

I. Introduction



Featuring the state-of-the-art miniaturized mainstream capnography, the VetSpecs® Capno-M Bluetooth Capnography monitor (hereinafter “the Capno-M”) works effectively in all cats, dogs, and other similar sized animals. It displays

- CO2 waveforms
- End-tidal CO2 reading (EtCO2)
- Respiratory rate (RR)



The Capno-M can be wirelessly connected to the VetSpecs® Flex™ modular display platform, as shown above. When linked with the Capno-M via Bluetooth, the display platform with a 5.6" color HD screen displays the following information, provides a respiratory sound, and saves registered waveforms, readings, and trend graphics on a USB flash drive for digital documentation and printing out a monitoring report.

- CO2 Waveforms
- End-tidal CO2 (EtCO2)
- Respiratory Rate (RR)
- Fractional Inspired CO2 (FiCO2)
- Trend Graphics for EtCO2 and RR

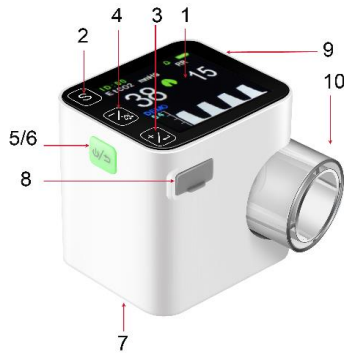
The Capno-M can also be wirelessly connected to the VetSpecs® SM100 vital signs monitor for integrated multiparameter monitoring in surgery.

For more information on the VetSpecs® Flex™ modular display platform or VetSpecs® SM100 vital signs monitor, please visit www.vetspecs.com.

Attention: The Capno-M is not for use in dentistry or MRI. Do not expose the Capno-M to water, liquid, corrosive substance, or heat. Do not use the Capno-M in wet, dirty, or hot environments.

II. Instructions for Use


1. Keys and Buttons









1. **Screen** The screen displays waveforms, readings, menus, and alarms. The Capno-M features automatic screen display orientation to the vertical viewing direction of the device.
2. **S** Press this key to move the cursor when the menu is displayed.
3. **+/-** When the menu is displayed, press this key to confirm the selected item or increase the number.
4. **-/🔔** (a) When the menu is displayed, press this key to

decrease the number. (b) In the main display screen, press this key to silence alarm for two minutes. (c) In the main display screen, press and hold this key for two seconds to switch the display screen to the big font mode as shown below.




5.  (a) Power Switch - press this button for two seconds to turn on or off the device. (b) Press and quickly release this button to enter or quit the menu.
6. Indicating Light - a flickering green light indicates the battery charger is plugged in and a steady green light indicates the Capno-M is ready for use.
7. Battery compartment - do not remove the internal battery.
8. USB port - only use the battery charger provided by VetSpecs.
9. Hanging point - you may attach a lanyard here if necessary.
10. Airway adaptor - only use an adapter provided by VetSpecs.



The screen displays patient ID, memory full indicator , alarm off , alarm on , Bluetooth symbol  and battery indicator . If the battery is almost fully depleted, the battery  indicates completely empty, the Capno-M will alarm continuously.

A green Bluetooth symbol indicates the Bluetooth is not connected.
A white Bluetooth symbol indicates the Bluetooth is connected.




When the airway adaptor is not attached on, NO ADAPTER will be displayed. When the Capno-M needs to perform a zero calibration, ZERO REQ will be displayed.

When EtCO₂ or RR exceed its high or low limits, the EtCO₂ or RR reading will flash and alert with an audible alarm. If the patient has stopped breathing longer than the preset apnea time, an alarm will be sounded, and APNEA will be flashed on the screen. Press the  key to silence alarm for two minutes. The apnea alarm will sound again if the patient does not resume breathing in two minutes.

2. The Menus





MAIN Menu

MAIN MENU	
CO2 SET	
TIME SET	
NEW PATIENT	
EXIT	

In the main display screen, press the  key to enter the main menu. Press the **S** key to move the cursor to choose item. Press the  key to enter the selected submenu. Press the  key again to go back to the main display screen.

CO2 SET Menu

CO2 SET		
EICO2	ALAR H	50.0
	ALAR L	19.0
RESP	ALAR H	30
	ALAR L	08
	APNEA TIME	30 S
	CO2 UNIT	mmHg
	ZERO	
	WAVE SCALE	54mmHg
	LOAD DEFAULTS	
	EXIT	

Press the **S** key to move the cursor to choose item, press the  or  key to change the highlighted number. If LOAD DEFAULTS or EXIT is selected, press the  key to confirm. Press the  key to exit the menu and return back to the main display screen.

TIME SET Menu

TIME SET	
YEAR	13
MONTH	01
DATE	10
HOUR	21
MINUTE	18
SAVE	
EXIT	

Press the **S** key to select item and press the **+/ \leftarrow** or **-/ \rightarrow** key to change the setting. Any time adjustment will delete all stored data.

NEW PATIENT Menu

NEW PATIENT	
CLEAR MEMORY	
MEM STOP WHEN FULL	
ID	05
SAVE	
EXIT	

Press the **S** key to move the cursor to choose item, press the **+/ \leftarrow** or **-/ \rightarrow** to change the setting. Press the **⏻/↵** key to exit the menu and enter the main display screen.

CLEAR MEMORY: Delete all saved data.

MEM: Switch data saving modes between STOP WHEN FULL (manual delete data) and AUTO LOOP (automatic overwriting).

ID: Enter the patient's ID (00 to 99).

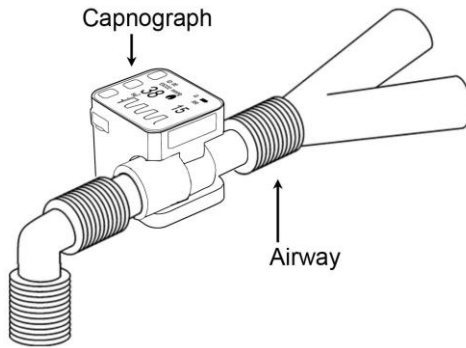
SAVE: Save the recorded data.

EXIT: Quit the current menu without saving the new settings.

3. Apply the Capno-M

For continuous monitoring in anesthesia or procedural sedation, insert the Capno-M with the airway adapter between the endotracheal tube and the breathing circuit after the patient is intubated.

For monitoring or spot check in intubation, postoperative anesthetic recovery, critical care, or emergency, attach the Capno-M with the airway adapter to the endotracheal tube.

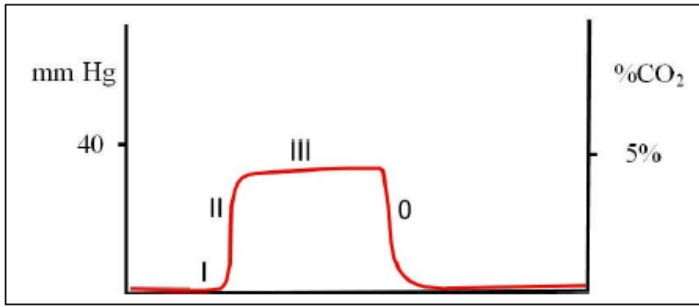


III. Clinical Instructions

1. Capnography

Capnography monitors various components of the patient and anesthesia equipment as well as the critical connection between the two. It provides information about CO₂ production, pulmonary perfusion, alveolar ventilation, respiratory patterns, and elimination of CO₂ from the anesthesia circuit and ventilator, and therefore is very effective for early detection of adverse respiratory events.

The CO₂ waveforms (capnogram) are the graphical waveforms depicting CO₂ concentration throughout respiration. In a single breath, air sampled during inspiration should contain virtually no carbon dioxide. As exhalation begins, the air passing the sampling site initially represents dead space that has not been in contact with alveolar air, therefore containing virtually no carbon dioxide. As exhalation continues, alveolar air mixes with the dead space, with a resultant gradual increase in the amount of carbon dioxide measured. Eventually, the air passing the sampling site is alveolar air, and the partial pressure of CO₂ reaches a plateau, which is reported as the end-tidal CO₂. The diagram below shows the shape of a normal capnogram.



Phase I: A near zero baseline - Exhalation of CO₂-free gas contained in dead space.

Phase II: Rapid rise - Exhalation of mixed dead space and alveolar gas.

Phase III: Alveolar plateau - Exhalation of mostly alveolar gas. At the end of exhalation, CO₂ concentration reaches the peak - end-tidal CO₂ value.

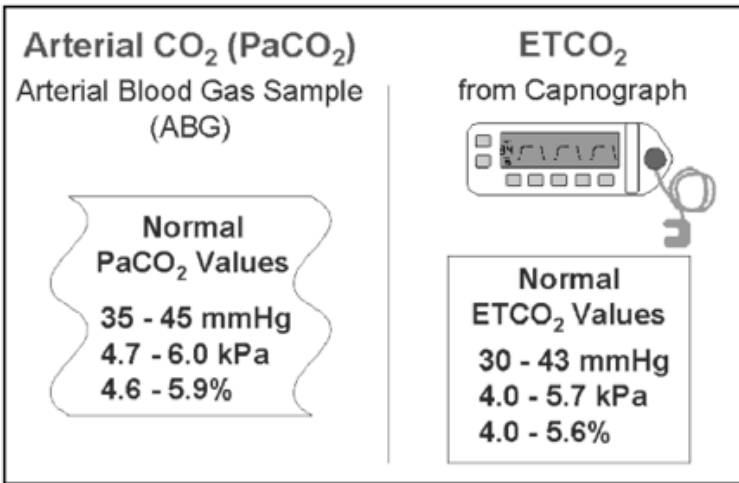
Phase 0: Rapid down-stroke - Inhalation.

The end-tidal CO₂ (EtCO₂), which can be expressed as mmHg or percentage, refers to the measurement of CO₂ concentration at the end of exhalation. The normal range of EtCO₂ for most mammals is 30 – 43 mmHg or 4.0 – 5.6%.

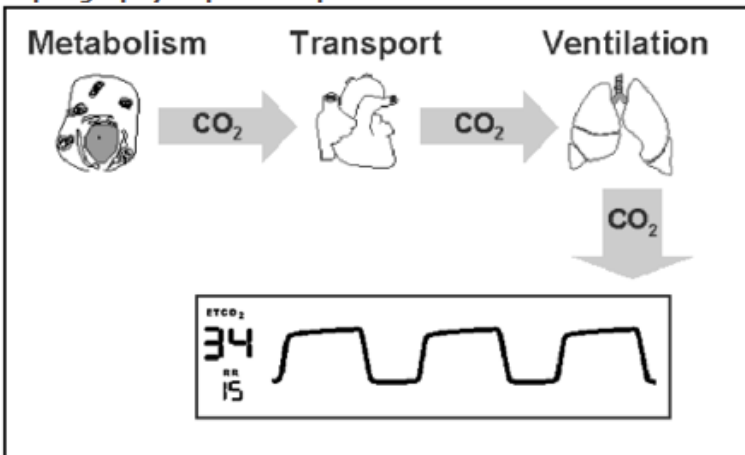
EtCO₂ is a product of three major determinants: the rate of CO₂ production by the tissues, the rate of exchange of CO₂ from the blood to the alveoli, and the rate of CO₂ removal by alveolar ventilation. Because CO₂ is a highly soluble gas, diffusing from air to liquid and back again occurs very quickly. Because of this solubility, the relationship between CO₂ and minute ventilation is a

straight line, the higher the ventilation, the lower the CO₂.
Conversely, hypoventilation leads to high CO₂ levels as the gas is retained. Therefore, EtCO₂ provides a close clinical estimate of the alveolar and thus the arteriolar CO₂.

Normal Values



Capnography Depicts Respiration

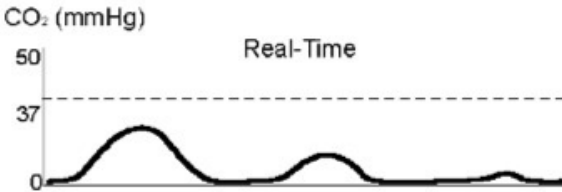


2. Clinical Implications

Normal EtCO₂ readings, together with a normal capnogram, indicate normal function of the patient's metabolism, circulation, and ventilation, and of the anesthesia machine. Increases in EtCO₂ may be due to anesthetic induced respiratory depression, increased metabolism, or the addition of CO₂ to the circulatory system as a result of re-breathing CO₂. Re-breathing CO₂ can be due to soda lime exhaustion or incompetent expiratory valve on the anesthesia machine allowing exhaled CO₂ to be re-inhaled. Decreased or abolished EtCO₂ may be due to hyperventilation, low cardiac output, respiratory arrest, or cardiac arrest.

Capnogram also provides vital information regarding the patient's airway patency. A depressed or absent capnogram may be due to a dislodged, misplaced, or obstructed endotracheal tube or airway, a leak around endotracheal tube cuff, or disconnection of the endotracheal tube from the anesthetic machine. The following are some examples of abnormal capnograms.

(1) No EtCO₂ recorded

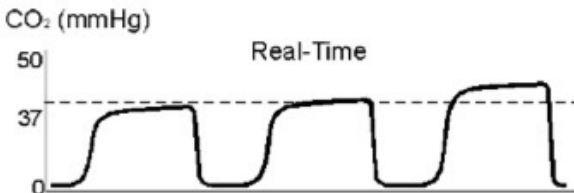


Possible causes:

- Apnea
- Accidental endotracheal tube disconnection
- Esophageal intubation
- Airway obstruction
- Cardiac arrest
- Respiratory arrest

A sudden drop of the EtCO₂ to near zero followed by the absence of capnogram is potentially life-threatening, which could indicate malposition of the endotracheal tube, disruption of airway integrity, disruption of sampling lines, or a sudden cardiac arrest.

(2) Increasing EtCO₂ (hypoventilation)

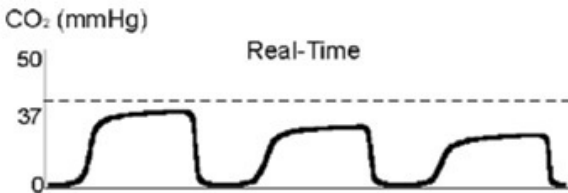


Possible causes:

- Decreased respiratory rate
- Decreased tidal volume
- Deep anesthesia
- Interference with chest expansion
- Increased metabolic rate

In anesthetized patients, EtCO₂ higher than 50 mmHg indicates hypoventilation.

(3) Decreasing EtCO₂



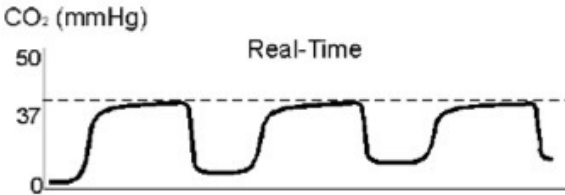
Possible causes:

- Increased respiratory rate
- Increased tidal volume
- Reduced cardiac output
- Leaks around the tube (dilution)
- Decreased metabolic rate – e.g. hypothermia

Gradual reductions in EtCO₂ often reflect decreases in PaCO₂

that occur following increases in minute ventilation or a reduction of the metabolic rate.

(4) Baseline does not return to zero

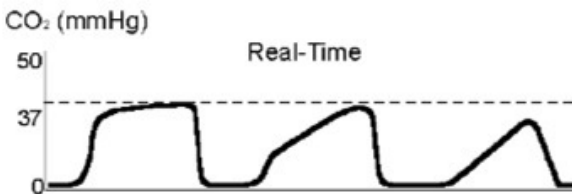


At the same time the EtCO₂ value will also start to rise.

Possible causes:

- Incompetent or absent unidirectional dome valves
- Insufficient fresh gas in non-rebreathing circuit
- Exhausted soda-lime in rebreathing circuit
- Absorber canister bypassed
- Leak in Bain circuit inner hose
- Excessive dead space in anesthetic circuit

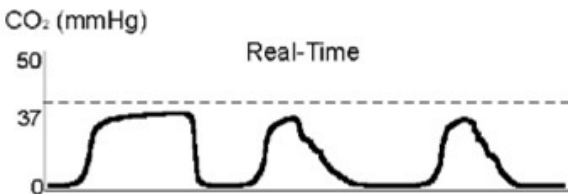
(5) Abnormal Upstroke (Shark Fins)



Possible causes:

- Kinked or occluded endotracheal tube.
- Upper airway obstruction
- Obstruction on expiratory side of anesthesia machine
- Bronchospasm

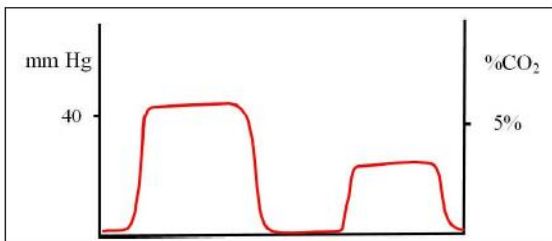
(6) Abnormal Down Stroke



Possible causes:

- Leak around endotracheal tube cuff
- Artificial airway is too small for the patient

(7) Abrupt fall in EtCO₂ level

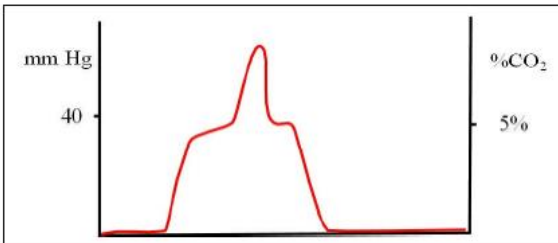
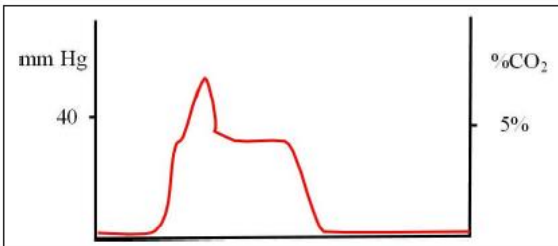


Possible causes:

- Pulmonary artery compression
- Pulmonary artery embolism
- Sudden hemorrhage
- Acute cardiac tamponade
- Cardiac compression

Abrupt decreases in the EtCO₂ are often associated with an altered cardiopulmonary status (embolism or hypoperfusion).

(8) Differential emptying



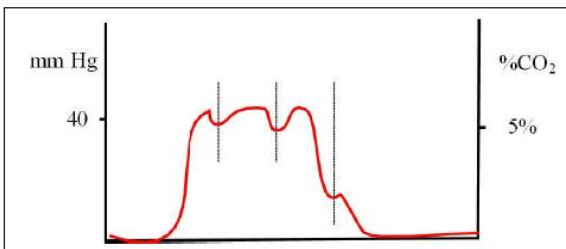
The above capnograms can result from the following:

- Positioning of the endotracheal tube at or beyond the carina,

so that one side of the lung has impaired emptying. This makes the retained gas higher in CO₂ and later to empty than from the normal lung. The “spike” can occur anywhere in the plateau phase.

- Any functional blockage of a major airway, below the carina – foreign body, mucous, compressed airway, etc.

(9) Cardiogenic oscillations



Cardiogenic oscillations are ripples superimposed on the expiratory plateau and the descending limb of the capnogram, which are caused by small gas movements inside the airway. Although cardiogenic oscillations can occur in any animal where the pulsations of the aorta and heart cause areas of lungs to be compressed and thereby emptied and filled, they are typically seen in large dogs with a slow RR. The guide to the fact that this is happening is that the oscillations are in synch with the heartbeats. The displayed respiratory rate can be much higher than the actual respiratory rate when cardiogenic oscillations occur.

IV. Maintenance

Keep the Capno-M away from water, liquid, flammable or corrosive materials, and heat sources. Do not store the Capno-M at dusty, humid, wet, or unsecure places.

Disconnect the Capno-M from the battery charger prior to cleaning. Never wash the Capno-M, or submerge it in liquid. If necessary, clean the exterior of the Capno-M with tissue papers moistened with a little bit of alcohol. Never sterilize the Capno-M by autoclave. Do not use the Capno-M if there are any external damages.

V. Customer Support

For technical training during your clinical trial, please call

1-800-705-0113

For customer support, or to order accessories, please call

1-800-599-2566

To ship the product back to manufacturer for testing and services, please visit www.vetspecs.com for instructions.

Limited Warranty

VetSpecs, Inc. (“VetSpecs”) warrants the VetSpecs® Capno-M (hereinafter “the Capno-M”) to be free from defects in materials and workmanship, when stored under appropriate conditions and given normal, proper and intended usage, for ONE (1) YEAR from the date of delivery of the Capno-M to the original end user purchaser (“Buyer”). The airway adapters are covered by an out-of-the-box warranty. VetSpecs agrees during the applicable warranty period to repair or replace defective unit without cost to Buyer. VetSpecs shall not have any obligation under this Limited Warranty to make replacements which result, in whole or in part, from catastrophe, fault or negligence of Buyer, or anyone claiming through or on behalf of Buyer, or from improper use of the Capno-M, or use of the Capno-M in a manner for which it was not designed, or by cause external to the Capno-M.

Buyer shall notify VetSpecs of any product which it believes to be defective during the warranty period. Such product shall be returned by Buyer, transportation and insurance prepaid, to VetSpecs for examination and testing. VetSpecs shall repair or replace any such product found to be so defective and return such product to Buyer, transportation and insurance prepaid. The provisions of the foregoing Limited Warranty are exclusive and are expressly in lieu of any other warranty, whether express or implied, written or oral. VetSpecs’ liability arising out of the manufacture, sale or supplying of the Capno-M shall not exceed the actual purchase price paid by Buyer for the Capno-M. In no event shall VetSpecs be liable to Buyer or any other person or entity for special, incidental or consequential damages (including, but not limited to, loss of profits, damages to properties, and injuries to the patient and/or the user) arising out of the manufacture, sale, supplying or use of the Capno-M. The foregoing Limited Warranty extends to Buyer only and shall not be applicable to any other person or entity including, without limitation, customers of Buyer.