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Puritan Bennett™ 980 ventilator

# Quick reference guide: Patient setup

## Short Self Test (SST)

This test checks circuit integrity, calculates circuit compliance, filter resistance, and checks ventilator breath delivery hardware function – including pressure and flow sensors.

**To run a Short Self Test:**

- Enter through the first power-up screen (Figure 1)
- Select **SST**
- Select **Run All SST** (Figure 2)
- Choose
  - Circuit Type: Adult, Pediatric, or Neonate (Figure 3)
  - Humidification type
  - Humidification volume
  - Follow the prompts to completion
- Touch **Accept**

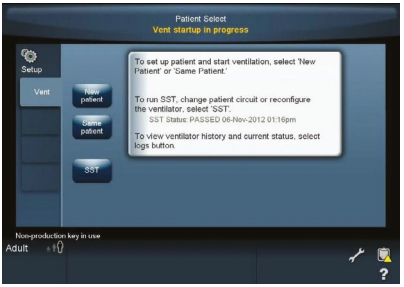


Figure 1


Figure 2


Figure 3

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## New patient complete setup†

**To set up a new patient:**

- Open the **wye connector of the breathing circuit** – the ventilator has a patient detection system
- Power ventilator on
- Touch **New Patient** button (Figure 1)
- Select gender and height or predicted body weight – once selected, use the knob to adjust (Figure 4)
- Select **Ventilation Type**
- Select **Mode**
- Select **Mandatory and/or Spontaneous Type**
- Select **Trigger Type**
- Select and set **Prescribed Settings** (Figure 5)
  - Rate
  - Tidal Volume
  - Pressure
  - $\%O_2$
  - PEEP
- Touch **Start** when done, ensure all alarms are appropriately set


Figure 4


Figure 5

## Same patient setup†

**To set up using Same Patient:**

- Open the **wye connector of the breathing circuit** – the ventilator has a patient detection system
- Power ventilator on
- Touch **Same Patient** button (Figure 1)
- Touch **Start** (Figure 5)


Figure 6

## Quick start†

This feature uses default values or institutionally configured breath delivery settings to ventilate the patient after predicted body weight (PBW), or gender and height, has been entered.

- Open the **wye connector of the breathing circuit** – the ventilator has a patient detection system
- Power ventilator on
- Touch **New Patient** button
- Enter PBW, or gender and height
- Touch **Quick START** (Figure 6)

Note: Adult/pediatric ventilators have a specific exhalation filter and door. Neonatal ventilators have a specific exhalation filter and door.

†Short Self Test (SST) shall be conducted in accordance to instructions in the operator's manual.



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# Quick reference guide: Touch screen

## Touch screen icons


**Home**
Touch icon to close all open dialogs and return to the main screen – displayed here.

**Alarm**
Touch icon to display the alarm settings screen.

**Configure**
Touch icon to display the configure screen.

**Logs**
Touch icon to display the logs screen which contains:

- Tabs for alarms
- Settings
- Patient data
- Diagnostics
- EST/SST status
- General event
- Service logs

**Help**
Drag icon to the item in question and release – a tooltip will appear describing the item's function.

**Screen Capture**
Touch icon to capture and store the image displayed on screen.

**Elevate $O_2$**
Touch icon to configure and increase the oxygen concentration for 2 minutes.

## Bezel keys

1. Display brightness key
2. Display lock key
3. Alarm volume key
4. Manual inspiration key
5. Rotary encoder dial
6. Inspiratory pause key
7. Expiratory pause key
8. Alarm reset key
9. Audio pause key

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## How to use the touch screen

| Action | Used for | How to use |
|---|---|---|
| Swiping | Opening or closing dialogs or panels, moving waveform data, expanding or collapsing tooltips, scrolling lists, or alarm banners. | Swipe toward the center of the screen to open dialogs or panels. Swipe toward the side of the screen (or upward if viewing the additional patient data or large-font patient data panels) to close. A downward swipe anywhere in the patient data area opens the additional patient data panel, and another swipe on the additional patient data tab displays the large-font patient data panel. |
| Touch and hold | Displaying a tooltip dialog on whatever item is touched; the tooltip appears to glow indicating the touch and hold action. | Touch an item and hold for at least 0.5 seconds. |
| Double touch | Maximizing or minimizing the viewable area of a dialog, control, or waveform, expanding or collapsing tooltips. | Double-tapping maximizes the viewable waveform area. Double-tapping again minimizes the viewable waveform area. |
| Drag | Gaining information about a particular screen parameter. | Drag the help icon (located at the lower right of the touch screen) to the item in question and drop. If a blue glow appears, a tooltip is available. |
| Sweep | Changing x- and y-axis scales, moving the waveform cursor, moving scroll-bars, scrolling lists; scrolling speed varies depending upon how far outside the list boundary the finger is positioned. | Touch the axis and drag to the right to increase the waveform x-axis scale, and to the left to decrease. Use similar motions with the y-axis but drag up and down. To move the cursor (when the waveform is paused), touch the cursor and drag it right or left. |



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# Quick reference guide: Leak Sync software

## What's new

Puritan Bennett™ leak compensation now works with VC+ and VS and is called Leak Sync software on the Puritan Bennett™ 980 ventilator.

## Key features

It automatically detects and compensates for leaks in the breathing circuit. The software is designed to differentiate between flow due to leaks, and flow due to patient respiratory effort – and adjust quickly.

## Leak Sync software offers

- Management of both invasive and noninvasive ventilation
- Maximum leak compensation flow
  - – Neonatal 15 L/min
  - – Pediatric 40 L/min
  - – Adult 65 L/min
- Automatic activation when the ventilator type is NIV – or if New Patient is selected and the circuit type is Neonate
- Active display – **LS** appears on the vent setup button in the lower left-hand screen (Figure 1)

## Initial setup

- Touch **Vent Setup** button – lower left (Figure 2)
- Touch **More Settings**
- Select **Enabled** or **Disabled** for Leak Sync
- Touch **Accept All**
- Leak Sync software typically adjusts for a leak present within three breaths

Figure 1

Figure 2

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## Values displayed

When Puritan Bennett™ Leak Sync software is enabled, the following values will be displayed in the patient data cells:

- An **L** will be present after a measured volume parameter
- **$V_{LEAK}$** inspiratory leak volume – the total volume delivered during inspiration to compensate for the leak
- **%LEAK** percent leak – the percentage of total delivered volume during inspiration attributed to the leak over total delivered inspiratory volume
- **$V_{TL}$** – the volume inspired for each breath when Leak Sync is enabled
- **LEAK** exhalation leak – the leak rate during exhalation at **PEEP** (Figure 3)


Figure 3


Figure 4


Figure 5

## Key alarms

**$D_{SENS}$**, the maximum allowable leak rate at set **PEEP**, displays L/min instead of % when the Leak Sync software is enabled (Figures 4 and 5).



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# Quick reference guide: PAV+™ software

## Key features

Provides ventilatory support proportional to the patient's inspiratory effort, letting the patient direct the duration and depth of each breath, enabling:

- Variable flow
- Variable volume
- Pressure delivery proportional to patient demand

## Key variables

Uses key variables to determine patient need (Figure 1):

- Flow
- Volume
- Compliance
- Resistance
- %Support

## Intended for patients with

- Intact respiratory drive
- Predicted body weight (PBW) 25 kg or greater
- Tube ID 6.0 or greater without circuit or artificial airway leaks

## How to set up PAV+™ software (Figure 2)

- Enter patient's gender and height or predicted body weight (PBW) at the ventilator setup screen
- Select **Invasive** vent type
- Select **SPONT** mode
- Select **PAV+** to select Spontaneous type
- Select desired trigger type (**P-TRIG**, **V-TRIG)**
- Select the %Support
- Select tube type
- Select tube ID – initially, a default value is shown based on the PBW entered at ventilator start-up. If this tube ID is not correct for the airway in use, turn the dial to adjust the tube ID setting.
- Set high **Peak** and high **VTI** alarms before touching **Start** (same as in **VC+**)
- Touch **Start**

## PAV+™ monitoring – graphics screen (Figure 3)

**The PAV+ screen will display:**

- $WOB_{PT}$, $WOB_{TOT}$, $C_{PAV}$, $R_{PAV}$, $PEEP_i$

**Data screen displays available:**

- PAV+-based lung compliance ($C_{PAV}$)
- PAV+-based lung elastance ($E_{PAV}$)
- PAV+-based respiratory resistance ($R_{PAV}$)
- PAV+- based total airway resistance ($R_{TOT}$)


Figure 1


Figure 2


Figure 3

This guide is provided as a convenient companion document to the operator's manual. It's not intended to replace the operator's manual, which should always be available while using the ventilator. It's important to familiarize yourself with all information in the operator's manual relevant to your institution's use of the ventilator, including on-screen help, instructions, warnings, and cautions.

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## How to calculate $P_{MUS,PEAK}$ and adjust %Support on the basis of $P_{MUS,PEAK}$

Authors of the Carteaux study suggest using a simple algorithm to adjust the %Support during PAV+™ mode to target a reasonable and predefined range of respiratory muscle pressure[1]:

- An estimate of $P_{MUS,PEAK}$ was calculated based on this equation:
  ($P_{AW,PEAK}$ -PEEP) x [(100-%Support)/%Support]
  – $P_{AW,PEAK}$ (peak airway pressure) values are obtained from the ventilator
- Example of the calculation of $P_{MUS,PEAK}$
  – $P_{AW,PEAK}$ = 20, PEEP 5, %Support = 70
  – $P_{AW,PEAK}$ = (20-5) x [(100-70)/70] = 6.43
- The %Support given by PAV™+ mode was adjusted to maintain $P_{AW,PEAK}$ between 5 and 10 $cmH_2O$.[1]

## Key alarms

- High circuit pressure (High $P_{PEAK}$)
- PAV+™ start-up too long
- PAV+™ R&C not assessed
- High inspired tidal volume (↑$V_{TI}$)

## Note

- Not intended for patients with leaks
- Not intended for NIV

Refer to the PAV+™ Management Protocol guide for additional information.

References
1. Carteaux G, Mancebo J, Mercat A, et al. Bedside adjustment of proportional assist ventilation to target a predefined range of respiratory effort. *Crit Care Med*. 2013;41(9):2125–2132.



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# Quick reference guide: Volume control plus (VC+) and volume support (VS)

## Key features

Automatically adjusts inspiratory target pressure from breath to breath to achieve the desired tidal volume:

- Variable flow (Figure 1)
- Targeted volume
- Variable pressure
- Breath-by-breath automatic adjustment in delivered pressure based on inspired volume

Figure 1

## Initial setup

**Patient setup: VC+ (Figure 2) and VS (Figure 3)**

- Touch **Vent Setup** button
- Select **Invasive**
- Select **AC/SIMV** and select **VC+** or select **Spont** and select **VS**
- Primary setting:
  - Set frequency – except for VS (Figure 3)
  - Set tidal volume – even if it was set in a previous breath type
  - Set inspiratory time – except for VS (Figure 3)
- Set rise time %
- Set alarms:
  - High circuit pressure (↑$P_{PEAK}$)
  - Low circuit pressure (↓$P_{PEAK}$) – except for VS
  - High inspired spontaneous and mandatory tidal volume
  - Low minute and tidal volume

Figure 2

Figure 3

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## Key alarms

- Volume not delivered – high peak circuit pressure
- High Inspired Tidal Volume alarm limit – terminates inspiration and commences exhalation during VC+, VS
- Low Circuit Pressure
- Compliance limited $V_T$

**Warning:**
Because the VC+ pressure control algorithm does not allow the target inspiratory pressure to fall below PEEP + 3 $cmH_2O$, attempting to set the $\downarrow P_{PEAK}$ alarm limit at or below this level will turn off the alarm.



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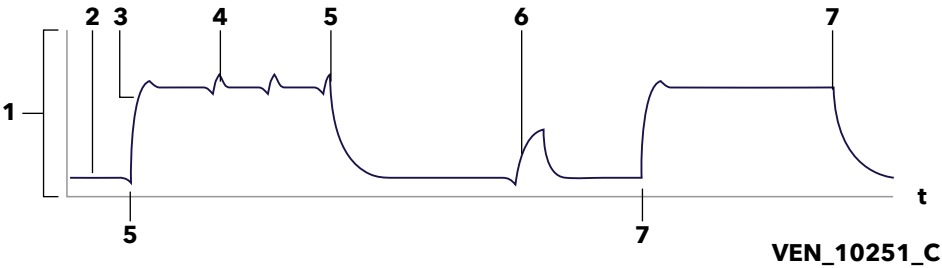
# Quick reference guide: BiLevel 2.0 software

## What is BiLevel?

The Puritan Bennett™ ventilator with BiLevel 2.0 software is SIMV Pressure Control enhanced. Breaths are delivered similar to SIMV mode with PC selected but provides two levels of positive airway pressure. The patient is free to initiate spontaneous breaths at either pressure level during BiLevel mode (Figure 1).

## BiLevel mode

1. Pressure (y-axis)
2. Low pressure ($P_L$)
3. High pressure ($P_H$)
4. Spontaneous breath
5. Synchronized transitions
6. Pressure support
7. Time-based transitions




The two pressure levels are called Low Pressure ($P_L$) and High Pressure ($P_H$). At either pressure level, patients can breathe spontaneously, breaths can be assisted with tube compensation or pressure support. BiLevel monitors mandatory and spontaneous tidal volumes separately.

Inspiratory time and expiratory time in BiLevel become Time high ($T_H$) and Time low ($T_L$), respectively. During inspiratory and expiratory times, $P_H$ is maintained during $T_H$ and $P_L$ is maintained during $T_L$.

## APRV approach

As $T_L$ begins to shorten with the $T_H$:$T_L$ ratio extending beyond 4:1, the breathing pattern assumes a distinctly different shape. In the extreme, the exaggerated time at $P_H$ and abrupt release to $P_L$ would match the pattern patented by John Downs and defined as Airway Pressure Release Ventilation.

Pressure support ($P_{SUPP}$) can be used to assist spontaneous breaths at $P_L$ and $P_H$.
$P_{SUPP}$ is always set relative to $P_L$.
Target pressure = $P_L$ + $P_{SUPP}$.

**Primary settings description:**

- Low pressure ($P_L$)
- High pressure ($P_H$)
- Low pressure time ($T_L$)
- High pressure time ($T_H$)
- $T_H$:$T_L$ ratio

**Note**

The pressure support level is always referenced to $P_L$.

- Spontaneous patient efforts at PH are not pressure supported unless PSUPP>(PH−PL)
- All spontaneous breaths (whether or not they are pressure supported) are assisted by a pressure of 1.5 $cmH_2O$

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## Initial setup

- Enter predicted body weight (PBW) or gender and height
- Select **BiLevel** mode button – once selected the ventilator uses the PC mandatory breath type and cannot be changed
- Select spontaneous type (**PS** or **TC**)
- Select trigger type (**P-TRIG** or **V̇-TRIG**)
- Default settings appear for BiLevel mode, select desired ventilator settings to make changes – $P_H$ must always be at least 5 $cmH_2O$ greater than $P_L$
- Set $T_L$, $T_H$, or the ratio of $T_H$ to $T_L$ – to select settings that would result in a $T_H$:$T_L$ ratio greater than 1:1 or 4:1, you must touch the **Continue** button to confirm (Figures 1 and 2)
- **Touch Accept All** (Figure 3)
- All spontaneous breaths are assisted by a pressure of 1.5 $cmH_2O$ – however, to add additional pressure support at $P_H$, $P_{SUPP}$ set must be > ($P_H$ - $P_L$)

Figure 1

Figure 2

## APRV specifics

**In APRV:**

- The $P_H$ and $P_L$ level is set to optimize pulmonary compliance and increase mean airway pressure, which may improve oxygenation – the f setting also impacts the mean airway pressure
- The differences between $P_H$ and $P_L$ levels, $T_L$ and the number of releases per minute (f setting) help manage $CO_2$ and alveolar ventilation
- The operator can configure the BiLevel padlock settings to allow direct control of $T_L$ to assure changes in the f setting will not inadvertently lengthen the $T_L$ period and result in destabilization of end-expiratory alveolar volume. With the $T_L$ period locked, changes in set f will change the $T_H$ period to accommodate the new f setting while maintaining the set $T_L$ period

Figure 3

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# Quick reference guide: Data management

## Vital patient data banner

Patient data is displayed across the top banner (Figure 1). Up to eight variables are visible, with the ability to scroll left and right to view an additional six values in the upper right-hand corner. Values may be configured to show different patient data values or may be left blank to reduce the number of visible patient data cells.

**To configure a patient data cells on the GUI:**

- Double tap on any one of the patient data cells displayed (Figure 1)
- Select the new display data value you want to display (Figure 2)
- Repeat for as many parameters as desired


Figure 1


Figure 2

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## Large-font screen

A drop-down display is available to show patient data or graphics in a larger font for ease of viewing.

**To display the large-font patient data panel:**

- Touch or swipe the **Vital Patient Data** banner tab downward – the additional patient data panel appears
- Touch or swipe the **Additional Patient Data** banner tab downward – patient data appears in a larger font

**To configure the large-font patient data display on the GUI:**

- Double tap on any of the displayed parameters to access the menu list of parameter options (Figure 4)
- Select the patient displayed parameter you wish to display
- Touch or swipe the **Large-Font Patient Data** panel tab upward to return the banner to its normal font size


Figure 4


Figure 5

## Waveform display

**To configure the waveforms and loops:**

- Touch **Waveform Layout** icon (Figure 5)
- Touch **Graphs** tab to reveal the five configurations available
- Touch the individual waveform configuration to select



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# Quick reference guide: Proximal flow system options

## Features

The Puritan Bennett™ proximal flow system combined with the NeoMode 2.0 software option is used for measuring flows, pressures, and tidal volumes of invasively ventilated neonatal patients.

When using the proximal flow system – flow, pressure, volume waveform, and data values for delivered and exhaled volumes are derived from proximal flow sensor measurements at the patient circuit wye.

## Proximal flow sensing is enabled

- When a "Y" is present after a measured parameter – for example, when exhaled tidal volume is being measured by proximal flow, it will change from $V_{TE}$ to $V_{TE\text{-}Y}$.
- When an "L" is present after a measured parameter – Leak Sync (LS) software is enabled

| Monitored Parameter | Description | Source |
|---|---|---|
| $V_{TI}$ | Inspired tidal volume (mandatory or spontaneous) | Internal sensor |
| $V_{TI\,Y}$ | Inspired tidal volume (mandatory or spontaneous) | Proximal sensor |
| $V_{TE\text{-}Y}$ | Exhaled tidal volume | Proximal sensor |
| $V_{TE\,SPONT\,Y}$ | Exhaled spontaneous tidal volume (at patient circuit wye) | Proximal sensor |
| $V_{TE\,MAND\,Y}$ | Exhaled mandatory tidal volume (at patient circuit wye) | Proximal sensor |
| $\dot{V}_{E\,TOTY}$ | Exhaled total minute volume | Proximal sensor |
| $\dot{V}_{Y}$ | Flow throughout the breath cycle | Flow waveform |
| $V_{TL}$ | Inspired tidal volume | Internal sensor + LS |
| $V_{TL\,Y}$ | Inspired tidal volume | Proximal sensor + LS |
| $LEAK_{Y}$ | Exhalation leak at PEEP in the patient | Proximal sensor + LS |
| LEAK | Exhalation leak at PEEP in the patient and circuit | Internal sensor + LS |
| $P_{CIRC\,Y}$ | Graph pressure throughout the breath cycle (at patient wye) | Circuit pressure waveform |

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## How to disable or enable the proximal flow system option

- In the constant access icons area, touch **Configure** icon – a menu containing tabs appears (Figure 1)
- Touch the **Options** tab – a screen appears containing **Installed Options** and **Prox** tab
- Touch **Enabled** or **Disabled** button

Figure 1

To connect the proximal flow sensor to the ventilator:

- Verify the proximal flow sensor, pneumatic lines, and connector are not damaged in any way
- Open the connector panel door and firmly attach the sensor connector to the right-most receptacle in the BDU's front connector port labeled Prox (See Attaching Proximal Flow Sensor to Ventilator in operator's manual – Proximal Flow Appendix)
- To attach the proximal flow sensor between the endotracheal tube and patient circuit:
  – Connect the larger end of the sensor (marked with UP and an arrow) to the endotracheal tube – do not force the connection – when the sensor is oriented correctly, insertion requires little effort

## Purge

An automatic purge is used to clear the lines at pre-set intervals – a manual purge control is also available.

## Calibrations

Manual calibration is done during short self-test (SST). Automatic calibrations are done at pre-set intervals during ventilation.

**Warning:** Do not install the proximal flow sensor in the patient circuit if the sensor isn't connected to the BDU.

**Caution:** Do not use aerosolized medications with the proximal flow sensor – they may damage the sensor.



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