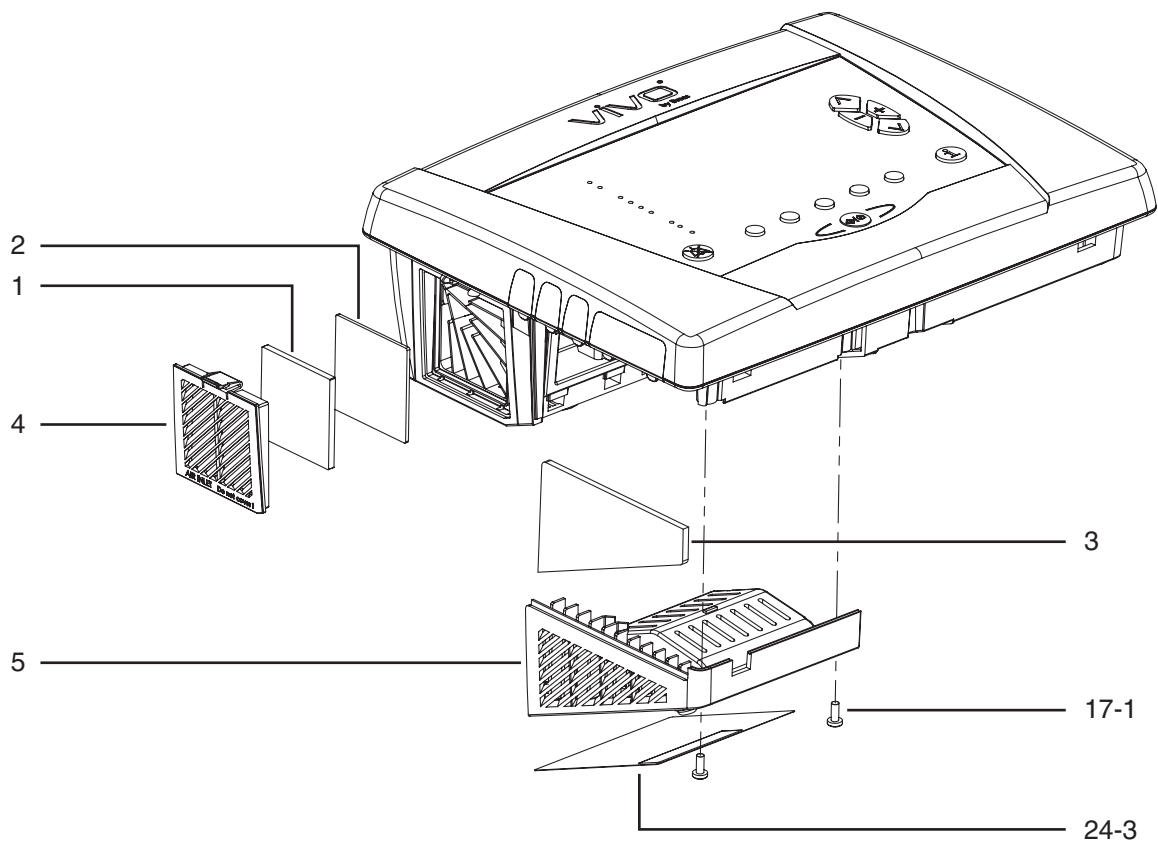
Limit value: SFC $<5 \text{ mA}$

3 Parts Location

This chapter contains part-number lists and drawings of the parts for the ventilator.

3.1 Parts Drawing 1 – Internal Battery, Filters

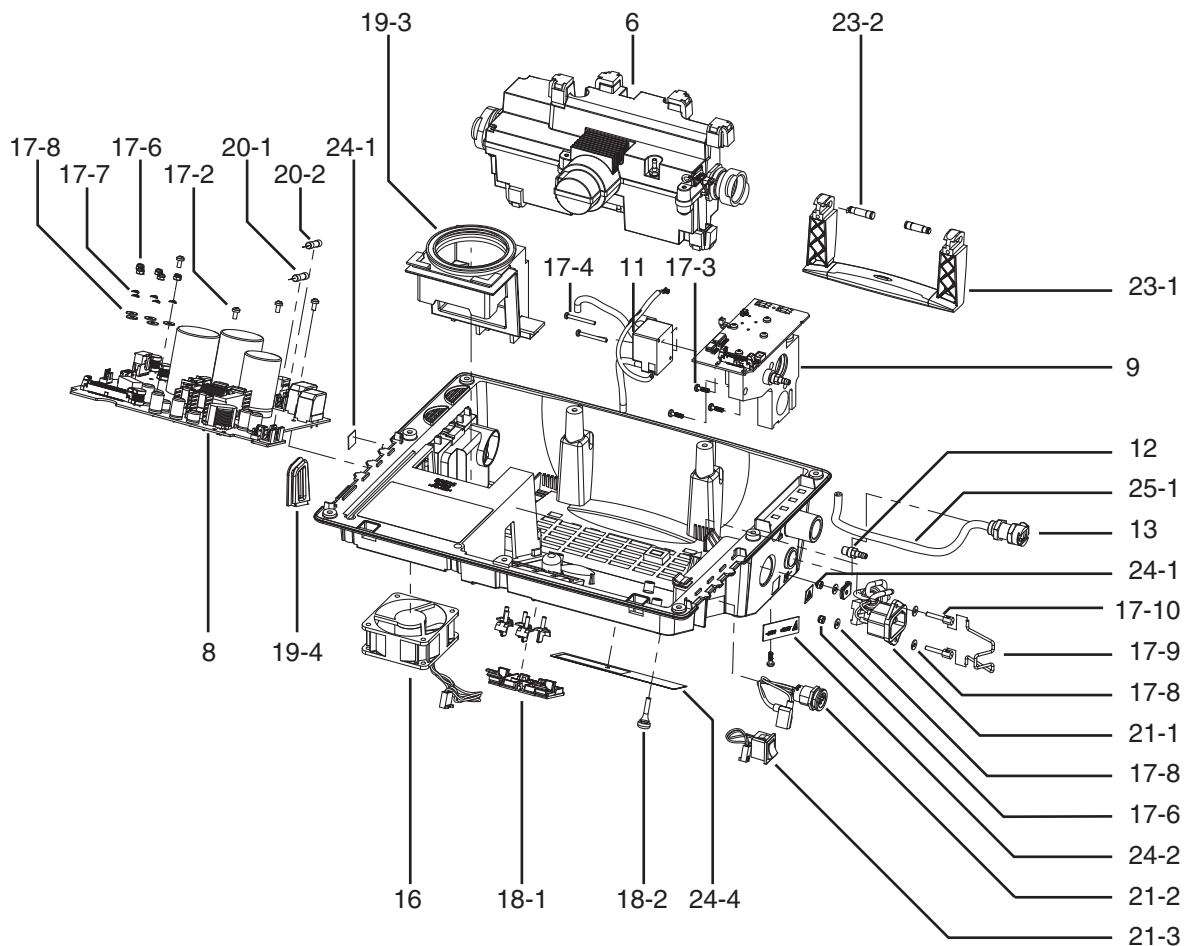
For definitions of the part numbers, refer to the parts list in section 3.5, "Parts List for the Vivo 50/60", on page 25.



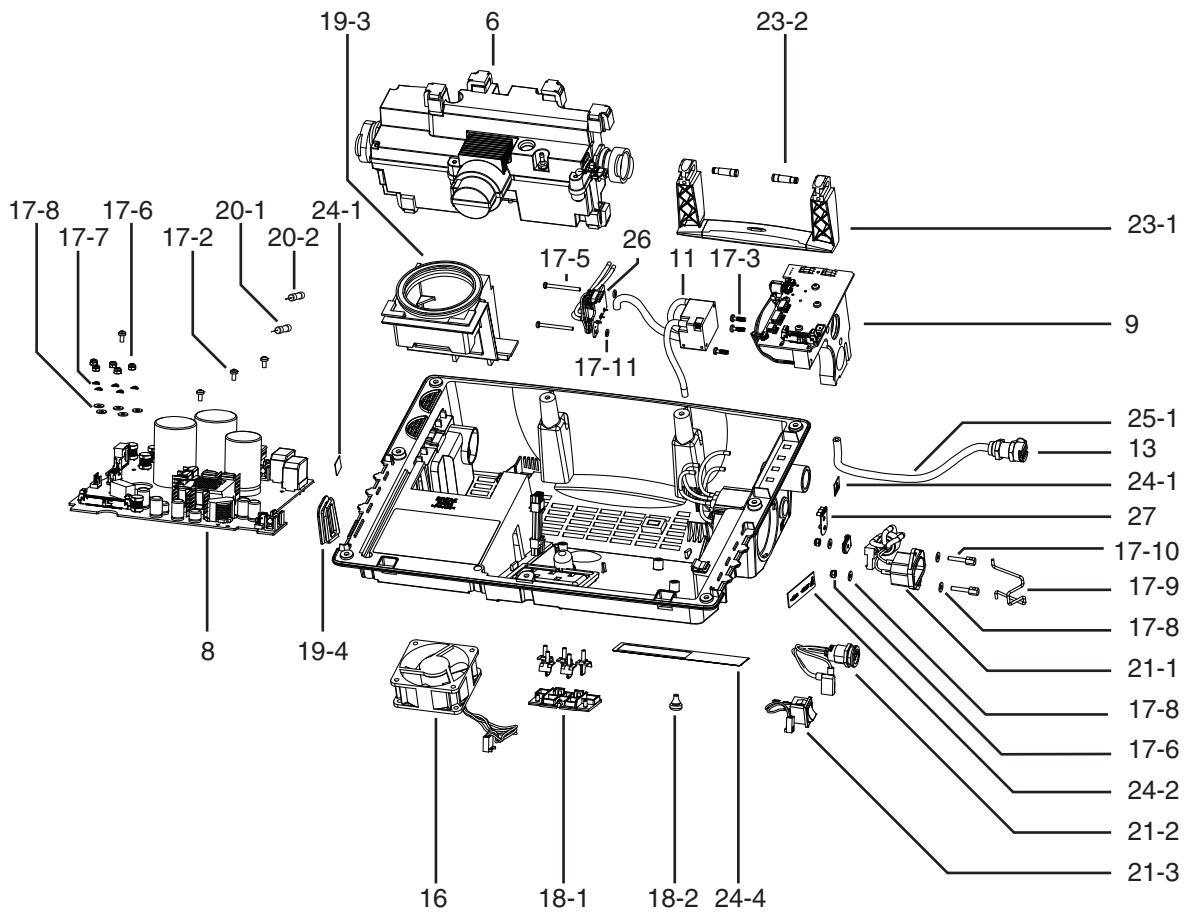
3.2 Parts Drawing 2 – Bottom Casing, PSU Board, Cables, Screws

For definitions of the part numbers, refer to the parts list in section 3.5, "Parts List for the Vivo 50/60", on page 25.

3.2.1 Vivo 50

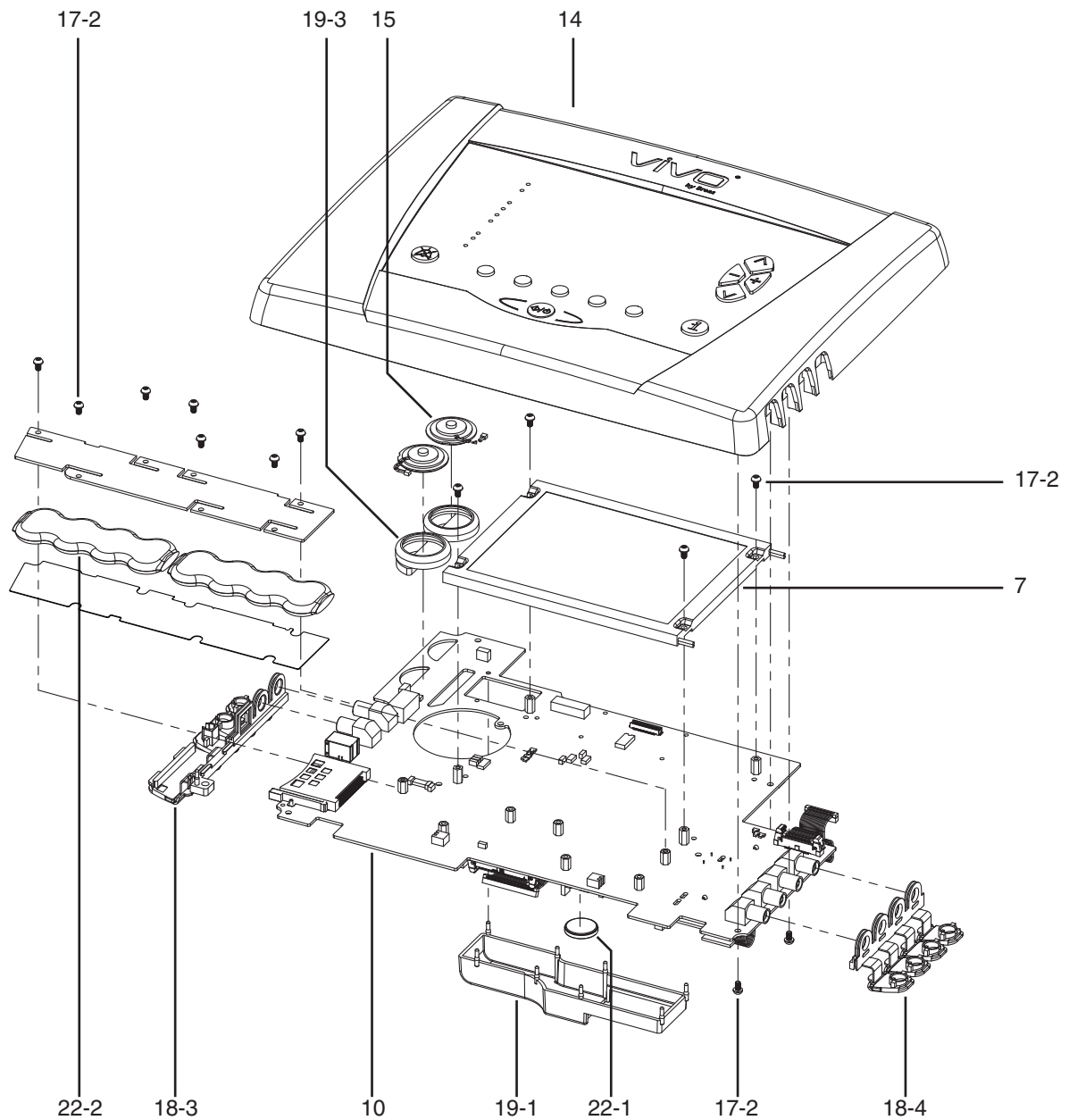


3.2.2 Vivo 60



3.3 Parts Drawing 3 – Top Casing, CPU Board

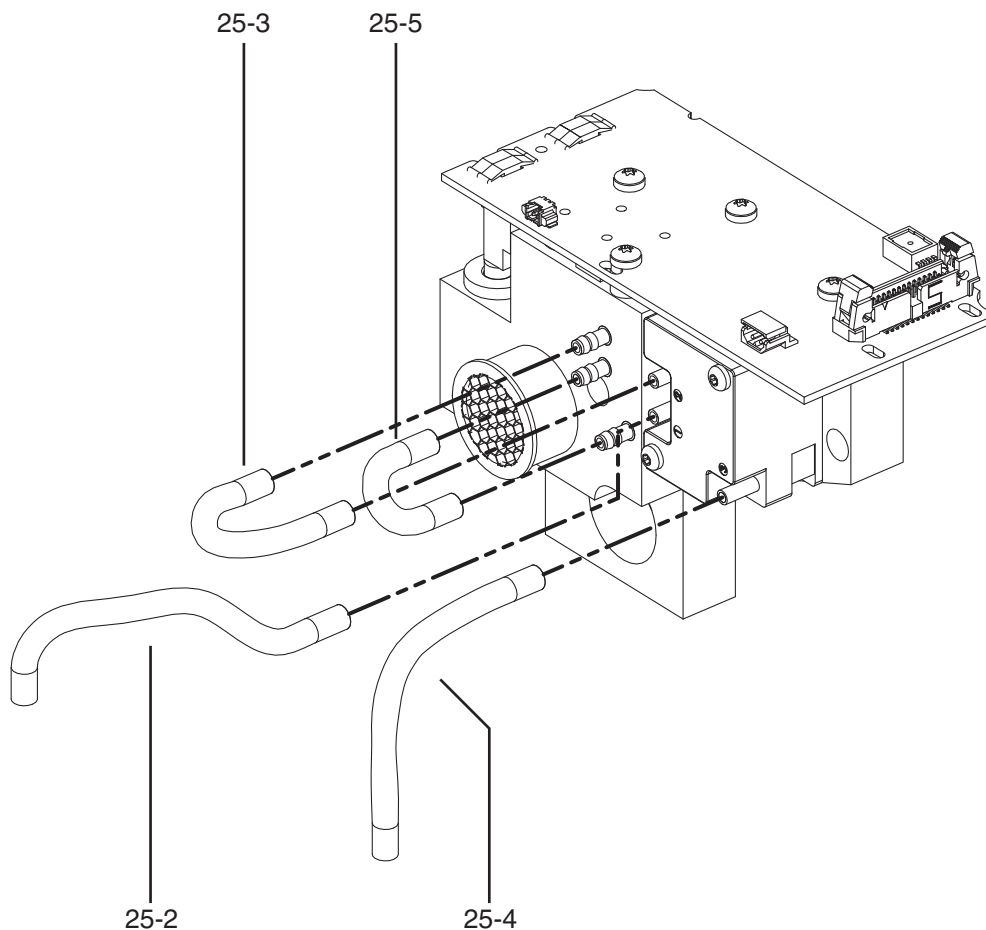
For definitions of the part numbers, refer to the parts list in section 3.5, "Parts List for the Vivo 50/60", on page 25.



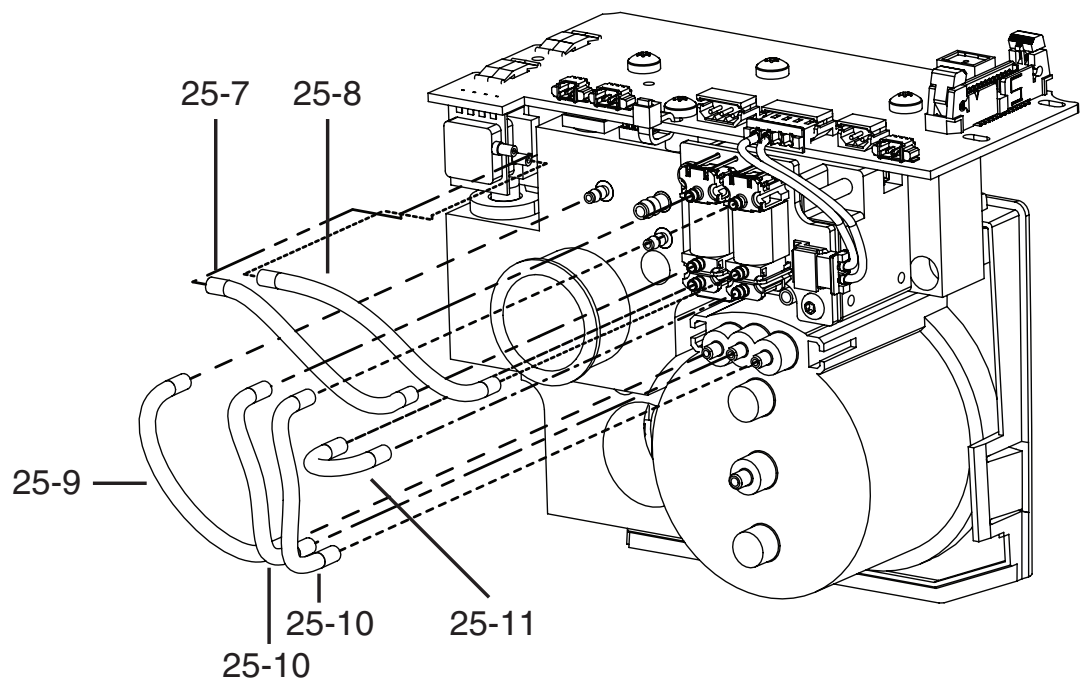
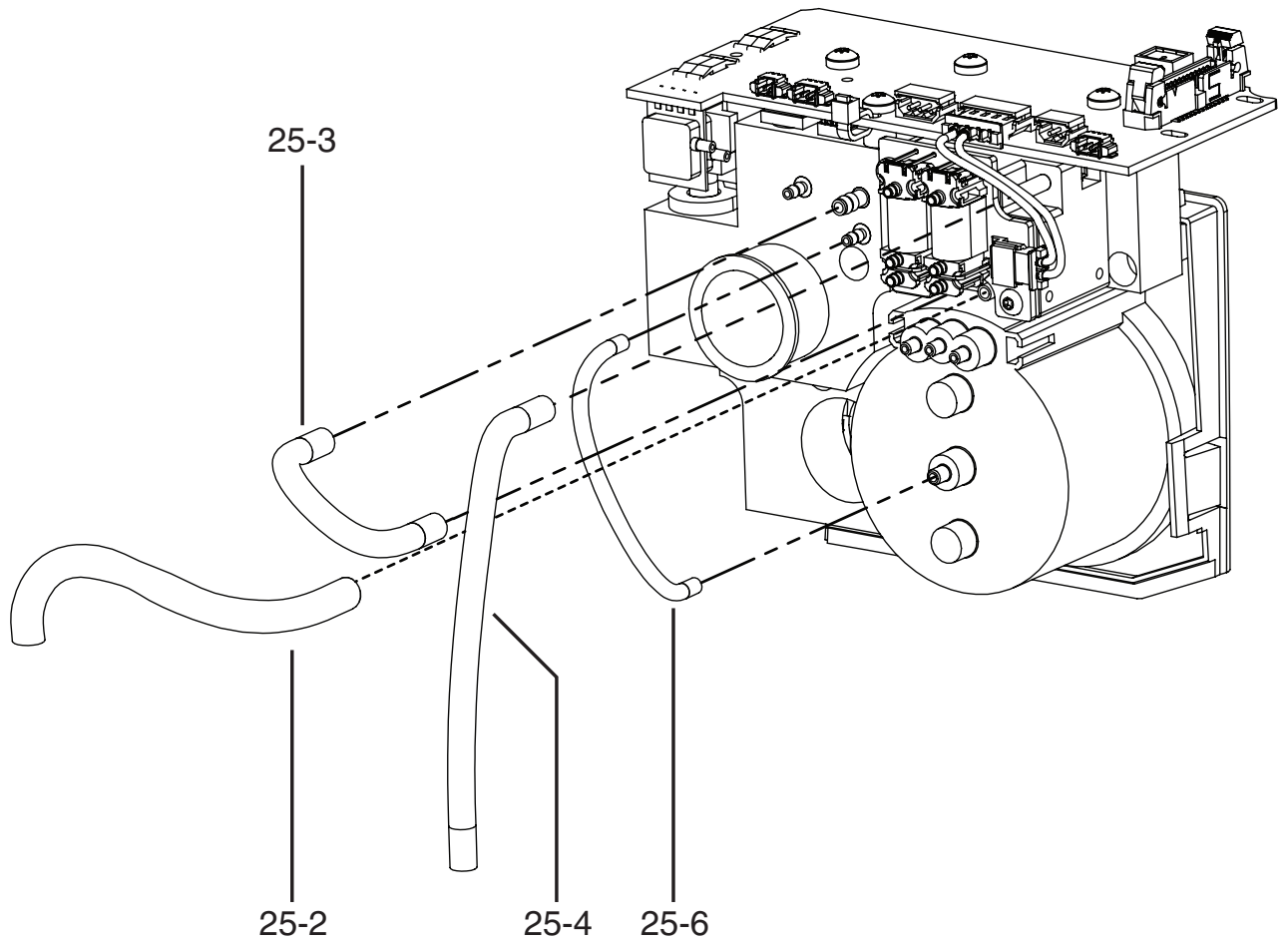
3.4 Parts Drawing 4 - Pneumatic Block, PTU Board

For definitions of the part numbers, refer to the parts list in section 3.5, "Parts List for the Vivo 50/60", on page 25.

3.4.1 Vivo 50



3.4.2 Vivo 60



3.5 Parts List for the Vivo 50/60

The parts of the Vivo 50/60 are listed in the table below.

KIT NO.	DESCRIPTION	BREAS PART NO.	AMOUNT
1	Air inlet filter, washable (grey)	004909	5
2	Air inlet filter, disposable (white)	004910	10
3	Cooling air filter	004911	5
4	Filter holder	004623	1
5	Internal battery	004554	1
6	Complete blower assembly	004558	1
7	Display	004584	1
8	PSU board	004702	1
9	Pneumatic block, PTU board and Exhalation valve control pressure valve (11) Including ZVU board (26)	Vivo 50: 004912 Vivo 60: 005607	1
10	CPU board (specify language package when ordering)	Vivo 50: 004701 Vivo 60: 005606	1
11	Exhalation valve control pressure valve	004718	1
12	Exhalation valve control pressure connector	004613	1
13	Oxygen low pressure/bleed-in connector	004614	1
14	Top casing (including buttons)	Vivo 50: 004916 Vivo 60: 005608	1
15	Beeper with cable	003509	1
16	Cooling fan	004716	1
17	Screw kit	004914	
17-1	Screw M4x10		11
17-2	Screw M3x5		10
17-3	Screw STT30x10 (for pneumatic block)		4

KIT NO.	DESCRIPTION	BREAS PART NO.	AMOUNT
17-4	Screw M2.5x25 (for exhalation valve control pressure valve)		2
17-5	Screw M2.5x30 (for exhalation valve control pressure valve and ZVU board)		2
17-6	Nut nylock M3		7
17-7	Spring washer		5
17-8	Washer M3		9
17-9	Cable restrainer		1
17-10	Holder for cable restrainer		2
17-11	Washer M3, nylon		2
18	Silicone parts kit, external	004915	
18-1	Click-on battery connector cover		1
18-2	Silicone rubber foot		4
18-3	Connector cover, left		1
18-4	Connector cover, right		1
27	Insert sealing		1
19	Silicone parts kit, internal	004920	
19-1	Cooling air channel, CPU board		1
19-2	Cooling fan holder		1
19-3	Alarm beeper sealing		2
19-4	Internal battery cable sealing		1
20	Fuses	004921	
20-1	Fuse, T10AL		10
20-2	Fuse, T3.15AH		10
21	AC/DC/switch kit	004923	
21-1	AC inlet		1
21-2	External DC inlet		1
21-3	Power on/off switch		1
22	Battery kit	005058	
22-1	Clock battery		1
22-2	Alarm battery		2
23	Handle kit	004924	
23-1	Handle		1

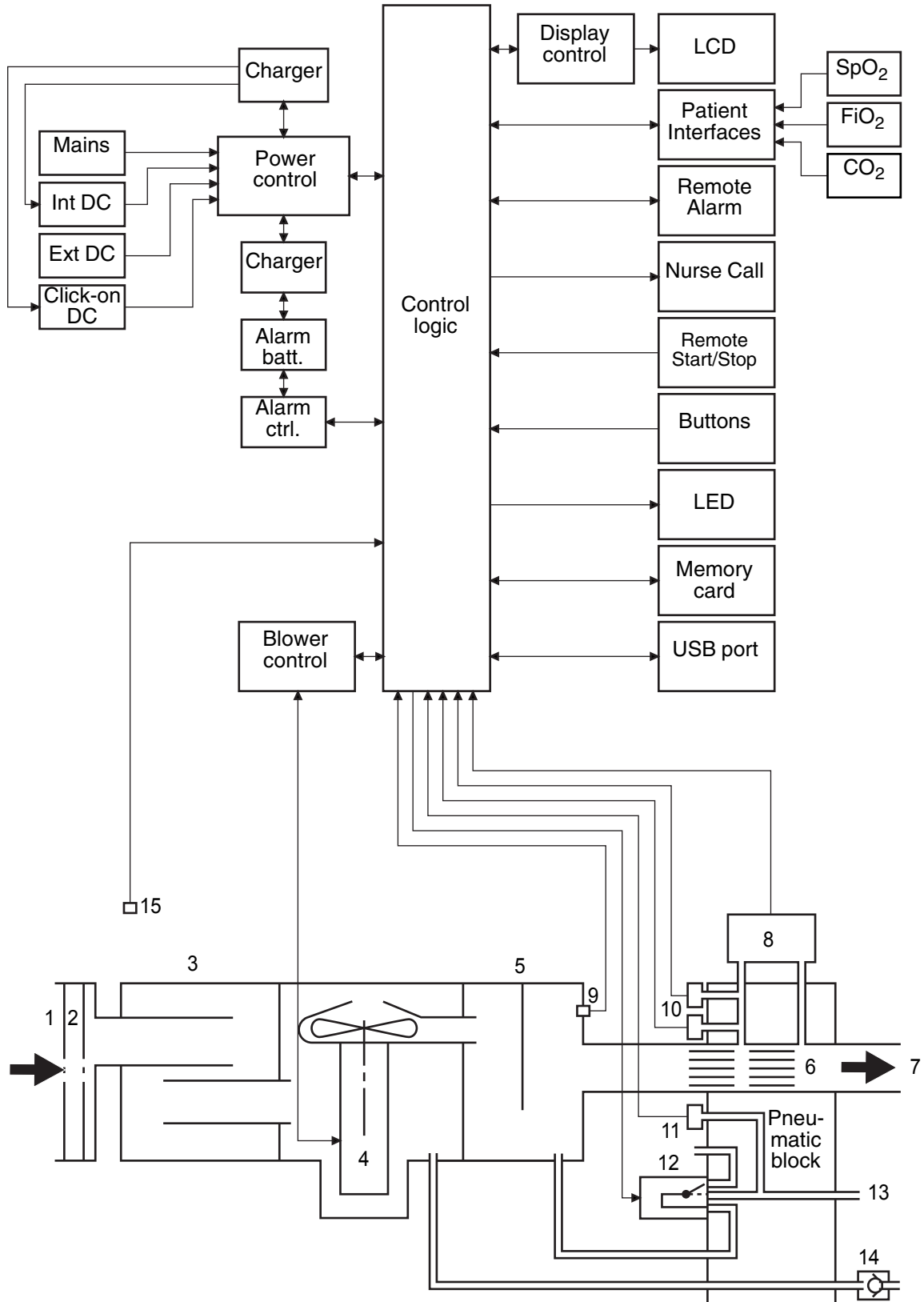
KIT NO.	DESCRIPTION	BREAS PART NO.	AMOUNT
23-2	Pin		2
24	Label kit	Vivo 50: 004919 Vivo 60: 005609	
24-1	Label, "Read manual"		2
24-2	Label, power inlet		1
24-3	Label, internal battery		1
24-4	Label covering serial number label		1
25	Tubing kit	004917	
25-1	Tube, low pressure oxygen, red		1
25-2	Tube, exhalation valve control pressure, blue		1
25-3	Tube, exhalation valve control pressure valve to pneumatic block, transparent		1
25-4	Tube, exhalation valve control pressure valve port 3, yellow		1
25-5	Tube, pneumatic block, Vivo 50, green		1
25-6	Tube, exhalation valve control pressure valve to exhalation valve control pressure outlet, Vivo 60		1
25-7	Tube, flow sensor to zeroing valve, Vivo 60		1
25-8	Tube, flow sensor to zeroing valve, Vivo 60		1
25-9	Tube, pressure sensor, Vivo 60		1
25-10	Tube, zeroing valve, upper connection, Vivo 60		2
25-11	Tube, zeroing valve, lower connections, Vivo 60		1
26	ZVU board	005645	1
27	Insert sealing	005646	5

4 Functional Diagram

This chapter contains a diagram of the pneumatic system of the ventilator and a block diagram of the Vivo 50/60's functions.

The functional block diagram below shows how the electronics and pneumatics are designed and how they are connected to the other components.

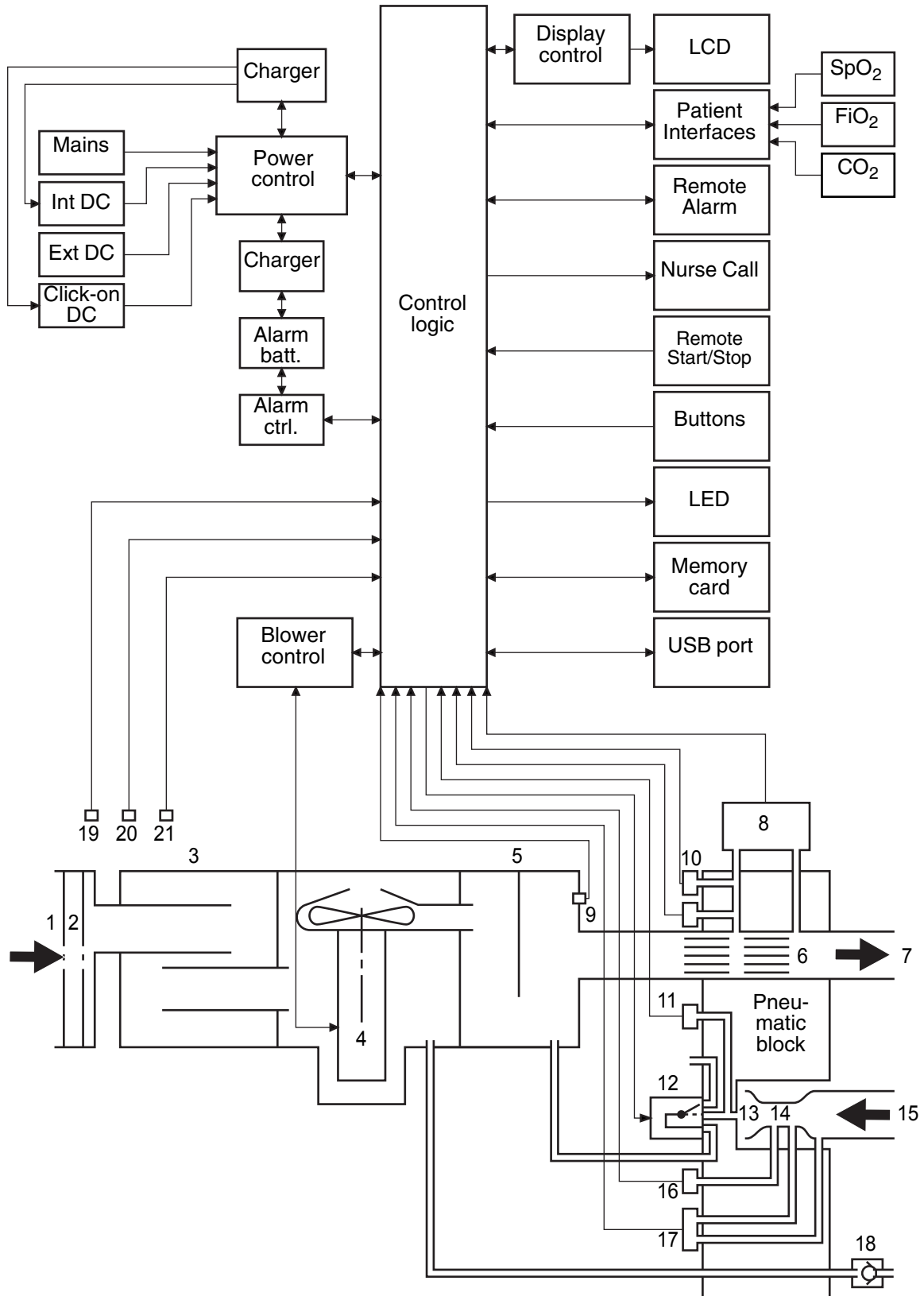
4.1 Vivo 50



The table below describes the components of the pneumatic diagram.

NO.	DESCRIPTION
1	Patient air inlet
2	Air inlet filter
3	Inlet silencer
4	Blower motor
5	Outlet silencer
6	Restriction
7	Patient air outlet
8	Inspiratory flow sensor
9	Patient air temperature sensor
10	Outlet pressure sensors
11	Exhalation valve control pressure sensor
12	Exhalation valve control pressure valve
13	Exhalation valve control pressure outlet
14	Low pressure/bleed-in oxygen inlet connection (with check valve)
15	Ambient air pressure sensor

4.2 Vivo 60



The table below describes the components of the pneumatic diagram.

No.	DESCRIPTION
1	Patient air inlet
2	Air inlet filter
3	Inlet silencer
4	Blower motor
5	Outlet silencer
6	Restriction
7	Patient air outlet
8	Inspiratory flow sensor
9	Patient air temperature sensor
10	Outlet pressure sensors
11	Exhalation valve control pressure sensor
12	Exhalation valve control pressure valve
13	<p>Exhalation valve control pressure outlet</p> <p>Vivo 60 with dual limb insert: the exhalation valve is part of the dual limb insert.</p> <p>Vivo 60 with single limb insert: the single limb insert provides a connection port for the control pressure tube of an external exhalation valve.</p>
14	Venturi pipe (Vivo 60 with dual limb insert only)
15	Exhaled air inlet (Vivo 60 with dual limb insert only)
16	Expiratory pressure sensor
17	Expiratory flow sensor
18	Low pressure/bleed-in oxygen inlet connection (with check valve)
19	Ambient air pressure sensor
20	Ambient temperature sensor
21	Ambient humidity sensor

4.3 Filtering/Smoothing Techniques

FUNCTION	TECHNIQUE DESCRIPTION
Pressure	Low pass average time constant 16 ms
Inspiration trigger	Differential mass flow resolution 4 ms
Expiration trigger	Flow low pass filtering with level sensing

4.4 Vivo 50/60 Measuring and Display Devices

DEVICE	PURPOSE	TYPE	RANGE	RESOLUTION	ACCURACY	SENSING POSITION
Pressure sensing	Pressure control	Differential to ambient	Vivo 50: -10 to +60 cmH ₂ O Vivo 60: -10 to +70 cmH ₂ O	0.1 cmH ₂ O	±0.1% FSS	Air outlet of Vivo 50/60
Inspiratory flow sensing	Flow control	Mass flow	0 to 300 l/min	1 l/min	±1 l/min	Air outlet of Vivo 50/60
Expiratory flow sensing	Indicate patients expired volume	Differential pressure	0 to 200 l/min	1 l/min	±1 l/min	Dual limb insert (Vivo 60 only)
Pressure display	Indicate patient pressure		Vivo 50: 0 to 60 cmH ₂ O Vivo 60: 0 to 70 cmH ₂ O	1 cmH ₂ O	±0.5 cmH ₂ O	Air outlet of Vivo 50/60



All measured pressure, flow and volume values used in calculations and shown on the display are converted into BTPS (Body Temperature and Pressure Saturated).

5 Opening the Vivo 50/60 and Replacing the Main Components



Make sure to disconnect all power supplies (mains and external DC) before removing the casing of the ventilator.

5.1 Replace the Internal Battery

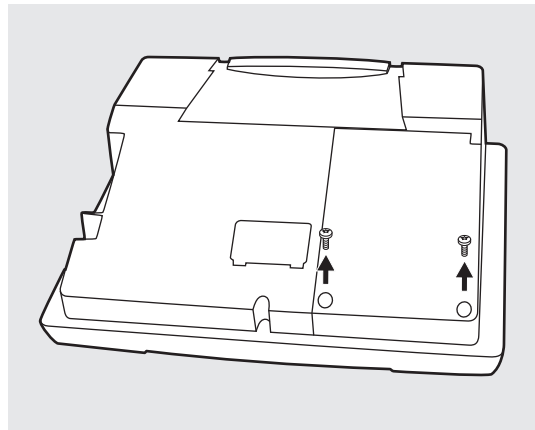


Use caution when handling damaged batteries.

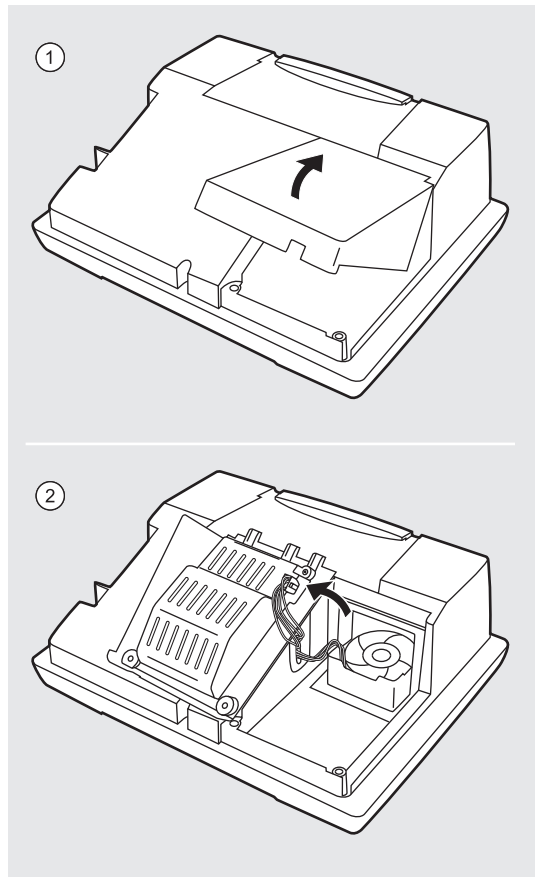
1 Place the Vivo 50/60 upside down on a clean, non-scratching surface.

2 Remove the two screws holding the internal battery.

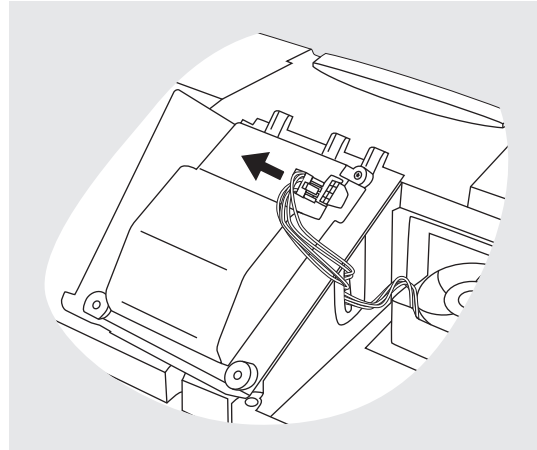
The torque applied when reassembling the two screws for the internal battery shall be 1.5 Nm.



3 Fold the internal battery up and place it on the Vivo 50/60 casing.



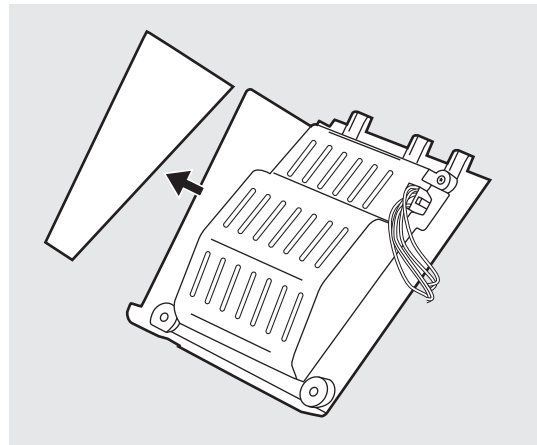
- 4 Disconnect the internal battery cable.



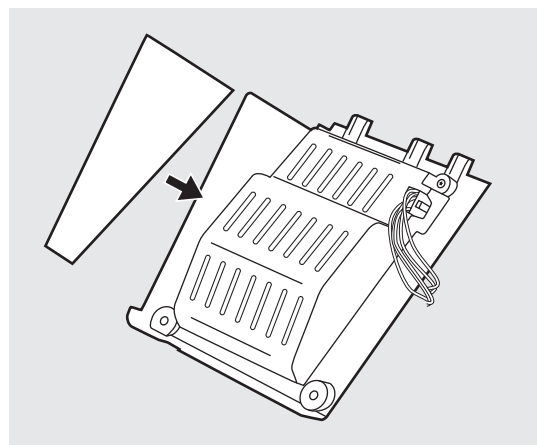
- 5 Reassemble in reverse order.

5.2 Replace the Cooling Air Filter

- 1 Open the internal battery as in section 5.1. There is no need to disconnect the battery cable.
- 2 Remove the old cooling air filter.



- 3 Insert the new cooling air filter. Make sure that the filter is fitted correctly.



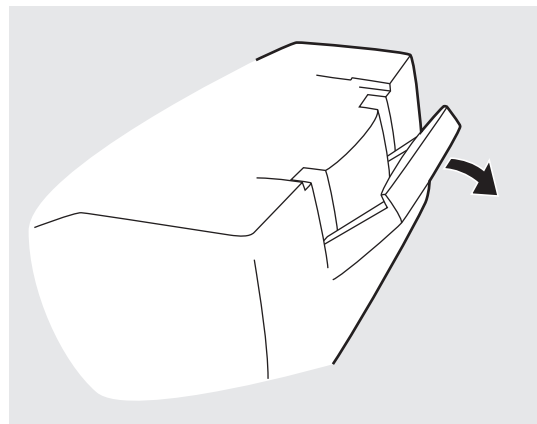
- 4 Reassemble in reverse order.

5.3 Open and Close the Vivo 50/60

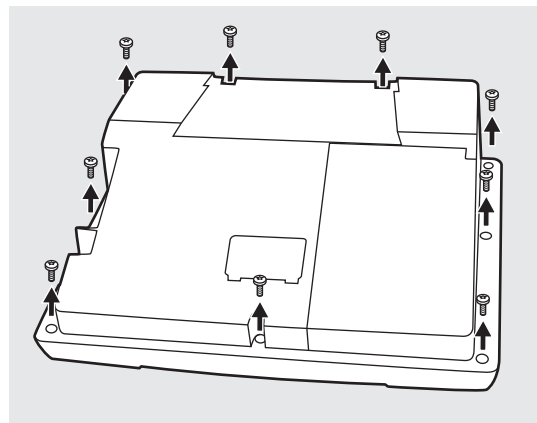


- Before closing the Vivo 50/60, perform an internal inspection, see “Internal Inspection” on page 12.
- Always perform a complete function test after reassembling the Vivo 50/60, see “Complete Function Test” on page 13.
- Always perform an electrical safety test after reassembling the Vivo 50/60, see “Electrical Safety Precautions” on page 18.
- Make sure that the Vivo 50/60 is placed on a clean, non-scratching surface.
- Make sure that the tubes are not pinched or kinked when closing the Vivo 50/60.

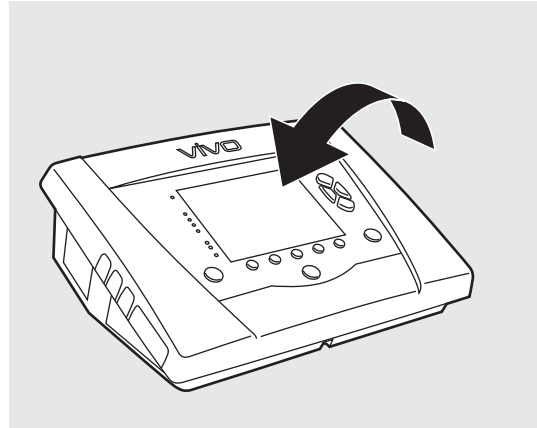
- 1 Remove the internal battery as in section 5.1.
- 2 Pull the handle down.



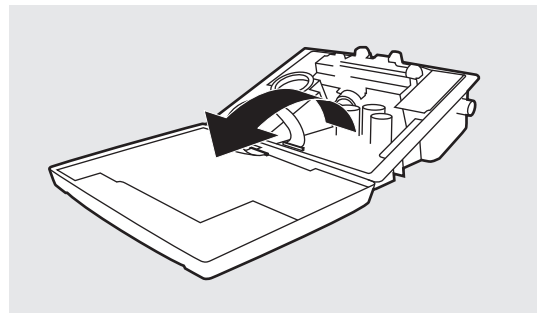
- 3 Remove the nine screws for the casing. The torque applied when reassembling the nine screws for the casing shall be 1.5 Nm.



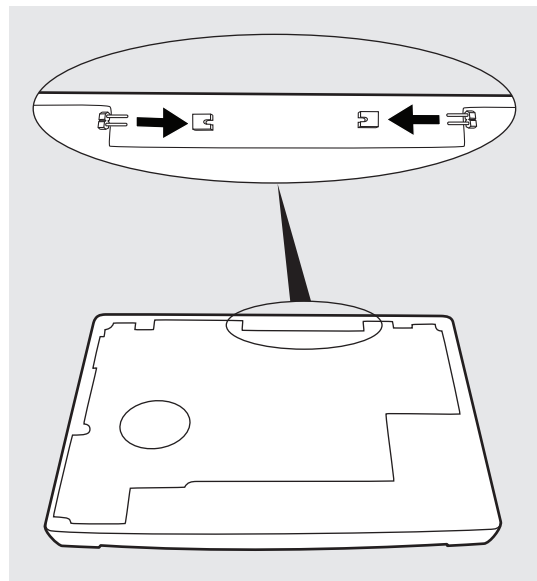
4 Hold the Vivo 50/60 together at the sides, turn it over and place it with its bottom down.



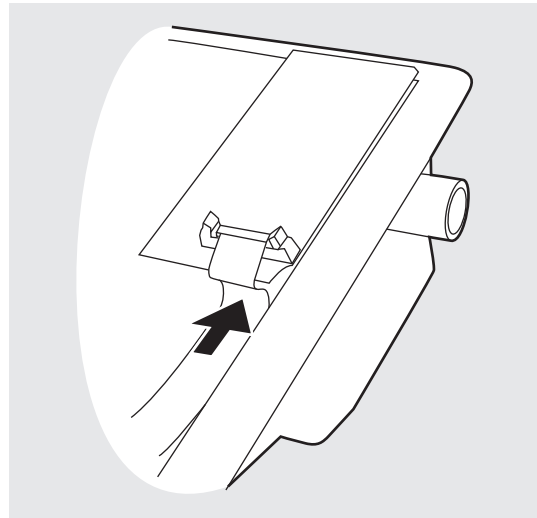
5 Gently fold the top casing forward.



6 Remove the jumpers for the alarm batteries.



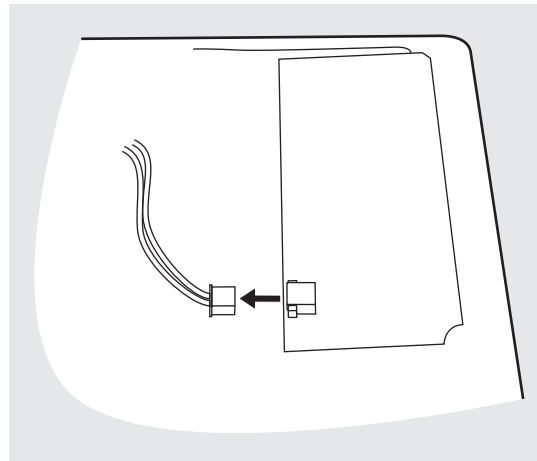
- 7 Reassemble in reverse order.
- Make sure that the cabling for the PTU board does not get squeezed between the top and bottom casing. To avoid this you can straighten the cabling by pushing it up under the PTU board.



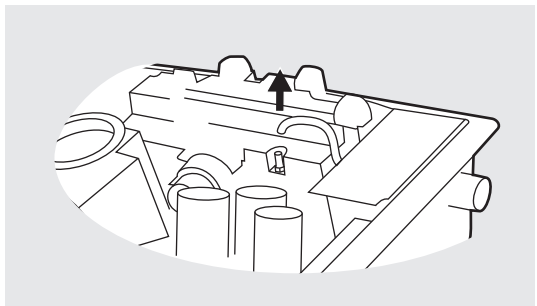
- Put the top casing back gently and straight (do not fold up) to not displace the vibration dampening pads on top of the blower assembly.

5.4 Replace the Complete Blower Assembly

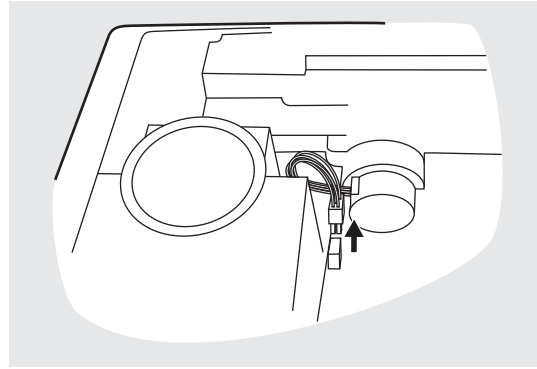
- 1 Open the Vivo 50/60 as in section 5.3.
- 2 Disconnect the patient air temperature sensor cabling.



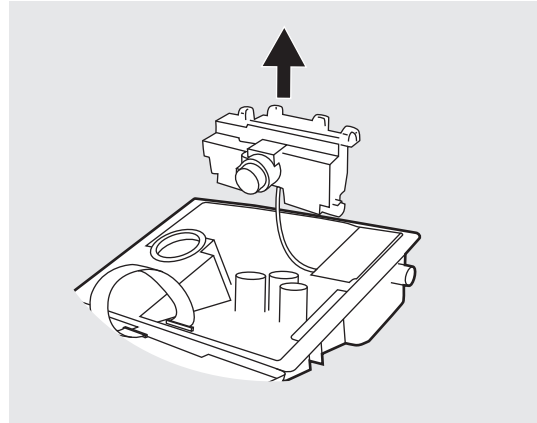
- 3 Disconnect the exhalation valve control pressure supply tube.



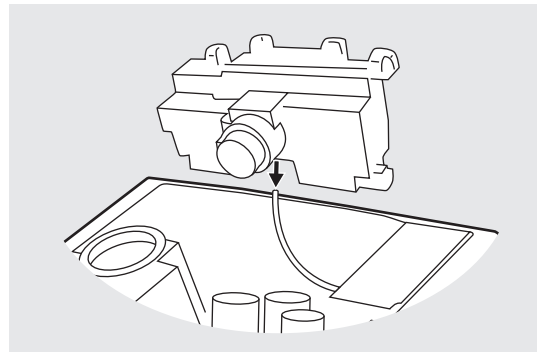
4 Disconnect the blower cable.



5 Gently disconnect the blower assembly's air inlet and outlet and lift the blower assembly up.



6 Disconnect the oxygen low pressure/bleed-in tube.

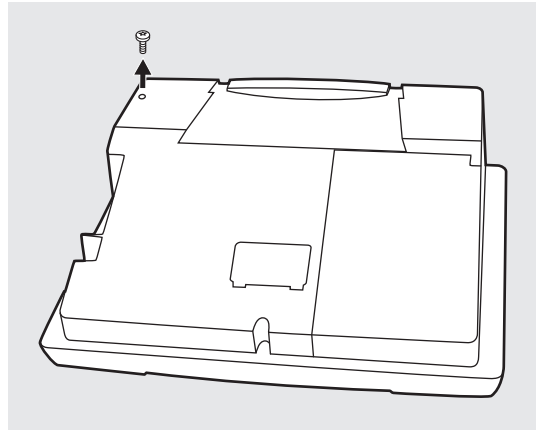


7 Reassemble in reverse order.

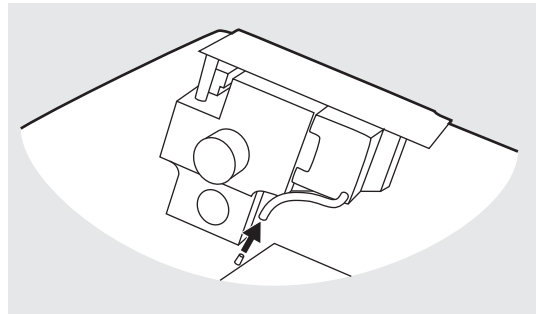
When reassembling: make sure that the oxygen low pressure/bleed-in tube (red) is not squeezed under the blower by holding it when the blower is fitted into the casing.

5.5 Replace the Vivo 50 Pneumatic Block and PTU Board

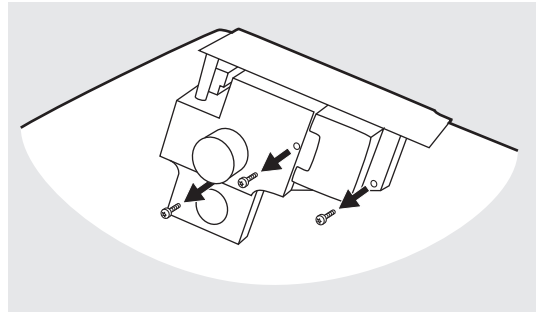
- 1 Remove the bottom screw for the pneumatic block.
The torque applied when reassembling the screw for the pneumatic block shall be 0.5 Nm.



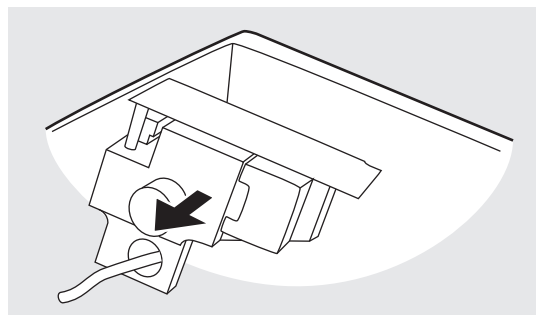
- 2 Open the Vivo 50 and remove the blower assembly as in section 5.4.
- 3 Disconnect the exhalation valve control pressure valve outlet tube (yellow).



- 4 Remove the three screws for the pneumatic block.
The torque applied when reassembling the three screws for the pneumatic block shall be 0.5 Nm.



- 5 Gently remove the pneumatic block.



6 Reassemble in reverse order.

When reassembling:

- It might be easier to connect the exhalation valve control pressure valve outlet tube first, before placing the pneumatic block.
- Make sure to find the existing screw threads when fastening the screws.



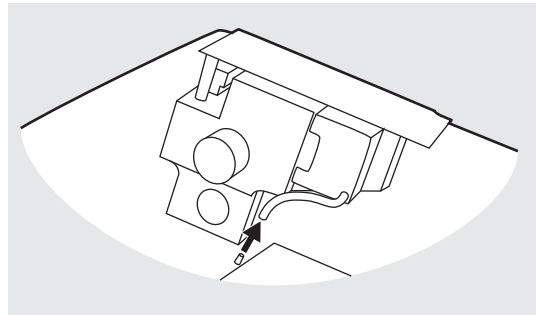
- Always calibrate the Vivo 50 after having replaced the pneumatic block and PTU board.
- Always perform a temperature compensation procedure after having replaced the pneumatic block and PTU board.



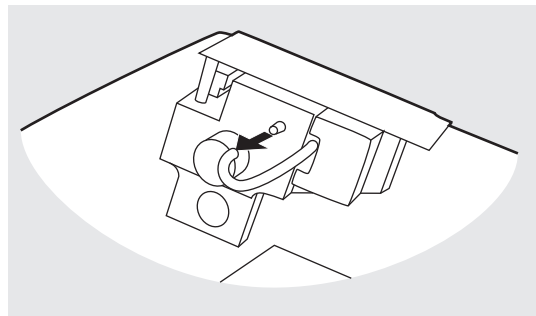
You need the Vivo 50/60 Service Software to calibrate and perform a temperature compensation procedure.

5.6 Replace the Vivo 50 Exhalation Valve Control Pressure Valve

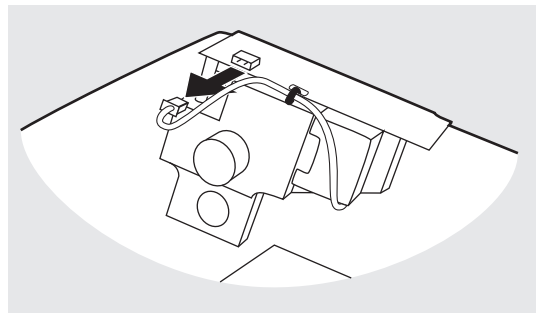
- 1** Open the Vivo 50 and remove the blower assembly as in section 5.4.
- 2** Disconnect the exhalation valve control pressure valve outlet tube (yellow).



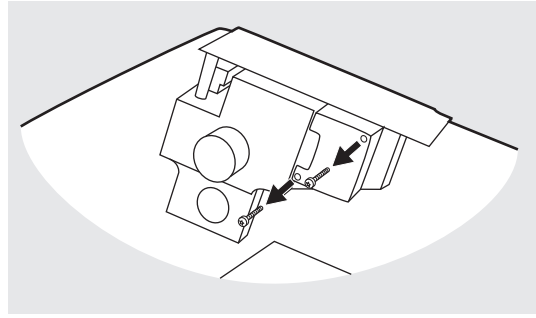
- 3** Disconnect the tube that goes between the exhalation valve control pressure valve and the pneumatic block.



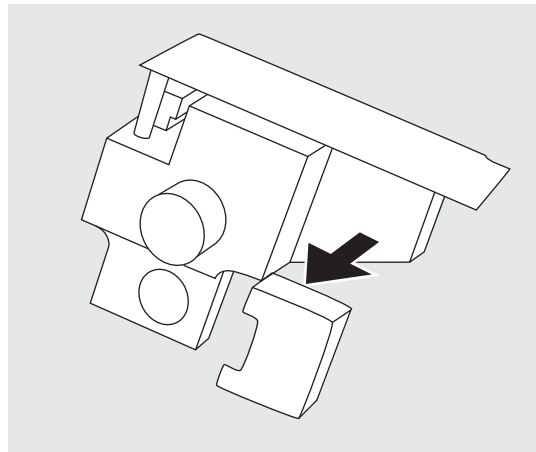
- 4** Disconnect the exhalation valve control pressure valve cable and cut the cable tie that holds the cable to the PTU board.



5 Remove the two screws for the valve.
The torque applied when reassembling the screws for the exhalation valve control pressure valve shall be 0.5 Nm.



6 Remove the exhalation valve control pressure valve.



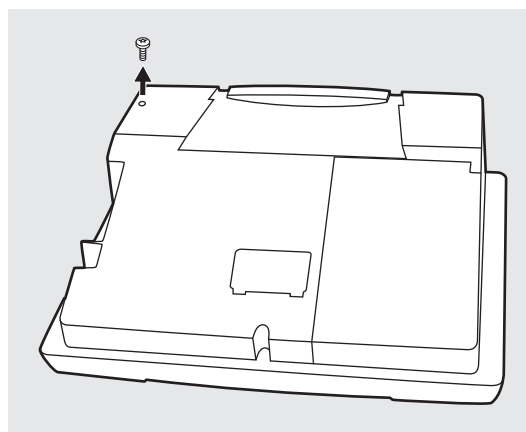
7 Reassemble in reverse order.

When reassembling:

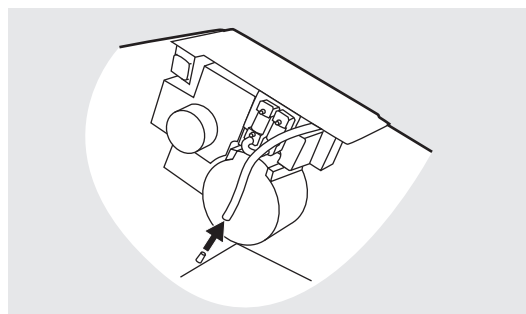
- It might be easier to connect the exhalation valve control pressure valve outlet tube first, before placing the pneumatic block.
- Make sure to find the existing screw threads when fastening the screws.
- See chapter 3.4.1, p.23 for an image of all tube connections on the Vivo 50 pneumatic block.

5.7 Replace the Vivo 60 Pneumatic Block and PTU Board

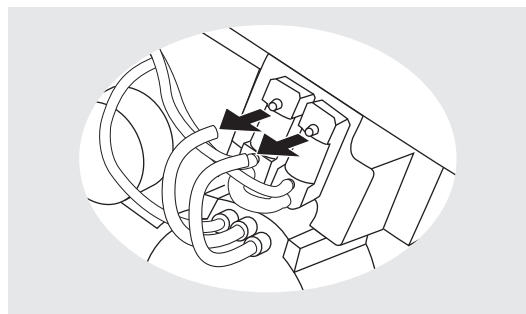
- 1 Remove the bottom screw for the pneumatic block.
The torque applied when reassembling the screw for the pneumatic block shall be 0.5 Nm.



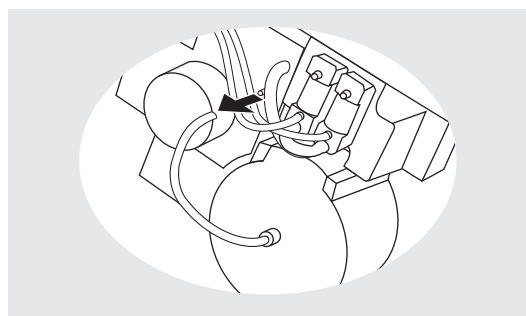
- 2 Open the Vivo 60 and remove the blower assembly as in section 5.4.
- 3 Disconnect the exhalation valve control pressure valve outlet tube (yellow).



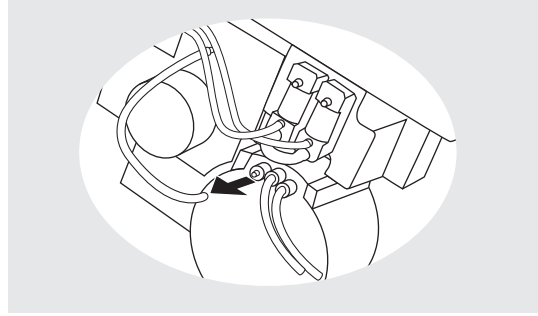
- 4 Disconnect the two upper tubes from the zeroing valves.



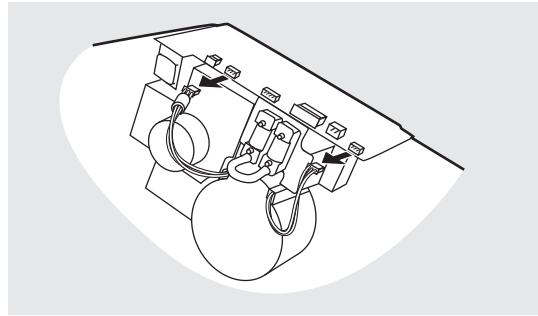
- 5 Remove the tube for the exhalation valve control pressure.



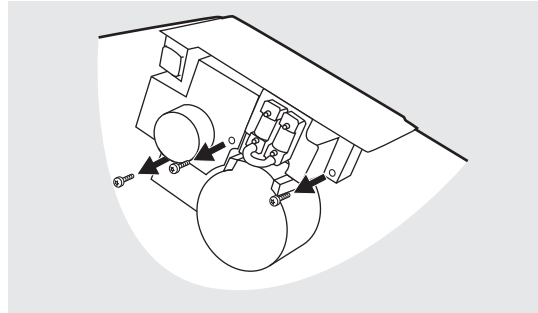
6 Remove the tube for the pressure sensor.



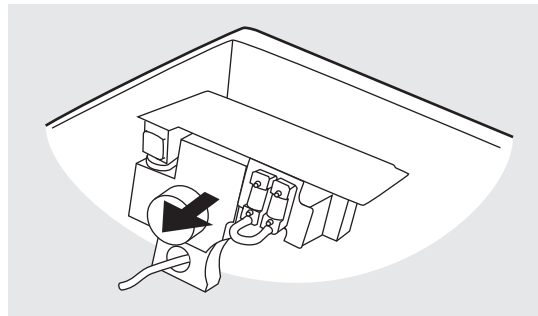
7 Remove the two connectors for the hall sensors.



8 Remove the three screws for the pneumatic block.
The torque applied when reassembling the three screw for the pneumatic block shall be 0.5 Nm.



9 Gently remove the pneumatic block.



10 Reassemble in reverse order.

When reassembling:

- It might be easier to connect the exhalation valve control pressure valve outlet tube first, before placing the pneumatic block.
- Make sure to find the existing screw threads when fastening the screws.
- See chapter 3.4.2, p.24 for an image of all tube connections on the Vivo 60 pneumatic block.



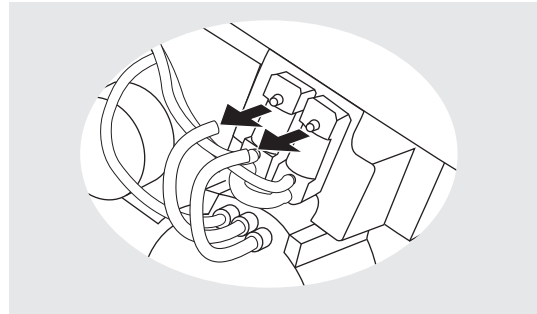
- Always calibrate the Vivo 60 after having replaced the pneumatic block and PTU board.
- Always perform a temperature compensation procedure after having replaced the pneumatic block and PTU board.



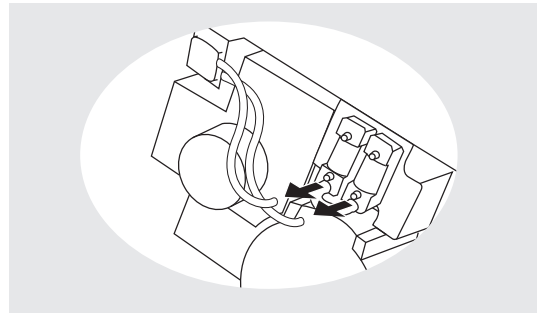
You need the Vivo 50/60 Service Software to calibrate and perform a temperature compensation procedure.

5.8 Replace the Vivo 60 ZVU Board

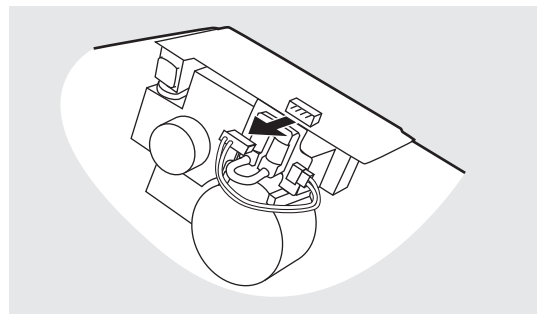
- 1 Open the Vivo 60 and remove the blower assembly as in section 5.4.
- 2 Disconnect the two upper tubes from the zeroing valves.



- 3 Disconnect the two tubes from the zeroing valves to the flow sensor.



- 4 Disconnect the ZVU board cable.

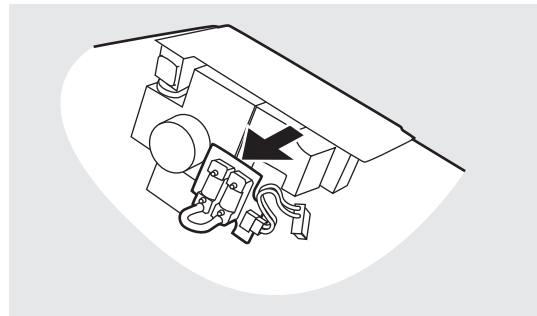
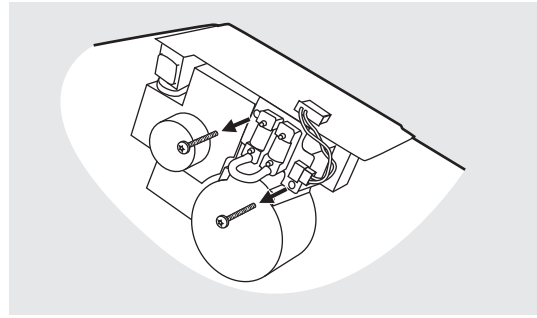


5 Remove the two screws for the ZVU board and the exhalation valve control pressure valve.

When reassembling: make sure that the two washers (one for each screw) are in place between the ZVU board and the pneumatic block.

The torque applied when reassembling the two screws for the ZVU board shall be 0.5 Nm.

6 Remove the ZVU board.



7 Reassemble in reverse order.

When reassembling:

- Make sure to find the existing screw threads when fastening the screws.
- See chapter 3.4.2, p.24 for an image of all tube connections on the Vivo 60 pneumatic block.



Always calibrate the Vivo 60 after having replaced the ZVU board.

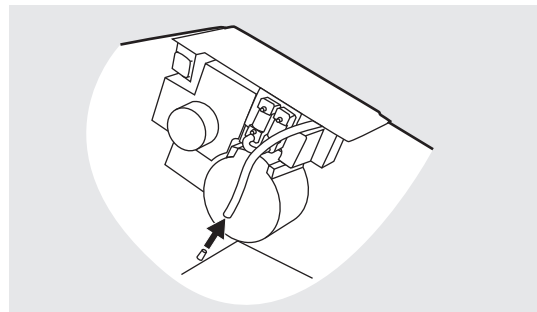


You need the Vivo 50/60 Service Software to calibrate the Vivo 60.

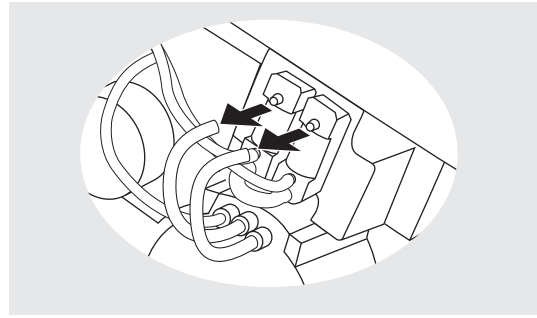
5.9 Replace the Vivo 60 Exhalation Valve Control Pressure Valve

1 Open the Vivo 60 and remove the blower assembly as in section 5.4.

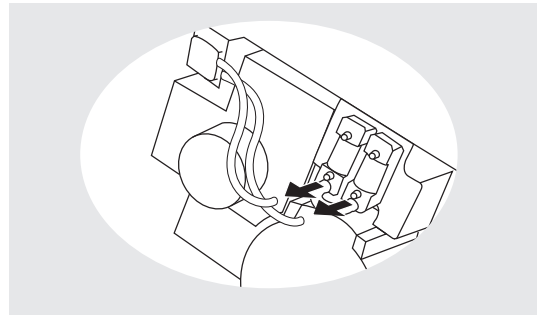
2 Disconnect the exhalation valve control pressure valve outlet tube (yellow).



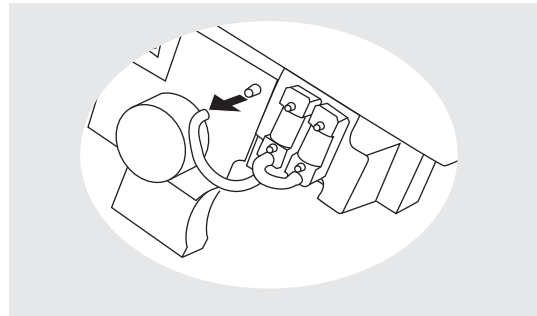
3 Disconnect the two upper tubes from the zeroing valves.



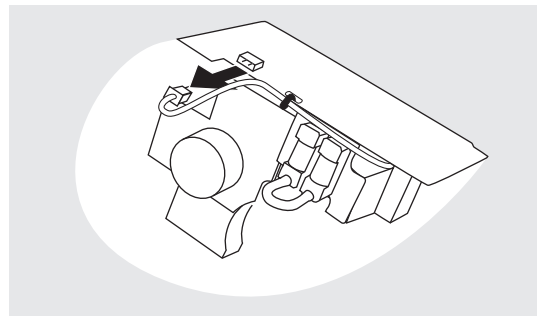
4 Disconnect the two tubes from the zeroing valves to the flow sensor.



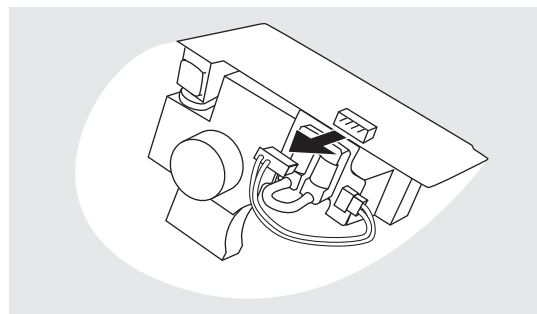
5 Disconnect the tube that goes between the exhalation valve control pressure valve and the pneumatic block.



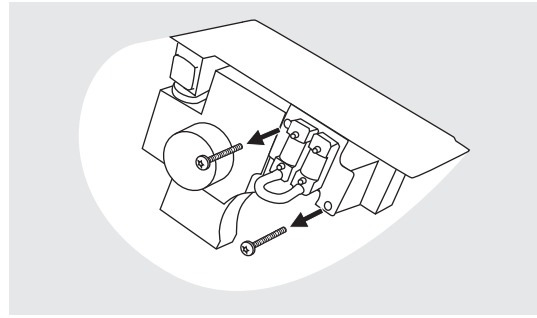
6 Disconnect the exhalation valve control pressure valve cable and cut the cable tie that holds the cable to the PTU board.



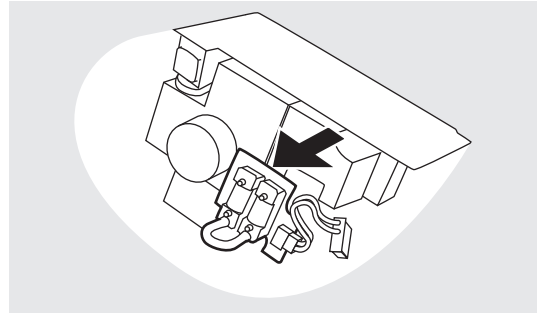
7 Disconnect the ZVU board cable.



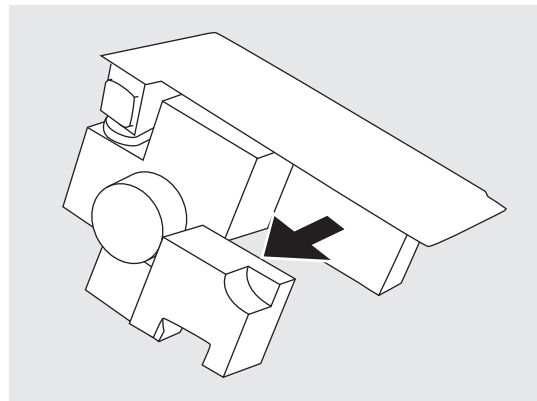
8 Remove the two screws for the ZVU board and the exhalation valve control pressure valve.
When reassembling: make sure that the two washers (one for each screw) are in place between the ZVU board and the exhalation valve control pressure valve.
The torque applied when reassembling the two screws for the ZVU board shall be 0.5 Nm.



9 Remove the ZVU board.



10 Remove the exhalation valve control pressure valve.



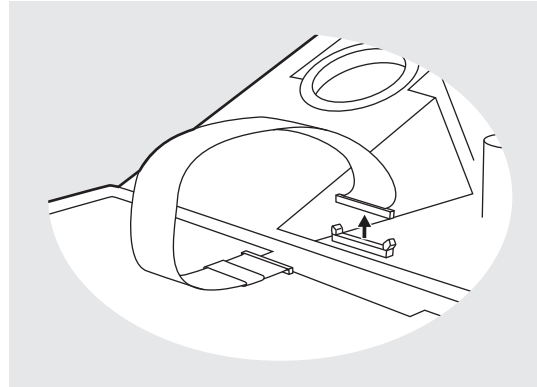
11 Reassemble in reverse order.

When reassembling:

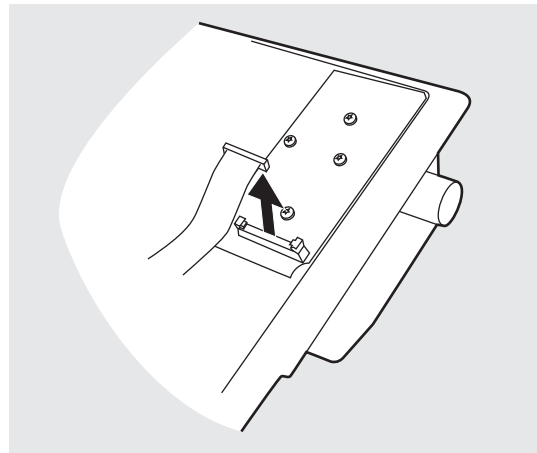
- It might be easier to connect the exhalation valve control pressure valve outlet tube first, before placing the pneumatic block.
- Make sure to find the existing screw threads when fastening the screws.
- See chapter 3.4.2, p.24 for an image of all tube connections on the Vivo 60 pneumatic block.

5.10 Replace the Cooling Fan

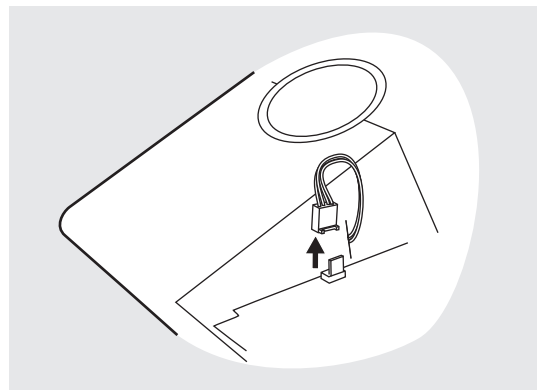
- 1 Remove the internal battery as in section 5.1.
- 2 Open the Vivo 50/60 as in section 5.3.
- 3 Disconnect the CPU board cable.
When reassembling: reconnect the cabling carefully and straight to not damage the connector.



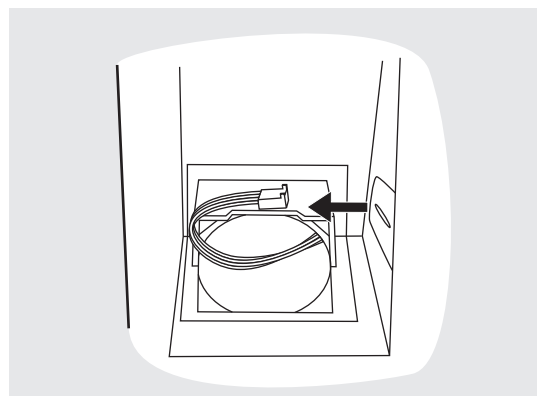
- 4 Disconnect the PTU board cable and put the top casing aside.
When reassembling: reconnect the cabling carefully and straight to not damage the connector.



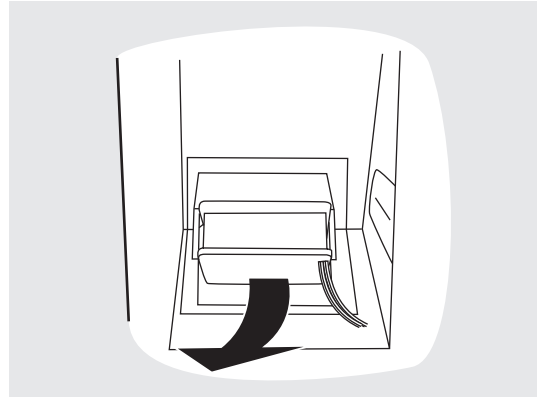
- 5 Disconnect the cooling fan cable.



- 6 Put the Vivo 50/60 on its back and pull the cable through.



- 7 Pull the cooling air fan out.

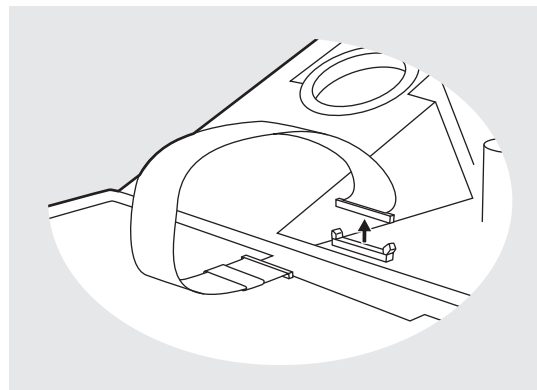


- 8 Reassemble in reverse order.

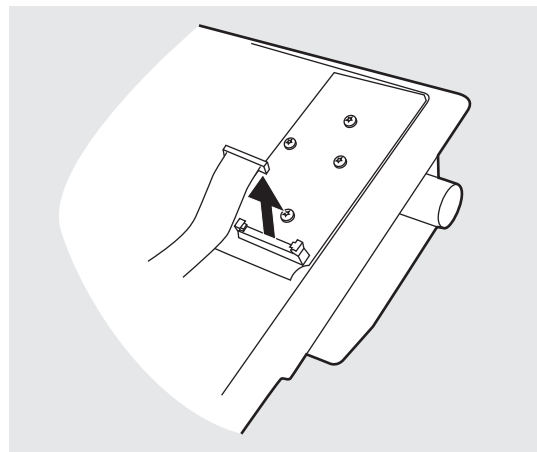
Make sure that the cooling fan and its holder is correctly fitted. The text on the fan shall be facing up.

5.11 Replace the PSU Board

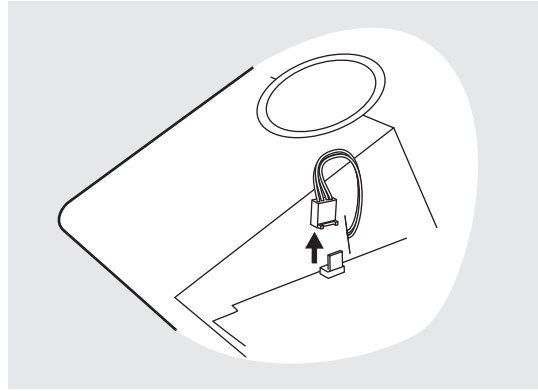
- 1 Open the Vivo 50/60 and remove the blower assembly as in section 5.4.
- 2 Disconnect the CPU board cable.
When reassembling: reconnect the cabling carefully and straight to not damage the connector.



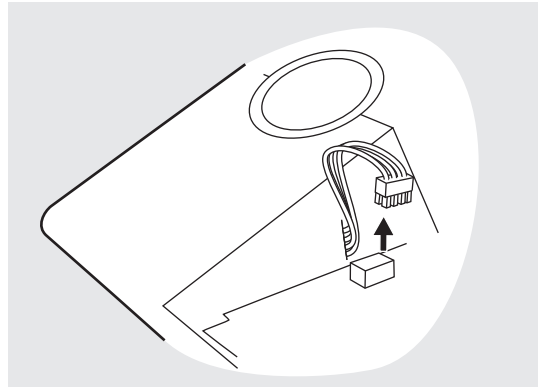
- 3 Disconnect the PTU board cable.
When reassembling: reconnect the cabling carefully and straight to not damage the connector.



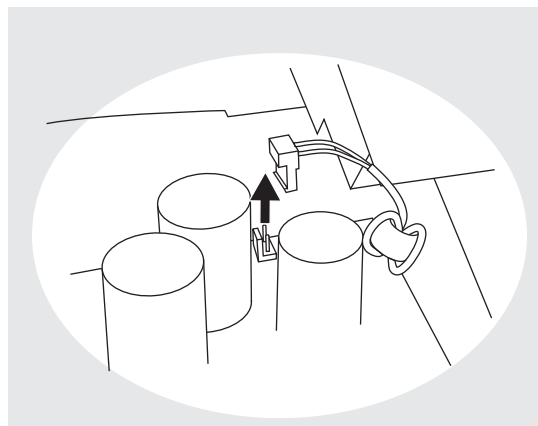
- 4 Disconnect the cooling air fan cable.



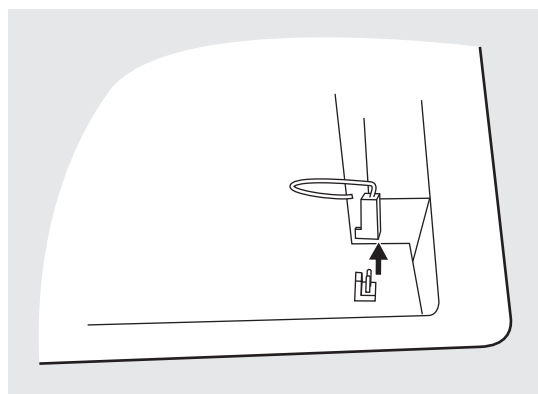
- 5 Disconnect the internal battery cable.



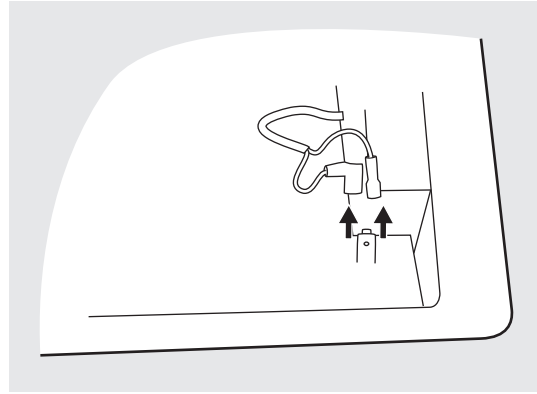
- 6 Disconnect the mains power cable.



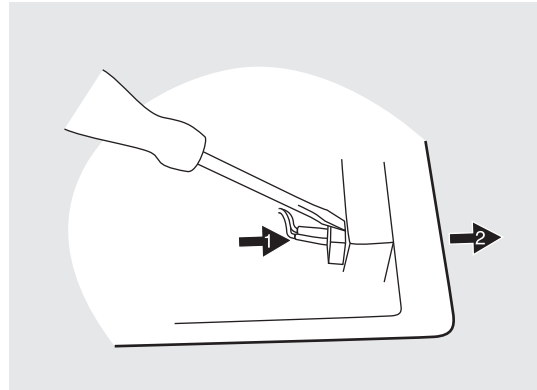
- 7 Disconnect the on/off switch cable.



8 Disconnect the two cables for external DC.

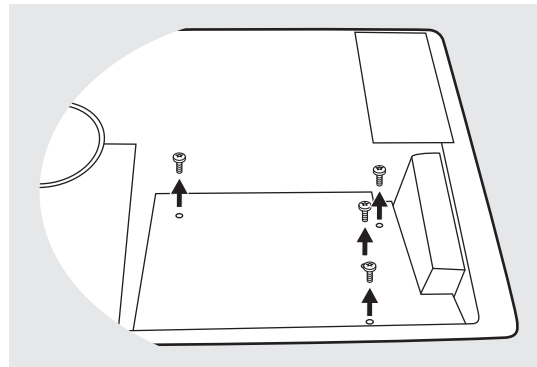


9 Remove the on/off switch using a flat head screwdriver.



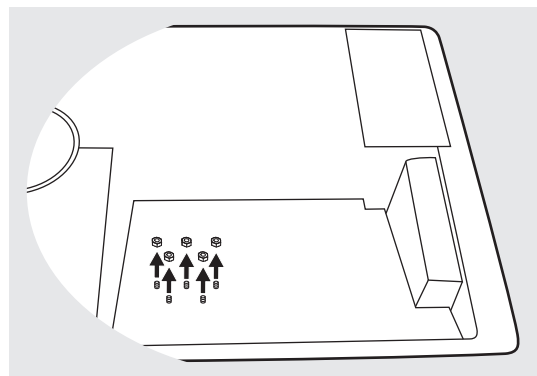
10 Remove the three or four screws (depending on revision of the PSU board) for the PSU board.

The torque applied when reassembling the four screws for the PSU board shall be 0.7 Nm.

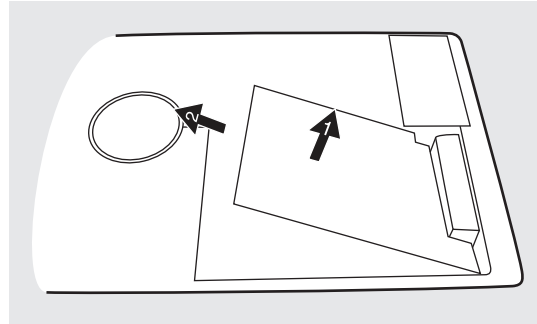


11 Remove the five nuts and ten washers for the click-on battery connector.

The torque applied when reassembling the five nuts for the click-on battery connectors shall be 0.7 Nm.

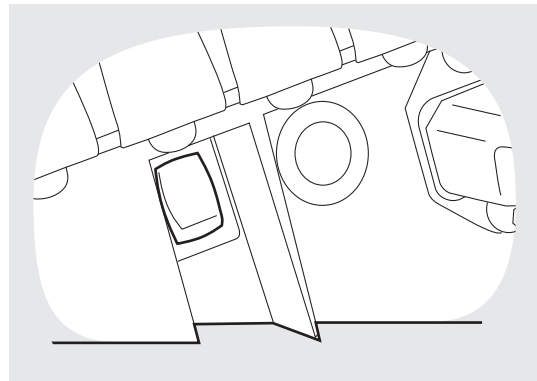


12 Lift the PSU board on the left side and pull it out.



13 Reassemble in reverse order.

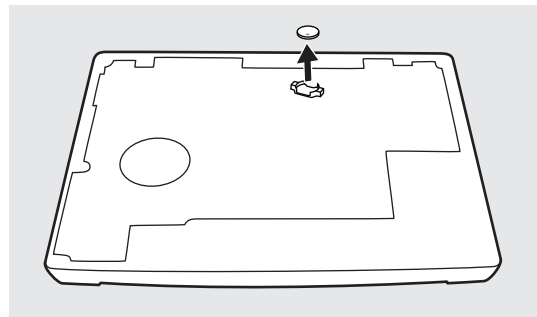
- The on/off switch shall be positioned with the high end down.



- Make sure that the click-on battery connector pins are correctly fitted.

5.12 Replace the Clock Battery

- 1 Open the Vivo 50/60 as in section 5.3.
- 2 Remove the clock battery by pulling it straight up. Press a new clock battery into place.



Make sure that the new battery is not handled with bare hands.

- 3 Reassemble in reverse order.

5.13 Replace the CPU Board

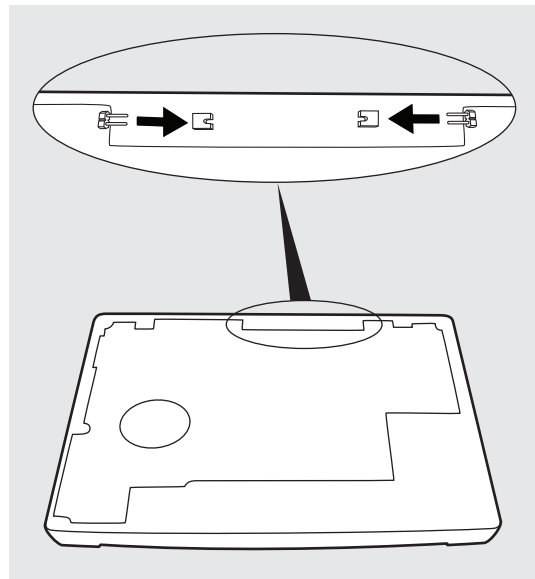


- The Vivo 50/60 serial number needs to be programmed into the new CPU board.
- Always perform a temperature compensation procedure after having replaced the CPU board.

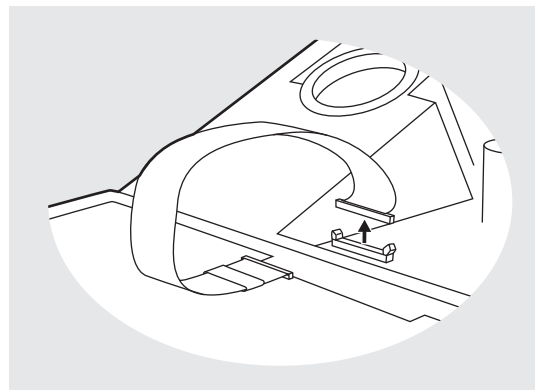


You need the Vivo 50/60 Service Software to program the CPU Board with the Vivo 50/60 serial number and perform a temperature compensation procedure.

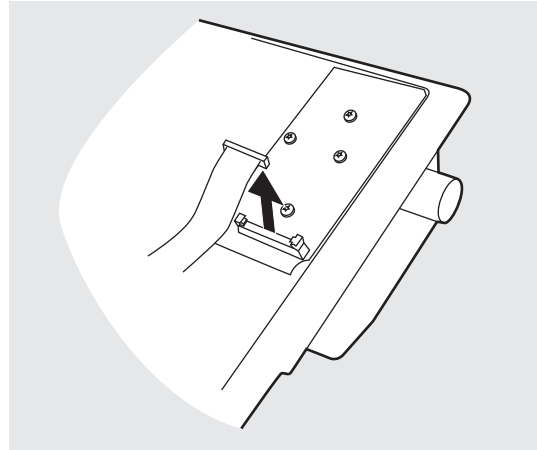
- 1 Open the Vivo 50/60 as in section 5.3.
- 2 Remove the jumpers for the alarm batteries.



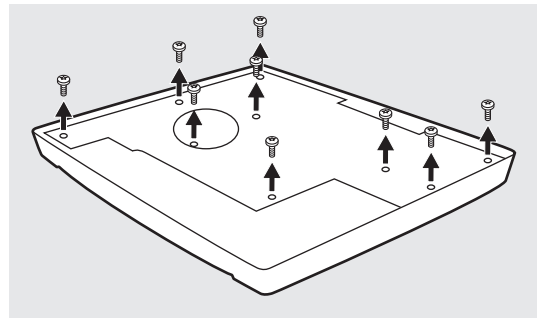
- 3 Disconnect the CPU board cable.
When reassembling: reconnect the cabling carefully and straight to not damage the connector.



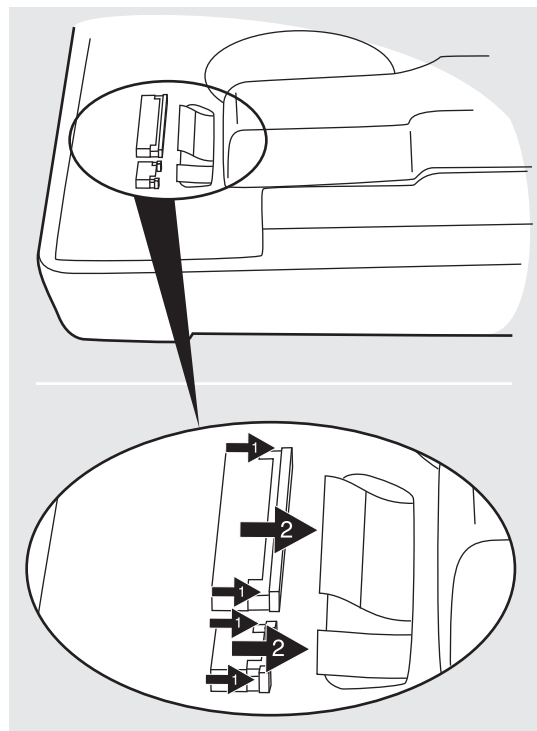
4 Disconnect the PTU board cable.
When reassembling: reconnect the cabling carefully and straight to not damage the connector.



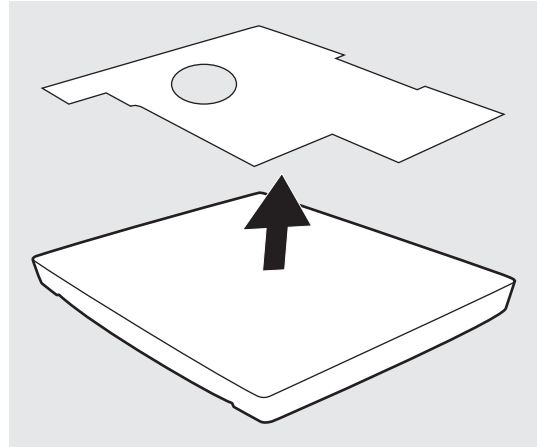
5 Remove the nine screws, marked with white rings, holding the CPU board.
The torque applied when reassembling the nine screws for the CPU board shall be 0.7 Nm.



6 Disconnect the cables for the front panel.



7 Remove the CPU board.



8 Reassemble in reverse order.

Before reassembling:

- Move the LCD display from the old CPU board to the new. See section 5.15 for instructions. Make sure that the display surface is clean before you reassemble the top casing.

When reassembling:

- Be careful not to crease or in any other way damage the front panel cables.
- Make sure that the connector covers are correctly fitted in the top casing on both sides.

5.14 Replace the Alarm Batteries

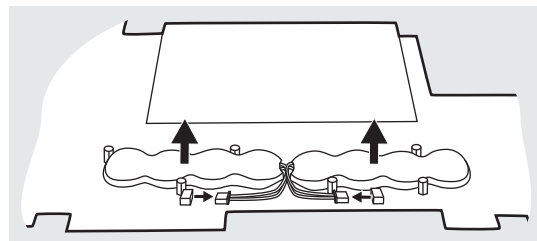
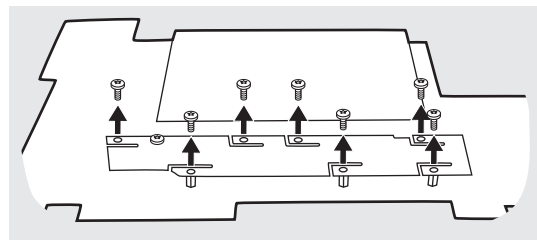
1 Open the Vivo 50/60 and remove the CPU board as in section 5.13.

2 Remove the six or seven screws (depending on revision of the CPU board) holding the alarm batteries and remove the board.

Do not loosen the eighth screw (only CPU board revision 10 or later).

The torque applied when reassembling the screws for the alarm batteries shall be 0.7 Nm.

3 Disconnect the alarm batteries and remove them.



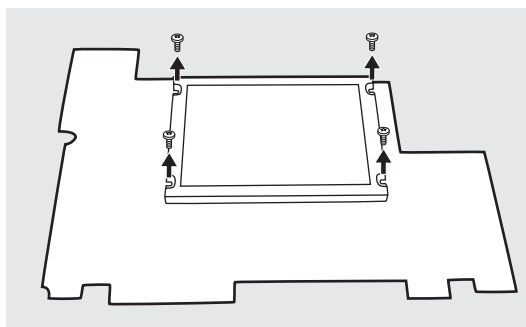
4 Reassemble in reverse order.

5.15 Replacing the LCD Display

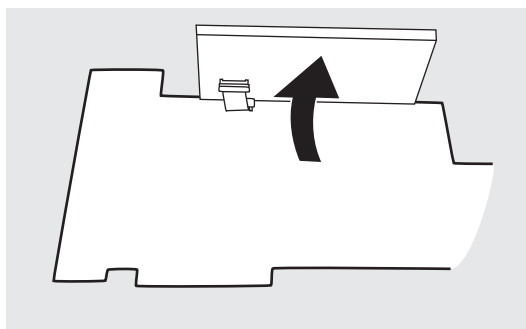
1 Remove the CPU board as in section 5.13.

2 Remove the four screws holding the display.

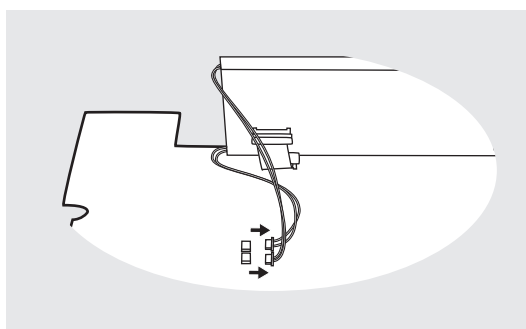
The torque applied when reassembling the four screws for the LCD display shall be 0.7 Nm.



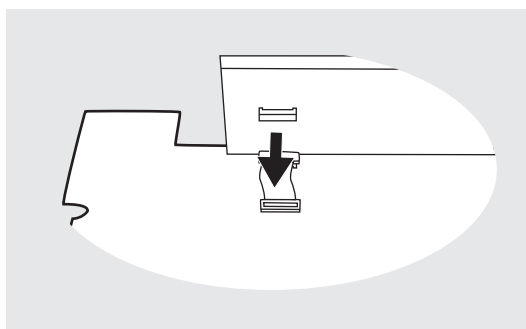
3 Carefully lift the display and angle it upwards



4 Disconnect the two backlight cables.



5 Disconnect the display cable.



6 Reassemble in reverse order.

Remove the protective film from the new display.

6 Upgrade and Calibration

6.1 Firmware Upgrade



To upgrade the Vivo 50/60 firmware you need the Firmware Upgrade Tool Vivo 50/60, which can be downloaded from the Breas extranet.

Contact Breas technical support for more information.

6.2 Pressure and Flow Calibration



To calibrate the Vivo 50/60 you need the Vivo 50/60 Service Software, which can be downloaded from the Breas extranet.

Contact Breas technical support for more information.

7 Electronics

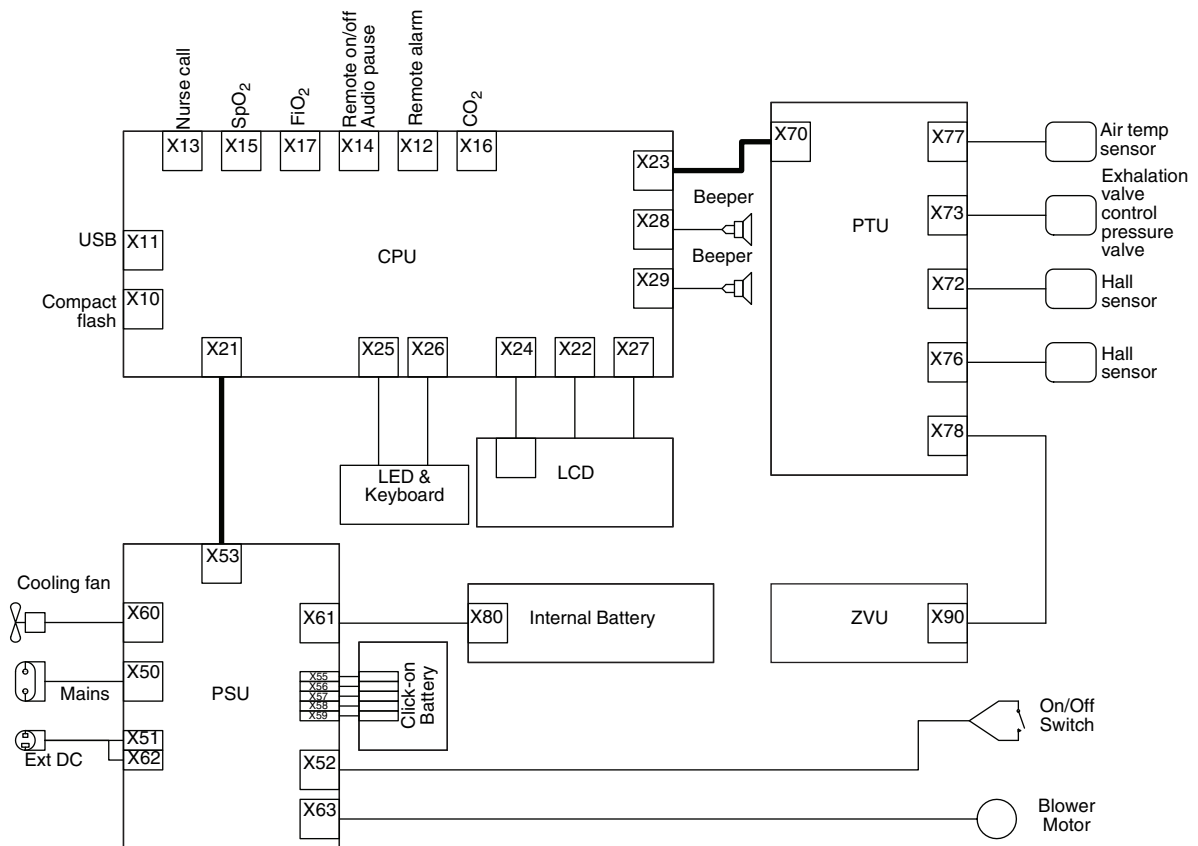


Always perform a complete function test after reassembling the Vivo 50/60.

The electronics, mechanics, and pneumatics of the Vivo 50/60 are integrated. To fully understand the electronics of the Vivo 50/60, you must know how to use the ventilator, study the pneumatic diagram and acquaint yourself with the mechanical construction.

7.1 Main Cabling Diagram of the Vivo 50/60

The diagram below illustrates the main cabling of the Vivo 50/60.

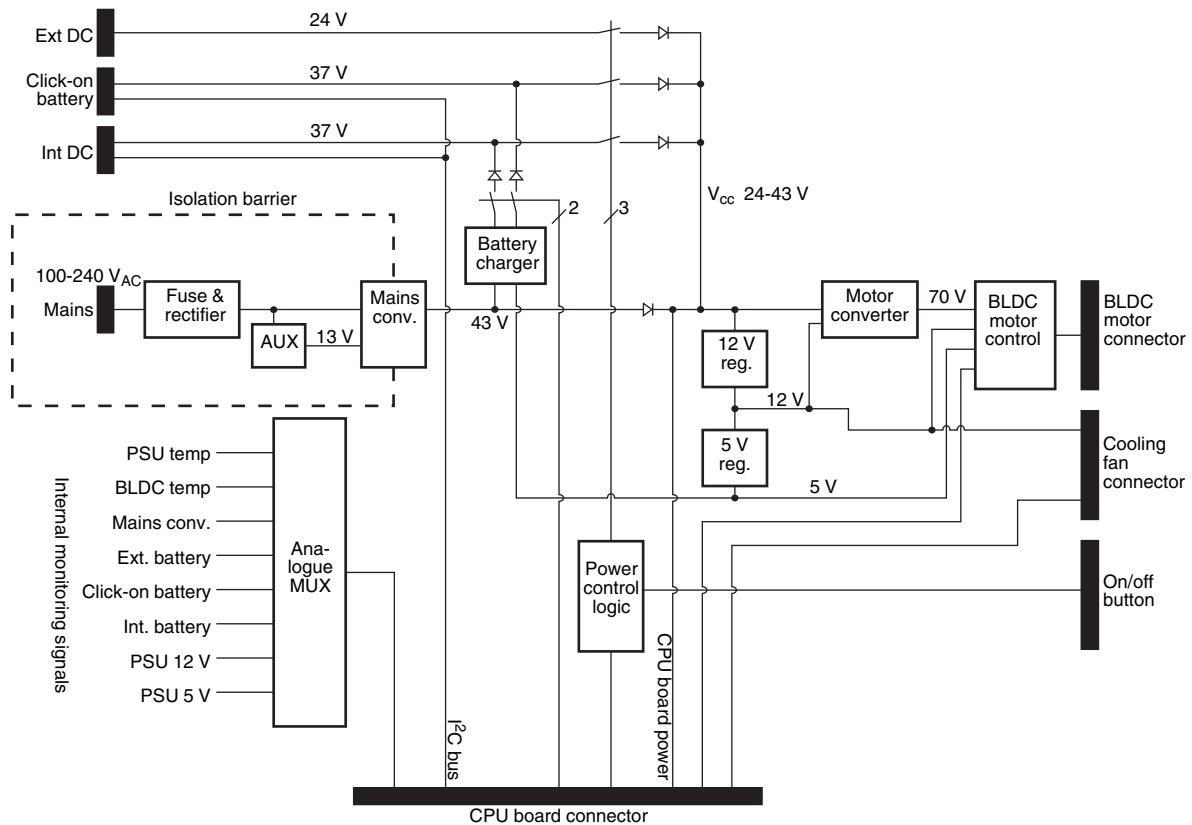


7.2 Circuit Board Descriptions

This section contains descriptions and figures of the circuit boards of the Vivo 50/60.

7.2.1 PSU (Power Supply Unit) Board

The diagram below is an overview of the PSU board



The PSU board contains the switch mode power supply (SMPS) built on the full bridge topology. The converter is powered with mains 100-240 V AC.

Power Source Selection

There are four power inputs, Mains, External DC (EXT DC), Click-on battery and Internal battery (INT DC).

The four power sources are controlled by the main processor on the CPU board. The processor senses status for each source and decides which power source to be used.

Motor Converter

The converter is a flyback converter that steps up V_{cc} to the nominal value for net VM (Voltage Motor).

Brushless DC (BLDC) Motor Controller

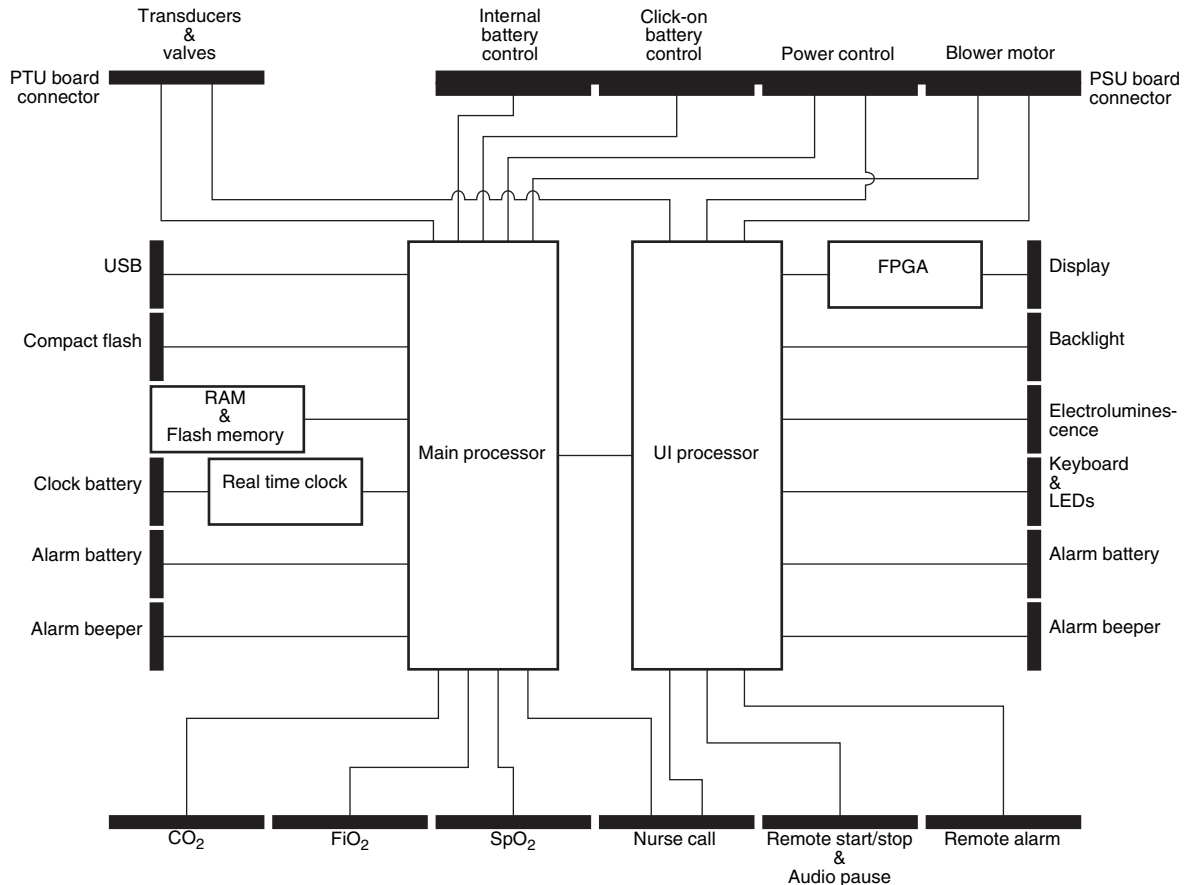
The BLDC motor controller is based on a three-phase inverter controlled by a motor control processor. The main processor regulates the speed with a PWM (pulse-width modulation) signal into the motor control processor. The main processor can also brake the BLDC motor via the control circuit. To determine if the fan is running, the main processor senses a hall element from the BLDC motor. The control circuit also has a built-in over current protection.

Internal Battery and Click-on Battery Connector

Vivo 50/60 is equipped with an internal battery pack and can be equipped with a click-on battery. Both are connected to and accessed from the PSU-board. The batteries contain its own processors and either supplies Vivo 50/60 with power, or gets charged from the Vivo 50/60.

7.2.2 CPU (Central Processor Unit) Board

The diagram below is an overview of the CPU board



Main Processor and UI Processor

The processing core of the main unit is two micro controllers.

The Main and UI processors are supplied with both +5 V and +3.3 V. The processors are not operating when the Vivo 50/60 is turned off and disconnected from mains.

FPGA (Field-Programmable Gate Array)

The FPGA serves as a graphic processor. It controls the GUI (Graphical User Interface) and drives the display.

The FPGA is connected to a separate flash memory that contains all graphical elements and GUI text strings.

Compact Flash Memory Interface

The main processor can transfer the Vivo 50/60 data memory to a compact flash memory card. The Vivo 50/60 supports CF cards up to 2 GB.

USB Interface

The USB interface is for connecting the Vivo 50/60 to a PC. When connected to a PC you can download memory data, upgrade firmware, perform calibration and more.

Display

The display used is a graphic colour type and have a visible area of approximately 135x100 mm, with a resolution of 640x480 pixels.

Alarm Beepers

Vivo 50/60 is equipped with two alarm beepers for redundancy. The alarm beepers consist of two 25 mm plastic membrane loudspeakers, each powered by a 2 W bridge-connected audio amplifier. One beeper is controlled by the main processor and the other is controlled by the UI processor.

The main processor alarm beeper can sound with adjustable volume. The UI processor alarm beeper can only give alarm at full volume.

Voltage Regulators

The CPU board contains voltage regulators for 1.2 V, 3.3 V, 5 V and 12 V.

Real Time Clock

The real time clock keeps track of time so that the clock is functioning and the memory data time is correct.

The real time clock is the only function that is running when the Vivo 50/60 is turned off and disconnected from mains. When the Vivo 50/60 is turned off and disconnected from mains the real time clock is powered by the clock battery.

Exhalation Valve Control

The exhalation valve control pressure is controlled by a piezoelectric valve that is placed in the pneumatic block. A pressure sensor monitors the pressure and gives feedback to the main processor.

The control signal is given from the main processor but goes via the PTU board to the exhalation valve control valve.

Clock Battery

The clock battery powers the real time clock when the Vivo 50/60 is not connected to mains or running from any battery power source. The only function of the clock battery is to power the real time clock.

Alarm Batteries

In case of a power failure, the alarm batteries will power the necessary components so that the Vivo 50/60 is able to give the power fail alarm.

7.2.3 PTU (Pressure Transducer Unit) Board

Sensors

The Vivo 50 and Vivo 60 PTU boards contains sensors for air flow, air outlet pressure, exhalation valve control pressure, ambient air pressure and patient air temperature. For redundancy there are two air outlet pressure sensors.

The Vivo 60 PTU board also contains sensors to measure expiratory flow when a dual limb insert is used.

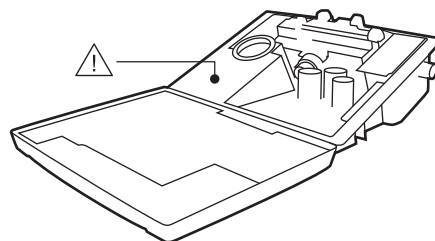
Insert recognition sensors (Vivo 60 only)

The PTU board is connected to two hall sensors that recognizes which insert that is connected to the Vivo 60.

7.3 Test Points

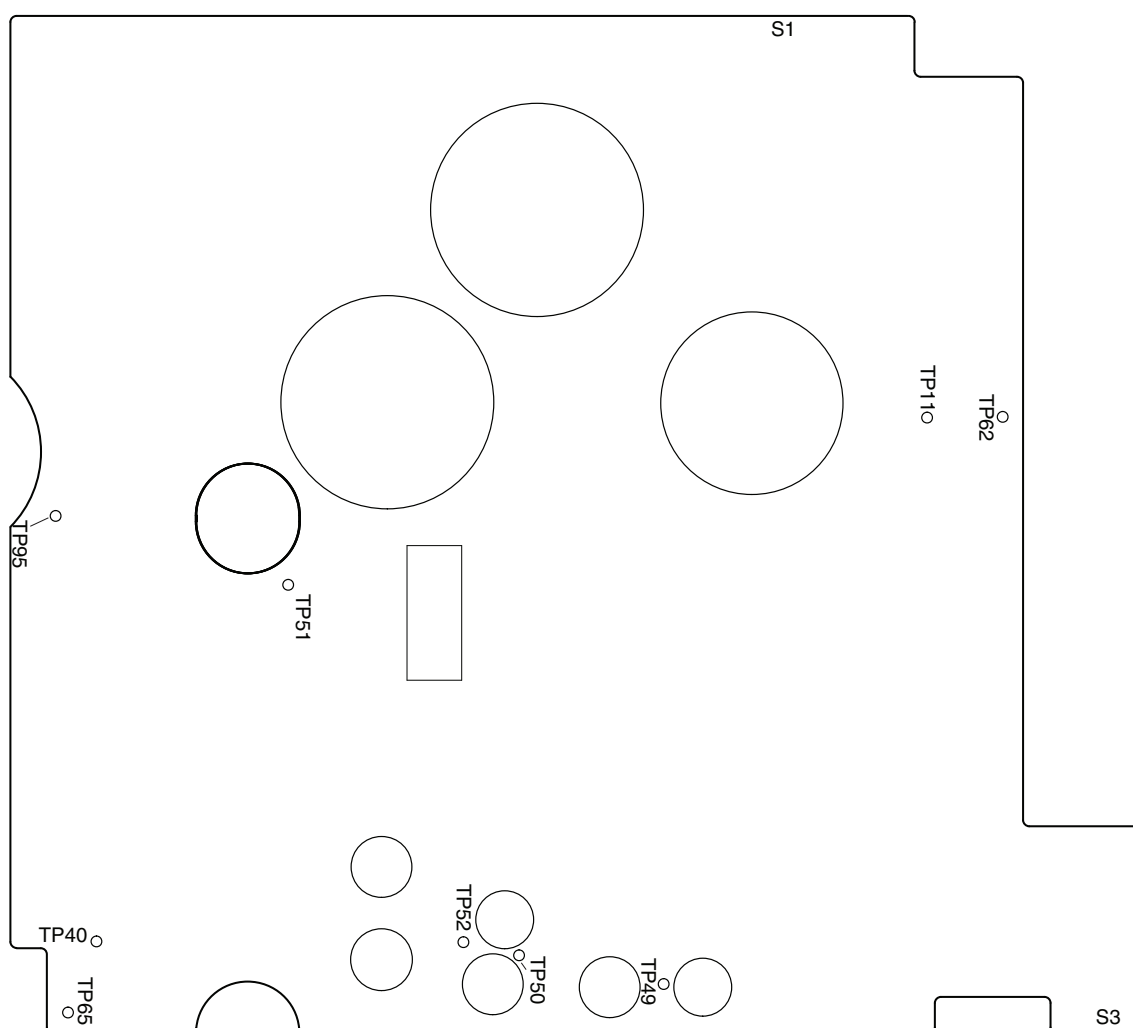


Always use extreme caution when working with the Vivo 50/60 when connected to any power source.



7.3.1 Test Point Locations

PSU Board



Test Point Matrix

The following are the test points on the PSU board of the Vivo 50/60.



All test point except TP 11 shall be measured against secondary side ground (TP 65). TP 11 shall be measured against primary side ground (TP 62).

TEST POINT	VOLTAGE	TOLERANCE	DESCRIPTION	MEASURE AGAINST	POWER SUPPLY WHEN MEASURE	MACHINE STATUS
TP 11	13.0 V	±1 V	V _{aux}	TP 62	Mains	Stand by
TP 40	42.6 V	±1 V	V _{cc}	TP 65	Mains	Stand by
TP 49	42.6 V	±1 V	Mains voltage	TP 65	Mains	Stand by
TP 50	12.15 V	±0.5 V	12 V supply regulator	TP 65	Mains	Stand by
TP 51	30-42 V		Click-on battery voltage	TP 65	Click-on battery	Stand by
TP 52	5 V	±0.25 V	5 V supply regulator	TP 65	Mains	Stand by
TP 62	0 V		Primary side ground	N/A		Stand by
TP 65	0 V		Secondary side ground	N/A		Stand by
TP 95	30-42 V		Internal battery voltage	TP 65	Int. bat.	Stand by

If any of the battery voltages (TP 51 and 95) is out of range, replace the battery.
If any other test point voltage is out of range, replace the PSU board.

Test Point Matrix

The following are the test points on the CPU board of the Vivo 50/60.

TEST POINT	VOLTAGE	TOLERANCE	DESCRIPTION	POWER SUPPLY WHEN MEASURE	MACHINE STATUS
TP1	12.2 V	±0.5 V	12 V voltage regulator	Mains	Standby
TP6	3 V	+0.5 V -1 V	Clock battery voltage	Mains disconnected	Off
TP8	4.096 V	±9 mV	Reference voltage for UI processor	Mains	Standby
TP14	4.096 V	±9 mV	Reference voltage for main processor	Mains	Standby
TP15	10.6 V	±650 mV	12 V for UI processor	Mains	Standby
TP29	10.6 V	±650 mV	12 V for main processor	Mains	Standby
TP32	30.0 V	±3.5 V	LCD backlight voltage	Mains	Standby
TP33	30.0 V	±3.5 V	LCD backlight voltage	Mains	Standby
TP54	0.6 V@ 0 cmH ₂ O, 2 V@ 50 cmH ₂ O	±0.4 V	Output from pressure sensor G2	Mains	Standby or operating at 50 cmH ₂ O
TP56	1.6 V	+0.5 V -0.7 V	Output from ambient pressure sensor	Mains	Standby
TP60	1.6 V	+1.2 V -0.5 V	Output from patient air temperature sensor	Mains	Standby
TP61	1.6 V	±0.8 V	Output from PTU board temperature sensor.	Mains	Standby
TP112	5.0 V	±250 mV	LCD power	Mains	Standby
TP113	5.0 V	±250 mV	5 V for main processor	Mains	Standby
TP114	3.3 V	±100 mV	3.3 V for main processor	Mains	Standby
TP115	5.0 V	±250 mV	5 V for UI processor	Mains	Standby
TP116	3.3 V	±100 mV	3.3 V for UI processor	Mains	Standby
TP117	4.8 V	+1 V -0.8 V	Alarm battery for UI processor	Mains disconnected	Off
TP118	4.8 V	+1 V -0.8 V	Alarm battery for main processor	Mains disconnected	Off

TEST POINT	VOLTAGE	TOLERANCE	DESCRIPTION	POWER SUPPLY WHEN MEASURE	MACHINE STATUS
TP159	78.2 V	±4 V	Button light power	Mains	Standby
TP164	42.6 V	±1 V	V _{cc}	Mains	Standby
TP165	42.6 V	±1 V	V _{cc}	Mains	Standby
TP174	1.2 V	±40 mV	+1.2 V for FPGA	Mains	Standby
TP176	3.3 V	±100 mV	+3.3 V for UI processor	Mains	Standby
TP179	5 V	±250 mV	+5 V for isolated components. Must be measured against isolated ground (TP 180).	Mains	Standby
TP180			Isolated ground	Mains	Standby

7.4 Ventilator Switch-over Operating Conditions

The Vivo 50/60 can run from four different power sources. The priority of the power sources is:

- Mains
- External DC
- Click-on battery
- Internal battery

7.4.1 Mains Power Supply Operation

If the mains drops below 60-80 V AC (depending on the settings) the Vivo 50/60 will switch over to the next available power source. The ventilator will also issue an information message stating that there has been a change of power source.

7.4.2 External Battery Operation

If the external battery voltage drops below 18 V the Vivo 50/60 will switch to next available power source. The ventilator will also issue an information message stating that there has been a change of power source.

7.4.3 Click-On Battery Operation

The click-on battery has its own integrated processor and electronics that estimates the battery's state of charge and communicates with the Vivo 50/60 main processor.

When the click-on battery is discharged it sends a signal to the Vivo 50/60 main processor which switches to the internal battery and issues an information message stating that there has been a change of power source.

7.4.4 Internal Battery Operation

The internal battery has its own integrated processor and electronics that estimates the battery's state of charge and communicates with the Vivo 50/60 main processor.

There will be an information message when the internal battery estimates that it has 50 percent of its capacity left.

When the internal battery estimates that it has 15 minutes of operation left, the Vivo 50/60 will issue a last power source low alarm.

When the internal battery is fully discharged the Vivo 50/60 will issue a power fail alarm and stop operation.

7.5 Battery Charging

7.5.1 Mains Power Supply Operation

When the Vivo 50/60 is connected to mains the internal and click-on batteries will be charged. Primarily the internal battery will be charged, then the click-on battery. Only if the click-on battery is completely discharged it will receive a short recharge before the ventilator switches to recharge the internal battery. This is to prevent the click-on battery from losing capacity due to draining (deep discharge). The internal and click-on batteries will only be charged when the internal temperature of the battery is within 0 to 45°C.

If the internal battery is not fully charged after 3 hours and 15 minutes the battery will be

considered faulty and the Vivo 50/60 will give an internal battery failure message. If the click-on battery is not fully charged after 5 hours and 30 minutes the battery will be considered faulty and the Vivo 50/60 will give a click-on battery failure message.

The alarm batteries will be charged, as well, independently from the internal and click-on battery charging.

7.5.2 External Battery Operation

The alarm batteries will be charged when the Vivo 50/60 is running from an external battery.

7.5.3 Click-On Battery Operation

The alarm batteries will be charged when the Vivo 50/60 is running from the click-on battery.

7.5.4 Internal Battery Operation

The alarm batteries will be charged when the Vivo 50/60 is running from the internal battery.

7.6 Checking the Internal Battery

1 Make sure that the battery is fully charged.

2 Adjust the settings as follows:

SETTING	VALUE
Ventilation Mode	Pressure
Breath Mode	Assist/Control
Insp. Pressure	20 cmH ₂ O
PEEP	8 cmH ₂ O
Breath Rate	15 bpm
Insp. Time	1.5 s
Rise Time	3
Insp. Trigger	Off
Target Volume	Off
Display Light	On
Light Intensity	5



Study the Vivo 50 or Vivo 60 operating manual for how to adjust the settings.

3 Disconnect the power cord.

4 Connect a test lung and start the ventilator.

5 The ventilator should run for at least one hour before shutdown. If not, replace the internal battery.

8 Fault Tracing



Always perform a Complete Function Test if you have opened the Vivo 50/60.

This chapter contains a fault-tracing table and a table of error codes to use when troubleshooting the Vivo 50/60.

8.1 Fault Tracing Table

If the Vivo 50/60 does not work properly try to identify the problem in the table below. Check the possible causes and carry out the suggested remedial actions.

SYMPTOM	POSSIBLE CAUSE	REMEDIAL ACTION	SEE REF.
The Vivo 50/60 does not start when connected to the mains supply.	A fuse has blown.	1 Check the fuses on the PSU board. 2 If it blows again, replace the PSU board.	Chapter 5.11
	The cabling for the front panel is disconnected or faulty.	1 Check the cabling for the front panel.	Chapter 5.13, 5
The keys does not work.	The front panel is faulty.	2 Replace the top casing.	
	The clock battery is discharged.	Replace the clock battery.	Chapter 5.14
The Vivo 50/60 does not show any flow during treatment.	The patient circuit type used is not the same as set on the Vivo 50/60.	1 Make sure that the correct patient circuit type is set.	
	The Vivo 50/60 is not properly calibrated.	2 Calibrate the Vivo 50/60.	Chapter 6.2
The Vivo 50 does not show EtCO₂ or Insp CO₂ during treatment, even though a CO₂ sensor is connected.	The Vivo 50 has an older Firmware that does not support the CO ₂ sensor.	1 Upgrade to the latest Firmware.	Chapter 6.1
The Vivo 50/60 does not give the adequate pressure.	External leaks from patient circuit or nasal mask.	1 Check the tubes, connectors and mask for leaks.	Chapter 2.5
	Internal leaks from tubes.	2 Check the tubes.	Chapter 2.6
	The Vivo 50/60 is not properly calibrated.	3 Calibrate the Vivo 50/60.	Chapter 6.2

8.2 Function Failure Error Codes



This chapter describes only the function failures that can occur in the Vivo 50/60. For information about alarms, refer to the Vivo 50/60 operating manual.

8.2.1 Reading the Error Codes

The error codes listed in the table in chapter 8.2.2 “Error Code Table” will appear on the display when occurs. The most recent error codes and alarms are logged in the alarm/event history.



- *Access the alarm/event history using the menu as described in the Vivo 50/60 operating manual.*
- *You can also access the alarm/event history using the Vivo 50/60 PC Software.*

8.2.2 Error Code Table

The table below lists each error code and the corresponding text that is shown on the display. The problem is explained together with the action that is necessary to correct the problem.

If more than one action is listed, the actions should be performed in the order in which they are listed. For example, if action no. 1 does not solve the problem you should continue with action no. 2, and so on.

See “Opening the Vivo 50/60 and Replacing the Main Components” on page 33 for information about how to perform the necessary replacement procedures.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
1	Int. Function Failure: 1	Main processor fails.	1 Restart the Vivo 50/60. 2 Replace the CPU board or send the Vivo 50/60 for service.
2	Int. Function Failure: 2	Main pressure sensor fails.	1 Restart the Vivo 50/60. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
3	Int. Function Failure: 3	Back-up pressure sensor fails.	1 Restart the Vivo 50/60. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
4	Int. Function Failure: 4	Sensor for exhalation valve control pressure fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
7	Int. Function Failure: 7	Flow sensor fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
8	Int. Function Failure: 8	Sensor for expiratory flow fails (Vivo 60 only).	<ol style="list-style-type: none"> 1 Restart the Vivo 60. 2 Check the pneumatic block tubes. Replace if necessary. 3 Replace the ZVU board. 4 Replace the pneumatic block and PTU board. 5 Replace the CPU board or send the Vivo 60 for service.
9	Int. Function Failure: 9	Main processor unable to communicate with UI processor.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the CPU board or send the Vivo 50/60 for service.
10	Int. Function Failure: 10	Supply current to the blower motor is too high.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the complete blower assembly. 3 Replace the CPU board or send the Vivo 50/60 for service.
11	Int. Function Failure: 11	Main processor unable to stop the blower motor.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the PSU board. 3 Replace the CPU board or send the Vivo 50/60 for service.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
12	Int. Function Failure: 12	UI processor unable to stop the blower motor.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the PSU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
13	Int. Function Failure: 13	Main processor unable to communicate with the real time clock.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 If a click-on battery is used, disconnect it and restart the Vivo 50/60. If the problem is solved replace the click-on battery. 3 Disconnect the internal battery and restart the Vivo 50/60. If the problem is solved replace the internal battery. 4 Replace the CPU board. 5 Replace the PSU board or send the Vivo 50/60 for service.
14	Int. Function Failure: 14	Main beeper fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the main beeper. 3 Replace the CPU board or send the Vivo 50/60 for service.
15	Int. Function Failure: 15	Back-up beeper fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the back-up beeper. 3 Replace the CPU board or send the Vivo 50/60 for service.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
16	Int. Function Failure: 16	Main processor unable to communicate with main beeper volume control.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 If a click-on battery is used, disconnect it and restart the Vivo 50/60. If the problem is solved replace the click-on battery. 3 Disconnect the internal battery and restart the Vivo 50/60. If the problem is solved replace the internal battery. 4 Replace the CPU board. 5 Replace the PSU board or send the Vivo 50/60 for service.
17	Int. Function Failure: 17	5 V or 12 V on CPU board is out of range.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check ribbon cable between CPU board and PSU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
18	Int. Function Failure: 18	5 V or 12 V on PSU board is out of range.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check ribbon cable between CPU board and PSU board. 3 Replace the PSU board or send the Vivo 50/60 for service.
19	Int. Function Failure: 19	Used treatment and alarm settings are corrupt. Ventilator settings returned to default values.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the CPU board or send the Vivo 50/60 for service.
20	Int. Function Failure: 20	Stored treatment and alarm settings are corrupt. Ventilator settings returned to default values.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the CPU board or send the Vivo 50/60 for service.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
21	Int. Function Failure: 21	Main processor unable to communicate with PTU board.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check ribbon cable between CPU board and PTU board. 3 Replace the pneumatic block and PTU board. 4 Replace the CPU board or send the Vivo 50/60 for service.
30	Int. Function Failure: 30	Main and back-up pressure sensors does not match.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
31	Int. Function Failure: 31	PTU board temperature is above 80°C (176°F).	<ol style="list-style-type: none"> 1 Let the Vivo 50/60 cool off and restart. 2 Check the cooling air filter. 3 Check the cabling to the cooling fan. 4 Check that the cooling fan runs. It shall always run when the Vivo 50/60 is connected to mains. If it is not running - replace the cooling fan. If it still doesn't run - replace the PSU board. 5 Replace the pneumatic block and PTU board. 6 Replace the CPU board or send the Vivo 50/60 for service.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
32	Int. Function Failure: 32	PTU board temperature is below -30°C (-22°F). Probable sensor failure.	<ol style="list-style-type: none"> 1 Place the Vivo 50/60 in normal room temperature. Open the Vivo 50/60 and make sure that there is no condensation inside. Reassemble the casing and restart. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
33	Int. Function Failure: 33	Blower temperature is above 105°C (221°F).	<ol style="list-style-type: none"> 1 Let the Vivo 50/60 cool off and restart. 2 Check the cooling air filter. 3 Check the cabling to the cooling fan. 4 Check that the cooling fan runs. It shall always run when the Vivo 50/60 is connected to mains. If it is not running - replace the cooling fan. If it still doesn't run - replace the PSU board. 5 Replace the complete blower assembly. 6 Replace the CPU board or send the Vivo 50/60 for service.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
34	Int. Function Failure: 34	Blower temperature is below -30°C (-22°F).	<ol style="list-style-type: none"> 1 Place the Vivo 50/60 in normal room temperature. Open the Vivo 50/60 and make sure that there is no condensation inside. Reassemble the casing and restart. 2 Check test point 52 (see chapter 7.3). If it is out of range - replace the PSU board. 3 Replace the complete blower assembly. 4 Replace the CPU board or send the Vivo 50/60 for service.
35	Int. Function Failure: 35	PSU board temperature is above 85°C (185°F).	<ol style="list-style-type: none"> 1 Let the Vivo 50/60 cool off and restart. 2 Check the cooling air filter. 3 Check the cabling to the cooling fan. 4 Check that the cooling fan runs. It shall always run when the Vivo 50/60 is connected to mains. If it is not running - replace the cooling fan. If it still doesn't run - replace the PSU board. 5 Replace the CPU board or send the Vivo 50/60 for service.
36	Int. Function Failure: 36	PSU board temperature is below -5°C (23°F).	<ol style="list-style-type: none"> 1 Place the Vivo 50/60 in normal room temperature for 30 minutes and restart. 2 Replace the PSU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
37	Int. Function Failure: 37	One or more sensors are out of range.	Calibrate the Vivo 50/60.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
38	Int. Function Failure: 38	Temperature compensation out of range.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Send the Vivo 50/60 for service.
39	Int. Function Failure: 39	The blower does not function properly.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check the cabling for the blower assembly. 3 Replace the complete blower assembly. 4 Replace the PSU board. 5 Replace the CPU board or send the Vivo 50/60 for service.
40	Int. Function Failure: 40	Patient air temperature is below -30°C (-22°F).	<ol style="list-style-type: none"> 1 Place the Vivo 50/60 in normal room temperature. Open the Vivo 50/60 and make sure that there is no condensation inside. Reassemble the casing and restart. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
41	Int. Function Failure: 41	The blower does not function properly.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check the cabling for the blower assembly. 3 Replace the complete blower assembly. 4 Replace the PSU board. 5 Replace the CPU board or send the Vivo 50/60 for service.
42	Int. Function Failure: 42	The blower does not function properly.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check the cabling for the blower assembly. 3 Replace the complete blower assembly. 4 Replace the PSU board. 5 Replace the CPU board or send the Vivo 50/60 for service.

ERROR CODE	TEXT ON DISPLAY	PROBLEM	ACTION
43	Int. Function Failure: 43	The blower does not function properly.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check the cabling for the blower assembly. 3 Replace the complete blower assembly. 4 Replace the PSU board. 5 Replace the CPU board or send the Vivo 50/60 for service.
50	Int. Function Failure: 50	UI processor fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the CPU board or send the Vivo 50/60 for service.
51	Int. Function Failure: 51	Cooling fan fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check the cabling for the cooling fan. 3 Replace the cooling fan. 4 Replace the PSU board. 5 Replace the CPU board or send the Vivo 50/60 for service.
53	Int. Function Failure: 53	Graphic controller (FPGA) fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the CPU board or send the Vivo 50/60 for service.
54	Int. Function Failure: 54	UI processor detects that the patient pressure is too high.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Replace the pneumatic block and PTU board. 3 Replace the CPU board or send the Vivo 50/60 for service.
55	Int. Function Failure: 55	Alarm batteries fails.	<ol style="list-style-type: none"> 1 Restart the Vivo 50/60. 2 Check the alarm battery jumpers. 3 Check the cabling for the alarm batteries. 4 Replace the alarm batteries. 5 Replace the CPU board or send the Vivo 50/60 for service.

9 Appendices

9.1 Emission and Immunity Declaration

According to IEC 60601-1-2(2001) + A1(2004).

9.1.1 Guidance and Manufacturer's Declaration – Electromagnetic Immunity


The Vivo 50/60 is intended for use in the electromagnetic environment specified below. The customer or the user of the Vivo 50/60 should assure that it is used in such an environment.

IMMUNITY TEST	IEC 60601 TEST LEVEL	COMPLIANCE LEVEL	ELECTROMAGNETIC ENVIRONMENT - GUIDANCE
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±8 kV contact ±15 kV air	The relative humidity should be at least 5 %.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	Mains power quality should be that of a typical commercial or hospital environment.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	30 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % <i>UT</i> (>95 % dip in <i>UT</i>) for 0.5 cycle 40 % <i>UT</i> (60 % dip in <i>UT</i>) for 5 cycles 70 % <i>UT</i> (30 % dip in <i>UT</i>) for 25 cycles <5 % <i>UT</i> (>95 % dip in <i>UT</i>) for 5 seconds	0 %	Vivo 50/60 runs on internal battery during voltage dips, short interruptions and voltage variations on power supply input lines.



UT is the mains voltage prior to application of the test level.

Portable and mobile RF (radio frequency) communications equipment should not be used no closer to any part of the Vivo 50/60, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.

IMMUNITY TEST	IEC 60601 TEST LEVEL	RECOMMENDED SEPARATION DISTANCE
Conducted RF IEC 61000-4-6	10 V _{rms} 150 kHz to 80 MHz	$d=0.35*\sqrt{P}$ m at 150 kHz to 80 MHz
Radiated RF IEC 61000-4-3	20 V/m 80 MHz to 2.5 GHz	$d= 0.6*\sqrt{P}$ m at 80 MHz to 800 MHz $d= 1.2*\sqrt{P}$ m at 800 MHz to 2.5 GHz Equation description: P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey ^a , should be less than the compliance level in each frequency range ^b .  Interference may occur in the vicinity of equipment marked with this symbol.

Notes

- At 80 MHz and 800 MHz, the higher frequency range applies.
 - These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.
- a) Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Vivo 50/60 is used exceeds the applicable RF compliance level above, the Vivo 50/60 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Vivo 50/60.
- b) Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

9.1.2 Guidance and Manufacturer's Declaration – Electromagnetic Emission

The Vivo 50/60 are intended for use in the electromagnetic environment specified below. The customer or the user of the Vivo 50/60 should assure that it is used in such an environment.

EMISSIONS TEST	COMPLIANCE	ELECTROMAGNETIC ENVIRONMENT – GUIDANCE
RF emissions CISPR 11	Group 1	The Vivo 50/60 use RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The Vivo 50/60 are suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emission IEC 61000-3-3	Complies	

9.1.3 Recommended separation distances between portable and mobile RF communications equipment and the Vivo 50/60

The Vivo 50/60 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Vivo 50/60 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Vivo 50/60 as recommended below, according to the maximum output power of the communications equipment.

RATED MAXIMUM OUTPUT POWER OF TRANSMITTER (W)	SEPARATION DISTANCE ACCORDING TO THE FREQUENCY OF TRANSMITTER (M)		
	150 kHz to 80 MHz $d = 0.35 \cdot \sqrt{P} \text{ m}$	80 MHz to 800 MHz $d = 0.6 \cdot \sqrt{P} \text{ m}$	800 MHz to 2.5 GHz $d = 1.2 \cdot \sqrt{P} \text{ m}$
0.01	0.035	0.06	0.12
0.1	0.11	0.19	0.36
1	0.35	0.60	1.2
10	1.1	1.9	3.6
100	3.5	6.0	12

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

Notes

- At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
- These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

9.2 Service Record Vivo 50/60



Use a photocopy of this service record for the maintenance inspection described in “Maintenance Instructions” on page 8. Use the next page for comments and notes.

Service record no. _____

Model:..... **Serial no.** **Inventory no.**

Accessories:

Delivery date: Device operating hours:

Service started: Signature:

Service completed:..... Signature:

Product returned:..... Signature:

General	See instruction ref.	Check OK
Open new service record and identify ventilator	2.3.2, p.10	.....
Note number of device operating hours	2.4.2, p.11	.....
Check all markings	2.4.3	.....
Check information from user	2.4.4	.....
Check validity of documentation	2.4.5	.....
External Checks		
Inspect for external damage and wear	2.5.1, p.12	.....
Check power connection	2.5.2	.....
Inspect patient circuit	2.5.3	.....
Inspect the ventilator accessories	2.5.4	.....
Change/wash the patient filters	2.5.5	.....
Perform minimum function check	2.5.6	.....
Internal Battery		
Every 3 years:		
Replace the internal battery	5.1, p.33	.....
Perform an power fail alarm check	2.7, p.13	.....
Alarm/Clock Battery		
Every 5 years:		
Replace the alarm batteries	5.14, p.55	.....
Replace the clock battery	5.14, p.55	.....
Blower Assembly		
Every 20 000 device operating hours:		
Replace the complete blower assembly	5.4, p.37	.....
Internal Checks (when required)		
Clean inside of ventilator	2.6.1, p.12	.....
Check cabling	2.6.2	.....
Check fastening of components	2.6.3	.....
Check the power supply	2.6.4	.....
Reassemble the casing	2.6.5	.....
Complete Function Test		
Perform a complete function test	2.8, p.13	.....

9.3 Returning Products to Breas



Use the RMA (return material authorisation) request on the Breas Extranet if you want to return any product to Breas.

Contact your Breas representative for more information.



Product damage caused by poor packaging or during transportation is not covered by the factory warranty.

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