AVEA® ventilator user guide

Critical care ventilation
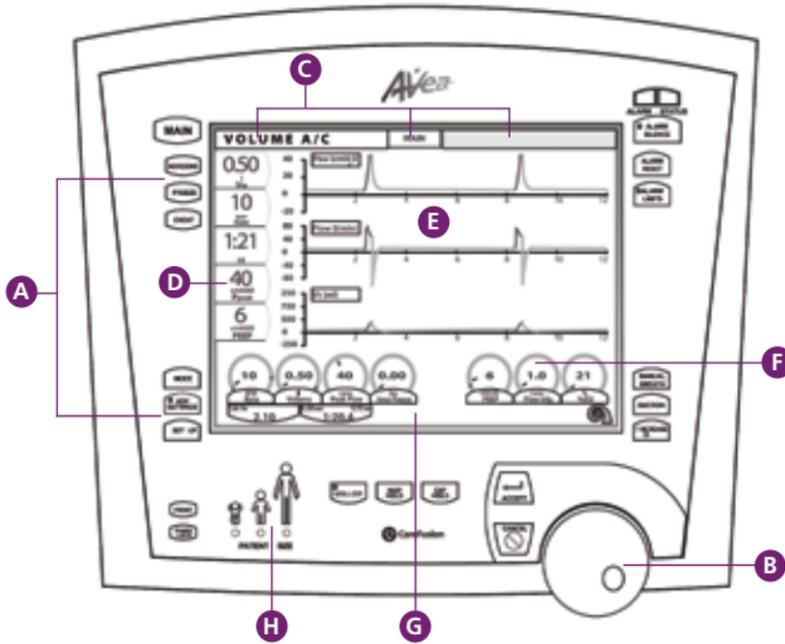
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The AVEA ventilator User Guide is not intended as a replacement for the operator's manual. You must become completely familiar with the AVEA ventilator operator's manual before using the AVEA ventilator.

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AVEA ventilator rear panel
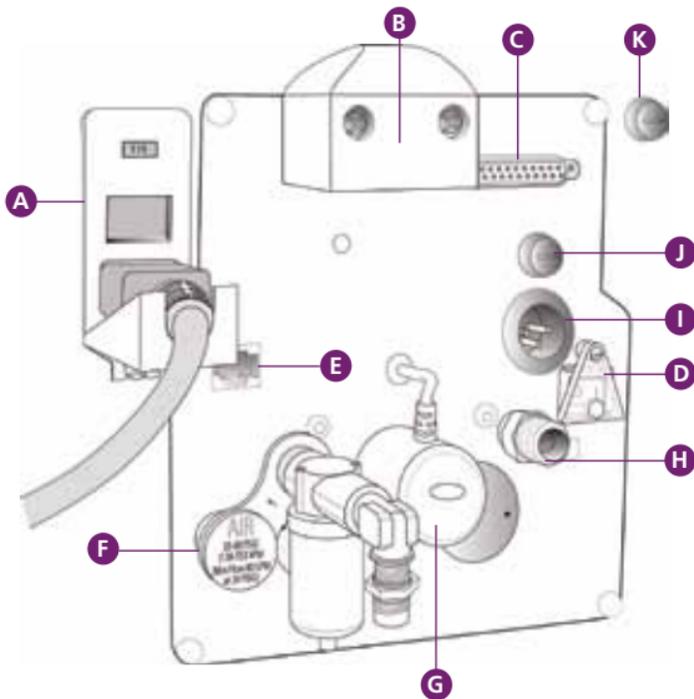
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Assembling the exhalation filter and water trap

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2.

Locating ridge
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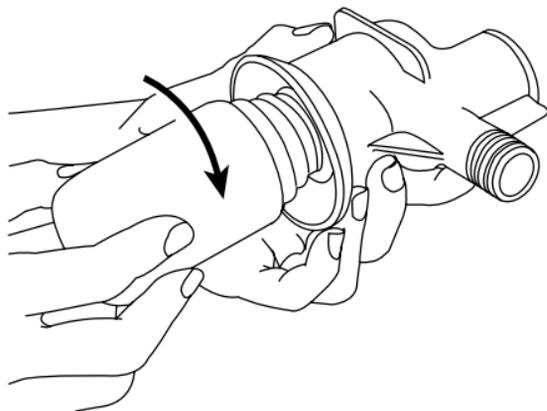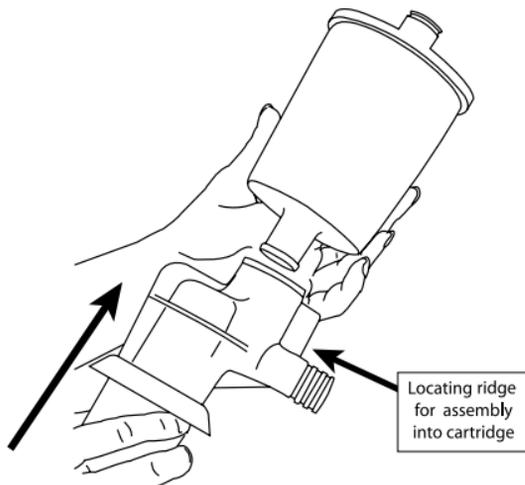
3. Align the locating ridge on the water trap assembly with the slot in the exhalation filter cartridge.
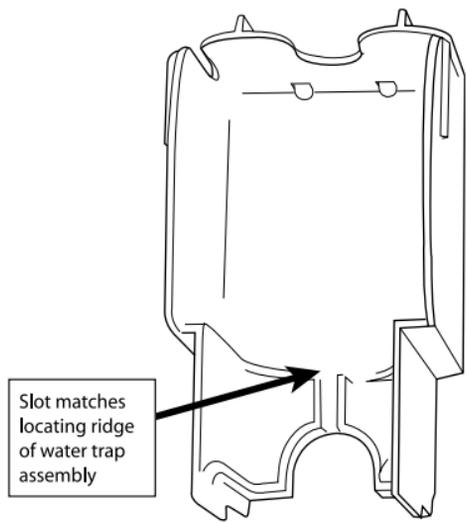
4. Slide the water trap/exhalation filter assembly into the cartridge.

Slot matches locating ridge of water trap assembly
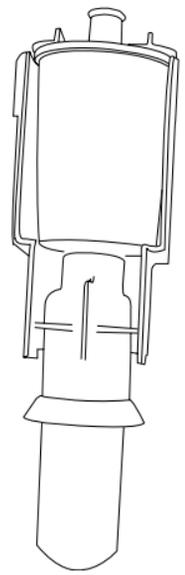
5. Open locking lever.
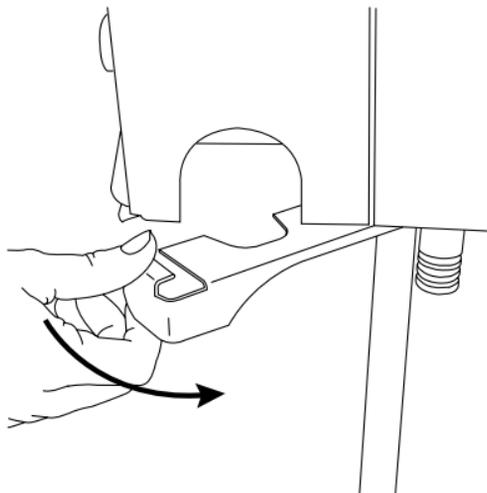
6. Insert exhalation filter.
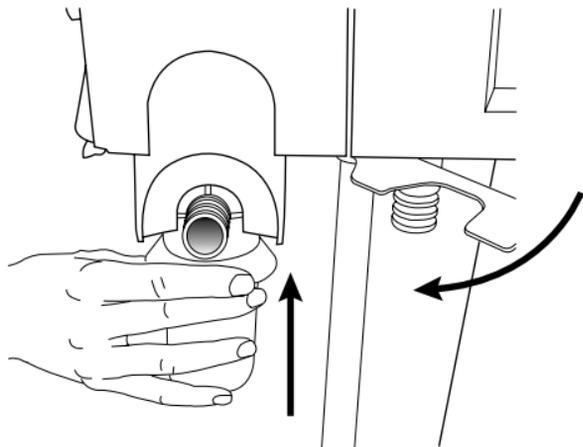
Disposable filter and water trap insertion
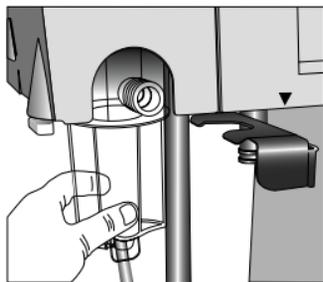
AVEA ventilator disposable water trap.
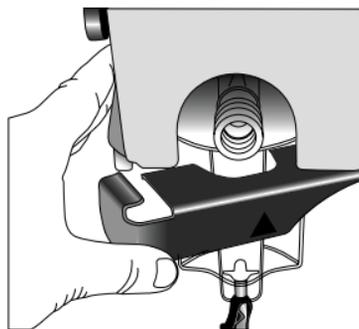
Insert cartridge into filter cavity. Close lever when fully inserted.
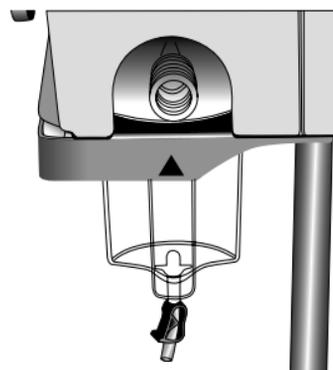
Cartridge fully inserted with lever closed.

Patient circuit assembly

The passive humidification system should be placed in-line in the patient circuit per the manufacturer's instructions.

Patient circuit with active humidifier
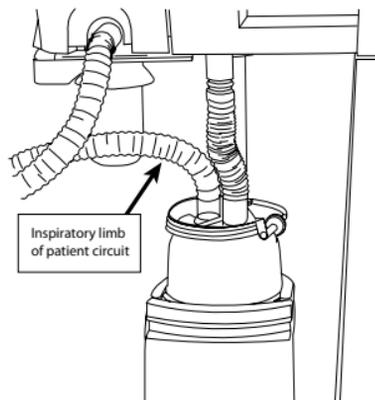
Patient circuit without active humidifier

Inspiratory limb of patient circuit
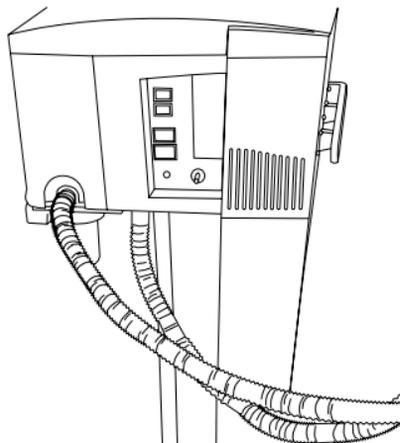
Attaching flow sensors

The AVEA ventilator can accept either a hot wire or a variable orifice proximal flow sensor. The monitored values displayed for volume and flow is proximal values when a proximal sensor is in use. These are in addition to the instrument's internal inspiratory flow sensor and heated expiratory flow sensor.

Variable orifice flow sensor

Hot wire flow sensor
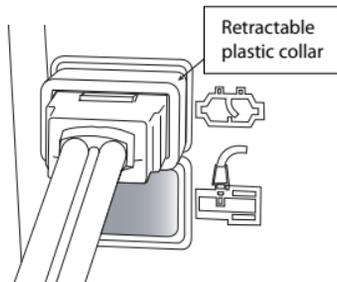
Retractable plastic collar
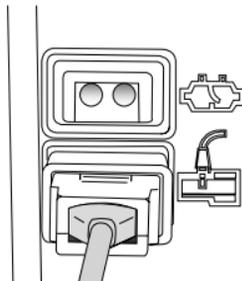
These are locking connectors. To attach, first pull back the plastic locking collar, then push firmly onto the ventilator receptacle. Then push the locking collar forward to lock the flow sensor in place.

To disconnect, first retract the plastic collar then firmly pull the connector away from the ventilator. Do not pull up or down as this can damage the connector.

Attaching flow sensors *(continued)*

The standard hot wire flow sensor is suitable for neonatal and pediatric applications where the peak inspiratory flow rate is less than 30 L/min. This flow sensor is not active in adult applications.

NOTE: Hot wire flow sensors will not function with Heliox gas mixtures. During Heliox delivery, a variable orifice flow sensor should be used for monitoring delivered volumes at the proximal airway. Variable orifice flow sensors are also available on some AVEA ventilator models. The neonatal VariFlex flow sensor is compatible in neonatal and pediatric applications where the peak inspiratory flow rate is less than 30 L/min and is not active in adult applications. For adult and large pediatric applications, a pediatric / adult VariFlex flow sensor is available for use with patients whose flow requirements fall within the range of 1.2 to 180 L/min. Detailed information on the specifications of each flow sensor can be found in *Appendix E: Sensor specifications and circuit resistance of the AVEA ventilator operator's manual.*

Hot wire flow sensor must be zeroed prior to use. Follow operator manual instructions.

User verification test

The User Verification Test consists of three separate elements:

1. Post Test: Automatic on power up. Normal ventilation begins after completion.

2. Extended System Test (EST)

   • Patient circuit leak test

   • Patient circuit compliance measurement

   • Two-point calibration of O2 sensor

3. Manual Alarms Testing: Detailed instructions are found in Ch. 2 of the AVEA ventilator operator's manual.

User verification test *(continued)*

Performing an Extended Systems Test (EST):

The EST is accessed from the Setup screen. To open this screen, press the Setup button on the lower left of the user interface. Select the appropriate Patient Size and proceed to second menu of Setup screen.
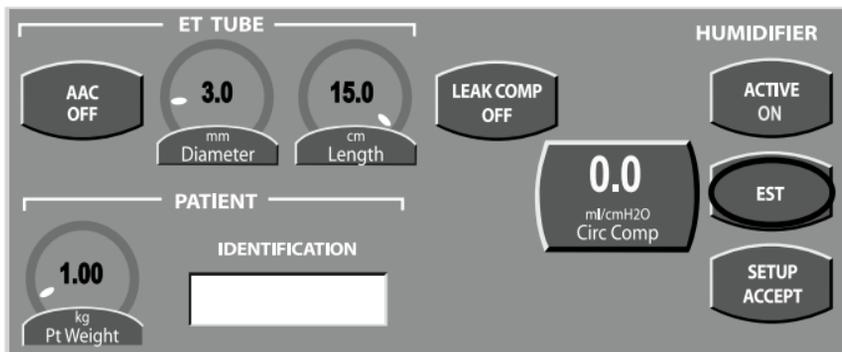
Press the EST button to access the EST screen

Performing an Extended Systems Test (EST) *(continued)*

REMOVE THE PATIENT.
BLOCK PATIENT CIRCUIT WYE.

CONT   CANCEL
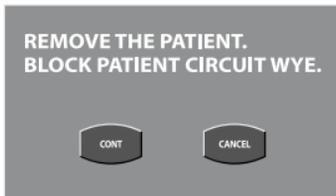
Remove the patient and block
the patient wye, then press the
Continue (Cont) button.

EXTENDED SYSTEM TEST

Leak Test: PASSED.
Circuit Compliance Test: PASSED.
O2 Sensor Calibration: IN PROGRESS.

45 sec   CANCEL

All tests are performed
simultaneously. The maximum
time for the EST is 90 seconds.
To restart the EST at any time,
select the Cancel button to
return to the Setup screen.

EXTENDED SYSTEM TEST

Leak Test: PASSED.
Circuit Compliance Test: PASSED.
O2 Sensor Calibration: PASSED.
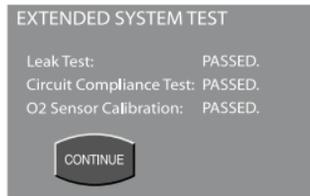
CONTINUE

Press the Continue button to
return to the Setup screen.

When possible the EST should be performed with an oxygen supply connected. A two point
calibration of the oxygen sensor is performed during the EST.

NOTE: If you do not connect the ventilator to an oxygen supply, the O_2 sensor calibration
will immediately fail.

CAUTION: Although failure of any of the above tests will not prevent the ventilator
from functioning, it should be checked to make sure it is operating correctly before use
on a patient.

Performing an Extended Systems Test (EST) *(continued)*

When possible the EST should be performed with an oxygen supply connected. A two point calibration of the oxygen sensor is performed during the EST.

NOTE: If you do not connect the ventilator to an oxygen supply, the O_2 sensor calibration will immediately fail.

CAUTION: Although failure of any of the above tests will not prevent the ventilator from functioning, it should be checked to make sure it is operating correctly before use on a patient.

Setting the ventilation breath type and mode

Advanced settings

You can further refine delivery of the breath by accessing the Advanced Settings. Not all primary controls have advanced settings. Primary Controls that feature advanced settings will display a yellow triangle to the right of the control name.

Accessing the advanced settings
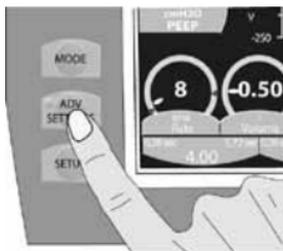
Press the Adv Settings membrane button.

Press the primary control to display the advanced settings available for that particular control.

Graphics

Configure main screen graphics for scale and sweep speed

1. Touch the vertical or horizontal axis
   to highlight.
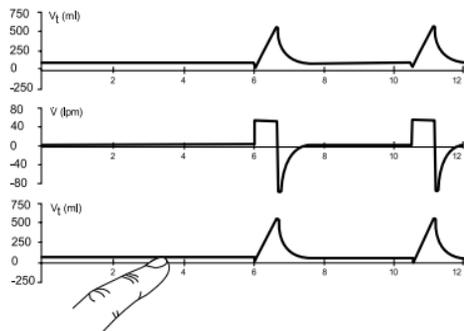
2. Turn the data dial to adjust scale or
   sweep speed. Touch the axis again
   or press the Accept button to confirm
   the changes.
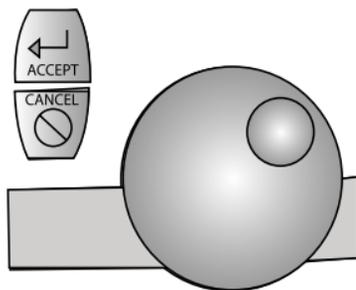
Loops

Accessing the Loops screen

To access the Loops screen, press the screen
indicator or the Screens membrane button on
the left of the UIM. Select Loop.

SCREEN SELECT

MAIN LOOP MONITOR

TRENDS MANEUVER STANDBY

UTILITY
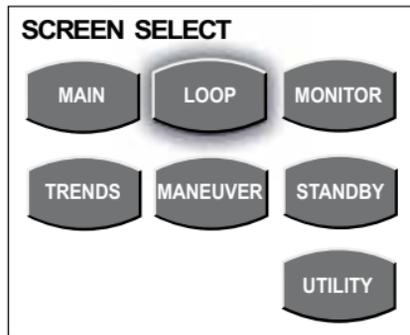
Choice of loops

The ventilator displays two loops in real time, selected from the following. Touch the Loop
heading to open the scrollable menu. Press the Accept button or touch the Loop heading to
confirm the change.

- Vt - Flow   Flow / Volume loop.

- PAW - Vt   Airway Pressure / Volume loop.

- PINSP - Vt   Inspiratory Pressure / Volume loop.

Configure Loops screen

Change vertical and horizontal scales with Touch-Turn-Touch or Touch-Turn-Accept techniques.

1. Touch the vertical or horizontal axis to highlight.
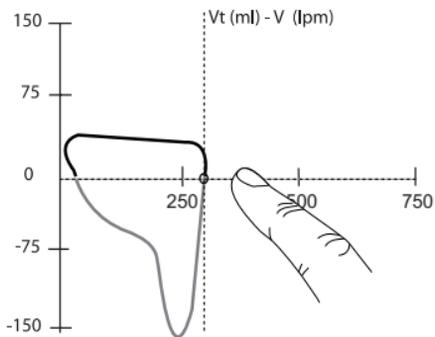
2. Turn the data dial to adjust the scale. Touch the axis again or press the Accept button to confirm the change.
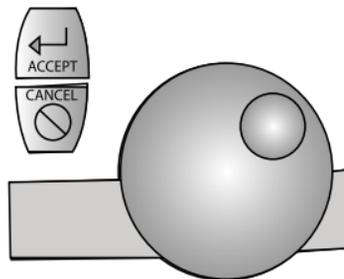
Freeze

The Freeze button freezes the current
screen and suspends real-time update
of data until pressed again. When a
screen is frozen you can use the data dial
to scroll through displayed waveforms,
loops or trends.
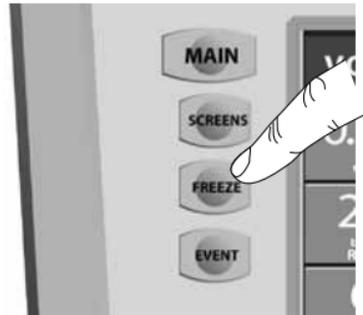
A Flow/Volume loop in Freeze mode is
shown below. As the dotted line cursor
traces the Frozen loop, flags display the
values along the curve of the loop.

Flags showing X and Y values at various points along the loop tracing

Flow/Volume loop tracing

Cursor currently overlays the "X" axis at zero
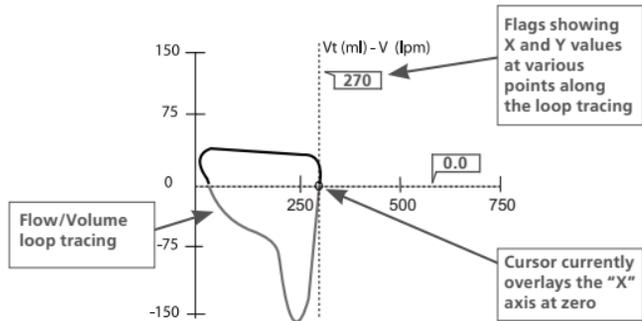
Saving loops

1. Press the Freeze button to freeze the graphics display.
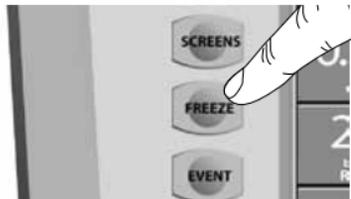
2. Press Save Loop.

3. Saved loops will appear with a time reference. A total of 4 loops can be saved at any time. If a 5th loop is selected, the oldest saved loop is removed.

Create reference loops

1. Press the Freeze button to freeze the
   graphic display.

2. Touch the saved loop you want as a reference.
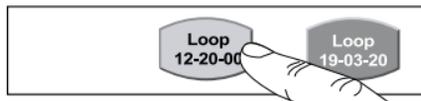
3. Press Ref Loop Off to toggle the Ref Loop On.

4. Press the Freeze button to return to live loops
   display over the reference loop.

   To remove the reference loop, press the Freeze
   button. Then press the Ref Loop On button to
   turn off the reference loop.

Message	Alarm condition	Range	Priority
High PPEAK	Peak inspiratory pressure is greater than the set high PPEAK. Inspiration is terminated and the circuit pressure is allowed to return to baseline pressure + 5 ± 1.5 cmH$_2$O before the next breath is delivered.	Normal breath range: 10 to 105 cmH$_2$O (adult/pediatric) Default 75 cmH$_2$O 10 to 85 cmH$_2$O (neonate) Default 50 cmH$_2$O nCPAP/IMV 2 to 45 cmH$_2$0 (Inspiratory pressure +3 cmH$_2$0, nCPAP/IMV rate not zero) Sigh Breath Range: 1.5	High
High nCPAP pressure	Pressure during nCPAP exceeds the high airway pressure threshold for a period of greater than 20 seconds.	Threshold: Set CPAP +c cmH$_2$0 tolerance ±0.5 cmH$_2$0	High
	Pressure during nCPAP falls below the low airway pressure threshold for a period of greater than 20 seconds.	Threshold: Set CPAP level -2 cmH$_2$0 (if set CPAP ≥ 3 cmH$_2$0) or set CPAP level -1 cmH$_2$0 (if set CPAP level <3 cmH$_2$0)	High

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Message	Alarm condition	Range	Priority
nCPAP Pressure Limit	Activated when nCPAP pressure is greater than airway pressure for 3 seconds. Deactivated when nCPAP pressure drops below 4.5 cmH_2O.	Pressure Limit: 11 cmH_2O (nCPAP only, rate set to off) Set CPAP level + Inspiratory pressure + 3 cmH_2O (nCPAP/IMV, rate not zero)	High
Low Ppeak	Low Ppeak is displayed and a high priority tone sounds, whenever the peak inspiratory pressure for a given breath is less than the preset threshold for Low Ppeak.	Range: 3 to 99 cmH_2O Defaults: 8 cmH_2O (adult/pediatric) 5 cmH_2O (neonate) for nCPAP /IMV: 1-40 cmH_2O (neonatal –nCPAP/IMV) Limitations: Not active for spontaneous breaths	High
High Ppeak, SUST	Activates whenever the High Ppeak alarm has been active for more than 5 seconds (i.e., if the circuit pressure fails to return to PEEP + 5 cmH_2O within 5 seconds). The safety and exhalation valves open and no breaths are delivered. The Safety Valve Open alarm activates. Bias flow is suspended while this alarm is active. PEEP may not be maintained. This alarm will remain active until the condition is resolved.	N/A	High
Low PEEP	Baseline pressure (Positive End Expiratory Pressure) is less than the set Low PEEP alarm threshold for a period greater than 0.25 ± 0.05 seconds. This alarm is off if set to zero.	0 to 60 cmH_2O Defaults:3 cmH_2O (adult/pediatric) 1 cmH_2O (neonate)	High

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Message	Alarm condition	Range	Priority
Low Ve	Monitored exhaled minute volume (Ve) is less than the set Low Ve alarm threshold.	Off (0), 1 to 50 L (adult) Off(0), 0.1 to 30 L (pediatric) Off (0), 0.01 to 5.00 L (neonate) Default Off	High
High Ve	Monitored exhaled minute volume (Ve) is greater than the set High Ve alarm threshold.	0 to 75 L (adult) 0.0 to 30.0 L (pediatric) 0.00 to 5.00 L (neonate) Defaults: 30.0 L (adult/pediatric)	High
Flow Sensor Error (neonatal volume guarantee only)	Occurs when 1) neonatal flow sensor is in use 2) volume guarantee is enabled and 3) monitored Vti drops below 20% of net delivered volume. The system will revert to operator set inspiratoy pressure.	Neonatal mode with volume guarantee active, Delay is 3 breaths or 10 sec if greater, or 30 sec if less	Medium
Low expired volume	When volume guarantee is active and monitored expiratory tidal volume is less than the set threshold of the volume target.	Neonatal mode with volume guarantee active, 30 sec or 10 breaths, whichever is greater	Medium

Message	Alarm condition	Range	Priority
High Vt	The absolute monitored exhaled tidal volume is greater than the set High Vt alarm threshold. (Inactive when using Volume Guarantee in Neonatal mode)	0.10 to 3.00 L (adult) 25 to 1,000 mL (pediatric) 2.0 to 300.0 mL (neonate) Defaults: 3.00 L (adult) 1,000 mL (pediatric) 300.0 mL (neonate)	High
Apnea Interval	Active in A/C, SIMV, APRV / BiPhasic and CPAP/PSV modes if the ventilator does not detect a breath within the preset Apnea time interval.	6 to 60 seconds Default 20 seconds	High
High Rate	The monitored total breath rate exceeds the set High Rate alarm threshold.	1 to 200 bpm Default 200 bpm	Medium
I-Time Limit	The inspiratory time for a breath plus pause time exceeds 5.0 seconds for adult/pediatric patients and 3.0 seconds for neonatal patients.	N/A	Medium
Limit	The I:E ratio for a mandatory breath exceeds 4:1. The inspiratory phase of the breath is terminated.	Not active in APRV/BiPhasic mode.	
Low FiO$_2$	Delivered oxygen percentage falls below the set FiO$_2$ minus 6% or 18% FiO$_2$, whichever is greater.	N/A	
High FiO$_2$	Delivered oxygen percentage rises above the set FiO$_2$ plus 6%.	N/A	
Circuit Disconnect	A high priority audible/visual alarm is activated, and Circuit Disconnect displayed, whenever the patient circuit becomes disconnected from the ventilator or patient. (See operator's manual for nCPAP/IMV disconnect sensitivity)	N/A	

Message	Alarm condition	Range	Priority
Low Battery	A high priority audible/visual alarm is activated, and Low Battery displayed, whenever the internal battery has been depleted to a level that provides a minimum of two minutes of safe operation.	N/A	High
Loss, AC Power	A high priority audible/visual alarm is activated and Loss, AC Power is displayed, whenever the power switch is on and AC power has been removed from the ventilator (i.e., power cord disconnect or loss of supply power)	N/A	High
ILV Disconnect	A high priority audible/visual alarm is activated, and ILV Disconnect displayed, whenever the master ventilator becomes disconnected from the slave ventilator during ILV.	N/A	High
Invalid Gas ID	A medium priority audible/visual alarm shall be activated, and Invalid Gas ID shall be indicated, whenever a defective gas ID connector is installed in the ventilator. When a defective Gas ID connector is detected, the gas corrections default to air.	N/A	Medium
Fan Failure	A low priority audible/visual alarm is activated, and Fan Failure indicated, whenever the fan has stopped rotating.	N/A	Low
Volume Guarantee Disabled	Proximal flow sensor disconnected or damaged (neonatal mode only).	N/A	Message
Volume Guarantee is only available in Pressure and TCPL	Selection of Volume Guarantee on the mode screen is not Pressure or TCPL (neonatal mode only).	N/A	Message
Set Vol Target will increase delivered press and volume	Volume Target set more than 20% above current setting (neonatal mode only).	N/A	Message

Message	Alarm condition	Range	Priority
Set Vol Target will decrease delivered press and volume	Volume Target set more than 20% below current setting (neonatal mode only).	N/A	Message
High Ppeak <PEEP +7 cmH$_2$0	When nCPAP /IMV mode is active and breath rate is not Off, attempt to set High Ppeak alarm limit or nCPAP such that High Ppeak alarm limit setting is less than +2 cmH$_2$0.	N/A	Message
Volume Guarantee pressure is limited	The pressure required to deliver the desired tidal volume is greater than the High Ppeak alarm limit of -3 cmH$_2$0.	N/A	Message

Rear panel connections

Oxygen sensor

The oxygen sensor cell is located on the rear panel, between the two gas fittings. The oxygen sensor cable emerges from the rear panel directly above the sensor. Carefully align and then gently push the connector onto the oxygen sensor until it seats, then slide the cover down and push over the sensor.
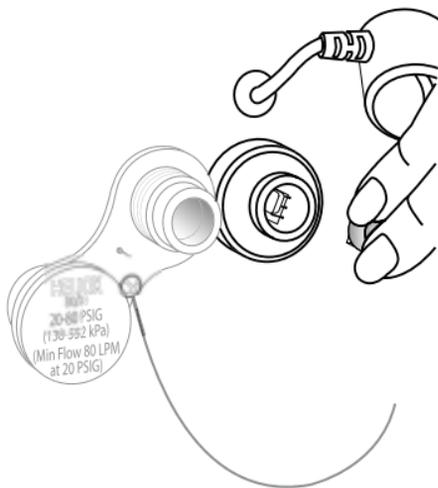
Ventilator operations

AVEA ventilator systems

The Membrane buttons are the UIM controls that surround the Touch Screen. Starting at the top right and moving clockwise around the UIM they are:

A. Alarm Silence (LED)

Pressing this button will disable the audible portion of an alarm for 2 minutes (± 1 second) or until the Alarm Silence button is pressed again. This button is not functional for a Vent Inop alarm.

NOTE: *Pressing the Alarm Silence button will not prevent the audible alarms sounding again later for certain alarm conditions.*
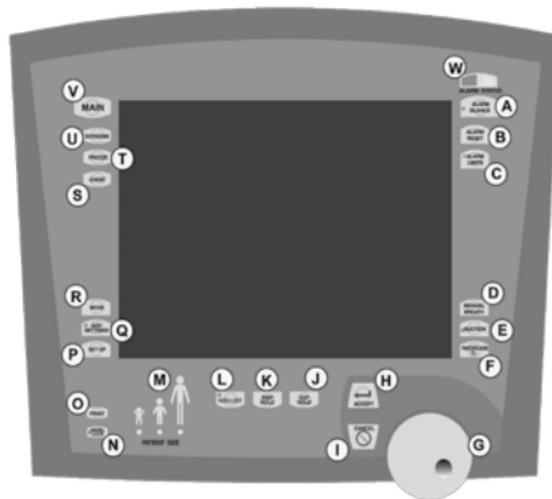
User interface module (English) showing button labels

B. Alarm Reset
Cancels the visual indicator for alarms that are no longer active.

C. Alarm Limits
Opens the Alarm Limits screen for data entry or adjustment. Toggles the screen on and off.

NOTE: *Pressing the Freeze button while the Alarm Limits window is open will automatically close the window and freeze the graphics.*

D. Manual Breath
Pressing this button during the expiration phase of a breath delivers a single mandatory breath at current ventilator settings. No breath is delivered if the key is pressed during inspiration.

NOTE: *The Manual Breath button is not active in APRV / BiPhasic.*

E. Suction (LED)

Pressing this button initiates a Disconnect for Suction maneuver. The ventilator will:
- Enable an Increase % O_2 maneuver for 2 minutes (see Increase O_2 below).
- While the Circuit Disconnect alarm is active, the ventilator will stop cycling and set a bias flow. The ventilator will automatically detect the patient upon reconnection and resume normal ventilation.
- Silences alarms for 120 seconds.

E. Suction (LED) (continued)

If the Suction key is pressed again during the 2 minutes that the disconnect for suction maneuver is active, the maneuver will be cancelled.

F. Increase O$_2$

When this key is pressed, the ventilator increases the oxygen concentration delivered to the patient for 2 minutes. If the $\uparrow$%O$_2$ key is pressed again within this two-minute period, the maneuver is cancelled and the ventilator will return to prior settings.

Defaults: +20% neonatal; 79% adult/pediatric

Adult/pediatric: 79% above the set % O$_2$

Neonate: 20% above the set % O$_2$ or 100%, whichever is less

To configure the Increase FiO$_2$, access the configuration tab on the Utilities screen:

Increase FiO$_2$

Configures the step increase used during the increase oxygen maneuver. Sets the amount of oxygen the ventilator will increase above the current set FiO$_2$.

Example: If the Increase FiO$_2$ is set at 20%

AND

The set FiO$_2$ is 40%

WHEN

The increase FiO$_2$ maneuver is activated the FiO$_2$ will increase to 60% for two minutes after which it will return to 40%.

The default setting for infants is 20% and 79% for pediatric and adult applications.

NOTE: *The settings will be reset to default values when New Patient is selected in the setup.*

NOTE: *To achieve 100% delivered FiO$_2$ during the Increase O$_2$ maneuver set the Increase FiO$_2$ setting to its maximum of 79%.*

WARNING: *Heliox delivery will be interrupted for the time that either the Suction or the Increase O$_2$ buttons are pressed during administration of Heliox. Tidal volume may be affected after the two-minute timeout period, or when the button is pressed, until the accumulator has been purged.*

G. Data dial
Changes the values for a selected field on the touch screen.

H. Accept
Accepts data entered into a field on the touch screen.

I. Cancel
Cancels data entered into a field on the touch screen. The ventilator will continue to ventilate at current settings.

J. Expiratory Hold
When the Exp Hold button is pressed, at the start of the next breath interval, the ventilator will not allow the patient to inspire or exhale for a maximum of 20 seconds (adult/pediatric) or 3 seconds (neonate). Expiratory Hold is NOT active in TCPL breaths.

K. Inspiratory Hold (Manual)
When the Insp Hold button is pressed, once the preset of a volume control or pressure control breath has been delivered, the patient will not be allowed to exhale for a maximum of 3.0 seconds (± 0.1 second).

L. Nebulizer

The ventilator supplies blended gas to the nebulizer port at 10 ± 1.5 psig (0.7 bar) when an in-line nebulizer is attached and the Nebulizer key is pressed, provided that the calculated delivered flow is >15 L/min.

Delivery of the nebulized gas is synchronized with the inspiratory phase of a breath and lasts for 20 minutes. Press the Nebulizer key a second time to end the treatment prior to the end of the 20-minute period.

CAUTION: *Use of an external flow source to power the nebulizer is not recommended.*

WARNING: *Using the nebulizer may impact delivered tidal volumes.*

NOTE: *Do not operate the nebulizer while using heliox*

M. Patient Size

The Patient Size Indicators for adult, pediatric and neonate at the bottom of the UIM show which patient size is currently selected. These LED indicators have no associated membrane button on the UIM.

M. Patient Size (continued)

NOTE: *The ventilator will not allow patient size changes when the active mode of ventilation is not available in the new patient size selection. The ventilator will display a message instructing you to first change the ventilation mode. For example, in neonatal ventilation with TCPL active, you cannot change to a pediatric or adult patient size without first changing the mode to one available for those patients.*

The ventilator will also not allow size changes if Machine Volume is active. A message displays indicating that Machine Volume must first be turned off before making a patient size change.

N. Panel Lock (LED)
The Lock key disables all front panel and screen controls except Manual Breath, Suction, ↑ %O₂, Alarm Reset, Alarm Silence and Lock.

O. Print
The Print key outputs the contents of the currently displayed screen to a suitably connected parallel printer.

P. Set-up

Opens the ventilator Set up screen.

NOTE: *Pressing the Set-Up button a second time before accepting Set-Up will close the window and restore the previous settings. The Set-Up screen uses an on-screen accept button. To change patient size without selecting a new patient requires that patient Set-Up be accepted after selecting patient size.*

Q. Advanced Settings (LED)

Opens the Advanced Settings screen for data entry or adjustment. Toggles the screen on and off.

NOTE: *Pressing the Freeze button while the Advanced Setting window is open will automatically close the window and freeze the graphics.*

R. Mode

Opens the Mode Select screen for data entry or adjustment toggles the screen on or off. Pressing the Mode indicator at the top of the touch screen will also access the screen.

NOTE: *Pressing the Mode button a second time before accepting the Mode will close the window and restore the previous settings. The Mode screen uses an on screen accept button.*

S. Event

Records an event for future reference. Some Events are recorded automatically others can be logged manually to display in this screen. See *Chapter 4, Monitors and Displays*, for a full list of Events.

T. Freeze

The Freeze key freezes the current screen and suspends real-time update of screen data until pressed again. While the screen is frozen, a scrollable cursor appears. The data dial can be used to scroll the cursor through data points on waveform, loop or trend screens. To restore the screen to active, press the Freeze button a second time.

Figure 3.2 shows a flow/volume loop in freeze mode. The cursors trace the "frozen" loop curve along an X-Y plot line. The values along the curve of the loop are displayed as shown below.
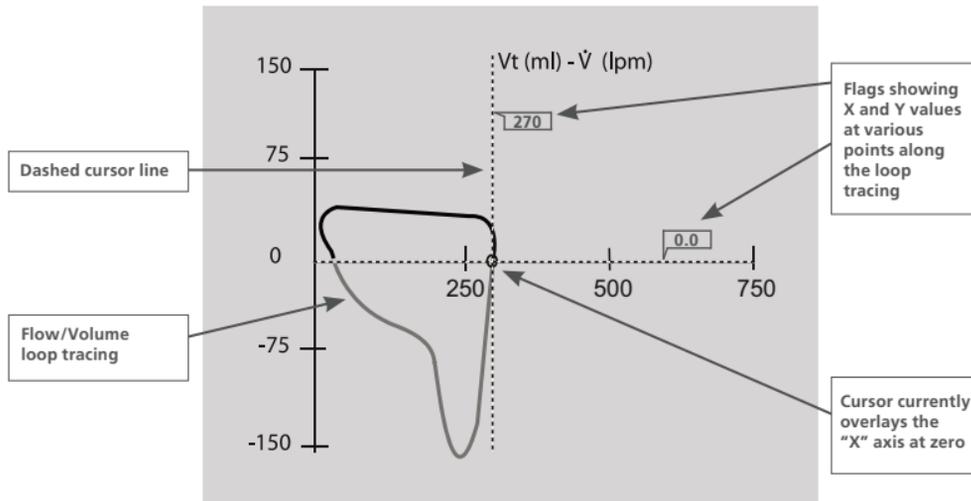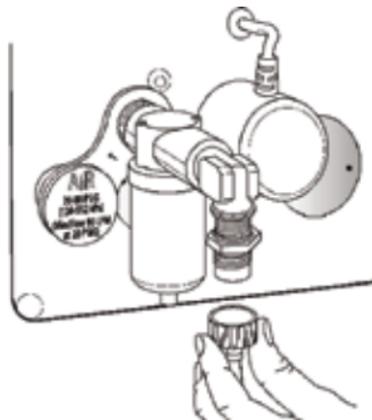
Connecting gas sources

Gas fittings

To connect either the Air or Heliox (80/20) Smart connector, align the connector, seat gently onto the fitting and screw down the fitting until finger tight.

Each Smart connector is permanently tethered to the rear of the ventilator.

WARNING: Connection of a gas supply at the Helium-Oxygen mixture inlet that does not contain 20% oxygen can cause hypoxia or death.

Although an 80/20 mixture of Helium and Oxygen is marketed as medical grade gas, the Helium/Oxygen gas mixture is not labeled for any specific medical use.
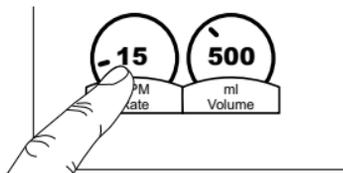
In order to prevent delivery of excess tidal volume, allow 90 seconds for the accumulator to purge before initiating patient ventilation with Heliox gas.

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

Changes to controls and displays are accomplished with a three-step technique.

1. Touch the control or
   display to be changed.

2. Turn the data dial to reach
   the desired setting.
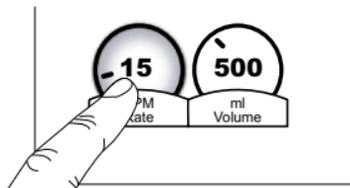
3. Touch the control again or press Accept to confirm change.

Changes not accepted by either method within 15 seconds revert to previous settings. Press Cancel prior to accepting proposed changes to return to previous settings.

New patient setup

1. Power on the ventilator and perform User Verification Tests as described in chapter 2 of your operator's manual.

2. After the power is turned on, a single audible tone may be heard when the internal capacitor linked to the alarm system reaches full charge.

3. Select New Patient. Select Resume Current or New Patient. Touch Patient Accept. Selecting Resume Current resumes ventilation and trending at previous settings. Selecting New Patient clears all trends and saved loops, and sets all controls to defaults. The Patient Size Select screen appears as the first step of the new patient setup sequence.

4. Using Touch-Turn-Touch or Touch-Turn-Accept technique, set controls found on the ventilation Setup screen as desired.

5. Touch Setup Accept to accept this screen.
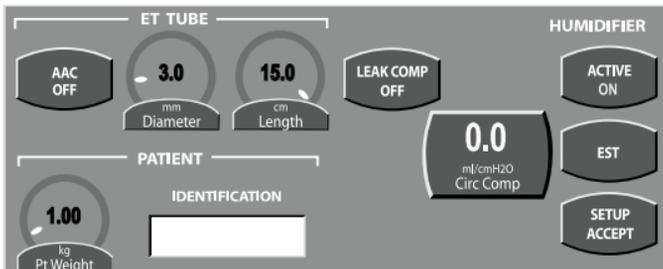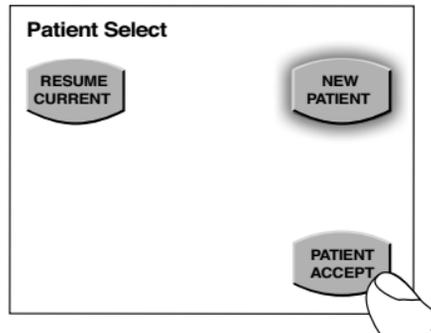
Setting the ventilation breath type and mode

Adult/pediatric breath type and mode screen
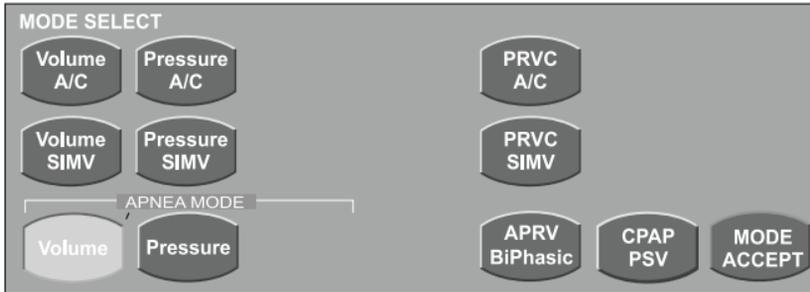
Infant mode select screen


```
MODE SELECT
 Volume    Pressure    TCPL                        Volume
  A/C        A/C        A/C                        Guarantee

 Volume    Pressure    TCPL                         Nasal
  SIMV       SIMV       SIMV                       CPAP/IMV

                  '                                CPAP/      Mode
                                                    PSV      Accept
```
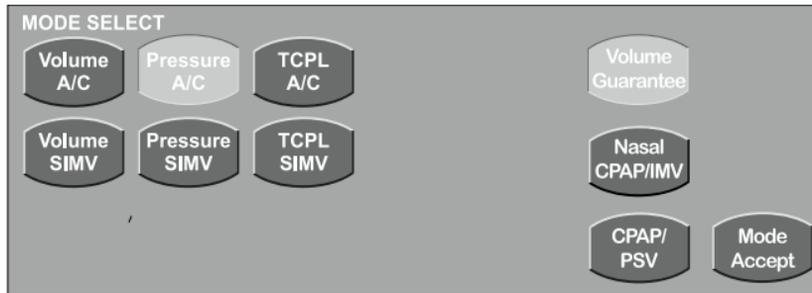
Apnea Backup ventilation choices appear when CPAP / PSV or APRV / BiPhasic modes are selected. Apnea Backup is active in all Assist Control, SIMV, APRV / BiPhasic and CPAP/PSV modes.

Setting nCPAP/IMV (neonatal mode only)

When mode is accepted, follow the on-screen instructions for flow characterization. See Operator's Manual for a list of approved nCPAP interfaces.
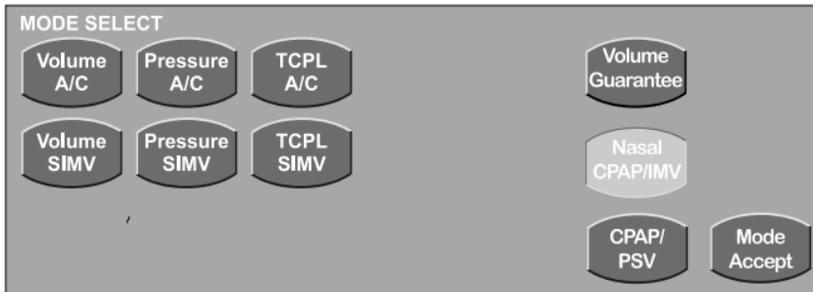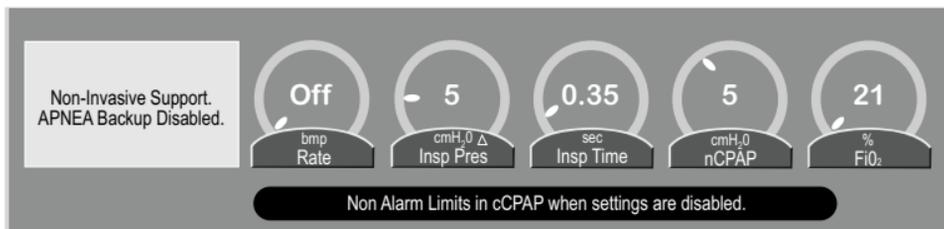
1. Once flow characterization is completed, the screen above is displayed.

2. Connect patient to ventilator, and set desired settings.

3. Alarm settings are only adjustable if rate is set other than Off. If nIMV is desired, then set rate, inspiratory pressure and inspiratory time to desired settings.

4. Check disconnect sensitivity. See operator's manual for detailed instructions.

| Non-Invasive Support. APNEA Backup Disabled. | Off | 5 | 0.35 | 5 | 21 |
| | bmp Rate | cmH₂0 △ Insp Pres | sec Insp Time | cmH₂0 nCPAP | % Fi0₂ |

Non Alarm Limits in cCPAP when settings are disabled.

Setting the ventilation breath type and mode

1. Touch the Mode indicator or the Mode membrane button to open the mode window (see pg. 1).

2. Select the desired mode and set the primary controls. Touch Mode Accept to accept the new mode and control settings.

3. Advanced settings and alarm limits may also be adjusted at this time.
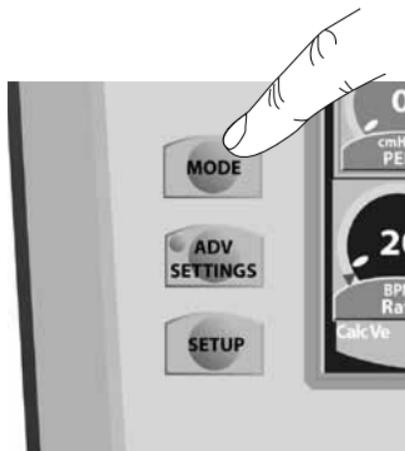
Breath type and mode

Setting Volume Guarantee (neonatal mode only)

1. Select Volume Guarantee with pressure or TCPL breath type ONLY! Assure proximal flow sensor is zeroed and in place if needed.

2. Select desired settings. Volume will then appear in place of inspiratory pressure. Set desired expired volume.

3. Under volume advanced settings, delivered starting pressure limit will appear. Set desired starting inspiratory pressure.

4. Pressure will vary ± 3 cm maximum to achieved set volume, but will give initial breath at set inspiratory pressure.
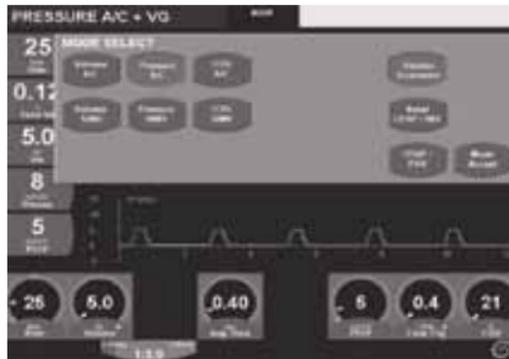
NOTE:

- If flow sensor becomes disconnected or non-functional, breath type will divert to preset inspiratory pressure. Inspiratory pressure will be limited to High Pressure Limit alarm -3 cm.
- In TCPL breath type, flow and /or inspiratory time may limit volume delivery. Expiratory volume alarm will be activated if expiratory volume falls below alarm threshold.
- Flow cycling is functional only in TCPL breath type.

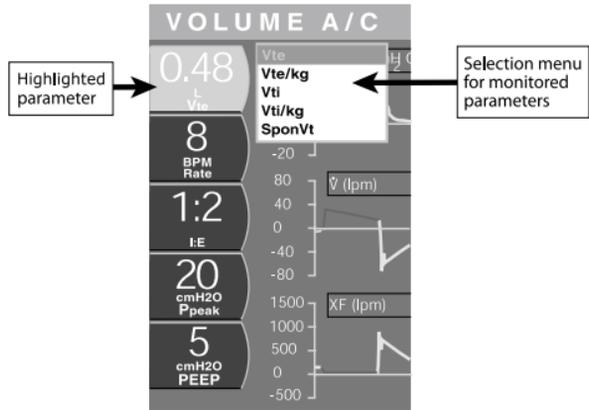## Monitored parameters

Main screen monitors

Five monitored parameters are
continuously displayed on the left
of the touch-screen display.

1. Touch the monitor you wish to set.

2. Scroll through the menu choices.

3. To accept your selection, press the
   Accept button.

NOTE: The main screen monitored values may be different than the monitored values on the
Loops screen or Trends screen.

The Monitor screen

To open the Screen Select menu, press the Screen indicator or the Screens membrane button to the left of the touch screen. Select Monitor.
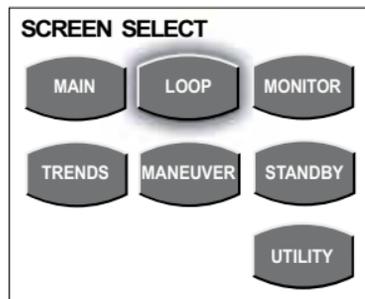
The Monitor screen can be configured in the same way as monitored parameters on the main or loops screen displays. For a complete list of monitored parameters, refer to chapter 4 of the AVEA ventilator operator's manual.

Graphics

Graphic displays are color coded to provide the clinician with helpful information. They may appear as red, blue, yellow, green or purple tracings.

- Red indicates the inspiratory portion of a mandatory breath

- Yellow indicates the inspiratory portion of an assisted or spontaneous breath (patient assisted or spontaneous breaths are also denoted with a yellow demand indicator that appears in the left hand corner of the mode indicator)

- Blue represents the expiratory phase of a mandatory, assisted or spontaneous breath

- Green during the expiratory phase of a single breath indicates that a purge of the expiratory flow sensor, or wye flow sensor (if attached) has occurred

- Purple indicates safety state, which occurs when the safety valve is open

Waveforms

Three waveforms can be selected and simultaneously displayed on the main screen.

Scroll through the waveform choices. Make your selection, touch the heading again or press the Accept button to confirm the change.
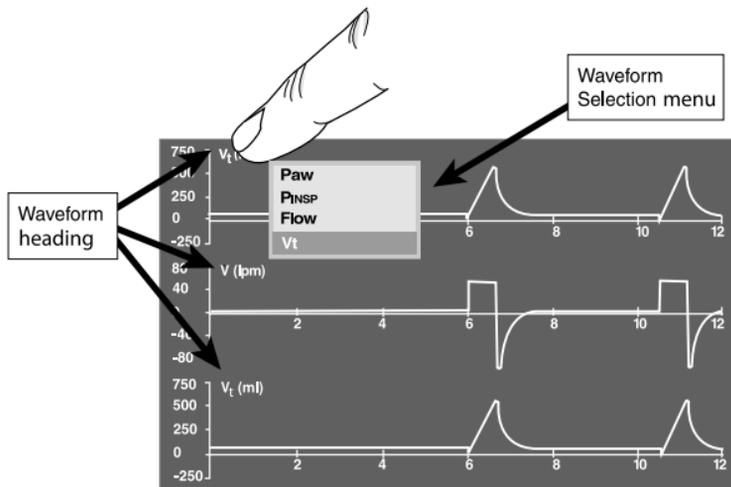
Events

Pressing the Event button opens a menu of selectable events that will appear in the trend buffer along with the monitored parameters. Scroll the menu and highlight the desired event. Press the Accept button adjacent to the data dial to place the event in the trend buffer. Events appear on the trend screen spreadsheet in green text. Certain events are automatically recorded by the ventilator. All events are listed below.
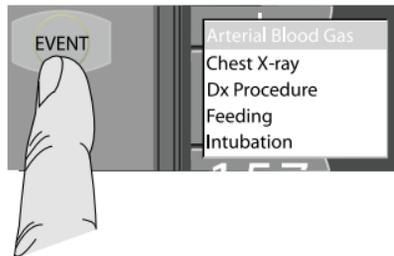
Selectable event

- Change of a primary or advanced control
- Powering the ventilator off or on
- Entering and exiting standby
- Activation of the nebulizer
- Activation of the inspiratory or expiratory hold

- A manual breath
- Activation of the suction button
- Activation of the increase O$_2$ button
- Selecting new patient
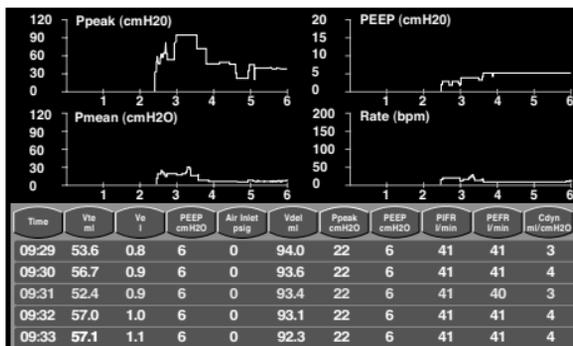- Involuntary power loss and recovery

Selectable event

- Arterial blood gas
- Chest X-ray
- Suction
- Intubation
- Feeding
- Diagnostic procedure
- Therapeutic procedure

Trends

Press the Screens button or the Screen indicator. Press Trends on the screen select menu. Monitored parameters are trended as one minute averages over a 24-hour period.

NOTE: If left open, the Trends screen will refresh every 10 minutes.

Time	Vte ml	Ve l	PEEP cmH2O	Air Inlet psig	Vdel ml	Ppeak cmH2O	PEEP cmH2O	PIFR l/min	PEFR l/min	Cdyn ml/cmH2O
09:29	53.6	0.8	6	0	94.0	22	6	41	41	3
09:30	56.7	0.9	6	0	93.6	22	6	41	41	4
09:31	52.4	0.9	6	0	93.4	22	6	41	40	3
09:32	57.0	1.0	6	0	93.1	22	6	41	41	4
09:33	57.1	1.1	6	0	92.3	22	6	41	41	4

Each histogram and column can be configured from the monitored parameters menu. Touch the title bar of any histogram or the heading of any column. Select the parameter to be displayed. Press the Accept button to accept the parameter.

Histograms can be scaled by touching either axis. Use the data dial to adjust the scale. Touch the axis again or press the Accept button to accept the change.

To look at histogram or spreadsheet trends over time, press the Freeze button and use the data dial to move the cursor through the timeline. The timeline is shown as yellow text on the spreadsheet. Event markers appear in green text.

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Synchronized nebulizer

An in-line nebulizer can be used with the AVEA ventilator. Nebulization is synchronized with inspiration, and will deliver gas at the set FiO_2/FiHe for 20 minutes. Attach the nebulizer tubing to the fitting at the bottom of the front panel.
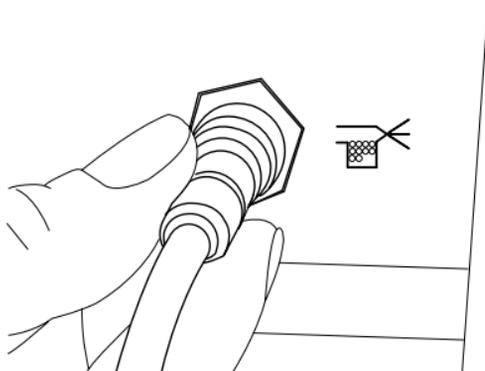
NOTE: To use the internal nebulizer, the AVEA ventilator must be connected to a high pressure Air or Heliox source. The nebulizer is not active while the AVEA ventilator is operating on its internal compressor. The nebulizer requires an inspiratory flow rate of at least 15 liters per minute to activate and is flow compensated to maintain set tidal volumes. The nebulizer is not active in neonatal applications.

CAUTION: When the internal nebulizer is used, the ventilator decreases the flow rate by 6 L/min to compensate for the nebulizer output. However, since flow from the internal nebulizer can vary, using the internal nebulizer may impact the tidal volumes delivered to the patient.
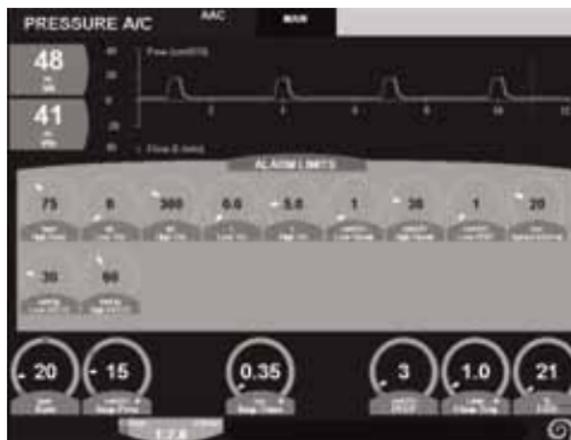
Alarms

Setting an alarm limit

Press the red Limits membrane button.

Use Touch-Turn-Touch/Touch-Turn-Accept technique to make changes to alarm controls.

NOTE: Red indicators appearing on the primary controls display the relative alarm settings of any associated alarm.

Message	Alarm condition	Range	Priority
Safety Valve Open	Safety valve is open.	N/A	High
Vent Inop	Ventilator failure due to non-recoverable condition. The safety valve opens, indicated by a Safety Valve Open message, and the patient is allowed to breathe room air. PEEP is not maintained.	N/A	High
Loss, Air	Wall air drops below 18.0 psig (1.2 bar) and no functional compressor is installed, or the compressor output is insufficient to meet instrument demand. Patient will continue to be ventilated by O_2 supply only.	N/A	High
Loss, O_2	Oxygen supply to the ventilator drops below 18.0 psig (1.2 bar) and the %O_2 is set to > 21%. Patient will continue to be ventilated by the air supply only.	N/A	Medium
Loss, Heliox	The alarm is triggered if heliox is being used and the heliox gas supply to the ventilator drops below 18.0 psig (1.2 bar). The patient continues to be ventilated by the oxygen supply only.	N/A	Low
Loss, Gas Supply	All sources of gas fail; wall air, internal compressor (if installed) and oxygen. The safety valve opens, indicated by a Safety Valve Open message, and the patient is allowed to breathe room air. PEEP is not maintained.	N/A	Message

Notes

Notes

Notes

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

CareFusion
22745 Savi Ranch Parkway
Yorba Linda, CA 92887

800.231.2466 toll-free
714.283.2228 tel
714.283.8493 fax

EC REP CareFusion Germany 234 GmbH
Leibnizstrasse 7
97204 Hoechberg
Germany

+49 931 4972-0 tel
+49 931 4972-423 fax

carefusion.com

CareFusion