

NOISELESS SEQUENTIAL AIR SAMPLER FOR INDOOR FACILITIES



USER MANUAL

JANUARY 2012 Edition – rev.00



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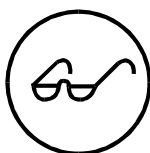
1 INTRODUCTION

1.1 GENERAL INFORMATION

The instructions of this manual meet safety, installation, starting and maintenance requirements of SILENT Sequential Air Sampler.

FAI Instruments s.r.l. reserves the right to modify the instrument described in this manual. Any update will be enclosed below or may be asked for straight the manufacturer.

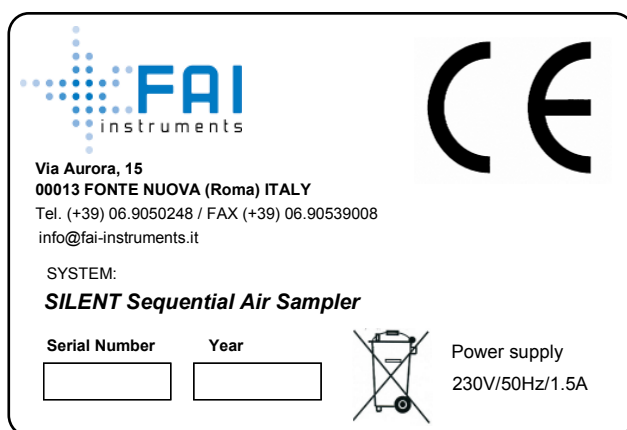
This manual must be considered integral part of the instrument. It must be always available for the interested personnel.



The operators in charge of the instrument installation, running and maintenance must read carefully this manual, in particular Charter 2 about SAFETY.

1.2 EQUIPMENT AND MANUFACTURER IDENTIFICATION

The identification label is placed at the back of the instrument sampling unit:



Device category:	<i>Indoor sampling system of suspended particulate matter on filter membranes.</i>
Device identification:	<i>SILENT Sequential Air Sampler</i>
Liabile manufacturer:	FAI Instruments s.r.l. Via Aurora, 15 - 00013 FONTE NUOVA (Roma) Tel. (+39) 06.9050248 (+39) 06. 90532398 Fax (+39) 06. 90539008 info@fai-instruments.it

1.3 GUARANTEE

Fai Instruments s.r.l. products are guaranteed, if they are properly used, from engineering, manufacturing and materials defects that could make them unusable.

If no different written agreement is stipulated between Fai Instrument s.r.l. and the Buyer, the guarantee is valid for 1 year as from the forwarding or the delivery date.

In case of failure during the guarantee period, FAI Instruments s.r.l. will pay guarantee, at his discretion, repairing or replacing at one's expense the defective parts. The guarantee doesn't cover for failures caused by accident, negligence, use of not original spare parts, improper use, installation or maintenance, repairs or repairing attempts carried out by not authorized personnel, normal wear of parts or components, or by any other cause not imputable to Fai Instruments.

1.4 INSTRUCTIONS FOR TECHNICAL ASSISTANCE REQUEST

The Customer can always contact the manufacturer for any kind of information about use, maintenance, installation, etc.

The Customer is requested to put the questions clearly, referring to this manual and always pointing out the instrument model and serial number mentioned in the identification label.

The Technicians qualified to carry out assistance and maintenance repairs are available at the telephone and fax number and at the email address of the manufacturer or of the authorized service center of the area.

1.5 INSTRUCTIONS FOR THE SPARE PARTS ORDER

The instrument may eventually need to have wearied or accidentally damaged parts replaced.

To this purpose the customer can order the spare parts order for the components to be replaced.

Remember that only Qualified Technicians can carry out repairs. The Operator is authorized just to use the instrument and to carry out the routine preventive maintenance operations described in this manual.

1.6 SILENT SEQUENTIAL AIR SAMPLER C E CONFORMITY DECLARATION

C E CONFORMITY DECLARATION

The manufacturer:

FAI Instruments s.r.l.

Via Aurora, 15 - 00013 FONTE NUOVA (Roma)

Tel. (+39) 06.9050248 06.90532398

Fax (+39) 06.90539008

hereby certifies that the instrument:

SILENT Sequential Air Sampler

is in accordance with the following European directives, last amendments included, and with the relative national legislation:

- directive 2006/95/EC about low-voltage electric material
- directive 2006/42/EC about machinery safety
- directive 2004/108/EC about Electromagnetic Compatibility

and that the following technical regulations have been applied:

Safety:

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
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Electromagnetic Compatibility:

EN 61326-1	Emission and Immunity
EN 61000-3-2	Harmonics
EN 61000-3-3	Flicker

Person authorized to compile the technical file :
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Via Aurora, 15 - 00013 FONTE NUOVA (Roma)

The managing director
Antonio Cesare Raffaele Imperatore

CHAPTER 2

2. GENERAL SAFETY WARNINGS

2.1 SYMBOLS

In this manual the following symbols are used to draw reader's attention to danger signals.

	High voltage	It marks HIGH VOLTAGE elements. Touching them may be fatal. The inobservance of this warning may expose to electrocution risks.
	Read carefully	Read carefully the text marked by this symbol. The information marked by this symbol are very important for the correct running of the instrument and for the operator's safety.
	Warning	This symbol is a warning: not observing it may cause instrument damages or it's incorrect running.

2.2 SAFETY WARNINGS



- ❑ *SILENT Sequential Air Sampler* is an air sampler only for indoor facilities.
- ❑ Only trained personnel can operate the instrument.
- ❑ Only technical trained and authorized personnel can carry out interventions inside the instrument.

2.3 SAFETY REGULATIONS

SILENT Sequential Air Sampler system has been engineered in such a way to satisfy the requirements listed in the following European directives and their subsequent modifications:

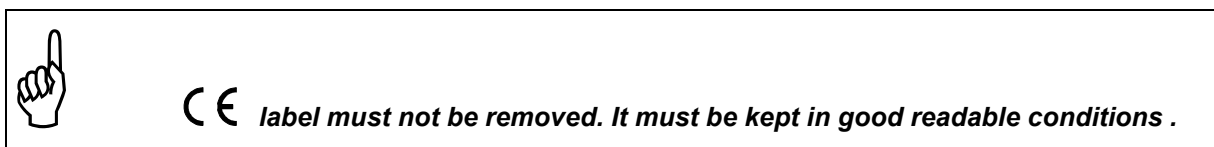
Directive 2006/95/EC	Low-voltage electric material
Directive 2006/42/EC	Safety of machinery
Directive 2004/108/EC	Electromagnetic Compatibility

The instrument is in compliance with the following harmonized technical regulations:

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
EN 61326-1	Electromagnetic Compatibility (EMC) – Emission and Immunity
EN 61000-3-2	Harmonics
EN 61000-3-3	Flicker

2.4 SAFETY LABEL

At the back of the *SILENT Sequential Air Sampler* system there is the **CE** label that has to be considered a safety label.



2.5 INTENDED USE OF THE INSTRUMENT

The instrument has been engineered for the following use:

- to sample in a sequential and automatic way the suspended particulate matter on filter membranes

The instrument must be used in the following conditions:

- indoor environment
- not potentially explosive or at fire risk atmosphere



The instrument must be used only for the operations and in the environmental conditions explicitly described in this manual: any other use is improper and it's prohibited.

2.6 PRESCRIBED USE

The instrument must be used as intended, only in perfect operating technical conditions and by qualified personnel in compliance with current safety and accident prevention regulations.

This "User manual" is meant for the **Qualified User**, who must:

- verify the operating room and the relative arrangements suitability for the instrument installation/use
- know in detail all needed operations for the correct use and routine maintenance, all general safety rules and the warnings of this manual
- do not carry out instrument repairs

This "User manual" is also meant for the **Qualified Technician**, who will be able, following the detailed instructions received during an apposite training course, to carry out instrument maintenance repairs.

If needed, for maintenance repairs call the **FAI Instruments s.r.l. Technical Assistance Service**, or one of its AUTHORIZED technical assistance service center, which can intervene with Specialized Technicians and with fitting tools and original spare parts.



Any modification or transformation of the instrument is prohibited. If modifications or transformations are carried out, the operator must take full responsibility for all possible resulting consequences.

In case of modifications, we recommend to contact the manufacturer in order to keep the guarantee validity.

CHAPTER 3

3 GENERAL INFORMATION

3.1 GENERAL INFORMATION ABOUT THE INSTRUMENT

SILENT Sequential Air Sampler is an indoor sampling system, for suspended particulate matter collected on one filter membrane or sequential sampling on four independent filter membranes.

3.2 INSTRUMENT COMPOSITION

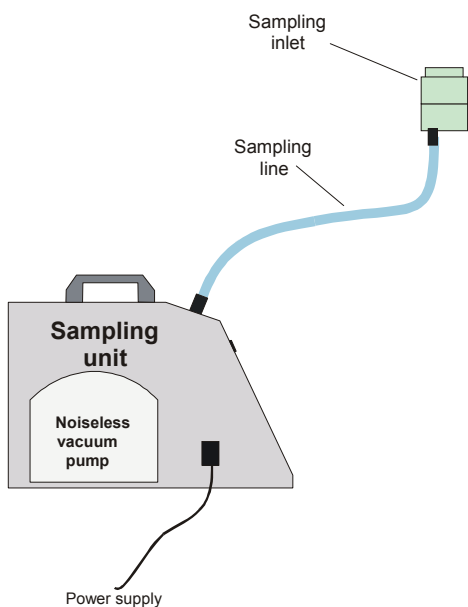
The instrument is made up of the following units (see picture 3.1):

- Sampling unit
- Sampling line and inlet

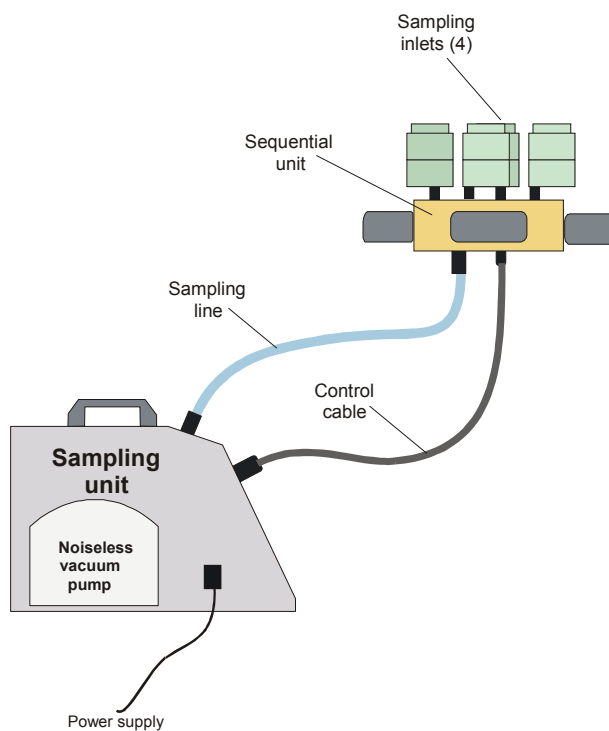
Optional supply:

- Sequential unit (optional switching unit for 4 inlets sequential sampling)
- Additional (3) Sampling Inlets

The system can be supplied together with the switching unit suitable for sequential sampling on 4 Sampling Inlets (optional configuration – picture 3.1a)



picture 3.1



picture 3.1a

3.2.1 Sampling unit

The unit contains a specially designed noiseless aspiration pump, all sampling control devices. Picture 3.2 shows the frontal view of the unit.



picture 3.2

3.2.2 Sampling Inlet

The sampling inlet has function of impactor for the selected granulometric cut size (PM_{2.5} or PM₁₀) at the operating flow rate of 10 liter/min .

The sampling inlet unit includes, in cascade, after the impactor section, the filter membrane, mounted in its filter holder, to collect the particulate matter of the selected granulometric cut size. The membrane has a standard size of 47 mm diameter.

Note: the impactor has to be greased (with Silicon oil) to hold the bigger size particulate matter.

Alternatively a filter membrane 25 mm diameter can be placed on the impactor to collect the bigger size particulate matter

Inlet orifice



Picture 3.3 shows the detail of the sampling inlet.



Inlet section

Impactor section

Filter holder section

**Sampling
INLET**

Impactor



Filter holder

*Filter membrane
(Ø 47mm)*

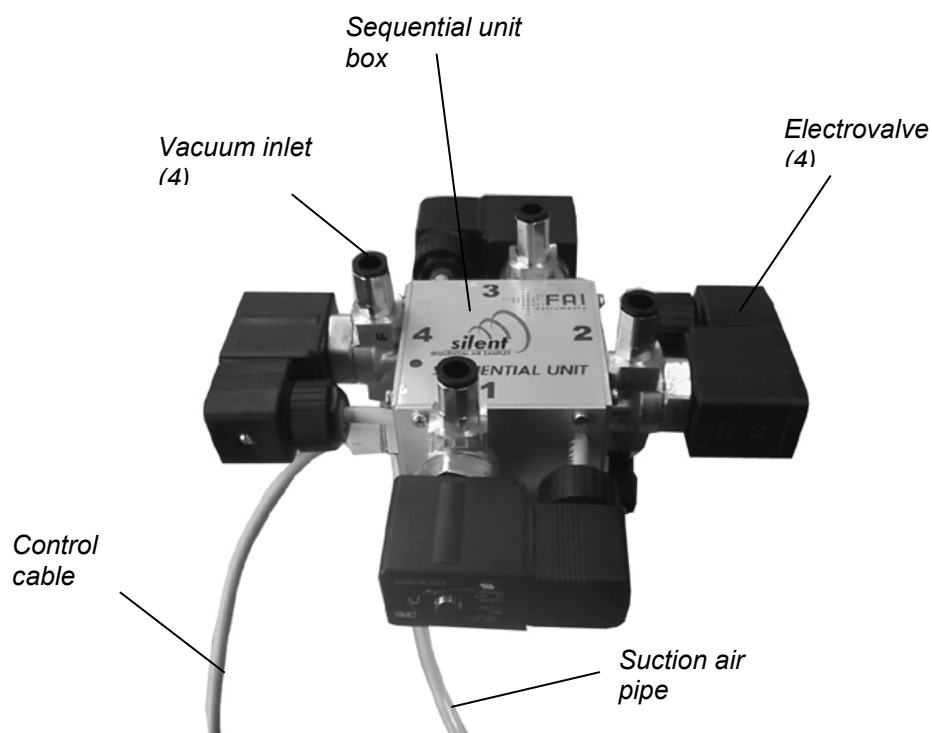


picture 3.3

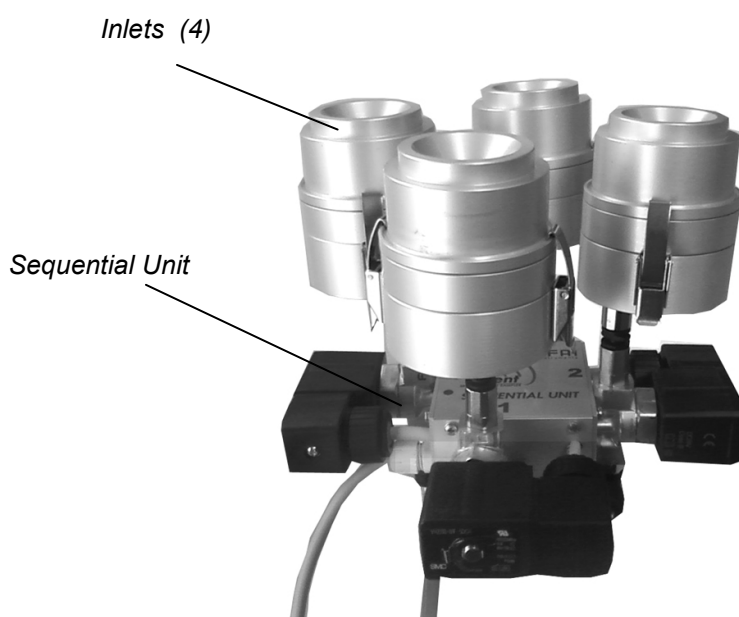
3.2.3 Sequential unit

The sequential unit, connected to the sampling unit, allows the sequential programmable sampling on 4 filters.

The sequential unit can be mounted on a tripod stand for photo cameras.



picture 3.4



picture 3.5

CHAPTER 4

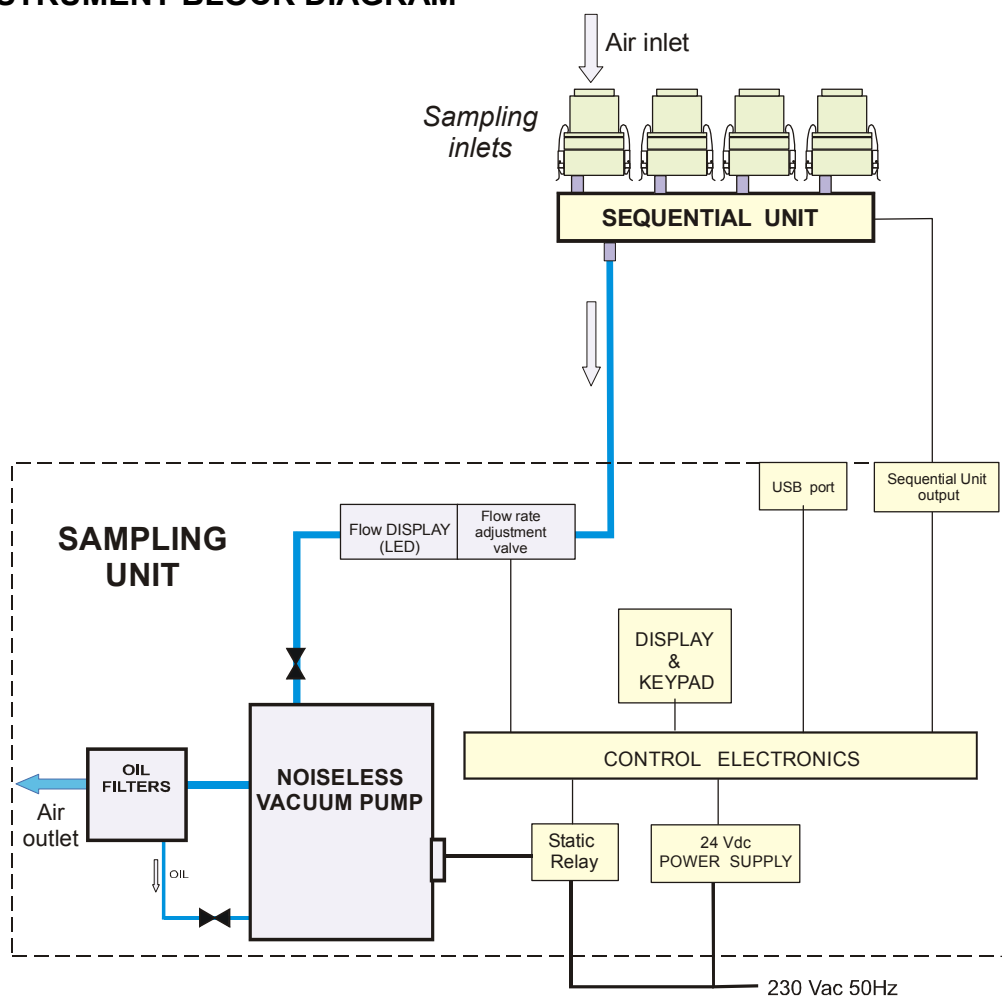
4. INSTRUMENT FUNCTIONAL DESCRIPTION

SILENT Sequential Air Sampler is an automatic system for the suspended particulate matter sequential sampling, on four independent filter membranes.

The technical choices adopted for the instrument **SILENT Sequential Air Sampler** engineering and manufacturing pursued the following important aims:

- To operate noiseless in the indoor environment, without disturbing possible human quiet activities in the area
- To guarantee a wide usage versatility with the possibility of operating in sequence on four independent sampling inlets.
- To guarantee the keeping of the technical specifications, relevant to air quality control for the suspended particulate matter.
- To guarantee a user friendly interface for the operator and for the technical assistance personnel.

4.1 INSTRUMENT BLOCK DIAGRAM



picture 5.1

4.2 TECHNICAL SPECIFICATIONS

Operating flow rate	Adjustable in the range 2 – 12 liter/ min
Flow rate measurement reproducibility	1% of the measured value
Flow rate measurement relative uncertainty	5% of the measured value
Flow rate setting	Manual adjustment with regulation valve moved by a knob
Sampling Inlet	PM _{2.5} at 10 Liter/min (optionally PM ₁₀ at 10 Liter/min)
Standard Filter cartridges accepted	Standard Ø 47 mm filter membranes for collecting PM _{2.5} (or PM ₁₀) particulate matter to be placed in the filter-holder
Additional Filter cartridges accepted	Additional standard Ø 25 mm filter membranes for collecting particulate matter > PM _{2.5} (or PM ₁₀) to be placed on the impactor plate
Filters capacity (installing the Sequential Unit)	No. 4 filter cartridges on four Inlets operated in sequence
Storage capacity	Buffer data with 50 records (battery backed-up)
Power supply	230 V (± 10%) 50 Hz single-phase
Absorbed electric power	300 W
Operating conditions	Indoor environment
Storage conditions	Temperature between - 20 and + 60 °C
Noise level	35 db(A)
Sizes(W x D x H) Sampling unit PM _{2.5} Inlet PM ₁₀ Inlet Sequential unit	175 x 410 x 350 mm Ø 65 x 95 mm Ø 65 x 110 mm 210 x 210 x 115 mm
Weights Sampling unit PM _{2.5} Inlet PM ₁₀ Inlet Sequential unit	17 kg 420 g 500 g 2.1 kg

4.3 SAMPLING CRITERIA

SILENT Sequential Air Sampler samples the suspended particulate matter, using sampling inlets equipped with a granulometric size fractionating device (impactor) operating at a certain constant volume flow rate.

The flow rate is not automatically controlled, but has to be adjusted manually with a valve, looking at the instant flow value indicated by the flow meter integrated with the valve. The flow adjustment has to be performed when the pump has reached steady temperature conditions (see *Flow test procedure Par. 6.8*)

The utilized flow meter is a mass flow meter and indicates the flow converted in volume in standard conditions: 20°C, 1 atm.

The instrument may be currently equipped with PM_{2.5} (or PM₁₀) sampling inlet/s (granulometric cut size value 2.5 µm (or 10 µm) at 10 liter/min volume flow rate).

The operating flow rate value has to be settled accordingly to the sampling inlets characteristics .

The particulate matter is collected on a filter membrane Ø 47mm housed inside the inlet (located below the impactor section), manually loaded before the beginning of the sampling cycle.

To cover a larger sampling program, up to 4 inlets (each one carrying one filters membrane) can be installed in parallel and programmed for cycles in the desired sequence.

At the end of the complete sampling program, or at any intermediate time, after each sampling cycle, the sampled filter/s can be removed from the inlets by the operator for the foreseen analysis.

Note 1: The impactor has to be greased (with Silicon oil) to hold the bigger size particulate matter.

Alternatively a filter membrane 25 mm diameter can be placed on the impactor plane to collect particulate matter of bigger size than PM_{2.5} or PM₁₀

Note 2: Inlets of different cut size values, compatible wit the basic Sampling Unit characteristics, can be supplied by FAI Instruments upon request.

CHAPTER 5

5 INSTALLATION AND STARTING



*During the instrument installation and starting, the operator must carefully follow the safety warnings for use and maintenance and the general **SAFETY** regulations as mentioned in Chapter 2 of his manual.*

5.1. STATE OF SUPPLY

If no different specification is present in the contract/order, the instrument is supplied in a standard commercial packaging and with the following configuration:

Posit.	DESCRIPTION	QUANTIT Y
1.	CD (including User Manual, Sw for buffer data downloading and firmware updating)	1
2.	Sampling Unit	1
3.	Power cord	1
4.	Sampling pipe (3 m)	1
5.	Tripod for sampling Inlet	1
6.	Service filter (for flow meter protection against dirty when testing the instrument without inlet and filter membrane)	1
	Optional items (**)	
7.	Sequential Unit	1
8.	PM _{2.5} sampling Inlet (standard spot area 11.95 cm ²) (each inlet supplied with #2 filter cartridges)	1 or 4
9.	PM ₁₀ sampling Inlet (standard spot area 11.95 cm ²) (each inlet supplied with #2 filter cartridges)	1 or 4
(**) Item supplied as provided for by the supply contract		

5.2 HANDLING AND TRANSPORTATION

Depending on the transport to be used for the delivery, the instrument will be packaged so as to stand up to possible stresses.



At goods receipt verify that no one of the system components has been damaged in transit.

In case of damages, signal it immediately at the conveyer man and note it in the freight paper, then contact FAI Instruments s.r.l.

The movements needed once the packaging has been removed, can be carried out manually, using the handle.

Unpacking the instrument follow these steps:

- Open the chests and take out with care the instrument and its attachments.
- Collect the chests and all the packaging material and keep it for next storages and/or transportations.

5.3 REQUIREMENTS FOR THE INSTRUMENT INSTALLATION

5.3.1 Site pre-requirements

- a) The system must be placed in the room, where the sampling has to be performed, with the electric installation in compliance with the electrical standards in force.
- b) The supply mains socket for the sampling unit connection must be able to supply 230 V 50Hz 1.5A.

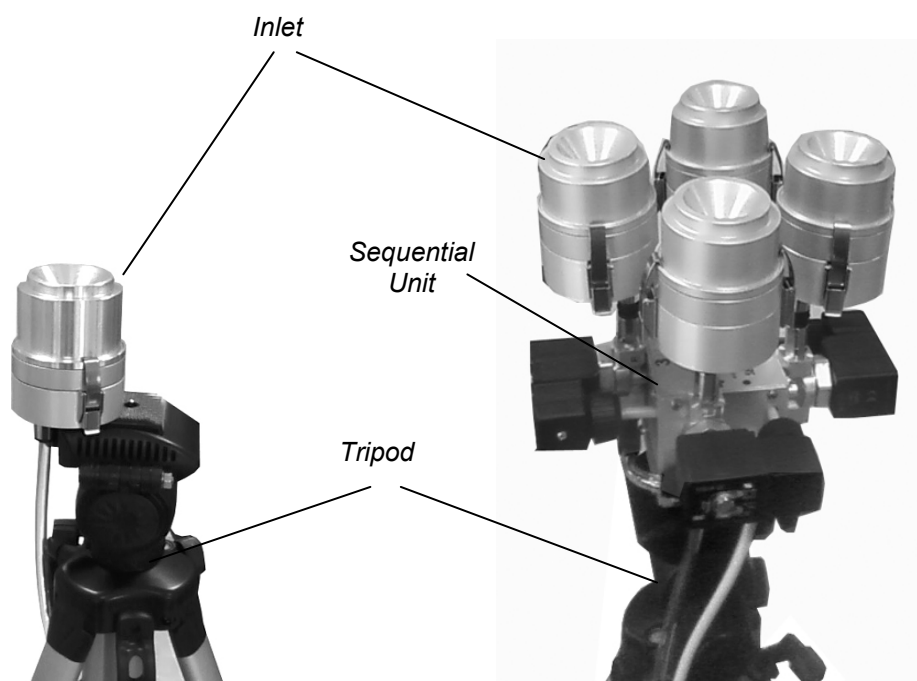
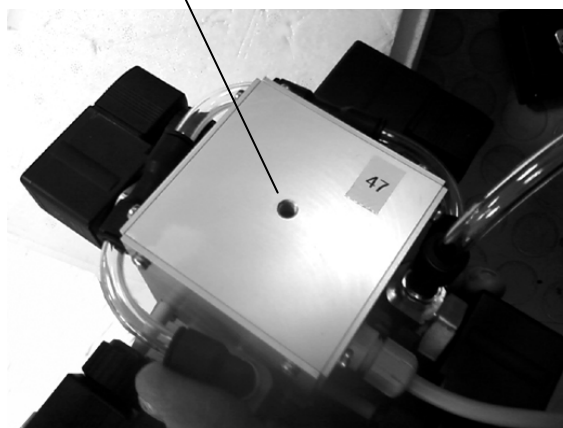
5.3.2 Sampling Inlet/s installation

The sampling Inlet alone or the Sequential Unit carrying 4 Inlets can be installed on a standard camera tripod using its standard fixing screw.

*Inlet
(bottom view)*



*Sequential Unit
(bottom view)*

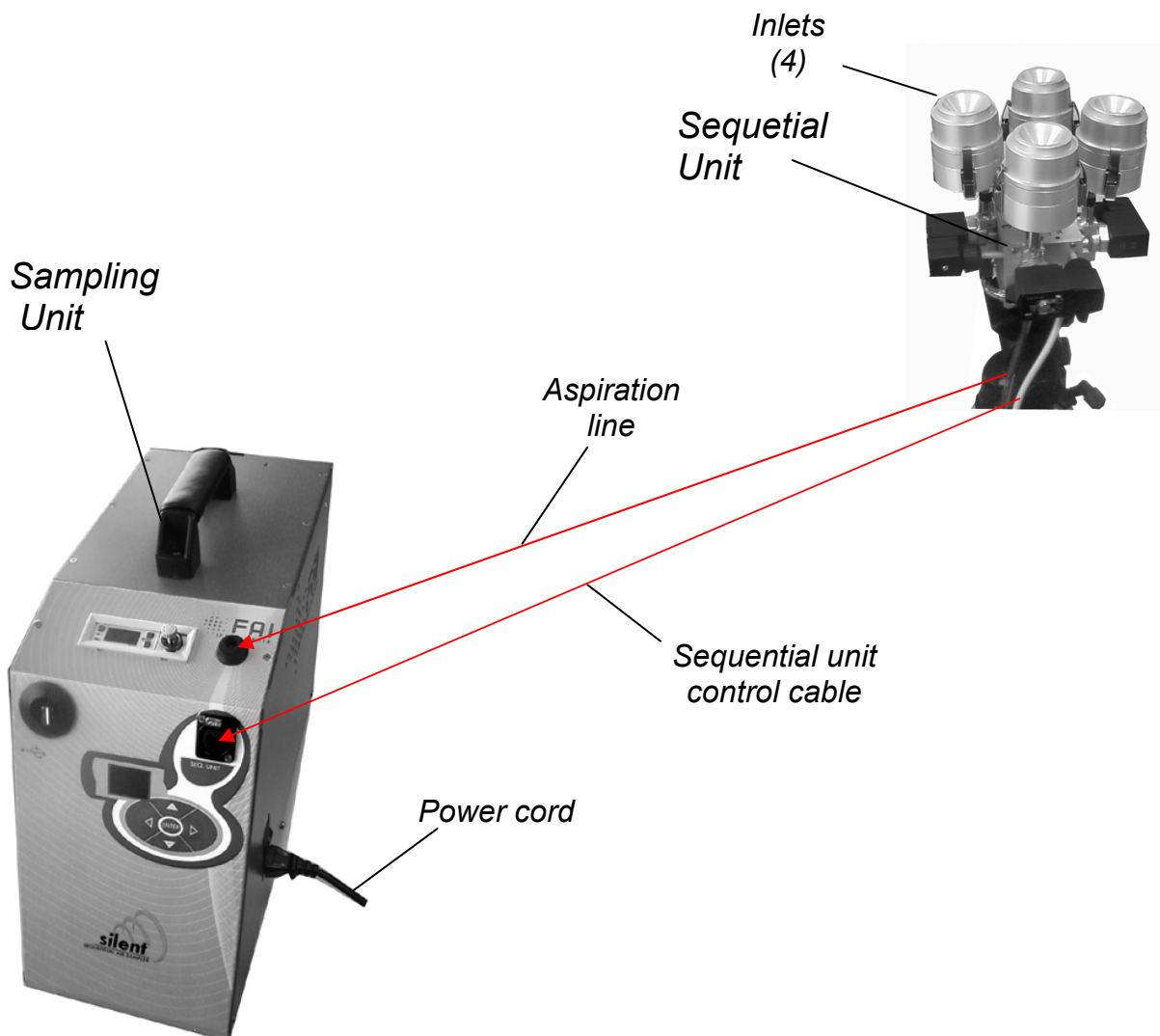


picture 5.1

5.3.3 Sampling Unit installation

The sampling unit must be installed inside the room on a horizontal surface (the floor or a table). It's suitable to leave at least a 15 centimeters space between the instrument lateral panels and the room wall in order to not clog the air inlets and to not limit the ventilation.

The position of the sampler must allow the connection to the sampling tube and the control cable, coming down from the inlet / sequential unit, to the sampler.



picture 5.2

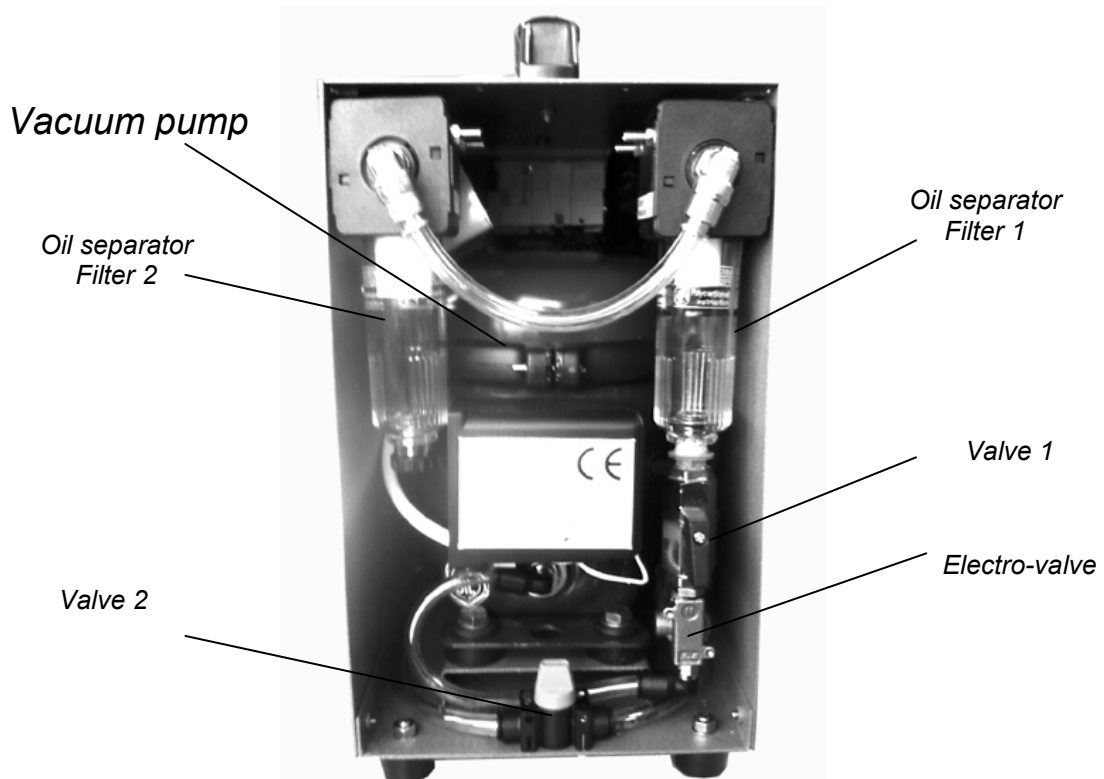


The aspiration line (Ø 8 mm pipe) has to be properly inserted in the two connectors, one on the Sampling Unit and the other on the Sequential Unit (or on the Inlet):

- insert the pipe pushing in deep
- tray to pull back the pipe to verify the effective connection

Note:

To disconnect the pipe, it is necessary, while pulling the pipe, to press the ring of the connector.



picture 5.3

	<i>On the back of the Sampling Unit are visible and accessible the two lubrication oil filters and the relevant collection sumps. The instrument at regular intervals automatically (activating the electro-valve), empties the right sump (filter 1) and discharge the oil back in the pump. The other sump on the left (filter 2) should not collect oil. In case it happens, the operator shall empty the sump (unscrewing the plug) before the oil reaches one half of the level in the sump.</i> <u>Caution:</u> ▪ <i>Empty the sump (unscrewing the plug) before the oil reaches one half of the level in the sump of the filter on the left (filter 2)</i>
	<i>The vacuum pump inside the Sampling Unit contains lubrication oil, to avoid oil leakage during handling and transportation Valve1 and Valve 2 are to be in closed position . The two valves are to be always opened during the instrument operation .</i> <u>Caution:</u> ▪ <i>When the two valves are open, to avoid oil leakage, do not over turn the Sampling Unit</i> ▪ <i>Before starting the instrument remember to open the two valves</i> ▪ <i>Before any transportation remember to close the two valves</i>

5.4 CONNECTION TO AN EXTERNAL PC

For the connection to a PC use the extractable USB cable, on the front panel of the instrument (see picture 5.4).



picture 5.4

A special software program "**SILENT SEQUENTIAL AIR SAMPLER DOWNLOADER**" supplied by FAI Instrument, can be installed in the PC to download the buffer data from the instrument (see Appendix A)

5.5 FILTER MEMBRANES MANAGEMENT

5.5.1 Filter membranes choice

The choice of the filtering mean depends on:

- chemical characteristics depending on the possible need of a particulate matter sample chemical characterization (ion analysis, metals, IPA...)
- mechanical characteristics
- costs

The choice of the filter membrane must result from the best compromise between analytical needs, sampling needs and management costs.

The following standard filter membranes Ø 47mm, of different manufactures, are normally used :

- Fiber glass
- Quartz
- Teflon™

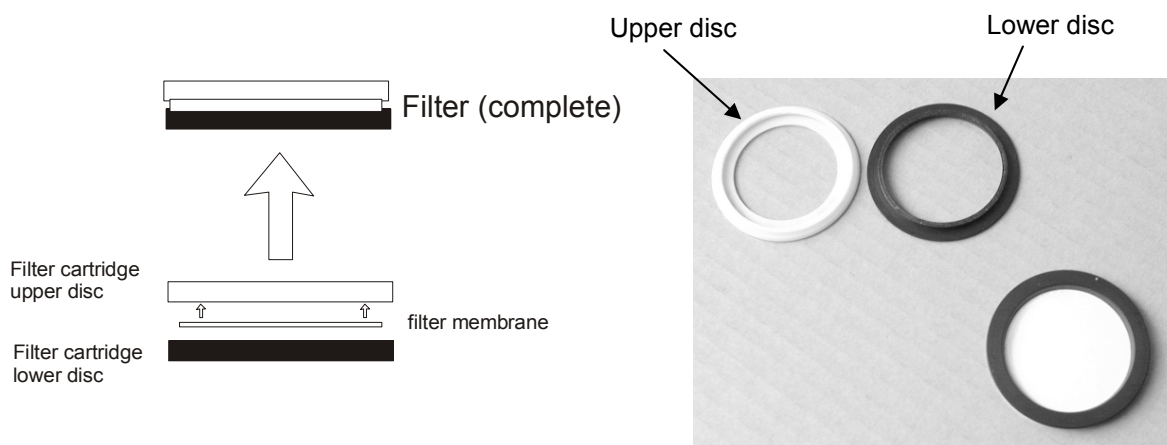


For more specific information, or for the direct supply of filter membranes, contact FAI Instruments Technical Assistance.

5.5.2 Complete filter composition

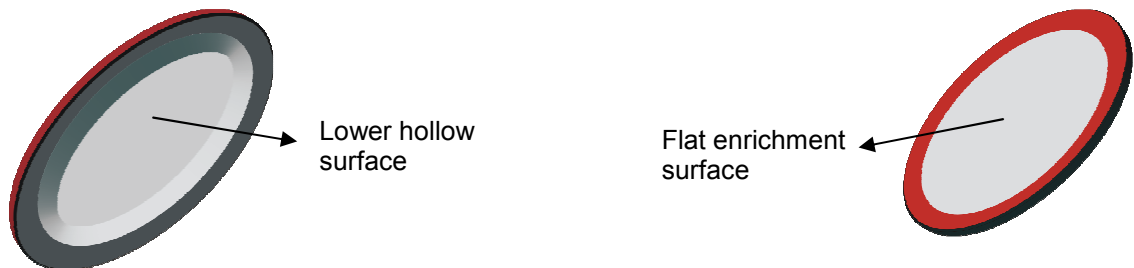
A complete filter is made up of a filter membrane placed in a filter cartridge made up of two circular discs, of two different colors, pressure coupling and keeping inside the filter membrane.

Picture 5.5 shows the complete filter composition.



picture 5.5

The filter membrane must be inserted in the upper disc and the lower disc has to be coupled on the upper disc pressing with the fingers to assure a tight enclosure. Once coupled the two discs, the lower part of the complete filter is hollow (see picture 5.6 and picture 5.7). Inserting the filters inside the Inlet, make sure that the filter cartridge has the hollow part turned downwards.



picture 5.6



picture 5.7



For the filter cartridge correct positioning, the significant element is its shape.

The complete filter must be inserted inside the Inlet with the hollow part turned downwards.

The colour of the filter cartridge discs is not relevant for the filter cartridge positioning inside the Inlet (FAI Instruments supplies filter cartridges with different colour couplings: white-black, red-.black, etc.).

CHAPTER 6

6. OPERATING INSTRUCTIONS



- ❑ **Only personnel trained as “Qualified Operator” can use SILENT Sequential Air Sampler and this personnel is bound to:**
 - verify that the room and the relative arrangement are fitting for the instrument installation/use
 - know in detail all needed operations for the correct use and routine maintenance and all the general safety regulations and the instructions mentioned in this manual
 - do not carry out instrument repairs.

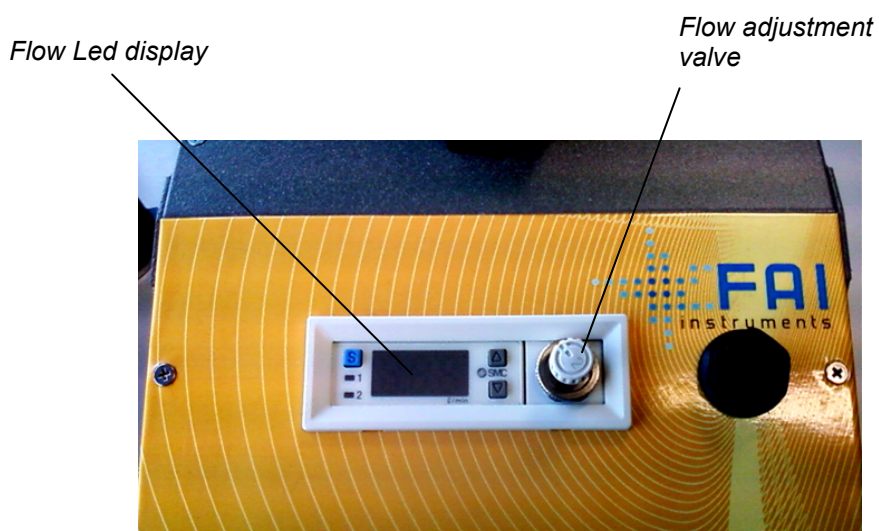
- ❑ **Only “Qualified Technical” personnel, appropriately trained and authorized, can carry out instrument repairs on the basis of detailed technical instructions received in an apposite training course and using original spare parts.**

6.1 INSTRUMENT STARTING & RUNNING



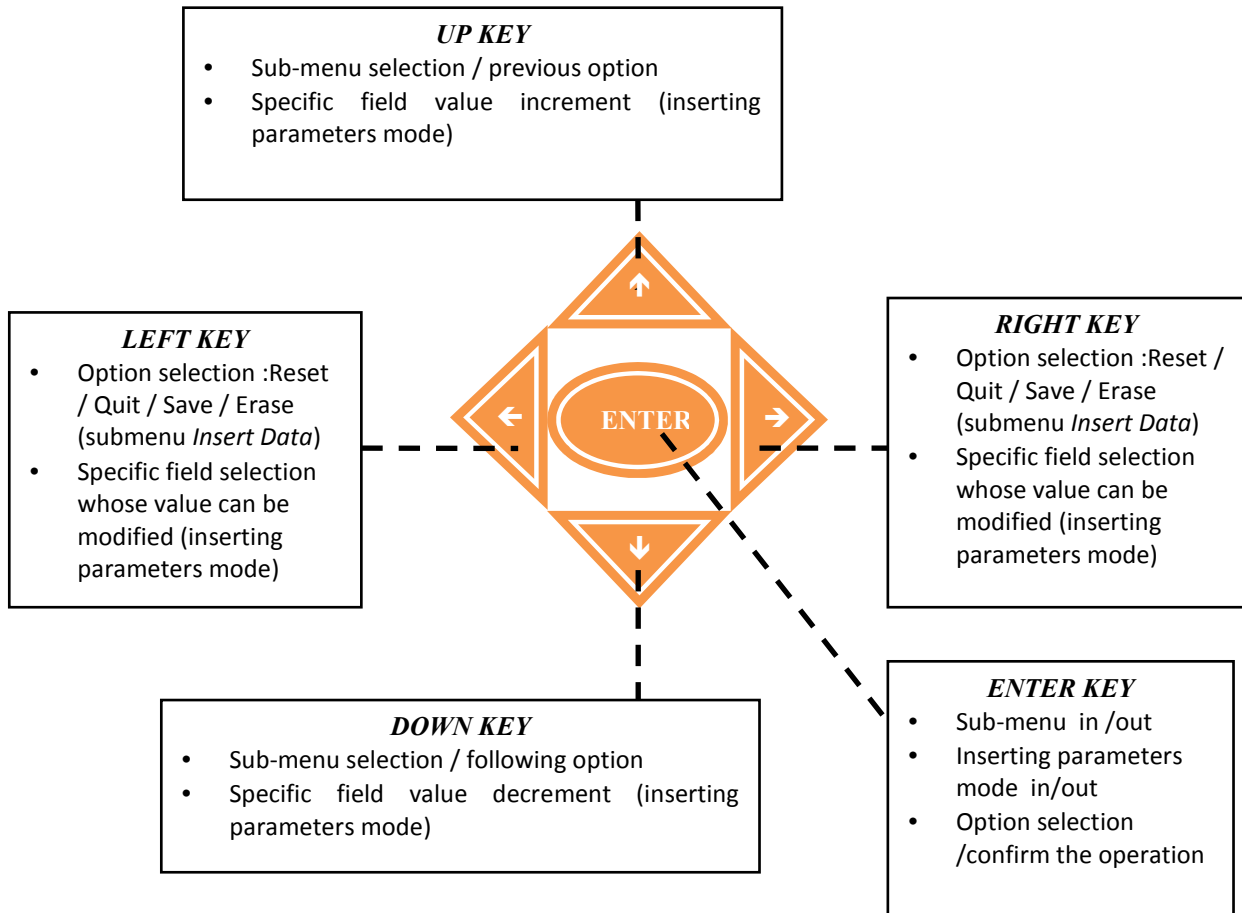
picture 6.1

6.1.1 Digital flow meter

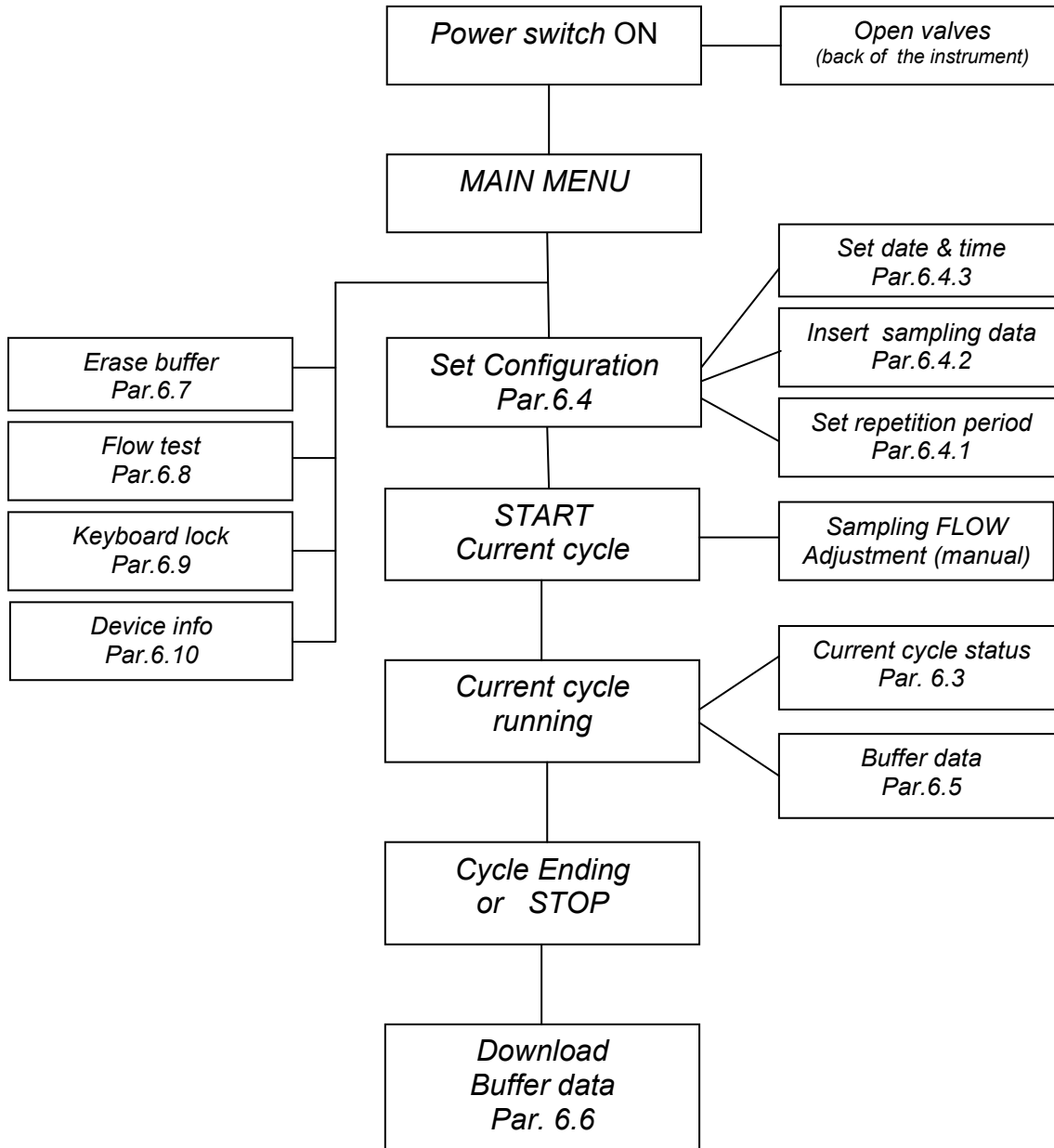


picture 6.1a

6.1.2 Navigation Keypad

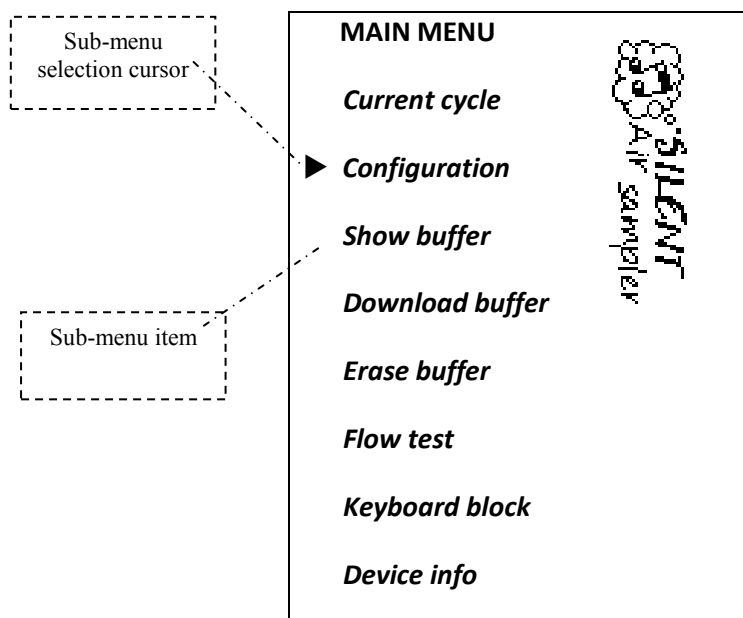


6.1.3 STARTING & RUNNING PROCEDURE



6.2 MAIN MENU STRUCTURE

Switching on the instrument, the FAI Instrument logo appears on the display and immediately after the main menu is presented.



6.3 CURRENT CYCLE SUB-MENU

In Level 1 sub-menu *CURRENT CYCLE* it is possible:

- To show the current date and time
- To show all the information about the running sampling cycle
- To stop the running sampling cycle.

CURRENT CYCLE				<u>ESC</u>
Date		Time		
14/12/11		13:45		
Line	2	Flow	02.05	}
Start	10/12/11		08:00	
Stop	16/12/11		15:20	
Volume	005.230		[cm]	
Status	00000001			
				Stop

There are two possible options selectable with the cursor ____
Pressing **ENTER** :

- **ESC** to go back to the *Main Menu*.
- **Stop** to stop the current sampling cycle

The sampled volume reported in the *Current cycle* sub-menu is updated every minute, while the instant flow is updated every 5 seconds.

In the following table the single field of information, relevant to the cycle in execution; are described.

FIELD	DESCRIPTION																		
LINE	Sampling line identification																		
START	Sampling starting date and time (as programmed)																		
STOP	Sampling ending date and time (as programmed)																		
VOLUME	Total air volume sucked from the start to the visualized instant, in liters [L]																		
STATUS	Information on the sampling cycle Status (Field of 8 Bit) : <table><tr><td rowspan="2">Bit [0] (first on the right)</td><td>1</td><td>In sampling</td></tr><tr><td>0</td><td>Not in sampling</td></tr><tr><td rowspan="2">Bit [1] (second from the right)</td><td>1</td><td>Cycle already concluded</td></tr><tr><td>0</td><td>Cycle not yet concluded</td></tr><tr><td rowspan="2">Bit [2] (third from the right)</td><td>1</td><td>Cycle resumed after a Power Off</td></tr><tr><td>0</td><td>No Power Off during the Cycle</td></tr><tr><td>Bit [3÷7]</td><td></td><td>Reserved fields</td></tr></table>	Bit [0] (first on the right)	1	In sampling	0	Not in sampling	Bit [1] (second from the right)	1	Cycle already concluded	0	Cycle not yet concluded	Bit [2] (third from the right)	1	Cycle resumed after a Power Off	0	No Power Off during the Cycle	Bit [3÷7]		Reserved fields
Bit [0] (first on the right)	1		In sampling																
	0	Not in sampling																	
Bit [1] (second from the right)	1	Cycle already concluded																	
	0	Cycle not yet concluded																	
Bit [2] (third from the right)	1	Cycle resumed after a Power Off																	
	0	No Power Off during the Cycle																	
Bit [3÷7]		Reserved fields																	

NOTE:

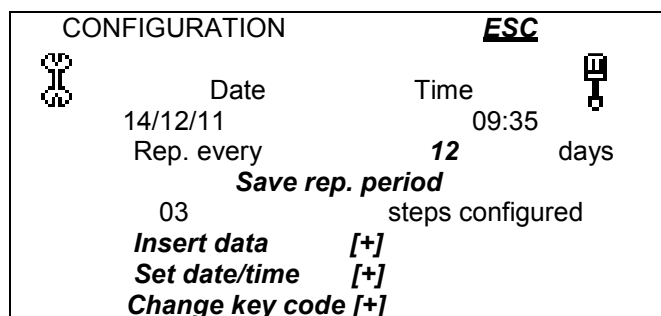
In the field STATUS, Bit [0] will be always 1, and Bit [1] will be always 0, as the given information in this sub-menu is related to a still running cycle .

Different situation will be in the field STATUS of the *Show buffer* sub-menu (see Par. 6.5)

6.4 CONFIGURATION SUB-MENU

In Level 1 sub-menu *CONFIGURATION* it is possible:

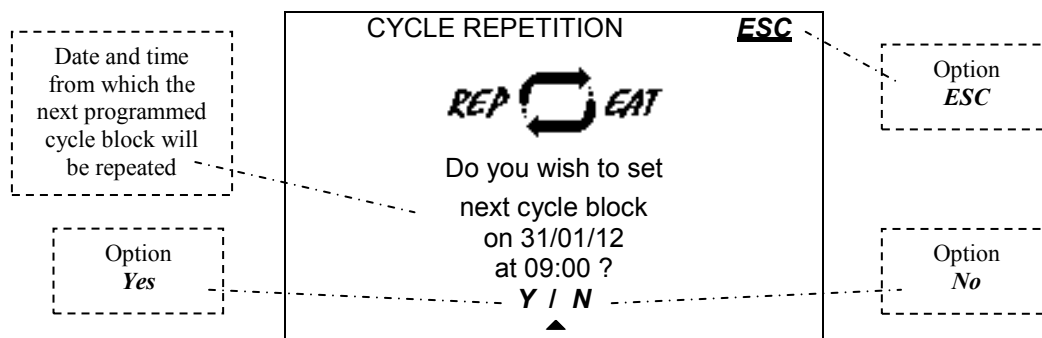
- To show the current date and time
- To show the number of sampling cycles configured/memorized (N_s steps configured)
- To set the repetition period of the configured/memorized group of cycles ($P_d = 0 \div 99$ days)
- To enter the level 2 sub-menu **Insert Data** to configure the individual sampling cycles
- To enter the level 2 sub-menu **Set date/time** to set current date and time of the instrument
- To enter the level 2 sub-menu **Change key code** to modify the keypad lock code.



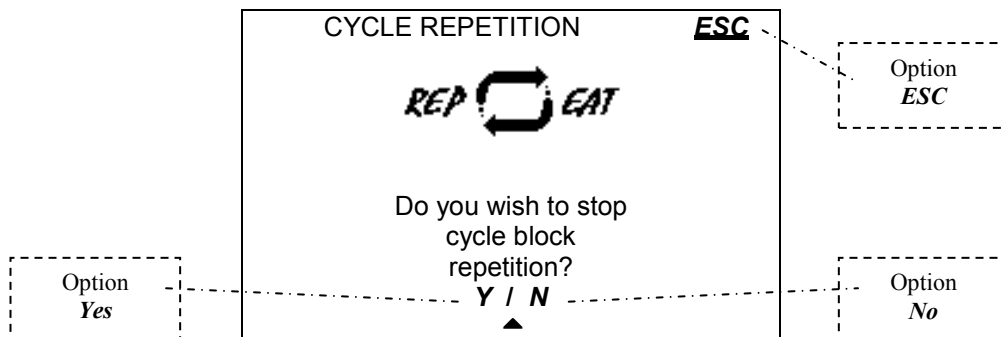
The navigation inside the sub-menu is possible using the buttons UP $\uparrow$ or DOWN $\downarrow$, positioning the cursor $\blacktriangleright$ in the desired position and pressing **ENTER** for the actuation.

6.4.1 Repetition Period

- **Repetition Period (P_d)** to set the number of days ($0 \div 99$ days) after which the sampling cycles group already defined is repeated. The P_d value can be changed using the pushbuttons UP $\uparrow$ or DOWN $\downarrow$, pressing **ENTER** to set the selected value.
- **Save rep. period** pressing **ENTER**, the following screen appears (if $P_d \neq 0$)

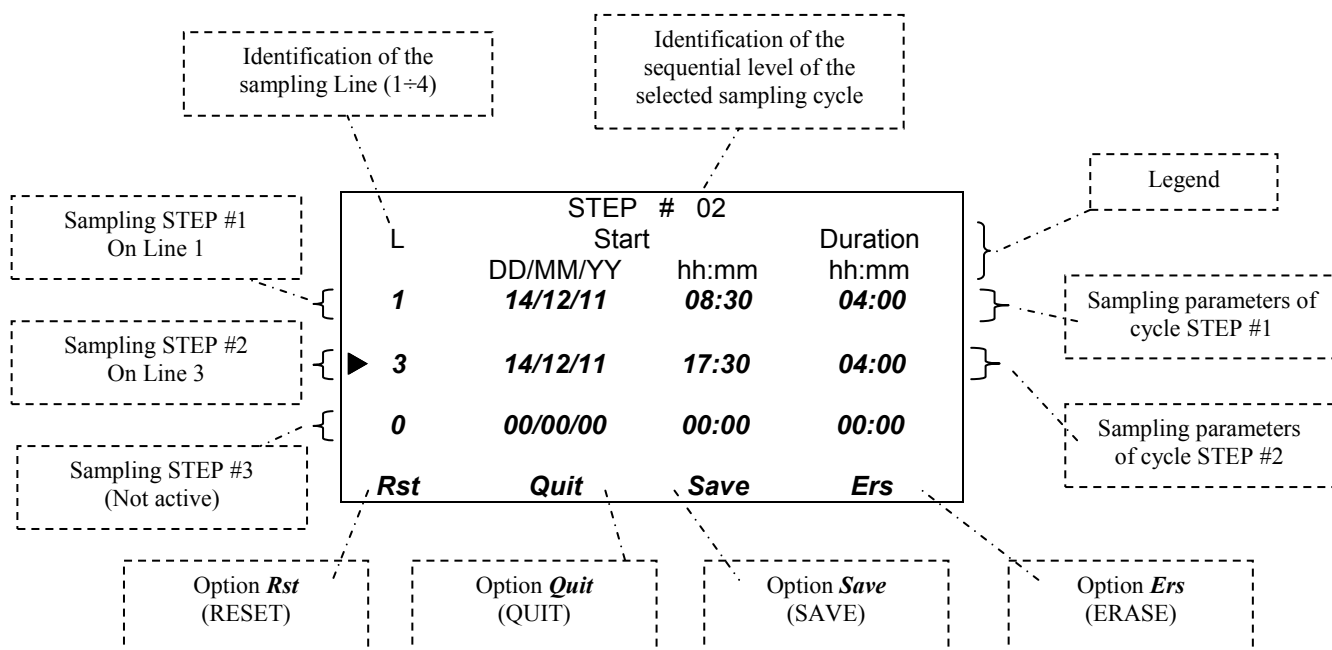


If $P_d = 0$, the following screen appears:



6.4.2 INSERT DATA Sub-menu

The level 2 sub-menu *Insert Data* allows to program the sampling cycles and it has the following structure:



- In the above example, two sampling cycles have been programmed as follows:

Sampling Line	Sampling start date	Sampling start time	Sampling duration
1	14/12/11	08:30	4 ore
3	14/12/11	17:30	4 ore

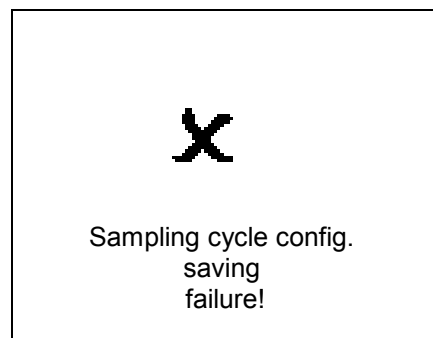
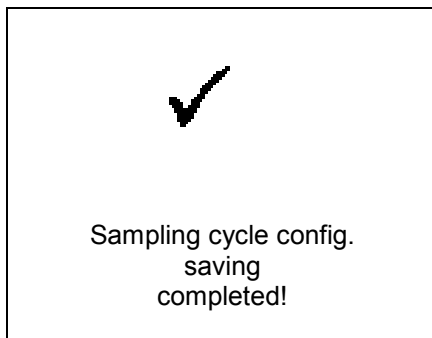
Note: if the programmed cycles are not chronologically coherent between the different steps, it is not possible to save the wrong programming.

The navigation inside the sub-menu is possible

- using the keyboard for positioning the cursor (▶ or ▲) in the desired position
- using the buttons UP ▲ or DOWN ▼, for field value incrementing/decrementing
- pressing **ENTER** for entering the different programming steps.

The following options are possible:

- **Rst** RESET all the parameters to the default value (0)
- **Quit** go back to the **Configuration** upper level menu without saving the parameters
- **Save** Save in the memory all the inserted parameters showing the result of the operation
 - “Sampling cycle config. saving completed”,
 - “Sampling cycle config. saving failure”



Ers ERASE the memory area where sampling parameters are stored, including the repetition period (**P_d**).

Pressing **ENTER** a window appears with the option **Y** (Yes) and **N** (Not), to confirm or cancel the operation. If confirmed, the result of the operation is shown:

At the end of the ERASE operation showing the result of the operation

- “Sampling cycle config. erasing completed”
- “Sampling cycle config. erasing failure”

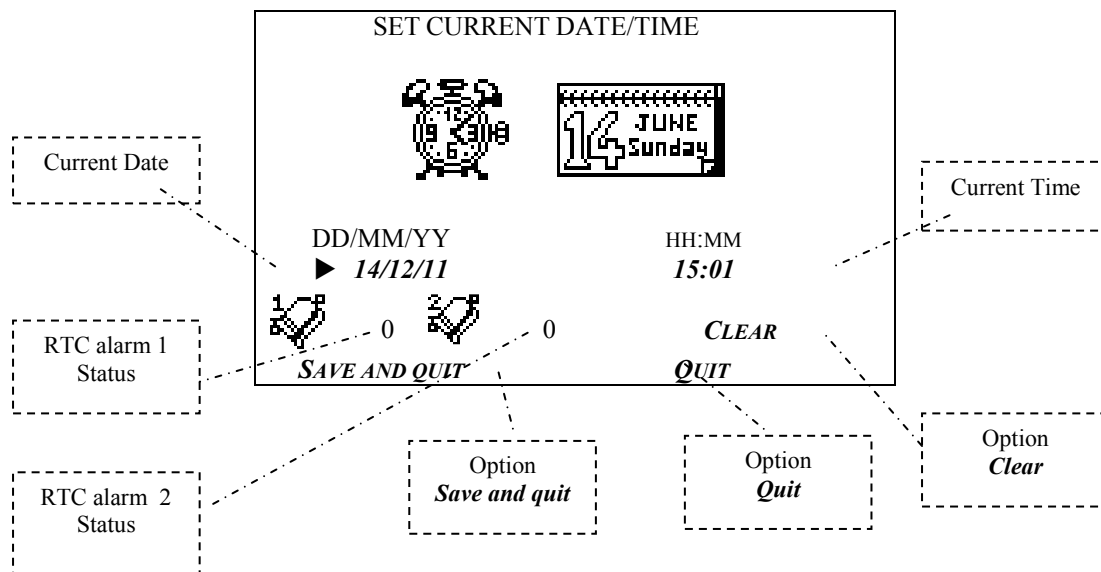
If a sampling cycle is active, the relevant configuration (marked in light gray) will not be erased

6.4.3 SET DATE/TIME Sub-menu

The level 2 sub-menu *Set date/time* allows :

- To set current date and time;
- Check/reset RTC alarms status.

The sub.menu has the following structure:



Below the date and time row, RTC alarm status is shown corresponding to the starting time and to the ending time of a sampling cycle.

The navigation inside the sub-menu is possible :

- using the keyboard for positioning the cursor (▶ or ▲) in the desired position
- using the buttons UP ▲ or DOWN ▼, for field value incrementing/decrementing
- pressing **ENTER** for entering the selection.

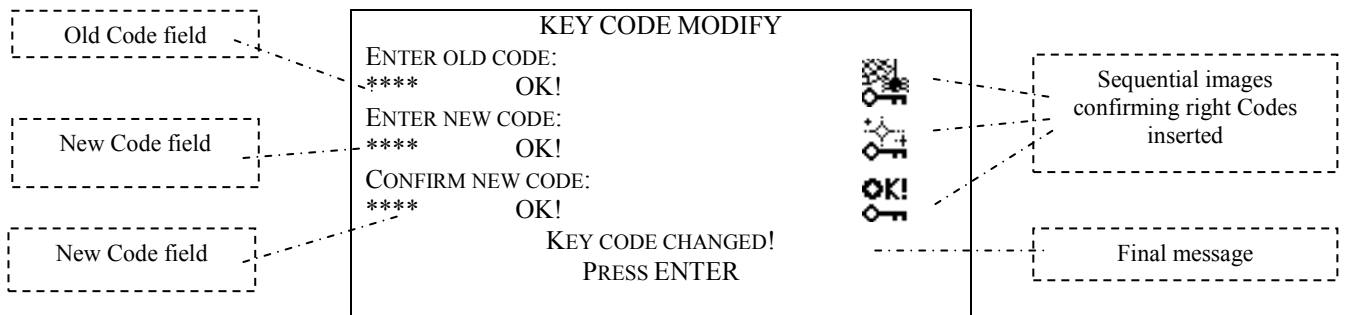
The following options are possible:

- **Clear** RTC alarms are reset to 0.
- **Save and quit.** Date and Time are setted and the results of the operation are shown:
 - “Current date/time setting completed”
 - “Current date/time setting failure”)
- **Quit** go back to the Configuration upper level menu without modifying date and time

6.4.4 CHANGE KEY CODE Sub-menu

The level 2 sub-menu *Change key code* allows to modify the code to unlock the keypad, eventually to be done having locked the keypad with the sub.menu *Keyboard block*

The sub.menu has the following structure:



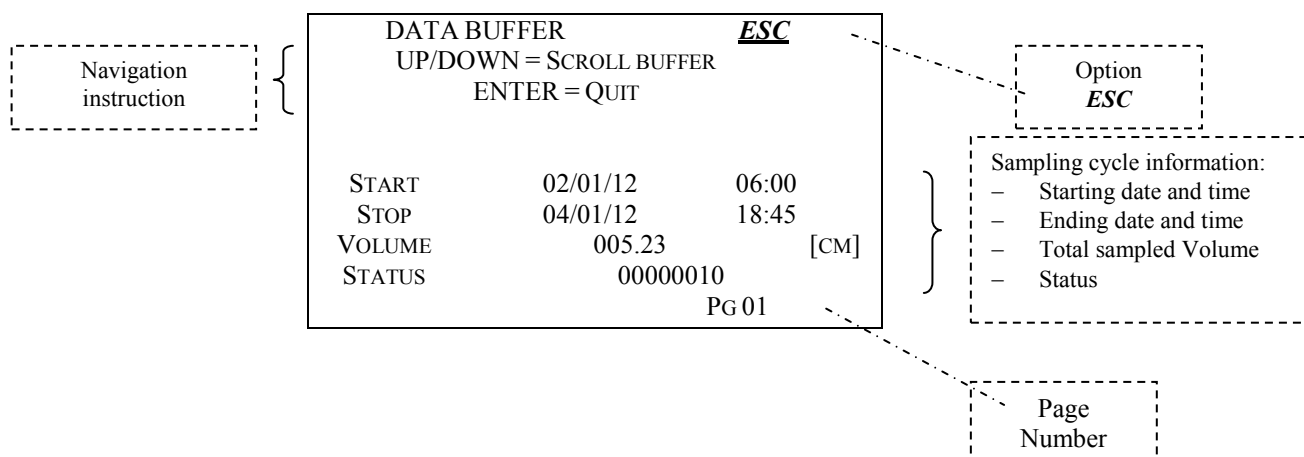
Pressing **ENTER** go back to the Configuration upper level menu.

If a new Code has been inserted, the program ask for the new code.

6.5 SHOW BUFFER SUB-MENU

In Level 1 sub-menu *SHOW BUFFER* it is possible to show the memorized data of each sampling cycle already concluded.

The sub-menu has the following structure:



Buttons UP ↑ and DOWN ↓, allow to scroll the pages in sequence (up to 50 pages). Every page has the data relevant to a specific cycle .

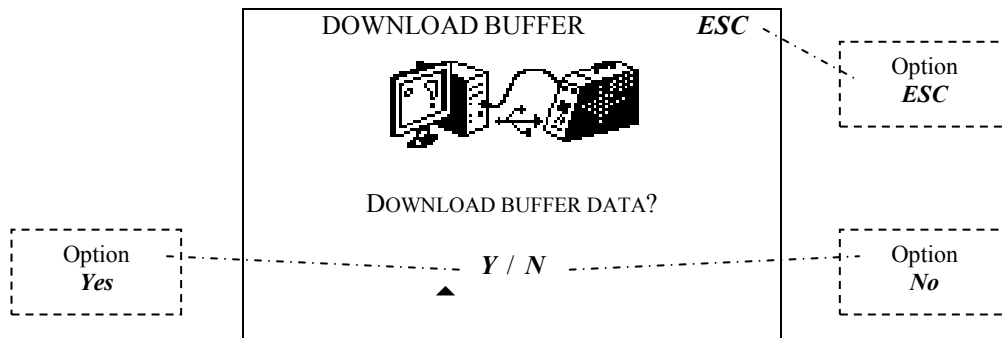
Buttons LEFT ← and RIGHT → allow to jump 10 pages at once.

Press **ENTER** on the option *ESC* to go back to the Main menu.

6.6 DOWNLOAD BUFFER SUB-MENU

In Level 1 sub-menu *DOWNLOAD BUFFER* it is possible to download the buffer utilizing the USB port of the instrument.

The sub-menu has the following structure:



The navigation inside the sub-menu is possible :

- using the buttons **LEFT** ← or **RIGHT** → for positioning the cursor (▲ or _) in the desired position
- pressing **ENTER** for entering the selection.

Press **ENTER** on the option :

- **ESC** to go back to the **Main Menu**.
- **Y** to download the buffer data to a PC connected with the USB port of the instrument. (See NOTE 1)

At the end of the download the results of the operation are shown:

- “Buffer data downloading completed”
- “Buffer data downloading failure”, going back to the **Main Menu**
- **N** to skip the download, going back to the **Main Menu**.

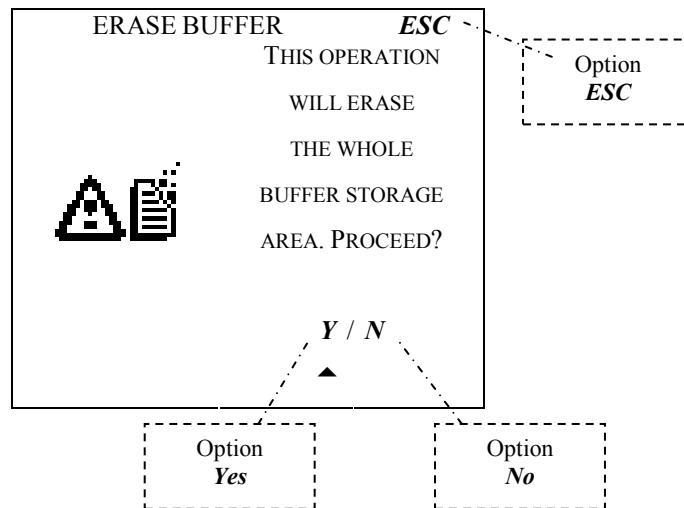
NOTE 1:

On the PC it is necessary to install and open the FAI Instrument software application “*Silent Sequential Air Sampler Downloader*”, supplied on a CD with the instrument (see instructions in **Appendix A**).

6.7 ERASE BUFFER SUB-MENU

In Level 1 sub-menu *ERASE BUFFER* it is possible to cancel the buffer data containing all the information related to the sampling cycles already performed and concluded.

The sub-menu has the following structure:



The navigation inside the sub-menu is possible :

- using the buttons LEFT  or RIGHT  for positioning the cursor ( or ) in the desired position
- pressing **ENTER** for entering the selection.

Press **ENTER** on the option:

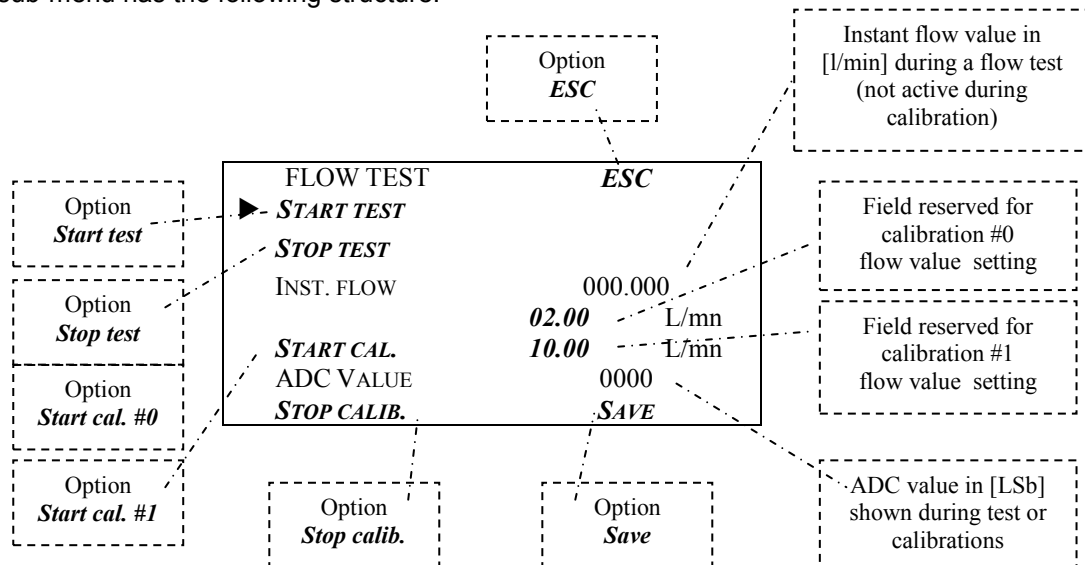
- **ESC** to go back to the *Main Menu*.
- **Y** to erase the buffer data
At the end of the cancellation, the results of the operation are shown:
 - “Buffer data erasing completed”
 - “Buffer data erasing failure”, going back to the sub-menu *Erase buffer*
- **N** to avoid the cancellation, going back to the sub-menu *Erase buffer*.

6.8 FLOW TEST SUB-MENU

In Level 1 sub-menu *FLOW TEST* it is possible :

- To run a flow verification test comparing the value shown by the instrument on its main display, with the one manually adjusted on the flow valve and readable on its flow meter
- To calibrate the instrument setting and storing the calibration values for the A/D converter (with these values successively the instant flow will be calculated in [L/min] and consequently will be calculated the total air volume in [m³] sucked by the instrument)

The sub-menu has the following structure:



The navigation inside the sub-menu is possible :

- using the buttons UP $\uparrow$ or DOWN $\downarrow$, for positioning the cursor ($\blacktriangleright$ or $__$) in the desired position
- pressing **ENTER** for entering the selection.

The following options are possible:

- **Start test.** Sampling on the line #1 starts and the instant air flow value in [L/min], red by the instrument, is shown in the field *Inst. flow*
- **Stop test.** Sampling on the line #1 stops
- **Start cal. #0.** Calibration for φ_0 flow value starts and the numerical sample calculated by the A/D converter is shown in the field *ADC Value* in [LSb].
- **Start cal. #1.** Calibration for φ_1 flow value starts and the numerical sample calculated by the A/D converter is shown in the field *ADC Value* in [LSb].
- **Stop calib.** Calibration action is completed
- **Save.** Calibration parameters are fixed in the instrument memory
- **Fields for calibration flow values setting (φ_0 φ_1)**
Pressing ENTER it is possible to insert the desired values : using the buttons UP $\uparrow$ or DOWN $\downarrow$ for flow value increasing or decreasing from a minimum of 0.0 [L/min] to a maximum of 25.0 [L/min], in step of 1.0 [L/min]. Press ENTER again, to exit the field.

The flow verification test allows to compare the value shown on the flow meter (taken as reference) with the value shown by the instrument and utilized for the sampled air total volume calculation.

The calibration allows to minimize the difference between the two values. It is recommended, to avoid erroneous air volumes calculations, to calibrate the instrument before any sampling cycle program takes pace.

The calibration defines a couple of points $P_0 = (\varphi_0, \gamma_0)$ and $P_1 = (\varphi_1, \gamma_1)$, through which passes the straight line that describe mathematically the relation between the numerical sample of the A/D converter and the instant air flow.

The calibration procedure is as follows:

- Set the first calibration point (flow value φ_0 in [l/min] for calibration #0)
- Start the calibration with **Start cal** and manually adjust the flow valve on the flow value φ_0
- Wait at least 5 seconds to allow to the instrument the correct reading of the flow. The corresponding value read by the A/D converter (γ_0 , in [LSb]) is shown in the corresponding field
- Finish the calibration of the first point with **Stop calib**
- Set the second calibration point (flow value φ_1 in [l/min] for calibration #1); it is not necessary to use a bigger value with respect to the first calibration point #0
- Start the calibration with **Start cal** and manually adjust the flow valve on the flow value φ_1
- Wait at least 5 seconds to allow to the instrument the correct reading of the flow. The corresponding value read by the A/D converter (γ_1 , in [LSb]) is shown in the corresponding field
- Finish the calibration of the second point with **Stop calib**
- Save the calibration parameters with **Save**



- *The mass flow decreases of about 10 % when the pump has warmed up to steady temperature conditions with respect to the ambient temperature. Operating the pump when the pump is close to the ambient temperature, the flow value adjustment should be increased of 10 % (see Note 1)*
- *To avoid flow meter damage due to unfiltered air flow, don't run the instrument without filters (see Note 2)*

NOTE 1:

*It is possible to warm up the instrument outside a sampling cycle entering the **Start test** option of the **TEST FLOW** menu*

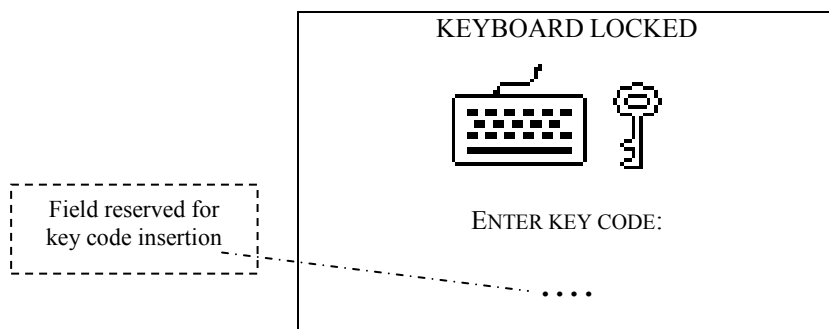
NOTE 2:

To avoid the squandering of operative filter membranes (installed in the Inlet), the Service Filter supplied with the instrument may be used, connecting it at the input of the instrument in place of the Inlet line.

6.9 KEYBOARD BLOCK SUB-MENU

In Level 1 sub-menu *Keyboard block* it is possible to prevent not authorized personnel to operate the instrument, locking the navigation through the keypad. Anyway the programmed sampling cycle sequence continues.

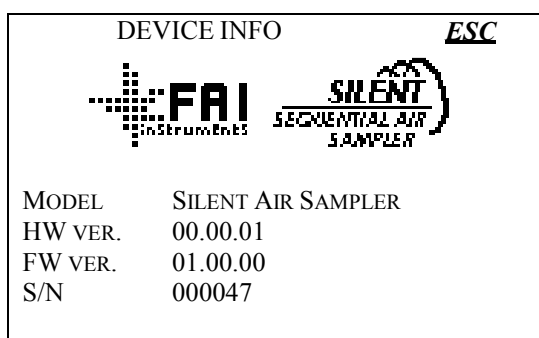
Restoration of navigation functionality may be obtained inserting the default key code or the code previously inserted by the user in the sub-menu *Change key code*.



6.10 DEVICE INFO SUB-MENU

In Level 1 sub-menu *Device info*, the information strictly related to the instrument is presented:

- Model name
- Hardware Version
- Firmware Version
- Serial Number of the instrument



The only option shown is *ESC*.

Press **ENTER** to go back to the *Main Menu*.

CHAPTER 7

7. MAINTENANCE



The maintenance interventions must be carried out only by qualified personnel, considering general warnings specified in Chapter 1 of this manual.

The instrument maintenance is subdivided into Routine preventive maintenance and Repairs:

- a. routine preventive maintenance must be carried out by control and maintenance trained personnel entrusted with the instrument.
- b. maintenance repairs can be carried out by technical personnel trained for the assistance, or by the technicians of the FAI Instrument s.r.l. Technical Assistance Service (see section 8.2 - Repairs).

7.1 ROUTINE PREVENTIVE MAINTENANCE

To preventive maintenance belongs the routine system management, including surveillance and cleaning operations, and all the checks that the operators will perform during the normal instrumental operating cycle.

Recommended check and preventive maintenance interventions are listed in the table below:

Intervention type		Recurrence
1	Sampling inlets cleaning and greasing	Every sampling session
2	Check filter cartridges status	Every 100 working hours
3	Substitute filter cartridges	Every 1000 working hours
4	Pump Oil level check and eventual refilling	Every 1000 working hours
3	Measurements quality tests and checks	Yearly

The instrumental operating conditions may be very different in time. Therefore we recommend to carry out the interventions at intervals fitting to the real use conditions, considering the recurrences of the table above as an indicative reference.

7.2 REPAIRS



Maintenance repairs must be carried out only by qualified Technical personnel (see Chapter 1 of this manual).

With repairs we mean the interventions needed to go back to the normal instrument running conditions after failures.



Maintenance repairs can be carried out only by:

- **Qualified Technician** who can carry out instrument maintenance repairs on the basis of detailed technical instructions received during apposite training course
- **FAI Instruments s.r.l. Technical Assistance Service**
- **Authorized technical assistance center**



Instrument modifications and transformations are prohibited. In case of modifications and transformations the user must take full responsibility for all possible resulting consequences.

In case of modifications, we recommend to contact the manufacturer in order to keep the guarantee validity.

7.3 POSSIBLE ANOMALIES AND RELATIVE SOLUTIONS

The table below sums up in a scheme the intervention modalities and some typical hitches.

ANOMALY	POSSIBLE CAUSE	SOLUTION
The instrument doesn't switch on	The instrument is not correctly powered	Check the socket and the power cord Check the fuses and if needed replace them
The instrument doesn't keep date and time	Internal battery not charged (it may happen after a long not operating period)	Wait some time after the switch ON, to allow battery recharging
	Exhausted internal battery	Apply to technical assistance
The instrument does not communicate with the PC	Connection cable or PC malfunction	Verify the connection between the instrument and the PC USB port
Instrument - PC communication problems	Wrong interface program setting on the PC	Verify that the PC setting is correct (as detailed in the procedure given in Annex 1 of the Manual)

7.4 INSTRUMENT OUT OF SERVICE

At the end of the instrumental operating life, it's necessary to get rid of it without causing dangers for the people and without damaging the environment

7.4.1 Temporary storage

The instrument, if possible in its original packaging, must be stored indoors, in horizontal position, no other weights must rest on it.

The storage temperature must be kept between - 10 and + 60 °C in order to avoid damages to the parts in synthetic material and to the electronics.

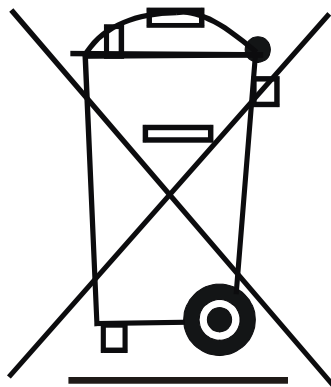
The storage relative humidity value is not important, as long as there is no condensation.

7.4.2 Disposal

In case of instrumental final dismantling, disassemble it selecting the materials depending on their type. The main components that can be disassembled are:

- Various metallic materials (aluminum, carbon and stainless steel, copper)
- Plastic materials
- Electric and electronic components
- Elastomers
- Batteries

The wreckage must be committed to specialized firms, depending on its type and dangerousness, in conformity with current regulations. If possible, the material must be recycled.



CHAPTER 8

8. APPENDICES

Appendix A	SILENT SEQUENTIAL AIR SAMPLER DOWNLOADER -- SOFTWARE FOR EXTERNAL PC

Appendix A

SILENT SEQUENTIAL AIR SAMPLER DOWNLOADER SOFTWARE FOR EXTERNAL PC

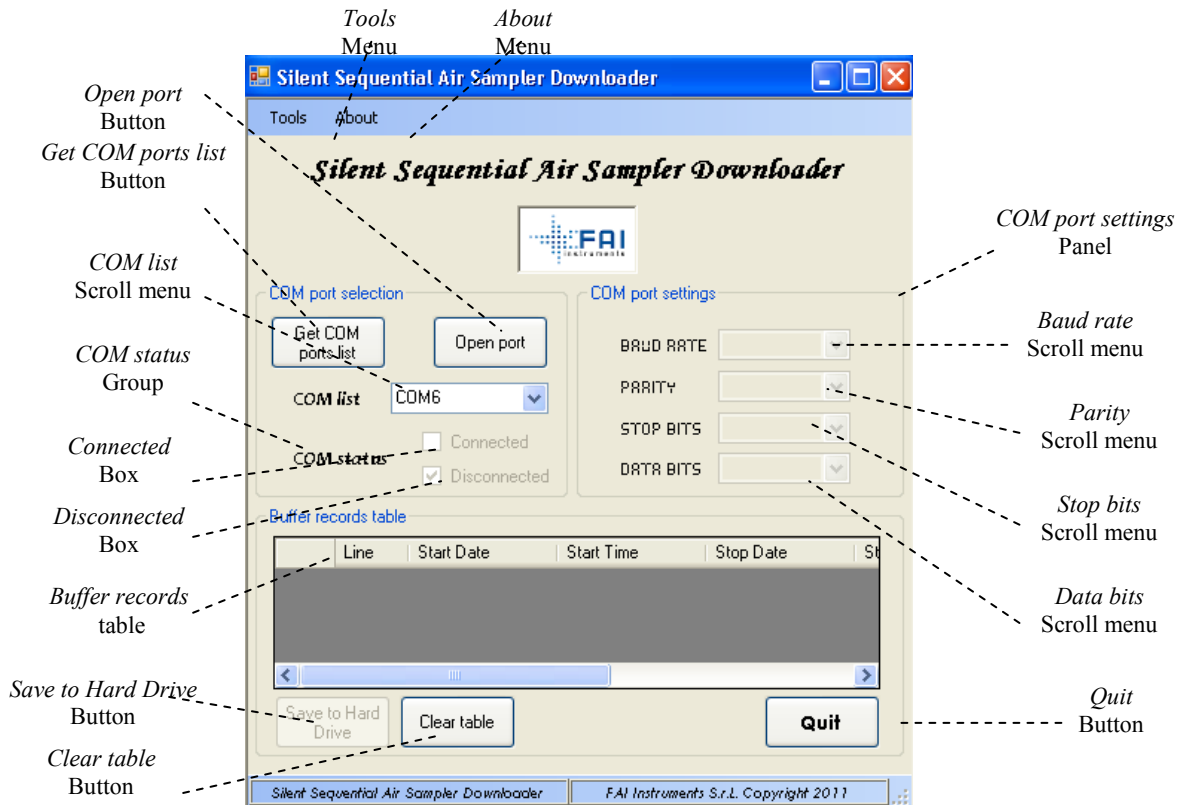


Fig. 1. Silent Sequential Air Sampler Downloader graphical user interface.

SOFTWARE INSTALLATION REQUIREMENTS

- The *Silent Sequential Air Sampler Downloader* GUI application, and the Microsoft .NET Framework version 4 library package as well, can both run under the following operative systems:
 - Windows 7;
 - Windows Server 2008;
 - Windows Vista family;
 - Windows XP Home or Microsoft Windows XP Professional, both with Service Pack 3 or later versions installed;
 - Windows Server 2003, with Service Pack or later versions installed;
- Check first if Microsoft .NET Framework library package (version 4 as minimum) is currently installed onto local machine; in order to do this, open a command prompt console and digit *regedit* to open the Windows registry dialog;
- Locate the following registry sub-key:


```
HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\NET Framework Setup\NDP\v4\Full
```

 and check the value of the *Install* field: if it's set to 0, the Microsoft .NET Framework version 4 is not currently installed onto local machine; it is thus required to run the executable file *dotNetFx40_Client_x86.exe*, contained within the CD-Rom delivered with the instrument;
- Follow now the steps illustrated within the installer dialog;

- It is also required the installation of the Microsoft Visual C++ 2010 Redistributable library packag, by launching the executable file *vcredist_x86.exe*, contained within the CD-Rom delivered with the instrument;
- Follow now the steps illustrated within the installer dialog.

USB CONNECTION WITH SILENT SEQUENTIAL AIR SAMPLER DEVICE

1. Connect the instrument USB cable to one of the USB ports currently available on the local machine: the Windows plug'n'play drivers manager will immediately execute;
2. Wherever the local machine shouldn't be shipped with the FTDI drivers used for USB communication, open *Device Settings* located within *Windows Control Panel*;
3. Three unknown peripherals (marked with a yellow "!" icon) will be present under the *Other Peripherals* tree view, namely *Stellaris Evaluation Port A*, *Stellaris Evaluation Port B* and *Stellaris Virtual COM Port*;
4. Click twice on each of the above listed unknown peripheral and, within the pop-up dialog, click on *Update driver*;
5. Skip the Windows Update connection option, select the *Find drivers from specific folder* option, uncheck the *Find drivers from removable media* option and check instead the *Include the following path* option;
6. In the shown dialog, click on *Browse*, select the *Stellaris_FTDI_Drivers* folder located within the CD-Rom and click on *Next*: the driver manager will install the correct drivers for the selected peripheral;
7. Repeat steps #5 and #6 for each of the above listed peripherals;
8. The local machine is now able to communicate with the instrument via USB: locate the *LPT and COM ports* tree view within the *Device Settings* dialog and check for the specific COM port number by which the operative system designated the *Stellaris Virtual COM Port* I/O stream.

DOWNLOAD OF BUFFER DATA

1. Connect, if it hasn't been done yet from the previous process *USB Connection with Silent Sequential Air Sampler Device*, the instrument USB cable to one of the USB ports currently available on the local machine;
2. Click on *Get COM ports list* button to list the whole serial ports (physical and virtual) currently available on the local machine;
3. Select the COM port on which the *Stellaris Virtual COM Port* is present and whose number should have been checked in the previous process *USB Connection with Silent Sequential Air Sampler Device* at step #8;
4. Click on *Open port* button: on success, the *Connected* box within the *COM status* group will appear checked and the following message will be shown:



Fig. 2. COM port correctly opened pop-up message.

5. The default COM port settings (Baud rate = 9600 [bps], Parity = None, Stop bits = 1 [bit], Data bits = 8 [bit]) will be shown in the corresponding lists within the *COM port settings* panel and they don't need any modifies;

6. To proceed with the download of instrument buffer data, enter the instrument *Download buffer* submenu, select, by using the ◀ / ▶ arrow buttons, the *Y* option and press ENTER: on success, a feedback message will appear onto the instrument display and the following pop-up message will be also shown:

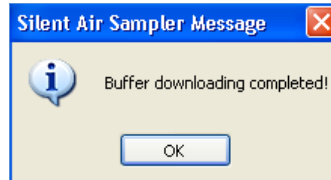


Fig. 3. Buffer data correctly downloaded onto local machine pop-up message.

7. The *Buffer records* table will be automatically filled with the data records currently contained in the instrument Flash memory: each record field in the table may be checked by using its scroll bars;
8. To export the current table to a text file, click on *Save to Hard Drive* button: the following pop-up dialog window will be shown:

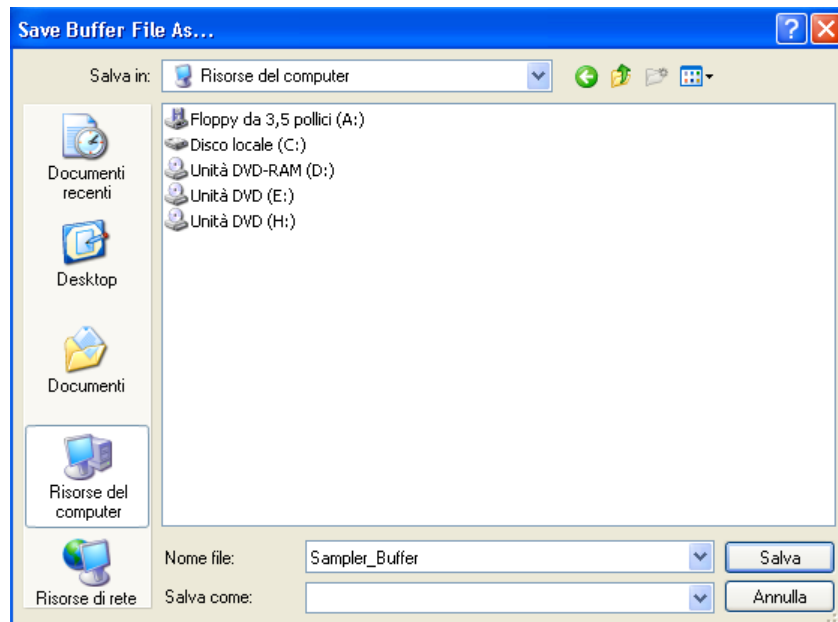


Fig. 4. Saving buffer data to text file dialog window.

Change the file name (if the default one *Sampler_Buffer* shown isn't desired), select the destination folder and click on the *Save* button; on success, the following message will be shown:

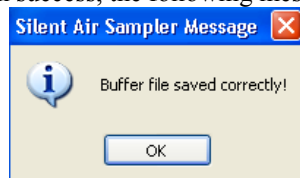


Fig. 5. Saving buffer data to text file process correctly completed pop-up message.

9. To clear the current table, just click on the *Clear table* button.
10. Wherever needed, for any convenience or particular cases (as in the firmware upgrading procedure, just like described in the following), close the USB communication on the actually opened COM port by clicking the *Close port* button;
11. Finally, to close the application, click on the *Quit* button.

FIRMWARE UPGRADING

1. Connect, if it hasn't been done yet from the previous process *USB Connection with Silent Sequential Air Sampler Device*, the instrument USB cable to one of the USB ports currently available on the local machine;
2. If a previous download of the buffer data should have been done and the COM port, on which the local machine and the instrument were communicating, shouldn't have been closed yet, close the COM port by clicking on the *Close port* button;
3. Click on *Tools* menu and select the *LM Flash Downloader* submenu; the following pop-up dialog window will be shown:

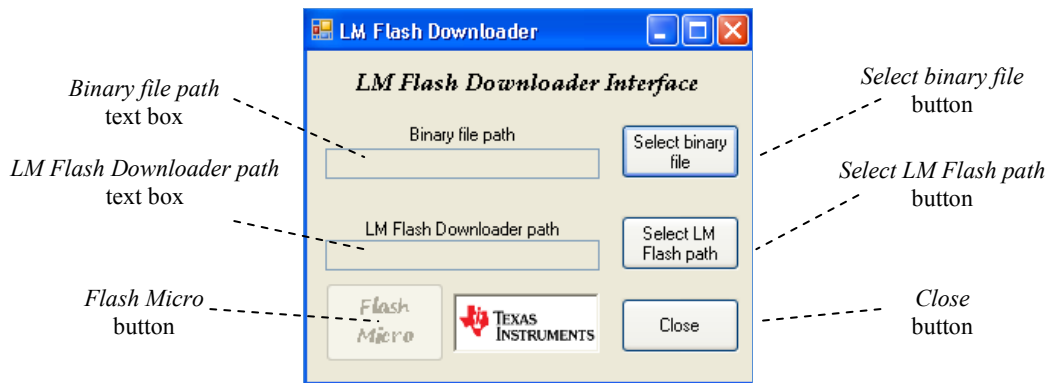


Fig. 6. Firmware upgrading tool.

4. Click on *Select binary file* button first: in the dialog window just popped-up, select the binary file (with ".bin" extension) by which the firmware currently running on the instrument should be upgraded and click on the *Open* button: the path for the selected file will be shown within the *Binary file path* text box;
5. Repeat the same procedure by clicking the *Select LM Flash path* button: in the dialog window just popped-up, select the executable file *LMFlash.exe*, located within its folder, and click on the *Open* button: the path for the selected file will be shown within the *LM Flash Downloader path* text box;
6. Click the *Flash Micro* button: a Windows command prompt console will be shown, into which the external application for the firmware upgrading will be executed; when completed, on success, click the *Close* button to close the *LM Flash Downloader* dialog window.

WARNING. Upgrade the instrument firmware only by using binary files delivered by FAI Instruments S.r.L.