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1 Introduction

This chapter gives an overview of the Vivo 30/40 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 30/40 service training.**

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

1.1 About the Vivo 30/40 Ventilator

1.1.1 Function

The Vivo 30/40 is a pressure-supported and pressure-controlled ventilator for patients who require intermittent support by mechanical ventilation.

It has three modes of operation: PSV, PCV, and CPAP. The PSV and PCV modes have an adjustable trigger sensitivity setting which allows the patient to initiate ventilator-assisted breaths.

In the PCV mode (Pressure Controlled Ventilation), the ventilator provides assisted or controlled pressure-regulated breathing.

In the PSV mode (Pressure Support Ventilation), the ventilator's expiratory sense can also be adjusted allowing the ventilator to more easily match each patient's needs.

In the CPAP mode (Continuous Positive Airway Pressure), the ventilator provides a continuous positive airway pressure.

The logs of the Vivo 30/40 can be downloaded to a PC, printed out, and analysed via the Vivo 30/40 PC Software. For more information about the Vivo 30/40 PC Software, please contact your Breas representative.

1.1.2 Intended Use

For a detailed description on intended use, refer to the Vivo 30/40 Clinician's or User Manuals.

1.1.3 Design

The Vivo 30/40 is constructed around a blower assembly.

An electronically controlled stepmotor rotates a valve to control the pressure. A microprocessor controls the correct speed of the blower motor and its power supply by means of calculations based on the settings for pressure, rate, inspiration time, etc. The pressure and trigger settings are monitored at the same time.

1.1.4 Service Personnel's Training Requirements

Service personnel working with the Vivo 30/40 should have medical/technical training and a good knowledge of the construction and function of respiratory devices. Authorisation by Breas after Vivo 30/40 service training is mandatory.

Always contact your Breas representative if you have any questions or if any 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 30/40. 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, wiring diagrams, component location guides, etc.

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

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 30/40 service training is mandatory.

Always contact your Breas representative if you have any questions or if any 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 30/40 Clinician's and User 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
	Warning! Risk of death and serious personal injury.
	Caution! Risk of minor or moderate injury. Risk of equipment damage, loss of data, extra work, or unexpected results.
	Note Information that may be valuable but is not of critical importance, tips.
	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 30/40.

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 30/40 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 30/40 User and Clinician's Manual.

2.1 Purpose

The Vivo 30/40 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 considerably increase the expected lifetime of the ventilator.

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	SECTION
Every 12 months	Perform external inspection.	2.5
	Perform a complete function test.	2.7
Every 2 years	Change the internal battery kit (Vivo 40 only).	5.1
Every 5 years	Change the clock battery.	5.6
	Change the alarm battery.	5.7
	Perform an internal inspection.	2.6
	Check the power failure alarm.	2.9
Every 20,000 total operating hours	Change the complete blower assembly.	5.2
	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 30/40:

- Do not work on the ventilator with the casing removed and the power supply connected, unless the instructions in this manual clearly says so.
- Always use caution when working with the ventilator connected to the mains 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 30/40 User and Clinician's Manuals 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 30/40, make sure you have the following equipment at hand:

- Test lung or reservoir bag (for example Breas part no 001917).
- Measuring instrument for tidal volume and minute volume/rate (ventilator tester, spirometer, or equivalent, for example Fluke VT Plus).
- Pressure manometer (for example Thommen HM 28 digital manometer, Breas part no 001937).
- Digital voltmeter.
- Standard toolkit containing screwdrivers, including small potentiometer screwdriver, and Torx keys, TX 10 and TX 20.
- Vivo to PC communication cable, Breas part no 003588.
- Vivo 30/40 Service Software (compatible with Fluke VT Plus, Thommen HM 28 and TSI 4040), available for download from Breas Extranet. Contact Breas technical support for more information.
- Vivo Training CD, Breas part no 004278.
- External battery (24 or 12 V, for example Breas EB 2).
- Flow meter (for example TSI 4040).
- Test connector kit, Breas part no 004829 (connectors and leakageports used when testing).

2.3.4 Replacement Parts

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

DESCRIPTION	PART NO.
Patient air filter, grey, washable	003563
Patient air filter, white, disposable	003564
If required:	
Internal battery kit (Vivo 40)	003452
Alarm battery, NiMH 4.8 V, 70 mAh Clock battery, CR 2032	004007
Blower assembly kit for replacement after a total operating time of 20,000 hours	003524

2.4 Preparing for Inspection

2.4.1 Initial Recording

1. Copy a new service record (see "Service Record Vivo 30/40" on page 67).
2. Identify the Vivo 30 or Vivo 40.
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 Total 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 30/40 Clinician's Manual.

2. Check the service schedule to see whether the alarm/clock batteries, the internal battery kit (Vivo 40 only), or the complete motor 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 before the next service?
- Other observations?

2.4.5 Validity of the Documentation

1 Check the validity of the User or Clinician's 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 that the rear lid is connected properly to the ventilator.

2.5.2 Checking the HA 01 Humidifier (if used)

1 Remove and open the HA 01.

2 Check that there is no visible damage.

3 Check that the water container is clean.

4 Check that the humidifier is connected properly to the ventilator.

2.5.3 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 strain-relief clamp for the power cord is not damaged.

3 Inspect the external battery cable, if used.

4 Check the external battery socket in the ventilator.

2.5.4 Inspecting the Patient Circuit

Inspect the patient circuit and replace it if necessary.

2.5.5 Inspecting the Ventilator Accessories

Check any other accessories that are used with the ventilator.

2.5.6 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.

2.5.7 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

Perform the internal inspection after having opened the Vivo 30/40.

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

2.6.1 Cleaning the Inside of the Ventilator

1. Open the casing. See "Opening the Vivo 30/40 and Replacing the Main Components" on page 34 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. Check the front and rear panels to make sure that the cables and the wires are not pinched or kinked.

2.6.3 Checking the Fastening of Components

Make sure that all the components, such as the blower assembly, the circuit boards and the connectors are securely fastened.

2.6.4 Checking the Power Supply

1. Make sure that the power connector is undamaged and that it is securely in place.
2. Check the wiring to the CPU board.
3. Check that the PSU cooling fan is securely in place.

2.6.5 Reassembling the Casing

See "Opening the Vivo 30/40 and Replacing the Main Components" on page 34 for instructions.

2.7 Complete Function Test

You can also perform the complete function test using the Vivo 30/40 Service Software.

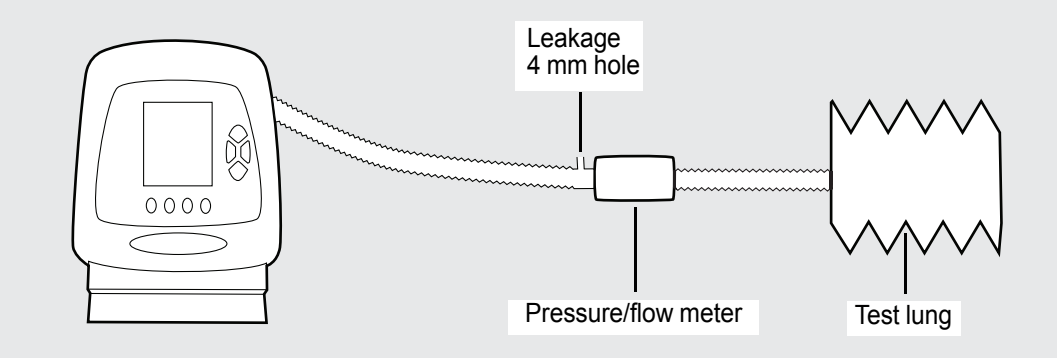
To perform a complete function test, all tasks in this section need to be completed in the written order.

2.7.1 Checking the Breath Rate and Inspiration Time

1 Adjust the settings as follows:

SETTING	VALUE
Mode	PCV
Target Volume	Inactive
IPAP	20 cmH_2O
EPAP	4 cmH_2O
Set Rate	10 bpm
Inspiration Time	3.0 s
Rise Time	3
Inspiration Trig	3

2 Connect a pressure/flow meter and test lung or a reservoir bag to the ventilator.



3 Measure and check that the measured values for rate and inspiration time are correct (tolerance ±10%).

2.7.2 Checking the Pressure

1 Adjust the settings as follows:

SETTING	VALUE
Mode	PCV
IPAP	4 cmH_2O
EPAP	2 cmH_2O
Inspiration Time	5.0 s

2 Connect a pressure manometer or ventilator tester to the ventilator.

3 Measure and check that the measured IPAP value for each pressure is correct.

EPAP	IPAP	TOLERANCE
5 cmH_2O	10 cmH_2O	±1.8 cmH_2O
10 cmH_2O	20 cmH_2O	±2.8 cmH_2O
15 cmH_2O	30 cmH_2O	±3.8 cmH_2O

If the measured pressure values are not within tolerance, perform a pressure calibration/adjustment of the ventilator (see "Pressure and Flow Calibration" on page 46).

2.7.3 Checking the Tidal Volume Indication

1 Adjust the settings as follows:

SETTING	VALUE
Mode	PCV
IPAP	30 cmH_2O
EPAP	4 cmH_2O
Set Rate	8 bpm
Inspiration Time	5.0 s

2 Connect a ventilator tester to the ventilator.

3 Measure and check that the measured value for volume is correct (tolerance ±20%).

If the measured volume value is not within tolerance, perform a volume calibration/adjustment of the ventilator (see "Pressure and Flow Calibration" on page 46).

2.7.4 Preparing the Ventilator for Alarm Checks

1 Connect the ventilator to the mains power supply and switch it on by pressing the On/Off button on the side panel.
The ventilator should be in stand-by mode (not operating) and the mains LED ⏦ on the front panel should be lit.

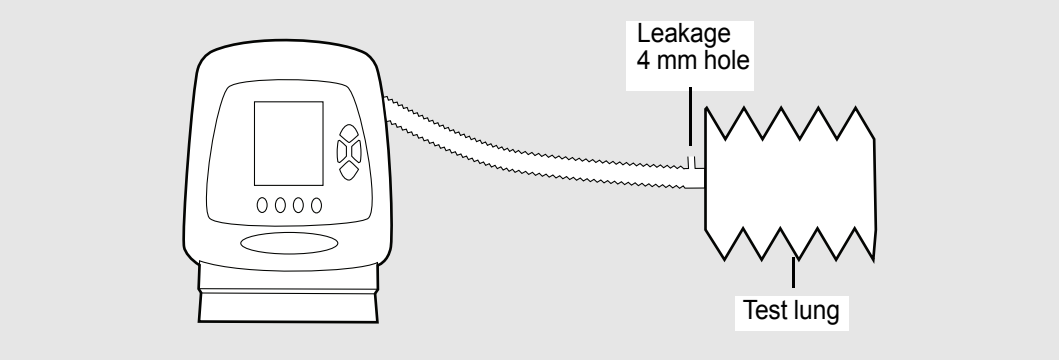
Do not connect the patient circuit.

2 Adjust the settings as follows:

SETTING	VALUE
Mode	PCV
IPAP	14 cmH_2O
EPAP	2 cmH_2O
Set Rate	10 bpm
Inspiration Time	1.5 s
Rise Time	4
Inspiration Trig	Off
Low Pressure Alarm	2 cmH_2O
Low Volume Alarm	0.05 l
High Breath Rate Alarm (Vivo 40 only)	Off
Low Breath Rate Alarm (Vivo 40 only)	4 bpm

2.7.5 Checking the Low Leakage Alarm and High Leakage Alarm

1 Connect a test lung or a reservoir bag to the ventilator.



2 Enter operating mode by switching the ventilator on with the Start/Stop button.

3 Block the leakage hole.

The low leakage Alarm shall occur within 60 seconds.

4 Disconnect the hose from the air outlet.

The low leakage Alarm shall disappear and the high leakage alarm shall occur within 30 seconds.

2.7.6 Checking the High Pressure Alarm

1 Enter stand-by mode by switching the ventilator off with the Start/Stop button.

2 Connect a patient circuit to the ventilator.

3 Enter operating mode by switching the ventilator on with the Start/Stop button.

4 Create pressure towards the ventilator by blowing air into the mask or patient tube.

The high pressure alarm shall be activated after 3 consecutive high pressure breaths.

2.7.7 Checking the Inspiratory Trigger

1 Set the inspiratory trigger to 3.

2 Create a spontaneous breath (inspiratory flow) and make sure a triggered breath is given.
The green Inspiratory Trigger (T) LED shall be lit.

2.7.8 Checking the Low Pressure Alarm

1 Enter stand-by mode by switching the ventilator off with the Start/Stop button.

2 Connect the patient circuit to a test lung (<1.5 l) and a leakage connector.

3 Adjust the settings as follows:

SETTING	VALUE
IPAP	12 cmH_2O
Low Pressure Alarm	10 cmH_2O

4 Enter operating mode by switching the ventilator on with the Start/Stop button.

5 Adjust the IPAP to 5 cmH_2O.
The low pressure alarm shall occur within 30 seconds.

6 Adjust the IPAP to 12 cmH_2O again.
The low pressure alarm shall disappear.

2.7.9 Checking the High Breath Rate Alarm (Vivo 40 only)

1 Adjust the settings as follows:

SETTING	VALUE
IPAP	15 cmH_2O
EPAP	10 cmH_2O
Set Rate	20 bpm
High Breath Rate Alarm	10 bpm

The high breath rate alarm shall occur within 30 seconds.

2 Adjust the set rate to 5 bpm.
The high breath rate alarm shall disappear within 30 seconds.

2.7.10 Checking the Low Breath Rate Alarm (Vivo 40 only)

1 Adjust the settings as follows:

SETTING	VALUE
Set Rate	5 bpm
High Breath Rate Alarm	Off
Low Breath Rate Alarm	15 bpm

The low breath rate alarm shall occur within 30 seconds.

2 Adjust the set rate to 20 bpm.
The low breath rate alarm shall disappear in 30 seconds.

2.7.11 Checking the Low Volume Alarm

SETTING	VALUE
Low Volume Alarm	2.0 l

1 Adjust the settings as follows:

The low volume alarm shall occur within 20 seconds.

2 Adjust the low volume alarm to 0.05 l.

The low volume alarm shall disappear within 30 seconds.

2.7.12 Checking the Audio Pause

1 Switch on the ventilator. Disconnect the patient circuit.

The low pressure alarm shall occur in 15 seconds.

2 Press the audio pause button and make sure the audible alarm is paused.

3 Check that the audible alarm starts again after approximately 1 minute.

2.7.13 Checking External Battery Operation

1 Start the ventilator.

2 Connect an external battery to the ventilator.

3 Disconnect the mains power cord while the ventilator is running.

4 Check that the ventilator automatically switches over to external battery operation.

The following shall occur:

- A short audible alarm sounds (Vivo 30 only).
- The message "Changed Power Source Switched to External Battery" is shown in the display.
- The power source LED is changed to external DC. ⎓

5 Reconnect the power cord and check that the power source LED is changed to mains. ∿

2.7.14 Checking the Internal Battery Operation (Vivo 40 only)

1 Start the ventilator.

2 Disconnect any external battery from the ventilator.

3 Disconnect the mains power cord while the ventilator is running.

4 Check that the ventilator automatically switches over to internal battery operation.

The following should occur:

- A short audible alarm sounds.
- The message "Changed Power Source Switched to Internal DC" is shown in the display.
- The power source LED is changed to internal DC. ▭

5 Reconnect the power cord and check that the power source LED is changed to mains. ∿

2.7.15 Adjusting the Settings for the Patient

Adjust the settings as prescribed for the patient.

2.8 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 MΩ .

Leakage Currents

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 mA

SFC <0.5 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 mA

SFC <0.5 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 mA

2.9 Power Failure Alarm Check

2.9.1 Vivo 30

1. Start the Vivo 30 with the power cord connected.
2. Disconnect the power cord.

The power failure alarm shall occur immediately.

2.9.2 Vivo 40

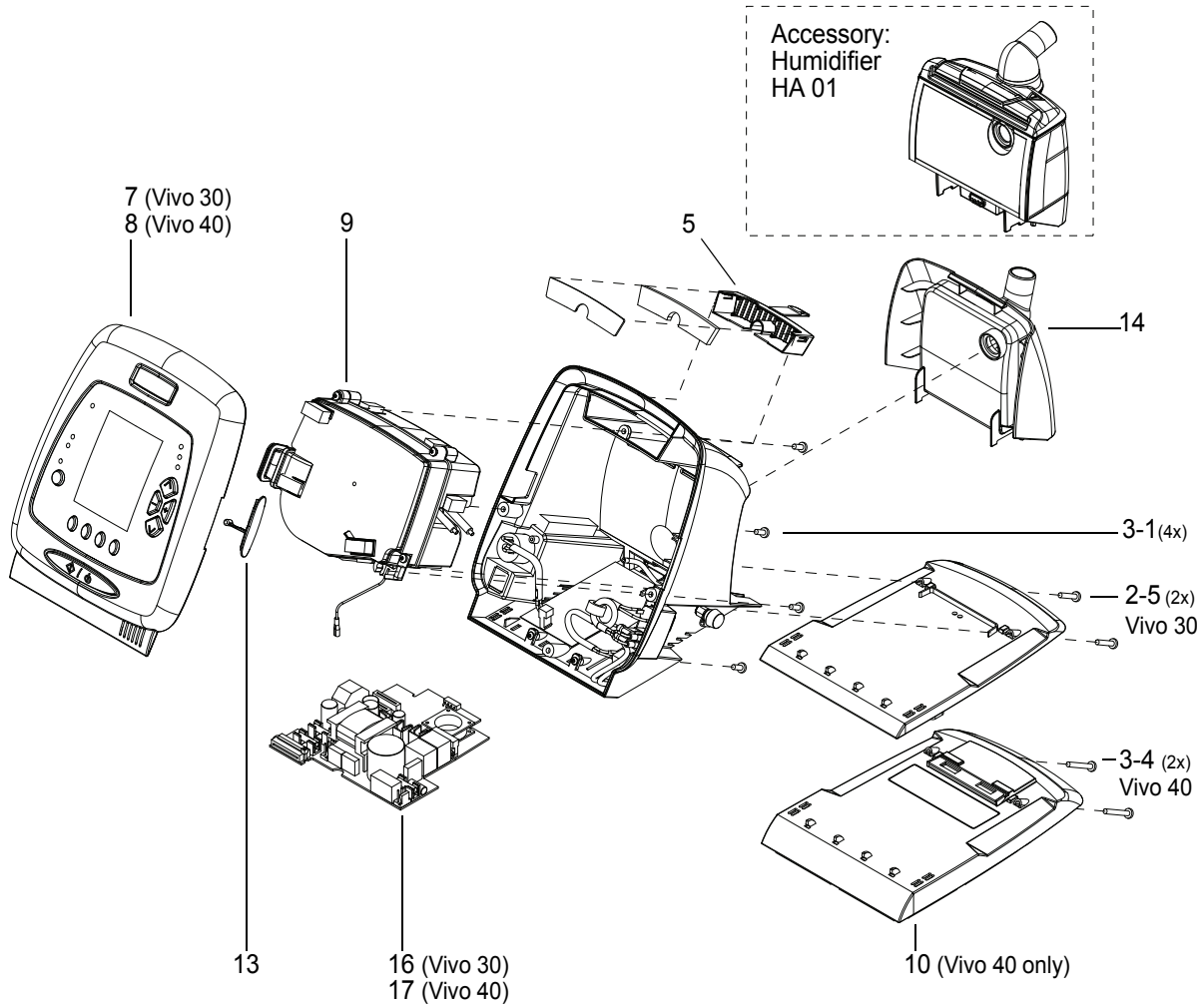
1. Remove the internal battery as in "Opening the Vivo 30/40" on page 34, 1-2.
2. Start the Vivo 40 with the power cord connected.
3. Disconnect the power cord.

The power failure alarm shall occur immediately.

3 Parts Location

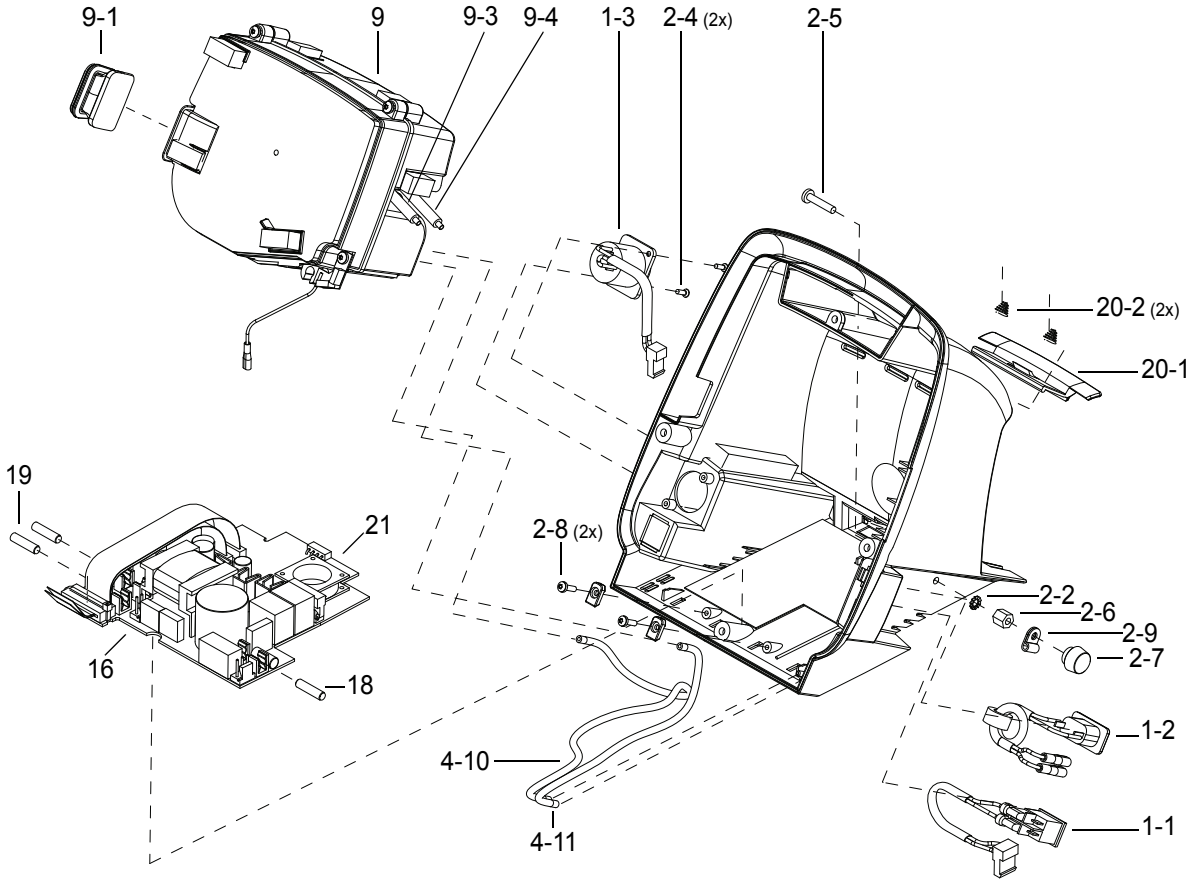
This chapter contains part-number lists and drawings of the parts for the ventilator.

3.1 Parts Drawing 1 – Main Components



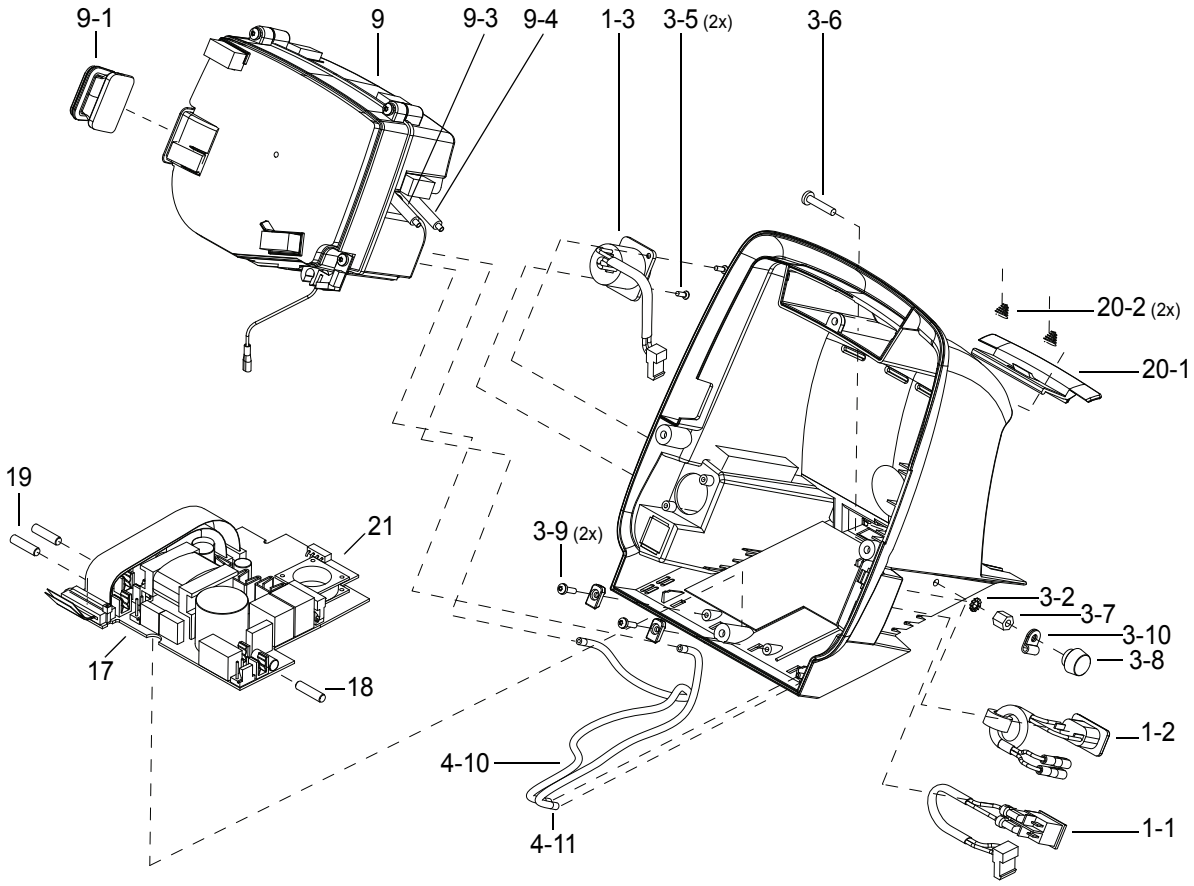
For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

3.2 Parts Drawing 2 – Vivo 30 Back Casing, Cables, Screws



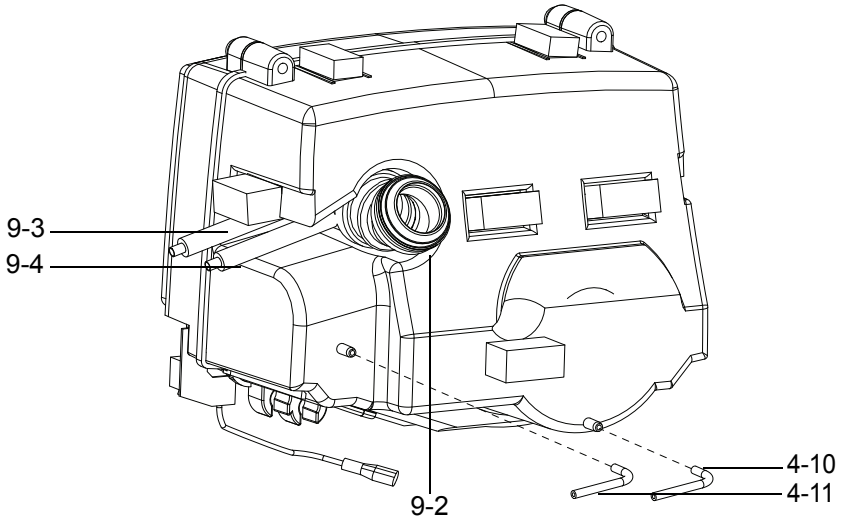
For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

3.3 Parts Drawing 3 – Vivo 40 Back Casing, Cables, Screws



For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

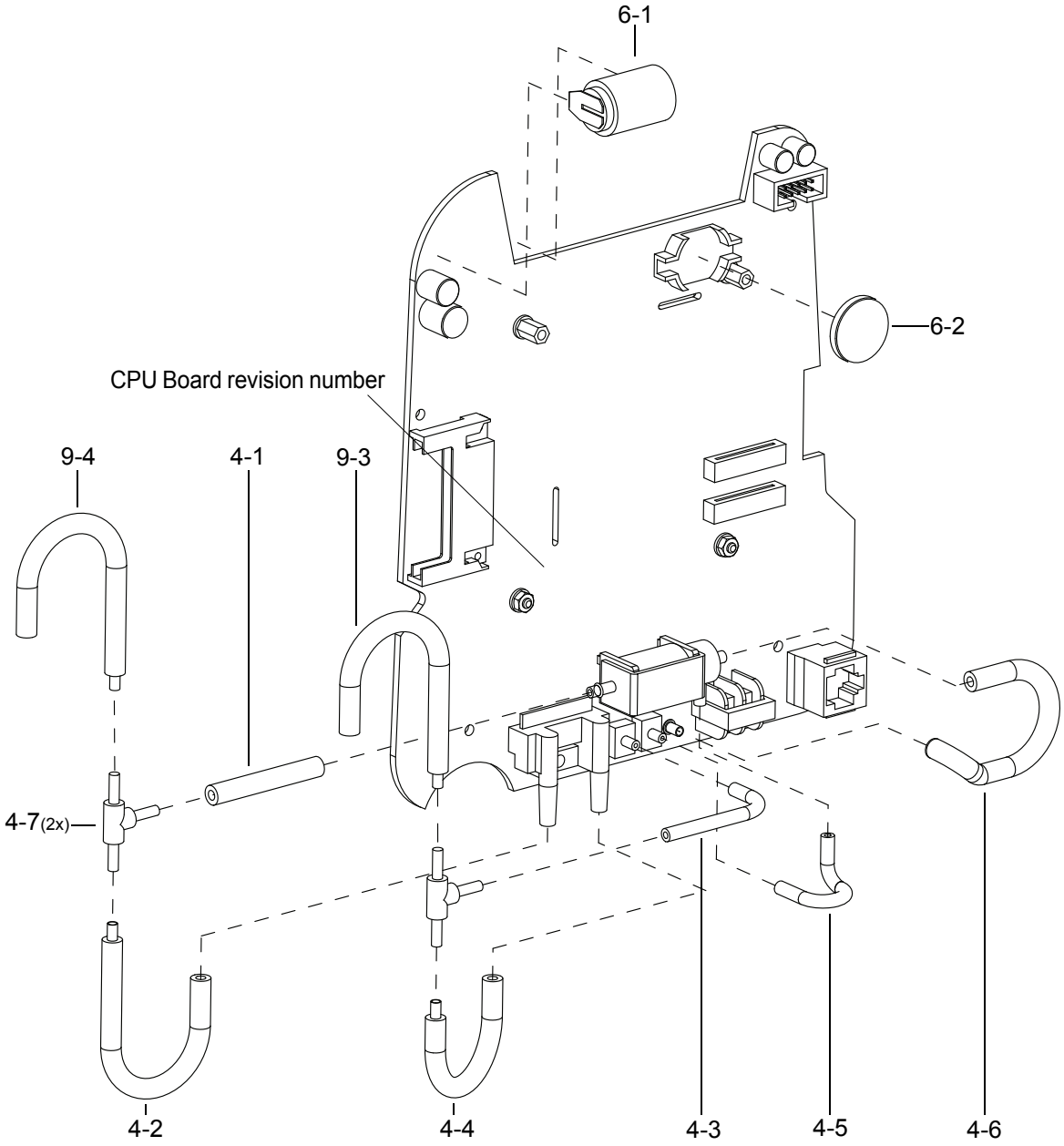
3.4 Parts Drawing 4 - Blower Assembly



For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

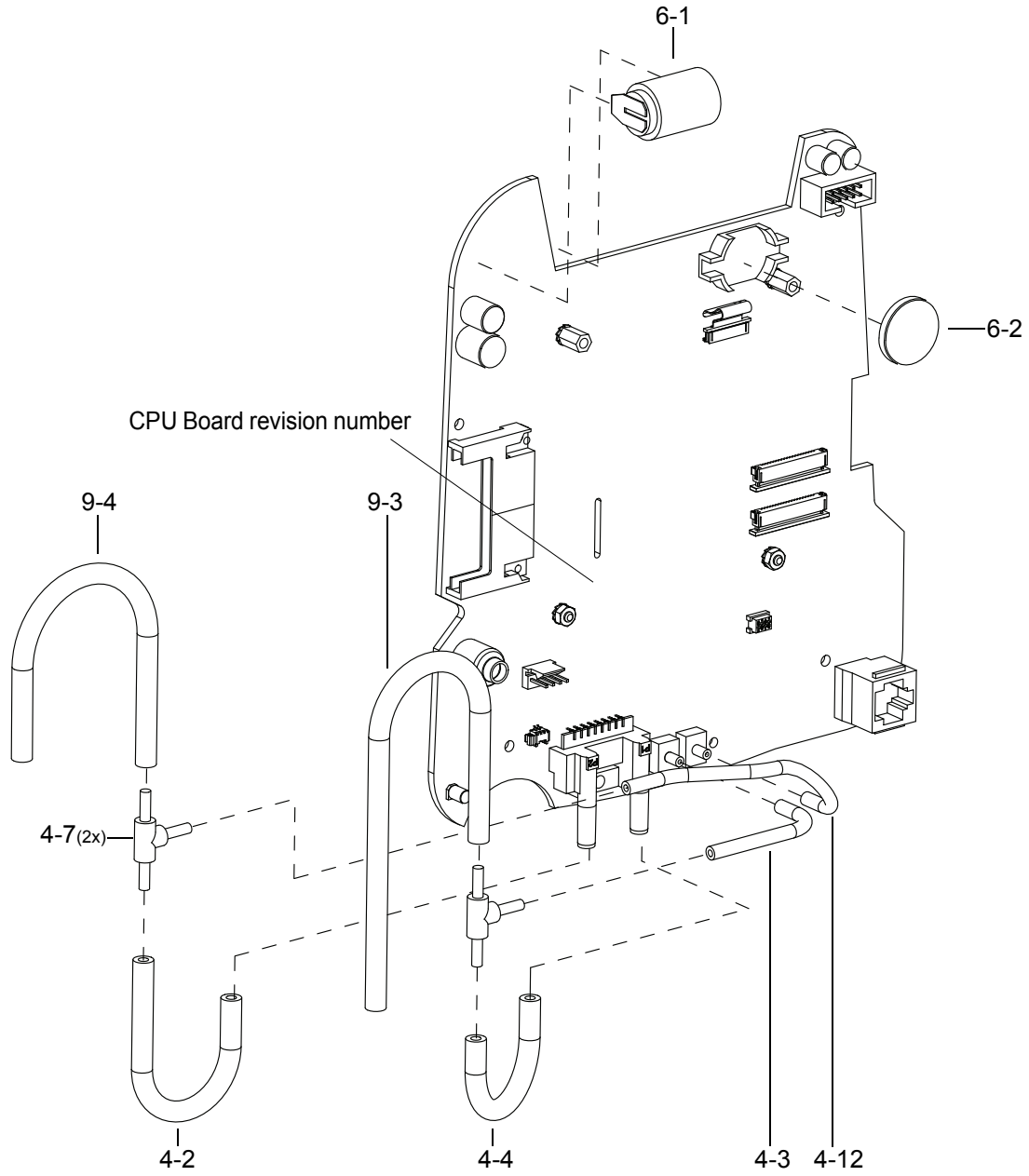
3.5 Parts Drawing 5 – Batteries, Tubings

3.5.1 CPU Boards revision 9 and earlier



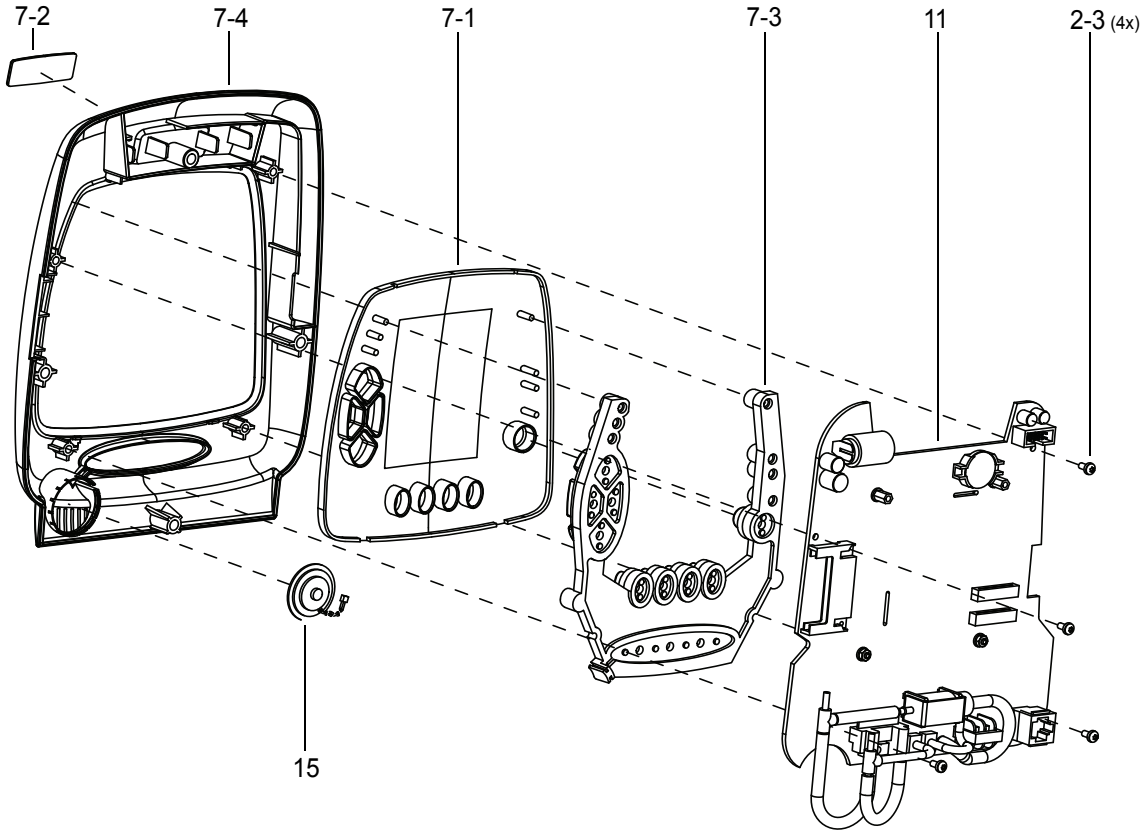
For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

3.5.2 CPU Boards revision 10 and later



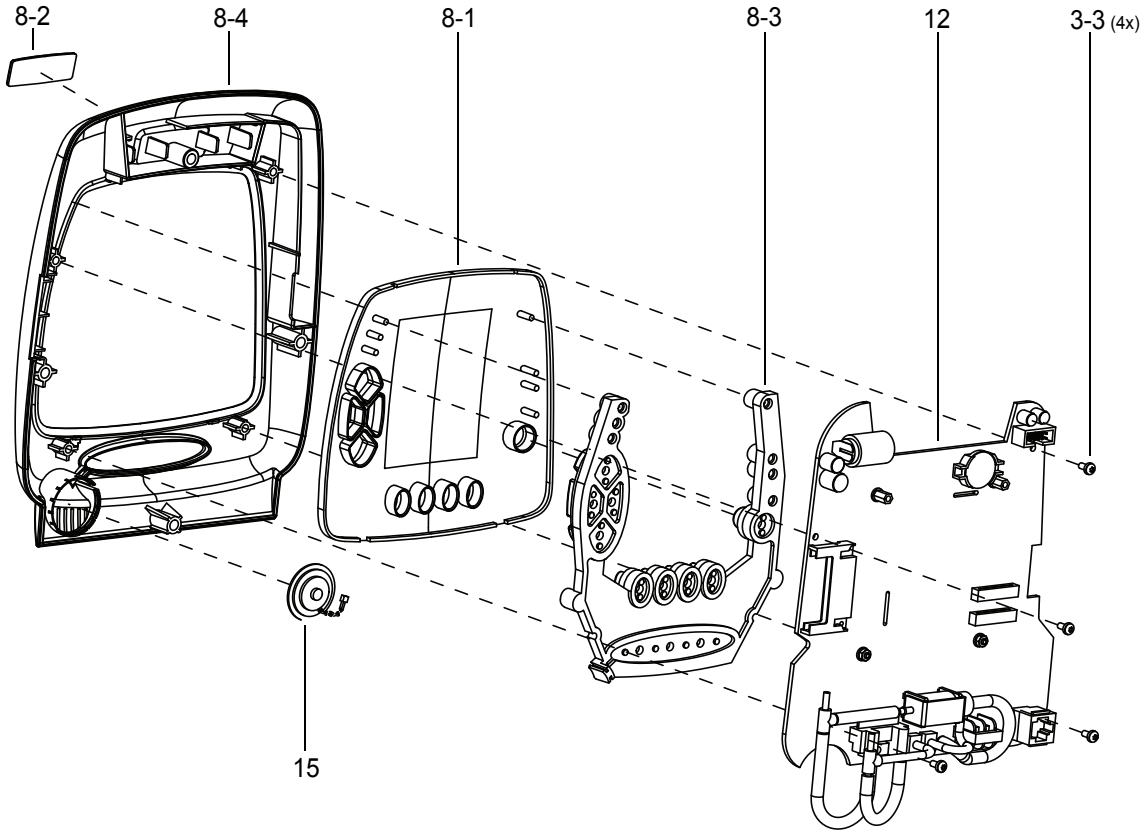
For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

3.6 Parts Drawing 6 – Vivo 30 Front Casing



For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

3.7 Parts Drawing 7 – Vivo 40 Front Casing



For definitions of the part numbers, refer to the parts list in section 3.8, "Parts List for the Vivo 30 and Vivo 40", on page 26.

3.8 Parts List for the Vivo 30 and Vivo 40

The parts of the Vivo 30 and Vivo 40 are listed in the table below.

KIT NO.	DESCRIPTION	BREAS PART NO.	*AMOUNT*
1	**Cable kit –Vivo 30/40**	**003567**	
1-1	Cable AC input PSU		*1*
1-2	Cable AC connection - switch		*1*
1-3	Cable DC input		*1*
2	**Screw kit – Vivo 30**	**003568**	
2-1	Screw MRT M4x10 FZB		*4*
2-2	M4- Serrated washer		*1*
2-3	Screw MRT M3x6 FZB		*4*
2-4	Screw PT WN 1413 KA 30x8		*2*
2-5	Screw Tx20 M4x20 FZB		*3*
2-6	Spacer M4x8		*1*
2-7	Knurled nut		*1*
2-8	Screw STS-KN1039 TX T30x10 FZB		*2*
2-9	Cable restrainer		*1*
3	**Screw kit - Vivo 40**	**004012**	
3-1	Screw MRT M4x10 FZB		*4*
3-2	M4 Serrated washer		*1*
3-3	Screw MRT M3x6 FZB		*4*
3-4	Screw Tx20 M4x30 FZB		*2*
3-5	Screw PT WN 1413 KA 30x8		*2*
3-6	Screw Tx20 M4x20 FZB		*1*
3-7	Spacer M4x8		*1*
3-8	Knurled nut		*1*
3-9	Screw STS-KN1039 TX T30x10 FZB		*2*
3-10	Cable restrainer		*1*
4	**Tube kit CPU - Vivo 30/40**	**003533**	
4-1	Tube 1 silicone 40 mm (yellow)		*1*
4-2	Tube 2 silicone 85 mm (yellow)		*1*
4-3	Tube 3 silicone 60 mm (white)		*1*
4-4	Tube 4 silicone (grey)		*1*

KIT NO.	DESCRIPTION	BREAS PART NO.	*AMOUNT*
4-5	Tube 5 silicone 45 mm (white)		*1*
4-6	Tube 6 silicone (blue)		*1*
4-7	Tube connector		*2*
4-10	Drain-tube 235 mm (white)		*1*
4-11	Drain-tube 185 mm (white)		*1*
4-12	Tube 12 silicone 75 mm (white)		*1*
5	**Filter carrier**	**003465**	***1***
6	**Battery kit - Vivo 30/40**	**004007**	
6-1	Battery, alarm		*1*
6-2	Battery, CR2032 3 V 230 mAh, lithium		*1*
7	**Case front kit - Vivo 30**	**003565**	
7-1	Window Vivo 30		*1*
7-2	Overlay logotype Vivo		*1*
7-3	Keypad		*1*
7-4	Case front		*1*
8	**Case front kit - Vivo 40**	**003566**	
8-1	Window Vivo 40		*1*
8-2	Overlay logotype Vivo		*1*
8-3	Keypad		*1*
8-4	Case front		*1*
9	**Blower complete - Vivo 30/40**	**003524**	***1***
9-1	Tube inlet		*1*
9-2	Tube outlet		*1*
9-3	Tube sense 2		*1*
9-4	Tube sense 1		*1*
10	**Internal battery complete - Vivo 40**	**003452**	***1***
11	**PCB CPU card - Vivo 30 (Language)**		
	PCB CPU card Vivo 30DA	*003625*	*1*
	PCB CPU card Vivo 30 DE	*003561*	*1*
	PCB CPU card Vivo 30 EL	*003628*	*1*
	PCB CPU card Vivo 30 EN	*003620*	*1*
	PCB CPU card Vivo 30 ES	*003622*	*1*
	PCB CPU card Vivo 30 FI	*003562*	*1*

KIT NO.	DESCRIPTION	BREAS PART NO.	*AMOUNT*
	PCB CPU card Vivo 30 FR	*003626*	*1*
	PCB CPU card Vivo 30 IT	*003623*	*1*
	PCB CPU card Vivo 30 JA	*003630*	*1*
	PCB CPU card Vivo 30 NL	*003624*	*1*
	PCB CPU card Vivo 30 NO	*003621*	*1*
	PCB CPU card Vivo 30 PL	*003629*	*1*
	PCB CPU card Vivo 30 PT	*003627*	*1*
	PCB CPU card Vivo 30 SV	*003560*	*1*
	PCB CPU card Vivo 30 US	*003631*	*1*
	PCB CPU card Vivo 30 ZH	*003632*	*1*
12	**PCB CPU card - Vivo 40 (Language)**		
	PCB CPU card Vivo 40 DA	*003641*	*1*
	PCB CPU card Vivo 40 DE	*003634*	*1*
	PCB CPU card Vivo 40 EL	*003644*	*1*
	PCB CPU card Vivo 40 EN	*003636*	*1*
	PCB CPU card Vivo 40 ES	*003638*	*1*
	PCB CPU card Vivo 40 FI	*003635*	*1*
	PCB CPU card Vivo 40 FR	*003642*	*1*
	PCB CPU card Vivo 40 IT	*003639*	*1*
	PCB CPU card Vivo 40 JA	*003897*	*1*
	PCB CPU card Vivo 40 NL	*003640*	*1*
	PCB CPU card Vivo 40 NO	*003637*	*1*
	PCB CPU card Vivo 40 PL	*003645*	*1*
	PCB CPU card Vivo 40 PT	*003643*	*1*
	PCB CPU card Vivo 40 SV	*003633*	*1*
	PCB CPU card Vivo 40 US	*003898*	*1*
	PCB CPU card Vivo 40 ZH	*003899*	*1*
13	**Plug memory card - Vivo 30/40**	**003542**	*1*
14	**Air outlet patient assembly - Vivo 30/40**	**003591**	*1*
15	**Beeper + cable - Vivo 30/40**	**003509**	*1*
16	**PCB PSU card Vivo 30**	**003492**	*1*
17	**PCB PSU card Vivo 40**	**003602**	*1*
18	**Fuse T2A, mains**	**003900**	*10*

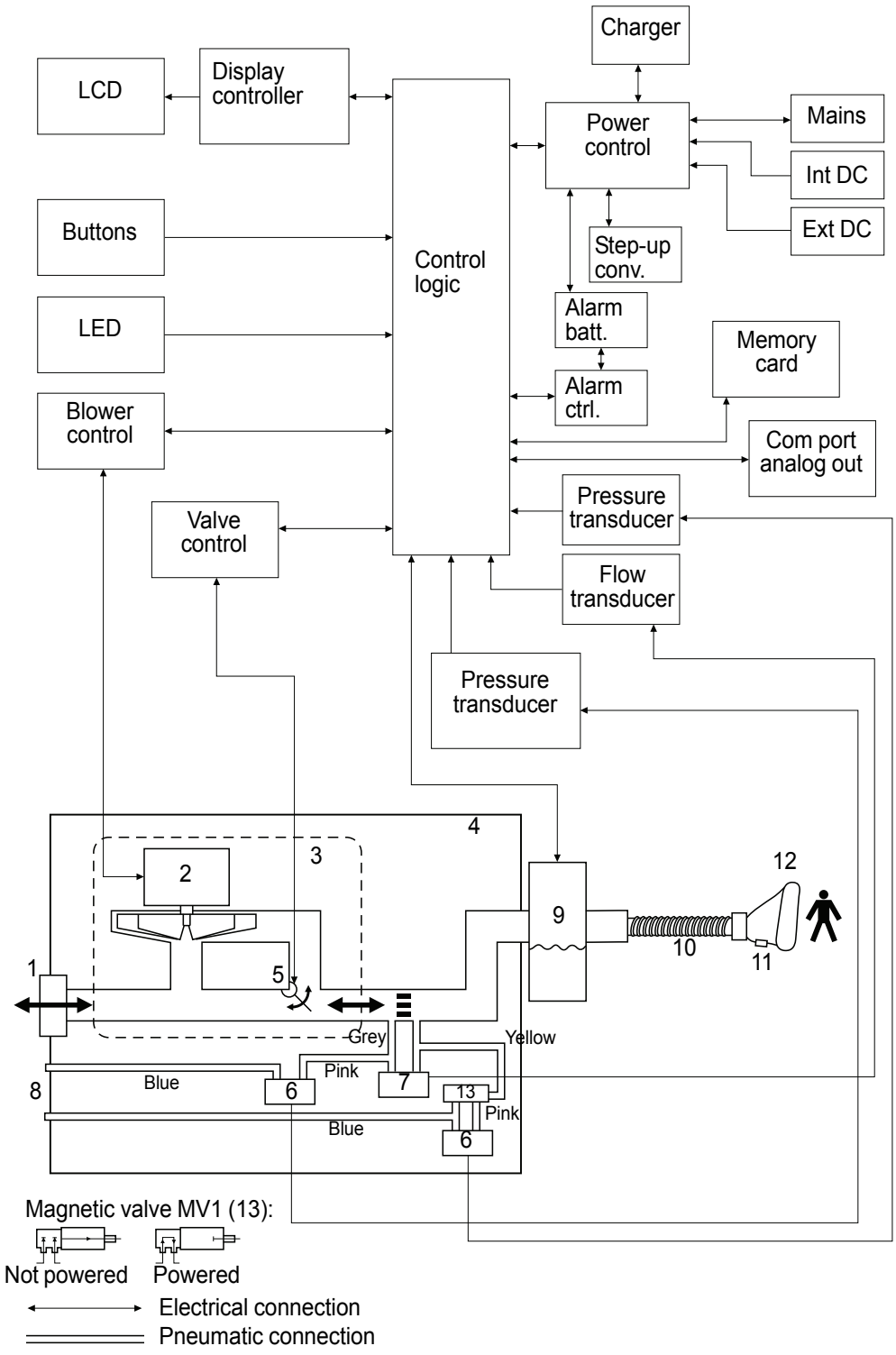
KIT NO.	DESCRIPTION	BREAS PART NO.	*AMOUNT*
19	**Fuse T8A, external DC**	**003901**	*10*
20	**Lock device kit**	**004289**	
20-1	Lock device		*1*
20-2	Spring conical		*2*
21	**Cooling fan kit**	**004827**	
21-1	Elina fan		*1*
21-2	Fan bracket		*1*
21-3	Screw MRX-H M2,5x25		*2*
21-4	Nut M2,5 DIN985		*2*

4 Functional Diagrams

This chapter contains a diagram of the pneumatic system of the ventilator and a block diagram of the Vivo 30/40's functions.

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

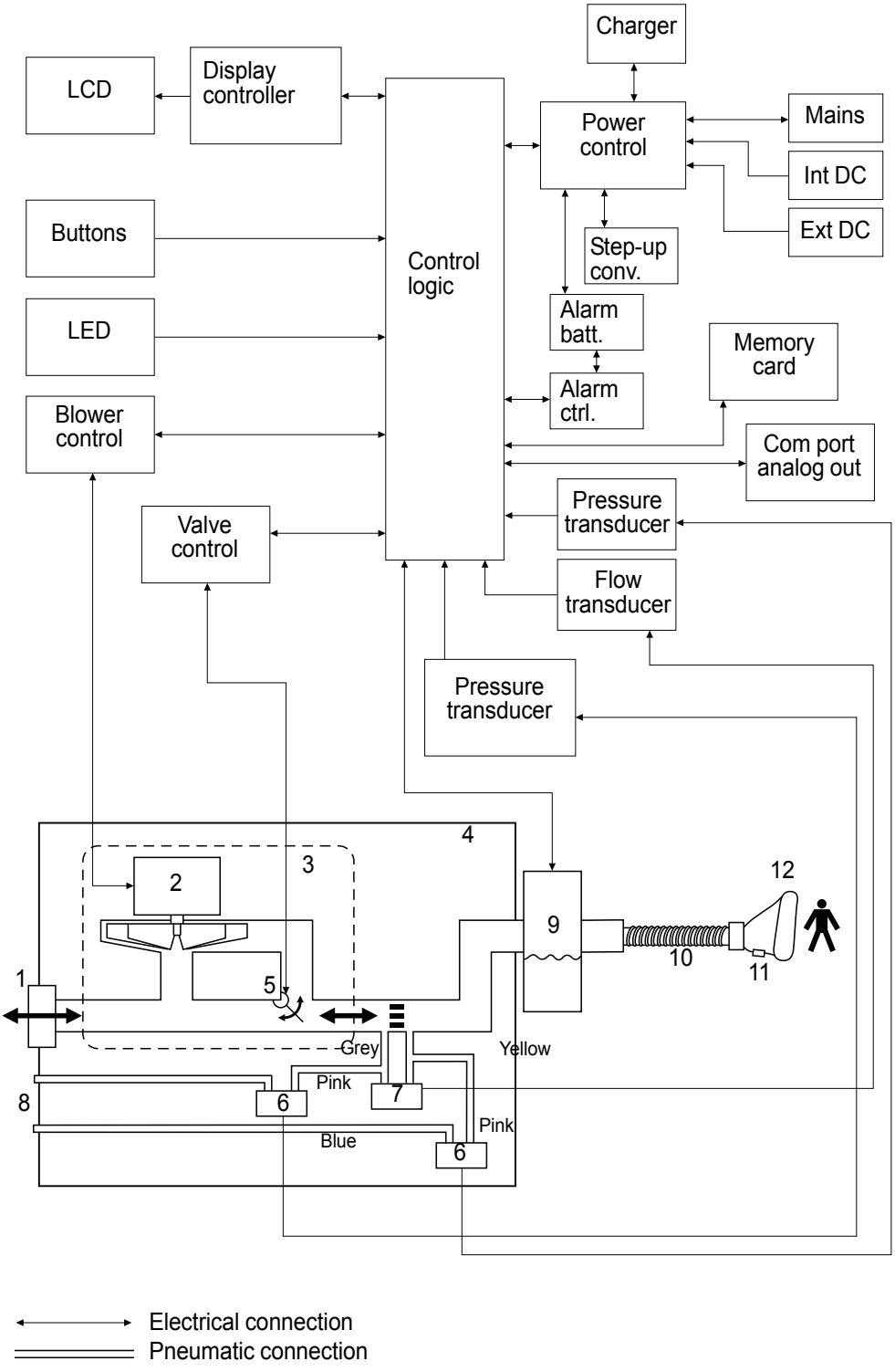
4.1 Vivo 30/40 with magnetic valve (CPU board rev 9 and earlier)



The table below describes the components of the pneumatic diagram.

NO.	DESCRIPTION
1	Air inlet filter
2	Turbine
3	Silencer box
4	Vivo 30/40 casing
5	Pressure regulating valve
6	Pressure sensor
7	Flow sensor
8	Ambient
9	Humidifier
10	Patient tube
11	Leak holes
12	Mask
13	Magnetic valve MV1

4.2 Vivo 30/40 without magnetic valve (CPU board rev 10 and later)



The table below describes the components of the pneumatic diagram.

NO.	DESCRIPTION
1	Air inlet filter
2	Turbine
3	Silencer box
4	Vivo 30/40 casing
5	Pressure regulating valve
6	Pressure sensor
7	Flow sensor
8	Ambient
9	Humidifier
10	Patient tube
11	Leak holes
12	Mask

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 30/40 Measuring and Display Devices

DEVICE	PURPOSE	TYPE	RANGE	RESOLUTION	ACCURACY	SENSING POSITION
Pressure sensing	Regulate pressure	Differ-ential to ambient	-10 to +60 cmH_2O	0.1 cmH_2O	±0.1% FSS	Air outlet of Vivo 30/40
Flow sensing	Regulate pressure	Mass flow	0 to 300 l/min	1 l/min	±1 l/min	Air outlet of Vivo 30/40
Pressure display	Indicate patient pressure	Graphic LCD	0 to 40 cmH_2O (Vivo 40) 0 to 30 cmH_2O (Vivo 30)	1 cmH_2O	±0.5 cmH_2O	Air outlet of Vivo 30/40

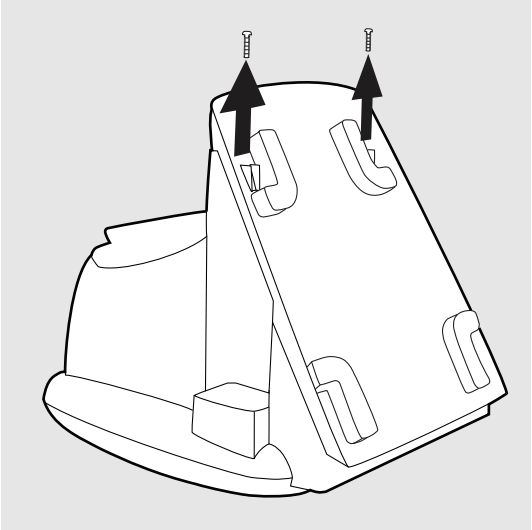
5 Opening the Vivo 30/40 and Replacing the Main Components

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

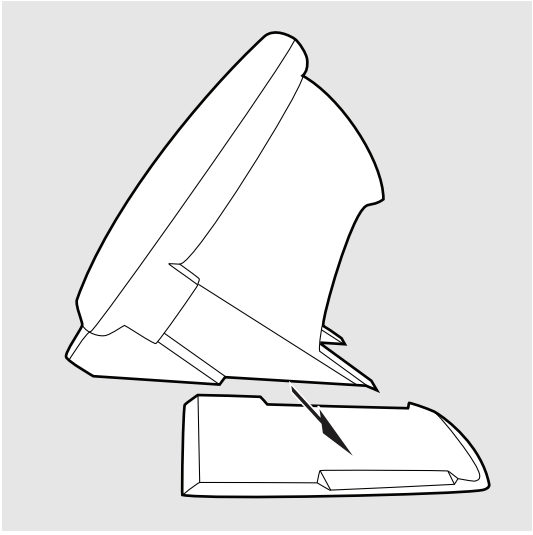
5.1 Opening the Vivo 30/40

- Before closing the Vivo 30/40, perform an internal inspection, see "Internal Inspection" on page 11.
- Always perform a complete function test after reassembling the Vivo 30/40, see "Complete Function Test" on page 12.
- Always perform an electrical safety test after reassembling the Vivo 30/40, see "Electrical Safety Precautions" on page 17.
- Make sure that the Vivo 30/40 is placed on a non-scratching surface.
- Make sure that the tubes are not pinched or kinked when closing the Vivo 30/40.

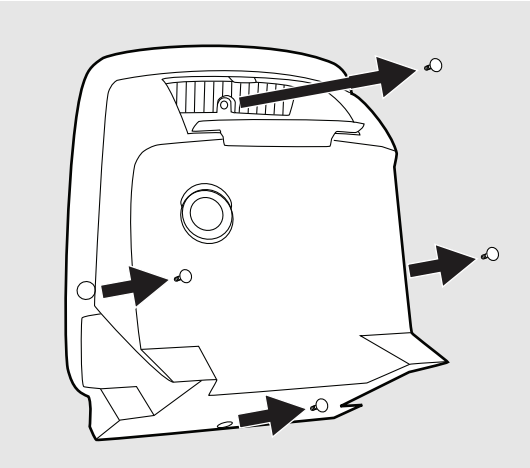
1 Remove the two screws for the base plate (Vivo 30) or the internal battery (Vivo 40).



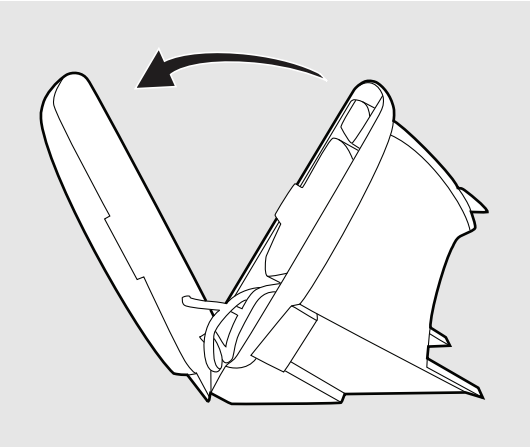
2 Remove the base plate (Vivo 30) or the internal battery (Vivo 40) by pulling it slightly backwards and down.



3 Remove the four screws for the casing.



4 Gently fold the front casing forward.



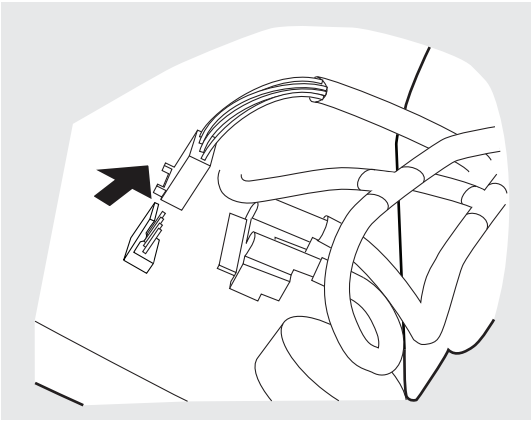
5 Reassemble in reverse order.

- Make sure that the hooks on the Vivo 40 internal battery is properly fitted in the Vivo 40 back casing.

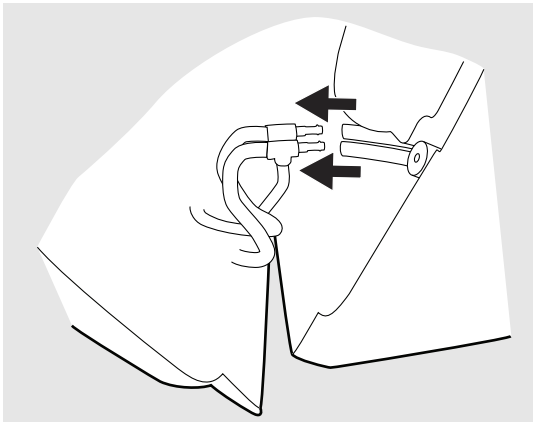
5.2 Replacing the Complete Blower Assembly

1 Open the Vivo 30/40 as in section 5.1.

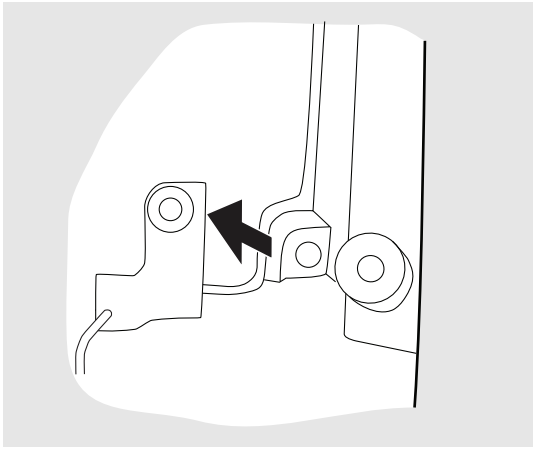
2 Disconnect the cabling for the flow valve.



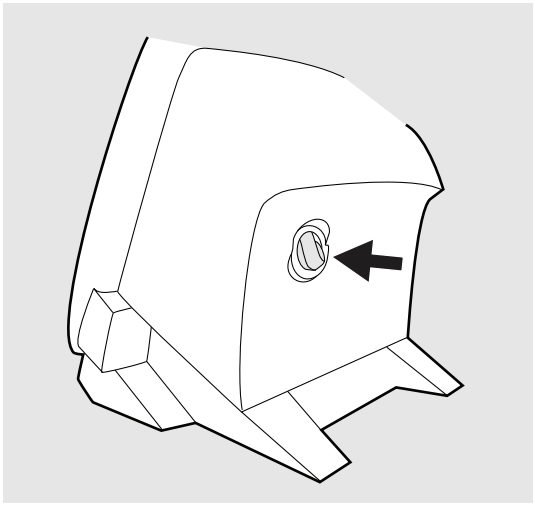
3 Disconnect the yellow and the grey tubing at the T-connectors.



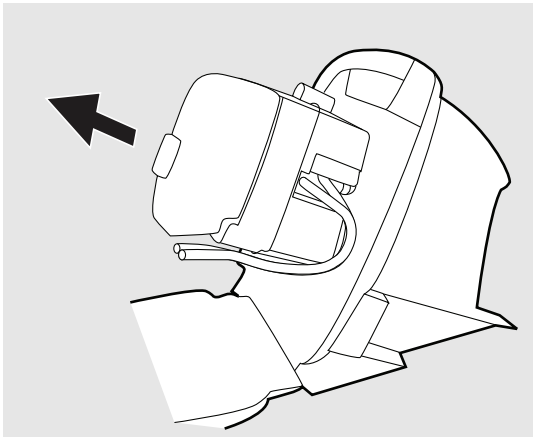
4 Loosen the lower right screw on the blower assembly to remove the small L-shaped board.



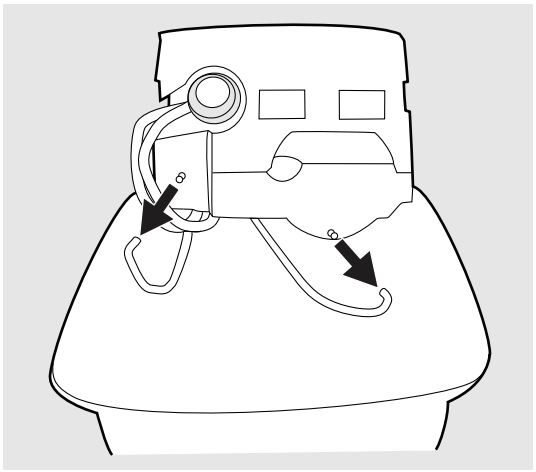
5 Push the tube outlet through the hole at the rear of the Vivo 30/40.



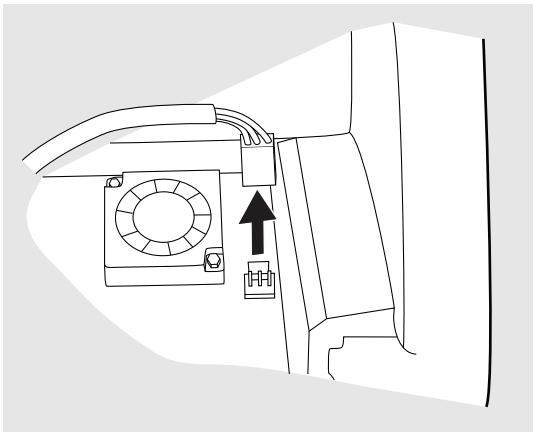
6 Pull the complete blower assembly straight out.



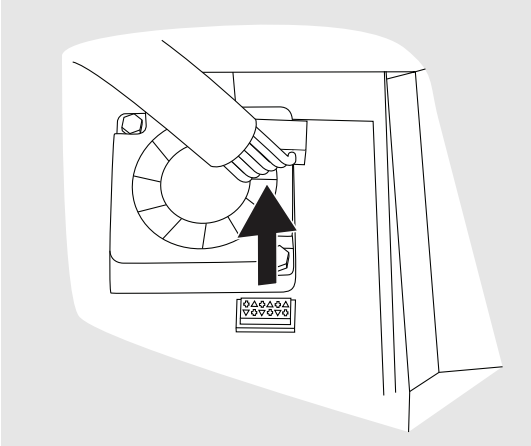
7 Disconnect the two drainage tubes from the rear side of the blower assembly.



8 Disconnect the BLDC motor control cable.

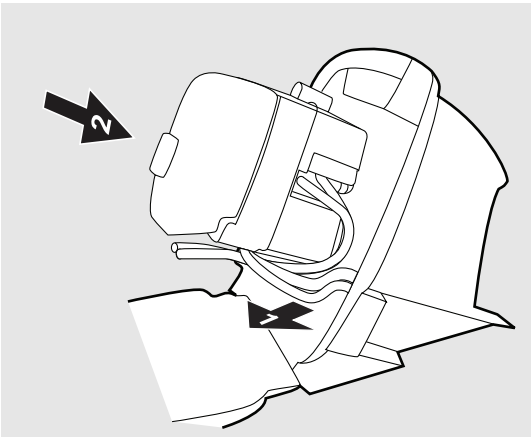


9 Cut the cable tie securing the blower cabling connector and disconnect it.



10 Reassemble in reverse order.

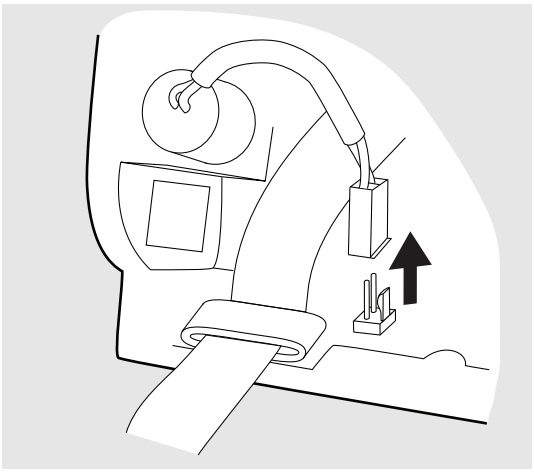
- Make sure that a new cable tie is securing the blower cabling connector. You need to remove the PSU board as in section 5.3 to replace the cable tie.
- Make sure you fit the tube outlet to the blower assembly, pointing slightly upwards. Gently pull the tube outlet through the hole at the rear of the Vivo 30/40.
- When reinserting the blower into the back casing, make sure that the cabling does not disrupt the PSU cooling fan air ways. Do this by pulling the cablings out and to the right when inserting the blower unit.



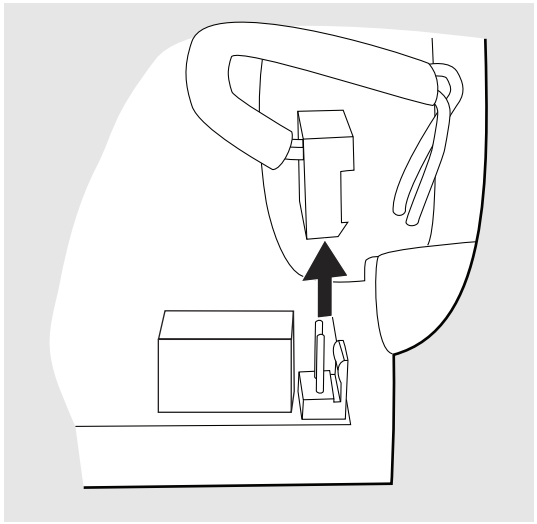
5.3 Replace the PSU Board

1 Remove the blower assembly as in section 5.2.

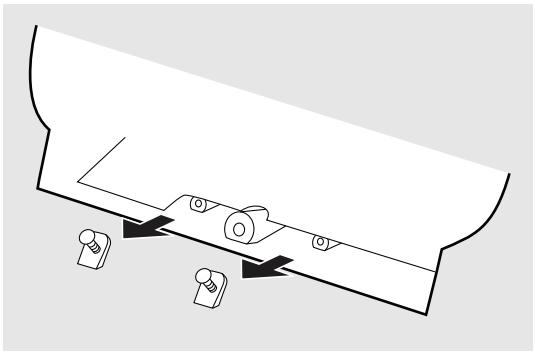
2 Disconnect the external DC connector.



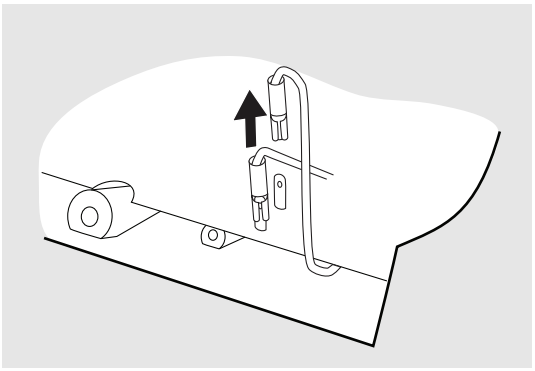
3 Disconnect the AC supply connector.



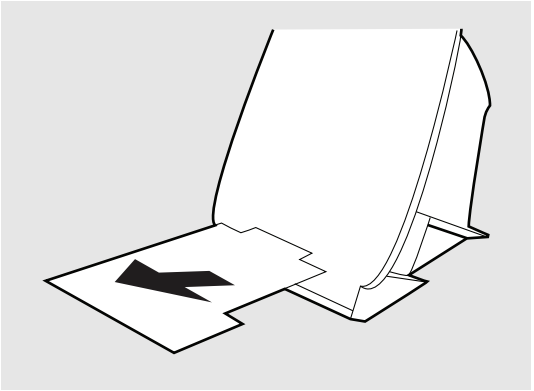
4 Remove the two screws holding the PSU board.



5 Remove the ground cable.



6 Remove the PSU board.
Be careful so you do not damage the Preci-dip contacts at the back of the PSU board (Vivo 40 only).

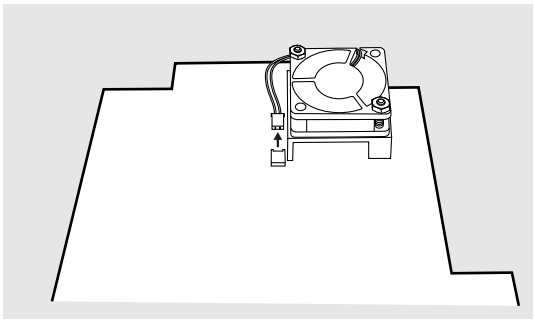


7 Reassemble in reverse order.

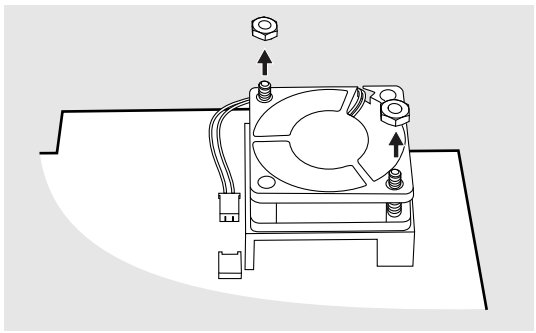
5.4 Replace the PSU Cooling Fan

1 Remove the PSU board as in section 5.3.

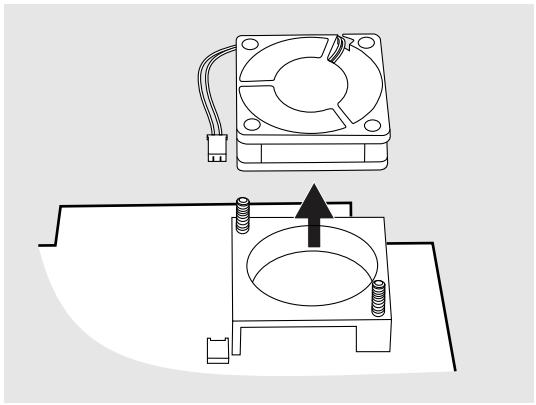
2 Disconnect the cooling fan from the PSU board.



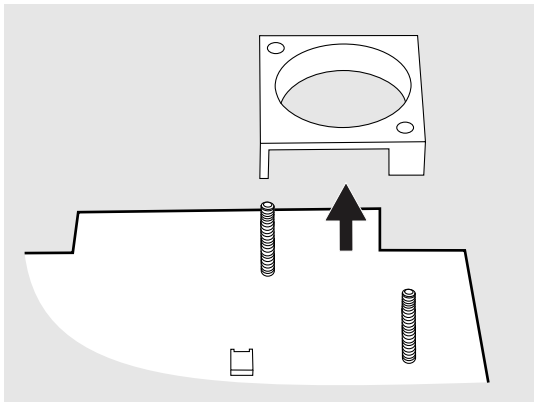
3 Remove the two nuts holding the cooling fan.



4 Remove the cooling fan.

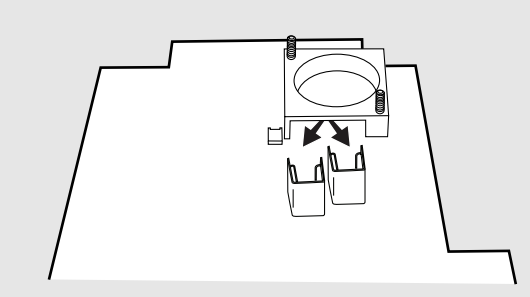


5 Remove the fan bracket.
You might have an earlier revision of the PSU cooling fan that do not have any fan bracket. If so, you shall install a bracket when replacing the PSU cooling fan to improve the Vivo 30/40 cooling air flow.



6 Reassemble in reverse order.

- Make sure that the opening in the fan bracket is facing towards the heatsinks.



- Make sure that the cooling fan is placed with the text upwards.

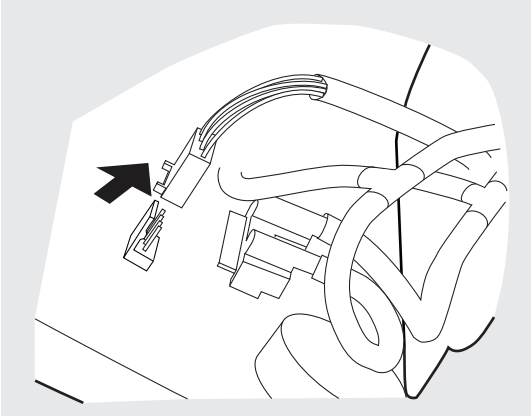
5.5 Replace the CPU Board

The Vivo 30/40 serial number needs to be programmed into the new CPU board.

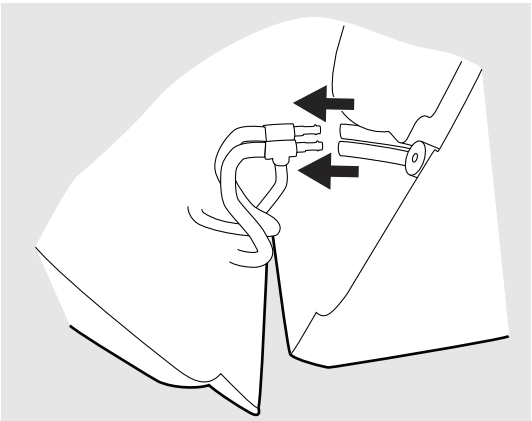
You need the Vivo 30/40 Service Software to program the CPU Board with the correct serial number after replacement.

1 Open the Vivo 30/40 as in section 5.1.

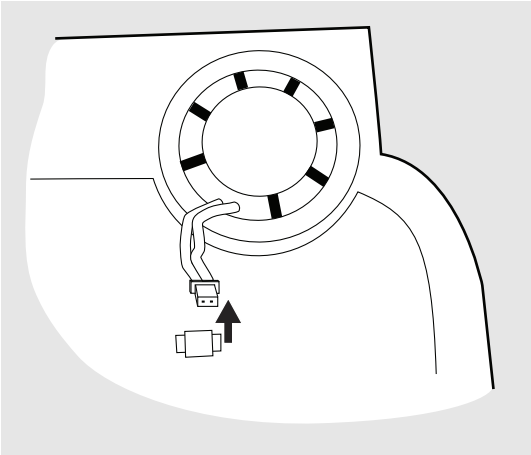
2 Disconnect the cabling for the flow valve.



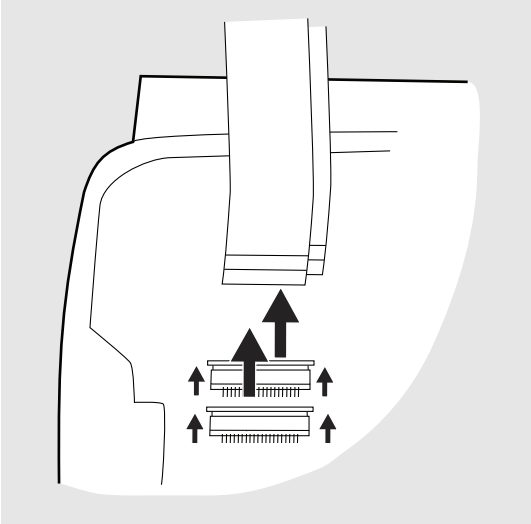
3 Disconnect the yellow and the grey tubing at the T-connectors.



4 Disconnect the beeper.

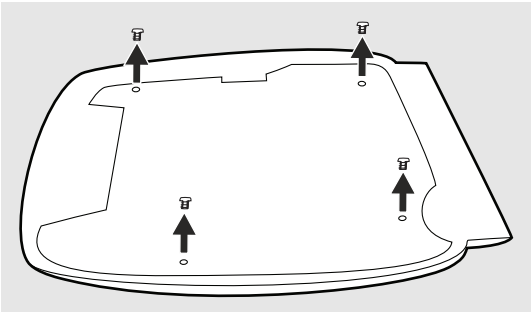


5 Disconnect the two ribbon cables by loosening the connectors.



- When reconnecting the two ribbon cables - be sure that they are fitted straight, otherwise there is risk of a short-circuit over the connectors.
- Make sure that the ribbon cables are properly fastened.

6 Remove the four screws and lift the CPU board straight up.



7 Reassemble in reverse order.

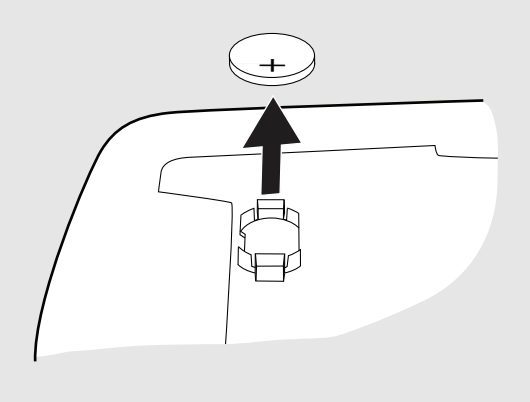
5.6 Replace the Clock Battery

Save the patient settings to a CF card before changing the clock battery. It will then be easier to restore all the patient settings after the procedure.

Study the Vivo 30/40 clinician's manual for instructions on how to use the CF card.

1 Open the Vivo 30/40 and disconnect the flow valve cabling and the tubings as in section 5.5, 1-3.

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.

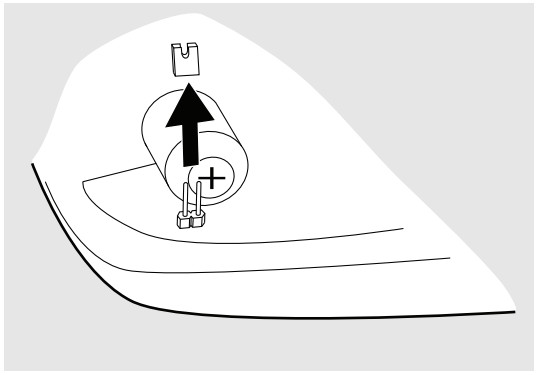
3 Reassemble in reverse order.

4 Restore the patient settings.

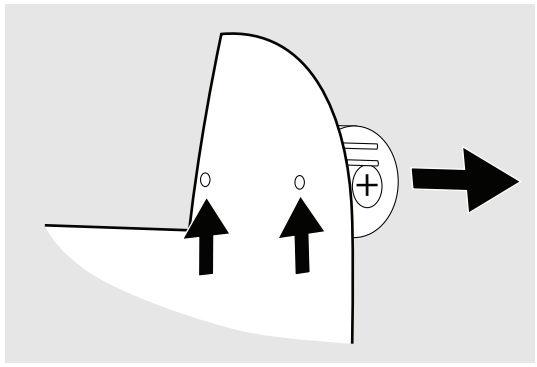
5.7 Replace the Alarm Battery

1 Open the Vivo 30/40 and remove the CPU board as in section 5.5.

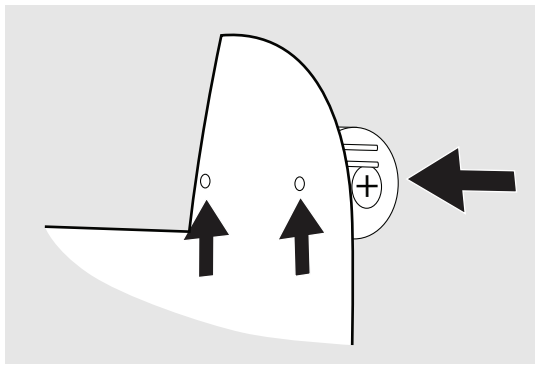
2 Remove the jumper.



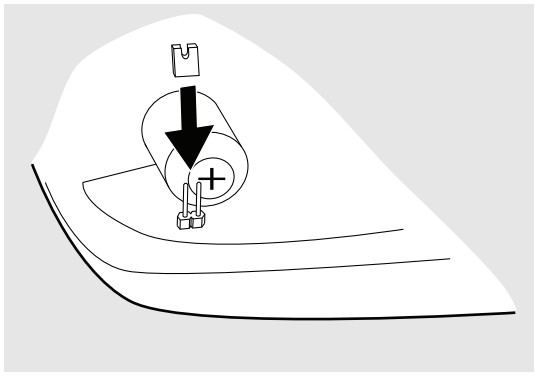
3 Unsolder the two pins on the alarm battery and remove the battery.



4 Remove any remaining solder from the holes. Fit a new battery, checking the polarity, and solder it in place.



5 Put the jumper back.

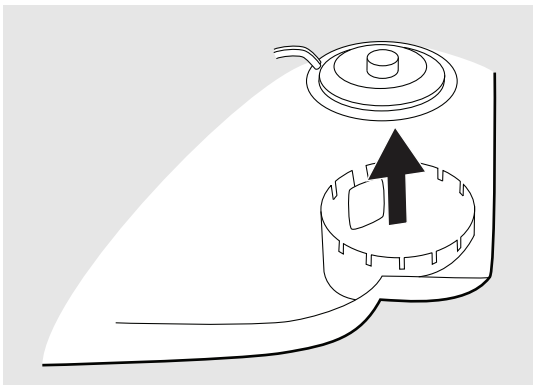


6 Reassemble in reverse order.

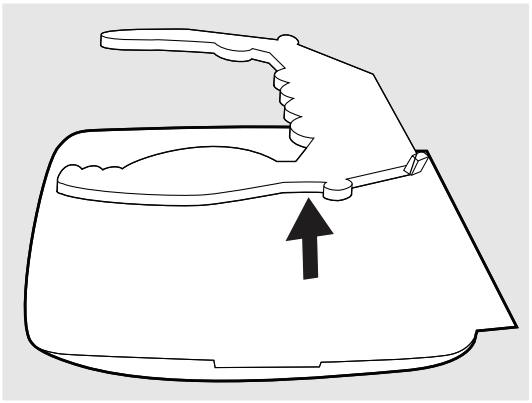
5.8 Replacing the Push Button Silicone Pad

1 Remove the CPU board as in section 5.5.

2 Remove the beeper.



3 Lift the push button silicone pad.



4 Reassemble in reverse order.

- Make sure that the silicon push pad's corner fits properly into the beeper holder.

6 Upgrade and Calibration

6.1 Firmware Upgrade

To upgrade the Vivo 30/40 firmware you need the "Firmware Upgrade Tool iSleep/Vivo". Contact Breas technical support for more information.

6.2 Pressure and Flow Calibration

To calibrate the Vivo 30/40 you need the "Vivo 30/40 Service Software". Contact Breas technical support for more information.

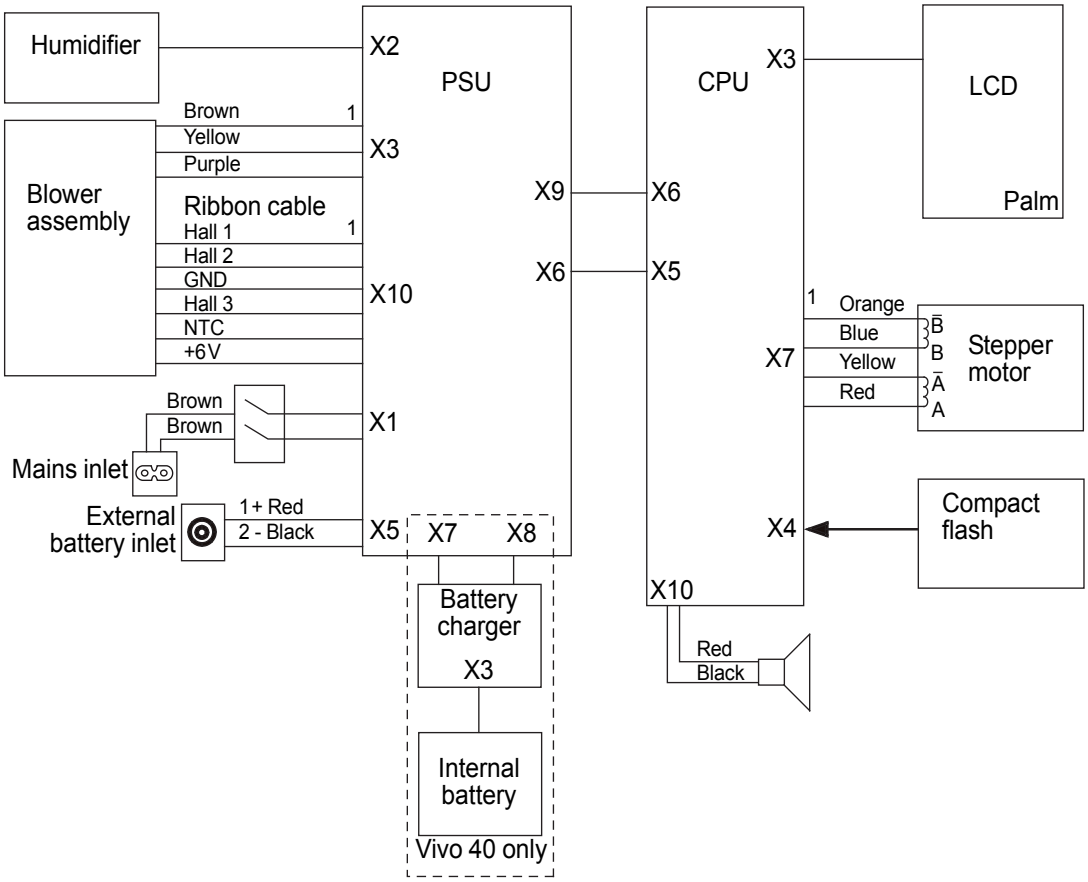
7 Electronics

Always perform a complete function test if you have opened the Vivo 30/40.

The electronics, optics, mechanics, and pneumatics of the Vivo 30/40 are integrated. To understand fully the electronics of the Vivo 30/40, 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 30/40

The diagram below illustrates the main cabling of the Vivo 30/40.

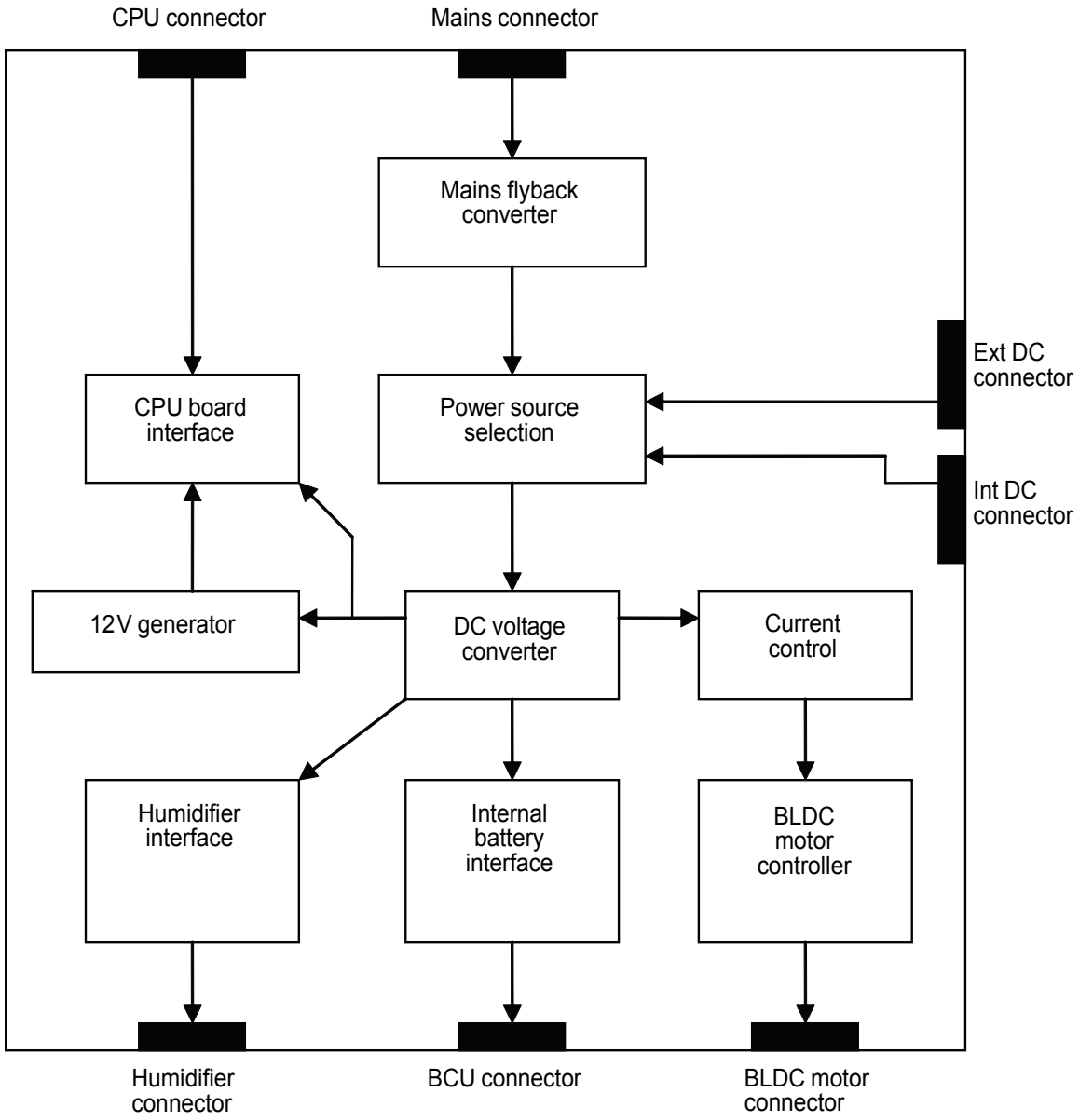


7.2 Circuit Board Descriptions

This section contains descriptions and figures of the circuit boards, the LCD display, and the push-button membrane panel of the Vivo 30/40.

7.2.1 PSU Board

The diagram below is an overview of the PSU board



PSU board contains the switch mode power supply (SMPS) built on the double ended flyback topology. The converter is powered with mains 100-240 V AC, +10%, -20% (i.e. 80 V AC-264 V AC).

Power Source Selection

There are three power inputs (two for Vivo 30), Mains, External DC (EXT DC) and internal battery (INT DC, Vivo 40 only).

The three power sources are controlled by the main processor on the CPU board. The processor senses status for each source to decides if to disable mains and enable any DC source.

Voltage Converter

The converter is a boost converter that steps up EXT DC or INT DC to +30 V DC, the nominal value for net VM (Voltage Motor). When Vivo 30/40 is running on mains, the DC step up converter is disabled because of the already +30 V DC from the SMPS.

Brush less DC (BLDC) Motor Controller

The BLDC amplifier is based on a three-phase inverter controlled by a MC33035 motor control circuit. The main processor regulates the speed with a 0-5 V analogue signal into the MC33035P. 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 Pack Connector (Vivo 40 only)

Vivo 40 is equipped with an internal battery pack, accessed from the PSU-board via 2x6 pole Preci-dip connectors. The battery pack contains its own charging processor and either supply Vivo 40 with power, or gets charging power from Vivo 40.

The main unit supplies the battery pack with +5 V from the CPU-board through this board.

HA 01 Humidifier Interface

The Vivo 30/40 can be equipped with an integrated HA 01 humidifier.

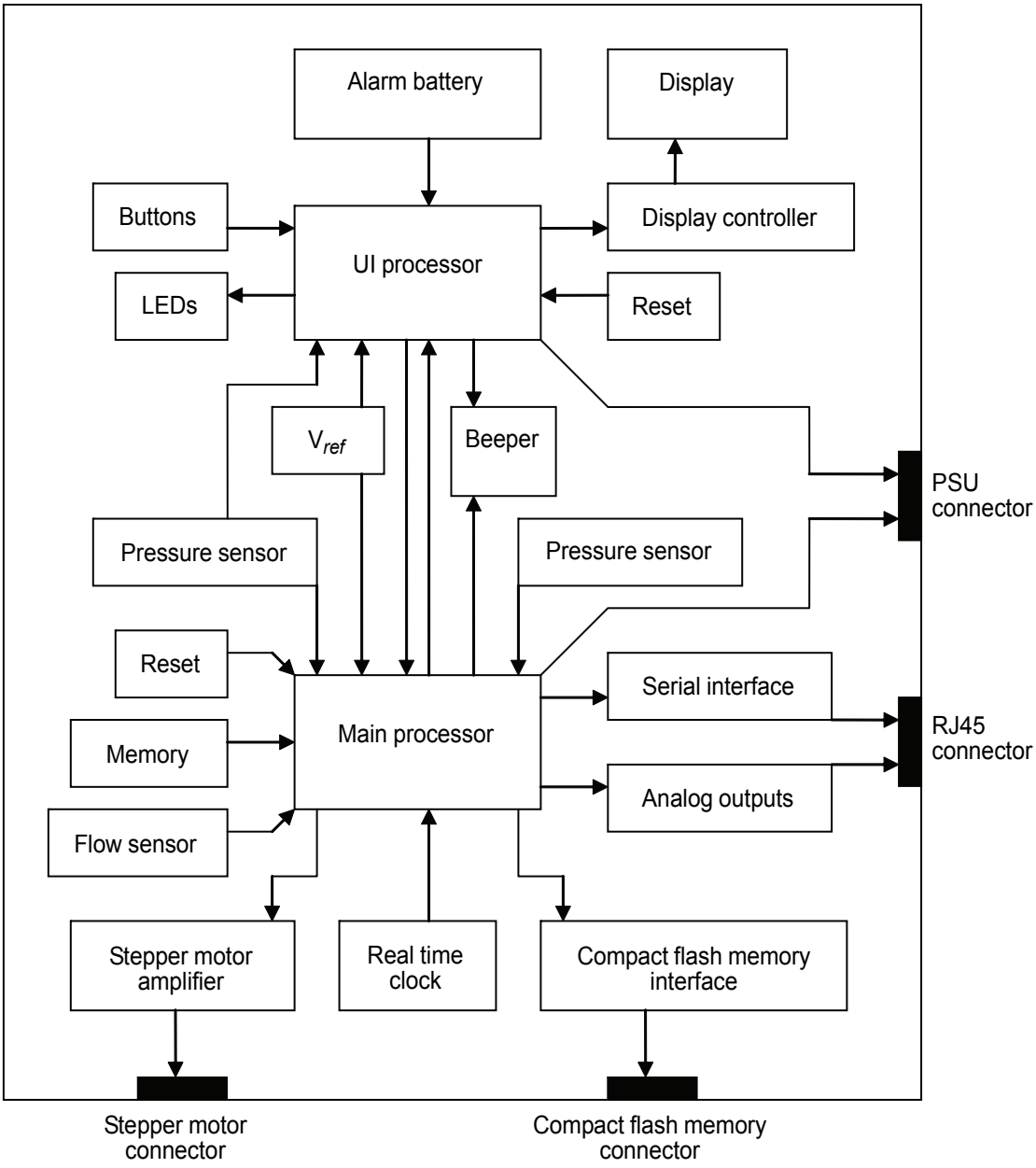
The HA 01 humidifier consumes 30-40 W depending on feeding voltage.

The power to the HA 01 humidifier is controlled from the main CPU via a transistor.

The other two signals in the interface beside power and ground are an analogue temperature signal from the HA 01 humidifier and a control signal to the HA 01 humidifier.

7.2.2 CPU Board

The diagram below is an overview of the CPU board



Main Processor and User Interface (UI) Processor

The processing core of the main unit is two M16C62P Microcontrollers.

The main processor has a supply voltage of +5 V and is not operating when Vivo 30/40 is shut of.

The UI processor is supplied with both +5 V (signal side) and +3,3 V (data side).

The UI processor is battery backed up and will operate in sleep mode when the Vivo 30/40 is switched off.

Compact Flash Memory Interface

The main processor can transfer the data log from the memory to the compact flash memory.

Display

The display used is a graphic type and have a visible area of approx. 60x80 mm, with a resolution of 240x320 pixels.

To drive the display a display controller is used.

RJ45 Connector

To communicate with a PC, the Vivo 30/40 uses a RS232 interface.

Pressure Sensors

Vivo 30/40 is equipped with two pressure sensors for redundancy. The main processor gets input from both pressure sensors, but the UI processor only gets input from one of the sensors. This means that both processors supervise the actual pressure and have the availability to stop the blower in case of an error condition.

Mass Flow Sensor

The mass flow sensor is used for air flow measurements.

Alarm Beeper

The alarm beeper is a 25 mm plastic membrane loudspeaker, powered by a 1 W bridge-connected audio amplifier. The alarm is generated by hardware and either of the two CPU:s can start and stop the alarm.

Stepper Motor Amplifier

The Vivo 30/40 uses a valve for controlling the exhalation phase. This valve is controlled by a stepper motor which is controlled by the main processor.

Voltage Regulators

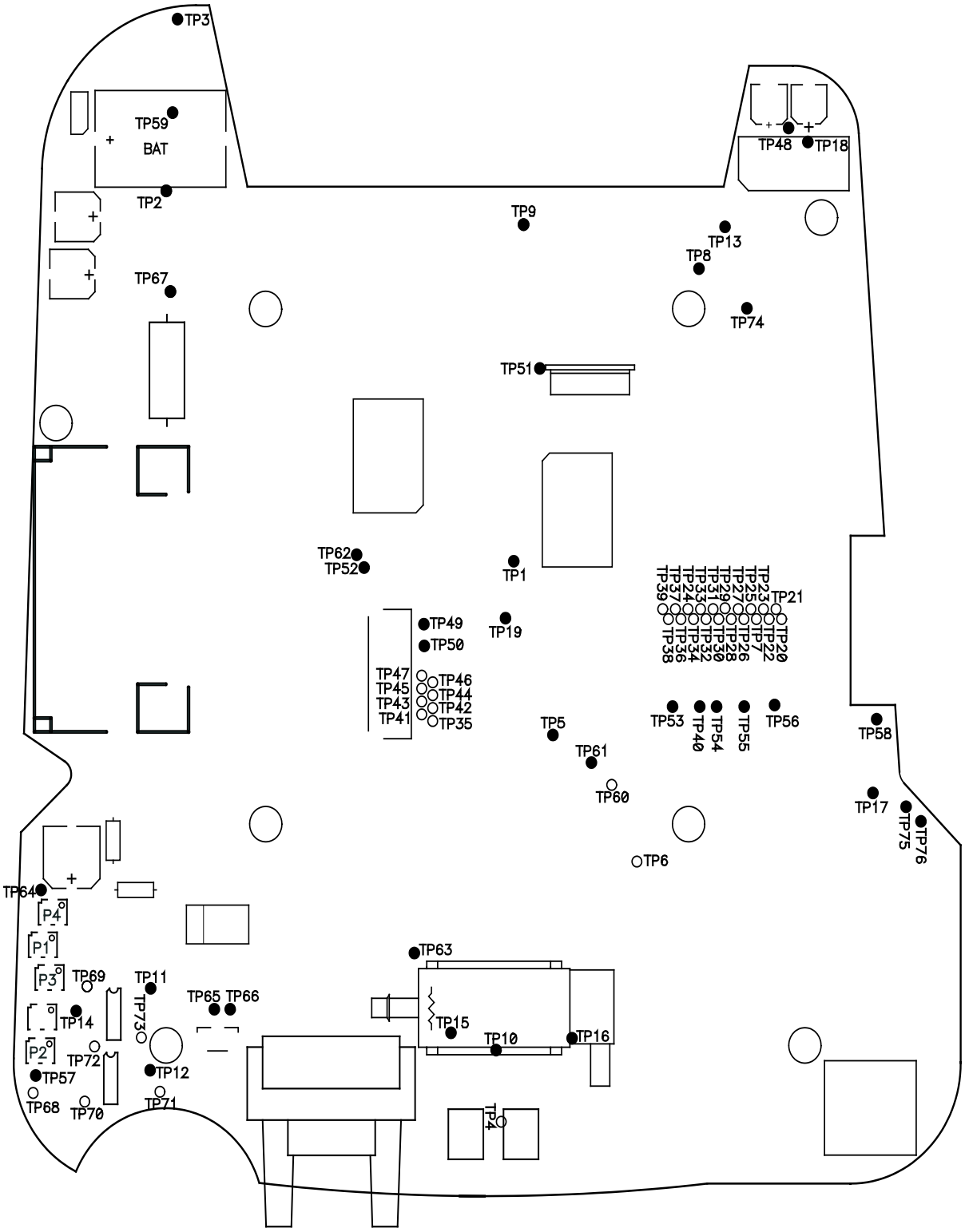
The CPU board contains voltage regulators for 3,3 V, 5 V, 8 V, 10 V and 24 V.

7.3 Test Points – CPU board

7.3.1 Test Point Locations

The locations of the test points for the CPU board are shown in the figure below.

The white test points are for production use only.



7.3.2 Test Point Matrix

The following are the test points on the CPU board of the Vivo 30/40.

TEST POINT	VOLTAGE	TOLERANCE	DESCRIPTION	POWER SUPPLY WHEN MEASURE	MACHINE STATUS
TP1	30 V	±2 V	VM Power good signal for U1	Mains	Stand by
TP2			For production use		
TP3	5.5 V	±1 V	5 V/LA	Mains	Stand by
TP4			For production use		
TP5	3.3 V	±0.5 V	+3.3 V	Mains	Stand by
TP6-7			For production use		
TP8	3 V	±0.3 V	Lithium battery CR2032	No supply	Off
TP9	5 V	±1 V	Reset signal for U15	Mains	Stand by
TP10	–	±0.5 V ±0.6 V	Pressure sensor 1 amplifier output: 0 mbar = 0.5 V 30 mbar = 2 V	Mains	Stand by
TP11	0–10 V	±0.15V ±0.2 V	Flow sensor amplifier (FlowL) output: 0 l/m = 2.5 V Adjust with P4 50 l/m = 3 V Adjust with P1 Be sure to reseal the potentiometer after adjusting	Mains	On
TP12	0–10 V	±0.15V ±0.2 V	Flow sensor amplifier (FlowH) output: 0 l/m = 2.5 V Adjust with P3 50 l/m = 4 V Adjust with P2 Be sure to reseal the potentiometer after adjusting	Mains	On
TP13	3.3 V	±0.5 V	Regulated 3.3 V	Mains	Stand by
TP14	10 V	±1 V	Regulated 10 V for flow sensor ampl.	Mains	Stand by
TP15	0–5 V		Control signal for magnetic valve. 5 V=powered	Mains	On
TP16		±0.5 V ±0.6 V	Pressure sensor 2 amplifier output: 0 mbar = 0.5 V 30 mbar = 2 V	Mains	Stand by
TP17	3.3 V	±0.5 V	Regulated 3.3 V	Mains	Stand by
TP18	5.5 V	±1 V	5 V/LA Reset signal for U1	Mains	Stand by
TP19	5.5 V	±1 V	VM divided for power good reset circuit(U2)	Mains	Stand by
TP20-39			For production use		

TEST POINT	VOLTAGE	TOLERANCE	DESCRIPTION	POWER SUPPLY WHEN MEASURE	MACHINE STATUS
TP40	12 V	±1 V	+12 V Regulated 12 V	Mains	Stand by
TP41-47			For production use		
TP48	25 V	±5 V	Contrast voltage for LCD	Mains	Stand by
TP49	4 V	±2 V	Backlight voltage depending on intensity	Mains	Stand by
TP50	0–4 V		PWM (not used)		
TP51	0–4 V		PWM (Pam LCD)	Mains	Stand by
TP52	5 V	±0.5 V	Regulated 5 V	Mains	Stand by
TP53	30 V	±2 V	VM Regulated 30 V	Mains	Stand by
TP54	5 V	±0.5 V	+5 V Regulated 5 V	Mains	Stand by
TP55	12–30 V		VCC CPU. Depending on power source	Mains/DC	On
TP56			EXT BAT		
TP57	0 V		Ground		
TP58	0 V		Ground		
TP59	0 V		Ground		
TP60			For production use		
TP61	0–5 V		Beeper current measure voltage	Mains	On. beeping
TP62	3.3 V	±0.5 V	Regulated 3.3 V	Mains	Stand by
TP63	5 V	±0.1 V	Reference voltage for A/D in U15		
TP64	24 V	±2 V	Regulated 24 V for valve motor	Mains	Stand by
TP65	0–5 V		Beeper amplifier speaker output	Mains	On, beeping
TP66	0–5 V		Beeper amplifier speaker output	Mains	On, beeping
TP67	5.5 V	±1 V	+ 5 V Regulator (CPU BAT)	Mains	Stand by
TP68-73			For production use		
TP74	5 V	±1 V	5 V when powered. 3 V when off	Mains/ No mains	Stand by/ Off
TP75	5 V	±0.5 V	Regulated 5 V	Mains	Stand by
TP76	12 V	±1 V	Regulated 12 V	Mains	Stand by
TP77	0 or 5 V	–	Mute 0 V if pushed	Mains	Stand by
TP78	0 or 5 V	–	Soft key 1 button. 0 V if pushed	Mains	Stand by

TEST POINT	VOLTAGE	TOLERANCE	DESCRIPTION	POWER SUPPLY WHEN MEASURE	MACHINE STATUS
TP79	0 or 5 V	–	Soft key 2 button. 0 V if pushed	Mains	Stand by
TP80	0 or 5 V	–	Soft key 3 button. 0 V if pushed	Mains	Stand by
TP81	0 or 5 V	–	Soft key 4 button. 0 V if pushed	Mains	Stand by
TP82	0 or 5 V	–	Up button. 0 V if pushed	Mains	Stand by
TP83	0 or 5 V	–	Down button. 0 V if pushed	Mains	Stand by
TP84	0 or 5 V	–	On/Off button. 0 V if pushed	Mains	Stand by
TP85	0 or 5 V	–	Plus button. 0 V if pushed	Mains	Stand by
TP86	0 or 5 V	–	Minus button. 0 V if pushed	Mains	Stand by

7.4 Ventilator Switch-over Operating Voltages

The Vivo 30/40 will issue alarm and switch between the various power sources available if any of the conditions described below occur.

7.4.1 Mains Power Supply Operation

If a voltage drop occurs while running from an mains power supply the ventilator will react as follows:

If the mains drops below 65 ±15 V AC the Vivo 30/40 will issue a low power alarm or switch over to the external battery, if available, or internal battery (Vivo 40 only).

7.4.2 External Battery Operation

24 V battery

Vivo 30: If the ventilator is running from an external battery and the voltage drops below 22.7 V the ventilator will issue a low external DC warning and continue to run until the voltage drops below 20 V. The ventilator will then issue a power-failure alarm and switch off.

Vivo 40: If the ventilator is running from an external battery and the voltage drops below 20 V the ventilator will switch to the internal battery supply.

When the external battery voltage returns to 24 V the ventilator will switch back to the external battery supply. The external battery voltage is checked continuously.

12 V battery

Vivo 30: If the ventilator is running from an external battery and the voltage drops below 11.3 V the ventilator will issue a low external DC warning and continue to run until the voltage drops to 10 V. The ventilator will then issue a power-failure alarm and switch off.

Vivo 40: If the ventilator is running from an external battery and the voltage drops below 10 V the ventilator will switch to the internal battery supply.

When the external battery voltage returns to 12 V the ventilator will switch back to the external battery supply. The external battery voltage is checked continuously.

7.4.3 Internal Battery Operation (Vivo 40 only)

If a voltage drop occurs while running from an internal battery the ventilator will react as follows:

If the voltage drops to 16.3 V the ventilator will issue a low-battery alarm and continue to run until the voltage drops to 14 ±0.75 V. It will then issue a power-failure alarm and switch off.

7.5 Checking the Internal Battery (Vivo 40 only)

1 Make sure the battery is fully charged.

2 Adjust the settings as follows:

SETTING	VALUE
Mode	PCV
IPAP	20 cmH_2O
EPAP	8 cmH_2O
Set Rate	15 bpm
Inspiration Time	3.0 s

Study the Vivo 40 Clinician's manual for how to adjust the settings.

3 Disconnect the power cord.

4 Connect a test lung and start the ventilator.

5 The ventilator shall run for at least one hour before shutdown.

8 Fault Tracing

Always perform a Complete Function Test if you have opened the Vivo 30/40.

This chapter contains a fault-tracing table and a table of error codes to use when troubleshooting the Vivo 30/40.

8.1 Fault Tracing Table

If the Vivo 30/40 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 30/40 does not start when running from the mains supply.	The power cord is not properly connected.	Connect the power cord.	5.2 in the Vivo 30/40 Clinician's manual
	The On/Off button on the side panel is switched off.	Switch on the On/Off button.	
	The mains fuse has blown.	**1** Replace the fuse on the PSU board. **2** If it blows again, replace the PSU board.	5.3 3.2 (Vivo 30) 3.3 (Vivo 40)
The Vivo 40 does not run from the internal battery supply.	The internal battery is discharged.	Charge the internal battery.	5.7 in the Vivo 40 Clinician's manual
	The internal battery is faulty.	Replace the internal battery.	5.1
The Vivo 30/40 does not run from the external battery supply.	External battery discharged.	Charge external battery.	
	The external battery cable is not connected properly or is faulty.	**1** Connect the cable. **2** If the cable is connected, measure the voltage. **3** Replace the cable if faulty.	5.7 in the Vivo 30/40 Clinician's manual
	The external DC is not within 12–24 V DC.	Check the power source and the cable polarity.	
	The external DC fuse on the PSU board has blown.	**1** Replace the fuse on the PSU board. **2** If it blows again, replace the PSU board.	5 3.2 (Vivo 30) 3.3 (Vivo 40
	Battery polarity faulty. May be the case if fuse blows immediately after connecting to external battery cable.	Check polarity.	

SYMPTOM	POSSIBLE CAUSE	REMEDIAL ACTION	SEE REF.
Ventilator does not give the adequate pressure.	External leaks from patient circuit or nasal mask.	Check the tubes, connectors and mask for leaks.	2.5
	Internal leaks from tubes, humidifier or air channels.	Check the tubes, air channels and the humidifier.	2.6
The air filters are dirty.	The air filters are dirty.	**1** Replace the white filter. **2** Wash the grey filter.	10.2 in the Vivo 30/40 Clinician's manual
Pressure indicator shows no pressure reading.	The internal supply tube is blocked or loose.	Check the tubes.	2.6
	The CPU board is faulty.	Replace the CPU board.	5.5

8.2 Function Failure Error Codes

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 six most recent error codes and alarms are logged in the alarm history.

Access the alarm history using the menu as described in the Vivo 30/40 Clinician's Manual.

8.2.2 Error Code Table

The table below lists each error code and the corresponding text that is shown on the LCD 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 30/40 and Replacing the Main Components" on page 34 for information about how to replace the circuit boards.

ERROR CODE	TEXT ON LCD DISPLAY	PROBLEM	ACTION
1	FUNCTION FAILURE MAIN PROCESSOR RAM FAIL	Ventilator fails main processor RAM self-test.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.
2	FUNCTION FAILURE MAIN PROCESSOR FLASH FAIL	Ventilator fails main processor FLASH self-test.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.

Error code	Text on LCD Display	Problem	Action
4	FUNCTION FAILURE PRESS G1 FAIL	Pressure sensor (PG 1) fail.	**1** Restart the Vivo 30/40. **2** Make sure that all internal tubings are properly fastened and not kinked. **3** Check test point 40 (see chapter 7.3). If it is out of range - replace the PSU board. **4** Replace the CPU board or send the Vivo 30/40 for service.
5	FUNCTION FAILURE PRESS G2 FAIL	Pressure sensor (PG 2) fail.	**1** Restart the Vivo 30/40. **2** Make sure that all internal tubings are properly fastened and not kinked. **3** Check test point 40 (see chapter 7.3). If it is out of range - replace the PSU board. **4** Replace the CPU board or send the Vivo 30/40 for service.
6	FUNCTION FAILURE FLOW G1 FAIL	Flow sensor (FG 1) fail.	**1** Restart the Vivo 30/40. **2** Make sure that all internal tubings are properly fastened and not kinked. **3** Check test point 40 (see chapter 7.3). If it is out of range - replace the PSU board. **4** Replace the CPU board or send the Vivo 30/40 for service.
10	FUNCTION FAILURE ALARM BATTERY LOW CONNECT TO MAINS AND RESTART IN 30 MIN	Alarm battery status fail (AD too low).	**1** Connect the Vivo 30/40 to mains for 30 minutes. **2** Replace the alarm battery. Make sure that the new battery is fully charged. **3** Replace the CPU board or send the Vivo 30/40 for service.

Error code	Text on LCD Display	Problem	Action
13	FUNCTION FAILURE MAIN PROCESSOR SHUT DOWN FAIL	Main processor unable to turn off motor.	**1** Restart the Vivo 30/40. **2** Replace the PSU board. **3** Replace the CPU board or send the Vivo 30/40 for service.
14	FUNCTION FAILURE UI PROCESSOR SHUT DOWN FAIL	UI processor unable to turn off motor.	**1** Restart the Vivo 30/40. **2** Replace the PSU board. **3** Replace the CPU board or send the Vivo 30/40 for service.
15	FUNCTION FAILURE DATE TIME MISMATCH FAIL	Power down time is not correct. Memory log may be Corrupt.	**1** Restart the Vivo 30/40 and check all settings. **2** Replace the clock battery and restore all settings. **3** Replace the CPU board or send the Vivo 30/40 for service.
16	FUNCTION FAILURE BEEPER FAIL	Beeper check fail.	**1** Restart the Vivo 30/40. **2** Replace the beeper **3** Replace the CPU board or send the Vivo 30/40 for service.
17	FUNCTION FAILURE CPU VOLTAGE FAIL	10 V ref and 3.3 V ref is not correct.	**1** Check test point 40 (see chapter 7.3). If it is out of range - replace the PSU board. **2** Replace the CPU board or send the Vivo 30/40 for service.
31	FUNCTION FAILURE REMOTE POWER FAIL		**1** Disconnect cable from RJ45 socket. **2** Restart the Vivo 30/40. **3** Replace the CPU board or send the Vivo 30/40 for service.
32	FUNCTION FAILURE MAIN PROCESSOR DATA FAIL	Inverse not match Memory log may be Corrupt.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.

Error code	Text on LCD Display	Problem	Action
35	FUNCTION FAILURE PRESSURE SENSOR HIGH TEMP. FAIL	Pressure sensor temperature >85°C (185°F).	**1** Let the Vivo 30/40 cool off and restart. **2** Check that the BLDC motor cablings does not disrupt the PSU cooling fan air way. **3** Replace the PSU board. **4** Replace the CPU board or send the Vivo 30/40 for service.
36	FUNCTION FAILURE FAN MOTOR OVERTEMPERATURE	Fan motor temperature >100°C (212°F).	**1** Let the Vivo 30/40 cool off and restart. Let the Vivo 30/40 run for 2 hours with the settings used in chapter 7.5. Switch to standby mode and try to listen if the PSU cooling fan runs. If not - replace the PSU cooling fan. If it still doesn't run - replace the PSU board. **2** Check that the BLDC motor cablings does not disrupt the PSU cooling fan air way. **3** Replace the complete blower assembly. **4** Replace the CPU board or send the Vivo 30/40 for service.
37	FUNCTION FAILURE MAINS TEMPERATURE HIGH TEMP. FAIL	Main processor temperature >100°C (212°F).	**1** Let the Vivo 30/40 cool off and restart. **2** Check that the BLDC motor cablings does not disrupt the PSU cooling fan air way. **3** Replace the PSU board. **4** Replace the CPU board or send the Vivo 30/40 for service.
38	FUNCTION FAILURE PATIENT PARAMETERS FAIL	Check Sum fail. Memory log may be Corrupt.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.

Error code	Text on LCD Display	Problem	Action
40	FUNCTION FAILURE INTERFACE COMM. ERROR	Communication fail between main processor and UI processor.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.
42	FUNCTION FAILURE VALVE FUSE BROKEN	Fuse on CPU board is blown.	Replace the CPU board or send the Vivo 30/40 for service.
43	FUNCTION FAILURE SENSOR CALIBRATION	A mandatory calibration is needed after firmware upgrade.	**1** Perform a pressure and flow calibration.
50	FUNCTION FAILURE UI PROC. RAM FAIL	RAM fail.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.
51	FUNCTION FAILURE UI PROC. FLASH FAIL	Flash fail.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.
53	FUNCTION FAILURE UI LEDS FAIL	LED fail.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.
54	FUNCTION FAILURE UI KEYS FAIL	Key fail.	**1** Restart the Vivo 30/40. **2** Make sure that the push button silicone pad is properly fitted. **3** Replace the push button silicone pad. **4** Replace the CPU board or send the Vivo 30/40 for service.
55	FUNCTION FAILURE UI HIGH PRESSURE	Pressure fail.	**1** Restart the Vivo 30/40. **2** Perform Pressure Calibration. **3** Make sure that all internal tubings are properly fastened and not kinked. **4** Replace the CPU board or send the Vivo 30/40 for service.

Error code	Text on LCD Display	Problem	Action
56		Communication fail between UI processor and LCD.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 for service.
57	FUNCTION FAILURE UI COMM. FAIL	Communication fail between main processor and UI processor.	**1** Restart the Vivo 30/40. **2** Replace the CPU board or send the Vivo 30/40 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 30/40 are intended for use in the electromagnetic environment specified below. The customer or the user of the Vivo 30/40 should assure that it is used in such an environment.

Portable and mobile RF (radio frequency) communications equipment should not be used no closer to any part of the Vivo 30/40, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.

IMMUNITY TEST	IEC 60601 TEST LEVEL	COMPLIANCE LEVEL	RECOMMENDED SEPARATION DISTANCE
Conducted RF IEC 61000-4-6	3 V_{rms} 150 kHz to 80 MHz	13 V	d= 0,27*√P m
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	13 V/m	d= 0.27*√P m at 80 MHz to 800 MHz d= 0.54*√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.

9.1.2 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 30/40 is used exceeds the applicable RF compliance level above, the Vivo 30/40 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Vivo 30/40.

b) Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

9.1.3 Guidance and Manufacturer's Declaration – Electromagnetic Emission

The Vivo 30/40 are intended for use in the electromagnetic environment specified below. The customer or the user of the Vivo 30/40 should assure that it is used in such an environment.

EMISSIONS TEST	COMPLIANCE	ELECTROMAGNETIC ENVIRONMENT – GUIDANCE
RF emissions CISPR 11	Group 1	The Vivo 30/40 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 30/40 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	

Recommended separation distances between portable and mobile RF communications equipment and the Vivo 30/40.

The Vivo 30/40 are intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Vivo 30/40 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Vivo 30/40 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= 0.27*√P m	**80 MHz to 800 MHz d= 0.27*√P m**	**800 MHz to 2.5 GHz d= 0.54*√P m**
0.01	0.03	0.03	0.05
0.1	0.08	0.08	0.17
1	0.27	0.27	0.54
10	0.85	0.85	1.7
100	2.7	2.7	5.4

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.

9.1.4 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 30/40

Use a photocopy of this service record for the maintenance inspection described in "Maintenance Instructions" on page 7. Use the next page for comments and notes.

Service record no._____

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

Accessories: .....

Delivery date: ..... Total 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.8	.....
Note number of total operating hours	2.4.2, p.9	.....
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.10	.....
Check the HA01 humidifier (if used)	2.5.2	.....
Check power connection	2.5.3	.....
Inspect patient circuit	2.5.4	.....
Inspect the ventilator accessories	2.5.5	.....
Change/wash the patient filters	2.5.6	.....
Perform minimum function check	2.5.7	.....
Internal Battery (Vivo 40 only)		
Every 2 years:		
Replace the Internal Battery	5.1, p.34	.....
Alarm/Clock Battery		
Every 5 years:		
Replace the alarm and clock battery	5.2, p.35	.....
Check the power failure alarm	2.9, p.18	.....
Blower Assembly		
Every 20,000 total operating hours:		
Replace the complete blower assembly	5.2	.....
Internal Checks (when required)		
Clean inside of ventilator	2.6.1, p.11	.....
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	.....

Continued on next page

Complete Function Check	See instruction ref.	Check OK
Check the breath rate and inspiration time	2.7.1, p.12	.....
Check the pressure	2.7.2	.....
Check the tidal volume indication	2.7.3	.....
Prepare the ventilator for alarm checks	2.7.4	.....
Check the low/high leakage alarm	2.7.5	.....
Check the high pressure alarm	2.7.6	.....
Check the inspiratory trigger	2.7.7	.....
Check the low pressure alarm	2.7.8	.....
Check the high breath rate alarm (Vivo 40 only)	2.7.9	.....
Check the low breath rate alarm (Vivo 40 only)	2.7.10	.....
Check the low volume alarm	2.7.11	.....
Check the audio pause	2.7.12	.....
Check the external battery operation	2.7.13	.....
Check the internal battery operation (Vivo 40 only)	2.7.14	.....
Adjust settings for patient	2.7.15	.....

Notes

9.3 Returning Products to Breas

You may need to return the ventilator, components or accessories to Breas Medical AB for service, warranty, upgrade or repair. In this case, follow the instructions below to ensure that the correct action is taken to avoid unnecessary delays.

1 Pack the product in its original packing. If this is not available, pack the product in packaging suitable for the transportation to Breas.

2 Take a photocopy of the delivery report on the next page.

3 Fill out the delivery report and pack it together with the product to be returned.

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

9.4 Product Return Form – Breas Vivo 30/40 ventilator

Breas ref. no.:.....

Customer information

Customer name:.....

Address: .....

.....

Phone:.....

Reference person: ..... **Customer ref. no.:**.....

Product information

Model: ..... **Serial no.:**..... **Total operating hours:**.....

Error – Complaint – Accessories

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