IngenieríaAnalítica
Chromatography & Spectrometry

Hydrogen generator

GENERAL INFORMATION OF H2 RUNNING

WATER TANK

Use only pure water > 10MΩ
Tank Capacity : 2.3 liters

O2/H20 separator module

H2/H20 separator module

Water come back in the tank

GAS LIQUID SEPARATOR

H2O+ H2

H2O+ O2

WATER PUMP

Increase pressure water
Allows a best speed of water through the cell to avoid overheating

FILTER

Contains deionizer bag and dust water filter

ELECTROLYSIS CELL

Separate hydrogen and Oxygen
2H2O => 4H+ + 4e- + O2

H2O+ H2

Electronic gas liquid separator with 2 levels of sensors safety

Hydrogen generator
ND series

- ND-H2 Purity > 99.9995%
- Pressure up to 10 bar
- Simple dessicant cartridge + Nafion tube

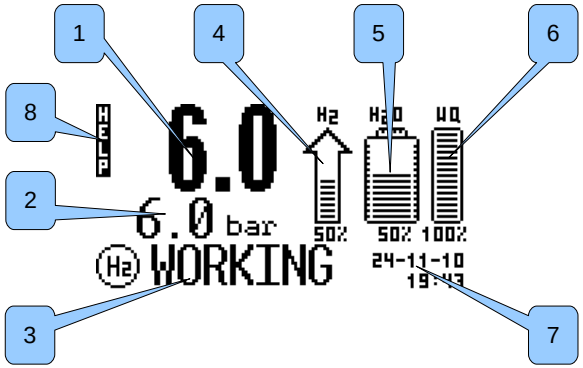
Hydrogen generator
PAR series

- Purity > 99.9999%
-Pressure up to 12 bar, on request 16 bar
-Single column dryer with programmable automatic regeneration via integrated clever calendar

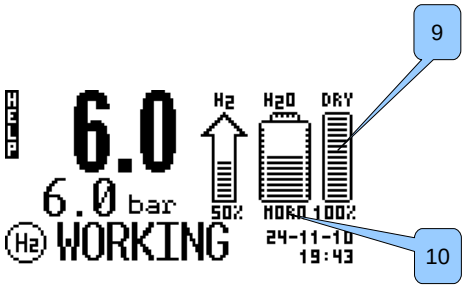
Hydrogen generator
WM series

- Purity >99.99999%
- Automatic dryer regeneration
- Pressure up to 12 bar, on request 16 bar

Touch Screen

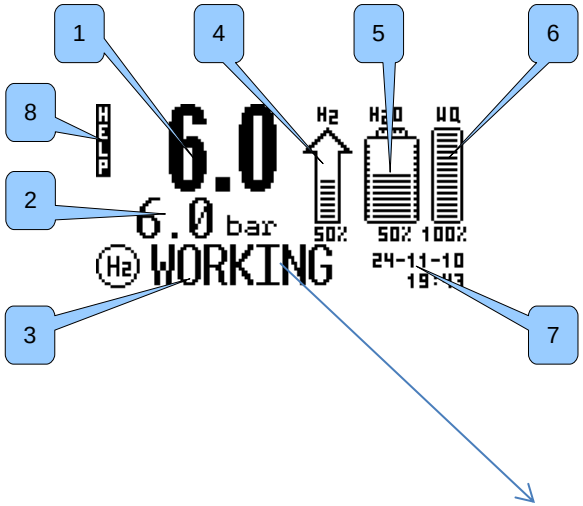


WM.H2 models



PAR.H2 models

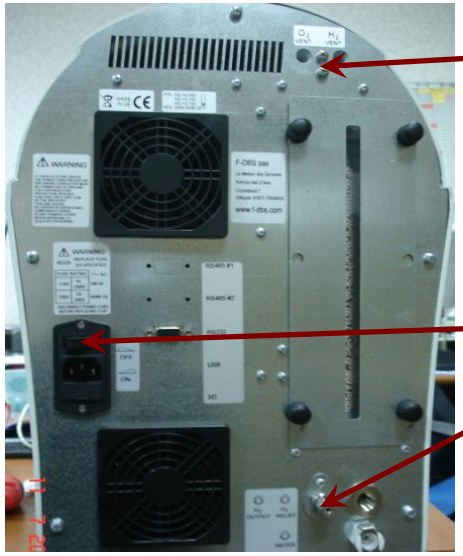
#	Description
1	Real outlet pressure
2	Pressure set by user (set-point)
3	System status and Pre-alarms display, see table 1 and 3
4	H2 Flow %
5	Water tank level
6 (WM.H2)	Water quality in percentages (100% GOOD – 0% BAD)
7	Date / Time
8	Touching this label an HELP windows will be shown
9 (PAR.H2)	Internal dryer residual life
10 (PAR.H2)	Quality of water : GOOD, NORMAL, BAD



Displayed on screen	Description
OFF	The system is STOPPED and does not produce H2
STARTING	The system is generating internal pressure before opening the OUTLET valve
CHECKING	When the system is pressurized, before to open the OUTLET valve, the unit make an automatic check of any internal leak.
FILLING	The system is filling the line connected ON the OUTLET with the maximum available flow
WORKING	The system is working and the line pressure has reached the VALUE set by the user
STANDBY	The system is internally pressurized and ready, but the OUTLET valve is close

START UP

1- Open the front door and fill water tank with pure water (Deionized, ASTM II, <0,1uS)



2- Remove the plugs from the back fittings of the generator

ON/OFF

•3- Connect the hose to the hydrogen output fitting

4- Connect the voltage wire to the power socket and Turn on the power switch

Set the work set-point

Real pressure

Pressure set

1- Touch the screen on the center for at least 2 seconds

2- Select « Adjust Pressure »

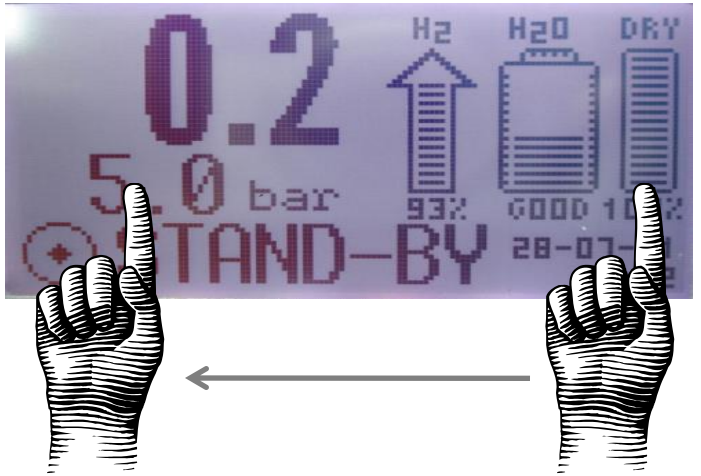
3- Increase or decrease the pressure with the arrows.

4- Touch the screen to valid it

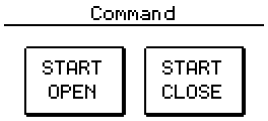
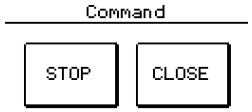
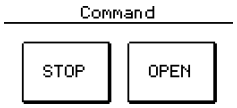
START UP

Touch the blue key or slide your finger right to left

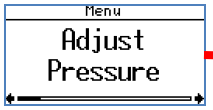
or



Choose START CLOSED or OPEN

System status	Control screen	Description
OFF		When the machine is in the OFF state (production stopped) you can give the START command with subsequent opening of the outlet valve (START/OPEN) or not (START/CLOSE)
STARTING WORKING FILLING		During operation we can give the command to STOP or closure of the outlet valve
STANDBY		In the STANDBY state can give the command STOP or opening of the outlet valve

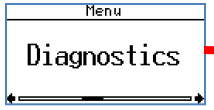
MENU



Change working pressure

User parameter

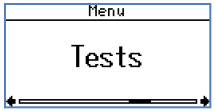
Alarm and prealarm history



Voltage, current, power values

Working time and H2 produced

Service Submenu



Leak test

Management of internal water tank

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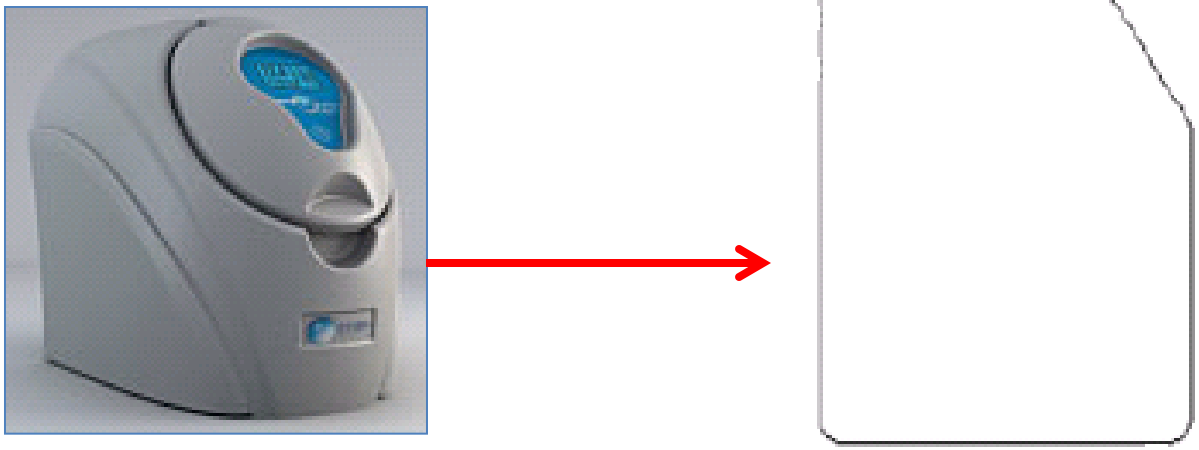
MENU: Parameter

Name	Description	Min	Max	Typical	Unit of measure
Pressure Drop Delay	If the system cannot bring the H2 pipes up to pressure, after having waited for the time set in this parameter production is interrupted with a buzzer and visual alarm (“Out Pressure error”).	2	10	10	min
Pressure Rise	During the filling stage of pipes connected on the H2 outlet, if the pressure does not rise with a minimum slope defined by this parameter, production is interrupted with a buzzer and visual alarm (“Low Out Press”). When the value is set to 0.0, this check will be disabled.	0	100	0,3	psi/min
Autostart	"Enabled": when power is restored after a black-out the system restart and goes into the working mode. “Disabled”, when power is restored after a black-out, the system stays in OFF status.	No	Yes	Yes	
Pressure Unit	Defines the pressure unit: psi, bar	Psi	Bar	Bar	
Temperature Unit	Defines the temperature unit: ˚F,˚C	˚C	˚F	˚C	

MENU: Parameter

Name	Description	Min	Max	Typical	Unit of measure
Auto Refill Water	Enables the automatic external tank automatic filling function. If Enabled when the level of internal water tank go below 5% the auto fill start and terminate when the level arrive to 95%.	Disabled	Enabled		

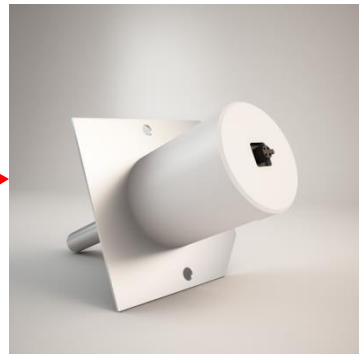


Name	Description	Min	Max	Typical	Unit of measure
ZeroAir Module	Add a Air Zero generator to connect a combine generator	NO	YES	NO	

Air Zero

Hydrogen

Name	Description	Min	Max	Typical	Unit of measure
Hydrogen sensor	Add a external hydrogen sensor	NO	YES	NO	



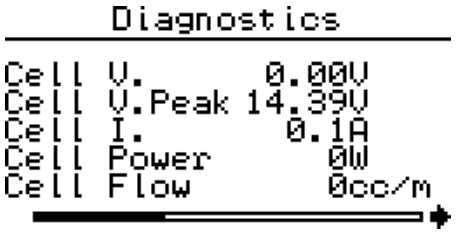
When the customer use hydrogen as carrier gas, the only drawback is the danger of explosion in case of a leak in the column oven

Detection Range	0.1% to 1% by volume (25% of LEL,Lower Explosion Limit)
Alarm threshold	Adjustable from 0.5% to 1% by volume
Ambiant Temperature of the body's sensor	0- 50℃ max
Oven temperature of the GC for the H2 sensor metal pipeline	500℃ max
Stability of reading	Better than 200 PPM (within one year)
Power Supply Voltage	From 8V to 30V (DC)
Communication port	RS-485
Protocol	MODBUS-RTU
Calibration:	Should be checked every year with a test gas (1.0%)

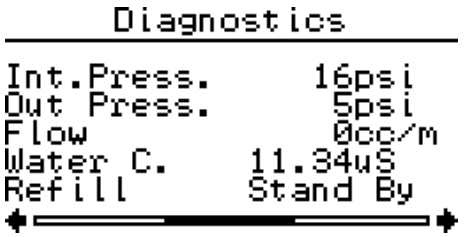
MENU: Parameter

Name	Description	Min	Max	Typical	Unit of measure
User flow limit	Allows to restrict the flow	50%	100%	100%	
Default Parameter	By selecting YES, all the parameters are set to their default values	No	Yes		
Start Mode	Defines the method used for line pressurization: Normal: The outlet valve is opened only after the internal circuit has been pressurized and after having automatically performed an “internal leak test” Fast: The valve is opened when the internal pressure is greater than the set-point set by the user and no "internal leak test" is carried out	Normal	Fast	Normal	
ID Address	Logical address in case of connection of the unit in a communication bus	1	1	31	
Baud Rate RS485	Speed of communication of the RS485 port	2400	38400	38400	

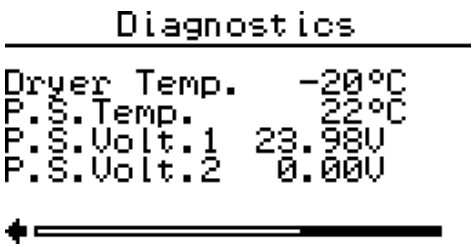
MENU: Diagnostic



- PEM cell voltage
- Peak PEM cell voltage
- PEM current
- PEM cell power supply
- H2 Cell flow produced (cc/min)



- Internal pressure
- External pressure
- Actual H2 Flow produced cc/min
- Water conductibility uS



- Column temperature
- Power Supply temperature
- power supply voltage no. 1
- power supply voltage no. 2 (only models with flow rates over 400 cc/min)

MENU=>Maintenance

Operation	Interval	Spare parts
Change water deioniser bag	4000 working hours or 1 year	SP.H2.DB01
Check the water filter	1000 working hours or 1 year	SP.H2.WFILT.M
Run an Automatic dryer regeneration program for PAR serie	As required or 12 months	
Change the dessicant cartridge for ND series	As required or 12 months	

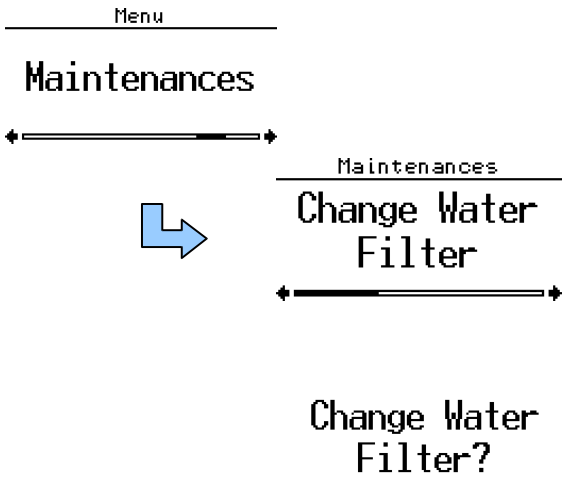
Change water deioniser bag and water filter

Unscrew the three screws

Pull the top cover and remove Oring and deionizer bag

Remove black O-ring

Remove water filter

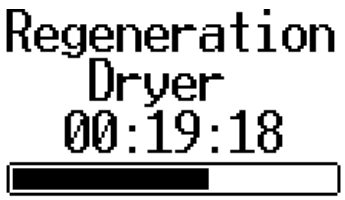


This command must be given when the DEIONIZER BAG is changed and the filter is cleared. It resets the counter that registers filter and deionizer bag's life as well as any correlated pre-alarms.

An additional confirmation is requested from the operator; to do so the operator touches the Touch Screen for 0.5 seconds.

Run an Automatic dryer regeneration PAR serie

The procedure occurs for 3:30 hours



To access the dryer regeneration function, touch the Touch Screen for 0.5 seconds.

To immediately enable dryer regeneration, select this option by touching the Touch Screen for 0.5 seconds.
Hydrogen production will be suspended up to the end of the regeneration cycle.

The advancement bar and the time signal tell the operator when the operation will end.
Scrolling from top to bottom interrupts dryer regeneration.

An additional confirmation is requested.
To confirm, touch this option for 0.5 seconds. Instead, scrolling from top to bottom returns the screen to the display of the advancement of the process in course.
NOTE:
any "Dryer Saturated" pre-alarm is cancelled only upon the conclusion of the regeneration cycle.

MENU=>Maintenance=>Service

This procedure can be enabled in case of emergency and when there is no instrument to measure the pressure in output from the machine. Close the output with the special plug and run the procedure.

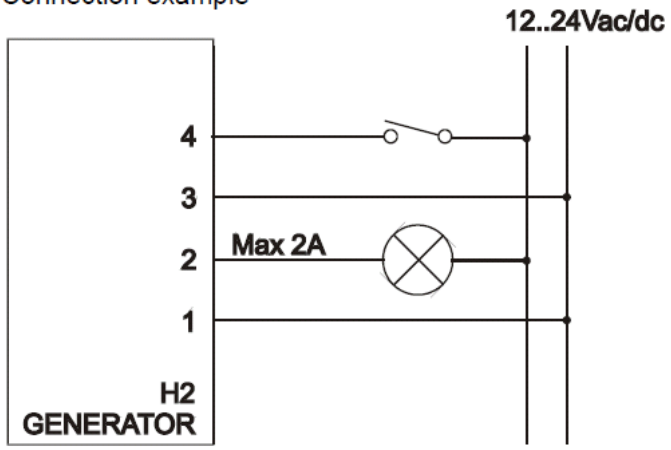
This procedure is enabled whenever the measurement of the internal pressure sensors needs calibration.
Connect the sample instrument to the exit of the generator and run the procedure

To update the display or main board firmware of the generator

Remote control

Pin	Description
1	Free contact (max 2A, 24Vac/dc) N.C.
2	Free contact (max 2A, 24Vac/dc) N.C.
3	Digital INPUT (+12..24Vdc) Impedance 5Kohm
4	Digital INPUT (0V)

Connection example



- A free potential contact (terminals 1 and 2) which is normally closed and opens when there is a stop of the production for any alarm.
– A digital input opto-isolated with which it can activate / stop the generation of hydrogen. When this input (terminals 3 and 4) is feeding the generator begins to produce, when you open the generator stops and goes into the OFF state.

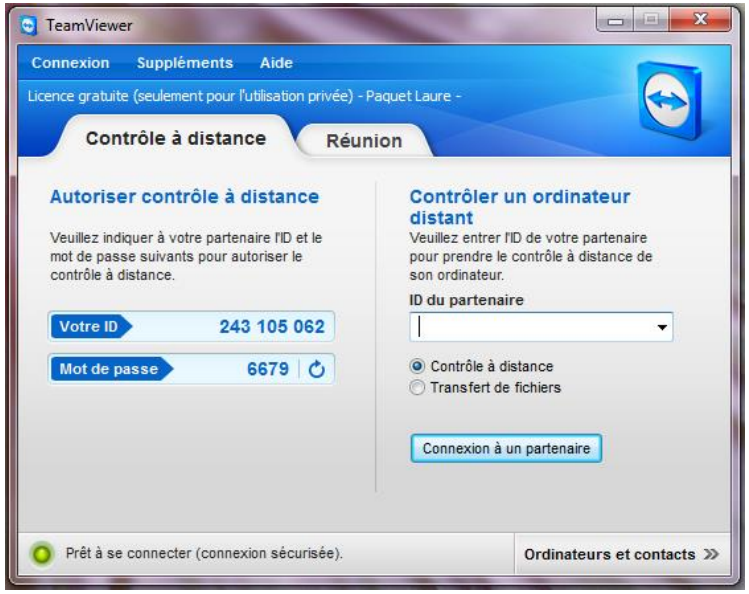
ETHERNET

CONNECTION

Ask your costumer to connect his laptop on the USB port on the back of his H2 generator

ETHERNET CONNECTION

ASK YOUR COSTUMER TO :
-DOWNLOAD TEAMVIEWER PROGRAM
-EXECUTED THE PROGRAM
-BEGIN TEAMVIEWER WITHOUT INSTALLING THE APPLICATION
THIS WINDOWS APPEAR :



-HE NEEDS TO GIVE YOU HIS ID AND PASSWORD TO HAVE ACCESS TO HIS COMPUTER

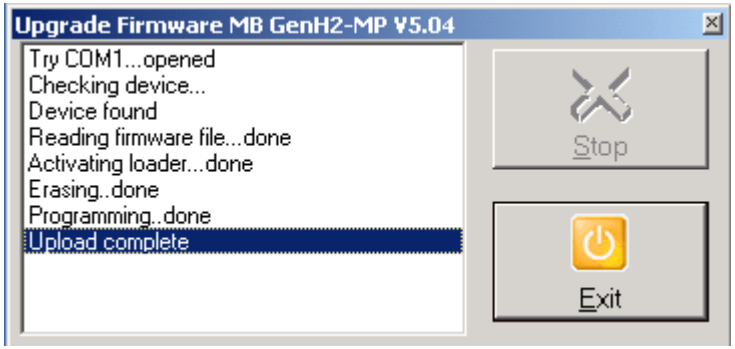
WHEN YOU HAVE THE HAND ON YOUR COSTUMER COMPUTER:
-CREAT AN H2 FOLDER TO REGISTER THE PROGRAM AND DOWNLOAD THE PROGRAM
-EXECUTE THE PROGRAM AND COLLECT DATA

Upgrade

Firmware Upgrade

The correct sequence of upgrade the firmware of H2 generators is :

– Upgrade firmware MAIN board
– Upgrade firmware LCD board
– Update configurations settings



Example: MAIN board Firmware Upgrade

Connect the Generator to a PC by USB cable or serial RS-232 port.

Install the driver if needed.

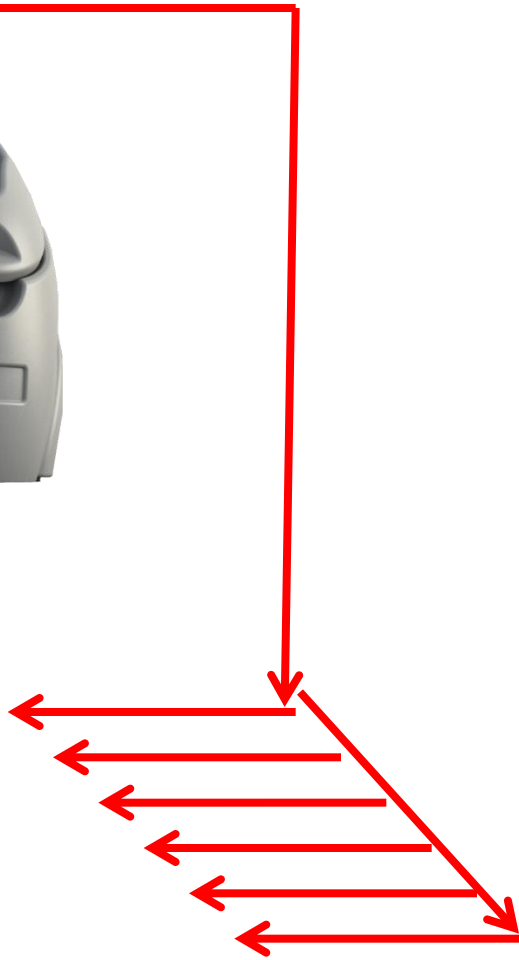
Run the program Firmware-MB-V504-HW4.exe, this program is valid for all models : ND, PAR, WM.

Before to proceed you have to confirm with “Continue” button.

After confirm “DON'T TOUCH THE GENERATOR, DON'T SWITCH OFF, DON'T STOP THE PROGRAM” until you see “Upload complete” on the white window

PARALLEL MODE

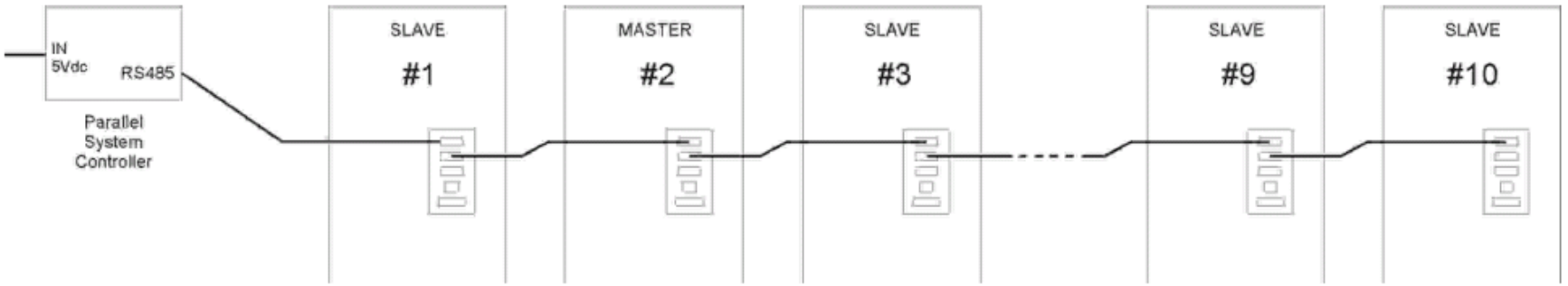
The “parallel mode“ is a system that allows you to add up the flow of multiple machines on a single line where each contributes in proportion to their ability. Maximum 10 units.



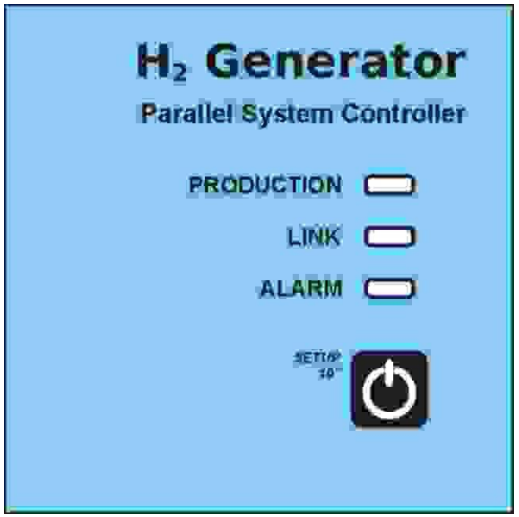
4x NM-H2-500
99.9999 % H_2
max. 2000 ml/min
max. 10 BAR
incl. I/O board and
RS-232 remote control

CONNECTION DIAGRAM

Connect the RS-485 controller with the BOX of 485 # 1 of the first generator and the RS 485 to RS # 2 of this 485 # 1 of the second and so on until the last generator.



BOX CONTROLLER (MASTER)



BOX controller acts as the master and controls all the generators connected to it.
This "BOX controller" has 3 LEDs and a button.
The meaning of the LEDs is specified in the follow table.

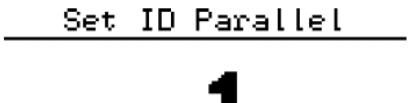
Green Led PRODUCTION	Yellow Led LINK	Red Led ALARM	Functionning
OFF	OFF	OFF	Controller is not powered
OFF	OFF	ON	no device connected
OFF	ON	OFF	In configuraztion mode
	ON	ON	No Master flow
	Regular FLASHING		Good communication
	Random FLASHING		Bad communication
		Fast FLASHING	Alarm or generator off line
		Slow FLASHING	Generator in pre alarm mode
ON			System in production
FLASHING			system ready for production

All LEDs blink when the controller BOX (Master Box) can not communicate with the generators connected to it (Slaves)

Pressing the start / stop button is activated or not the production.

SYSTEM IDs CONFIGURATION

In order for the system to work properly you must assign a unique number (ID) for each generator.



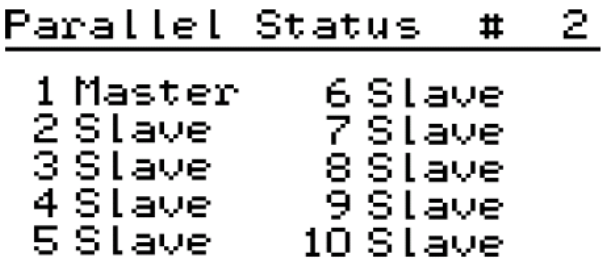
Holding down the button on the BOX controller for more than 10 seconds to start the search procedure of the generators connected to it (see par. 1.2)
Once activated the setup of all generators connected to the currently displayed "1“ on the display.
At this point
1. hold the center button on one of the generators for about half a second
2. the system will "beep" and all the other generators will see the number 2
3. Repeat the step 1 until the last generator
4. Press the button on the controller BOX
If everything works correctly, the yellow LED should flash controller of the BOX and evenly on the top LEFT of the display of each generator should see a "P".

The P in "reverse" indicates that the machine is being used by the system to read the line pressure and control it ("master flow controller")

The P is not in reverse indicates that the generator is simply a "slave"

SYSTEM'S STATUS

From any machine connected to the system you can:
– activate or stop the production
– open or close the outlet valve
– change the set of output pressure
– Check the status of each generator connected to the system
To access the status window, simply make a scroll from right to left on the touch screen

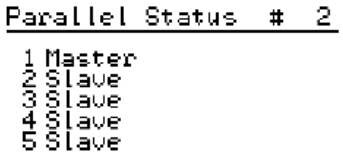


The list is displayed for each unit the following records:

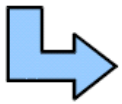
Master	Unit to be used to read the line pressure and control it (Master flow controller)
Slave	Unit connected to the system as a slave
Out line	Unit off-line: interrupted communication with the controller
Alarm	Units on alarm
Pre-Alarm	Units on prealarm

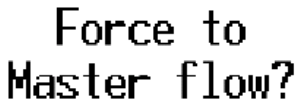
MASTER FLOW CONTROLLER

Normally, the system chooses the car with ID 1 as the "master flow controller" that is the machine designed to read and control the line pressure.
If you want to force the system to choose another press for half a second about the touch screen and displays the status



Press the touch screen for half a second



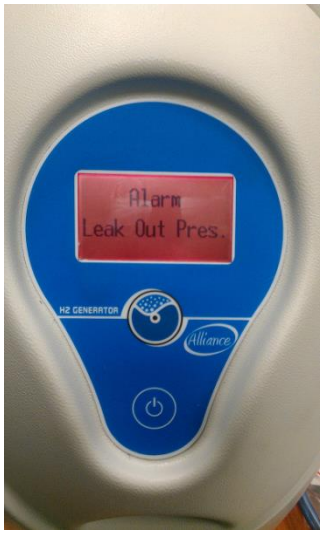


Confirm by pressing the touch screen for half a second.

Troubleshooting

ALARM / PREALARM

During operation, the system executes other automatic checks.



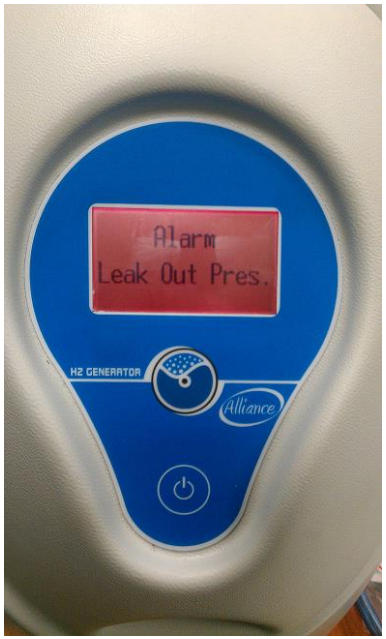
In case of serious anomalies, the display turns red, the buzzer is rapid and intermittent, a message identifying the problem is displayed and hydrogen production is immediately interrupted.

In case of anomalies which are not serious, the LDC display turns yellow, the buzzer sounds every 5 seconds and pre-alarm messages are displayed.

PREALARM

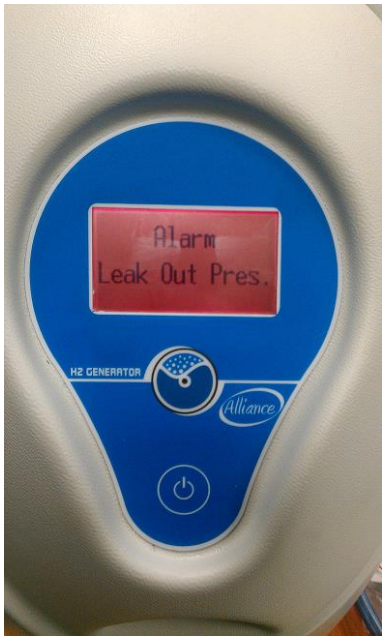
Displayed on screen	Cause	What to do
Power Supply T. Too High	Temperature of electronic power supply too high	- Check that the system working ambient temperature is less than 40°C - Check that the intake/ventilation fans are not blocked and that the corresponding filters are clean, see
Bad Water Quality	Poor quality of the water in the tank	- Change the water using better quality water - Check the water filter and deioniser bag
Water Tank Level Low	Water level less than 5% of the tank capacity	Fill manually the internal tank with new deionised water
Dryer Saturated	Dryer saturated. This alarm continues until a dryer regeneration cycle is completed.	Run a dryer regeneration cycle
Clock Not Set	Internal clock not set or working poorly	Reset system date and time
Check A. Refill	Failed attempt to automatically fill of internal water tank	Check that the external water tank is correctly connected and there is water inside
Check Power Supply	Input power voltage not correct	Try turning off and turning on the system.
Change Deionizer	Water deionization filter saturated	Clean the water filter, replace the deionizer bag and reset the filter remaining life counter using the appropriate function from the “MAINTENANCE” menu

ALARM



Displayed on LCD	Cause	What to do
Low Int.Press.	When the internal pressure cannot reach the value pre-set by the manufacturer	Try to restart the system; if the problem persists, call for service
Low Out Press.	When the external pressure does not reach the outlet pressure set in the correct time	Check that the line is connected to the H2 outlet port
Refill Water	When the internal water tank level goes below the minimum level	Fill manually the internal tank with new water
Bad Water Q.	When the quality of the water is too poor	Completely replace the water in the tank, replace the deionizer bag if necessary and check the water filter
Hight Cell V.	When the cell voltage exceeds the alarm threshold	Try to restart the system; if the problem persists.
Over Current	When the cell current exceeds the alarm threshold	Try to restart the system; if the problem persists, call for service
Over Int.Press	When the internal pressure exceeds the alarm threshold	Try to restart the system; if the problem persists, call for service
P.S. Temp.	When the electronic power source temperature exceeds the maximum threshold	Check that ambient temperature is less than 35°C - Check that the intake/ventilation fans are not blocked and that the corresponding filters are clean, see picture 2 , point 7 and 8
Out Pressure error	When the outlet pressure remains lower than the working set-point during the time set by the user parameter (during the line filling phase).	Check the connections pipes on the H2 outlet port
Memory data	When an error is detected in the reading of the saved parameters	Try to restart the system; if the problem persists, call for service

ALARM



Memory damage	When the parameter and alarm chronology storage device fails	Try to restart the system; if the problem persists, call for service
G.L.S. failure	When a malfunction of the gas-liquid separator is detected	Try to restart the system; if the problem persists, call for service
Power Supply	When the input power voltage of the electronic section is not correct	Try to restart the system; if the problem persists, call for service
P.S. damage	When a power source voltage failure is detected	Try to restart the system; if the problem persists, call for service
Pump failure	When the internal water pump is blocked	Try to restart the system; if the problem persists, call for service
Leak Int.Pres.	When an internal pressure leak is detected	Try to restart the system; if the problem persists, call for service
Leak Out Pres.	When an external pressure leak is detected	Check that the gas line is connected to the output
Heater damage	When the dryer heater does not function	Try to restart the system; if the problem persists, call for service

Open the generator

Remove the five screw

Disconnect the screen of the main board (C037)

Main Alarm message

Low internal pressure
Pump failure
High cell voltage
Gas Liquid Separator failed
Power supply failure
Other Alarms

Low internal pressure

Raison:

Not enough pressure

Possible causes:

- Leaks
- Gas Liquid separator valve still open
- Problem with dryer
- Problem with the sensor
- Problem with the cell

Leak test

Use a leak detector

Never use soap inside the generator

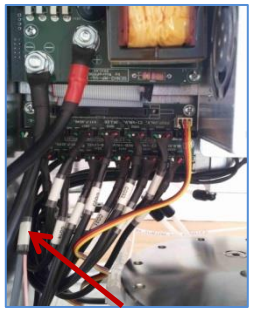
Check all the quick connections

Gas Liquid separator valve still open

Check if there are bubbles in the transparent tube.

In this case, remove it and test the purge valve.

How to remove the GLS



Disconnect CO35

Disconnect pipes on quick connections

Unscrew the 2 screws with Allen key

•Diconnect the "black"
•Wire and then remove the
•clear tube,

How to Clean the GLS valve

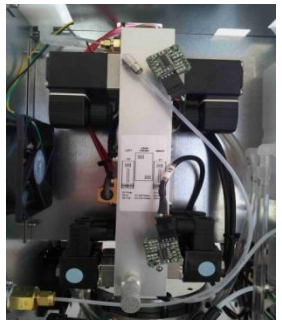
•Unscrew the central nut

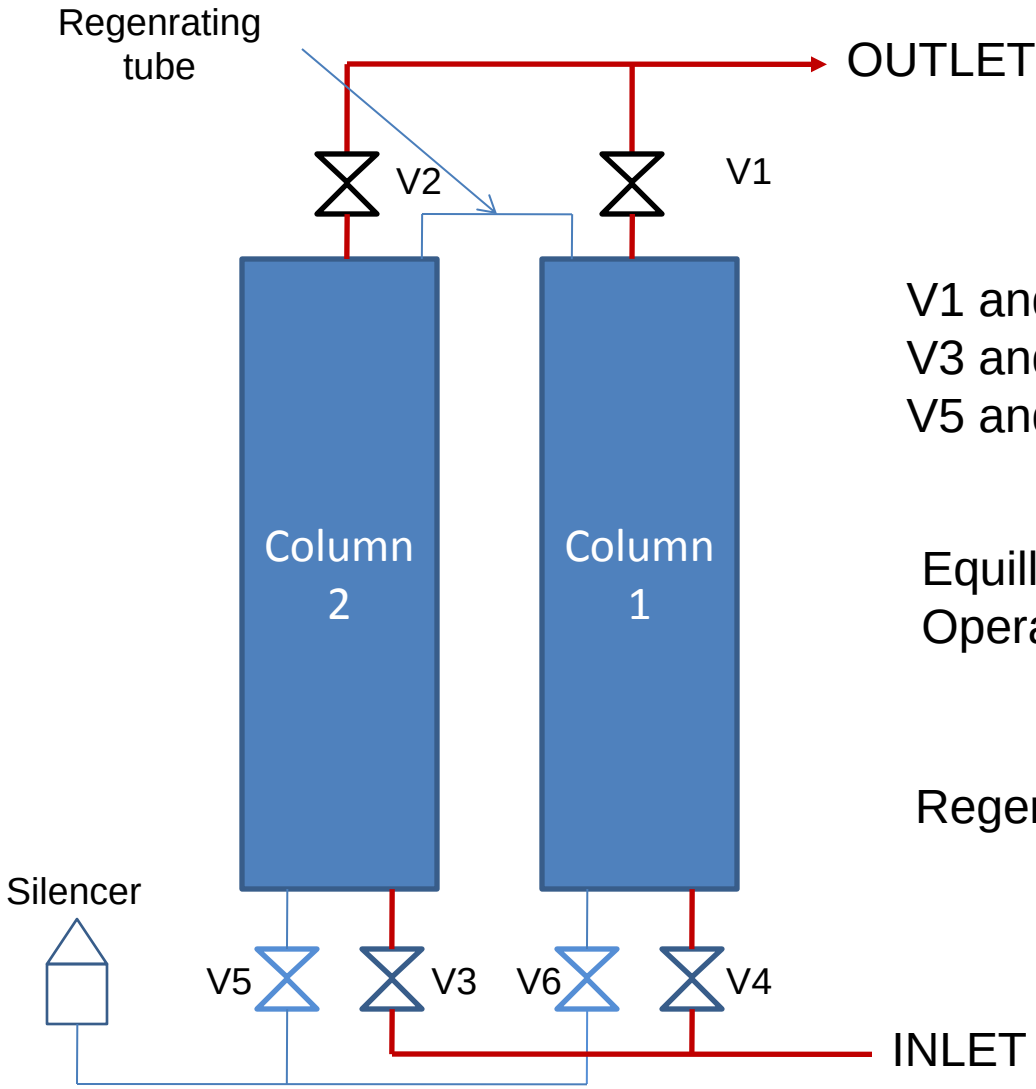
•Unscrew the two screws at the top left and bottom right and remove the valve

•Unscrew the two screws at the top right and bottom left to open the valve

Clean the valve

Check the dryer





V1 and V2: Proportionnal Valves
V3 and V4: Inlet valves
V5 and V6: Purge valves

Equillibrating time: 1200s
Operating time: 10800s

Regenaration ratio: 10%

Check the dryer:
Check proportional valve

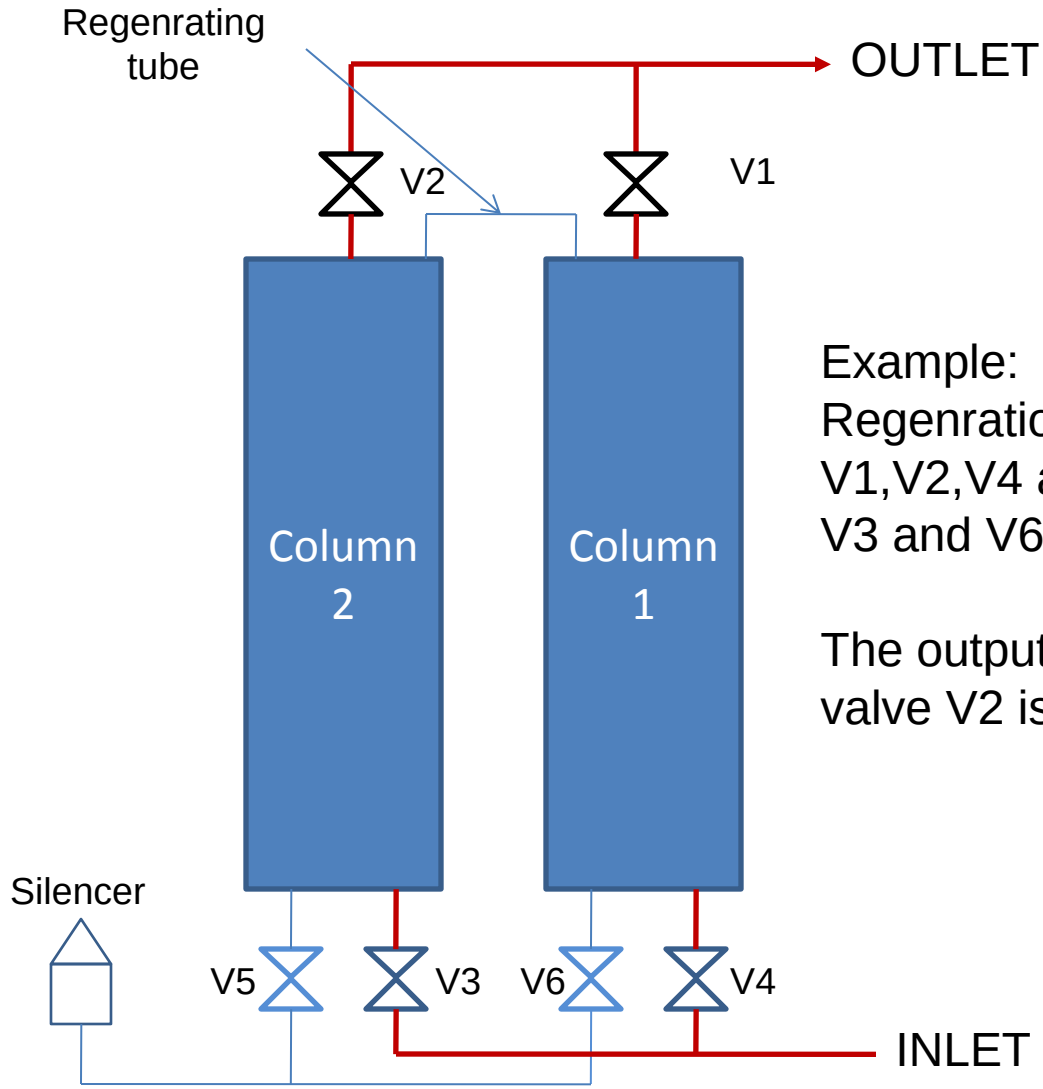
1- Put an external cap and start the generateur with the command START CLOSED

2- Go to MENU=> MAINTENANCE => SERVICE
Enter the code 345 => SWITCH DRYER COLUMN

3- Check if the output pressure stay at 0 bar. In the other case, remove the proportional valve of the opposite colum and check it

4- Push Two times on the screen to change the column. If in this 2 operations, the output pressure stay at 0, check the inlet and purge valve.

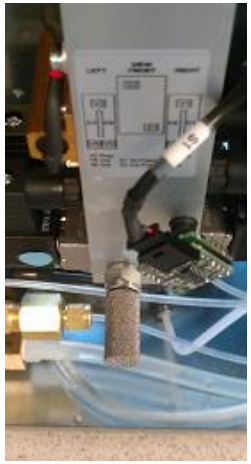
Proportionnal valve

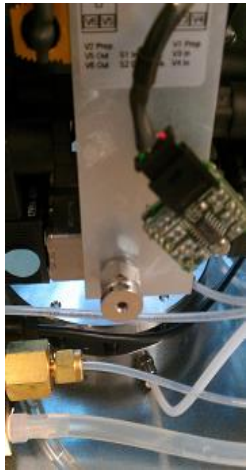


Example:
Regenration column 1:
V1,V2,V4 and V5 are closed
V3 and V6 is opened

The output pressure increase the valve V2 is opened and damaged

Check the dryer:
Check inlet and purge valve





1- Remove the grey silencer and exchange it by a cap

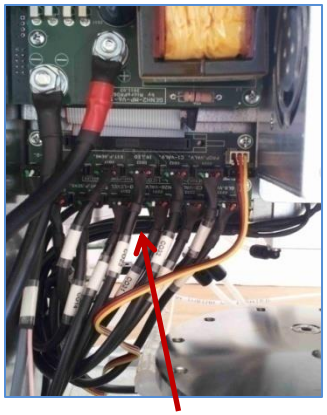
2- Start the generator and check if the generator increase and pressure.

3- Go to MENU=> MAINTENANCE => SERVICE
Enter the code 345 => SWITCH DRYER COLUMN.
Push Two times on the screen to change the regenerating column. If in this 2 operations, the internal pressure reach correctly, check the inlet and purge valve.

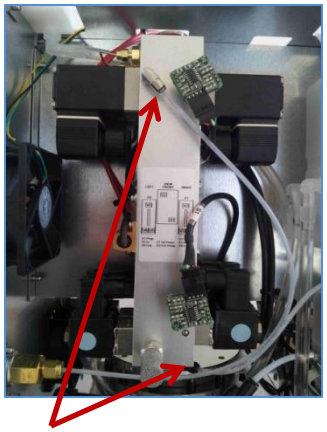
If the pressure still be at 0, check the pressure sensor or the cell.

Remove the dryer

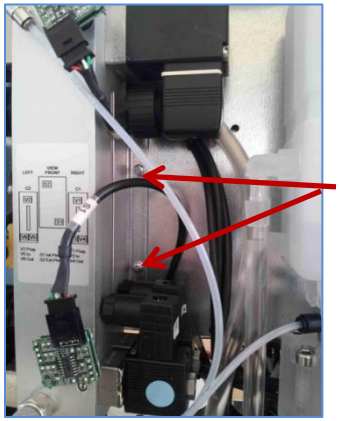
Disconnect the terminal block central green



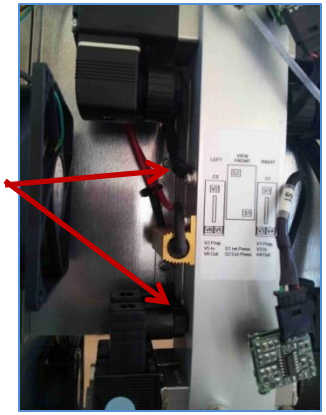
Disconnect CO6, CO14, CO17, CO32, CO33, CO34



Disconnect the two pipes on quick connections



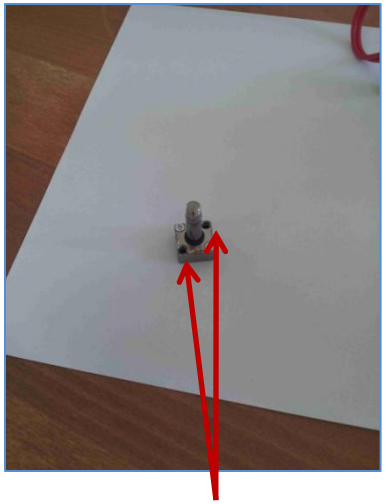
Unscrew the four mounting screws



Check or remove inlet/purge valve

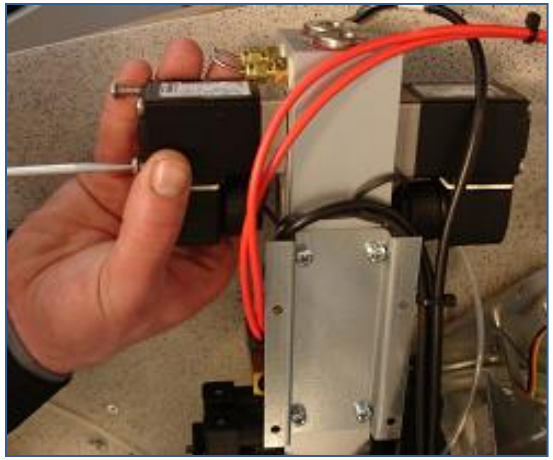
Unscrew the central nut

Unscrew the two screws at the top left and bottom right and r emove the valve



Then unscrew the remaining two screws and clean the internal components after verification of the presence of impurities

Check or remove proportional valve



Unscrew the two screws at the top left and bottom right and r emove the valve

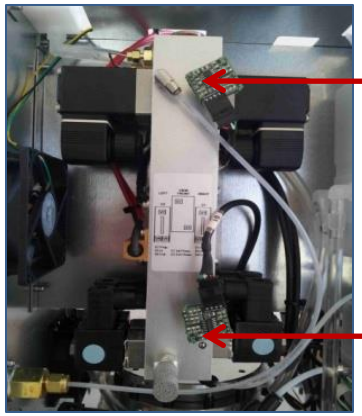
Then unscrew the remaining two screws and clean the internal components
after verification of the presence of impurities

Check the pressure sensor

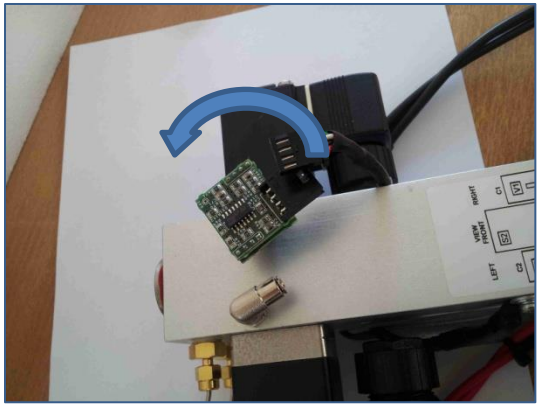
1. Put a gauge between GLS and dryer
2. START CLOSED tht generator
3. Go to MENU => DIAGNOSTIC
4. Compare manometer and the value

If the pressure gauge increase and the screen value still be 0, change pressure transmitter

Remove the sensor



1. Disconnect the connector
2. Turn left the sensor, unplug it and replace it
3. Repeat everything for the second sensor
4. Start the calibration

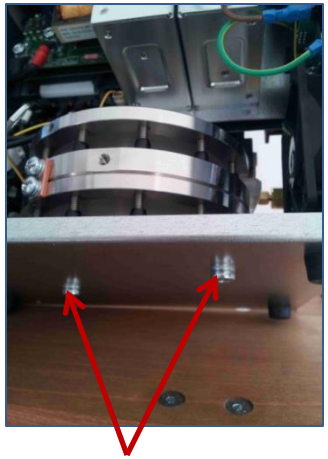


Sensor calibration

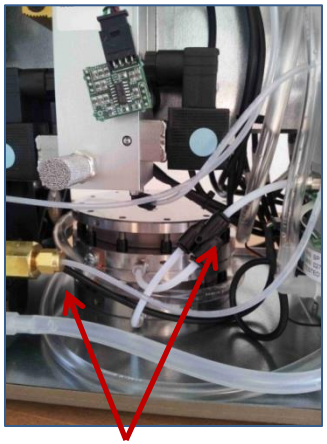
1. Put an external gauge
2. Go to MENU => MAINTENANCE => SERVICE => MANUAL CALIBRATION
3. In the display menu select "manual pressure calibration" and start the procedure
4. Wait for the terms automatically until the pressure reach 10 bar
5. Read the pressure gauge on the exact set on the generator and press the center of the display to save and exit the menu

Remove the cell

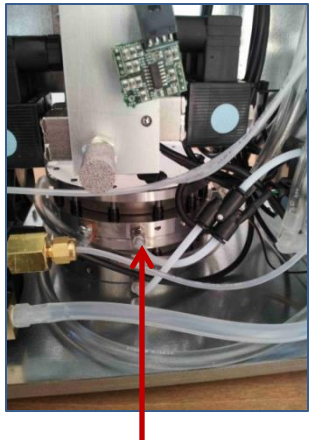
Unscrew the two screws on the cables of the cell power



Remove the two screws below



Disconnect the two transparent tubes inlet and outlet water



Disconnect the two white tubes

PUMP Failure

Raison:

The message « Pump failure » means that the pump don’t work

Possible causes:

- The pump is disconnected, check the connector C061
- The pump need to be replace

Replace the pump

- Empty the water tank

- Unplug the connector CO61, located at the end of the wires yellow / red / black and

Unscrew the two screws located below the generator

Disconnect the two transparent tubes

High cell Voltage

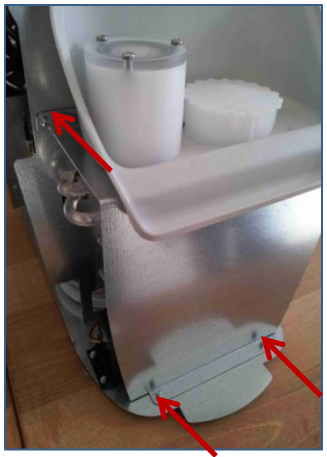
Raison:

The voltage of the cell is too high

Possible causes:

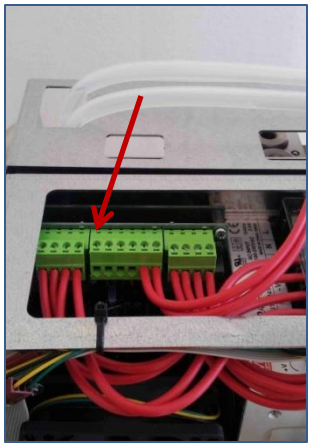
- The fan is damaged and the temperature increase
- The quality of water is bad
- The water filter is full of dust
- Problem of the pump
- The cell is damaged, most probability
- The main board is damaged

Check and replace the main board



Unscrew the four screws

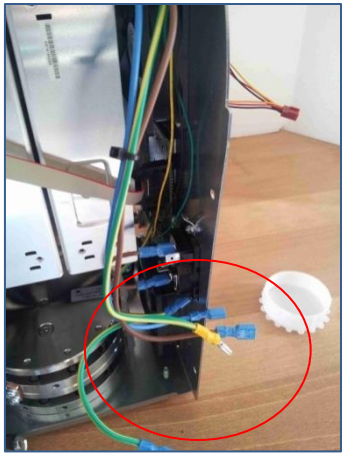
Remove the water cap



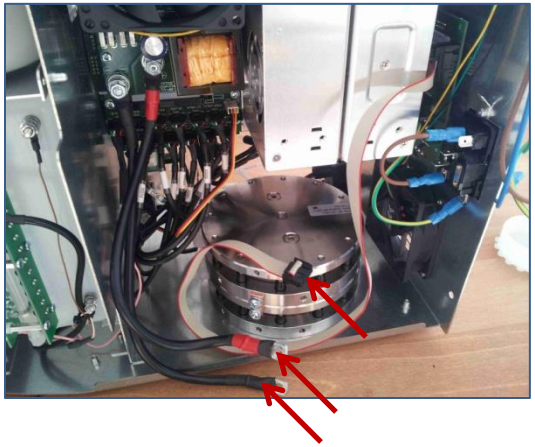
Unplug the connector central green

Cut the three fixing wires

Disconnect the cable connection of the cooling fans



Disconnect the cables connecting the power supply and the earth

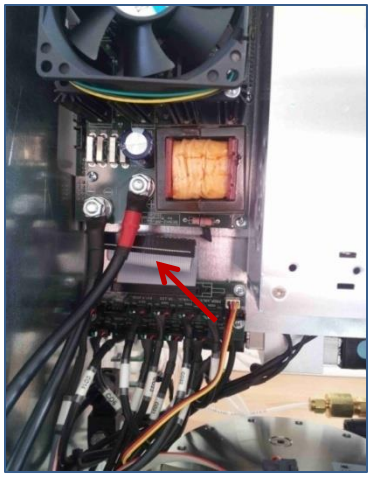


Disconnect the cable "flat" and the power cords of the cell

Check and replace the main board

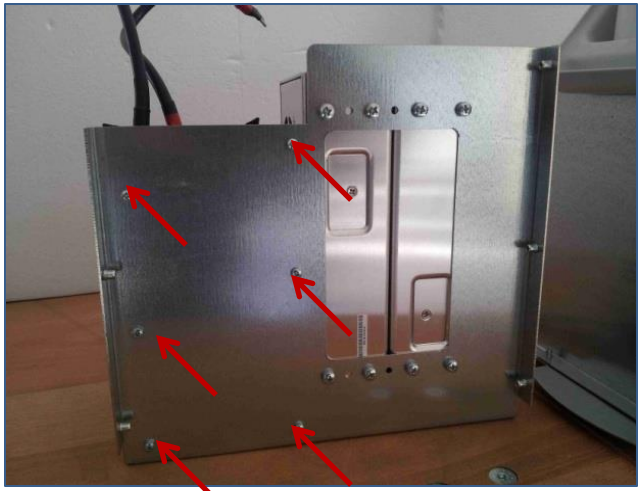
Unscew the four front screws

Unscrew the five screws on the rear panel



Disconnect the cable "flat"

Pull the rack



Unscrew the sixscrews

GLS Failure

Raison:

The message « GLS failure » means that the second IR sensor has detect water

Possible causes:

- The valve doesn’t open well
- There is a ball of water between 2 IR sensors
- There is a defect on the IR sensors

The valve doesn’t open well

Correct position

Bad position

Solutions:

-Check the valve
-Remove Valve
-Remove GLS

How to Check the IR sensors

Go to:
MAINTENANCE ▸ SERVICE ▸ PASSWORD 345 ▸ COMPLETE TEST

When the test is finished, take a picture of the screen or write down all the data

LEAK TEST:
C1 PASS
C2 PASS
GLS PASS
IR1: xx xxx xxx
IR2: xx xxx

The first number of IR1 must be under 20

The first number of IR2 must be under 30, but the last numbers of IR2 must be above 100 (if not, means the second IR sensor has a problem)

Power supply failure

Raison:

The power supply is damaged

Possible causes:

- Check the power supply
- Check the electrical connection