AVEA® ventilator

Ventilation modes
user guide

CareFusion

Table of contents

The AVEA® ventilator user guide is not intended to replace the operator manual. You must become completely familiar with the AVEA ventilator operator manual before using the AVEA ventilator.

Section 1: UIM navigation

Touch-Turn-Touch™/Touch-Turn-Accept™ techniques

To change most controls on the AVEA ventilator:

1. Touch the screen directly over the control to select it. The control highlights *(changes color),* indicating that it is active.

2. Turn the data dial clockwise to increase the selected value, and turn the dial counter-clockwise to decrease it. Turning the data dial quickly accelerates the rate of change from one setting to another. Turning the data dial slowly gradually changes the setting.

3. Touch the screen directly over the highlighted control again, or press the **ACCEPT** membrane button to the left of the data dial to accept your new setting.

   Note: If you press the **CANCEL** button or do not actively accept the new setting within 15 seconds, ventilation continues at the previous setting.
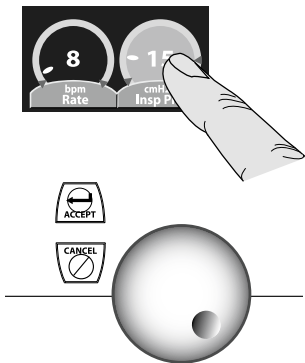
Setting breath type and mode

To access the **MODE SELECT** screen, press the **MODE** indicator on the touch screen or the **MODE** button on the membrane panel.

A. MODE indicator

B. MODE button

Setting breath type and mode *(continued)*

The **MODE SELECT** screen appears. Select the touch-screen button for the desired mode.
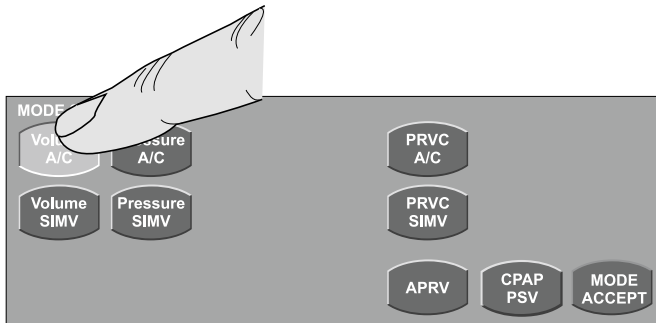
Selecting Volume A/C mode

Primary controls for the proposed mode appear at the bottom of the touch screen. Use the techniques described on page 3 to set these controls. Press **MODE ACCEPT** to accept the new mode and primary control settings.

Setting advanced settings

To set advanced settings, press the **ADV SETTINGS** button on the lower left of the user interface. Advanced settings refine the breath delivery beyond the primary breath control settings. Press the **ADV SETTINGS** button for the desired primary control. Not all primary controls have advanced settings. Primary controls with advanced settings are marked with a yellow triangle.

Detailed descriptions of all advanced settings are in section 3.

A. ADV SETTINGS button
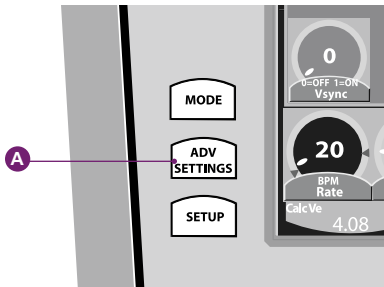
Setting advanced settings *(continued)*
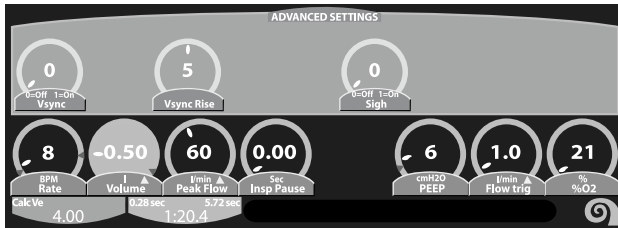
Advanced settings for volume

Use the Touch-Turn-Touch or Touch-Turn-Accept technique to modify the advanced settings *(see page 3).*

Setting alarm limits

Press the **ALARM LIMITS** membrane button *(to the upper right of the UIM)* to open or close the window.

A. ALARM LIMITS button
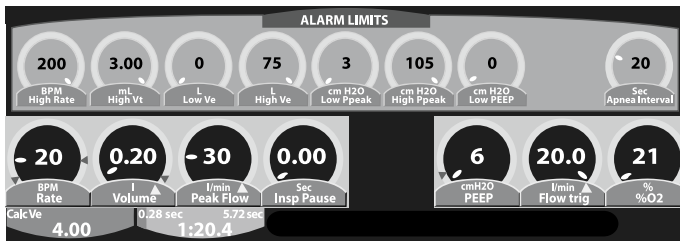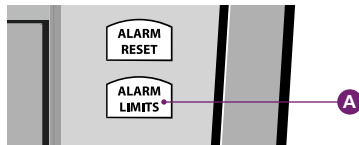
Alarm Limits window with Volume A/C mode selected on MODE SELECT window

Use the Touch-Turn-Touch or Touch-Turn-Accept technique to modify the alarm limits settings *(see page 3)*.

Section 2: Breath types and modes

This section describes the breath types and ventilation mode combinations available for adult, pediatric and neonatal patients using the AVEA ventilator.

Breath types

There are two basic breath types:

- Mandatory breaths *(delivered according to the set ventilator parameters)*
- Demand breaths *(triggered by the patient)*

All breaths are defined by four variables:[1]

- Trigger *(initiates the breath)*
- Control *(controls the delivery)*
- Limit *(terminates the breath)*
- Cycle *(initiates the frequency of delivery)*

Mandatory breaths

Mandatory breaths can be triggered by the machine, patient or operator. The AVEA ventilator can deliver five mandatory breath types:

1. Volume breaths
2. Pressure breaths
3. Time cycled pressure limited (TCPL) breaths *(neonatal patients only)*
4. Pressure regulated volume control (PRVC/Vsync®) breaths *(adult and pediatric patients only)*
5. Volume Guarantee (VG) breaths *(neonatal patients only)*

Note: The volume controlled breath is the default breath type for adult and pediatric patients. The TCPL breath type is only available for neonates and the default breath type for neonate patients.

Demand breaths

All demand breaths are patient triggered, pressure controlled and flow or time cycled. Demand breaths can be either pressure supported (PSV) or spontaneous. All demand breaths are accompanied by the yellow patient demand indicator, which flashes in the upper left of the touch screen. The AVEA ventilator delivers two demand breath types:

1. PSV: Active when CPAP/PSV, synchronized intermittent mandatory ventilation (SIMV) and airway pressure release ventilation (APRV)/BiPhasic modes are selected.

2. Spontaneous breath: For adult and pediatric patients during a spontaneous demand breath, inspiratory pressure is pre-set at positive end-expiratory pressure (PEEP) + 2 cmH$_2$O. For neonatal patients, a spontaneous breath is a demand flow breath delivered at the pre-set PEEP.

Volume controlled ventilation

AVEA ventilator intra-breath demand system

The AVEA ventilator features a unique intra-breath demand system in volume controlled ventilation designed to provide additional flow to the patient during periods of demand.

The AVEA ventilator measures the peak inspiratory pressure (Ppeak) every 2 ms throughout the breath cycle and sets a virtual pressure support target at the greater of PEEP + 2 cmH_2O or Ppeak–2 cmH_2O.

The minimum virtual pressure support level is set PEEP + 2 cmH_2O, and the maximum is two times the set PEEP. Simultaneously, the ventilator monitors and compares the Ppeak measurement to its previous value. If the Ppeak decreases by 2 cmH_2O, the ventilator recognizes the patient demand and automatically switches over to deliver a pressure support breath at the virtual pressure support target. This allows flow to exceed the set peak flow, thereby meeting patient demand.

Once the set tidal volume has been delivered, the ventilator looks at the inspiratory flow. Should the peak inspiratory flow be greater than set peak flow, the ventilator determines that the patient continues to demand flow. The breath then cycles when inspiratory flow falls to 25% of the peak inspiratory flow. If the peak inspiratory flow is equal to the set flow, the ventilator determines the patient is not demanding flow and ends the breath as a volume control breath.

Volume breaths are controlled by inspiratory flow, limited by a pre-set volume or maximum inspiratory pressure and cycled by volume or time. During mandatory breaths, the demand system can provide additional flow if needed. The mode for this breath type is Volume Assist Control (A/C) mode.

All breaths are mandatory breaths at the set tidal volume. Breaths are triggered when a patient effort is detected, the breath interval elapses when no patient effort is detected or the **MANUAL BREATH** key is activated. The initiation of a breath by any means resets the breath interval. The patient may initiate all breaths. Without patient effort, breaths deliver at the set breath rate.
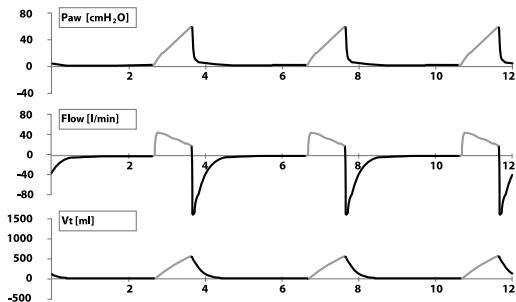
Volume A/C with decelerating flow pattern

In a volume breath, airway pressure increases until the set tidal volume delivers. Flow delivers at the set flow rate for the duration of the inspiratory time *(with a square waveform selected)* or can decelerate to 50% of the set peak flow during the inspiratory phase of the breath *(with a decelerating waveform selected)*.

Primary controls: Active in Volume A/C mode are Rate, Volume, Peak Flow, Inspiratory Pause, PEEP, Flow Trigger and %O_2.

Advanced settings: Available in Volume A/C mode are Vsync[*], Vsync Rise[*], Volume Limit[++], Demand Flow, Flow Cycle[++], Sigh[*], Waveform, Bias Flow and Pressure Trigger.

[*]Available for adult and pediatric patients only.

[++]Only available when Vsync is active.

Volume SIMV mode

In synchronized intermittent mandatory ventilation (SIMV), mandatory and demand breath types can deliver. Mandatory breaths deliver when the SIMV Time window is open as a patient effort is detected, the breath interval elapses when no patient effort is detected or the **MANUAL BREATH** key is activated.

Primary controls: Active in Volume SIMV mode are Rate, Volume, Peak Flow, Inspiratory Pause, PSV, PEEP, Flow Trigger and %O_2.

Advanced settings: Available in Volume SIMV mode are Vsync*, Vsync Rise*, Volume Limit, Sigh*, Waveform, PSV Rise, PSV Cycle, PSV Tmax, Demand Flow, Bias Flow, Flow Cycle++, Waveform and Pressure Trigger.

*Available for adult and pediatric patients only.
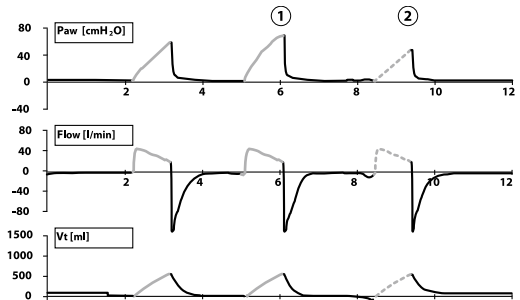
++Only available when Vsync is active.

Volume SIMV with mandatory *(1)* and assisted *(2)* breaths

Pressure controlled ventilation

Pressure breaths are controlled by pressure *(inspiratory + PEEP)*, limited by pressure *(inspiratory + PEEP)* and cycled by time or flow. The mode for this breath type is Pressure Assist Control (A/C) mode.

All breaths are mandatory breaths. Breaths may be triggered when a patient effort is detected, the breath interval times out when no patient effort is detected or the **MANUAL BREATH** key is activated.

The initiation of a breath resets the breath interval. Patients may initiate all breaths. Without patient effort, breaths deliver at the set breath rate. During mandatory breaths, the demand system can provide additional flow if needed.
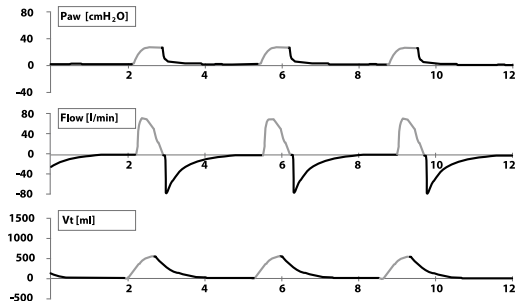
Pressure A/C, mandatory breaths

In a pressure breath, a variable flow delivers to reach the set inspiratory pressure above baseline. Once the set pressure level is achieved, flow is regulated to maintain this pressure for the duration of the set inspiratory time. The monitored peak pressure is equal to the sum of the inspiratory pressure and PEEP settings.

Primary controls: Active in Pressure A/C mode are Rate, Inspiratory Pressure, Inspiratory Time, PEEP, Flow Trigger and %O_2.

Advanced settings: Available in Pressure A/C mode are Machine Volume, Volume Limit, Inspiratory Rise, Flow Cycle, Bias Flow and Pressure Trigger.

Volume Guarantee breaths[*] *(neonatal patients only):* When Volume Guarantee is selected, the control Insp Pres becomes an advanced setting, the Volume setting displays as a primary control and the ventilator delivers a test breath at the set inspiratory pressure.

The inspiratory pressure for subsequent breaths adjusts breath-to-breath. The pressure adjusts separately for time triggered breaths, patient triggered breaths, apnea backup breaths and manual breaths to maintain monitored expired tidal volume close to the set target.

[*]Requires wye flow sensor.

Pressure SIMV

In SIMV mode, the ventilator can deliver mandatory and demand breath types. Mandatory breaths deliver when the SIMV Time window is open as a patient effort is detected, the breath interval has elapsed when no patient effort is detected or the **MANUAL BREATH** key is activated.

Primary controls: Active in Pressure SIMV mode are Rate, Inspiratory Pressure, Inspiratory Time, Pressure Support, PEEP, Flow Trigger and %O_2.

Advanced settings: Available in Pressure SIMV mode are Machine Volume, Volume Limit, Inspiratory Rise, Flow Cycle, Pressure Support Rise, Pressure Support Cycle, Pressure Support Tmax, Bias Flow and Pressure Trigger.

Pressure SIMV with mandatory *(1)* and assisted *(2)* breaths

Volume Guarantee breaths *(neonatal patients only):* When Volume Guarantee is selected, the control Insp Pres becomes an advanced setting, the Volume setting displays as a primary control and the ventilator delivers a test breath at the set inspiratory pressure.

The inspiratory pressure for subsequent breaths is adjusted breath-to-breath. The pressure adjusts separately for time triggered breaths, patient triggered breaths, apnea backup breaths and manual breaths to maintain monitored expired tidal volume close to the set target.
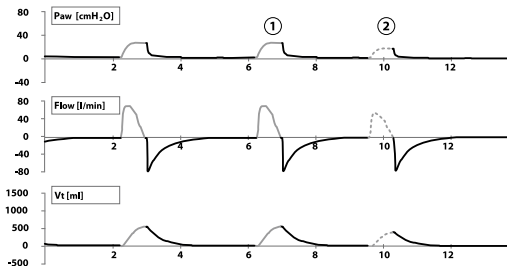
TCPL mode

TCPL breaths are controlled by inspiratory flow, limited by pressure *(inspiratory + PEEP)* and cycled by time, inspiratory flow or volume *(Volume Limit).* The mode for this breath type is TCPL Assist Control (A/C) mode.**

All breaths are mandatory breaths. Breaths can be triggered when a patient effort is detected, the breath interval times out when no patient effort is detected or the **MANUAL BREATH** key is activated.

TCPL A/C, mandatory breaths

*Requires wye flow sensor.
**Available for neonatal patients only.
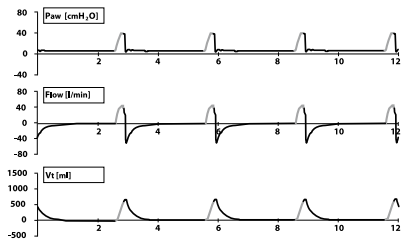
The initiation of a breath resets the breath interval. Patients may initiate all breaths. Without patient effort, breaths deliver at the set breath rate. During mandatory breaths, the demand system can provide additional flow if needed.

In a TCPL breath, the inspiratory flow is used to achieve a set inspiratory pressure. During the inspiratory phase of the breath, inspiratory pressure maintains while flow is allowed to decelerate.

Primary controls: Active in TCPL A/C mode are Rate, Inspiratory Pressure, Peak Flow, Inspiratory Time, PEEP, Flow Trigger and $\%O_2$.

Advanced settings: Available in TCPL mode are Volume Limit*, Flow Cycle, Bias Flow and Pressure Trigger.

Volume Guarantee breaths *(neonatal patients only)*:* When Volume Guarantee is selected, the control Insp Pres becomes an advanced setting, the Volume setting displays as a primary control and the ventilator delivers a test breath at the set inspiratory pressure.

The inspiratory pressure for subsequent breaths is adjusted breath-to-breath. The pressure adjusts separately for time triggered breaths, patient triggered breaths, apnea backup breaths and manual breaths to maintain monitored expired tidal volume.

*Requires wye flow sensor.

TCPL SIMV mode*

In SIMV mode, the ventilator can deliver mandatory and demand breath types. Mandatory breaths deliver when the SIMV Time window is open as a patient effort is detected, the breath interval has elapsed when no patient effort is detected or the **MANUAL BREATH** key is activated.

Primary controls: Active in TCPL SIMV mode are Rate, Inspiratory Pressure, Peak Flow, Inspiratory Time, PEEP, Flow Trigger and $\%O_2$.

Advanced settings: Available in TCPL SIMV mode are Volume Limit, Flow Cycle, Bias Flow and Pressure Trigger.

Volume Guarantee breaths *(neonatal patients only)*:**
When Volume Guarantee is

TCPL SIMV with mandatory *(1)* and assisted *(2)* breaths

selected, the control Insp Pres becomes an advanced setting, the Volume setting displays as a primary control and the ventilator delivers a test breath at the set inspiratory pressure.

*Available for neonatal patients only.
**Requires wye flow sensor.
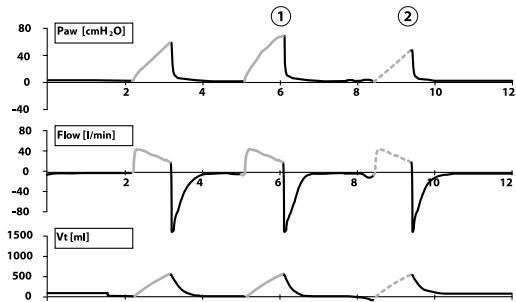
The inspiratory pressure for subsequent breaths is adjusted breath-to-breath. The pressure adjusts separately for time triggered breaths, patient triggered breaths, apnea backup breaths and manual breaths to maintain monitored expired tidal volume.

PRVC Mode

In pressure regulated volume control (PRVC) breaths, the pressure level modulates up or down to achieve a pre-set tidal volume. Breaths are controlled by pressure *(inspiratory + PEEP)* and volume, limited by pressure *(inspiratory + PEEP)* and cycled by time.

When PRVC is selected, the ventilator delivers a decelerating flow, volume controlled test breath to the set tidal volume with a 40 msec pause. It sets the target pressure at the end inspiratory pressure for the first pressure control breath. The next breath and all subsequent breaths deliver as pressure control breaths.

Inspiratory pressure adjusts automatically to maintain the target volume based on the dynamic compliance of the previous breath. The maximum step change between two consecutive breaths is 3 cm of water pressure. The maximum tidal volume delivered in a single breath is determined by the Volume Limit setting.

The test breath sequence initiates when:

• Entering the PRVC mode

• Changing the set tidal volume while in PRVC

- Reaching the Volume Limit setting
- Reaching a delivered tidal volume > 1.5 times the set volume
- Terminating the flow of the test breath
- Activating the:
  - High Peak Pressure alarm
  - Low Peak Pressure alarm
  - Low PEEP alarm
  - Patient Circuit Disconnect alarm
  - I-Time Limit
  - I:E Limit
  - When exiting Standby

The mode for the PRVC breath type is PRVC Assist Control (A/C) mode.*

All breaths are mandatory breaths. A breath can be triggered by the detection of a patient effort, the breath interval timing out or the **MANUAL BREATH** key being activated. The initiation of a breath resets the breath interval. A patient may initiate all breaths. Without patient effort, breaths deliver at the set breath rate. During mandatory breaths, the demand system can provide additional flow if needed.

Primary controls: Active in PRVC A/C mode are Rate, Volume, Inspiratory Time, PEEP, Flow Trigger and %O_2.

Advanced settings: Available in PRVC A/C mode are Volume Limit, Inspiratory Rise, Flow Cycle, Bias Flow, PSV Rise, PSV Cycle, PSV Tmax and Pressure Trigger.

*Available for adult and pediatric patients only.
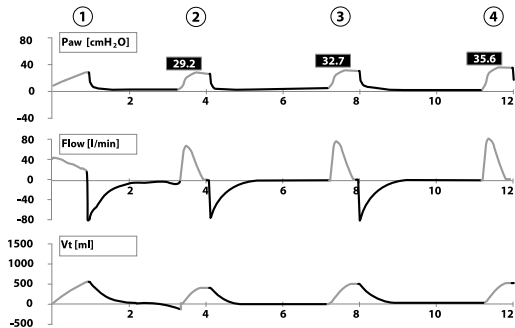
PRVC A/C with test breath *(1)* and step changes *(2–4)* to achieve target volume

PRVC SIMV mode*

In SIMV mode, the ventilator can deliver mandatory and demand breath types. Mandatory breaths deliver when the SIMV Time window is open as a patient effort is detected, the breath interval has elapsed when no patient effort is detected or the **MANUAL BREATH** key is activated.

Primary controls: Active in PRVC SIMV mode are Rate, Volume, Inspiratory Time, Pressure Support, PEEP, Flow Trigger and %O_2.

Advanced settings: Available in PRVC SIMV mode are Volume Limit, Pressure Support Rise, Pressure Support Cycle, Pressure Support Tmax, Bias Flow, Flow Cycle and Pressure Trigger.

*Available for adult and pediatric patients only.
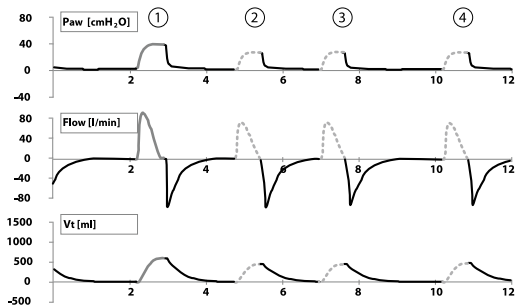
PRVC SIMV with mandatory *(1)* and assisted *(2–4)* breaths

APRV/BiPhasic mode*

Airway pressure release ventilation (APRV)/BiPhasic is a time cycled pressure mode that cycles between two different baseline pressures based on time, which can be synchronized with patient effort. Controlled ventilation can be maintained by time cycling the transitions between baseline pressures. Pressure support can be added to improve comfort for the spontaneously breathing patient.

In this mode, the patient can breathe spontaneously at two pre-set pressure levels. These are set using the Pres High and Pres Low controls. The maximum duration at each pressure during time cycling is set with the Time High and Time Low controls. The operator can also adjust the length of the respective trigger *(Sync)* windows with the Time High and Time Low Sync controls, which are advanced settings of Time High and Time Low. The Sync windows are adjustable from 0% to 50%, in 5% increments of set Time High and Time Low. The change synchronizes from Pressure Low to Pressure High with the detection of inspiratory flow or first inspiratory effort within the T Low Sync window. Transition from Pressure High to Pressure Low occurs with the first end of inspiration detected after the T High Sync window opens.

Note: Time High and Time Low are the maximum time settings for a time cycled transition. Actual times may vary depending on the patient's spontaneous breathing pattern and Sync window setting. Setting the Sync to 0% cycles the transition between pressure levels on time only and does not synchronize with patient efforts. The **MANUAL BREATH** button is not active in APRV/BiPhasic.

APRV/BiPhasic mode features adjustable PSV. The PSV delivers above the current phase baseline pressure. PSV breaths are available during Time High and by activating T High PSV, which is an advanced setting of Time High. If activated, the same PSV level for both Pressure Low and Pressure High delivers during Time High.
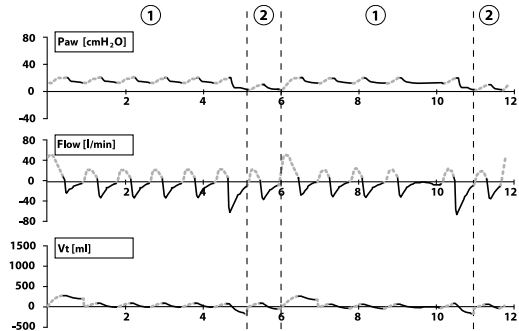
1 - Time High, Pressure High
2 - Time Low, Pressure Low APRV/BiPhasic mode

Apnea ventilation is available in APRV/BiPhasic mode. If the patient does not initiate a spontaneous effort or the ventilator does not time cycle between pressure levels before the apnea interval has elapsed, the ventilator alarms for apnea and begins apnea ventilation at the apnea ventilation settings. A spontaneous effort from the patient or a transition in baseline pressure resets the apnea alarm and timer and returns the ventilator to APRV/BiPhasic ventilation.

Primary controls: Active in APRV/BiPhasic mode are Time High, Pressure High, Time Low, Pressure Low, Pressure Support, Flow Trigger and $\%O_2$.

Advanced settings: Available in APRV/BiPhasic mode are T High PSV, T High Sync, T Low Sync, Volume Limit, Pressure Support Rise, Pressure Support Cycle, Pressure Support Tmax, Bias Flow and Pressure Trigger.

*APRV/BiPhasic mode is available for adult and pediatric patients only.

CPAP/PSV*

Continuous positive airway pressure with pressure support ventilation (CPAP/PSV) breaths are demand breaths with the pressure level during inspiration equal to the pre-set PSV level plus PEEP. This breath type is controlled by pressure *(pre-set PSV level + PEEP)*, limited by pressure *(pre-set PSV level + PEEP)* and cycled by time *(PSV Tmax)* or flow *(PSV cycle)*.

All breaths are patient-initiated demand breaths unless the **MANUAL BREATH** key is pressed. When the **MANUAL BREATH** key is pressed in CPAP/PSV, a single breath delivers at the apnea backup control settings.

Primary controls: Active in CPAP/PSV mode are Pressure Support, PEEP, Flow Trigger and %O_2.

CPAP/PSV

Advanced settings: Available in CPAP/PSV are Volume Limit, Pressure Support Rise, Pressure Support Cycle, Pressure Support Tmax, Bias Flow and Pressure Trigger.
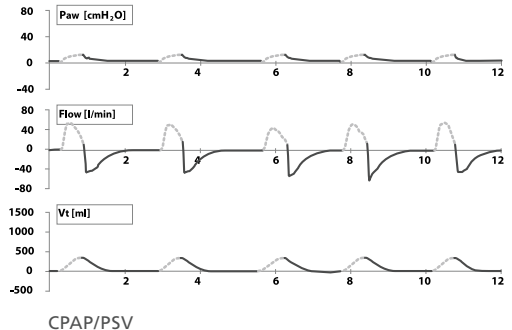
Apnea Backup ventilation

Apnea Backup ventilation is available in Assist Control (A/C), SIMV, APRV/BiPhasic and CPAP/PSV modes.

Apnea Backup in Assist Control or SIMV

The set mandatory breath rate or the Apnea Interval setting *(whichever provides the highest respiratory rate)* determines the apnea backup rate.

When the Apnea Interval setting *(found in the Alarm Limits window)* determines the backup rate, the ventilator continues to ventilate at this rate until the apnea has been resolved. All other controls for apnea ventilation in Assist Control (A/C) and SIMV are the current active primary controls.

Apnea ventilation ends when a patient initiates a spontaneous breath, a manual breath is delivered or the rate control is increased above the Apnea Interval setting.

Apnea Backup in APRV/BiPhasic and CPAP/PSV

When these modes are selected, you must:

1. Set the primary and advanced settings for CPAP/PSV or APRV/BiPhasic.

2. Select the breath type for Apnea Backup mode *(Volume or Pressure in adult and pediatric patients or Volume, Pressure or TCPL in neonatal patients)* by pressing the Apnea Settings button.

3. Set the primary controls appearing at the bottom of the touch screen, for the selected apnea breath type before pressing the **MODE ACCEPT** button.

Note: The controls for apnea backup ventilation are not visible once the **MODE ACCEPT** button has been pressed. Only the controls that are active and required for the selected mode display on the main screen once the **MODE ACCEPT** button is pressed.

nCPAP/IMV

Nasal CPAP (nCPAP) is a spontaneous ventilation. In this mode, no mechanical positive pressure breaths deliver. Nasal IMV is a time triggered, time cycled mode of pressure control ventilation provided via nasal prongs as an enhancement to the nCPAP mode. When a rate is set greater than zero, time triggered, time cycled mandatory breaths deliver. Each breath comprises an inspiratory phase, during which the delivered pressure increases from baseline (PEEP) to PEEP + Inspiratory Pressure, and an expiratory phase, during which the delivered pressure returns to PEEP.

Nasal IMV breaths are:

• Controlled by pressure

• Limited by pressure

• Cycled by time

Primary controls: nCPAP level, Inspiratory Pressure, Inspiratory Time, FiO$_2$% and Rate

Advanced settings: Inspiratory Rise*

*__No advanced settings appear when Rate is set to off.__

nCPAP/IMV is only available in the neonatal patient size setting.

Standby

When activated, Standby retains the primary controls, advanced settings and alarm limits when the patient is away from the ventilator. To initiate Standby, press the screen's membrane button.

The Standby Check message appears, asking you to confirm your intent to stop ventilation. **The patient should be disconnected from the ventilator prior to the user initiating Standby.**

If YES is selected, ventilation stops, the safety valve closes and the ventilator supplies 2 L/min of gas continuously to the circuit. This supply reduces the risk of an overheated circuit if an active humidifier is in use and left on.

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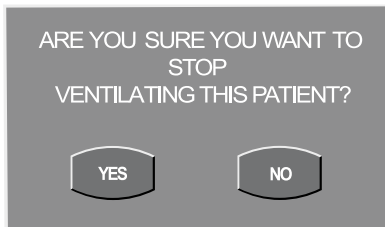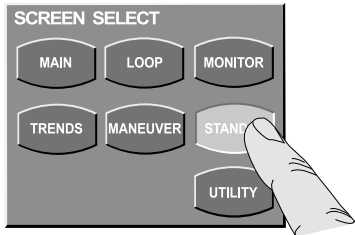
Standby *(continued)*

Note: The patient wye must be blocked for this flow to be directed through the full length of the patient circuit.

The **STANDBY NOT VENTILATING** message displays. Press Resume to restart ventilation at the current settings.

**STANDBY
NOT VENTILATING**

Resume

Section 3: Advanced settings

Volume Limit

The Volume Limit (Vol Limit) setting sets the volume limit for a pressure limited breath. When the volume delivered to the patient meets or exceeds the pre-set volume limit, the inspiratory phase of the breath terminates.

The volume limit is active for Pressure, PRVC/Vsync, TCPL and PSV breaths only. In neonatal applications, the volume limit requires a wye flow sensor. Whenever a proximal flow sensor is used *(neonatal, pediatric or adult applications),* the volume limit activates by the inspiratory tidal volume measured by the wye flow sensor. In adult and pediatric applications that do not use a wye flow sensor, the volume limit is determined by the calculated inspiratory wye flow. When the volume limit threshold has been reached, the ventilator alarm status indicator changes to yellow and displays Volume Limit. The alarm status indicator cannot be reset until the ventilator has delivered a breath, which does not meet the volume limit threshold. To reset the alarm status window, use the **ALARM RESET** button.

Note: Excessive inspiratory flow rates or highly compliant ventilator circuits may allow tidal volume delivery that exceeds the Volume Limit setting. This is due to the ventilator circuit recoiling and providing additional tidal volume to the patient. Delivered tidal volumes should be closely monitored to ensure volume limit accuracy.

Machine Volume

The Machine Volume (Mach Vol) control sets the minimum tidal volume delivered as the control is activated in a pressure control breath. This control is always used with the time cycling criterion in pressure control ventilation. The machine volume is circuit compliance compensated in adult and pediatric applications.

Once you set the machine volume, the ventilator calculates the decelerating inspiratory flow required to deliver the machine volume in the set inspiratory time. When a pressure control breath delivers and peak flow decelerates to this calculated peak inspiratory flow, if the machine volume has not been met, the ventilator automatically transitions to a continuous flow until the machine volume has been delivered. Once the set machine volume has been delivered, the ventilator cycles into exhalation. Upon meeting or exceeding the machine volume or pressure control breath delivery, the ventilator completes the breath as a normal pressure control breath.

During this transition in flow, the inspiratory time remains constant and the Ppeak increases to reach the set machine volume. The maximum Ppeak is determined by the High Peak Pressure alarm setting.

Note: Pmax disables when the machine volume is set. If flow cycling is active in pressure control, the ventilator does not cycle the flow until meeting the machine volume. The machine volume is circuit compliance compensated in adult and pediatric applications.

To set the machine volume in adult and pediatric applications *(with circuit compliance compensation active),* simply set the minimum desired tidal volume.

In neonatal applications with proximal flow sensor in use:

1. Adjust the peak inspiratory pressure to reach the desired tidal volume.

2. Select Vdel as one of the monitored parameters. Read the Vdel *(uncorrected tidal volume delivered from the machine)* during a pressure control breath.

3. Set the machine volume to or slightly below the Vdel measurement. This sets the machine volume to provide more consistent tidal volume delivery for slight decreases in lung compliance.

Note: To protect against larger changes in lung compliance, the machine volume should be set higher and volume limit should be added.

Inspiratory Rise

The Inspiratory Rise (Insp Rise) setting controls the slope of the pressure rise during a mandatory breath. This control is a relative control with fast at a setting of 1 and slow at a setting of 9. The Insp Rise control is not active for TCPL breaths.

Flow Cycle

The Flow Cycle setting sets the percentage of the peak flow that terminates the inspiratory phase of a pressure control or TCPL breath. Flow cycling is active for pressure or TCPL breaths only.

Note: If flow cycling is active during a pressure control breath, monitored airway pressures *(inspiratory)* are higher than active automatic airway compensation (AAC). An Inspiratory Pressure setting of zero AAC still provides an elevated airway pressure, which compensates for the resistance of the endotracheal tube.

Waveform

During the delivery of a volume breath, flow can be delivered in one of two user-selectable waveforms: Square Wave or Decelerating Wave. The default waveform is Decelerating Wave.

Square Wave *(Square)*

With this waveform selected, the ventilator delivers gas at the set peak flow for the duration of the inspiration.

Decelerating Wave *(Decel)*

With this waveform selected, the ventilator delivers gas starting at the peak flow and decreasing until the flow reaches 50% of the set peak flow.

Sigh

The ventilator delivers sigh volume breaths when this setting is on. A sigh volume breath delivers every 100th breath in place of the next normal volume breath.

Sigh breaths are only available for volume breaths in Assist and SIMV modes for adult and pediatric patients.

Bias Flow

The Bias Flow control sets the background flow available between breaths. Additionally, this control establishes the base flow for flow triggering.

Note: To ensure adequate bias flow for inspiratory triggering, the Bias Flow setting should be at least 0.5 L per minute greater than the flow trigger threshold. Consult the ventilator circuit manufacturer to ensure the Bias Flow setting can sufficiently prevent overheating the ventilator circuit.

Pressure Trigger

The Pressure Trigger (Pres Trig) control sets the level below PEEP that activates the inspiratory trigger mechanism. When the pressure in the patient circuit falls below PEEP by the set pressure trigger level, the ventilator cycles to inspiration. Pres Trig is also used to activate the inter-breath demand system in volume controlled ventilation.

Note: Setting the Pres Trig to excessively high levels can impair the patient's ability to activate the inter-breath demand system in volume controlled ventilation.

Vsync*

When Vsync is selected, a decelerating flow, volume test breath to the set tidal volume with a 40 msec pause delivers to the patient. The ventilator sets the target pressure at the end inspiratory pressure for the first pressure control breath. The next breath and all subsequent breaths deliver as pressure control breaths. Inspiratory pressure adjusts automatically to maintain the target volume based on the dynamic compliance of the previous breath. The maximum step change between two consecutive breaths is 3 cm of water pressure. The maximum tidal volume delivered in a single breath is determined by the Volume Limit setting.

This test breath sequence initiates when:

• Entering the mode *(Vsync)*

• Changing the set tidal volume while in Vsync

• Reaching the Volume Limit setting

• Reaching a delivered tidal volume > 1.5 times the set volume

Vsync* *(continued)*

• Terminating the flow the test breath

• Activating the:

  - High Peak Pressure alarm

  - Low Peak alarm

  - Low PEEP alarm

  - Patient Circuit Disconnect alarm

  - I-Time Limit

  - I:E Limit

*Vsync is only available for adult and pediatric patients.

Note: The Peak Flow control sets the flow rate, which is used for the test breath only. The ventilator uses the Peak Flow setting and inspiratory pause to determine the maximum inspiratory time during Vsync ventilation.

Vsync Rise

With Vsync active, this control sets the slope of the pressure rise during the PRVC/Vsync breath. It is a relative control ranging from fast at a setting of 1 to slow at a setting of 9.

PSV Rise

The PSV Rise setting sets the slope of the pressure rise during a pressure-supported breath. It is a relative control with a range from fast at a setting of 1 to slow at a setting of 9.

PSV Cycle

The PSV Cycle setting sets the percentage of peak inspiratory flow that terminates the inspiratory phase of a PSV breath.

PSV Tmax

The PSV Tmax setting controls the maximum inspiratory time of a pressure-supported breath.

Note: PSV Rise, PSV Cycle and PSV Tmax are active even if the PSV level is zero.

Volume Limit

The Vol Lim setting sets the volume limit for a pressure limited breath. When the volume delivered to the patient meets or exceeds the pre-set volume limit, the inspiratory phase of the breath terminates.

T High PSV

The T High PSV setting sets the volume limit for a pressure limited breath. When the volume delivered to the patient meets or exceeds the pre-set volume limit, the inspiratory phase of the breath terminates.

T High Sync

The T High Sync setting sets the length of the Time High trigger *(Sync)* window. The Sync window adjusts from 0% to 50%, in 5% increments of set Time High, and synchronizes the change from Pressure High to Pressure Low with the first end of inspiration detected after the T High Sync window opens. If no patient effort detected, the transition occurs when the set Time High has elapsed. Setting the T High Sync window to 0% provides time cycling only.

T Low Sync

The T Low Sync setting sets the length of the Time Low trigger *(Sync)* window. The Sync window adjusts from 0% to 50%, in 5% increments of the set Time Low, and synchronizes the change from Pressure Low to Pressure High when detecting inspiratory flow or the first inspiratory effort within the T Low Sync window. If no patient effort is detected, the transition occurs when the set Time Low has elapsed. Setting the T Low Sync window to 0% provides time cycling only. The Volume Limit setting sets the volume limit for a pressure limited breath. When the volume delivered to the patient meets or exceeds the pre-set volume limit, the inspiratory phase of the breath terminates.

AVEA ventilator modes, primary controls and advanced settings

Breath type and mode	Vol A/C	Vol SIMV	Pres A/C	Press SIMV
Primary controls				
Rate BPM	*	*	*	*
Volume mL	*	*		
Insp Pres cmH$_2$O			*	*
Peak flow L/min	*	*		
Insp time sec			*	*
Insp pause sec	*	*		
PSV cmH$_2$O		*		*
PEEP cmH$_2$O	*	*	*	*
Flow trig L/min	*	*	*	*
% oxygen %O$_2$	*	*	*	*
Pres High cmH$_2$O				
Time High sec				

*Available with Vsync activated for adult or pediatric patients only.
**Available for adult and pediatric patients only.

AVEA ventilator modes, primary controls and advanced settings *(continued)*

Breath type and mode	Vol A/C	Vol SIMV	Pres A/C	Pressure SIMV
Time Low sec				
Pres Low cmH$_2$O				
Advanced settings available within each mode	• Vsync* • Vsync Rise* • Sigh** • Waveform • Bias Flow • Pres Trig • Vol Limit *(when Vsync = On)* • Flow Cycle *(when Vsync = On)* • Demand Flow	• Vsync* • Vsync Rise* • Sigh** • Waveform • Vol Limit • PSV Rise • PSV Cycle • PSV Tmax • Bias Flow • Pres Trig • Flow Cycle *(when Vsync = On)* • Demand Flow	• Mach Vol • Vol Limit • Insp Rise • Flow Cycle • Bias Flow • Pres Trig	• Mach Vol • Vol Limit • Insp Rise • Flow Cycle • PSV Rise • PSV Cycle • PSV Tmax • Bias Flow • Pres Trig
VG breaths	N/A	N/A	Available in neonatal patient type	Available in neonatal patient type

*Available with Vsync activated for adult or pediatric patients only.
**Available for adult and pediatric patients only.

AVEA ventilator modes, primary controls and advanced settings *(continued)*

Breath type and mode	PRCV A/C	PRVC SIMV	CPAP/PSV	APRV/ BiPhasic	TCPL A/C	TCPL SIMV
Primary controls						
Rate BPM	*	*	Apnea mode*	Apnea mode*	*	*
Volume mL	*	*	Apnea mode*	Apnea mode*		
Insp Pres cmH$_2$O			Apnea mode*	Apnea mode*	*	*
Peak flow L/min			Apnea mode*	Apnea mode*	*	*
Insp time sec	*	*	Apnea mode*	Apnea mode*	*	*
Insp pause sec			Apnea mode*	Apnea mode*		
PSV cmH$_2$O	*	*	*	*		*
PEEP cmH$_2$O	*	*	*	*	*	*
Flow trig L/min	*	*	*	*	*	*
% oxygen %O$_2$	*	*	*	*	*	*
Pres High cmH$_2$O				*		
Time High sec				*		

*Available with Vsync activated for adult or pediatric patients only.
**Available for adult and pediatric patients only.

AVEA ventilator modes, primary controls and advanced settings *(continued)*

Breath type and mode	PRCV A/C	PRVC SIMV	CPAP/PSV	APRV/ BiPhasic	TCPL A/C	TCPL SIMV	nCPAP/IMV
Time Low sec				*			
Pres Low cmH₂O				*			
Advanced settings available within each mode	• Insp Rise • Bias Flow • Pres Trig • Vol Limit • Flow Cycle	• Vol Limit • PSV Rise • PSV Cycle • PSV Tmax • Bias Flow • Pres Trig • Flow Cycle • Insp Rise	• Vol Limit • PSV Rise • PSV Cycle • PSV Tmax • Bias Flow • Pres Trig	• Vol Limit • PSV Rise • PSV Cycle • PSV Tmax • Bias Flow • Pres Trig • T High Sync • T High PSV • T Low Sync	• Vol Limit • Flow Cycle • Bias Flow • Pres Trig	• Vol Limit • Flow Cycle • PSV Rise • PSV Cycle • PSV Tmax • Bias Flow • Pres Trig	• Insp Rise***
VG breaths	N/A	N/A	N/A	N/A	Available in neonatal patient type	Available in neonatal patient type	N/A

*Available with Vsync activated for adult or pediatric patients only.
**Available for adult and pediatric patients only.
***Not available when rate is set to OFF.

Notes

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Notes

References

1 Branson, R., Chatbum, R. Proceedings of consensus conference on the essentials of mechanical ventilators, Cancun, Mexico, February 1992.

⚠ **WARNING**—U.S. Federal Law restricts this device to sale by or on the order of a physician.

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