

Multigas (92518)

Overview

The Spacelabs Healthcare Multigas Module is a sidestream analyzer that simultaneously monitors gas concentrations and alerts clinical personnel when the concentration of anesthetic agents, oxygen (O₂), carbon dioxide (CO₂), or nitrous oxide (N₂O) moves outside the defined limits. The anesthetic agent being administered is automatically identified.

Although the 92518 Multigas Module alarms when the duration between breaths exceeds user-defined limits, it is not intended to be a primary diagnostic apnea monitor and/or recording device.



The 92518 Multigas Module is not intended to be used as the only means of monitoring a patient. It is intended as an adjunct in patient assessment and must be used in conjunction with other assessments of clinical signs and symptoms.

Note:

Refer to [Compatibility](#) on page 17-13 for more information.

Intended Use/Intended Purpose

The Spacelabs Multigas Module, Model 92518, is intended to provide a means of monitoring a variety of gas concentrations and alert clinical personnel when the concentration of anesthetic agent(s), oxygen, carbon dioxide, or nitrous oxide moves outside of user-defined limits. The 92518 Multigas Module is capable of automatically identifying which anesthetic agent(s) is being administered. The 92518 Multigas Module is intended to be used with and controlled by a Spacelabs Healthcare Ultraview-family monitor. The 92518 Multigas Module is intended to be used for monitoring

Adult, pediatric, and neonate patients, under the direction of trained healthcare professionals. Although the 92518 Multigas Module alarms when the duration between breaths exceeds user-defined limits, it is not intended to be a primary diagnostic apnea monitor and/or recording device.

Indications for Use

The Spacelabs Multigas Module, Model 92518 is intended to provide a means of monitoring a variety of gas concentrations and alert clinical personnel when the concentration of anesthetic agent(s), oxygen, carbon dioxide or nitrous oxide moves outside of user-defined limits. The multigas module is capable of automatically identifying which anesthetic agent(s) is being administered. The 92518 Multigas Module is intended to be used with and controlled by a Spacelabs Healthcare Ultraview-family monitor. The 92518 Multigas Module is intended to be used for monitoring all hospitalized patients, under the direction of qualified medical personnel. Although the 92518 Multigas Module alarms when the duration between breaths exceeds user defined limits, it is not intended to be a primary diagnostic apnea monitor and/or recording device.

Contraindications

There are no known contraindications for Multigas Module (92518).

Target Patient Group

The patient population for Multigas Module (92518) is neonate, pediatric, and adults.

Intended Users

The primary intended user group for Multigas Module (92518) is healthcare professionals, primarily anesthesiologists. The primary intended user is always present during operation.

[Table 17-1](#) lists the intended user groups for Multigas Module (92518).

Table 17-1: Intended Users

User group	Role	Training*
Healthcare Professionals (e.g., surgeon, physician, anesthesiologist, certified nursing assistant (CNA), registered nurse (RN), licensed practical nurse (LPN), mid-level practitioner, physician assistant (PA) or nurse practitioner (NP), respiratory therapist, monitor technician)	This group is the primary user group and consists of clinicians within medical practices who have training and experience using medical products within healthcare environments, including vital sign monitoring devices, central nursing stations, and retrospective data viewing software.	Training may consist of any of the following or a combination of: <ul style="list-style-type: none">• In-person classroom training with access to monitoring equipment• Self-directed online training• Self-directed CD-ROM training• Instructor-led online training
Administrative Clinicians (e.g., nursing manager, clinical educator, administrative clinical user)	This group is the secondary user group and consists of healthcare staff that are designated as "Privileged Clinical Users."	
Service and JField Support (e.g., biomedical engineer, technician, IT professional, field service engineer (FSE))	This group is the tertiary user group and consists of biomedical and IT personnel who install and maintain medical monitoring systems.	<ul style="list-style-type: none">• Biomedics and IT personnel do not complete formal product training, but may coJJ

* For information about educational and training formats offered by Spacelabs, go to <https://spacelabshealthcare.com/education>.

Clinical Benefit

The Clinical Benefit of the 92518 is allowing authorized clinical personnel to simultaneously monitor the concentrations of anesthetic agents, oxygen, carbon dioxide or nitrous oxide gases and providing alerts when the concentration moves outside the defined limits. Physiological parameters for the patient, such as respiration rates and oxygen concentration, can also be concurrently monitored.

Device Description

The Spacelabs Healthcare Multigas Module, Model 92518, is an etCO₂ sidestream analyzer that simultaneously monitors gas concentrations and alerts clinical personnel when the concentration of anesthetic agents, oxygen (O₂), carbon dioxide (CO₂), or nitrous oxide (N₂O) moves outside the defined limits. The anesthetic agent being administered is automatically identified.

The device is 11.3 cm high, 17.84 cm deep, 5.6 cm wide and has a mass of 1.026 kg. The device does not come in direct contact with the patient's skin. The device can only monitor one patient at a time. The 92518 is a durable, reusable medical device. The device is not intended to be sterilized and produces no radioactivity.

The device is modular is that it's intended to be inserted into a compatible monitor or expansion bay. As such, it has a long, rectangular steel body which is not visible once inserted. At the rear of this body is the data interface which connects to the monitor. Once inserted, there is a polymer face plate which includes the interface to connect a compatible side-stream sampling patient interface supplies, and a gas scavenging line.

The functional technology within the 92518 module is the gas analyzer. Here, Spacelabs is an OEM integrator as it uses the Masimo ISA AX+ COV sidestream gas analyzer. The sidestream sampling lines, cannula and airway adapters indicated for the device are also genuine Masimo NomoLine branded devices, which Spacelabs distributes off-the-shelf. These are the only such patient interface devices that Spacelabs indicates for use with the module. The gas analyzer and patient interface supplies are medical devices of Masimo corporation and carry their own regulatory approvals.

The device is part of the modular monitoring system in that it cannot function independently. It must be inserted into a compatible monitoring device like the Xprezzon, Qube, Qube Mini or compatible expansion bay. Once properly installed into the monitoring device, it can send data to the monitor display which can be presented in the form of waveform and numeric displays, trends, and alarms.

Expected Service Life

The expected service life is seven years from the date of installation. Perform safety checks and maintenance on regular schedules. Spacelabs Healthcare offers a refurbishment program for equipment that has passed its expected service life. Contact your local service representative for more information.



To protect the environment, properly dispose of all batteries, electronic assemblies, plastics, and metals.



Obey your internal procedures or local (provincial) laws regarding disposal or recycling.

Warnings and Cautions

This chapter includes warnings and cautions specifically related to the 92518 Multigas Module. Refer to the user manuals for your patient monitor for cautionary disclosures that apply to several physiological parameters or to the monitoring system itself.

Warnings

The life or health of a patient, clinical staff members, or other persons may be endangered if the warnings in this section are not followed.

	<ul style="list-style-type: none">• No modification of this equipment is allowed without authorization of the manufacturer. If this equipment is modified, appropriate inspection and testing must be conducted to ensure continued safe operation.• Always verify that all sample line adapter connections are tight, and verify proper operation before attaching the sample line to a patient.• Connect the multigas module's sample gas outlet to the hospital scavenging system to prevent pollution of the room air.• To avoid explosion hazards, flammable anesthetic agents, such as ether and cyclopropane, must not be used in the multigas module.• Only halothane (HAL), enflurane (ENF), isoflurane (ISO), sevoflurane (SEV), and desflurane (DES) are suitable for use. If any other halogenated anesthetic agent is present, it will be misidentified and/or will interfere with the reported anesthetic agent concentrations.• The use of antistatic or electrically conductive breathing tubes when using high-frequency electrosurgery equipment may increase the risk of burns and is, therefore, not recommended in any application of the multigas module.• The multigas module is not intended for use in an MRI environment.• Operation outside the specified values may cause inaccurate results.
	<ul style="list-style-type: none">• Carefully route patient cabling (the sample line) to reduce the possibility of patient entanglement or strangulation.• To ensure patient electrical isolation, connect only to other equipment with circuits that are electrically isolated.• Do not use adult/pediatric type sample line configurations with infants; this may add dead space to the patient circuit.• Do not use infant type sample line configurations with adults; this may result in excessive flow resistance.• All NomoLine supplies, as indicated by the manufacturer, are single-patient use and should not be used on other patients.

Cautions

Equipment may be damaged or cease to function properly if the cautions in this section are not followed.



- When administering anesthetic agents, incorrect agent identification may occur when a mixture of more than two anesthetic agents occurs in the sample circuit.
- Always verify your vaporizer setting when administering anesthetic agents.
- Use only supplies and accessories available from the *Spacelabs Healthcare Supplies and Accessories Catalog*.
- Follow local hospital protocols to dispose of used and contaminated single-use accessories.
- The diameter of the scavenging system line must be two to three times larger than the sample line tubing to avoid changes in the operating pressure of the multigas module and consequential inaccurate readings or internal damage.
- Route the scavenger hose so that it does not kink during operation of the monitor. A kinked or partially kinked scavenger hose will impair performance of the multigas module.
- If the patient's airway is configured with a closed suctioning system, the airway adapter must be placed near the suctioning system (on the ventilator side). This helps to ensure that the sampling adapter is not impaired during and after suctioning.



- Check the integrated NomoLine water filter/trap of the sampling supply regularly during monitoring.
- Do not operate the 92518 Multigas Module outside the specified operating temperature environment.
- Since a successful zeroing requires the presence of ambient air (21% O₂ and 0% CO₂) in the gas analyzer, ensure that the module is placed in a well-ventilated location.
- Avoid breathing near the analyzer before or during the zeroing procedure.
- Refer to the manufacturer's instructions for proper cleaning procedures.
- Use only adapter cables supplied by Spacelabs Healthcare.
- Do not use the 92518 Multigas Module with metered-dose inhalers or nebulized medications; this may clog the bacteria filter in the sample line connector.
- Check that the gas sample flow is not too high for the present patient category.
- Measurements can be affected by mobile and RF communications equipment. Make sure that the 92518 Multigas Module is used in the non-electromagnetic environment specified in this manual.



- The 92518 Multigas Module is intended for use by authorized and trained medical personnel only.
- To ensure that parameter measurements (readings) are accurate, take readings only when the multigas module is in a stable condition.
- Do not get this module wet; it may stop functioning. If your module does get wet, contact a Spacelabs Healthcare field service representative.
- When an actively heated humidification device is used in line with an anesthesia machine and the module is actively sampling the patient gas, the user should be aware that excessive amounts of water may collect within the gas sampling line. This water accumulation may limit the ability of the module to pull in a gas sample. This may cause the sample line to become occluded resulting in an alarm condition.

Notes:

- *Too strong a positive or negative pressure in the patient circuit may affect the sample flow.*
- *Strong scavenging suction pressure may affect the sample flow.*
- *Refer to the manufacturer's instructions for proper use of supplies.*
- *Before you administer nebulized drugs to a patient connected to the multigas module, disconnect the sample line from the patient or stop the pump by touching the **SUSPEND SAMPLING** key.*

92518 Multigas Setup

Refer to the *Multigas Module 92518 Service Manual* (P/N 070-2362-xx) for instructions on connecting the module to a Spacelabs Healthcare monitor.

Compatibility

The 92518 Multigas Module is compatible with the following Spacelabs Healthcare monitors:

- Xprezzon (91393)
- Qube (91390)

If more zones are selected than are available, the **GAS** key appears at the bottom of the display, in the numeric key zone. When you touch the **GAS** numeric key, the GAS parameter is displayed in the lowest-priority display zone.

When monitoring gas concentrations on a monitor limited to three or four waveforms, the GAS parameter should be set to display only one or two zones.

Notes:

- If a 92518 Multigas Module is connected to a monitor that is not supported, the module will sign on with the following message: *This monitor does not support GAS.*
- If a remote view is attempted of a bedside monitor hosting a 92518 Multigas Module that displays this message, the remote shall display the same message as well.



Figure 17-1: Multigas module front panel controls and features

- 1 Gas scavenging port
- 2 Inlet sample port (LEGI — Light Emitting Gas Inlet)

Light Emitting Gas Inlet (LEGI)

Common to all 92518 multigas modules is the light emitting gas inlet (LEGI), which detects the presence of a NomoLine sample line and presents color-coded status information (refer to [Table 17-2](#) on page 17-15).

As long as no sample line is connected, a multigas module stays in a low-power, sleep mode. Once the sample line is connected, the multigas module switches to measuring mode and starts delivering gas data.

Table 17-2: Status Indicated by the LEGI

Indication	Status
Steady green light	System OK
Blinking green light	Zeroing in progress
Steady blue light	Anesthetic agent present
Steady red light	Sensor error
Blinking red light	Check sample line

Patient Connection

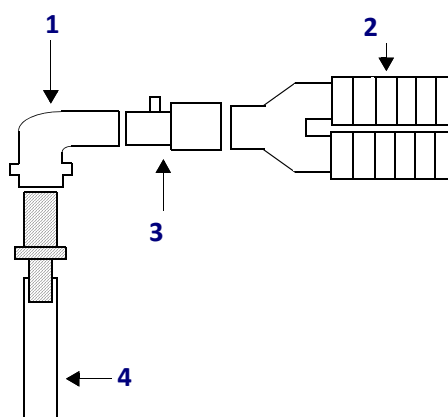


Figure 17-2: Example of sidestream multigas setup for an adult

- 1 Elbow
- 2 Ventilator circuit
- 3 Integrated NomoLine airway adapter + sampling line
- 4 Endotracheal tube

Note:

For a full list of available supplies and accessories, refer to the Spacelabs Healthcare Supplies and Accessories Catalog at <https://www.spacelabshealthcare.com/supplies>.

Pre-Use Check

Before connecting the integrated NomoLine airway adapter + sampling line to the breathing circuit, do the following:

- 1 Connect the integrated NomoLine airway adapter + sampling line to the module gas inlet connector (LEGI).

- 2 Check that the LEGI shows a steady green light indicating that the system is OK.
- 3 Check that the O₂ reading on the monitor is correct (21%).
- 4 Perform the leakage test according to the manufacturer's directions for use of the integrated NomoLine airway adapter + sampling line.
- 5 The exhaust port is then connected to the scavenging system.

Maintenance

Gas readings should be verified by conducting the recommended maintenance checks (refer to *Multigas Module 92518 Service Manual* (P/N 070-2362-xx) for more information).

Operation

CO₂, N₂O, and anesthetic agents are measured by drawing a sample gas stream into the measuring chamber. The multigas module uses nondispersive infrared radiation to measure the absorption of the gas sample at seven infrared wavelengths, which are selected using optical narrow band filters. The infrared radiation detectors are thermopiles.

Concentrations of CO₂ and N₂O are calculated from absorption measured at 3 to 5 μ m. Identification of anesthetic agents and calculation of their concentrations is performed by measuring absorptions at five wavelengths from 8 to 9 μ m, and by solving a set of five equations. Measurement accuracy is achieved through software compensation.



Only halothane (HAL), enflurane (ENF), isoflurane (ISO), sevoflurane (SEV), and desflurane (DES) are suitable for use with the multigas module. If any other halogenated anesthetic agent is present, it will be misidentified and/or will interfere with the reported anesthetic agent concentrations.



- **Caregivers should account for the 50 \pm 10 ml/min sampling rate when working with low volume capacity patients.**
- **When administering anesthetic agents, incorrect agent identification may occur when a mixture of more than two anesthetic agents occurs in the sample circuit.**

O₂ concentration is measured with a paramagnetic oxygen sensor. The sensor uses a differential pressure transducer to compare the pressure gradient produced when reference and sample input gases are exposed to an oscillating magnetic field.

Because this method of measurement has a fast response time, inspired and expired values of O₂ can be reported. A sidestream sampling technique is used to acquire respiratory gases from an endotracheal or tracheostomy tube or anesthesia mask. A constant-flow vacuum system maintains the flow rate through the sample line.

The multigas module automatically compensates for the ambient barometric pressure to ensure accurate readings. Both CO₂ values may appear in partial pressure (in mmHg or kPa) or in percent (%).

$$\% \text{ Gas} = \frac{\text{PARTIAL PRESSURE GAS}}{\text{BAROMETRIC PRESSURE}} \times 100\%$$

Note:

Respiration rate and alarm limit accuracies are not specified above 95 breaths per minute.

Powering Up the Unit

It is not possible to power ON the 92518 Multigas Module directly. The 92518 Multigas Module only powers up through the module's connection to the host monitor.

Note:

The multigas module is protected against the effects of a cardiac defibrillation discharge, and it is safe to use on patients with a cardiac pacemaker or other electrical stimulation.

Initialization

The message **GAS SENSOR WARMING UP** may display when the module is first powered up. This message can last up to one minute before the bench is warmed up enough. The monitor may also display one or more zeroes progress messages because of an automatic zeroing process.

During power-up, the normal screen may display on the monitor before the **GAS SENSOR WARMING UP** message displays.

Notes:

- Typical rise time of CO₂ is <200 ms.
- Typical rise time of O₂ is <450 ms.
- Typical rise time of N₂O is <350 ms.
- Anesthetic Agents identification time is <20 seconds.
- Operation to full specification in <20 seconds.



- The multigas module requires approximately 20 seconds to warm up for concentration reporting, automatic agent identification, and full accuracy specification. You may use the multigas module prior to full warm-up, but be aware of possible inaccuracies in gas analysis.
- When the module is powered up through the host monitor, all default settings for gas monitoring will be re-established. Any modifications made to the default settings (alarm limits, text display, etc.) prior to interruption of power will be lost.

To start multigas monitoring with the power-up monitor (host device)

- 1 Plug the module into the monitor.
- 2 Connect the sample line to the inlet sample port.
- 3 Touch **GAS**.
- 4 Prepare the patient according to hospital procedures.
- 5 Allow the multigas module to warm up for a minimum of 20 seconds for CO₂, O₂, and N₂O detection, automatic agent identification, and full accuracy specification.
- 6 Connect the other end of the gas sample line to the gas sampling tee or breathing circuit.
- 7 During the use of anesthetic agents, ensure that the hospital scavenging line is connected to the scavenger port on the multigas module.

Patient Monitoring

Some Spacelabs Healthcare monitors support START CASE/END CASE functions. When available, touch **START CASE** on the monitor to begin patient monitoring.

When using the multigas module with monitors that do not support START CASE/END CASE, power up the module by connecting it to a monitor, then wait for initialization to complete. Patient monitoring begins when initialization is complete.

When a case has been ended by touching **END CASE** on the monitor, all alarms are deactivated, the multigas module's sampling pump is turned OFF, and the multigas module automatically enters suspended sampling mode.

The multigas module remains warmed up so that no additional warm-up time is required when you resume patient monitoring. Touch the **START CASE** or **RESUME SAMPLING** key to resume monitoring (refer to [Suspending and Resuming Sampling](#) on page 17-31).

Display Detail

When you first connect the multigas module to a monitor, the GAS parameter key displays to the right of a flat waveform.

Some display formats may be unavailable on some Spacelabs Healthcare monitors. Refer to [Compatibility](#) on page 17-13.

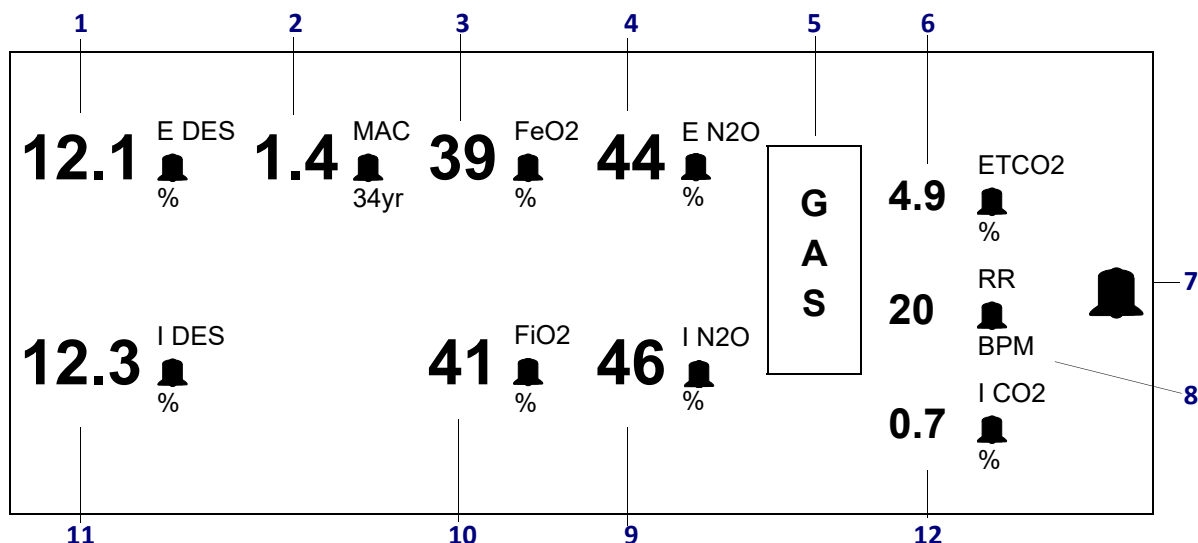


Figure 17-3: Bedside display

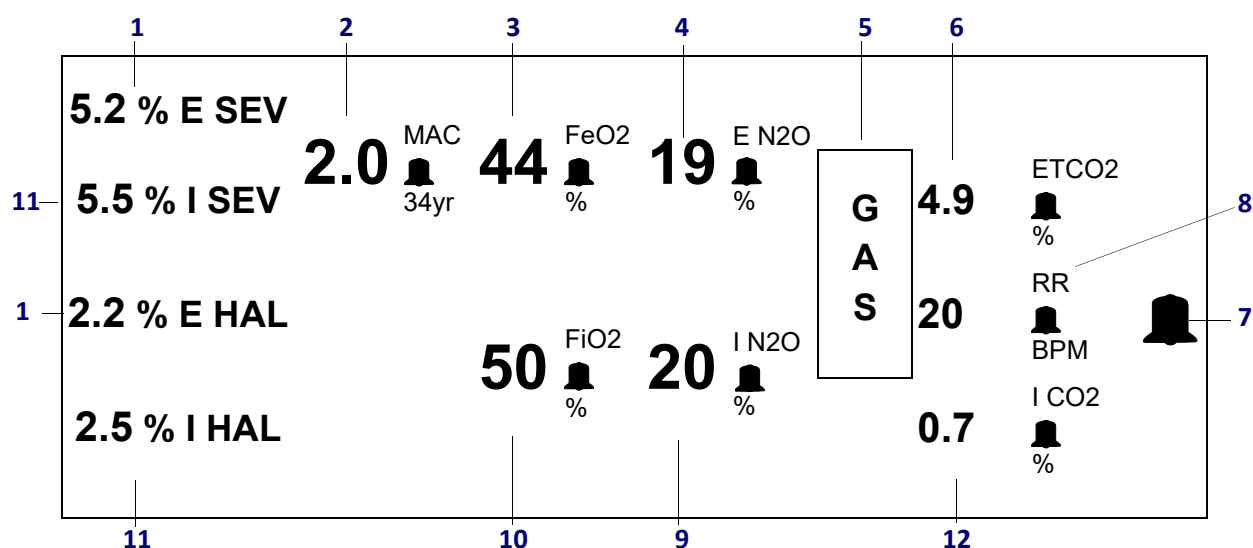


Figure 17-4: Bedside display, two anesthetic agents

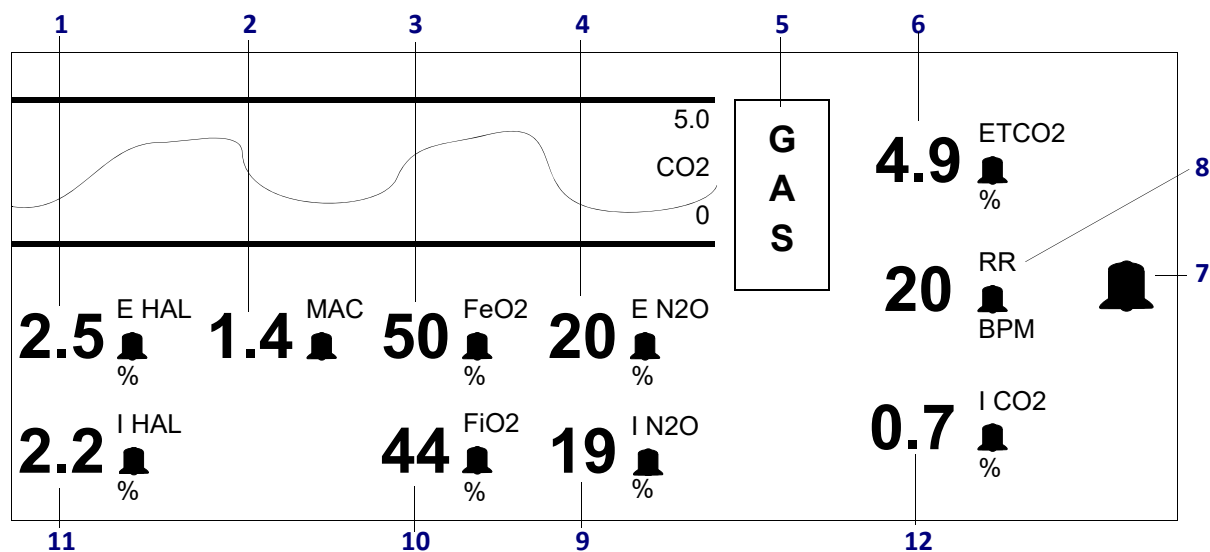


Figure 17-5: Bedside display (one zone), CO₂ waveform ON

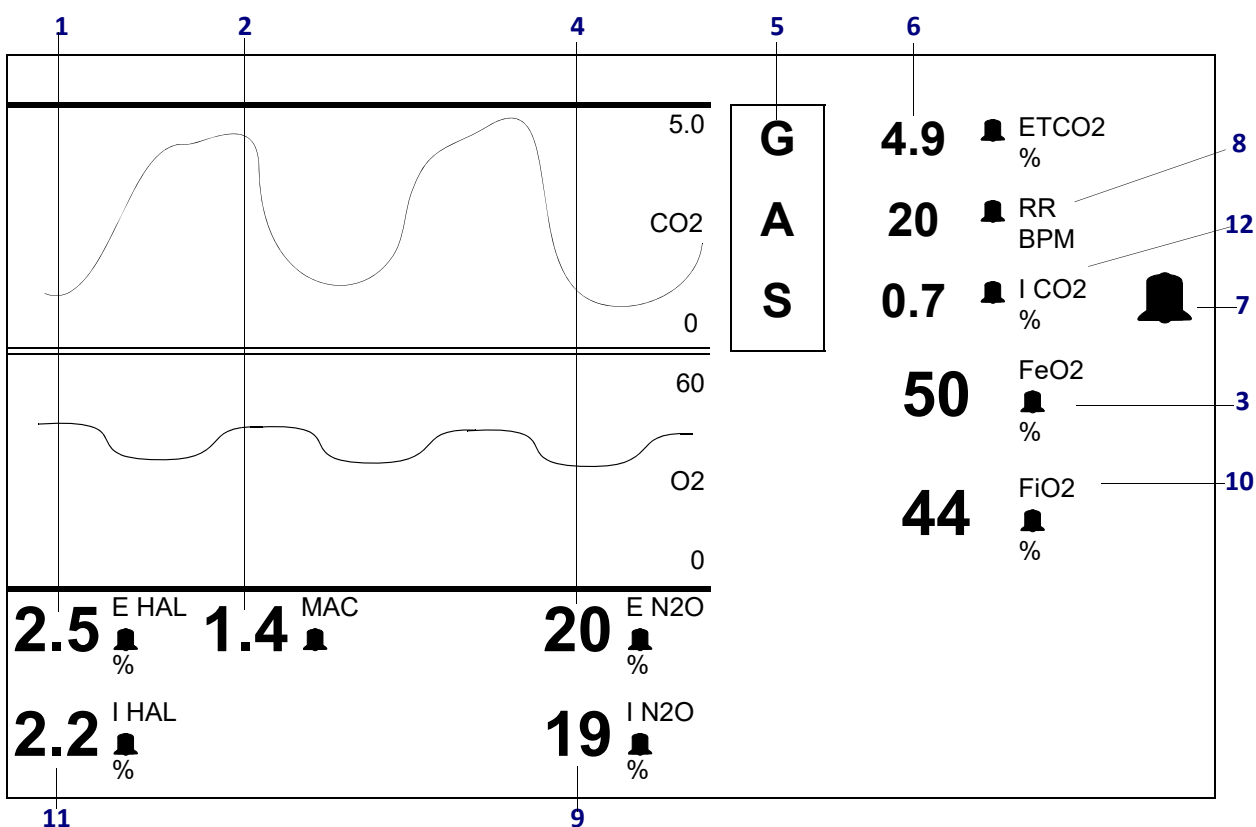


Figure 17-6: Bedside display (two zones), CO₂ and O₂ waveforms ON

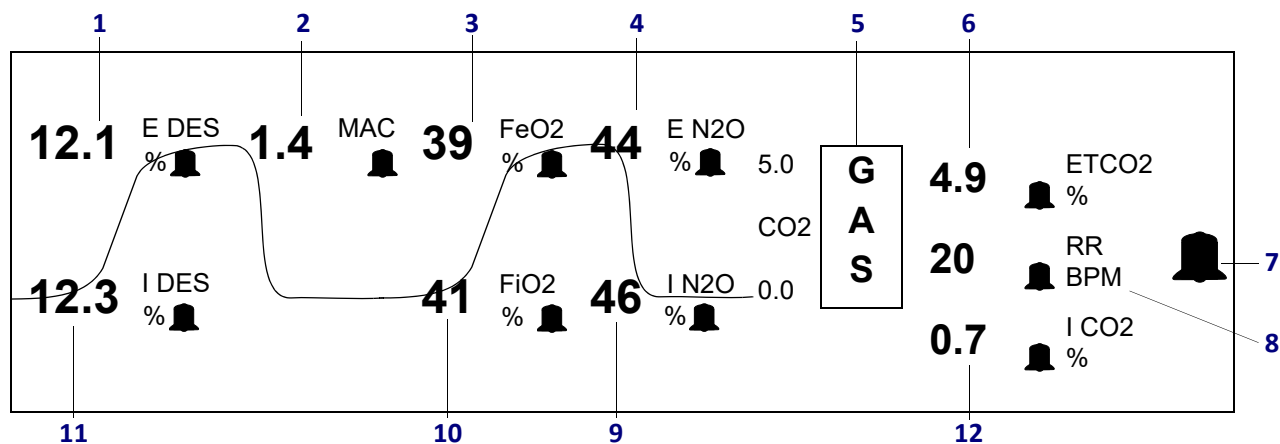


Figure 17-7: Full-width remote view, CO₂ waveform ON

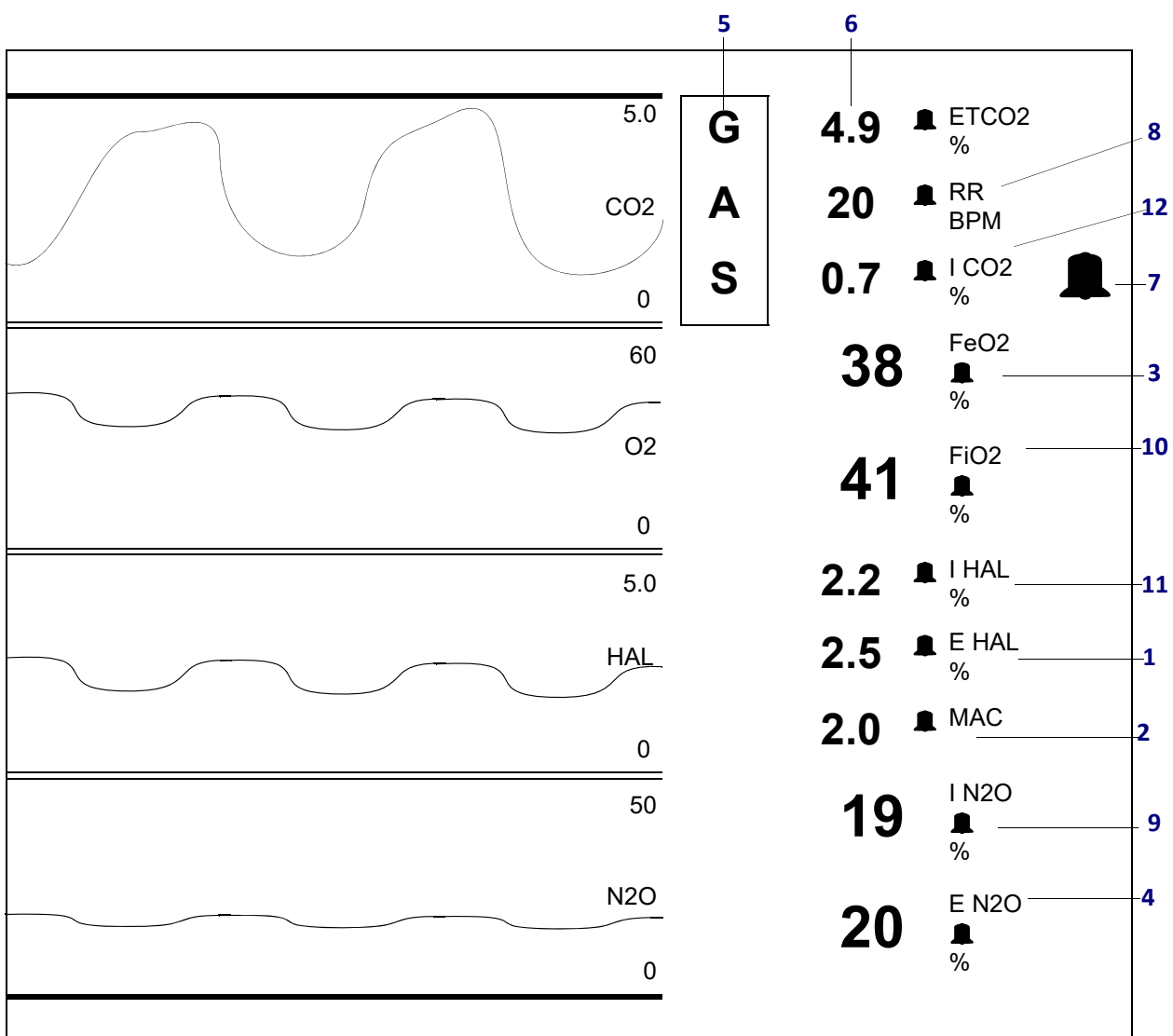


Figure 17-8: Bedside display (four zones), all waveforms ON,
two anesthetic agents

- 1 Expired agent
- 2 MAC value (or AMAC, depending on user selection)
- 3 Fractional expired oxygen
- 4 Expired nitrous oxide
- 5 **GAS** parameter key
- 6 End-tidal carbon dioxide
- 7 Alarms status (refer to [Alarm Behavior](#) on page 17-22)
- 8 Respiratory rate
- 9 Inspired nitrous oxide
- 10 Fractional inspired oxygen
- 11 Inspired agent
- 12 Inspired carbon dioxide

Alarm Behavior

The following behaviors are seen during all alarm conditions:

- The **GAS** key shall flash at all displays.
- Alarm Limits parameter key and **HI** or **LO** key shall flash at all displays.
- Large bell shall flash for Limit alarms at the local (bedside) and full-screen remote views.
- Parameter small bell shall flash at the local bedside.
- Alarm tone shall sound at the local (bedside) and central (if enabled in MCM settings).
- Alarm Watch window shall display (if enabled in MCM settings).
- Alarm recording shall be initiated (if enabled in MCM settings).

Changing the Display Format

You can select to display the expired or inspired values of parameters on the top line of the display. ETCO_2 values are always displayed on the top line.

To display inspired/expired values on the top line

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **DISPLAY FORMAT**.
- 4 Select **INSP TOP/EXP TOP**.

Note:

*EtCO₂, I CO₂, RR, and MAC/AGEMAC display is not affected by **INSP TOP/EXP TOP** key.*

You can turn off the parameter's numeric display by touching the parameter's respective **ON/OFF** key. Selecting **OFF** will clear the parameter's numeric values from the display. You cannot turn off the numeric display for FiO₂, EtCO₂, and respiration rate.

To turn OFF numeric displays

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **DISPLAY FORMAT**.
- 4 Touch **NUMERIC CONTROLS**.
- 5 Touch the **ON/OFF** key for the particular parameter.

The **WAVEFORM CONTROLS** menu controls the waveforms ON/OFF for CO₂, O₂, N₂O, and anesthetic agent parameters. CO₂ is available on all monitors. All other waveform control keys are available only on the local (bedside) monitor.

To turn OFF waveform displays

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **DISPLAY FORMAT**.
- 4 Touch **WAVEFORM CONTROLS**.
- 5 Touch the **ON/OFF** key for the particular parameter.

For all parameters, except EtCO₂, the expired numeric values can be added to or removed from the display through each parameter's respective expired or inspired **ON/OFF** key in the **NUMERIC CONTROLS MENU** (for example, **E N2O, ON/OFF**). Setting this key to ON will display the related parameters' associated numeric (expired) values on the monitor.

Two Agents

When two anesthetic agents are detected, the anesthetic agent with the higher concentration displays on the top line (numeric display only; refer to [Figure 17-4](#) on page 17-19), and its position is not user-configurable.

When a second anesthetic agent is no longer present, the display reverts to a single-agent display (refer to [Figure 17-3](#) on page 17-19).

Mixed Agents

When a mixture of anesthetic agents is detected, and the analyzer is not able to identify the agents, an **AGENT MEASUREMENT MAY BE UNRELIABLE** message displays and an alarm tone sounds.

During this condition, the anesthetic agent labels display as **I MIX** and **E MIX**. Inspired, expired, instantaneous numeric values display as question marks (???).

Unidentified Agents

If no anesthetic agent is identified in the system, the multigas module will display **AA** for the agent label and **???** for numeric values.

No Breath Mode

The normal mode of operation is in effect as long as breathing is detected. When no breath has been detected for a duration equal to the APNEA alarm limit setting, the multigas module switches to no breath mode automatically.

When in no breath mode:

- A **NO BREATH DETECTED** message displays in the EtCO₂ waveform zone.
- An alarm tone sounds.
- The **ACKNOWLEDGE ALARMS** key displays in the EtCO₂ waveform zone.

To stop alarms in no breath mode

- 1 Touch **ACKNOWLEDGE ALARMS**.

If the patient is not connected when gas monitoring is started, then the analyzer will remain in no breath mode.

During no breath mode, measurements of CO₂, O₂, N₂O, and the anesthetic agent(s) are continuously performed. Measurements referred to as instantaneous numeric values are displayed at one-second intervals in place of the inspired numeric values. Instantaneous numeric values can change with each display update.

In no breath mode, respiration rate (RR) and the expired values for CO₂, O₂, N₂O and the anesthetic agents are displayed as ???.

Enabling and Adjusting Alarms

The Alarm Limits menu allows you to enable and adjust alarm limits for the following:

- RR (respiration rate) — high and low limits
- Apnea (delay is measured in seconds) — high limit
- EtCO₂ — high and low limits
- I CO₂ — high limit
- FiO₂ — high and low limits
- FeO₂ — high and low limits
- Inspired and Expired N₂O — high and low limits

- Inspired and Expired Anesthetic Agent — high and low limits
- MAC — high and low limits
- AMAC — high and low limits

To enable and adjust alarm limits

- 1 Touch **GAS**.
- 2 Touch **ALARM LIMITS**.
- 3 Select a parameter.
- 4 Touch **ON** for the parameter selected.
- 5 Select the **HI =** or **LO =** key.
- 6 Use the arrow keys to set the high and/or low alarm limit or the apnea alarm delay time.
- 7 Touch a parameter key on the right side of the menu to cycle to the next parameter for setting alarm limits.
- 8 Repeat the fourth through seventh steps above until all limits are set.

When the alarm is initially turned ON for EtCO₂ and RR, the limit values depend on the patient's current readings for those parameters (these limit values are learned). Alarm limits for all other monitored parameters, when turned ON, always have the same fixed values.

Default values appear for alarm limits when you initially power ON the multigas module, or when patient data is purged during patient admit/discharge. You can modify limits for any of the monitored parameters. These modifications will remain in effect until the unit is turned OFF. Refer to the user manuals for your patient monitor for details on operating system alarms.

Table 17-3: Alarm Ranges

Parameter	Units	Low Alarm			High Alarm			Increments
		Min.	Max.	Default	Min.	Max.	Default	
APNEA	s	-	-	-	20	45	20	5
RR	bpm	4	90	Learned	15	95	Learned	1 when ≤30 5 when >30
ETCO ₂	mmHg	0	119	Learned	1	120	Learned	1
	kPa	0	15.9		0.1	16		0.1
	%	0	14.9		0.1	15		0.1
I CO ₂	mmHg	-	-	-	1	40	8	1
	kPa	-	-	-	0.1	5.3	1	0.1
	%	-	-	-	0.1	5	1	0.1
FiO ₂	%	20	95	20	21	100	100	1 when ≤30 5 when >30

Table 17-3: Alarm Ranges (continued)

Parameter	Units	Low Alarm			High Alarm			Increments
		Min.	Max.	Default	Min.	Max.	Default	
FeO ₂	%	15	95	18	16	100	100	1 when ≤30 5 when >30
I N ₂ O	%	5	75	5	10	80	60	5
E N ₂ O	%	0	75	0	5	6	4	0.1
I HAL	%	0	5.9	0	0.1	6	4	0.1
E HAL	%	0	5.9	0	0.1	6	4	0.1
I ENF	%	0	5.9	0	0.1	6	4	0.1
E ENF	%	0	5.9	0	0.1	6	4	0.1
I ISO	%	0	5.9	0	0.1	6	4	0.1
E ISO	%	0	5.9	0	0.1	6	4	0.1
I SEV	%	0	7.9	0	0.1	8	6	0.1
E SEV	%	0	7.9	0	0.1	8	6	0.1
I DES	%	0	19.9	0	0.1	20	15	0.1
E DES	%	0	19.9	0	0.1	20	15	0.1
MAC	-	0	4.9	0	0.1	5	3	0.1
AGEMAC	-	0	4.9	0	0.1	5	3	0.1

Table 17-4: Alarm Delays

Alarm Setting	Range	Alarm Delay
Resp Rate High	15 to 60 bpm	Less than 1 second
Resp Rate Low	4 to 55 bpm	
Apnea		Apnea alarm delay + 1 second
EtCO ₂ High	1 to 120 mmHg	Less than 1 second
EtCO ₂ Low	0 to 119 mmHg	
I CO ₂ High	1 to 40 mmHg	Less than 1 second
FiO ₂ High	21 to 100%	Less than 1 second
FiO ₂ Low	29 to 95%	
FeO ₂ High	16 to 100%	Less than 1 second
FeO ₂ Low	15 to 95%	

Table 17-4: Alarm Delays (continued)

Alarm Setting	Range	Alarm Delay
iN ₂ O High	10 to 80%	Less than 1 second
iN ₂ O Low	5 to 75%	
eN ₂ O High	5 to 80%	Less than 1 second
eN ₂ O Low	0 to 75%	
iHAL High	0.1 to 6%	Less than 1 second
iHAL Low	0 to 5.9%	
eHAL High	0.1 to 6%	Less than 1 second
eHAL Low	0 to 5.9%	
iENF High	0.1 to 6%	Less than 1 second
iENF Low	0 to 5.9%	
eENF High	0.1 to 6%	Less than 1 second
eENF Low	0 to 5.9%	
iISO High	0.1 to 6%	Less than 1 second
iISO Low	0 to 5.9%	
eISO High	0.1 to 6%	Less than 1 second
eISO Low	0 to 5.9%	

Waveform Settings

Waveforms can be displayed for CO₂, O₂, N₂O and anesthetic agents. Some display formats may be unavailable on some monitors. Refer to [Compatibility](#) on page 17-13. Turning on multiple waveforms expands the display and increases the number of waveforms in use.

If more zones are selected than are available, the **GAS** key appears at the bottom of the display, in the numeric key zone. When you touch the **GAS** numeric key, the GAS parameter is displayed in the lowest-priority display zone.

CO₂ MODE displays only the CO₂ waveform and the numeric values in a single zone (refer to [Figure 17-7](#) on page 17-21). When **CO₂ MODE** is **ON**, the **CO₂**, **O₂**, **N₂O**, and anesthetic agent keys on the Waveform Controls menu are disabled.

You can turn OFF the waveforms for CO₂, O₂, N₂O and anesthetic agents and display only the numeric values. When all waveforms are OFF, the **SCALE**, **SWEEP SPEED**, and **FREEZE ON/OFF** keys are disabled.

If a parameter's waveform is too large to fit within the screen zone, use the parameter's waveform scale keys to adjust the waveform size.

To freeze the waveform screen, set the **FREEZE** key to **ON**. When you freeze the waveform, numeric information continues to be updated. The waveform stays frozen until you touch **FREEZE / OFF** or touch the Home (or **NORMAL SCREEN**) key. The **SCALE**, **SWEEP SPEED**, and **WAVEFORM CONTROLS** keys are disabled when waveforms are frozen.

The sweep speed determines the speed at which the waveform moves across the screen. Available sweep speeds are 25, 12.5, 6.25, 3.12, or 1.56 mm/second.

To turn CO2 MODE ON or OFF

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **DISPLAY FORMAT**.
- 4 Touch **WAVEFORM CONTROLS**.
- 5 Touch **CO2 MODE ON** or **OFF**.

To turn the waveform ON or OFF for a particular parameter

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **DISPLAY FORMAT**.
- 4 Touch **WAVEFORM CONTROLS**.
- 5 Touch **ON** or **OFF** for the particular parameter.

Note:

*Waveform controls are disabled when **CO2 MODE** is **ON**. To turn waveforms ON or OFF, **CO2 MODE** must be set to **OFF**.*

To adjust the waveform scale size

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **SCALE**.
- 4 Touch the parameter you wish to change.
- 5 Select the desired scale size.

To freeze all waveform screens

- 1 Touch **GAS**.
- 2 Touch **FREEZE / ON**.

To select a sweep speed (for all waveforms)

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **SWEEP SPEED**.
- 4 Select the desired sweep speed.

MAC and AGEMAC Calculations

You can select Minimum Alveolar Concentration (MAC) calculations to be a MAC only calculation, or you can select **AGEMAC** for **MAC** calculations based on patient age. When **AGEMAC** is selected, the patient age is displayed, except on the split-screen display.

If the patient age is not available, the calculation will default to **MAC**, and the **MAC/AGEMAC** key will be disabled. The **MAC/AGEMAC** value will display ??? if the expired values of N₂O and the anesthetic agent are unavailable.

To select MAC or AGEMAC

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Touch **DISPLAY FORMAT**.
- 4 Touch **MAC** or **AGEMAC**.

MAC Calculations

$$\text{MAC(AA)} = \frac{\% \text{EAA}}{\times(\text{AA})} \quad (\text{should be calculated for first and second agents})$$

$$\text{MAC(N}_2\text{O)} = \frac{\% \text{EN}_2\text{O}}{\times(\text{N}_2\text{O})}$$

$$\text{MAC} = \text{MAC(AA)} + \text{MAC(N}_2\text{O)}$$

Where:

AA = any of five anesthetic agents: HAL, ENF, ISO, SEV, or DES

MAC(AA) = Calculated value of MAC for a given AA

MAC(N₂O) = Calculated value of MAC for N₂O

EAA = Expired value of AA

EN₂O = Expired value of N₂O

×(AA) = Agent-specific coefficient, as follows: HAL=0.75%, ENF=1.7%, ISO=1.15%, SEV=2.05%, DES=6%

×(N₂O) = 100, the coefficient for N₂O

For example:

If ENF = 1%, SEV = 1%, and N₂O = 20%

$$\text{MAC(AA)} = 1/1.7 + 1/2.1 = 1.064$$

$$\text{MAC(N}_2\text{O)} = 20 / 105 = 0.19$$

$$\text{MAC} = 1.064 + 0.19 = 1.254 \quad (\text{The result would be rounded to 1.3})$$

AGEMAC Calculations

$$\text{AGEMAC(AA)} = \frac{\text{MAC(AA)}}{[(0.05 \times \text{TEMP} - 0.85) \times (1.32 \times 10^{(-0.00303 \times \text{AGE})})]}$$

$$\text{AGEMAC(N}_2\text{O)} = \frac{\text{EN}_2\text{O}}{[114 \times 1.378 \times 10^{(-0.00347 \times \text{AGE})}]}$$

$$\text{AGEMAC} = \text{AGEMAC(AA)} + \text{AGEMAC(N}_2\text{O)}$$

Where:

AGEMAC(AA) = AGEMAC value calculated based on AA

AgeMAC(N₂O) = AGEMAC value calculated based on N₂O

TEMP = Body temperature of the patient. If temperature is not available, then use a value of 37° C

AGE = Patient age

AGEMAC = Calculated value of AGEMAC

For example:

If ENF = 1%, SEV = 1%, N₂O = 20%, TEMP = 35, and AGE = 50

MAC(AA) = (1/1.7) + (1/2.1) = 1.064

AGEMAC(AA) = 1.064 / [(0.05 × 35 - 0.85) × (1.32 × 10^(-0.00303 × 50))] = 1.27

AGEMAC(N₂O) = 20 / (114 × 1.378 × 10^(-0.00347 × 50)) = 0.19

AGEMAC = 1.27 + 0.19 = 1.46 (The result would be rounded to 1.5)

Printing the Gas Waveform Zone

You can print multigas values. Refer to the user manuals for your patient monitor for additional information.

To print the gas waveform zone

- 1 Touch **GAS**.
- 2 Touch **PRINT**.

Note:

The **PRINT** key is available at all monitors.

Selecting a Unit of Measurement

CO₂ values and alarm limits can be displayed as a percentage (%) or as units of pressure. The units of pressure are either mmHg or kPa, depending on the monitor setup.

To select units of measurement, touch the **PERCENT/mmHg** (or **PERCENT/kPa**) key until the desired unit is highlighted.

To select a measurement unit

- 1 Touch **GAS**.
- 2 Touch **SETUP**.
- 3 Select **PERCENT** or **mmHg** (or **kPa**, depending on the monitor's setting).

Suspending and Resuming Sampling



Suspend processing can also take place automatically after an occlusion.

Sampling can be suspended by touching the SUSPEND SAMPLING key under the following conditions:

- When suctioning a patient.
- When use (by the patient) is temporarily discontinued.
- When nebulized drugs are being used.

This stops the sampling pump and keeps the system free of debris. When sampling is suspended, the **ZERO** key on the Calibration menu is disabled. The analyzer remains warmed up so that no additional warm-up time is required. Touch the **RESUME SAMPLING** key to resume sampling.

Note:

*The **SUSPEND SAMPLING** key is available only at the local/bedside monitors.*



Sampling must be resumed for proper monitoring of respiratory gases.

To suspend sampling

- 1 Touch **GAS**.
- 2 Touch **SUSPEND SAMPLING**.
- 3 Touch **RESUME SAMPLING** to resume sampling.

Calibrations



- *Calibrations must be performed by qualified service engineers.*
- *The calibration should occur when the multigas module is not actively monitoring a patient.*

Auto Zero Calibration (Zeroing)

The 92518 Multigas Module performs zeroing automatically by switching the gas sampling from the respiratory circuit to ambient air. The automatic zeroing is performed every 24 hours and takes less than 10 seconds for the multigas module to complete.



Since a successful zeroing requires the presence of ambient air (21% O₂ and 0% CO₂) in the module, ensure that the module is placed in a well ventilated place. Avoid breathing near the sidestream gas analyzer before or during the zeroing procedure.

If the module is fitted with an oxygen sensor, the automatic zeroing also includes room air calibration of the oxygen sensor.

To guarantee accurate readings, the zero reference of the multigas module is automatically calibrated on a regular basis. Auto zero calibrations last less than 15 seconds. During auto zero calibrations, the **AUTO ZERO IN PROGRESS** message displays.

The interval between auto zero calibrations depends on the amount of time the multigas module operates.

The infrared gas analyzer needs to establish a zero reference level for the CO₂, N₂O, and anesthetic agent gas measurement.

Gas Calibration

A gas calibration is recommended when gas values appear to be too low or too high. A gas calibration is required when the **O2 CALIBRATION REQUIRED** message displays.



- **Performing a gas calibration without the calibrated gas mixture connected adversely affects the accuracy of the multigas module.**
- **Gas calibrations must be performed by trained personnel only.**
- **Gas calibrations must be performed with 100% O₂ concentration.**

The gas calibration procedure is used to recalibrate the gas channels for O₂. Refer to the *Multigas Module 92518 Service Manual* (P/N 070-2362-xx) for details on calibrating the multigas module.

Note:

Waveforms and numeric values may disappear during calibration.

Gas Span Calibration

To calibrate gas spans

- 1 Allow the analyzer to warm up for at least one minute.
- 2 Make sure that the surrounding gas is normal air (21% O₂ and 0% CO₂).
- 3 Ensure that there is no breath detected and that all expired numerics and RR display ??? (refer to [Figure 17-9](#)).
- 4 Touch **GAS**, then **CAL** to enter the **GAS - CALIBRATION MENU**.
- 5 Touch the **SERVICE CAL** key five times (**SERVICE CAL** is a hidden key).
- 6 Supply the calibration gas with 100% O₂ into the sample line.
- 7 Observe and wait until the O₂ display is almost stable on the display page in the **SERVICE CAL** menu.
- 8 Once the gas display is stable, touch 100% O₂ Cal.
- 9 Touch **YES** to proceed with the O₂ calibration.
- 10 The message **CAL GAS IN PROGRESS** appears.
- 11 This message may display for 15 seconds or until the calibration is complete.
- 12 The message **CAL GAS COMPLETED** displays when a successful calibration is complete.
- 13 The message **CAL GAS FAILED** displays if the calibration process fails.

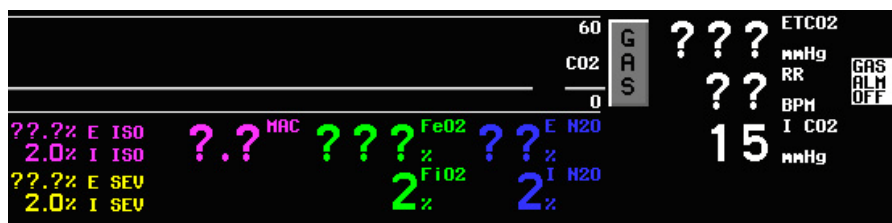


Figure 17-9: Before calibration—??? display for expired numerics and RR

To verify a successful calibration

- 1 Touch the Home (or **NORMAL SCREEN**) key, enable the O₂ waveform, and check the following:
 - a The O₂ numerics display 100% in the case of gas supply (refer to Figure 17-10).
 - OR-
 - b The O₂ numerics display 21% in the case of room air supply.

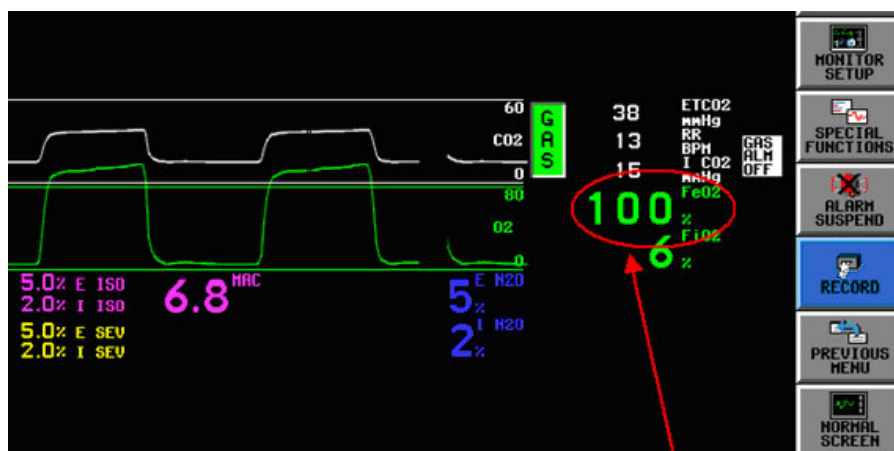


Figure 17-10: Proper display of O₂ numerics upon successful calibration.

Essential Performance

Table 17-5: Essential Performance

Standard/Section	Required Performance Summary	Impact on Multigas Module	Essential Performance Category
IEC 80601-2-55: 2018, Respiratory gas monitors (RGM)			
201.12.1.101	Measurement accuracy	<p>The measurement accuracy levels are achieved for:</p> <ul style="list-style-type: none"> halogenated agent: $\pm(0.2\% + 15\%$ of gas level) CO₂: $\pm(0.43\% + 8\%$ of gas level) NO₂: $\pm(2.0\% + 8\%$ of gas level) O₂: $\pm(2.5\% + 2.5\%$ of gas level) 	Measurement accuracy and alarm condition
201.12.1.101.2	Drift of measurement accuracy	The drift of measurement accuracy shall meet the accuracy requirements levels specified by the manufacturer (Table 201.102 of IEC 80601-2-55).	Measurement

Table 17-5: Essential Performance (continued)

Standard/Section	Required Performance Summary	Impact on Multigas Module	Essential Performance Category
201.12.1.101.3	Measurement accuracy of gas readings for gas mixtures	The RGM requirements shall be achieved with the gas mixtures specified in Table 201.104 of IEC 80601-2-55 and the tolerance of less than $0.2 \times$ the error tolerance given in Table 201.102 of IEC 80601-2-55.	Measurement
201.12.1.101.4.1	Calibration/zeroing	Calibration/zeroing of an RGM in normal use shall be indicated on the gas measurement display.	Measurement
201.12.1.101.4.2	Suppression of automatic calibration/zeroing	Unless calibration/zeroing is required to generate gas readings, an automatic calibration/zeroing of an RGM shall be suppressed. Any suppression of an automatic calibration/zeroing shall be limited to no more than 20 minutes.	Measurement
208.6.1.2	Determination of alarm conditions and assignment of priority	The RGM shall generate a low or medium priority technical alarm condition if the RGM fails to measure the parameters specified.	Alarm/indications
201.11.8.101.1	Supply failure technical alarm condition	The RGM should provide a minimum medium priority technical alarm if power supply falls outside of normal operation. If switchover to internal power occurs, then information/low priority signal to be given.	Alarm/indications

92518 Multigas Troubleshooting Guide

The multigas module displays error messages in the gas waveform zone. Many of these messages also trigger an alarm, if configured to do so. If the prompt line is available, the monitor displays messages there as well.



Status messages indicate a problem or condition which may affect accurate monitoring values. Do not ignore these messages. Correct any fault before continuing.

Note:

Depending on the severity of the error, the multigas module may not analyze sampled gases while the monitor displays any of these messages. Numeric values are always available for a specific waveform if that numeric is not turned off.

Whenever a gas calibration failure occurs, the previous calibration factors are not lost. The multigas module continues to function and report the gas values, but the full accuracy of the values is not guaranteed.

Clinical Situation or Message	Possible Cause	Solution
Module does not sign on	Defective hardware.	Contact a qualified field service engineer.
	Flash memory programming error, or defective software on the interface board.	Contact a qualified field service engineer.
Module does not power up	Improper insertion of the module into the bay.	<ul style="list-style-type: none">Remove and reinsert the module.Unplug and replug in the monitor.
	Defective hardware.	Contact a qualified field service engineer.
SENSOR OVER TEMPERATURE	The operating environment temperature is too high.	Use the multigas module only within its intended operating temperature range of 10° to 40° C.
		Contact a qualified field service engineer, and return the unit to Spacelabs Healthcare for repair if the message persists.

Clinical Situation or Message	Possible Cause	Solution
SAMPLE LINE OCCLUDED	The sample line is blocked.	<ul style="list-style-type: none"> • Disconnect and reconnect the sample line. • Check the sample line for blockages or crimps; replace as necessary. • Replace the NomoLine adapter after occlusion is detected.
COMMUNICATION LINK LOST - Service required -OR- COMMUNICATION DROP OUTS - Service required	An internal communication problem was detected.	Contact qualified field service personnel and return the unit to Spacelabs Healthcare for repair.
SERVICE CAL MODE - Patient is not monitored	The SERVICE CAL menu is displayed on the bedside monitor.	Touch the Home (or NORMAL SCREEN) key to exit this mode on the bedside monitor.
SAMPLING SUSPENDED - Patient is not monitored	Sampling was suspended by the user by pressing the SUSPEND SAMPLING or END CASE key.	Touch RESUME SAMPLING or START CASE to exit this mode on the bedside monitor.
	Occlusion of the sampling line.	Replace NomoLine adapter after occlusion is detected.
NO BREATH DETECTED	Breaths are not detected for a duration equal to the APNEA timeout duration.	Verify sensor is properly connected to the patient. Message will clear after a valid respiratory rate is detected, or the ACKNOWLEDGE ALARMS key is touched.
Inspired values fluctuate over a wider and more extreme range than what is expected.	Analyzer is in no breath mode.	<p>Verify sensor is properly connected to the patient. Message will clear after a valid respiratory rate is detected, or the ACKNOWLEDGE ALARMS key is touched. To exit this mode, if the ACKNOWLEDGE ALARMS key is not present:</p> <ol style="list-style-type: none"> 1 Touch the GAS key. 2 Touch SUSPEND SAMPLING, then touch YES. 3 Touch RESUME SAMPLING, then touch YES.

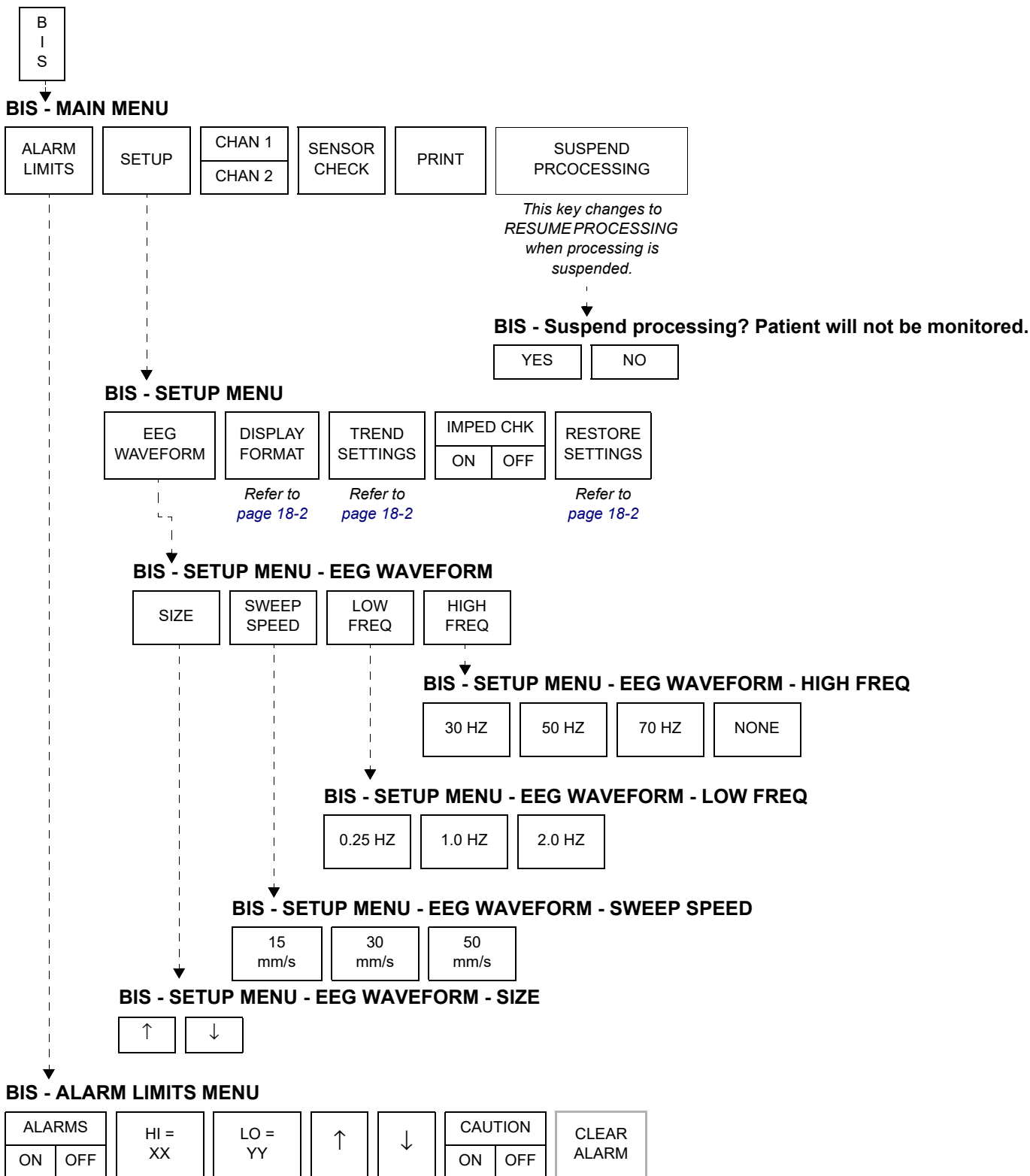
Clinical Situation or Message	Possible Cause	Solution
NO BREATH message appears constantly and red alarm indicator flashes.	Physiological cause	Check the patient.
	Clogged or blocked filter line.	Check the sample line and replace if blocked.
	Filter line caught in something or tube is kinked.	Check the sample line from the module to the patient to see if the line is kinked, twisted, or caught in the bed or equipment.
AUTO ZERO IN PROGRESS	An automatic zero or manual zero calibration is in progress.	Wait for the message to disappear.
CAL GAS IN PROGRESS	CAL GAS calibration is in progress.	Wait until the CAL GAS calibration is successfully completed. The message disappears.
CAL GAS FAILED - Check gas supply	The unit could not calibrate the gas channel.	Repeat the calibration. Contact your biomed or qualified field service personnel if the CAL GAS fails again.
SENSOR WARMING UP	The unit is warming up.	Wait until warm up completes before operating.
AMBIENT PRESSURE OUT OF NORMAL OPERATION RANGE	The atmospheric (ambient) pressure exceeds the multigas module environmental operating requirements.	Check the multigas module environmental operating requirements in the 92518 <i>Multigas Module</i> data sheet.
AGENT MEASUREMENT MAY BE UNRELIABLE.	A mixture of anesthetic agents is detected, and the analyzer is not able to identify the agents.	The multigas module is not designed to simultaneously identify and measure more than two anesthetic agents. Inaccurate numeric concentration values may be displayed when agents are mixed. Depending on the agents used, the residue in the breathing or delivery system, and the concentration left in the patient's lungs, a mixed agent condition can last for more than an hour.
		If the message persists, contact your biomed or qualified field service personnel.

Clinical Situation or Message	Possible Cause	Solution
Sample line connected but pump not working and no CO ₂ , EtCO ₂ , or RR readings are shown.	Sample line not plugged in properly.	Check the plug's connection at the monitor.
		Check that the sample line is connected properly at the module; replace as necessary.
		Remove and reattach the sampling line.
No sampling line	Sample line not plugged in properly.	Remove and check the sample line.
Error: Maintenance required	Hardware or sensor error.	Contact a qualified field service engineer.
O2 CALIBRATION REQUIRED	Recommended O2 sensor calibration.	Enter the GAS - SERVICE CAL menu at the display to calibrate the O2 sensor.

BISx (91482)

Directory of Keys

SETUP MENU



SETUP MENU Continued

