Dräger medical
A Dräger and Siemens Company

Evita 4

Intensive Care Ventilator

Instructions for Use
Software 4.n

MT-159-99

Working with these Instructions for Use

Header line – the title...
of the main chapter

The title of the specific sub-section is printed underneath the main header – to help you find your way quickly from subject to subject.

Page body...
the Instructions for Use

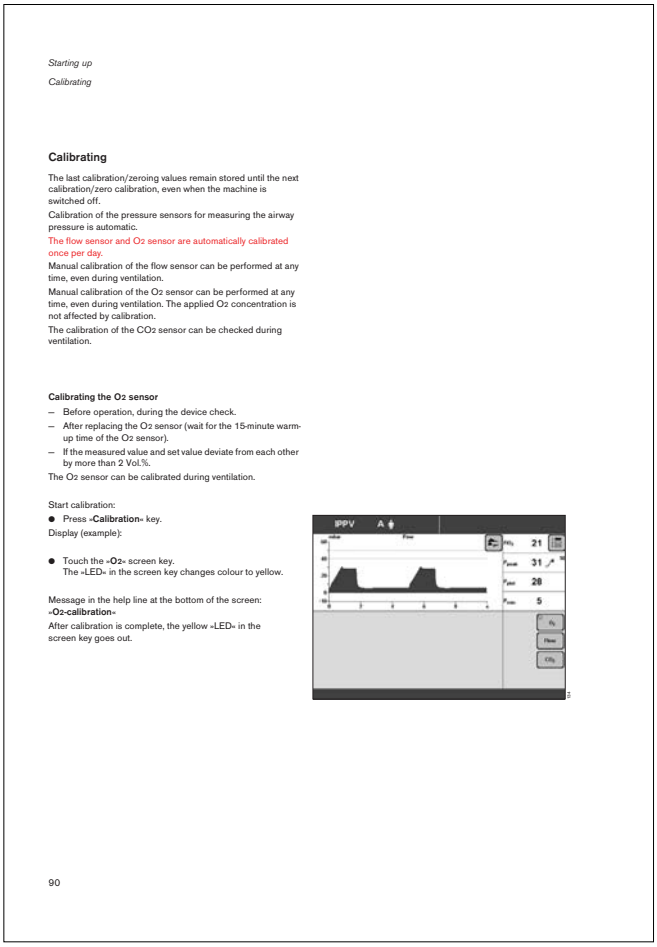
in combined text/illustrations. The information is expressed in the form of practical actions, giving the user direct hands-on experience in learning how to use the machine.

Left-hand column – the text...

provides explanations and instructs the user step-by-step in the practical use of the product, with short, clear instructions in easy-to-follow sequence.
Bullet points indicate separate actions. Where several actions are described, numbers are used both to refer to the relevant details in the illustrations and to specify the sequence of actions.

Right-hand column – the illustrations...

provide the visual reference for the text and make it easier to locate the various parts of the equipment. Elements mentioned in the text are highlighted. Unnecessary details are avoided. Screen displays prompt the user to proceed and confirm correct actions.



Starting up

Calibrating

Calibrating

The last calibration/zeroing values remain stored until the next calibration/zero calibration, even when the machine is switched off.
Calibration of the pressure sensors for measuring the airway pressure is automatic.
The flow sensor and O_2 sensor are automatically calibrated once per day.
Manual calibration of the flow sensor can be performed at any time, even during ventilation.
Manual calibration of the O_2 sensor can be performed at any time, even during ventilation. The applied O_2 concentration is not affected by calibration.
The calibration of the CO_2 sensor can be checked during ventilation.

Calibrating the O_2 sensor

– Before operation, during the device check.
– After replacing the O_2 sensor (wait for the 15-minute warm-up time of the O_2 sensor).
– If the measured value and set value deviate from each other by more than 2 Vol.%.

The O_2 sensor can be calibrated during ventilation.

Start calibration:
● Press »**Calibration**« key.
Display (example):

● Touch the »**O2**« screen key.
The »LED« in the screen key changes colour to yellow.

Message in the help line at the bottom of the screen:
»**O2-calibration**«
After calibration is complete, the yellow »LED« in the screen key goes out.

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What's new in Evita 4 software 4.n*

Specification of the humidifier used

— »Active humidifier«
or
— »HME/Filter« (artificial nose)
— for more accurate measurement of the volume parameters

Apnoea ventilation On/Off

— can be selected as starting configuration

Extended range of settings for the alarm time T_{Apnoea}

— from 5 to 60 seconds
(formerly 15 to 60 seconds)

Frequency can be reduced to 0

— for BIPAP and SIMV, for weaning without transitions

Ventilation mode BIPAP$_{Assist}$

— for pressure-controlled assisted ventilation

Patient mode »prev. patient« can be selected

— to adopt the settings, including alarms, which were effective before switching off the equipment

Leakage compensation On/Off

— for activation and deactivation of the automatic leakage compensation function

Extended logbook entries

— Evita 4 4.n identifies alarms which are active but not displayed with an asterisk

Monitoring of tube blockages

— new alarm message »Tube blocked !!!«

Additional weaning parameters

available as software version 4.n plus upgrade

in addition to the parameter occlusion pressure P 0.1 Evita 4.n also determines the parameters

— RSB Rapid Shallow Breathing index
and
— NIF Negative Inspiratory Force index

External flow source

available as software version 4.n plus upgrade

— The amount of external flow is calculated by Evita 4 4.n (e.g. for additional tracheal gas insufflation) and adjusts the volume monitoring tolerances in order to avoid inadvertent alarms

Extended use of loop presentations

available as software version 4.n plus upgrade

— Loops can be zoomed and frozen
— Loops can be displayed permanently in the upper part of the screen

Evita Remote (Remote Pad)

optionally available

— Remote control pad for parallel remote operation of function keys on Evita 4

NIV

optionally available

— Application mode to support non-invasive ventilation therapies

Nurse call

optionally available

— Connection for transmitting alarm signals to a central hospital alarm station

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* See page 180 onwards for new features in software versions 2.n and 3.n

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For Your Safety and that of Your Patients

Strictly follow the Instructions for Use

Any use of the apparatus requires full understanding and strict observation of these instructions. The apparatus is only to be used for purposes specified here.

Maintenance

The apparatus must be inspected and serviced regularly by trained service personnel at six monthly intervals.
Repair and general overhaul of the apparatus may only be carried out by trained service personnel.
We recommend that a service contract be obtained with DrägerService and that all repairs also be carried out by them.
Only authentic Dräger spare parts may be used for maintenance.
Observe chapter "Maintenance Intervals".

Accessories

Do not use accessory parts other than those in the order list.

Not for use in areas of explosion hazard

This apparatus is neither approved nor certified for use in areas where combustible or explosive gas mixtures are likely to occur.

Safe connection with other electrical equipment

Electrical connections to equipment which is not listed in these Instructions for Use should only be made following consultations with the respective manufacturers or an expert.

Liability for proper function or damage

The liability for the proper function of the apparatus is irrevocably transferred to the owner or operator to the extent that the apparatus is serviced or repaired by personnel not employed or authorized by DrägerService or if the apparatus is used in a manner not conforming to its intended use.

Dräger cannot be held responsible for damage caused by non-compliance with the recommendations given above.
The warranty and liability provisions of the terms of sale and delivery of Dräger are likewise not modified by the recommendations given above.

Dräger Medical AG & Co. KGaA

Safe Use of the Equipment

This equipment must only be used under the supervision of qualified medical staff, so that help is available immediately if any faults or malfunctions occur.

This equipment must not be used with flammable gases or anaesthetic agents. Danger of fire!

Do not use mobile telephones within 10 metres of ventilators!

Mobile telephones may impair the functioning of electromedical equipment and endanger the patient.*

Unit must not be tilted more than 5° on the trolley, otherwise it may tip over.

Appropriate ventilation monitoring

The built-in monitoring facilities of Evita 4 ensure appropriate monitoring of ventilation therapy and there-fore detect any undesirable changes in the following ventilation parameters:

- Airway pressure, Paw
- Expiratory minute volume, MV
- Inspiratory O_2 concentration, FiO_2
- Inspiratory breathing gas temperature, T
- Expiratory CO_2 concentration, $etCO_2$ (optional)
- Inspiratory breathing volume, V_{Ti}
- Apnoea time
- Tachypnoea monitoring

Changes in these parameters may be caused by:

- Acute changes in the patient's condition
- Incorrect settings and faulty handling
- Equipment malfunctions
- Failure of power and gas supplies

If a fault occurs in this equipment, separate measuring instruments should be used.

Back-up ventilation with an independent manual ventilation device

If a fault is detected in Evita 4 so that its life-support functions are no longer assured, ventilation using an independent ventilation device must be started without delay – if necessary with PEEP and/or increased inspiratory O_2 concentration (e.g. with the Dräger Resutator 2000).

* Dräger medical equipment meets the requirements for immunity to interference in accordance with the specific product standards and EN 60601-1-2 (IEC 601-1-2). Depending on the type of mobile telephone used and on the application situation, however, field strengths exceeding the values specified in the applicable standards may develop in the immediate vicinity of the mobile telephone and therefore lead to faults and malfunctions.

Intended Medical Application

Long-term ventilator for intensive care.
For adults, children and neonates.
For premature babies with the "NeoFlow" option.

With the following ventilation modes:

IPPV (**I**ntermittent **P**ositive **P**ressure **V**entilation)
controlled and assisted constant-volume ventilation.
With the options:

- CPPV (**C**ontinuous **P**ositive **P**ressure **V**entilation)
- PLV (**P**ressure **L**imited **V**entilation)
- AutoFlow®
  for automatic regulation of inspiration flow
- IRV (**I**nversed **R**atio **V**entilation)

SIMV (**S**ynchronized **I**ntermittent **M**andatory **V**entilation)
procedure for weaning patients off the ventilator after they have started spontaneous breathing.
With the options:

- PLV (**P**ressure **L**imited **V**entilation)
- AutoFlow®
  for automatic regulation of inspiration flow

MMV (**M**andatory **M**inute **V**olume **V**entilation)
spontaneous breathing with automatic adjustment of mandatory ventilation to the patient's minute volume requirement.
With the options:

- PLV (**P**ressure **L**imited **V**entilation)
- AutoFlow®
  for automatic regulation of inspiration flow

SB (**S**pontaneous **B**reathing)
spontaneous breathing at ambient pressure.

CPAP (**C**ontinuous **P**ositive **A**irway **P**ressure)
spontaneous breathing with positive airway pressure.

ASB (**A**ssisted **S**pontaneous **B**reathing)
pressure-assisted spontaneous breathing.

BIPAP* (**B**iphasic **P**ositive **A**irway **P**ressure)
pressure-controlled ventilation combined with free spontaneous breathing during the complete breathing cycle, and adjustable pressure increase to CPAP level.

BIPAPAssist (**B**iphasic **P**ositive **A**irway **P**ressure **A**ssisted)
Pressure-controlled assisted ventilation

APRV (**A**irway **P**ressure **R**elease **V**entilation)
Spontaneous breathing on two pressure levels with long time ranges – independently adjustable.

Special modes:

Apnoea Ventilation
For switching over automatically to volume-controlled mandatory ventilation, if breathing stops.

If apnoea occurs, Evita 4 emits an alarm after the preset alarm period (T_{Apnoea}) and starts volume-controlled ventilation.

ILV (**I**ndependent **L**ung **V**entilation)
Separate, differentiated, synchronised ventilation with two Evita units.

Diagnostics:

Intrinsic PEEP-measurement
for determining intrinsic PEEP and measuring trapped volume

Occlusion pressure measurement
for evaluating breathing drive during spontaneous breathing

With monitoring for

airway pressure, Paw
expiratory minute volume, MV
inspiratory O_2 concentration, FiO_2
inspiratory breathing gas temperature, T
expiratory CO_2 concentration, $etCO_2$
inspiratory breathing volume, V_{Ti}
apnoea time
tachypnoea monitoring to detect rapid, shallow spontaneous breathing

Automatic gas switch-over.
In the event of a gas failure, the change-over to another gas is automatic.

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* Registered trade mark

Operating Concept

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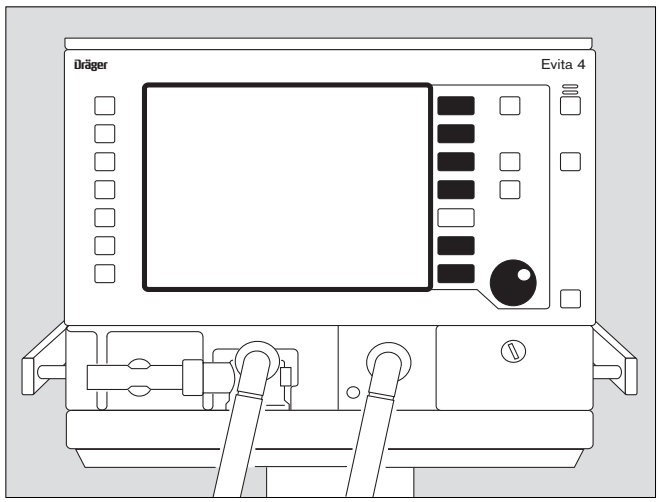
Operating Concept

Structure of the Control Unit

The main components of the control unit are the screen, a set of **fixed function** keys and the **central rotary dial-knob.**

The function keys are used to call up the **screen pages** appropriate to the application.



In addition to curves, measured values and status displays, the screen contains, in a separate field, touch-sensitive keys and touch-sensitive rotary knobs for parameter setting.

The touch-sensitive **screen keys** and the **screen knobs** are used in a similar way to ordinary keys and knobs:

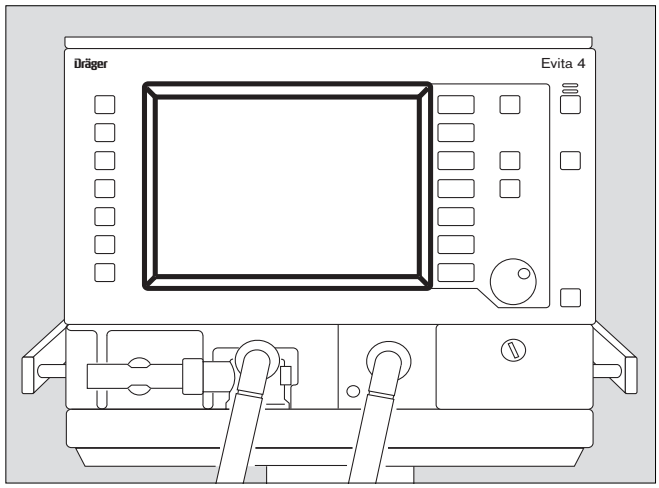
Touching with the fingertip is equivalent to pressing a key or taking hold of a knob.

The display always contains only the screen keys and screen knobs required for function selection and/or adjustment.

Settings and confirmations are made by turning and pressing the central, rotary knob.

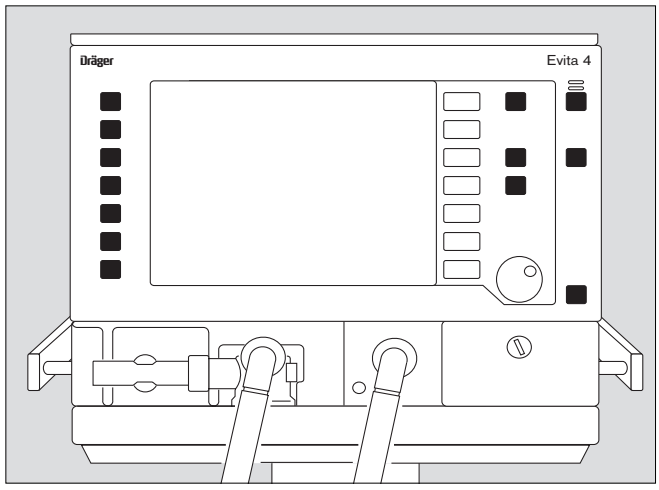
Do not cover the black plastic frame around the screen and do not place any objects in the frame.

The touch-sensitive screen keys and knobs will no longer function correctly.



The keys for routine functions are placed to the right and left on the outside of the front panel.

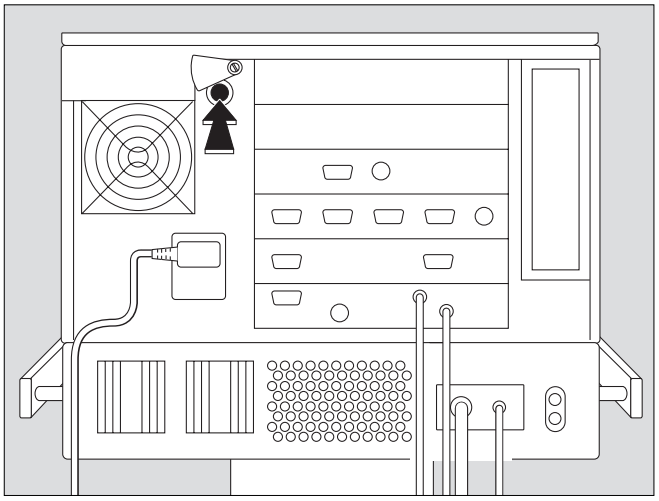
Frequently used function keys are placed on the right, e.g. the key »« for selecting the standard page or the »**Alarm Reset**« key for resetting or confirming messages.

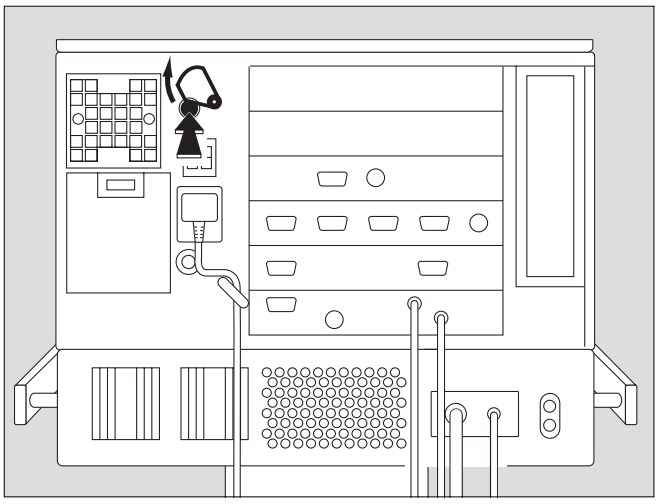


Less frequently used function keys are placed on the left-hand side of the front panel,
e. g. the key »« for switching the medicament nebuliser on/off,
or the »**O2 suction**« key for bronchial suctioning.

The Power Switch

for switching the device on/off.
The power switch is located on the back panel and has a pivoting cover to protect against being inadvertently switched off.





On-Screen Controls

The lower half of the screen contains touch-sensitive coloured **screen keys** and **screen knobs**.

Touching these controls with the fingertip is equivalent to pressing key or taking hold of a knob.

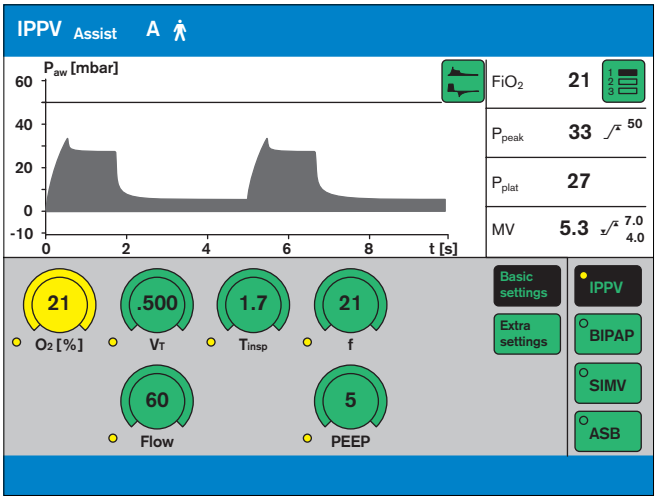
The colour displays the status of the "control" and "LEDs":

green = usable

white = not usable

yellow = adjust/confirm

black = effective function/display

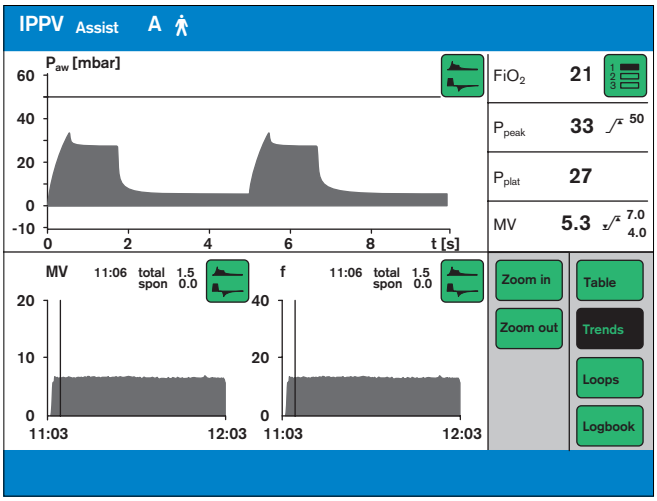


Screen Keys for Selecting Functions without Confirmation

e.g.for paging through the system on-screen

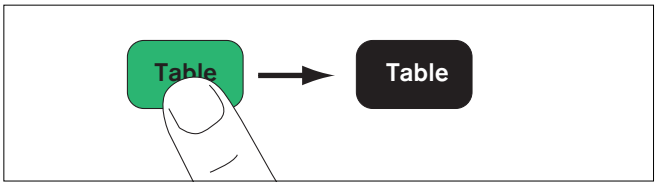
for changing the menu

for switching over displays.



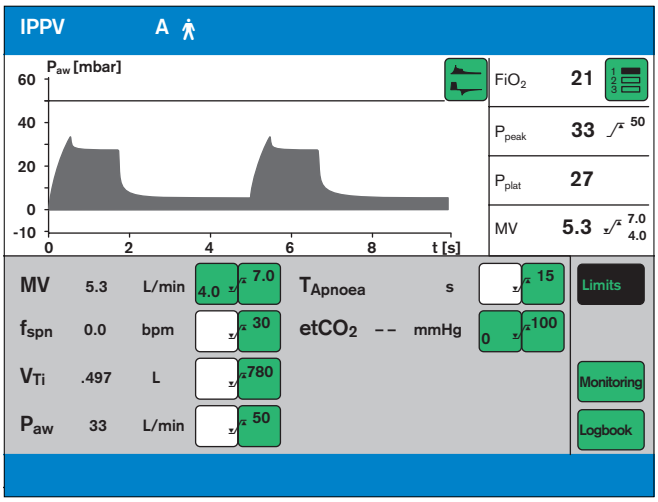
Example:

- Press the »**Table**« key = select display.
  The key goes black to show that the function is active.



Screen Keys for Function Selection, Adjustment and Confirmation

Display (example):

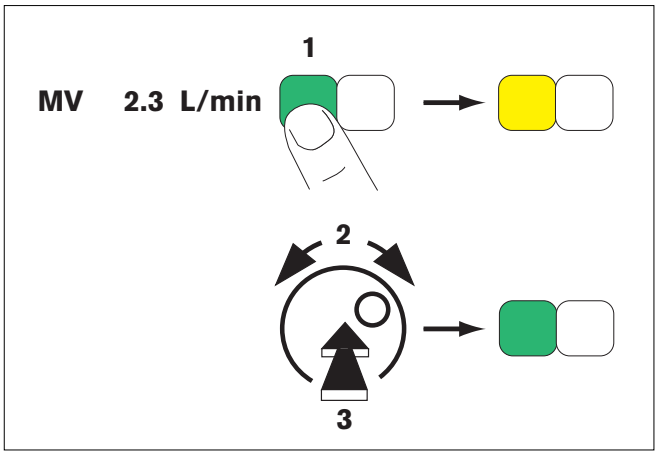


1 Touch the relevant screen key for the alarm limits, e.g.:
MV 2.3 L/min

The colour changes from green to yellow = setting function is set.

2 Turn the rotary knob = adjust the alarm limit. The value is displayed in the screen key.

3 Press the rotary knob = the colour changes from yellow to green, and the set alarm limit is confirmed and effective.

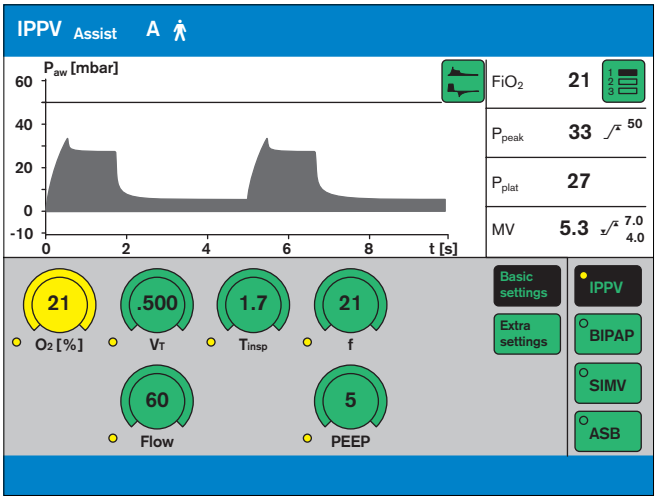


To cancel the setting:

- Touch the screen key again
  or
- touch another screen key.

Screen Knobs for Setting Parameters

Display (example):

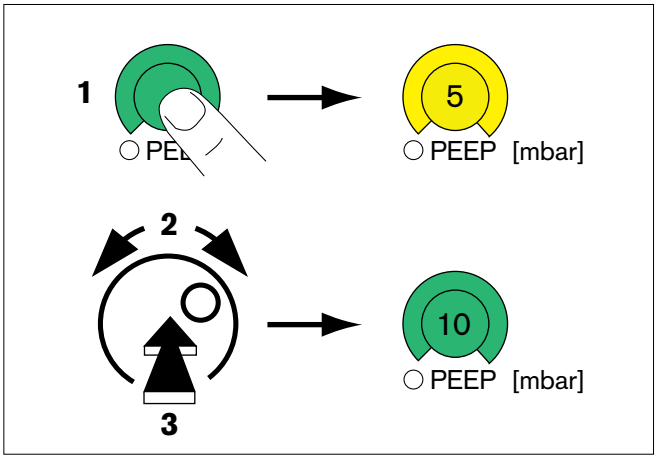


e.g. »**PEEP**« screen knob.

1 Touch the »**PEEP**« screen knob:
It changes colour from green to yellow = setting function selected.

2 Turn rotary knob = Adjust setting. The value is displayed in the knob.

3 Press rotary knob = Confirm. The knob changes colour from yellow to green, and the setting is validated and takes effect.



While pressure values, such as Pmax, are being set, they are displayed in the Paw (t) curve as a dashed black line.

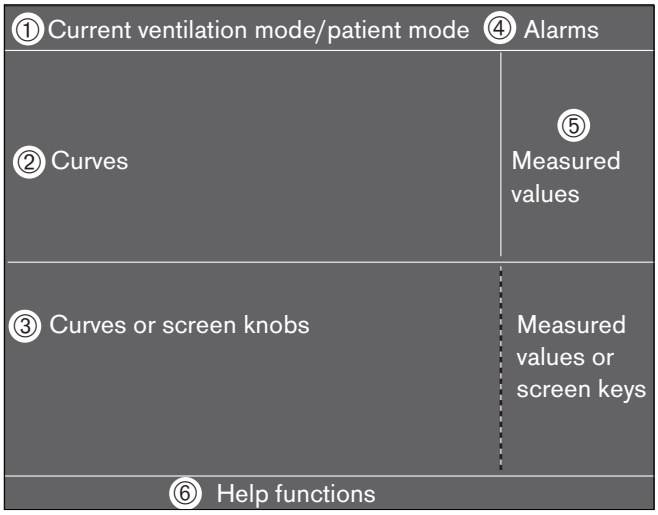
To cancel the setting:

- Press the screen knob again
  or
- press another screen knob.

Screen Pages

All the screen pages have the same structure, i.e. their contents are always arranged in the same positions on the screen:

Messages indicating ventilation modes and alarms, displays of measured values and curves, and help functions, always appear in the same position on the screen:



① The **active ventilation mode/patient mode** is displayed on the left-hand side of the top line.
The ventilation mode is indicated by its abbreviation, e.g. BIPAP.
The patient mode is indicated by a symbol:
A for adults
P for paediatric
In the case of spontaneous breathing activity by the patient, a lung symbol is briefly displayed as indicator.

② **Curves** are displayed in the upper left-hand quarter of the screen.

③ The lower half of the screen shows curves and measured values or **screen keys** and **screen knobs** – depending which screen page is selected.

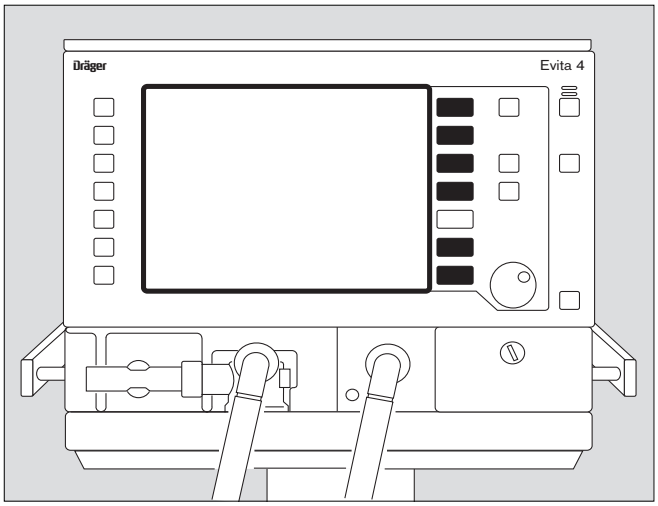
④ **Alarms** are displayed on the right of the top line.

⑤ **Measured values** are displayed in the upper right-hand quarter of the screen.

⑥ **Help functions** appear in the bottom line of the screen. On the right, Evita 4 provides setting instructions. On the left, Evita 4 provides information on the current status – this information can be accessed by pressing key » i «.

The solid function keys to the right of the screen are used to select the screen pages for the following specific application situations:

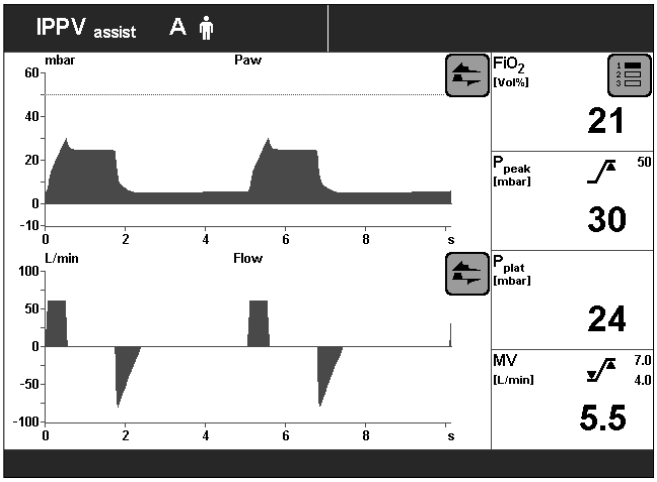
— **Settings**
— **Alarm limits**
— **Measured values**
— **Special measurement procedures**
— **Calibration**
— **Configuration**



Standard Page

For displaying the ventilation status

- Press » « key.
  Display (example):



The standard page shows the ventilation situation at a glance – reduced to the most important measurement parameters and curves.

Four measured values are shown on the right, and two curves on the left.

Other measured values and curves can be selected in the standard page and all subsequent screen pages.

To select other measured value combinations:

- Touch screen key » « repeatedly.

To select other curves:

- Touch key » « and touch the screen key corresponding to the desired curve.

»Settings« Screen

For displaying the setting parameters

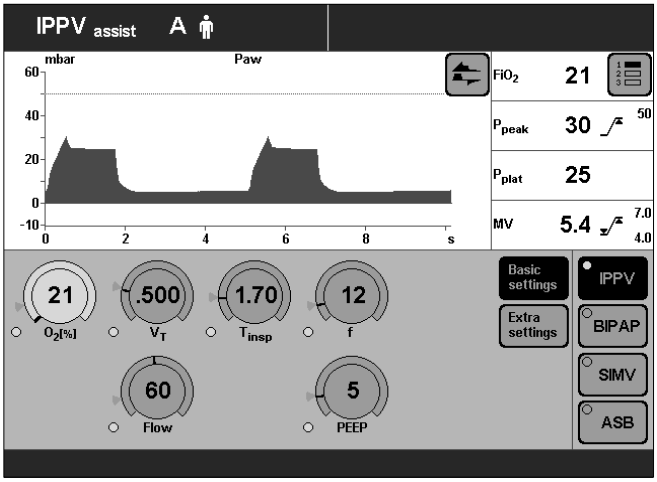
The bottom right-hand side of the screen contains the screen keys for selecting the ventilation modes.

The screen key displayed in black (IPPV in the example) represents the currently activated ventilation mode.

The bottom left-hand side of the screen contains the on-screen rotary control knobs.

The values of the setting parameters are displayed in the screen knobs relevant to the ventilation mode.

The user-definable start-up settings are marked by an arrow (▶) on the scales of the screen knobs. See "Configuration" on page 101 onwards.

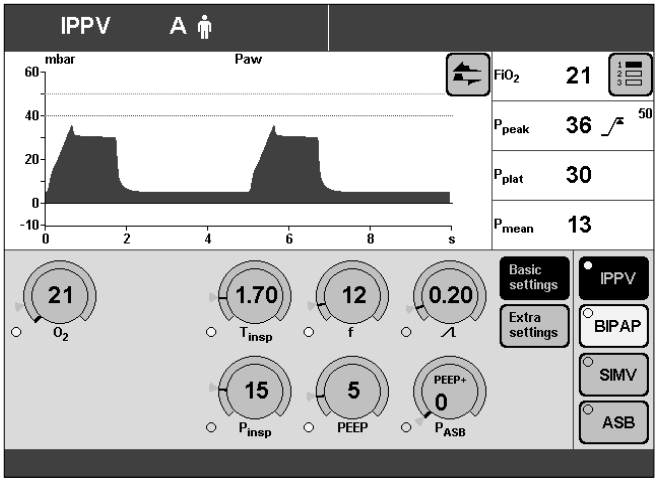


Changing the settings of an active ventilation mode

- Touch the appropriate screen knob, which will change colour from green to yellow = setting function enabled.
- Turn the rotary knob on the control unit = adjustment of the value of setting in the screen knob.
- Press the rotary knob: the screen knob changes colour from green to yellow = the setting is confirmed (validated) and active.

Selecting another ventilation mode and setting its parameters

- Touch the appropriate screen key, e.g. »**BIPAP**«. The key changes colour from green to yellow, and the parameter setting page for BIPAP is displayed.



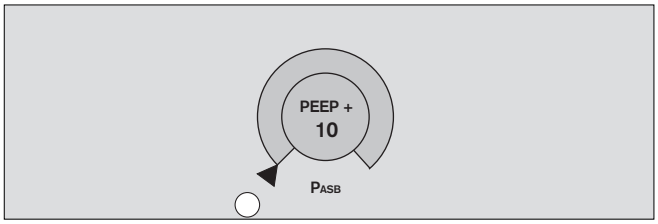
To set the parameters for BIPAP:

- Touch the screen knob, which changes colour from green to yellow = adjustment function selected.
- Turn rotary knob = adjust value displayed in screen knob.
- Press rotary knob: the screen knob changes colour from yellow to green = setting validated and effective.

If the indicator "LED" next to a screen knob is illuminated white, the knob setting will only be effective after the new ventilation mode has been switched on (example: »**PASB**« knob).

If the indicator "LED" is illuminated yellow, the relevant knob setting is already active in the existing ventilation mode (example: »**O2**« knob).

The start-up values effective on switching on the ventilator are marked on the relevant knob-scale with an arrow (▶)
Example: PASB = 0 mbar



- Press the rotary knob: the screen key changes colour from yellow to black = the ventilation mode is active.

For detailed instructions on setting the ventilation modes, please refer to page 48 onwards.

Cancel selection of ventilation mode:

- Press the black screen key for the effective ventilation mode again

  or
- touch another screen key for selecting ventilation modes.

Cancel parameter setting:

- Touch screen key or screen knob again

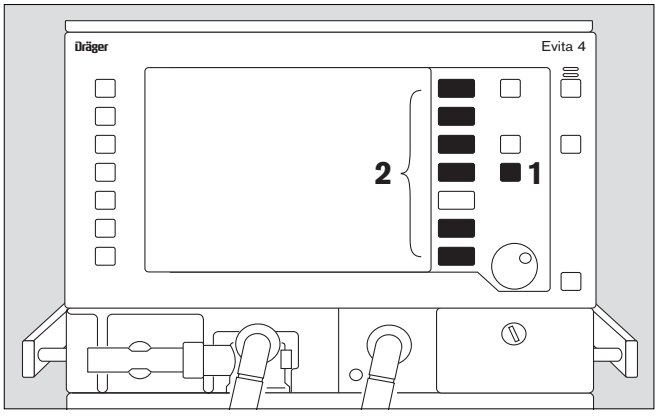
  or
- press another screen key or another screen knob.

To quit a screen page:

1 Press »⌂« key = return to standard page

  or

2 press any of the function keys next to the screen on the right.



»Alarm Limits« Screen Page

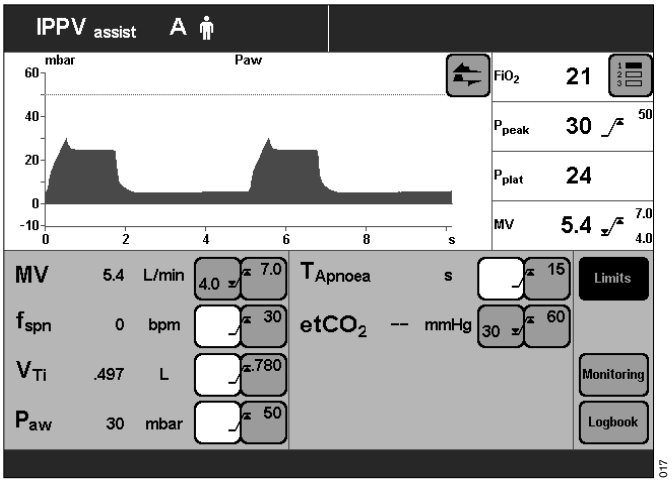
Displaying the measured values and the corresponding alarm limits.

Setting the alarm limits.

Setting the monitoring function.

Displaying the logbook.

The alarm limits are grouped together in a field and combined with a curve and four measured values.



Limits, monitoring and logbook are selected by the screen keys on the right of the screen.
The currently activated screen key is highlighted in black.

Displaying/Setting Alarm Limits

- Touch the »**Limits**« screen key. The screen key will change to black.
  The monitored measured values will be displayed, together with their alarm limits.

Example:

MV 5.4 L/min

Left-hand screen key = lower alarm limit.

Right hand screen key = upper alarm limit.

Set the alarm limit:

- Touch the relevant screen key.
  The key changes colour to yellow = adjustable.
- Turn the rotary knob = adjust value displayed in the key.
- Press the dial-knob. The screen key changes colour to green = setting confirmed.
  The alarm limit is now effective.

For detailed operating instructions, please refer to page 70.

»Measured Values« Screen Page

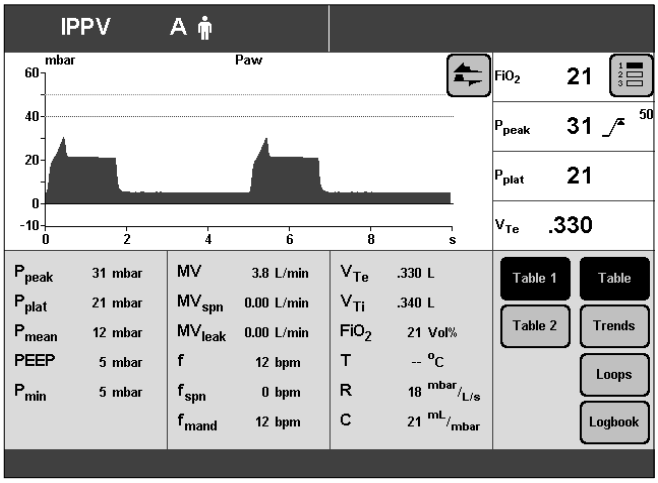
This page is used to display:

— the measured values in table format
— the trend curve
— loops
— logbook.

Tables, trend, loop and logbook are selected by the right-hand block of screen keys.

Example table of measured values »**Table 1**«

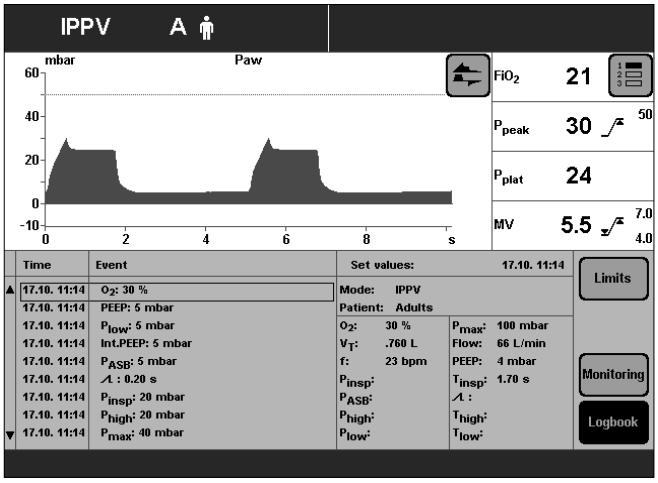
For detailed operating instructions, please refer to page 74.



Display Logbook

- Touch the »**Logbook**« screen key.
- Turn the dial-knob = select alarm events.

For detailed operating instructions, please refer to page 78.



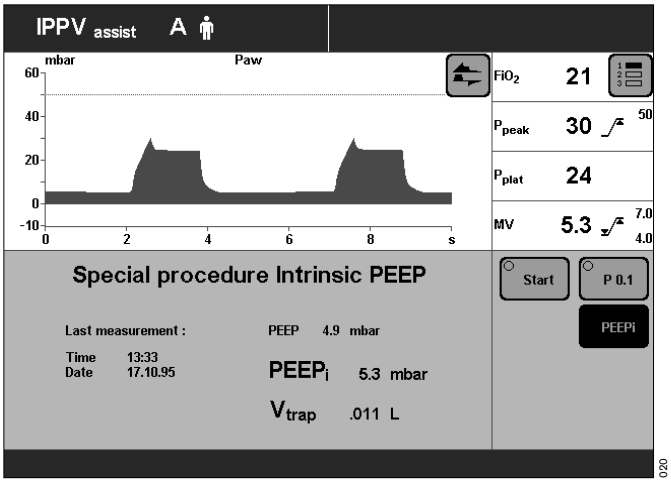
»Special Procedures« Screen Page

This page is used to display and perform the following special measuring procedures:

– Intrinsic PEEP
  and
– Occlusion pressure P 0.1

The desired special procedure is selected by the appropriate screen key on the right. The result of the last special procedure is displayed.

Example: Intrinsic PEEP



To start the special procedure:

- Touch the **»Start«** screen key.

For detailed operating instructions, please refer to page 86 and page 87.

»Calibration« Screen Page

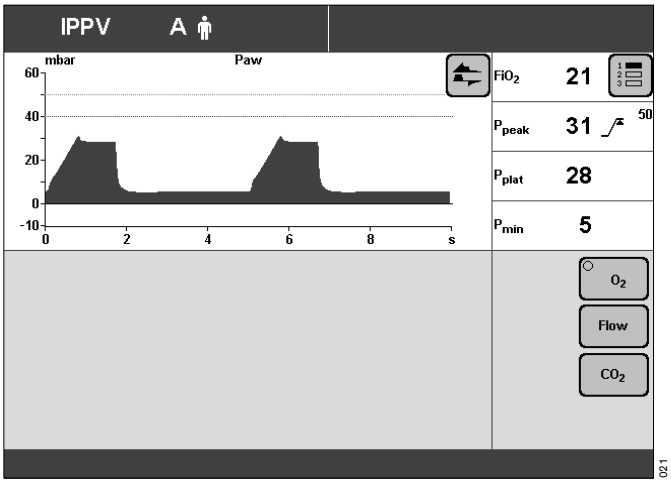
This page is used for calibrating

– the O_2 sensor
– the Flow sensor
– the CO_2 sensor

- Select the desired sensor with the **»O_2«**, **»Flow«** or **»CO_2«** screen keys.

Evita 4 provides the necessary calibration instructions in the Help Function line at the bottom of the screen.

For detailed operating instructions, please refer to page 90 onwards.



»Configuration« Screen Page

For selecting/adjusting the following functions:

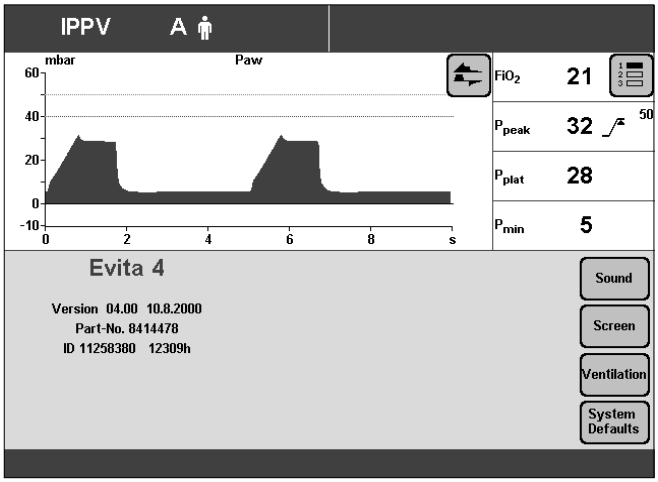
Sound
Setting the volume of the alarm tone.

Screen
Selecting the displayed measured values.
Selecting the displayed curves.
Selecting the displayed trends.

Ventilation
Selecting ventilation modes.
Selecting the patient mode.
Selecting the initial setting.

System Defaults
Setting the external interface.
Setting the time and date.
Selecting the language and measurement units.
Selecting service diagnosis.

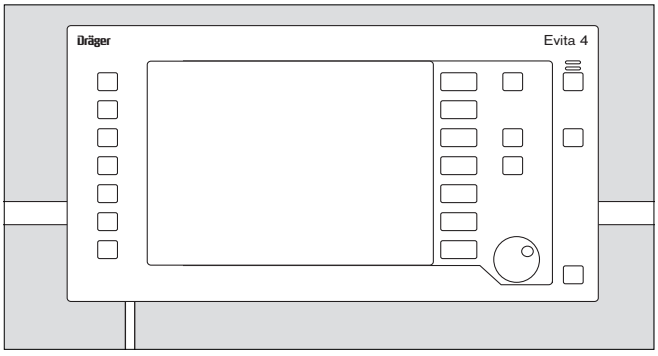
For detailed operating instructions, see page 102.



Control Unit Location

To adapt to the situation of the ventilation location, the control unit can be placed
or
separately, on a wall rail.

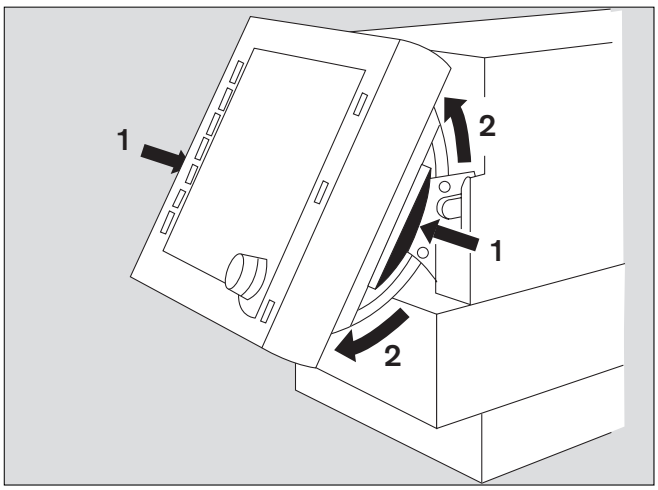
For detailed instructions on placing, see page 41.



Ergonomic Positioning

To ensure best viewing, free of reflections.

1 Hold down the blue segments on the right and left
und
2 at the same time, tilt the control unit to the desired position.



Preparation

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Preparation

The following instructions include:

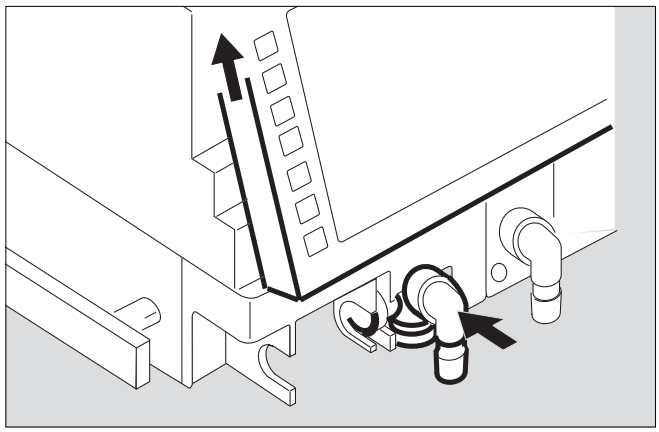
— Equipment assembly.
— Electrical and gas connections.
— Setting the language for the display texts.
— Automatic device check with sensor calibration.

Attaching Components

- Always use properly prepared parts, see Preparing, page 128.

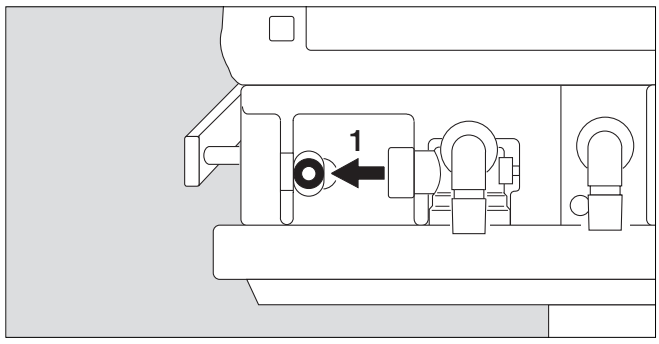
Fitting the expiration valve

- Tilt the control unit upwards.
- Push the expiration valve as far as it will go into the mounting. Check that it is properly engaged by gently pulling the port.



Fitting the flow sensor

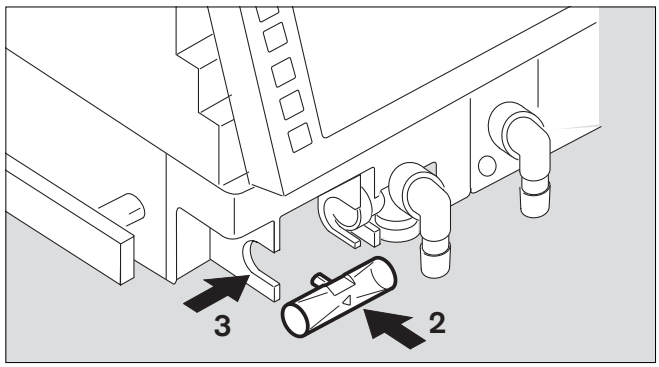
1 Push socket to left as far as it will go.



2 Fit flow sensor – with the probe facing towards the ventilator – into the mounting and push it into the socket as far as it will go.

Then:

3 Push flow sensor to the right as far as it will go into the rubber lip of the expiration valve.



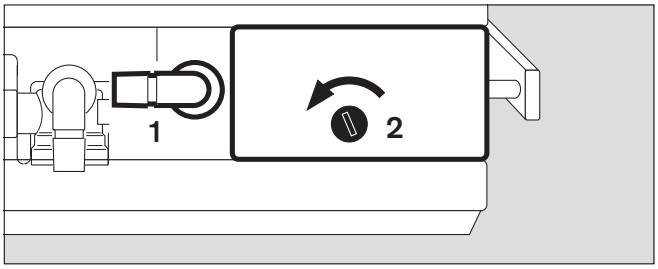
Fitting O_2 sensor capsule

– when using the system for the first time
– when the display reads:
»O_2 measurement inop«
– when calibration can no longer be performed.

● Tilt control unit upwards.

1 Turn port downwards or to the left.

2 Use coin to loosen screw, and remove protective cover.



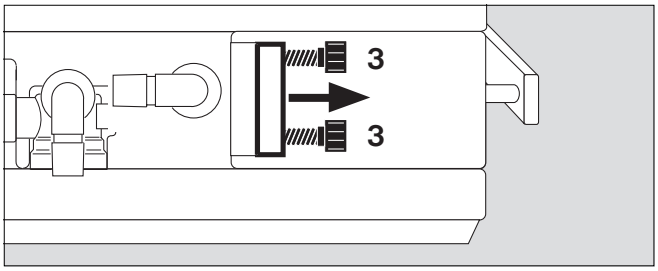
3 Loosen the two knurled screws and open the sensor housing.

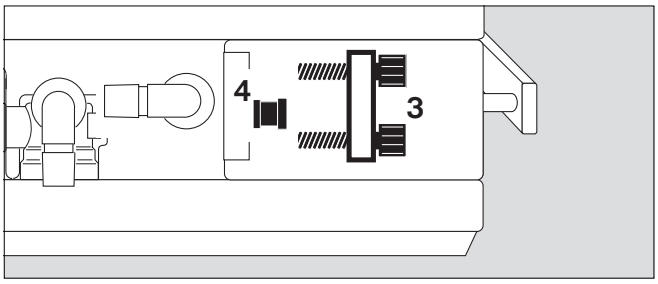
4 Insert new sensor capsule.The sensor end with the circular tracks on the contacts goes into the housing.

● Close the sensor housing securely with the two knurled screws.

● Screw protective cover back in place.

● Dispose of the used sensor, please refer to page 136.





Note on the Use of Heat and Moisture Exchangers

The use of a heat and moisture exchanger (HME) in the patient connection can increase breathing resistance considerably. An increase in breathing resistance will lead to greater effort in spontaneous breathing and greater trigger effort during assisted ventilation. Under unfavourable conditions, an increase in breathing resistance can lead to an inadvertent PEEP.

This breathing resistance in the patient hose system cannot be monitored by the ventilator.

● Therefore you should regularly check the condition of the patient and the ventilator's measured values for volume and resistance.

● Follow the Instructions for Use of the heat and moisture exchanger (HME)!

● Do not use the heat and moisture exchanger (HME) at the same time as a medicament nebuliser or humidifier!

Ventilation Adults and Children

From 100 mL tidal volume V_T upwards

Patient mode: »Adults«

Do not use a heat and moisture exchanger at the same time as a humidifier! Risk of increased breathing resistance due to condensation.

Connecting Aquapor humidifier

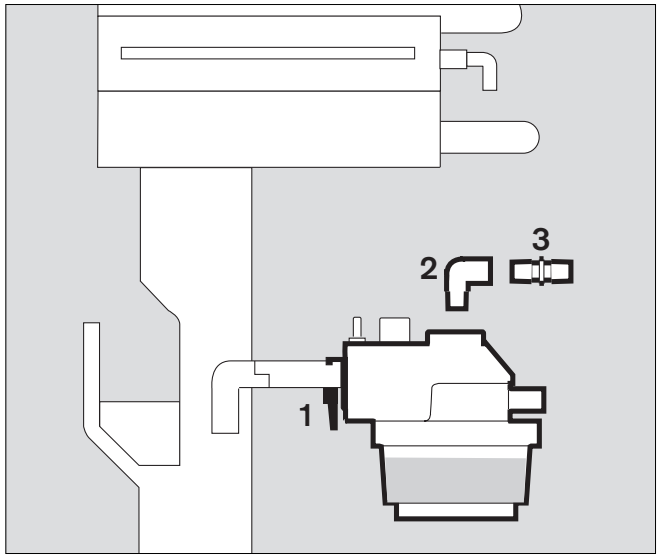
Prepare Aquapor following the relevant Instructions for Use.

1 Hang Aquapor from rail by bracket and tighten screws.

2 Insert elbow connector into Aquapor.

3 Insert the double connector into the elbow connector.

- Fill Aquapor bowl to the upper mark with distilled water.



Connecting ventilation hoses

Do not use antistatic or conductive hoses*.

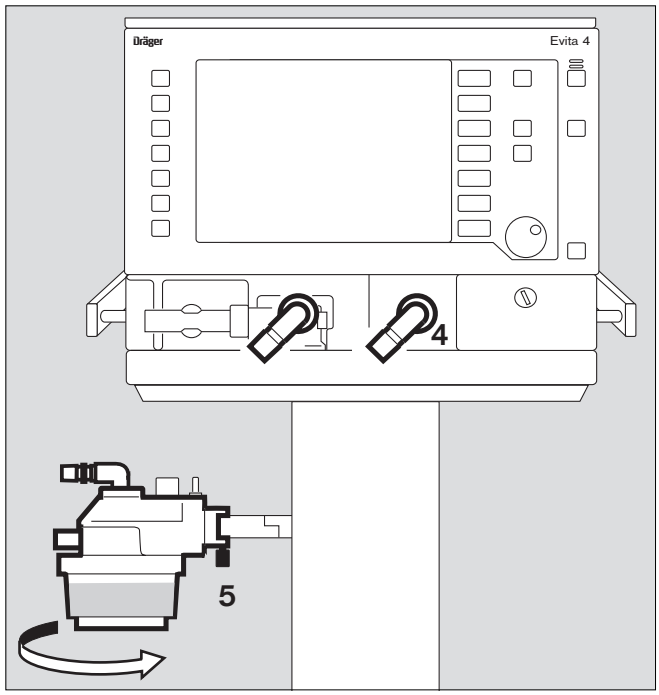
Depending on the desired position of the ventilator in relation to the bed, the hinged arm can be fitted to either side of the machine.

Attachment on **left-hand** side:

4 Turn both ports to the left.

5 Turn Aquapor to the left.

The following description applies when the ventilation hoses have been attached on the **left-hand** side.



* DIN VDE 0750 Part 215:
The use of anti-static or electrically conductive material in the breathing system of the lung ventilator is not considered conducive to greater safety. On the contrary, the use of these materials increases the danger of electric shock to the patient and of fire due to the presence of oxygen.

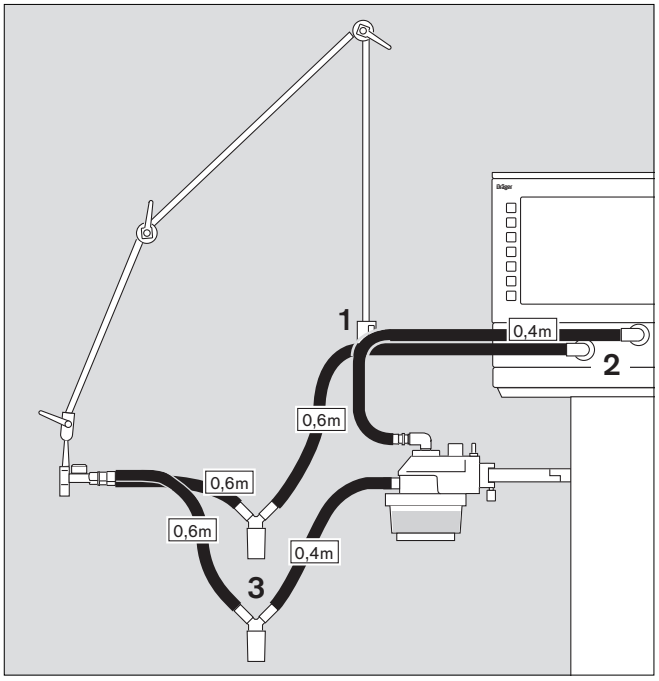
1 Hang the hinged arm from the rail on the left-hand side and tighten screws.

- Connect ventilation hoses, and note length of hose (metres).

2 Turn ports in direction of hoses.

3 Install water traps in vertical position.

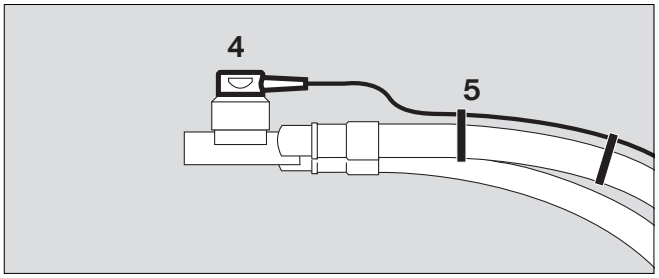
- Connect the Y-piece, with the rubber sleeve of the Y-piece on the inspiratory side.



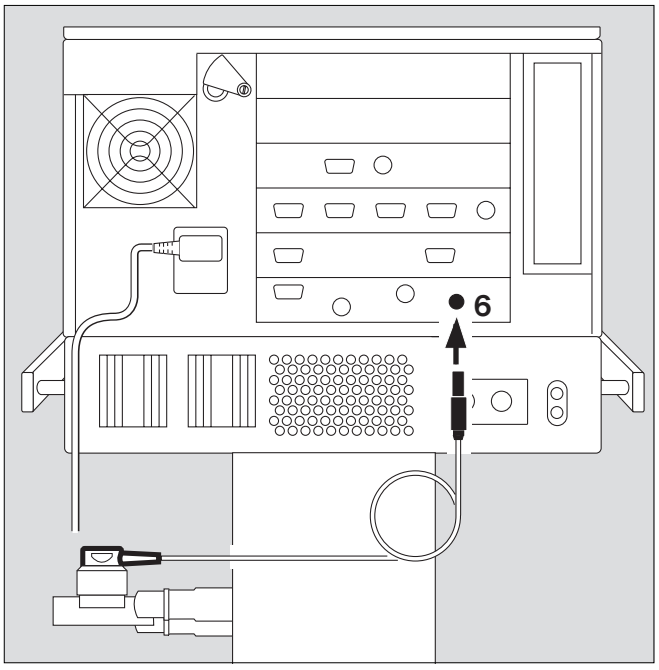
Fitting temperature sensor

4 Push sensor as far as it will go into the rubber sleeve on the inspiratory side of the Y-piece. Align the Y-piece so that the sensor is at the top.

5 Attach the sensor cable with hose clips.



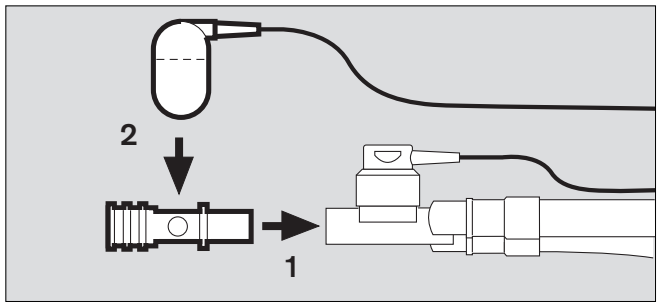
6 Plug temperature sensor into »**Temp** « socket on the back of the unit.



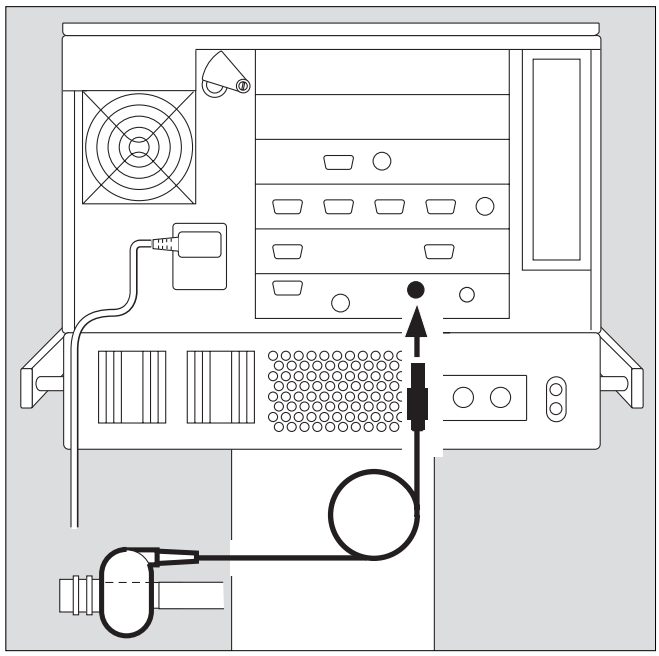
Fitting CO_2-cuvette and CO_2-sensor (optional)

1 Fit the cuvette to the patient connection of the Y-piece, with the cuvette windows facing the side.

2 Push the CO_2 sensor on to the cuvette, with the cable trailing towards the unit.



- Plug CO_2 sensor into »**CO_2** « socket on the back of Evita 4.



Ventilating Infants

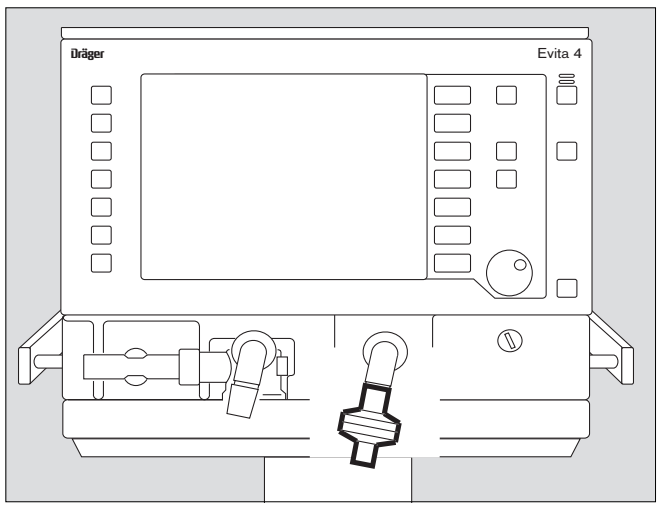
Up to 300 mL tidal volume V_T

Patient mode »Paediatrics«

Do not use a heat and moisture exchanger at the same time as a humidifier! Risk of increased breathing resistance because of condensation.

Fitting bacterial filter

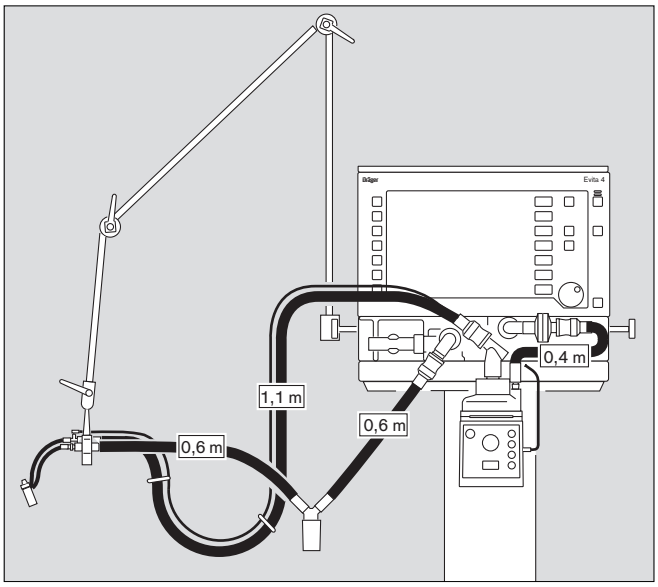
- Fit the bacterial filter to the inspiratory port.



Fitting humidifier and ventilation hoses

- Prepare the "Fisher & Paykel MR 730" breathing gas humidifier as specified in the Instructions for Use of the humidifier.
  Use the relevant hose set K (paediatric).
- Clamp the humidifier to the stand under the apparatus and screw firmly into place.
- Clamp the articulated arm to the left-hand rail and screw firmly into place.
- Fit the ventilation hoses. Check the hose lengths (metres).
- Fit the water trap in the vertical position.

Do not place any liquid containers above or on top of Evita 4! Any leaking or spilled liquid could cause malfunctions!



If Using Bacterial Filters

The use of expiratory bacterial filters on the ventilator is not recommended.

However, if bacterial filters are nevertheless used on the expiration side, an undesirable increase in breathing resistance is possible.
Especially during medicament nebulisation and humidifying, the resistance of the bacterial filter may increase gradually. For the patient, the effect may be increased breathing effort and intrinsic PEEP.

An intrinsic PEEP can be recognised by the fact that the expiratory flow does not return to "0" before the end of expiration.

If PEEP is unacceptably high, the unit signals the »**PEEP high !!!**« alarm:

- Check the bacterial filter and replace it if it is the cause of the PEEP.

For Transport within the Hospital

To ensure that the equipment cannot topple over, the accessories must be moved to the most convenient position:

- Hinged arm set to minimum deflection.
- Drawers pushed in fully.
- Hoses hooked as close as possible to the trolley.
- Humidifier hooked onto the trolley, not onto the unit itself!

Supply and Connections

Electrical power supply

The ventilator is designed for a mains voltage of:

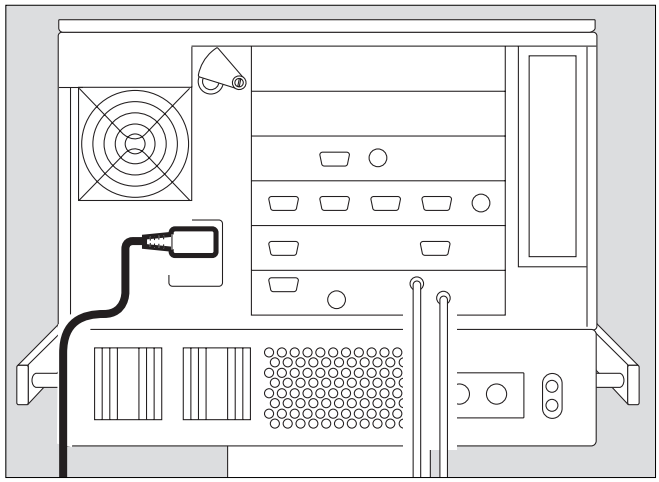
either : 220 V to 240 V

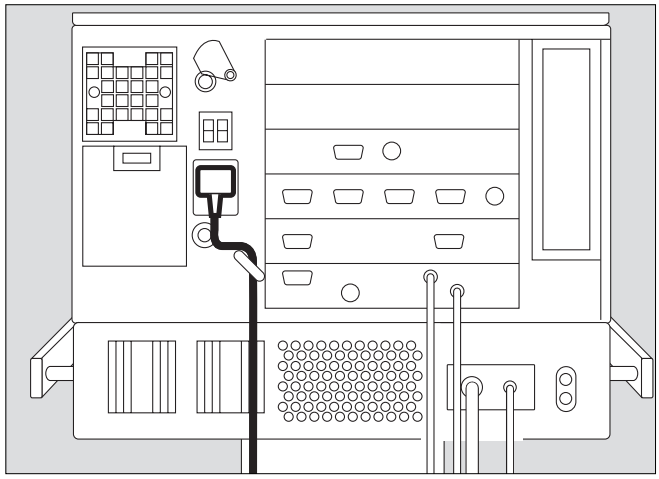
or : 100 V to 127 V

- Insert the plug in the mains socket.

For operation with Evita DC power supply and external battery (optional):

- Connect external battery via battery lead. Note Instructions for Use of Evita DC power supply.





Note on the use of a socket strip for ancillary equipment

Connecting other devices to the same extension socket strip may, in the event of earth failure, cause the current leakage to the patient to increase beyond the permissible values. In this case, the risk of electric shock cannot be eliminated.

Temporary interruption of power supply

e.g. if hospital reserve power supply is activated.

Without optional Evita DC power supply:

During a power interruption, Evita 4 outputs a continuous alarm tone for max. 2 minutes.
The duration of this alarm tone may be shorter if Evita 4 was switched on for less than 15 minutes.

Evita 4 tolerates power interruptions shorter than 10 milliseconds – without any effect on ventilation.

In the case of power interrupts lasting longer then 10 milliseconds, the machine restarts with a short self-test lasting about 4 seconds – ventilation is continued with the same values that were set before the power interruption. If a lower alarm limit has been set for the minute volume, the »**MV low !!!**« alarm is activated until the measured value has risen above the lower alarm limit.

With optional Evita DC power supply:

Follow Instructions for Use of Evita 4 DC option (DC power supply).

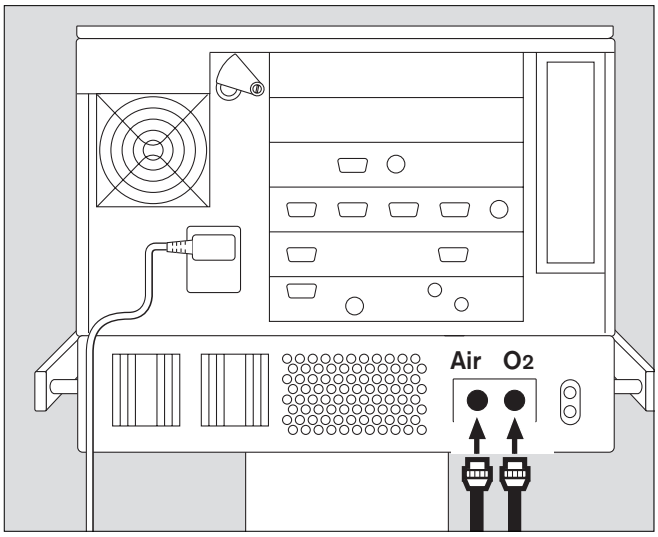
Other equipment, e.g. printers, may only be connected to the COM port if Evita 4 is connected to the mains power supply via a mains power cable or if it has been earthed via the earth connection on the back of the unit.

Electric power may pose a hazard in all other cases.

Gas supply

- Screw the connecting hoses for medical air and oxygen to the back panel of Evita 4 and insert their probes into the terminal units.

  The compressed gases must be dry and free from dust and oil. Gas pressure must be 3 to 6 bar.



Evita Remote

Optional remote control unit (Remote Pad)

The kit may only be installed and programmed by specialists.

For parallel, remote operation of the following LED and key functions:

1 Red LED – to indicate warning messages

2 Yellow LED – to indicate caution and advisory messages

3 »🔔« key – to suppress the alarm tone for approx. 2 minutes

4 »**Alarm Reset**« key – to acknowledge alarm messages

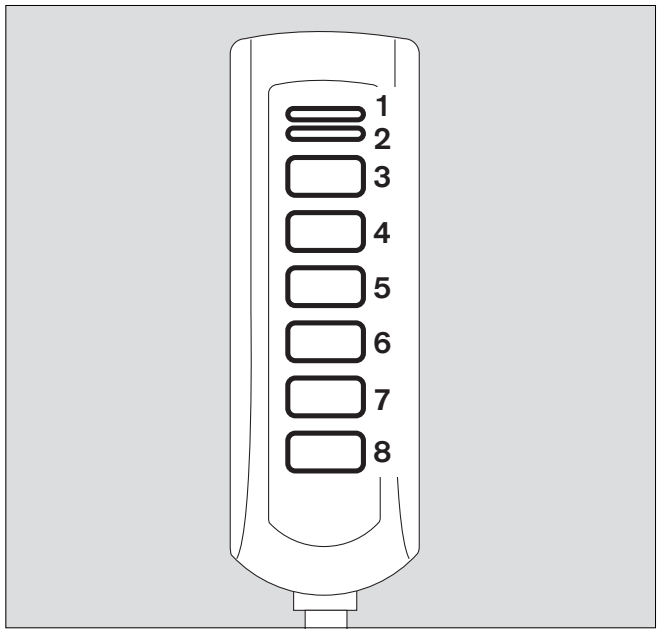
5 »**Neb.**« key – to start and end medicament nebulisation

6 »**O2 suction**« key – for bronchial suctioning

7 »**Insp. hold**« key – for sustained, manually induced inspiration

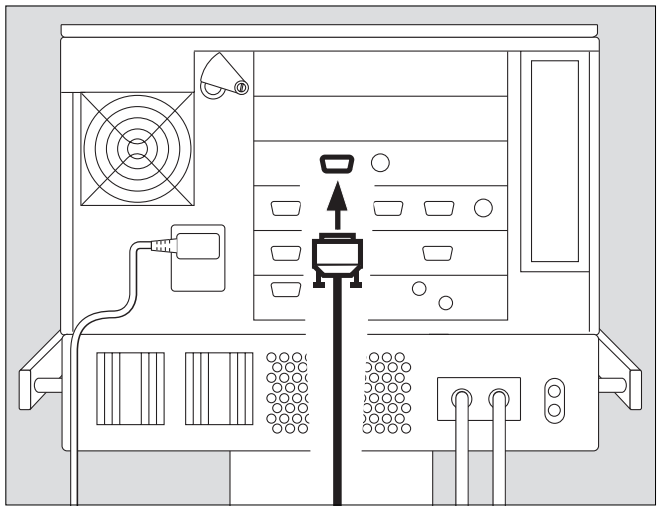
8 »**Exp. hold**« key – for extended and sustained expiration

The function of the respective LEDs and keys is the same as that of the corresponding elements on the front panel of Evita 4 and is described in the application chapters of the Instructions for Use.

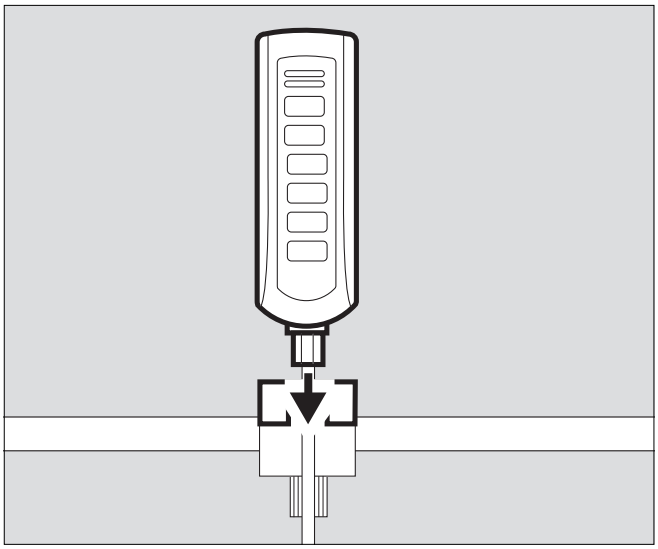


Connection

- Plug the lead of the Remote Pad into the socket »▯« on the rear of Evita 4. The plug can be connected or disconnected at any time without impairing operation of Evita 4.



- Hook holder onto a standard rail and clamp into place.
- Hang Remote Pad into holder from above.



Note automatic self-test

— when connecting the Remote Pad to Evita 4 while the latter is switched on

or

— when switching on Evita 4 after connecting the Remote Pad.

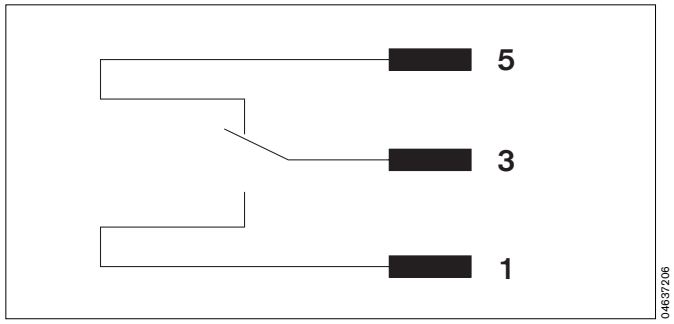
- Do not press any keys on the Remote Pad.
- All LEDs on the Remote Pad light up for 5 seconds:
  – red LED
  – yellow LED
  – yellow LEDs in the keys
- The Remote Pad is tested by Evita 4. An advisory message is output if a fault is detected,
  see page 120 "Troubleshooting".

Nurse Call (Optional)

Socket on the rear of Evita 4 for connecting alarm signals to a central alarm station in the hospital.

- The kit may only be installed by specialists.
- The 6-pin round DIN plug (female connector) must be connected to the lead for the central alarm station in the hospital by a specialist.

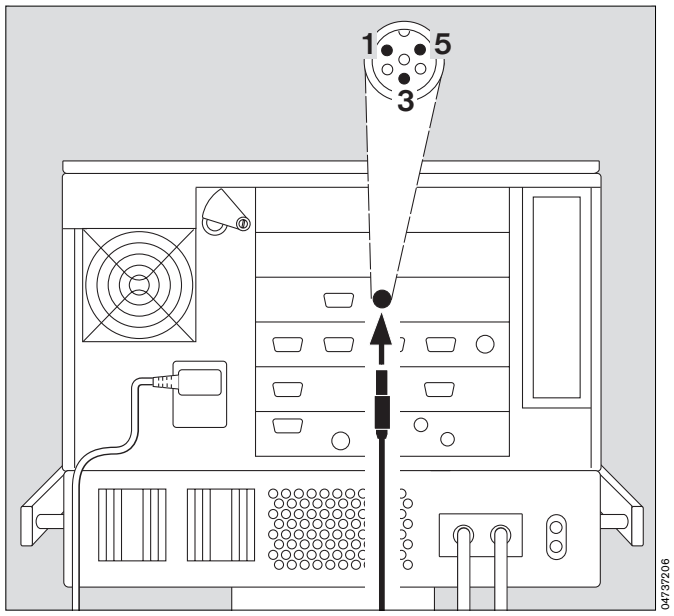
Connection 3-5 makes and the nurse call is activated as soon as Evita 4 signals an alarm.



The central hospital alarm system may only be connected to the nurse call if Evita 4 is connected to the mains power supply via a mains power cable or if it has been earthed via the earth connection on the back of the unit.

Electric power may pose a hazard in all other cases.

- Plug the connector into the »⏚« socket on the rear and screw into place.
- Check correct operation of connected nurse call system.



Only alarm messages of the highest priority (see page 71), are transmitted via nurse call

Warning messages are displayed in the top line of the screen in red and with three exclamation marks, see page 71. Caution and advisory messages are not transmitted. The nurse call is also activated when the internal loudspeaker in the ventilator is defective.

Connection of a nurse call does not relieve staff of their duty to check the monitoring on the Evita 4 screen at regular intervals.

- **Screen displays must be checked regularly.**

A fault in any of the components in the link between nurse call and central hospital alarm system (e.g. in the electronics for nurse call in Evita 4, in the Evita 4 power supply or in the alarm generator of the central hospital alarm system) may result in failure of the nurse call.

Background: The hospital connections to the central alarm typically use only one channel. The electronics for nurse call consequently also uses only one channel.

Technical Data

Floating DC contact

Input voltage	max. 40 V =
Input current	max. 500 mA
Switching capacity	max. 15 W

Before Using for the First Time

Setting the language of the screen texts

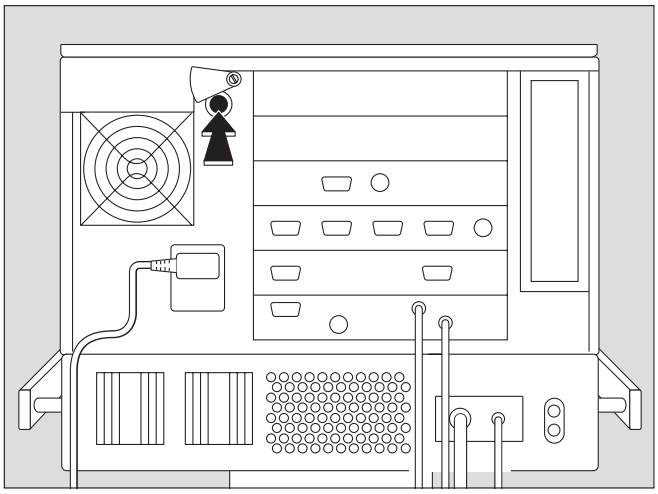
The Evita 4 is set by the manufacturer to the language of the ventilator's owner.

The following alternative languages can be selected:

- English
- French
- Italian
- Spanish
- Dutch
- Swedish
- American English
- Japanese
- Greek
- Russian
- Portuguese
- Arabic
- Chinese
- Turkish

- If necessary, ask our specialists to change the labels on the control unit keys.

Switch on machine = pivot flap* upwards and press power switch on the back panel until it clicks into position. The flap falls over the button to protect against inadvertent switching off.



Evita 4 runs through its self-test procedure,

- Wait until the 10-second test phase is complete.

* Flaps may differ, depending on the power supply used, see "Switching on", page 45.

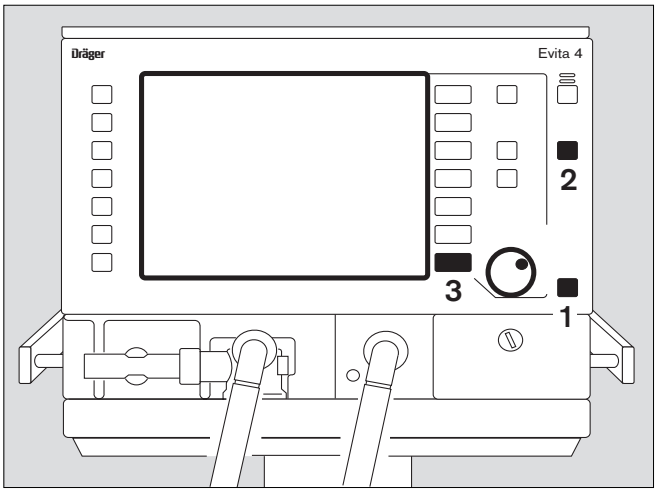
After the self-test:

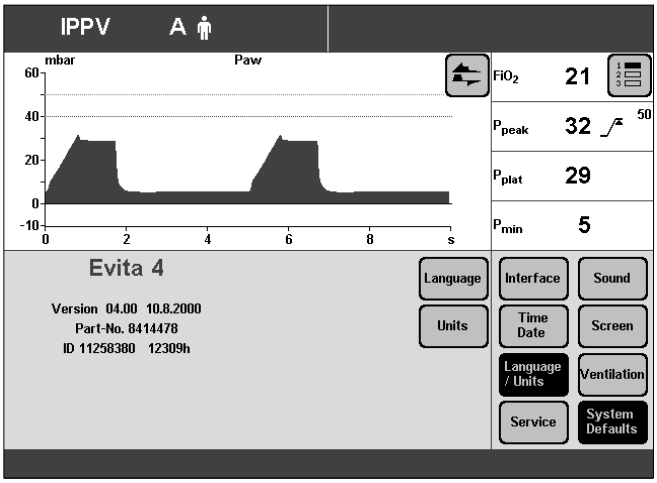
1 Switch Evita 4 to Standby = hold down key »⏻« for about 3 seconds.

2 Switch off the standby alarm tone with the »**Alarm Reset**« key.

3 Press the »**Configuration**« key.

- Touch the »**System Defaults**« screen key.
- Touch the »**Language/Units**« screen key.
- Touch the »**Language**« key.
- Select the desired language and confirm. The selected language is now active.





Device Check

Before use on patient

Immediately before using on the patient, check that the machine is working properly and is ready for operation.

Evita 4 supports this device check by means of a built-in checklist that guides the user through the test in a dialogue mode.

The following functions are performed during this device check:

– Checking that the machine assembly is complete,
– Testing the alarm tone
– Testing the expiratory valve
– Testing the air-O_2 change-over valve
– Testing the safety valve
– Calibrating the flow sensor
– Calibrating the O_2 sensor
– Calibrating the CO_2 sensor
– Testing the leakproofing of the hose system
– Checking the compliance of the hose system

The test results obtained from this device check and the calibration and zero-checking values of the sensors remain stored until the next calibration – even if the device is switched off.

If the hose system, type of humidification or patient mode is changed after performing the device check, the leakproofing test must be repeated before starting operation.

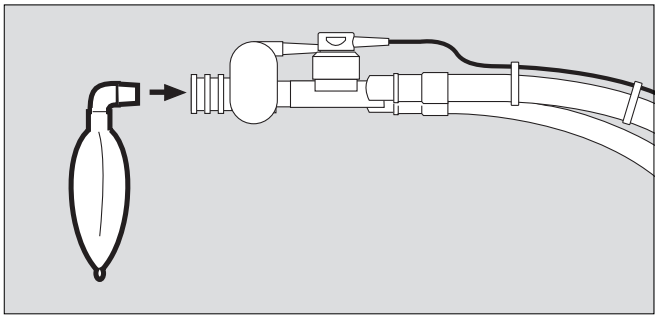
Preparing the adult test lung 84 03 201

for the adult hose system

The test lung consists of an elbow connector for connection to the Y-piece, a 7 mm diameter catheter connection for simulating the resistance of the airways and a 2 litre breathing bag to simulate compliance.

- **Overextended breathing bags must not be used as they may cause artefacts during the device check!**

- The elbow connector must not be plugged into the patient connection of the Y-piece until directed by Evita 4.

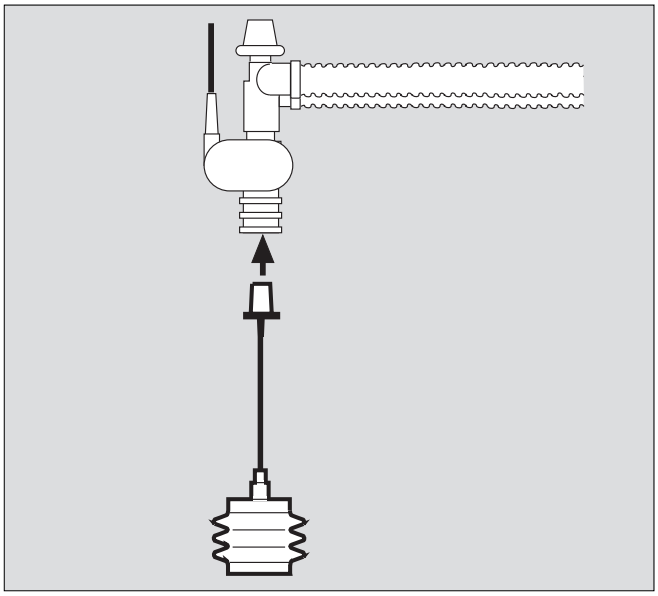


Preparing the child test lung 84 09 742

for the paediatric hose set

The test lung consists of a tracheal tube CH 12 to simulate the resistance of the airways and a small bellows to simulate compliance.

- Only insert the elbow connector into the Y-piece when Evita 4 advises you to do so on the screen.

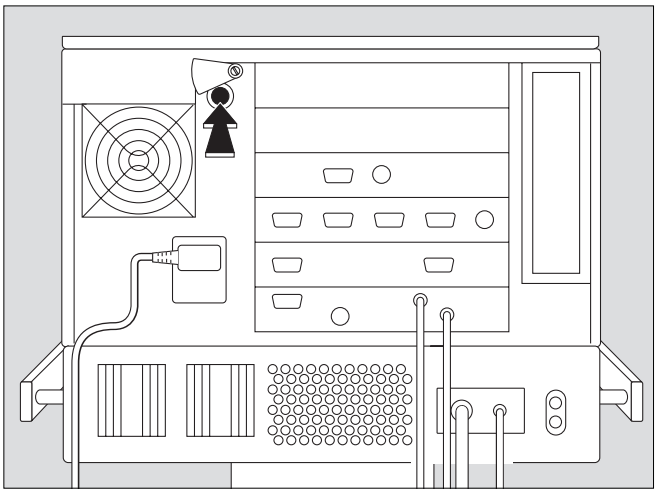


Performing the device check

- Switch on machine = pivot flap* upwards and press power switch on the back panel until it clicks into position.

Evita 4 runs through its self-test procedure.

- Wait until the 10-second test phase has been completed.

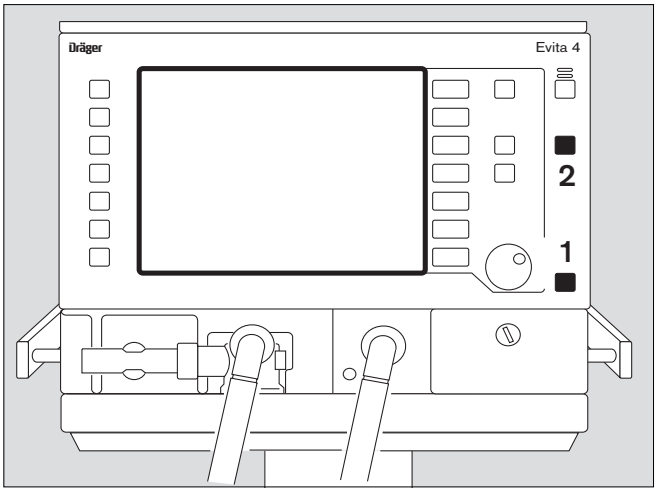


After the self-test:

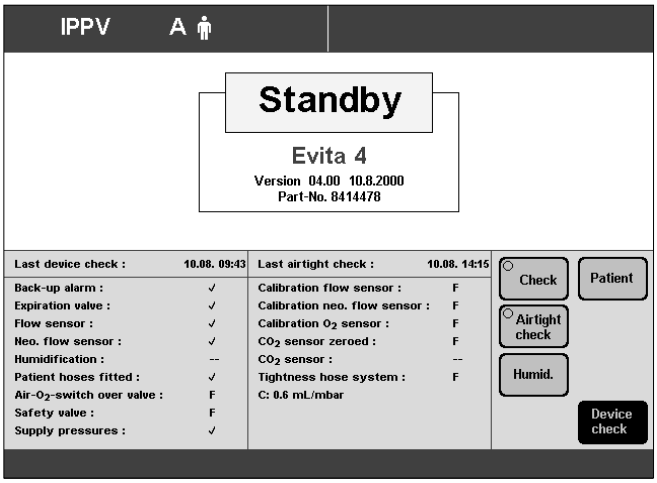
1 Switch Evita 4 to standby = Hold down key »⏻« for about 3 seconds.

2 Switch off the standby alarm tone with the »**Alarm Reset**« key.

- Touch the »**Device check**« screen key.



Display:



Before starting the check, enter the type of humidifier selected:

– Active humidifier, e.g. Dräger Aquapor
  or
– HME/Filter (artificial nose)

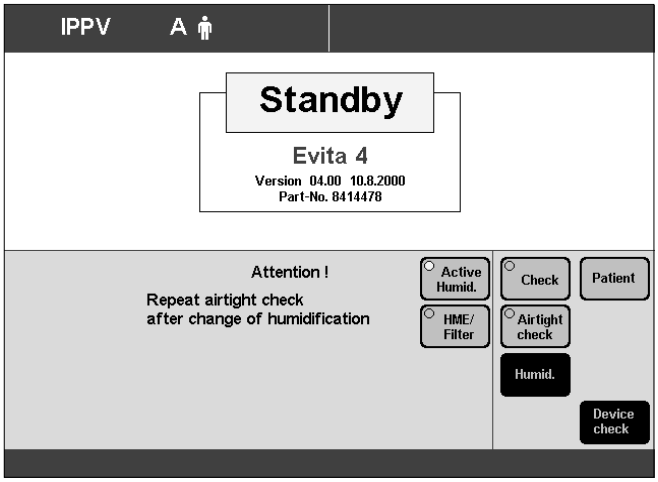
If the type of humidifier is known, Evita 4 can take the temperature and moisture situation into account when measuring the volume parameters.

- Touch the »**Humid.**« screen key

---

* Flaps may differ, depending on the power supply used, see "Switching on", page 45.

Display:



- Touch the »**Active Humid.**« screen key
  or
- Touch the »**HME/Filter**« screen key.
- Confirm selection = press rotary knob.

The selected type of humidifier is indicated by a yellow LED.

The humidifier selection is saved and remains effective even when the equipment is switched on again.

If the type of humidifier is changed and has to be reselected on the screen, the following test steps are shown to be invalid (– –) after the device check:

– Humidification
– Air tight check

The operator is prompted to repeat the device check for these two steps.

Start the check procedure:

- Press the »**Check**« screen key.

Evita 4 starts running through the dialogue-oriented check.

The check procedure is semi-automatic. During the device check, the user is instructed by Evita 4 to perform specific actions on the device.

A device check cannot be performed during automatic calibration of the flow sensor or O_2 sensor:

- Wait until calibration is complete and start the device check again.

The following tests are performed during the device check:

– Correct operation of auxiliary and power failure alarms
– Seating and clear passage of the expiratory valve
– Seating of the flow sensor
– Seating of the neonate flow sensor (if "NeoFlow" option is installed)
– Type of humidifier
– Completeness of hose system
– Function of the air-O_2 changeover valve
– Function of the safety valve
– Gas supply
– Calibration of the flow sensor
– Calibration of the neonate flow sensor (if "NeoFlow" option is installed)
– Calibration of the O_2 sensor
– Leakproofing of the hose system

On completion of the device check, a checklist is displayed on the screen to show the results of the check.

Correct result :✓

Incorrect result : **F**

Check not performed : **– –**

In the event of incorrect results, e.g. if the hose system is not sufficiently leakproof:

- Eliminate the cause of the fault
- Touch the »**Repeat check**« screen key.

Only the tests with incorrect results are repeated.

After successful completion of the device check, Evita 4 is ready for operation.

Either:

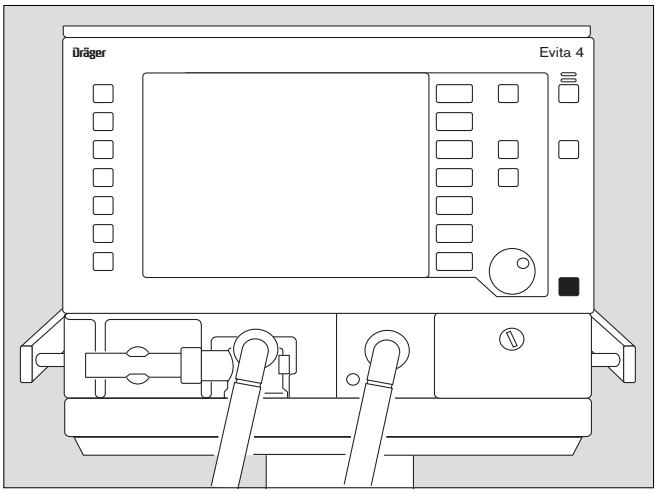
- immediately start up Evita 4 by pressing key »⏻«

or:

- leave Evita in standby mode

or:

- switch off Evita for later use. Switch on back panel = pivot flap to the side and press button in fully and release.



Checking the hose system for leaks

The hose system is tested for leaks during the device check but must also be monitored independently of the device check, e.g. after changing the hose system.

- Touch the »**Air tight check**« screen key.

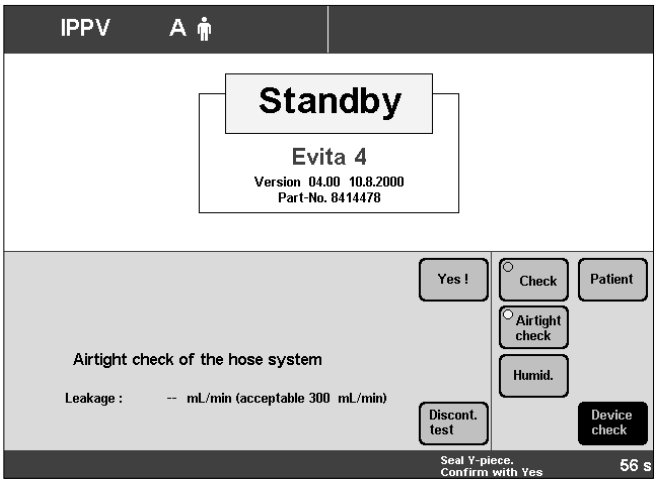
During the test, the current leakage flow is continuously displayed. A leakage flow of 300 mL/min at a pressure of 60 mbar is permitted.

After the leak test, the Evita 4 unit determines the compliance and resistance of the hose system.

The calculated compliance of the hose system is used by Evita 4 for automatically correcting the volumecontrolled ventilation strokes and the measured values of the flow monitoring system, see page 164.

The calculated resistance of the hose system is used by Evita 4 to correct the pressure measurement in the presence of a basic flow (NeoFlow option).

When changing the patient mode or type of humidifier, the device automatically sets the hose compliance and resistance to the default values.



By checking the system for leaks, the device determines the momentary compliance and resistance.

Therefore:

When changing the patient mode, hose system or type of humidifier:

- Always perform the leak test!

Positioning the Control Unit

- Do not lean the control unit!
  When changing, lay it on its back.

To position the control unit on the wall rail

1 Hold down the segments on the right and left, and tilt the control unit fully downwards.

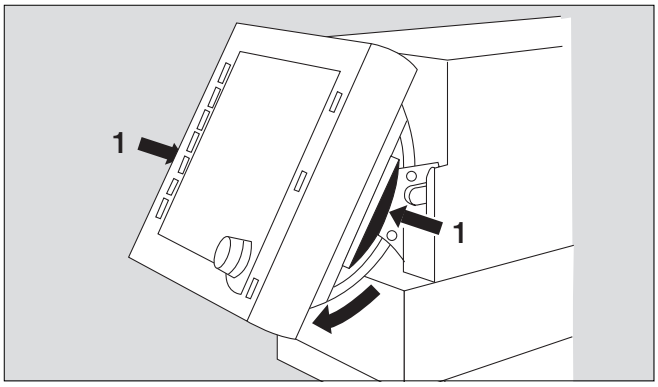
2 Hold down the release buttons on the left and right, and remove the control unit from the Evita 4 mounting.

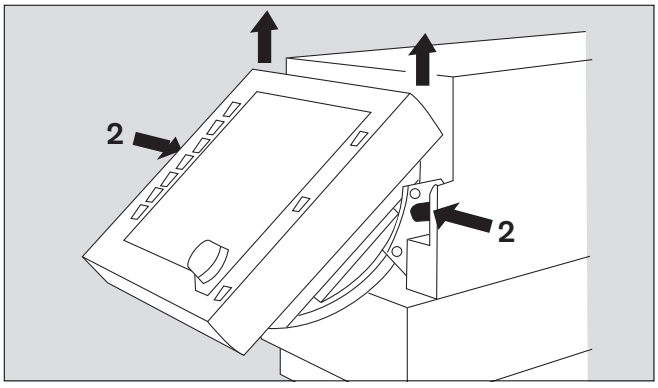
- Uncoil the cable as far as necessary.
- Clip the control unit to the wall rail and

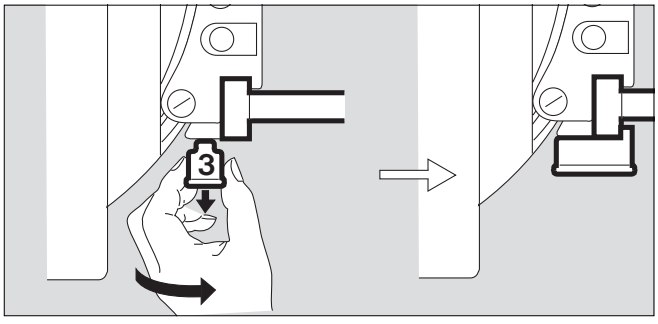
3 lock in place = pull down the latch situated beneath the bracket and turn it in the direction of the wall rail.

Positioning:

1 Hold down the segments on the right and left and at the same time tilt the control unit to the desired position.







To position the control unit on the device

- Hold down the segments on the right and left and tilt the control unit fully downwards.
- Release the control unit = turn the latch away from the wall rail and lift the control unit off the rail.
- Coil the cable.
- Hang the control unit in the Evita 4 mounting so that it rests in position.

Positioning:

- Hold down the segments on the right and left, and at the same time tilt the control unit to the optimal position.

Operation

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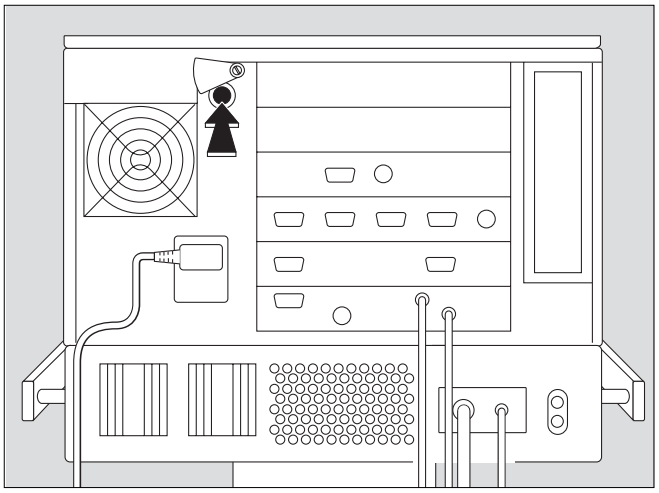
Operation

Starting up

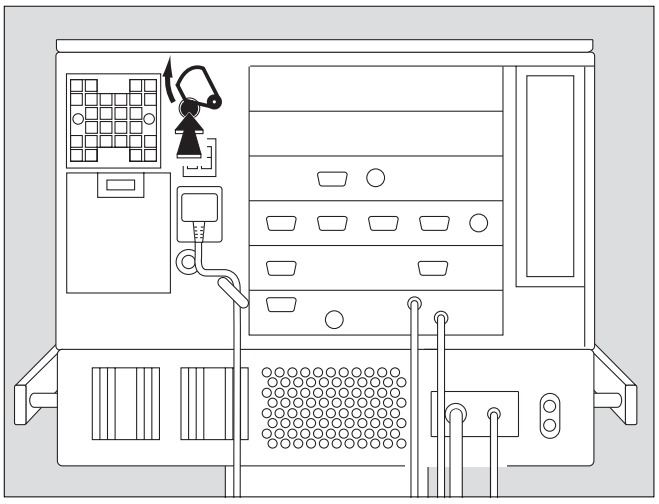
Switching on

- Switch on machine = press power switch on the back panel until it clicks into position.
  The flap falls over the button to protect against inadvertent switching off.
  To switch off, pivot the flap upwards and press the button in fully.



Machines with DC power supply MB:

- Switch on machine = pivot flap upwards and press power switch on the back panel until it clicks into position.
  The flap falls over the button to protect against inadvertent switching off.
  To switch off, pivot the flap upwards and press the button in fully.



Evita 4 runs a self-test.

- Wait until the 10-second test phase is complete.

Evita 4 always begins ventilation with the start-up values marked by an arrow on the on-screen knobs.
To select these start-up values, please refer to page 112 onwards.
After power cuts and after standby mode, the settings valid immediately before the interruption of operation remain in use.

Patient Mode

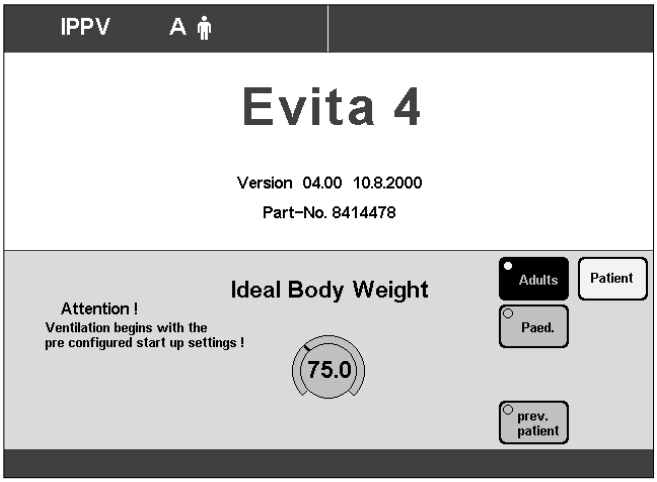
After switching on, Evita 4 displays a choice of patient modes:

— »**Adults.**« = adult patients
— »**Paed.**« = children
— »**Neo.**« = neonates (when using the "NeoFlow" option)
— »**prev. patient**« = previous patient

The device also asks the user to enter the weight of the patient (ideal body weight).

Example:

Adult ventilation



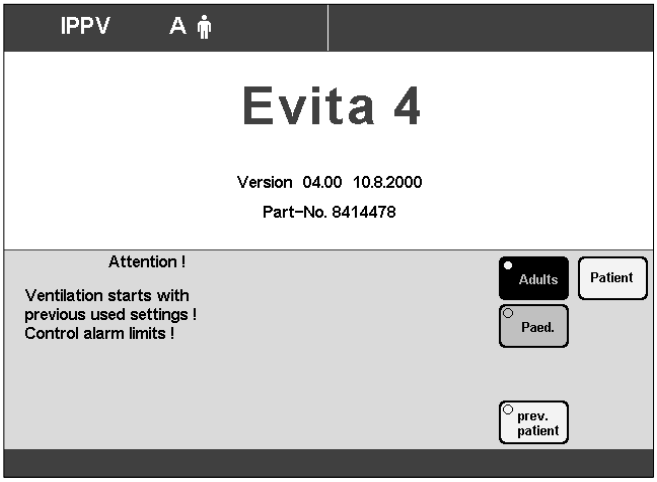
With this information, Evita 4 defines the adjustment ranges and the start-up values of the ventilation parameters.

The starting procedure, with selection of the patient mode, can be configured by the user, see "Configuration"on page 102 onwards.

The screen key **»prev. patient«** can be used to restore the specific patient settings, including alarm limits and monitoring status, effective before switching off the device.

Example:

Previous patient



The previous modes are displayed in the status line:

— Previous ventilation mode
— Previous patient mode
— Previous application mode (tube or mask for optional NIV)

The key **»prev. patient«** is not displayed by Evita 4 following a loss of data or removal of a previously used option (e.g. NeoFlow), thus preventing restoration of the previous setting. Restoration of the previous setting is similarly prevented by Evita 4 if it was configured in such a way before switching off that the former patient mode is no longer available.

Selecting the patient mode

if configured

Either:

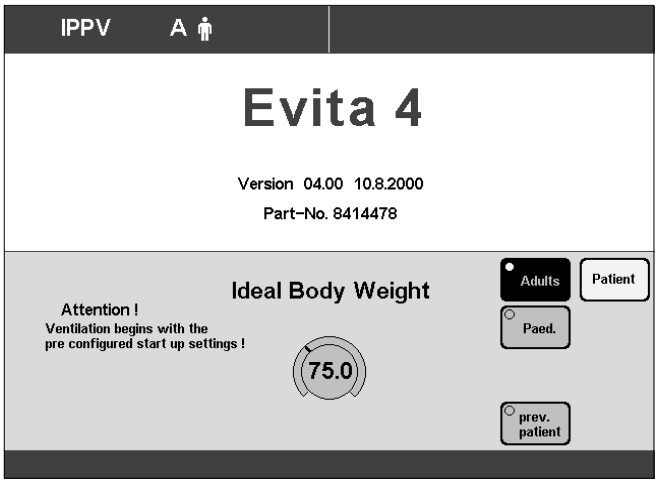
- the »**Adults**« key or
  the »**Paed.**« key or
  the »**Neo.**« key (NeoFlow option) and

enter the ideal body weight

if configured

With the ideal body weight, Evita 4 determines the start-up settings of the ventilation parameters. The start-up value is marked on the relevant screen knob by an arrow (▶).

- Touch the screen knob.
- Enter the ideal body weight [kg] with the manual dial-knob = turn rotary knob.
- Confirm the setting = press rotary knob.



or

Select the previous settings

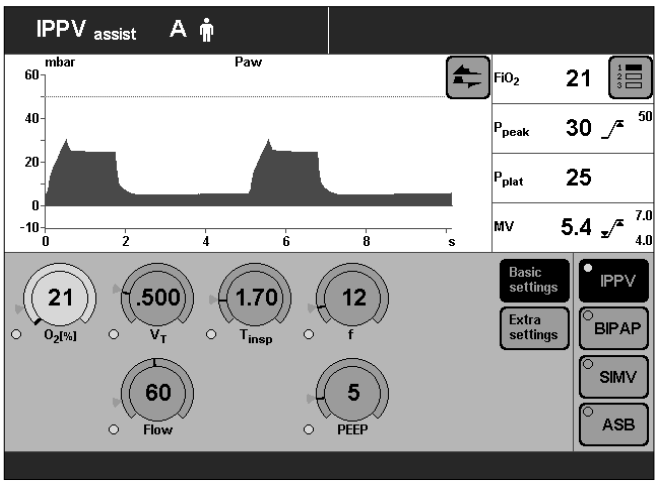
- Touch the key »**prev. patient**«.
- Confirm = press rotary knob.

Starting Ventilation

- Press the rotary knob again.
  Evita 4 starts ventilation with the ventilation mode configured by the user.

The machine is factory-set to IPPV.

Evita 4 displays the »**Settings**« screen page. The user can check and correct the settings on the screen.



Setting Ventilation Modes

The ventilation modes IPPV, BIPAP, SIMV and ASB are already configured in the unit. If other ventilation modes are used, please refer to page 106 "Selecting ventilation modes".

IPPV

Intermittent **P**ositive **P**ressure **V**entilation

Volume-controlled ventilation with fixed, mandatory minute volume MV and user-adjusted tidal volume V_T and frequency f.

For patients having no spontaneous breathing.

Set the pattern of ventilation for IPPV with the ventilation parameters:

Tidal volume »**V_T**«

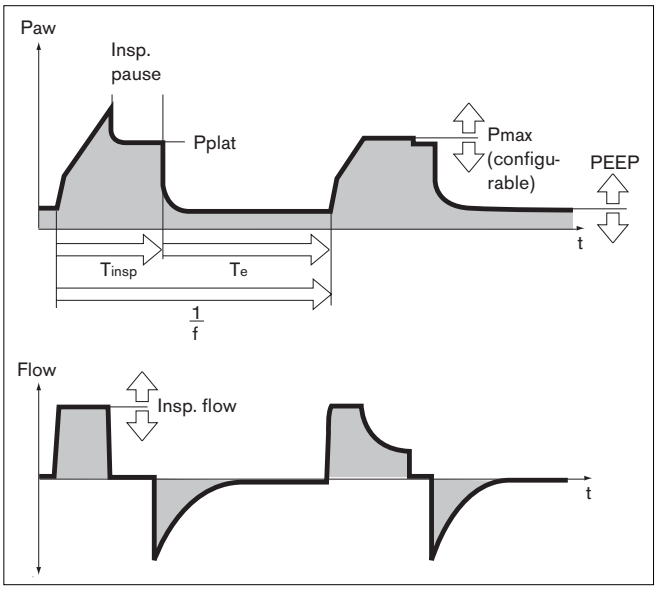
Insp. Flow »**Flow**«

Frequency »**f**«

Inspiration time »**T_{insp}**«

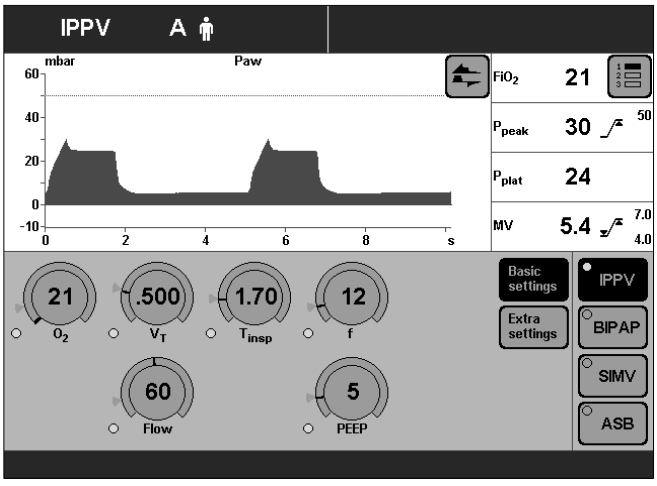
O_2-concentration »**O_2**«

Positive end-expiratory pressure »**PEEP**«



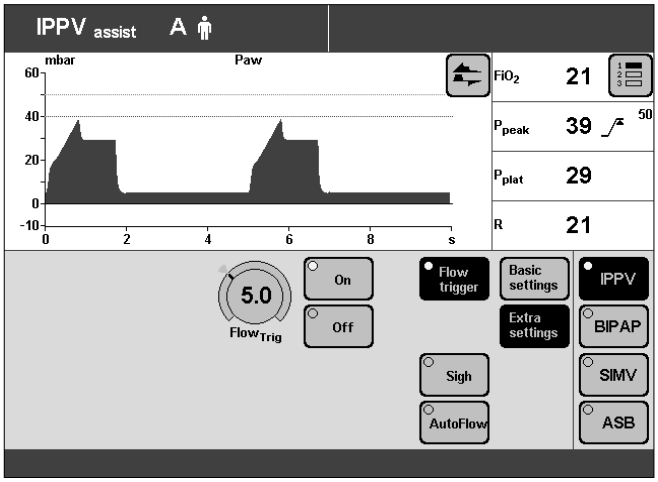
To set:

- Touch the relevant screen knob.
- Adjust value = turn rotary knob.
- Confirm setting = push rotary knob.

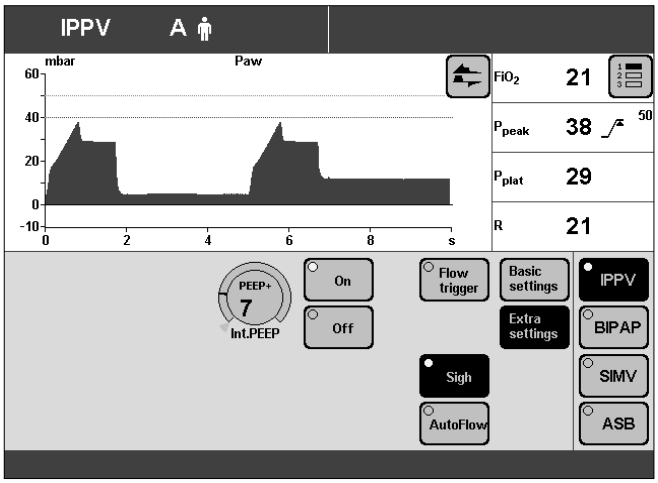


IPPV can be expanded by the following ventilation parameters:

Flowtrigger (IPPV Assist) – for synchronisation with attempted spontaneous breathing by the patient.
By switching on the flow trigger and setting the trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.
Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.



Sigh – for prophylactic treatment of atelectasis.
Atelectasis can be prevented by switching on the Sigh function and setting the sigh in the form of an intermittent PEEP.
When the Sigh function is activated, the end-expiratory pressure increases for two ventilation strokes every 3 minutes by the set value of the intermittent PEEP.



AutoFlow® – for automatic regulation of the inspiration flow.

With AutoFlow®*, the inspiration flow is decelerated and regulated, so that at the selected tidal volume V_T with the current lung compliance a minimum airway pressure is reached and pressure peaks are avoided.

Evita 4 delivers additional inspiration flow if and when the patient breathes in – limited by the alarm limit V_{Ti} ⌟̄.

The patient can also breathe out during the inspiratory plateau phase.
The inspiratory pressure is limited by the Paw ⌟̄ alarm limit.

* Please refer to page 156 for a detailed description of AutoFlow®.

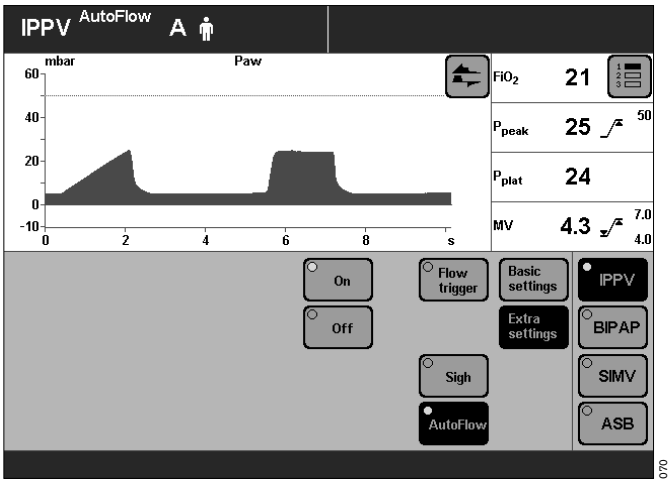
- Set the alarm limits MV ↓ and MV ↑ in order to avoid excessive or insufficient flow following rapid changes in compliance.

To set:

- Touch the »**Extra settings**« screen key.
- Touch the screen key corresponding to the desired function.

For Flow Trigger and Sigh:

- Touch the appropriate screen key.
- Adjust the desired value = turn the rotary knob
- Confirm the desired setting = press the rotary knob
- Switch on the function = touch the »**On**« screen button and press the rotary knob.



IPPV can be configured for the additional ventilation parameter Pmax. Selecting »Pmax pressure limiting«, see page 108.

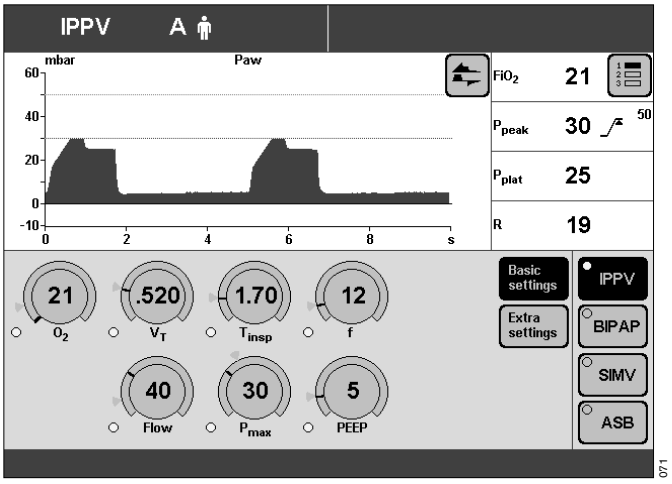
Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the Pmax pressure limit.
The tidal volume remains constant as long as the pressure curve shows a plateau and the inspiratory flow curve shows a brief flow pause between inspiration and expiration.

- To set the "Pmax" pressure limit, please refer to page 108.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The **»Inconstant volume !!«** alarm is always active. It is triggered automatically if the tidal volume VT can no longer be applied.

This visual and audible alarm can be suppressed with the **»Alarm Reset«** key until the cause of the alarm is remedied.



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* Please refer to page 156. for a detailed description of PLV.

SIMV, SIMV/ASB

Synchronized **I**ntermittent **M**andatory **V**entilation*
Assisted **S**pontaneous **B**reathing**

Fixed mandatory minute volume MV set with tidal volume V_T and frequency f. Between the mandatory ventilation strokes, the patient can breathe spontaneously, thereby contributing to the minute volume. Spontaneous breathing can be supported by ASB.

For patients with insufficient spontaneous breathing or for patients who are being weaned by progressive reduction of the mandatory proportion of the total minute volume.

The frequency can be reduced to 0 during the weaning process. The device automatically changes to the ventilation mode CPAP or CPAP/ASB. This ventilation mode is also indicated on the screen.
The screen key **»SIMV«** and the screen knobs for setting the SIMV parameters remain on display.

Set the pattern of ventilation for SIMV and SIMV/ASB with the ventilation parameters:

Tidal volume »**V_T**«

Insp. Flow »**Flow**«

Frequency »**f**«

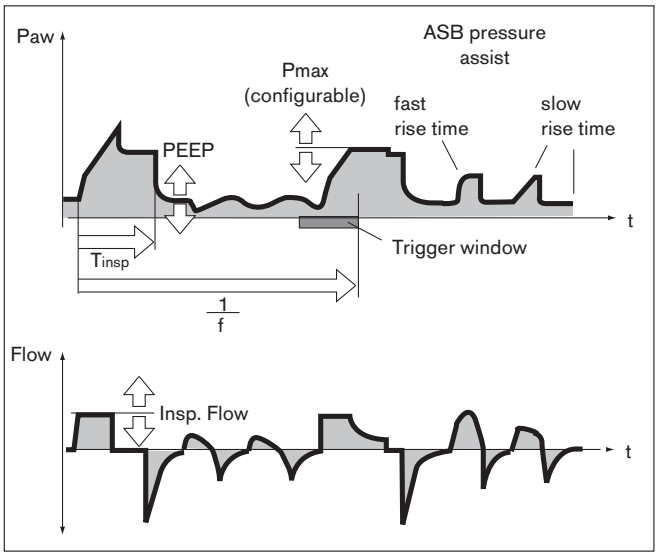
Inspiration time »**T_{insp}**«

O_2-concentration »**O_2**«

Positive end-expiratory pressure »**PEEP**«

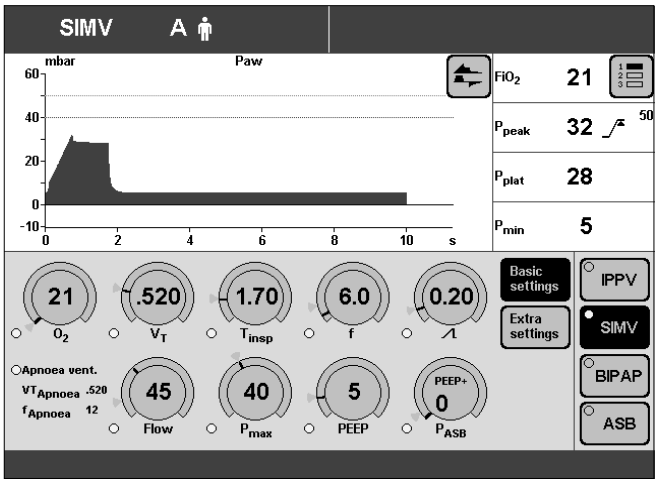
Pressure support »**P_{ASB}**«

Pressure rise time » ⩘ «



To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



SIMV and SIMV/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.
By setting on the flow trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.

Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

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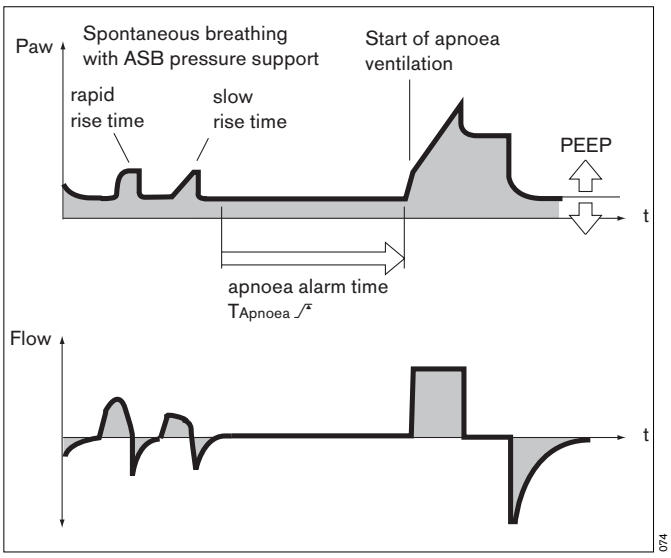
* Please refer to page 159 for a detailed description of SIMV.
** Please refer to page 160 for a detailed description of ASB.

Apnoea Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.

If breathing stops, Evita 4 emits an alarm after the set alarm time (T_{Apnoea} ⚠) and starts volume-controlled ventilation with the set ventilation parameters:

Frequency »**fApnoea**«

Tidal volume »**VTApnoea**«



AutoFlow® – for automatic optimisation of the inspiration flow.

With AutoFlow* the inspiration flow is decelerated and regulated, so that at the selected tidal volume V_T with the current lung compliance a minimum airway pressure is reached and pressure peaks are avoided.

Evita 4 delivers additional inspiration flow when the patient breathes in – limited by the alarm limit V_{Ti} ⚠

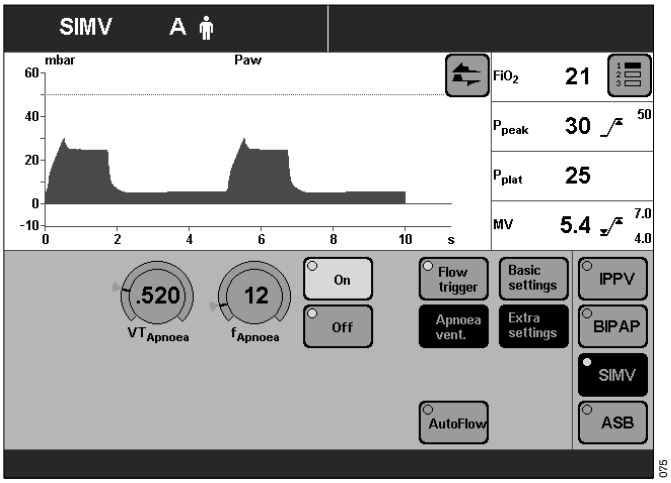
The patient can also breathe out during the inspiratory plateau phase.

The inspiratory pressure is limited by the Paw ⚠ alarm limit.

- Set the alarm limits MV ⚠ and MV ⚠ in order to avoid excessive or insufficient flow following rapid changes in compliance.

To set (Example: Apnoea Ventilation)

- Touch the »**Extra settings**« screen key.
- Touch the screen key corresponding to the desired function , e.g. »**Apnoea vent.**«.
- Switch on the function = touch the »**On**« screen knob and press in the rotary knob.
- Set values = touch the corresponding screen knob, turn and press rotary knob.



SIMV and SIMV/ASB can be configured with the additional ventilation parameter Pmax. Select Pmax pressure limiting, see page 108.

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* Please refer to page 156 for a detailed description of AutoFlow.

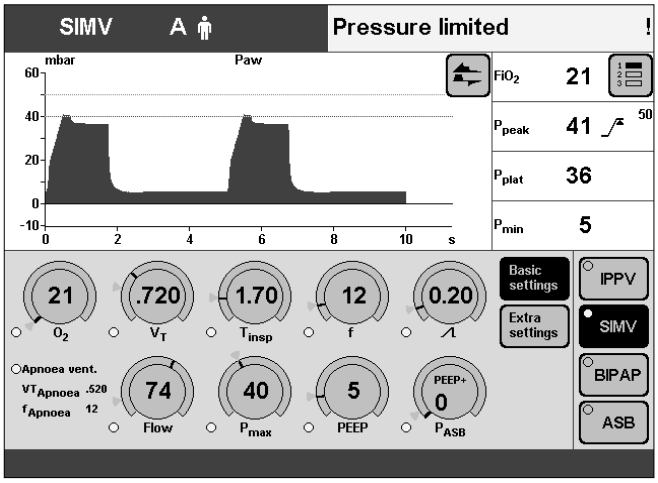
Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the inspiratory flow curve shows a brief flow pause between inspiration and expiration.

- To set the Pmax pressure limit, please refer to page 108.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The **»Inconstant volume !!«** alarm is always active. It is triggered automatically if the tidal volume VT can no longer be applied.

This visual and audible alarm can be suppressed with the **»Alarm Reset«** key until the cause of the alarm is remedied.



* Please refer to page 156 for a detailed description of PLV.

BIPAP, BIPAP/ASB

Biphasic **P**ositive **A**irway **P**ressure
Assisted **S**pontaneous **B**reathing

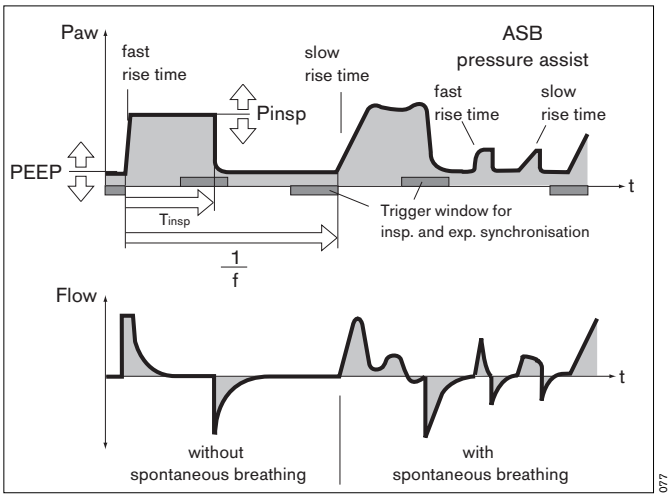
Pressure-controlled ventilation combined with free spontaneous breathing during the complete breathing cycle, and adjustable pressure support at CPAP level.

The mandatory proportion of the total minute volume MV is set with inspiratory pressure P_{insp} above PEEP and Frequency f.

For a range of patients, from those unable to breathe spontaneously to those breathing spontaneously before extubation. Patients are weaned off the ventilator by progressive reduction of the mandatory proportion of the overall minute volume MV and reduction of the pressure support P_{ASB}.

The frequency can be reduced to 0 during the weaning process. The device automatically changes to the ventilation mode CPAP or CPAP/ASB. This ventilation mode is also indicated on the screen.

The screen key **»BIPAP«** and the screen knobs for setting the BIPAP parameters remain on display.



Set the pattern of ventilation for BIPAP and BIPAP/ASB with the ventilation parameters:

Inspiration pressure »**P_{insp}**«

Frequency »**f**«

Time »**T_{insp}**«

O_2-concentration »**O_2**«

Positive end-expiratory pressure »**PEEP**«

Pressure support »**P_{ASB}**«

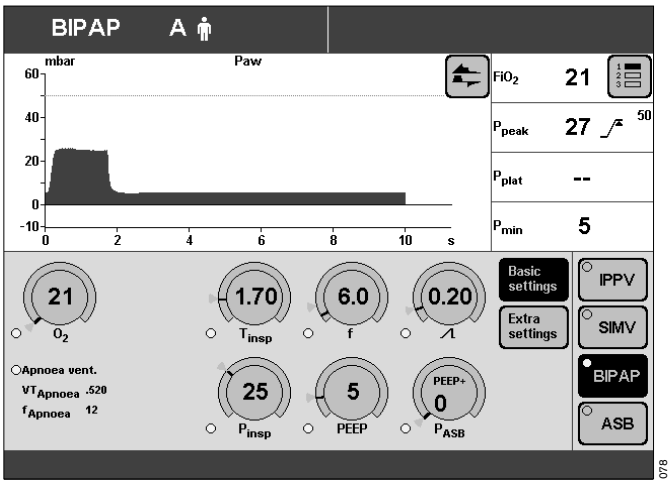
Pressure rise time »⟋⌞«

The inspiration pressure »**P_{insp}**« can be reduced to the PEEP level, in which case the ventilation pattern corresponds to CPAP or CPAP/ASB.

The inspiration pressure »**P_{insp}**« is set as an absolute value. Pressure support »**P_{ASB}**« is set relative to the PEEP level.

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



BIPAP and BIPAP/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.
By setting on the flow trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.
Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

Apnoea-Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.

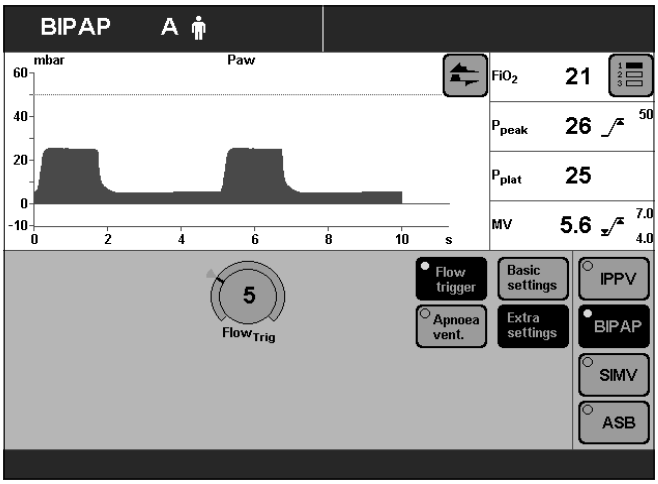
If breathing stops, Evita 4 emits an alarm after the set alarm time (T_{Apnoea}) and starts volume-controlled ventilation with the set ventilation parameters:

Frequency »**fApnoea**«

Tidal volume »**VTApnoea**«

To set (Example: Flowtrigger)

- Touch the »**Extra settings**« screen key.
- Touch the screen key corresponding to »**Flowtrigger**«.
- Set values = touch the »**FlowTrig**« screen knob, and turn and press the rotary knob.



BIPAPAssist

Biphasic **P**ositive **A**irway **P**ressure **A**ssisted

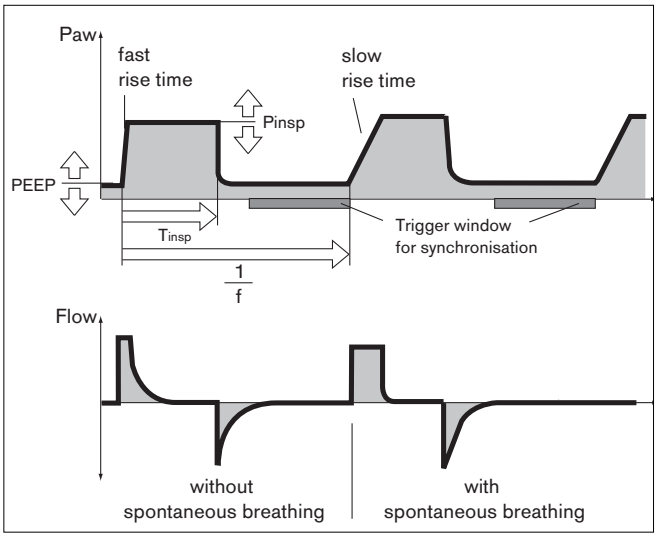
pressure-controlled, assisted ventilation

The inspiratory strokes are the same as for BIPAP, but the changeover from P_{insp} to PEEP is not synchronised with expiration by the patient.
The patient can breathe spontaneously at PEEP level through the entire ventilation process.

Every spontaneous breathing activity by the patient triggers a synchronised inspiratory stroke.

A non-synchronised inspiratory stroke is started by the device at the latest upon expiry of the time »f«.

For all patients, from those unable to breathe spontaneously to those breathing spontaneously before being weaned off the ventilator.



Set ventilation pattern for BIPAPAssist with the following parameters:

Inspiratory pressure »**P_{insp}**«

Frequency »**f**«

Inspiration time »**T_{insp}**«

O_2-concentration »**O_2**«

Positive end-expiratory pressure »**PEEP**«

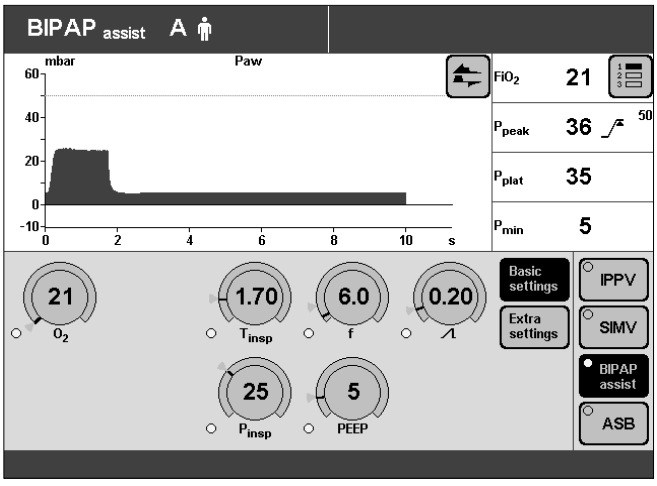
Pressure rise time » ⩘ «

Flow trigger »**$Flow_{Trig.}$**«

The inspiratory pressure »**P_{insp}**« is set as an absolute value.

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.

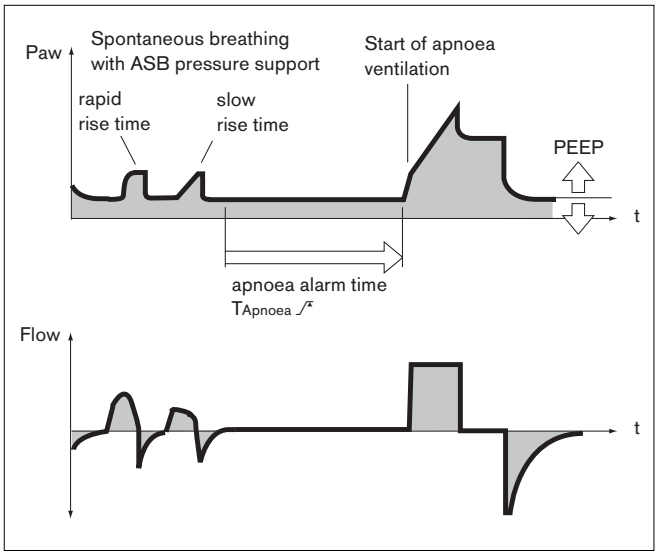


CPAP, CPAP/ASB

Continuous **P**ositive **A**irway **P**ressure
Assisted **S**pontaneous **B**reathing

Spontaneous breathing at a raised pressure level in order to increase the functional residual capacity (FRC). Spontaneous breathing can be assisted with additional pressure by ASB.

For patients breathing spontaneously.



Set the pattern of ventilation for CPAP and CPAP/ASB with the following ventilation parameters:

O_2-concentration »**O_2**«

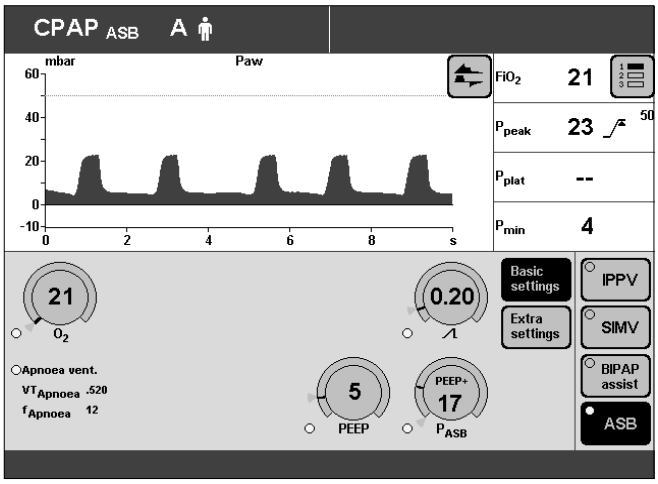
Positive end-expiratory pressure »**PEEP**«

Pressure support »**PASB**«

Pressure rise time » ⟋⌞ «

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



CPAP and CPAP/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.

By setting the trigger level, the mandatory ventilation strokes are synchronised with the patient's spontaneous breathing attempts.

Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

Apnoea-Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.

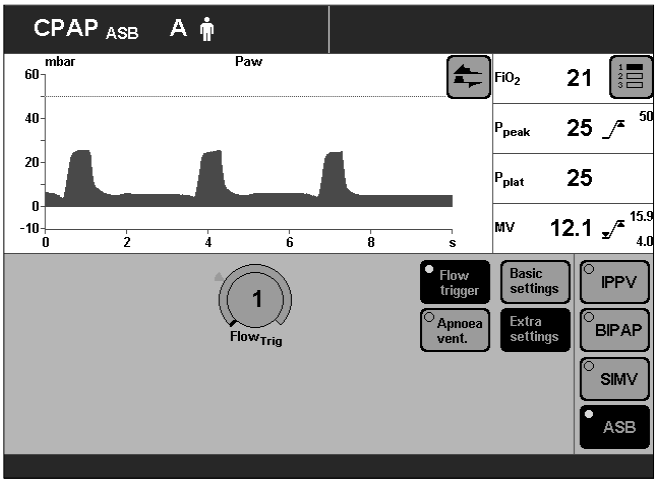
If breathing stops, Evita 4 emits an alarm after the set alarm time (TApnoe ⟋) and starts volume-controlled ventilation with the set ventilation parameters:

Frequency »**fApnoea**«

Tidal volume »**VTApnoea**«

To set (Example: Flowtrigger)

- Touch the »**Extra settings**« screen key.
- Touch the »**Flow trigger**« screen key.
- Set the value = touch the »**Flow**Trig« screen knob, and turn and press the rotary knob.

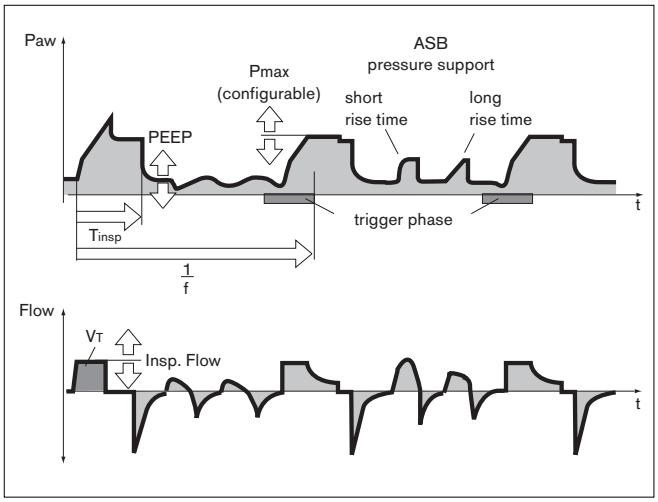


MMV, MMV/ASB

Mandatory **M**inute **V**olume **V**entilation
Assisted **S**pontaneous **B**reathing

The overall minute volume is preset to a mandatory level, which can be adjusted by means of the tidal volume V_T and frequency f.
The patient can breathe spontaneously, thereby contributing a portion of the overall minute volume.
The difference between the spontaneously breathed minute volume and the set minute volume is covered by the mandatory ventilation strokes. Spontaneous breathing can be assisted by ASB pressure support.

This mode is intended for patients being weaned off the ventilator by progressively reducing the mandatory proportion of the overall minute volume.



Set the pattern of ventilation for MMV and MMV/ASB with the ventilation parameters:

Tidal volume »**V_T**«

Insp. flow »**Flow**«

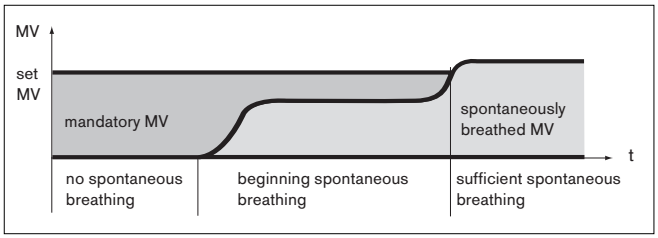
Frequency »**f**«
Inspiration time »**T_{insp}**«

O_2-concentration »**O_2**«

Positive end-expiratory pressure »**PEEP**«

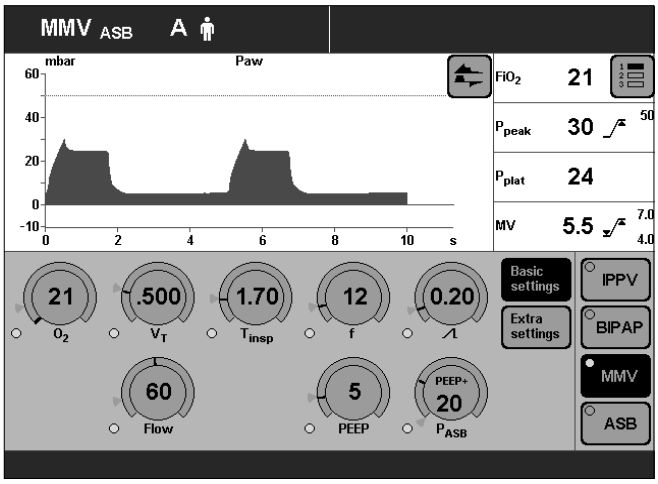
Pressure support »**P_{ASB}**«

Pressure rise time » ⩘ «



To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



MMV and MMV/ASB can be expanded with the following ventilation parameters:

Flowtrigger – for synchronisation with attempted spontaneous breathing by the patient.
By setting on the flow trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.

Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

AutoFlow® – for automatic regulation of the inspiration flow. With AutoFlow®* the inspiration flow is decelerated and regulated, so that at the selected tidal volume VT with the current lung compliance a minimum airway pressure is reached and pressure peaks are avoided.

Evita 4 delivers additional inspiration flow when the patient breathes in – limited by the alarm limit VTi.

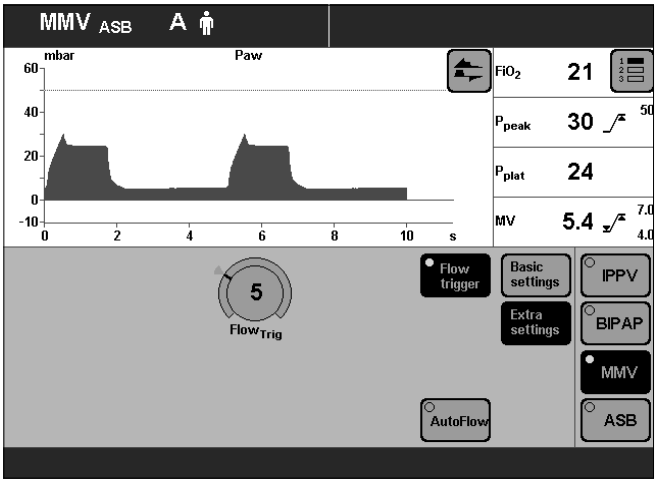
The patient can also breathe out during the inspiratory plateau phase.

The inspiratory pressure is limited by the Paw alarm limit.

Set the alarm limits MV and MV in order to avoid excessive or insufficient flow following rapid changes in compliance.

To set (Example: Flowtrigger)

- Touch the »**Extra settings**« screen key.
- Touch the »**Flowtrigger**« screen key.
- Set value = touch the »**FlowTrig**« screen knob, and turn and press the rotary knob.



MMV and MMV/ASB can be configured with the additional ventilation parameter Pmax. Select Pmax pressure limiting, see page 108.

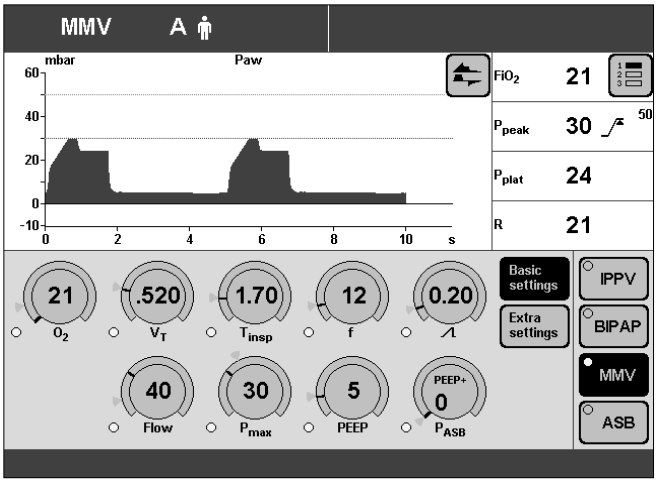
Pressure Limited Ventilation (PLV)** – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the inspiratory flow curve shows a brief flow pause between inspiration and expiration.

- To set the Pmax pressure limit, please refer to page 108.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The **»Inconstant volume !!«** alarm is always active. It is triggered automatically if the tidal volume VT can no longer be applied.

This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.



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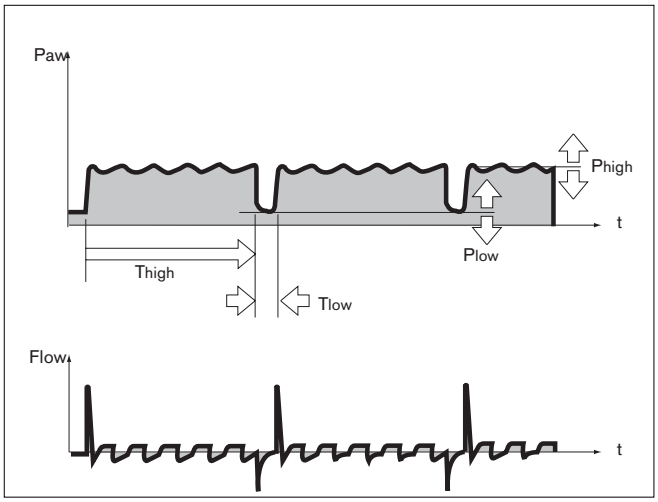
* Please refer to page 156 for a detailed description of AutoFlow.
** Please refer to page 156 for a detailed description of PLV.

APRV

Airway **P**ressure **R**elease **V**entilation

Free spontaneous breathing at a raised CPAP pressure level together with a short period of low pressure (Release).

This mode is intended for patients who are breathing spontaneously but who need assistance with CO_2 removal.



Set the pattern of ventilation for APRV with the ventilation parameters:

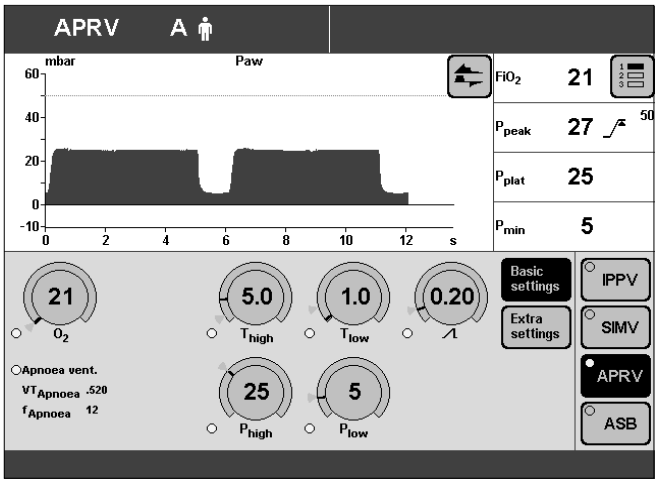
Inspiration time »**Thigh**«
Expiration time »**Tlow**«

Inspiration pressure »**Phigh**«
Positive end-expiratory pressure »**Plow**«

O_2-concentration »**O_2**«

To set:

- Touch the appropriate screen knob.
- Adjust to the desired value = turn rotary knob.
- Confirm setting = press the rotary knob.



APRV can be expanded with the following ventilation parameters:

Apnoea-Ventilation – for automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing

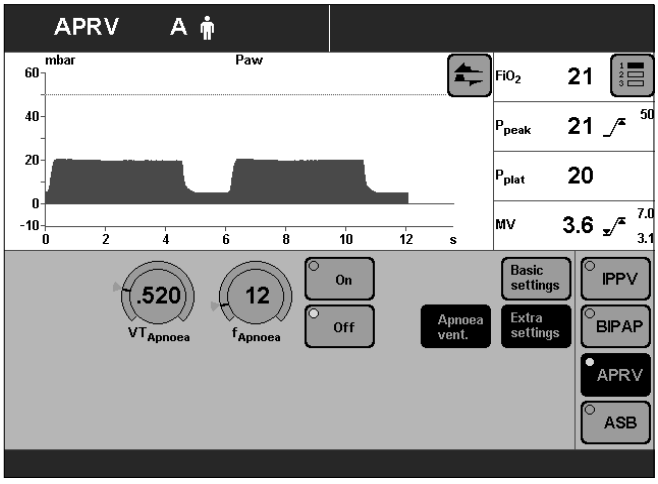
If breathing stops, Evita 4 emits an alarm after the set alarm time (T_{Apnoea}) and starts volume-controlled ventilation with the set ventilation parameters:

Frequency »**fApnoea**«

Tidal volume: »**VTApnoea**«

To set (Example: Apnoea Ventilation)

- Touch the »**Extra settings**« screen key.
- Touch the »**Apnoea vent.**« screen key.
- Switch on the function = touch the »**On**« screen knob and press in the rotary knob.
- Set values = touch the corresponding screen knob, turn and press rotary knob.



ILV

Independent **L**ung **V**entilation

Separate, differentiated, synchronised ventilation with two Evita units, one for each lung. The two Evita units are connected by analogue interfaces.

The two devices operate together in master/slave mode. The master device controls the operation.

Preparation

If a protective cap is fitted:

- Remove cap from ILV connection.

The following device combinations are possible:

– Combination of two Evita 4 units
– Combination of Evita 4 and Evita 2 dura
– Combination of Evita 4 and Evita 2
– Combination of Evita 4 and Evita.

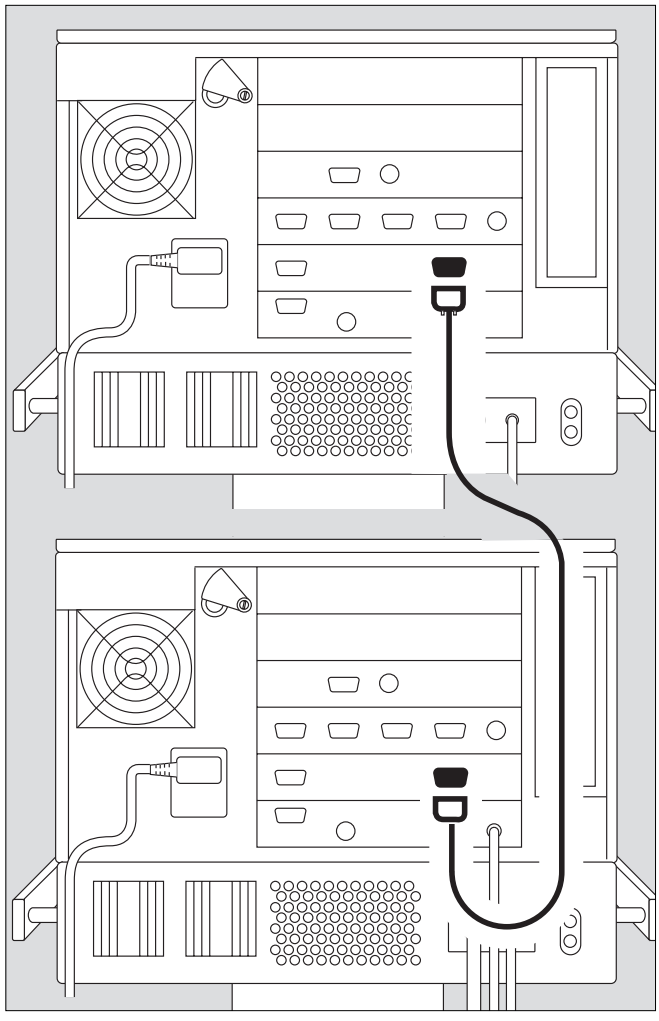
Requirements for combinations

– Evita 2 or Evita units must be fitted with the EvitaBus analogue interface (optional).
– Connecting cable 84 11 794 must be used to connect Evita 4 to another Evita 4 or with an Evita 2 dura.
– Connecting cable 84 11 793 must be used to connect Evita 4 to an Evita 2 or Evita 3.

The ILV cable should only be connected when the unit is switched off!

For Evita 4 – Evita 2 dura
and
Evita 4 – Evita 4:

- Connect the ILV ports of the two Evita units using connecting cable 84 11 794.

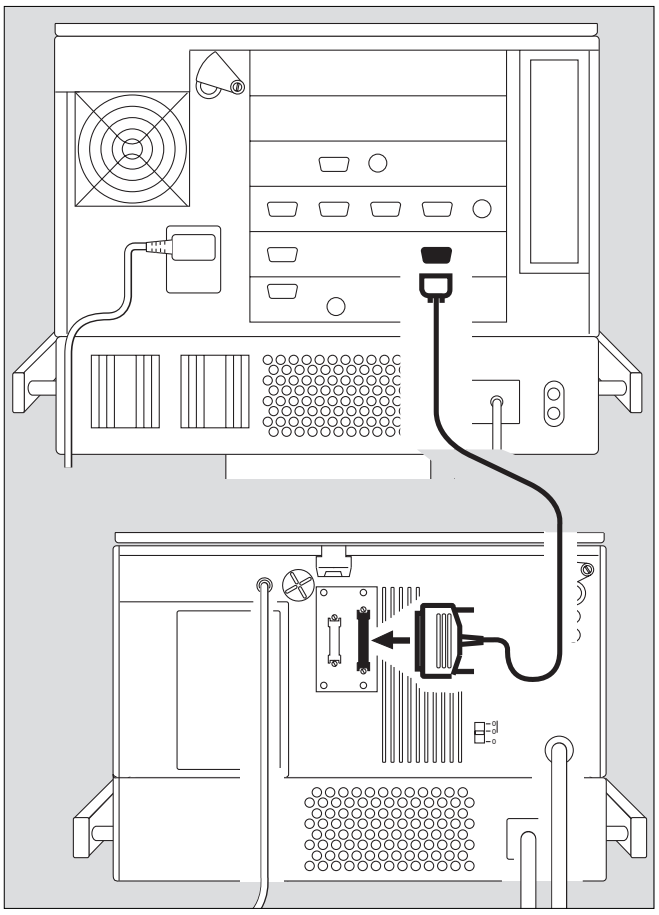


for Evita 4 – Evita 2

and

Evita 4 – Evita:

- Connect the ILV port of the Evita 4 to the analogue interface of the other Evita unit using connecting cable 84 11 793.



Setting the Master and Slave device

To perform independent lung ventilation:

- Set up one device for ILV/Master mode
  and
- the other device for ILV/Slave mode.
- Set the desired parameters – see page 13.
- **Do not activate ILV mode until all the parameters for the ILV/Master and ILV/Slave are fully set.**

Setting ILV/Master

Volume-controlled ventilation with fixed, mandatory minute volume MV, set with tidal volume V_T and frequency f.

For independent lung ventilation of patients with no spontaneous breathing.

Set the ILV ventilation pattern with the parameters:

Tidal volume »**V_T**«

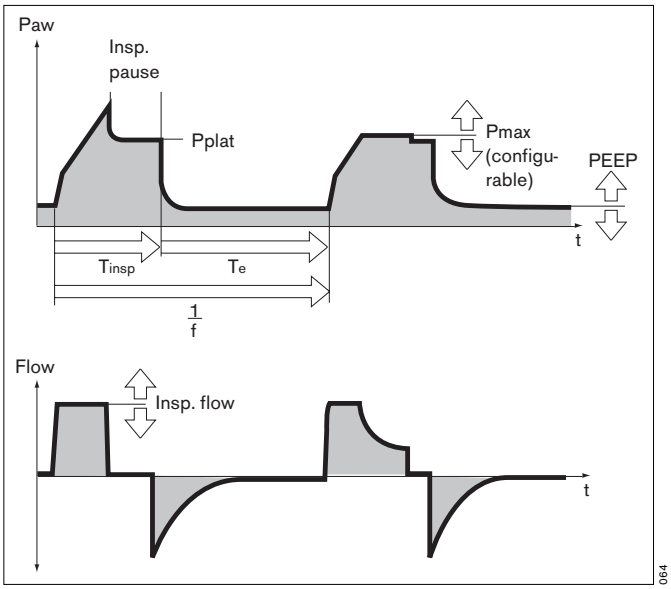
Insp. flow »**Flow**«

Frequency »**f**«

Inspiration time »**T_{insp}**«

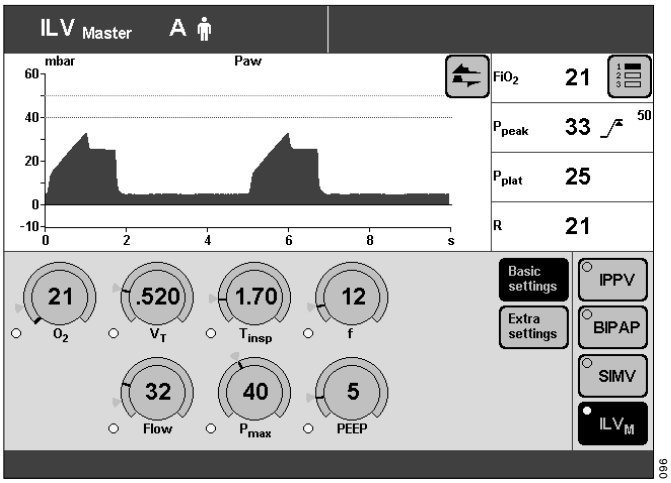
O_2-concentration »**O_2**«

Positive end-expiratory pressure »**PEEP**«



To set:

- Touch the appropriate screen knob.
- Adjust the desired value = turn rotary knob.
- Confirm setting = press rotary knob.



ILV/Master can be supplemented by the following ventilation parameters:

Flowtrigger (ILV/Master Assist) – for synchronisation with attempted spontaneous breathing by the patient.

By switching on the flow trigger and setting the trigger level, the mandatory strokes are synchronised with the patient's spontaneous breathing attempts.

Spontaneous breathing activity by the patient is indicated by the brief display of a lung symbol instead of the usual symbol for the patient mode.

Sigh – for prophylactic treatment of atelectasis.
Atelectasis can be prevented by switching on the sigh function and setting the sigh in the form of an intermittent PEEP. When the Sigh function is activated, the end-expiratory pressure is increased by the set value of the intermittent PEEP for 2 ventilation strokes every 3 minutes.

ILV/Master can also be configured with the additional ventilation parameter Pmax. To set the »Pmax pressure limit«, please refer to page 108.

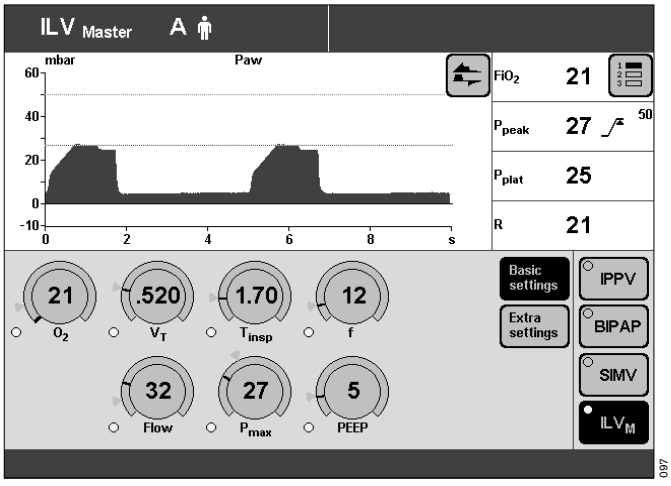
Pressure Limited Ventilation (PLV) – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the flow curve shows a brief flow pause between inspiration and expiration

- To set the "Pmax pressure limit", please refer to page 108.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The tidal volume is constantly monitored. If the tidal volume VT can no longer be applied, the "Inconstant volume" alarm is automatically triggered.

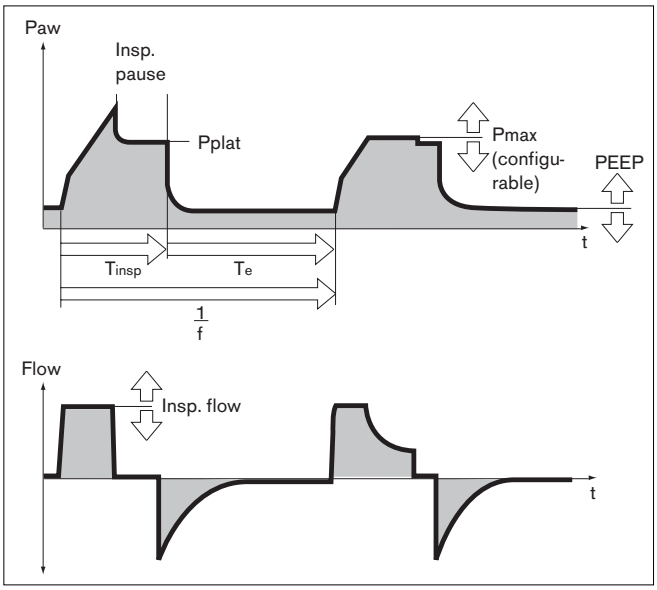
This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.



Setting ILV/Slave

Volume-controlled ventilation with fixed, mandatory minute volume MV, set with the tidal volume VT and frequency f of the ILV Master device and selectable Slave mode.

For independent lung ventilation of patients with no spontaneous breathing.

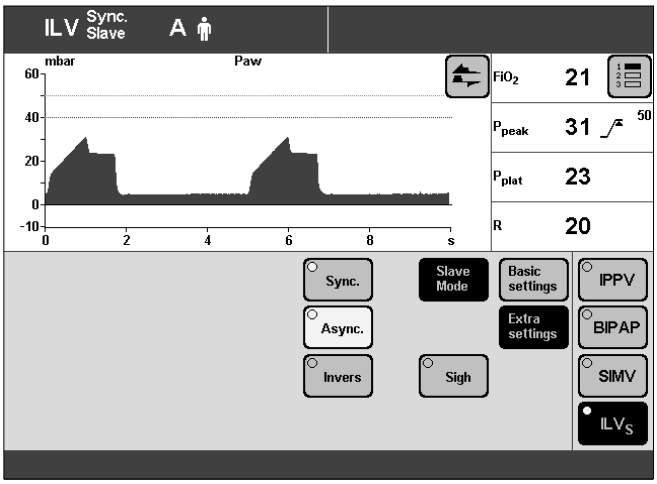


To set Slave mode:

- Touch the »**Extra settings**« screen key.
- Touch the »**Slave Mode**« screen key

To select the desired slave mode (e.g. »**Async.**«):

- Touch the appropriate screen key and press the rotary knob.



ILV/Master and Slave Synchronisation

Master device

I:E ratio

Slave device:

Sync. – The I:E ratio of the slave device is determined by the I:E ratio of the master device.
The start of inspiration is synchronised with the inspiration of the master device.

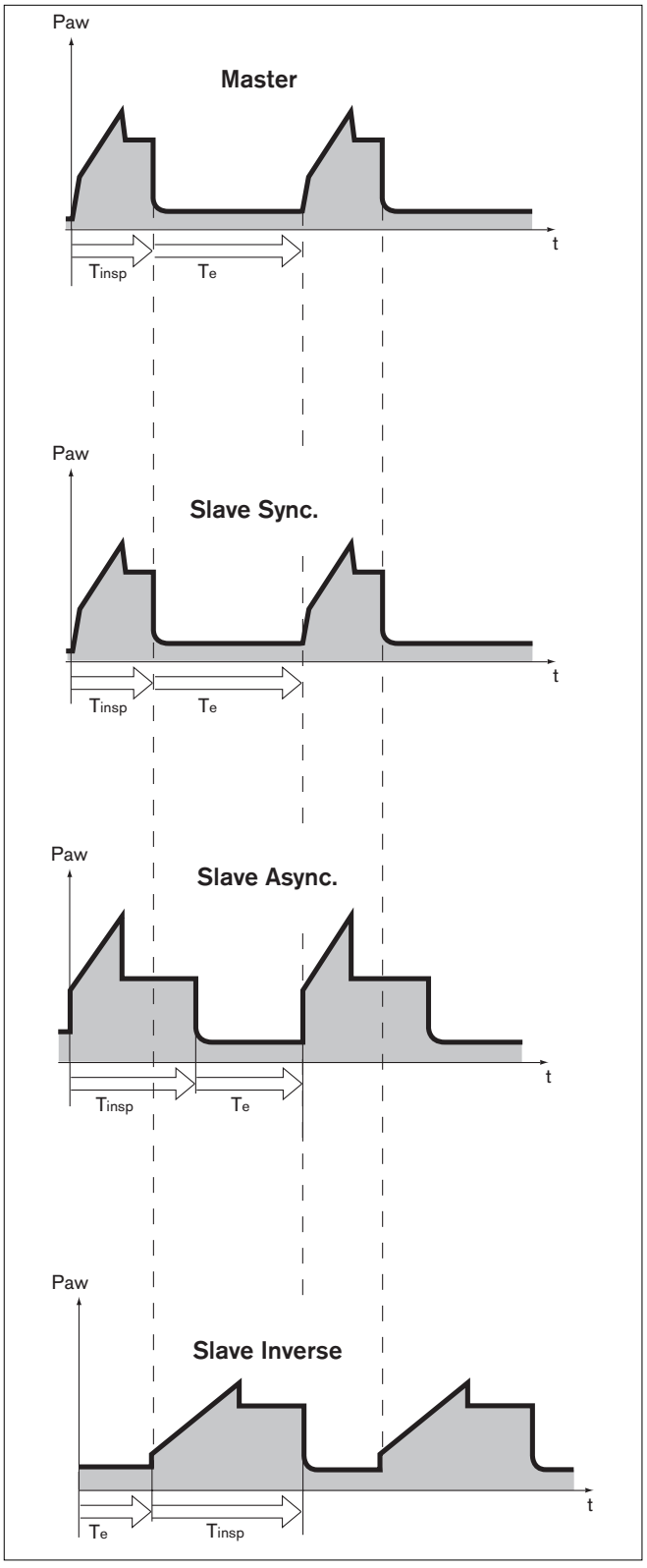
Slave device

Async. – The start of inspiration is synchronised with the inspiration of the master device.

The end of inspiration (incl. pause time) is determined by the »**Tinsp**«. setting. The I:E ratio of the slave device is freely selectable.

Slave device

Inverse – The start of inspiration is synchronised with the start of expiration of the master device and vice versa.
The I:E ratio of the slave device is the inverse of the I:E ratio of the master device.



Set the ventilation pattern for ILV/Slave with the following ventilation parameters:

Tidal volume »**VT**«

Insp. flow »**Flow**«

Frequency »**f**«

Inspiration time »**Tinsp**«

O2-concentration »**O2**«

Positive end-expiratory pressure »**PEEP**«

To set:

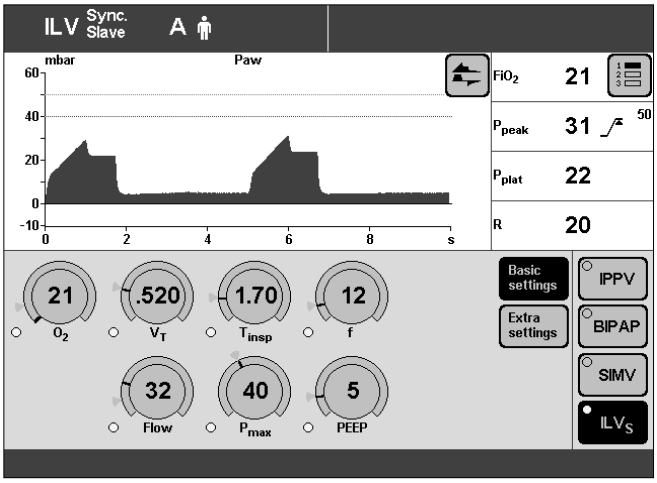
- Touch the appropriate screen knob.
- Adjust the desired value = turn rotary knob.
- Confirm setting = press rotary knob.

The »**f**« setting is not immediately effective.

Nevertheless, to make sure that the two lung compartments are not ventilated with different frequencies in the event of inadvertent separation of the two devices:

Set **»f«** on the slave device to the same value as on the master = safety setting.

In Async. slave mode, the »**Tinsp**« setting is immediately effective.
In "Synchronised" and "Inverse" modes, »**Tinsp**« is only effective if the devices are inadvertently separated.



ILV/Slave can be supplemented by the following ventilation parameters:

Sigh – for prophylactic treatment of atelectasis.

Atelectasis can be prevented by switching on the Sigh function and setting the sigh in the form of an intermittent PEEP.
When the Sigh function is activated, the end-expiratory pressure is increased by the set value of the intermittent PEEP for 2 ventilation strokes every 3 minutes.

ILV/Slave can also be configured with the additional ventilation parameter Pmax. To set the Pmax pressure limit, please refer to page 108.

Pressure Limited Ventilation (PLV) – for manually limiting pressure peaks using the Pmax pressure limit. The tidal volume remains constant as long as the pressure curve shows a plateau and the flow curve shows a brief flow pause between inspiration and expiration.

- To set the Pmax pressure limit, please refer to page 108.

The value of Pmax is displayed as a dashed blue line in the Paw (t) curve.

The tidal volume is constantly monitored. If the tidal volume VT can no longer be applied, the **»Inconstant volume !!«** alarm is automatically triggered.
This visual and audible alarm can be suppressed with the »**Alarm Reset**« key until the cause of the alarm is remedied.

Apnoea-Ventilation

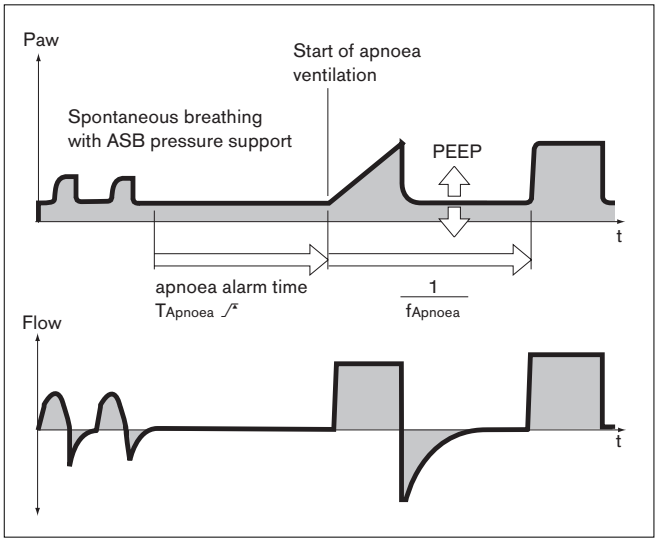
For automatic switch-over to volume-controlled mandatory ventilation if the patient stops breathing.

It can be switched on in the ventilation modes SIMV, BIPAP, CPAP, APRV.

Evita 4 emits an apnoea alarm if during the set alarm period »**TApnoea**« no expiration flow is measured or insufficient inspiratory gas is delivered.
If breathing stops, Evita 4 emits an alarm after the set alarm time (T_{Apnoea}) and starts volume-controlled ventilation with the set ventilation parameters:

Frequency »**fApnoea**«

Tidal volume »**VTApnoea**«



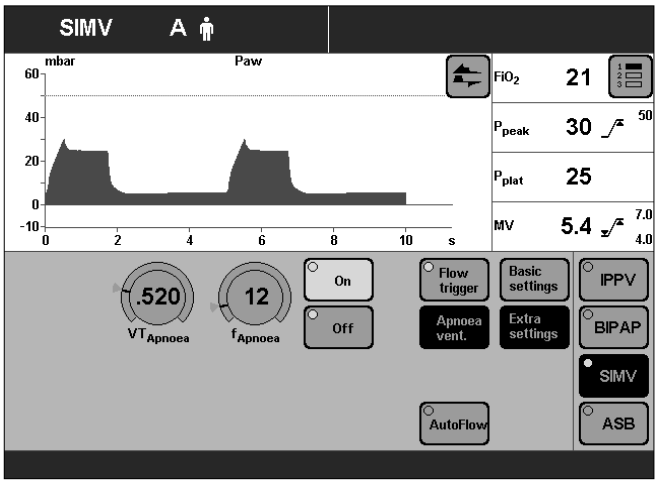
The ventilation parameters »**O2**« and »**PEEP**« correspond to the settings effective at the time.
The inspiration time for apnoea ventilation is determined from the set apnoea frequency »**fApnoea**« and a fixed I:E ratio of 1:2.

As in SIMV, the patient can breathe spontaneously during apnoea ventilation, and the mandatory ventilation strokes will be synchronised with the patient's spontaneous breathing. The apnoea ventilation frequency remains constant.

To set:

- Touch the »**Extra settings**« screen key.
- Touch the »**Apnoea vent.**« screen key.
- Switch on the function = touch the screen knob marked »**On**«, and press the rotary knob.
- Set values = touch the appropriate screen knob, and then turn and press the rotary control.

Status and settings for apnoea ventilation are displayed by Evita 4 on the »Settings« screen.



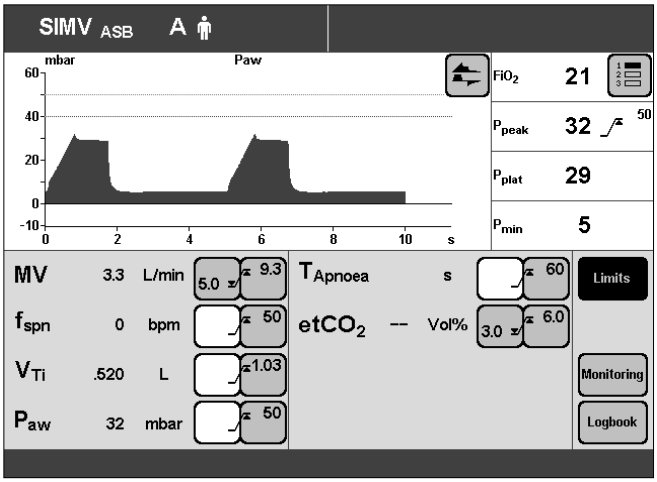
To terminate Apnoea Ventilation:

- Press the »**Alarm Reset**« key: the device will continue operating in its previous ventilation mode
  or
- select another ventilation mode.

For configuring the status of apnoea ventilation when switching on the device, see page 110.

Setting Alarm Limits

- Press key »**Limits**«.
  Display screen »**Alarm limits**« (example):
  This page displays all the adjustable alarm limits.
  = lower alarm limit
  = upper alarm limit



Example: Lower alarm limit for minute volume MV.

- Touch the screen key for MV: the key changes colour from green to yellow.
- Set the alarm limit and confirm by turning and pressing the rotary knob. The new alarm limit will now be effective.

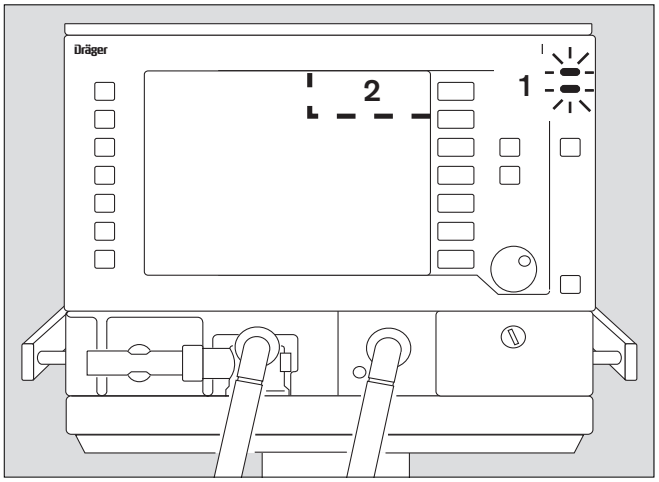
The lower alarm limits do not have to be set for the airway pressure Paw, which is automatically coupled with the PEEP setting.

The alarm limits do not have to be set for the O_2 concentration. These limits are automatically coupled to the O_2 concentration setting.

Lower alarm limit:
Setting –4 Vol.% (for settings up to 60 Vol.%)
Setting –6 Vol.% (for settings from 60 to 100 Vol.%)
Upper alarm limit:
Setting +4 Vol.% (for settings up to 60 Vol.%)
Setting +6 Vol.% (for settings from 60 to 100 Vol.%)

Setting ranges for alarm limits, see "Technical Data", page 150.

In the Event of an Alarm



1 the red lamp or yellow lamp flashes.
2 The alarm message is displayed in the right-hand corner of the top line of the screen.

Evita 4 assesses the alarm message with corresponding priority, marks the text with exclamation marks and different coloured backgrounds and generates the various alarm tone sequences.

Warning = top priority message

The red lamp flashes.
The alarm messages are marked with three exclamation marks
Example: **Apnoea !!!**
Warning messages are displayed against a red background.
Evita 4 generates a 5-tone sequence that is sounded twice and is repeated every 7 seconds.

Caution = medium priority message

The yellow lamp flashes.
Warning messages are marked with two exclamation marks.
Example: **O_2 supply pressure high !!**
Caution messages are displayed against a yellow background.
Evita 4 generates a 3-tone sequence that is repeated every 20 seconds.

Advisory = low priority message

The yellow lamp remains constantly lit.
Note messages are marked with one exclamation mark.
Example: **Malfunction fan !**
Advisory messages are displayed against a yellow background.
Evita 4 generates a 2-tone sequence that sounds only once.

If the loudspeaker for audible alarms fails on account of a defect, an auxiliary signal will sound continuously.
This continuous tone also serves as power failure alarm, see page 30, if power is interrupted while the ventilator is in use.

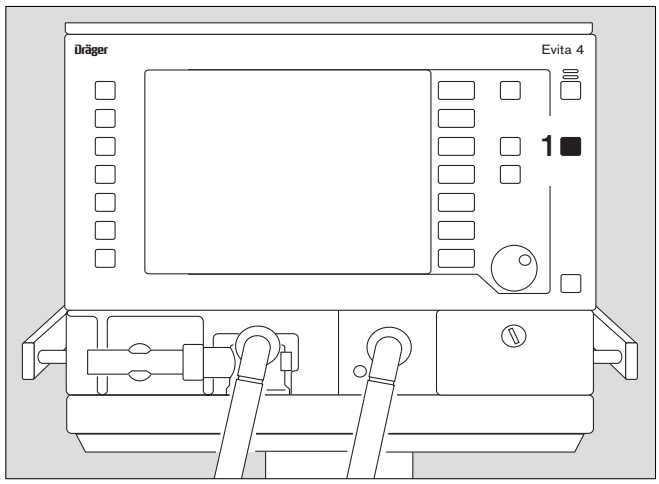
To remedy the faults, please refer to the "Troubleshooting" section starting on page 120.

Once the fault has been remedied, the alarm tone is switched off. Caution and advisory messages disappear automatically.

Warning messages (!!!) are displayed in the colour of the status line and must be acknowledged:

1 Press »**Alarm Reset**« key.

The message is erased from the screen. However, it is stored in Evita 4 and can be displayed with the logbook function in the **»Alarm limits«** screen page, see page 78.



Cancel alarm tone

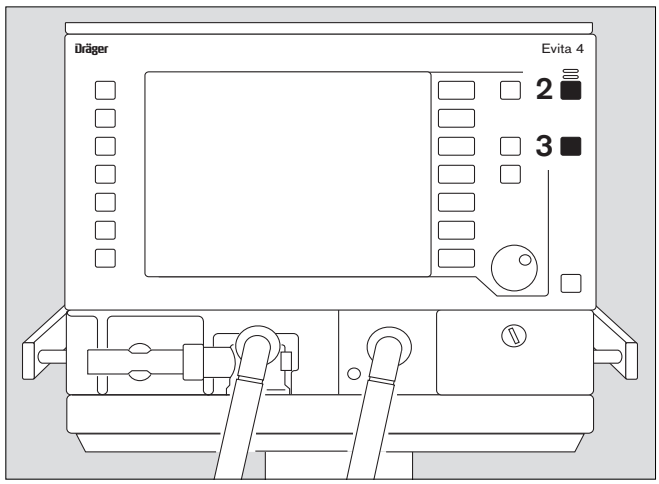
for max. 2 minutes:

2 Press the »🔔« key with the lit yellow indicator LED. The acoustic alarm will be cancelled for 2 minutes.
If the fault that triggered the alarm is still not remedied, the acoustic alarm starts up again.

If you wish to reactivate the acoustic alarm temporarily:

2 Press the »🔔« key (with the yellow LED now switched off) again.

3 Press »**Alarm Reset**« to acknowledge the alarms that can be suppressed with "Alarm Reset", please refer to "Troubleshooting" on page 120.



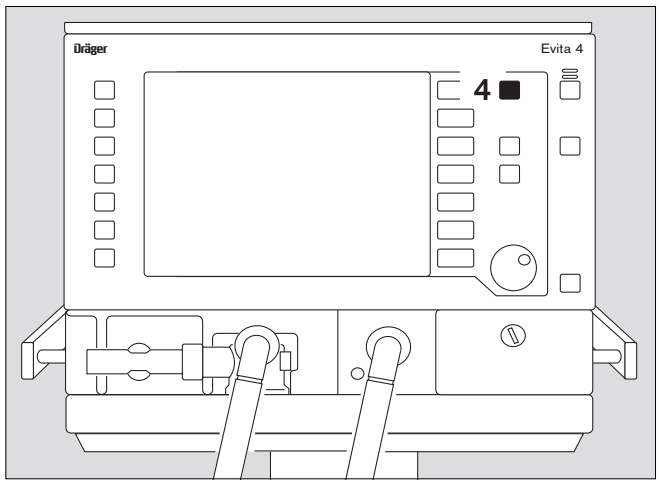
Information ℹ

– For help in operating the system – with setting instructions.
– For help in troubleshooting.

4 Press the »ℹ« key: information is displayed in the bottom line of the screen.

To erase the message:

4 Press the »ℹ« key again.



Displaying Curves and Measured Values

In the standard page

- Press » « key.

»**Standard page**« display:

In the right-hand field: 4 measured values

In the left-hand field: 2 curves

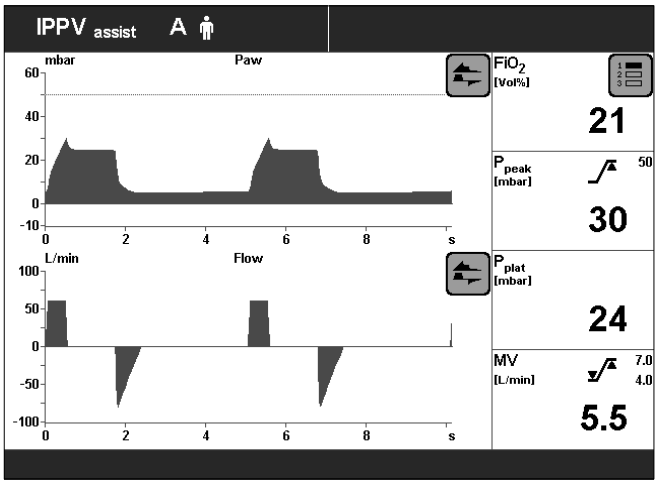
To select one of the three measured value combinations:

- Touch screen key » « repeatedly.

To select one of the three measured value combinations:

- Touch screen key » « and touch the relevant screen key.

Measured values and curves can be selected, see configuration, page 103 or page 104 onwards.



In all other screen pages

e.g. **»Settings page«**

- Press **»Mode settings«** key.

»**Settings**« display:

Right-hand field: 4 measured values (as in the standard page) left-hand field: 1 curve.

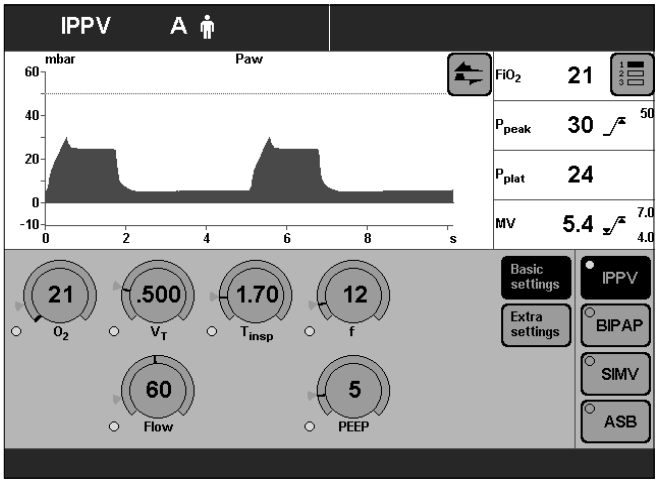
To select one of the three measured value combinations:

- Touch the screen key » « repeatedly.

To select three other curves:

- Touch the screen key » « and touch the relevant screen key.

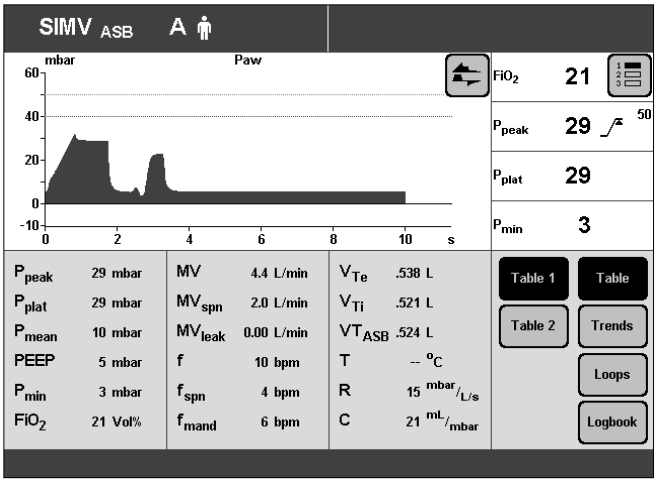
Measured values and curves can be selected, see configuration, page 103 or page 104 onwards.



Displaying Measured Values

- Press the »**Values measured**« key.

»**Table 1**« display



Evita 4 displays the measured values with the units of measure in the form of a table. The measured values are summarised in Table 1 and Table 2.

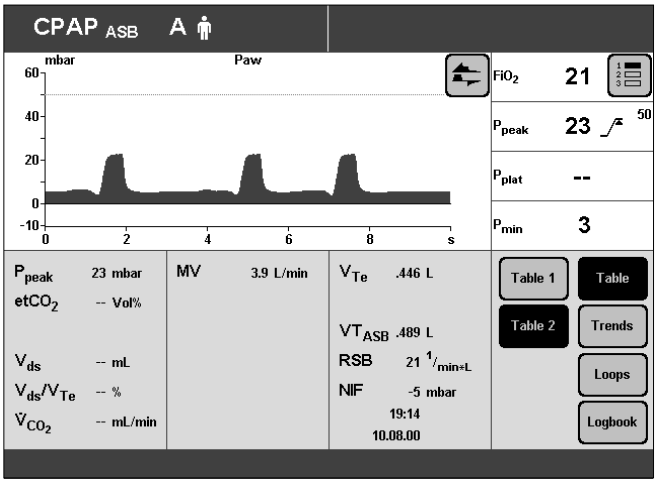
»**Table 2**« display

The following are displayed optionally:

VTASB – inspiratory breathing volume during an ASB stroke

RSB Rapid Shallow Breathing*

NIF Negative Inspiratory Force**



* For a detailed description of RSB, refer to the Annex, page 169.

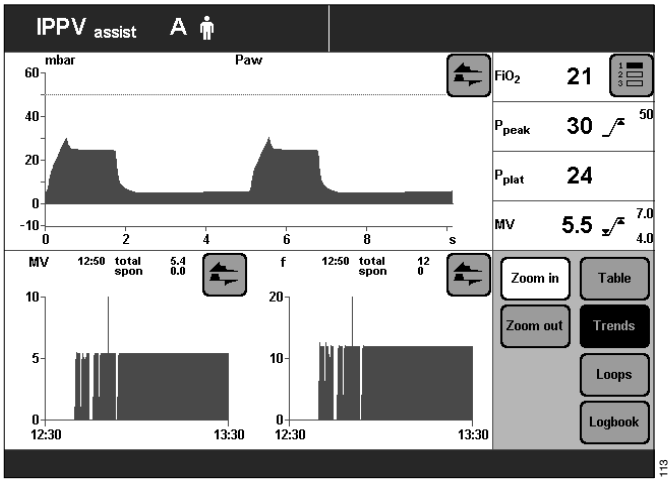
** For a detailed description of NIF, refer to the Annex, page 169.
For information on using NIF, refer to "Manual expiration", page 80.

Trends

- Touch the **»Trends«** screen key.

»**Trend**« display:

The trend of two measured values is displayed.



To enlarge the time window (zoom function):

- Touch the »**Zoom out**« screen key.

To reduce the time window:

- Touch the »**Zoom in**« screen key.

To evaluate the measured value at a specific time

- Position the ▼cursor on the time by turning the rotary knob. The time and associated measured value are displayed above the trend curve.

To display another preset measured value trend:

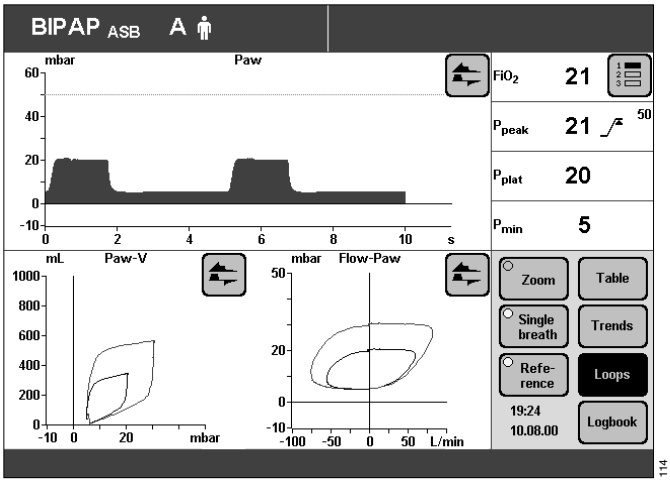
- Touch the » « screen key, and touch the corresponding screen key.

To preselect measured values for the trend display, please refer to Configuration on page 105.

Loops

- Touch the »**Loops**« screen key.

»**Loop**« display:
Two pairs of measured values plotted against each other appear in the ventilation cycle as a loop, e.g. the Paw-V loop and the V-Flow loop.



To select another preset pair of measured values as a loop:

- Touch the » « screen key in the Loop display.

Reference curve displays

To display the recorded loop of a particular breathing cycle as a permanent on-screen reference for the current loop:

Date and time of the reference are displayed on the screen.

- Press the »**Reference**« screen key.

The date and time of the reference curve appear below the **»Reference«** screen key (available as upgrade).

Single stroke displays

To display an individual breathing cycle in ventilation modes that have both mechanical and spontaneous components, e.g. SIMV:

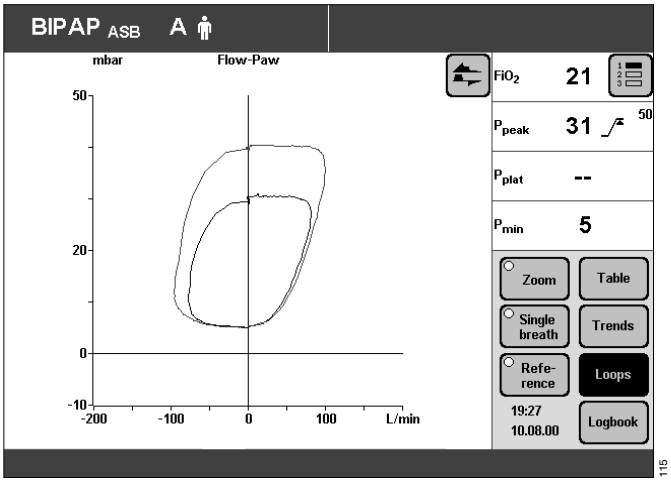
- Press the »**Single breath**« screen key.

If no single stroke is selected for display, the entire breathing activity from mandatory stroke to mandatory stroke will be recorded.

Zoom loops (available as upgrade)

The right-hand loop can be zoomed to fill the full screen including the graphic areas at the top and bottom.

- Touch the »**Zoom**« screen key.
  Display **»Loops«**.
  The right-hand loop is zoomed and the other loop disappears with the time-based curves.



The loop to be displayed can be selected even when zoomed.

The functions »**Reference**« and »**Single stroke**« are retained.

Return to the normal loop display:

- Touch the »**Zoom**« screen key.

The time-based curve automatically reappears when the loop page is exited.

Display loops in the upper graphic area (available as upgrade)

- Touch the » ⇄ « screen key.
- Touch the »**Loops**« screen key.

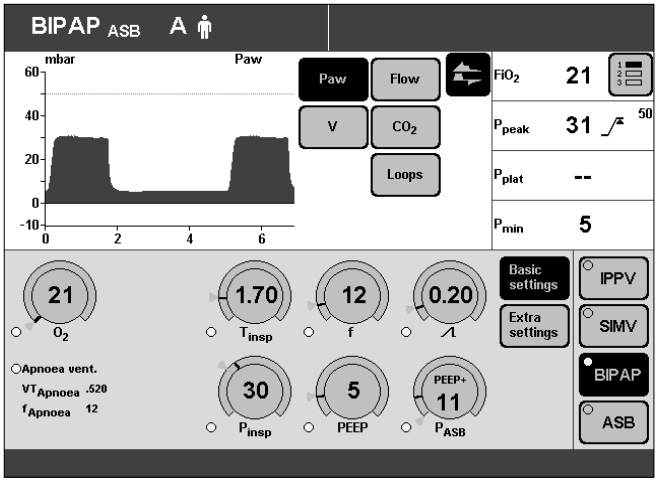
The time-based curves are replaced by the two loops in the upper graphic area.

The Freeze function can also be used with loops in the upper graphic area.

Loops in the upper graphic area cannot be configured when

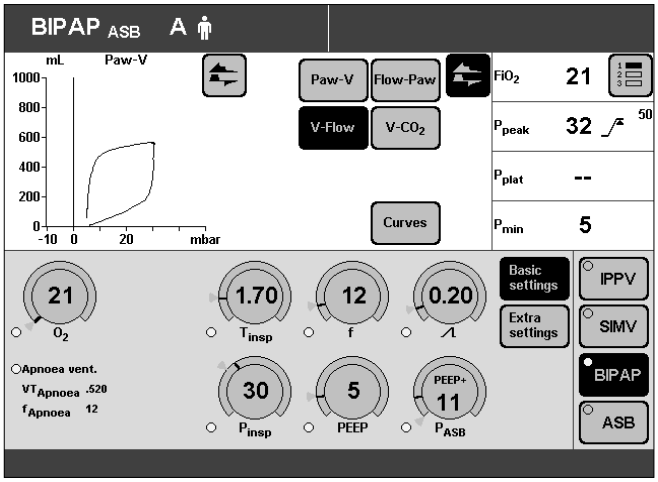
— the »**Loops**« menu is open,

— the »**Configuration**« key has been selected.



To restore the time-based curves in the upper graphic area:

- Touch the right-hand » ⇄ « screen key.
- Touch the »**Curves**« screen key.



Logbook

Settings and alarms are entered in the logbook in chronological order by Evita 4.

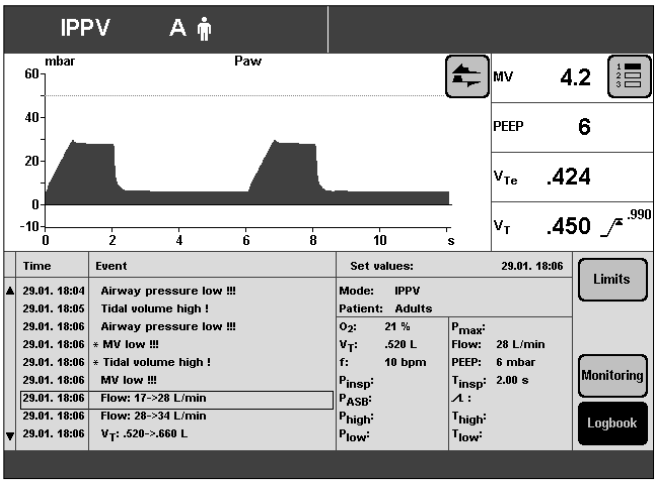
Display logbook:

- Touch the »**Logbook**« screen key.

»**Logbook**« display (example):

Alarms and settings are presented in a vertical list in chronological order.

The status of the setting is displayed with date and time on the right, next to the logbook.



To select an older entry:

- Turn the rotary knob clockwise and position the box cursor over the desired line.
  Example: 29.01. 18:06 Flow: 17 ->28 L/min

To select a more recent entry:

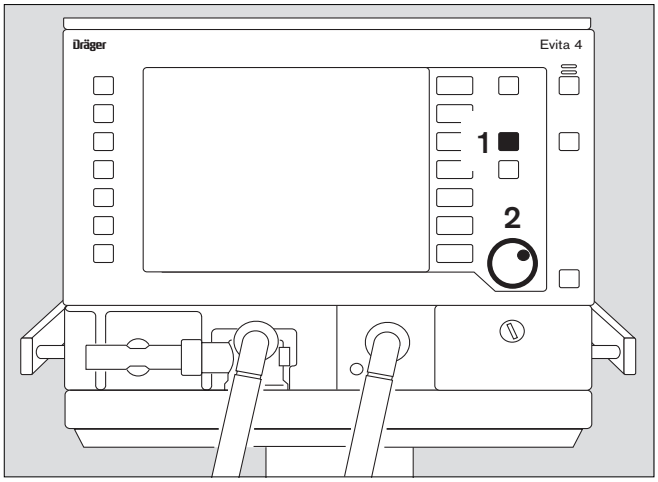
- Turn the rotary knob counter-clockwise, and position the box cursor over the desired line.

Evita 4 enters all alarms in the logbook. If an alarm is not displayed on the screen immediately when it occurs, for instance because the device has signalled an alarm with higher priority, the undisplayed alarm is correspondingly highlighted with an asterisk (*) in the logbook.
Alarms are listed without asterisk if they are displayed on the screen when they occur.

Screen Freeze

To "freeze" the curves and loops (freezing loops is optional)

1 Press »**Freeze**« key.



To display the pair of measured values, a point on the curve or loop:

2 Position the cursor on the relevant point by turning the rotary knob.
The corresponding pair of measured values is displayed above and beside the curve.

The Reference key remains disabled as long as the Freeze function is active.

To display new curves / loops again:

1 Press »**Freeze**« key again.

Screen freeze mode is automatically terminated 3 minutes after the rotary control was last turned.

Special Functions

Manual inspiration

This function may be used in all modes except CPAP without ASB pressure support.

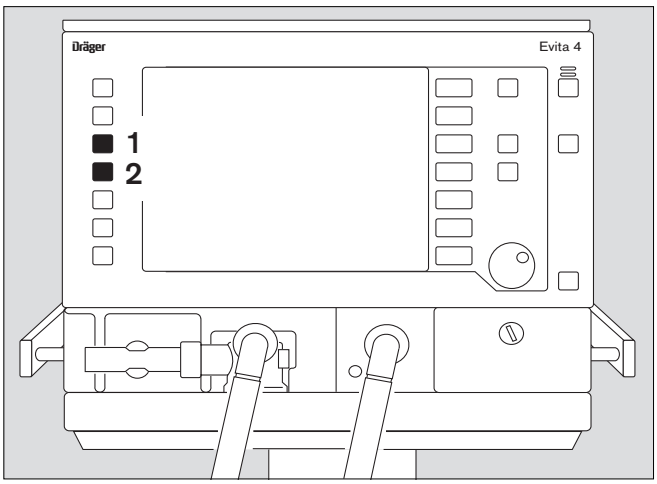
Depending on the start time, an automatic ventilation stroke is prolonged for a maximum of 15 seconds.
Or:
Between two automatic ventilation strokes, a ventilation stroke can be manually started and held for max. 15 seconds.

The pattern of the manually started ventilation stroke corresponds to the ventilation pattern of the currently active automatic ventilation mode.

In CPAP/ASB:
a pressure-assisted ventilation stroke (defined by the PASB setting) is triggered.

1 Press »**Insp. hold**« key and hold it down for as long as inspiration is required.

Either a just activated automatic ventilation stroke will be prolonged or a new ventilation stroke will be started and appropriately prolonged – max. 15 seconds.



Exspiration Hold

This function may be used in all ventilation modes.
For determining the measured NIF* value for weaning

2 Hold down the »**Exp. hold**« key.

The expiration phase remains effective as long as the key is held down and Evita 4 determines the measured NIF value. If the key is not released, the device automatically terminates the expiration phase after 15 seconds.

---

* Display NIF, see page 74.
For a detailed description of NIF, refer to the Annex, page 169.

Medicament nebulisation

Inflammable agents must not be nebulized! They may be ignited by the glowing flow sensor.

During adult ventilation

Applicable in every ventilation mode.

Evita 4 applies the medicament aerosol in synchronisation with the inspiratory flow phase and maintains the minute volume constant.

The medicament nebuliser is supplied by the ventilator with medical air, oxygen or a mixture of medical air and oxygen according to the set O_2 concentration. Deviations in O_2 concentration are therefore kept to a minimum. In extreme cases (with a minimum inspiration flow of 15 L/min), the deviations can be up to ± 4 % by volume*. To avoid greater deviations, medicament nebulisation is automatically switched off with inspiration flows below 15 L/min.

During paediatric ventilation

Medicament nebulisation is possible in the pressure-controlled paediatric ventilation modes.

In volume-controlled ventilation modes, medicament nebulisation is only possible with AutoFlow®.

Unlike in adult ventilation, the medicament nebuliser nebulises continuously in paediatric ventilation, but the aerosol generated during expiration does not reach the lungs.

Depending on the set O_2 concentration, the medicament nebuliser is supplied by the ventilator with medical air, oxygen or a mixture of medical air and oxygen. Deviations in O_2 concentration are therefore kept to a minimum.

We recommend that you do not use the medicament nebuliser at breathing rates of less than 12 bpm.

For breathing rates above 12 bpm, please refer to the graph on page 171. The maximum possible deviations in O_2 concentration are ±4 % by volume.

For breathing rates of less than 12 bpm, the deviations in O_2 concentration may be much greater. These deviations cannot be detected by the device's internal O_2 concentration monitor.

The minute and tidal volumes displayed may be considerably higher or lower than those actually applied to the patient on account of tolerances in the nebulizer flow. The measured values prevailing before nebulization must be taken into account if necessary.

If the V_T and MV values diverge strongly, the ventilation pressure can be used for assessment of the ventilation. V_T and MV values can be compared by comparing the difference between PEEP and plateau pressure before and during nebulization.

---

* For a detailed description of the inspiratory O_2 concentration during medicament nebulization, see page 171.

The medicament nebuliser is automatically switched off after 30 minutes.

After administration of the aerosol, the flow sensor is automatically cleaned and calibrated in order to prevent malfunctions in flow measurement.

Only use medicament nebuliser 84 12 935 (white central body).

Prepare the medicament nebuliser in accordance with its Instructions for Use.

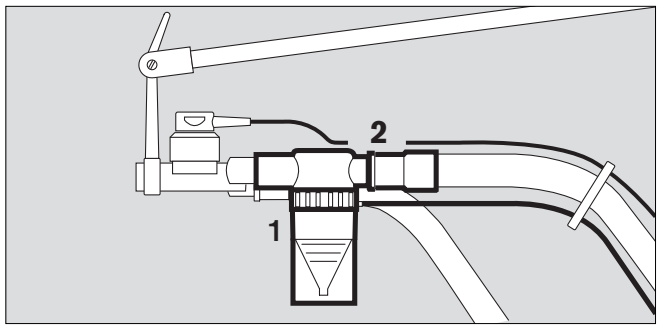
If other pneumatic medicament nebulisers are used, there may be major deviations in tidal volume and inspiratory O_2 concentration!

For use during adult ventilation

1 Connect the nebuliser to the inspiratory side (temperature sensor side) of the Y-piece.

2 Connect the inspiration hose to the medicament nebuliser.

- Place the medicament nebuliser in the vertical position.
- Using clamps, route the nebuliser hose back to the ventilator along the expiratory hose.

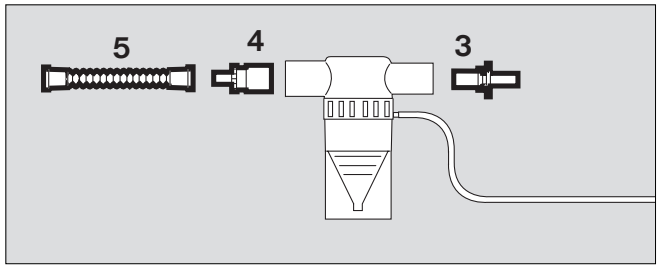


For use during paediatric ventilation

3 Insert the catheter connector (ISO cone Ø15 / Ø11) in the inlet of the medicament nebuliser.

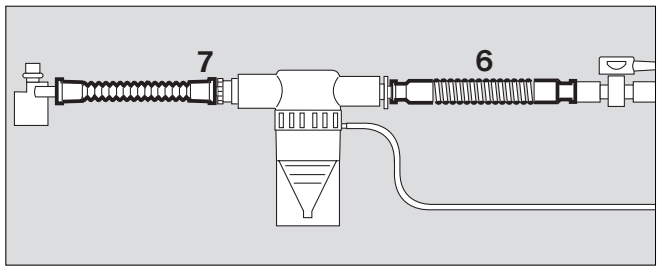
4 Insert the adapter (ISO-cone Ø22 / Ø11) in the outlet.

5 Fit the corrugated hose (0.13 m lang) to the outlet adapter.



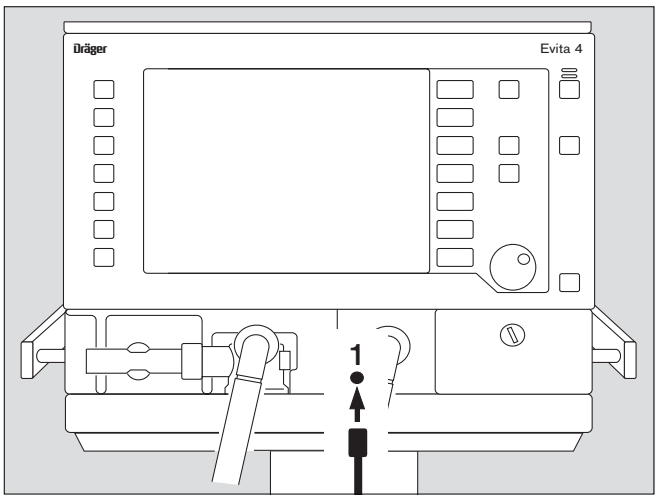
6 Remove the corrugated hose of the hose set from the inspiratory adapter of the Y-piece and connect it to the inlet adapter of the medicament nebuliser.

7 Connect the free end of the corrugated hose at the outlet of the medicament nebuliser to the inspiratory adapter of the Y-piece.



1 Connect the nebuliser hose to the port on the front panel of the Evita 4.

- Fill the medicament nebuliser in accordance with the specific Instructions for Use.



Warning: the effect of aerosols on sensors, filters and heat and moisture exchangers (HME) must be taken into account!

The measuring function of the flow sensor may be impaired.

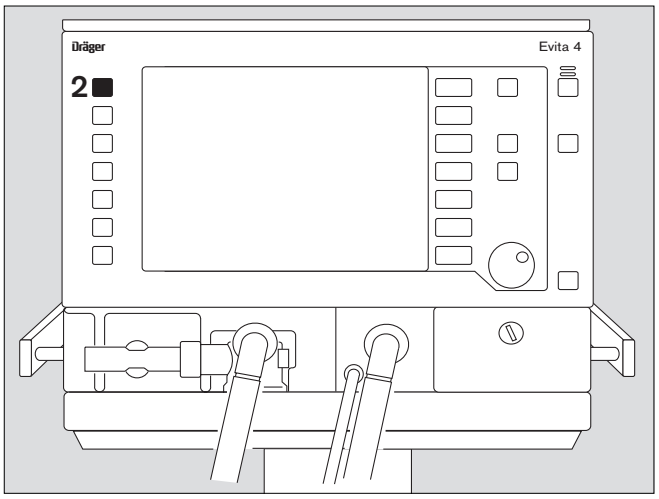
The flow resistance of filters is liable to increase and may impair ventilation.

Do not place a microbial filter on the nebuliser outlet during nebulisation!

During medicament nebulisation, do not use a heat and moisture exchanger (HME) at the Y-piece. Risk of increased breathing resistance!

2 Hold down » ☕ « key until the yellow LED lights up.

- Note message on-screen:
  »Nebuliser on!«
  The nebuliser operates for 30 minutes.



If medicament nebulisation needs to be stopped prematurely:

2 Press » ☕ « key again. The yellow LED goes out, and the nebuliser is switched off.

The flow sensor is then automatically cleaned and calibrated.

- Screen display:
  »Flow Calibration«
- Remove any left-over medicament. Follow the Instructions for Use of the medicament nebuliser.

Oxygen enrichment for bronchial suction

To avoid any risk of hypoxia during bronchial suction, Evita 4 offers a program for oxygen enrichment during the removal of secretions.

After the program is started, Evita 4 ventilates the patient in the selected ventilation mode for an initial oxygen enrichment phase of 180 seconds. In adult mode, the ventilator supplies 100 % oxygen by volume, and in paediatric mode it delivers the set O_2 concentration* plus 25 % (for example: setting = 60 % by vol.; administered = 75 % by vol.)

When the ventilator is disconnected for suction, Evita 4 interrupts ventilation. During the suction phase, the audible alarms are suppressed so that the suction routine is not disturbed.

After suction and automatically recognised reconnection, Evita 4 delivers an increased O_2 concentration* for the final oxygen enrichment phase of 120 seconds. In adult mode, the O_2 concentration is 100 % by volume. In paediatric mode, the enriched concentration is 25 % higher than the set concentration*.
During suction and for 2 minutes afterwards, the lower alarm limit for the minute volume is switched off.

Other alarms are switched off during suction and for 15 seconds afterwards

Oxygen enrichment is only possible with a fully functioning flow sensor and if flow monitoring is switched on!

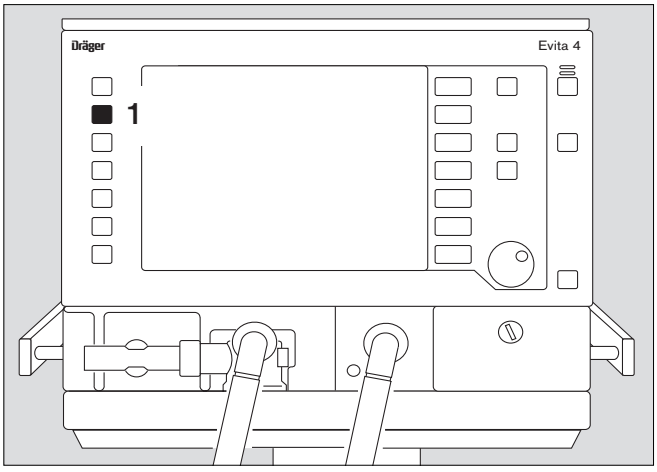
Before suction

1 Hold down the »**O_2 ↑ suction**« key until the yellow LED comes on.
Evita 4 ventilates the patient in the set ventilation mode with increased O_2 concentration: 100 % O_2 by volume in adult mode, and 25 % higher O_2 concentration than the set value in paediatric mode.
If PEEP is not set to more than 4 mbar, PEEP will be applied automatically at 4 mbar. This PEEP will enable Evita 4 to detect any subsequent disconnection. The other ventilation parameters remain unaffected.

- Display in the help line at the bottom edge of the screen: »**O_2 enrichment 180 s**«

The remaining time is counted down continuously. This initial oxygen enrichment lasts for a maximum of 180 seconds. During this time, Evita 4 waits for a dis-connection for suction.

If there is no disconnection after expiry of the 180 seconds, the oxygen enrichment program is terminated.



* For a detailed description of the inspiratory O_2 concentration during medicament nebulization, see page 171.

After disconnection for suction

Evita 4 delivers a minimal flow for the duration of suction in order to detect automatically the end of the disconnection phase. In the help line at the bottom edge of the screen, the time available for suction is displayed continuously in seconds (example):

»**Execute suction and reconnect 120 s**«

If suction is ended and the system is reconnected within the displayed time, Evita 4 terminates the disconnection phase.

Automatic interruption of oxygen enrichment

If there is still no reconnection after 120 seconds, the oxygen enrichment program is interrupted. All alarms are immediately reactivated. Evita 4 continues ventilating in the set ventilation mode.

After reconnection

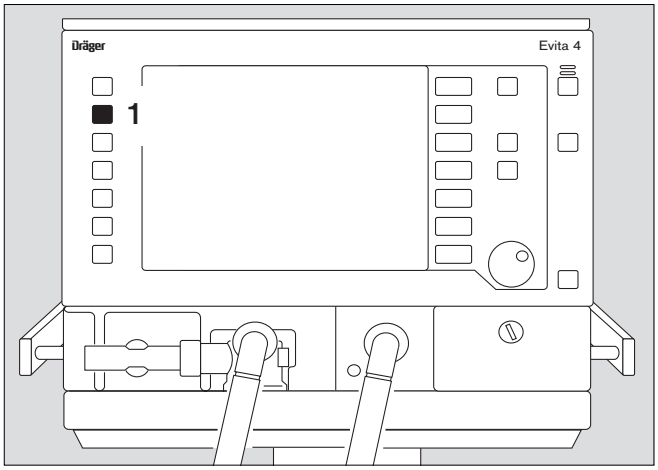
After reconnection, Evita 4 continues ventilating in the set ventilation mode, except that for 120 seconds the increased oxygen concentration of 100 % by volume for adults and 25 % above the set concentration for paediatric ventilation will continue to be delivered for final (post-suction) oxygen enrichment.

- Display in the help line at the bottom of the screen: »**Final O_2 enrichment 120 s**«

The remaining time is counted down continuously.

If you need to interrupt oxygen enrichment:

1 Press the »**O_2 suction**« key again.



Special measuring procedure: Intrinsic PEEP

Intrinsic PEEP* is the actual end-expiratory pressure in the lung.

Due to the dynamics of lung mechanics (resistance, compliance and closing volume) and the ventilation setting parameters, the intrinsic PEEP differs from the PEEP in the upper airways.

The Intrinsic PEEP measuring procedure also measures the trapped volume resulting from the different PEEP values, i.e. the amount of air trapped in the lungs and not taking part in the gas exchange process.

This special procedure can be performed in all ventilation modes.

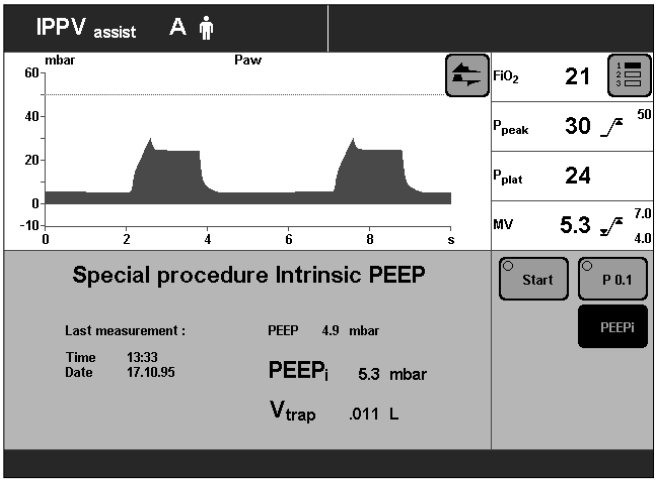
Activity by the patient during this procedure can distort the measured values.

Select the Intrinsic PEEP special procedure:

- Press the »**Special proc.**« key and touch the »**PEEPi**« screen key.

Display (example):

The measured values and the time of the last measurement are displayed on the screen.



To start the Intrinsic PEEP measurement:

- Touch the »**Start**« screen key.

The Intrinsic PEEP measurement runs automatically.

At the end of the procedure, the new measured values PEEPi and V_{trap} are displayed.

The displayed curve is automatically stopped.

To evaluate the measured value at a particular time:

- Position the ▼-cursor on the time by turning the dial knob. The associated measured value is displayed above the curve.

---

* Please refer to page 170 for a detailed description of Intrinsic PEEP.

P 0.1 occlusion pressure measuring procedure

The occlusion pressure P 0.1 characterises the negative pressure during a short occlusion (0.1 s) at the start of spontaneous inspiration.

It is a direct measure of the neuro-muscular breathing drive.

For patients with healthy lungs and regular breathing, a pressure drop of –3 to –4 mbar = P 0.1.

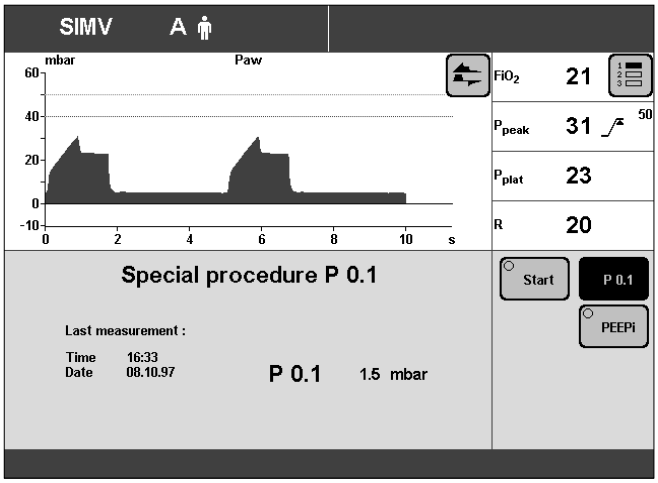
High values represent a high breathing drive which can only be maintained for a short time.
Values greater than –6 mbar for a patient with chronic obstructive pulmonary disease indicate impending exhaustion (respiratory muscle fatigue).

This special measuring procedure can be used in all ventilation modes in order to check the breathing drive of a spontaneously breathing patient or to assess the amount of spontaneous breathing during controlled ventilation.

To select the P 0.1 occlusion pressure measuring procedure:

- Press the »**Special proc.**« key and touch screen key »**P 0.1**«.

Display (example):
The measured value and time of the last measurement is displayed on the screen.



To start the P 0.1 occlusion pressure measuring procedure:

- Touch the »**Start**« screen key.

The P 0.1 special procedure runs automatically.

At the end of the procedure, the displayed curve is automatically stopped.

To evaluate the measured value at a particular time:

- Position the▼-cursor on the time by turning the dialknob.
- The relevant measured value is displayed above the curve. Evita 4 displays the P 0.1 value as a negative pressure without the minus sign.

Switching off the monitor functions

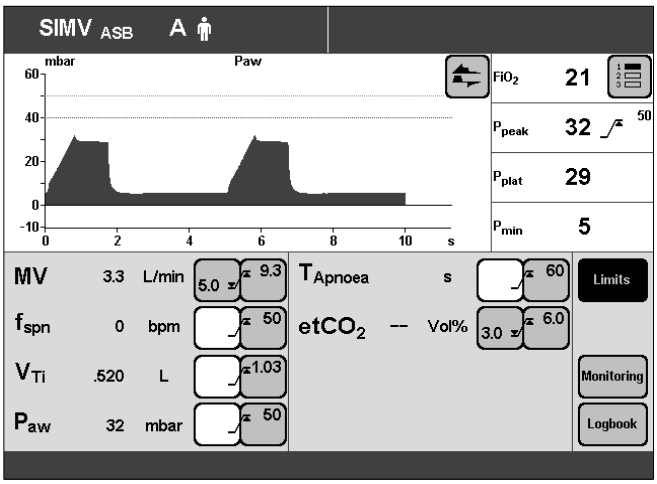
e.g. if a spent sensor cannot be replaced.

Immediately make sure there is an adequate external monitor backup!

Example: Switching off Flow Monitoring.

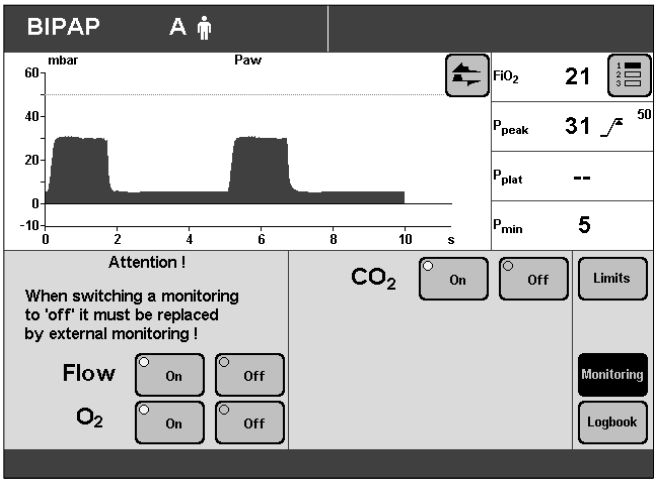
- Press **»Alarm limits«** key.

Display (example):



- Touch »**Monitoring**« screen key.

Display (example):



For the example of switching off flow monitoring:

- Touch the »**Flow Off**« screen key.
  The key changes colour from green to yellow

To confirm that you wish to switch off Flow Monitoring:

- Press rotary knob. Flow Monitoring is switched off, and the corresponding measured values disappear. The alarm function is switched off.

After replacing the sensor:

- Switch the monitor function back on.

Selecting Standby Mode

No ventilation takes place in standby mode!

Uses of Standby:

— to perform the device check,
— to maintain Evita 4 ready for operation while the patient is absent,
— to change patient mode.

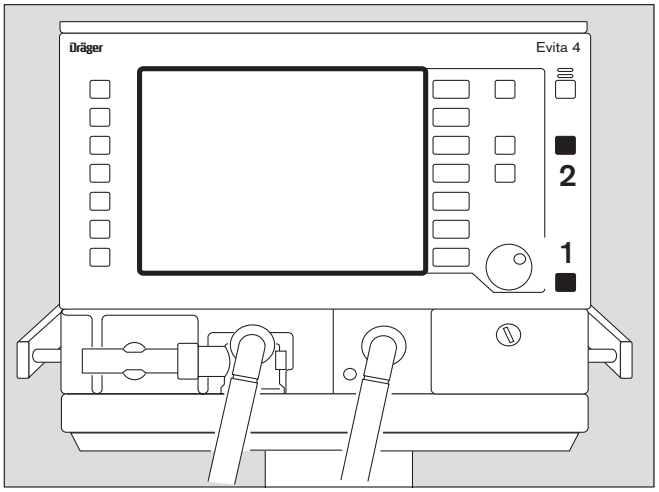
1 Hold down the »⏻« key for about 3 seconds.

An alarm tone sounds after switching on standby.

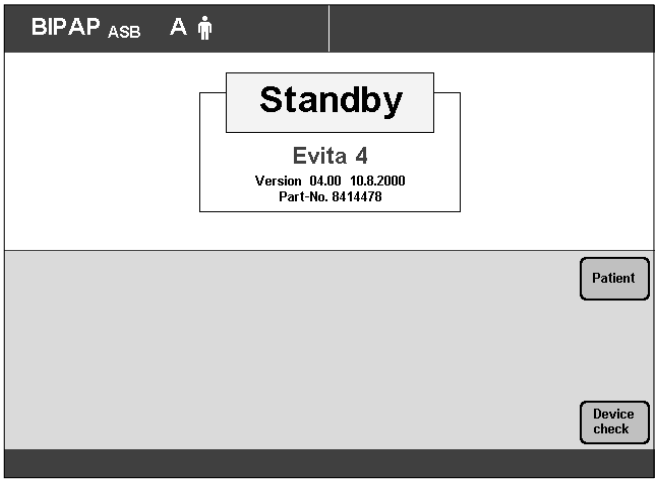
To switch off the standby alarm tone:

2 Press »**Alarm Reset**« key.

The standby alarm tone cannot be cancelled with the»🔕« key.



Display (example):



If the patient mode or ideal body weight should be changed during Standby, Evita 4 will determine new start values for ventilation, see page 47.

Terminating standby mode

— to continue ventilation.

1 Press »⏻« key.
The LED goes out, and the current ventilation parameters are again effective.

Calibrating

The last calibration/zeroing values remain stored until the next calibration/zero calibration, even when the machine is switched off.

Calibration of the pressure sensors for measuring the airway pressure is automatic.

The flow sensor and O_2 sensor are automatically calibrated once per day.

Manual calibration of the flow sensor can be performed at any time, even during ventilation.

Manual calibration of the O_2 sensor can be performed at any time, even during ventilation. The applied O_2 concentration is not affected by calibration.

The calibration of the CO_2 sensor can be checked during ventilation.

Calibrating the O_2 sensor

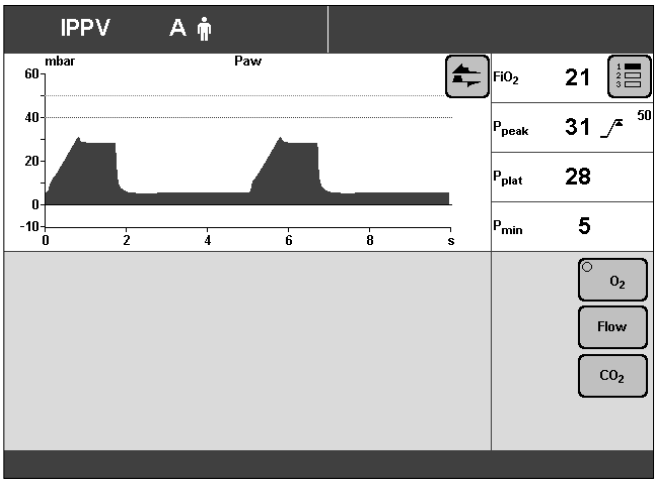
— Before operation, during the device check.
— After replacing the O_2 sensor (wait for the 15-minute warm-up time of the O_2 sensor).
— If the measured value and set value deviate from each other by more than 2 Vol.%.

The O_2 sensor can be calibrated during ventilation.

Start calibration:

- Press »**Calibration**« key.

Display (example):



- Touch the »**O_2**« screen key.
  The LED in the screen key changes colour to yellow.

Message in the help line at the bottom of the screen:
»**O_2-calibration**«

After calibration is complete, the yellow LED in the screen key goes out.

Calibrating the Flow Sensor

– Before operation, during the device check.
– After replacing the flow sensor.

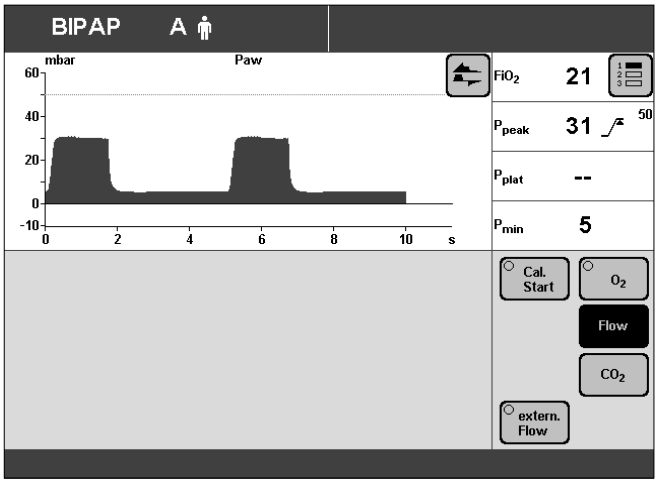
The flow sensor is automatically cleaned before each calibration.

After using the medicament nebuliser, the flow sensor is automatically cleaned and calibrated.

To start calibration:

- Avoid flammable gases (e.g. alcohol vapours after disinfection).
- Flow sensors which have been disinfected in ethanol must be left to dry in air for at least 30 minutes.
- Press the »**Calibration**« key.
- Touch the »**Flow**« screen key.
- Touch the »**Start Cal.**« screen key.
  The LED in the screen key turns yellow.

Display:



Evita 4 uses the next inspiration phase for the calibration. Short inspiration times are prolonged to about 1 second.

Message in the help line at the bottom of the screen:

»**Flow calibration**«

The yellow LED in the screen key goes out when calibration is complete.

External flow source

When a constant external flow of up to 12 L/min is supplied (e.g. during medicament nebulisation with separate gas supply and not from Evita 4 or during separate tracheal gas insufflation), this flow can be calculated by Evita 4 and the tolerance increased for the monitoring parameters of the flow sensor in order to avoid generation of the alarms »Flow measurement inop.« and »Neo. flow meas. inop.« (NeoFlow option) during these applications.
The originally measured expiratory volume is maintained: During an expiratory flow, Evita 4 measures a correspondingly higher value for V_{Te} and MV.

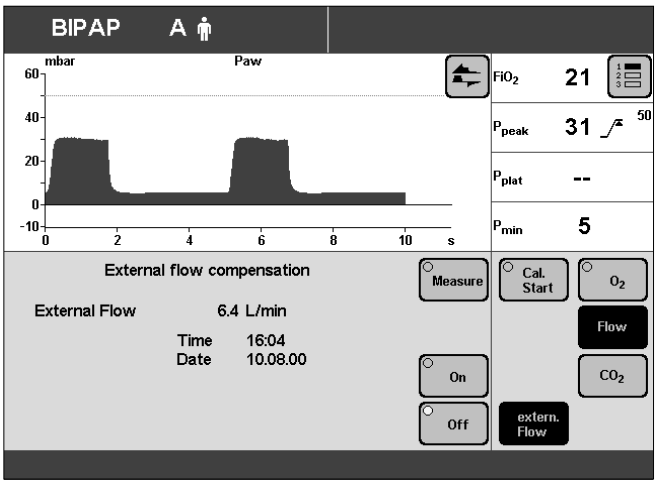
To avoid alarms:

- Adjust upper limit for MV.

For initial calculation of the external flow:

- Start external flow.
- Press the »**Calibration**« key.
- Touch the »**Flow**« screen key.
- Touch the »**extern. Flow**« screen key.
- Touch the »**Measure**« screen key, confirm = press rotary knob.
- Yellow LED in »**Measure**« key lights up.

Evita 4 calculates the external flow.
The following message is displayed on Evita 4 during this time:
»**External flow is being measured**«



When the external flow has been calculated, it is displayed by Evita 4 with the time and date.

The following prompt is also displayed on Evita 4:
»**Confirm value with** ⊙ «

- Confirm = press rotary knob.

Calculation of the external flow is interrupted by Evita 4 if it is greater than 12 L/min or the flow measurement function is defective.

Once the external flow has been calculated successfully, it is taken into account automatically:
The yellow LED in the »**On**« key lights up.

The advisory message
»**External flow!**«
is displayed as long as the external flow is taken into account by Evita 4.

If an external flow is not applied:

- Switch off: touch the »**Off**« key, confirm = press rotary knob.

Once the value of the external flow has been calculated by Evita 4, its inclusion can be reactivated at any time:

- Touch the »**On**« screen key, confirm = press rotary knob.

If the external flow changes:

- Press the »**Measure**« key and the external flow is redetermined by Evita 4.

Zero/check/calibrate CO_2-sensor (if Capno Plus option is installed)

The CO_2 sensor is works-calibrated and can be used without further calibration on any Evita 4 unit.

Before measurement and when transferring the sensor to another Evita 4 unit, the zero indication should be checked with the sensor on a clean park bracket and zero calibration performed if necessary.

CO_2 zero calibration is performed as part of the device check. However, zero calibration can also be performed manually at any time.

There must not be any increased CO_2 concentration between the windows of the park bracket when checking the zero indication or performing zero calibration. In other words only the background concentration of approx. 0.4 Torr or 0.05 % by volume normally present in rooms may be present.
For this reason:

- Do not breathe onto the park bracket when checking the zero indication or performing zero calibration.

The calibration (sensitivity) of the sensor can be roughly checked with the test filter attached to the sensor lead; it can be checked more precisely with calibration gas.

Calibration must be checked with calibration gas:

– if the result of testing with the test filter is unsatisfactory,
– but at least every six months in conjunction with the device inspection.

Recalibration of the sensor is only required if the specified calibration values are not met when testing calibration with the calibration gas.

Zero calibration on the park bracket, testing of the calibration with test filter or calibration gas and recalibration of the sensor can all be performed during ventilation.

Error messages relating to CO_2 measurement can be found in the chapter "Fault – Cause – Remedy" on page 120.

Notes concerning the alarm **»CO_2-Sensor? !!!«**:

If the alarm **»CO_2-Sensor? !!!«** is displayed although the sensor is connected and the cuvette is fitted, the windows on the park bracket or sensor may be soiled:

- Perform zero calibration with a cleaned park bracket and cleaned sensor.

If the dirt on the park bracket cannot be removed:

- Perform zero calibration with a clean cuvette – particularly with clean windows – in room air, taking care not to breathe in the direction of the cuvette.

Notes concerning the alarm **»CO_2 zero calibration? !!!«**:

If the alarm **»CO_2 zero calibration? !!!«** is displayed during measurement or if incorrect measured values are suspected, e.g. etCO_2 values too low or inspiratory values too high:

- check whether the cuvette windows are soiled: clean the cuvette if necessary or use a different, clean cuvette.

Despite design measures to minimize the zero shift, major soiling of the cuvette windows, e.g. with deposits due to medicament nebulization, may result in a zero shift with incorrect CO_2 measured values long before the alarm **»Clean CO_2 cuvette !!!«** appears due to excessively low intensity of the measuring light.

If the alarm »**CO_2 zero calibration? !!!**« does not subsequently disappear or if the measured values remain suspect:

- perform zero calibration on the park bracket.

If the measured values are still suspect:

- perform zero calibration on a clean cuvette in room air, taking care not to breathe in the direction of the cuvette, and continue measurement with the cuvette used for zero calibration.

Notes concerning the message »**CO_2-cal./-zero/-check impossible«** in the bottom line of the screen:

If the message »**CO_2-cal./-zero/-check impossible«** appears after pressing the screen key **»Zero«, »Filter check«, »Gas check« or »Cal.«** either:

— the CO_2 sensor has not been plugged in,

- connect CO_2 sensor

or

— the CO_2 sensor is defective,

- replace CO_2 sensor

or

— the CO_2 electronics in the unit is defective,

- call DrägerService.

CO_2 zero calibration

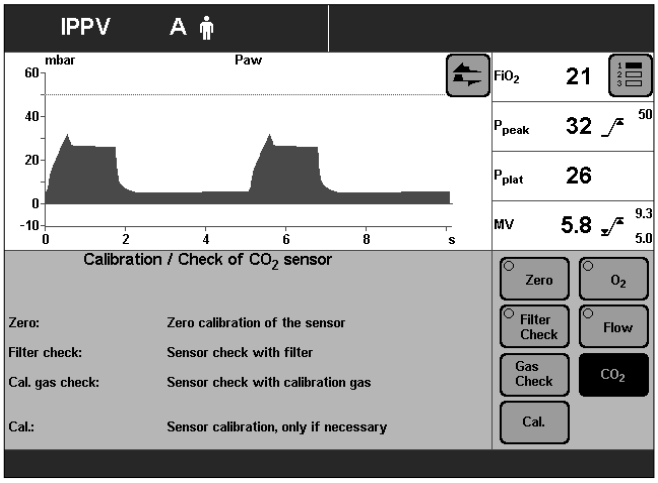
Only possible with a clean park bracket and clean sensor!

- Switch on Evita 4 and wait at least 3 minutes for the CO_2 sensor to complete its warm-up phase.

After at least three minutes, the measured values will be inside the specified tolerance range.

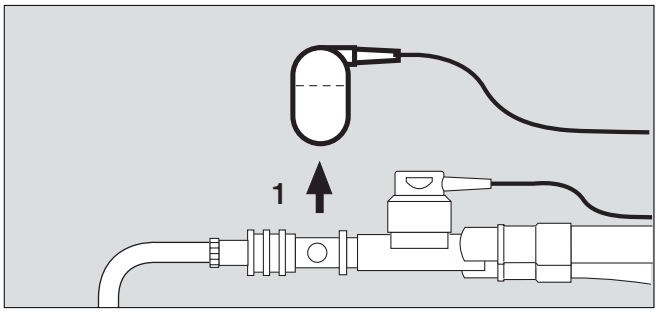
- Press the **»Calibration«** key.

Display (example):



- Touch the **»CO_2«** screen key.
- Touch the **»Zero«** screen key.
  Message:
  »Park CO_2 sensor
  Confirm with ⊙ «

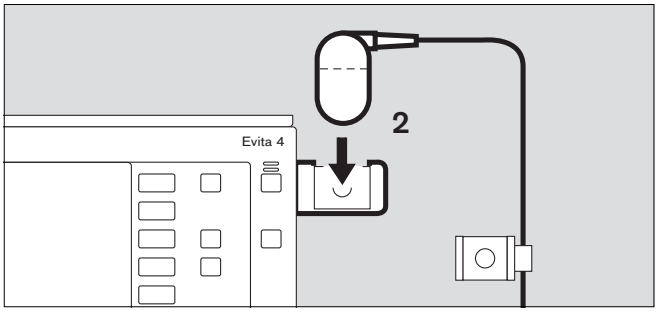
1 Remove CO_2 sensor from the cuvette,



2 place the sensor on its park bracket, taking care not to breathe onto the park bracket.

- Confirm with rotary knob:
  CO_2 zero calibration will now be performed.

Display:
»CO_2 zero calibration«



After about 5 seconds, the device confirms with the message:
»CO_2 zero ok«

- Fit the sensor back on the cuvette.

A failed zero calibration is indicated by the device with the message:
»CO_2-sensor not zeroed«

- Repeat CO_2 zero calibration.

If zero calibration is still impossible:

- Check whether the park bracket or sensor is soiled and clean it if necessary.

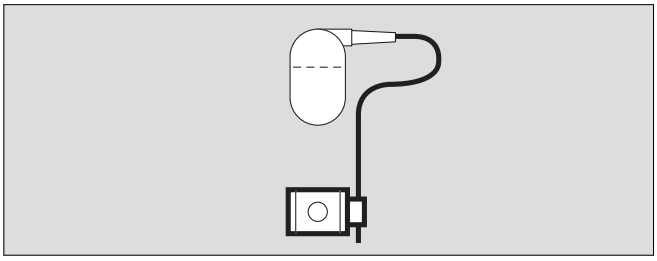
The sensor may also be defective:

- Replace sensor and repeat zero calibration.

Checking CO_2 calibration with test filter

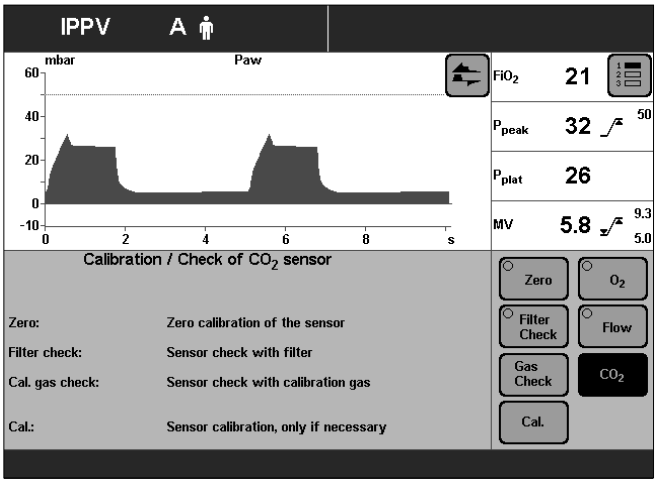
Use the test filter on the cable of the CO_2 sensor.

- Switch on Evita 4, and wait for about 3 minutes for the CO_2 sensor to complete its warm-up phase.



- Press the »**Calibration**« key.

Display (example):



- Touch the »**CO_2**« screen key.

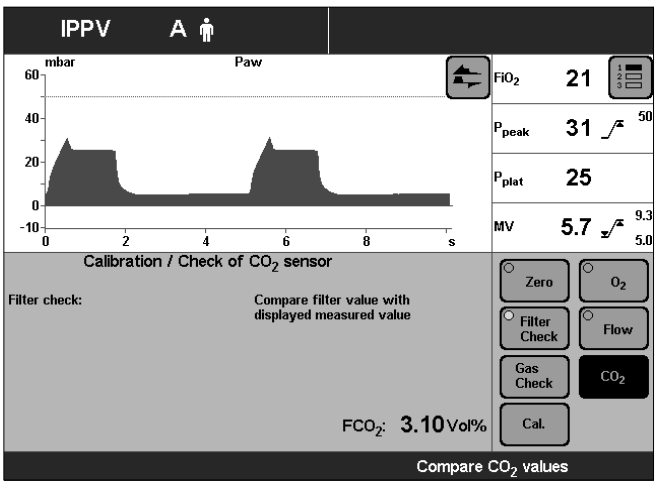
Display (example):

- Carry out CO_2 zero calibration, see page 95.

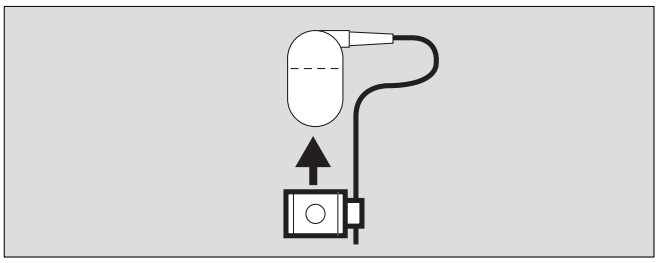
After CO_2 zero calibration:

- Touch the »**Filter Check**« screen key.

Display (example):

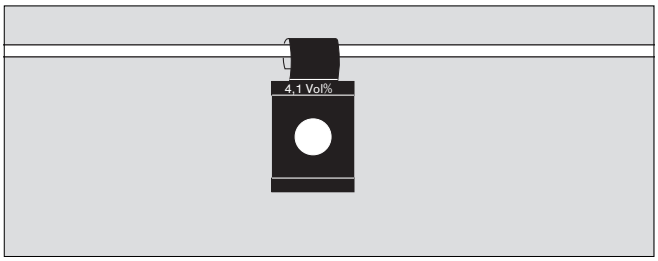


- Place the test filter in the CO_2 sensor.



The screen displays the test value of the CO_2 concentration FCO_2.
This value must agree to within ±0.3 Vol.% with the specification on the test filter.
Example: 4.1 Vol.% on the filter:
permitted value range: 3.8 to 4.4 Vol.%

If the test value is outside the permitted tolerance, the test gas must be checked or calibrated.



- Push the CO_2 sensor back on to the cuvette.

Checking CO_2 calibration with calibration gas

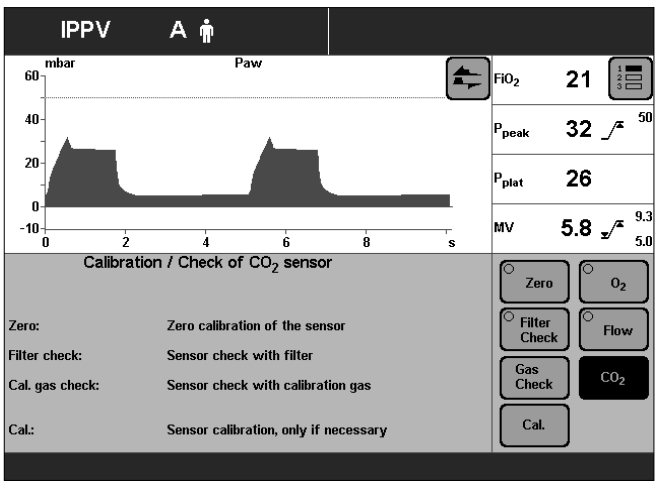
– If the specified calibration value was not met when testing with the test filter
– at least once every six months.

Calibration gas containing N_2O must not be used!

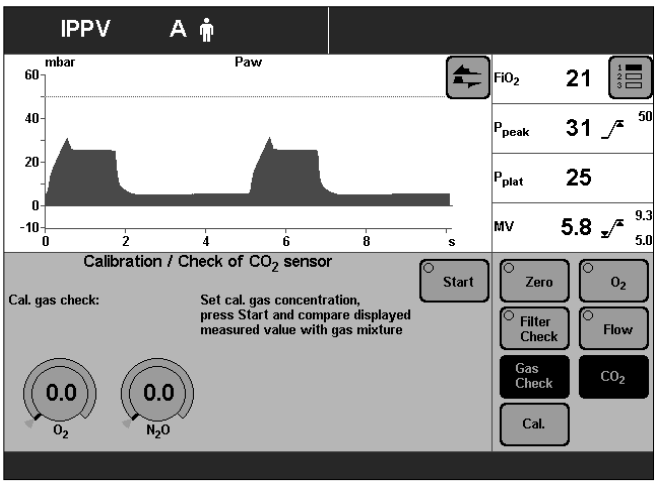
- Switch on Evita 4 and wait at least 3 minutes for the CO_2 sensor to complete its warm-up phase.
- Press the »**Calibration**« key.

Display (example):

- Touch the »**CO_2**« screen key.



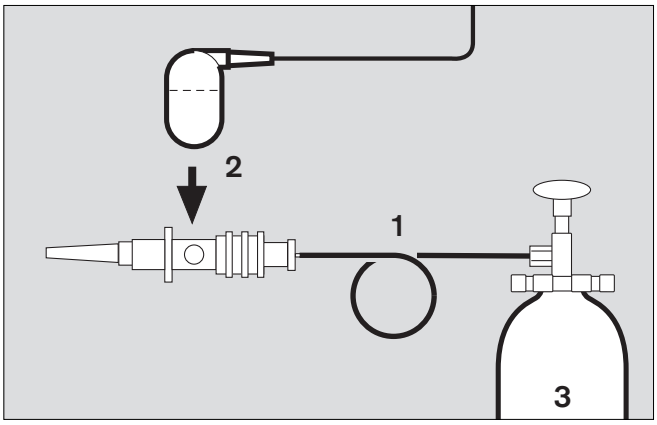
Display (example):



- Carry out CO_2 zero calibration, see page 95.

After completing CO_2 zero calibration:

- Touch the »**Gas Check**« screen key.



- Connect the calibration gas supply.
  Use the cuvette from the calibration set!

1 Connect the calibration gas cylinder and cuvette of the calibration set to the hose.

2 Remove the CO_2 sensor from its park bracket and fit it to the calibration set cuvette.

3 Read the CO_2 and O_2 concentration (if applicable) of the calibration gas from the calibration gas cylinder.

- Enter these concentrations with the screen setting knob:
  Touch the screen knob,
  Enter the concentration = turn knob,
  confirm = press knob.

If the calibration gas comprises CO_2, O_2 and N_2:

- Enter the O_2 concentration read from the cylinder and set the N_2O concentration to **»0«**.

If the calibration gas comprises CO_2 and N_2 only:

- Set the O_2 and N_2O concentration to **»0«**.

- Touch the »**Start**« screen key.

The CO_2-concentration **FCO_2** is displayed on-screen.

After approx. 10 seconds, the FCO_2 value should match to within ±0.2 Vol.% the CO_2 content of the calibration gas read from the calibration gas cylinder.

If the calibration value is outside the permitted tolerance, the CO_2 sensor must be recalibrated with test gas.

- Push CO_2 sensor back on the cuvette.

Calibrating the CO_2 sensor

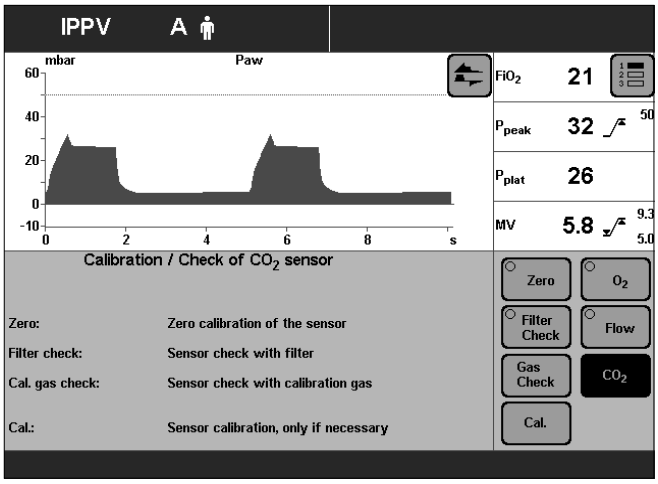
– If the check values are not met on checking calibration with filter or calibration gas.

Calibration gas containing N_2O must not be used!

- Switch on Evita 4 and wait at least 3 minutes for the CO_2 sensor to complete its warm-up phase.
- Press the »**Calibration**« key.

Display (example):

- Touch »**CO_2**« screen key.

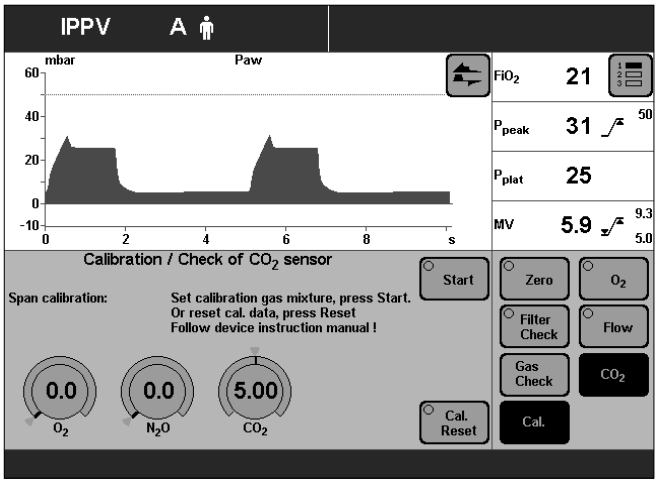


Display (example)

- Carry out CO_2 zero calibration, page 95.

After the CO_2 zero calibration:

- Touch the »**Cal.**« screen key.



- Connect the calibration gas supply.
  Use the cuvette from the calibration set!

1 Connect the calibration gas cylinder and the cuvette of the calibration set to the hose.

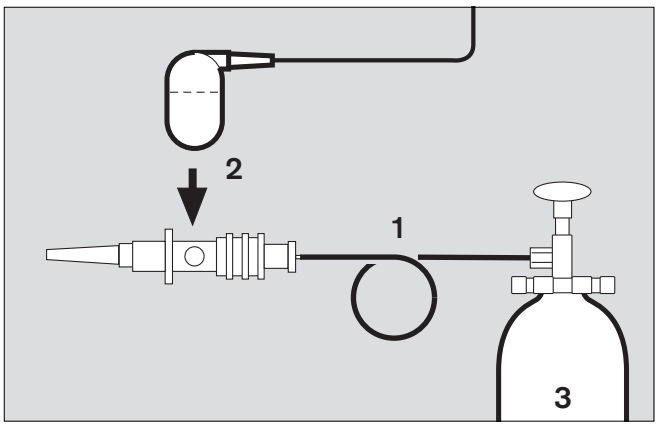
2 Remove the CO_2 sensor from its park bracket and fit it to the cuvette of the calibration set.

3 Read the CO_2 and O_2 concentrations (Vol.%) of the calibration gas from the test cylinder.

- Enter these concentrations with the screen setting knob:
  touch the screen knob,
  enter the concentration = turn knob,
  confirm = press knob.
- Set the N_2O concentration to »**0**«.

When using the standard calibration gas (5 Vol.% CO_2 and 95 Vol.% N_2):

- Set the O_2 and N_2O concentration to »**0**«,
  and the CO_2 concentration to »**5**« .
- Touch the »**Start**« screen key.



During calibration, the following message is displayed on the screen:
»**CO_2 calibration. Please wait**«

Evita 4 carries out calibration and confirms with the message:
»**CO_2 calibration ok**«

Failed calibration is indicated by the device with the message:
»**CO_2 calibration interrupted**«
or
»**CO_2 calibration not ok**«

- Repeat the calibration of the CO_2 sensor.

If calibration still proves impossible, the CO_2 concentration value entered may not be the same as that in the cylinder:

- Check CO_2 value entered,

or

calibration gas cylinder is empty:

- Use a new calibration gas cylinder

or

sensor is defective:

- Replace sensor.

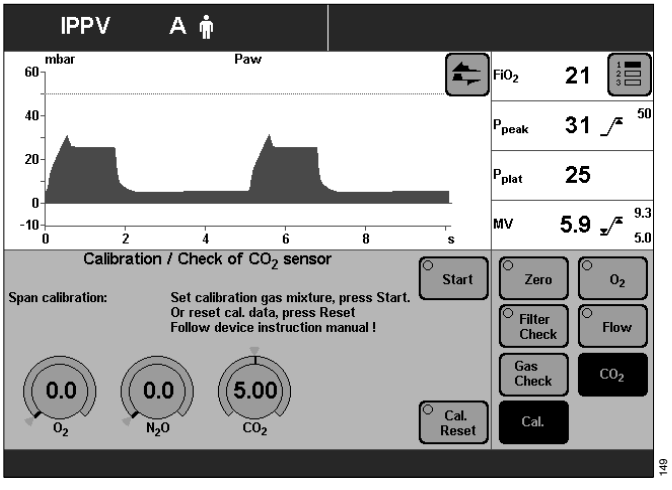
Resetting CO_2 calibration

– If calibration with calibration gas was unsuccessful, the factory-set calibration value can initially be used.

- Press »**Calibration**« key.
- Touch »**CO_2**« screen key.
- On the CO_2 calibration side, touch the »**Cal.**« screen key and then touch the »**Cal. Reset**« screen key.

After about 5 seconds, resetting is complete, and the factory-set calibration value is active.

- Test sensor with calibration gas!



Configuration

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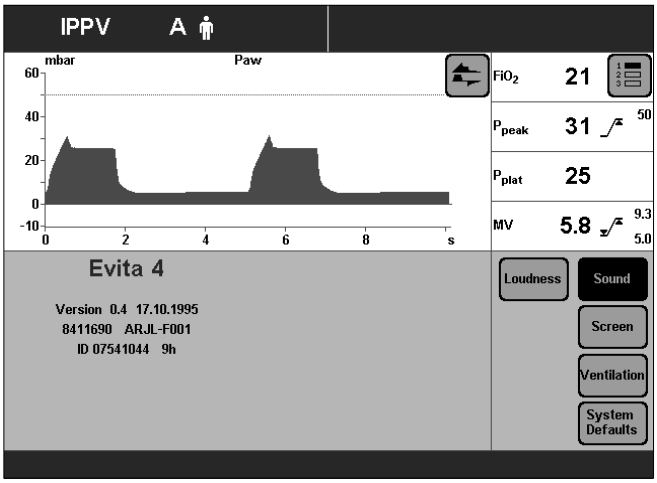
Configuration

Sound

Adjusting the volume of the alarm tone

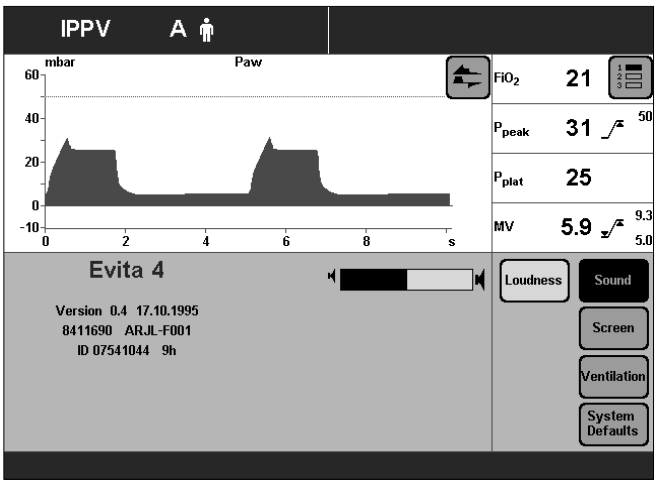
- Press the »**Configuration**« key.
- Touch the »**Sound**« screen key.

Display (example):



- Touch the **»Loudness«** screen key.

Display (example):



- Adjust volume = turn rotary knob.
  The band displayed on the screen shows the current setting between minimum and maximum.
- Confirm setting = press rotary knob.
- After confirmation, the alarm tone is sounded to test the volume.

Adjust volume of the acoustic alarm so that an alarm cannot be overheard!

Screen

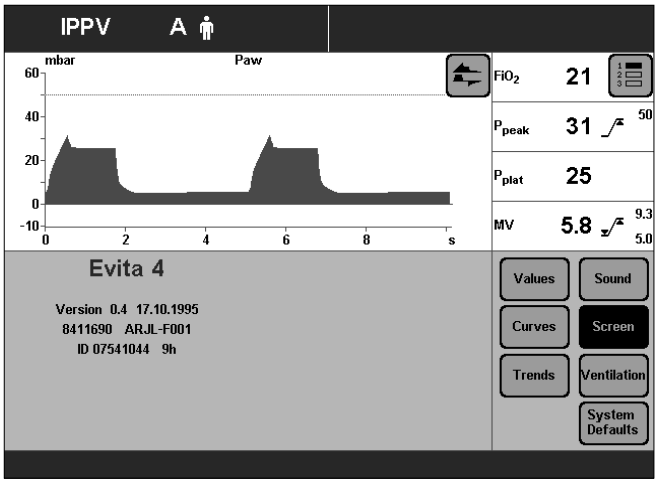
Selecting displayed measured values

Evita 4 displays a group of 4 measured values in the right-hand field of each screen page.

A second or third group can be displayed by touching the »⁞≡« key. These groups can be put together in the configuration page.

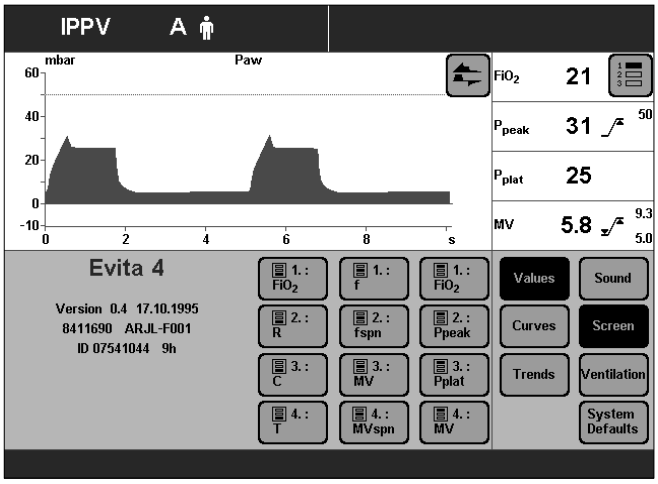
- Press the »**Configuration**« key.
- Touch the »**Screen**« screen key.

Display (example):



- Touch the **»Values«** screen key.

Display (example):

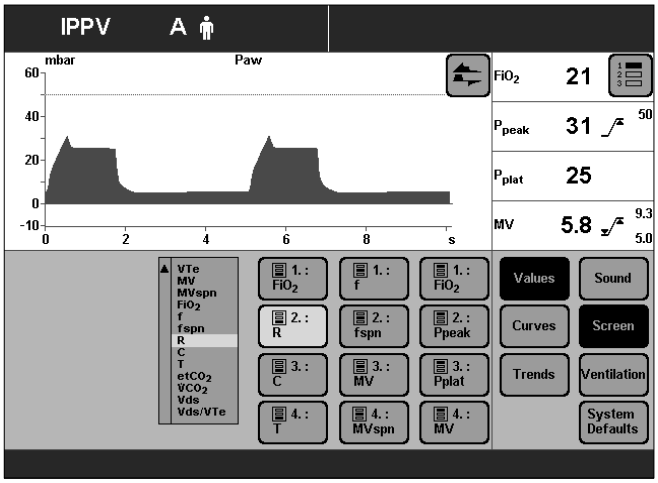


To replace one displayed measured value by another:

- Touch the corresponding screen key.

The selection list with all available measured values is displayed next to the screen keys.

- Select the other measured value, e.g. »**R**« (Resistance) = turn rotary knob.
- Confirm selection = press rotary knob.

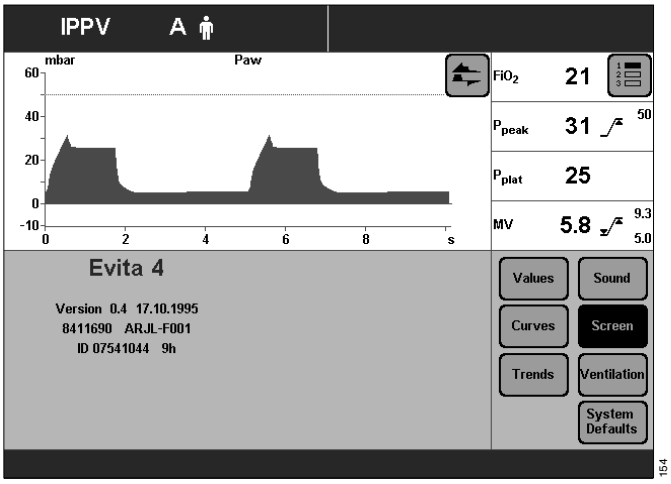


Selecting displayed curves

This function serves to combine the two displayed curves on the standard page.

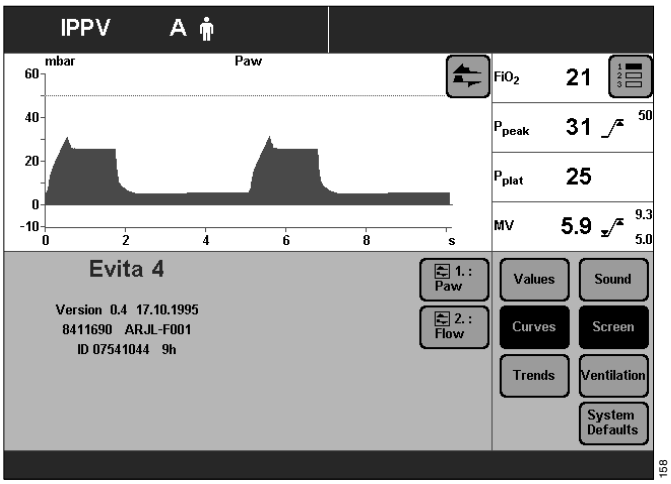
- Press the »**Configuration**« key.
- Touch the »**Screen**« screen key.

Display (example):



- Touch the »**Curves**« screen key.

Display (example):



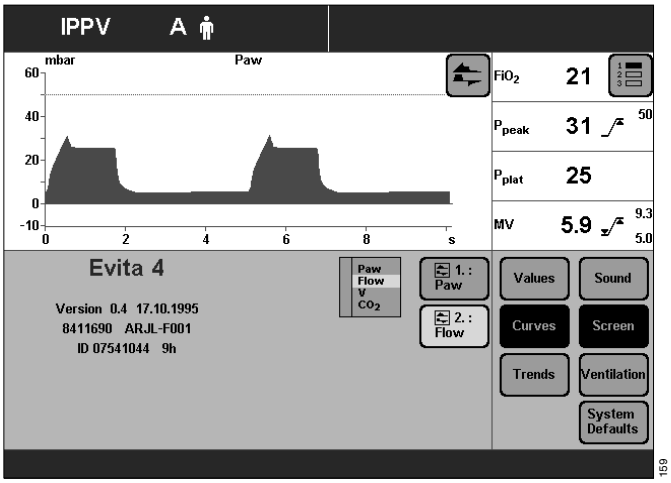
Replace one displayed curve by another:

- Touch the corresponding screen key.

Display (example »**Flow**«):

The selection list containing all available curves is displayed next to the screen keys.

- Select the other curve = turn rotary knob.
- Confirm selection = press rotary knob.

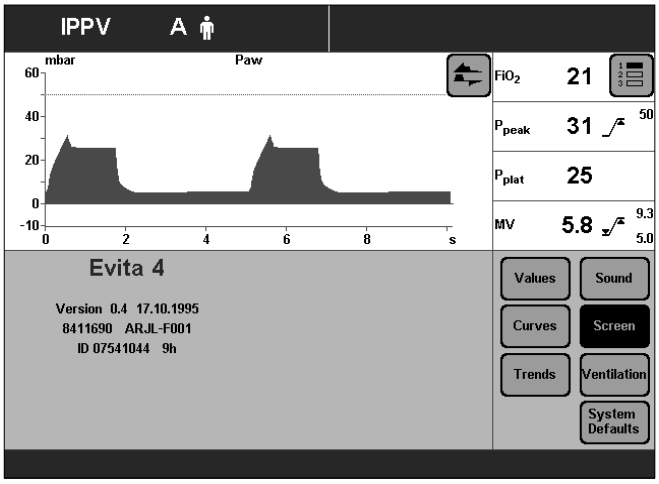


Selecting displayed trends

This function serves to select 8 measured values that are stored by Evita 4 as a trend.

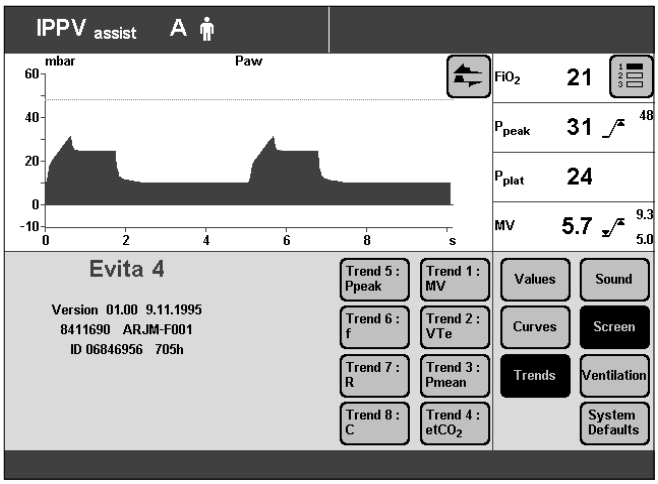
- Press the »**Configuration**« key.
- Touch the »**Screen**« key

Display (example):



- Touch the »**Trends**« screen key.

Display (example):



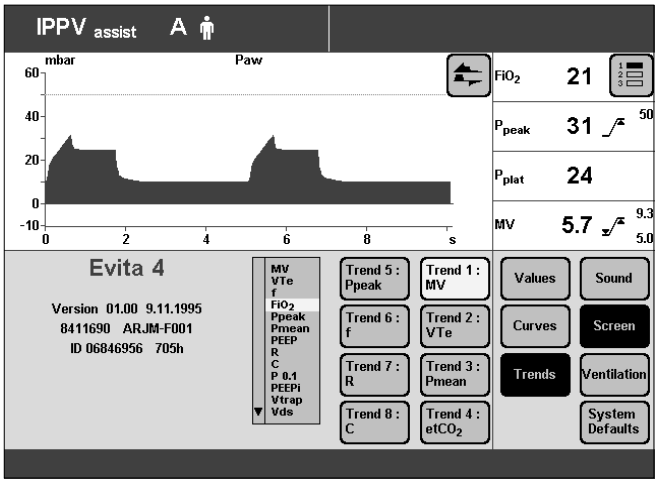
To replace one displayed trend by another:

- Touch the relevant screen key.

Display (example: »**Trend 1:MV**«):

The selection list containing all available measured values is displayed next to the screen keys.

- Select the other measured value, e.g. »**FiO2**« for the trend display = turn rotary knob.
- Confirm selection = press rotary knob.



Ventilation

This page is used:

– To select the available ventilation modes for the »**Settings**« screen page and to select the initial ventilation mode.
– To select the patient mode active on switching on the device.
– To set the ventilation parameters and alarm limits active on switching on the device.

The configuration menu for the ventilation criteria can only be opened after entering access code **3032**.
This precaution is intended to prevent unauthorised modifications to the ventilation criteria.

Selecting ventilation modes

To select the ventilation modes on the »**Settings**« screen page.

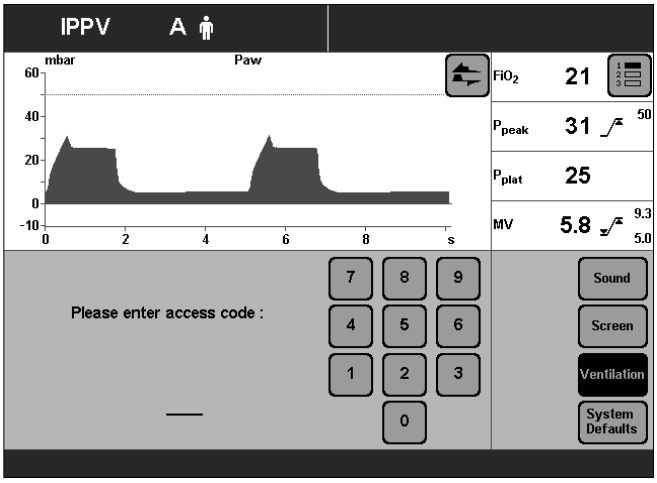
- Press the »**Configuration**« key.

Display:

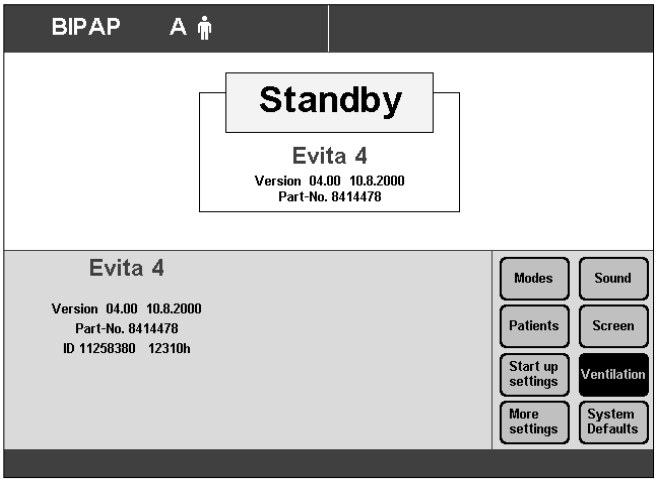
- Touch the »**Ventilation**« screen key.

Enter access code **3032**:

- Touch the corresponding screen keys.

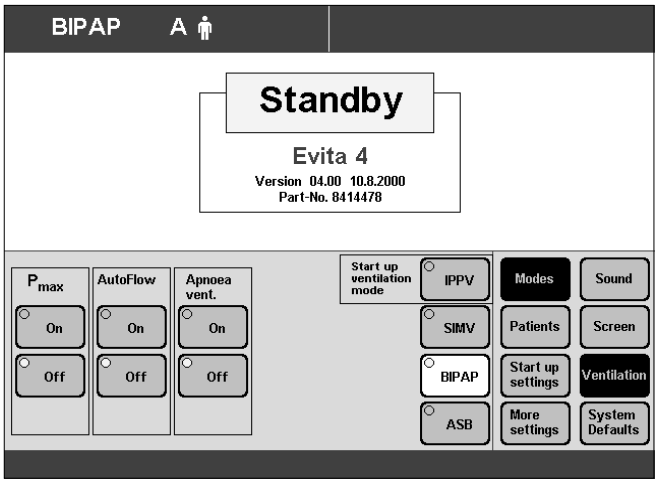


Display (example):



- Touch the **»Modes«** screen key.

Display (example):
The ventilation mode displayed in the top screen key is the factory-set start-up ventilation mode (in this example: »**IPPV**«). Evita 4 starts in this ventilation mode immediately after being switched on.



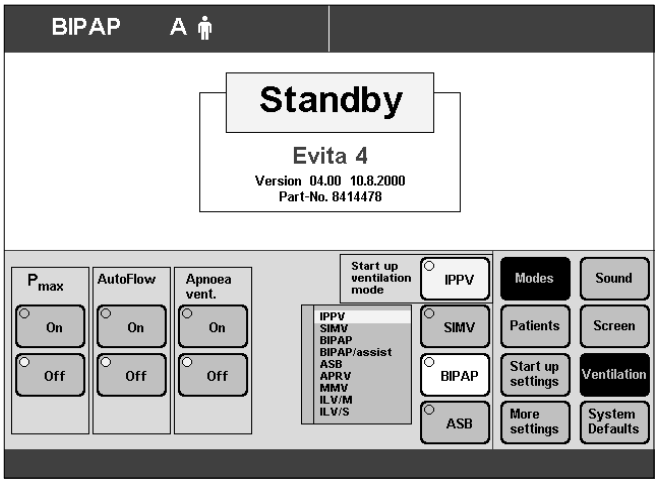
To replace one displayed mode by another:

- Press the corresponding screen key.

Display (example »**IPPV**«):

The selection list with all available ventilation modes is displayed next to the screen keys.

- Select another mode = turn rotary knob.
- Confirm selection = press rotary knob.

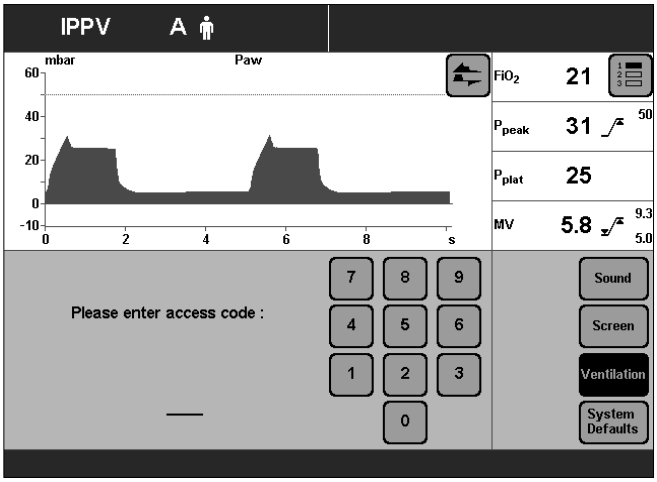


Selecting Pmax pressure limit

– This function serves to limit the ventilation pressure in ventilation modes IPPV, SIMV, MMV.

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

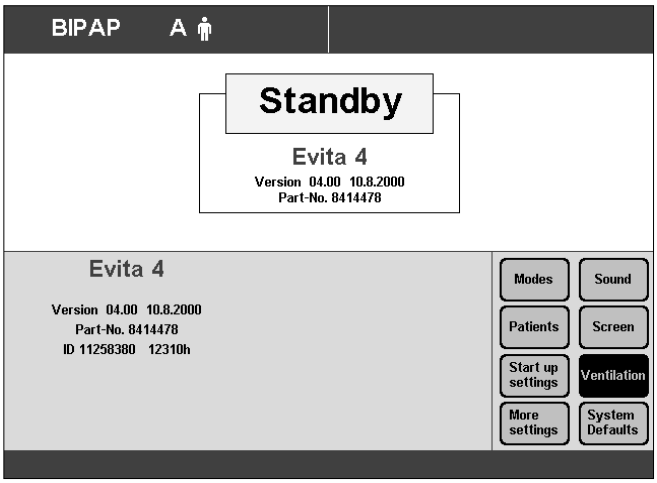
Display (example):



Enter access code **3032**:

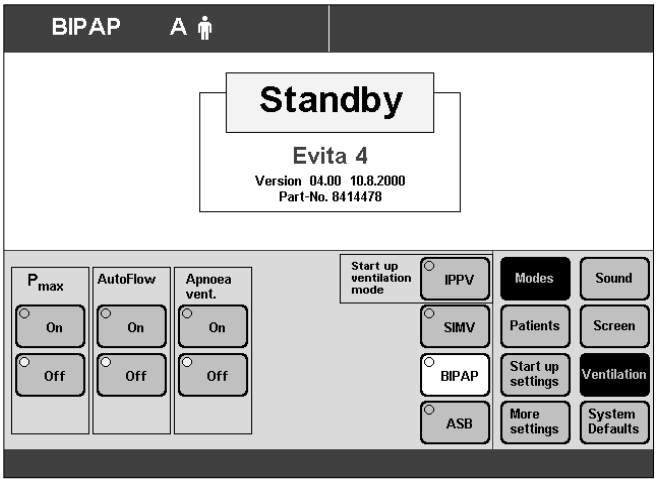
- Touch the corresponding screen keys.

Display (example):



- Touch the »**Modes**« screen key.

Display (example):



- Touch the screen key Pmax »**On**«.
- Confirm selection = press rotary knob.
  Pmax pressure limiting is selected.

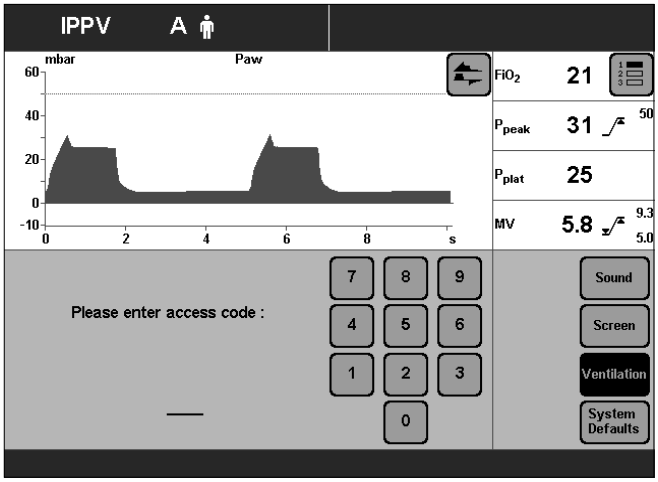
The »**Pmax**« screen knob is displayed on the **»Settings«** screen page.

Selecting AutoFlow® as start-up ventilation mode

– For automatically setting the AutoFlow® ventilation option after switching on the apparatus. The user can define whether the additional AutoFlow® option is active or not after switching on

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

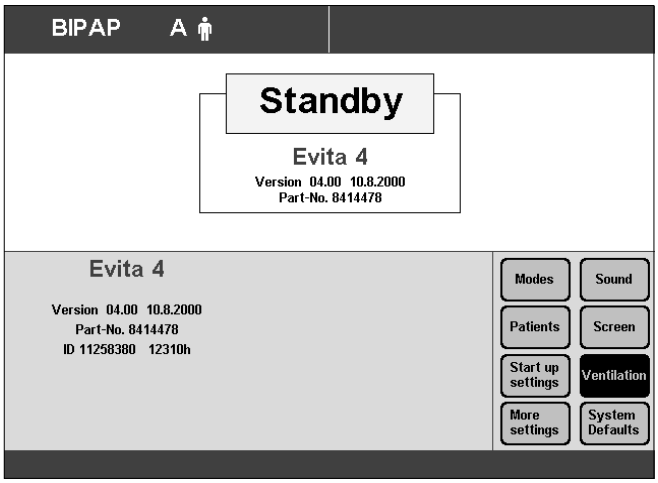
Display (example):



Enter access code **3032**:

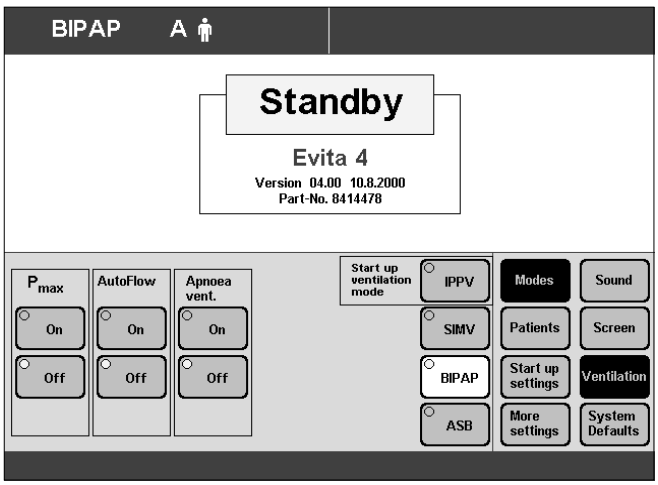
- Touch the corresponding screen keys.

Display (example):



- Touch the »**Modes**« screen key.

Display (example):



To activate AutoFlow® in the start-up ventilation mode:

- Touch »**Modes**« screen key.
- Touch screen key AutoFlow »**On**«.
- Confirm selection = press rotary knob.

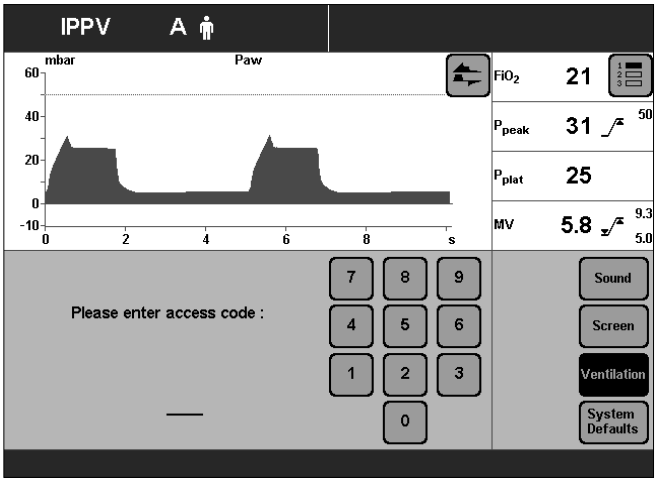
The AutoFlow® option will be automatically activated the next time the apparatus is switched on.

Apnoea ventilation On/Off

To determine whether apnoea ventilation is automatically ready for use when starting.

- Press the »**Configuration**« key.
- Touch the »**Ventilation**« screen key.

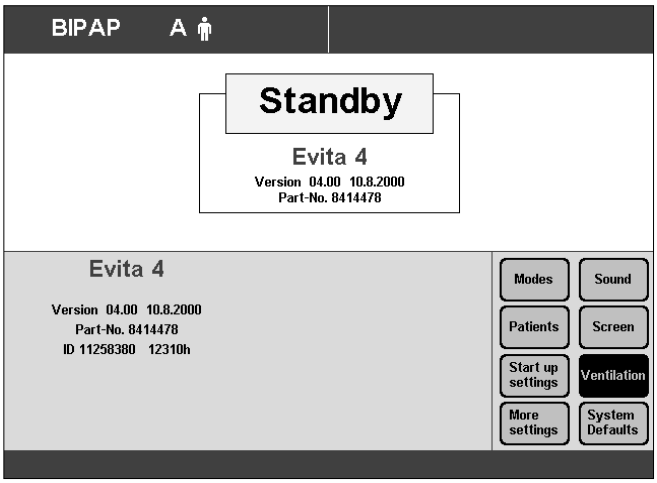
Display (example):



Enter access code **3032**:

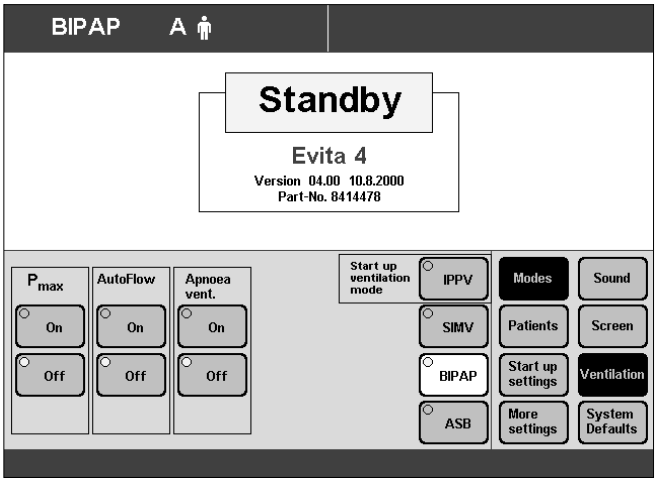
- Touch the corresponding screen keys.

Display (example)



- Touch the »**Modes**« screen key.

Display (example)



To prepare apnoea ventilation:

- Touch the Apnoea vent. **»On«** screen key.
- Confirm = press rotary knob. The LED in the key lights up.

Apnoea ventilation is automatically ready for use when the device is switched on again.

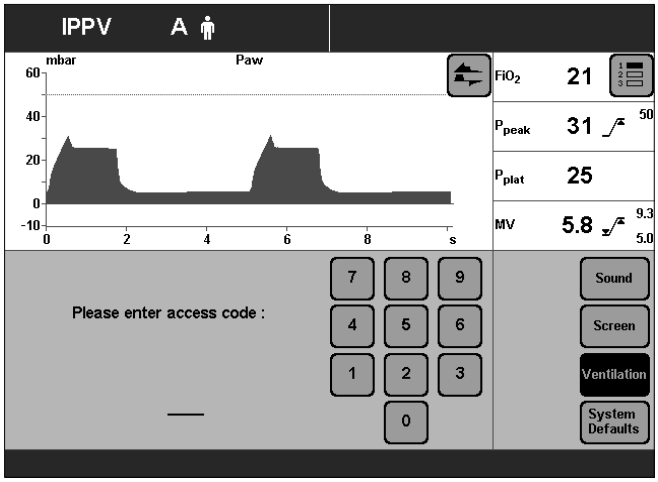
Selecting patient mode

Adults/Paediatrics

– To select the patient mode you would like automatically activated on switching on, or
– To select whether the device should first ask for the patient mode.

- Press the »**Configuration**« key.
- Touch the »**Ventilation**« screen key.

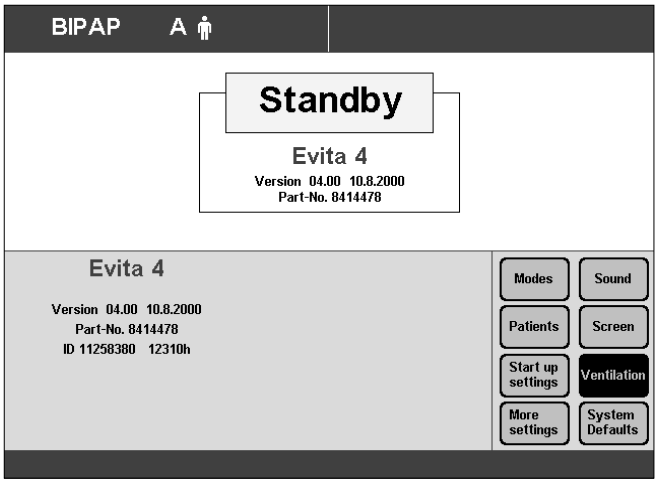
Display (example):



Enter access code **3032**:

- Touch the corresponding screen keys.

Display (example):

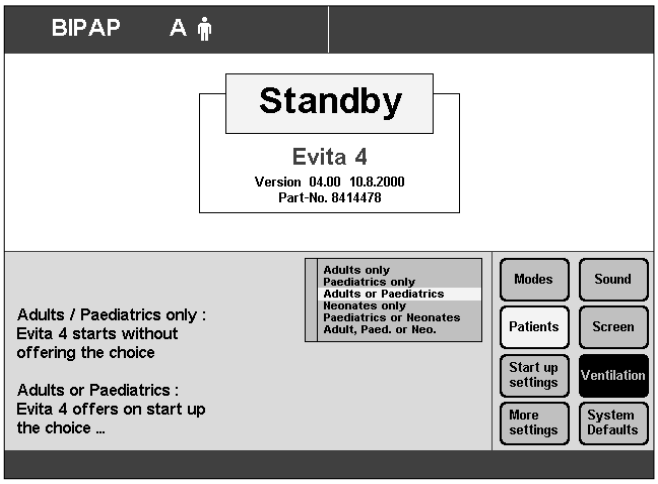


- Touch the »**Patients**« screen key.

Display (example):

The selection list with the two patient modes appears next to the screen keys.

- Select the corresponding patient mode = turn rotary knob.
- Confirm the patient mode = press rotary knob.



Start-up values for ventilation parameters and alarm limits

– To set the ventilation parameters and alarm limits you would like to be activated on switching on the device.

Setting start-up values for ventilation parameters »VT, f«

The start-up values for the tidal volume »VT« and frequency »f« required for the patient are determined by Evita 4:

– either as a function of the ideal body weight

or

– as a function of the patient mode (paediatrics or adults).

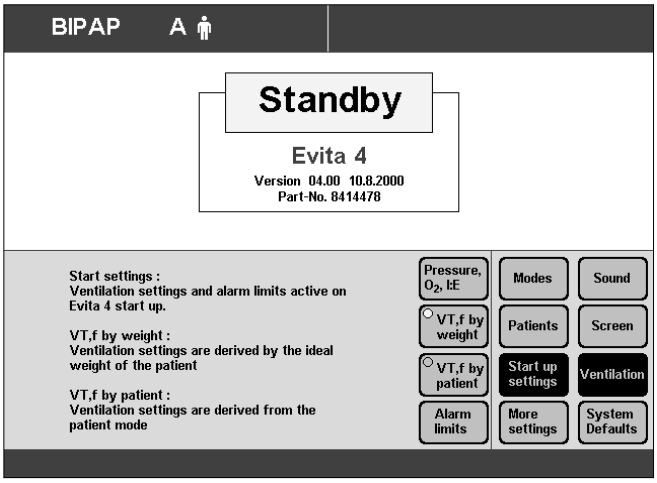
- Press **»Configuration«** key.
- Touch the **»Ventilation«** screen key.

Enter access code **3032**:

- Touch the corresponding screen keys.

- Touch the **»Start up settings«** screen key.

Display (example):



To determine the start-up values of the ventilation parameters **»VT, f«** on the basis of the ideal body weight:

- Touch the screen key **»VT, f by weight«** and confirm with the rotary knob.

To determine the start-up values of the ventilation parameters **»VT, f«** on the basis of the patient mode:

- Touch the screen key **»VT, f by patient«** and confirm with the rotary knob.

Start-up values **»VT, f«** dependent on ideal weight. The values are selected with reference to the Radford nomogram:

Weight kg	Factory settings		Hospital-specific settings	
	Tidal volume VT mL	Ventilation frequency f bpm	Tidal volume VT mL	Ventilation frequency f bpm
3	20	30		
15	110	26		
65	450	13		
100	700	10		

The hospital-specific start-up values can be entered in the table.

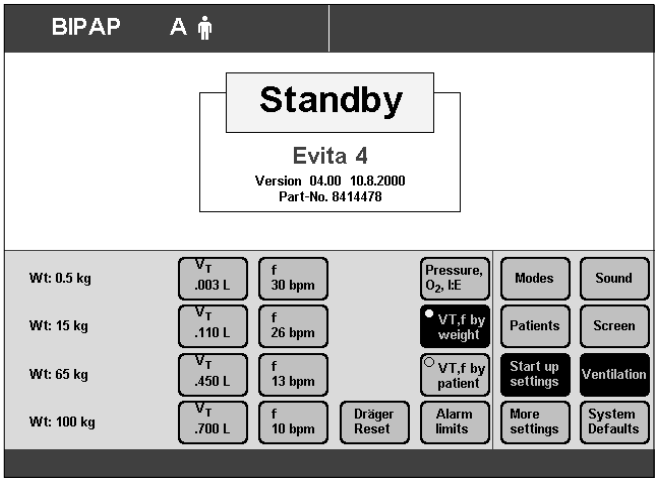
Start-up values **»VT, f«** dependent on patient mode.

Patient mode	Factory settings		Hospital-specific settings	
	Tidal volume VT mL	Ventilation frequency f bpm	Tidal volume VT mL	Ventilation frequency f bpm
Paed.	50	29		
Adults	500	12		

The hospital-specific start-up values can be entered in the table.

To change the start-up values of **»VT, f«**:

- Touch the screen key of the parameter to be changed.
- Change value = turn rotary knob.
- Confirm value = press rotary knob.



If you wish to return to the factory settings:

- Touch **»Dräger Reset«** screen key.

Setting the start-up values for the »Pressure, O2, I:E« ventilation parameter

- Press **»Configuration«** key.
- Touch **»Ventilation«** screen key.

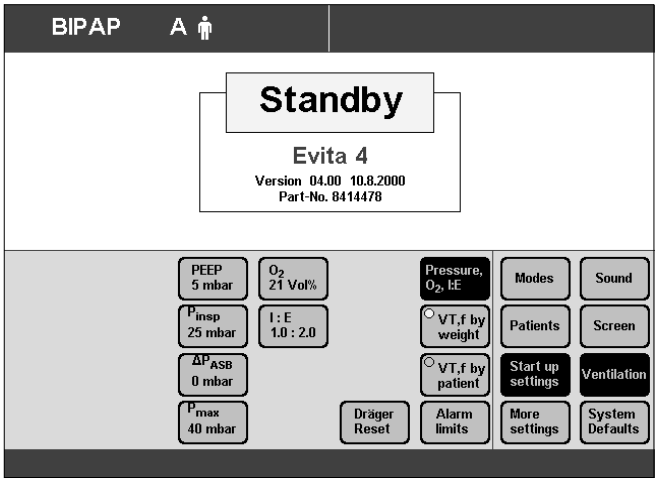
Enter access code **3032**:

- Touch the corresponding screen key.

- Touch the **»Start up settings«** screen key.

Display (example):

- Touch the **»Pressure, O2, I:E«** screen key.



Starting values of **»Pressure, O2, I:E«**

	PEEP mbar	P_{insp} mbar	ΔP_{ASB}* mbar	Pmax mbar	O_2 Vol.%	I:E
Factory settings	5	15	0	40	30	1:2
Hospital-specific settings						

* $\Delta P_{ASB} = P_{ASB} - PEEP$

The hospital-specific start-up settings can be entered in the table.

To change the start-up values of **»Pressure, O2, I:E«**:

- Touch the screen key for the parameter to be changed.
- Change value = turn rotary knob.
- Confirm value = press rotary knob.

Leakage compensation* On/Off

The automatic leakage compensation function is used by the device to compensate leakages of up to 100 % of the set tidal volume in all volume-controlled ventilation modes.

The selection "leakage compensation on/off" is saved and reactivated when the device is restarted.

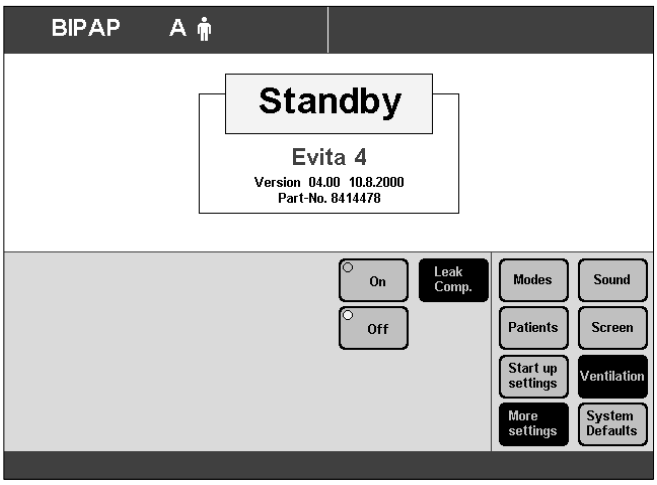
- Press the **»Configuration«** key
- Touch the **»Ventilation«** screen key.

Enter access code **3032**:

- Touch the corresponding screen keys.

- Touch the **»More settings«** screen key.

Display:



- Touch the **»Leak Comp.«** screen key.
- Touch the **»On«** or **»Off«** screen key.
- Confirm = press rotary knob. The selected key is highlighted by the yellow LED.

* For a detailed description of the leakage compensation function, refer to the Annex, page 166 onwards.

Setting the start-up values of the alarm limits

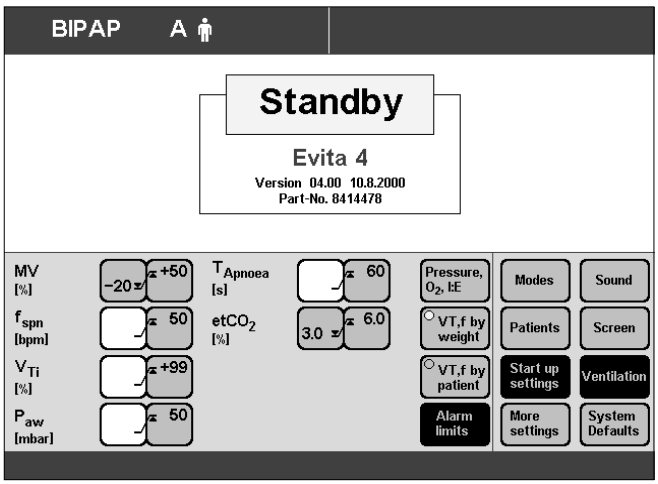
- Press the **»Configuration«** key.
- Touch the **»Ventilation«** screen key.

Enter the access code **3032**:

- Touch the corresponding screen keys

- Touch the **»Start up settings«** screen key.
- Touch the **»Alarm limits«** screen key.

Display (example):



Start-up values of the alarm limits:

Alarm limit	Factory settings	Hospital-specific settings
Paw high [mbar]	50	
MV low [L/min]	(VT f) –20 %	
MV high [L/min]	(VT f) +50 %	
VT high [L]	VT + 100 %	
etCO2 low [mmHg]	30	
etCO2 high [mmHg]	60	
fspon [1/min]	50	
TApnoea [s]	15	

The factory-specific start-up settings can be entered in the table.

To change the start-up values of the alarm limits:

- Touch the screen key of the alarm limit you wish to change.
- Change value = turn rotary knob.
- Confirm value = press rotary knob.

System Defaults

Setting the external interface

Evita 4 offers the following interface protocols:

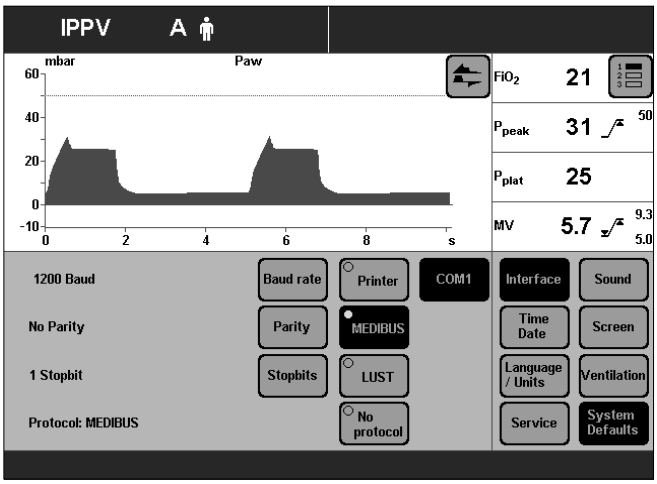
– Printer
– MEDIBUS (Dräger communications protocol for medical equipment)
– LUST (list-driven universal interface driver program, compatible with the Evita RS 232 interface from software version 7.n)

Other equipment, e.g. printers, may only be connected to the COM port if Evita 4 is connected to the mains power supply via a mains power cable or if it has been earthed via the earth connection on the back of the unit.

Electric power may pose a hazard in all other cases.

- Press the **»Configuration«** key.
- Touch the **»System Defaults«** screen key.
- Select the required port with screen keys **»COM1«, »COM2«, »COM3«** (COM2 and COM3 are optional).
- Select the required interface protocol with the screen keys **»Printer«**, **»MEDIBUS«** and **»LUST«**

Display (example):



Select the interface parameters for the selected interface protocol:

- Touch the screen key for the parameter, e.g. **»Baud rate«**
- Change value = turn rotary knob.
- Confirm value = press rotary knob.

For MEDIBUS protocol:
Baud rate
Parity check bits (see Operating Manual of the connected device)
Number of stop bits (see Operating Manual of the connected device)

For LUST protocol:
Baud rate

For printer protocol:
Baud rate (see Operating Manual of the printer)
Print interval (set in accordance with protocol requirement)

To connect a printer to Evita 4 (HP Deskjet 500 and compatible printers with serial interface).

At a programmable regular interval (0 to 60 minutes), all important measured values of the Evita 4 and all settings modified since the last printout are automatically printed out. If the print time interval is set to 0 no printout occurs.

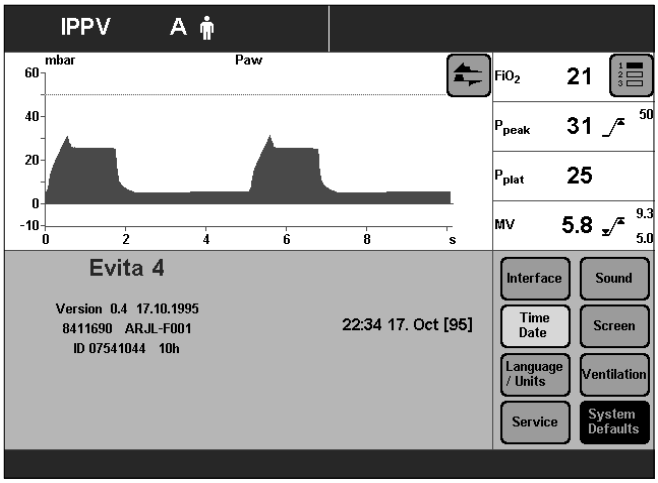
Regardless of the selected time interval, all alarms are printed out when the alarm conditions occur.

In addition, printout can be manually started by pressing the »**Printer**« key. The time interval in progress will remain unaffected.

Setting time and date

- Press »**Configuration**« key.
- Touch »**System Defaults**« screen key and
- touch »**Time Date**« screen key.

Display (example):



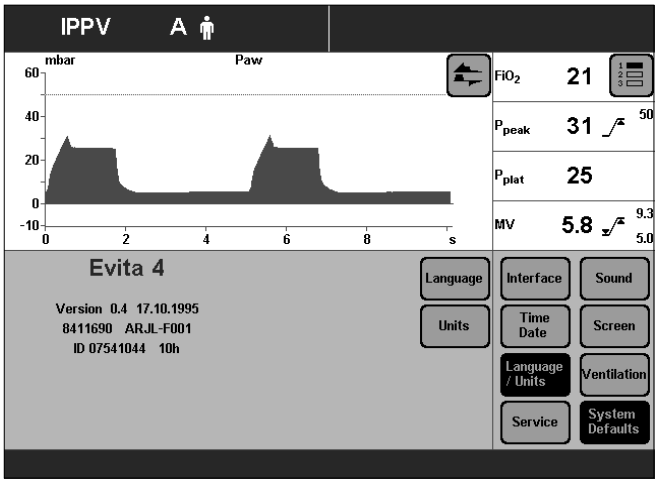
- Change value in cursor (Example **[95]**) = turn rotary knob.
- Confirm value = press rotary knob.

Selecting language and units

– To select the desired language for the screen texts.
– To select the units for pressure and CO_2 concentration.

- Press »**Configuration**« key.
- Touch the »**System Defaults**« screen key.

Display (example):



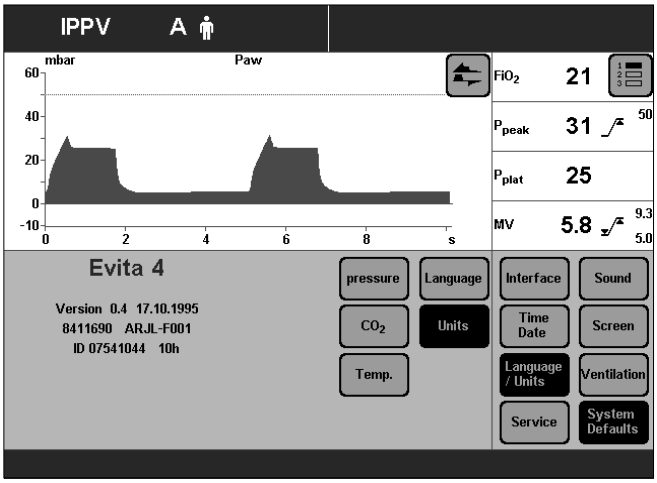
Select language:

- Touch the »**Language/Units**« screen key.
- Touch the »**Language**« screen key.
- Select language = turn rotary knob.
- Confirm language = press rotary knob.

Select unit:

- Touch the **»Units«** screen key.

Display (example):



- Touch the relevant screen key, e.g. **»pressure«**.
- Select unit = turn rotary knob.
- Confirm unit = press rotary knob.

Service diagnosis

- Only for trained personnel with the appropriate servicing documentation.

Troubleshooting

Troubleshooting 120

Troubleshooting

Alarm messages in the alarm display field are displayed in hierarchical order.

If, for example, two faults are detected at the same time, the more critical of the two is displayed.

The priority for alarm messages is marked by exclamation marks:

Warning = Message with top priority !!!

Caution = Message with medium priority !!

Advisory = Message with low priority !

In the table below, the messages are listed in alphabetical order. The table should help you identify the cause of any alarm, and to ensure rapid remedy of the problem.

Message		Cause	Remedy
Air supply down	**!!!**	Air supply pressure too low.	Make sure pressure is greater than 3 bar.
Air supply down	**!**	Air supply pressure too low. Air supply pressure not required when FiO_2 = 100 Vol.%.	Make sure pressure is greater than 3 bar.
Air supply pressure high	**!!**	Air supply pressure too high.	Ensure pressure is less than 6 bar.
Air supply pressure high	**!**	Air supply pressure too high. Air supply is not needed for FiO_2 = 100 Vol.%.	Ensure pressure is less than 6 bar.
Airway pressure high	**!!!**	The upper alarm limit for the airway pressure has been exceeded. The patient is "fighting" the ventilator, cough.	Check patient condition, Check ventilation pattern, Correct alarm limit if necessary.
		Ventilation hose buckled.	Check hose system and tube.
Airway pressure low	**!!!**	Leaking cuff	Inflate cuff and perform leak test.
		Leak or disconnection.	Check hose system for tight connections. Check that the expiration valve is properly engaged.
Apnoea	**!!!**	Patient's spontaneous breathing has stopped.	Apply controlled ventilation.
		Stenosis	Check condition of patient. Check tube
		Flow sensor not calibrated or faulty.	Calibrate flow sensor. Replace if necessary.
Apnoea ventilation	**!!**	Due to detected apnoea, the system has switched over automatically to mandatory ventilation.	Check ventilation procedure. Return to the original ventilation procedure with **»Alarm Reset«**. Check condition of patient. Check tube.
ASB > 1,5 s	**!**	Only appears in paediatric mode. The ASB cycle has been switched off 3 times due to time limitation.	Test ventilation system for leaks.

Message		Cause	Remedy
ASB > 4 s	**!!!**	Only appears in adult mode. The ASB cycle has been switched off 3 times due to time limitation.	Test ventilation system for leaks.
Check frequency **ILV Slave** Message on slave device	**!**	The frequency (breathing rate) of the master and slave devices differ by more than 12 %.	Adjust the frequency of the slave device to that of the master.
Check settings	**!!**	Power interruption while setting a ventilation pattern or the alarm limits.	Check pattern of ventilation and alarm limits. Confirm message with key **»Alarm Reset«**.
Clean CO_2 cuvette	**!!!**	Cuvette window dirty.	Use clean cuvette.
		Sensor window dirty.	Clean CO_2 sensor.
CO_2 measurement inop	**!!!**	CO_2 sensor faulty.	Replace faulty CO_2 sensor.
		CO_2 measurement incorrect.	Call DrägerService.
CO_2 monitoring off	**!**	CO_2 monitoring is switched off.	Switch CO_2 monitoring on again, page 88, or ensure adequate external monitoring without delay.
CO_2 sensor ?	**!!!**	Probe of CO_2 sensor withdrawn during operation.	Reinsert probe.
		CO_2 sensor not positioned on cuvette.	Place CO_2 sensor on cuvette.
		Last zero calibration was performed with a soiled park bracket or soiled CO_2 sensor.	Clean park bracket or CO_2 sensor and carry out zero calibration, page 95. Or perform zero calibration with clean cuvette in room air, page 95.
		CO_2 sensor faulty.	Replace defective CO_2 sensor.
CO_2 zero ?	**!!!**	Cuvette window or sensor window soiled, e.g. with deposits from medicament nebulization.	Use a clean cuvette or clean the CO_2 sensor.
		Zero point outside the permissible tolerance.	Perform zero calibration, page 95.
Device failure	**!!!**	Device faulty.	Call DrägerService.
etCO_2 high	**!!!**	End-expiratory CO_2 concentration above upper alarm limit	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary
etCO_2 low	**!!!**	End-expiratory CO_2 concentration below lower alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
Evita Remote ?	**!**	The Remote Pad has not been identified correctly.	Remove Remote Pad. Confirm message with key **»Alarm Reset«**. Call DrägerService at the next opportunity.
Evita Remote inop.	**!**	Key pressed on Remote Pad during self-test.	Confirm message with key **»Alarm Reset«**. Remove Remote Pad and reconnect. Ensure that no key is pressed on the Remote Pad.
		Remote Pad faulty.	Confirm message with key **»Alarm Reset«**. Remove Remote Pad. Call DrägerService at the next opportunity.
Execute device check	**!!**	Device check not performed.	Perform device check, page 38. Confirm message with **»Alarm Reset«** key.

Message		Cause	Remedy
Exp. hold interrupted	!	The **»Exp. hold«** key has been pressed for more than 15 seconds.	Release the**»Exp. hold«** key.
Exp. valve inop.	!!!	Expiration valve not properly connected to socket.	Push expiration valve firmly into socket until it clicks into place.
		Flow sensor not calibrated or defective.	Calibrate flow sensor, page 91, replace if necessary.
		Expiration valve faulty.	Replace expiration valve.
External Flow	!	Evita 4 calculates the externally supplied flow when monitoring correct functioning of the flow measurement.	Deactivate calculation of the external flow, see page 92.
Fan failure	!!!	Fan failure.	Call DrägerService.
FiO2 high	!!!	O2 sensor not calibrated.	Calibrate O2 sensor, page 90.
		Faulty mixer function.	Call DrägerService.
FiO2 low	!!!	O2 sensor not calibrated.	Calibrate O2 sensor, page 90.
		Faulty mixer function.	Call DrägerService.
Flow measurement inop.	!!!	Water in flow sensor.	Dry flow sensor.
		Flow sensor faulty.	Calibrate flow sensor, page 91, replace if necessary.
		Flow measurement malfunction	Call DrägerService.
Flow monitoring off	!	Flow monitoring is switched off.	Switch on flow monitoring again, as described on page 88, or immediately ensure an adequate external monitor function.
Flow sensor ?	!!!	Flow sensor not fully inserted in rubber lip of expiration valve.	Insert flow sensor correctly.
Hard key xx failed	!!	Key xx (e. g. »🔔«) can no longer be pressed.	Call DrägerService.
High frequency	!!!	Patient is breathing at a high spontaneous frequency.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
ILV Sync. inop. Message on both devices	!!!	Frequency on master device less than 4 breaths per minute.	Set a higher frequency.
		Device defective.	Call DrägerService.
Insp. hold interrupted	!	The **»Insp. hold«** key was held down longer than 15 seconds.	Release **»Insp. hold«** key.
Insp / Exp cycle failure	!!!	The device does not deliver any gas.	Check the Pmax/PEEP setting. Set an IPPV frequency of at least 4/min. Increase TApnoea ⏃ alarm time.
		Device faulty.	Call DrägerService.
Key xx overused ?	!!	Key has been pressed several times in a short period (e. g. »🔔«).	Confirm message with key **»Alarm Reset«.** If this message occurs repeatedly, call DrägerService.

Message		Cause	Remedy
Key overused ?	**!!**	Due to very frequent key use, the screen contents of the display are repeatedly redrawn.	Confirm message with key **»Alarm Reset«**.
		Brief communication failure between the display processor and main processor.	Confirm message with key **»Alarm Reset«**. If this message occurs again, call DrägerService.
Leakage	**!**	The measured leakage minute volume MV_{leak} is 20 % higher than the minute volume measured on the expiration side.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
Loss of data	**!!!**	Lithium batterie discharged.	Call Dräger Service.
Malfunction fan	**!**	Temperature in machine too high.	Check fan function, clean cooling-air filter or call DrägerService.
MEDIBUS COM. inop.	**!**	The connector of the MEDIBUS cable was unplugged during operation.	Plug the connector in again and secure it against disconnection with the two screws.
		MEDIBUS cable defective.	Use a new MEDIBUS cable.
		Interface defective.	Call DrägerService.
Mixer inop.	**!!!**	Mixer malfunction. FiO_2 can deviate considerably.	**Immediately ventilate with separate manual ventilation device!** Call DrägerService.
Multi functional board inop.	**!**	The multi-functional board for operating the nurse call or Remote Pad is faulty.	Confirm message with key **»Alarm Reset«**. Call DrägerService at the next opportunity. The original ventilation functions of Evita 4 are not affected. Correct functioning of the nurse call or Remote Pad is not guaranteed, however: remove the nurse call and/or Remote Pad.
Multi functional board inop.	**!!**	The multi-functional board for operating the nurse call or Remote Pad is faulty.	Confirm message with key **»Alarm Reset«**. Call DrägerService at the next opportunity. The original ventilation functions of Evita 4 are not affected. Correct functioning of the nurse call or Remote Pad is not guaranteed, however: remove the nurse call and/or Remote Pad.
MV high	**!!!**	The minute volume has exceeded the upper alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, page 91, replace if necessary.
		Water in flow sensor.	Drain water trap in hose system. Dry flow sensor.
		Machine malfunction.	Call DrägerService.

Message		Cause	Remedy
MV low	**!!!**	The minute volume has fallen below the lower alarm limit	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
		Stenosis.	Check condition of patient. Check tube.
		Leak in breathing system.	Establish leakproof breathing system.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, page 91, replace if necessary.
		Machine malfunction.	Call DrägerService.
Nebulisation interrupted	**!!**	Only in paediatric mode. Nebulisation is only possible in pressure-controlled ventilation or with AutoFlow®.	Select the patient mode. Restart nebulisation. Acknowledge the alarm with **»Alarm Reset»**.
		Only in paediatric mode, only for ventilation with AutoFlow®: Flow sensor not ready for measurement.	Switch on flow monitoring or calibrate flow sensor, page 98, or replace flow sensor or change mode. Restart nebulisation. Acknowledge the alarm with **»Alarm Reset»**
Nebulizer on	**!**	The medicament nebuliser is switched on, page 81.	Switch off the medicament nebuliser if necessary, page 81.
O_2 measurement inop.	**!!!**	O_2 sensor provides invalid measured values	Calibrate O_2 sensor page 90, replace if necessary.
		O_2 measurement malfunction	Call DrägerService.
O_2-Monitoring off	**!**	O_2 monitoring switched off.	Switch on O_2 monitoring again, as described on page 90 or immediately ensure an adequate monitor function.
O_2 supply down	**!!!**	O_2 supply pressure too low.	Make sure pressure is greater than 3 bar.
O_2 supply down	**!**	O_2 supply pressure too low. O_2 supply pressure is not required when FiO_2 = 21 Vol.%.	Make sure pressure is greater than 3 bar.
O_2 supply pressure high	**!!**	O_2 supply pressure too high.	Make sure pressure is less than 6 bar.
O_2 supply pressure high	**!**	O_2 supply pressure too high. O_2 supply pressure is not required when FiO_2 = 21 Vol.%.	Make sure pressure is less than 6 bar.
PEEP high	**!!!**	Expiratory system obstructed.	Check hose system and expiration valve
		Expiratory resistance is increasing.	Check bacterial filter. Replace if necessary.
		Machine faulty.	Call DrägerService.
PEEP valve inop.	**!!!**	Internal PEEP valve faulty.	Call DrägerService.
Pressure limited	**!**	Pmax pressure limit is active.	Check condition of patient, check pattern of ventilation, correct setting if necessary.
Pressure meas. inop.	**!!!**	Fluid in expiration valve.	Replace expiration valve, page 130, then clean and dry.
		Pressure measurement malfunction.	Call DrägerService.
Standby activated	**!!!**	Evita 4 has been switched to standby.	Confirm standby with **»Alarm Reset«** key.
Temperature high	**!!!**	Breathing gas temperature higher than 40 °C.	Switch off humidifier.
Temperature meas. inop.	**!!!**	Temperature sensor faulty.	Fit new temperature sensor, see page 27.

Message		Cause	Remedy
Temperature sensor ?	**!!!**	Temperature sensor probe has been disconnected during operation.	Reconnect probe.
		Sensor cable broken	Fit new temperature sensor.
Tidal volume high	**!!!**	The upper alarm limit of the applied inspiratory tidal volume VT has been exceeded during three consecutive ventilation strokes.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
		Leak or disconnection.	Check that hose system connections are leakproof.
Tidal volume high	**!**	The inspiratory tidal volume VT has exceeded the upper alarm limit	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
		Leak or disconnection.	Check that hose system connections are leakproof.
Tube blocked	**!!!**	Evita 4 only applies a very small volume with each mechanical stroke, e.g. because the tube is blocked.	Check condition of patient, check tube.
		Patient "fights" against the mechanical strokes in pressure-controlled ventilation, so that the set inspiratory pressure volume is achieved with only a very small volume.	Check condition of patient, check machine settings.
Volume not constant	**!!**	Due to pressure limit or time limit, the set tidal volume VT has not been applied.	Prolong inspiratory time **»Tinsp«** Increase inspiratory flow **»Flow«** Increase pressure limit **»Pmax«**. Press the **»Alarm Reset«** key to suppress the visual and acoustic alarm until the cause of the alarm is remedied.

Preparing

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Preparing

Dismantling

Clean and prepare the machine after each patient.

Recommendation:
Change the hose system and expiration valve every 24 hours.
Keep the replacement systems ready.

To avoid endangering hospital staff and other patients, the ventilator must be disinfected and cleaned whenever it has been used. Follow accepted hospital procedures for disinfecting contaminated parts (protective clothing, eyewear, etc.).

- Switch off the ventilator and humidifier, and remove their power plugs.
- Drain the water traps and ventilation hoses.
- Drain the water container of the humidifier.

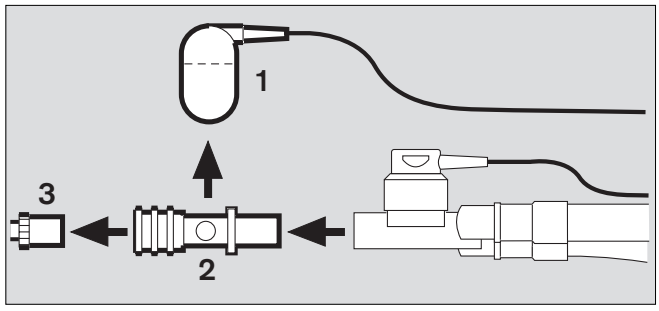
CO_2 sensor (optional)

1 Remove from the cuvette. Unplug the connector from the back of the unit.

2 Remove the cuvette of the CO_2 sensor from the Y-piece.

3 Remove the catheter cone from the cuvette.

- Prepare the CO_2 sensor for wipe disinfecting.
- Prepare the cuvette for disinfecting and cleaning in the autoclave.

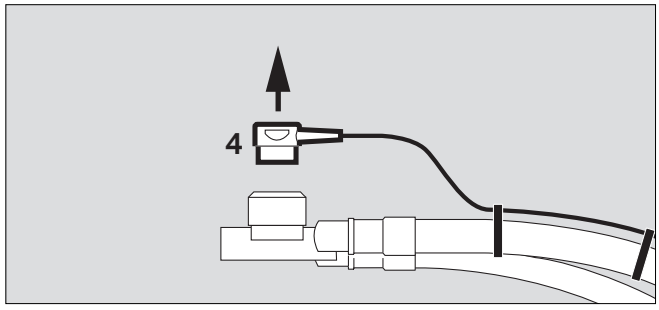


Temperature sensor

4 Remove from the Y-piece or from the mounting of hose set K. Do not pull the cable.

- Unplug the connector from the back of the Evita 4.
- Prepare the temperature sensor for wipe disinfecting.

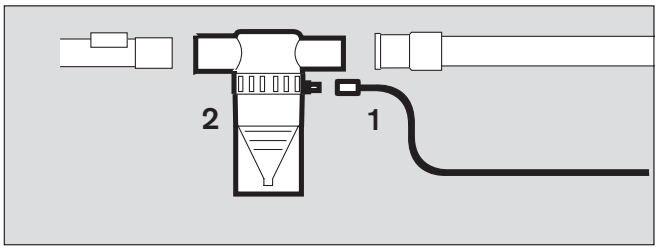
The temperature sensor is not suitable for autoclaving or immersion in a disinfectant bath!



Medicament nebuliser (option)

1 Remove the nebuliser hose from the nebuliser and from the port on the device.

2 Remove the medicament nebuliser from the hose system or:



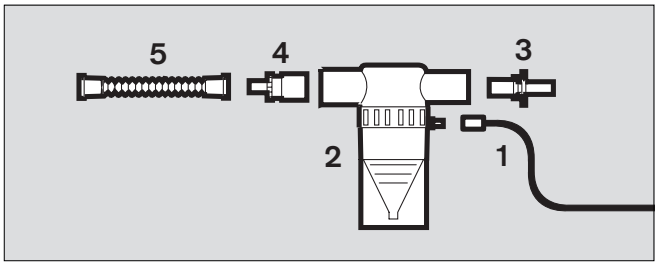
2 Dismantle the medicament nebuliser from the paediatric hose system.

3 Remove the catheter connector (ISO cone ø15 / ø11) from the inlet.

4 Remove adapter (ISO cone ø22 / ø11) from the outlet.

5 Remove corrugated hose from the adapter.

- Dismantle the medicament nebuliser in accordance with its specific Instructions for Use.
- Prepare the individual parts of the medicament nebuliser and the adapting components for disinfecting and cleaning in the autoclave.



Ventilation hoses

- Remove from the adapters and ports.
- Remove the water traps from the ventilation hoses. Remove the collecting jars from the water traps.
- Prepare the ventilation hoses, water traps and their collecting jars and the Y-piece for cleaning in the autoclave.

Flow sensor

- Tilt the control unit upward.

6 Push the flow sensor to the left as far as it will go and

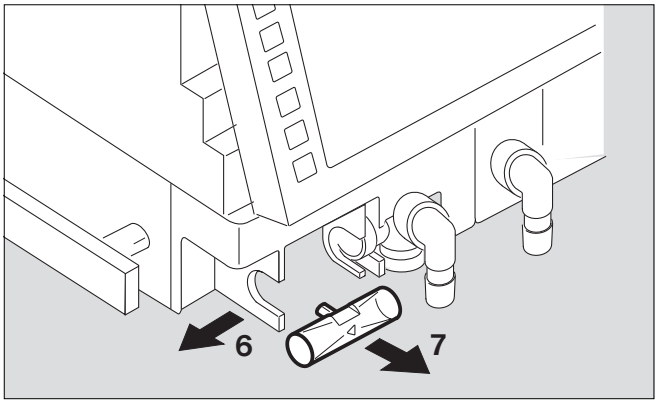
7 pull out.

The flow sensor cannot be disinfected/cleaned by autoclaving and cannot be sterilised by the hot steam method.

- Disinfect the flow sensor for about 1 hour in 70 % ethanol solution.

Expose the sensor to air for at least 30 minutes. Otherwise residual alcohol could damage the sensor beyond control due to ignition during calibration.

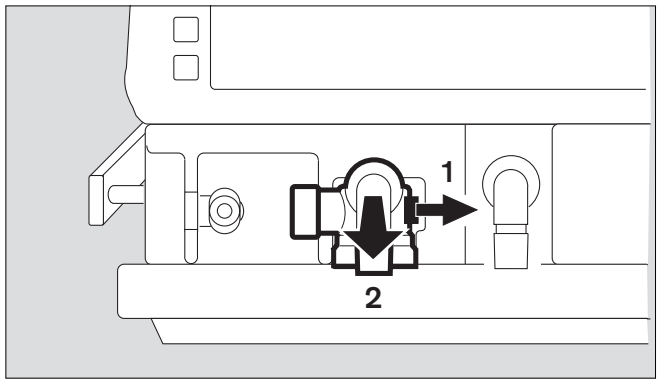
- The flow sensor may be reused as long as calibration can be carried out successfully.



Expiration valve

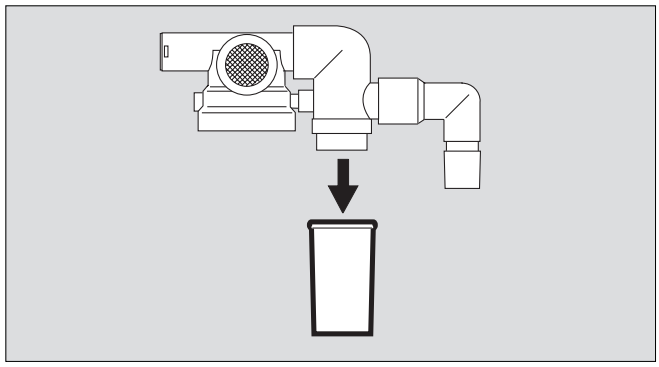
1 Push the catch to the right while at the same time

2 pulling out the expiration valve.



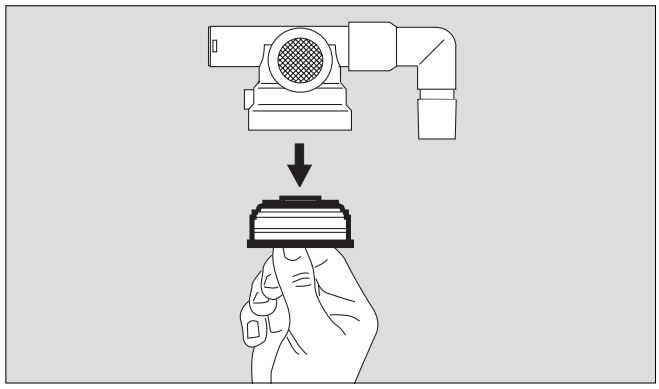
If the expiration valve is fitted with an optional water trap:

- Pull off the collecting jar.



Only strip down the expiration valve if badly soiled:

- Unscrew the stopper by hand and remove together with the diaphragm.
- Do not disassemble the expiration valve any further.
- Prepare the expiration valve for disinfecting and cleaning by autoclave
  and
- prepare the expiration valve for hot steam sterilisation.
- Place the open expiration valve in the basket so that it cannot be damaged by other parts.



Humidifier

- Dismantle in accordance with the specific Instructions for Use and prepare for disinfecting/sterilising.

Disinfecting/Cleaning

Use surface disinfectants. For surface compatibility, use disinfectants based on:

— aldehydes,

— quaternary ammonium compounds.

To avoid the possibility of damage to material, do not use any disinfectants based on:

— alkylamine-based compounds

— phenol-based compounds,

— halogen-releasing compounds,

— strong organic acids,

— oxygen-releasing compounds.

For users in the Federal Republic of Germany, we recommend that only disinfectants on the current DGHM list are used (DGHM: German Society for Hygiene and Microbiology).

The DGHM list (published by mhp-Verlag, Wiesbaden) also classifies each disinfectant by its active agents.

For countries where the DGHM list is not available, we recommend the types of disinfectant given above.

Disinfectants often contain – besides their main active agents – additives that can also damage materials. If in doubt, ask the supplier/manufacturer of the disinfectant/ cleaning agent.

A list of substances used is given on page 153.

Do not sterilise parts in ethylene oxide!

The screen is made of Plexiglas.

- **Do not handle with alcohol or agents containing alcohol. Danger of cracking.**

To avoid endangering hospital staff and other patients, the ventilator must be disinfected and cleaned whenever it has been used. Follow accepted hospital procedures for disinfecting contaminated parts (protective clothing, eyewear, etc.).

Basic device without ventilation hoses, gas connection hoses and temperature sensor

Wipe disinfect

- e.g. with Buraton 10 F or Terralin (Schülke & Mayr, Norderstedt). Comply with the manufacturer's instructions.

Cooling air filter, room air filter

- Filters must be cleaned or replaced when soiled or at the latest after 4 weeks, see page 136.

CO_2 cuvette

Wipe off dirt, particularly inside and outside the windows:

- with disposable tissue and cotton buds, under running water if necessary.

Then:

- Disinfect with moist heat (93 °C/10 minutes) in a cleaning and disinfecting machine. Use only cleaning agent.

Or:

- Disinfect in bath of disinfectant based on the listed active substances, e.g. Cidex, Johnson & Johnson, Norderstedt.

Or:

- Steam-sterilise at 134 °C.

CO_2 sensor

- Wipe off dirt with cotton buds, in particular on the windows of the CO_2 sensor.
- Disinfect by wiping, e.g. with 70 % Ethanol.

Ventilation hoses, water traps and associated jars, Y-piece, expiration valve (or, in the event of severe fouling, their individual parts)

- Disinfect with moist heat (93 °C/10 minutes) in cleaning and disinfecting machine. **Use only cleaning agent.**
- After disinfecting with moist heat, steam-sterilise the expiration valve and its individual parts **at 134 °C:** Make sure that no liquid remains in the pressure measuring line, since it might cause malfunction.

Or:

If no washing machine is available:

- Bath disinfecting e.g. with Sekusept (Henkel). Comply with manufacturer's instructions.
- Then rinse with clean water, preferably from a soft water supply. Shake water out thoroughly, and leave the products to dry.

Expiration valve and individual parts

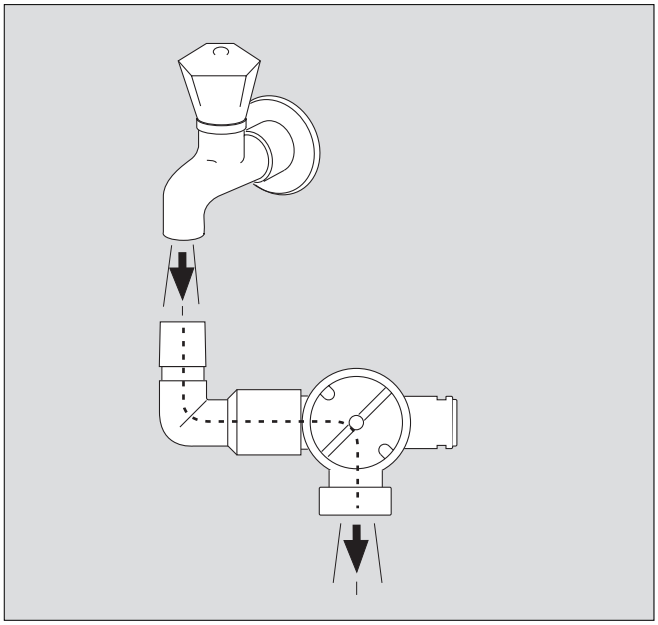
after rinsing

- steam-sterilise at 134 °C.

Or

Expiration valve

- Rinse thoroughly with clear water, preferably from a soft water supply. Shake water out thoroughly.
- After rinsing thoroughly, dry expiration valve.
- After drying, steam-sterilise at 134 °C.



Ventilation hoses, water traps and associated water jars, Y-piece, expiration valve, temperature sensor

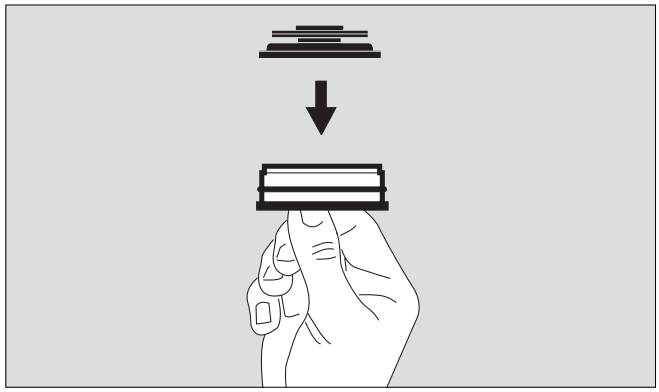
- These parts can be steam-sterilised at 134 °C.

Assembling

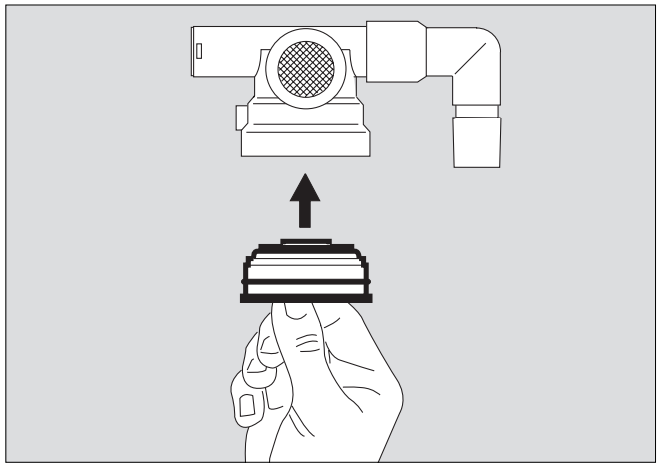
Mounting the expiration valve

The parts must be entirely dry to prevent malfunctioning.

- Hold stopper by the flange and place diaphragm on the collar of the stopper. Be careful to fit the diaphragm properly.

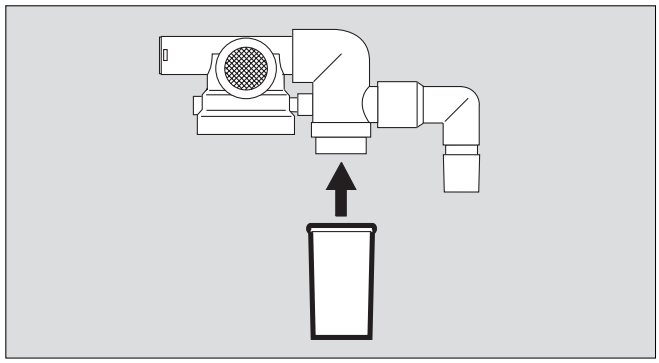


- Insert stopper with diaphragm on top into the housing from below and screw in tightly.



If the expiration valve has an optional water trap:

- Fit the collecting jar.



Medicament nebuliser

- Assemble in accordance with separate Instructions for Use.
- Install, see page 82.

Humidifier

- Assemble in accordance with separate Instructions for Use.

Before Reusing on Patient

- Assemble machine as described under "Preparation" on page 24 onwards et seq.
- Carry out checks to ensure readiness for operation, see "Device Check" on page 36.

Maintenance Intervals

Clean and disinfect equipment and/or components before any maintenance procedures – and before returning for repair!

Note the maintenance intervals for the options installed as specified in the corresponding Instructions for Use of the options.

O_2 sensor capsule	Replace sensor capsule in event of display message: **»O_2 measurement inop«** and if calibration is impossible. Disposal, see page 136.
Ambient-air filter Cooling-air filter	Clean or replace after 4 weeks,see page 136, Replace every year. Dispose of with normal domestic waste.
Filters in the compressed gas inlets	To be replaced by trained service personnel every 2 years.
Lithium battery for data protection	To be replaced by trained service personnel every 2 years. Disposal, see page 136.
Clock module	To be replaced by trained service personnel after 6 years.
Pressure reducererer	Complete overhaul every 6 years by DrägerService.
Equipment inspection and service	Every 6 months by trained service personnel.

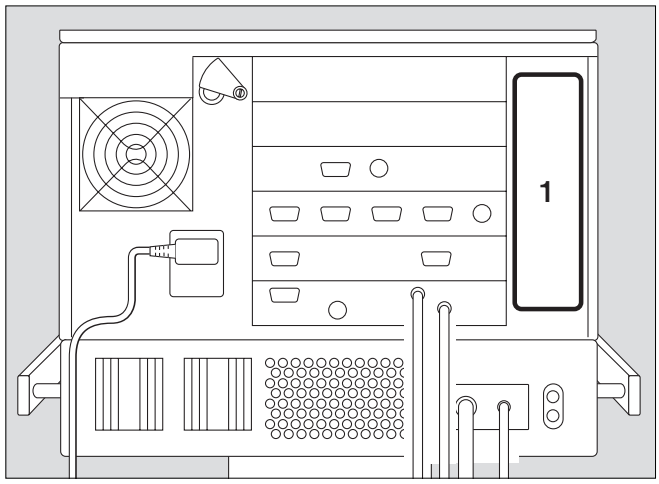
Clean or replace cooling air filter.

– Filter must be cleaned or replaced when soiled or at the latest after 4 weeks.
  Replace after 1 year at the latest.

1 Remove cooling-air filter from its slot on the back of machine.

- Replace or clean in warm water with detergent added; dry well.
- Insert cooling-air filter in slot, taking care not to crease it.
- Dispose of used cooling-air filter with domestic waste.

Note the Instructions for Use of the option when using the DC power supply MB (optional).



Correct disposal of batteries and O_2 sensors

Batteries and O_2 sensors:

- Do not throw in a fire; risk of explosion!
- Do not open using force; risk of corrosion!
- Do not re-charge batteries.

Batteries and O_2 sensors must be disposed of as special waste:

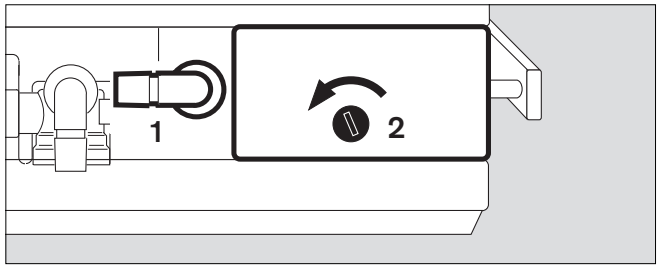
- Disposal must conform to local waste disposal regulations. Information may be obtained from the local environmental and public health authorities and from approved waste disposal companies.

Removing and reinserting ambient-air filter

– Filter must be cleaned or replaced when soiled or at the latest after 4 weeks.
  Replace filter every year.

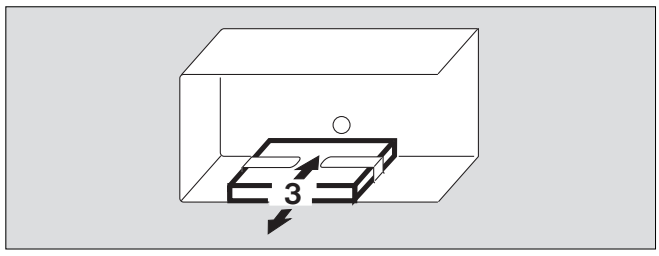
1 If necessary, swivel port to the left.

2 Loosen screw with a coin, and remove the protective cover.



3 Remove the ambient-air filter from the protective cover.

- Push ambient-air filter under the lugs.
- Replace protective cover, and tighten screw with a coin.
- Dispose of used ambient-air filter with domestic waste.



Correct disposal of apparatus

– at the end of its useful life

After contacting the competent waste disposal company, hand over Evita 4 for appropriate disposal.The applicable legal regulations must be observed.

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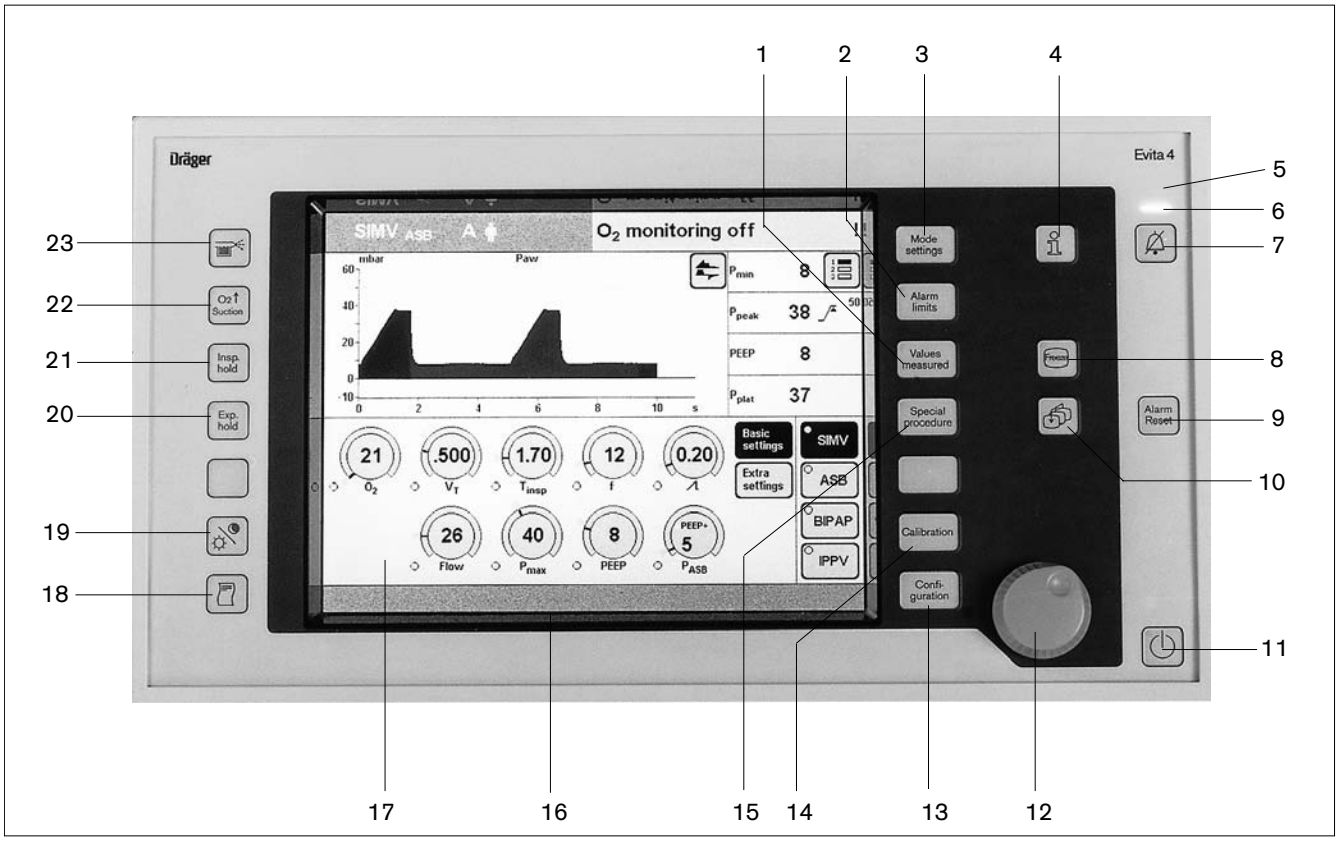
What's what

Control Unit



1 Key for displaying the »Measured Values« screen page.

2 Key for displaying the »Alarm LimitS« screen page. For displaying the measured values and alarm limits, and for setting the alarm limits.

3 Key for displaying the »Settings« screen page. For setting the ventilation modes and ventilation parameters.

4 »**i**« key for displaying help information for settings.

5 Red LED to indicate warnings

6 Yellow LED to indicate cautions and advisory messages

7 »🔔« key for cancelling the acoustic alarm for 2 minutes.

8 **»Freeze«** key for "freezing" curves.

9 **»Alarm Reset«** key for acknowledging alarm messages.

10 »🏠« key for selecting the standard screen page.

11 »⏻« key for switching between operating and standby mode.

12 Central rotary dial-knob for selecting and confirming settings.

13 Key for displaying the »Configuration« screen page.

14 Key for displaying the »Calibration« screen page.

15 Key for displaying the »Special Procedures« screen page. For measuring PEEPi and Occlusion Pressure.

16 Plastic frame (ensures correct functioning of the touch-sensitive screen)

17 Touch-sensitive screen for displaying application-specific screen pages.

18 »🖨« key for manual printer logging.

19 »☼/●« key for switching the screen to bright or dark.

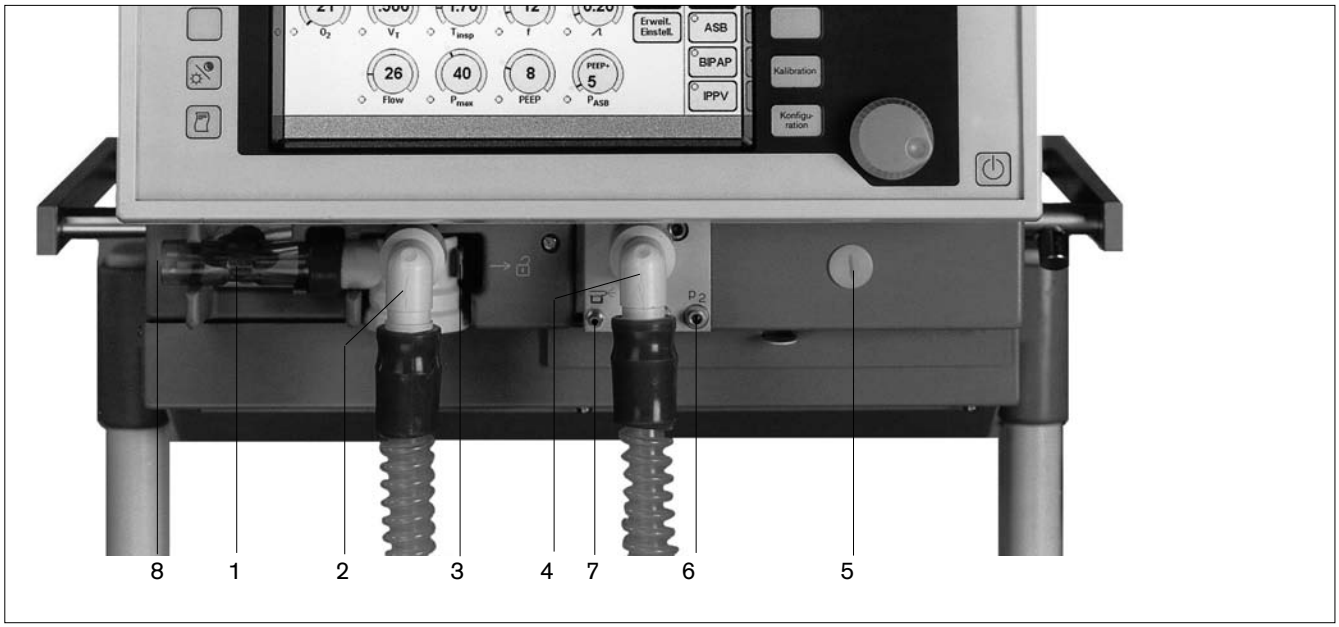
20 »**Exp. hold**« key for prolonging/holding expiration.

21 »**Insp. hold**« key for manual inspiration.

22 Taste »**O2 ↑ Suction**« key for oxygenation for bronchial suction.

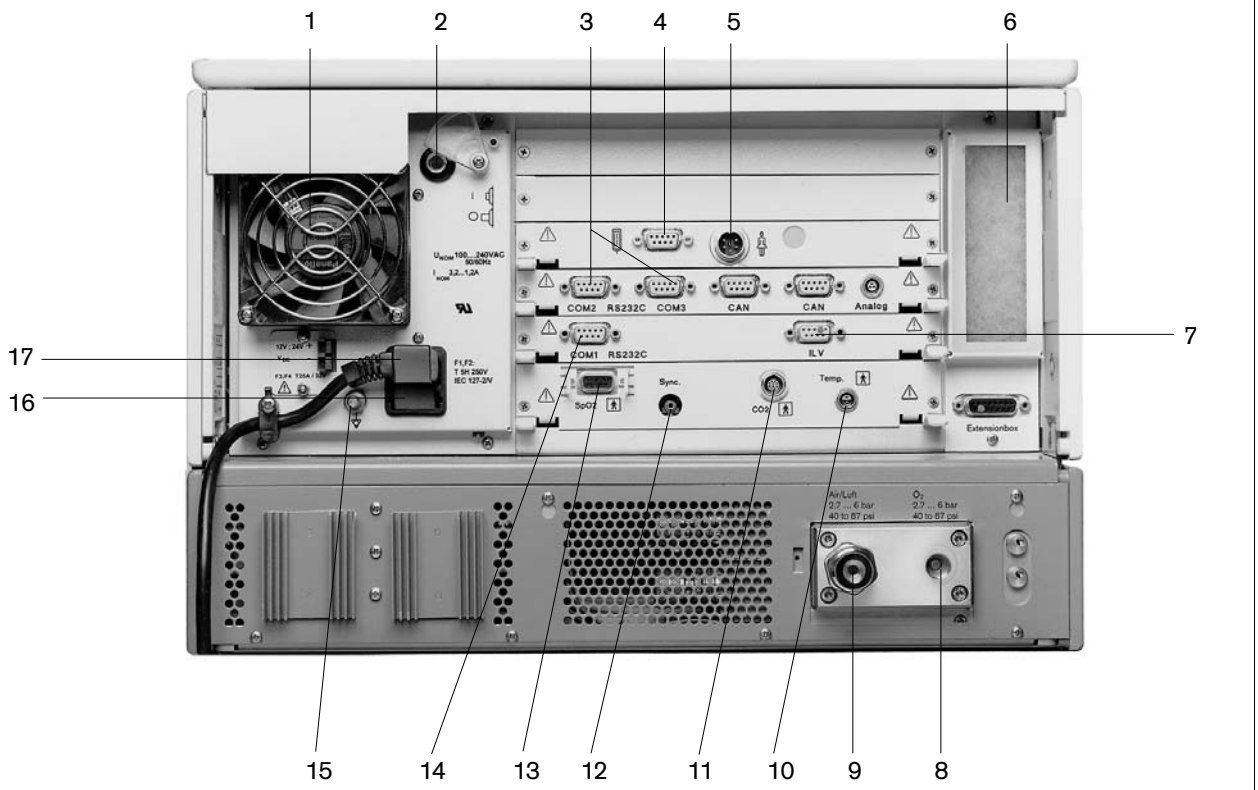
23 »🚬« key for switching on the medicament nebuliser.

Front Connections



1 Flow sensor
2 Expiration valve with expiration port (GAS RETURN)
3 Latch for expiration valve
4 Inspiratory port (GAS OUTPUT)
5 Locking screw for protective cover
(behind it: O_2 sensor and ambient-air filter)
6 Connections for optional pressure measurement (not used)
7 Gas supply port for the medicament nebuliser
8 Gas outlet (EXHAUST – NOT FOR SPIROMETERS)

Back Panel



1 Fan

2 Power switch with protective flap

3 **»COM2«, »COM3«** sockets for RS 232 and analog interfaces (optional)

4 Connection » « for Remote Pad, optional

5 Connection » « for nurse call, optional

6 Cooling-air filter

7 ILV socket

8 Connection for oxygen

9 Connection for medical air

10 **»Temp** « socket for temperature sensor

11 **»CO_2** « socket for CO_2 sensor

12 **»Sync.«** socket for C-Lock-ECG synchronisation for optional SpO_2 measurement

13 **»SpO_2** « socket for functional SpO_2 measurement, optional

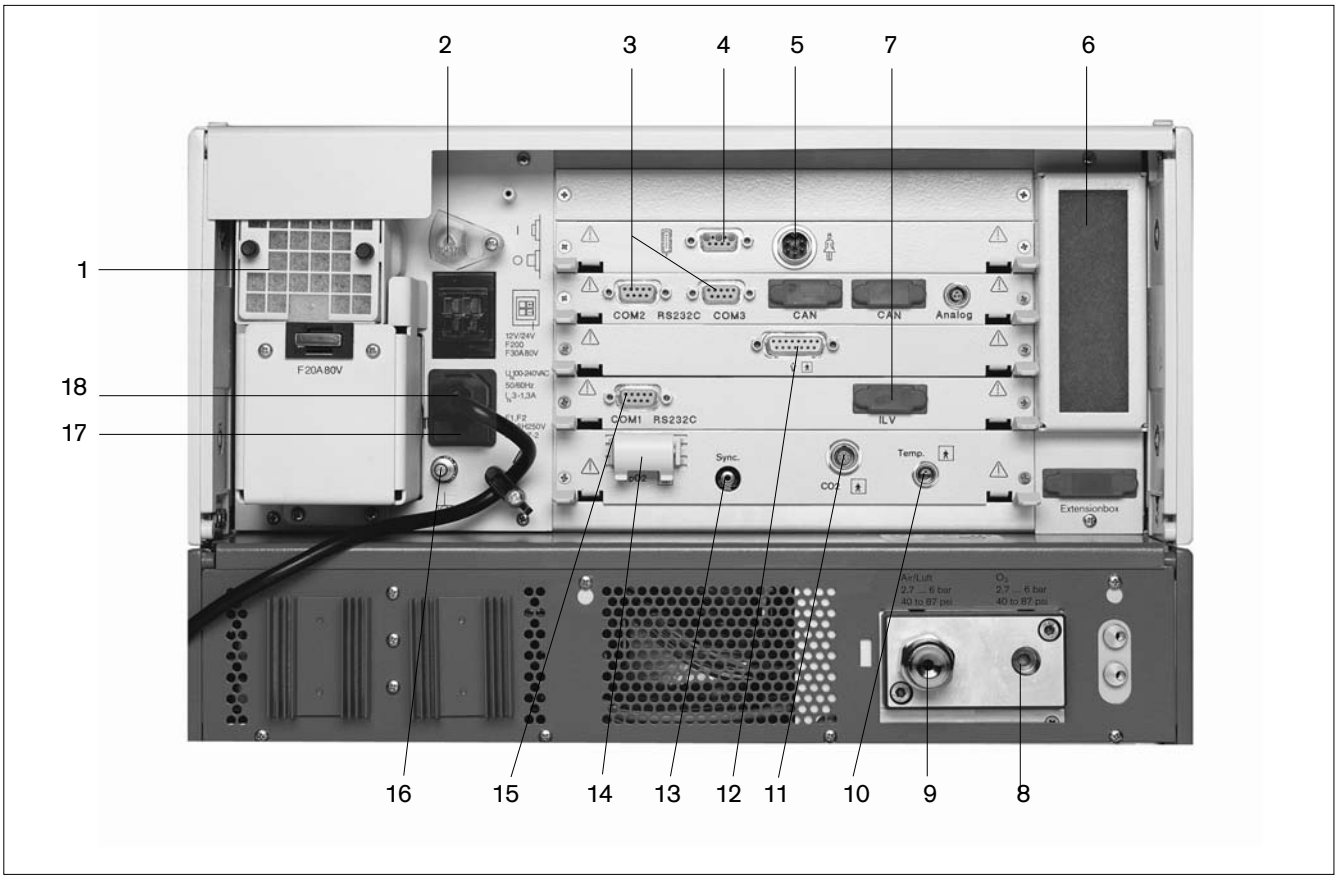
14 **»COM1 RS232C«** socket for RS 232 interface, e.g. for printer

15 Earth connection

16 Main fuses

17 Connector for power cord

Rear View with DC Power Supply MB



1 Equipment fan with filter

2 Power switch with protective flap

3 »**COM2**«, »**COM3**« sockets for RS 232 and analog interfaces (optional)

4 Connection » « for Remote Pad, optional

5 Connection » « for nurse call, optional

6 Cooling-air filter

7 ILV socket

8 Connection for oxygen

9 Connection for medical air

10 »**Temp** « socket for temperature sensor

11 »**CO2** « socket for CO_2 sensor

12 Flow sensor connection for neonates, optional

13 »**Sync.**« socket for C-Lock-ECG synchronisation for optional SpO_2 measurement

14 »**SpO2** « socket for functional SpO_2 measurement, optional

15 »**COM1 RS232C**« socket for RS 232 interface, e.g. for printer

16 Earth connection

17 Main fuses

18 Connector for power cord

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Technical Data

Environmental conditions

In operation	
Temperature	10 to 40 °C
Atmospheric pressure	700 to 1060 hPa
Rel. humidity	5 to 90 %, without condensation
In storage and transport	
Temperature	–20 to 60 °C
Atmospheric pressure	500 to 1060 hPa
Rel. humidity	0 to 100 %

Settings

Ventilation frequency f	0 to 100/min
Inspiration time T_{insp}	0.1 to 10 s
Tidal volume V_T	
Paediatrics	0.02 to 0.3 L, BTPS*
Accuracy	±10 % of set value, or ±10 mL, whichever is greater.
Adults	0.1 to 2.0 L, BTPS*
Accuracy	±10 % of set value, or ±25 mL, whichever is greater.
Inspiratory pressure P_{insp}	
Paediatrics	6 to 30 L/min
Adults	6 to 120 L/min
Inspiratory pressure P_{insp}	0 to 80 mbar
Inspiratory pressure limit Pmax	0 to 100 mbar
O_2-concentration	21 to 100 Vol.%
Accuracy	±5 % of set value, or ±2 Vol.%, whichever is greater.
Positive end-expiratory pressure PEEP or interm. PEEP	0 to 35 mbar
Trigger sensitivity	0.3 to 15 L/min
Pressure assist P_{ASB}	0 to 80 mbar
Rise time for pressure assist	0 to 2 s
Independent lung ventilation (ILV)	
Master	with trigger / without trigger
Slave	synchr. / asynchr. / inverse I : E

* BTPS = Body Temperature, Pressure, Saturated.
Measured values relating to the conditions of the patient lung: body temperature 37 °C, steam-saturated gas, ambient pressure.

Performance Data

Control principle	time-cycled, volume-constant, pressure-controlled
Intermittent PEEP frequency	2 cycles every 3 minutes
Medicament nebulisation	for 30 minutes
Bronchial suction	
Disconnection detection	automatic
Reconnection detection	automatic
Oxygen enrichment	max. 3 minutes
Active suction phase	max. 2 minutes
Final oxygen enrichment	2 minutes
V_{alve} response time $T_{0...90}$	≤5 ms
Supply system for spontaneous breathing and ASB	adaptive CPAP system with high initial flow
max. flow rate	2 L/s in 8 ms
max. inspiratory flow	180 L/min
Equipment compliance (with humidifier Aquapor and patient tubing system for adults)	≤2 mL/mbar
Insp. Resistance	≤2.3 mbar/L/s
Exp. Resistance	≤3.8 mbar/L/s
Dead Space Volume incl. CO_2-cuvette	≤16 mL
Equipment compliance (with Fisher & Paykel MR 730 humidifier and tubing system paediatric)	≤1 mL/mbar
Insp. Resistance	≤4.1 mbar/L/s
Exp. Resistance	≤4.1 mbar/L/s
Dead Space Volume incl. CO_2-cuvette	≤6 mL
Additional functions	
Inspiratory relief valve	opens if medical air supply fails (pressure <1.2 bar), enables spontaneous breathing with filtered ambient air.
Safety valve	opens the breathing system at 100 mbar.

Measured value displays

Airway pressure measurement	
Max. airway pressure	P_{peak}
Plateau pressure	P_{plat}
Pos. end-exp. pressure	PEEP
Mean airway pressure	P_{mean}
Min. airway pressure	P_{min}
Range	0 to 99 mbar
Resolution	1 mbar
Accuracy	±2 mbar

O_2 measurement in main flow (inspiratory side)

Inspiratory O_2 concentration FiO_2

Range	15 to 100 Vol.%
Resolution	1 Vol.%
Accuracy	±3 Vol.%

Flow Measurement

Minute Volume MV

Spontaneously breathed minute volume MV_{spn}

Range	0 to 99 L/min, BTPS*
Resolution	0.1 L/min or for values less than 1 L/min: 0.01 L/min
Accuracy	±8 % of measured value
$T_{0...90}$	approx. 35 s

Tidal volume V_{Te}

Spontaneously breathed tidal volume VT_{spn}

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

Tidal volume VT_{ASB}

Inspiratory tidal volume during an ASB stroke

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

Frequency Measurement

Breathing frequency f_{total}

Spontaneous breathing frequency f_{spn}

Range	0 to 150 /min
Resolution	1 /min
Accuracy	±1 /min
$T_{0...90}$	approx. 35 s

Breathing gas temperature measurement

Range	18 to 51 °C
Resolution	1 °C
Accuracy	±1 °C

* BTPS = Body Temperature, Pressure, Saturated
Measured values based on the conditions of the patient lung: body temperature 37 °C, steam-saturated gas, ambient pressure.

CO_2 measurement in main flow	
End-expiratory CO_2 concentration etCO_2	
Range	0 to 100 mmHg or 0 to 13.3 Vol.% or 0 to 13.3 kPa
Resolution	1 mmHg or 0.1 Vol.% or 0.1 kPa
Accuracy	
for 0 to 40 mmHg	±2 mmHg
for 40 to 100 mmHg	±5 % of measured value
$T_{0...90}$	≤25 ms
Warm-up time	max. 3 minutes
CO_2-production $\dot{V}CO_2$	
Range	0 to 999 mL/min, STPD*
Resolution	1 mL/min
Accuracy	±9 % of measured value
$T_{0...90}$	12 minutes
Serial dead space V_{ds}	
Range	0 to 999 mL, BTPS
Resolution	0.1 mL
Accuracy	±10 % of measured value or ±10 mL, whichever is greater
Dead space ventilation V_{ds}/V_T	
Range	0 to 99 %
Resolution	1 %
Accuracy	±10 % of measured value
Computed value displays	
Compliance C	
Range	0.7 to 200 mL/mbar
Resolution	
Range 0.7 to 99.9 mL/mbar	0.1 mL/mbar
Range 100 to 200 mL/mbar	1 mL/mbar
Accuracy	±20 % of measured value**
Resistance R	
Range	0.7 to 200 mL/mbar
Resolution	
Range 3 to 99.9 mbar/L/s	0.1 mbar/L/s
Range 100 to 200 mbar/L/s	1 mbar/L/s
Accuracy	±20 % of measured value***

* STPD = Standard Temperature, Pressure, Dry Measured values based on normal physical conditions 0 °C, 1013 hPa, dry.

** C-values may be considerably falsified as spontaneous breathing increases; compliance with the measuring accuracy therefore cannot be guaranteed for spontaneous breathing.

*** R-values may be considerably falsified as spontaneous breathing increases; compliance with the measuring accuracy therefore cannot be guaranteed for spontaneous breathing

Leakage minute volume MV_{Leak}	
Range	0 to 99 L/min, BTPS
Resolution	0.1 L/min or for values less than 0.1 L/min: 0.01 L/min
Accuracy	± 18 % of measured value
$T_{0...90}$	approx. 35 s
Rapid Shallow Breathing RSB	
Range	0 to 9999 1/(min x L)
Resolution	1/(min x L)
Accuracy	see measurement of V_T and f
Negative Inspiratory Force NIF	
Range	–45 bis 0 mbar
Resolution	1 mbar
Accuracy	±2 mbar
Curve displays	
Airway pressure Paw (t	–10 to 100 mbar
Flow Flow (t)	–150 to 180 L/min
Volume V (t)	0 to 2000 mL
Exp. CO_2 concentration FCO_2	0 to 100 mmHg or 0 to 13 kPa or 0 to 13 Vol.%
P 0.1	0 to 25 mbar

Monitoring

Expiratory minute volume **MV**	
Upper alarm limit alarm	when MV exceeds the upper alarm limit.
Setting range	0.1 to 41 L/min, in 0.1 L/min steps
Lower alarm limit alarm	when MV falls below the lower alarm limit.
Setting range	0.01 to 40 L/min, in 0.1 L/min steps
Airway pressure Paw	
Upper alarm limit alarm	if the "Paw high" value is exceeded.
Setting range	10 to 100 mbar
Lower alarm limit alarm	if the value "PEEP +5 mbar" (coupled with the PEEP set value) is not exceeded for at least 96 ms in 2 successive ventilation strokes.
Insp. O_2 concentration **FiO_2**	
Upper alarm limit alarm	if FiO_2 exceeds the upper alarm limit for at least 20 seconds.
Lower alarm limit alarm	if FiO_2 falls below the lower alarm limit for at least 20 seconds.
Range	both alarm limits are automatically allocated to the set value: under 60 Vol.% with ±4 Vol.% over 60 Vol.% with ±6 Vol.%
Endexspiratory CO_2-concentration **$etCO_2$**	
Upper alarm limit alarm	if the upper alarm limit has been exceeded
Setting range	1 to 100 mmHg or 0.1 to 15 kPa or Vol.%
Lower alarm limit alarm	if the lower alarm limit fell below
Setting range	0 to 99 mmHg or 0 to 14.9 kPa or Vol.%

Insp. breathing gas temperature	
Upper alarm limit alarm	when temperature reaches 40 °C. (Evita 4 can also be used without temperature sensor if the sensor is not connected on switching on).
Tachypnoea monitoring f_{spn}	
Alarm	during spontaneous breathing, when the spontaneous breathing frequency has been exceeded.
Setting range	5 to 120/min
Volume monitoring	
Lower alarm limit alarm	if the set tidal volume V_T (coupled with the set value V_T) has not been supplied.
Upper alarm limit alarm	if the applied tidal volume exceeds the value of the alarm limit, inspiration is interrupted and the expiration valve is opened.
Setting range	21 to 4000 mL
Apnoea alarm time T_{Apnoea}	
Alarm	f no breathing activity is detected
Setting range	5 to 60 s, adjustable in 1 second steps.

Operating data

Mains power connection	100 V to 240 V 50/60 Hz
Current	
at 230 V	max. 1.3 A
at 100 V	max. 3.2 A
Power consumption	typically approx. 125 W
Machine fuses	
Range 100 V to 240 V	F 5 H 250 V IEC 127-2 (2x)
Protection class	
Machine	Class I
CO_2 sensor (sensor connected)	Type BF
Temperature sensor AWT 01 (sensor connected)	Type BF
Gas supply	
O_2 gauge pressure	3 bar –10 % bis 5.5 bar +10 % at 60 L/min (peak flow 200 L/min)
O_2 connection thread	M 12 x 1, female
air gauge pressure	3 bar –10 % bis 5.5 bar +10 % bei 60 L/min (peak flow 200 L/min)
air connection thread	M 20 x 1.5, male
	The gases must be dry and free from oil and dust.
Gas consumption of control system	Medical air or O_2 approx. 3.5 L/min
Output for pneumatic medicament nebuliser	Medical air or O_2
	max. 2.25 bar, max. 11 L/min
Automatic gas switch-over	if one gas fails (inlet pressure <1.5 bar), the device switches to the other gas.
Sound pressure level (for free-field measurement over a reflecting surface)	max. 47 dB (A)

Dimensions (W x H x D)	
Basic machine	530 x 290 x 450 mm
Machine with trolley	580 x 1335 x 660 mm
Weight	
Basic machine	ca. 27 kg
Basic machine with trolley incl. cabinet 8H	ca. 69 kg

Machine outputs

Digital output	Output and reception via an RS 232 C interface
COM 1	LUST protocol Baudrate: 1200, 2400, 4800, 9600, 19200 baud Data bits: 7 Parity: even Stop bits: 1 MEDIBUS protocol Baudrate: 1200, 2400, 4800, 9600, 19200 baud Data bits: 8 Partiy: even, odd, no Stop bits: 1 or 2 (19200 baud are required for transmission of high-speed data, e.g. for flow curve) Printer protocol HP Deskjet, series 500 Baudrate: 1200, 2400, 9600, 19200 baud Data bits: 8 Parity: no Stop bits: 1
Cable length:	Up to15 m
Load impedance:	3000 to 7000 Ω
Signal level (at load impedance 3000 to 7000 Ω)	
Low	Between 3 and 15 V
High	Between –3 and –15 V
Electrical isolation	Port COM 1 is electrically isolated from the machine electronics. The test voltage for the electrical isolation equals 1500 V.
Pin assignment	Pin 2 RxD Pin 3 TxD Pin 5 GND Connector housing Machine housing
Digital output	Output for independent lung ventilation (ILV)
Digital output (optional)	or output and reception via two RS 232 C interfaces
Digital output (optional)	for output and reception via a CAN interface
Analogue output (optional)	for output of analog data

Electromagnetic compatibility (EMC) (conforming to European Directive 89/336/EEC)	Tested in accordance with EN 60601-1-2
Classification as per EC Directive 93/42/EEC Annex IX	II b

UMDNS-Code 17-429
Universal Medical Device Nomenclature System –
Nomenclature for medical products

Materials used

Part	Appearance	Material
Ventilation hose	milky, transparent	silicone rubber
Water traps	milky, transparent	polysulphone
Y-piece	yellow, transparent	polysulphone
with connector for temperature measurement	yellow, transparent	silicone rubber
Expiration valve housing, closure	white	polyamide
Diaphragm	whitish and grey	silicone rubber and aluminium
CO_2 cuvette	yellow, transparent	polysulphone with glass windows
Temperature sensor / cable	milky / green or blue	silicone rubber
CO_2 sensor / cable	grey / grey	polyurethane

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Description

Ventilation Modes

Volume-controlled ventilation with PLV and AutoFlow®

AutoFlow® is a new additional function that regulates inspiratory flow during the mandatory ventilation stroke in the constant-volume ventilation modes IPPV, SIMV and MMV.
To explain the improvement achieved by this function, the conventional methods are explained first:

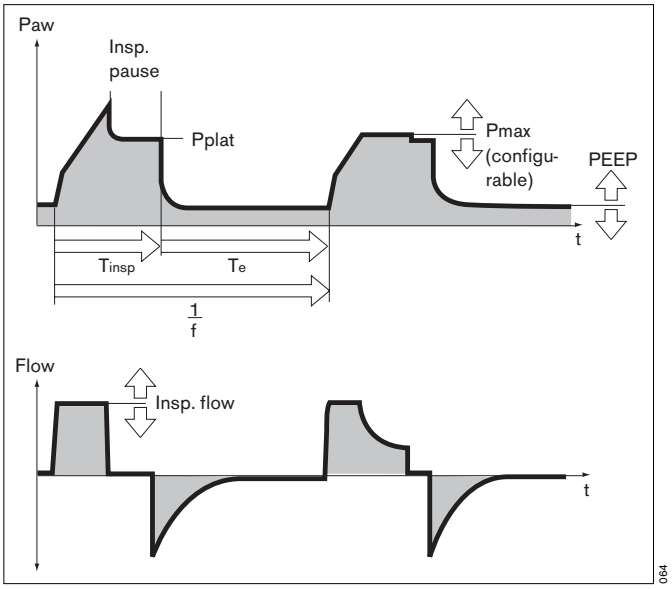
Classic volume constant mandatory ventilation stroke

In mandatory ventilation strokes without AutoFlow®, the »Insp.Flow« parameter restricts the inspiration flow. If the inspiration flow is so high that the set tidal volume V_T is attained before the inspiration time T_{insp} has fully elapsed, the inspiration valve closes, and the breathing gas supply stops. The expiration valve remains closed until the end of the inspiration time T_{insp}. This phase, the inspiratory pause, can be identified in the curve Paw (t) as the plateau P_{plat}.

This type of mandatory ventilation stroke, which for technical reasons is found in the same form in almost all intensive care ventilators, has two serious drawbacks:

— If the lungs are extremely non-homogeneous, the pressure peaks can lead to the overdistension of specific lung areas, and

— the limited inspiration flow and closed inspiration and expiration valves during the inspiratory pause can cause the patient to "fight" the machine, unless the pattern of ventilation is regularly adapted to the needs of the spontaneously breathing patient.



Manual pressure limiting with Pmax

Evita 4 can prevent pressure peaks, while maintaining the set tidal volume V_T, by means of the pressure limit Pmax. The tidal volume V_T remains constant as long as a pressure plateau P_{plat} is still detectable and the flow curve shows a brief zero flow between inspiration and expiration.

Evita 4 performs this function by reducing the Insp. Flow on reaching the set Pmax value. If the tidal volume V_T can no longer be attained with the selected pressure Pmax, due to reduced compliance, the alarm »Volume not constant !!« is automatically generated.
Manual pressure limiting can be performed with all Evita models.

AutoFlow®

The AutoFlow® function can be activated in the »Extra settings« menu. AutoFlow® takes over the task of setting both »Insp.Flow« and »Pmax«: the screen knobs for these parameters are no longer displayed.

With AutoFlow®, the inspiration flow is automatically adjusted to changes in lung conditions (C, R) and to the spontaneous breathing demand of the patient.

Always set the alarm limit »Paw ↑« in order to generate an alarm in the event of an increase in airway pressure with reduced compliance.

Typically, the selected inspiration time T_{insp} is much longer than the lung filling time. The inspiration pressure P_{insp} corresponds to the minimum value calculated from the tidal volume V_T and compliance C of the lung.

The inspiration flow is automatically controlled so that there is no pressure peak caused by the resistances of the tube and the airways. The plateau pressure P_{plat} varies with changes in compliance C, as is normal in all constant-volume ventilation strokes. With AutoFlow®, these variations occur in maximum steps of 3 mbar between ventilation strokes.

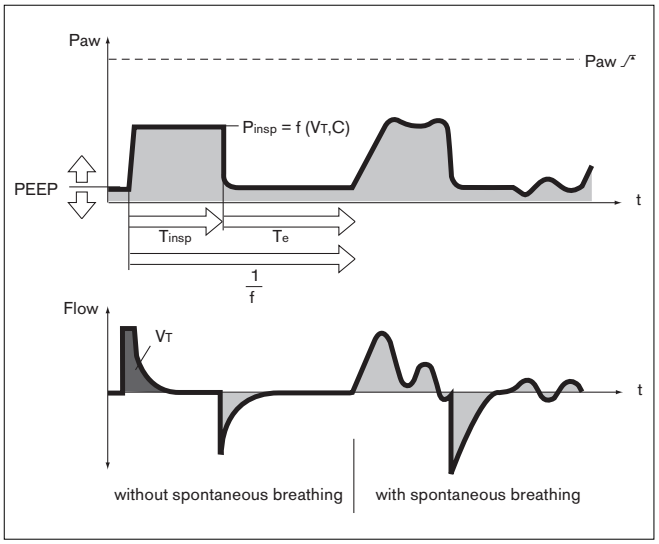
If the tidal volume V_T is reached (inspiration flow = 0) before the inspiration time T_{insp} has fully elapsed, the control system for the inspiration and expiration valves ensures that the patient can breathe in and out during the remaining inspiration time, even during a constant pressure plateau P_{plat}.

If the patient breathes in or out during mandatory inspiration, the plateau pressure P_{plat} is not changed for this ventilation stroke: only the inspiration and expiration flow are adapted to the patient's demand. The individually applied tidal volume V_T may differ from the set tidal volume V_T in specific ventilation strokes, but on average over time a constant tidal volume V_T is supplied.

Any overstepping of the tidal volume V_T can be limited by the alarm limit »V_{Ti} ↑« If the set alarm limit is exceeded once, Evita 4 generates an advisory (!); if the alarm limit is exceeded three times, Evita 4 generates a warning (!!!). In the above examples the volume is actively limited to the alarm limit value »V_{Ti} ↑« by switching over to the PEEP level.

- **Set the alarm limits MV ↓ and MV ↑ in order to avoid excessive or insufficient flow following rapid changes in compliance.**

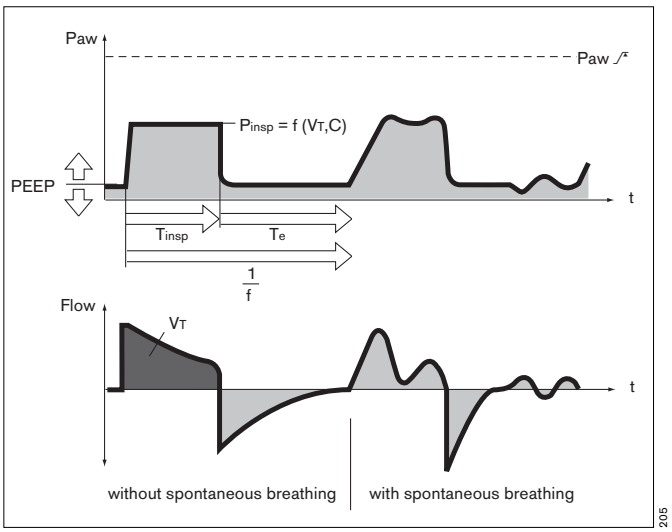
A set inspiration time T_{insp} shorter than the lung filling time can be recognised from the flow curve: the flow at the end of the inspiration time has not dropped to zero. Here, it must be decided whether the current condition of the patient permits prolongation of the inspiration time in order to reduce the peak pressure even further.



This effect can also be caused during ventilation, e.g. due to a build-up of secretion. In this situation, the pressure is limited by the alarm limit »Paw ⚠↑« The pressure rise stops 5 mbar below the alarm limit »Paw ⚠↑« and the alarm »Volume not constant !!« is only given when the set tidal volume V_T is not longer applied.

The start of mandatory inspiration can be synchronised with the patient's own efforts with the aid of the variable Flowtrigger. Only in IPPV mode can Flowtrigger be fully switched off (IPPV$_{Assist}$ -> IPPV).

The steepness of the pressure rise from the PEEP level to the inspiration level can be even more closely adapted to the needs of the patient in SIMV and MMV modes by means of the pressure rise timet » ⚠ « .



Start-up procedure with AutoFlow®

On switching on the AutoFlow® function, Evita 4 applies the set tidal volume V_T through a volume-controlled ventilation stroke with minimum inspiration flow and subsequent inspiratory pause. The plateau pressure P_{plat} calculated for this ventilation stroke serves as start-up inspiration pressure for the AutoFlow® function.

Sigh

"Sigh« is operative in the form of intermittent PEEP in IPPV, IPPV$_{Assist}$ and ILV.

The purpose of expiratory sigh during ventilation is to open collapsed areas of the lung, or to keep open "slow" areas of the lung.

Since atelectatic alveoli have a longer time constant – also caused by obstructed bronchioles – increased airway pressure maintained over a longer period is required to open them.

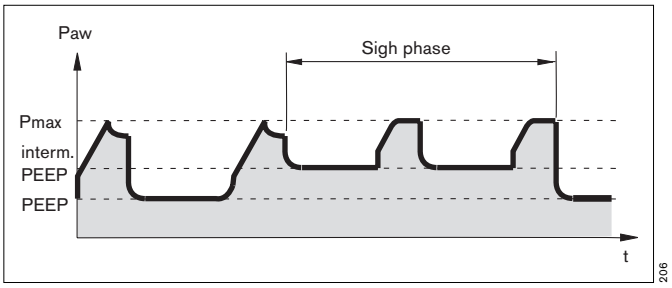
In many cases, the sigh function is achieved by increasing the ventilation stroke; however, due to the short time available, the filling of the »slow« alveoli is only marginally improved.

In Evita 4, the sigh operates during expiration with an intermittent PEEP for two ventilation strokes every 3 minutes.

The average airway pressure is higher, and a longer filling time is normally available.

To avoid overinflation of the lung, the pressure peaks during the sigh phase can be limited by pressure limitation Pmax, without impairing the sigh function.

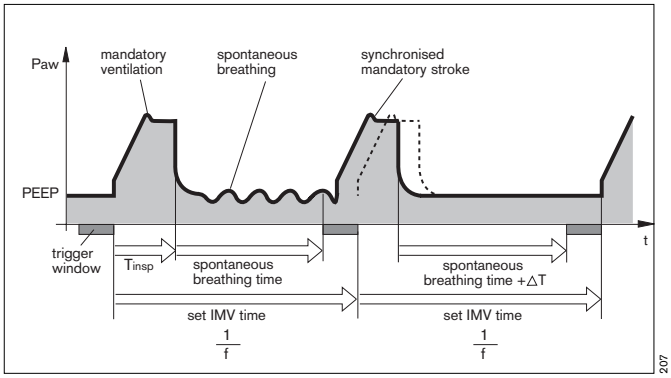
During the sigh phase, the »Volume not constant« alarm is disabled.



SIMV

Synchronisierte **I**ntermittierende **M**andatorische **V**entilation

Combination of machine ventilation and spontaneous breathing.



SIMV enables the patient to breathe spontaneously in regular prescribed cycles, with the mechanical mandatory ventilation strokes providing a minimum ventilation during the remaining cycles. The minimum ventilation is controlled by the two set values tidal volume (V_T) and ventilation frequency (f) and is determined from the product of V_T x f.

The ventilation pattern results from the set values V_T, Insp. Flow, frequency f and inspiration time T_{insp}. To prevent the mandatory ventilation stroke being applied during spontaneous expiration, the Flowtrigger of the machine ensures that the ventilation stroke is triggered in synchrony with the patient's spontaneous inspiratory effort within a "trigger window".

The "trigger window" is 5 seconds long in adult mode and 1.5 seconds long in paediatric mode. If the expiration times are less than 5 seconds or 1.5 seconds, the "trigger window" covers the entire expiration time.

Since the synchronisation of the mandatory ventilation stroke reduces the effective SIMV time, which would result in an undesirable increase in effective IMV frequency, Evita 4 prolongs the subsequent breathing time by the missing time difference ΔT. thus preventing an increase in SIMV frequency. The frequency parameter f remains constant. This parameter, in combination with the tidal volume V_T, sets the minimum ventilation. If the inspiratory volume of the patient is considerable at the beginning of the "trigger window", the machine reduces the subsequent mandatory ventilation stroke by shortening the time for the inspiratory flow phase and the inspiration time. In this way, the tidal volume V_T remains constant, and overinflation of the lungs is avoided.

During the spontaneous breathing phases, the patient can be assisted with pressure by ASB pressure support.

In the further weaning process, the frequency f on the ventilation unit is further reduced, thereby prolonging the spontaneous breathing time, until finally the required minute volume is entirely covered by spontaneous breathing.

ASB

Assisted **S**pontaneous **B**reathing

Pressure support for insufficient spontaneous breathing.

The function of the machine in assisting insufficient spontaneous breathing is similar to that of the anaesthetist who manually assists and monitors the patient's spontaneous breathing by feeling the breathing bag.

The machine takes over part of the inhalation function, with the patient maintaining control of spontaneous breathing.

The CPAP system supplies the spontaneously breathing patient with the breathing gas, even if the inspiration effort is weak.

The pressure support of the ASB system is started:

— when the spontaneous inspiration flow reaches the set value of the Flowtrigger,
or at the latest

— when the spontaneous inspired volume exceeds 25 mL (12 mL in paediatric mode).

The machine then produces an increase in pressure up to the preselected ASB pressure PASB, which is adjustable to the breathing requirement of the patient.

The time for this pressure increase is adjustable from 64 milliseconds to 2 seconds.

With a rapid increase in pressure
Evita 4 supports the insufficient spontaneous breathing of the patient with a high peak flow.

With a slow increase in pressure
Evita 4 begins gently with regular inspiratory flow. The patient has to take over more breathing effort, and tone of breathing muscles improves.

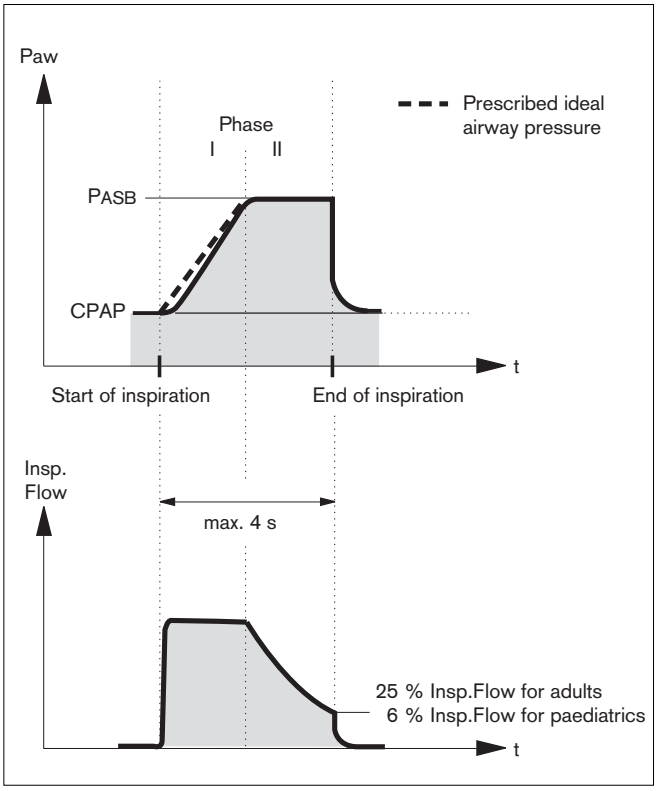
With the patient adjusted pressure increase and the present ASB level, the patient's own breathing activity defines the required inspiration flow, which can rise in 8 ms to 2 L/s.

ASB is terminated:

— when the inspiration flow returns to zero during phase I, i.e. when the patient exhales or fights the ventilator, or

— when the inspiration flow in phase II falls below a certain ratio of the maximum value previously supplied:
for adult ventilation: 25 % Insp.Flow
for paediatric ventilation: 25 % Insp.Flow
or

— at the latest after 4 seconds (1.5 seconds in paediatric ventilation) if the two other criteria have not come into operation.
If this 4-second criteria occurs three times in succession, Evita 4 sounds an alarm and warns of a possible leak in the ventilation system.



BIPAP

Biphasic **P**ositive **A**irway **P**ressure

The BIPAP ventilation mode is a pressure/time-cycled ventilation mode in which the patient can always breathe spontaneously. BIPAP is therefore often described as a time-cycled alternation between two CPAP levels.*

The time-cycled change of pressure gives controlled ventilation, which corresponds to pressure-controlled ventilation PCV. However, the constant option of spontaneous breathing allows the transition from controlled breathing to independent spontaneous breathing to take place smoothly via the weaning phase, without requiring any change the ventilation mode. To adapt easily to the patient's spontaneous breathing pattern, the change-over from expiratory pressure level to inspiratory pressure level, and also the changeover from inspiratory pressure level to expiratory pressure level, are synchronised with the patient's spontaneous breathing.

The frequency of the change-over is kept constant, even when synchronisation occurs via a "trigger window" with fixed time constant.

The "trigger window" is 5 seconds long in adult mode and 1.5 seconds long in paediatric mode. For expiration times shorter than 5 seconds or 1.5 seconds, the "trigger window" covers the entire expiration time. At P_{insp} level, the "trigger window" is 1/4 x T_{insp} seconds long.

As recent clinical research** has shown, this smooth adaptation to the patient's spontaneous breathing requires less sedation, so that the patient returns to spontaneous breathing more rapidly.

As in all pressure-controlled ventilation modes, the patient is not prescribed a fixed tidal volume (V_T).
The tidal volume results principally from the pressure difference between the settings for PEEP and P_{insp}.

Changes in lung compliance and airways, as well as active breathing by the patient can lead to changes in tidal volume. This is a desired effect in this ventilation mode.

With the knowledge that the tidal volume, and therefore the minute volume, are not constant, the alarm limits for minute volume must be adjusted with care.

The display of the expiratory measured tidal volume V_{Te} must be used to set the required difference between the two pressure levels. Any increase in differential will cause an increased BIPAP ventilation stroke.

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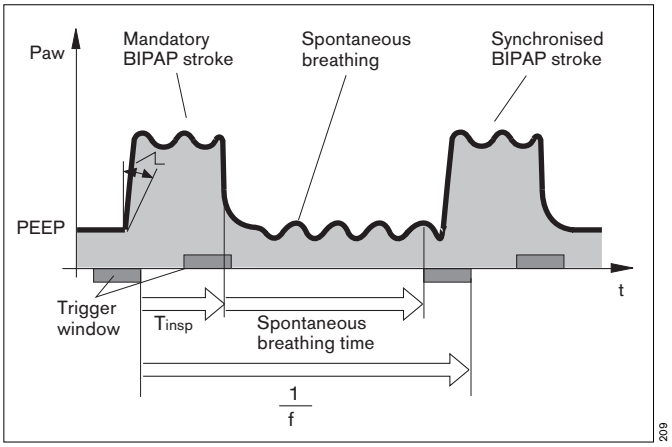
* Bibliography (3), (4), (7), (11), (12) page 175
** Bibliography (8) page 175

As with SIMV, the time pattern is set using the basic setting parameters of frequency f and T_{insp}. The resulting inspiration and expiration times are cal-culated by Evita 4 and displayed in the lower half of the screen below the curve setting. The lower pressure level is set with the PEEP parameter, while the upper level is set with P_{insp}. When switching over from IPPV to BIPAP mode, only the P_{insp} setting needs to be changed.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the setting ⩘ The effective time for the increase in pressure cannot become greater than the set inspiratory time T_{insp}. This precaution ensures that the upper pressure level P_{insp} is reached safely during inspiration. The transition from controlled ventilation via the weaning phase to fully spontaneous breathing is achieved by a gradual reduction of inspiratory pressure P_{insp} and/or frequency f.



BIPAPAssist

Biphasic **P**ositive Airway **P**ressure **A**ssisted

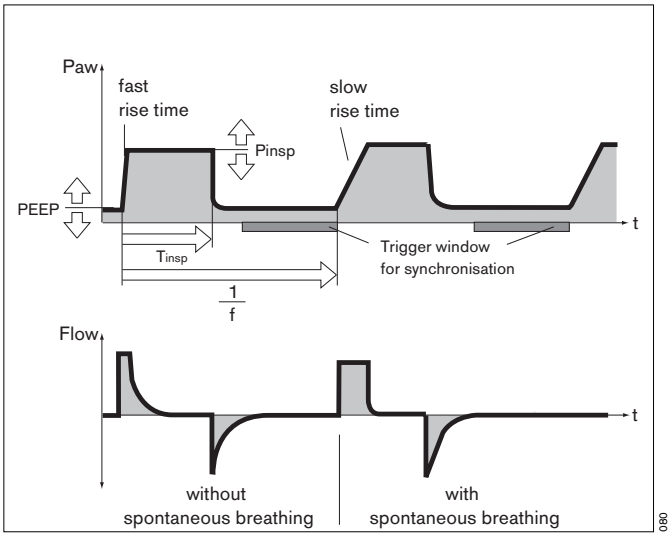
Pressure-controlled, assisted ventilation

The inspiratory strokes are the same as for BIPAP, except that the change from P_{insp} to PEEP is not synchronised with expiration by the patient. The duration of P_{insp} depends on T_{insp}. The patient can breathe spontaneously throughout the ventilation process.

Every detected spontaneous breathing activity by the patient triggers a synchronised inspiration stroke.

A non-synchronised inspiratory stroke is triggered by the machine at the latest upon expiry of the inspiration time defined by »f« and »T_{insp}«.

For all patients, from those unable to breathe spontaneously to those breathing spontaneously before being weaned off the ventilator.



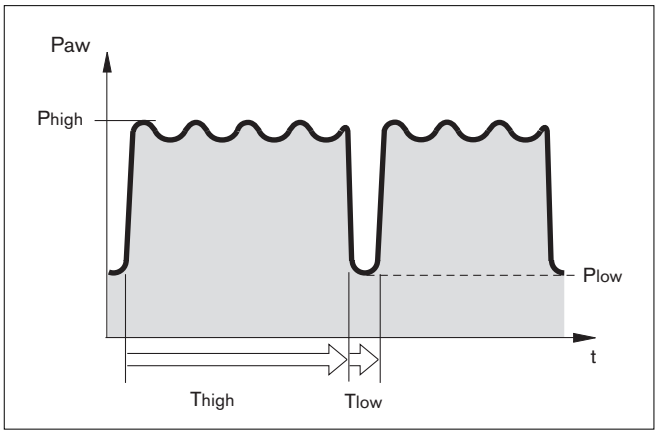
APRV

Airway **P**ressure **R**elease **V**entilation

Spontaneous breathing under continuous positive airway pressure with brief pressure release. This ventilation mode is suitable for patients with a poor gas exchange. The patient breathes spontaneously at a high pressure level P_{high} for an adjustable length of time T_{high}. For very short expiration times T_{low}, Evita 4 switches to a low pressure level P_{low}. The normal lung areas are emptied, but the "slow" lung areas only change volume to a lesser extent.*

In this way, the ventilation/perfusion ratio can be improved for patients with a poor gas exchange.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the setting ⩘ The effective time for the increase in pressure cannot become greater than the set time T_{high}.



MMV

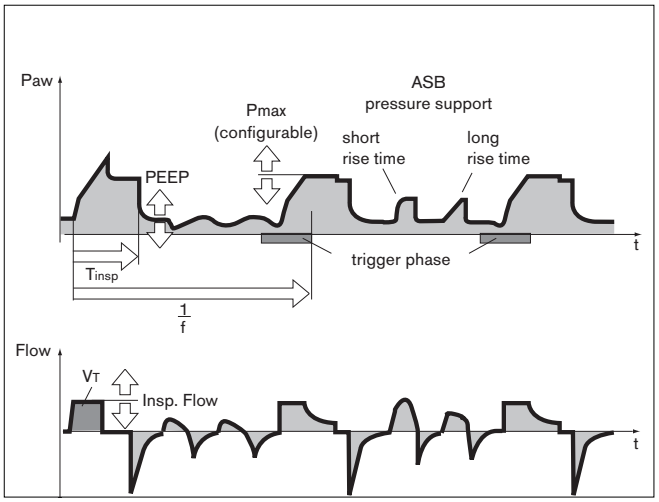
Mandatorische **M**inutenvolumen-**V**entilation

In contrast to SIMV, the MMV ventilation mode gives mandatory breathing only if spontaneous breathing is not yet sufficient and has fallen below a pre-selected minimum ventilation. This minimum ventilation is controlled by the two set values tidal volume V_T and frequency f, and results from the product V_T x f.

Unlike SIMV, the mandatory strokes are not given regularly but only in cases of insufficient ventilation.

The frequency of mandatory strokes is determined by the level of spontaneous breathing: if spontaneous breathing is sufficient, mandatory strokes are not used. If spontaneous breathing is not sufficient, intermittent mandatory strokes of the set tidal volume V_T are applied. If there is no spontaneous breathing at all, the mandatory strokes are applied at the set frequency f.

Evita 4 continuously balances the difference between spontaneous breathing and the set minimum ventilation. As soon as the balance becomes negative, because spontaneous breathing is no longer sufficient, Evita 4 applies a mandatory ventilation stroke at the set tidal volume V_T, so that the balance is again positive.



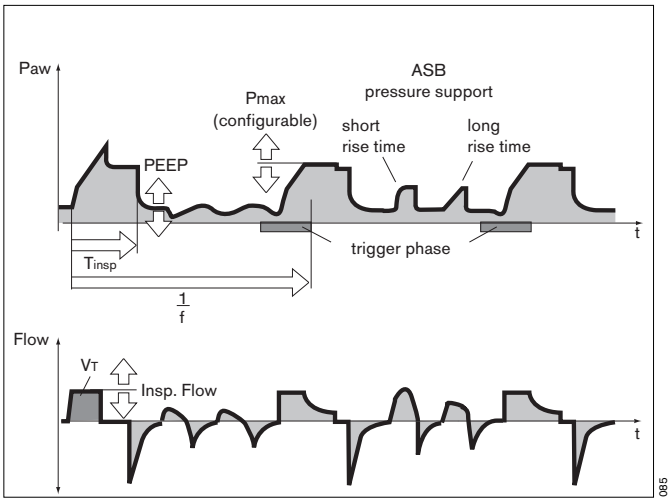
* Bibliography (6), (7), (8), (9), page 175

Experience shows, patients breathe very irregularly. Phases of weak breathing alternate with phases of heavy breathing. In order to allow for these individual fluctua-tions, the balancing process also takes account of the extent by which the set minimum ventilation has been exceeded. This positive allowance is progressively reduced to zero by Evita 4 within a maximum of 7.5 seconds after apnoea.

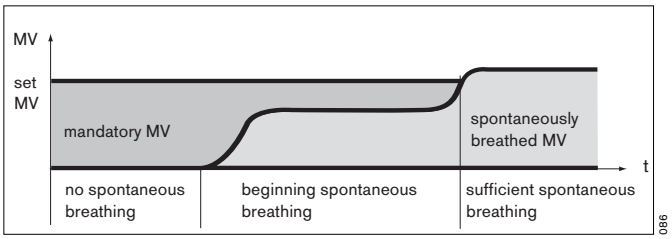
In other words, the response time of Evita 4 before activating mandatory ventilation is automatically adapted to the preceding cycle of spontaneous breathing:

If this spontaneous breathing was close to the minimum ventilation, the machine responds rapidly within the IMV time. By contrast, if the patient's spontaneous breathing was much higher than the set minimum ventilation, Evita 4 tolerates a longer breathing pause. In extreme cases of sudden apnoea after a phase of heavy breathing, the response time will be 7.5 seconds plus the trigger time, with a minimum of 1 IMV cycle time.

Response times longer than 15 seconds may only occur if the minimum ventilation with a low IMV frequency f is set to correspondingly low values.



In this case, Evita 4 triggers an apnoea alarm that is cancelled again as soon as the mandatory ventilation strokes have been applied. If the IMV is set to a longer period than the T_{Apnoea} > alarm limit, and if there is no spontaneous breathing between the mandatory ventilation strokes, the apnoea alarm will be regularly triggered.



Example:

f = 3/min = IMV time = 20 seconds

T_{Apnoea} = 15 seconds

This system is designed to prevent mandatory ventilation being prematurely triggered in the event of irregular spontaneous breathing, whilst at the same time giving an alarm for any long period of low ventilation.

Flow measurement

Regardless of whether ventilation is volume-controlled or pressure-controlled, positive pressures are generated in both the breathing system and patient lung during the inspiration phase. Depending on the ratio of lung compliance to hose system compliance, the volume delivered by the ventilator is distributed to the patient's lung and to the hose system installed between the ventilator and patient. Deviations in the measured expiration flow and derived values, such as the minute volume and breath volume, are low for adult patients, due to their relatively high lung compliance in relation to the much lower compliance of the ventilation hoses.

However, since only the volume attained and surrendered by the lung is relevant to the efficiency of ventilation, and since higher differences are possible during paediatric ventilation, Evita 4 provides basic compensation for hose compliance during ventilation.

Compensation of the effect of hose system compliance

During the device check before ventilation, Evita 4 determines the compliance of the ventilation hoses, and then, during ventilation, compensates for the effect of compliance on volumetric flow measurement.

Depending on the airway pressure, Evita 4 increases the tidal volume by the amount that remains in the ventilation hoses.

In addition to hose system compliance, flow/volume measurement is influenced by the environmental factors of temperature and humidity and by leaks in the hose system. Evita 4 takes these factors into account and corrects the settings and measured values accordingly.

Conversion according to ambient conditions

The volume occupied by a gas depends on the ambient conditions of temperature, pressure and humidity.
In lung physiology, the minute volume and tidal volume are related to the ambient conditions in the lung:
37 °C body temperature, pressure in the lung,
100 % relative humidity.

The flow and volume values measured under these conditions are marked with BTPS* On the other hand, medical gases from cylinders or from the central supply are dry (approx. 0 % r.h.) and are delivered by the ventilator at 20 °C. The flow and volume values measured under these conditions are marked NTPD** The difference between measured values under NTPD and BTPS conditions is typically approx. 12 %.

Example: a tidal volume of 500 mL NTPD is increased to 564 mL BTPS by heating to 37 °C and humidifying to 100 % r.h. Evita 4 delivers the tidal volume after conversion, so that the set tidal volume is effective in the lung under BTPS conditions.

---

* BTPS = Body Temperature, Pressure, Saturated.
** NTPD = Normal Temperature Pressure Dry.

Automatic leakage compensation

Evita 4 determines the difference between the delivered flow on the inspiration side and the measured flow on the expiration side.
This difference provides a measure of the amount of leakage and is displayed by Evita 4 as the leakage minute volume MV_{leak}. Evita 4 can compensate for this leakage in volumecontrolled ventilation.

Example:
Tidal volume setting V_T = 500 mL,
10 % leakage in tube.

Leakage compensation Off

Evita 4 delivers 500 mL. This is indicated as the inspiratory tidal volume V_{Ti}. 50 mL escape as leakage during inspiration, and 450 mL reach the lung. 450 mL are expired, and 45 mL again escape as leakage. A tidal volume of 405 mL is measured on the expiration side and indicated as V_{Te}. With a ventilation rate of 10 strokes per minute, a minute volume of 5.0 L/min is delivered on the inspiration side and a minute volume of 4.05 L/min is measured on the expiration side. The lung is ventilated with an MV of 4.5 L/min.

Without leakage compensation, the set V_T determines the volume delivered by Evita 4.

Leakage compensation On

With automatic leakage compensation, Evita 4 delivers 550 mL on the basis of the measured leakage minute volume, instead of the 500 mL set. 500 mL enter the lung and the displayed inspiratory tidal volume V_T is 500 mL. The volume of 450 mL measured on the expiration side is displayed without compensation, even when leakage compensation is activated. The minute volume measured on the expiration side is 4.5 L/min and is also uncompensated. If this were not so, the alarm for a low minute volume could be inhibited by the expiratory leakage compensation. Evita 4 must always emit an alarm if the minute volume is too low.

With leakage compensation, the set V_T determines the volume to be delivered to the patient.

This example has been simplified:
In fact, the calculated leakage correction takes into account the pressures in the hose system. A higher percentage volume is lost on the inspiration side than on the expiration side because the pressure during inspiration is higher. The displayed leakage minute volume MV_{leak} is based on the mean pressure P_{mean}.

The leakage minute volume MV_{leak} also takes the inspiratory leaks into account. The sum of the minute volume MV + the leakage minute volume MV_{leak} is consequently greater than the inspiratory minute volume delivered to the patient.

Unlimited volume compensation is inappropriate.
Evita 4 compensates for losses of up to 100 % of the set tidal volume V_T. Due to technical tolerances, a small leakage minute volume may be displayed even if the hose system is leakproof.

Weaning Parameters

P 0.1, RSB, NIF:

A number of criteria must be taken into account by the doctor when deciding whether or not a patient is ready to be weaned off the ventilator. In addition to the results of examinations and laboratory analyses, ventilation parameters can also be used to judge whether the patient can be weaned successfully.

The following weaning parameters are calculated by Evita 4:

- Occlusion pressure P 0.1
- Rapid Shallow Breathing RSB
- Negative Inspiratory Force NIF

Occlusion pressure P 0.1

Breathing drive can be measured at the start of inspiration by measuring the mouth pressure during a shortterm occlusion: within 100 ms, the pressure is not influenced by physiological compensation reaction (e.g. reflected breathing stop or increased breathing drive). This pressure is always dependent on the muscle strength of the diaphragm. Therefore, the negative mouth pressure P 0.1 after 0.1 seconds is a direct measure of neuro-muscular breathing drive*.

For patients with healthy lungs and regular breathing, P 0.1 will be about –3 to –4 mbar. A higher P 0.1 signifies a high breathing drive which can only be maintained for a limited period. P 0.1 values about –6 mbar, e.g. for a COPD** patient, indicate impending exhaustion (RMF – respiratory muscle fatigue).

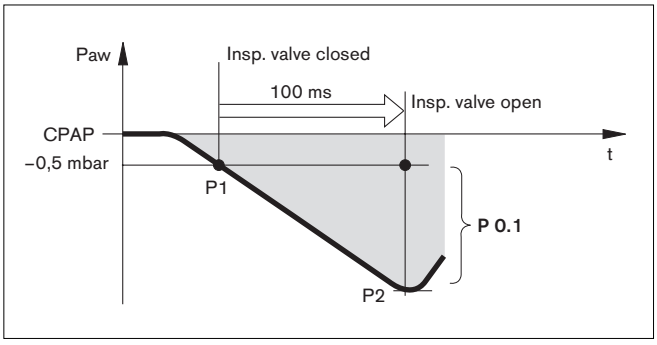
When weaning COPD patients off the Ventilator, measurement of P 0.1 can define the weaning point.

To measure P 0.1, Evita 4 keeps the inspiratory valve closed after one expiration and measures the airway pressure produced by the inspiratory effort during 100 ms (P1).

The 100 ms time interval starts when a negative pressure of –0.5 mbar is measured as a result of the inspiratory effort.

A second pressure value (P2) is activated after 100 ms. Simultaneously, the inspiratory valve is opened so that the patient can breathe normally again.

The occlusion pressure P 0.1 is the difference between the pressure values P2 – P1.



* Bibliography (10), (15), page 175
** COPD = Chronic Obstructive Pulmonary Disease

Rapid Shallow Breathing RSB

The Rapid Shallow Breathing index (RSB)* is the quotient of the spontaneous breathing frequency (spontaneously breathed breaths per minute) and the tidal volume:

$$RSB\ [1/(min \times L)] = \frac{f_{spn}\ [1/min]}{V_T[L]}$$

The lower the RSB index for a patient with spontaneous breathing, the more probably he or she can be weaned successfully. The significance of the RSB index is due to the fact that patients who can be weaned successfully tend to have a lower spontaneous breathing frequency and a higher tidal volume than those who are not yet ready to be weaned.

In their 1991 study*, Yang and Tobin showed that the RSB index is an effective instrument for predicting the success of an attempt to wean the patient. Patients with an RSB index <100 1/(min x L) were weaned with a probability of 80 %, while 95 % of those with an RSB index >100 were not yet ready to be weaned. Evita 4 indicates the RSB index in CPAP/ASB and PPS modes.

Negative Inspiratory Force NIF

The Negative Inspiratory Force index (NIF)** measures the patient's maximum inhalation effort after exhaling. The patient system is closed during measurement of the NIF. This value is also known as the Maximum Inspiratory Pressure (MIP). As a result of the inhalation effort during manually extended expiration, the patient generates a negative pressure in relation to PEEP. The probability that the patient can be weaned successfully increases with the magnitude of this negative pressure. Patients with a NIF < –30 mbar can in all probability be weaned successfully, while those with a NIF of up to –20 mbar will most probably prove unsuccessful.
Evita 4 determines the NIF value during manually extended expiration. The patient system closes following expiration by the patient while the **»Exp. hold«** key is held down and Evita 4 measures the maximum inhalation effort made by the patient. The NIF is measured as a pressure against PEEP. The measuring procedure is ended when the **»Exp. hold«** key is released or after not more than 15 seconds. The last measured NIF value and the time of measurement are shown in Table 2 on the screen.

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* Bibliography (16),page 175
** Bibliography (17), (18), page 175

Intrinsic PEEP

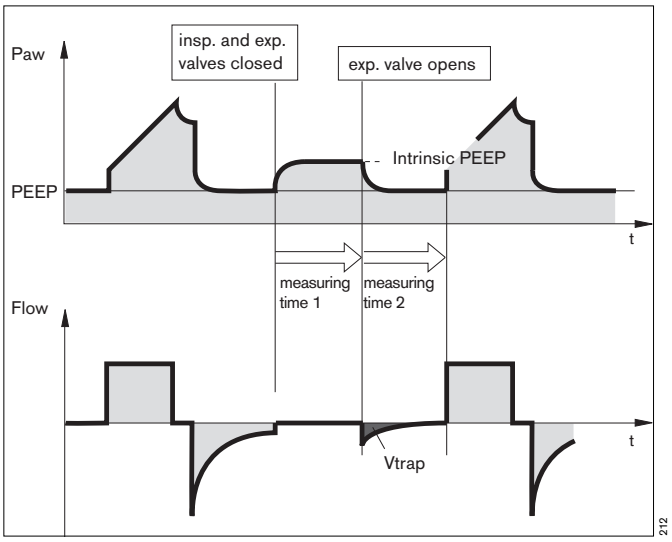
Evita 4 keeps the inspiratory valve and expiratory valve closed during measuring time 1, so that it is impossible for gas either to flow into the ventilation system from inspiration or to escape from it. During this closed phase, pressure is equalised between the lungs and the ventilation system. Evita 4 measures the pressure curve.
Measuring phase 1 is ended:

— when there is no further change in the pressure curve but at the earliest after 0.5 seconds.
— at the latest after 3 seconds in adult mode and after 1.5 seconds in paediatric mode.

The start value corresponds to PEEP, and the value at the end of the closed phase is the Intrinsic PEEP.

At the end of measuring time 1, Evita 4 opens the expiration valve and measures the expiratory flow generated by Intrinsic PEEP during a defined measuring time 2. During this period, the lung is depressurised to PEEP.
Measuring phase 2 is ended:

— when the expiration flow has returned to 0 but at the earliest after 0.5 seconds.
— at the latest after 7 seconds in adult mode or after 3.5 seconds in paediatric mode.



The integrated flow corresponds to the air volume trapped in the lungs (V_{trap}) by Intrinsic PEEP.

Measuring times of the measuring phase 1 for Intrinsic PEEP:

For adult ventilation	max. 3 seconds
For paediatric ventilation	max. 1.5 seconds

Measuring times of the measuring phase 2 for V_{trap}:

For adult ventilation	max. 7 seconds
For paediatric ventilation	max. 3.5 seconds

Insp. O_2 Concentration During Medicament Nebulisation

Use only medicament nebuliser 84 12 935 (white central section).

If other medicament nebulisers are used, con-siderable deviations may occur in the tidal volume and the inspiratory O_2 concentration.

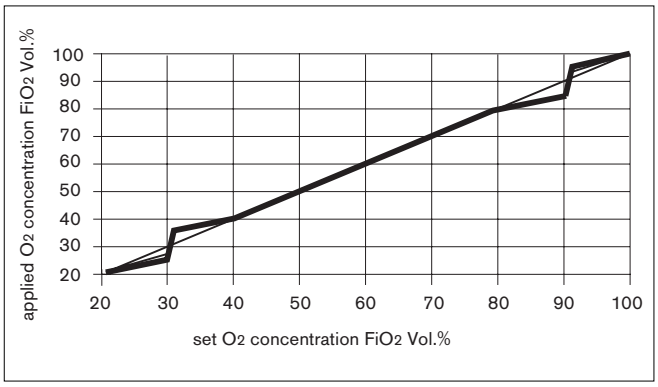
To minimise the deviation from the set O_2 concentration, Evita 4 uses a mixed gas to drive the medicament nebuliser.

In adult ventilation, this mixed gas is generated by switching over between compressed gases (medical air and oxygen) in synchronisation with inspiration.

In paediatric ventilation, the nebuliser is operated continuously, with medical air or oxygen in alternation.

The drive gas of the medicament nebuliser therefore roughly corresponds to the set FiO_2.

The graph shows the possible deviations of the applied O_2 concentration as a function of the set FiO_2 with a minimal inspiratory flow (15 L/min) in adult ventilation or at ventilation frequencies above 12 bpm in paediatric ventilation.



Abbreviations

Abreviation	Definition
APRV	**A**irway **P**ressure **R**elease **V**entilation Spontaneous breathing at continuous positive airway pressure with short-term pressure release
ASB	**A**ssisted **S**pontaneous **B**reathing Pressure supported spontaneous breathing
BIPAP	**B**iphasic **P**ositive **A**irway **P**ressure Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
$BIPAP_{Assist}$	**B**iphasic **P**ositive **A**irway **P**ressure Assisted Ventilation mode for assisted ventilation with continuous positive airway pressure with two different pressure levels
bpm	breath per minute
BTPS	**B**ody **T**emperatur, **P**ressure. **S**aturated Measured values based on the condition of the patient's lungs, with body temperature 37 ºC, steam-saturated gas, atmospheric pressure
C	Compliance
CPAP	**C**ontinuous **P**ositive **A**irway **P**ressure Breathing with continuous positive pressure in the airways
$etCO_2$	End-expiratory CO_2 concentration
$FeCO_2$	Expiratory CO_2 concentration
f	Frequency
f_{Apnoea}	Frequency setting for apnoea ventilation
f_{mand}	Mandatory mechanical portion of overall breathing frequency
f_{spn}	Spontaneous breathing portion of overall breathing frequency
Fail to cycle	Breathing cycle failure. Machine detects no inspiration
FiO_2	Inspiratory O_2 concentration
Flow	Set value of the maximum inspiratory flow
$Flow_{Trig}$	Set value of the flow trigger threshold
ILV	Independent **L**ung **V**entilation Ventilation with 2 ventilators, 1 for each lung
Int. PEEP	Intermittent Positive End-Expiratory Pressure = Sigh
IPPV	**I**ntermittent **P**ositive **P**ressure **V**entilation
$IPPV_{Assist}$	Trigger Assist Intermittent Positive Pressure Ventilation
IRV	**I**nversed **R**atio **V**entilation Ventilation with inversed inspiration/ expiration ratio

Abreviation	Definition
ISO 5369	International standard for mechanical ventilators – "Lung Ventilation"
I : E	Ratio of Inspiration to Expiration
KG	Body weight [kg]
MMV	**M**andatory **M**inute Volume **V**entilation
MV	**M**inute **V**olume
MV_{Leak}	Leakage minute volume
MV_{spn}	Spontaneous breathed minute volume
NIF	**N**egative **I**nspiratory **F**orce Maximum inhalation effort
O_2	Set value for inspiratory oxygen concentration [Vol.%]
P 0.1	100 ms occlusion pressure
P_{ASB}	Set value of ASB pressure support
Paw	Airway pressure
PEEP	**P**ositive **E**nd-**E**xpiratory **P**ressure
PEEPi	Intrinsic Positive End-Expiratory Pressure
P_{high}	Set value of the upper pressure level APRV
P_{insp}	Set value of the upper pressure level in BIPAP
P_{max}	Set value for pressure limited ventilation
P_{mean}	Mean airway pressure
PLV	**P**ressure **L**imited **V**entilation
P_{peak}	Peak pressure
P_{plat}	End-inspiratory airway pressure
P_{low}	Set value of the lower pressure level in APRV
PS	**P**ressure **S**upport
R	Resistance
RSB	**R**apid **S**hallow **B**reathing Quotient of spontaneous breathing frequency and tidal volume
SIMV	**S**ynchronized **I**ntermittent **M**andatory **V**entilation
T	Inspiratory breathing gas temperature
T_{Apnoea}	Apnoea alarm time
Te	Expiration time
TGI	**T**racheale **G**as **I**nsuflation
T_{high}	Time for the upper pressure level in APRV
T_{insp}	Set value of the inspiratory time
T_{low}	Time for the lower pressure level in APRV

Abreviation	Definition
$\dot{V}CO_2$	CO_2 production [L/min]
Vds	Serial dead space
V_T	Setting for tidal volume
VT_{Apnoea}	Setting for tidal volume of apnoea ventilation
VT_{ASB}	Inspiratory breathing volume during an ASB stroke
V_{Te}	Expiratory tidal volume
V_{Ti}	Inspiratory tidal volume
V_{trap}	Volume trapped in the lung by intrinsic PEEP, and exhaled during subsequent expiration

Symbols

Symbol	Definition
	Switch medicament nebuliser on / off
	Switch oxygen enrichment for bronchial suction on / off
Insp. hold	Manual inspiration
Exp. hold	Manual expiration
	Blank/unblank screen display
	Manual printer logging
	Switch help function on / off
	"Freeze" curves in screen
	Back to standard page
	Cancel acoustic alarm for 2 minutes
Alarm Reset	Alarms
	Standby / Operation
	Select other measured value combination
	Select other curve(s)
	Time setting for pressure increase during PASB
	Lower / upper alarm limit
	Observe Instructions for Use!
	Type B
	Type BF
	Insert flow sensor
	Unlocking expiration valve
Exp.	Exp. expiration port (GAS RETURN)
Insp.	Insp. inspiratory port (GAS OUTPUT)*
	Gas outlet (EXHAUST – NOT FOR SPIROMETER)*
A	Patient mode Adults
P	Patient mode Paediatrics
	Spontaneous breathing activity by the patient
	Evita Remote Pad
	Nurse call
	Earth

* additional, depending on equipment status

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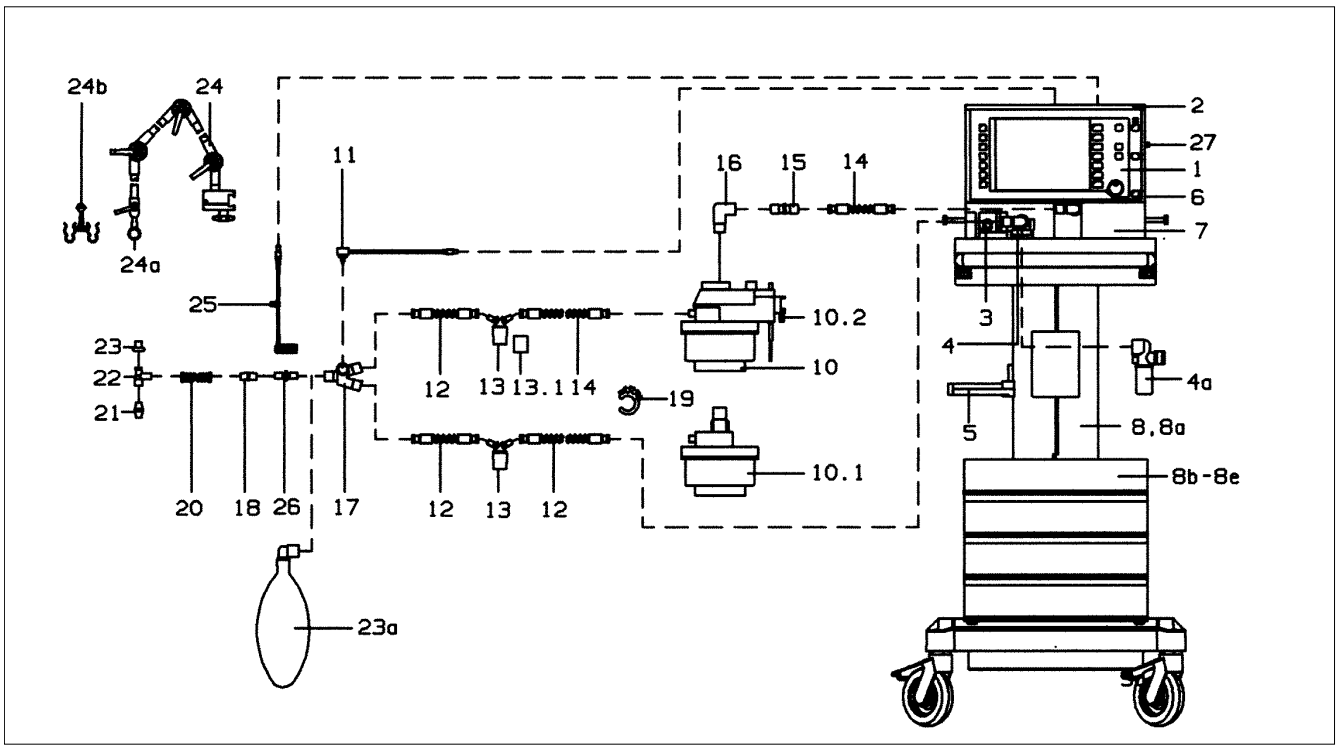
Parts List

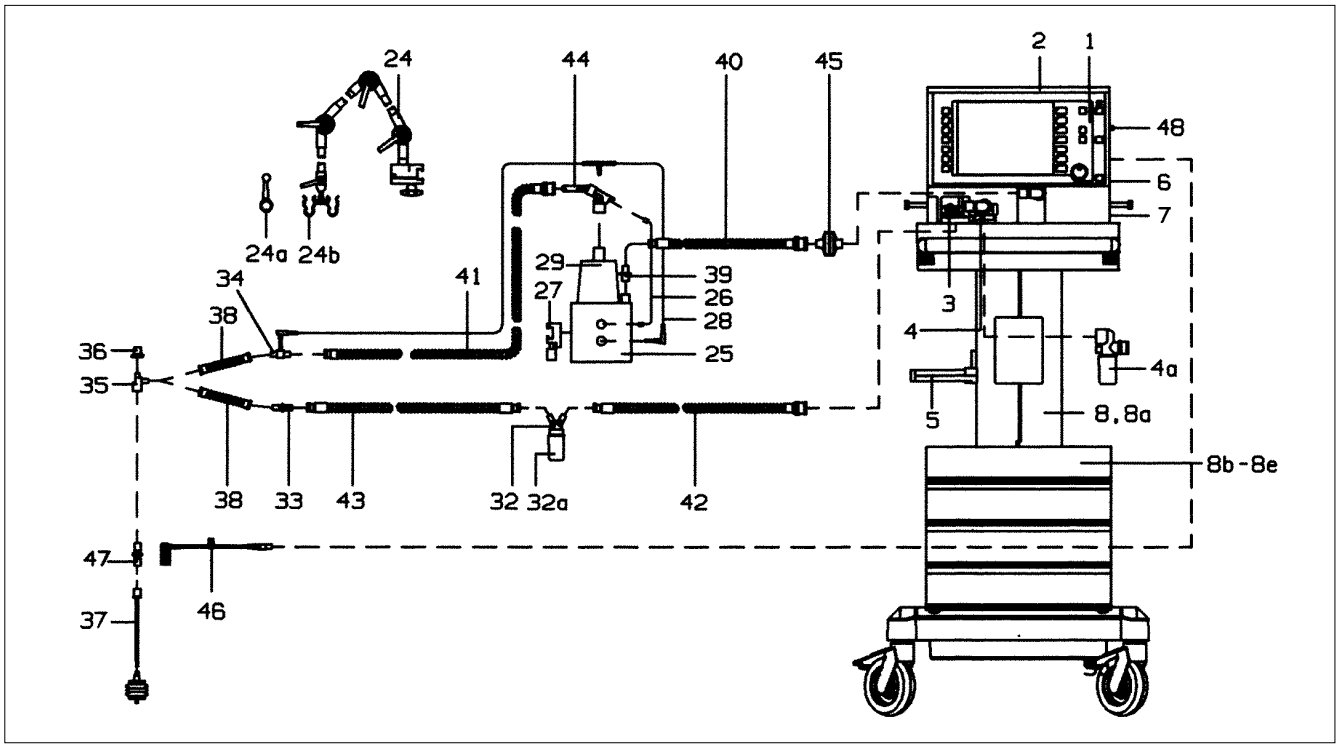
For adults ventilation



Item No.	Name/Description	Order No.
1	Evita 4	84 11 900
2	Instrument tray	84 12 723
3	Flow sensor (set of 5)	84 03 735
4	Expiration valve (patient system)	84 10 580
5	Bracket (for Aquapor)	84 11 956
6	O_2 sensor housing	68 50 645
7	Ambient-air filter	84 12 384
7a	Cooling-air filter (back of Evita 4, not illust.)	84 12 384
8	"EvitaMobil" trolley (high)	84 11 950
8a	"EvitaMobil" trolley (low)	84 11 965
8b	Cabinet 8H, 360 mm high (4 drawers)	M 31 796
8c	Cabinet 4H (2 drawers) (not illust.)	M 31 795
8d	"EvitaMobil" cylinder holder set (not illust.)	84 11 970
8e	Breathing air compressor (not illust.)	84 13 890
10	Aquapor (220 – 240 V)	84 05 020
	Aquapor (110 V)	84 05 199
10.1	Patient part, Aquapor	84 05 029
10.2	Set of spare brackets	84 03 345
11	Temperature sensor	84 05 371
12-23	Hose set, adult (blue socket)	84 12 092
12	Spiral hose adult, silicone 0.6 m	21 65 627

Item No.	Name/Description	Order No.
13-13.1	Water traps	84 04 985
13.1	Water container	84 03 976
14	Spiral hose adult, silicone 0.35 m	21 65 619
15	Connector	M 25 647
16	ISO elbow connector	M 25 649
17	Y-piece, straight	84 05 435
18	Catheter connector, straight, size 12.5 (set of 10)	M 23 841
19	Hose clamp	84 03 566
20	Corrugated hose	84 02 041
21	Catheter connector, adult	
	Set of catheter connectors, adult Sizes 6 to 12 (set of 12)	84 03 685
22	Adaptor adult	84 03 076
23	Cap (set of 5)	84 02 918
23a	Adult test lung (bag)	84 03 201
24-24b	Hinged arm	84 09 609
or	Quick-fix hinged arm 2	2M 85 706
24a	Bracket	84 09 746
24b	Hose clamp	84 09 841
25	CO_2 main flow sensor	68 70 300
26	Cuvette, adult	68 70 279
27	Holder for parking CO_2 sensor	84 12 840

For paediatric ventilation



Item No.	Name/Description	Order No.
1	Evita 4	84 11 900
2	Instrument tray	84 12 723
3	Flow sensor (set of 5)	84 03 735
4	Expiration valve (patient system)	84 10 580
5	Bracket (for Aquapor)	84 11 956
6	O_2 sensor housing	68 50 645
7	Ambient-air filter	84 12 384
7a	Cooling-air filter (back of Evita 4, not illust.)	84 12 384
8	"EvitaMobil" trolley (high)	84 11 950
8a	"EvitaMobil" trolley (low)	84 11 965
8b	Cabinet 8H, 360 mm high (4 drawers)	M 31 796
8c	Cabinet 4H (2 drawers) (not illust.)	M 31 795
8d	"EvitaMobil" cylinder holder set (not illust.)	84 11 970
8e	Breathing air compressor (not illust.)	84 13 890
24-24b	Hinged arm	84 09 609
or	Quick-fix hinged arm 2	2M 85 706
24a	Bracket	84 09 746
24b	Hose clamp	84 09 841
26-28	Humidifier, basic unit MR 730 (Fisher & Paykel)	84 11 046
26	Hose heater adapter	84 11 097
27	Mounting set (clamps for rail)	84 11 074
28	Double temperature sensor	84 11 048
29-30	Humidifier chamber MR 340	84 11 047

Item No.	Name/Description	Order No.
30	Filter paper (set of 200, not illustr.)	84 11 073
31	Single-strand wire 1.5 m (not illustr.)	84 11 050
32-43	Hose set, paediatrics (Fisher & Paykel)	84 12 081
32-32a	Condensation trap, expiration	84 09 627
32	Water container	84 03 976
33	Double conical connector	84 09 897
34	Temperature sensor mounting	84 11 044
35	Adapter K90	84 03 075
36	Cap	84 01 645
37	Bellows, paediatric, complete	84 09 742
38	Corrugated hose, flex, 0.13 m	84 09 634
39	Catheter connector, size 11	M 19 351
40	Spiral hose, paediatric, silicone 22/10, 0.40 m	21 65 856
41	Spiral hose, paediatric, silicone 22/10, 1.10 m	21 65 651
42	Spiral hose, paediatric, silicone 22/10, 0.60 m	21 65 821
43	Spiral hose, paediatric, silicone 10/10, 0.60 m	21 65 848
44	Hose heater 1.10 m	84 11 045
45	Bacterial filter	MX 02 650
46	CO_2 main flow sensor	68 70 300
47	Cuvette, paediatrics	68 70 280
48	Holder for parking CO_2 sensor	84 12 840

Order List

Name/Description	Order No.
Basic unit	
Evita 4	84 11 900
Accessories required for operation	
Hinged arm	84 09 609
or	
Quick-fix hinged arm 2	2M 85 706
O_2 connecting hose 3 m, blue	M 29 231
or	
O_2 connecting hose 5 m, blue	M 29 251
or	
O_2 connecting hose 3 m, neutral colour	M 34 402
or	
O_2 connecting hose 5 m, neutral colour	M 34 403
Medical air connecting hose 3 m, yellow	M 29 239
or	
Medical air connecting hose 5 m, yellow	M 29 259
or	
Med. air connect. hose 3 m, neutral colour	M 34 408
or	
Med. air connect. hose 5 m, neutral colour	M 34 409
Trolley	84 11 680
For adult ventilation	
Temperature sensor	84 05 371
Aquapor EL humidifier	84 14 698
Set of spare brackets	84 03 345
Hose set, adult consisting of: patient hoses, water traps, Y-piece, catheter connectors	84 12 092
For paediatric ventilation	
Humidifier, basic unit, MR 730 (Fisher & Paykel), incl. adaptor, hose heater	84 11 097
Mounting set (rail brackets)	84 11 074
Humidifier chamber, MR 340	84 11 047
Double temperature sensor	84 11 048
Single-strand wire, 1.5 m	84 11 050
Hose set, paediatric (Fisher & Paykel) consisting of: hose heater 84 11 045, patient hoses, water traps, Y-piece, catheter connectors	84 12 081
Bacterial filter	MX 02 650

Name/Description	Order No.
For CO_2 measurement	
Calibration set	84 12 710
Test gas cylinder 5 Vol.% CO_2, 95 Vol.% N_2	68 50 435
CO_2 main flow sensor	68 70 300
Holder for parking CO_2 sensor	84 12 840
Special accessories	
Instrument tray	84 12 723
Wall bracket, module 2000 Type 13 alternative to trolley	84 08 613
Pneumatic medicament nebuliser	84 12 935
Flow sensor cover	84 14 714
For manual ventilation:	
Resutator 2000	21 20 046
Child Resutator 2000	21 20 984
Baby-Resutator	21 20 941
Hook for Resutator	M 26 349
Adult test lung	84 03 201
"EvitaMobil" trolley (high)	84 11 950
"EvitaMobil" trolley (low)	84 11 965
For trolley:	
Cabinet 8H, 360 mm high (4 drawers)	M 31 796
Cabinet 4H (2 drawers)	M 31 795
"EvitaMobil" cylinder holder set	84 11 970
Set of cabinet mountings for trolley	84 09 018
Modification set – socket strip	84 11 969
Breathing air compressor for supplying Evita 4 with medical air	84 13 890
MEDIBUS cable	83 06 488
Printer cable	83 06 489
Water trap for expiration valve	84 13 125
Optionen	
Modification set – communications	84 11 735
Modification set – SpO_2 measurement	84 13 035
Modification set – DC module	84 13 034
Modification set – Evita DC power supply MB	84 15 581
Modification set – NeoFlow	84 13 563
Modification set – Breathing Support Package	84 13 562

Name/Description	Order No.
Modification set – Mask ventilation (NIV)	84 14 474
Modification set – Nurse call	84 14 476
Plug for connecting the nurse call	18 46 248
Modification set – Evita Remote	84 14 472
Upgrade modification set – Software 4.n plus Evita 4, comprising the software upgrades "Weaning parameters", External flow measurement" and "Extended use of loop displays"	84 14 469
Modification set – software 4.00 Evita 4 (update)	84 14 467
Modification set – software 4.10 Evita 4 (update)	84 14 665
Modification set – Capno Plus	84 13 780
Modification set – 2nd pressure sensor	84 15 570
Spare set for sterilisation	
Expiration valve (patient system)	84 10 580
Water trap for expiration valve	84 13 125
For adult ventilation:	
Hose set, adult	84 06 550
Patient part for Aquapor	84 05 029
Temperature sensor	84 05 371
Pneumatic medicament nebuliser	84 12 935
Cuvette, adult	68 70 279
For paediatric ventilation:	
Hose set, paediatric (Fisher & Paykel)	84 12 082
Humidifier chamber MR 340	84 11 047
incl. filter paper for humidifier chamber (set of 100)	
Cuvette, paediatric	68 70 280
Replacement parts	
For Evita 4:	
O_2 sensor capsule	68 50 645
Flow sensor (set of 5)	84 03 735
Cooling air filter, blue	84 12 384
Cooling air filter for DC power supply MB	84 15 572
Lithium battery for data protection	18 35 343
For hinged arm:	
Holder	84 09 746
Hose clamp	84 09 841
For adult ventilation:	
Temperature sensor	84 05 371
Replacement set of lids for Aquapor	84 06 135

Name/Description	Order No.
Aquapor bowl	84 05 739
Float for Aquapor	84 04 738
Spiral hose, adult, silicone 0.6 m	21 65 627
Spiral hose, adult, silicone 0.35 m	21 65 619
Water traps	84 04 985
Water container	84 03 976
Hose clamp	84 03 566
Connector	M 25 647
Y-piece	84 05 435
Catheter connector, straight, size 12.5 (set of 10)	M 23 841
Corrugated hose	84 02 041
Adaptor, adult	84 03 076
Set of catheter connectors, adult	84 03 685
Set of caps (set of 5)	84 02 918
ISO elbow connector	M 25 649
Cuvette, adult	68 70 279
For paediatric ventilation:	
Spiral hose, paediatric, silicone, 22/10, 1.10 m	21 65 600
Spiral hose, paediatric, silicone, 22/10, 0.60 m	21 65 821
Spiral hose, paediatric, silicone, 10/10, 0.60 m	21 65 848
Spiral hose, paediatric, silicone, 22/10, 0.40 m	21 65 856
Corrugated hose flex 0.13 m	84 09 634
Catheter connectors, size 11 (set of 10)	M 19 490
Cap	84 01 645
Adaptor, paediatric 90°	84 03 075
Double conical connector	84 09 897
Temperature sensor mounting	84 11 044
Condensation trap, expiration	84 09 727
Water container	84 03 976
Hose heater 1.10 m	84 11 045
Double temperature sensor	84 11 048
Adaptor for hose heater	84 11 097
Single-strand wire, 1.5 m	84 11 050
Humidifier chamber MR 340 incl. filter paper (set of 100)	84 11 047
Filter paper for humidifier chamber (set of 100)	84 11 073
Bacterial filter	MX 02 650
Cuvette, paediatric	68 70 280
Technical documentation available on request	

What was new in Evita 4 software 2.n

P_{insp} not linked to PEEP during BIPAP

— The ventilation parameter P_{insp} is set as an absolute value. P_{insp} is no longer affected by changes in PEEP

Aids for setting pressure ventilation parameters

— While setting the listed pressure ventilation parameters, the parameter concerned appears as a dashed line in the pressure curve Paw.

Continuous indication of the hose system leakage during the leak test

— The test step "Tightness of hose system" can be selected separately in the "Device check" menu. Corrective measures can be undertaken with the aid of the continuous leakage indication.

Compensation of the hose system compliance

— The hose system compliance determined during the leak test is indicated at the end of the test.

— The volume-controlled ventilation strokes are automatically corrected with the calculated hose system compliance, as are the measured values for flow monitoring.

Leakage monitoring and compensation

— Evita 4 compares the minute volume delivered on the inspiration side with that measured on the expiration side, balances the leakage and indicates this as the measured value MV_{leak}.

— The applied tidal volume V_{Ti} is automatically corrected by the amount of the measured MV_{leak}. The same also applies for the Flow and V_{Te} values measured on the expiratory side.

— The measured minute volume values are not corrected for safety reasons.

Apnoea ventilation with SIMV pattern

— The patient can breathe spontaneously during apnoea ventilation.

— The apnoea ventilation frequency remains constant.

AutoFlow® On/Off as start-up parameter

— The AutoFlow® function can be configured as a start-up parameter so that AutoFlow® is switched on automatically when the device is switched on.

Loop display also for single strokes

— In addition to the loop for a complete ventilation cycle, e.g. in IPPV, the loop for a single breath (ventilated or spontaneous) can now also be displayed, for instance in such "mixed" ventilation modes as SIMV.

NeoFlow (Option)

— Paediatric flow monitoring in paediatric and neonatal ventilation is extended to include a flow sensor specifically for neonates and positioned close to the patient.

Breathing Support Package (optional

— To support spontaneous breathing.

— To compensate the elastic and resistive resistance of the respiratory system.

What was new in Evita 4 software 3.n

Additional screen languages

— Portuguese
— Russian
— Arabic
— Greek
— Chinese

Additional function key »☼/● «

— For blanking / unblanking the screen.

Independent lung ventilation ILV

— For independent ventilation of each lung using two Evita ventilators.

Additional function keye »Exp. hold«

— To extend expiration.
— To occlude the ventilation system following expiration.

Medicament nebulisation

— Can also be applied during paediatric ventilation.

Bronchial suctioning

— In the patient modes »Paediatric« and »Neonates«, Evita 4 increases the set O_2 concentration commensurately, but not up to 100 % by volume.

Warning »Volume not constant«

— Can be suppressed.

Automatic Tube Compensation ATC (optional)

— For specific reduction of the breathing effort attributable to the tube.

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These Instructions for Use apply only to
Evita 4
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If no Serial No. has been filled in by Dräger these Instructions for Use are provided for general information only and are not intended for use with any specific machine or device.

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