OPERATING INSTRUCTIONS

Zepto special
Serial number

Zepto
Serial number

Atto
Serial number 114292

Please read this manual carefully before installing the machine.

LOW PRESSURE PLASMA SYSTEM

electronic diener
Plasma-Surface-Technology

Summary of Delivered Components

Customer: _____

Date of delivery: _____

Please note that only the marked chapter have to be read to operate your machine!

1. Cabinet	☐	**Zepto special**	☐	**Zepto**	☒	**Atto**
2. Gas supply	☒	obligatory				
3. Connections	☒	obligatory				
4. Control	☒	obligatory				
5. Generator	☐	40 kHz	☒	13,56 MHz		
6. Pump	☐	No Name vacuum pump	☐	Pfeiffer vacuum pump		
7. Options	☐	Carrier aluminium	☐	Carrier borosilicate glass		
	☒	Timer analog	☐	Pirani sensor		
	☐	Spare parts	☐	Pressure regulator		
	☐	Process gas bottle	☐	Gas bottle retainer		
	☐	Faraday box	☐	Monomere bottle		
	☐	Test ink set	☐	slowly venting		
	☐	slowly pumping down	☐	Quartz glass chamber		

Table of Contents

Manual for
Low Pressure Plasma Systems
Of following production series: Zepto special, Zepto, Atto

Producer: Diener electronic GmbH + Co. KG
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Status of: 2013-12-17

1.1 Delivered Components and Description

1.1 Cabinet

1.1.1 CABINET TYPR ZEPTO SPECIAL

- Dimensions: Width approx. 269 mm
  Depth approx. 324 mm
  (463 mm incl. plug)
  Height approx. 176 mm

1.1.2 VACUUM CHAMBER TYPE ZEPTO SPECIAL

- Material: Borosilicate glass
- Dimensions: Ø approx. 105 mm
  Length approx. 200 mm
  Volume approx 1.7 Litre

1.1.3 CABINET TYPE ZEPTO

- Dimensions: Width approx. 425 mm
  Depth approx. 450 mm
  (477 mm incl. plug)
  Height approx. 185 mm

1.1.4 VACUUM CHAMBER TYPE ZEPTO

- Material: Borosilicate glass
- Dimensions: Ø approx. 105 mm
  Length approx. 300 mm
  Volume approx. 2.6 Litre

1.1.5 CABINET TYPE ATTO

- Dimensions: Width approx. 425 mm
  Depth approx. 450 mm
  (477 mm incl. plug)
  Height approx. 275 mm

1.1.6 VACUUM CHAMBER TYPE ATTO

- Material: Borosilicate glass
- Dimensions: Ø approx. 211 mm
  Length approx. 300 mm
  Volume approx. 10.5 Litre

1.2 GAS SUPPLY

1.2 GAS SUPPLY ZEPTO SPECIAL

Gas channels with 1 needle valve:

Gas flow: Gas 1 ZEPTO SPECIAL: 100 sccm

sccm : standard cubic centimeters per minute

1.3 GAS SUPPLY ZEPTO AND ATTO

- 2 Gas channels each with 1 needle valve:

- Gas flow:

Gas 1 ZEPTO:	100 sccm
Gas 2 ZEPTO:	100 sccm
Gas 1 ATTO:	100 sccm = 100 milliliter/minute
Gas 2 ATTO:	100 sccm

The handling of the needle valve is very easy. To control the gas flow and therefore the process pressure, the valve will be opened or closed.
The direction (to open and close the valve) is easily to see.

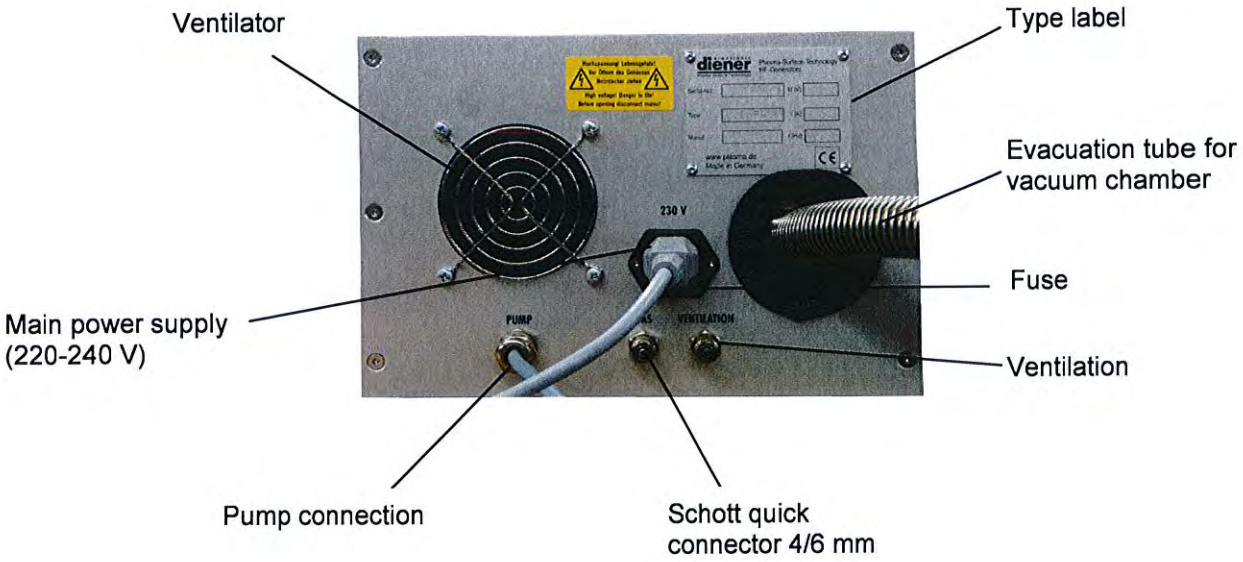
Please note following things:

- The not used valve needs to be closed with a blind flange, otherwise gas will still be fed into the chamber.
- The **gas flow ball**, in the glass gauge tube of the valve, sometimes **gets caught** at the upper end of the scale. That happens when the **valve** has been **opened too much**. To release the ball in the flow indicator, tap lightly on the glass surrounding the gauge tube
- **Liquids** may **damage** the needle valve. (Agglutinating of the valve)
- Some **aggressive solutions and gases** (like HNO3, HCl, NH_4) may destroy the sealing of the needle valve.
- **The machine is not qualified for usage of aggressive gases and chemicals!**

1.3 Connections

1.3.1 CONNECTIONS FOR CABINET TYPE ZEPTO SPECIAL

- Gas: Schott quick connector 4/6 mm
- Voltage / Power: 230 V / 6,3 A
- Exhaust air: plastic tube, inner diameter approx. 10 mm



1.3.2 CONNECTIONS FOR CABINET TYPE ZEPTO

- Gas: Schott quick connector 4/6 mm
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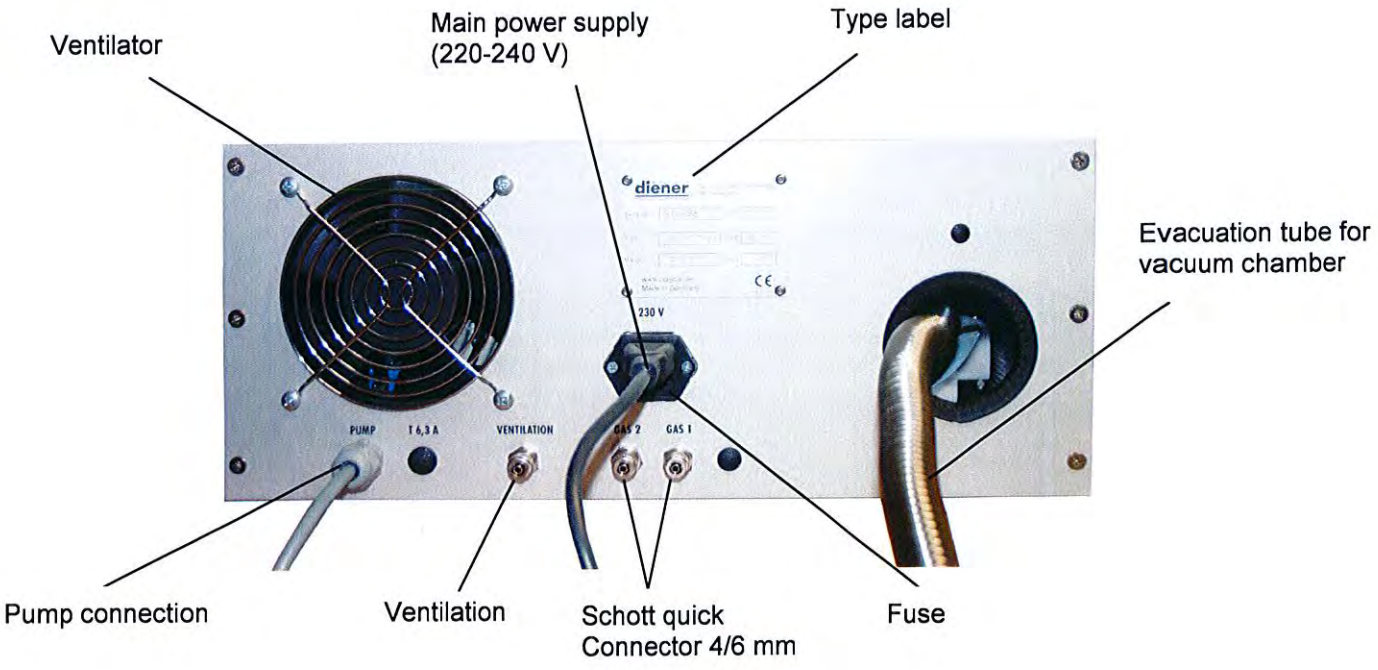
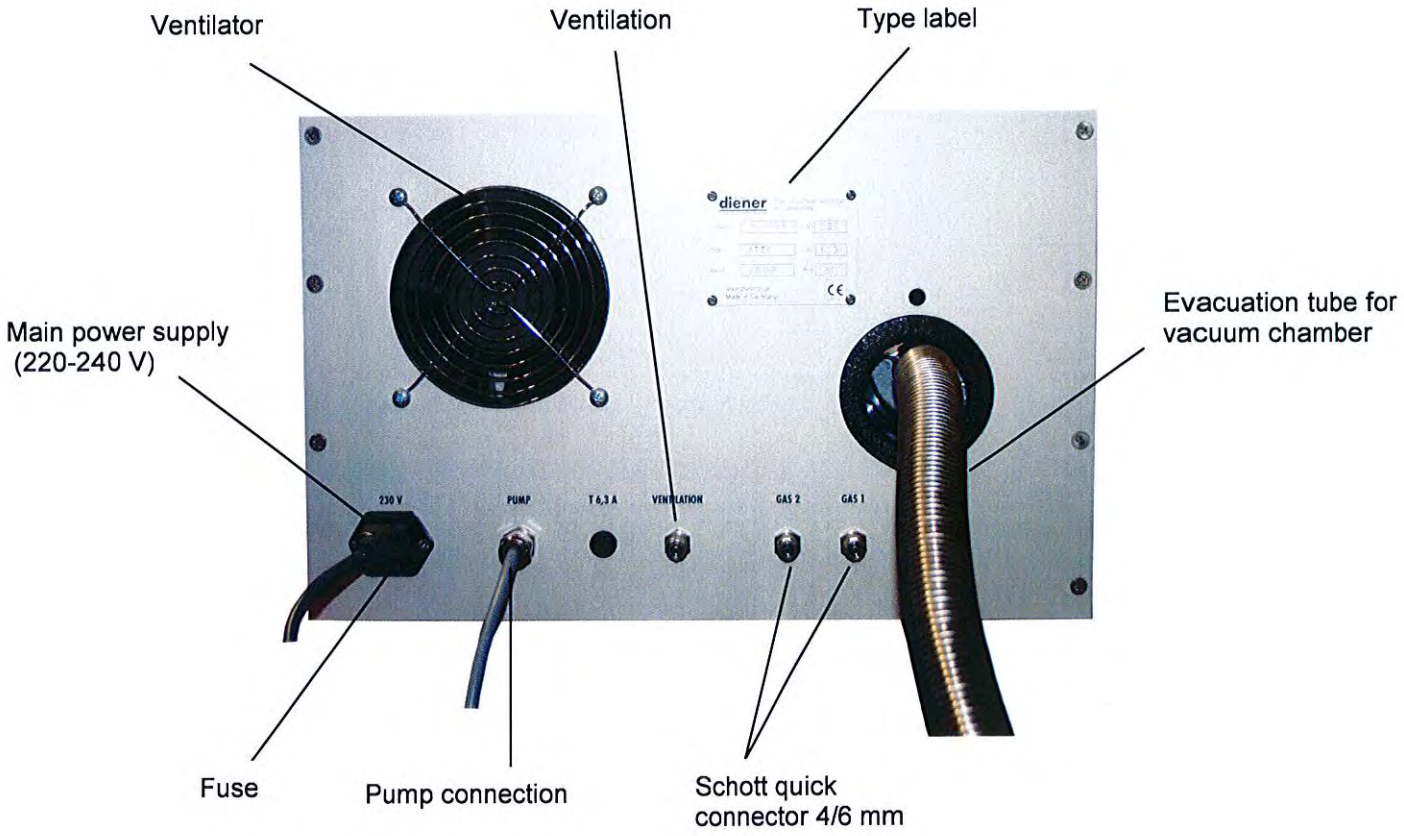
- Exhaust air: plastic tube, inner diameter approx. 10 mm



1.3.3 CONNECTIONS FOR CABINET TYPE ATTO

- Gas: Schott quick connector 4/6 mm
- Voltage / Power: 230 V / 6,3 A
- Exhaust air: plastic tube, inner diameter approx. 10 mm



1.4 Control

At all machines, without reference to the type of control, there are 5 process steps:

1. Pumping down: Recipient is evacuating to lower pumping down pressure

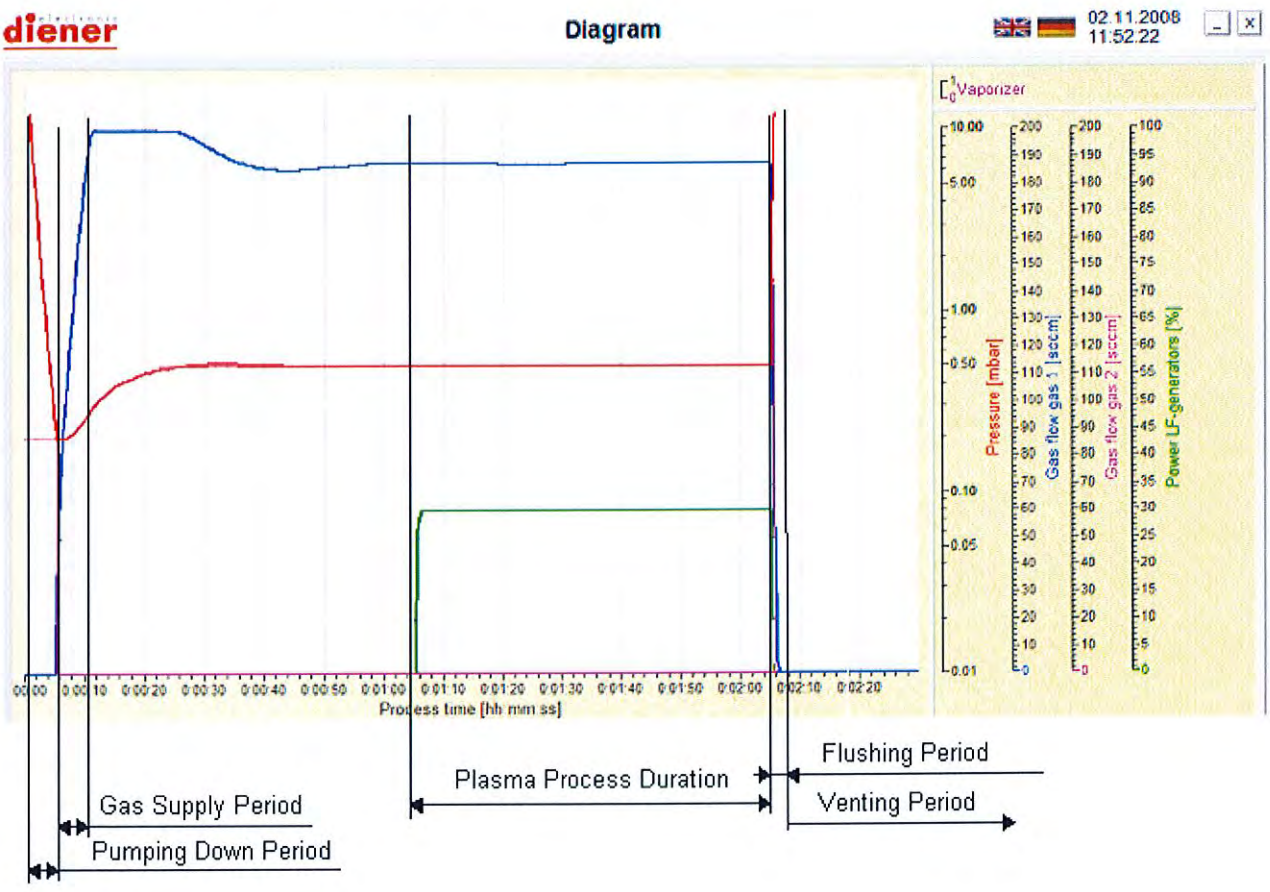
2. Gas stabilization time: Gas is feeding in and pressure stabilize automatic

3. Process time: HF-Generator is turned on

4. Flushing time: Pump is running while purge gas (f.e. Air) rushes into the chamber. The chamber is flushed from eventually harmful process gases.

5. Venting time: Chamber is filling with Air. The pump has to be off.

*For more Information see **chapter 10 'Information According Plasma Processes'** and the **brochure 'Plasma Technology'***



1.4 Control

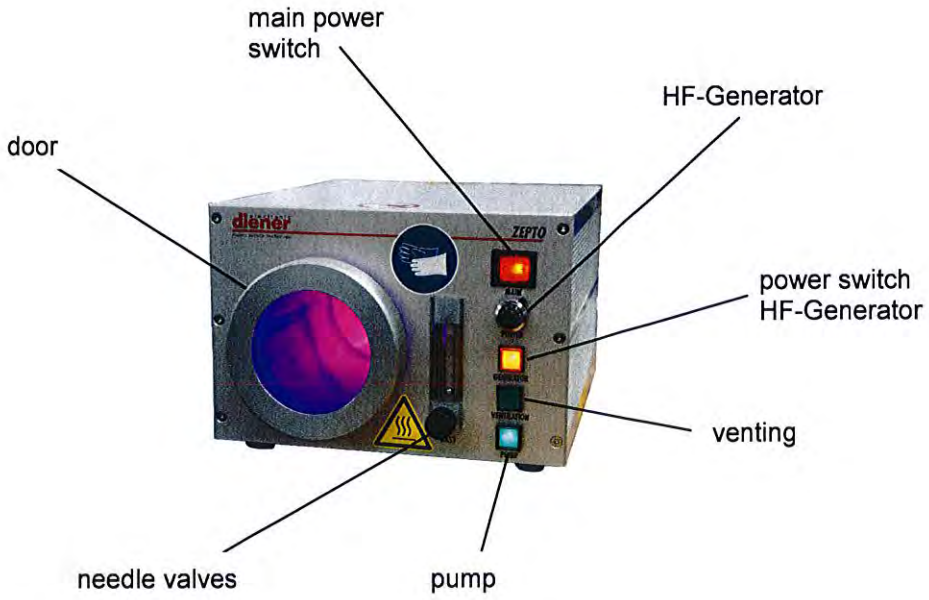
1.7.1 CONTROL TYPE: SEMI - AUTOMATIC

- The control of the process requires some manual intervention
- Pump, gas flow, plasma process and venting have to be started manually
- Selectable parameters: process time, power, kind of gas, gas flow

The single process steps are selected manual by user:

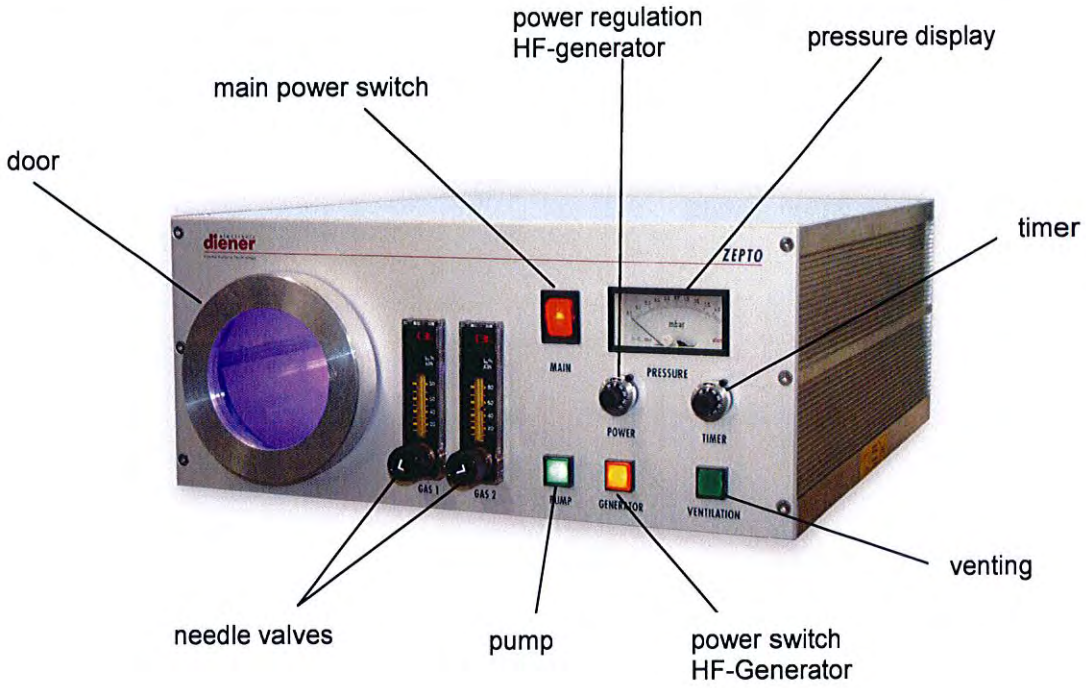
1. turn on pump
2. turn on process gas (open needle valve)
3. set time
4. set power
5. start generator
6. vent

ZEPTO SPECIAL

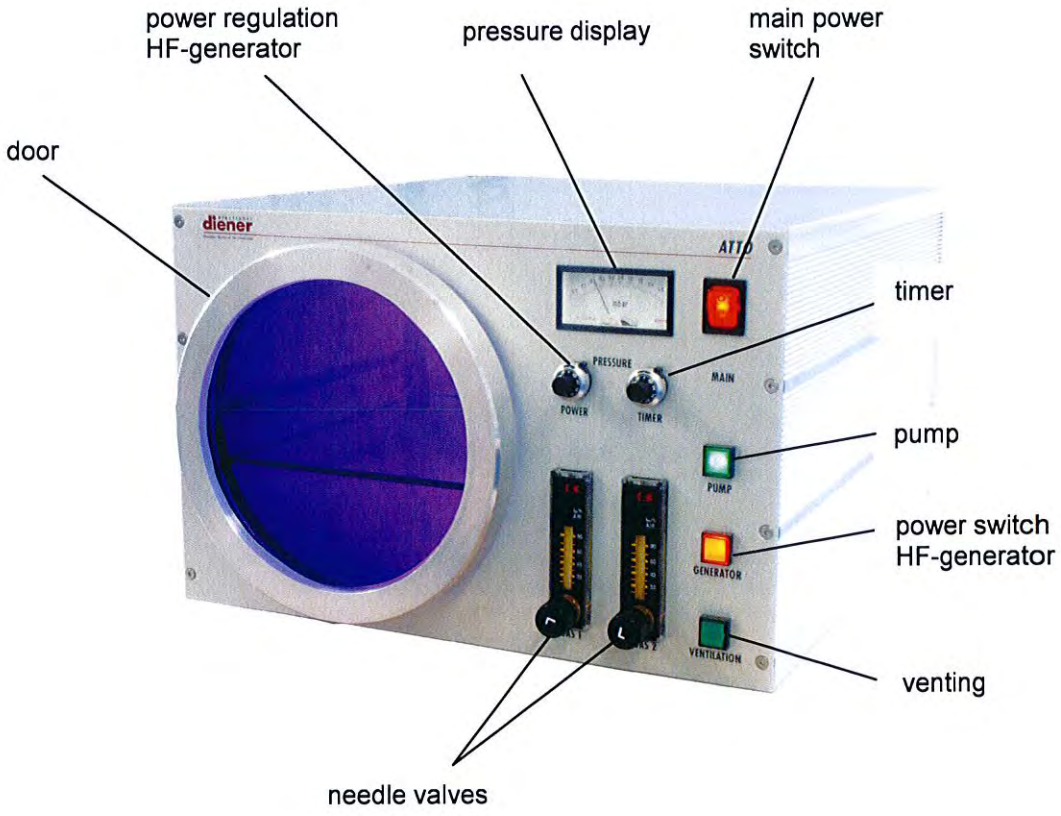


1.4 Control

ZEPTO



ATTO



1.4 Control

Timer settings – Zepto and Atto

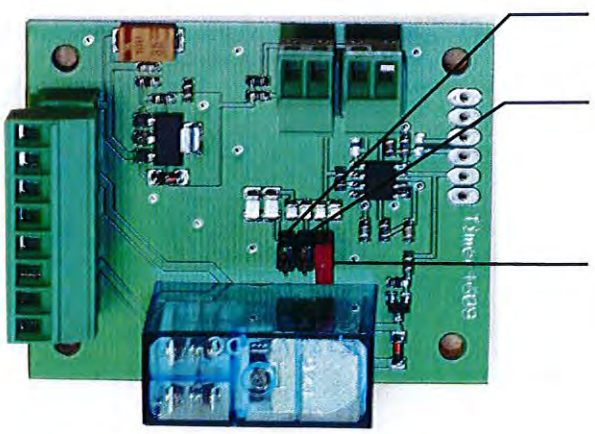
On the timer board (see photo) are three jumper positions selectable:

Final value 10000 seconds 166.66 min

Final value 1000 seconds* (*State of Delivery) 16.6 min

Final value 100 seconds

Accordingly of this preselected range is a variation by means of the front-sided mounted potentiometer possibly.
Nevertheless, the set value must be checked because the scale of the potentiometer will not correlate with the time target.



Choose the time range accordingly the process:

Example:	Process duration:	5 minutes
	Pre chosen time range:	1000 seconds
	At the potentiometer on the front of the machine the time can be varied between 1 second und 16.67 minutes via the scale division parts 0 – 100.	
	Set value potentiometer:	30

For more Information see chapter 9 'Information According Plasma Processes' and the brochure 'Plasma Technology'.

- Connect 230 V (16 A)
- Turn on main power switch
- Turn off venting valve
- Load machine
- Take the door and push it against the chamber opening (while pump is on)

This type of control is very comfortable to handle by operating with just one switch. The single process steps are shown via analog measurement instruments.

1.4 Control

Timer setting – Zepto Special

The timer can be adjusted with a screwdriver at the bottom of the plant.

The direction of adjustment is indicated.

1.5 Generator

SELECTION OF GENERATORS	1.5.1 TYP A	1.5.1 TYPE A	1.5.2 TYPE B	1.5.3 TYPE C
Frequency	80 kHz	40 kHz	40 kHz	13,56 MHz
Power	0 - 30 W	0 - 100 W	0 - 200 W	0 - 50 W
Available for machine type	**only Zepto special**	**only Zepto**	**only Atto**	**Zepto + Atto**
Puls function	-	-	-	-
Impedanz matching	-	automatic	automatic	fixed
Display of forward power	-	-	-	-
Display of reflected power	-	-	-	-
Quartz stabilized frequency (+/- 0,05 %)	-	-	-	✓
PC Interface	-	-	-	-
Main areas of application	activation, cleaning, etching, semi conductor (back-end) Plasma-polymerisation	activation, cleaning, etching, semi conductor (back-end) Plasma-polymerisation	activation, cleaning, etching, semi conductor (back-end) Plasma-polymerisation	activation, cleaning, etching, semi conductor (back-end) Plasma-polymerisation

1.6 Vacuum pump

Vacuum pumps are necessary to produce a vacuum in the plasma machine's recipient.

SELECTION OF VACUUM PUMPS	1.6.1 TYPE A	1.6.2 TYPE B
Description	DUO 1,3	DUO 3
Description	rotary slide pump	rotary slide pump
Exhaust filter	✓	✓
Manufacturer	Pfeiffer	Pfeiffer
Suction power (m^3/hour)	1,3 m^3 / h	3,0 m^3 / h
Oil type	mineral oil	mineral oil
Can work with oxygen, argon and all other usual process gases	✓	✓

* The working life of the pump is limited at using of CF_4 / O_2 or SF_6.

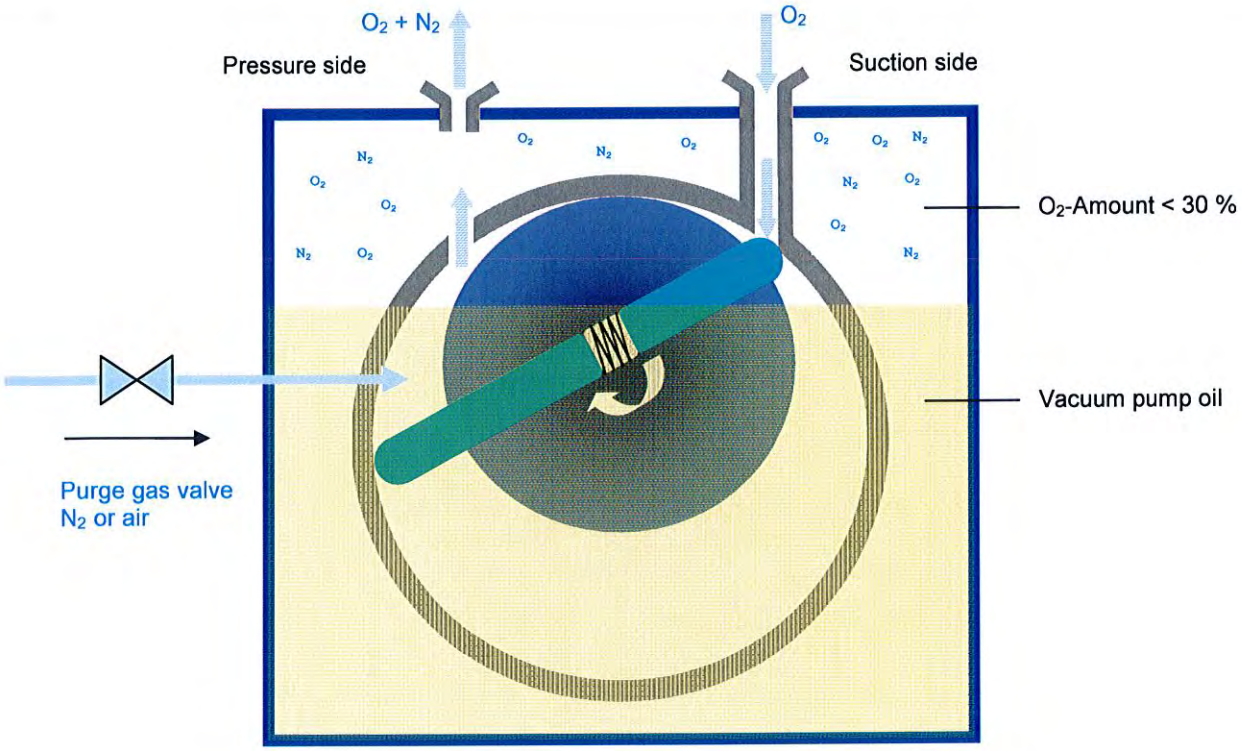
Purge gas valve for pump

By the factory made installation (by Diener electronic) of a purge gas valve, a save working method is guaranteed.
The rotary slide pump compress the gas, therefore a oil mist can arise and in worst case it may happen, that a explosive mixture of oil mist and oxygen gas arises. To avoid this risk the purge gas valve will be installed.
The venting prevents the arising of the critical concentration of O_2 (<30%).

For better understanding see figure below.

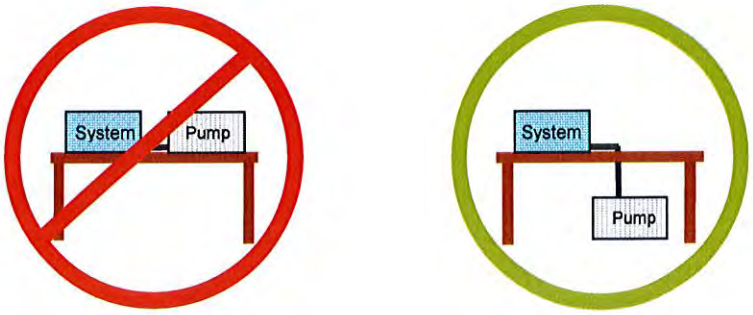
1.6 Vacuum pump

Figure: Function of pump with purge gas valve:



1.6 Vacuum pump

Connect vacuum pump with chamber. Place pump below the machine (on the floor) to avoid that in case of malfunction pump oil flows back to the chamber.



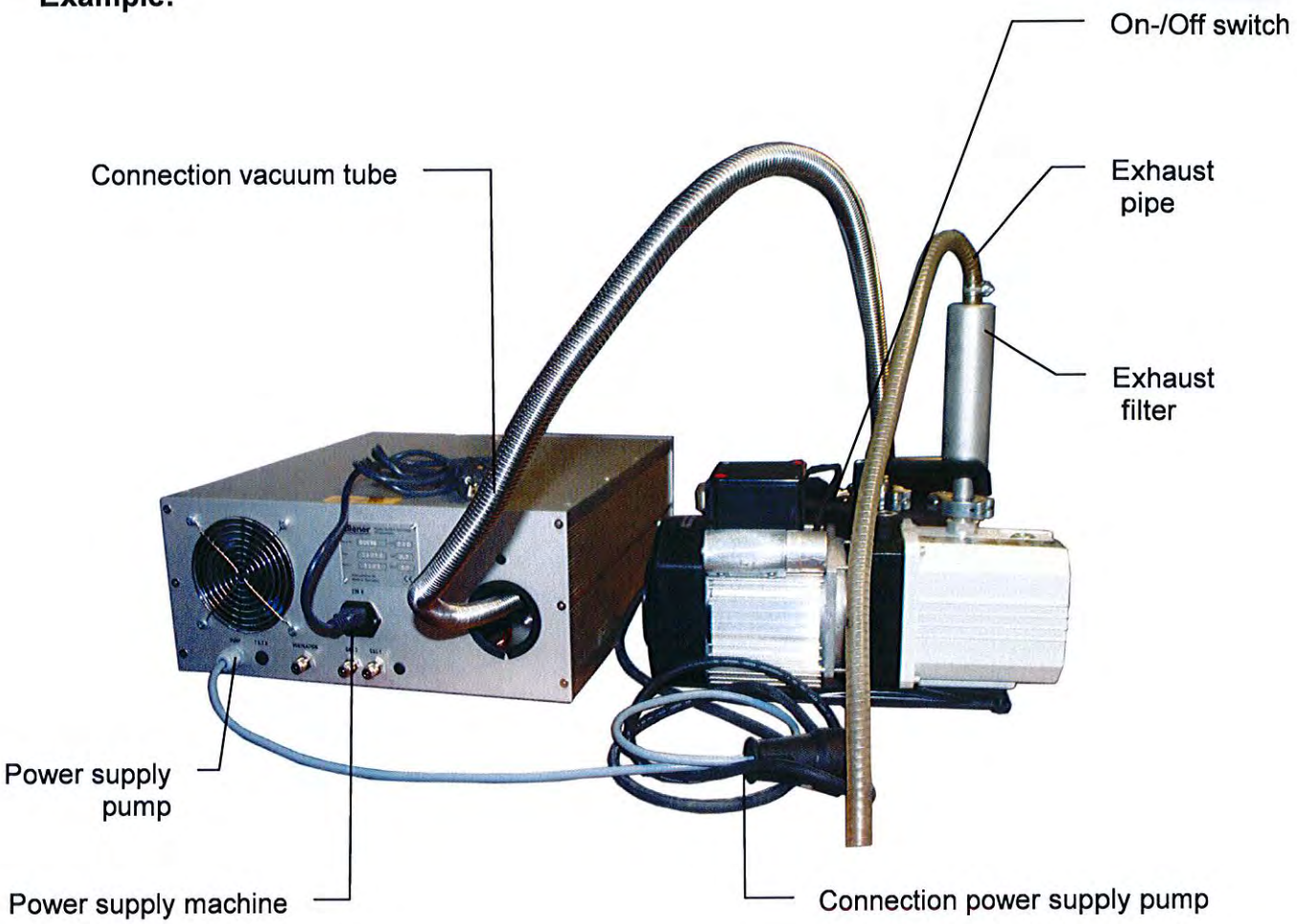
Connect exhaust pipe. Exhausts have to be directed to fresh air or a professional exhaust system.

- Connect pump power supply line at plug 'Pump' at the back of the machine.
- Connect process gases (Pre - pressure at gas bottle approx. 0,5-1,0 bar)

1.6 Vacuum pump

Pump – Connections

Example:



1.7 Options

1.7.1 Spare Part Set – Standard

- 1 clamping ring + 1 seal
- 1 glass window
- 1 door seal
- 10 pcs. fuses for plasma machine
- 1 litre mineral oil for vacuum pump

1.7.2 Carrier made of metal

Material: aluminium

- Dimensions for Zepto special: 160 mm x 85 mm x 3 mm
- Dimensions for Zepto: 260 mm x 85 mm x 3 mm
- Dimensions for Atto: 260 mm x 200 mm x 3 mm

1.7.3 Carrier made of glass

Material: borosilicate glass

- Dimensions for Zepto special: 160 mm x 85 mm x 5 mm
- Dimensions for Zepto: 260 mm x 85 mm x 5 mm
- Dimensions for Atto: 260 mm x 200 mm x 5 mm

1.7.4 Timer

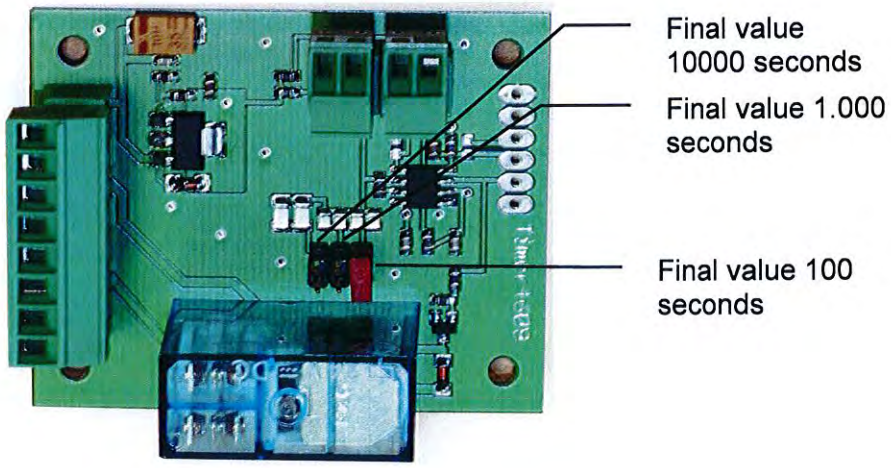
- Analog timer without display only Zepto and Atto

Timer settings:

On the timer board (see photo) are three jumper positions selectable:

Final value	10000 seconds
Final value	1000 seconds*
Final value	100 seconds

Accordingly of this preselected range is a variation by means of the front-sided mounted potentiometer possibly. Nevertheless, the set value must be checked because the scale of the potentiometer will not correlate with the time target.



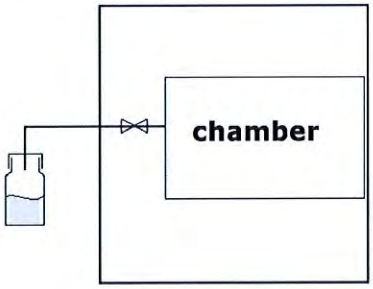
* State of delivery

1.7 Options

1.7.5 Monomer Bottle

- Accessory for polymerizations
- To connect liquid monomers with the vacuum chamber
- Connection is only possible with needle valve!

Figure: Connection monomer bottle



1.7.6 Vacuum pump

1.7.6.1 No Name Vacuum Pump

- Suction Power 1.5 m^3 / h

1.7.6.2 Pfeiffer Vacuum Pump

- Type: DUO 3,0
- Suction Power: 3,0 m^3 / h
- Manufacturer: Pfeiffer

1.7.7 Pressure Regulatores

- For connection to the gas bottle - 200 bar
- Available / pressure: 200 bar
- Different gases require different pressure regulators
- Pressure regulators for noble gases, H_2, O_2, N_2, CF_4, C_4F_8

connector no.	permitted gases	thread
1	methane, silane, hydrogen	W 21,80 x 1/14" LH
3	acetylene	connection for clamp
5	carbon monoxide	1" LH
6	ammonia, argon, helium, hexafluoroethane, carbon dioxide, sulfur hexafluoride, tetrafluoromethane	W 21,80 x 1/14"
8	hydrogen chloride, nitrogen dioxide	1"
9	oxygen	G 3/4"
10	nitrogen	W 24,32 x 1/14"

1.7 Options

1.7.8 Process Gas Bottle

- **Oxygen** – gas bottle as process gas
- **Hydrogen** – gas bottle as process gas
- **Argon** – gas bottle as process gas

Purity of Gases:

In general gases with technical purity are used. Do you want to treat parts with a very high demand on the surface purity so choose a gas with high purity.

This is relevant special for semi conductor front end processes or analytic applications (SEM, ...).

For more information to the gases see chapter 10 Information According Plasma Processes.

1.7.9 Gas Bottle Retainer

- To mount on desk, wall or shelf
- Span width 70 mm
- Lashing strap retains bottle without any skope
- Suitable for all bottle sizes

1.7.10 Pressure Gauge

- Pirani Sensor

1. The pirani sensor measures the pressure in the vacuum chamber at a process pressure below 10 mbar.

   The pirani sensor itself is made of a thin metal wire.

   This wire has a resistor of approx. 2.5 Ω at atmospheric pressure.

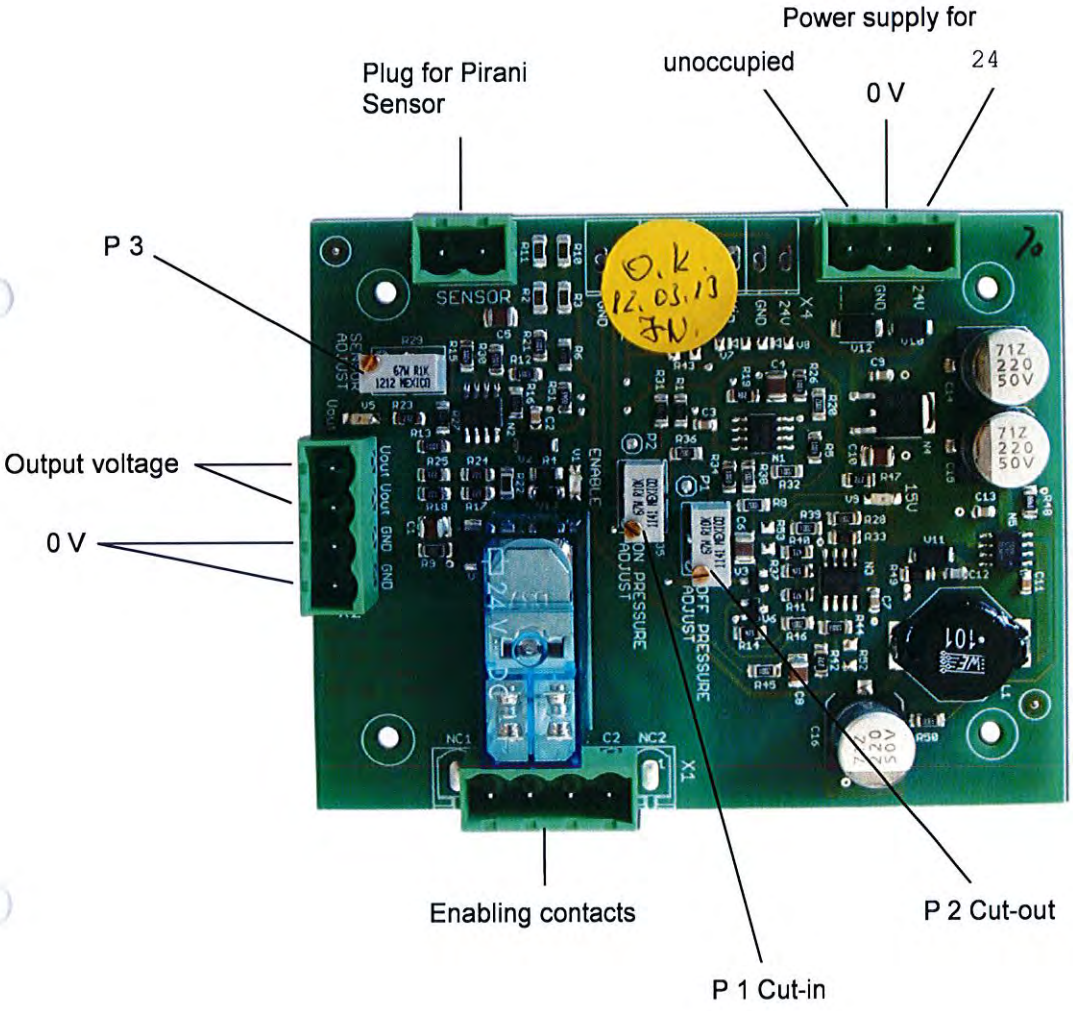
   The resistor rises with lower pressure, when the wire is heating up by current flow (approx. 0.1 A).

Pirani sensor

2. Test of Pirani-Sensor – not for Zepto special

To test the sensor, the resistor should be tested with an ohmmeter. Before the testing, the plug for the pirani sensor has to be disconnected.

The resistance has to be between 2.2 and 2.6 Ω.



Voltmeter
Nominal voltage 10.05 V
M 1 to GND

3. Calibration of Printed Circuit Board (PCB):

3.1. The PCB has to linger with all connections in the machine.

3.2. Ventilate the vacuum chamber.

3.3. Apply voltmeter to M1 and GND.

3.4. Adjust 9.9 V with the potentiometer P3.

3.5. Check the adjusted value: PC-controlled machine: 9.99 mbar
other machines: 10 mbar

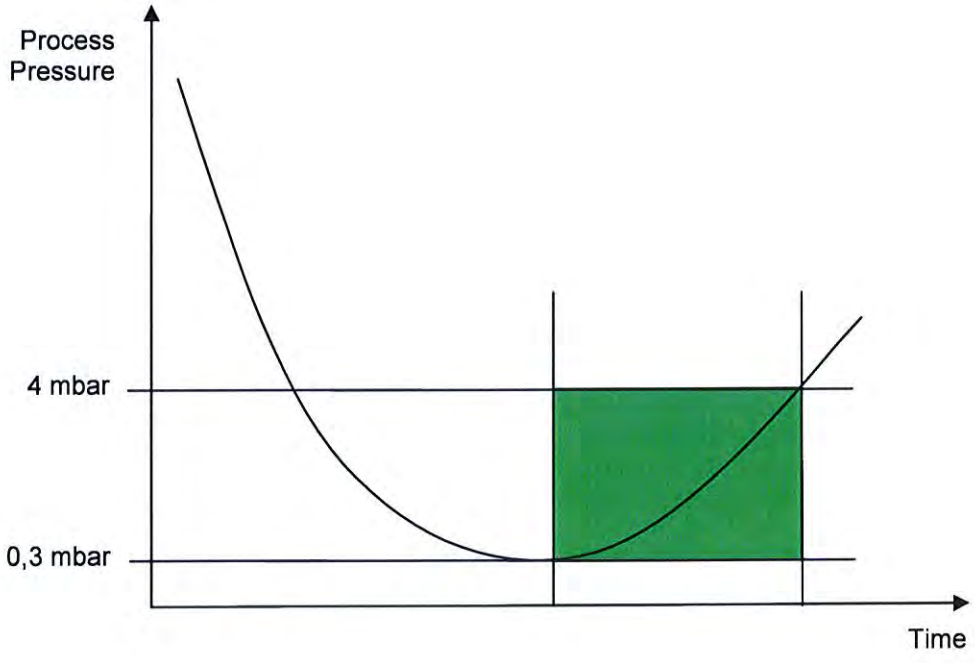
3.6 Now evacuate vacuum chamber.

3.7. The relay will turn on / off the gas supply and the generator.

3.8. Lower switchpoint: The LED shines green at a pressure below 0.4 mbar (adjust with P1).
In special cases, the pressure can be raised up to max. 1 mbar.
Normally the machine has to be pumped down to a pressure of approx. 0,3 mbar.
In special cases (heavy outgasing parts) up to approx. 1 mbar.

3.9. Upper switchpoint: The LED turns off at a pressure over 4.0 mbar (adjust with P2).
For safety reasons the gas supply has to be closed at a process pressure over 4 mbar, for the same reason the generator turns off.

3.10. The PCB is a window comparator, the machine works with a pressure between 0.4 and 4 mbar.



1.7.11 Pirani - digital

1. Application Areas

Measuring pressures of vacuum systems

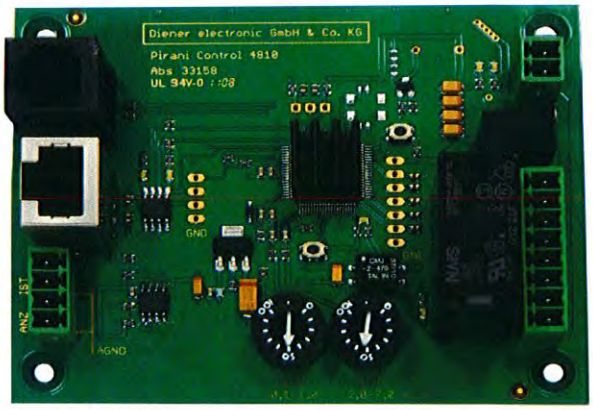
Technical Data:

Measurable Pressure Range:	10^{-2} to 10 mbar
Absolut tolerance of final scale:	< 5%
Analog outlet:	0 to10 Volt
Power supply:	24 +/- 10% V DC
Power consumption max.:	150mA
Mass (sensor head):	180g
Sensor size:	D: 60 mm, L: 63 mm
Flange connection:	KF 16
PCB-dimensions:	100 mm x 76 mm

Sensor head

Switching output for process release (min./max. pressure) loadable up to 24V AC/8A
Threshold values adjustable with internal adjustment regulator possible via software

Interface: RS485 for embedded mode available in process control.



Controller-PCB

Due to the electro-mechanical design of the sensor head (0.1 mm wire made from a stainless steel alloy) very robust against chemical influence.

Can be supplied with a calibration certificate.

Data cable

2. Pirani – Inspection and Calibration

Calibration

The Pirani sensor head can only be calibrated at the factory.

There the relevant precise measuring devices are used, which take up the characteristic lines of the sensor and calibrate accordingly.

Checking the Sensor Head

For checking, a reference sensor of the same make is used with the relevant controller board.

Both are operated parallel to the sensor to be measured and can easily be attached to the system.

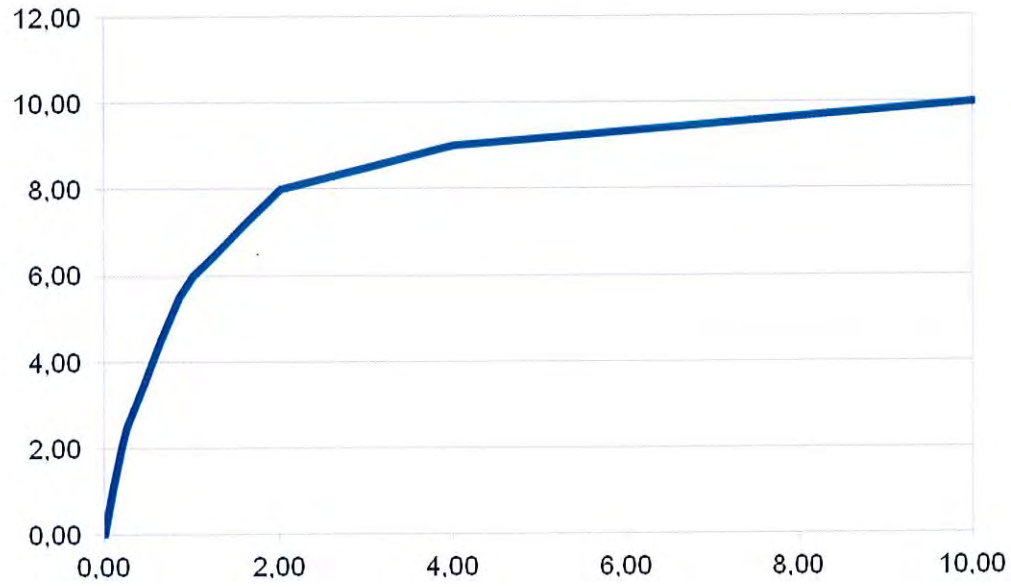
For this reason there exists a further flange, measuring value inlet and bus connection at the system.

A sub-programme can be called up in the control computer of the system that permits the simple comparison of both measuring values at different pressures.

In case of deviations being too large, the programme reports a fault and the sensor must be exchanged.

3. Characteristic output curve Pirani digital

Pressure [mbar]	Initial Voltage [V]
0.01	0.00
0.10	1.00
0.20	2.00
0.25	2.50
0.45	3.50
0.65	4.50
0.85	5.50
1.00	6.00
2.00	8.00
4.00	9.00
10.00	10.00



1.7 Options

1.7.12 Faraday Box / Cage

- For electric sensitive parts
- The parts will be placed at the inside of the box.
- The Faraday Box can be moved out of the vacuum chamber.

1.7.13 Test Ink Set

- Test inks for an easy analysis of the surface energy.
- Included sizes in ink set: 28, 38, 56, 64, 72 and 105 mN/m
- Other values are available on request.

For more information see brochure ‚Plasma Technology'.

1.7.14 Slow ventilation of the vacuum chamber

- The vacuum chamber will be vented slower by installing a filter.
- The gyrate of small parts will be prevented.

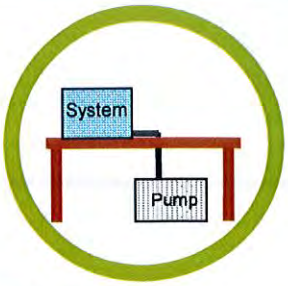
1.7.15 Slow pump down of the vacuum chamber

- The chamber will be slowly pumped down by bypass valve.
- The gyrate of small parts will be prevented.

1.7.16 Documentation in national language

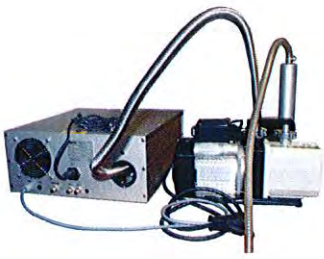
- Documentation according to the machine rules 89/392/EWG
- does not apply for german and english language
- this option have to be ordered, otherwise a documentation isn't attached

2. Connecting the machine

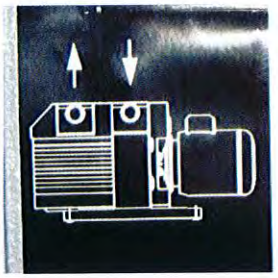


1. Place machine on table or on the place you supposed for it.
2. Place pump on the floor.
3. Remove protective caps from pump and machine.
4. Place seals between vacuum tube and junctions (1x machine, 1x vacuum exit of pump), before mounting the clamp to fix the tube with the junctions.

5. Connect exhaust tube with pump. Normally a picture sticks on the pump by the manufacturer, which clearly shows the in- and output of the suction power.



or



6. Connect power supply of pump with machine. (The connections are obvious marked on the back of the machine.) Turn on main power switch of pump. See pictures below:

7. Connect power supply of machine with mains.
8. Connect gas tube with machine and gas bottle.

order for connection of gas

gas connection on machine

9. Adjust max. a pre-pressure of 0,5-1,0 bar at the gas bottle!

10. Find more information to the controls in chapter 1.4 Controls.

Note: The following steps have to be processed in correct order, otherwise the chamber may be damaged!

Diener electronic GmbH does not grant warranty for defects caused by wrong usage!

a) Load chamber.

b) Press door against chamber opening.

c) Turn on pump ('Pump' button). Keep door pressed against chamber wall until it will be primed.

d) Adjust time. More information in chapter 1.4 Control.

e) Turn on gas supply by opening the needle valve. (The not used needle valve/ gas channel need to be closed with a blind flange during the process.)

f) Adjust desired gas flow or pressure by opening/closing the needle valve.

g) Adjust the desired generator power. The upper row of numbers on the potentiometer shows the tenth, the lower row the unit place. See figures below:

100% power

65% power

h) Start generator (The generator turns off automatic after cycle of time.)

i) Turn off pump, by pushing of ‚Pump' button.

j) Vent chamber („Vent")

k) When chamber is ventilated, the door let's easily open/remove.

3.Safety Guidelines

Voltage

- The altitude of generators idle may has until approx. 2000 V! Handle with care!
- The machine has to be connected with a power supply system, which voltage is conformable with specification on type label.
- Diener electronic GmbH & Co. KG does not grants liability for defects caused by incorrect usage (e.g. short circuit caused by unsuitable power supplies)!

Vacuum

- Caution! Hands off from openings of the vacuum chamber, valves and the connections of the pump during the running process.

Damp Rooms

- The plasma machine is not moisture proof.
  The machine must not be used in damp rooms.

Short Circuit

- The electrode must not be circuited. Conductive parts must not touch the electrode.

Thermic Endanger

- The electrode may become hot during operation. Take care while loading the machine, to not touch the electrode (to avoid burn).

Process Gas

- Check for leaks in the pipes before any start.
- It is forbidden to produce explosive gas mixtures in the chamber.
- The machine must not be operated with flammable gases.
- Please note the appropriate rules (TRG) of each process gas.

Exhausts

- Exhausts have to be piped into fresh air/ outside.
- Outlet of exhaust pipe must not be closed, to not destroy pump.

Aggressive Liquids

- Needle valves may be destroyed by agggressive liquids (formic acid).

Design	unprohibited gases	Formula
Standard	argon, helium, hexamethyldisiloxane, carbon monoxide, carbon dioxide, air, oxygen, nitrogen, nitrogen dioxide, nitrogen oxide, hydrogen,	Ar, He, HMDSO, CO, CO_2, O_2, N, NO_2, NO, H_2

Following materials must never be connected with our machines:
Bromine, chlorine, iodine, bortrichlorine, tetrachloromethane and all other chlorine containing and high corrosive materials.

Diener electronic GmbH & Co. KG will not grant liability for damages on the machine which are caused by using those materials (corrosive gases on standard machines and oil pumps)!

The machine is NOT suitable for aggressive gases and liquids!

Power Plug

- Do not pull out power plug on wire.
- In case that the power plug of the plasma system is damaged it has to be replaced, to avoid endanger.
- Before open the cabinet, pull power plug.

Animals

- Animals must not be encased in the plasma system.

Contaminations

- Try to avoid contaminations like dust, dirt, glass- and metal splinters before and during the operation. Those can damage the machine permanent and change the effect of the plasma treatment as well.

Pacemakers

- No persons with pacemakers
  In rare cases electromagnetic fields that emanate from these devices can cause temporary interference with the pacemaker. Signs of danger may include: dizziness, palpitations or an irregular pulse. For more information on Electromagnetic Fields see BGV B11 "Electromagnetic Fields" - www.bgn.de/9418

Maintenance and Repair

- The maintenance has to be done all 6 months by Diener electronic GmbH + Co. KG.
- Only mineral oil from Diener electronic must be refilled into the pump.
  We don't use fluorine containing oil. Therefore the pumps can be used for oxygen processes.
- Do not perform unlicensed changes on the machine.
- Repairs on this machine are only permitted by experts of Diener electronic GmbH + Co. KG. Otherwise the liability expires.

Further Manuals

- **Please follow all information in the supplied manuals!**

4. Maintenance

4.1 Pump

- Check oil level daily.
- Please follow manual of pump manufacturer.
- For oil change interval see manual. The oil change has to occur every 3 months.

4.2 Cleaning

- For the cleaning of the outside of the plasma system use only a light wet cloth. For the cleaning of the chamber see chapter 1.4 Vacuum Chamber. Never use solvents for the cleaning!
- Stainless steel recipients are easier to clean with chrome polisher. Therefore remove / uninstall electrode previously.

4.3 Seals

- The door seal should be wiped off every day and semi-annual changed.

5. Troubleshooting

Fault	Possible cause	Remedy
plasma system running, plasma not burning	gas line is not opened	open gas line
	needle valve is closed	open needle valve
	short circuit, caused by conductive parts touching the electrode	place conductive parts in that way, that they don't touch the electrode
door can not be opened	pump is still running	turn off pump
protections trips / fuse blows	pump is still cold (room temperature < 20° C)	regard on a room temperature higher than 20° C
pump not running	power switch on pump is off	turn on power switch
	power plug of pump is off	check power plug and plug in
plasma turns off	needle valve is closed, no gas flow comes into the recipient, therefore generator is not able to support power	open needle valve and adjust gas flow
machine doesn't start the generator	needle valve is opened too much	close needle valve and decrease gas flow

Otherwise: Contact our service technicians!

6. EC-Declaration of Conformity

CE

electronic diener
Plasma-Surface-Technology

Diener electronic GmbH + Co. KG
Nagolder Str. 61
D-72224 Ebhausen

We hereby declare that our plasma systems in the

Production series:

Atto – Serial number: 114292

in the versions that we placed on the market, meet the following fundamental safety requirements. This declaration loses its validity where a modification is made without our agreement.

Applicable EU Directives:	EU Machinery Directive (2006/42/EC) EU EMC Directive (2004/108/EC) EU Low Voltage Directive (2006/95/EC)
Applied, harmonized standards:	DIN EN ISO 12 100:2010 DIN EN 62 311:2008-09 DIN EN 60 204-1:2011-01 DIN EN 61 000-4-2:2009-12 DIN EN 61 000-4-4:2012
Applied national standard:	VDE 0848

Ebhausen, dated 2014-06-24

C. Die

Diener electronic GmbH + Co. KG
Christof Diener
Managing Director

7. Warranty

The warranty is for 1 year commencing on the date of the invoice.

If you have any problems with your plasma system, we'll be very pleased to help. Please call us on:
Tel: 00 49 74 58 999 31 - 0
From USA: 011 49 74 58 999 31 - 0

During the warranty period:

The faulty plasma system can be sent back to us. You will receive a new or repaired device in return.

After the warranty period runs out:

You can also send the faulty device to the address below for repair. A charge will then be made for the repair.

The warranty is invalidated if the device is misused or handled incorrectly, if excessive force is applied, or in the case of intervention by anyone other than ourselves.

For repair purposes, please pack the plasma system carefully and send it to:

electronic diener
Plasma-Surface-Technology

Diener electronic GmbH + Co. KG
Nagolder Str. 61
D-72224 Ebhausen
Germany

Tel.: 00 49 74 58 / 999 31 0
From USA: Tel.: 011 49 74 58 / 999 31 0
Fax: 00 49 74 58 999 31 50
E-mail: info@plasma.de
www.plasma.de

8. Information According Plasma Processes

Directory Plasma Process:

8. Information According Plasma Processes

In the following chapter you will find some information, which shall help you to find the right process parameters.

8.1 Parameters:

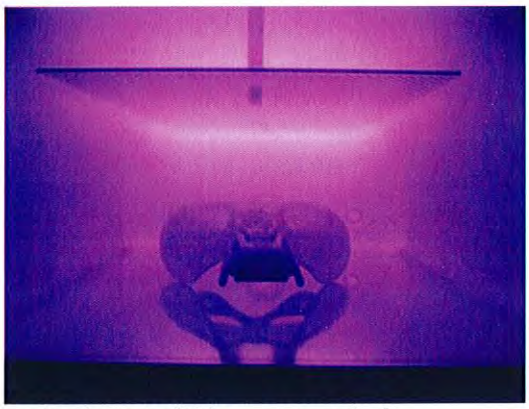
These parameters are not exact specifications, which refer to our standard systems. For the parameters it doesn't matter what kind of generator is installed.

8.2 Materials:

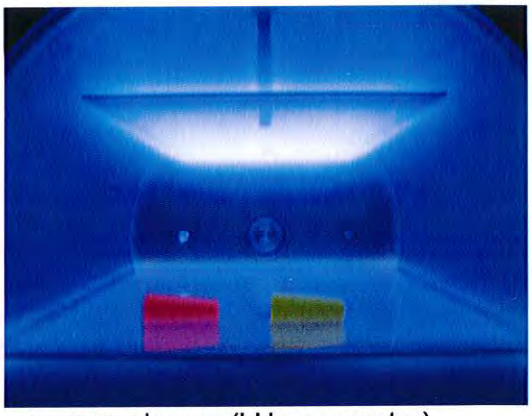
Regard the product attributes concerning sensitivity to heat, UV or single process gases, by choosing the process parameters.

8.3 Spread of Plasma:

For an optimal plasma treatment, the plasma has to be spread equable into the chamber (see pictures).



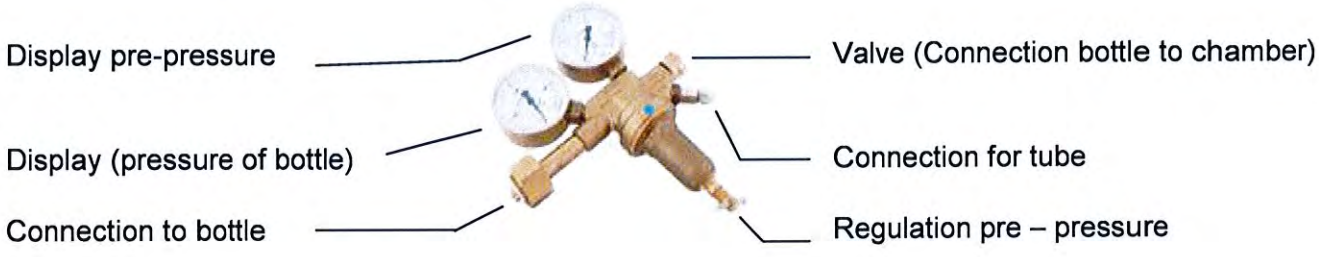
air plasma (kHz – generator)



oxygen plasma (kHz-generator)

8.4 Pressure of gas bottle:

Pleas check the pressure of the gas bottle before starting the process (Is there enough gas in the bottle?) and check the adjusted pre-pressure on pressure regulator (pre – pressure not higher than 0,5 -1,0 bar, because MFC may be damaged).



8. 5 Selection of gases

To select the right gases for the different plasma processes, look for information in the chapters cleaning, activation, etching and coating according to your application.

8.5.1 Purity of gases:

Most commonly used are gases with technical purity, if you want to treat parts with very high requirements to the surface purity, choose a gas with ultra high purity.

This applies special to semi-conductor-front-end – processes or for analysis applications (SEM,...)

8.5.2 Selection of pressure regulator

There are some standard pressure regulators for oxygen, flammable gases (e.g. hydrogen) and noble gases (e.g. argon), also there exist some special pressure regulators for special gases. To select the right pressure regulator, see table below.

Standard Pressure Regulator:

O_2 – pressure regulator

Ar – pressure regulator

H_2 – pressure regulator

Special Pressure Regulator:

CO – pressure regulator

NH_3 – pressure regulator

8. Information According Plasma Processes

Find following table as an overview to select the right pressure regulator for your gas bottle. For special gases ask your local gas supplier.

Gas connections according to DIN 477

Connection-no.	Allowed gases	Threads
1	methane, silane, hydrogen	W 21,80 x 1/14" LH
3	acetylene	Anschluss für Spannbügel
5	carbon monoxide	1" LH
6	ammonia, argon, helium, hexafluoroethane, carbon dioxide, sulfurhexafluoride, tetrafluormethane	W 21,80 x 1/14"
8	nitrogen dioxide	1"
9	oxygen	G 3/4"
10	nitrogen	W 24,32 x 1/14"

8.6 Gas piping

Our machines are equipped with swageloks of the size 6 mm, therefore you need stainless steel tubes with an inner diameter of 4 mm and an outer diameter of 6 mm to observe the regulation TRGS (no. 220) for gas piping.
To open and close the piping you will need an open-end-wrench with a size of 14 mm. For laboratory operation with incombustible and non-toxic gases you can use pressure resistant flexible tubes (PU-hose with Ø outside: 6 mm, Ø inside: 4 mm) instead of stainless steel tubes.
Quite safely gases are: N_2, O_2, noble gases, CF_4,
Etching gases like NF_3 and NH_3 have to be piped with stainless steel.
At use of special gases contact your local gas supplier.

More information on www.swagelok.com.

8.7 Gas bottle safety guideline

To ensure a riskless operation with gas bottles note following things:

- Store gas bottles in suitable containers at the outside of the building (if possible).
- In case that it is not possible to store the containers outside (by structural engineering of the building), the gas bottle has to be protected from impacts and falling down. Therefore special equipment is available, like bottle retainers with chains.
- Check fitting for leaks by connecting the fitting with the bottle. At obscurities check the fitting audible (is there a hissing to hear?) and visual (drop some water on fitting and look for bubbles).
- The connection for the tube towards the fitting must never be mounted with tools! This will squeeze the flexible tube too much and may damage it.
- By using PU-tubes as gas piping, you have to operate with the right equipment (bracing sleeve, clamping ring, screw cap). **Brass connectors must ever be mixed with stainless steel connectors!**


Screw cap


clamping ring


bracing sleeve


correct order of connection


hose connection

- Concerning the safety guidelines for special gases, please contact your local gas supplier or read the particular safety data sheet (chapter 'safety data sheets').
- An amount of 4 % hydrogen in the air is already explosive. To calculate the explosion hazard for your workstation use following formula:

e.g.: Volume of hydrogen bottle: 2 litres
Pressure of bottle (full): 200 bar

Dimension of room: 50 m²,
Height of room: 3 m
Volume of room: 150 m³

Gas escapes / leak: 2l (200bar) → 400l (1bar)
400l → 0.4 m³/150 m³ = **0.0026 %** hydrogen in atmosphere of a 50m² big and 3 m high room.

8.8 Gas consumption

The enclosed table should create an overview on the gas consumption:
The values are in relation to the max. flow per MFC. That means: at a MFC with 50 sccm we originated from a gas flow of 50 sccm/min. per process.
To calculate your individual gas consumption, you find the formula below the table.

Type of machine	size of bottle [litres]	bottle pressure [bar]	size of MFC [sccm]	bottle empty in ... hours	average consumption [sccm]	bottle empty in ... hours
Femto	2	200	20	333	10	667
Pico	2	200	50	133	30	222
Nano	2	200	100	67	40	167
Nano	15	200	90	556	20	2.500
Tetra 100	15	200	100	500	50	1.000
Tetra 100	15	200	200	250	100	500

The individual gas consumption strongly depends on the suction power of your pump.

Formula:

1. Volume of bottle (litre) x volume (in bar) = volume (litre) at 1 bar

2. $\frac{\text{volume at 1 bar x 1000}}{\text{Gas flow in cm}^3} = \text{t [minutes]}$

3. $\frac{\text{t [minutes]}}{60} = \text{t [hours]}$

Calculation example Femto *(first line of table)*

1. *2 l x 200 bar = 400 l (at 1 bar)*

2. $\frac{\textit{400 l x 1000}}{\textit{20 cm}^3} = \textit{20.000 minutes}$

3. $\frac{\textit{20.000 Min.}}{\textit{60}} = \textit{333 hours}$

8.9 Gas correction factor (GKF)

The gas correction factor (GKF) has to be typed in at computer controlled machines. This setting can be changed in the software 'PRS' in the table 'settings'.

Changing the gas correction factor:

1. First you have to login (password: PRS)
2. Select table 'settings'.
3. Type in the name of the gas in data item 'gas correction factor' (overwrite therefore the data item 'frei')
4. Change gas correction factor as shown in table below.

Gas	Symbol	GKF
Air	---	1,00
Ammonia	NH_3	0,73
Argon	Ar	1,39
Chlorine	Cl_2	0,86
Carbon dioxide	CO_2	0,70
Carbon monoxide	CO	1,00
Ethane	C_2H_6	0,50
Freon 14	CF_4	0,42
Freon C318	C_4F_8	0,17
Helium	He	1,45
Hydrogen	H_2	0,89
Nitrogen	N_2	1,00
Nitrogen dioxide	NO_2	0,74
Nitrogen monoxide	NO	0,99
Methane	CH_4	0,72
Oxygen	O_2	1,00
Propane	C_3H_8	0,36
Silane	SiH_4	0,60
Sulfur hexafluorine	SF_6	0,26

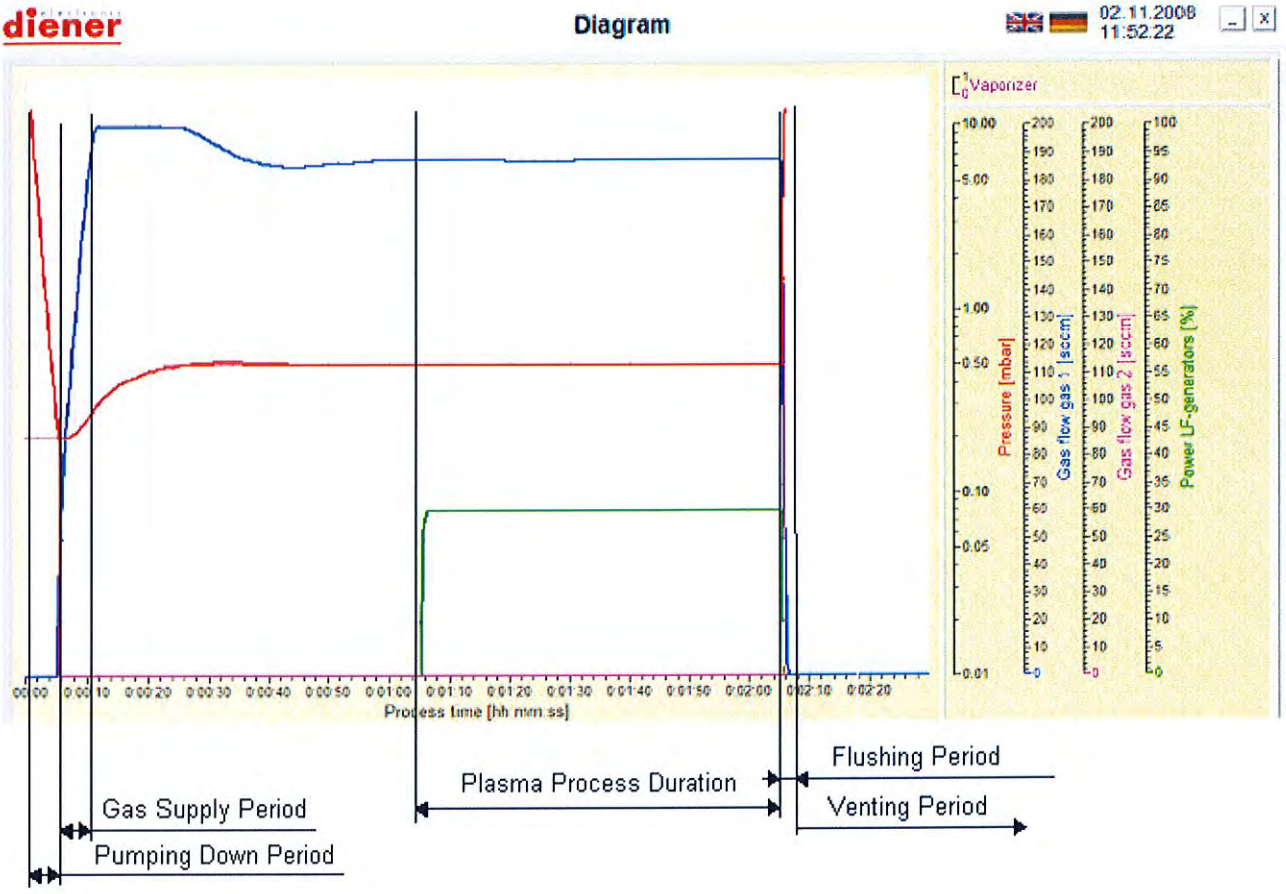
5. Don't forget to save the changing!

In case that your gas is not listed here, contact the company MKS, our supplier of MFC's.

8.10 Process parameters in general:

Following parameters can be adjusted:

- Process duration
- Gas
- Pressure (process pressure)
- Power (is shown in %)
- (Temperature, only if chamber heating is installed)



Detailed process parameters

8.10.1 Cleaning

Application	Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
CLEANING	Metal	Aluminium	O_2	0,2-0,5	50-100	1-60
		Copper	H_2/Ar	0,3-0,8	50-100	1-60
		Gold	O_2/Ar	0,2-0,5	50-100	1-60
		Silver	H_2/Ar	0,3-0,8	50-100	1-60
		Stainless steel	O_2	0,2-0,5	50-100	1-60
	plastic	ABS	O_2	0,2-0,5	30-70	1-20
		PA	O_2	0,2-0,5	70-100	1-30
		PE	O_2	0,2-0,5	50-100	1-30
		POM	O_2	0,2-0,5	100	10-40
		PP	O_2	0,2-0,5	70-100	1-20
		PTFE	H_2	0,3-0,5	100	20-60
	other	Al2O3	O_2	0,2-0,5	50-100	1-60
		SiO_2	O_2	0,2-0,5	50-100	1-60

8.10.1.1 Cleaning of metals

Removing of oils, fat and releasing agents:
Some parts are covered with oils, fat, releasing agents and other organic and inorganic (also oxides) pollutions.
With plasma it is only possible to remove some nm/s. Are the layers too thick, the pollutions may be hardened.
Fat contains e.g. lithium connections, from those only the organic compounds can be removed. The same applies to fingerprints.

Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
Metal	Aluminium	O_2	0,2-0,5	50-100	1-60
	Copper	H_2/Ar	0,3-0,8	50-100	1-60
	Gold	O_2/Ar	0,2-0,5	50-100	1-60
	Silver	H_2/Ar	0,3-0,8	50-100	1-60
	Stainless steel	O_2	0,2-0,5	50-100	1-60

(The process parameters power and time have to be adapted according to the specification of the machine (type of generator, power of generator, type of electrode) and according to the properties of the product/sample.)

There are two methods to measure the cleaning effect:

1. Measuring the surface energy with test inks (see also brochure 'Plasma Technology')
2. Perform a LABS –Test *(german: Lack Benetzungs Stoerung; english: lacquer wetting fault)*

LABS-Test performance:

Place the sample parts on a clean glass plate and flush the part with acetone. After evaporating of the acetone paint the glass plate with a silicone free lacquer. In case that the sample contains silicone, the painting will not bond on the surface (see pictures below).

At the reduction of oxides the metal oxide reacts chemical with the process gas.
As process gas pure hydrogen or a mixture with argon is used.
The mode of action of plasma can be read in the brochure 'Plasma Technology'.

General parameter (valid for all machines):

Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
Copper	H2/Ar	0,3-0,8	50-100	1-60
Silver	H2/Ar	0,3-0,8	50-100	1-60

(The process parameters power and time have to be adapted according to the specification of the machine (type of generator, power of generator, type of electrode) and according to the properties of the product/sample.)

8.10.1.2 Cleaning of plastic parts

At the cleaning of plastic parts there is always an activation of the surface at the same time included. As process gas oxygen with technical purity is used, sometimes air as process gas is enough. The plasma treatment can be repeated. The principle of the process is conform to the cleaning of metals.

Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
plastic	ABS	O_2	0,2-0,5	30-70	1-20
	PA	O_2	0,2-0,5	70-100	1-30
	PE	O_2	0,2-0,5	50-100	1-30
	POM	O_2	0,2-0,5	100	10-40
	PP	O_2	0,2-0,5	70-100	1-20
	PTFE	H_2	0,3-0,5	100	20-60

(The process parameters power and time have to be adapted according to the specification of the machine (type of generator, power of generator, type of electrode) and according to the properties of the product/sample.)

8.10.1.3 Cleaning of glass and ceramics

The cleaning of glasses and ceramics happens in the same way as the cleaning of metals. As process gas for the cleaning of glasses argon or oxygen is advisable.

Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
other	Al_2O_3	O_2	0,2-0,5	50-100	1-60
	SiO_2	O_2	0,2-0,5	50-100	1-60

(The process parameters power and time have to be adapted according to the specification of the machine (type of generator, power of generator, type of electrode) and according to the properties of the product/sample.)

8.10.2 Activation

General Parameters

Application	Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
ACTIVATION	Metal	Aluminium	O_2	0,2-0,5	50-100	1-10
		Copper	H_2	0,3-0,8	50-100	1-10
		Gold	O_2/Ar	0,2-0,5	50-100	1-10
		Silver	H_2	0,3-0,8	50-100	1-10
		Stainless st.	O_2	0,2-0,5	50-100	1-10
	plastic	ABS	O_2	0,2-0,5	30-70	1-20
		PA	O_2	0,2-0,5	70-100	1-30
		PE	O_2	0,2-0,5	50-100	1-20
		POM	O_2	0,2-0,5	100	1-40
		PP	O_2	0,2-0,5	70-100	1-20
		PTFE	H_2	0,3-0,5	100	20-60
	other	Al2O3	O_2	0,2-0,5	50-100	1-60
		SiO_2	O_2	0,2-0,5	50-100	1-60

8.10.2.1 Activation of metals

As a matter of principle it is possible to activate metals, but the activation is very unsteady and therefore just of short shelf life.
Activated metal has to be processed very fast (within half an hour, max. one hour), because the adherent radicals and ions react fast with the particles of the air.

Nearly any material can be treated with oxygen, except easily corrosive materials as f.e. copper.

Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
Metal	Aluminium	O_2	0,2-0,5	50-100	1-10
	Copper	H_2	0,3-0,8	50-100	1-10
	Gold	O_2/Ar	0,2-0,5	50-100	1-10
	Silver	H_2	0,3-0,8	50-100	1-10
	Stainless st.	O_2	0,2-0,5	50-100	1-10

8.10.2.2 Acitivation of plastics

Plastics like polypropylene or PTFE are covalent. That means, that those materials have to be pretreated before printing, painting and bonding.

The common process gas for this application is oxygen with technical purity. Exceptions are fluorine containing plastics like PTFE, FEP, ...

Most of the activations can be performed with air as process gas.

The durability of the activation varies between some minutes (e.g. on rubber) and several weeks (e.g. on PA, PE, ...) Some plastics have to be etched for a better adhesion, see chapter 'Etching'.

General Parameters

Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
plastic	ABS	O_2	0,2-0,5	30-70	1-20
	PA	O_2	0,2-0,5	70-100	1-30
	PE	O_2	0,2-0,5	50-100	1-20
	POM	O_2	0,2-0,5	100	1-40
	PP	O_2	0,2-0,5	70-100	1-20
	PTFE	H_2	0,3-0,5	100	20-60

(The process parameters power and time have to be adapted according to the specification of the machine (type of generator, power of generator, type of electrode) and according to the properties of the product/sample.)

untreated

plasma treated

8.10.2.3 Activation of glasses and ceramics:

Glasses and ceramics have similar activation attributes as metals (see chapter above) and are not easy to activate (long-term durable), but be etched. (See chapter 'Etching of glasses and ceramics'.)

Group	Material	Gas	Pressure [mbar]	Power [%]	Time [min.]
other	Al2O3	O_2	0,2-0,5	50-100	1-60
	SiO_2	O_2	0,2-0,5	50-100	1-60
	Powder	O_2	0,2-0,5	30-70	30-120

(The process parameters power and time have to be adapted according to the specification of the machine (type of generator, power of generator, type of electrode) and according to the properties of the product/sample.)

9. Index

9. Index

Customer: Umea Universitet

Location: 90187 Umea

Project: Atto-BRS

	V	phases	Hz	A
operating voltage	230	1	50/60	16
help voltage 1	+24			
help voltage 2				
help voltage 3				

Cable colours :

mains voltage :

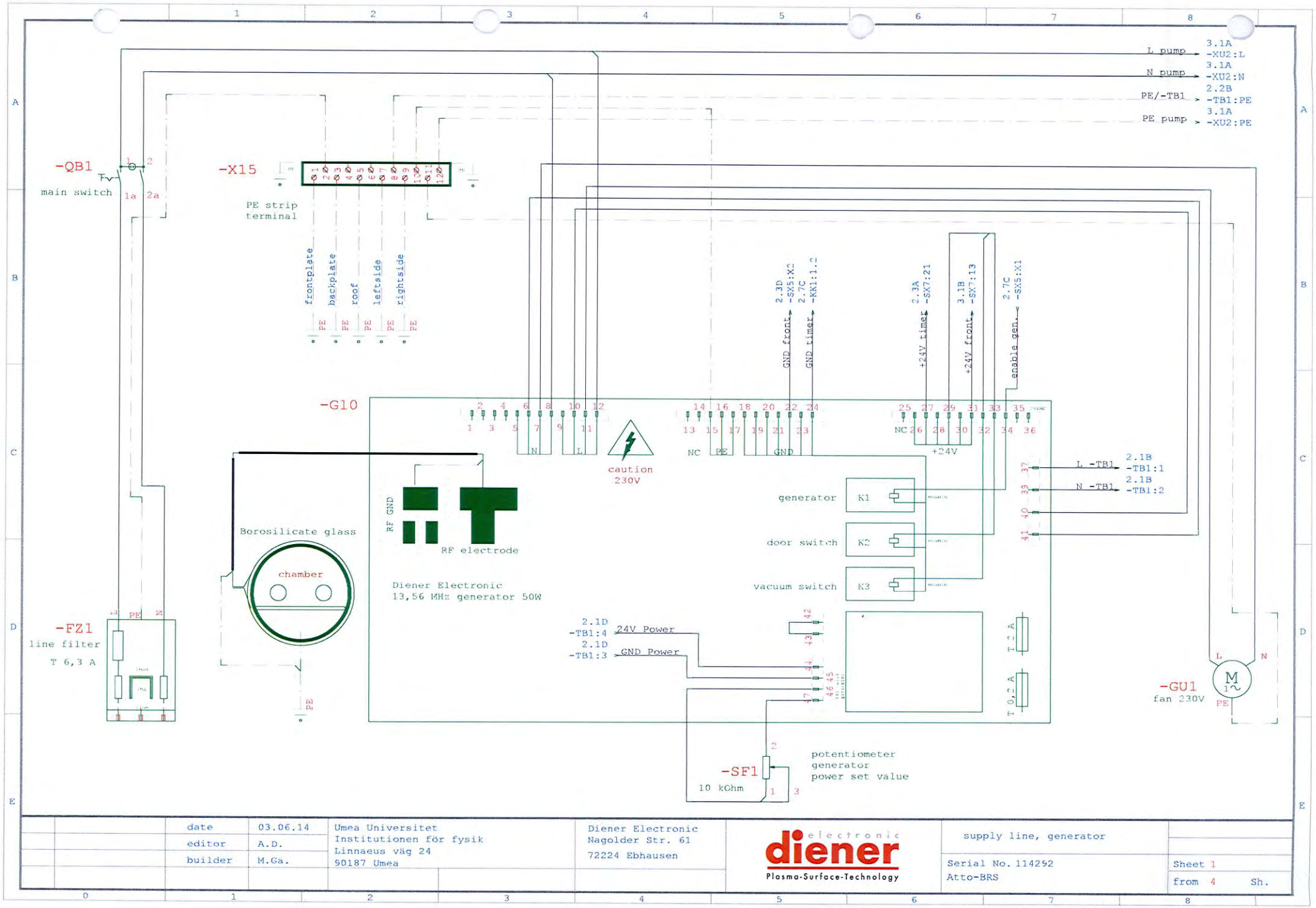
outher conductor	-	black
neutral conductor	-	light blue
protective conductor	-	green/yellow

control voltage :

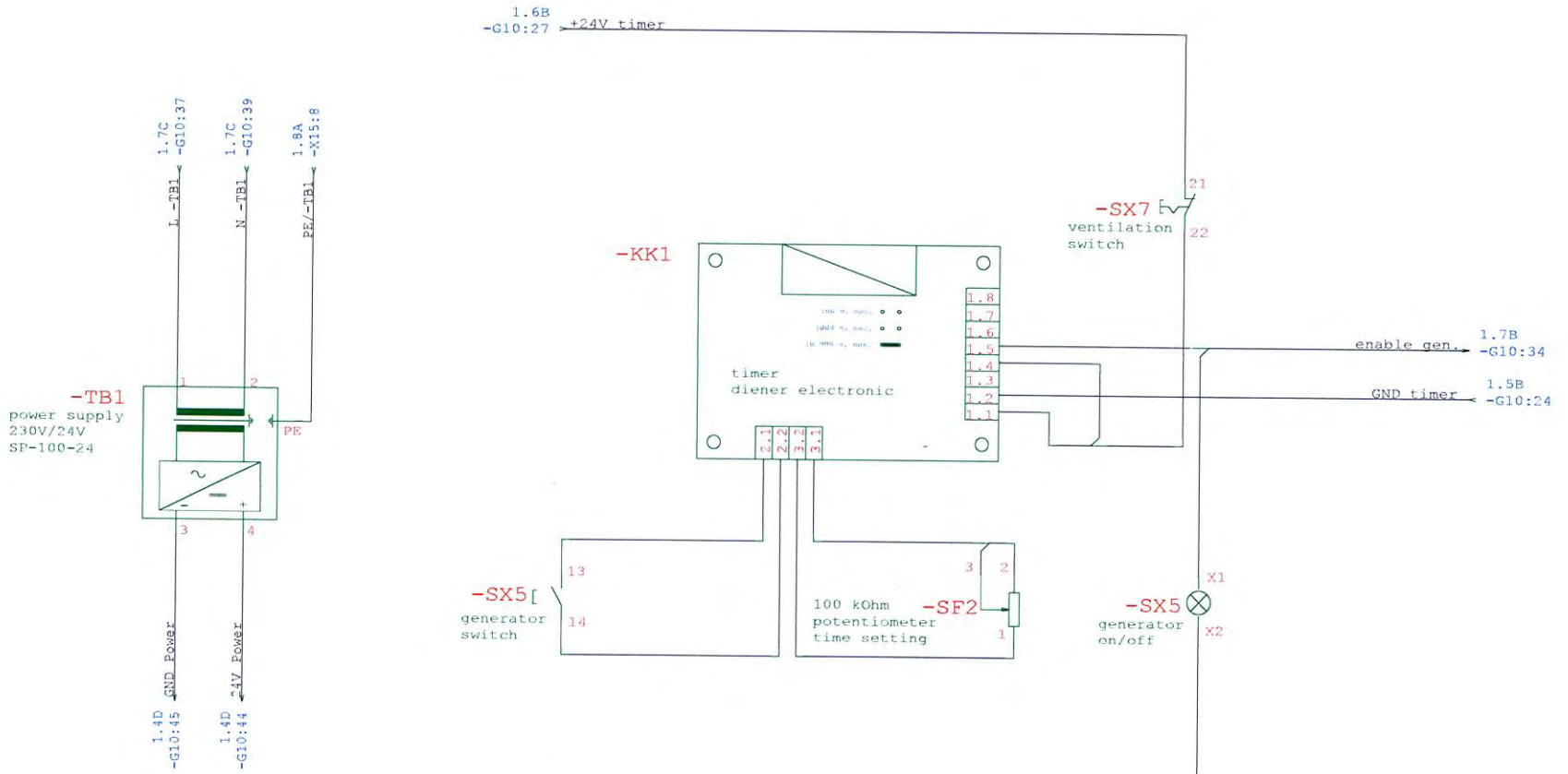
+24V	-	dark blue
-24V	-	violet
GND	-	blue/white
+15V	-	grey
-15V	-	green
actual value	-	white
set value	-	brown
other control voltage	-	pink

date	03.06.14	Umea Universitet Institutionen för fysik Linnaeus väg 24 90187 Umea	Diener Electronic Nagolder Str. 61 72224 Ebhausen	cover sheet
editor	A.D.			Serial No. 114292 Atto-BRS
builder	M.Ga.			Sheet 1 from 1 Sh.

electronic diener Plasma-Surface-Technology



	date	03.06.14	Umea Universitet Institutionen för fysik Linnaeus väg 24 90187 Umea	Diener Electronic Nagolder Str. 61 72224 Ebhausen	electronic diener Plasma-Surface-Technology	supply line, generator
	editor	A.D.				Serial No. 114292 Atto-BRS
	builder	M.Ga.				Sheet 1 from 4 Sh.



		date	03.06.14	Umea Universitet Institutionen för fysik Linnaeus väg 24 90187 Umea	Diener Electronic Nagolder Str. 61 72224 Ebhausen	electronic diener Plasma-Surface-Technology	power supply / timer
		editor	A.D.				Serial No. 114292 Atto-BRS
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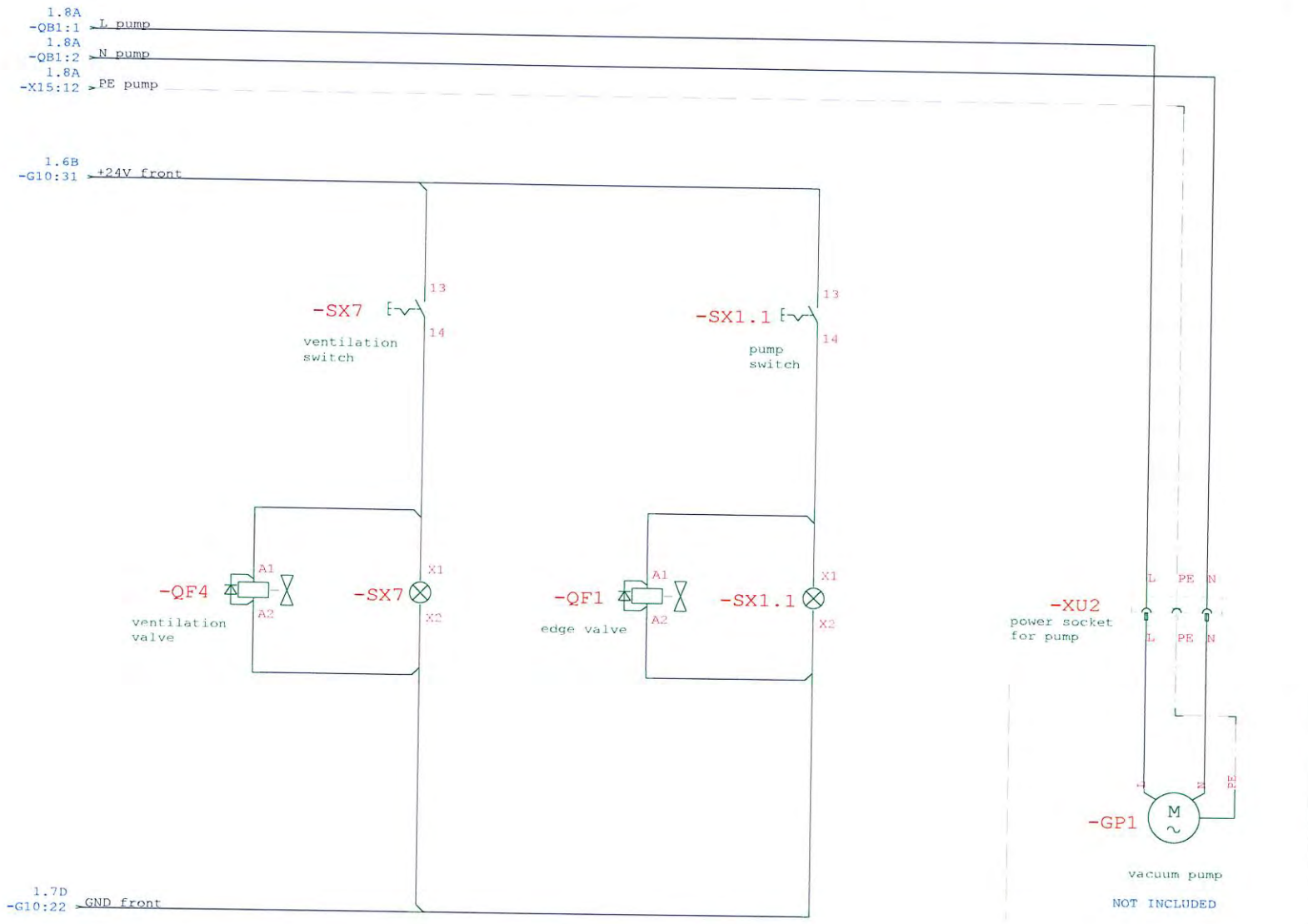
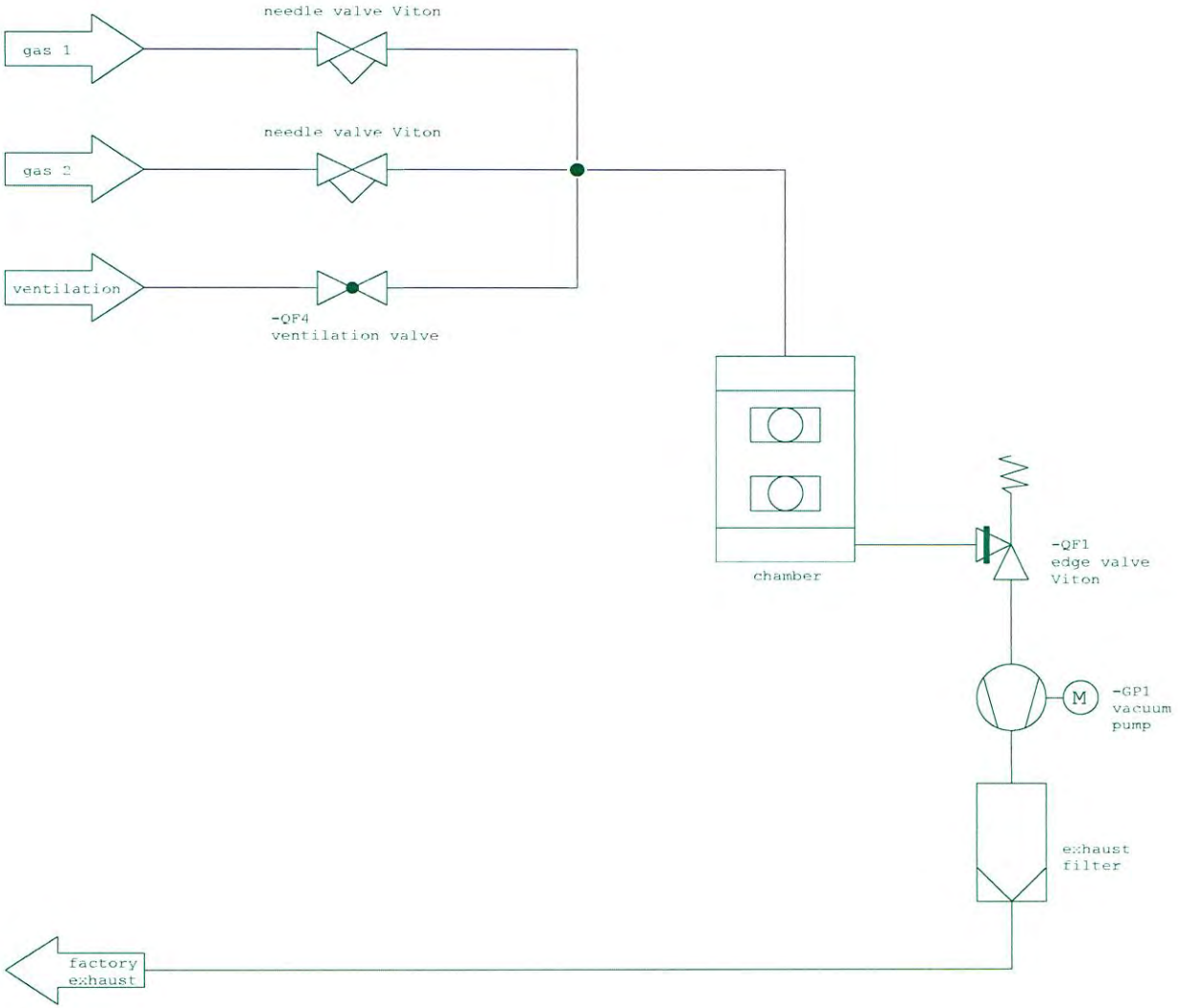


		date	03.06.14	Umea Universitet Institutionen för fysik Linnaeus väg 24 90187 Umea	Diener Electronic Nagolder Str. 61 72224 Ebhausen	electronic diener Plasma-Surface-Technology	valves / vacuum pump
		editor	A.D.				Serial No. 114292 Atto-BRS
		builder	M.Ga.				Sheet 3 from 4 Sh.



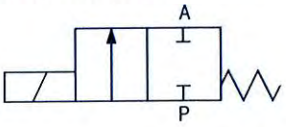
		date	03.06.14	Umea Universitet Institutionen för fysik Linnaeus väg 24 90187 Umea	Diener Electronic Nagolder Str. 61 72224 Ebhausen	electronic diener Plasma-Surface-Technology	gas flow diagram
		editor	A.D.				
		builder	M.Ga.			Serial No. 114292 Atto-BRS	Sheet 4 from 4 Sh.

2/2-Wege Magnetventil
2/2-way solenoid valve

Baureihe 210
type 210

direktgesteuert
direct acting

Schaltfunktion: NC (stromlos geschlossen)
function: NC (normally closed)



Bauart	Sitzventil	***design***	*seat valve*
Nennweite	DN 1,0 – 2,5	***diameter***	*DN 1,0 – 2,5*
Druckbereich	0 – max. 16 bar (siehe Tabelle)	***pressure range***	*0 – max. 16 bar (see table)*
Gehäusewerkstoff	Messing, 1.4305	***body material***	*brass, AISI 304*
Dichtwerkstoff	NBR, FKM	***seals***	*NBR, FKM*
Temperatur	Medium: bei NBR - 10 bis + 90°C bei FKM - 10 bis + 130°C Umgebung: max. + 50°C	***temperature***	*media: with NBR - 10 up to + 90°C* *with FKM - 10 up to + 130°C* *ambient: max. + 50°C*
Anschlüsse	G 1/8	***connection***	*G 1/8*
Elektr. Anschluss	Gerätesteckdose nach DIN EN 175301-803	***electr. connection***	*cable plug acc. DIN EN 175301-803*
Anschlussspannung	230V 50Hz, 24V DC, Sonderspannungen	***nominal voltage***	*230V 50Hz, 24V DC, special voltages*
Spannungstoleranz	+ / - 10 % nach VDE 0580	***voltage tolerance***	*+ / - 10 % acc. VDE 0580*
Leistungsaufnahme	230V 50Hz: 9,2 VA 24V DC: 6 Watt	***power consumption***	*230V 50Hz: 9,2 VA* *24V DC: 6 Watt*
Einschaltdauer	100 % ED	***duty factor***	*100 % ED*
Schutzart	IP 65 mit montierter Gerätesteckdose	***protection class***	*IP 65 with cable plug mounted*
Einbaulage	beliebig	***mounting***	*in any position*

DN [mm]	**Druck** *pressure range* [bar]	**Anschluss** *connection*	**Kv-Wert** *flow rate* [l/min]
1,0	0 – 16	G 1/8	0,5
1,5	0 – 13	G 1/8	1,2
2,0	0 – 10	G 1/8	2,1
2,5	0 – 8	G 1/8	2,8

Technische Änderungen vorbehalten. *Modifications reserved.*
Stand: 06/2005

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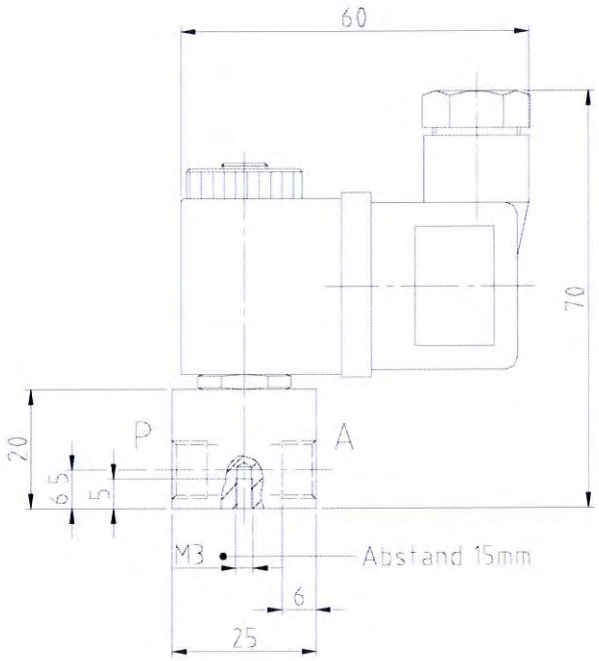
2/2-Wege Magnetventil
2/2-way solenoid valve

Baureihe 210
type 210

Maßzeichnung
dimension drawing



Bestellbezeichnungen
order specifications

DN [mm]	Werkstoffe Gehäuse / Dichtung *material body / seal*	Druck *pressure range* [bar]	Anschluss *connection*	Typenbezeichnung *order specifications* 230V 50Hz	Typenbezeichnung *order specifications* 24V DC
1,0	Messing / *brass* / NBR	0 – 16	G 1/8	210A0000/1,0/M0G18N 23050	210A0000/1,0/M0G18N 2400
1,5	Messing / *brass* / NBR	0 – 13	G 1/8	210A0000/1,5/M0G18N 23050	210A0000/1,5/M0G18N 2400
2,0	Messing / *brass* / NBR	0 – 10	G 1/8	210A0000/2,0/M0G18N 23050	210A0000/2,0/M0G18N 2400
2,5	Messing / *brass* / NBR	0 – 8	G 1/8	210A0000/2,5/M0G18N 23050	210A0000/2,5/M0G18N 2400
1,0	Messing / *brass* / FKM	0 – 16	G 1/8	210A0000/1,0/M0G18F 23050	210A0000/1,0/M0G18F 2400
1,5	Messing / *brass* / FKM	0 – 13	G 1/8	210A0000/1,5/M0G18F 23050	210A0000/1,5/M0G18F 2400
2,0	Messing / *brass* / FKM	0 – 10	G 1/8	210A0000/2,0/M0G18F 23050	210A0000/2,0/M0G18F 2400
2,5	Messing / *brass* / FKM	0 – 8	G 1/8	210A0000/2,5/M0G18F 23050	210A0000/2,5/M0G18F 2400
1,0	1.4305 / *AISI 304* / FKM	0 – 16	G 1/8	210A0000/1,0/V2G18F 23050	210A0000/1,0/V2G18F 2400
1,5	1.4305 / *AISI 304* / FKM	0 – 13	G 1/8	210A0000/1,5/V2G18F 23050	210A0000/1,5/V2G18F 2400
2,0	1.4305 / *AISI 304* / FKM	0 – 10	G 1/8	210A0000/2,0/V2G18F 23050	210A0000/2,0/V2G18F 2400
2,5	1.4305 / *AISI 304* / FKM	0 – 8	G 1/8	210A0000/2,5/V2G18F 23050	210A0000/2,5/V2G18F 2400

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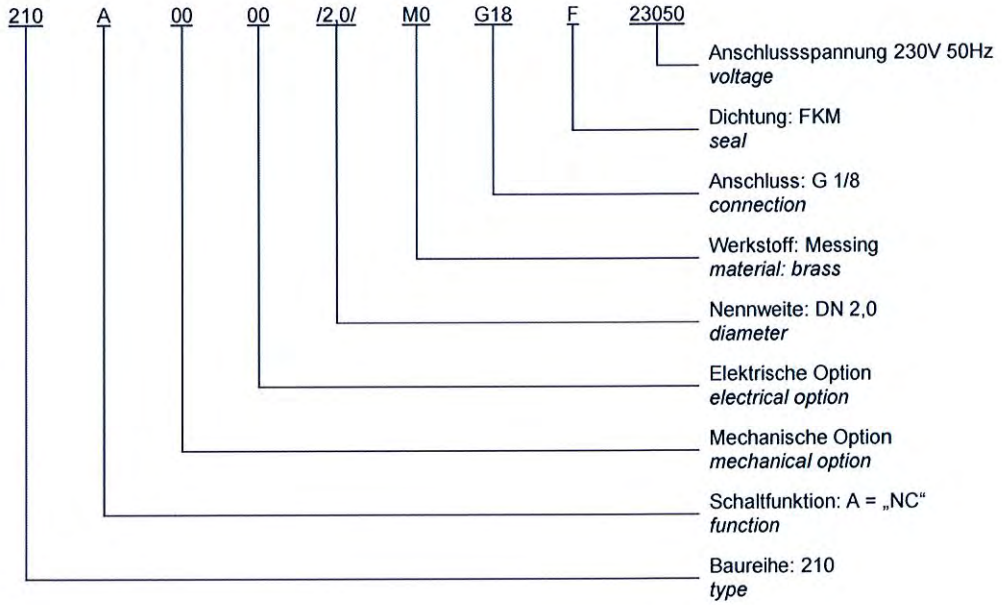
2/2-Wege Magnetventil
2/2-way solenoid valve

Baureihe 210
type 210

Typenschlüssel
type code

Die Typenbezeichnung setzt sich zusammen aus:
Structure of the order specification:



Technische Änderungen vorbehalten. *Modifications reserved.*
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