Handheld Mainstream and Sidestream CO_2/SpO_2 Monitors
VM-2500-M and VM-2500-S

Technical Support Manual

VM-2500-M/S Technical Support Manual

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The information in this document is subject to change without notice.

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⚠ Warnings

Warnings are identified by the WARNING symbol shown above. Warnings alert the user to potential serious outcomes, such as death, injury, or adverse events to the patient or user.

⚠ **Changing the default start up settings of the device can seriously affect the functionality of the device and the alarms!**

⚠ **Only suitably qualified personnel with the required technical and medical knowledge are allowed to change the default start up settings!**

1 Intended use of the service menu

The main focus of the SERVICE MENU is to provide option to adjust the default start up parameters of the VM-2500-M/S device.

Every time the device is switched on, the Start-up Default Settings will be active, no matter what has been set before the device was switched off.

Under normal operating conditions the factory default settings don't need to be changed. They are carefully chosen to provide secure alarms in the most usual operation conditions and to fulfil the requirements of the applied capnograph and pulse oximeter standards.

Next to this SYSTEM INFORMATION can be viewed and the DEMO MODE can be activated on the device.

Some sections are applicable only on the sidestream device VM-2500-S. If not stated otherwise, the sections are applicable to both versions.

This manual (and service menu structure) is based on device Firmware **v8.8**.

2 PIN CODE

⚠ **Never give patients access to the service menu! The Access PIN code for the service menu has to be separated from the normal user manual!**

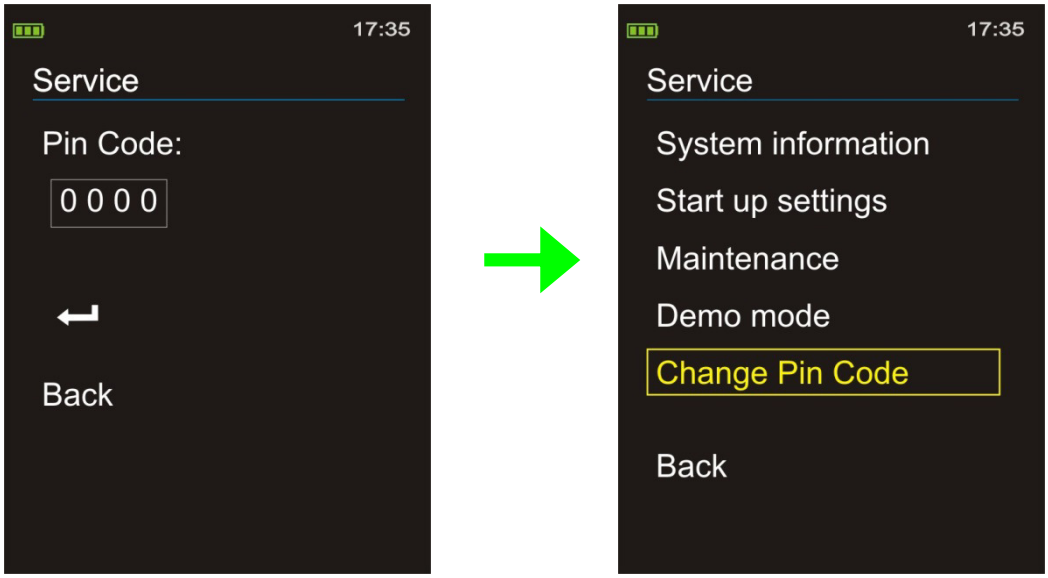
By entering the Service PIN CODE you confirm that you have read and understood the service manual and take full responsibility for the consequences that might result from the changed alarm functionality.

PIN CODE : *1 9 8 1*

3 Accessing the SERVICE MENU

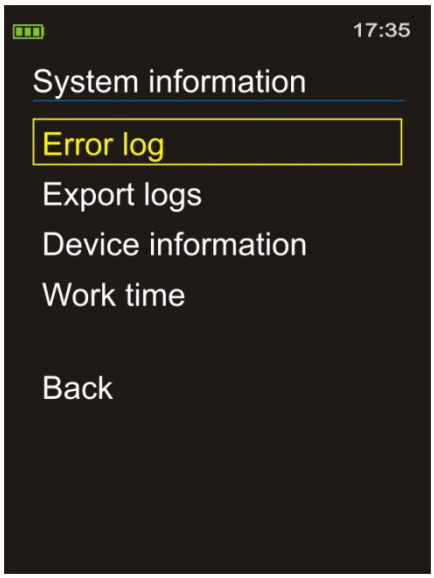
1. Press the menu button on the device, use the up/down buttons to select menu point SETUP
2. Confirm with the enter button
3. Use the up/down buttons to select menu point SERVICE
4. Confirm with the enter button
5. Enter the PIN Code, using the up/down buttons and the enter button
6. Confirm correct PIN with menu point ENTER

7. Within the SERVICE menu you can
   - View SYSTEM INFORMATION (component serial numbers etc.)
   - Change the default START UP SETTINGS (adjust start up settings and restore factory default settings)
   - Perform MAINTENANCE tasks (only VM-2500-S)
   - Activate the DEMO MODE (demonstration of device function)
   - Change the service PIN CODE



4 System information

The service menu point SYSTEM INFORMATION is for factory internal use only; there are no adjustable parameters in this menu.



5 Start-up settings

Within the service menu point START UP SETTINGS selective default start up parameters can be adjusted or the default start up parameters can be reset to the factory defaults.

⚠ **Changing the default start up settings of the device can seriously affect the functionality of the device and the alarms!**

⚠ **Only suitably qualified personnel with the required technical and medical knowledge are allowed to change the default start up settings!**

5.1 Adjustable DEFAULT SETTINGS and factory default values

Parameter		Possible settings	Factory default
Pulse tone		On / Off	On
Volume		1 - 4	4
O2 compensation		0-30% / 30-70% / 70-100%	0-30%
Mode		adult / neonatal	adult
Adult defaults	$EtCO_2$ High	0.1 - 9.9 % / off	7.3
	$EtCO_2$ Low	off / 0.1 - 9.9 %	3.2
	SpO_2 High	1 - 99 % / off	off
	SpO_2 Low	off / 1 - 99 %	85
	RR High	4 – 150 /min / off	off
	Apnoea	off, 20, 40, 60 sec	20
	PR High	1 - 250 /min / off	140
	PR Low	off / 1 - 250 /min	45
	$FiCO_2$ High	0.1 - 9.9 % / off	1.2
Neonatal defaults	$EtCO_2$ High	0.1 - 9.9 % / off	7.3
	$EtCO_2$ Low	off / 0.1 - 9.9 %	3.2
	SpO_2 High	1 - 99 % / off	95
	SpO_2 Low	off / 1 - 99 %	85
	RR High	4 – 150 /min / off	off
	Apnoea	20, 40, 60 sec	20
	PR High	1 - 250 /min / off	150
	PR Low	off / 1 - 250 /min	30
	$FiCO_2$ High	0.1 - 9.9 % / off	1.2
High alarms		On / Off	On
Medium alarms		On / Off	On
Low alarms		On / Off	On
SpO2 averaging		Stb / Std / Sens	Std
Alarm delay mode		On / Off	Off
Memory full		On / Off	On
Auto-off		On / Off	On
Hide delete data		On / Off	Off

5.2 Explanation of the adjustable start up parameters

The service menu is available only in English language. Device language settings have no effect on the service menu.

⚠ **All changes in the start settings are only activated if SAVE DEFAULT SETTINGS is selected at the end of the DEFAULT SETTINGS menu and after restarting the device!**

5.2.1 Pulse tone

Defines if the pulse tone is muted or not at start up (on / off). When muted, the corresponding symbol  is displayed at the top of measurement screen. (During normal operation mode the pulse tone mute button toggles pulse tone on/off.)

5.2.2 Volume

Defines which pulse tone loudness is used at device start up. Range: 1 – 4

NOTE: Alarm loudness is not affected.

5.2.3 O_2 compensation

The presence of oxygen can cause some interference in the CO_2 measurement. These interferences are compensated by setting the range of O_2 concentration under the menu point “Gas compensation” accordingly.

5.2.4 Mode

Selection between adult and neonatal mode at start up is possible.

When NEONATAL is selected, the neonatal symbol  is displayed at the measurement screen top. In this mode the default alarm limits are adjusted to neonatal default settings (refer to Chapter 5.1).

⚠ **Please ensure that accessories appropriate for neonates are used!**

5.2.5 Adult and neonatal alarm limit defaults

Under normal operating conditions the factory alarm limit defaults don’t need to be changed. They are carefully chosen to provide secure alarms in the most usual operation conditions and to fulfil the requirements of the applied capnograph and pulse oximeter standards.

Special operating conditions like sleep monitoring or dedicated use on small children might require to permanent change of the alarm limits to more appropriate values.

Alarm limit defaults can be adjusted at the menu points ADULT DEFAULTS or NEONATAL DEFAULTS.

5.2.6 High priority alarm on/off

When set to off, all high priority alarms (e.g. “Bad signal quality” or “Apnoea”) do not result in audible alarm. Optical indication is still active.

5.2.7 Medium priority alarm on/off

When set to off, all high priority alarms (e.g. Alarm limit violation) do not result in audible alarm. Optical indication is still active.

5.2.8 Low priority alarm on/off

When set to off, all high priority alarms (e.g. “SpO2 Sensor off”) do not result in audible alarm. Optical indication is still active.

5.2.9 SpO2 averaging

Defines the SpO_2 averaging mode at device start up:

Stable (Stb): When this setting is selected any strong and sudden variations in data will not immediately affect the reading (data incorporated over time); minor irregularities have little or no effect on the displayed reading.

Standard (Std): Averaging parameters used for this setting are between those of the stable and sensitive settings.

Sensitive (Sens): The reading is more sensitive to irregularities but reacts very quickly to any changes in measured parameters.

Refer to Chapter "Technical Specifications" in the User Manual for further details on the influence of the SpO_2 averaging settings on the SpO_2 reaction time.

5.2.10 Alarm delay mode

The function of the “Alarm delay Mode” is to prevent false alarms which are typical if a patient is monitored for a long time (movement and other artefacts).

If the “Alarm delay Mode” is activated in the Service Menu all functions of the device will be the same as in “Standard Mode”, only the sensitivity of the Limit Alarms is changed.

In Alarm delay Mode **Limit Alarms are only activated, if the limit is violated for 15 seconds continuously.**

This is valid for limit alarms only. This is not valid for the alarm messages and especially not for the Apnoea message.

Find below all limit alarms listed:

$EtCO_2$ High and Low (expired CO_2)

$FiCO_2$ High (inspired CO_2)

RR High (respiration rate)

SpO_2 High and Low (oxygen saturation)

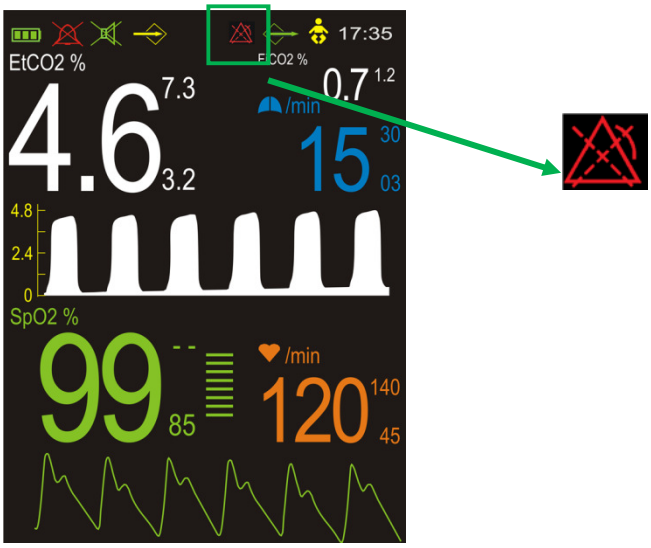
PR High and Low (pulse rate)

For example:

If SpO_2 low is active for 9 seconds and then SpO_2 is normal again = no alarm will sound, but values are displayed and stored.

If SpO_2 low is active for 16 seconds = SpO_2 low limit alarm is activated (yellow flashing of number and medium priority audible alarm) as long as the alarm situation is present.

After activating the mode the **Alarm delay Mode symbol** is displayed in the measurement screen:



5.2.11 Memory full warning

If the MEMORY FULL warning is set to off, there is no warning that the device's memory for measurement data is nearly full.

If the memory space is full, the oldest data is overwritten without warning or confirmation.

The symbol for memory full is still displayed at the top of the measurement screen, but no message has to be confirmed by the user at start up.

5.2.12 Auto-Off

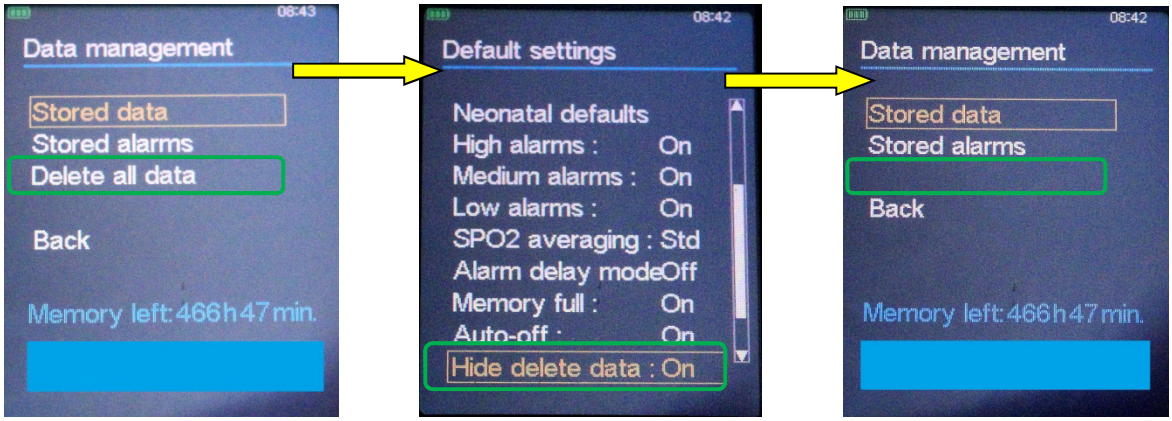
When the parameter Auto-off is set to value "on", the device switches off automatically after having no valid signal for 2 minutes. It doesn't switch off when an alarm condition is present.

When the parameter Auto-off is set to value "off" the device never switches off automatically.

5.2.13 Hide delete data

An option is now available to deactivate the "delete data" button in the menu. This operation is reversible and can be set in the pin protected service menu.

Default settings **Activate "Hide delete data"**



If "Hide delete data" is set to back to "off", the button to delete the data is visible again.

5.3 FACTORY SETTINGS

Factory reset sets all values which can be modified in service menu back to the factory default values (see Chapter 5.1 for the factory default values).

5.4 Non-adjustable start parameters

Some of the device parameters are not adjustable in the DEFAULT SETTINGS.

Alarm volume	The volume of the alarms is always on fixed level
Brightness level	The last used brightness level is restored at start up. Brightness can be adjusted in the regular setup menu
Battery low warning	The warning sound can be suppressed, but the message is always shown
Time resolution of data records	The time between the record of two trend view data points is fixed to 8 seconds
Language	The last used language setting is restored after start up. Language can be set in the regular user setup menu.
Date and time	Date and time can be set in the regular user setup menu, when the devices starts the actual time is taken from the internal Real Time Clock

6 Maintenance

The Handheld capnograph and pulse oximeter VM-2500-M/S with accessories is permanently factory calibrated.

The maintenance and calibration-free technology (gas analyzer and SpO_2 Module) integrated in the VM-2500-M/S ensures a robust measurement function throughout the lifetime of the monitor.

No routine calibration is required however a basic maintenance plan is highly recommended. Recommended maintenance tasks are described below.

6.1 Zeroing

⚠ **Warning:** Incorrect probe Zeroing will result in false gas readings.

In order to secure high precision of the IRMA analyzer measurements the following zeroing recommendations should be followed:

- Zeroing is performed by snapping a new IRMA airway adapter onto the IRMA analyzer, without connecting the airway adapter to the patient circuit.
- Select MAIN MENU > SETUP > ZEROING at the monitor. Ensure that ambient air (21% O_2 and 0% CO_2) is present in the IRMA airway adapter.
- Start the zeroing by selecting “Yes” when the message “Start Zeroing?” is displayed. The message “Zeroing completed !” indicates that the zeroing was successful.

⚠ **Warning:** Special care should be taken to avoid breathing near the airway adapter before or during the Zeroing procedure. The presence of ambient air in the IRMA airway adapter is of crucial importance for a successful Zeroing.

Always perform a pre-use check after Zeroing the IRMA analyzer.

VM-2500-M (IRMA CO_2):

Zeroing needs to be performed ONLY when an offset in gas values is observed, or when an unspecified accuracy message is displayed.

Allow 10 seconds for warm up of the IRMA CO_2 analyzer after power on before proceeding with the Zeroing Procedure.

Allow the IRMA probe to warm up for at least 10 seconds after changing the IRMA airway adapter before transmitting the Zero reference command.

VM-2500-S (integrated ISA Module):

The VM-2500-S performs zeroing automatically by switching the gas sampling from the respiratory circuit to ambient air. The automatic zeroing is performed 1 to 3 times per 24 hours, and takes less than 3 seconds.

⚠ **Warning:**

Since a successful zeroing requires the presence of ambient air (21% O_2 and 0% CO_2) in the device, ensure that the VM-2500-S is placed in a well ventilated environment. Avoid breathing near the VM-2500-S before or during the zeroing procedure. Incorrect zeroing of the integrated ISA CO_2 analyzer will result in false gas readings.

6.2 Check gas accuracy

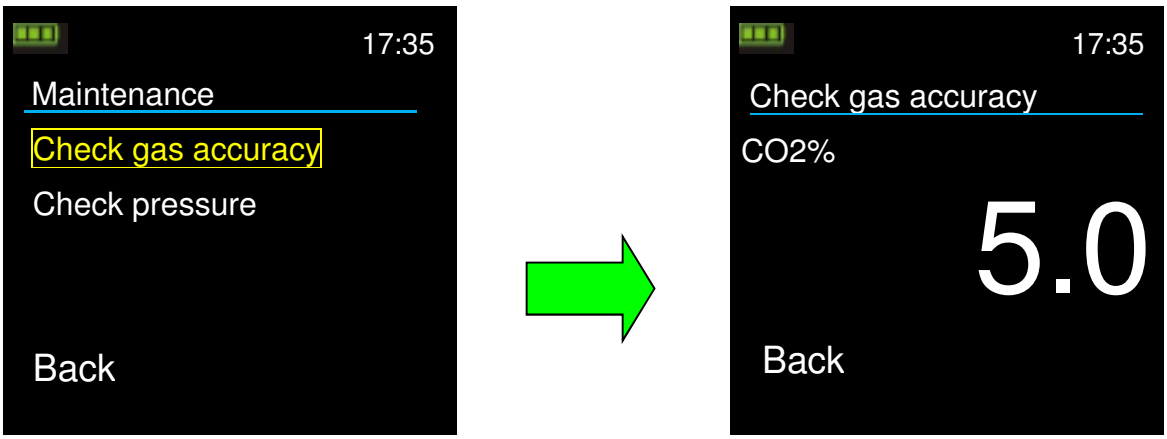
Calibration and test gas:

Gas accuracy check of the VM-2500 CO_2 module requires the use of a suitable test gas mixture. A cylinder containing such mixture may be acquired from the vendor of your choice, provided the following gas concentrations and accuracy are as follows:

5% ±0.1vol% CO_2, 20.9% O_2 , balance N_2

Gas measurement check:

1. Connect a new CO_2 disposable part (Airway adapter to IRMA of VM-2500-M, Filter sampling line with airway adapter for gas inlet of VM-2500-S)
2. Warm up for at least 1 min.
3. Connect the calibration gas to the airway adapter
4. Select Service > Maintenance > Check gas accuracy



5. Check that the displayed gas concentration readings correspond to the calibration gas values.

6. The gas reading shall be within the following range:

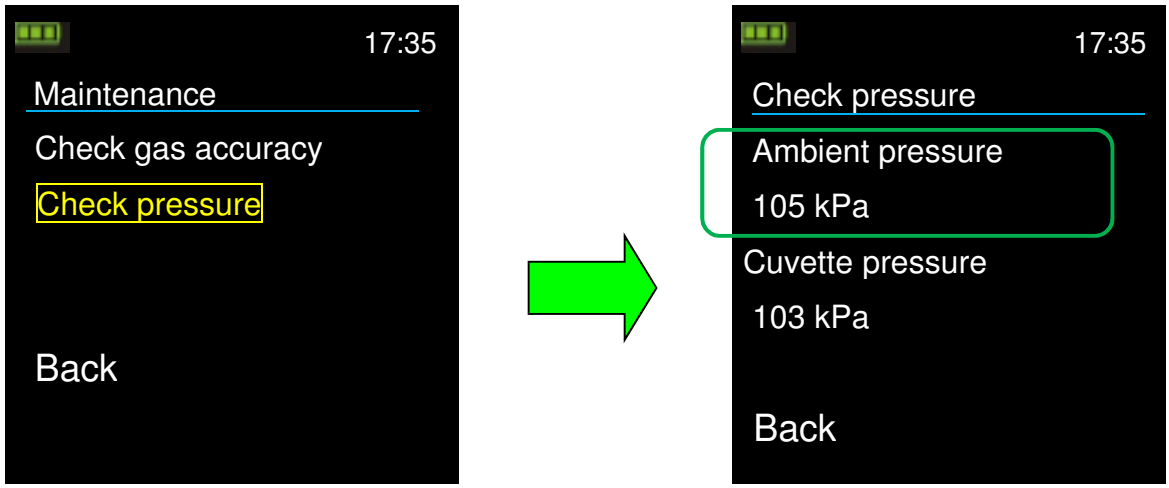
   ±(0.2 vol% + 2% of reading)

7. If the readings are outside the specified range, perform zeroing (see 6.1). If the test fails repeatedly, return the device to Viamed.

NOTE:
The VM-2500 monitor is designed to display end tidal CO_2 concentrations etCO_2. For this reason the monitor will not display a measurement value, if test gas with a constant flow is applied during normal monitoring mode.

6.3 Pressure test (only VM-2500-S)

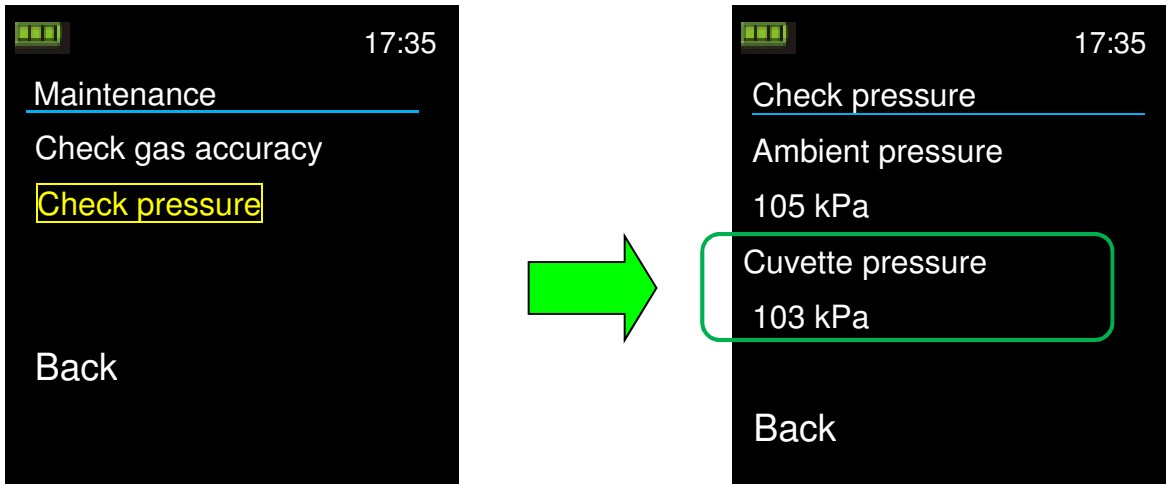
1. Select CHECK PRESSURE in the maintenance menu
2. Check that the barometric pressure value displayed corresponds to the actual barometric pressure value at the local site. The value is not allowed to differ more than ±5 kPa from the actual barometric pressure.



3. If the value differs more than ±5 kPa from the actual barometric pressure, return the device to Viamed.

Cuvette pressure test:

1. Connect a new sampling line assembly (Filter sampling line with airway adapter) to the VM-2500-S
2. Select CHECK PRESSURE in the maintenance menu



3. Check that the cuvette pressure value displayed is 1 to 5 kPa lower than the ambient pressure. If the value is outside the specified range, return the device to Viamed.

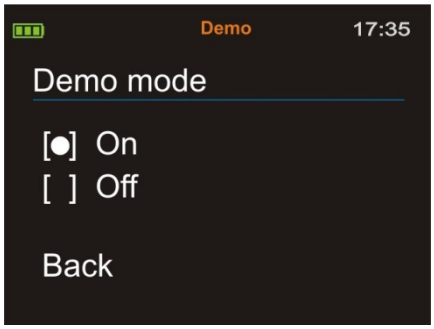
6.4 Leakage test (only VM-2500-S)

NOTE: only trained personnel are intended to perform the leakage test because the device needs to be opened for this test.

1. Connect a new leakage Test Sampling Line with silicon tubing to VM-2500-S.
2. Exhale a long breath into the silicon tubing until the CO_2 concentration is greater than 4.5 vol% or 34 mmHg.
3. Quickly connect the silicon tubing tightly to the exhaust port of the ISA module inside the VM-2500-S.
4. Wait 1 minute until the CO_2 concentration has stabilized. Note the value.
5. Wait 1 minute and check that the CO_2 concentration has not decreased more than 0.4 vol% or 3 mmHg. If it has decreased more there is a major leakage in the sidestream unit or in the sampling line. Do not operate the VM-2500-S if there is a major leakage in the unit.

7 Demo mode

For demonstration and promotion purposes it is possible to activate a DEMO MODE at the device. If activated the Demo symbol is displayed in orange at the header of the screen.



In this mode SpO_2 and CO_2 measurement values are continuously simulated and displayed. The demo data is also available at the USB port for Real Time Mode measurements.

8 Change pin code

Only suitably qualified personnel with the required technical and medical knowledge are allowed to enter the SERVICE menu. To avoid unauthorised access to the menu the PIN CODE can be changed.