Service manual

1.Product Description

ETCO2 provides sidestream and mainstream methods for CO_2 monitoring.

The principle of CO2 measurement is primarily based on the fact that CO2 molecule can absorb 4.3μm infrared ray. Absorption intensity is proportional to CO2 concentration of patient sample, the CO2 concentration will compute according to the detecting CO2 absorption intensity of patient sample.

Sidestream ETCO2 contains a gas sampling pump, which draws small samples of gas from the patient's airway via a nasal cannula or airway adapter, and passes these gases through a solid state infrared sensor (located away from the patient's airway) that measures CO2. While the sidestream system is typically used on non-intubated patients, it can also be used for EtCO2 measurement on intubated infant, pediatric and adult patients.

Mainstream measurement uses a CO2 sensor attached to an airway adapter directly inserted into the patient's breathing system

2.Warnings

1.Carefully read the Operator's Guide and these operating instructions before operating the EtCO2 monitoring option.

2.Ensure that the EtCO2 option is operated by qualified personnel only.

3.Do not use the EtCO2 option as an apnea monitor.

4.Do not immerse the unit, patient cables, or sensors in water, solvents, or cleaning solutions.

5.If the accuracy of any reading is suspect, first check the patient's vital signs by alternate means and then check the EtCO2 option for proper operation.

6.If an alarm condition occurs while the alarms are suspended, the suspended alarm indications will only be visual displays and symbols. No audio alarm indications will occur.

7.Elevated oxygen levels, nitrous oxide, or halogenated agents contained in the breathing gases may degrade the accuracy of measurements made with the EtCO2 option. Activate oxygen compensation if O2 levels in excess of 60% are introduced. Activate N2O compensation if nitrous oxide is introduced into the airway circuit. The presence of Desflurane beyond 5% may positively bias the carbon dioxide reading by up to 3 mmHg.

8.Do NOT use the Sidestream module on patients who cannot tolerate the removal of 50ml/min of breathing gases from the airway.

9.Carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.

10.Do not touch the bed, patient, or any equipment connected to the patient during defibrillation. A severe shock can result. Do not allow exposed portions of the patient's body to come in contact with metal objects, such as a bed frame, as unwanted pathways for defibrillation current may result

11.Do NOT store sensors, modules, airway adapters, or cannula sets at temperatures less than -20° C or greater than 70° C.

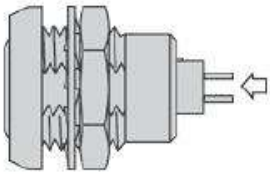
12.Do not operate ETCO2 sensors at temperatures less than 10° C or greater than 40° C.

3.Monitoring Procedures

3.1Connecting

3.1.1 Connector Definition

Universal type CO2 Sensor use 8 Pin Double Cut Plug, its PIN Definition as follows:



Pic 1 Welding

Pic 2 PIN1-PIN8

PIN	Definition	Description
PIN1	VA	5.0V
PIN2	AGND	GND
PIN3	DGND	GND
PIN4	VDD	5.0V
PIN5	TXD	CO2 Sensor Data SEND
PIN6	RXD	CO2 Sensor Data RECEIVE
PIN7	AGND	GND
PIN8	SYNC	Communication

3.2Warm Up

Plug the sensor cable into the monitor's CO2 input connector. Allow the sensor two minutes for warm-up.

Appropriately connect the cannula, airway adapter or sample line to the sensor. It will click into place when seated correctly

3.3 Zeroing the sensor

You must perform zeroing following the steps when using the new airway adapter.

Expose the sensor to room air and keep it away from all sources of CO2 including the ventilator, the patient's breath and the operator's.

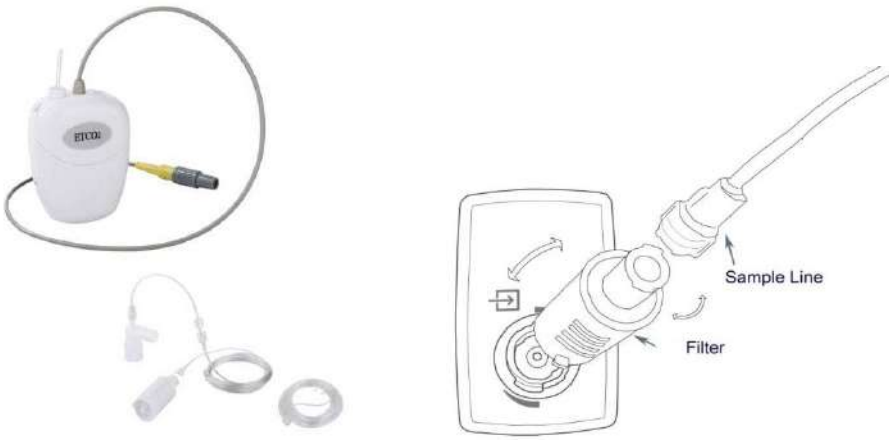
In the CO2 Setup menu, please set the Work Mode to Measure.

For patient monitor menu, select User Maintain > CO2 Maintain, and click Zero.

For Mainstream ETCO2 sensor, when remove adapter and connect again, Module would be zeroing automatically.

If the system briefly displays Zero In Progress, the process is successful. After the zeroing calibration is finished, you can start CO2 Monitoring. If the system displays Breath detected or Zero required, zeroing has failed. Zero calibration must be performed again.

4 Sidestreram CO2 Sensor Connect with Filter



Pic 3

Notes：

4.1 Calibration Zero

In order to make sure the sensor can up to the best measuring accuracy, the user is advised to calibrate zero sensor each time before measure. However, this operation is not necessary.

During calibrating zero operation， the user has to make sure that the gas for sample should be air. When Apnea alarm(“no breath” or “Apnea”) show on display， the user has to make sure it is not use sample patient’s CO2 gas, then the user can calibrating zero

4.2 When showing“Check adapter”alarm on display, the user need to check whether the adapter is connected, if not connect the adapter and show the alarm, please connect the adapter.

4.3 When the sensor get Power Supply, if the user did not doing any related compensation settings, then “compensation not set” alarm may show on the display.

Enter Set Menu， Modify setting to related Compensation Parameters, the user can also keep default setting, this time the “compensation not set”would disappear from the display. The settings for sensor would not be saved when power off. The User should reset when next time power on. The user can also modify another compensation such as atmospheric pressure, N2O, and O2.

4.4 For Sidestream Sensor, please keep Air way connector in correct location, when the dewater accessories are useless resulted from the water gas too much or dewater accessories over lifetime. The following situation would appear:

A:water gas is too much and jam the air way, would showing ”check sampling line” alarm on display.

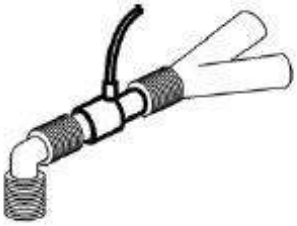
B:water gas is too much and flow into the inside sensor, would show ”zero required” or ”check adapter” alarm on display.

For “Zero required” alarm， the user just need to Zero Calibrating to make it disappear.

For ”check adapter” alarm. the user should get the dried air for the sensor, clean the water gas from the sensor. If alarm continue, the sensor still can not work normally, please contact the manufacturer for maintenance.

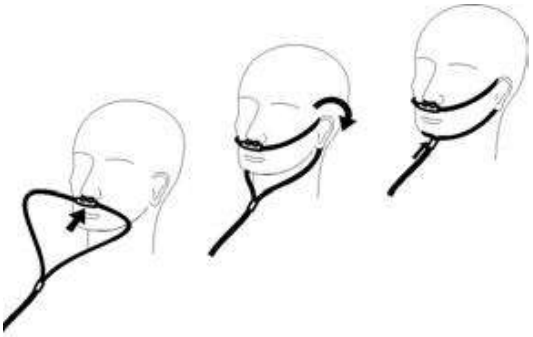
4.5Connecting Method：

4.5.1 Connect to Ventilator or Anaesthesia machine air way (through air way adapter and sample line),see Pic 4:



pic4

4.5.2 Connect to nostrils of the Monitoring Objects (use nasal line),see pic6



Pic 5

5.Mainstream CO2 Module

Pic 6

NOTE:

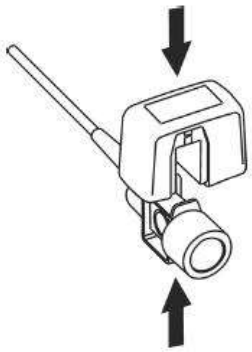
You must perform a zero calibration as described in this procedure each time you use a new airway adapter.

Measurement Steps

1.Attach the sensor connector to the CO_2 connector on themonitor.

2.Wait two minutes, allowing the sensor to reach its operating temperature and a stable thermal condition.

3.Choose the appropriate airway adapter and connect it to the sensor head. The airway adapter clicks into place when seated correctly.



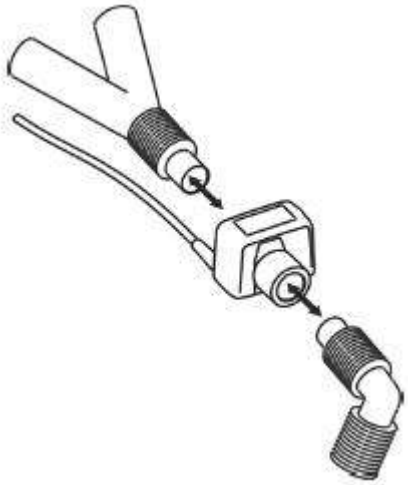
Pic 7

Connecting Sensor

4.To zero the sensor, please refer to zeroing the sensor.

5.Install the airway adapter at the proximal end of the circuit between the elbow and the ventilator Y-section.

Connecting Airway Adapter



Pic 8

1.No routine user calibration required.

2.Accuracy is affected by temperature and barometricpressure.

3.It is forbidden to insert or draw out the module when the monitor is working, for it can cause instability of the system. If you do it inadvertently, please turn off the module in menu immediately. The module enters STANDBY mode if you reconnect it to monitor which it is powered on. If the readings are inaccurate, you should do calibration

NOTE:

1.Replace the airway adapter, if excessive moisture or secretions are observed in the tubing or if the CO_2 waveform changes unexpectedly without a change in patient status.

2.To avoid infection, use only sterilized, disinfected or disposable airway adapters.

3.Inspect the airway adapters prior to use. Do not use it if airway adapter appears damaged or broken. Observe airway adapter color coding for patient population.

4.Periodically check the flow sensor and tubing for excessive moisture or secretion buildup.

Removing Exhaust Gases from the System

Anesthetics: when using the mainstream CO_2 measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system, to avoid exposing medical staff to anesthetics.

Use an exhaust tube to remove the sample gas to a scavenging system. Attach it to the mainstream sensor at the outlet

Troubleshooting

COMMON MESSAGES		
Message/Symptom	**Possible Cause(s)**	**Recommended Action(s)**
CO2 COMM ERROR	There is no communication from the $EtCO_2$ module or sensor.	Remove and connect again, then on again to reset. Try another $ETCO_2$ sensor. If the problem persists, return sensor and/or unit for service.
CO2 NOT INITIAL	The zero operation cannot be initiated because: • The sensor or module is still warming up. • No sensor or module is attached to the unit. • The sample cell is not plugged into the module. • Zeroing was attempted within 20 seconds of a detected breath.	Wait for sensor or module to warm up. Attach sensor or module to the unit. Plug sample cell into sample cell receptacle on module.
CO2 OUT OF RANGE (dashed lines for CO_2)	The calculated CO_2 value is greater than 150 mmHg.	If error persists, perform a mainstream airway adapter or module zero, as described in "Zeroing the Mainstream CO2 Sensor and "Zeroing the Sidestream CO2 Module
CO2 UNIT ERROR	The $EtCO_2$ sensor or module has detected a hardware error.	Check that the sensor is properly plugged in. Reinsert the sensor. Turn E Series unit off, then on again to reset. Perform a mainstream airway adapter or module zero, as described in "Zeroing the Mainstream CO2 Sensor/Airway Adapter", and "Zeroing the Sidestream CO2 Module If the problem persists, contact Technical Support.
WARM UP	The mainstream sensor or Sidestream module is warming up. This may take up to 2 minutes.	Wait for sensor or module to warm up. If the message persists more than 3 minutes, replace the sensor.
ZERO DONE	The sensor/adapter zero, or the Sidestream module zero is finished.	No action required.
ZERO FAILED	The zero operation did not complete successfully.	Clear the occlusion, remove any source of CO_2, and try zeroing again. If problem persists, contact Technical Support.

SIDESTREAM MESSAGES		
Message/Symptom	**Possible Cause(s)**	**Recommended Action(s)**
CHECK Adapter	Sample line blockage or damage. Sample line is kinked or pinched. Exhaust tube is blocked.	Verify that the sample line is plugged into the module and seated properly. Verify that neither the sample line nor the exhaust tube are blocked, kinked, or pinched. Verify that the airway adapter is not blocked. If the sample line, exhaust tube, or the airway adapter is blocked or otherwise compromised for 15 seconds, this message will appear. The pump will shut off after 2 minutes if the condition that caused the message is not cleared. To restart the pump, correct the blockage, then remove and reinsert the sample cell into the sample cell receptacle. If the problem persists, replace the sample line.
CHECK CO2 Sensor	Module not properly plugged in. Module over temperature.	Check that module cable is plugged in and seated properly in the connector. Check that module is not exposed to excessive heat. If problem persists, replace module.
CO2 IN LINE: WAIT	CO_2 in cannula/adapter when attempting to zero. Sample line disconnected while zero in progress.	Wait up to 20 seconds before retrying module zero. Remove adapter or cannula tip from CO_2 source including the patient's - and your own - exhaled breaths, and ventilator exhaust valves.
ZERO CO2 MODULE	Negative CO_2 detected. May be caused by a module that was zeroed with CO_2 in the sample line.	Perform module zero as described in "Zeroing the Sidestream CO2 Module
ZEROING CO2 MODULE	Module zeroing in progress.	Wait for module zeroing to finish.

MAINSTREAM MESSAGES		
Message/Symptom	**Possible Cause(s)**	**Recommended Action(s)**
CHECK ADAPTER	This is usually caused when the airway adapter is removed from the Mainstream CO_2 sensor, or when there is an optical blockage on the windows of the airway adapter. It may also be caused by not having performed an adapter zero after changing the adapter type (single patient use vs. reusable).	Clean the airway adapter and reattach it. If the problem persists or the adapter type was changed, perform a mainstream airway adapter zero as described in "Zeroing the Mainstream Mainstream CO2 Sensor/ Airway Adapter" on page 5.
CHECK CO2 SENSOR	The Mainstream CO_2 sensor cable is not properly plugged in or is over temperature.	Check that the sensor cable is plugged in and properly seated in the connector. Check that the sensor is not exposed to excessive heat. If the problem persists, replace the sensor.
ZERO CO2 ADAPTER	Negative CO_2 detected. May be caused by a sensor that was zeroed with CO_2 in the airway, or by an optical blockage of the airway adapter.	Check the airway adapter and clean if necessary. Perform a mainstream airway adapter zero as described in "Zeroing Mainstream CO2 Sensor
ZEROING CO2 ADAPTER	Adapter zeroing is in progress.	Wait for the adapter zeroing to finish.

Specifications

Transducer Type	Mainstream	Sidestream
Principle of Operation	Non-Dispersive Infrared (NDIR) single beam optics, dual wavelength, no moving parts.	
Warm Up Time	Full specifications within 2 minutes at an ambient temperature of 25º C. Capnogram in 15 seconds.	
$EtCO_2$ Measurement Range	0 - 150 mmHg 0 - 20% 0 - 20 kPa	
$EtCO_2$ Accuracy (at 760 mmHg, ambient temperature of 25°C)	0 - 40 mmHg, ±2 mmHg 41 - 70 mmHg, ±5% of actual 71 - 100 mmHg, ±8% of actual 101 - 150 mmHg, ±10% of reading (At respiration rates > 80 breaths per minute, all ranges are ±12% of actual.)	
$EtCO_2$ Resolution	0.1 mmHg 0 - 69 mmHg 0.25 mmHg 70 - 150 mmHg	
$EtCO_2$ Stability	Short-Term Drift: Drift over four hours ≤ 0.8 mmHg. Long-Term Drift: Accuracy specification will be maintained over a 120 hour period after zeroing.	
$EtCO_2$ Rise Time (10-90%)	< 60 ms (Adult/pediatric adapters) < 60 ms (Infant/pediatric adapters)	< 3 seconds (includes transport and rise time)
Respiration Rate Range	3 - 150 breaths per minute	
Respiration Rate Accuracy	±1 breath per minute	
Sample Flow Rate	N/A	50 ml/min ±10 ml/min
Compensations	Barometric pressure 450 - 850 mmHg (automatic). Operator selectable O_2/N_2O/He compensation.	
$EtCO_2$ Alarm Limits	User selectable.	
Respiration Rate (RR) Alarm Limits	User selectable	
Halogenated Agents	Specification allows for halogenated anesthetic agents that may be present at normal clinical levels. The presence of Desflurane in the exhaled breath beyond normal values (5-6%) may positively bias carbon dioxide values by up to an additional 2-3 mmHg.	
Environmental (sensor or module)	Operating Temperature: 10º C to 40º C Storage and Shipping Temperature: -40º C to 70º C	
Voltage Requirements	5.0VDC ±5%，600mA (Sensor Average Power Consumption Less than 1W)	