Continuous Monitoring Flux Station

Handbook

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Each West Systems instrument is warranted by West Systems Srl to be free from defects in material and workmanship under normal operating conditions; however, West Systems's sole obligation under this warranty shall be to repair or replace any part of the instrument which West Systems 's examination discloses to have been defective in material or workmanship without charge and only under the following conditions, which are:

1. The defects are called to the attention of West Systems in writing within one year after the shipping date of the instrument.

2. The instrument has not been maintained, repaired or altered by anyone who was not approved by West Systems.

3. The instrument was used in the normal, proper, and ordinary manner and has not been abused, altered, misused, neglected, involved in an accident or damaged by act of God or other casualty.

4. The purchaser, whether it is a distributor or direct customer of West Systems or a distributor's customer, packs and ships or delivers the instrument to West Systems (at West Systems 's main office in Pontedera (PI) Italy, within 30 days after West Systems has received written notice of the defect. Unless other arrangements have been made in writing, transportation to West Systems is at customer expense.

5. No-charge repair parts may be sent at West Systems 's sole discretion to the purchase for installation by purchaser.

6. West Systems 's liability is limited to repair or replace any part of the instrument without charge if West Systems 's examination disclosed that part to have been defective in material or workmanship.

7. Before returning an instrument for repair, the Customer must obtain a Return Goods Authorization (RGA), writing to support@westsystems.com and providing information about part number, serial number and description of the issue. Instructions on packaging and shipping will be e-mailed back to the Customer. The company-issued RGA number must be displayed on the return package.

The laws of some locations may not allow the exclusion or limitation on implied warranties or on incidental or consequential damages, so the limitations here in may not apply directly. This warranty gives you specific legal rights, and you may already have other rights which vary from location to location. All warranties that apply, whether included by this contract or by law, are limited to the time period of this warranty which is a twelve-month period commencing from the date the instrument is shipped to the customer.

Responsibility

West shall not be held responsible for any damage to the equipment or for any physical injury or death resulting in whole or in part from the inappropriate use, installation or storage of the equipment, which is the result of not complying with the instructions and warnings, and/or with the standards and regulations in force.

READ THESE INSTRUCTIONS CAREFULLY BEFORE THE FIRST USAGE.

IMPORTANT INFORMATION FOR CORRECT DISPOSAL OF THE PRODUCT IN ACCORDANCE WITH EC DIRECTIVE 2002/96/EC.

At the end of its working life, the product must not be disposed of as urban waste. It must be taken to a special local authority differentiated waste collection centre or to a dealer providing this service. Disposing of a household appliance separately avoids possible negative consequences for the environment and health deriving from inappropriate disposal and enables the constituent materials to be recovered to obtain significant savings in energy and resources. As a reminder of the need to dispose of household appliances separately, the product is marked with a crossed-out wheeled dustbin.

If your equipment requires maintenance in Italy
Before shipping the instrument back to Italy, remember:
- When you ask your shipping agent to send the instrument to Italy check that on the Air Waybill the Airport of destination is Pisa. Any other airport of destination creates a lot of problems in delivering the items (delay, costs, custom problems, etc).
!- Check that the Company your shipping agent chooses lands in Galileo Galilei Airport in Pisa. If not, ask your shipping agent to change the Company or send the items by DHL or UPS or FedEx
- Mark each item with a serial number, if not already present, and write this number on the document (proforma or original invoice or item list) where you list the parts you are sending back to Italy.
- Specify a correct value of the parts you are sending back in the documents mentioned above. *Pay attention to these rules because Custom law in Italy is very complicated and probably different from your Country.*
If you follow these suggestions everything will be easier for you and for us.

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1.Introduction

1.1 Safety information

Carbon dioxide is a **toxic gas**. Carbon dioxide is colourless, odourless, tasteless and is heavier than air. Air concentration higher than 5000 ppm can cause dizziness, shortness of breath, rapid pulse. Higher concentrations of carbon dioxide can be **lethal**. Diffuse carbon dioxide fluxes are normally related to anomalous carbon dioxide air concentration. The user must verify the safety conditions before entering dangerous areas using specific and approved instrumentation.

The flux meter described in this manual is designed to measure diffuse emission of soil gases and CANNOT be used for different purposes, especially if related with safety.

The chamber contains moving parts that may cause harm to people or things. When the chamber is opening or closing, there is a risk of pinching.

Use the greatest attention when operating in the chamber range. Do not touch the chamber when the motor is running. When the flux station is ON, the chamber will open and close automatically at regular intervals.

The instrument and the electronic accessories are NOT designed to work in explosion risk areas.

1.2 Hints

About installation
Before starting the installation of the flux station is better to install the WS-Scada software suite on the computer. The on-field installation is described on chapter 2.

About soil fluxes
The flux phenomena can be perturbated by the installation, because of digging the soil, hammering, placing the collar.
The normal regime will be restored in few days.

2.On-Field Installation

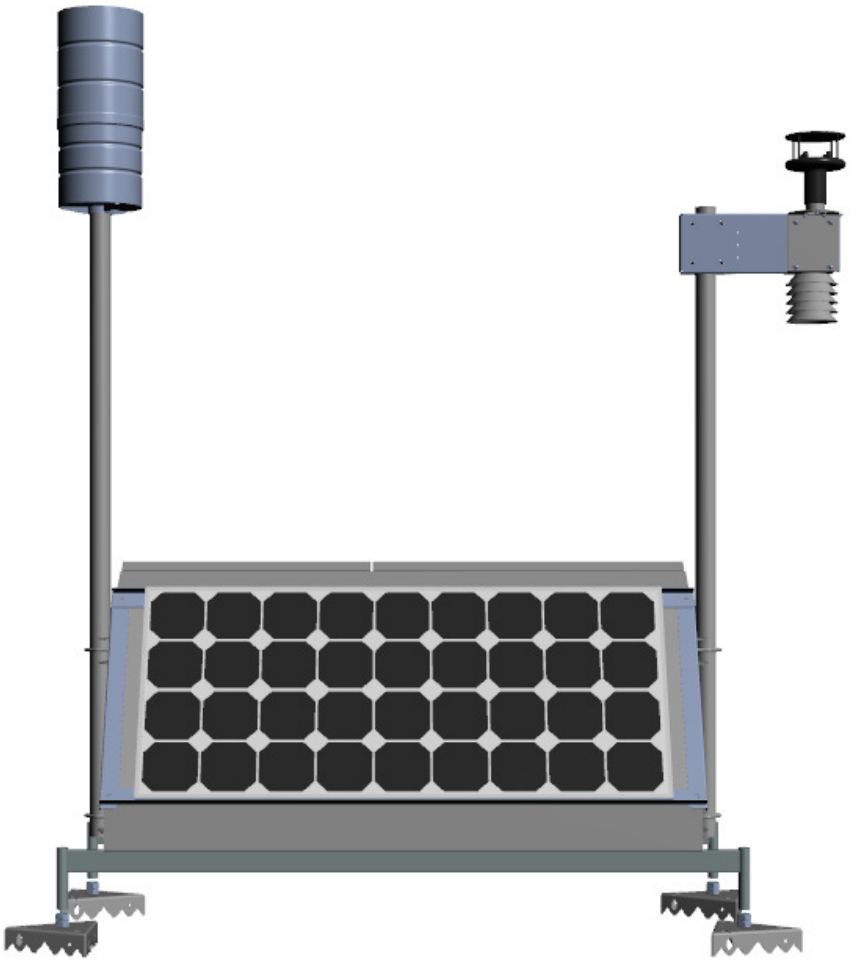
2.1 Installation of the Shelter

Select the installation site after a carbon dioxide flux survey. The best location is in the middle of an anomalous efflux area with an homogeneous flux distribution. The optimal flux value is in the range from 2 to 250 moles per square meter per day. For the choice of the site it is necessary to take into account that the solar panel has to be oriented in the correct direction and that it must be exposed to sunbeams at least for 4-6 hours per day.

It is necessary to consider also the functioning of the telemetry system. In case you are using a GSM/3G/4G telemetry please verify the coverage and the signal strength using a mobile telephone with a SIM card of the provider you choose for data transmission. In case you use a SSR24 telemetry from the selected site you must have a very good direct visibility of the Master Center or of the site where you will install the radio repeater bridge if necessary.

Moreover, it is necessary to evaluate the soil stability and the possibility of flooding.

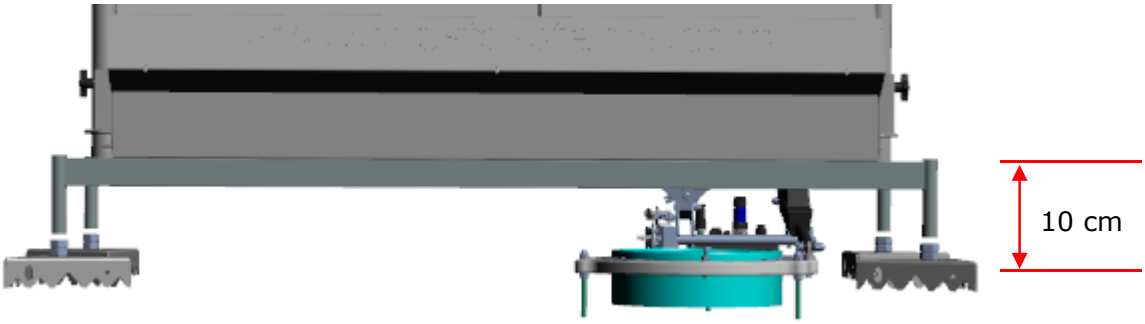
If besides the carbon dioxide emission also strong water vapour emission are present it is necessary to evaluate the possibility of installation of a water condensing system along the gas sampling line.



2 On-field Installation

The optimal orientation of the solar panel must be estimated basing on the installation site latitude. Install the shelter accordingly, by means of a compass. Fix the sensors and antenna poles, the sensors, the accumulation chamber and then the station. Following the instructions described in the next pages connect the different devices.

The base of the shelter must be 10 - 15 cm far from the soil. Such distance allows a good circulation of atmospheric air in the accumulation chamber area.

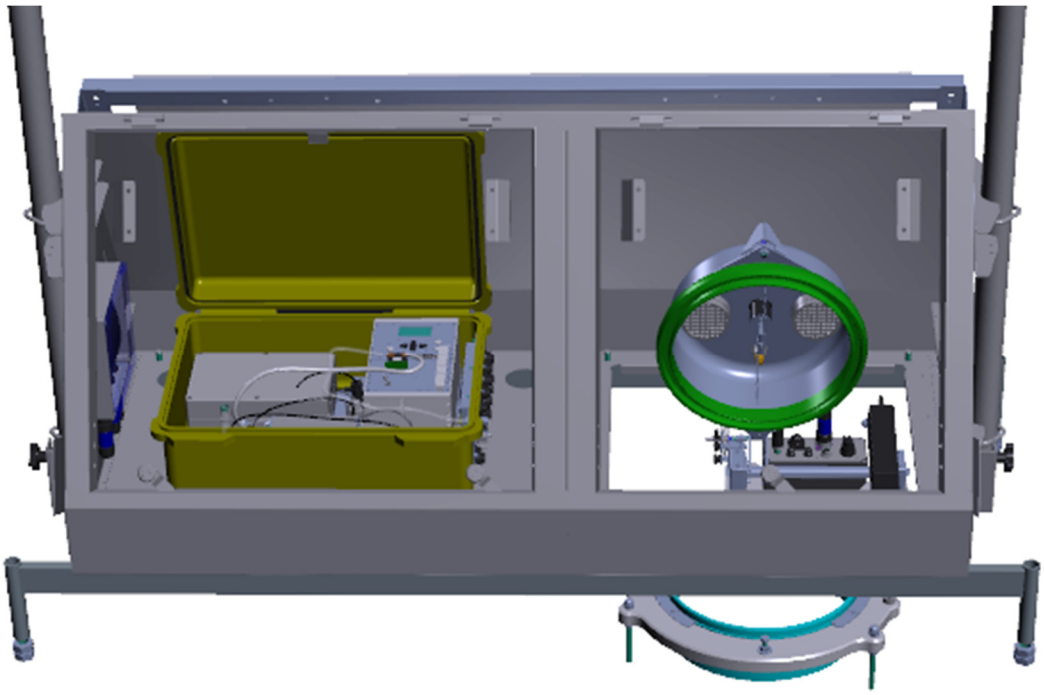


Once the shelter is in its final position, fix each shelter foot to the ground by inserting the 3 piquets. Use a hammer to push the piquets into the soil.

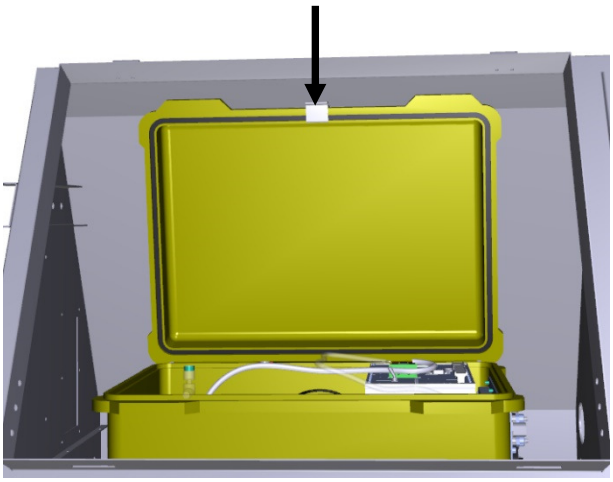
View from above of the shelter foot and piquests

2 On-field Installation

The flux station must be mounted on the left part of the shelter.
Let the tubes and the chamber cable pass through the hole placed behind the flux station.
The picture shows the housing of the flux station case and the chamber.



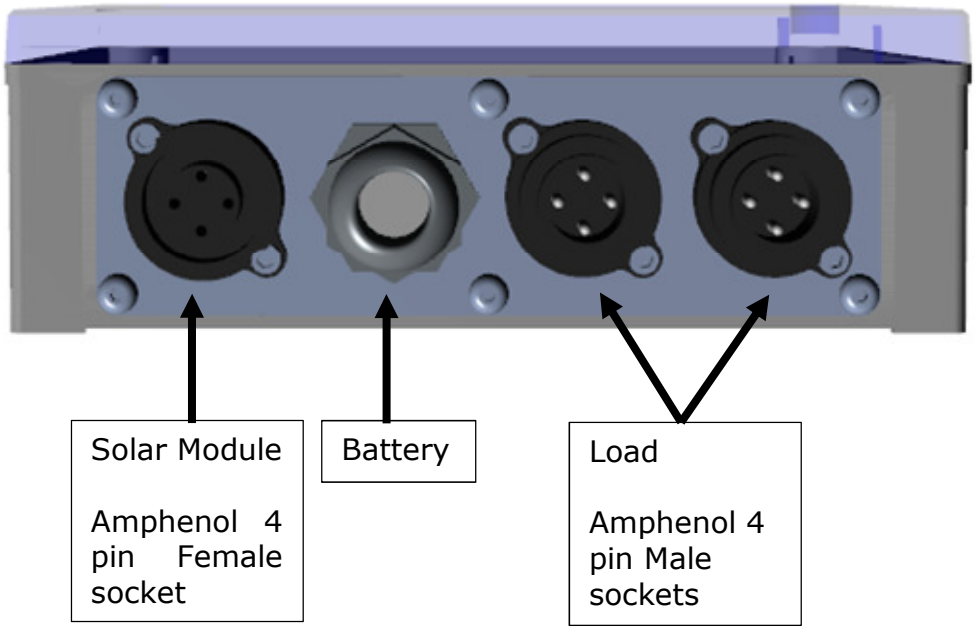
Case cover handle



When operating the flux station, open the case and fix the cover on the handle located on the ceiling of the shelter. When the operation is finished, unhook the cover from the handle and close the flux station case.

2.2 Power Supply

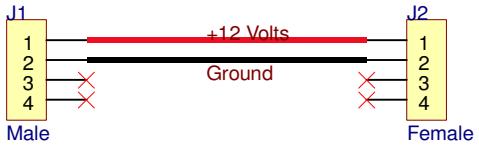
The power-box provides power supply to the whole unit. It is equipped with an internal charge regulator. The power-box is installed inside the shelter, on the left wall.
View from below of the power-box:



One of the two Load is used to power the flux station.
The one that remains free can be used as an auxiliary power source for external devices.

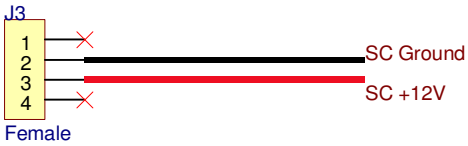
Power supply cable

J1 Amphenol 3 + T Pin Male J2 Amphenol 3 + T Pin Female

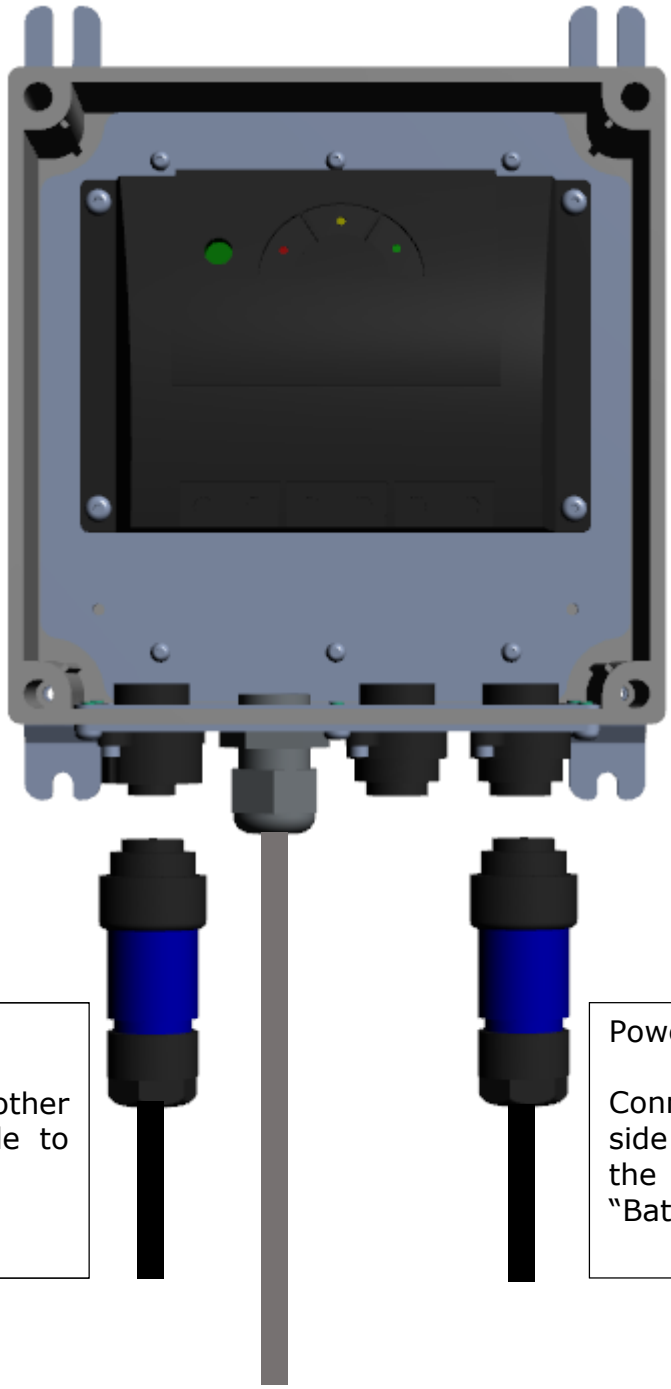


Solar cell cable

J3 Amphenol 3 + T Pin Female



2 On-field Installation



Solar cell cable

Connect the other side of the cable to the solar panel

Power supply cable

Connect the other side of the cable to the FluxStation "Battery" socket

Battery cord

The positive wire (red) is protected with a 10 A fuse

2.3 Solar cell charge regulator

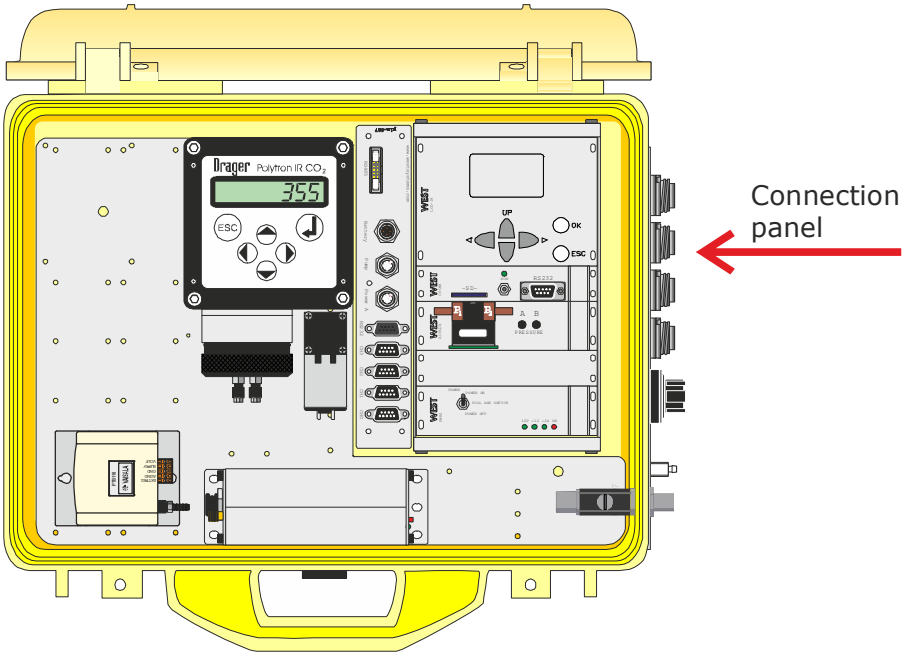
The status of the charge is indicated by the following table:

LED	Status	Meaning
Info LED	lluminates green	normal operation
	flashes slowly red*	system fault - too high charging current - overload / short circuit - overheated together with red LED: - too low battery voltage together with green LED: - too high battery voltage
Battery red LED	flashing quickly*	battery empty, low voltage disconnection prewarning, loads still on
	flashing slowly*	deep discharge protection active (LVD), loads disconnected
Battery yellow LED	illuminates	battery weak, loads are on
	flashes slowly yellow*	LVD reconnection setpoint has not yet been reached, loads still disconnected
Battery green LED	illuminates	battery good
	flashes quickly green*	battery full, charge regulation active

If the battery voltage falls down to 11.1 Volt, the charge regulator turns off the load (the flux station) in order to save the battery against the over-discharge. The load will be reconnected when the battery voltage increases up to 12.6 Volt.

Specifications
System voltage: 12 V
Own consumption: < 4 mA
Load current: 10 A
End of charge voltage: 13.9 V
Boost charge voltage: 14.4 V
Reconnection voltage (SOC / LVR): > 50 % / 12.4 V
Deep discharge protection (SOC / LVD): < 30 % / 11.2 V

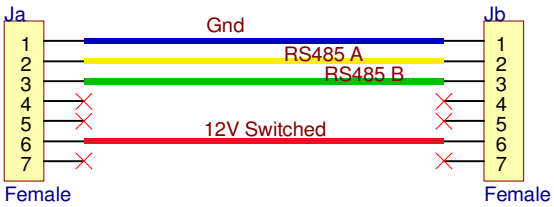
2.4 Station connections



All electrical and pneumatic connections to the flux station are on the right-side connection panel.

RS485 cable (RS485_1)

Ja Amphenol 6 + T Pin Female Jb Amphenol 6 + T Pin Female



RS485 Cable

Pin	Function	Color
1	Gnd	Blue
2	RS485 A	Yellow
3	RS485 B	Green
4	n.c.	
5	n.c.	
6	+12V	Red
T	n.c.	

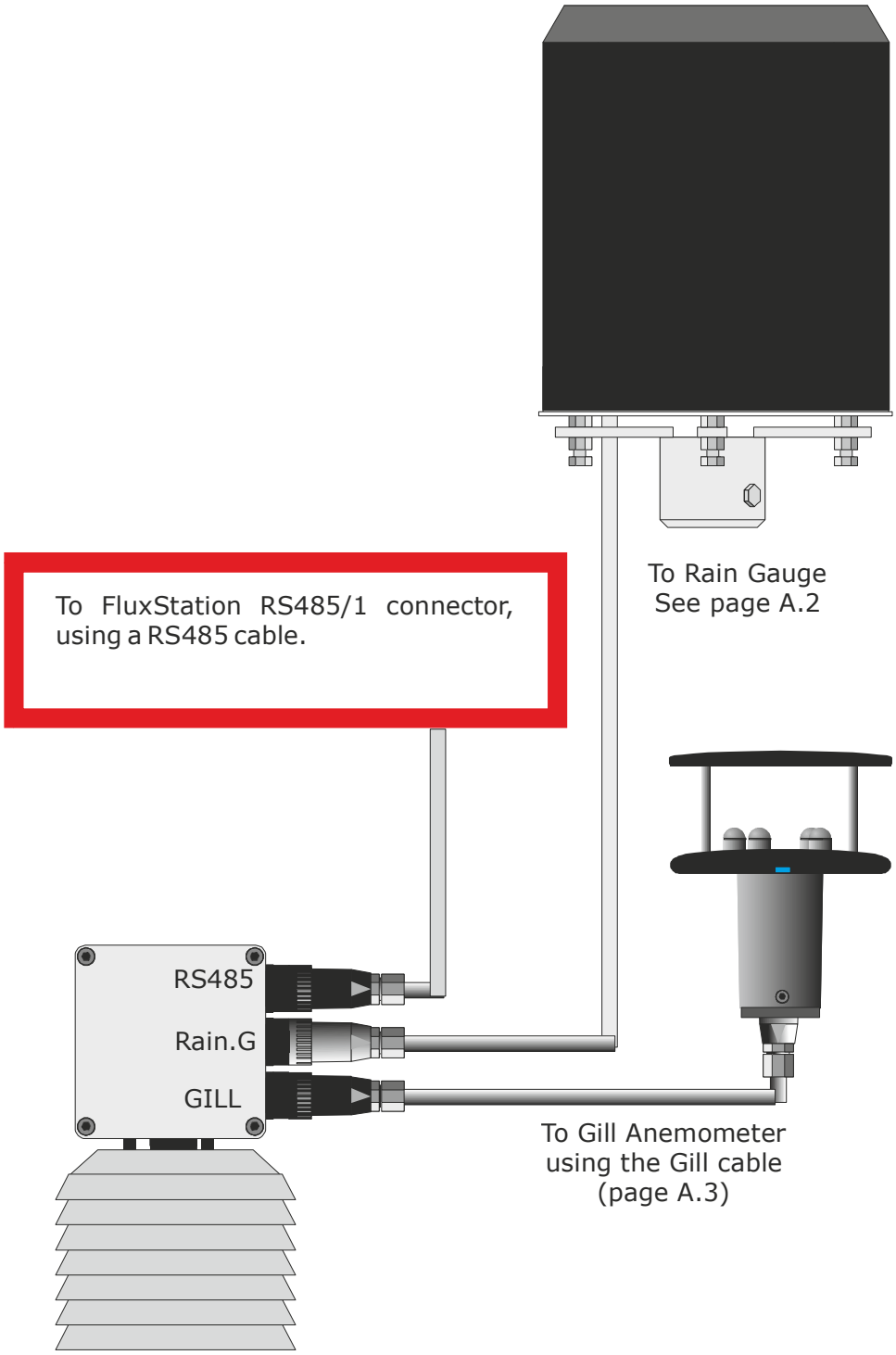
The RS485 connectors

The FluxStation is equipped with 3 RS485 connectors, marked as RS485/1, RS485/2, RS485/3;

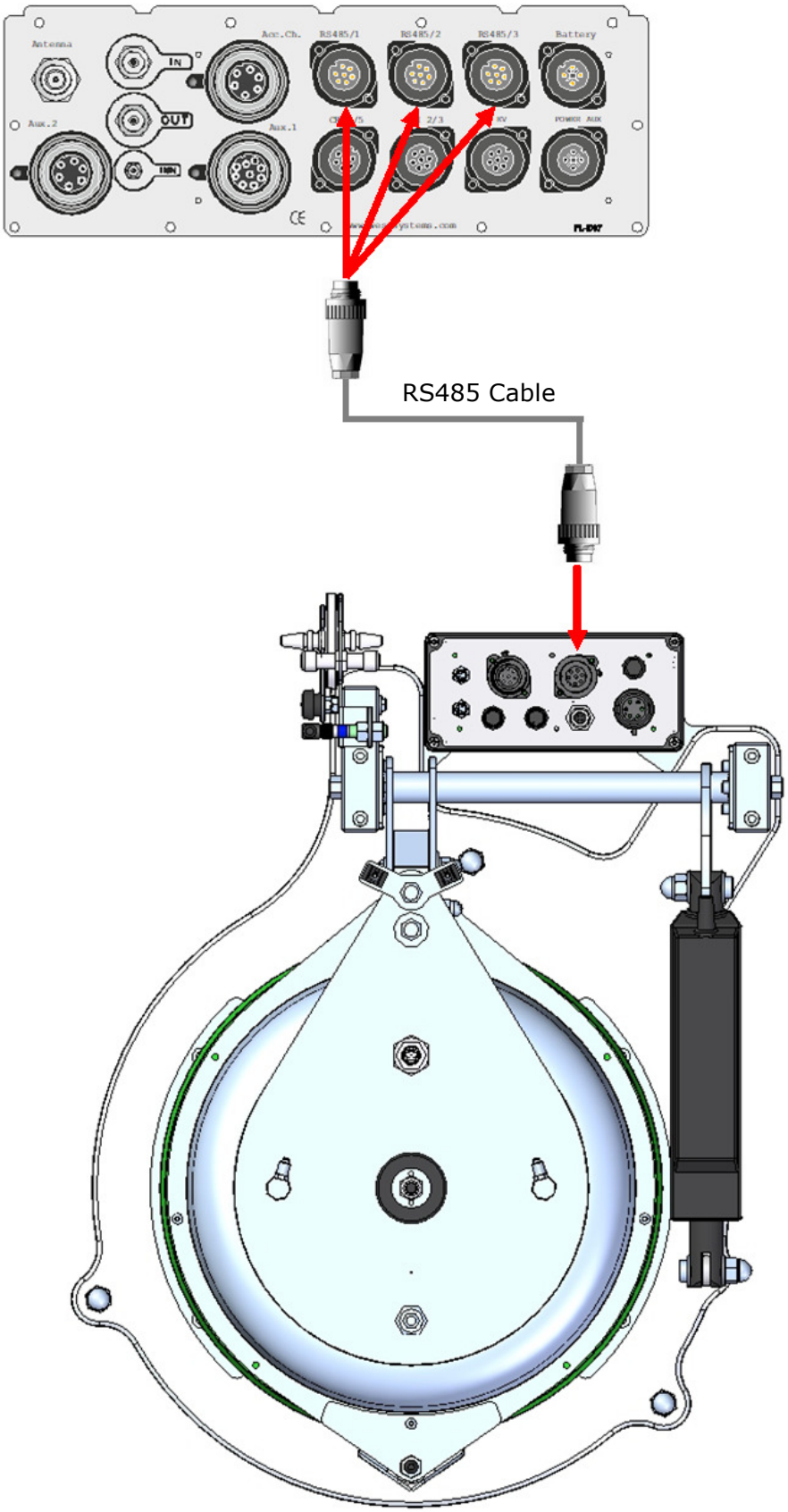
RS485/1, 2 and 3 have the same pin-out and the same function.

2.5 Meteorological detectors and AirBox

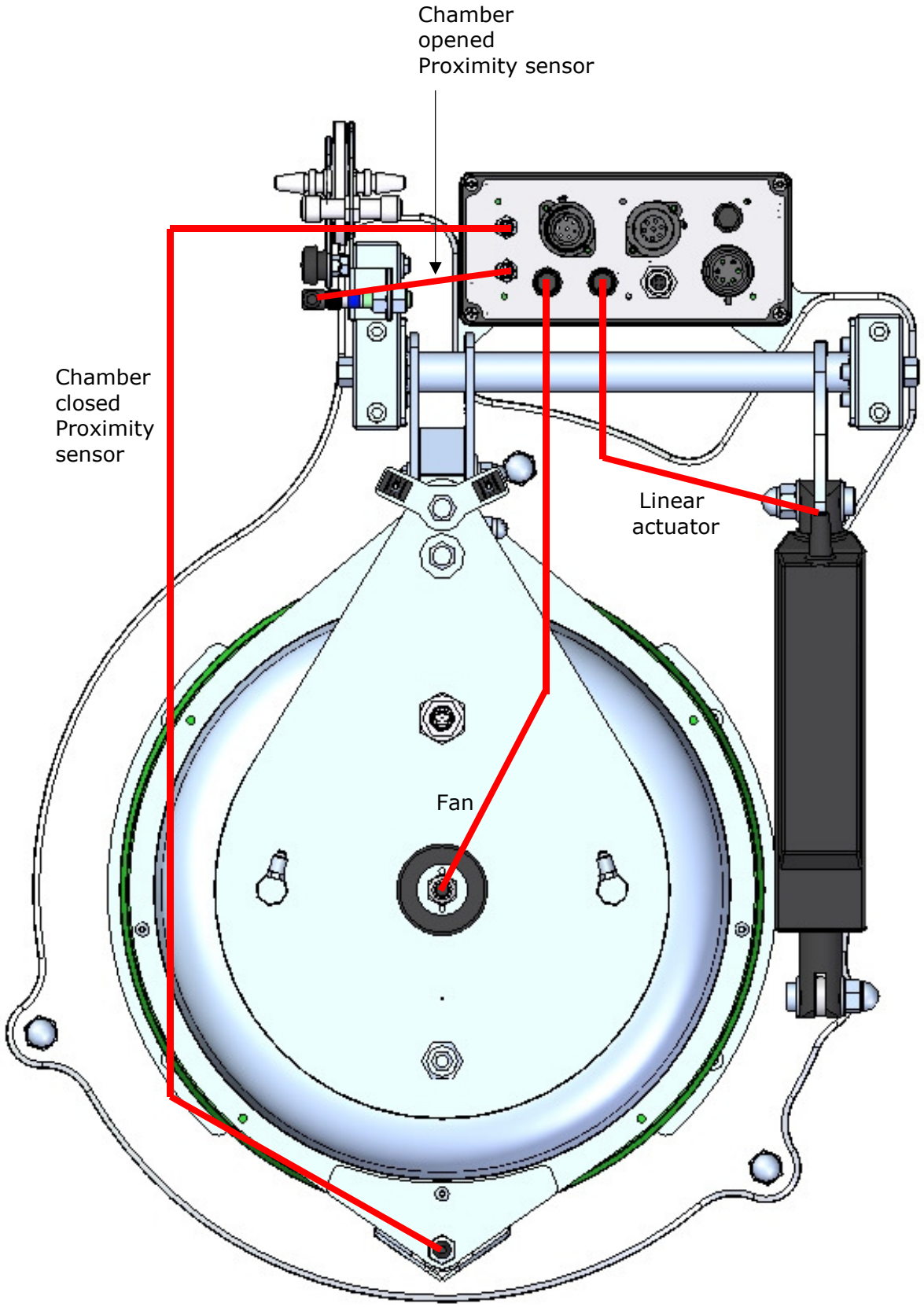
The AirBox is an interface (described in detail in the appendix A) that allows the flux station to connect with a sonic wind speed and direction gauge, an air temperature and relative humidity digital probe, a rain fall gauge.



2.6 Accumulation chamber connection



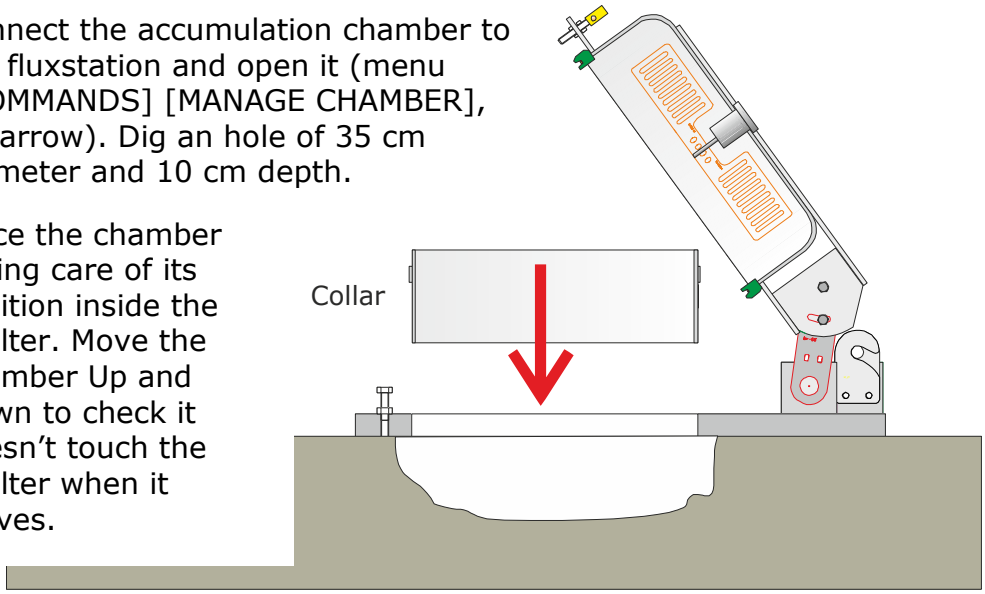
2 On-field Installation



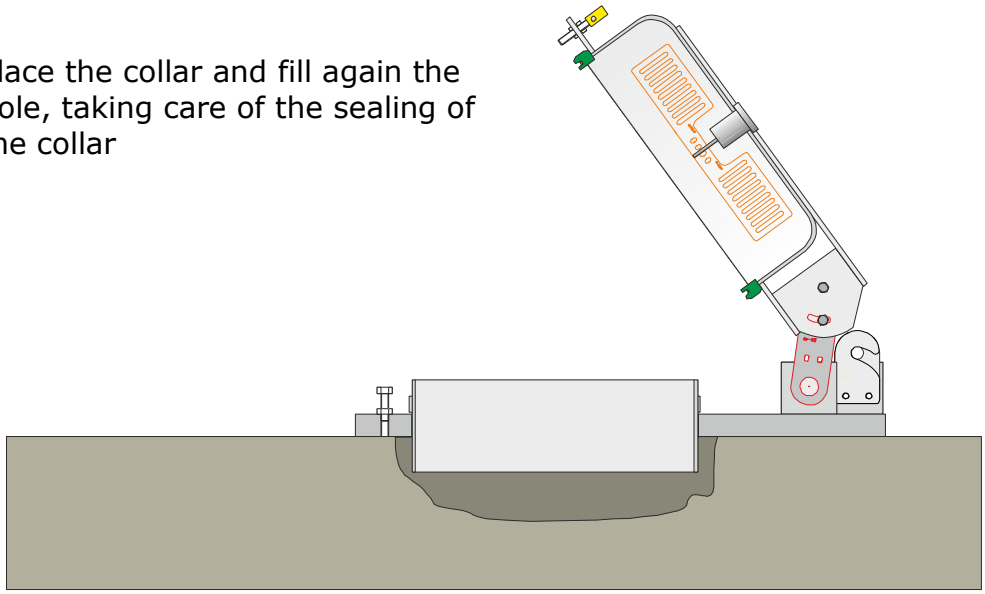
2.7 Accumulation chamber operation

Connect the accumulation chamber to the fluxstation and open it (menu [COMMANDS] [MANAGE CHAMBER], Up arrow). Dig an hole of 35 cm diameter and 10 cm depth.

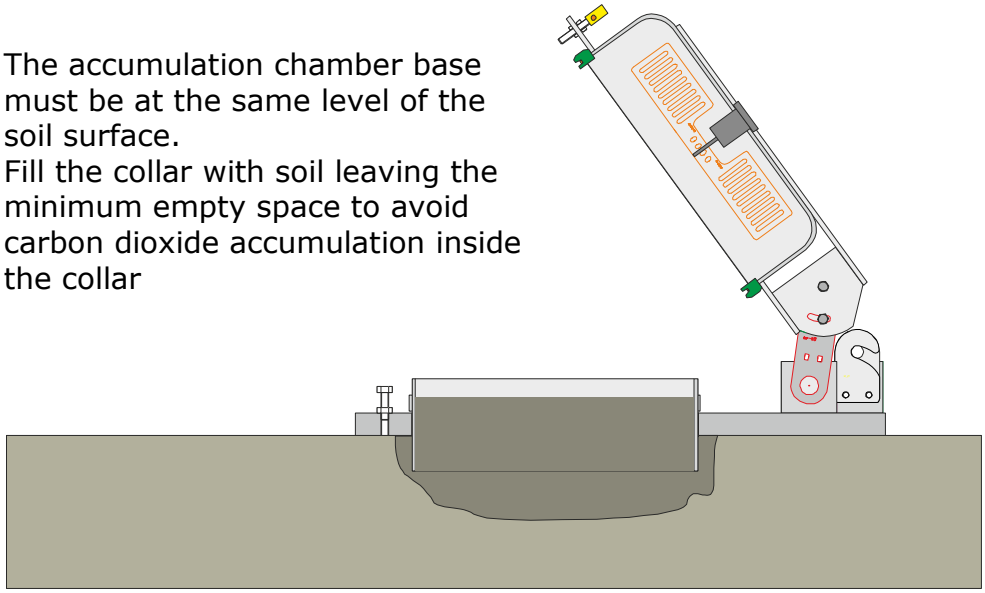
Place the chamber taking care of its position inside the shelter. Move the chamber Up and Down to check it doesn't touch the shelter when it moves.



Place the collar and fill again the hole, taking care of the sealing of the collar



The accumulation chamber base must be at the same level of the soil surface.
Fill the collar with soil leaving the minimum empty space to avoid carbon dioxide accumulation inside the collar



2 On-field Installation

You can check the status of the accumulation chamber (the information acquired with the proximity sensors) in the following ways:

1- Locally, on the station menu [2.1 Manage Accumulation Chamber]. See chapter 6 Display for more info.

2- Remotely, when downloading the data with WS-SCADA software. The field AC Status will assume the following values:

OK: the station managed to close and open the chamber.

NFC (Not Fully Closed): the chamber couldn't close perfectly: The lower proximity sensor didn't light at the end of the Chamber-Down run.

A possible cause is that an obstacle is preventing the chamber to close. Although, if the flux curve shows a good accumulation, it's more likely than the proximity sensor is not well placed.

NFO (Not Fully Opened): the chamber couldn't open perfectly: The upper proximity sensor didn't light at the end of the Chamber-Up run.
In this case check the proximity sensor is not well placed or if there is an external cause.
Note that when the battery voltage is very low (under 11.5 V) the run will be slower, so it can happen that the chamber cannot fully open within the maximum time.

NFC-NFO: both NFC and NFO cases are present.

ERR: the proximity sensors didn't respond correctly.

3- Exporting the data into Excel or CSV files using the Query software.
Since numeric values are required, you'll find the following codification:

AC Status
0: OK
1: NFC
2: NFO
3: NFC-NFO
4: ERR

4- Checking the graphs generated by the Monitor software. The same codification shown at point 3 is applied. In normal condition, the plot should show a flat line with all values equals to 0.

2.8 Proximity sensors test

Once the installation is completed, execute the following steps to verify the status of the connections:

1) Open the flux station case and switch on the system by pulling the switch and moving it into the ON position. The display of the station will turn on, displaying the West Systems logo and showing the menu after a couple of seconds. If the display is still off, check again the installation of the power supply system.
2) Access the menu *2. Commands*, then *2.1 Manage chamber*. If the chamber is closed, on the display the proximity sensors "DW" must be checked.

   ☐ UP

   ■ DN

   If not, check the chamber connections.
   Also, check if the sensor is in the correct position, about 1 mm far from the bolt. If necessary, move the bolt closer or farther from the sensor.
3) Press the UP key to open the chamber. If the chamber is not moving, control the linear actuator cable. Once the chamber is opened, check the display: the proximity sensors "UP" must be checked.

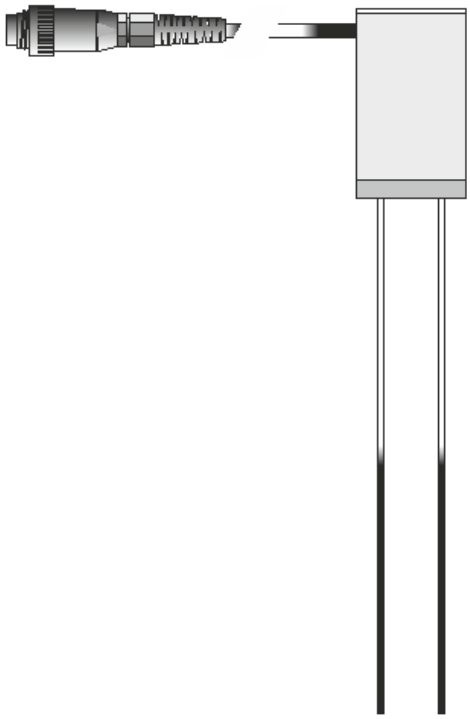
   ■ UP

   ☐ DN

2.9 Installation of soil sensors

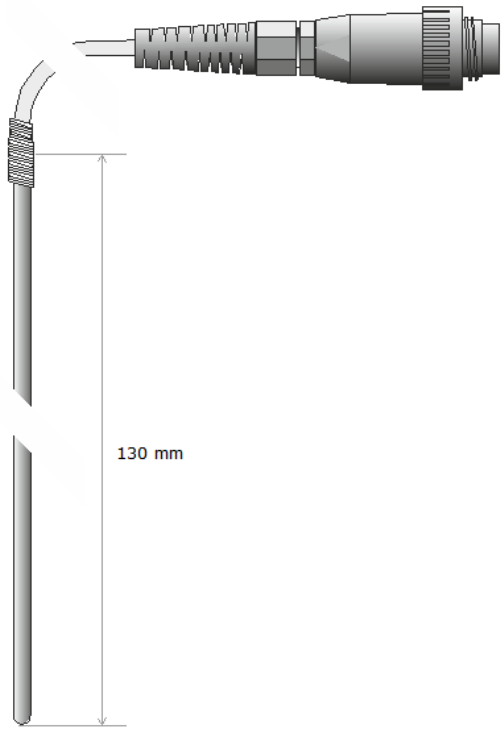
A platinum 100 Ohm temperature probe and a Campbell Scientific CS616 Time Domain Reflectometer can be connected to the chamber box in order to measure the soil temperature and the soil water content.

Soil water content probe



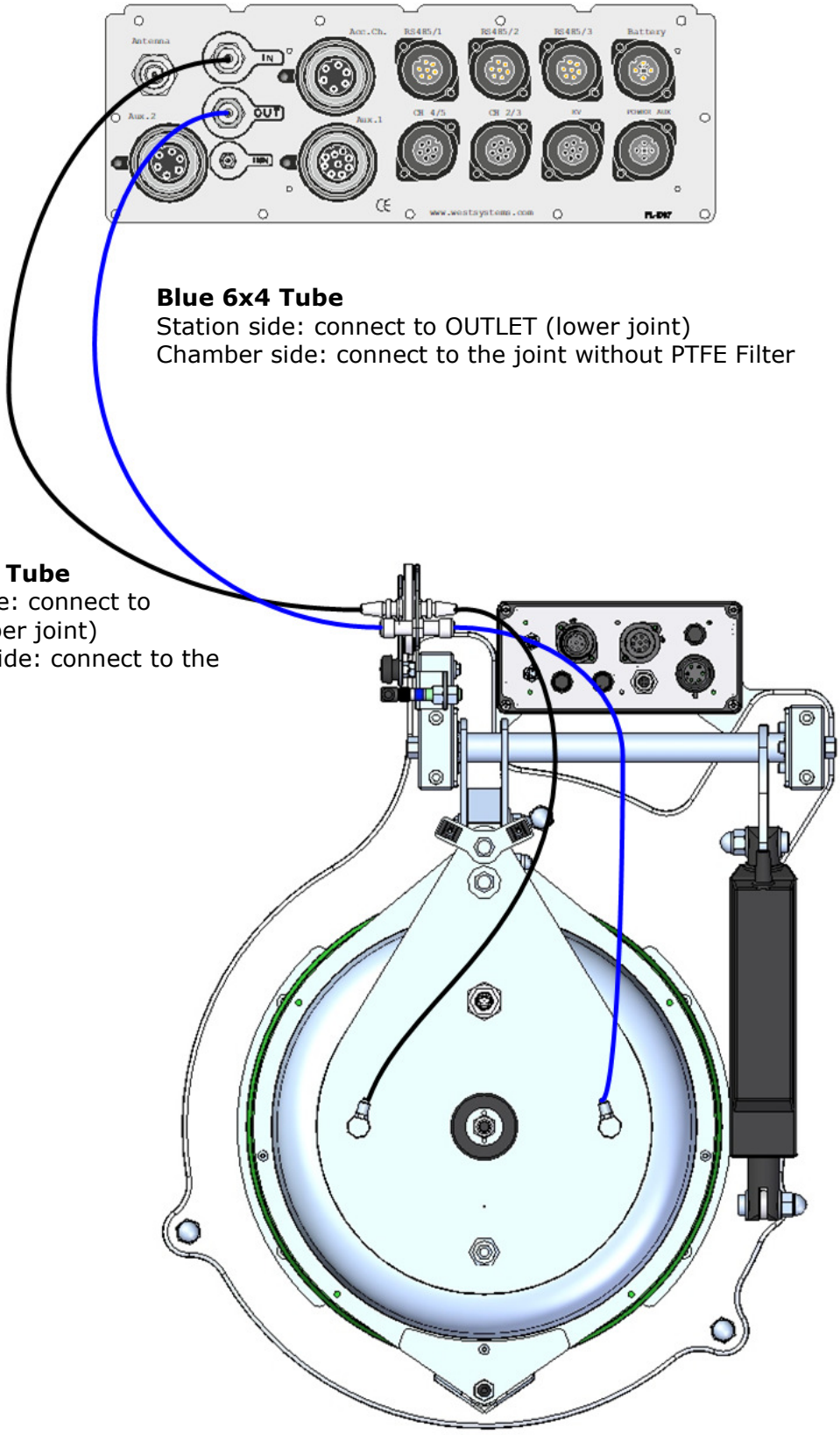
Plug the probe to the C6 connector of the chamber box. Make sure the plug is fully inserted and tighten the ring.
Make sure the cable does not interfere with the chamber movement. From the station menu, close the chamber to verify all the cables are in a secure position. Open the chamber again at the end of test.
Insert the probe into the soil. The probe rods can be inserted vertically into the soil surface or buried at any orientation to the surface. A probe inserted vertically into a soil surface will give an indication of the water content in the upper 30 cm of soil. The probe can be installed horizontal to the surface to detect the passing of wetting fronts or other vertical water fluxes. A probe installed at an angle of 30 degrees with the surface will give an indication of the water content of the upper 15 cm of soil.
The method used for probe installation can affect the accuracy of the measurement. **The probe rods should be kept as close to parallel as possible** when installed to maintain the design wave guide geometry. The sensitivity of this measurement is greater in the regions closest to the rod surface than at distances away from the surface. Probes inserted in a manner which generates air voids around the rods will reduce the measurement accuracy. In most soils, the soil structure will recover from the disturbance during probe insertion.

Soil temperature probe



Plug the probe to the C5 connector of the chamber box. The connector is a quick release and doesn't need to be screwed. Insert the probe into the soil at the desired depth.
Make sure the cable does not interfere with the chamber movement. From the station menu, close the chamber to verify all the cables are in a secure position. Open the chamber again at the end of test.

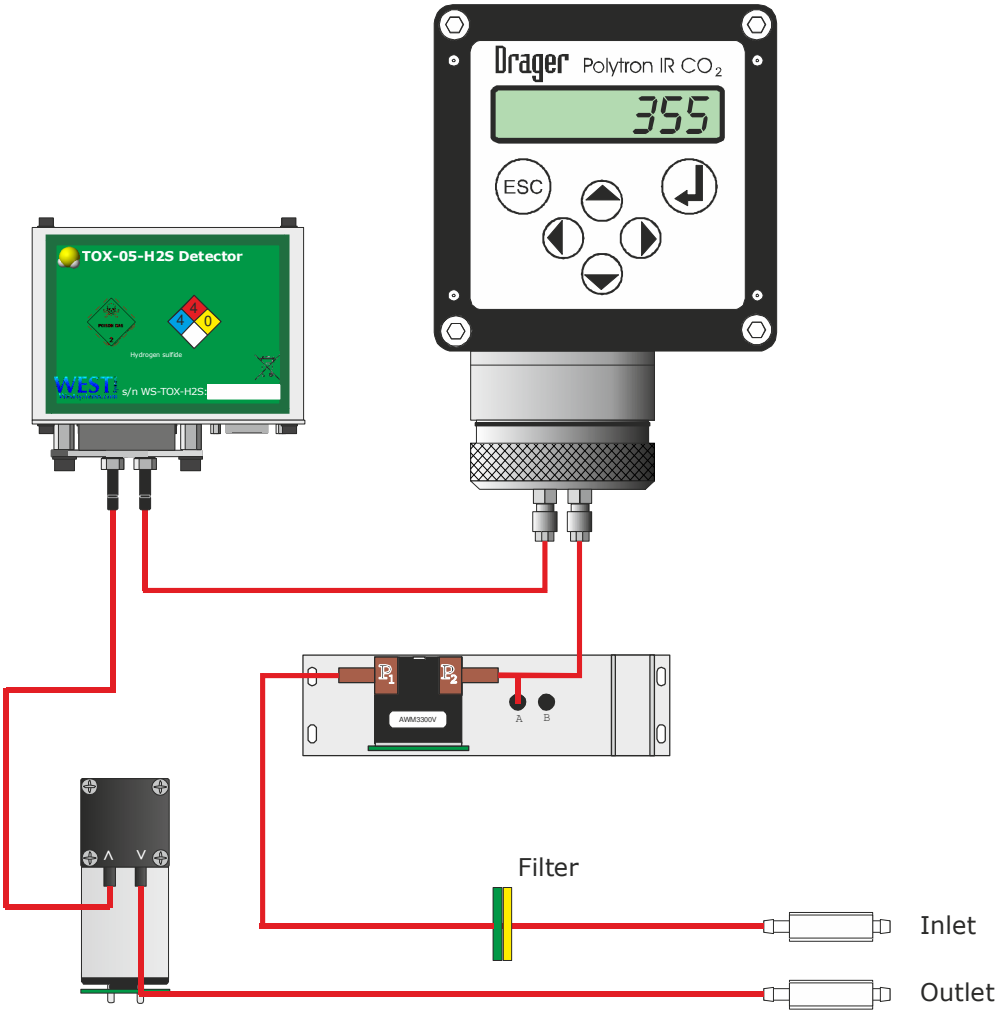
2.10 Accumulation chamber pneumatic connection



3.Pneumatic circuit

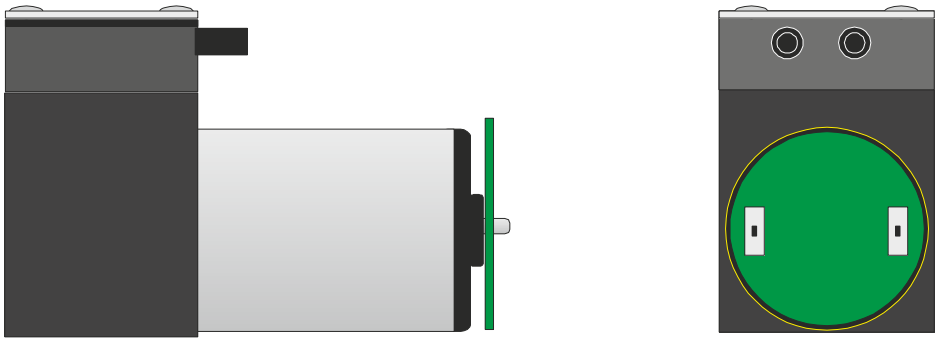
The pneumatic circuit is composed following this order:
1- Inlet
2- 0.20 micron PTFE filter
3- Flowmeter
4- Gas analysers
5- Diaphragm pump
6- Outlet

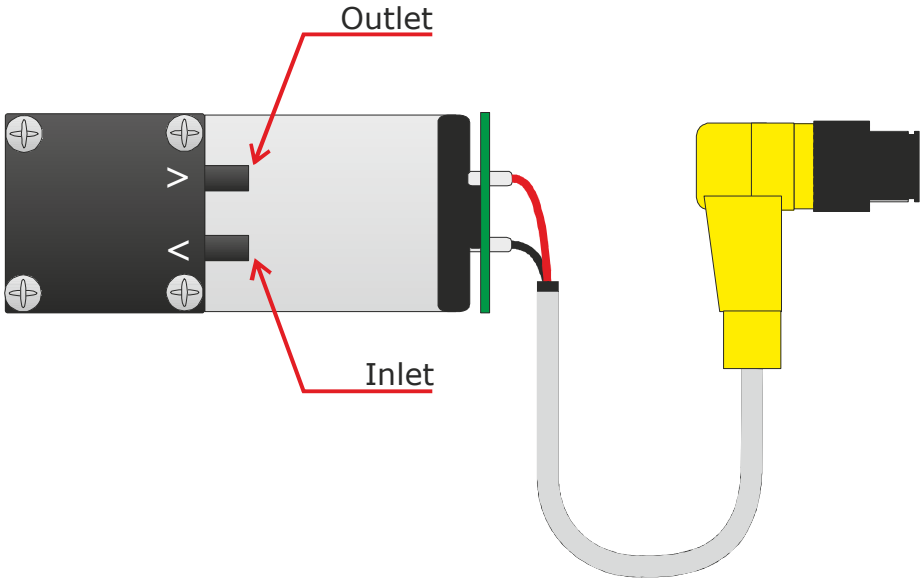
The gas analyzers
In the following diagram, it is described a configuration example, where the gas analysers are an electrochemical H_2S detector and a Draeger Polytron IR CO_2 detector.



All the internal connections are made with silicon tube 8 mm external diameter 3.3 mm internal diameter;

3.1 Pump





Pump connections

Pin	Signal
1	+12V
2	NC
3	NC
4	GND

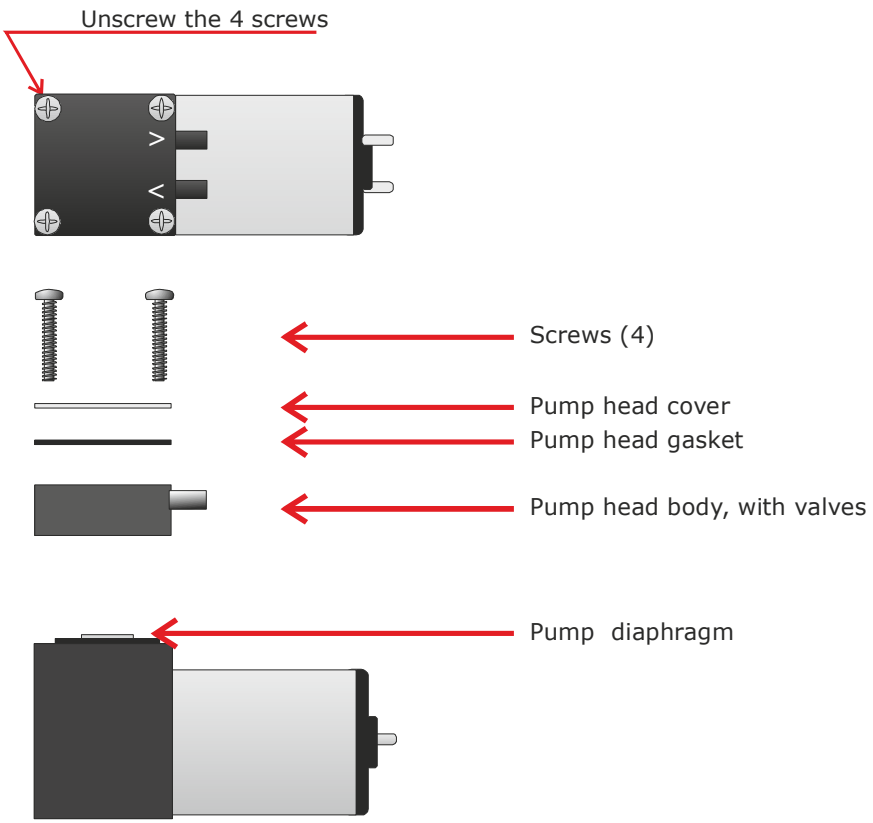
Pump specifications
Rated flow: 1200 SCCM (Standard cubic centimeter per minute)
Power supply 150 mA @ 12 Volts

Manufacturer: KNF
Ordering code: NMP830KNDC
Pneumatic fittings diameter: 4 mm

Pump maintenance

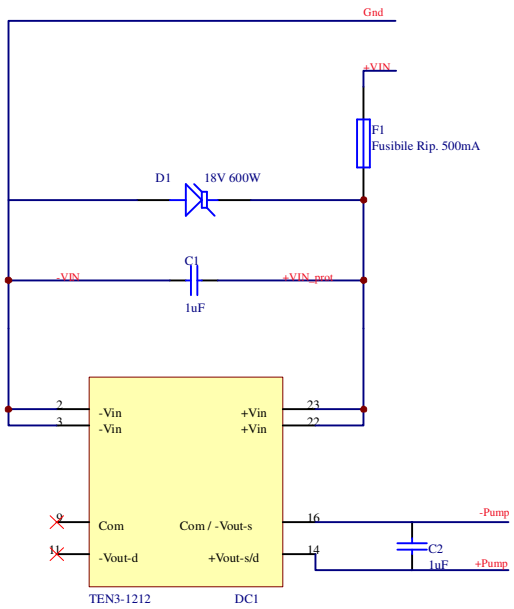
The pump efficiency can be affected by deposits of dust or water. When necessary it's possible to clean the pump:

- Disassemble the pumping head
- Clean the diaphragm, the washer, and the valves using a compressed air flow.
- Reassemble the head.

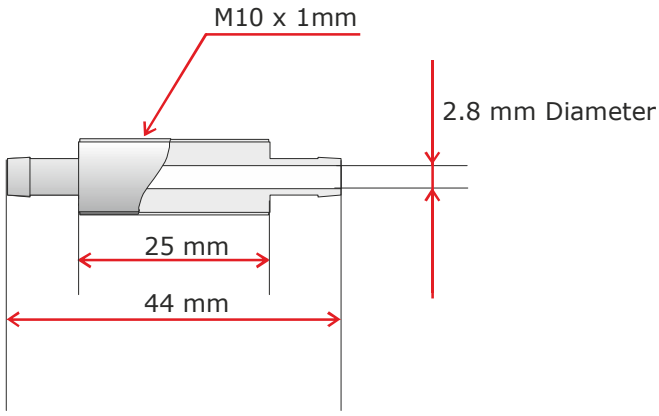


Pump stabilizer scheme

3 Pneumatic circuit



The fittings
WEST Systems Tube fitting for 6x4 tubes



Material : Chromed brass

3.2 Filters

The PTFE membrane filters are permeable to gases and water vapour and are impermeable to liquid water and dust particles. The use of the filters protects the gas detectors and the other pneumatic parts. Please check the status of the filters every month.

Two types of filters are used:
- 25 mm diameter, 0.20 µm PTFE membrane
  Model: Cole-Parmer 2915-20 or equivalent
- 50 mm diameter, 0.45 µm PTFE membrane
  Model: Cole-Parmer 2915-30 or equivalent

3.3 Tubes

The gas sampling line is realized with three different types of tubing.

The connection between the chamber and the flux station is realized with the following tubing:

www.westsystems.com

Material: Polyurethane
External diameter: 6 mm
Internal diameter: 4 mm
Color: Black (supply) and Blue (return)
Max operating pressure: 9 Bar
Minimum bending radius: 15 mm
Operating temperature: –20 to +70°C
Manufacturer: Legris
Ordering code: 1420U06 41

The chamber sampling line is realized with the following tubing:

Material: Polyurethane
External diameter: 4 mm
Internal diameter: 2.5 mm
Color: Black (supply) and Blue (return)
Max operating pressure: 10 Bar
Minimum bending radius: 12 mm
Operating temperature: –20 to +70°C
Manufacturer: Legris
Ordering code: 1420U04 41

The sampling line inside to the flux station case is realized with the following tubing:

Material: Polyurethane
External diameter: 6 mm
Internal diameter: 4 mm
Color: Clear (transparent)
Max operating pressure: 0.8 MPa
Minimum bending radius: 15 mm
Operating temperature: –20 to +60°C
Manufacturer: SMC
Ordering code: TU0604C-20

4.Sensors

4.1 Carbon dioxide detector

Manufacturer: VAISALA
Model: GMP343
Working principles: Single-Beam Dual-Wavelenght NDIR
Measurement range: from 1000 ppm to 2%, configurable by the operator.

Accuracy (excluding noise) at 25°C and 1013 hPa after factory calibration with 0.5% accurate gases with different range options

0 … 1000 ppm	±(3 ppm CO_2 + 1% of reading)
0 … 2000 ppm – 0 … 2%*	±(5 ppm CO_2 + 2% of reading)

*Accuracy below 200 ppm CO2 not specified for 2% range option

Noise (repeatability) at 370 ppm (CO2)

With no output averaging	±3 ppm CO_2
With 30s output averaging	±1 ppm CO_2

Short term stability (up to 6 hours) at 370 ppm CO2 ±1 ppm CO_2

Long term stability

In easy operating conditions	±2% of reading*/year
In moderate operating conditions	±2% of reading*/6 months
In harsh operating conditions	±2% of reading*/3 months

*Always at least ±10 ppm CO_2

Pressure compensation range: from 700 to 1300 mBar
Operating temperature: between -40 and +60 °C.
Power supply: 11-36 Volt DC
Power consumption: < 1 W without optics heating
< 3.5 W with optic heating

Connections

The GMP343 is equipped with an 8-pin M12 connector which provides power supply, analog output and a serial port for communication (RS232).
The wiring is explained in the following diagram.

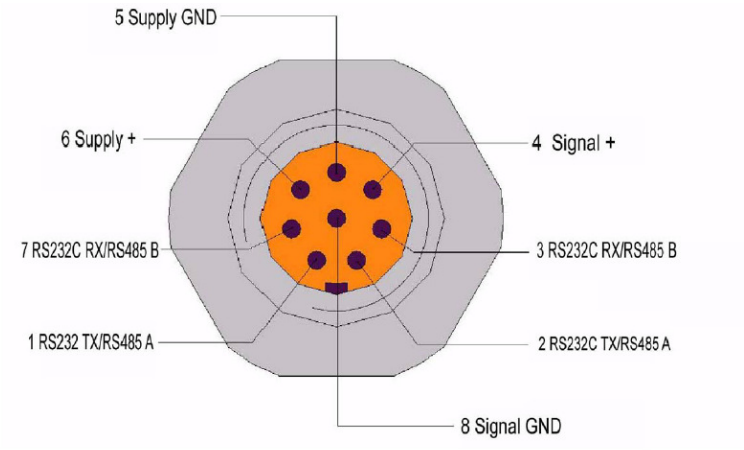
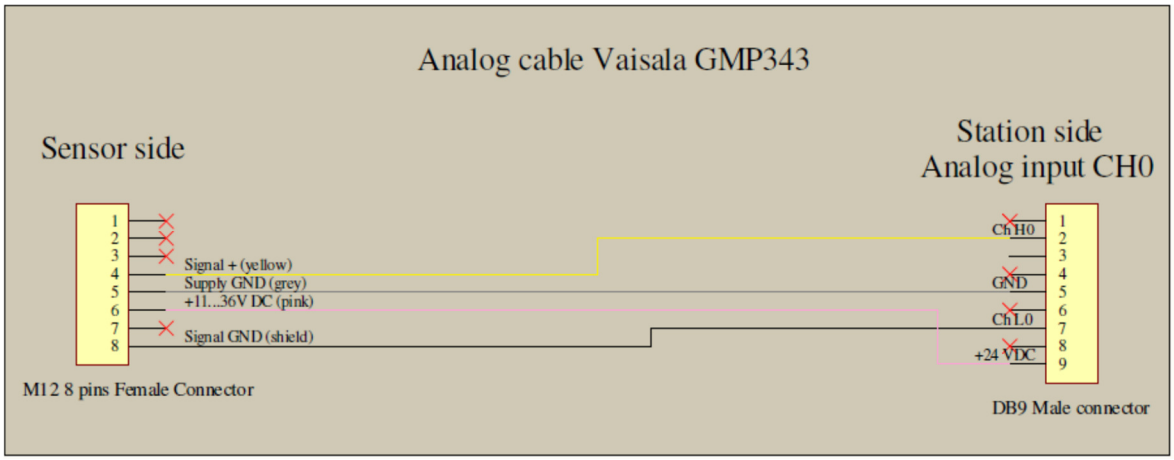


Table 2 Wiring Pins

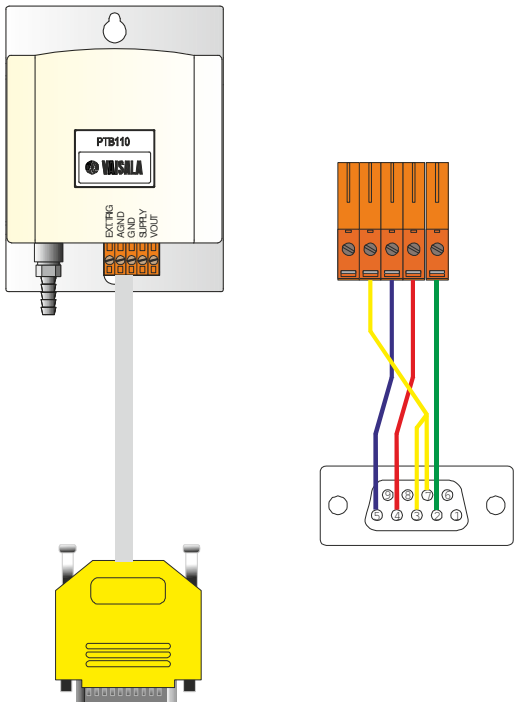
Pin	Wire	Serial signal (RS-232 or 2-Wire RS-485 interface)		Analog signal
1	White	RS232C: TX	RS485: A(+)	-
2	Brown	RS232C: TX	RS485: A(+)	-
3	Green	RS232C: RX	RS485: B(-)	-
4	Yellow	-	-	Signal +
5	Grey	Supply GND	Supply GND	Supply GND
6	Pink	+11...36 V DC	+11...36 V DC	+11...36 V DC
7	Blue	RS232C: RX	RS485: B(-)	-
8	Shield	-	-	Signal GND

The Vaisala GMP343 CO2 detector is connected to Analog Channel Input 0 (DB9 female socket).
The cable connection is explained in the following diagram:



4.2 Barometric pressure gauge

Manufatcurer: VAISALA
Model: PTB110 4A0AB
Pressure Range: 600-1060 hPa (mBar)
Temperature range: -40 ... +60 °C
Max pressure limit: 2000 hPa abs
Min pressure limit: 0 hPa abs
Accuracy: 0.3 hPa
Output: 0 ... 5 Vdc
Power supply: 10 ... 30 Vdc (typical 4 mA @ 12 Vdc)
Channel Barometric pressure
Ch. Name B.Pr.HPa
CH. # 1

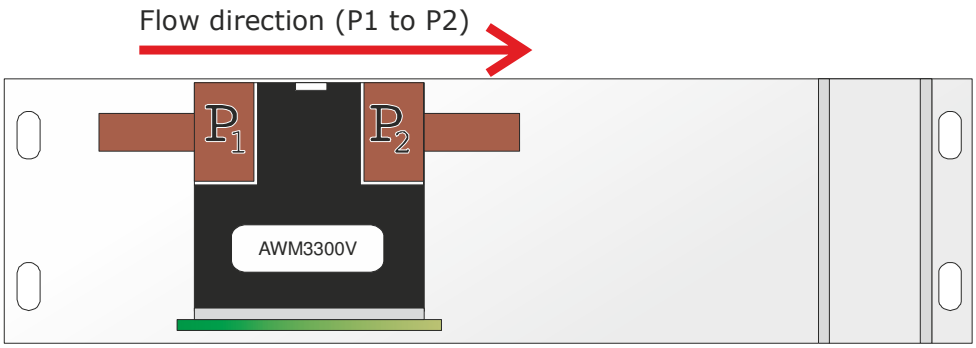


DB 9 Male : Ch.1

Vaisala Cable			
Pin	**Color**	**Function**	**DB9 pin**
Supply	Red	+12V	4
Gnd	Blue	Gnd	5
AGnd	Yellow	S.Low	3,7
VOut	Green	S.High	2

4.3 Gas line flow meter

Manufacturer: WEST Systems
(Sensor made by Honeywell-SensorTechnics)
Ordering code :AWM3300
Gas flow
Range: 0 to 1300 SCCM
Accuracy: 2% of F.S.
Power supply: 10 Volt Typical 30 mA @ 24 Volt



The P.Flow channel measures the gas flow in the sampling line.
The value must be in the range 700-1450 SCCM. A value less than that means there is some kind of obstruction, or the filters are dirty.
A value close or less than zero means that the pump is not working.

4.4 Other sensors

Gill sonic wind speed and direction gauge
For the description of the wind and direction gauge refers to the page A.3 in the Air Box's Appendix.

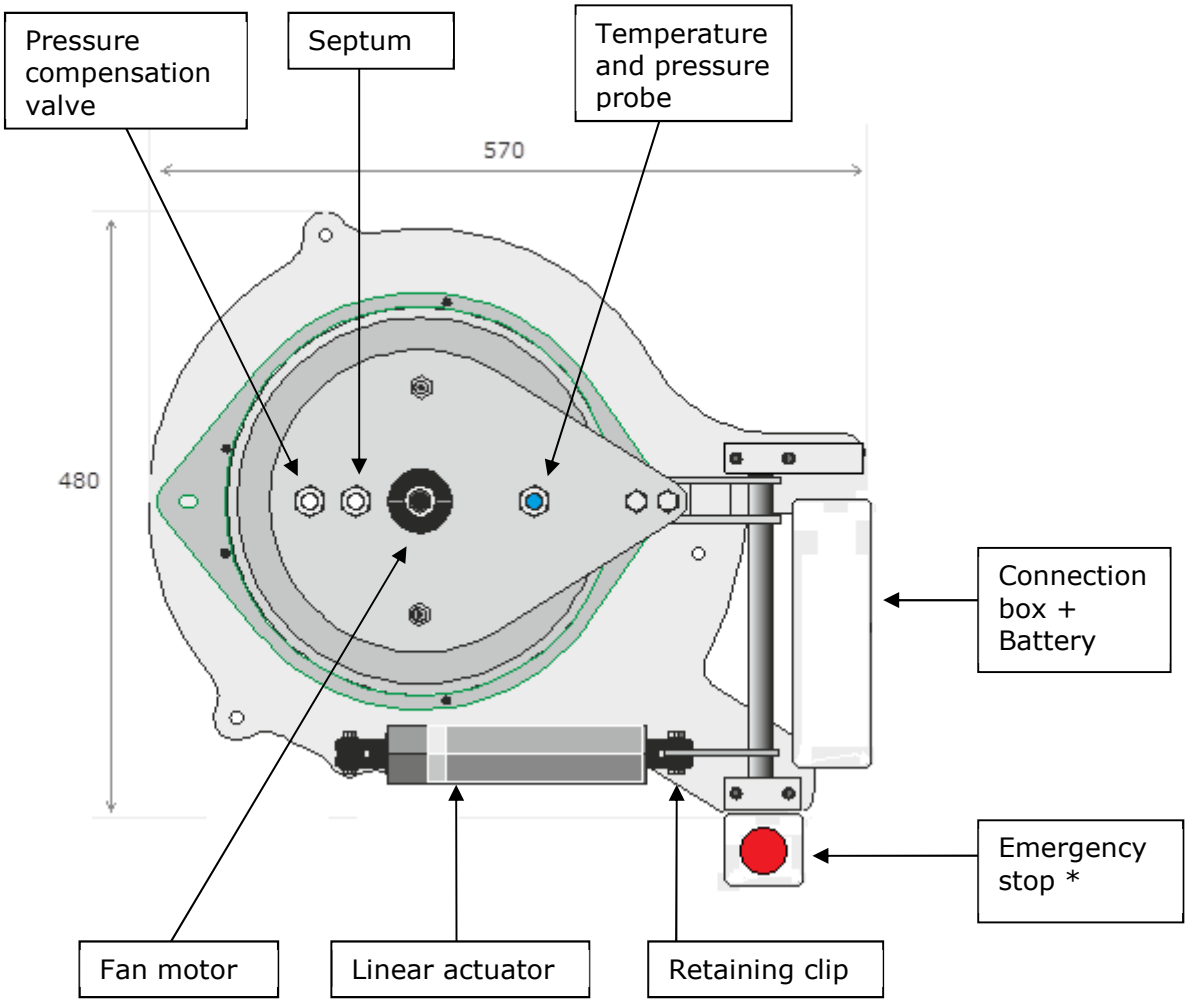
Silicon Air Temperature and relative humidity gauge
For the description of the air temperature and relative humidity gauge refers to the page A.4 in the Air Box's Appendix.

Rain gauge
For the description of the rain gauge refers to the page A.7 in the Air Box's Appendix.

Soil water
For the description of the soil water refers to the page S.5 in the Soil Box's Appendix.

Soil temperature
For the description of the soil temperature refers to the page S.6 in the Soil Box's Appendix.

5.The accumulation chamber



5.1 Components

Linear actuator
The linear actuator moves the chamber from the open position (idle) to the closed position (sampling) and vice versa.
The actuator is equipped with a safety retaining clip (see chapter 1.1), for freeing the motor from the chamber axle in emergency situations.

Manufacturer: Linak
Model: LA12
Maximum thrust: 750 N

Emergency-stop *
The linear actuator is equipped with an emergency stop button which allows to immediately stop the movement of the chamber, in case persons or goods are in the way of the chamber movement and risk of being pressed.
Once pressed, the operation of the linear actuator is inhibited until it is manually restored. Twist the button clockwise to re-enable the operation.

* The button is furnished only when the shelter is not present.

Pressure compensation valve
The valve is used to maintain pressure equilibrium between inside the chamber and the surrounding air outside the chamber, avoiding the pressurization of the chamber that would alter the gas flow from the soil.

Pressure and temperature sensor
Each chamber is equipped with a digital barometric pressure and air temperature sensor. The parameters are acquired inside the chamber during the measure.

Manufacturer: Freescale
Ordering code: MPL3115A2
Pressure range: 500 to 1100 mBar
Temperature range: -40 to 85 °C

Septum
The septum is used for trace gas sampling. It allows collecting subsamples directly from the chamber gas content. The flux of trace gas species can be manually computed by analysing the subsample.

Manufacturer: Supelco
Ordering code: 27356
Material: PTFE/Silicone
Diameter: 11 mm

Battery
Internal buffer battery, enclosed in the connection box. The battery provides additional local current to the chamber. It is automatically recharged by the flux station.

Manufacturer: Yuasa
Ordering code: NP0.8-12
Type: Lead acid
Voltage: 12 V
Capacity: 0.8Ah at 20hr rate to 1.75VPC

Fan
The chamber internal fan ensures the homogenization of the gas mixture inside the chamber during the flux measurement.

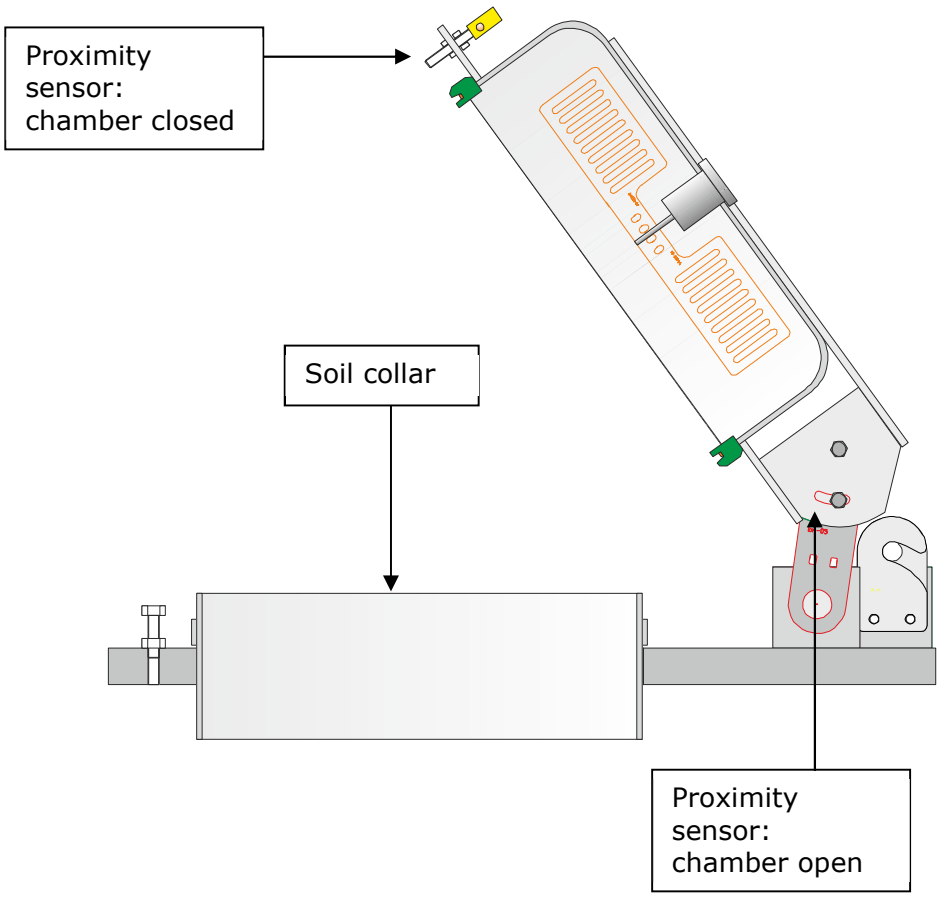
Manufacturer: McLennan
Model: 1271-12-21
Output speed: 80 rpm
Maximum output torque: 2.5 Ncm

Soil temperature probe
Manufacturer: Jumo
Type: Pt100 DIN IEC 751 Class B 4 wires
Range: 0 to 200 °C
Accuracy 0.3°C
Probe length 130 mm
Probe diameter 6 mm
Cable length 3 m
Cable PTFE and silicone with protective anti-bend spring.

Soil water content probe
Manufacturer: Campbell Scientific
Ordering code: CS616
Water content Range 5-50 %
Water content Accuracy 3%

The CS616 Water Content Reflectometer measures the volumetric water content of porous media using time-domain measurement methods.
The Water Content Reflectometer consists of two stainless steel rods connected to a printed circuit board. A shielded four-conductor cable is connected to the circuit board to supply power, enable the probe, and monitor the pulse output. The circuit board is encapsulated in epoxy. The probe rods can be inserted from the surface or the probe can be buried at any orientation to the surface.
The CS616 response is dependent on the dielectric constant of the material surrounding the probe rods. Water is the principal contributor to the dielectric constant value, but the solid constituents such as quartz, clay and organic matter also affect the measurement. The same calibration of volumetric water content to probe output signal period may not apply to all soils. Accuracy can be optimized by using calibrations derived for a specific soil. Accuracy of ± 2.0% over the entire water content range and for a wide range of soil types is routinely obtained in our laboratory. Applying the general calibrations from the operating manual provides accuracy of ± 3.0%.

Proximity sensors
Two proximity sensors are installed, one at the base of the chamber and one at the axle. The sensors control the full opening and full closing of the accumulation chamber. The information is stored as meta-data of the analysis file and therefore is stored in the database when it is download by WS-Scada. The information can be consulted anytime to cross-check the flux measurement validation.
Type: inductive proximity
Manufacturer: Wenglor
Model: IM020BM60TB8
Range: 2mm-Shielded
Protection grade: IP67
Thread: M8



5.2 Connections

The paragraph will explain the connection panel of the accumulation chamber. Please note that it is not possible to connect a device to the wrong connector since each socket is univocal. In case two connectors are of the same type (example: C8/C9 and C3/C4 sensors), it means that each plug can be connected to either one of the sockets.

5 The accumulation chamber

Chamber connection panel

Connector C1: Expansion
The connector C1 can used to connect auxiliary sensors. The chamber allows the connection of up to two analog sensors, sampled by two 24-bit Analog to Digital Converters. Moreover, it is possible to acquire a sensor equipped with a RS232 serial port. Please note that in this case it is necessary to load on the chamber board a customized firmware which implements the sensors serial protocol.

C1 Connector Pinout	
Pin	**Signal**
1	Analog input 1 (+)
2	Analog input 1 (-)
3	Sensor power supply
4	RS232 TX
5	RS232 RX
6	Analog input 2 (+)
7	Analog input 2 (-)

Connector C2: Pressure and temperature gauge
The connector C2 is used to connect the pressure and temperature gauge built-in inside the chamber. The gauge is connected through a I^2C serial bus.

C2 Connector Pinout	
Pin	**Signal**
1	I^2C SDA
2	GND
3	I^2C SCL
4	POWER SUPPLY

Connectors C3/C4: Fan and linear actuator
The connectors C3 and C4 are used to connect the fan motor and the linear actuator which opens and closes the chamber.

The emergency stop button is inserted between the linear actuator and the C3/C4 connector. Please note that the fan and the actuator can be connected to either one of the sockets.

C3/C4 Connector Pinout	
Pin	**Signal**
1	GND
2	PUMP
3	CHAMBER UP
4	CHAMBER DOWN
5	FAN

Connector C5: Soil temperature probe
The connector C5 is used to connect the 4-wire PT100 soil temperature probe.

C5 Connector Pinout	
Pin	**Signal**
1	PT100-RED (1)
2	PT100-RED (2)
3	PT100-WHITE (1)
4	PT100-WHITE (2)
5	GND

Connector C6: Soil water content probe
The connector C6 is used to connect the TDR soil water content sensor. The sensor output is a voltage square wave with frequency dependent on water content.

C6 Connector Pinout	
Pin	**Signal**
1	POWER SUPPLY
2	IGNITION
3	FREQUENCY
4	GND
5	NC
6	NC
7	NC

Connector C7: RS485
The connector C7 is used to connect the chamber to the flux station or to the multiplexer unit, in case of a multi-chamber system. The connector provides both power supply to the chamber and communication with the station control unit. The flux station provides two power supply voltages. The "+12V NOT SWICTHED" is always ON if the station is ON. It is used for recharging the chamber internal battery. The "+12V SWITCHED" is activated by the multiplexer only when the chamber needs to be sampled.

C7 Connector Pinout	
Pin	**Signal**
1	GND
2	RS485 A
3	RS485 B
4	GND
5	+12V NOT SWITCHED
6	+12V SWITCHED
7	NC

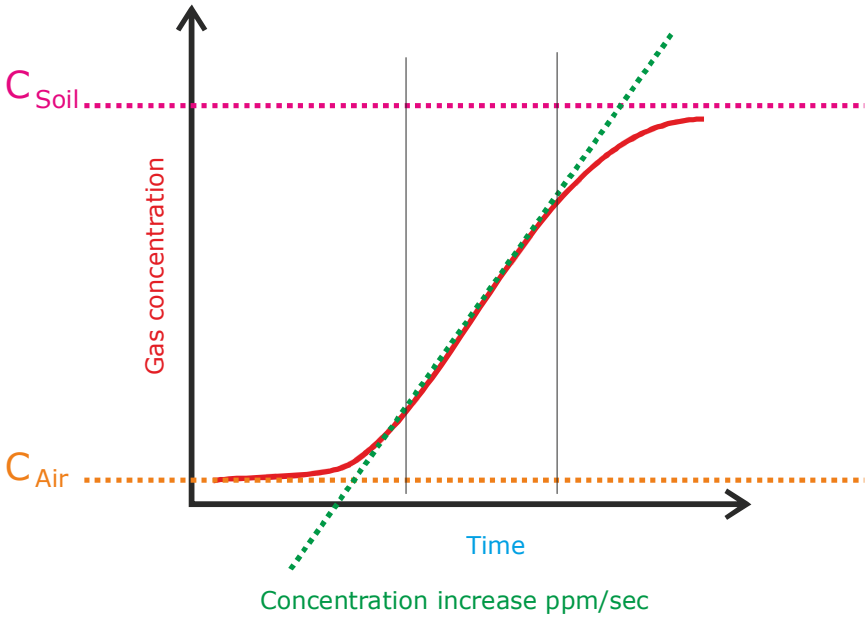
Connectors C8/C9: Proximity sensors

The connectors C8 and C9 are used to connect the proximity sensors which gives indication of whether the chamber could successfully open or close.

C8/C9 Connector Pinout	
Pin	**Signal**
1	POWER SUPPLY
2	PROX.SENSOR 1 SIGNAL
3	GND
4	PROX.SENSOR 2 SIGNAL

5.3 Measuring soil flux

The flux is proportional to the concentration increase ratio ppm/sec. The proportionality factor depends on the chamber volume/surface ratio as well as the barometric pressure and the air temperature inside the accumulation chamber.



The station samples the barometric pressure and the air temperature inside the chamber.
The variation of few degrees of temperature do not affect the evaluation of flux very much, then if the temperature of the gas mixture into the accumulation chamber is not available, it's possible to use the air temperature instead.

Choosing the flux measurement unit
The first measurements made, 20 years ago, with the accumulation chamber was expressed in cm/sec which is a speed, the speed of carbon dioxide flowing out from the soil. During the last decades, several units have been used by volcanologist and by geochemistry researchers. The most common unit is [grams/m^2 per day], but using the same instrument for two gas species to express the flux using this unit means to have two different conversion factors. West Systems uses the unit [moles/m^2 per day] that has two advantages: A single conversion factor for every gas specie and an easy conversion of the flux in [grams/m^2 per day] simply multiplying the result expressed in [moles/m^2 per day] times the molecular weight of the target gas.

The WS-Scada software expresses the flux using the unit [moles/m^2/day]

The accumulation chamber factors
Here following the formula used to compute the A.c.K.:

$$K = \frac{86400 \cdot P}{10^6 \cdot R \cdot T_k} \cdot \frac{V}{A}$$

Where

- **P** is the barometric pressure expressed in mBar (HPa)
- **R** is the gas constant 0.08314510 bar L K-1 mol-1
- **Tk** is the air temperature expressed in Kelvin degree
- **V** is the chamber net volume in cubic meters
- **A** is the chamber inlet net area in square meters.

The dimensions of the A.c.K. are

$$K = \frac{moles \cdot meter^{-2} \cdot day^{-1}}{ppm \cdot sec^{-1}}$$

An example:
The slope of the flux curve is 2.5 ppm/sec, the barometric pressure is 1000 mBar (HPa) and the air temperature is 25 °C.
From the following table, get the value that corresponds to the barometric pressure and temperature. In this case, the value corresponding for 25°C and 1000 mBar is 0.455.
Then the flux is: 2.5 x 0.455 = 1.14 moles per square meter per day.

WS-Scada
WS-Scada automatically computes the ACK value every time it receives data from the station.
The chamber area and volume are stored in the database.
The values of pressure and temperature are acquired from the sensors.

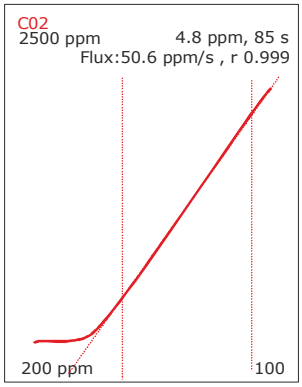
In the following table the factors for the conversion from ppm/sec slope to moles/m^2/day are reported.

Barometric pressure [mBar]	Air temperature [°C]												
	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40
1100	0.589	0.578	0.567	0.556	0.546	0.536	0.527	0.517	0.509	0.500	0.492	0.484	0.476
1080	0.578	0.567	0.556	0.546	0.536	0.526	0.517	0.508	0.499	0.491	0.483	0.475	0.467
1060	0.567	0.557	0.546	0.536	0.526	0.516	0.507	0.499	0.490	0.482	0.474	0.466	0.459
1040	0.557	0.546	0.536	0.526	0.516	0.507	0.498	0.489	0.481	0.473	0.465	0.457	0.450
1020	0.546	0.536	0.525	0.516	0.506	0.497	0.488	0.480	0.472	0.464	0.456	0.449	0.441
1000	0.535	0.525	0.515	0.505	0.496	0.487	0.479	0.470	0.462	0.455	0.447	0.440	0.433
980	0.525	0.515	0.505	0.495	0.486	0.478	0.469	0.461	0.453	0.445	0.438	0.431	0.424
960	0.514	0.504	0.494	0.485	0.476	0.468	0.460	0.452	0.444	0.436	0.429	0.422	0.415
940	0.503	0.494	0.484	0.475	0.466	0.458	0.450	0.442	0.435	0.427	0.420	0.413	0.407
920	0.493	0.483	0.474	0.465	0.456	0.448	0.440	0.433	0.425	0.418	0.411	0.405	0.398
900	0.482	0.473	0.464	0.455	0.447	0.439	0.431	0.423	0.416	0.409	0.402	0.396	0.390
880	0.471	0.462	0.453	0.445	0.437	0.429	0.421	0.414	0.407	0.400	0.393	0.387	0.381
860	0.460	0.452	0.443	0.435	0.427	0.419	0.412	0.404	0.398	0.391	0.384	0.378	0.372
840	0.450	0.441	0.433	0.425	0.417	0.409	0.402	0.395	0.388	0.382	0.376	0.369	0.364
820	0.439	0.431	0.422	0.414	0.407	0.400	0.392	0.386	0.379	0.373	0.367	0.361	0.355
800	0.428	0.420	0.412	0.404	0.397	0.390	0.383	0.376	0.370	0.364	0.358	0.352	0.346
780	0.418	0.410	0.402	0.394	0.387	0.380	0.373	0.367	0.361	0.355	0.349	0.343	0.338
760	0.407	0.399	0.391	0.384	0.377	0.370	0.364	0.357	0.351	0.345	0.340	0.334	0.329
740	0.396	0.389	0.381	0.374	0.367	0.361	0.354	0.348	0.342	0.336	0.331	0.325	0.320
720	0.385	0.378	0.371	0.364	0.357	0.351	0.345	0.339	0.333	0.327	0.322	0.317	0.312
700	0.375	0.368	0.361	0.354	0.347	0.341	0.335	0.329	0.324	0.318	0.313	0.308	0.303
680	0.364	0.357	0.350	0.344	0.337	0.331	0.325	0.320	0.314	0.309	0.304	0.299	0.294
660	0.353	0.347	0.340	0.334	0.327	0.322	0.316	0.310	0.305	0.300	0.295	0.290	0.286
640	0.343	0.336	0.330	0.323	0.318	0.312	0.306	0.301	0.296	0.291	0.286	0.281	0.277
620	0.332	0.326	0.319	0.313	0.308	0.302	0.297	0.292	0.287	0.282	0.277	0.273	0.268
600	0.321	0.315	0.309	0.303	0.298	0.292	0.287	0.282	0.277	0.273	0.268	0.264	0.260
580	0.311	0.305	0.299	0.293	0.288	0.283	0.278	0.273	0.268	0.264	0.259	0.255	0.251
560	0.300	0.294	0.288	0.283	0.278	0.273	0.268	0.263	0.259	0.255	0.250	0.246	0.242

5 The accumulation chamber

In the following table the factors for the conversion from ppm/sec slope to CO_2 grams/m2/day are reported.

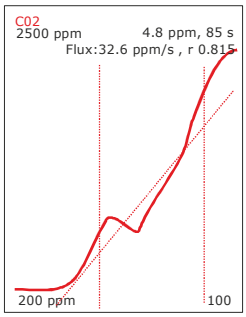
Barometric pressure [mBar]	Air temperature [°C]												
	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40
1100	25.918	25.416	24.933	24.468	24.020	23.588	23.172	22.770	22.381	22.006	21.643	21.292	20.952
1080	25.447	24.954	24.480	24.023	23.583	23.159	22.750	22.356	21.974	21.606	21.250	20.905	20.571
1060	24.975	24.492	24.026	23.578	23.147	22.731	22.329	21.942	21.567	21.206	20.856	20.518	20.190
1040	24.504	24.029	23.573	23.133	22.710	22.302	21.908	21.528	21.161	20.806	20.463	20.130	19.809
1020	24.033	23.567	23.120	22.688	22.273	21.873	21.487	21.114	20.754	20.406	20.069	19.743	19.428
1000	23.562	23.105	22.666	22.244	21.836	21.444	21.065	20.700	20.347	20.005	19.675	19.356	19.047
980	23.090	22.643	22.213	21.799	21.400	21.015	20.644	20.286	19.940	19.605	19.282	18.969	18.666
960	22.619	22.181	21.760	21.354	20.963	20.586	20.223	19.872	19.533	19.205	18.888	18.582	18.285
940	22.148	21.719	21.306	20.909	20.526	20.157	19.801	19.458	19.126	18.805	18.495	18.195	17.904
920	21.677	21.257	20.853	20.464	20.090	19.728	19.380	19.044	18.719	18.405	18.101	17.808	17.523
900	21.205	20.795	20.400	20.019	19.653	19.300	18.959	18.630	18.312	18.005	17.708	17.421	17.142
880	20.734	20.333	19.946	19.574	19.216	18.871	18.537	18.216	17.905	17.605	17.314	17.033	16.762
860	20.263	19.871	19.493	19.130	18.779	18.442	18.116	17.802	17.498	17.205	16.921	16.646	16.381
840	19.792	19.408	19.040	18.685	18.343	18.013	17.695	17.388	17.091	16.805	16.527	16.259	16.000
820	19.321	18.946	18.586	18.240	17.906	17.584	17.274	16.974	16.684	16.404	16.134	15.872	15.619
800	18.849	18.484	18.133	17.795	17.469	17.155	16.852	16.560	16.277	16.004	15.740	15.485	15.238
780	18.378	18.022	17.680	17.350	17.032	16.726	16.431	16.146	15.870	15.604	15.347	15.098	14.857
760	17.907	17.560	17.226	16.905	16.596	16.297	16.010	15.732	15.463	15.204	14.953	14.711	14.476
740	17.436	17.098	16.773	16.460	16.159	15.868	15.588	15.318	15.057	14.804	14.560	14.324	14.095
720	16.964	16.636	16.320	16.015	15.722	15.440	15.167	14.904	14.650	14.404	14.166	13.936	13.714
700	16.493	16.174	15.866	15.571	15.286	15.011	14.746	14.490	14.243	14.004	13.773	13.549	13.333
680	16.022	15.712	15.413	15.126	14.849	14.582	14.324	14.076	13.836	13.604	13.379	13.162	12.952
660	15.551	15.249	14.960	14.681	14.412	14.153	13.903	13.662	13.429	13.204	12.986	12.775	12.571
640	15.079	14.787	14.506	14.236	13.975	13.724	13.482	13.248	13.022	12.803	12.592	12.388	12.190
620	14.608	14.325	14.053	13.791	13.539	13.295	13.060	12.834	12.615	12.403	12.199	12.001	11.809
600	14.137	13.863	13.600	13.346	13.102	12.866	12.639	12.420	12.208	12.003	11.805	11.614	11.428
580	13.666	13.401	13.146	12.901	12.665	12.437	12.218	12.006	11.801	11.603	11.412	11.227	11.047
560	13.195	12.939	12.693	12.456	12.228	12.009	11.797	11.592	11.394	11.203	11.018	10.839	10.666



The "perfect" curve

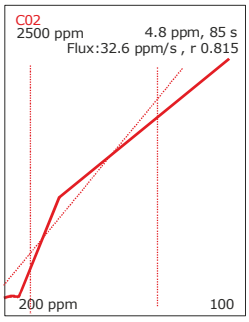
In the figure on the left the plot of a flux measurement.
The shape of the curve is quite perfect, and the computation of the flux is done with a very good accuracy: r (regression quality factor) very close to 1.

The following figures show some examples of flux curve shapes**:**



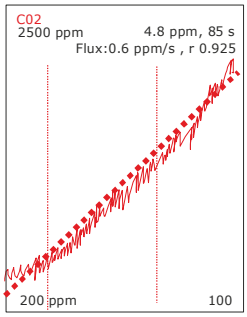
Air contamination

The flux curve is no longer "linear", the linear best fit curve doesn't fit exactly the flux curve as pointed out by the regression quality factor (0.815 in the example). This effect is probably due to atmospheric air contamination.
If you obtain this kind of curve check the sealing of the accumulation chamber with the soil or check that tubes, filters and pump are intact.



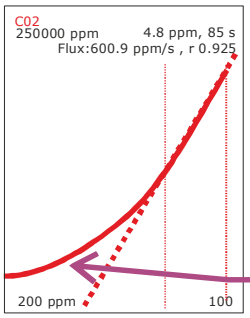
Gas stratification

This shape of curve indicates that the concentration of the target in air, close to the soil, is very high. This stratification is quite common in case of very high flux combined with a very stable atmosphere. You can use the measurement manually choosing (see DataRevision software) the second part of the curve for regression computation.



Low fluxes

This type of curve is normal when the flux is low, and the "noise" of the detector is comparable with the increase of concentration.



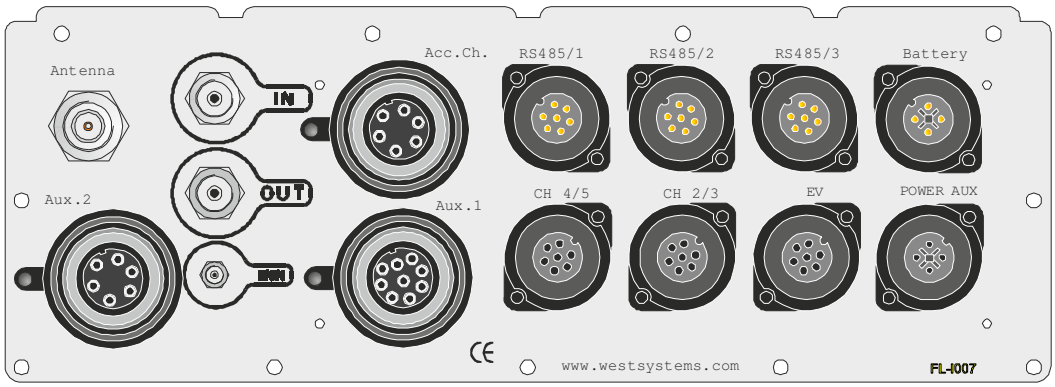
Very high flux

The first part of the curve is not linear. The problem is due to the combined effect of the high flux and the sampling line cleaning. To avoid this, increase the flux curve record time until the concentration of gas reaches the full scale value and select the last part of the curve for the flux computation.

This effect is due to the cleaning of the sampling line dead volumes

6.Flux Station

6.1 Connection panel



Ports ***RS485 1/2/3*** are used for connecting the accumulation chamber and the digital sensors. They're all connected to the same RS485 line so you can plug the digital sensors (e.g. airbox, soilbox, weather station) or the chamber to any port indifferently.

Port ***Ch 2/3*** and ***Ch 4/5*** are used to connect additional sensors with analog output to the station. In the default configuration, channel 2 accepts current input (4-20 mA). Channels 3-4-5 accept voltage input (0-5 Volts). Note that channels 2 and 3 input are replied inside the case in the backplane ports.

Battery is the power input port. It's connected to the charge regulator or to a power supply.

Power AUX is a power output port. It can be used to power any device with the same power input that comes from the Battery port.

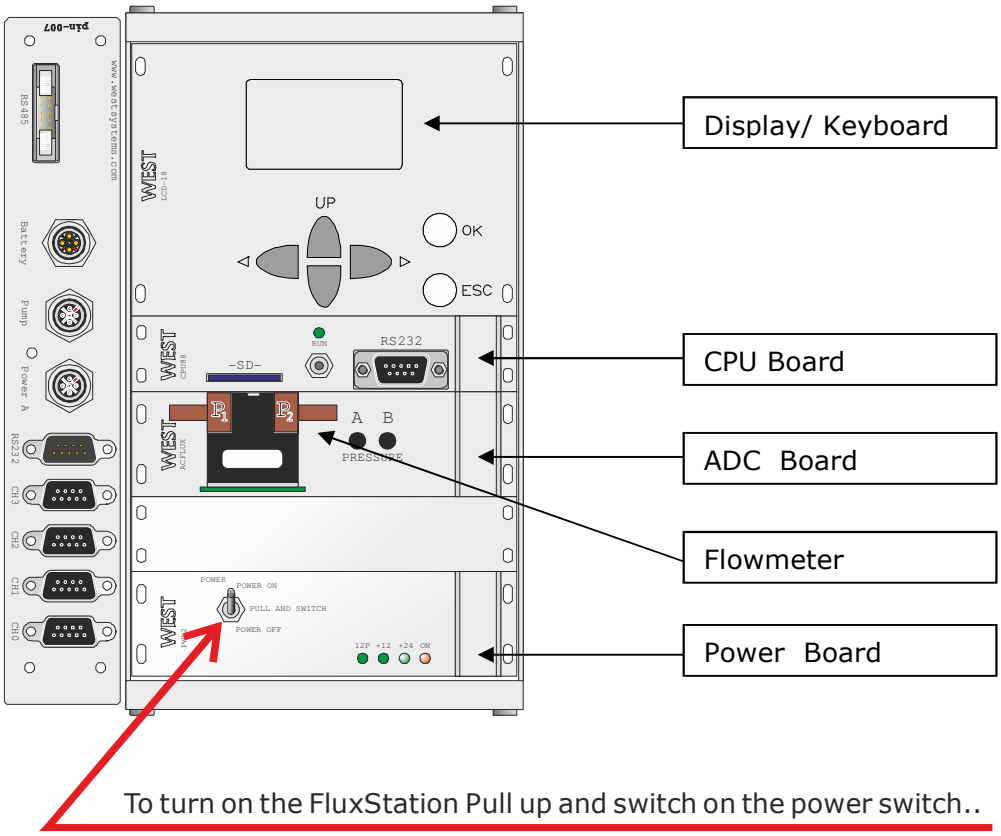
EV is the digital output port. The station has 4 digital output signals that can be configured to turn on or off at a certain moment of the flux analysis.

Acc Ch. and ***Aux.1*** ports are used to connect an analog accumulation chamber. Note: the two sockets are not present if the fluxstation configuration includes a digital chamber, connected via RS485.

Antenna port is used to connect an external antenna, if needed. Type is N-female.

Aux. 2 port contains an Ethernet socket, protected by a cap against dust and water. The Ethernet port is connected directly the Modem-Router LAN port. The Aux.2 port can be used to communicate to the flux station without having to open the station. A laptop with an Ethernet port is needed.

6.2 Backplane

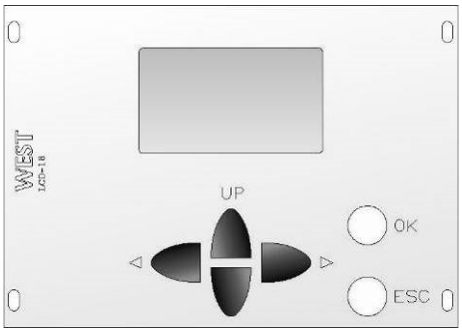


The flux station electronics is composed by 4 boards:

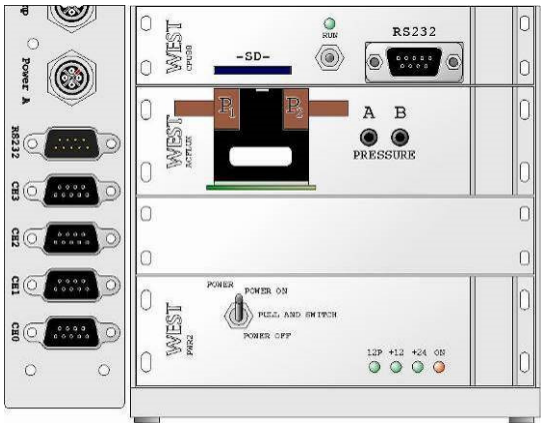
- Display and keyboard.
- The CPU Board manages the analysis, the storage of data and the communication with the outside.
- The ADC Board managed the 24-bit Analog-to-Digital conversion of the 8 analog channels.
- The Power Board provides the 12V and 24V channels, necessary to the functioning of the sensors and the devices.

6.3 Display

The station is equipped with a LCD monochromatic display for configuration and testing of the sensors.



Readable surface: 5.1 cm X 3.1 cm
Input: 6 buttons (up, down, left, right arrows, OK, ESC).



The display is kept usually off in order to minimize power consumption. To wake it up, press the "RUN" button.
At the startup, the display will show the West Systems logo. If no buttons are pressed, the display will remain in this state. Otherwise after 2 seconds the main menu will be showed.

Pressing ESC from the main menu, a frame will show the current status of the station, the next status and the remaining time.

Example 1:

STATION STATUS : IDLE
Current Event:
Waiting to start analysis
Next event:
…
Time to Next Event:
900 s

The station is waiting for the next measurement that will start in 15 minutes.

Example 2:

```
STATION STATUS :   BUSY
Current Event:
  Pump start
Next event:
  Chamber Down start
Time to Next Event:
  3000 ms
```

The station is performing the measurement cycle. The last action was starting the pump. In 3 seconds the chamber will start closing.

Press any key to return to the main menu.

General menu and keyboard rules:

- To enter onto a submenu: Select the entry and press *OK*.
- To exit from a submenu: Select *Back* and press *OK*, or press *ESC*
- To navigate between multi pages submenu:
  - Select *Prev page* or *Next page* and press *OK*.
  or
  - Press *LEFT* for previous page or *RIGHT* for next page.

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6.4 Menu structure

- 1 MEASURE
  - 1.1 SHOW ANALOG VALUES
  - 1.2 SHOW DIGITAL VALUES
  - 1.3 START ANALYSIS (MAIN SCH.)
  - 1.4 START ANALYSIS (SEC SCH.)
  - 1.5 STOP ANALYSIS
- 2 COMMANDS
  - 2.1 MANAGE ACCUMULATION CHAMBER
  - 2.2 SET RADIO STATUS
  - 2.3 SET FAN STATUS
  - 2.4 SET PUMP STATUS
  - 2.5 GET STATION STATUS
  - 2.6 GET CLOCK TIME-DATE
  - 2.7 GET INTERNAL TEMPERATURE
  - 2.8 GET BATTERY VOLTAGE
  - 2.9 RS485 MENU
  - 2.10 FILE MENU
  - 2.11 POWER SUPPLY MENU
  - 2.12 HANDLE EVS
  - 2.13 SELECT ACTIVE CHAMBER
  - 2.14 GET GSM SIGNAL
- 3 SETTINGS
  - 3.1 STATION SETTINGS
  - 3.2 LCD SETTINGS
  - 3.3 STATION VERSION
- 4 POWER MANAGEMENT
  - 4.1 LCD STAND-BY
  - 4.2 LCD SWITCH OFF
  - 4.3 CPU RESET
  - 4.4 RADIO OFF - CPU SLEEP

When you're finished your job, you can turn off the LCD display with the menu POWER MANAGEMENT and then LCD SWITCH-OFF, but it is not usually necessary because the display will automatically shut down after a certain amount of time (configurable in LCD SETTINGS menu).

[1 MENU MEASURE]

[1.1 SHOW ANALOG VALUES]
The real-time readings of the 8 analog channels are displayed. The analog channels are the ones connected to the internal Backplane (for example the CO2 detector, the Vaisala pressure sensor, the flowmeter) or plugged to the external connector (CH 2/3 and CH 4/5).

[1.2 SHOW DIGITAL VALUES]
The real-time readings of the digital channels are displayed. The digital channels are the ones connected to the RS485 chain. Their number is variable from 0 to 31.

[1.3 START ANALYSIS (MAIN SCH.)]
Start one cycle of measure using the Main Scheduler. The cycle starts from the lower timing (usually "+24 ON") and ends with the higher one (usually "radio off" or "write file"). This command executes manually what is automatically executed by the scheduler (for example every hour).

[1.4 START ANALYSIS (SEC. SCH.)]
Start one cycle of measure using the Secondary Scheduler (if enabled). The cycle starts from the lower timing (usually +24 ON) and ends with the higher one (usually radio off). This command executes manually what is automatically executed by the scheduler (for example every hour).

[1.5 STOP ANALYSIS]
Stop the current analysis if it's running. So the station will remain in idle mode until another measure is started manually or by the scheduler.

[2 MENU COMMANDS]

[2.1 MANAGE CHAMBER]
The accumulation chamber is equipped with 2 proximity sensors to evaluate remotely if the chamber can close and open without obstacles. This page shows the current status of the proximity sensors on the accumulation chamber. Press and release the up and down arrows to start moving the chamber. Press Ok to stop. When the chamber is fully opened, you should see "PXY UP" ON the other OFF. While the chamber is going up or down you should
see both proxies off and when the chamber is closed you should see the "PXY DN" ON and the other OFF. If you see both "PXY DN" and "PXY UP" the chamber is not working or the proximity sensors are not well placed. See chapter 5 for more details.

[2.2 SET RADIO STATUS]
Allows to temporarily switch ON and OFF the radio. Then when a measure will start, the radio will return to be managed by the station. To set the radio always ON, you have to modify the event timings (set Radio ON e Radio Off to 0, see chapter 10 for more details)

[2.3 SET FAN STATUS]
Allows to temporarily switch ON and OFF the accumulation chamber mixing fan. Then when a measure will start, the fan will return to be managed by the station.

[2.4 SET PUMP STATUS]
Allows to temporarily switch ON and OFF the pump. Then when a measure will start, the pump will return to be managed by the station.

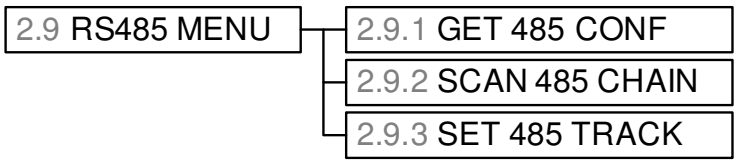
[2.5 GET STATION STATUS]
Show the status of the station and the current event of the measure (if 0 a measure is not running).

[2.6 GET CLOCK TIME-DATE]
Shows the station internal date and time. It's very important that this clock is correct because the measure files that will be recorded will be marked with this date. A wrong clock could make useless all the saved data. However the clock is automatically synchronized every time the master centre computer is able to communicate with the station (we advise furthermore to set the master centre personal computer to automatically synchronize its clock every day from a time server, e.g. time.windows.com). If the telemetry or the master centre are not active, synchronize the clock manually, using the [SET CLOCK DATE] and [SET CLOCK TIME] functions in the menu [SETTINGS].
Note: the clock is powered by the station or, when the station is switched on, by a 3V battery on the CPU board. If the station remains off for a large amount of time, the 3V battery will run down and the station clock will reset to January 1, 2000. In both cases, the clock integrated in the station is not so accurate (it could lose or gain even 1 or 2 seconds per day). Consider that if the station remains isolated (not interrogated by the master centre) for a large period of time, the date of the measures could drift.

[2.7 GET INTERNAL TEMPERATURE]
Show the station internal temperature.

[2.8 GET BATTERY VOLTAGE]
Shows the battery status. Since the battery is recharged by a solar panel, the voltage should fluctuate reaching the maximum value on the afternoon and the minimum at dawn. A value lower than 10 Volts is critical and the station could shut down.

[2.9 RS485 MENU]



[2.9.1 GET 485 CONF] shows the list of connected RS485 sensors.
The following fields are displayed:
- ID: hexadecimal view of the sensor ID in the RS485 chain
- Name: description of the sensor

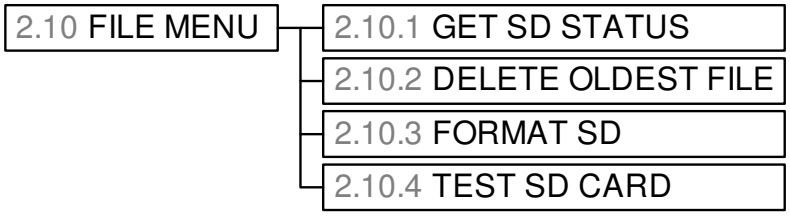
- Track On/Off: if you select Track=On a curve will be acquired for the selected channel. Otherwise only one sample per sensor will be saved. If one or more sensors are connected but they're missing on the list you should execute a RS485 SCAN.

[2.9.2 SCAN 485 CHAIN] update the list of digital sensors connected to the station. Perform this action if you added a new digital sensor, as SoilBox and AirBox. An RS485 scan will take several minutes.

[2.9.3 SET 485 TRACK] allows to set/unset the track of the sensor (see GET RS485 CONF). First select the sensor you'd like to set and then select ON or OFF.
This operation can be also executed remotely with Scada (allows to change the track of all channels, both analog and digital):

- Select "Get channels' configuration" and then "Call now".
- Open the table "PhisicalChannels" on the database
- Set the "PlotCurve" field of the corresponding row to 0 if you want to disable the track or to -1 if you want to enable it. Close the database.
- Select "Set channels' configuration" and then "Call now".

[2.10 FILE MENU]



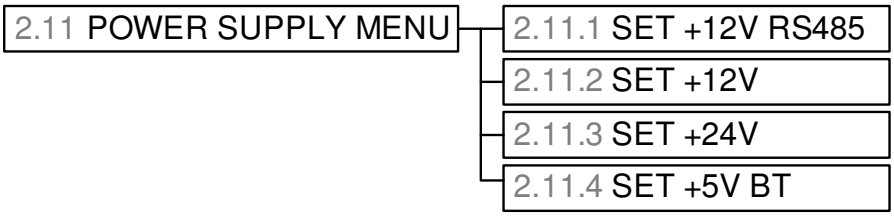
[2.10.1 GET SD STATUS] checks if the SD card is working and retrieves information about the capacity, space left and number of files on device. This process could take several minutes.

[2.10.2 DELETE OLDEST FILE] removes from the SD card the oldest file. It's the same operation done by Scada when a file is successfully downloaded.

[2.10.3 FORMAT SD] executes the memory card formatting. Warning: this operation will erase all the recorded data. Don't execute this command unless you want to empty the card.

[2.10.4 TEST SD CARD] executes a deep read/write access to the SD card. If this test is passed, we can be sure the SD is working fine. The same test is executed every time the station is switched on. We strongly advice to make this test every time you insert a new memory card, to make sure not to use damaged or unsupported SD card (example: SDHC).

[2.11 POWER SUPPLY MENU]



[2.11.1 SET +12V RS485]

Allows to temporarily switch ON and OFF the 12 Volt RS485 power supply (which powers the RS485 detectors like airbox and soilbox). Then when a measure will start, the supply will return to be managed by the station.

[2.11.2 SET +12V]

Allows to temporarily switch ON and OFF the 12 Volt power supply (which powers for example the barometric pressure probe, the flowmeter). Then when a measure will start, the supply will return to be managed by the station.

[2.11.3 SET +24V]

Allows to temporarily switch ON and OFF the 24 Volt power supply (which powers for example the CO2 detector). Then when a measure will start, the supply will return to be managed by the station.

[2.11.4 SET +5V BT]

Allows to temporarily switch ON and OFF the 5 Volt power supply (which powers for example the BlueTooth module). Then when a measure will start, the supply will return to be managed by the station.

[2.12 HANDLE EVs]

Allows to read and set the status of the digital output EV0, EV1, EV2, EV3.

[2.13 SELECT ACTIVE CHAMBER]

(Only in multi-chamber mode) This command selects one of the accumulation chambers on the multiplexer. When a chamber is selected, the actions you call on the station (motor up, motor down, fan on) are forwarded to the active chamber, and the sampling line is switched.

[2.14 GET GSM SIGNAL]

Allows to check the GSM signal quality (if a GSM/GPRS modem is connected).
To check the signal of GSM network, follow the procedure:

- Turn on the GSM modem (menu 2.12 Handle EV, then activate EV3)
- Get back to GSM menu (2.14). The display will show a couple of numbers separated by a comma

The first number is the RSSI (Received signal strength indication). It has the following meaning:

0: –113 dBm or less
1: –111 dBm
30: –109 to –53 dBm
31: –51dBm or greater
99: not known or not detectable

The second number is the BER (Bit Error Rate).
You may need an RSSI greater than 20 to have a good communication with the master center.

[3 MENU SETTINGS]

- 3.1 STATION SETTINGS
  - 3.1.1 SET CHANNELS PARAMETERS
  - 3.1.2 SET SAMPLE PARAMETERS
  - 3.1.3 SET EVENT TIMINGS
  - 3.1.4 SET STATION ADDRESS
  - 3.1.5 SET CLOCK DATE
  - 3.1.6 SET CLOCK TIME
  - 3.1.7 SET GPS TIME ZONE
  - 3.1.8 SET COMM SPEED
  - 3.1.9 SET CHAMBER NUMBER

[3.1.1 SET CHANNELS PARAMETERS]

Allows to modify the settings of the analog channels. Use the left and right arrows to move from the channel 0 to 7. Use the up and down arrows to move between the fields of one channel. Press OK to edit selected field. You can modify the following parameters:

- Conf: Is the type of channel, and it defines the way the station translate an analog input to a readable measure unit.

Valid Conf are:

- FF05: the output of sensor connected to the channel is 0-5V and the station will consider 0 V equal to the "Low Scale" value and the 5 V equal to the "Full Scale" value.
- FF06: the output of sensor connected to the channel is 4-20 mA and the station will consider 4mA equal to the "Low Scale" value and the 20 mA equal to the "Full Scale" value.
- FF07: the output of sensor connected to the channel is 1-5V and the station will consider 1 V equal to the "Low Scale" value and the 5 V equal to the "Full Scale" value.
- FF0F: special Conf. reserved to the P.Flow sensor (AWM3300). A special trasfer function is applied to this channel to linearize the answer. Since an hardware adjustement is necessary to change the input from current to voltage these field must considered read only.

- Name: is a description of the channel, to help the operator.

- Gain/Offset: the reading of the channel can be calibrated using these 2 parameters as result of the formula: y=ax+b where x = original value, a = gain, b = offset, y = calibrated value. Use the Gain/Offset to correct the answer of a detector. Default values are Gain=1 Offset = 0. These values leave the original reading.

- Offset: See Gain.

- Low Scale/Full Scale: see Conf. Usually you will need to change those parameters only if you change a sensor of if you modify its measurement range. Instructions to change the detector full scale are reported in the following pages.

- Track: If you select Track=On a curve will be acquired for the selected channel. Otherwise only one sample per sensor will be saved.

[3.1.2 SET SAMPLE PARAMETERS]
Allows to set the number of samples that will be recorded for a curve (default: 90) and the time interval between 2 samples (default: 2000 milliseconds).
With the default parameters, the accumulation chamber will take 180 seconds.
Note: if you want to enlarge the sampling window by increasing one of those 2 parameters, you have also to modify the timings (for example to shift the time of the pump power off or of the chamber rise). Don't hesitate to contact West Systems support before to perform those operations.

[3.1.3 SET EVENT TIMINGS]
Allows to set the station event timings. Use left and right arrows for fast scrolling. Those settings allow to manage the frequency of the measures and the analysis cycle . Those parameters can also be accessed in remote by calling in Scada "Get station parameters" and opening the table "HWR7_Parameters" of the database scada_data.
Modifying the timings is a delicate operation so don't hesitate to contact West Systems support before.
The event timings (timings from 1 to 31 included) are those timings that regulate at what instant a certain event is executed. All event timings are relative to the start of the analysis cycle.
For example if the timing 7 (event Pump On) is set to 120000, the pump will start 2 minutes after the start of the cycle.
Scada furnishes (menu "Edit station parameters") a simplified interface to set all the timings starting from the wanted settings.
For example if you desire a Warm-Up time of 10 minutes, Scada will automatically delay all the following events. See chapter 10 for more details.

The following table describes the default values for the event timings (from 0 to 31).

ID	Description	Default	Note
0	Analisys frequency [s]	3600	One measure every hour. If set to 0, measure will start only manually: the scheduler is not active
1	+24 on [ms]	1	The 24V sensors are swicthed on at the beginning of the measure, to allow the warm-up
2	+24 off [ms]	365000	The 24V sensors are swicthed off at the end of the cycle
3	AC Down start [ms]	120000	The chamber starts closing after a 2 minutes warm-up and cleaning

4	AC Down stop [ms]	149000	The chamber is pushed down for a maximum of 29 seconds. If the Chamber-Closed proximity sensors detects the chamber is closed, it will stop pushing immediately
5	AC Up start [ms]	335000	The chamber starts opening when the sampling has finished
6	AC Up stop [ms]	364000	The chamber is pushed up for a maximum of 29 seconds. If the Chamber-Opened proximity sensors detects the chamber is open, it will stop pushing immediately
7	Pump on [ms]	60000	The pump starts after one minute warm-up
8	Pump off [ms]	365000	The pump stops at the end of the cycle
9	Fan on [ms]	60000	The fan starts after one minute warm-up
10	Fan off [ms]	365000	The fan stops at the end of the cycle
11	+12 on [ms]	1	The 12V sensors are swicthed on at the beginning of the measure, to allow the warm-up
12	+12 off [ms]	365000	The 12V sensors are swicthed off at the end of the cycle
13	Sampling [ms]	150000	The accumulation curve sampling begins when the chamber is fully closed, and will go on according to NumSamples and DeltaT parameters
14	All Off [ms]	365000	All the devices are swithed off at the end of the cycle
15	RS485 Sampling [ms]	331000	The digital sensors (connected to the airbox and to the chamber) are sampled at the end of the accumulation curve sampling, when the chamber is still closed
16	Write File to SD [ms]	366000	The writing of the measure file on the SD card must be the last event of the cycle (excluding radio on and off)
17	+12 RS485 on [ms]	2000	The chamber and the airbox are switched on 2 seconds after the beginning of the cycle

18	+12 RS485 off [ms]	365000	The chamber and the airbox are swicthed off at the end of the cycle
19	EV0 on [ms]	0	The digital outputs can be used to switch on one or more devices at some particular moment of the cycle. Not used in the default configuration
20	EV0 off [ms]	0	
21	EV1 on [ms]	0	
22	EV1 off [ms]	0	
23	EV2 on [ms]	0	
24	EV2 off [ms]	0	
25	EV3 on [ms]	0	
26	EV3 off [ms]	0	
27	BT on [ms]	0	
28	BT off [ms]	0	
29	-	0	Not used
30	Radio on [ms]	600000	If both are equal to 0, the station will never go to sleep mode and the telemetry apparatus will be always swicthed on, meaning that the station can be interrogated at any time. Otherwise, the station will go to sleep mode immediately after the writing of the file to the SD card. The station will wake up 10 minutes after the beginning of the cycle. It will go to sleep mode again 15 minutes after the beginning of the cycle. If during this 5 minutes telemetry window WS-Scada interrogates the station successfully, it will force the station into sleep mode without waiting for the whole telemetry window.
31	Radio off [ms]	900000	

[3.1.4 SET STATION ADDRESS]

Allows to set the station address. The default station address is 0001. There are 65535 possible addresses from 0001 to FFFF. If you have more that a station on the same network, it's strongly advised to assign a different address to every station, in order to prevent Scada to download data from the wrong station. However this parameter is set in the factory so you won't need to perform this operation. A station will respond only to the request having the correct address. Changing the station address without configuring also Scada will result in the impossibility of the communication with the master centre. It corresponds on the database to the StationIP field of the table Stations.

[3.1.5/6 SET CLOCK DATE / SET CLOCK TIME]

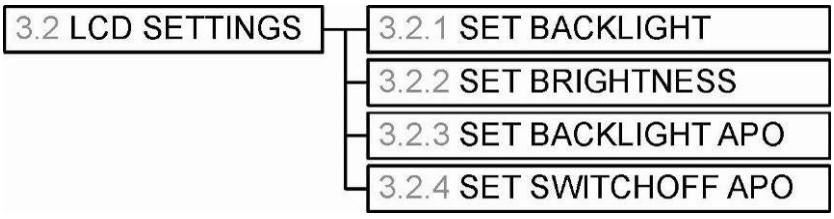
Allows to set the internal clock of the station. It's very important that this clock is correct because the measure files that will be recorded will be marked with this date. A wrong clock could make useless all the saved data. However, the clock is automatically synchronized every time the master centre computer is able to communicate with the station, so use this operation only if the telemetry is down.
We advise furthermore to set the master centre personal computer to automatically synchronize its clock every day from a time server (like time.windows.com).
Note: the clock is powered by the station or, when the station is switched on, by a 3V battery on the CPU board. If the station remains off for a large amount of time, the 3V battery will run down and the station clock will reset to January 1, 2000. In both cases, the clock integrated in the station is not so accurate (it could lose or gain even 1 or 2 seconds per day). So consider that if the station remains isolated (not interrogated by the master centre) for a large period of time, the date of the measures will derive.

[3.1.7 SET GPS TIME ZONE]
This section allows to change time zone when the GPS device is available. In this case the station clock is synchronized with GPS Time shifted by the time zone selected.

[3.1.8 SET COMM SPEED]
This section allows to change the baud rate settings of the serial ports. It is a very delicate operation that will be needed only in particular circumstances, so we strongly advise not to change these parameters, because this will interrupt the communication with the master centre or with the digital sensors.

[3.1.9 SET CHAMBER NUMBER]
Allows the setting of the number of accumulation chambers that are connected directly to the station (1 chamber) or to the multiplexer (from 2 to a maximum of 8).

[3.2 LCD SETTINGS MENU]



[3.2.1 SET BACKLIGHT]
Allows to regulate the power of the LCD backlight.

[3.2.2 SET BRIGHTNESS]
Allows to regulate the brightness of the LCD.

[3.2.3 SET BACKLIGHT APO] (Auto Power Off)
Allows to set the time interval after which if any of the buttons will be pressed the station will switch off LCD backlight.

[3.2.4 SET SWITCHOFF APO] (Auto Power Off)

Allows to set the time interval after which if any of the buttons will be pressed the station will switch off the display.

[3.3 STATION VERSION]
Displays the serial number of the station and the firmware version of the station.

[4 MENU POWER MANAGEMENT]

[4.1 LCD STAND BY]
The display is temporarily switched off. It can be awaken by pressing the OK button.

[4.2 LCD SWITCH OFF]
The display is turned off and will be turned on again only when the CPU wakes up from a sleep state (or obviously if you switch on the station again). This operation doesn't affect the station behavior, only the LCD display will be shut down.

[4.3 CPU RESET]
Reset the CPU. This operation corresponds to switching off and on the station.

[4.4 RADIO OFF - CPU SLEEP]
Put the CPU in sleep mode. While in sleep mode, the station is like switched off, except for the fact that it will be woke up by its internal alarm clock or by pressing the CPU run button. It's the state of minimum power consumption.
The station goes to sleep mode in the following circumstances:

- After writing a file to the SD card: it will wake up at the event Radio ON (if different from 0) or at the next measure.
- After Radio Off: it will wake up at the next measure
- When Scada has finished interrogating the station, sending a specific command.
- Through this command on the LCD display.

6.5 Changing the Vaisala GMP343 measurement range

In case the measurement range is not well fitted to the magnitude of the soil emission, you could have one of the following scenarios:
- Range too wide: you can't appreciate the carbon dioxide concentration variations because masked by the "noise". In this case you've to decrease the full-scale value.
- Range too short: the CO2 concentration inside the chamber exceeds the full scale of the detector so you have a saturation of the signal. In this case you've got to increase the full-scale value;
In both scenarios it’s preferable to modify the measurement range.

This is made in 2 steps:
1- Editing the sensor configuration.
2- Editing the input channels configuration on the station with the new range.

With GMP343 it’s possible to set the range to one of the following values:
0-1000 ppm
0-2000 ppm
0-3000 ppm
0-4000 ppm
0-5000 ppm
0-2% (default)

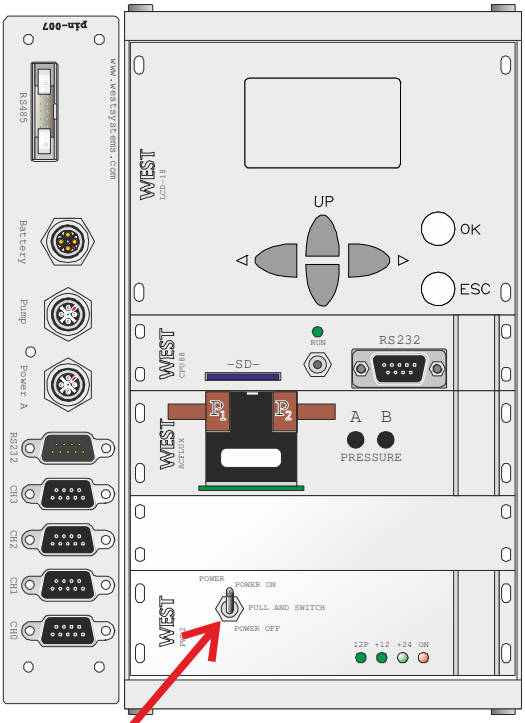
To modify the measurement range you’ll need:
- A PC/laptop with a RS232 port (or USB adapter)
- The Vaisala PC connection cable (DB9 to M11 adapter).
Please refer to Vaisala user guide for instructions (chapter 4). The “RANGE” command is the one necessary for modifying the range.

Remember now to set the same value on the station (menu 3.1.1 Set Channel parameter), if not already done.

.

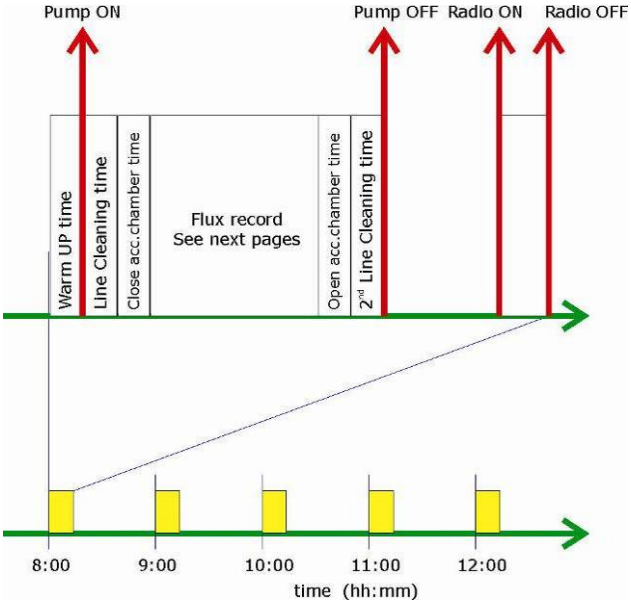
7.Running FluxStation

7.1 Quasi-continuous monitoring

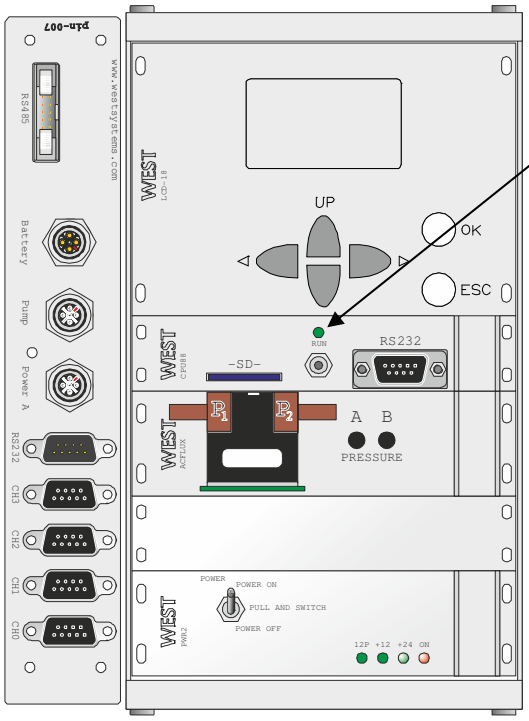


To turn on the FluxStation Pull up and switch on the power switch..

After a quick boot the station starts the quasi-continuous monitoring task. There is no need to manually activate the measurements. The next measurement will start automatically according to the Analysis Every timing.



Following the default configuration, the station performs one analysis cycle every hour. See chapter 5.



CPU RUN LED/BUTTON:

- If the LED is off, the station is in sleep mode. To wake up, press the same button
- If the LED is blinking every 2 seconds, the station is running
- If the LED is on, the station is going to write the file to the SD card (it's a warning to wait to replace the card)

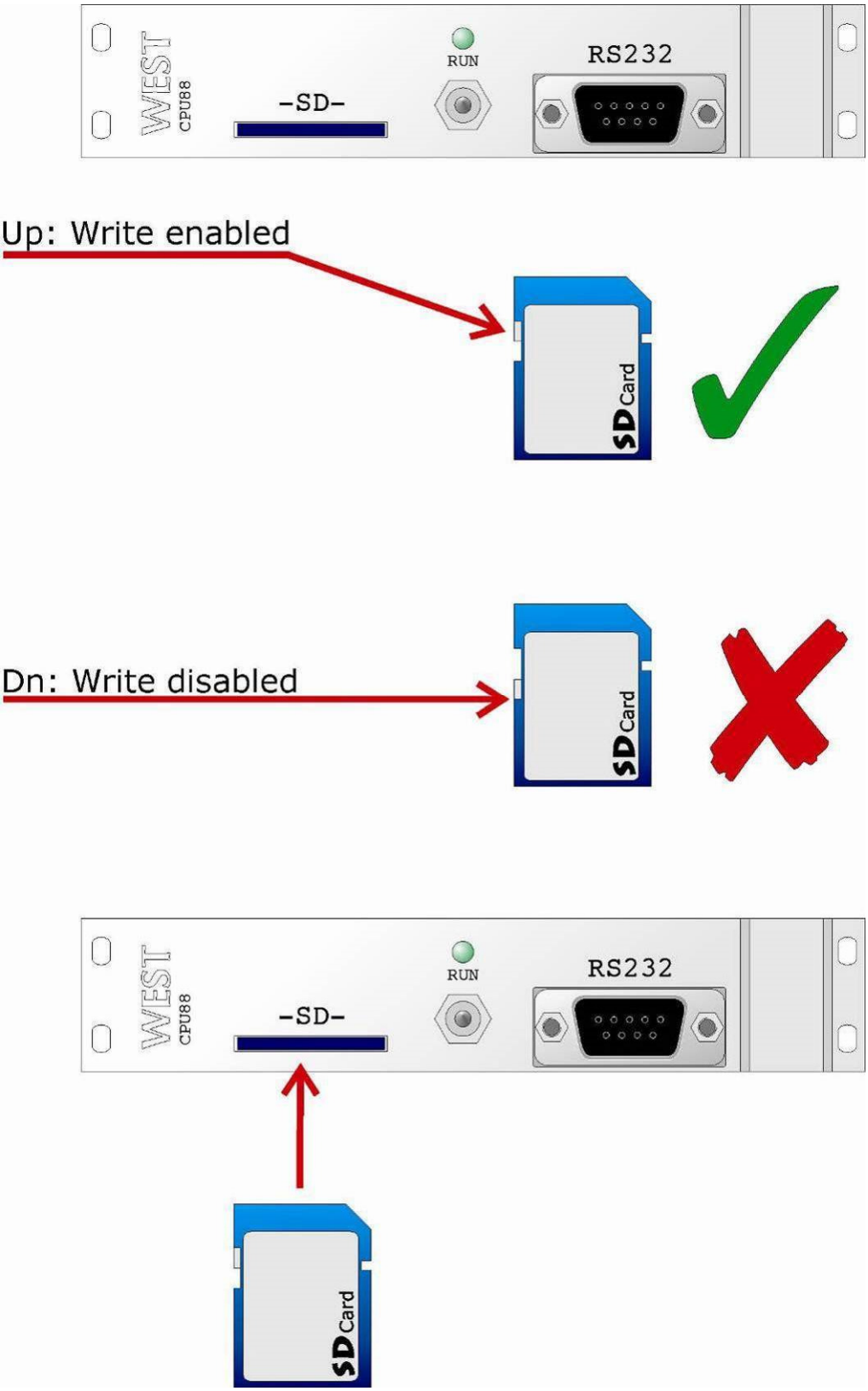
The station stores the result of analysis cycles on a SD memory card. The SD card is formatted using the FAT32 file system and can be read directly from Windows XP / Vista on a PC.

Each analysis cycle requires a couple of kilobytes on the SD card (it depends on the number of tracks and the number of samples per track), but due to the file system the "disk dimension" of file is 4 Kbytes. Then for the default sampling frequency (one measure every hour) are necessary 96 KB/day (35 MB/year). An SD card with 1 GB capacity will store data for 28 years.

But if the station is regularly interrogated, the SD card will contain only 1 file at once, because as Scada downloads a file and saves it on the Database, commands the station to remove the file from the SD card.

Note: the station is NOT compatible with High-Capacity (SDHC) cards.
Please use standard SD cards (capacity up to 2 GB).

Before to insert the SD memory card in the CPU slot verify that the Write On/Off switch of the card is in the enabled position.



After inserting the SD card check if it's working correctly making a read/write test though the menu [2.10.4 Test SD Card]

This menu displays also the space left on device.

The station writes on the card at the end of the measurement cycle. Removing the card during the cycle can cause the loss of data.

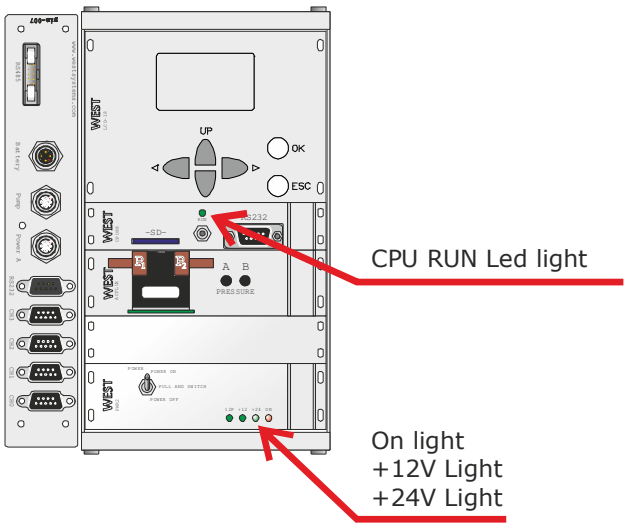
In order to inform the operator of the next writing operation, the CPU run led light will be solid ON for a 60 second period before starting to write on the card.

In order to swap the card on the FluxStation, you have to:

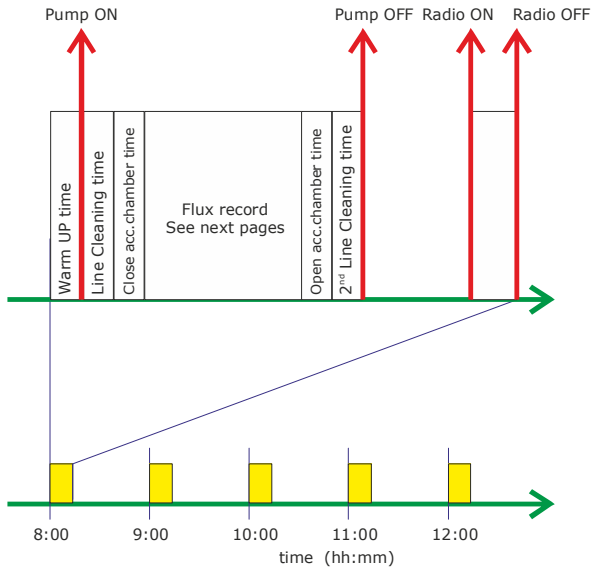
- Prepare the empty SD card. The SD card must be not SDHC. High Capacity cards are NOT compatible with the station. The card has to be formatted with FAT32;
- Check that the "CPU RUN LED" is flashing once every 2 seconds or that it's OFF;
- Remove the card on the slot;
- Place the empty card in the slot.

If you want to be sure the card is correctly inserted and functional, execute a read-write test: menu [COMMANDS][FILE MENU][TEST SD CARD].

7.2 Station Status



7 Running Flux Station



The station has two working states:

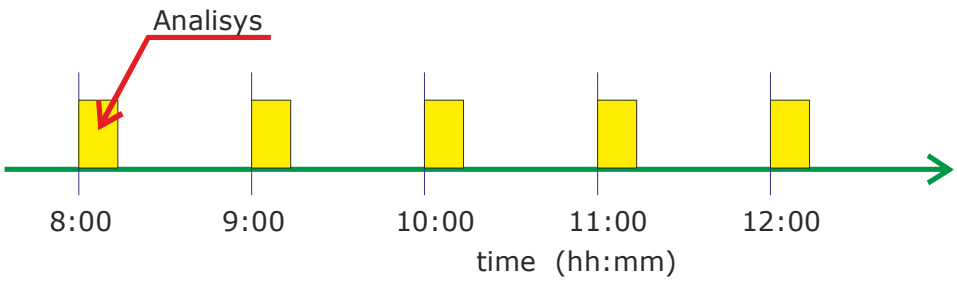
1) Standby: the time between the analysis cycles;

2) Analysis cycle (Yellow boxes in the drawings).

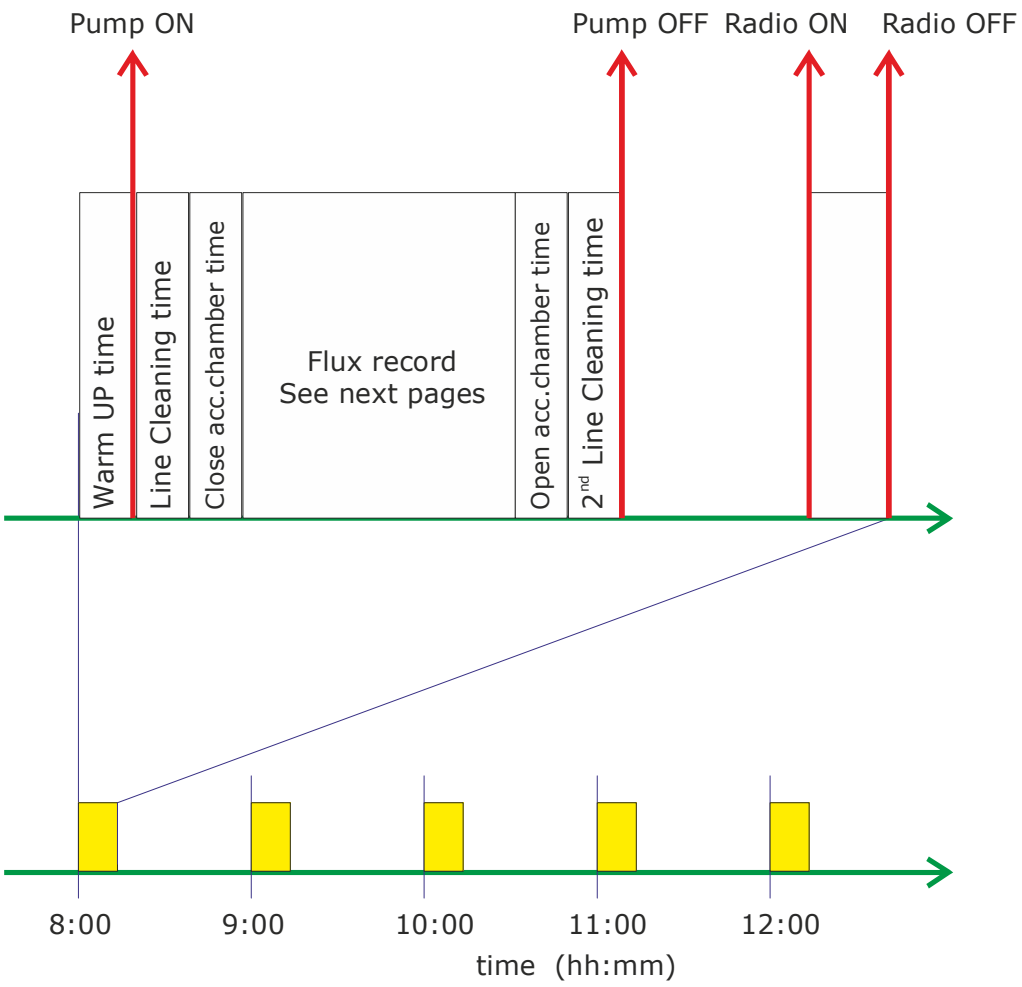
Stand-By State
During the stand-by state the CPU RUN led light, on the CPU board, flashes once per second and the ON light on the Power board is solid ON.

Analysis running state
While the analysis cycle is running the CPU RUN led light, on the CPU board, flashes once per second and the ON light on the Power board is solid ON. The +12V and +24V led light are solid ON (or OFF) depending on the phase of the analysis.

Analisys frequency
The first timing is the interval between analysis, expressed in seconds. Normally the station makes an analysis every hour and then the default value of the parameter is 3600 sec;
Valid range is from 300 to 7200 seconds;
If the time between analysis is 3600 secs (1 hour), the analysis will start exactly at the beginning of hour, for instance the sampling time will be 8 sharp, 9 sharp etc.



Every measurement cycle (analysis) is composed by several actions, that are scheduled by some parameters described below.

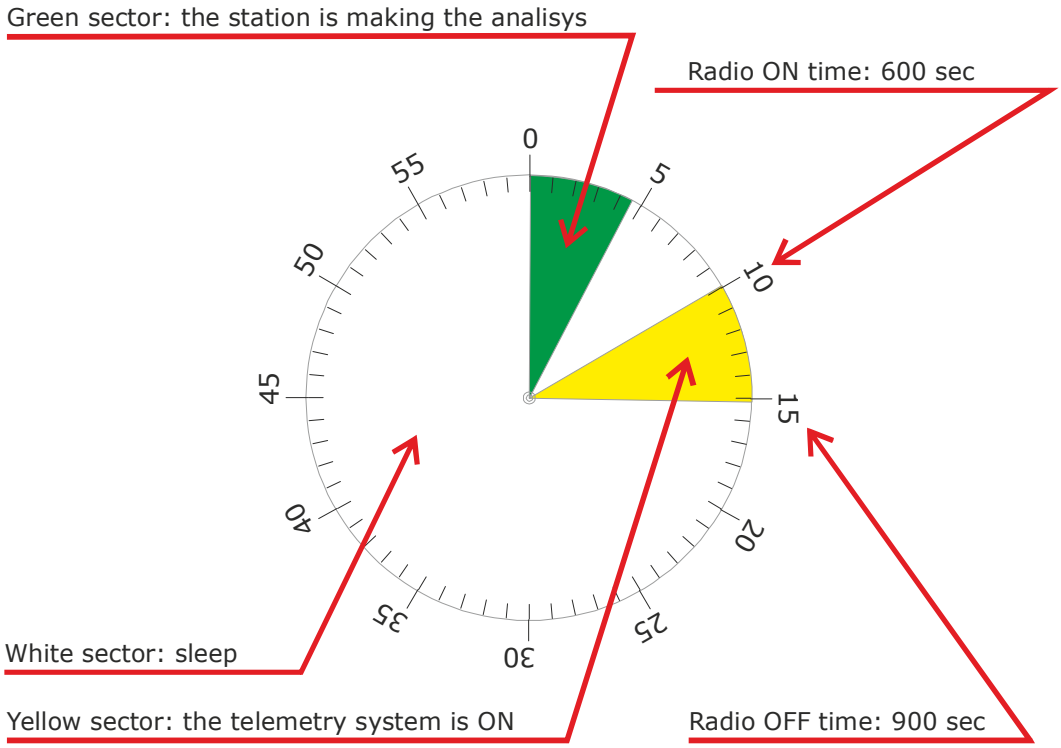


Set RADIO On/OFF:
In order to reduce the power consumption, the telemetry system is managed as follow:

- RADIO On time (sec)
The telemetry system will be turned ON after every analysis starting from the time, expressed in minutes, you set.

- RADIO Off time (sec)
The telemetry system will be turned OFF after every analysis starting from the time, expressed in minutes, you set.

7 Running Flux Station



In the drawing an example of
Radio On time = 600 (sec)
Radio Off time = 900 (sec)

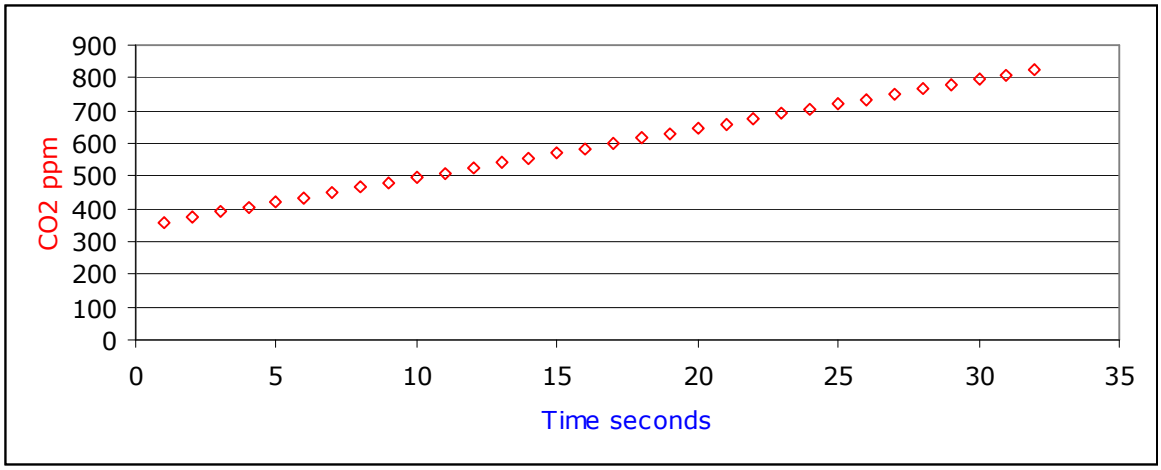
If *Radio Off Time* or *Radio On Time* are set to 0, the station will keep the radio ALWAYS ON and will never go to sleep mode.

Num. Samples: Is the number of points in the flux record. Normally the value is between 32 and 256 points. The increase of this parameter will increase the size of the record, reducing the capability of station data storage and increasing the data transmission time.

Delta T.: Is the time, expressed in millisecond, between the points sampled in the flux record.
Normally the value is between 500 (0.5 seconds) and 3000 (3 seconds)

The global flux record time is: **Delta T. x Num. Samples/ 1000**

In the following plot a sample of flux record with Num of Samples = 32 and DeltaT. = 1000 (1 second). The overall flux record length is 32 second.



The normal record length must be in the interval 90 .. 240 seconds. If the flux is quite high the length can be 90 seconds, is the flux is quite low is better to increase the record length.

8.Calibration

8.1 Calibration of Vaisala GMP343

The subjects regarding calibration of your instrument for the measurement of diffuse flux will be discussed in this chapter.

As explained previously the flux measurement is proportional to the slope of the concentration curve versus time. The proportionality factor depends on the volume/surface ratio of the accumulation chamber used for the measurement, as well as, the barometric pressure and air temperature at the moment of making the measurement.
The most important aspect to understand is that the flux is proportional to the gradient of concentration over time: ppm/second.
This aspect allows us to simplify the control of the response of the gas sensors utilised.

When to calibrate

The recommended calibration interval is one year. The operating conditions affect the long-term stability. In a harsh operating environment, it is recommended to check readings more often than in an easy environment.
When you change the range of the detector, in order to achieve the maximum of accuracy a re-calibration could be necessary.

What you need in order to check the calibration of the GMP343

- A cylinder of nitrogen or CO_2-free mixture.
- A cylinder of standard mixture of a known concentration of carbon dioxide in air (or nitrogen) *;
- Two Tedlar gas sampling bags, of 5 or 10 liters capacity.

* The carbon dioxide concentration should be between 50% and 95% of the detector measurement range. If the full-scale value of detector is set to 20,000 ppm, you can use a standard with a concentration of CO2 between 10,000 and 19,000 ppm. If the concentration is less than the 50% of the full-scale value you will increase the calibration error.
If the full scale of the detector is 1,000 ppm, you can use a standard with concentration of CO2 between 500 and 950 ppm.

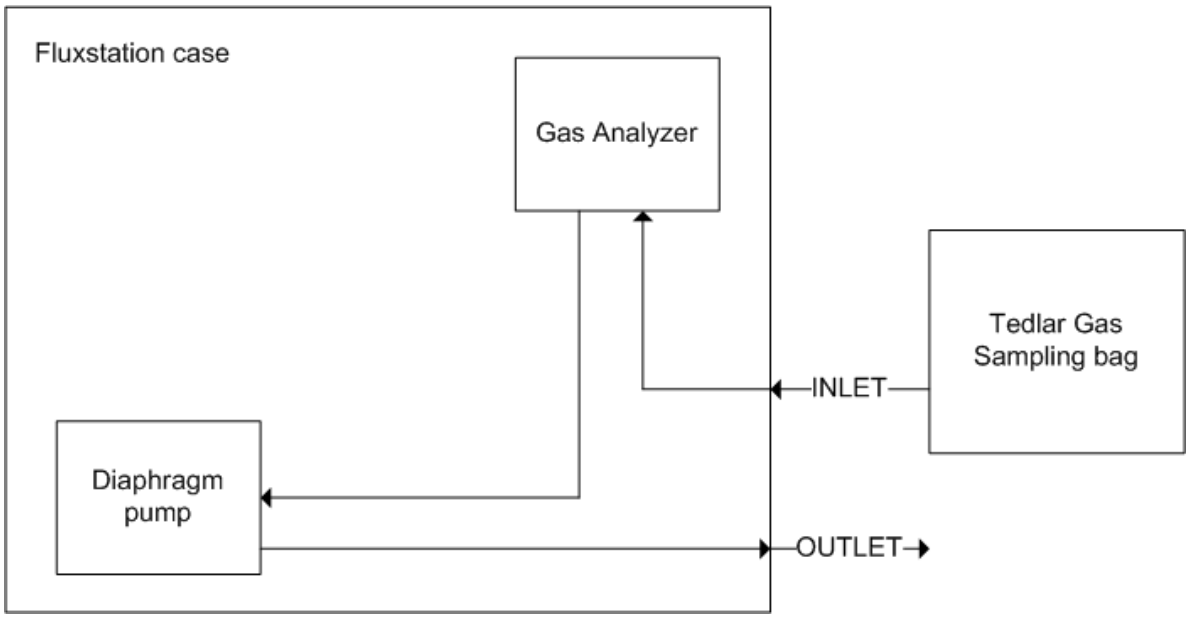
How to perform a calibration check

1- Before verifying the calibration, turn on the detectors (menu [MEASURE] [SHOW ANALOG VALUES]) and leave it on for a minimum of 5 minutes to warm up.

2- Start the pump from the menu [COMMANDS] [SET PUMP STATUS]

3- Fill the first Tedlar bag with nitrogen.

4- Connect the Tedlar bag to the inlet port of the flux station, as shown in the following diagram. In this way the pump will get the content of the bag into the detector and finally to exhaust passing from the outlet port.



5- Check the reading on the station display (menu [MEASURE] [SHOW ANALOG VALUES]). Wait for the value to stabilize and finally take note of the reading.

6- Disconnect the bag from the inlet.

7- Fill the second Tedlar bag with the CO_2 mixture.

8- Connect the Tedlar bag to the inlet port of the flux station.

9- Check the reading on the station display (menu [MEASURE] [SHOW ANALOG VALUES]). Wait for the value to stabilize and finally take note of the reading.

To simplify the explanation, please see the following example:

Let's suppose that the check performed gave the following results:
Injecting a mixture at zero concentration of carbon dioxide the CO2 detector returns a reading of 10 ppm.
Injecting a mixture containing a 10,000 ppm concentration of carbon dioxide the CO2 detector returns a reading of 9940 ppm.
At a variation of concentration set at 10,000 ppm the instrument has a slightly different response: 9930 ppm (=9940-10 ppm). The evaluation error is of about 70 ppm, which in percentage points over the span corresponds to 0.6% less.

8 Calibration

The error in evaluating the increment in concentration manifests as a systematic error in the evaluation of flux and, therefore, must be corrected by calibrating the instruments when it is too high (> 5%).

If the calibration check results are not satisfactory, it's necessary to re-calibrate the detector.

What you need in order to calibrate the GMP343

- A cylinder of nitrogen or CO_2-free mixture.
- A cylinder of standard mixture of a known concentration of carbon dioxide in air (or nitrogen) *;
- Two Tedlar gas sampling bags, of 5 or 10 liters capacity.
- A laptop with a RS232 serial port (or USB adapter)
- The PC adapter cable, provided by West Systems (West Systems P/N ASTVCC00). This cable supplies both power to the GMP343 and communication via RS232. In this way it is possible to calibrate the sensor while still installed inside the station.
  Otherwise it is possible to use the Vaisala PC connection cable (Vaisala P/N 213379).

* The carbon dioxide concentration should be between 50% and 95% of the detector measurement range. If the full scale value of detector is set to 20,000 ppm, you can use a standard with a concentration of CO2 between 10,000 and 19,000 ppm. If the concentration is less than the 50% of the full scale value you will increase the calibration error.
If the full scale of the detector is 1,000 ppm, you can use a standard with concentration of CO2 between 500 and 950 ppm.

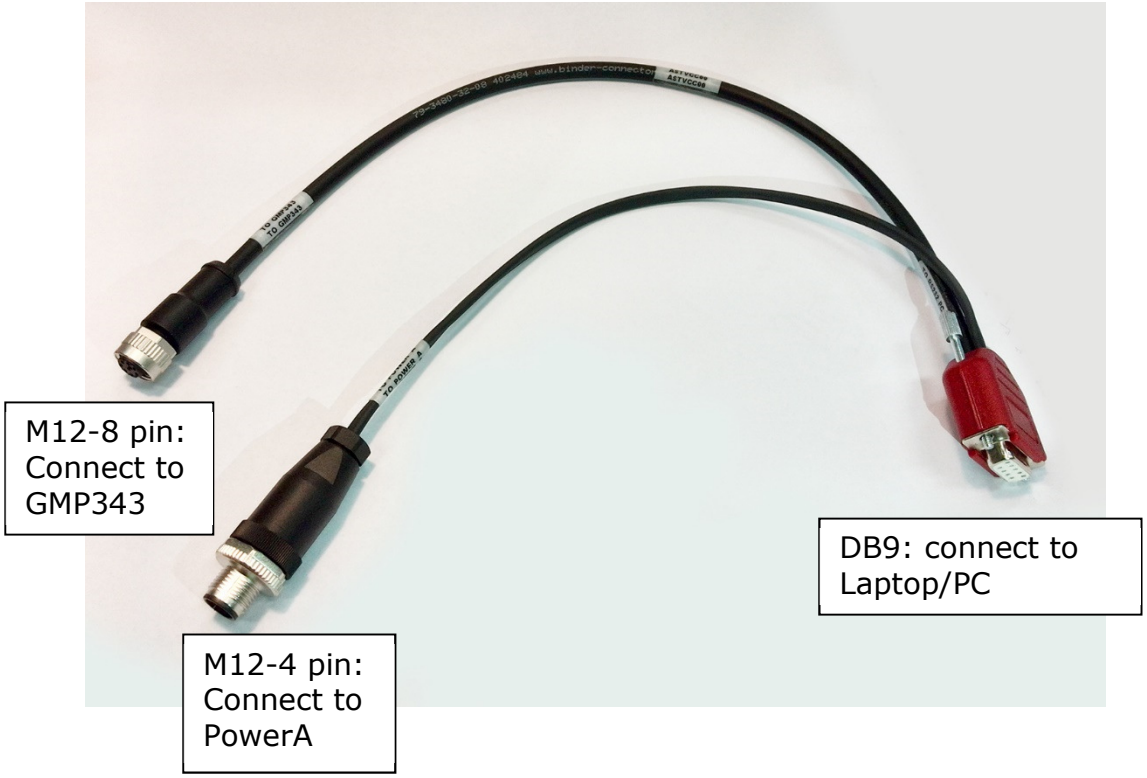
How to perform a calibration

1- Disconnect the Vaisala GMP343 from the *analog signal cable* which, during normal operation, is connected to the Channel 0 of the station analog input panel.

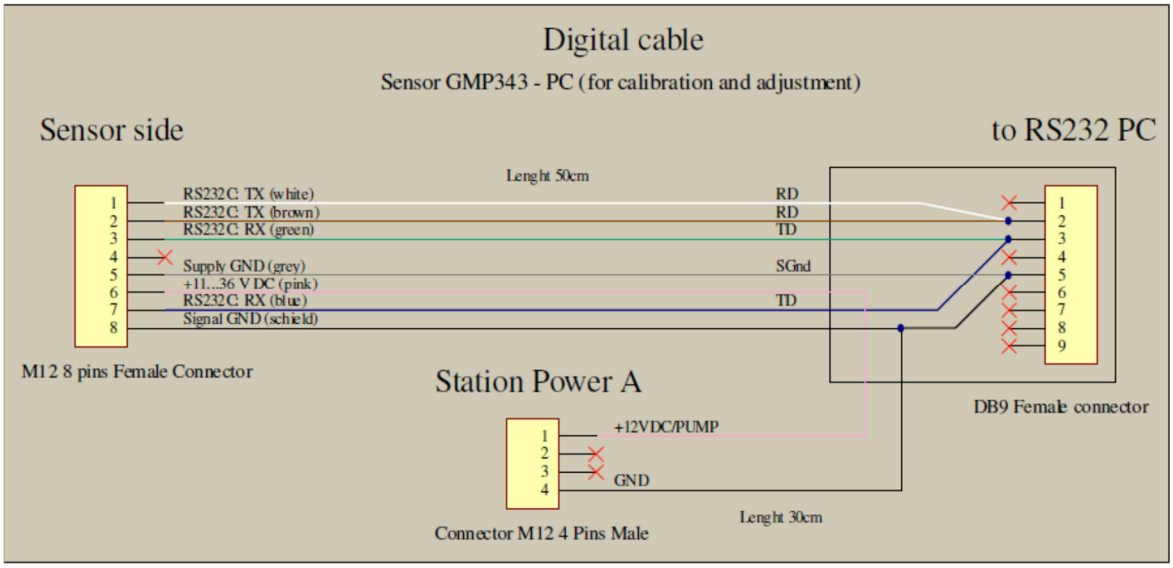
2- Install the adapter cable ASTVCC00 as show in the following picture:

   The M12 4 pin connector must be connected to the Power A socket, locate in the internal connectors panel of the flux station. This connection provides power supply from the sensor while it is disconnected from Channel 0.

   The DB9 connector must be plugged to the serial port of the laptop (usually provided by an USB-to-RS232 adapter).



The pinout of the ASTVCC00 is explained in the following diagram:



3- Turn on the pump of the station through the menu [COMMANDS] [SET PUMP STATUS]. This operation will switch on both the pump (that you'll need to flow the calibration gas into the detector) and the Vaisala GMP343.

4- Once connected, open a terminal on the laptop with the following settings:
Baudrate: 19200
Parity: No
Data bits: 8
Stop bits: 1
Flow Control: None

5- Follow the detailed instructions provided by the Vaisala GMP343 user guide (chapter 5: Calibration). We now report the paragraph extracted from the mentioned user guide:

Measurements in Reference Gases

1. If your GMP343 is the diffusion model, remove the filter cover and place the calibration adapter onto the probe.
2. Let the device warm up for 30 minutes to achieve full calibration accuracy.
3. Turn on the calibration mode by giving the command **CALIB ON**. This changes some of the transmitter parameters for the duration of the calibration.

   CALIB ON <cr>
4. Connect the reference gas to the inlet of GMP343 transmitter and let the gas flow for 5 minutes (about 0.5 l / min).
5. To output the measurement result, key in the command **R**. Check that the reading is stabilized and write down the CO_2 reading (ppm). Enter command **S** to stop outputting. For the best calibration result, it is recommended to calculate an average of 20 measurements instead of a single reading.
6. Shut off the reference gas flow and remove the tubings from the gas bottle. When calibrating at several points, connect the other gases to GMP343 similar to the first gas and carry out the measurements as instructed above (steps 6 and 7).
7. After measurements turn off the calibration mode by giving the command **CALIB OFF** (this reverts to the original transmitter settings).

   CALIB OFF <cr>

Adjustment in 1...2 Points

First carry out checking the compensations and perform the reference gas measurements as instructed in the previous section, Calibration and Adjustment by the User on page 62. Then continue as follows:

1. Key in the command

   LCI <cr>
2. Key in the **reading** at the reference gas (ppm) and press ENTER (1.Reading?).
3. Key in the **reference** gas concentration (ppm) and press ENTER (Reference?).
4. When making a one-point calibration press ENTER again and go to step 6 in this list. When making a two-point calibration, key in the reading at the **second reference** gas and press ENTER (2.Reading?).
5. Key in the **reference** gas 2 concentration (ppm) and press ENTER (Reference?).
6. Now the correction values are calculated, but the adjustment is not valid until the correction is confirmed.
7. Confirm the new correction values with the command

   LC ON <cr>
8. Use the command **R** to check with both reference gases that the correction has taken place and the readings are ok.
9. Save the settings:

   SAVE <cr>

   Saves parameters and settings to EEPROM memory.

Adjustment in 3...8 Points

First carry out checking the compensations and perform the reference gas measurements as instructed in the previous section, Calibration and Adjustment by the User on page 62. Then continue as follows:

1. Feed the readings (Reading?) and the corresponding concentrations (Reference?) with the command

   MPCI <cr>

2. Confirm the adjustment and the new correction values with the command

   MPC ON <cr>

3. Save the settings with the command

   SAVE <cr>

   Saves parameters and settings to EEPROM-memory.

Example of the 2-Point Adjustment Procedure

The following section presents an example of the 2-point adjustment procedure with reference gas concentrations of 0 ppm and 1007 ppm.

NOTE	Use the actual concentrations given usually in the side of the gas bottle. For example, a gas with a nominal 1000 ppm CO_2 concentration might actually contain 1007 ppm CO_2.

1. First turn on the calibration mode for measuring reference gases.

```
>
>calib on
Calibration mode started.
Use CALIB OFF to stop the mode.
```

2. The GMP is now measuring the first reference gas (0 ppm). Use command **R** and let the reading stabilize for several minutes. Calculate the average reading (reading 1).

```
>r
...28.2
28.2
28.1
28.1
28.2
```

3. The GMP343 is now measuring the second reference gas (1007 ppm). Use command R and let the reading stabilize for several minutes. Calculate the average reading (reading 2).

```
>
>r
1067.1
1066.8
1067.2
1066.7
1066.6
```

4. Turn off the calibration mode with command **CALIB OFF**.

```
>calib off
Calibration mode stopped.
```

5. Next feed the readings: use command **LCI** to feed the first and second reference gas readings (28 ppm and 1066 ppm), and the corrected values (= the concentrations of the reference gases, 0 ppm and 1007 ppm).

```
>lci
Reading Reference
   0.00      0.000
1000.00  1000.000
NOTE: Entering new correction
values all previous correction points!
Abort without losing correction points
by using ESC.
1. Reading ? 28
   Reference ? 0
2. Reading? 1066
   Reference? 1007
```

6. Confirm the adjustment with command **LC ON**.

```
>lc
LC : OFF ? on
```

7. Check the reading with the second reference gas, 1007 ppm.

```
>r
1005.4
1006.2
1007.1
1007.1
```

8. Check the reading with the first reference gas, 0 ppm.

```
>r
0.2
0.1
-0.1
-0.1
-0.0
-0.2
```

9. Save the settings.

```
save>
EEPROM saved successfully.
>
```

NOTE	You can revert the GMP343 back to factory settings with the command **FACTORY**.

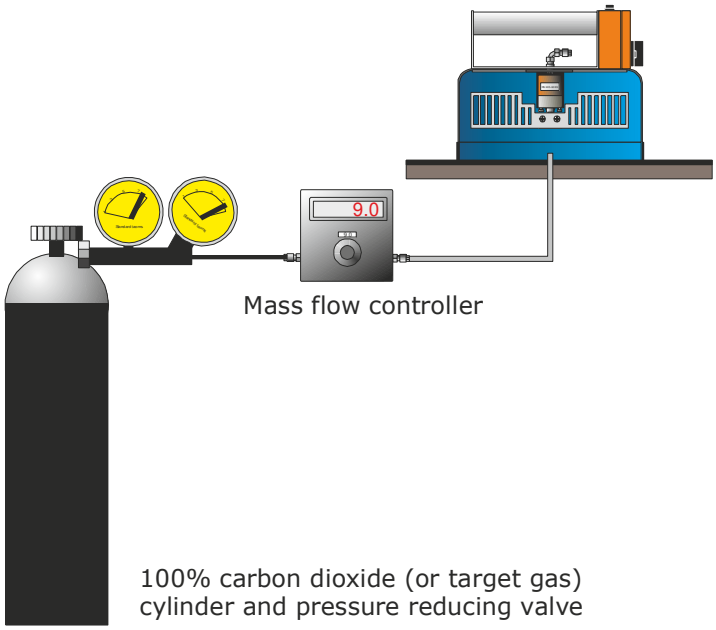
8.2 Calibration of the flux meter

As the computation of flux is a function of the gradient of concentration vs. time, barometric pressure, air temperature and the accumulation chamber volume / surface ratio, the calibration of the instrument depends only on the detector calibration. The accuracy of the barometric pressure and air temperature measurement affect the evaluation of flux: 3 degrees Celsius of error while evaluating the temperature will cause a 1 % of error when computing the flux. A 10 HPa (mBar) error measuring the barometric pressure will cause a 1% error in the flux evaluation.

How to verify the fluxmeter calibration

The calibration described refers to carbon dioxide calibration, for other gases, like methane or hydrogen sulphide, the same procedure has been followed.

Sketch of calibration device

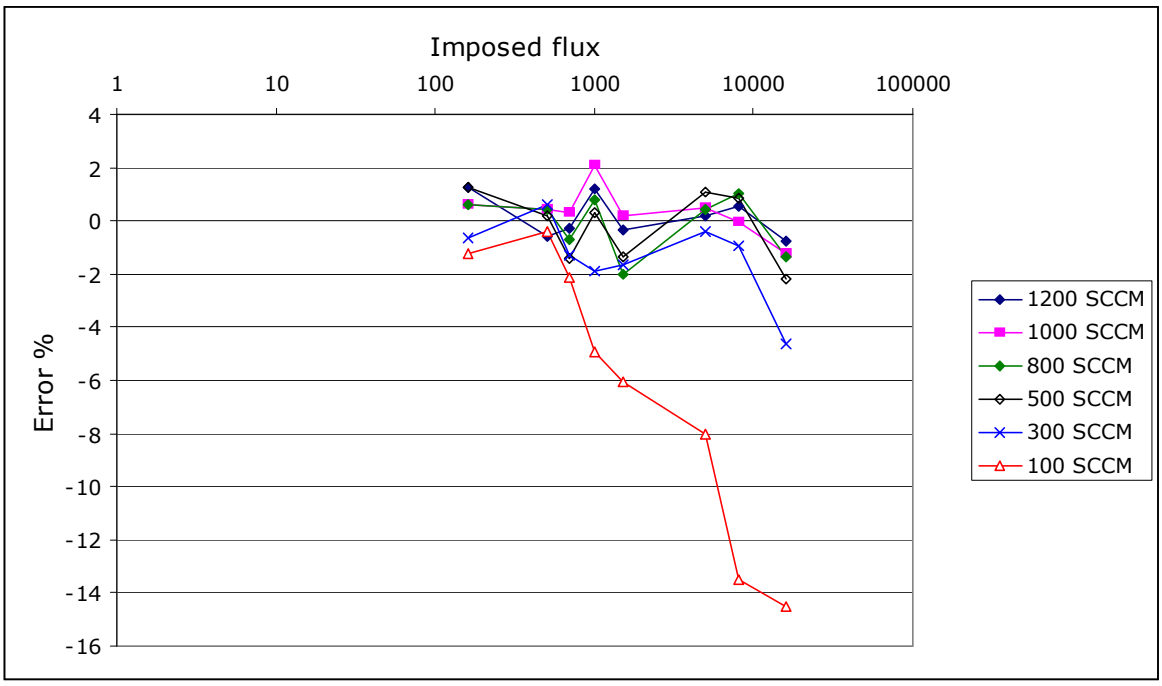


CO2 fluxes from soil are simulated by injecting a known flow of gas into the accumulation chamber. The interface between the accumulation chamber and the calibration table is built to minimize the gas leakage.
The apparatus is schematized in figure 1.
The injected flux is controlled and measured with a precision mass flow controller. This MFC, calibrated for CO2, is electronically stabilized, with accuracy: ± (0.8% of Reading + 0.2% of Full Scale).

A thermometer and barometer were utilized to measure the barometric pressure and the air temperature during the experiment in order to select the correct accumulation chamber conversion factor.
A flow meter is utilized to measure the pumping flow during the experiment.
During all the measures a 100% CO2 flow was utilized.
The same procedure was utilized to check the instrumental response to methane / Hydrogen Sulphide.

The influence of pumping flow
Influence of pumping efficiency on the flux measurement results:
We have carried out some sets of measures utilizing the same injected flux but with different pumping flow from the accumulation chamber to the detector.
The pumping flow was changed by means of a mechanical flow reducer and measured with a Microbridge Mass Airflow sensor (Accuracy 2%).
We have not noted a significant variation of the measures except when the pumping flow is less than 200 SCCM.

8 Calibration



In the diagram the plot of the measurement error versus the imposed flux of carbon dioxide (expressed in grams per square meter per day) at different pumping flow rates is shown.

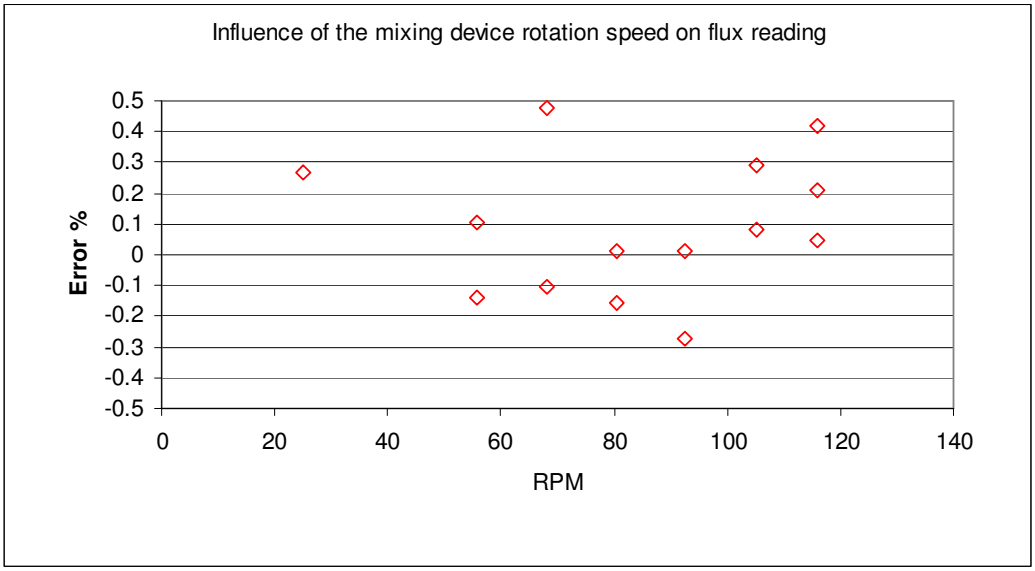
In order to avoid unwanted variation of pumping flow due to power supply the pump is supplied at 12 V DC with a stabilized voltage regulator.

The efficiency of pump can vary due to dust or moisture in the pump body. Periodic maintenance is necessary.

The influence of mixing device

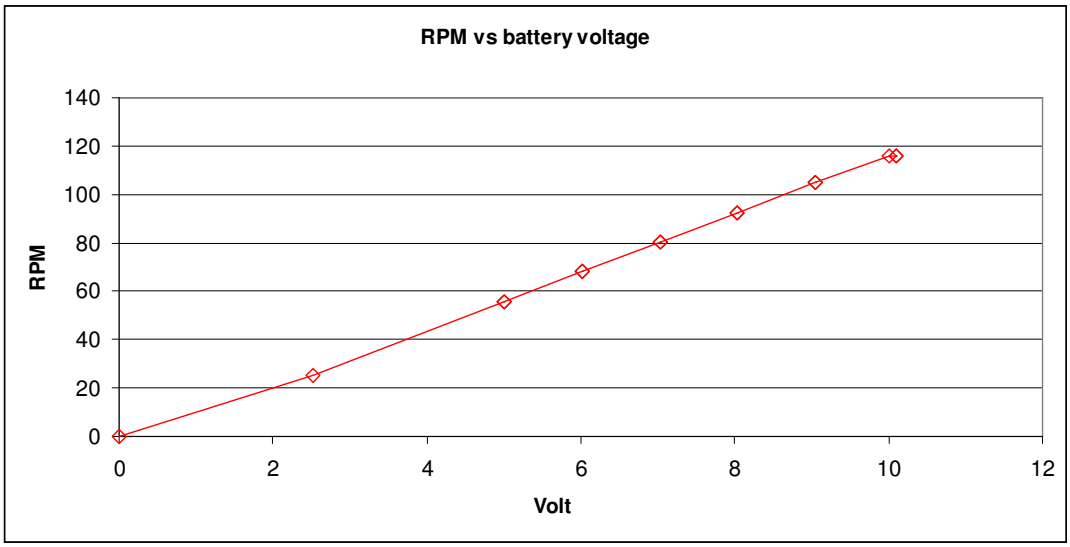
The mixing device was suspected, by some researcher, to affect the accuracy of the flux measurement.
In our experience the precision of the measurements was notably reduced without a mixing device present.
In the two plots below the measurements at various regimes of mixing device rotation are reported.

Influence of the mixing device rotation speed



In the plot the measured flux vs the mixing device rotation speed.

Battery status vs RPM.



In the plot the mixing device RPM (Rotation per minute) vs power supply voltage. The normal range for the battery voltage is between 9.6 V (new battery) and 6 Volt (discharged battery)

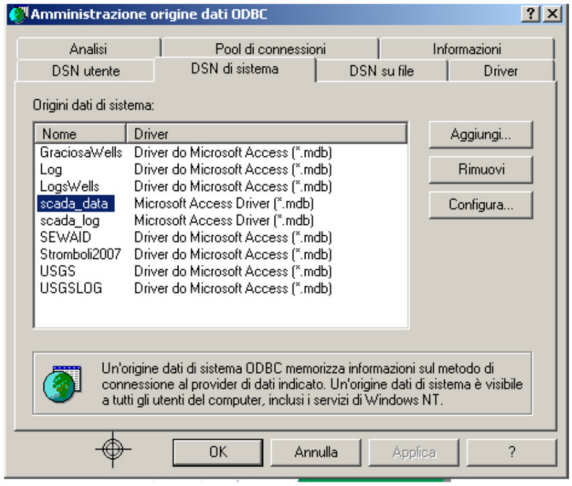
9.Database Structure

9.1 The databases

All the information necessary to run WS-Scada, as well as the data acquired by the fluxstation, are stored in the database *scada_data*.

A second database (*scada_log*) is used by WS-Scada to log messages, error reports and other information that are generated by WS-Scada and that can be helpful to diagnose some malfunctions of the system.

The two databases are accessed by our software via ODBC. For this reason 2 DSN entries are store in the ODBC manager of the operating system.



Both DSN are created automatically by the WS-Scada setup. Normally it's not necessary to modify it manually.

The four applications of WS-Scada suite read the system DSN from the ODBCName.txt file, located in the C:\WEST\scada\source\ folder.

The first line sets the DSN that point to the data and settings database and the second line sets the DSN that point to the log database.

Database *scada_log*

The database *scada_log* is composed by several tables:

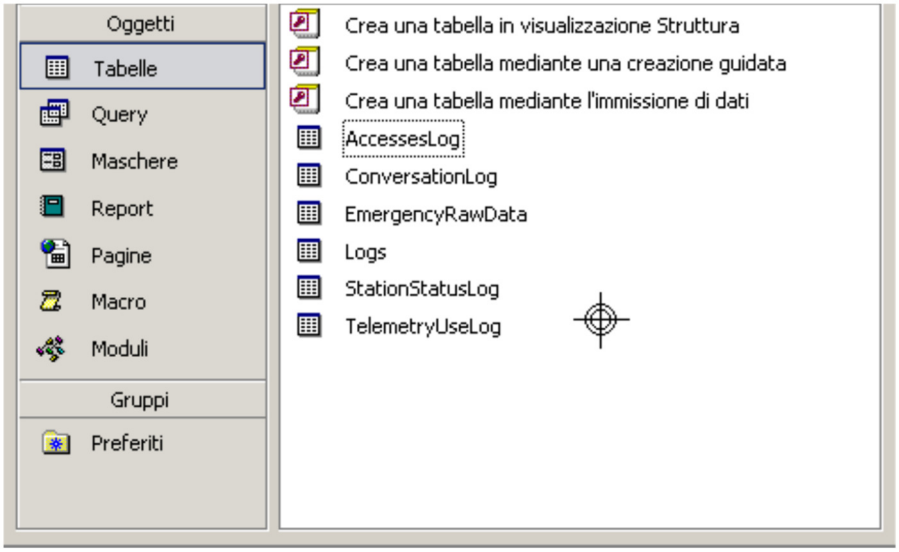
AccessesLog:

ConversationLog: Information about the "conversation between Scada and the FluxStation(s);

EmergencyRawData: Raw data coming from the fluxstations: usefull for malfunction diagnostic;

StationStatusLog: Informations about the status of the fluxstations;

TelemetryUseLog: information about the use of the telemetry system. Designed to check the bill, in case of GSM based telemetries.



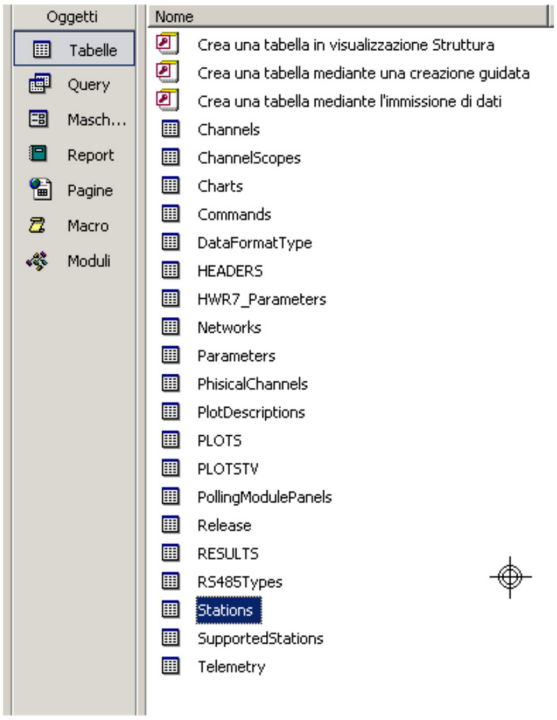
The information in scada_log.mdb is not useful during the "normal" operation of the system. Some of troubleshooting can be understood using its information.

Database *scada_data*

To understand the structure of the database is not important for the standard use of the system. This information is reported for documentation purpose.

scada_data is composed by several tables, some of them are to define the fluxstations and their configuration. Some of them contain the results acquired by the fluxstations.

9 Database structure



The tables:
HEADERS
RESULTS
PLOTS
PLOTTV
contain the data generated by the fluxstations

The tables:
ChannelScopes
Commands
Parameters
DataFormatType
RS485Types
SupportedStations

contain the auxiliary data necessary for the correct working of the Scada software suite.

The tables:

Networks
Stations
Channels
PlotDescription
PhisicalChannels
Telemetry
HWRT_Parameters

contain the description of the monitoring network:

Scada, up to now, support only a single network (NetworkID: WS), each network can be composed by several Fluxstations.

Each FluxStation must be defined in the ***Stations*** table.

Field	*Value*	*Description*
ID	13	Record ID (Counter)
Active	-1	-1 = Active // 0 Not active
NetworkID	WS	Has to be **WS**
StationID	OVK01	Identifier of station
StationIP	0001	Address of station
Description	Flux Station 2007	
TelemetryID	SSR24	Type of telemetry
TelemetryName	2427581	* Address of remote telemetry system
TelemetryPath		* Optional repeater address
Site		Name of the site
Latitude		Localization of site
Longitude		Localization of site
Elevation		Localization of site
Responsible		Name of responsible
Type	HWR7	Station type
Model	1	Station subtype
PollingFrequency	24	** See note
PollingTimeShift	00.15.00	** See note
PollingRetryDelay	5	** See note

note *

The **telemetryname** and **telemetrypath** formats and values are depending on the telemetry type (**TelemetryID**). If the station is connected with a serial cable (**TelemetryID = "COM_1"**), or with a point to point radio connection these to fields are not considered, simply because there is not necessity to address the communication. If your system has a SSR24 (SpreadSpectrum radio system) based telemetry you'll find more information about this argument on the Appendix.F

note **

PollingFrequency is the number of telemetry calls that Scada will perform during a day to download the FluxStation data.

PollingTimeShift is a delay, expressed in hh:mm:ss, that will be added to the time of telemetry call: If pollingfrequency is 24 Scada will execute a call every hour plus the PollingTimeShift time. Then Scada will call the station at 1:15, 2:15 , 3:15 and so on. The PollingShiftTime must be synchronized with the radio ON and radio OFF parameters of the FluxStation in order to call the station when the telemetry is ON.

PollingRetryDelay, expressed in minutes, is used in case of fail if the communication. If Scada is not able to call the remote station it retry to call after PollingRetryDelay minutes. If PollingRetryDelay is set to zero Scada will retry to call the station only at the next scheduled time.

The Site, Latitude, Longitude, Elevation and Responsible fields contain only descriptive data.

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Type and *Model* are critical parameters that indicate to Scada how to manage the station and must be not modified.

StationID is the station identifier and cannot to be modified. The *StationIP* is the logical address of the station and cannot to be modified.

9.2 Databases structure

Database *scada_data*
The *PhisicalChannels* table contain information about the "phisical" configuration of the station channels.

ID	StationID	Number	Name	FullScale	LowScale	Gain	Offset	Statistics	PlotCurve	Conf	Type
47	OVK01	0	CO2	20000	0	1	0	1	-1	FF06	ANALOG
48	OVK01	1	Bar.P	1060	600	1	0	1	0	FF05	ANALOG
49	OVK01	2	Ch.2	5000	0	1	0	1	0	FF06	ANALOG
50	OVK01	3	Ch.3	5000	0	1	0	1	0	FF05	ANALOG
51	OVK01	4	Ch.4	5000	0	1	0	1	0	FF05	ANALOG
52	OVK01	5	Ch.5	5000	0	1	0	1	0	FF05	ANALOG
53	OVK01	6	dP	1100	600	1	0	1	0	FF05	ANALOG
54	OVK01	7	P.Flow	1000	0	1	0	1	0	FF0F	ANALOG
55	OVK01	1	SOILBOX Soil W.	100	0	1	0	1	0	A0	DIGITAL
56	OVK01	2	SOILBOX Soil W. Raw	35	15	1	0	1	0	A1	DIGITAL
57	OVK01	3	SOILBOX Soil T.	200	0	1	0	1	0	22	DIGITAL
58	OVK01	4	SOILBOX Soil T. Raw	200	0	1	0	1	0	A2	DIGITAL
59	OVK01	169	AIRBOX Air RH	0	0	1	0	1	0	DA	DIGITAL
60	OVK01	170	AIRBOX Air T	0	0	1	0	1	0	D9	DIGITAL
61	OVK01	171	AIRBOX Wind Speed	0	0	1	0	1	0	D7	DIGITAL
62	OVK01	172	AIRBOX Wind Dir	0	0	1	0	1	0	D8	DIGITAL
63	OVK01	173	AIRBOX Rain Gauge	0	0	1	0	1	0	DF	DIGITAL

There are two basic type of "channel": ANALOG or DIGITAL; The 8 analog channels are managed by the AC board of the flux station. The digital channels are devices (AirBox and SoilBox in the base configuration) that are connected to the station with a serial connection (RS485).

ANALOG
Number is the phisical ADC ID;
Name is a short mnemonic description;
FullScale, **LowScale** and **Conf** are used to set the type of signal to be read (Voltage or Current) and the range of the detector connected to the channel;
Gain and **OffSet** can be used to scale the result of the measurement;
Statistics change the statistic treatment reserved to the channel;
PlotCurve: Setting to -1 this value force the flux station to acquire a Flux Curve of the signal coming from this detector.

DIGITAL
Number is the logical RS485 ID of the device;
Name is a short mnemonic description;
Conf is the type device connected;
FullScale and **LowScale** depends on Conf and must not modified.
Gain and **OffSet** must not modified.

Statistics change the statistic treatment reserved to the channel;
PlotCurve: Setting to -1 this value force the flux station to acquire a Flux Curve of the signal coming from this detector.

Information about how to change the configuration and to send it to the FluxStation are reported on Chapter 10.

***Channels* table**

The *Channels* table is derived from the *PhisicalChannels* one, integrated with additional records and contain all the "definition" necessary to manage the several signals managed by the station.

Each record define a **channel** , for instance **Air temperature** or **CO2 Flux**.

Most of the field of the table must not be modified by the user and are not documented here.

PanelPage: set the Scada panel where the channel information are displayed;

RowOnPanel: set the row on the Scada panel where the information are displayed;

RevisionPriority: When using Query.exe the list of channels will be in descending order and only the channels with RevisionPriority > 0 will be visible;

Monitored: Monitor.exe will show the channels with monitored <> 0, see chapter 11;

MonitoringGroup: see chapter 11;

AlarmType, **ActiveThresholds**, **UPAlarm**, **UPPrealarm**, **DnPrealarm**, **DnAlarm**: these fields are related with an "alarm" signal managed by Scada.exe: see chapter 10;

Gain, **OffSet**: by varing these fields it's possible to scale the result values of the channel, ask to West Systems;

Name, **Description**: The name and the description of the channels;

Active: If active = -1 the channel will be managed by Scada.exe. To exclude a channel set active=0;

The direct (manual) modification of the *Channels* table can be very critical. Ask support to West Systems before to make any modification.

Telemetry table

The *Channels* table is derived from the *PhisicalChannels* one, integrated with additional records and contain all the "definition" necessary to manage the several signals managed by the station.

There are 3 possible base types of telemetry (Field *BaseType*):

- **DISK**

The station has not a telemetry system and the data is transferred via SDmemory card. In the telemetry table we defined a telemetry of this base type:

TelemetryID = SD
WindowStart=00:00:00
WindowStop=23:59:59
CommPort= 0
HostID= <blank>
Settings=<blank>
TelemetryType=DISK
BaseType=DISK
CommTimeOut=<blank>

If you want to set this telemetry for your station you've to put the ***Stations.TelemetryID = SD*** in the record of the *Stations* table that define your station.

- **ETH**

The station telemetry system is based on a
ethernet to serial converter (as the Moxa DE211)..

TelemetryID = Moxa_1
WindowStart=00:00:00
WindowStop=23:59:59
CommPort= Socket port of the IP.
HostID= IP address of the Moxa
Settings= RS232 parameters of the RS232 port of the moxa;
TelemetryType=MOXA
BaseType=ETH
CommTimeOut=2000

If you want to set this telemetry for your station you've to put the ***Stations.TelemetryID = Moxa_1*** in the record of the Stations table that define your station.

- **RS232**

The base type RS232 supports several TelemetryTypes:

GSM: Gsm based data modems;

SSR24: Spread spectrum 2.4 or 0.9 GHz in switched mode;

RS232: Direct cable connection.

The base type RS232 supports several TelemetryTypes:

The configuration of each type is described in the telemetry handbook.

SSR24 : Appendix F;
GSM : Appendix G; (not included)
RS232 : Appendix M;

General settings:
WindowStart, **WindowStop**: are used to define an activity time window for the telemetry: If Scada.exe has to share the telemetry with another application is possible to define a time window, for instance between 11:00:00 and 16:00:00.
Scada.exe will use the telemetry system only during this interval.

CommTimeOut: Is a TimeOut interval, expressed in milliSeconds. The communications can suffer of latency times (as for example a Moxa device connected via a IEEE802.xx network, or via an ADSL connection). By setting a proper value to CommTimeOut can solve the problems due to long latency times.

10. WS-Scada software suite

10.1 Software installation

The Scada software runs on Microsoft Windows operating system (XP, Vista, 7, 8, 10). Microsoft .NET Framework is required.

WS-Scada Software Suite is compatible with the following DBMS:

- MYSQL
- PostgreSQL
- Microsoft SQL Server
- Microsoft Access

In this chapter the Postgres and MYSQL installation will be described.

10.1.1 Postgres based Installation

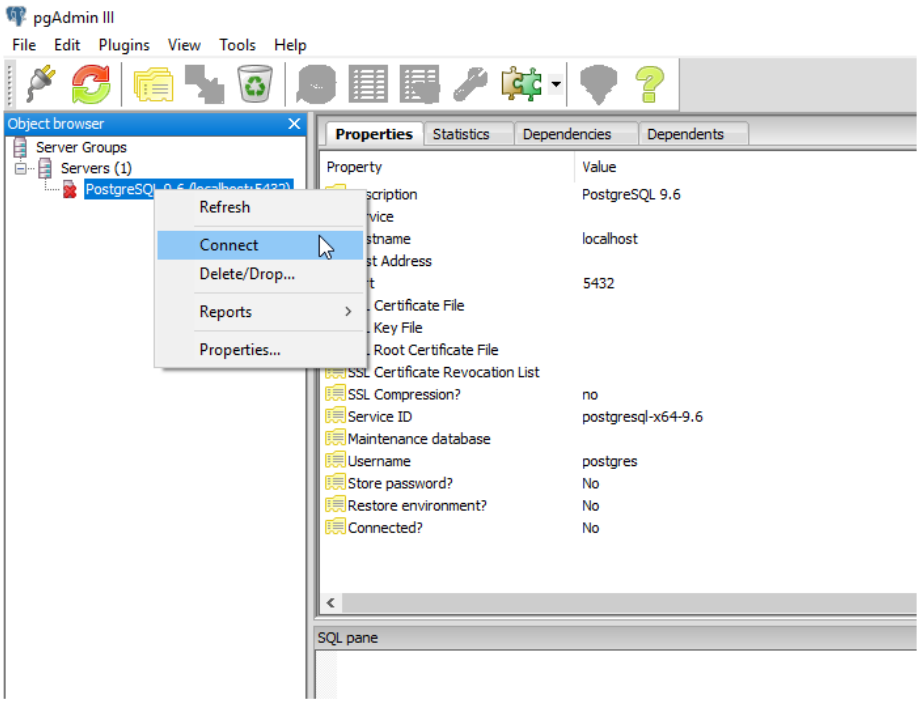
This manual assumes the following prerequisites:

- On the Windows machine on which you're going to install the WS-Scada Suite, the Postgres ODBC Driver (*psqlODBC*) must be installed. If it isn't, the installer it is furnished with the West Systems installation CD or it can be downloaded from PostgreSQL website.
- You have installed the Postgres administration interface pgAdmin. A pgAdmin version is also furnished in the West Systems installation CD, or it can be downloaded from PostgreSQL website.
- The machined has access to a Postgres server instance (version 9 or later), already active on the local machine or in remote. Otherwise, a Postgres server version is also furnished in the West Systems installation CD, or it can be downloaded from PostgreSQL website.

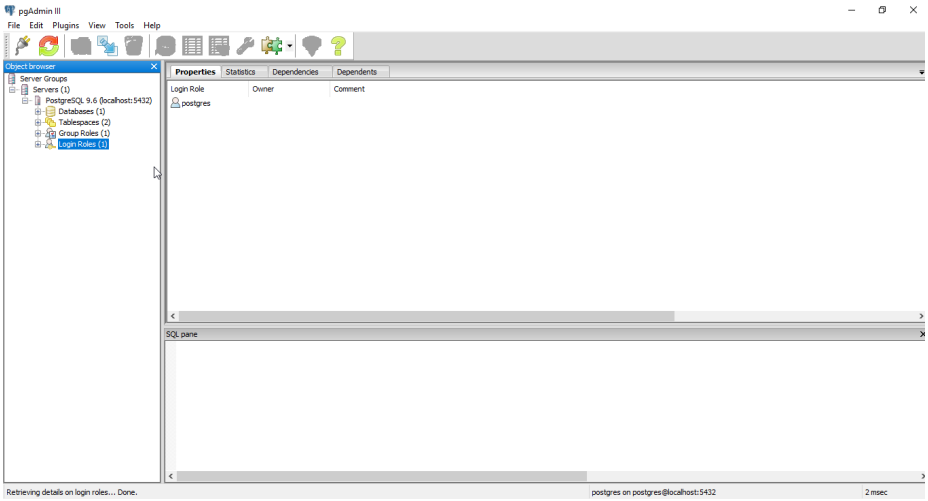
1 – Launch the West Systems Scada setup application. The installer will extract the applications file in C:\WEST\Scada\source and the database dump files (C:\WEST\Scada\scada_data.backup and C:\WEST\Scada\scada_log.backup) which you'll need in the next steps.

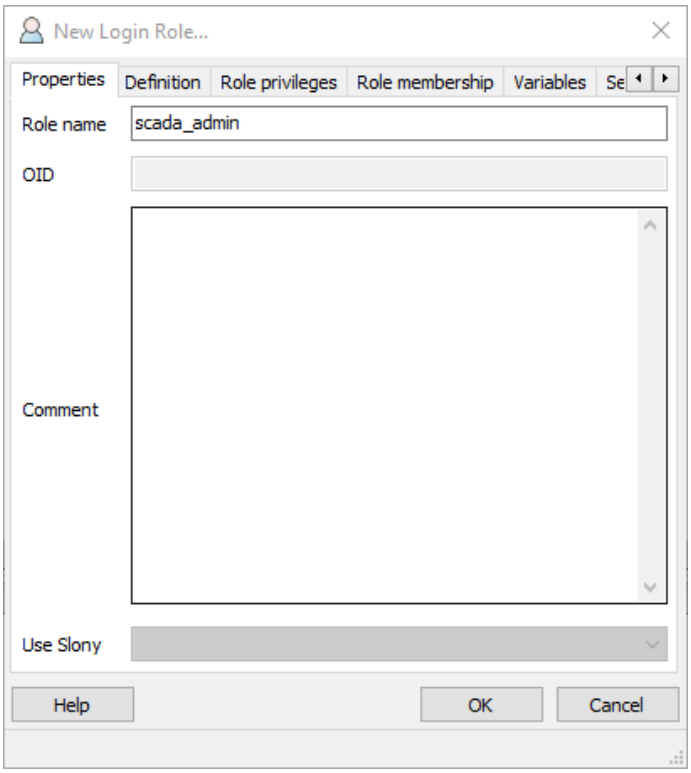
2 - Create user and schemas

2.1 – Open PgAdmin and connect to the server as superuser (e.g. user postgres)

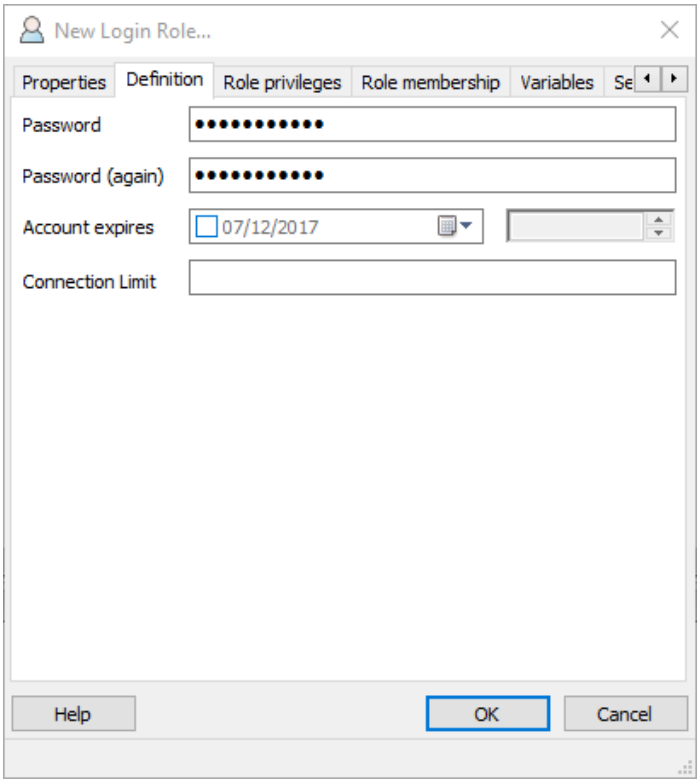


2.2 – Click on Login Roles and add a new role, with name *scada_admin*.

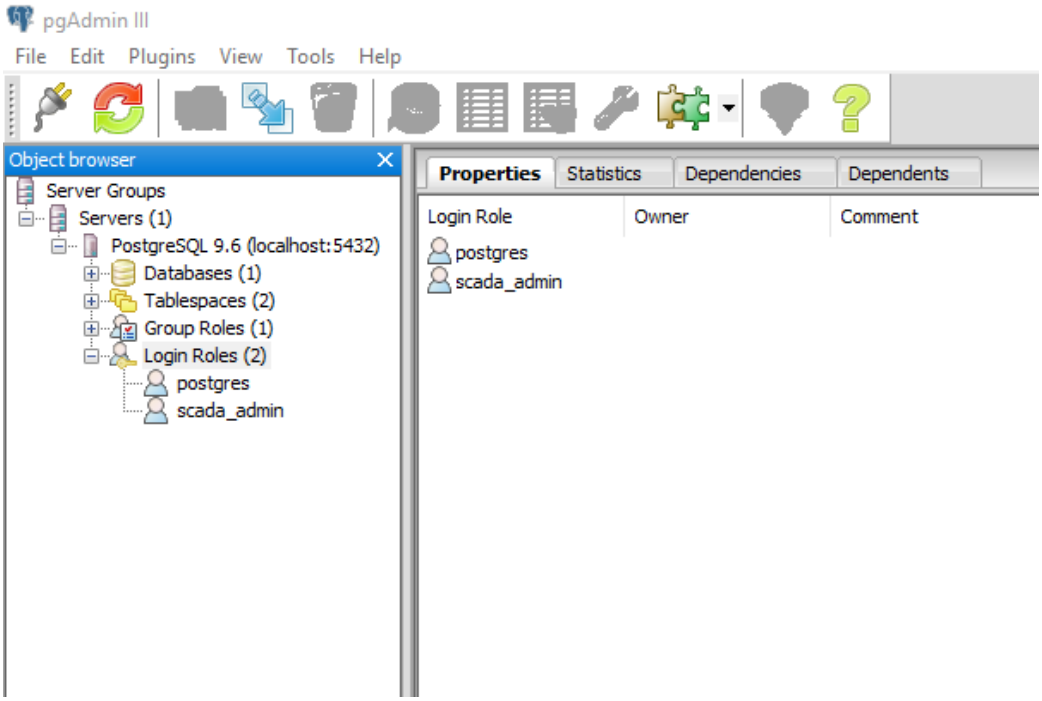




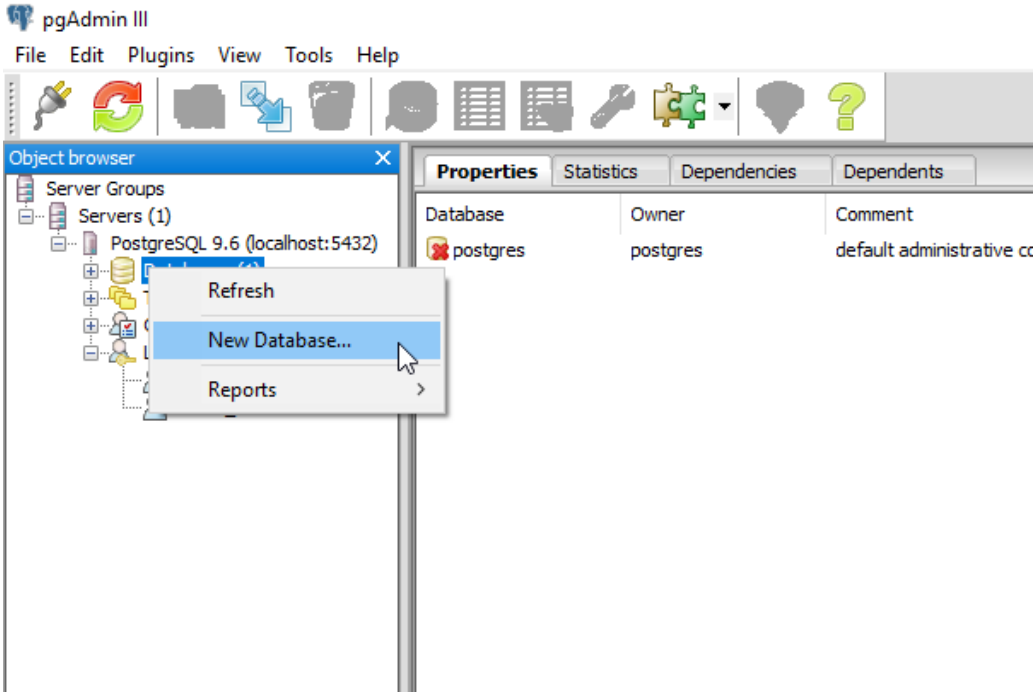
Go to the Definition tab and set a password for the user.

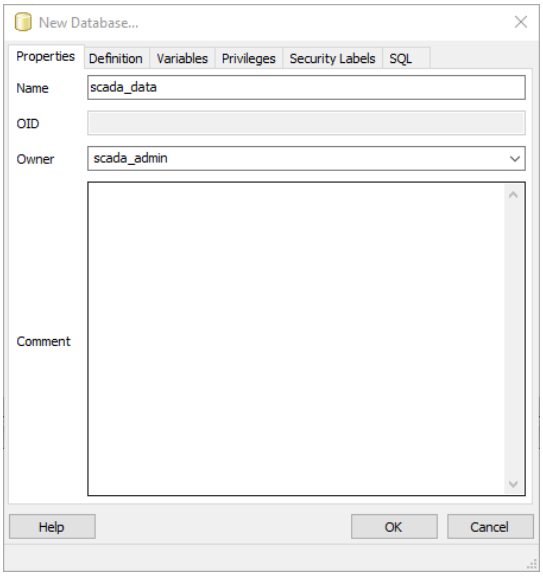


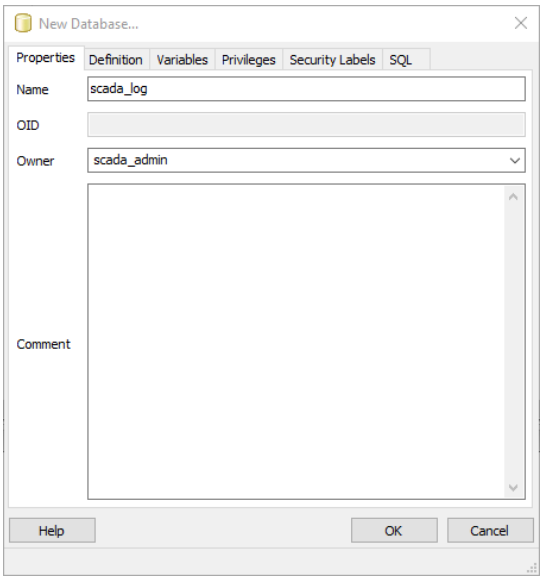
Login roles after the insert of the new role:



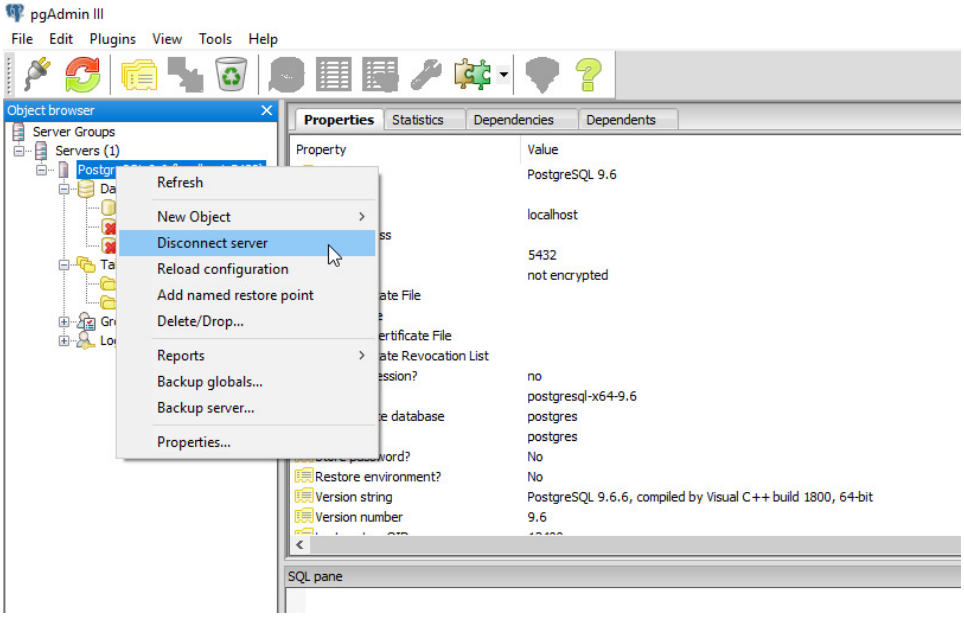
2.3 – Click on Databases and add a new database called *scada_data* with owner *scada_admin*. Repeat the procedure creating a second database called *scada_log* with owner *scada_admin*.



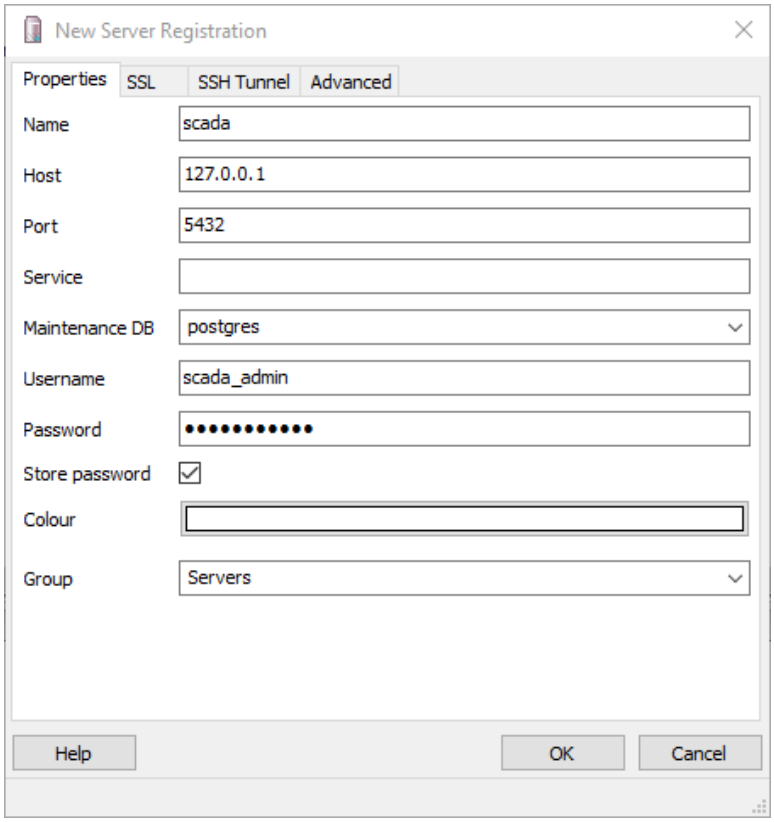




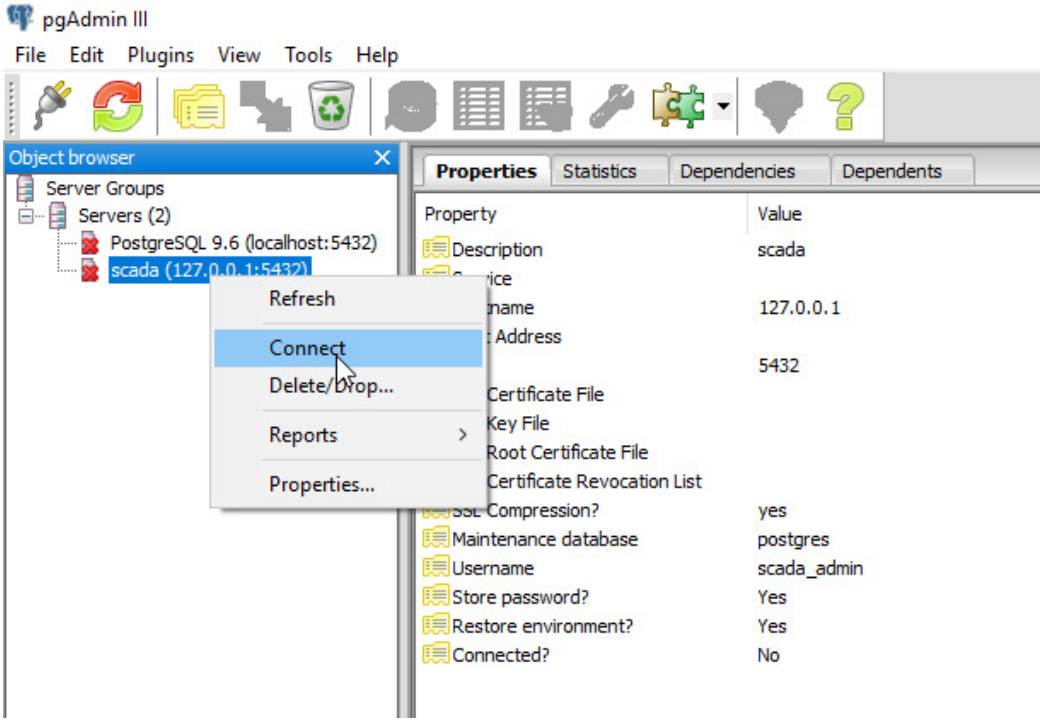
2.4 – Disconnect from the server as superuser and create a new connection to the server with user *scada_admin*.



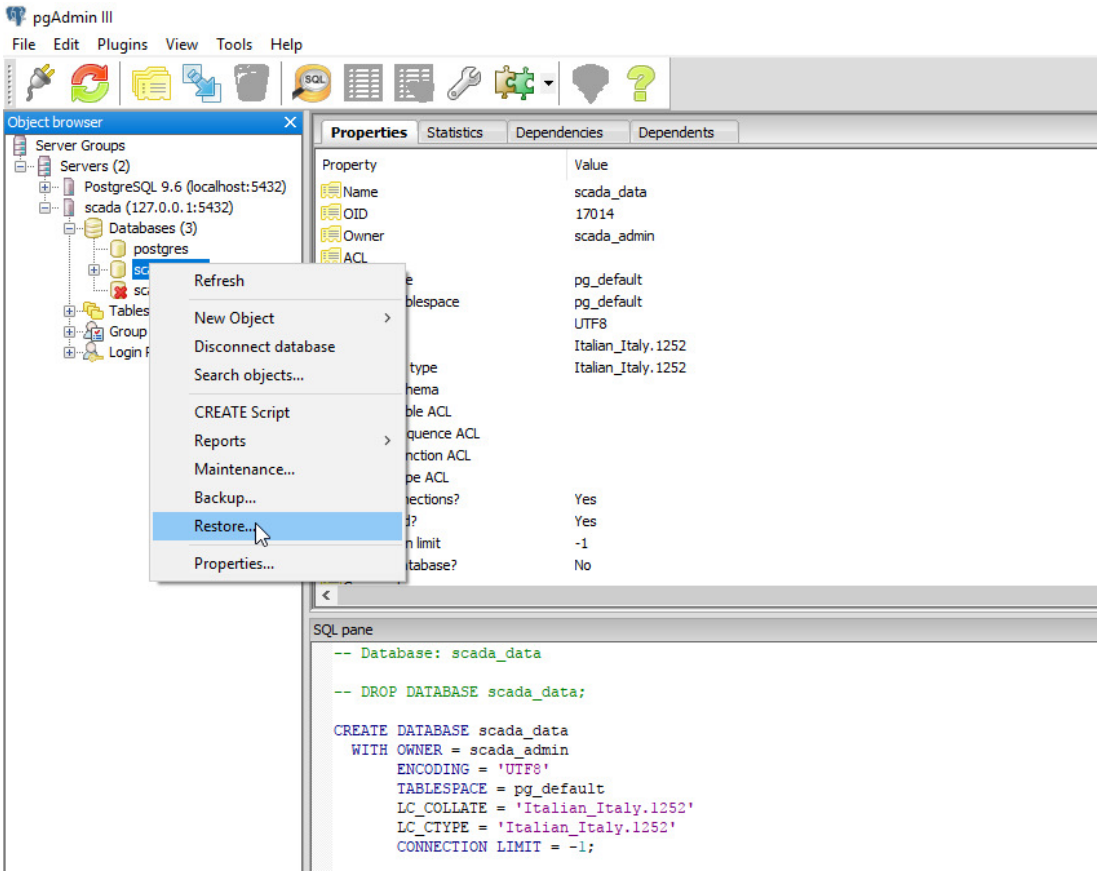
Fill the fields as in the image below. Replace the *Host* address with the correct address if the server is not running on the local machine. Insert *scada_admin* as *Username* and the password you choose at the previous step as *Password*.



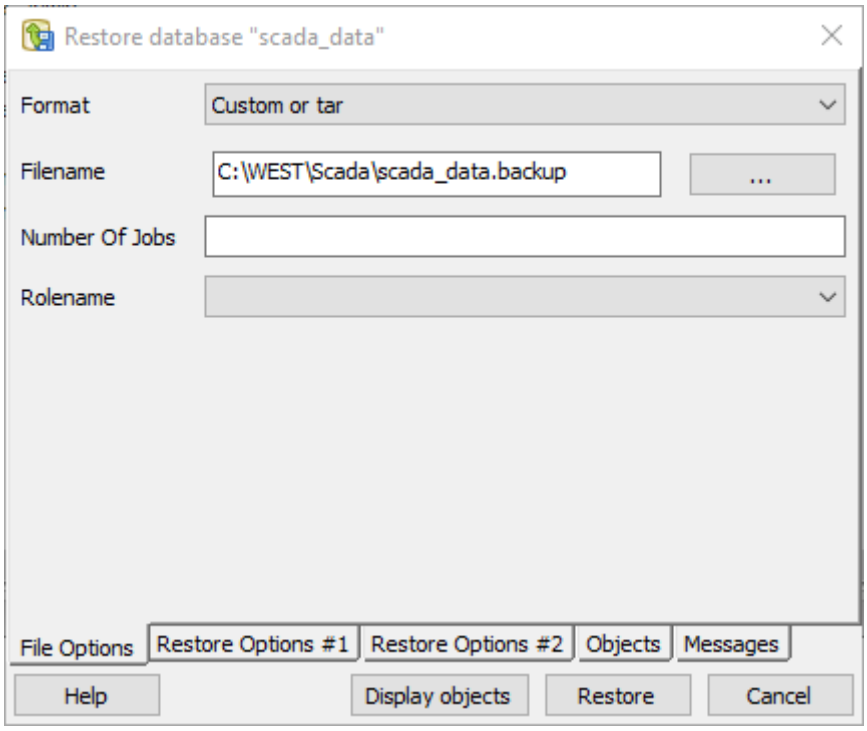
2.5 – Connect using the recently created connection.



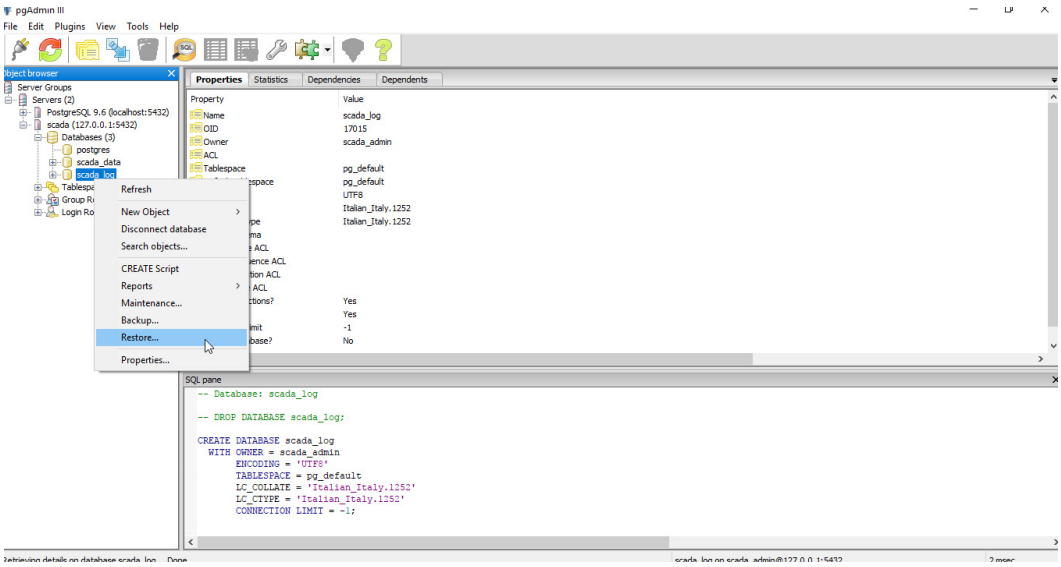
2.6 – Expand Databases and click on *scada_data*. Select Restore.

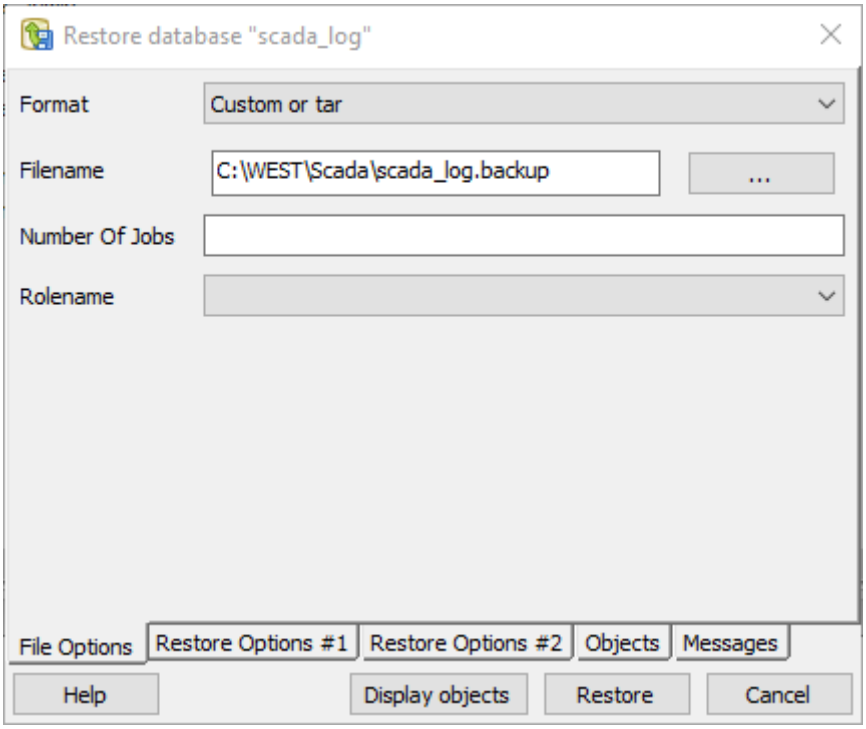


2.7 – Select the file C:\WEST\Scada\scada_data.backup which was created by the WS-Scada installer. Press Restore and wait for the process to finish.



2.8 – Repeat the steps 2.6 and 2.7 for the *scada_log* database.



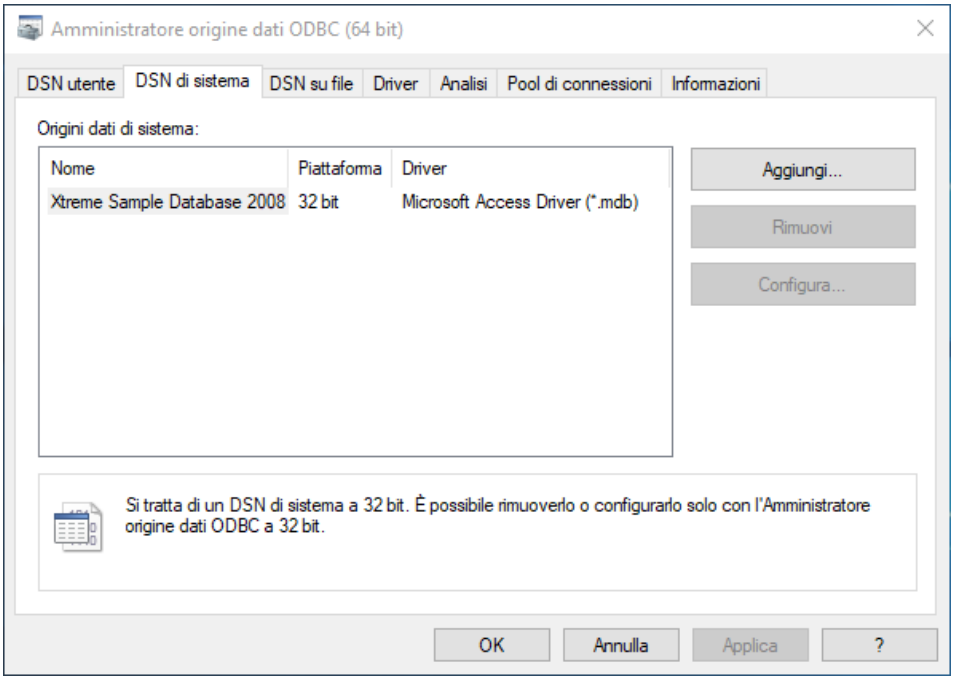


3 - Create ODBC connections

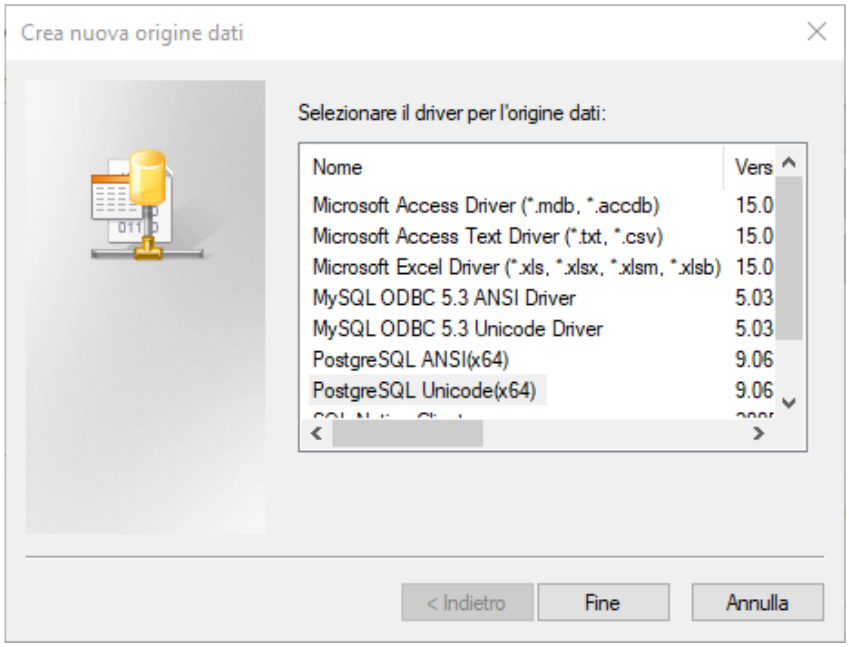
Once the databases are created, you need to make them accessible to the software suite. The software accesses the database using the ODBC layer (Open Database Connectivity).

3.1 - On the Windows machine where the application WS-Scada will be running, you need to install the Postgres ODBC Driver, if not already installed.

3.2 - Once the Connector installation is completed, open the Windows Control Panel (Start – Setttings – Control panel). Open Administrative Tools, then Data Sources (ODBC).



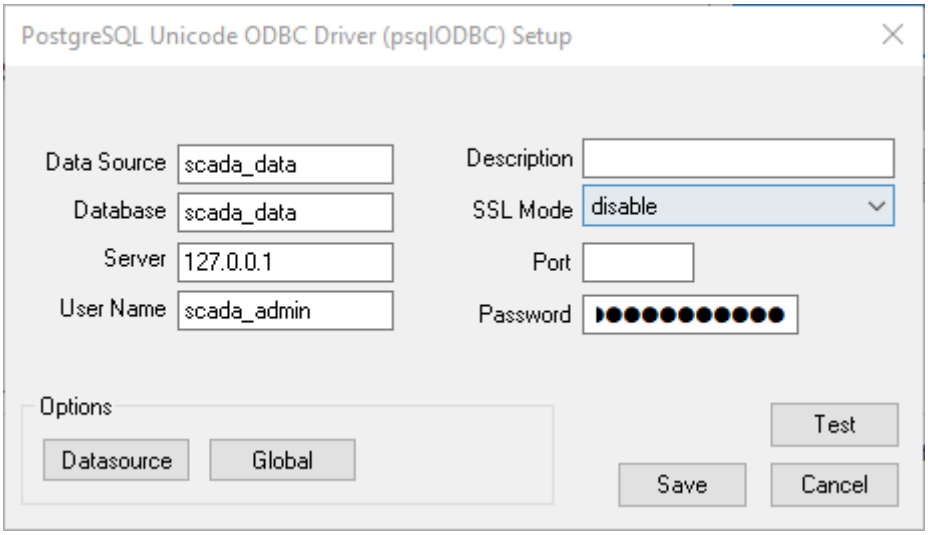
3.3 - Move to the *System DNS* tab and press Add. Select PostgreSQL Unicode (x64) and press Finish.



3.4 - Fill the fields as illustrated and press OK

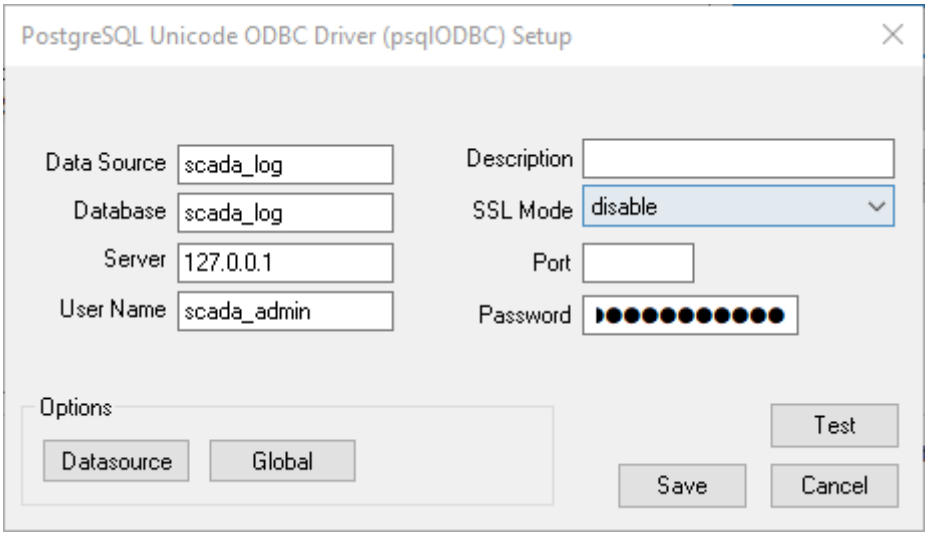
Data Source Name:	scada_data
Description:	West Systems Scada database (data)
Server:	127.0.0.1 (replace with your Postgres server IP)
Port:	3306 (replace with your Postgres server port)
User:	scada_admin
Password:	Insert the password you have inserted at point 2.2

Database: scada_data



3.5 - Repeat steps 3.3 and 3.4 for the second database using the following settings:

Data Source Name: scada_log
Description: West Systems Scada database (log)
Server: 127.0.0.1 (replace with your Postgres server IP)
Port: 3306 (replace with your Postgres server port)
User: scada_admin
Password: Insert the password you have inserted at point 2.2
Database: scada_log



The databases are ready. You can launch now WS-Scada.

10.1.2 MYSQL based Installation

This manual assumes the following prerequisites:

- On the Windows machine on which you're going to install the Scada Suite, the MYSQL ODBC Connector must be installed. If it isn't, the installer it is furnished with the West Systems installation CD or it can be downloaded from MySql website.

- The machined has access to a MYSQL server instance (version 5 or later), already active on the local machine or in remote. Otherwise, a MYSQL server version is also furnished in the West Systems installation CD.

Examples of the commands to be executed (and the corresponding responses by the server) will be shown in red.

1 – Launch the West Systems Scada setup application. The installer will extract the applications file in C:\WEST\Scada\source and the database dump files (C:\WEST\Scada\scada_data.sql and C:\WEST\Scada\scada_log.sql) which you'll need in the next steps.

2 - Create user and schemas

2.1 - Open a Windows console (press Start, then Run and digit cmd). Log in to the MYSQL server as super-user. Replace in the following examples the IP address 127.0.0.1 with the IP address of the machine where your MySql server is active, or leave it if the server is local. Replace also root and password with your credentials. Example:

```
mysql -h 127.0.0.1 -u root -ppassword

Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 636577
Server version: 5.0.45 Source distribution
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.
mysql>
```

2.2 - Once authenticated, create the 2 schemas scada_data and scada_log.

```
mysql> create database scada_data;
Query OK, 1 row affected (0.04 sec)

mysql> create database scada_log;
Query OK, 1 row affected (0.04 sec)
```

2.3 - Create a user for the access to the database scada_data you've just created. The example shows how to create the user "scada_admin" setting the password "scada_admin", to be replaced with a more secure password.

```
mysql> grant all privileges on scada_data.* to scada_admin identified by
'scada_admin';
Query OK, 0 rows affected (0.10 sec)
```

2.4 - Grant privileges to the other database (scada_log) to the same user scada_admin.

```
mysql> grant all privileges on scada_log.* to scada_admin;
Query OK, 0 rows affected (0.10 sec)
```

2.5 - Finally, execute a flush to allow the settings to take effect immediately.

```
mysql> flush privileges;
Query OK, 0 rows affected (0.07 sec)
```

2.6 - Log out

```
mysql> exit
Bye
```

3 - Database import

At this point, we have two empty databases. To populate them with tables and data it's necessary to import the structures using the dump files furnished by West Systems. In the following example the 2 sql files has been previously copied to C:\scada_data.sql and C:\scada_log.sql.

3.1 - Access to the console and digit:

```
mysql -h 127.0.0.1 -u scada_admin -pscada_admin scada_data <
c:\scada_data.sql
```

At this point the import process will start. It could take several minutes. Wait until the command execution is completed.

3.2 - Import the structure of the second database:

```
mysql -h 127.0.0.1 -u scada_admin -pscada_admin scada_log <
c:\scada_log.sql
```

4 - Create ODBC connections

Once the databases are created, you need to make them accessible to the software suite. The software accesses the database using the ODBC layer (Open Database Connectivity).

4.1 - On the Windows machine where the application WS-Scada will be running, you need to install the MYSQL ODBC Connector, if not already installed. Execute the setup file mysql-connector-odbc-5.1.8-win32.msi.

4.2 - Once the Connector installation is completed, open the Windows Control Panel (Start – Setttings – Control panel). Open Administrative Tools, then Data Sources (ODBC).

4.3 - Move to the System DNS tab and press Add. Select MySQL ODBC 5.1 Driver and press Finish. The MySQL Connector/ODBC panel will show.

4.4 - Fill the fields as illustrated and press OK

Data Source Name:	scada_data
Description:	West Systems Scada database (data)
Server:	127.0.0.1 (replace with your MYSQL server IP)
Port:	3306 (replace with your MYSQL server port)
User:	scada_admin
Password:	scada_admin (replace with the password you have inserted at point 2.3)
Database:	scada_data

4.5 - Repeat steps 4.3 and 4.4 for the second database using the following settings:

Data Source Name:	scada_log
Description:	West Systems Scada database (log)
Server:	127.0.0.1 (replace with your MYSQL server IP)
Port:	3306 (replace with your MYSQL server port)
User:	scada_admin
Password:	scada_admin (replace with the password you have inserted at point 2.3)
Database:	scada_log

The databases are ready. You can launch now WS-Scada.

Note: How to execute a database dump
A dump exports into a single sql file both the structures of the tables and the data of a database. A dump can be used for several purposes:
Make a backup of the database
Export the data to be archived or sent to someone.
Open a console and digit:

```
mysqldump -h 127.0.0.1 -u scada_admin -pscada_admin scada_data >
c:\dump_scada_data.sql
mysqldump -h 127.0.0.1 -u scada_admin -pscada_admin scada_log >
c:\dump_scada_log.sql
```

10.2 General description

The software suite of Scada is composed by 4 applications:

WS-Scada: This application, designed to run continuously, performs the polling of the stations in your network, downloads and stores the data in a database and allow you to configure and manage the remote stations using a telemetry system.
Scada reads the network configuration from the scada_data ODBC data souce name (Chapter 9). Once reads the configuration it runs continuously to manage the information of all the stations that compose your network.

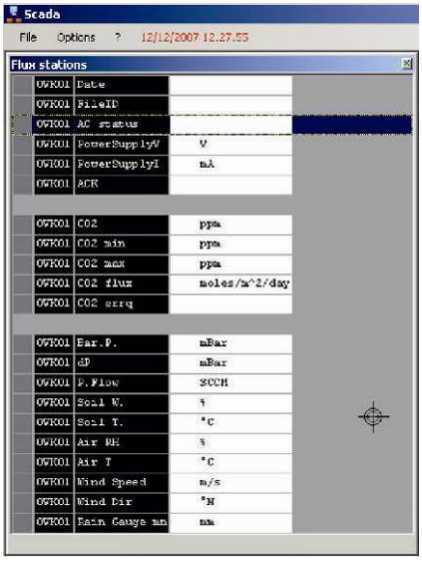
DataRevision: This application allows you to review the curves acquired by the stations.

Monitor: This application displays graphical charts of the last days of data.

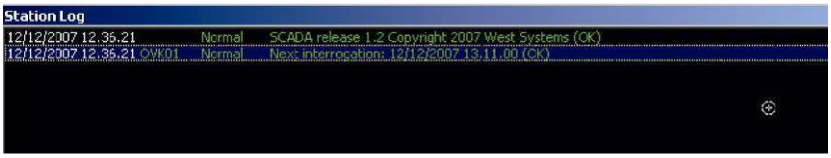
Query: This application allows you to query the database and obtain a table in the .xls or .csv format of the data stored in the database.

10.3 WS-Scada

Scada Panel
The Panel form resumes all the information of the station and its channels;
In the first column is reported the name of the station (Stations.StationID).
In the second column the name of each channel (Channels.Name) and in the third column the result (empty in the example) of the last downloaded measurement and the unit.



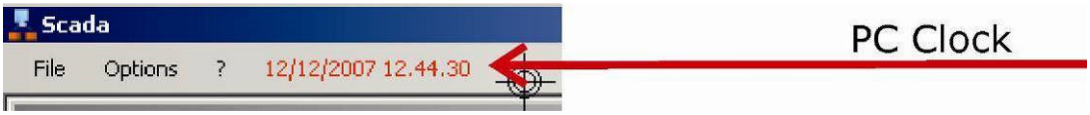
Station Log dialog box



The dialog "Station log" reports all the events related with the management of station and telemetries. This information is saved in the ***Conversation*** table of the **scada_log** database.
Normal events are reported in green, **Warnings** are reported in yellow and **Alarms** and **Errors** are reported in red.
In the drawing, after the CopyRight message, a Normal event is reported:

The next interrogation of the OVK01 station is scheduled at 13:11:00 of 12/12/2007.

The log can be saved as text file by right clicking the text box and selecting {Save as}.



On the left-top corner of WS-Scada, the pc clock is shown: WS-Scada will use this date/time information to set the clock of each station, every time it will be able to communicate with the station. We suggest setting up a NTP service on the PC where WS-Scada runs, to make sure the station clock is always synchronized.

Also we suggest disabling the daylight saving time in the Windows PC. Keeping the automatic daylight saving time will result in the loss of one hour of data at each switch (twice per year).

After each interrogation, WS-Scada updates the channels panel with the last recorded data.

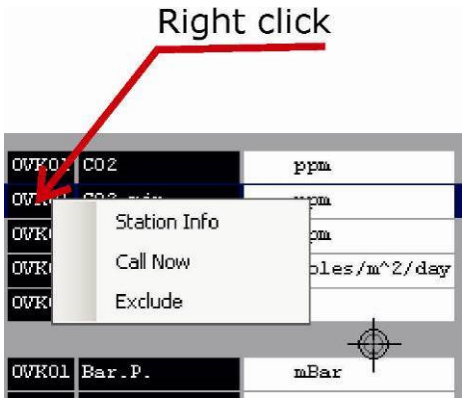
The general panel contains the following information:

- **Date**: the date and time of the last downladed analysis
- **AC Status**: status of the accumulation chamber. The status is codified as following:

> OK: the station managed to close and open the chamber correctly.
>
> NFC (Not Fully Closed): the chamber couldn't close perfectly: The lower proximity sensor didn't turn on at the end of the Chamber Down run. A possible cause is that an obstacle is preventing the chamber to close. If the flux curve shows a good accumulation, then it's more likely than the proximity sensor is not well placed.
>
> NFO (Not Fully Opened): the chamber couldn't open perfectly: The upper proximity sensor didn't turn on at the end of the Chamber Up run.
> In this case check the proximity sensor is not well placed or if there is an external cause. Note that when the battery voltage is very low (under 11.5 V) the run will be slower so it can happen that the chamber cannot fully open within the maximum time.
>
> NFC-NFO: we have both NFC and NFO situation.
>
> ERR: the chamber is not connected or did not respond correctly.
>
> MUX-ERR: the multiplexer is not connected or did not respond correctly.
>
> Note: Exporting the data into Excel or CSV files using the Query software, the AC status is presented under numeric form following codification:
> 0: OK
> 1: NFC
> 2: NFO
> 3: NFC-NFO
> 4: ERR
> 5: MUX-ERR

- **Battery:** voltage of the main station battery, recharged by the solar panel.
- **Pump flow**: the flow rate of the pump.
- **Air CO2**: carbon dioxide air concentration, measured at the beginning of the flux curve, before the accumulation.
- **CO2 Flux**: carbon dioxide flux rate, expressed in [moles/m^2/day]

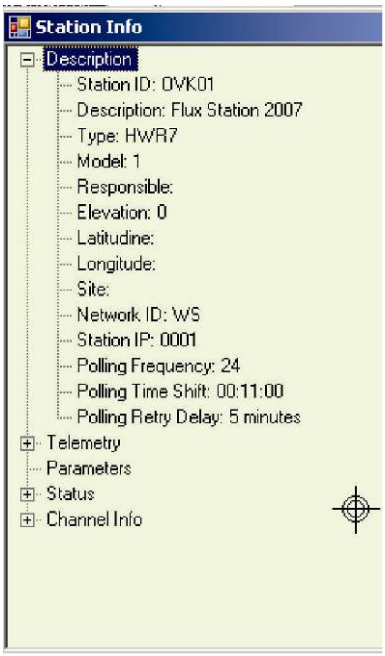
- **CO2 Errq**: carbon dioxide linear regression coefficient of determination, from 0 to 1.
- …
- [Flux repeated for each monitored gas species]
- [Errq repeated for each monitored gas species]
- …
- **Bar Pressure**: barometric pressure, expressed in [mBar], measured by the Vaisala PTB110 barometer.
- **Air Temp**: air temperature, expressed in [°C], measured by the AirBox.
- **Air RH**: air relative humidity, expressed in [%], measured by the AirBox.
- **Wind Speed**: wind speed, expressed in [m/s], measured by the AirBox.
- **Wind Dir**: wind direction, expressed in [°N]. 0 is wind coming from North, 180 is wind coming from South.
- **Rain**: rain fall, expressed in [mm] , measured by the AirBox
- **Soil VWC**: volumetric water content of the soil, measured by the CS616 probe.
- **Soil Temp**: temperature of the soil, measured by the PT100 probe.
- **Chamber Pressure**: pressure measured inside the chamber, expressed in [mBar]
- **Chamber Temp**: air temperature measured inside the chamber, expressed in [°C]
- **Chamber Battery**: voltage of the chamber buffer battery.



By right clicking on the StationID field of a station a menu appears.

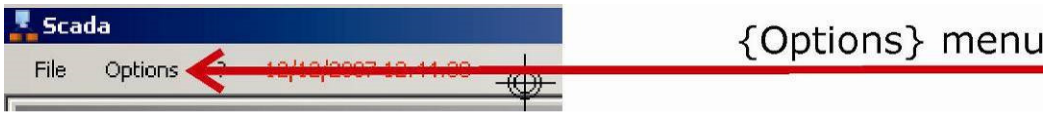
Station Info
By selecting StationInfo you can get a report where all the information about the station, the telemetry , the configuration parameters, the status and about all the channels that belong to the station are present. The StationInfo report will be automatically closed after 30 seconds.

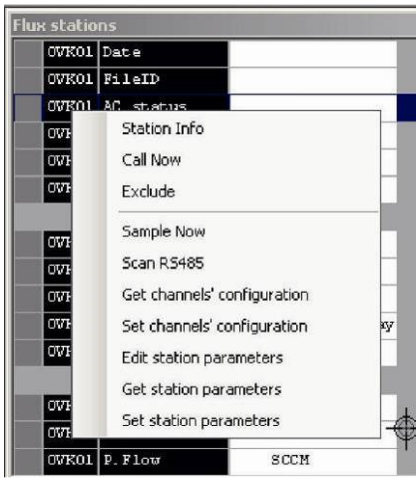
Exclude
By selecting Exclude you can temporary exclude the station. While excluded a station is not managed by the application. This feature is normally used when a station is under maintenance to avoid useless telemetry calls. While excluded the background colour of the station will be red. To reactivate



the station, select Include from the same menu.

Call Now
By selecting Call Now the application re-schedule the next call to now. Of course, you've to consider that the remote telemetry system can be off and then the call will be not successful.





By selecting ***Options/Show advanced menu***, an advanced station menu will be enabled, then now right clicking the StationID field a more complete menu is shown.

Sample Now
By selecting *Sample Now* you force the immediate execution of an analysis cycle. The command will be sent to the station during the next call, then to have an immediate effect {Sample Now} must be followed by {Call Now}.

Get channels configuration
By selecting *Get channels configuration* the application will download the configuration of the channels from the station and will store this configuration in the database. The action will be performed during the next scheduled call.

Set channels configuration

By selecting *Set channels configuration* the application will upload the configuration of the channels from the database to the station, reconfiguring the station with the database settings. The action will be performed during the next scheduled call.

Get station parameters

By selecting *Get station parameters* the application will download the timing parameters of from the station and will store it in the database. The action will be performed during the next scheduled call.

Set station parameters

By selecting *Set station parameters* the application will upload the timing parameters from the database to the station and will re-configure the timings of the analysis cycle. The action will be performed during the next scheduled call.

Edit station parameters

By selecting *Edit station parameters* the application allows you to modify the timings of the analysis cycle (parameters) and to save it in the database.

Since all the actions described in this page, except *Sample Now*, are quite critical we advise you to follow this procedure:

!

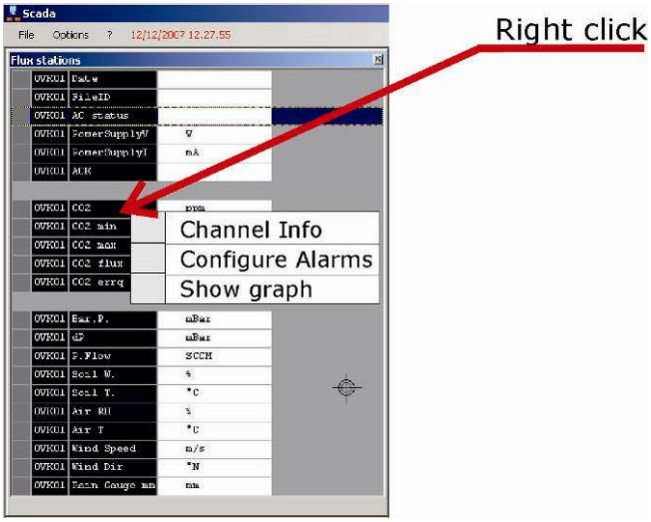
a) Do NOT get or set the channels configuration unless big malfunction of the system. Anyway, before to do that, please contact West Systems support.

b) To change the parameters:

1) select *Get Station Parameters*; wait the next successful call;
2) Edit the parameters *Edit station parameters* and save into the database;
3) select *Set Station Parameters*; wait the next successful call;

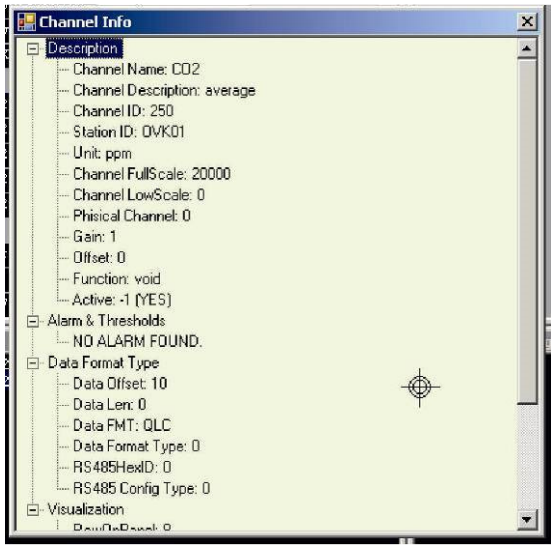
Now the station is set with new parameters

10 WS-Scada software suite



By right clicking on the Channel name field, a menu appears.

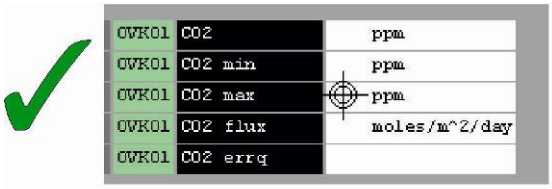
Channel Info
By selecting *Channel Info* a report of the channel configuration and status will be shown.



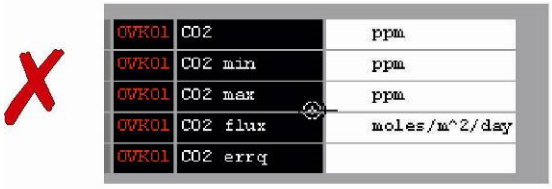
Configure Alarms
By selecting *Configure Alarms* will be possible to set alarm level and modalities for the channel.
All thresholds / only upper thresholds / only lower thresholds / Alarm not active;

Show graph
By selecting {Show Graph}, active only for the channels that are configured to be acquired as curve, the last downloaded curve will be displayed.

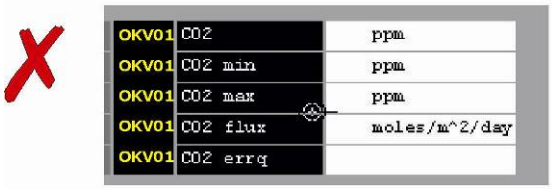
The StationID field backdoor and forecolour change in function of the status of the call.



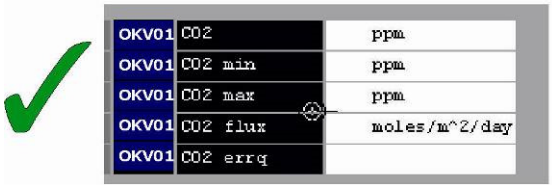
Green, Black:
Scada is calling the station;



Black, Red:
Scada was not able to reach the station: The remote telemetry is off / the telemetry is not working ;



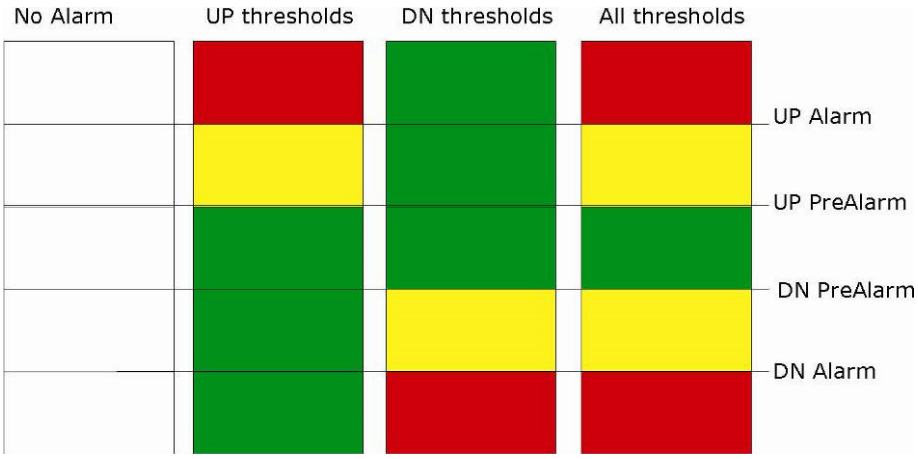
Black, Yellow:
Scada was able to reach the station, but the station is not answering correctly;



Blue, White:
Scada was able to reach the station and get the data; This mus be the "normal" situation when Scada is waiting the next call.

10.4 The alarms

For each channel is possible to set an alarm:



The alarm management will modify the backcolor of the result field of the channel in order to highlight when a value is not "correct"

The channel result field backcolor can be:

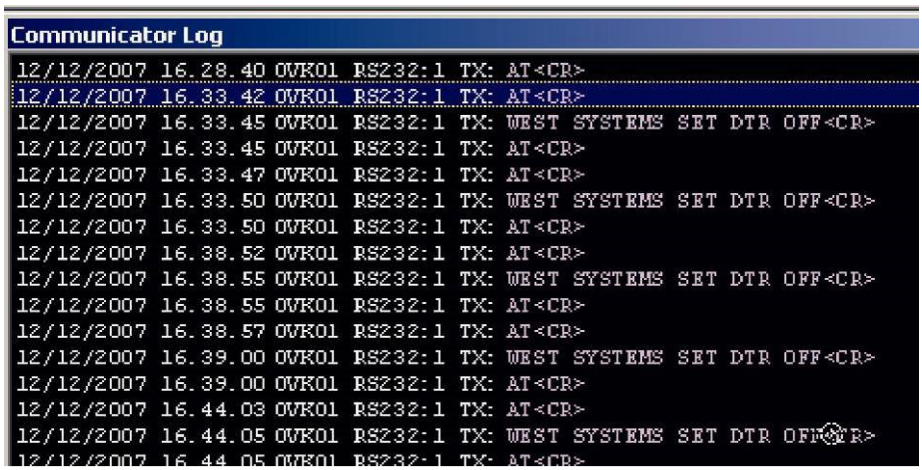
WHITE: if the channel has not alarms configurated. All the values are considered OK;

GREEN: The channel has alarms configurated and the value is in the normal range;

YELLOW: The channel value is between the prealarm and alarm thresholds;

RED: The channel value higher than the UPalarm threshold (Or is less than the DNAlarm one);

In the lower right corner a dialog shows the "binary" communication that flows on the communication stream between computer and telemetry device:



Some of the byte are "translated" in a visible format: for example the byte &0D (That correspond to the Enter key) is displayed as <CR>.

The format is:

dd/mm/yyyy hh:mm:ss : 12/12/2007 16.28.40
stationID : OVK01
Telemetry Type : RS232
Communication port: 1
Direction of communication: TX (or RX)
Transmitted data: AT<CR>

The communication log can be saved on a text file by right clicking on the text box and selecting {Save as}.

10.5 How to download data without telemetry

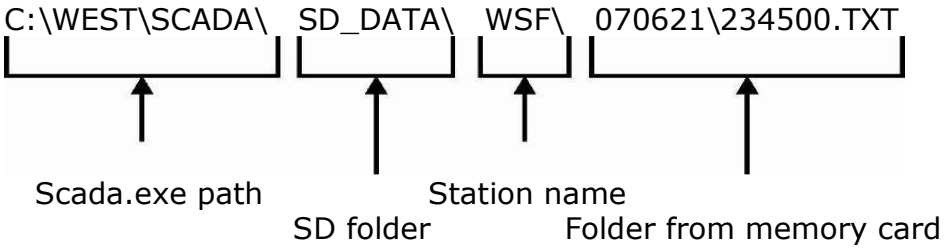
In case of a telemetry fault, it could be useful to download the data manually taking the SD card from the station and copying the files into the personal computer where WS-Scada is running.

Extract the memory card

You should avoid extracting the memory card while the "CPU RUN" LED is green still, in order not to risk losing any data: this is a warning that the station is going to access the card. The station turns on the "CPU RUN" LED 60 seconds before writing the measure file (usually every hour). Any other moment (LED off or blinking) is useful to safely extract and replace the card.

Copy the data to the PC

The station produces and writes to the memory card one folder per day. The folder is named according to the format YYMMDD (year, month, day): for example "070621" is referred to the 21th of June, 2007. In the folder are placed the analysis files named according to the format HHMMSS, for example "182900.txt" means that the file has been written at 6.29 PM. With the default configuration a folder can contain a maximum of 96 files, one every 15 minutes. WS-Scada supports both remote and local download of the data. In this case we'll use the local one, because the files are manually transferred to the PC.
You have to place the folders copied from the SD card into the directory C:\WEST\Scada\SD_DATA\STATION_NAME
This is an example of a probable complete path:

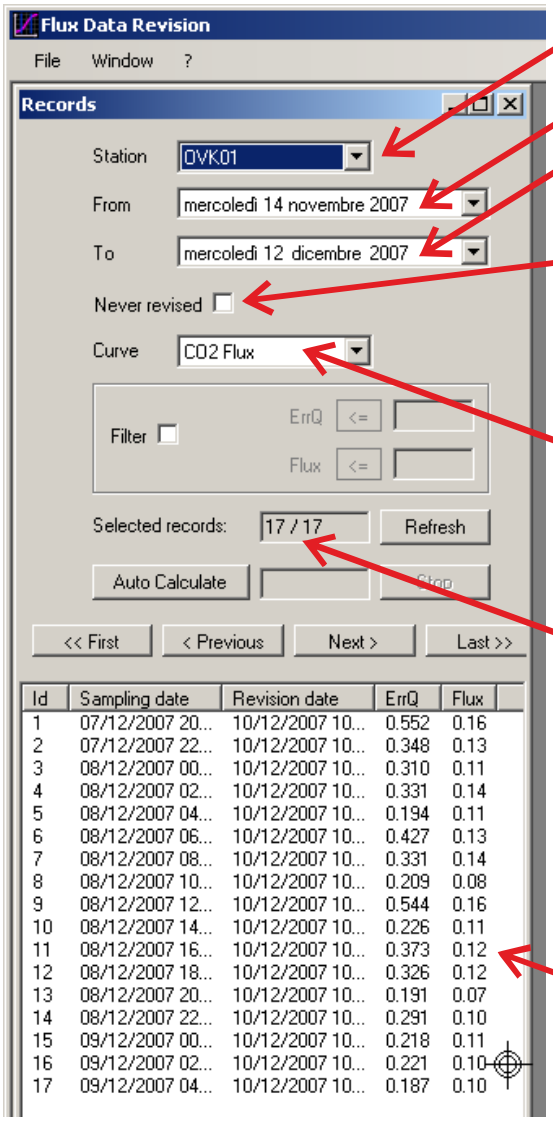


Import the files

When the station is called, WS-Scada scans its "SD_DATA" directory before accessing the telemetry, and imports the analysis file in the database. When a file is successfully read and saved to the database, WS-Scada automatically deletes it.

10.6 Data revision

DataRevision allows analysing the plots acquired by the station.



Select your station.

Select the initial date of the period.

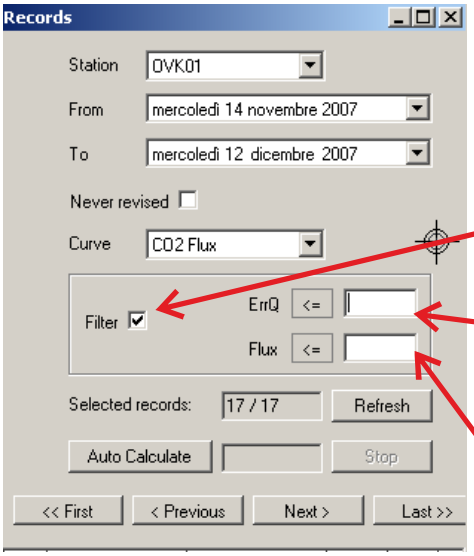
Select the end date of the period.

By selecting "Never revised" you can select the curves you never checked

Select the gas specie (If the station has additional gas detectors)

Number of selected curves / Total number of curves in the query period.

The list of flux curves that correspond to your selection



By selecting [Filter] you can apply a more restrictive filter to your query.

ErrQ <= 0.9 will select the curves where ErrQ is less than 0.9 (That means not very well shaped curves).

Flux >= 1500 Moles/sm/day will select the curves where the flux is more than 1500 moles/sm/day (That means exceptionally high flux).

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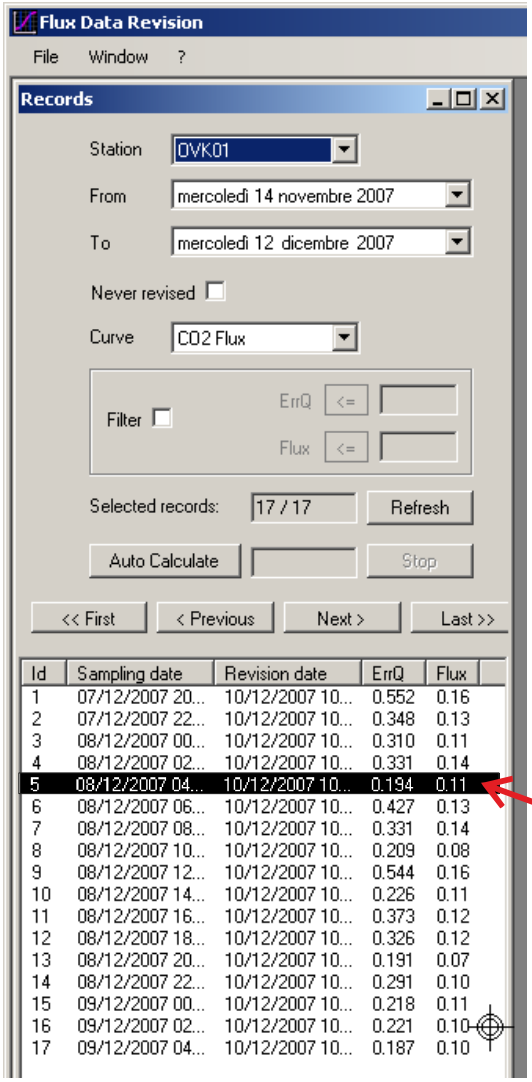
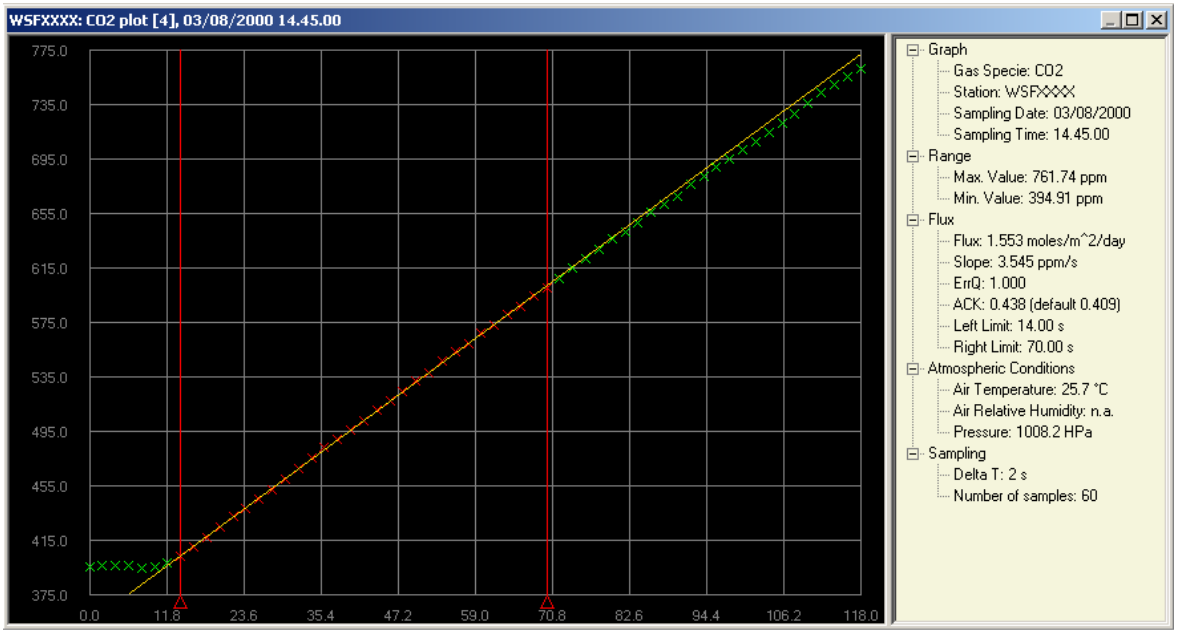


To see the flux curve click on the list.

The flux curve



On the right part of the form is reported the information related with the flux curve.

The interval used to compute the regression is highlighted in red.

The regression computed is drawn in yellow.

The limit of the interval are the two red vertical lines.

The left and right limits are automatically selected by Scada when downloading of the data. Scada tries to pick the right fit using the DataRevision parameters. To modify the settings open the menu [File] [Settings].

The settings are individual for every gas specie and accumulation chamber, because different gas detectors, as well as different accumulation chamber tube lenghts, can produce different response time.

See *Batch Processing* paragraph in the next pages for further detail.

Manual revision
Modify the limits by dragging the vertical lines in the desired position.

The flux, the slope and the ErrQ will be automatically updated.

To save the new result right clik and select {Save Flux}

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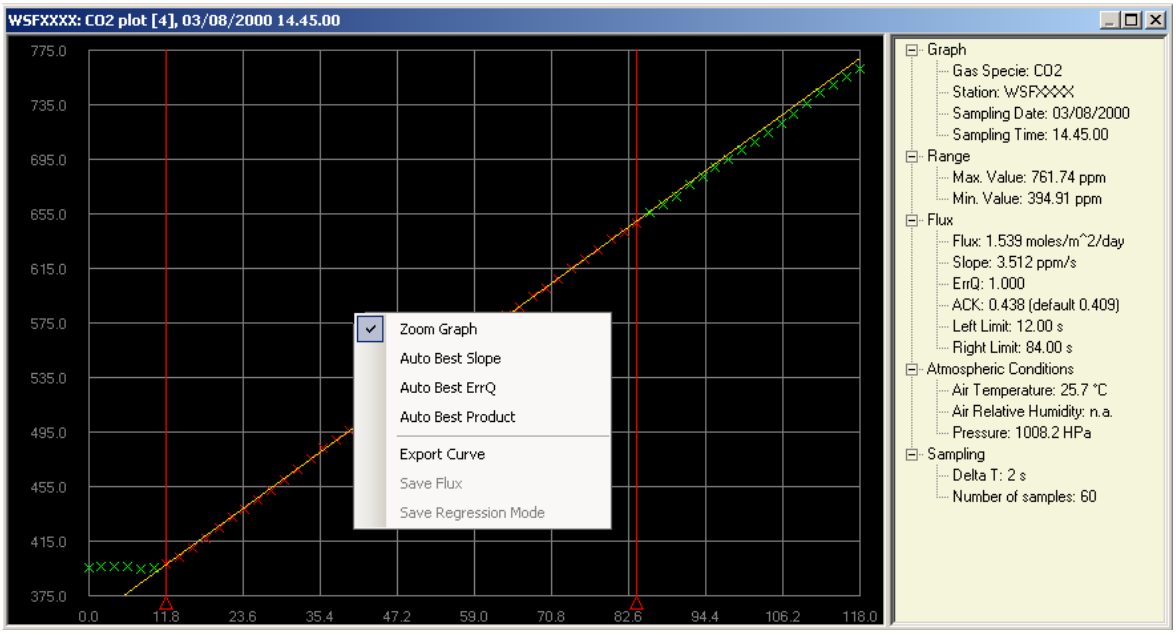


Using the manual revision the computation of flux is completely under your responsability. You can select wrong interval and get wrong results, as in the drawing.

The slope of the curve is positive, but the seleted interval, too short, gives a negative result.

Automatic computation of flux
DataRevision can compute the flux following 3 different algorithms:

By selecting ***Auto Best slope***: the flux will be computed searching for the higher flux;
By selecting ***Auto Best ErrQ***: the flux will be computed searching for the better regression quality;

By selecting ***Auto Best Product***: the flux will be computed searching for a compromise between higher flux and best regression quality.

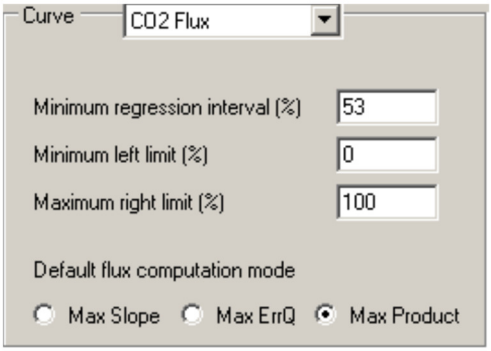
The automatic computation uses, as minimum interval to be used, the interval selected by left and right limits (The two red vertical lines), then if you want to compute the flux using at least 50% of the points in the curve you've to select approximately the 50% of the curve and after select one of the 3 methods for the auto computation. After that you've to select {Save regression mode} to save this settings.

The saved settings will be used by the batch processing of DataRevision and by WS-Scada, when it process the curves while downloading for the station.

Batch processing

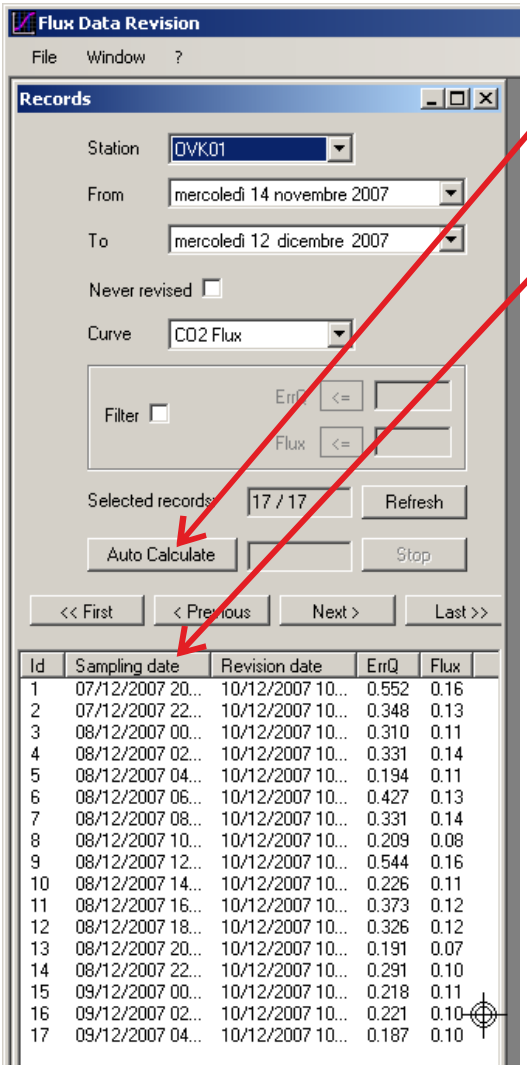
By pressing the [Auto Calculate] button DataRevision will process all the flux curves in the list. The method and the minimum interval will be the one selected with the procedure described before.

More restrictive settings to the automatic processing can be set by opening the {File}{Settings} menu.



For each gas species you can set the minimum interval, the minimum left limit and the maximum right limit, as well as the processing algorithm.
If you need a rigid processing, you can set rigid parameters as:

Interval: 80%
Minimum left: 10%
Maximum right:10%
With these settings WS-Scada and DataRevision are obliged to compute the flux in the range from 10% to 90% of the curve.



Batch processing

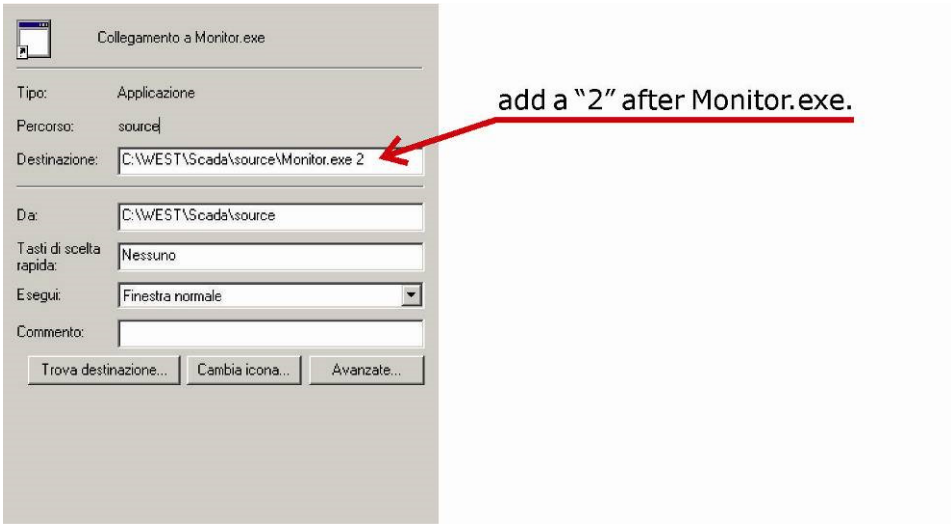
By clicking on [Sampling Date] you can order the list by date in ascending or descending mode .

same consideration for the Revision date, the ErrQ and the Flux.

10.7 Monitor

Monitor is a simple application designed to have a quick view of the last days of data (typically last week or last month).
Monitor displays the data of the channels that are active and having the field Channels.Monitored > 0 and the Channels.MonitoringGroup = 1;
The field Channels.MonitoringGroup can be used to assign a group of channels to a specific instance of Monitor.
To have two instances of Monitor, one showing a group of channels and the second showing a second group of channels you've to:

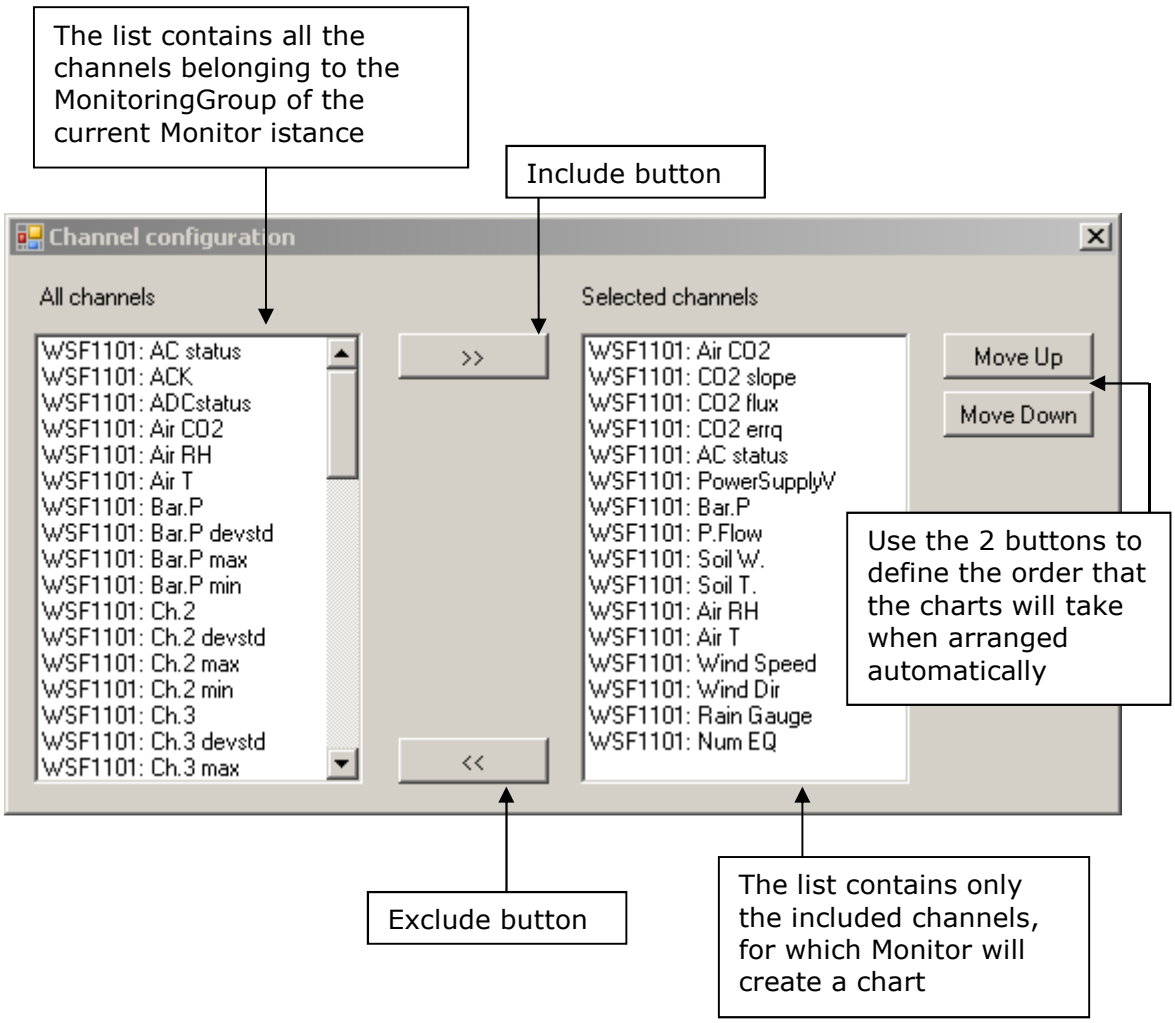
1) Open the Channels table of the database, put the value 2 on the Channels.MonitoringGroup of the channels you want to assign to the second group.
2) Create a new ShortCut of Monitor and modify the properties of the shortcut as following:



10.7.1 Channels

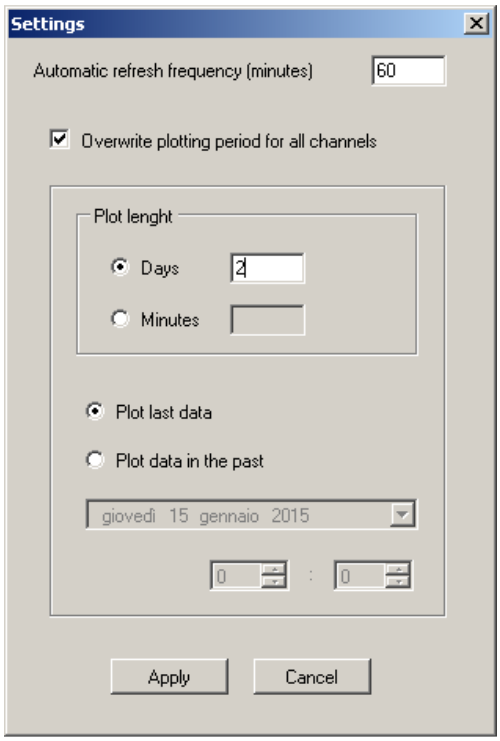
Each Monitor window shows the values of a single parameter (channel). Each instance of Monitor displays the channels belonging to a *MonitoringGroup*. A channel cannot belong to more than one *MonitoringGroup*, so if you have more Monitor instances, a single channel can compare only in one of them.
Once you defined a *MonitoringGroup*, you can configure the channels to be displayed on the current Monitor instances, by opening the menu [Channels][Configure].

The following configuration panel will appear:



10.7.2 Global settings

The global settings are accessible though the menu File – Settings.

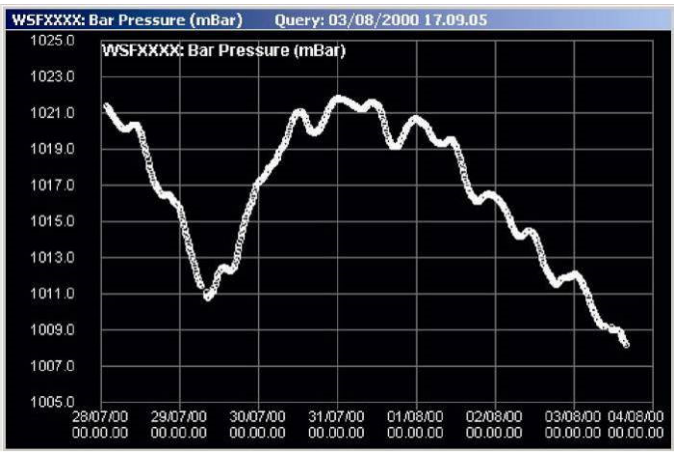


Automatic refresh frequency expresses the time between two refreshes of the charts. Edit this setting according to the sampling frequency: if for example the station takes flux measurement once every hour, it is useless to refresh the charts every 10 minutes.

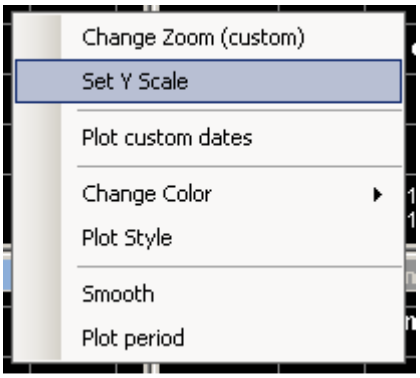
Checking the box *Overwrite plotting period for all channels*, it's possible to determine global settings that applies for all the charts. In this way Monitor will overwrite the settings that you may have previously edited with *Plot Period* and *Plot Custom Dates* menu (see next paragraph).

10.7.3 Chart appearance

By right-clicking on a chart window, you can modify the appearance properties of that chart, as the color of the grid, background, styles, filters.



With a right-click on the plot the following context menu will appear:



Change Zoom: changes the y-scale of the plot. This command will switch among 3 options:

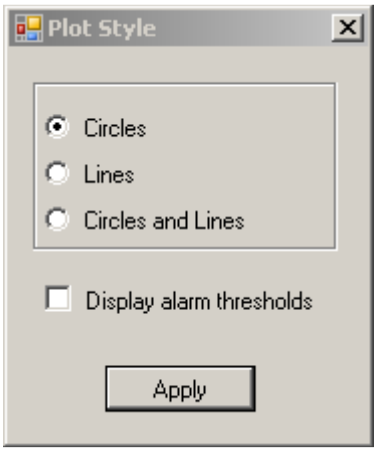
- Auto: selects automatically the best zoom fit
- Min-Max: it's the maximum zoom level that displays all the points.
- Custom: allows entering specific values (see Set Y Scale). Warning: this option will not display points outside the thresholds.

Set Y Scale: allows setting the minimum and maximum values to be displayed when in Custom Zoom mode.

Plot custom dates: By default, the last *x* days of data are plotted (where *x* is editable through Plot Period menu), so the right limit of the x-axis is the current day at midnight. Selecting *Plot Custom dates*, it's possible to plot any date in the past.

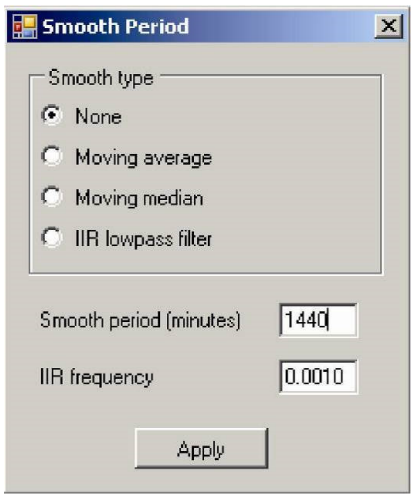
Change color: allows changing the color of grid, background, plot and labels.

Plot style: allows switching between points-based and lines-based plot. If you check the *Display alarms threshold* box, Monitor draws the plots basing on the value represented by the point. The values above alarm threshold are drawn red, the values in pre-alarm yellow and the rest green. If the box is not checked or the channel doesn't have any alarm limit set, the plot is painted with the default color (see *Change color* menu above).



Smooth: allows applying a filter on the plot. Three filters are available: moving average, moving median and lowpass filter.

The *Smooth period* setting refers to Moving average and Moving Median filters. *IIR frequency* is the cutoff frequency of the low pass IIR filter.

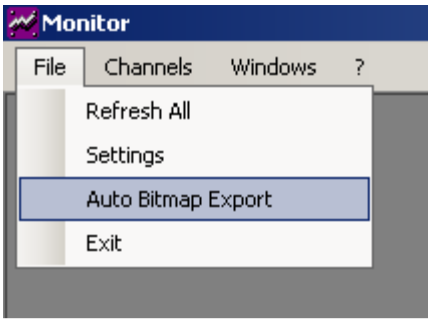


Plot period: Sets the time period to be displayed. Enter for example 14 to monitor the last two-weeks of data.

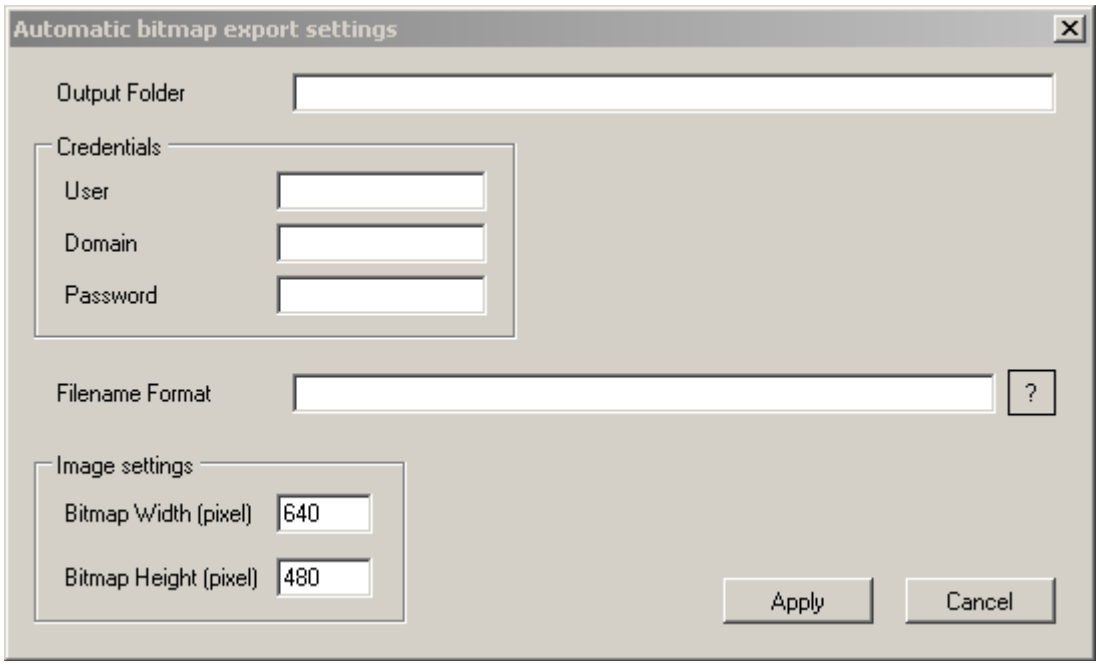
10.7.4 Automatic bitmap export function

Monitor can be configured to automatically export the generated plots to bitmap files.
The files are generated when the automatic scheduler of the application updates the charts (see global settings paragraph). To force the drawing and writing of the files, select on the menu [File][Refresh all]

To activate and configure the function, select [File][Auto Bitmap Export]



The following window will appear:



Insert into the field *Output folder* the path of the directory where you want to have the files saved. Remember that when setting the folder, the directory must exist. The application will try to access it when pressing *Apply*.

Examples:

C:\data\export
\\server\data\export

If the path requires particular credentials, because it is not accessible by the user which started the Monitor application, insert into the fields *User*, *Domain* and *Password* the needed credentials.
Otherwise just leave the fields empty.

Then insert into *Filename Format* a string that will be used by the software to assign a name to the saved file. You can insert into the filename the following keys:

%station% : Name of the station
%chid% : Id of the channel (numeric)
%chname% : Name of the channel
%chdesc% : Description of the channel
%monitored% : Id of the chart
%querydatetime% : Date and time of the chart drawing
%querydate% : Date of the chart drawing
%lastsampledatetime% : Date and time of the last sample
%lastsampledate% : Date of the last sample

The default value is %station%_%chname%

Any string which is not one of the listed key will be just replied into the name files.
Finally, insert into *Bitmap Width* and *Bitmap Height* the dimensions (in pixel) that you want the image files to have.

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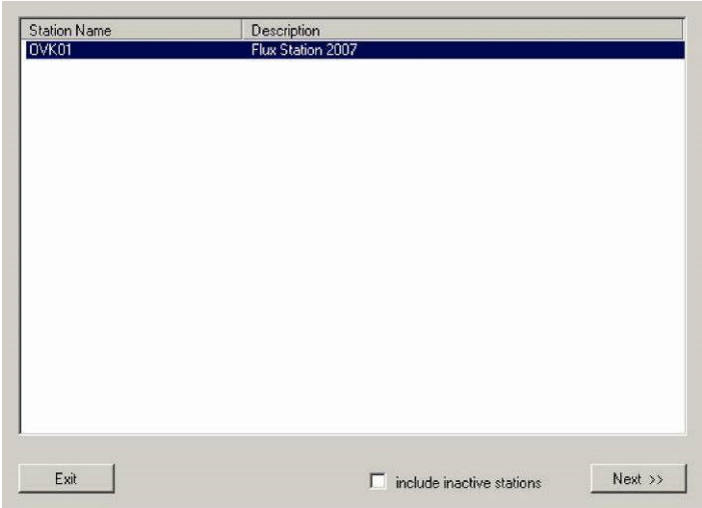
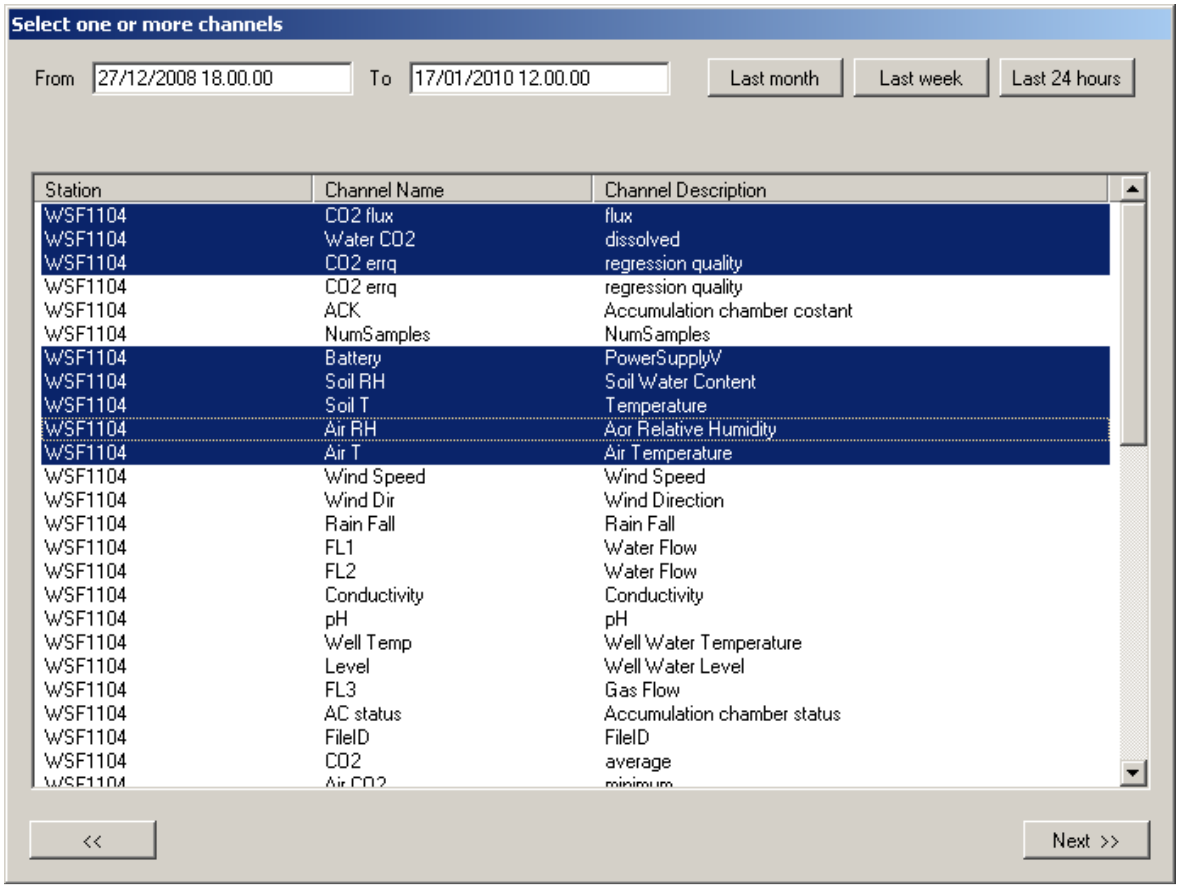
10.8 Query

The Query application allows you to extract the data from the database and to save into a Microsoft Excel spread sheet or into a text file (CSV comma separated value)
Run **Query** and select the station(s) you want to query.

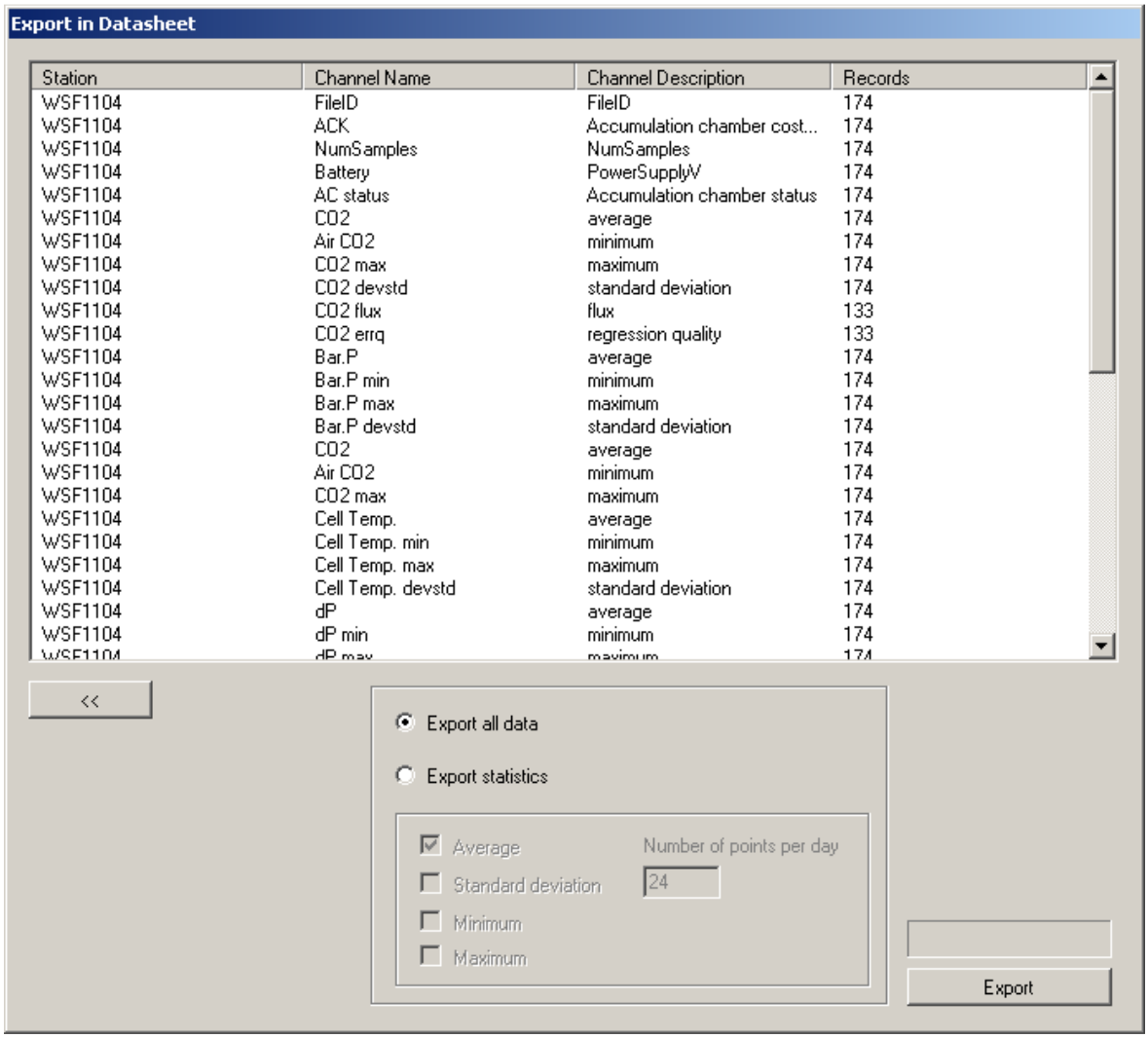


Press the [Next >>] button.



Set the date interval you want to query and Select the Channels then press [Next >>];

The buttons [Last month], [Last week] [Last 24 hours] will help you by setting a "standard" time interval.



A resume of the query is reported: The column "Records" shows how many record are present in the time interval you selected for each channel;

By selecting [Export all data], you'll get a file containing a row for each record (and a column for each channel, plus one for the date/time).

By selecting [Export statistics], you'll get a file containing a number of rows corresponding on the specified "Number of points per day". For example, insert "1" for daily average, "24" for hourly average, etc. Query will generate for each channel one column for every checked statistic (average, standard deviation, minimum, maximum).

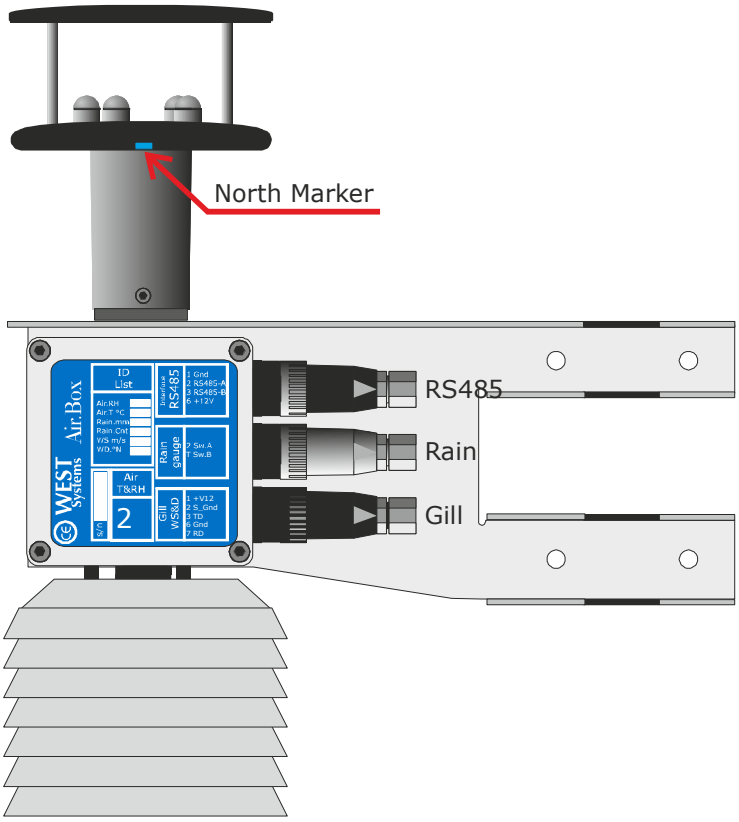
After pressing the button, you have to choose the format (Excel or CSV) and the output path.

11. Airbox

11.1 General description

The air box is an hardware/software interface that convert the signal of Air Temperature/ Relative Humidity gauge and Sonic wind speed / direction gauge to a digital format compatible with the DF1A soilflux station.

The output of the air box is a RS485 with the standard WEST Systems pin out. Since the AirBox is designed to be the last device in the bus the RS485 line is terminated with a 120 Ohm embedded resistor.



Description	Conf	Unit	Sw6 Off	Sw6 On
Rain Gauge	DF	mm	**A8**	AD
Wind direction	D8	°N	**A7**	AC
Wind Speed	D7	m/s	**A6**	AB
Air Temperature	D9	°C	**A5**	AA
Air rel.humidity	DA	%	**A4**	A9

The air box is designed to be mounted on a 50 mm diameter pole. Avoid obstacles that can affect the wind speed and direction measurement accuracy. **The blue marker must be pointed in NORTH direction, using a compass, to get the correct reading of wind direction.**

The rain-gauge must be levelled using the bubble gage

Wind sensor Connections

Panel 6+T female connector			PCB Pin	
Pin 1:	+V12	RED	5)	+12V
Pin 3:	SGND	Green	8)	Gnd
Pin 5:	TD	Yellow	7)	RD
Pin 6:	Gnd	Black	8)	Gnd
Pin 7 (T):	RD	Blue	6)	TD

Air RH & Temp sensor Connections

Panel 6+T female connector			PCB Pin	
Pin 2:	+5V	Red	9)	+5V
Pin 3:	Data	Yellow	11)	Data
Pin 5:	Sck	Blue	10)	Sck
Pin 6:	Gnd	Black	12)	Gnd

Rain Gauge Connections

Panel 3+T male connector		PCB Pin
Pin 2:	SW_A	13)
Pin T:	SW_B	14)

RS485 Connections

Panel 6+T male connector			PCB Pin	
Pin 1:	Gnd	Black	4)	Gnd
Pin 2:	A	Yellow	1)	A
Pin 3:	B	Green	2)	B
Pin 6:	+V12	Red	3)	+Vin

AirBox DIP switch settings

SW1	Air RH%	**On**
SW2	Air T.°C	**On**
SW3	W.Speed m/s	**On**
SW4	W.Dir °N	**On**
SW5	Rain G.	**On**
SW6	ID Base/Extended	**On**
SW7	Set Conf=05	Off
SW8	Calibration enabled	Off

The switch from 1 to 5 can be used to enable or disable the sensors.

SW6: If two airbox are installed on the same RS485 chain the SW6 switch of one of them must be set to On in order to avoid addresses interference.

11.2 Wind speed and direction gauge

Manufacturer: Gill
Model: Windsonic
Speed

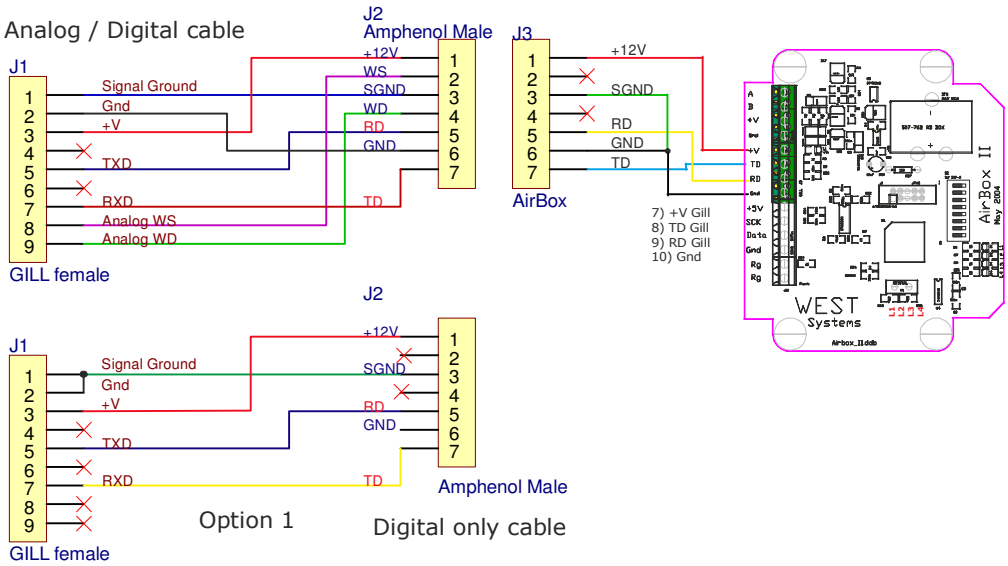
- Range 0..60 m/sec
- Accuracy : 4%
- Resolution : 0.01 m/sec

Direction

- Range 0..360 degree North without dead zone.
- Accuracy : 3%
- Resolution : 1 degree

Power supply

- 9..30 VDC 40 mA typical @ 12VDC

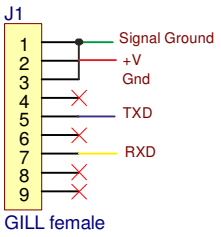


Gill configuration

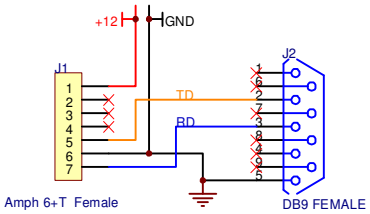
M2 Gill Polar Continuous data format mode
U1 WInd Speed Unit meter/second
O1 Comma Separated Format CSV
L1 CR/LF Message terminator
P1 Out rate 1 sample / second
B3 Baud rate 9600
F1 No parity 8 bit
H1 Power-up message on
NQ Node address not defined
E3 communication protocol E3 = RS232

If analogue output is present:
S6 = 0-60 m/sec Wind Speed analogue range output
C2 = Wrap around 0-359°

Option 2/3



Test/Setup cable

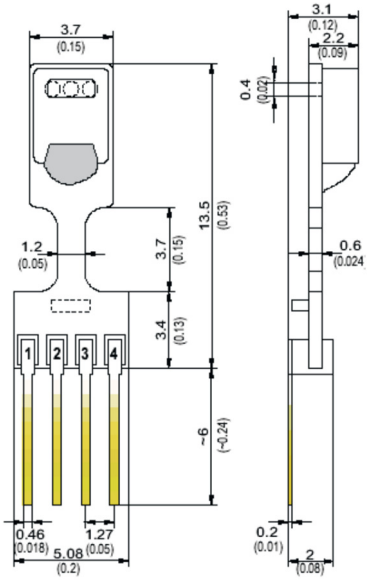


T1 = 0..5 Volts analoge voltage output
(T2=4-20mA)

To configure the GILL connect it via RS232 using a 9600-n-8-1 configured terminal.
Send a "*" to enter in the set mode and D3 to list the actual settings.
Send a
E3<Enter>
and check it sending an
E<Enter>

Turn off the GILL, wait 5 second and turn on it.
Enter * and D3 to check that the configuration changed.
The GILL save the modifications automatically

11.3 Air Temperature and relative humidity gauge

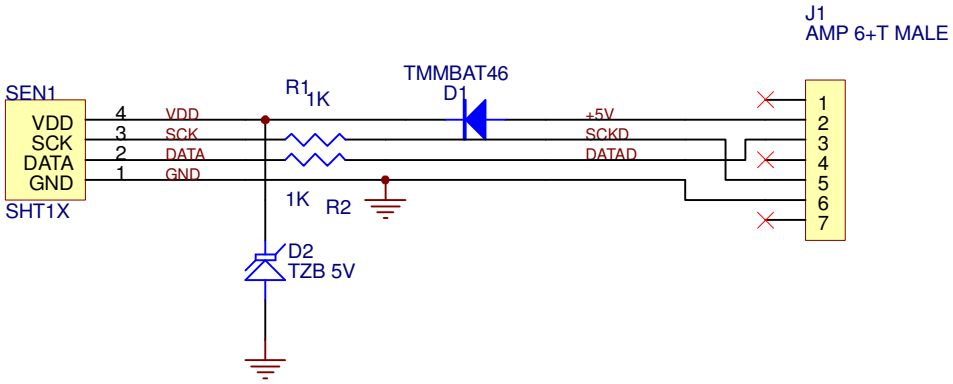


Sensor specifications

2 sensors for relative humidity & temperature

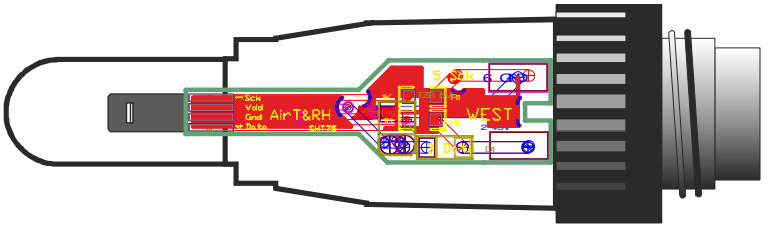
- Measurement range: 0-100% RH
- Absol. RH accuracy: +/- 2% RH (10...90% RH)
- Repeatability RH: +/- 0.1% RH
- Temp. accuracy: +/- 0.4°C (5-40 °C)
- Calibrated & digital output
- Fast response time < 3 sec.

Probe schematics



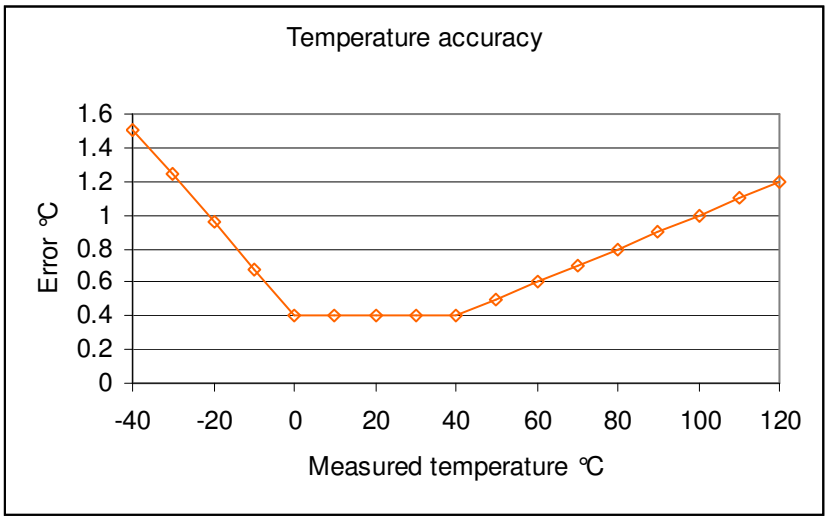
11 Airbox

Probe Layout (actual size)

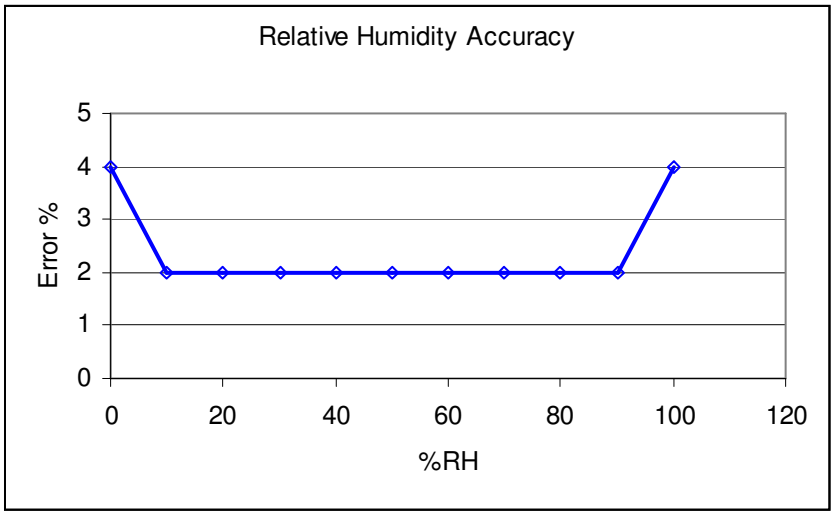


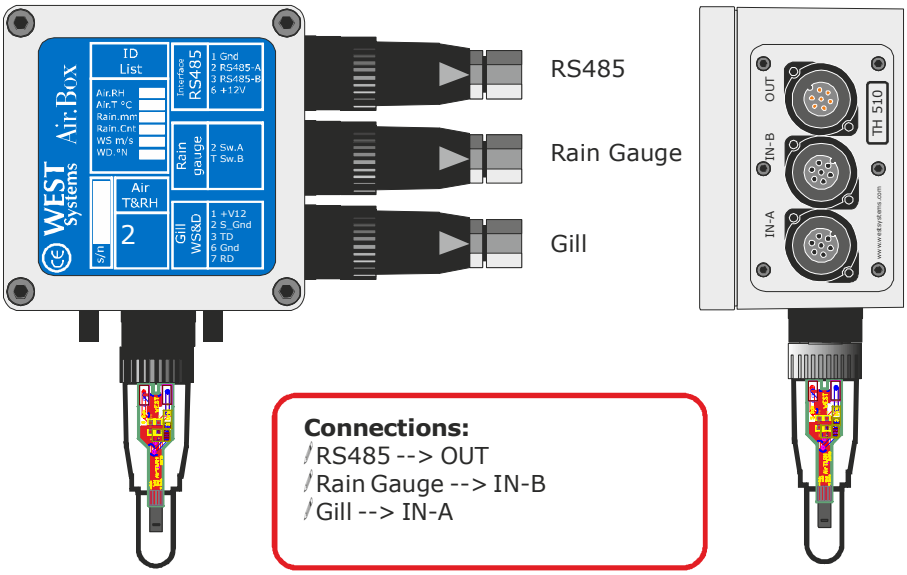
Amphenol 6T male

Air Temperature accuracy Vs. temperature



Relative Humidity accuracy Vs. RH%



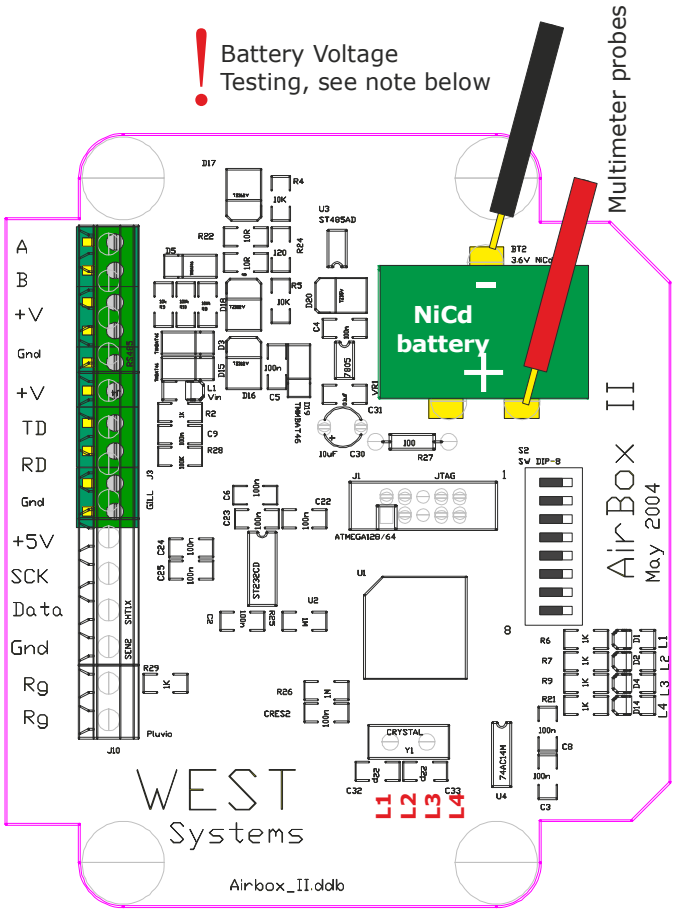


Connections:
- RS485 --> OUT
- Rain Gauge --> IN-B
- Gill --> IN-A

Air TH & T. Probe

PCB Layout

1) RS485_A
2) RS485_B
3) +V in
4) Ground
5) Gill +12V
6) Gill TD
7) Gill RD
8) Gill Gnd
9) Ss +5V
10) Ss SCK
11) Ss Data
12) Ss Gnd
13) Rg Sw.A
14) Rg Sw.B



The correct working of RAIN gauge, when the station is in stand-by, is sustained by the internal NiCd battery. To allow the proper operation of the system the battery voltage must be more than 4.6 Volt.

To test it:

1) power off the station;
2) measure the NiCd battery voltage;

3) drop 100 cc of water inside the RainGauge: the 4 LED lights must Flash for a 1/5 second period per each raing gauge balance "click".

11.4 Rain gauge

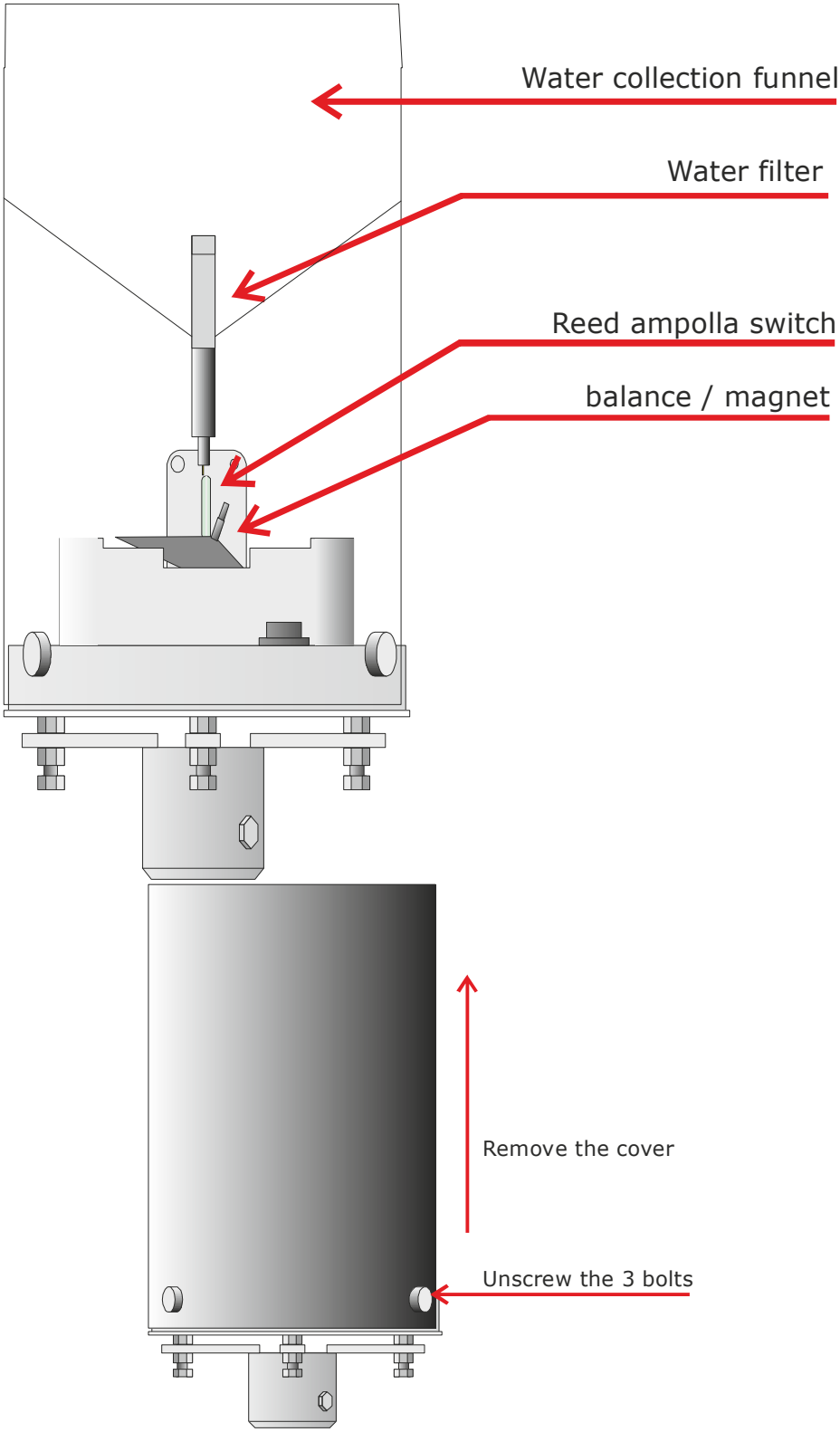
Manufacturer: LSI-LASTEM
Ordering code: DQA130
Heated Rain gauge
Range: incremental
Accuracy 1%
Resolution 0.2 mm
Collector surface area: 324 square centimeter
Collector area diameter: 203 mm
Temperature range 0..+50°C

Rain gauge support for 50 mm diameter mast mounting

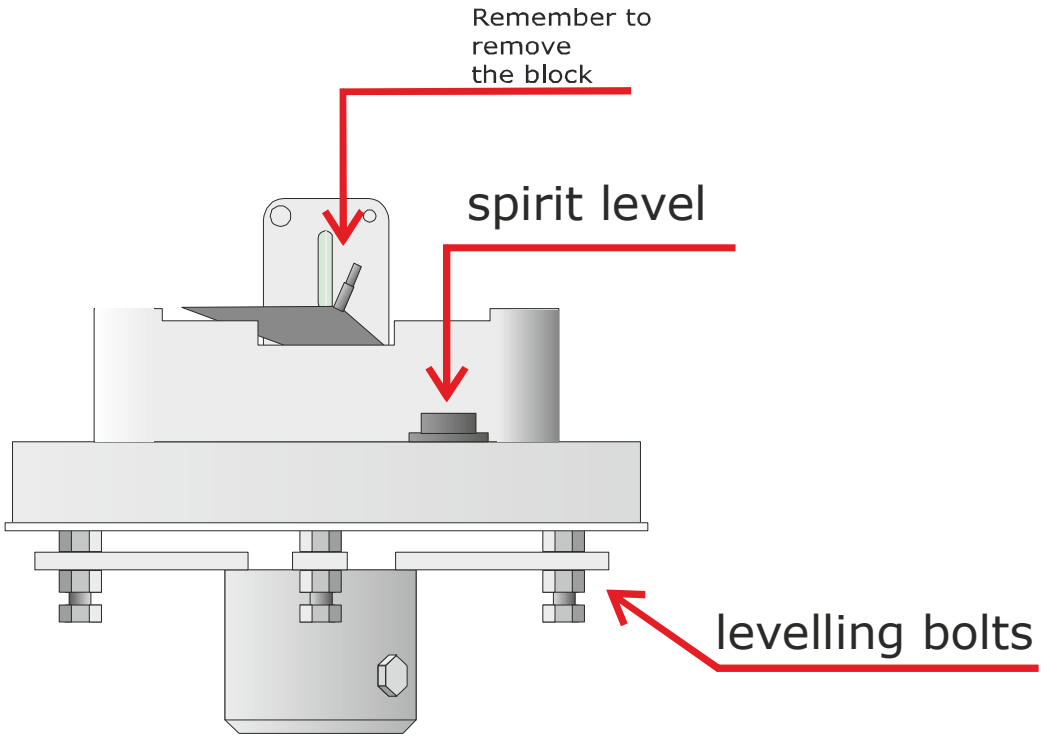
AirBox
While the FluxStation is in stand-by state the airbox reads and store the reading of the rain gauge. The airbox is power supplied with a 3.6V rechargeable battery that's charged by the FluxStation every analysis cycle.

Check
To check the calibration of the raingauge:
Enter, slowly, 1.0 liter of water in the funnel. The reading must be increased of 30.8 mm.
Since the rain gauge channel reading is cumulative, you've to note any test you made, in order to do not confuse tests with real rain.

11 AirBox


Water collection funnel
Water filter
Reed ampolla switch
balance / magnet
Remove the cover
Unscrew the 3 bolts

11 Airbox



In order to have a correct working the raing-gauge must be levelled by trimming the 3 levelling bolts. A spirit-level will help in the levelling.

12. Ethernet interface

The Flux Station is equipped with two native RS232 ports.
In order to easily integrate the flux station into an existing LAN network, or to make use of an existing TCP/IP telemetry system, the station is also equipped with an industrial grade serial server (Moxa NPort 5110), connected to one of the two RS232 port. This device is configured as a TCP server: it waits for an incoming connection. Once it is contacted by TCP client (WS-Scada application), a socket is opened and the data transfer can begin.

12.1 Specifications

Serial Server Moxa NPort 5110 specifications:

Ethernet Interface
Number of Ports 1
Speed 10/100 Mbps, auto MDI/MDIX
Connector 8-pin RJ45
Magnetic Isolation Protection 1.5 kV built-in

Serial Interface
Number of Ports 1
Serial Standards NPort 5110: RS-232
NPort 5130: RS-422/485
NPort 5150: RS-232/422/485
Connector DB9 male
RS-485 Data Direction Control ADDC® (Automatic Data Direction Control)
Pull High/Low Resistor for RS-485 1 kΩ, 150 kΩ

Serial Communication Parameters
Data Bits 5, 6, 7, 8
Stop Bits 1, 1.5, 2
Parity None, Even, Odd, Space, Mark
Flow Control RTS/CTS and DTR/DSR, XON/XOFF
Baudrate 50 bps to 230.4 kbps (Supports standard baudrates)

Serial Signals
RS-232 TxD, RxD, RTS, CTS, DTR, DSR, DCD, GND

Network Protocols
ICMP, IPv4, TCP, UDP, DHCP, BOOTP, Telnet, DNS, SNMP V1, ARP, HTTP, SMTP

Configuration Options
Web Console, Serial Console (NPort 5110/5150 only), Telnet Console, Windows Utility

Windows Real COM Drivers
Windows 95/98/ME/NT/2000, Windows XP/2003/Vista/2008/7/8/8.1/10 (x86/x64), Windows 2008 R2/2012/2012 R2 (x64), Windows Embedded CE 5.0/6.0, Windows XP Embedded

Fixed TTY Drivers
SCO Unix, SCO OpenServer, UnixWare 7, QNX 4.25, QNX 6, Solaris 10, FreeBSD, AIX 5.x, HP-UX 11i, Mac OS X

Linux Real TTY Drivers
Linux 2.4.x, 2.6.x, 3.x, 4.x

Environmental Limits
Operating Temperature Standard Models: 0 to 55°C (32 to 131°F)
Wide Temp. Models: -40 to 75°C (-40 to 167°F)
Storage Temperature -40 to 75°C (-40 to 167°F)
Ambient Relative Humidity 5 to 95% (non-condensing)

Standards and Certifications
Safety UL 60950-1
EMC EN 55032/24
EMI CISPR 32, FCC Part 15B Class A
EMS IEC 61000-4-2 ESD: Contact: 4 kV; Air: 8 kV
IEC 61000-4-3 RS: 80 MHz to 1 GHz: 3 V/m
IEC 61000-4-4 EFT: Power: 1 kV; Signal: 1 kV
IEC 61000-4-5 Surge: Power: 1 kV
IEC 61000-4-6 CS: 150 kHz to 80 MHz: 3 V/m; Signal: 3 V/m
IEC 61000-4-8 PFMF
IEC 61000-4-11 DIPs

Reliability
Automatic Reboot Trigger: Built-in WDT (watchdog timer)

MTBF (mean time between failures)
Time: 3,126,448 hrs
Standard Telcordia (Bellcore) Standard TR/SR

12.2 Moxa NPort status

The Moxa NPort is equipped with three LEDs which have the following functions:

LED Name	LED Color	LED Function
Ready	Red	Steady on: Power is on, and the NPort is booting up.
		Blinking: Indicates an IP conflict, or the DHCP or BOOTP server did not respond properly.
	Greeen	Steady on:Power is on, and the NPort is functioning normally.
		Blinking: The device server has been located by NPort Administrator's Location function.
	Off	Power is off, or a power error condition exists.
Link	Orange	The device is connected to a 10 Mbps Ethernet connection.
	Green	The device is connected to a 100 Mbps Ethernet connection.
	Off	The Ethernet cable is disconnected, or has a short.
Rx/Rx	Orange	The serial port is receiving data.
	Green	The serial port is transmitting data.
	Off	Data is NOT being transmitted or received through the serial port.

12.3 Moxa NPort Configuration

The serial server can be configured through the web interface using a common web browser. Please follow the steps below:

1- Connect the Flux Station LAN Interface to a laptop using an Ethernet cable.

2- Make sure the serial server is currently switched on. If it isn't, you can turn it on using one of the following two methods:

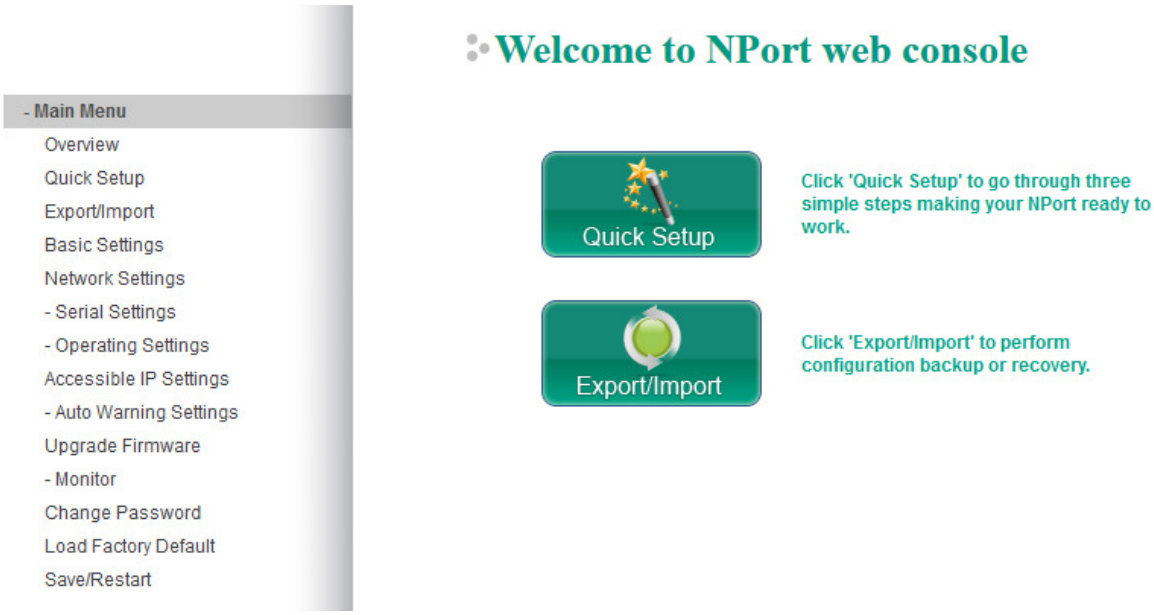
   a. Reset the flux station by turning off and on the main switch.
   b. Access the flux station display, navigate to the command *2.2 Set Radio* (see Chapter 6 for details) and turn ON the radio.

3- Open the web browser (e.g. Chrome, Firefox) and digit the Moxa NPort address, which is written on a label on the Moxa NPort case. If the IP address is unknown, reset the unit to the fabric configuration using the reset button: the default address is reset to 192.168.127.254.
   Note: the laptop IP address must be in the same subnet of the Moxa NPort (mask 255.255.255.0). For example, if the NPort address is 192.168.127.254, the laptop address must be 192.168.127.x, where x is different from 254.

4- Default access parameters are: user *admin*, no password.

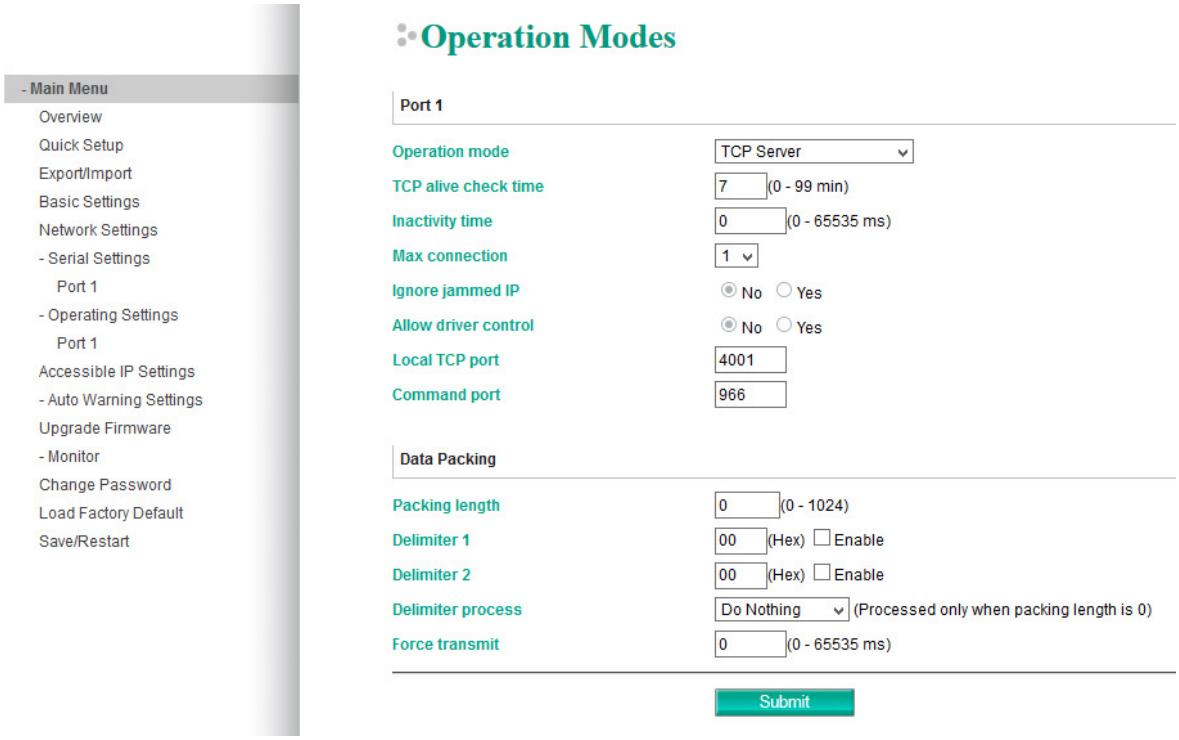
12 Ethernet interface

The following windows will show on the browser. The main menu is on the left.



Operation Modes

Access to Operation Settings / Port 1.
The Operation mode must be set to TCP server.
The Local TCP port must be set to 4001.

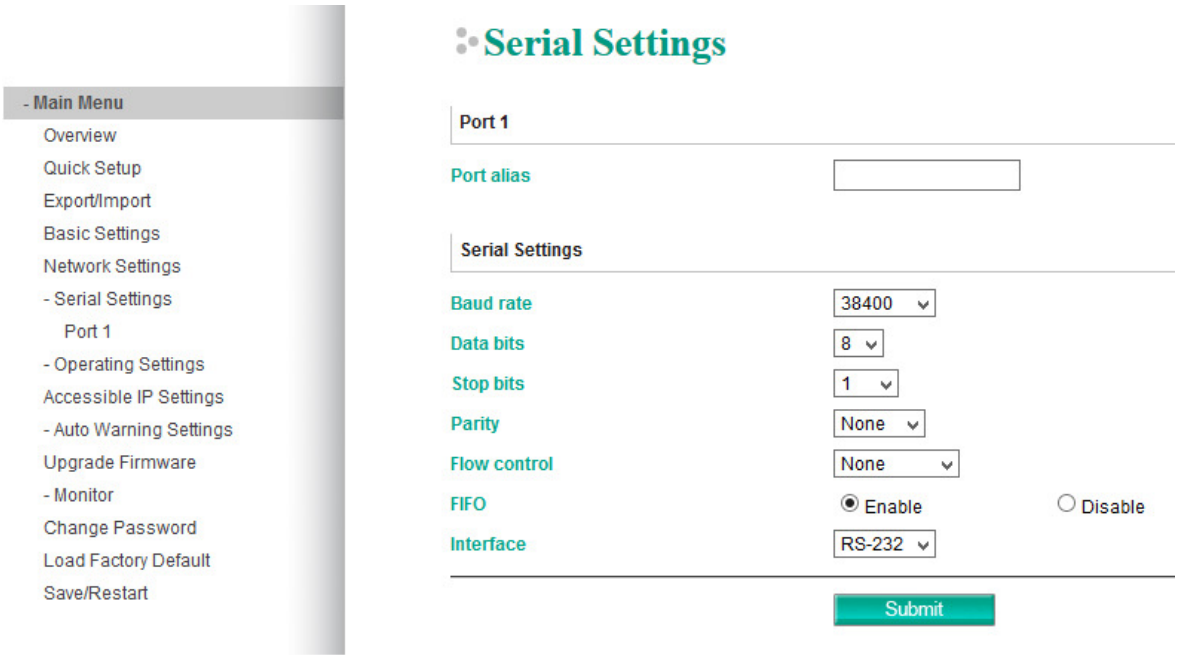


Serial settings

Note: The Moxa NPort serial server comes from the West Systems fabric already configured with the correct serial setting. These settings must not be changed otherwise the flux station will not be able to communicate.

Access to Serial Settings / Port 1 and check that the configuration is as following:

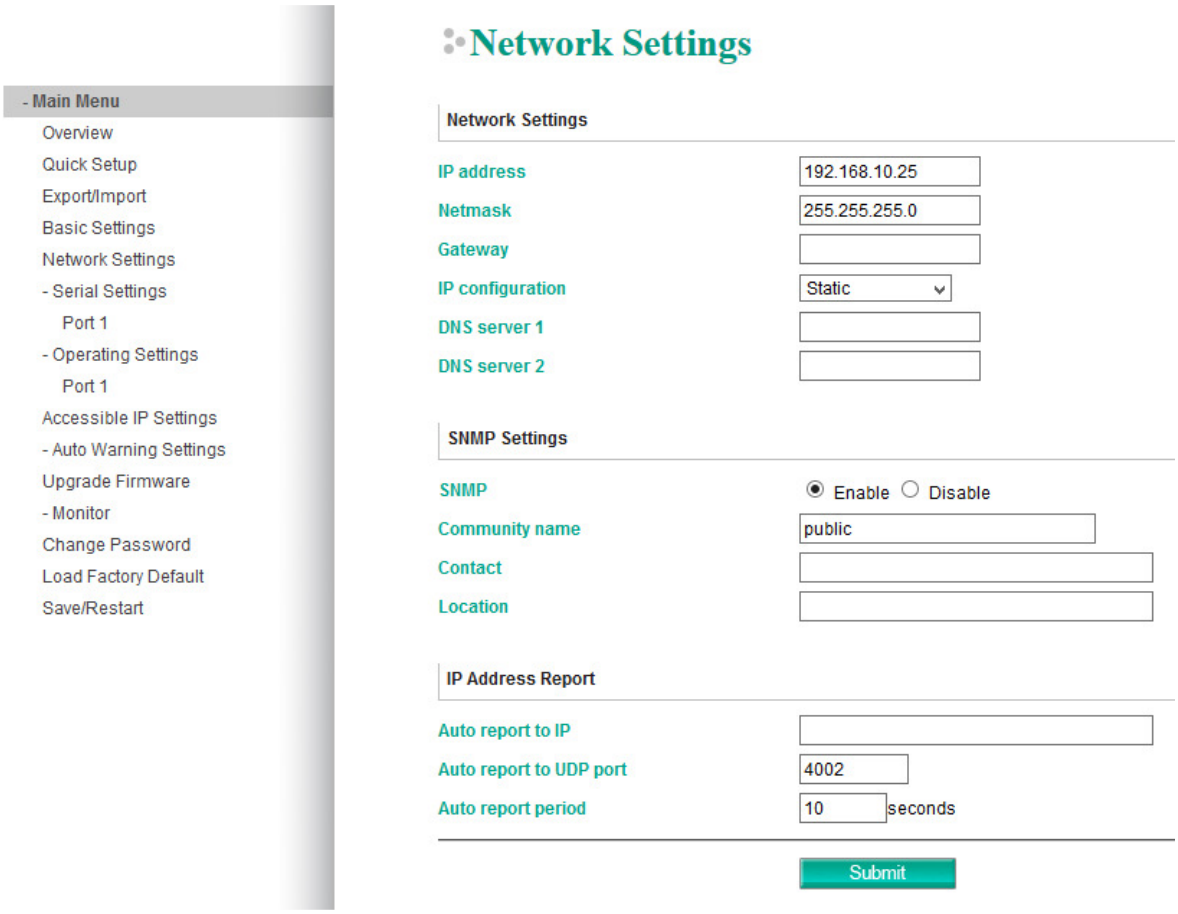
Baudrate 38400
Data Bits 8
Stop Bits 1
Parity None
Flow Control None
Interface RS232



Network settings

You will need to necessarily edit the Moxa NPort network settings in order to integrate the flux station into an existing network.

Access to Network settings and set the IP address, Netmask and Gateway according to your network configuration.

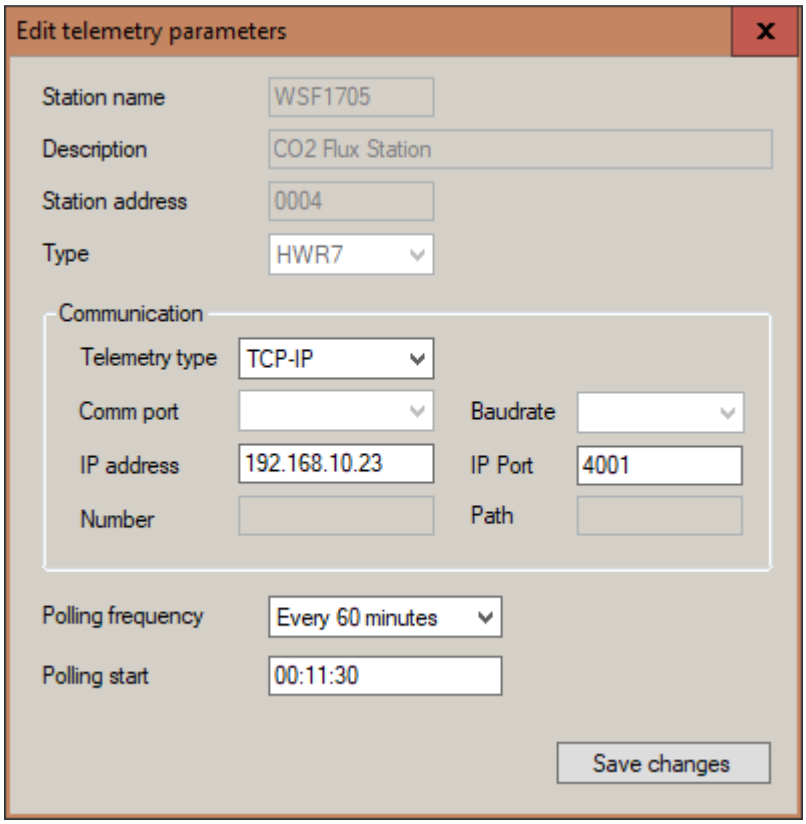


12.4 WS-Scada Configuration

Once you edited the Moxa NPort network settings, you need to configure WS-Scada with the new flux station IP address. Execute the following steps:

- Open WS-Scada, select [Options][Show Advanced Menu]
- Right-Click on the name of the station you want to set, press [Edit Telemetry]

The following windows will be displayed:



- The Telemetry Type must be set to TCP-IP
- Input into the [Port] field the port number you configured in Moxa NPort server (default is 4001)
- Input into the [IP Address] field the IP address you configured in Moxa NPort server.
- Press [Save changes]
- Restart WS-Scada.

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Continuous Monitoring Flux Station
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