

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

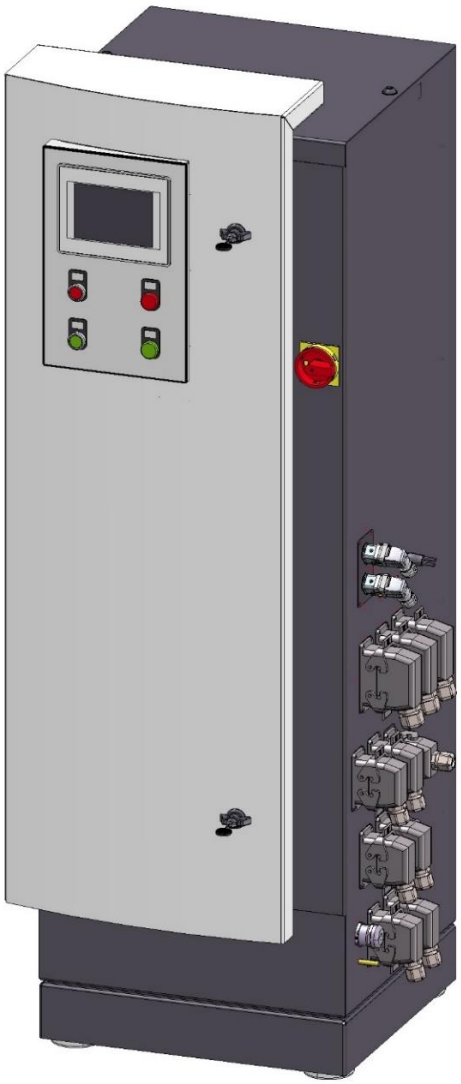
User manual

Openair® Plasma treatment facility

FG5002S/FG5005S

V20.0

08.11.2019



plasmatreat

1 CONTENTS

1 Contents 1
1.1 Introduction 5
1.2 Keywords 6
1.3 Used symbols 7
1.4 Nameplate and Manufacturer / service addresses 8
1.4.1 Nameplate according to machinery Directive 2006/42/EG 8
1.4.2 Nameplate according UL508A / NFPA79 9
1.1 References to copyrights and industrial property rights 10
1.2 Information for the owner/operator 10
1.3 Instructional and training assistance 11
1.4 Appropriate Use 11
1.5 Safety information for UL508A / NFPA 79 certified devices 11
2 Safety Information 12
2.1 General Safety Information 12
2.2 Duties of the Owner/Operator 13
2.3 Safety Information during Commissioning 14
2.4 Safety Information during Operation 14
2.5 Safety Information during Maintenance, Commissioning and Troubleshooting 15
2.6 Safety Information regarding electrical energy 16
2.7 Structural modifications to the machine 17
2.8 Remaining Dangeres 17
2.8.1 Dangers in the area of plasmajets 17
2.8.2 Safety instructions for people with pacemakers 19
2.8.3 Safety instructions of the working gas 19
2.8.4 Safety information regarding the use of solvents 19
2.8.5 Safety information regarding explosion protection 20
2.8.6 Sound pressure level of individual components 20
2.9 Warning signs at the device 20
2.9.1 Warning signs in accordance with machinery directive 2006/42/EG 20
2.9.2 Warning signs in accordance with UL508A / NFPA 79 21
3 Liability, Guarantee 22
4 Functional description of individual components 23
4.1 Generator 23
4.1.1 Generator Specifications FG5002S/FG5005S 24
4.1.2 Design control cabinet 25

4.1.3 Rittal Schaltschrank 26
4.2 High-Voltage transformers 27
4.2.1 HTR12 27
4.2.2 HTR22 28
4.2.3 HTR12-G105 28
4.3 Monitoring functions 29
4.3.1 Light-Control-ModulE (LCM) 29
4.3.2 LCM1405 29
4.3.3 LCM1606 30
4.3.4 LCM1705 30
4.3.5 Rotation-Control-Modul (RCM) 31
4.3.6 Pressure control Modul (PCM) 32
4.4 Air supply 33
4.4.1 Compressed air supply unit DVE20 33
4.4.2 Compressed air preparation unit DAE10 (SMC) (Option) 35
4.5 PCU Plasma Control Unit 37
4.5.1 Connections PCU1604 39
4.5.2 Connections PCU1710 41
4.5.3 High-Voltage Transformers of the PCU 42
4.5.4 Monitoring functions of the PCU 42
4.6 PlasmaJet 43
4.6.1 HVC-plug (High-Voltage Contactor) 45
4.6.2 Mounting plate for plasmajets 46
4.6.3 Warnings for plasmajets 46
4.6.4 PFW10/PFW10R 47
4.6.5 RD1004 / RD1004R 48
4.6.6 RD2004 / RD2004R 49
4.6.7 RD2005 50
4.6.8 RD1010 50
5 Preparation and realisation of commissioning 51
5.1 Transport 51
5.2 Connectors on the generator 52
5.3 Installation and commissioning 54
5.3.1 Transformer (High voltage unit) 55
5.3.2 Generator 55
5.3.3 Air supply 56
5.3.4 Customer interface X40 56
5.3.5 Commisioning 58

6 Operation of the control unit 61
6.1 Control panel on the Generator FG5002S/FG5005S 61
6.2 Control panel on the PCU 62
6.3 Parameter setting in the text display of the PCU 62
6.4 Operation of the PCU1604 63
7 Production process – standard control unit 64
7.1 Safety information regarding the automatic operation of the plasma treatment facility 64
7.2 Interrupting production, switching off facility 67
7.2.1 Switching off via „Emergency off“ 67
7.2.2 Switching off via „Plasma off“ 67
7.2.3 Production Operation 67
7.2.4 Flow chart 68
7.3 Decommissing and disposal 69
7.3.1 Decommissing 69
7.3.2 Disposal 69
8 Maintenance and servicing of the facility for plasma treatment 70
8.1 Safety information for the maintenance, servicing and fault clearance of the device for plasma treatment 70
8.1.1 Safety information on accordance with machinery directive 2006/42 EG 71
8.1.2 Warning in Accordance with UL 508A / NFPA 79 / NFPA70E / NFPE 71
8.2 Daily visual inspection of the device 72
8.3 Monthly inspection, replacement 72
8.4 Quarterly inspection, replacement 73
8.4.1 Generator 73
8.4.2 Transformer HTR12 / HTR22 73
8.4.3 Compressed Air supply unit DVE20 / filter unit DAE10 73
8.4.4 Plasma jets PFW10 / RD1004 / RD2004 / RD2005 / RD1010 73
8.5 Semi-annual inspection, replacement 75
8.5.1 Plasma jets RD1004 / RD2004 / RD2005 / RD1010 75
8.6 Plasma nozzle maintenance 76
8.6.1 Plasma jet PFW10 / PFW10R 77
8.6.2 Plasma jet RD1004/RD1004R 78
8.6.3 Plasma jet RD2004 / RD2004R 81
8.6.4 Plasma jet RD2005 83
8.6.5 Plasma jet RD1010 86
9 Problems and error messages 90
9.1 Fault message on the control panel 90

9.2 Servicekontact 90
10 User manual Control panel 91
10.1 Switching on the control panel 92
10.2 Start-up screen 92
10.3 Main menu 93
10.4 Service menu 95
10.4.1 User manager menu 97
10.4.2 Service I/O 98
10.5 Input menu 99
10.6 Limit Menu 100
10.6.1 Recipe menu 101
10.7 Malfunction menu 102
10.7.1 Malfunction cause and solution 103
10.7.2 Alarmlist 108
10.8 Statusmenu 109
10.8.1 Statusmenu Can 110
10.9 Chart view 111
10.10 Profibus/Profinet/Ethercat (Optional) 112
11 Appendix 113
11.1 Appendix A – Specification Personal Protection 113
11.2 Appendix B – Declaration of incorporation 114
11.3 Appendix C X40 Interface 115
11.4 Appendix D Partlists PFW10 / PFW10R 117
11.5 appendix E Partlists RD1004 / RD1004R 118
11.6 Appendix F Partlists RD2004 / RD2004R 119
11.7 Appendix G Partlists RD2005 121
11.8 Appendix H partlists RD1010 123
11.9 Appendix I – selection of standard nozzles 125
11.9.1 Nozzles for static Plasma jets 125
11.9.2 Nozzels for rotating plasma jets 126
11.10 APPENDIX J Maintenance 129
11.11 Appendix K Passwords 134

1.1 INTRODUCTION

These Operating Instructions are a major aid towards the successful and danger-free operation of the linear bench pre-treatment system.

The Operating Instructions contain important information for operating the components for plasma pre-treatment safely, appropriately and efficiently; their observations helps to avoid dangers, reduce repair costs and down times and increase reliability and service life.

The Operating Instructions must always be kept available near the equipment and must be read and applied by every person who is entrusted with working with or on the machine, e.g.:

- operation, including set-up, repairing malfunctions during operational sequences, disposal of manufacturing supplies,
- repairs (maintenance, care, servicing) and/or
- transportation

If in this user manual terms such as: the “facility“, the “device“ or the “components of the plasma treatment facility“ are employed, said terms always describe the “incomplete machine for plasma treatment“ in accordance with the Machinery Directive 2006/42/EG.

1.2 KEYWORDS

The following keywords are used in this user manual.

DANGER!

Hazard level: Immediate danger!

- Danger indicates a hazard with ahigh level of risk which will resultin serious injury or death!

WARNING!

Hazard level: Possibly dangerous situation!

- Death or serious injury can result if the information is ignored!

ATTENTION!

Hazard level: Potentially dangerous situation!

- Failure to observe the safety instructions may result in moderate to slight injuries!

INFORMATION!

Hazard level: Application tips!

- Failure to observe the safety instructions may result in material damage!
- Useful and important information on the operation on the system.

1.3 USED SYMBOLS

The following symbols are used in this user manual.

Warning sign	Meaning
	Danger high voltage
	Warning of hot surface
	Warning of electromagnetic field
	Warning of rotating shaft
	Prohibited for people with pacemakers
	Before working on the system: Unlock
	Request to read manuals and regulations
	Suction device is to be used

1.4 NAMEPLATE AND MANUFACTURER / SERVICE ADDRESSES

1.4.1 NAMEPLATE ACCORDING TO MACHINERY DIRECTIVE 2006/42/EG

plasmatreat
www.plasmatreat.com

serial no.:	XXXX
type:	FG5002S [FG5005S]
voltage:	3~/360-510V/PE/50-60Hz
I_{max} / fuse:	8A [12A] / ⊟ 32A
I_{cw} / I_{cu}:	0,64kA/-
year of construction:	cw XX / 2019
com no.:	2XXXXX
plasma jets patented:	EP Patent / US Patent No.:
	EP 0761415 / US 5.837.958

CE
Made in Germany

Manufacturer	
Address	Plasmatreat GmbH Queller Straße 76-80 D-33803 Steinhagen
Telephone	+49 (0) 5204 9960 0
Fax	+49 (0) 5204 9960 33
E-Mail	info@plasmatreat.de
Internet	www.plasmatreat.com
Technical service, telephone	+49 (0) 5204 9960 1400
Technical service, e-mail	service@plasmatreat.de

1.4.2 NAMEPLATE ACCORDING UL508A / NFPA79

PLASMATREAT NORTH AMERICA INC.
1480 SANDHILL DRIVE. UNIT 8
ANCASTER. ON L96. 4V5. CANADA
Tel.:+1 905 304 5200
Fax: +1 905 304 5260
Email: tim.smith@plasmatreat.com

Serial no.:	XXXX
Type:	FG5002S [FG5005S] + TRAFO + DÜSE
Year of construction:	cw XX / 2019
Com no.:	2XXXXX
Plasma jets patented:	EP Patent / US Patent No.: EP 0761415 / US 5.837.958 E468235

Industrial control panel for industrial machinery

Diagram number:	EPLAN_2XXXXXA
Full load amperes:	XXA
Largest Motor:	not provided
Largest heater load:	not provided
Voltage:	3x480V AC / 277V 3W+GRD (solidly grounded WYE source only)
Phase and frequency:	3 Phase + GRD + 60Hz
Max SCCR:	5kA rms symmetrical. 480V AC max.
Main overcurrent protection:	Class CC. 600V AC.20A.I.R. 200kA
Supply fuse (field provided):	Any suitable BCPD. Rated min.480V AC.max.32A. min I.R.5kA
Max air pressure:	6bar
UL Enclosure type:	1

Supply conductor and machine overcurrent protection provided at main supply

Manufacturer	
Address	Plasmatreat GmbH 1480 Sandhill Ave, Unit 8 L9G 4V5 Ancaster, ON
Telephone	+1 905 304 5200
Fax	+1 905 304 5260
E-Mail	tim.smith@plasmatreat.com
Internet	www.plasmatreat.com
Technical service, telephone	+1 905 304 5200
Technical service, e-mail	service@plasmatreat.com

1.1 REFERENCES TO COPYRIGHTS AND INDUSTRIAL PROPERTY RIGHTS

These Operating Instructions must be treated confidentially. They must only be made accessible to authorised persons.

Third party access to these instructions required the written permission of Plasmatreat® GmbH.

All the documentation is protected in terms of the copyright legislation. Passing on or reproducing documentation, even as extracts, and any use or notification of their content is prohibited unless it has been expressly authorised in writing.

1.2 INFORMATION FOR THE OWNER/OPERATOR

The Operating Instructions represent a major part of the components for plasma pre-treatment. The owner/operator is responsible for ensuring that the operating personnel take note of these guidelines.

The owner/operator must supplement the Operating Instructions with operating instructions based on existing national accident prevention regulations and environmental safety, including taking consideration of information on duties of supervision and notification, operational peculiarities, e.g. respective to organising the work, operational sequences and staff.

The recognised technical rules for safety and skilled working must be observed in addition to the Operating Instructions and the valid binding accident prevention rules for the place and country of use.

The owner/operator of the components for plasma pre-treatment must not perform any modifications, additions or changes to the system that might impinge on safety and/or the functions without the permission of Plasmatreat!

This also applies for installing and adjusting safety equipment or valves and for doing welding work on load-bearing components.

All spare parts that may be used by Plasmatreat must comply with the established technical requirements. This is guaranteed with original spare parts.

Use only trained or instructed staff. Areas of staff responsibility for operations, set-up, maintenance and repairs must be clearly defined!

A machinist should be selected who will be responsible for the system and the staff. He has the right to refuse third party instructions that may have safety implications!

1.3 INSTRUCTIONAL AND TRAINING ASSISTANCE

As the owner/operator of the equipment, you are obligated to inform and/or train your personnel about the existing legal and accident prevention guidelines and about existing safety equipment on or near the equipment.
The various qualifications of the personnel must be taken into consideration here.

The operating personnel must have understood the instructions provided; you must assure that the instructions are observed.

This is the only way to ensure the operating personnel work in a safety and danger-conscious fashion. This should be checked at regular intervals. As the owner/operator, you should therefore have every member of staff confirm his participation in training sessions in writing.

1.4 APPROPRIATE USE

The plasma pre-treatment components are parts of a plasma pre-treatment system, which must comply with the safety requirements of the Guideline for Machinery and other guidelines and standards. These components exclusively serve for integration in such systems; commissioning and operation without the required safety equipment is prohibited.

The plasma pre-treatment system is a machine for the surface treatment of materials such as plastic or EPDM profiles, skeins or sheets of aluminium. As a rule, it is a component of a production line and using the Plasmatreat process ® results in the activation of the outer surfaces of the material so that its wettability improves.

Different or additional uses are considered as inappropriate. The owner/operator of the system is solely liable for all ensuing damages. This also applies for self-initiated machine modifications.

Adhering to instructions with regard to the following:

- safety
- operations
- repairs / maintenance

as described in these Operating Instructions is also part of appropriate usage.

1.5 SAFETY INFORMATION FOR UL508A / NFPA 79 CERTIFIED DEVICES

Note that this equipment has been evaluated in accordance with UL 508A / NFPA 79 requirements. The Industrial Control Panel on the machine has been evaluated as a UL Type 1 enclosure (Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt).

Note that in accordance with UL508A requirements, section 1.1, the equipment shall be installed in ordinary locations only, in accordance with the latest Edition of the National Electrical Code, ANSI/NFPA 70, where the ambient temperature does not exceed 40°C (104°F) maximum.

2 SAFETY INFORMATION

DANGER!

Danger high voltage!



- The safety instructions in this chapter apply exclusively to fully assembled plasma pretreatment systems which comply with the safety requirements of the EC Machinery Directive 2006/42 / EC and other directives and standards.
- Commissioning and operation are only permitted with appropriate safety devices.

2.1 GENERAL SAFETY INFORMATION

The Plasma pre-treatment system is a state of the art system designed using the latest technology and recognised safety rules.

Even so, dangers can arise for the user or third parties or the system itself or other assets if the system is used under the following circumstances:

- if the system is not operated by trained and familiarised personnel,
- if the system is not used appropriately,
- if the system is inappropriately repaired or serviced.

INFORMATION!

Observe general safety instructions!



- Any person involved with the set-up, commissioning, operation or repair of the system must have read and fully understood these Operating Instruction.
- The Operating Instructions must always remain handy near the location of usage
- In-house training, taking the specialist qualifications of the assigned personnel into consideration, is a further possibility

2.2 DUTIES OF THE OWNER/OPERATOR

The safety of the system can only be implemented into the operation if all the necessary measures are undertaken. Planning for these measures and controlling their performance is part of the owner/operator's duty of care.

The owner/operator must guarantee the following:

The system must only be used if the system is in perfect working condition and if the Operating Instructions are observed with regard to the system's appropriate use and awareness of safety and any potential dangers! Malfunctions, especially those that could impair safety, must be repaired immediately!

The relevant Accident Prevention Guidelines and other generally recognised rules of safety and industrial medicine must be maintained.

The responsibilities for various activities within the framework of operating, maintaining and repairing the system must be defined clearly and must be observed. There is no other way to prevent erroneous handling, especially in the event of situations of danger.

The owner/operator must obligate the operating personnel to wear personal safety equipment, inasmuch as this is required by local regulations.

If required by the regulations or mandatory, additional personal safety equipment may also need to be used.

If changes in the operating characteristics or system malfunction occur that can have safety implications, the system must be shut down immediately and the responsible party/person must be notified of this immediately!

First Aid facilities (first aid boxes, etc.) must be kept within easy reach!

Information on the location and operation of fire extinguishing equipment must be posted.

Fire detection and fire detection information must be observed.

The procedures to switch equipment on/off must be observed where all work, operations, modifications, system set-up and the system safety equipment is involved!

Observe the Information concerning Repair Work for all inspections, maintenance, system repairs and safety equipment!

All work on the system should only be performed by reliable personnel!

All work on the system may only be performed by trained and familiarised personnel!

Apprentices, trainees or personnel undergoing orientation may not work on/near the system unless an experienced skilled worker is supervising them!

2.3 SAFETY INFORMATION DURING COMMISSIONING

The system may only be assembled and commissioned by qualified skilled personnel.

All the system parts and components should be checked for transit and functional damages before they are assembled.

Workshop equipment appropriate for the task is absolutely mandatory for performing any repairs.

All the general Safety and Accident Prevention regulations must be observed for all maintenance, commissioning and fault rectification work.

2.4 SAFETY INFORMATION DURING OPERATION

DANGER!



Risk of injury and destruction!

- Press the emergency off button (red mushroom-head button) in case of danger and malfunctions and to avoid dangers and malfunctions!

The system can only be commissioned if it is in a fully assembled and operational conditional.

Keep operational areas within the machine intake and discharge areas clear and uncluttered.

The system must not be operated unless all the safety equipment and safety-based devices are present and fully functional, e.g. detachable safety equipment!

Check system at least one daily for externally recognisable damages and defects! The responsible place/person must be notified immediately of any occurring changes (including changes in the operating characteristics). Shut down and secure system immediately!

Specially trained personnel must repair malfunctions immediately!

Observe the Operating Instructions with regard to all ON/OFF procedures, control panels!

2.5 SAFETY INFORMATION DURING MAINTENANCE, COMMISSIONING AND TROUBLESHOOTING

All maintenance, commissioning work and malfunction repairs may only be carried out by qualified personnel.

The Operating staff must be informed about performing maintenance repair work before commencing with such work.

Observe maintenance and repair instructions for the individual components.

Always adhere to prescribed or specified time periods in the Operating Instructions for recurring testing / inspections.

The entire area must be secured when repair work is required!

Perform the following basic measures:

- Stop and switch off system
- Switch off main switch, secure against unintentional restarting
- Shut off compressed air valve
- Allow system to cool down adequately
- Attach warning sign to operating panel

Workshop equipment appropriate for the task is absolutely mandatory for performing any repairs.

Always use suitable and perfectly functioning load suspension equipment and fixing materials when replacing heavy system components.

All work on electrical equipment may only be performed by a qualified electrician or by trained personnel under the direction and supervision of a qualified electrician in accordance with electrical and technical regulations!

All loosened screwed connections must be re-tightened when maintenance and repair work is being performed!

All set-up, re-fitting, adjustment and repair work may only be performed if the main switch is disabled (shut off). Manual intervention can cause accidents when equipment is in use; they are therefore prohibited.

The system and any connections and couplings in specific must be cleaned prior to any maintenance/repairs involving oil, operational equipment, dirt and cleaning materials.

If safety equipment has to be dismantled during re-fitting, maintenance and repair work, then the assembly and inspection of the safety equipment must be performed immediately after completing the maintenance and repair work!

Please ensure chemicals, operational equipment and processing materials as well as any replacement parts are disposed of safely and in an environmentally safe fashion.

Comply with the general safety and accident prevention regulations when performing maintenance, repair work and rectifying malfunctions.

2.6 SAFETY INFORMATION REGARDING ELECTRICAL ENERGY

Repair work on the electrical equipment on the system may only be carried out by a trained electrician.

In the event of malfunctions in the system's electrical supply, switch system off immediately with main switch!

Never work on voltage-conducting (live) system parts!

Only original fuses with the prescribed current may be used!

Re-connect loosened connections properly.

Replace damaged wires and cables immediately.

System parts must be de-energised if inspection, maintenance or work is going to be performed. Observe the five safety rules

1. **Disconnect mains**
   - The electrical installation must be disconnected from live parts on all poles.
2. **Prevent reconnection**
   - Reliably prevent an accidental re-connection of an installation where work is in progress. This is achieved by just replacing the unscrewed fuses in the low-voltage system by lockable lock-out devices.
3. **Test for absence of harmful voltages!**
   - With a suitable measuring device (two-pole voltage tester) the voltage must be determined all poles.
4. **Ground and short circuits!**
   - All conductors must be short-circuited and grounded with suitable tools to cause tripping of the upstream safety device (in the event of erroneous start-up).
5. **Cover or close of nearby live parts!**
   - Neighboring live parts must be protected against contact.

Design features must not be changed so as to reduce safety for repairs (e.g. creepage distance and air clearances and gaps must not become smaller because of the insulation).

If work is required on live components (only in exceptional cases!), then an additional personal must be used to activate the emergency off button or the main switch in the case of an emergency. Use only insulated tools!

Proper earthing of the electrical system must be guaranteed by using a protective circuit

Always wait for five minutes after switching off the system for maintenance or repair work to ensure that the capacitors in the controls are fully discharged. Opening the casing or the control cabinet doors is only permitted after this time has elapsed.

Check electrical system equipment regularly.

2.7 STRUCTURAL MODIFICATIONS TO THE MACHINE

Replace system parts immediately if they are not in perfect condition.

Use only original spare parts and consumables. Using third party parts does not guarantee that they are designed and manufactured in accordance with stress and safety requirements.

All modification work requires the written approval of Plasmatreat GmbH.

Unauthorised, independent modifications, additions or changes in the system exclude the liability of the manufacturer for any ensuing damages. The manufacturer's warranty / guarantee becomes null and void.

2.8 REMAINING DANGERES

The operation of the system is always accompanied by a remaining risk even if all the safety requirements are observed during operation of the system.

Everyone working on and with the system must be aware of these remaining risks and must follow all the instructions that prevent these remaining risks from leading to accidents or damages.

A detailed description of the special remaining dangers can be found in the following sections or in the technical descriptions of the components.

2.8.1 DANGERS IN THE AREA OF PLASMAJETS

DANGER!



Danger of electric shock!

- High voltage inside the jets!

The plasmajets conduct a high voltage (20 kV) during the plasma discharge!

Never insert any metal conductive items (screwdrivers, pencils, ball point pens, etc.) into the plasmajet.

WARNING!



Danger of burns!

- Plasmajets are very hot during and after operation!
- Let the Plasmajet cool down before it is touched!

There is a risk of burns due to HF arc.
Allow to cool sufficiently.
In addition, please observe the following safety instructions:

- Never direct the plasmajet towards persons, animals
  Danger of burns!
- Never touch the plasmajet while in operation!!
  Danger of burns! Electric shock!
- Never press plasmajet directly onto the material being treated.
  Danger of fire!
- Shut the pre-treatment system off immediately in the event of damages to high voltage parts or safety equipment.
- Repairs must be performed immediately by qualified technical personnel or by our Customer Service Department.
- Earthing, control and high voltage wires relating to the plasmajets must be installed in such a way that they cannot be damaged (as a result of being driven over, being crushed, external affects, etc.).
  High voltage shock!
- Mount the safety identification, danger and information signs in the vicinity of the areas of danger
- The electrical system connections may only be connected by qualified electricians according to the circuit diagrams!

INFORMATION!



Risk of overheating!

- System can only be operated with air supply!
- Observe valid VDE and electric power provider regulations!

The air also ensures the heat from the jet is taken away. Before switching on the system, always check whether the air supply is guaranteed. System damages due to overheating can occur otherwise.

WARNING!



Rotating components, danger of injury!

- Never touch the jet during operation!

2.8.2 SAFETY INSTRUCTIONS FOR PEOPLE WITH PACEMAKERS

DANGER!



Malfunction of pacemakers due to pulsed voltage!



- The system uses pulsed voltage. This can lead to danger to life for carriers of pacemakers or comparable life-support devices.
- The responsibility for informing the persons concerned is borne by the operator of the facility.

2.8.3 SAFETY INSTRUCTIONS OF THE WORKING GAS

ATTENTION!

Risk of poisoning by working gas!



- An extraction unit is to be installed by the operator. It shall hereby be ensured from a control point of view that the operation of the plasma treatment facility is not possible in case of extraction failure.
- The volume flow of ionizing gas per plasmajet can be found in chapter 4.6 for the respective plasmajet used. The volume flow of the extraction must be higher than the supplied ionizing gas to the plasmajet. Plasmatreat GmbH recommends a factor of 10!
- Ensure that the facility area is well ventilated.
- The operator of the facility is responsible for the adherence to TRC/TLV limit values and the respective national provisions regarding possible workplace concentrations.
- In case of extraction failure, immediately ventilate the working rooms thouroughly!

2.8.4 SAFETY INFORMATION REGARDING THE USE OF SOLVENTS

The storage or use of solvents of any kind in the immediate vicinity of the facility for plasma treatment is prohibited. The use of solvents for cleaning purposes is also prohibited.

2.8.5 SAFETY INFORMATION REGARDING EXPLOSION PROTECTION

The device for plasma treatment is not protected against explosion.

2.8.6 SOUND PRESSURE LEVEL OF INDIVIDUAL COMPONENTS

Noise from individual components is emitted especially when the jets are switched on:If no sound-insulating hood is present, then a sound pressure level L_{pA} exceeding 70 dB(A) is emitted from the jet(s). The system owner/operator is obliged to undertake suitable soundproofing measures.

2.9 WARNING SIGNS AT THE DEVICE

The facility for plasma treatment as described in this user manual is provided with warning signs, which are to be attached at the respective hazard areas to the affected devices before the commissioning of the facility by the operator.The warning signs are included in the respective applicable standard (CE 2006/42 / EC - UL508A / NFPA 79). In the following, the warning signs are listed in accordance with the respective standards.

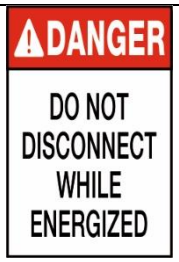
2.9.1 WARNING SIGNS IN ACCORDANCE WITH MACHINERY DIRECTIVE 2006/42/EG

The following warning labels are enclosed with the delivery or fixed on the system.

Warning sign	Meaning
	Beware of dangerous electrical voltage
	Danger due to hot surface
	Warning of an electromagnetic field
	Prohibited for persons with life support equipment

2.9.2 WARNING SIGNS IN ACCORDANCE WITH UL508A / NFPA 79

The following warning labels are enclosed with the delivery or fixed on the system.

Warning sign	Meaning
	Beware of dangerous electrical voltage.
	Beware of electrical voltage
	Warning not to interrupt the power supply during operation
	Warning to read and understand the user manual prior to using the devices for plasma treatment

3 LIABILITY, GUARANTEE

Plasmatreat GmbH provides its products with a guarantee (see contract). The only exceptions to this are spare parts and consumables such as jet nozzles, fuses, etc. The guarantee covers the no charge rectification of possible malfunctions as well as the no charge replacement of any defective parts.

The prerequisite for granting the guarantee is the appropriate use of the system and the components in accordance with the explanations in these Operating Instructions. Malfunctions or defective parts that can be attributed to improper handing are not covered by the guarantee's scope.

Transportation damages are also not included in the scope of guarantee services. The shipping company must be notified of these without delay.

Plasmatreat GmbH supplies its products according to the currently valid General Terms of Delivery for Products. Please familiarise yourself with these delivery terms as well as with our Additional, Service and Assembly Conditions, which also represent a component of the Sales Agreement.

The plasma pre-treatment system and the plasma pre-treatment components may only be used for its intended purpose or appropriate use. The manufacturer is not responsible for any personal and property damages arising as a result of inappropriate use; instead, these are the responsibility of the owner/operator. One must always watch that no personal and property damages occur during usage of the system.

Plasmatreat GmbH does not assume any liability for possible production errors and damages and follow-up damages arising from this, especially in the case of inappropriate use of the plasma pre-treatment system, once it has been inspected, installed and has been declared to be ready to function.

The guarantee becomes null and void in the event of non-observance of the Operating Instructions and the additional documentation and improper handling of the system.

We reserve the right to make technical changes, which will not affect the indicated performance and usability within the framework of further technical developments without prior notice.

These Operating Instructions may not be copied, photocopied, reproduced, translated or rendered legible electronically or by machine in whole or in part without prior permission from Plasmatreat. The instructions can be changed without prior announcement within the framework of further technical developments.

Copyright 2019, Plasmatreat GmbH.

4 FUNCTIONAL DESCRIPTION OF INDIVIDUAL COMPONENTS

You have purchased a device for plasma treatment from Plasmatreat GmbH. You would like to integrate it into the complete production facility. This user manual goes into detail on various usable implementable product components.

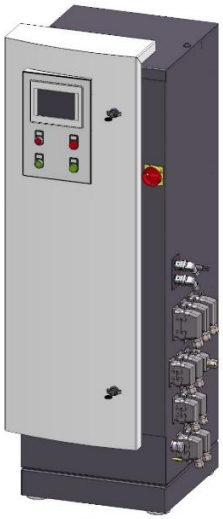
4.1 GENERATOR

The generator FG5002S/FG5005S provides the output voltage for the high voltage transformers and furthermore assumes control functions (such as limit switch monitoring, door lock, EMERGENCY STOP, compressed air and material control).

The control panel of the system is located on the generator.

The generator is available in different versions as shown below.

Design control cabinet



Rittal control cabinet



Fig. 4-1: Generator FG5002S/FG5005S

4.1.1 GENERATOR SPECIFICATIONS FG5002S/FG5005S

Generator type	FG5002S	FG5005S
Input voltage	3~/360 – 510 V/PE/50 – 60Hz	
Nominal current	8A	12A
Supply protection	32A	
Total output	2kVA	5kVA
Power control	Electronic	
Customer interface	2-channel input emergency stop device, 2-channel end circuit or safety circuit for external emergency stop, generator on / off, electronic release functions, acknowledgment faults, status messages (generator ON, plasma ready), fault or error messages when reaching set limits	
Communication interface (optional)	Profibus, Profinet, Ethercat, Ethernet/IP	
Output frequency	19 - 23 kHz	
Permissible ambient temperature	0 °C to 40 °C	
Connectable plasma jets (exemples)	max. 2 pieces: RD2005, RD1010 max. 4 pieces : PFW10, PFW20 RD1004, RD2004	max. 4 pieces : RD2005, RD1010 max. 8 pieces : PFW10, PFW20 RD1004, RD2004
Conformity designation	CE UL	
Short circuit details acc. CE	I_{cw} = 0,64 kA	
E-File number. acc. UL508	E468235	
Short circuit acc. UL 508	SCCR = 5,0 kA	

4.1.2 DESIGN CONTROL CABINET

Dimensions	Measures [mm]	weight [kg]	
		FG5002S	FG5005S
Default	B 559 x H 1602 x T 567	app.143	app.147
With wheels	B 559 x H 1602 x T 567	app.144	app.148
With transformer	B 559 x H 1750 x T 567	app.226	app.230
Color	RAL Design white / anthracite		

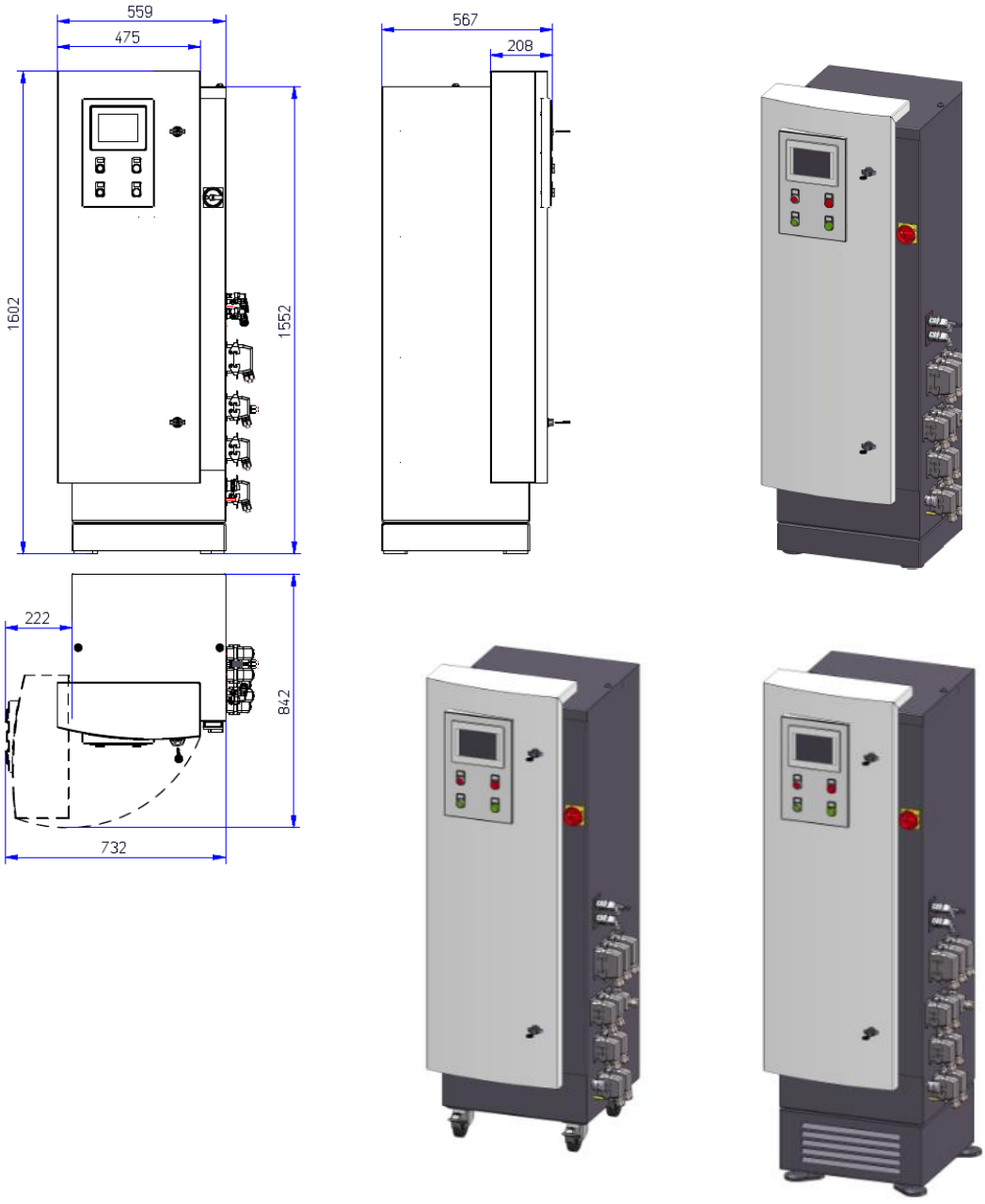


Abbildung 4-2: Design control cabinet FG5002S/FG5005S

4.1.3 RITTAL SCHALTSCHRANK

Dimensions	Measures [mm]		weight [kg]	
	FG5002(K)RS	FG5005(K)RS	FG5002(K)RS	FG5005(K)RS
Default	B 600 x H 1900X T 505	B 800 x H 1900 x T 505	app.160	app.203
With wheels	B 600 x H 1919 x T 505	B 800 x H 1919 x T 505	app.163	app.206
With transformer	B 600 x H 1919 x T 505	B 1104 x H 1919 x T 505	app.212	app.255
Color	RAL 7035			

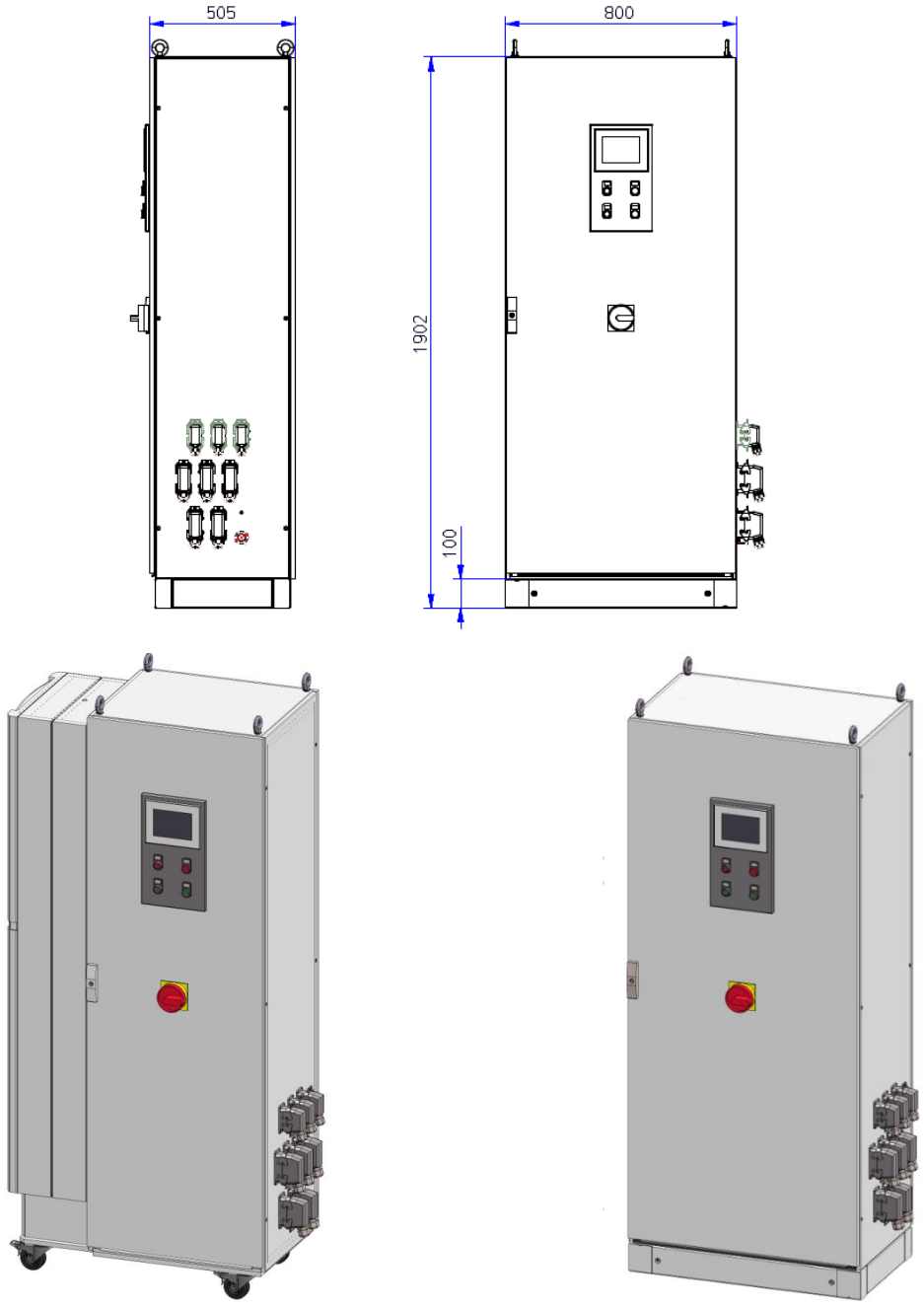


Abbildung 4-3: Rittal control cabinet FG5002(K)RS/FG5005(K)RS

4.2 HIGH-VOLTAGE TRANSFORMERS

The high-voltage transformers HTR12 or HTR22 increase the output voltage of the generator (1000 V) to a breakdown voltage of approximately 20000 V as well as a burning voltage of approximately 2000 V with 19-23 kHz during operation of the plasmajet.

Each plasmajet is fed by a separate high-voltage transformer. Up to four jets can be operated on a generator of the type FG5002S. Up to eight plasmajets can be operated on an FG5005S generator.

The high-voltage transformers are located in a metal housing, which is protected against contact and electrically shielded. The high voltage transformer can be mounted directly on the system.

4.2.1 HTR12

The high-voltage generator HTR12 is intended for the operation of a plasmjets.

The installation position is defined by the designation "OBEN -TOP". The installation position must be adhered to for proper operation, and to prevent transformer damage.

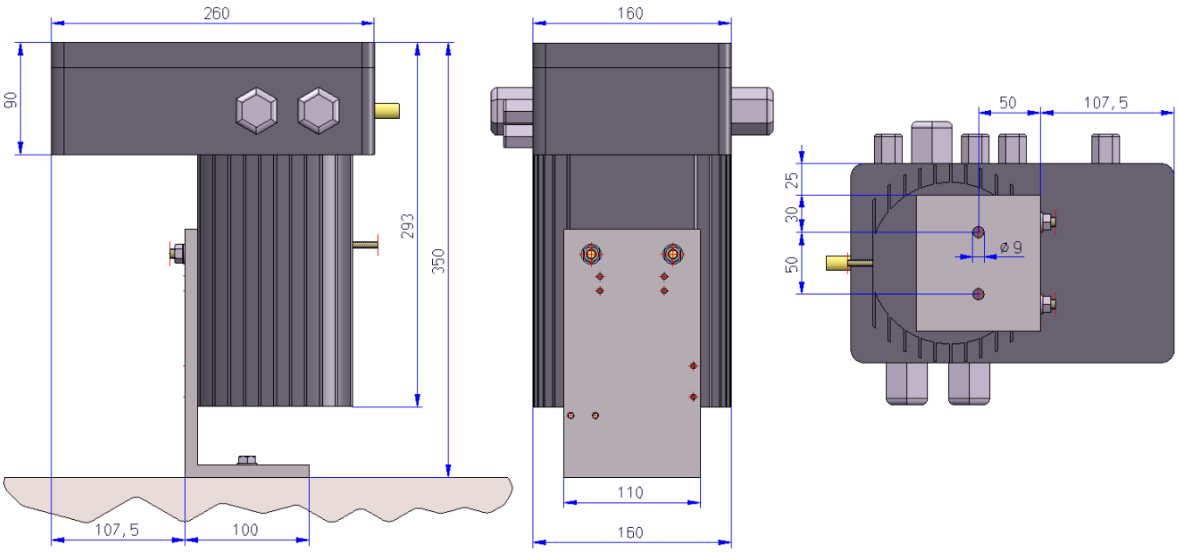


Fig. 4-4: Transformer HTR12, mounted version

4.2.2 HTR22

The high-voltage transformer HTR22 is intended for the operation of two plasmajets. In contrast to the HTR12, this product contains two transformers instead of one.
The installation position is fixed by the designation "OBEN -TOP". The installation position must be adhered to for proper operation, and to prevent transformer damage.

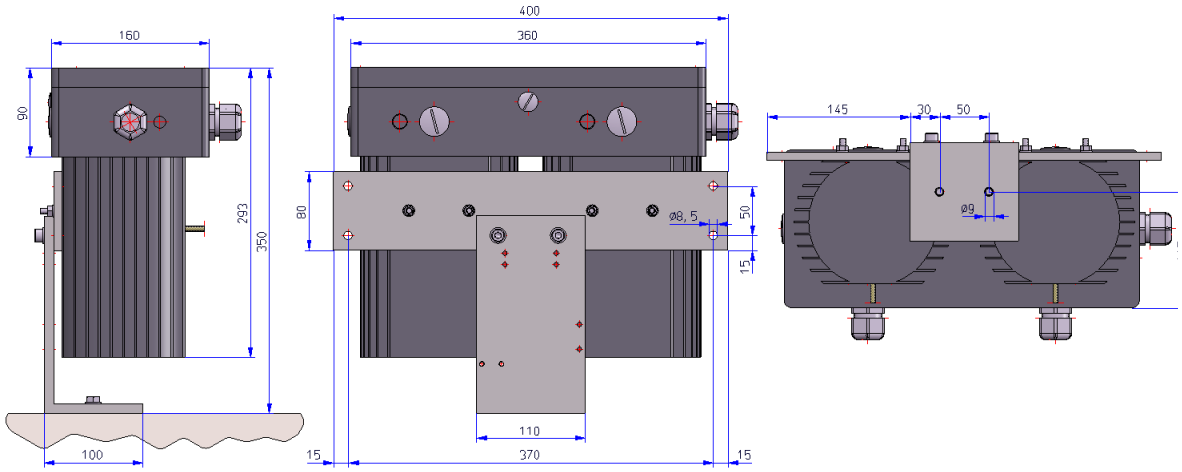


Fig. 4-5: Transformer HTR22, installation version

4.2.3 HTR12-G105

The functional characteristics of the transformers of this model range are similar to the characteristics of the transformers HTR12 and HTR22.

The high voltage transformer is encapsulated casted with this design.

Any installation position can be used with this design. This makes the transformer suitable for installation on a robot.

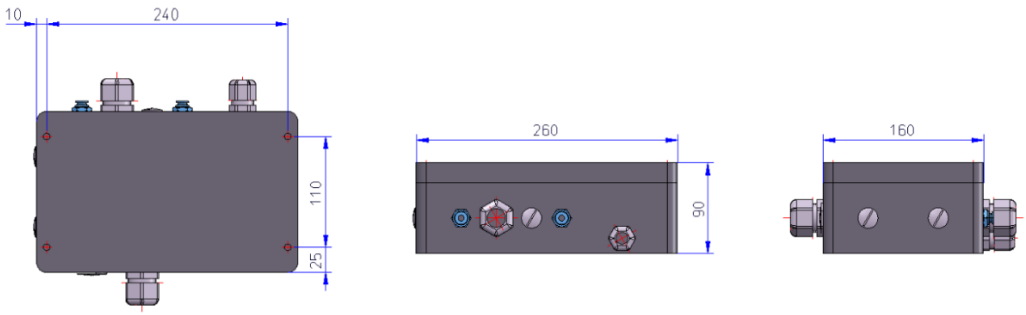


Fig. 4-6: Transformer HTR12-G105

4.3 MONITORING FUNCTIONS

4.3.1 LIGHT-CONTROL-MODULE (LCM)

The LCM is an oportional monitoring feature fort he Openair®Plasma. The LCM module evaluates the light intensity oft the plasma with the aid of an optical fiber. If the plasma goes off or does not ignite this will be detected as a malfunction.

If a malfunction is detected, a warning message is issued on the control panel and on the costomer interface. At delivery, this malfunction is set as a warning.

If an error message (generator shutdown) is gernerated instead of a warning message, this can be changed in the service menu. It is also possible to disable LCM monitoring.

All LCMs have LEDs for status indication

Green = Plasma OK or LCM is off

Red = Plasma not ok at least one jet

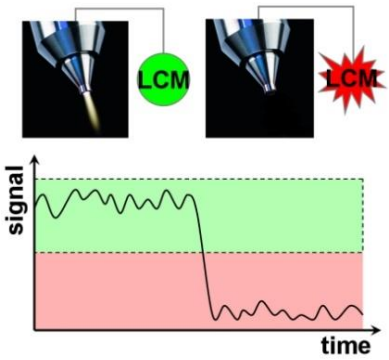


Fig. 4-7: LCM-monitoring

4.3.2 LCM1405

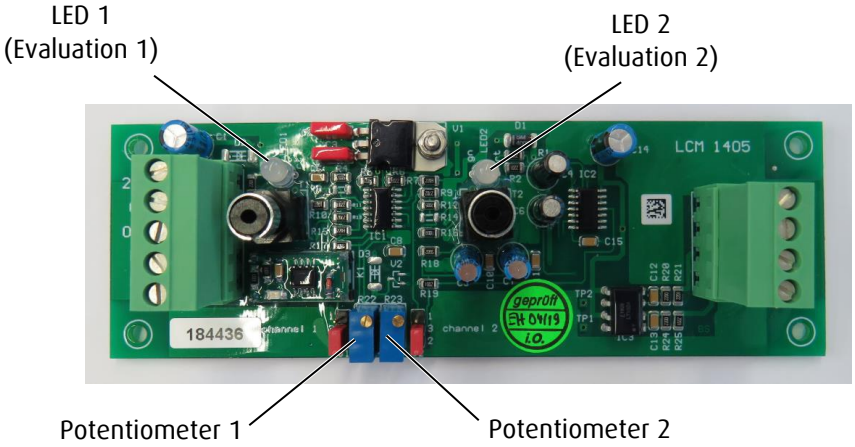


Fig. 4-8: LCM1405

The LCM1405 has two evaluation units and is mainly installed in the HTR12 and HTR22. If only one evaluation is required, as with the HTR12, the second is bridged. The HTR22 need both. The electronics evaluate permanently light from the plasma jet. The LCM1405 is not suitable for double rotation jets (RD2005, RD1008, RD1010).

Each evaluation unit has an LED, which lights up either green or red. The light intensity can be adjusted via the potentiometer.

4.3.3 LCM1606

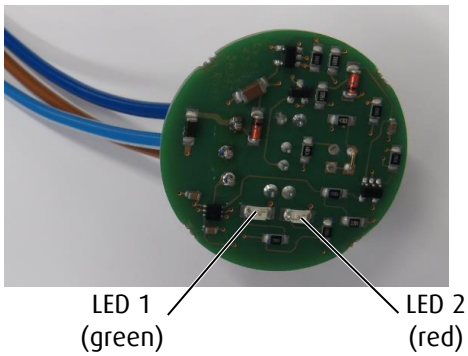


Fig. 4-9: LCM1606

The LCM1606 is installed in the HVC plug in conjunction with a PCU. It has an evaluation unit and two LEDs. The sensitivity is not adjustable. The electronics evaluate permanently light from the plasma jet and is not suitable for double rotation jets (RD2005, RD1008, RD1010).

4.3.4 LCM1705

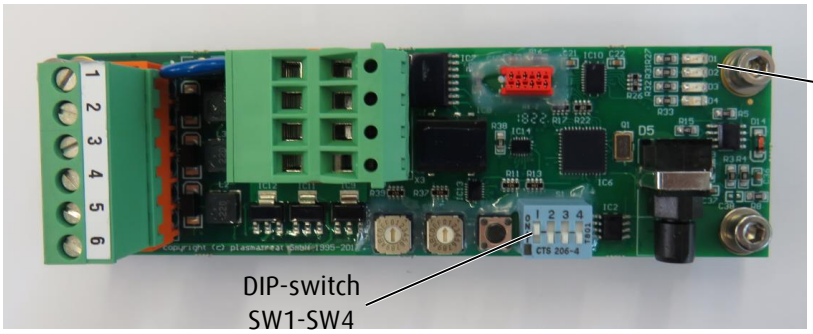


Fig.4-10: LCM1705

The LCM1705 is installed in the double rotation jets RD2005, RD1008, RD1010 and RD1013. The electronics evaluate light pulses of the plasma beam and therefore are not suitable for static signals on the optical fiber (e.g., PFW10, RD1004).
The sensitivity is not adjustable, therefore the possibility of misdetection by extraneous light has to be checked.This is in alignment of the jet in the direction of Light sources or on reflective surfaces particularly relevant.
To shield electromagnetic radiation, the module is installed in a housing.
The LCM module has 4 LEDs, the upper two indicate the status.
The jet type is selected via the DIP switches (see table).

SW1	SW2	SW3	SW4	Funzione	Segnale (Hz)	Numero di giri	Configurato per:
0	0	0	0	LCM disabled Permanent plasma OK			
1	0	0	0	Low speed	≥ 36,6 Hz	≥ 1100 rpm	RD1008..RD1013 (50Hz-Netz)
0	1	0	0		≥ 50 Hz	≥ 1500 rpm	RD1008..RD1013 (60Hz-Netz)
1	1	0	0		≥ 66,7 Hz	≥ 2000 rpm	RD2005

4.3.5 ROTATION-CONTROL-MODUL (RCM)

The RCM is an optional speed monitor for rotating plasmjets. A sensor (inductive proximity sensor) monitors the speed of the plasmajets.

If the speed is outside the limits set in the control panel, a fault is gernated.

If the setpoint speed is changed, the speed limit must be adjusted.

The distance of the sensor to the jet is 2mm.
If a PCU used the RCM signal is evaluated there.
When using an HTR12 / 22, the pulsed signal is forwarded to the controller, which evaluates it.

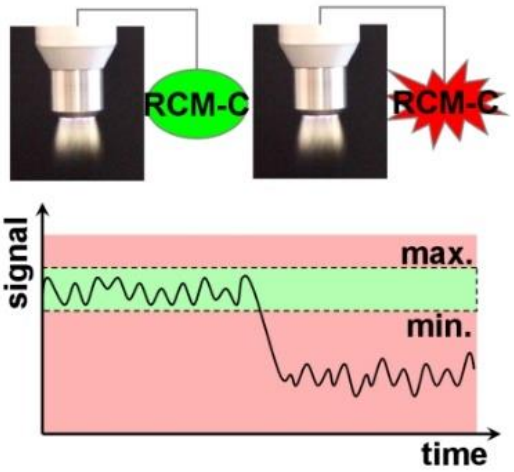


Fig. 4-11: RCM control

For more than two rotary jets the rotation signal is evaluated via a frequeny / voltage converter. This must be set accordingly in the configuration menu.

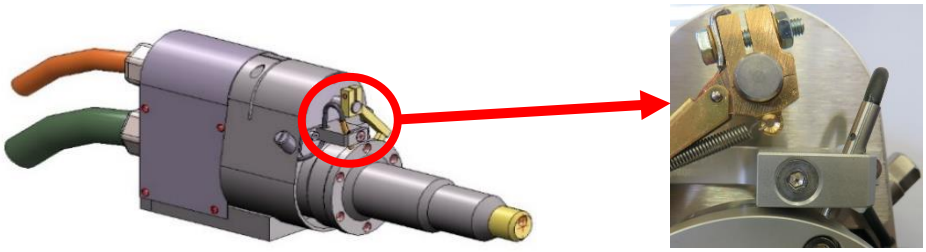


Fig. 4-12: Sensor on the RD1004

In the RD2005 there ist he same sensor, as in the RD1004. In the double rotation jets RD1008, RD1010 and RD1013 is a larger sensor installed.

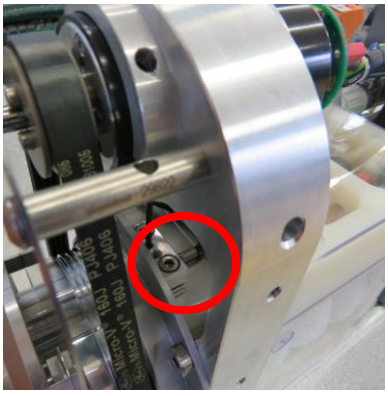


Fig. 4-13: Sensor on the RD2005

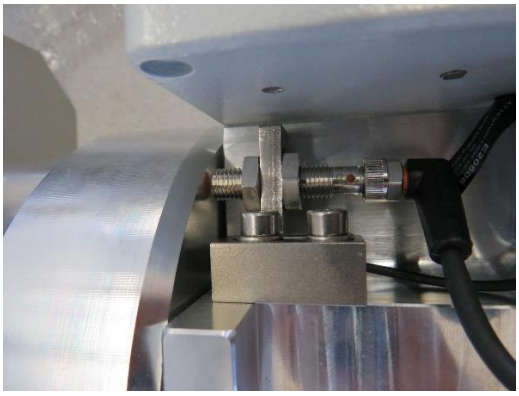


Fig. 4-14: Sensor on the RD1008, RD1010, RD1013

4.3.6 PRESSURE CONTROL MODUL (PCM)

The PCM monitoring is a measurement oft the backpressure in the plasmajet.

If the back pressure is outside the set limits, a homogeneous plasma is no longer guaranteed.

When using a PCU, the dynamic pressure within the PCU is measured, shown in the display and transmitted via the CAN BUS to the display of the generator.
When using the HTR12 or HTR22, the back pressure is measured with a pressure sensor in the generator. The pressure is shown on the display.



Fig. 4-15: pressure sensor in the generator

Decreasing back pressure is a reliable indicator of the wear of a nozzle.

4.4 AIR SUPPLY

INFORMATION!



Danger of overheating!

- The compressed air supply must alwasy be available during operation.

The RF electric arc resulting in the plasma jet is focused using compressed air in the jet outlet opening and carried outside. The compressed air supply of the plasmas jet(s) is provided by the operator.

INFORMATION!



- Suitable constructions measures may be needed to ensure the compressed air is free of particles, oil and water.
- The compressed air quality has to be in accordance with DIN ISO 8573-1: 2010
  - Minimum: DIN ISO 8573-1: 2010 class 2.4.2
  - Recommended: DIN ISO 8573-1: 2010 class 1.4.1
- Required inlet pressure to DVE20 or DAE10 is 6-10 bar.

4.4.1 COMPRESSED AIR SUPPLY UNIT DVE20

In front of the proportional pressure control valve, a pressure of min. 6 to max. 10 bar is provided.

A valve switches the compressed air to the proportional digital pressure control valve. During operation, the digital pressure control valve automatically adjusts the pre-pressure value specified by the generator. The regulated compressed air is fed to the plasmajets.

The given air pressure also has an effect on the plasma jet, i.e. on the treatment result:

- air pressure is too low: plasma discharge remains in the jet and leads to the inner parts overheating
- air pressure is too high: plasma discharge is blown out – no – or little effect

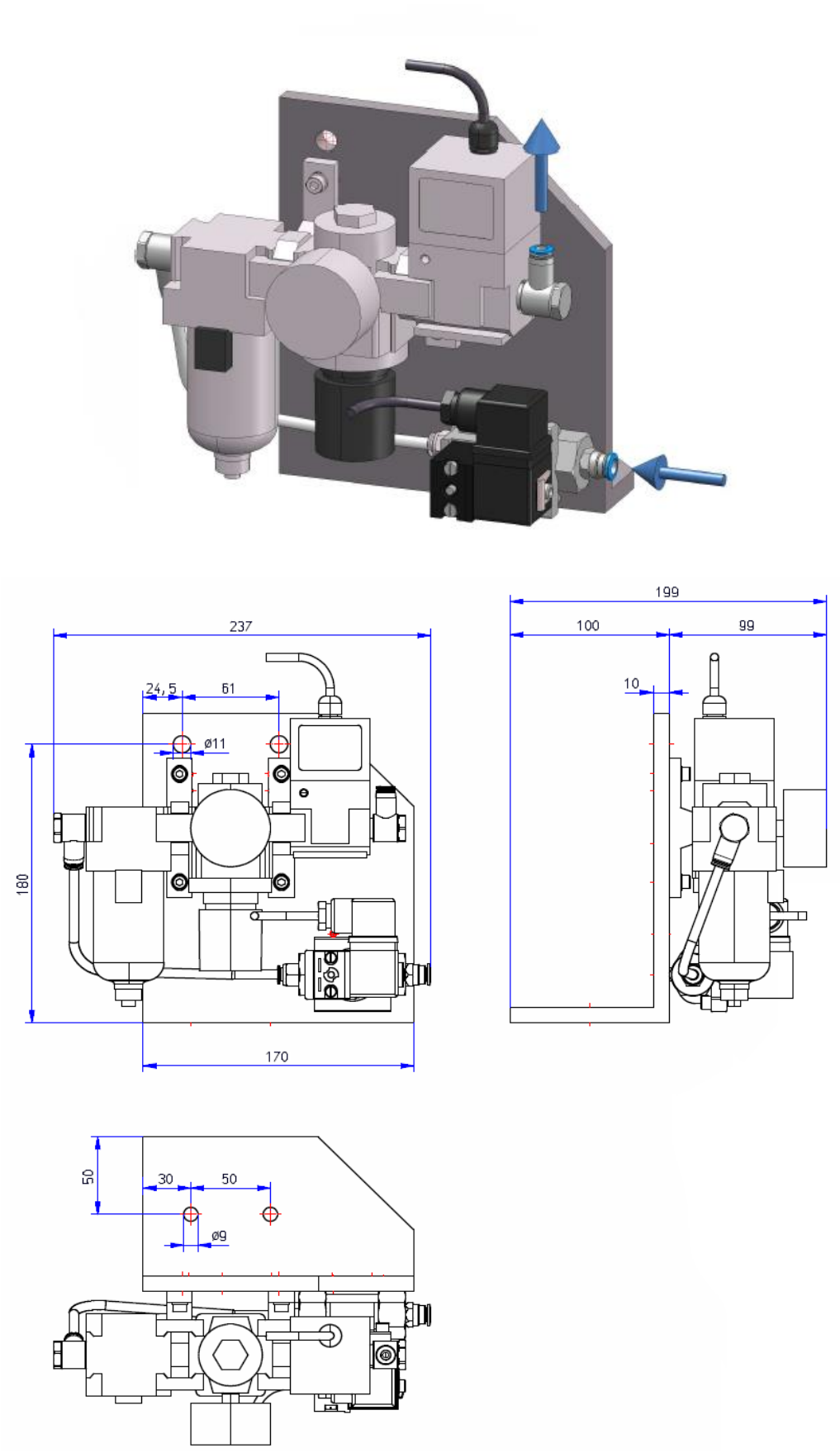


Fig. 4-16: Compressed air supply unit DVE20

4.4.2 COMPRESSED AIR PREPARATION UNIT DAE10 (SMC) (OPTION)

The compressed air preparation unit DAE10 can optionally be installed in front of the compressed air supply unit DVE20, if the compressed air quality recommended by Plasmatreat GmbH in accordance with ISO 8573.1 cannot be ensured by the operational compressed air supply.

Minimum requirement of compressed air quality:	ISO class 2.4.2
Plasmatreat recommendation for compressed air quality: (can be achieved through the use of the filtration unit DAE10)	ISO class 1.4.1

The quality of the compressed air for the operation of the plasma is important for both the service life of the plasma generator and for the treatment effect. Oil or water in the compressed air make parasitic coatings possible, which can lead to varying results.

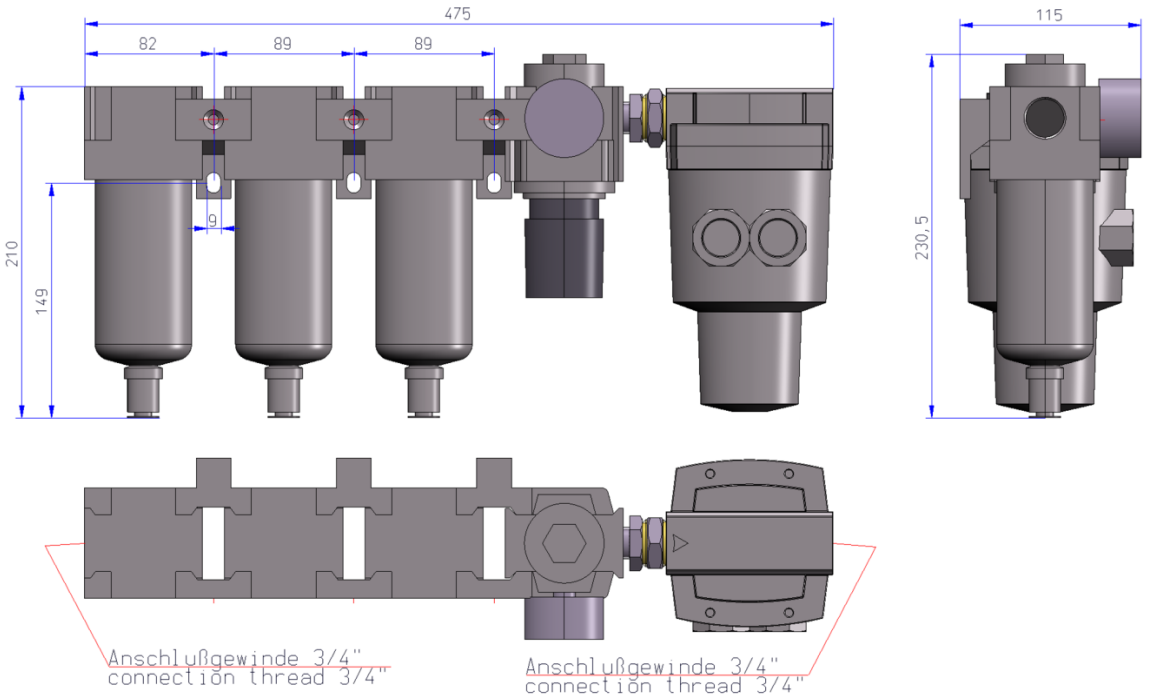


Fig 4-17: Compressed air preparation unit DAE10

The DIN ISO 8573-1: 2010 standard is a group of international standards describing the quality and purity of compressed air.

The standard has been mandatory for automation with pneumatics since 2010. The classification of the air is done by establishing a certain maximum content of pollutants that may be present in the air. Pollutants substances are particles, water and oil. Each class has a defined maximum value for these three substances.

The classes range from 0 to 9 - added to the class X. The required purity decreases with increasing class number. Class 0 can be set by the device user himself, but must be stricter than Class 1.

Compressed air quality classes according to DIN ISO 8573					
class	Particles (dirt)		Water (condensate)		Oil
	Particle size in µm max.	Particle density in mg/m^3 max.	Pressure dew point in °C	Water content in g/m^3	Residual oil in mg/m^3
0	<0.1	<0.1	< -70°C	<0.003	<0.01
1	0.1	0.1	-70°C	0.003	0.01
2	1	1	-40°C	0.11	0.1
3	5	5	-20°C	0.88	1
4	15	8	+3°C	6	5
5	40	10	+7°C	7.8	25
6	>40	>10	+10°C	9.4	>25
7	-	-	>10°C	>9.4	-

Indication of classification

The classification of the compressed air is carried out according to the standard DIN ISO 8573-1: 2010 by the naming of the respective classes. It should be noted that for solid particles, water and oil each one class is specified separately. The format looks like this:

DIN ISO 8573-1:2010 [A:B:C]

A – Cleanliness class of particles
B – Cleanliness class for moisture content and water
C – Cleanliness class for total oil

Systems that are equipped with DAE10 achieve:

DIN ISO 8573-1:2010 [1:4:1]

Which means:

- Particles = Class 1
- Water = Class 4
- Oil = Class 1

Spare parts for DAE10:

Order no.	meaning
14232	Compressed air preparation unit DAE10
15846	DAE10 SMC Filter cartridge pre filter
15847	DAE10 SMC Filter cartridge fine filter
15848	DAE10 SMC Filter cartridge ultra filter
15849	DAE10 SMC Filter cartridge Activated carbon filter
32385	PTF 8143-1 Mounting plate DAE10
37936	PTF10836-1 Angle DAE10

4.5 PCU PLASMA CONTROL UNIT

The PCU (Plasma Control Unit) contains, in addition to a high-voltage transformer, components for the control, regulation and monitoring of a plasma jet. The connection is established to a generator so that one plasma jet can be operated by one PCU.

The PCU1604 (PCU-M) has a high voltage transformer and depending on the desired number of plasma jets (no double rotation jets), several function modules can be connected in series.

The PCU1710 (PCU-DM) has two high-voltage transformers and is only suitable for double rotation jets. The dual PCU can not be switched in series.

With the display unit of the PCU can used to be read values and operate the PCU.

The PCU has the following functions.

- Provision of plasma voltage by high voltage transformer
- Provision of DC voltage for rotary motor (for rotational jets)
- Speed control of the rotary motor
- Overcurrent shutdown DC current of the rotary motor
- Rotation speed monitoring of the rotary motor (RCM)
- Control and monitoring of process gas flow (FCM)
- Monitoring plasma (LCM)
- Measurement of power (PPM)
- Measurement of back pressure (PCM)
- CAN bus function:
    - Selection / deselection of the plasmajet (only with CAN-Bus ON)
    - Adjustment of the plasma frequency (only with CAN-Bus ON)
    - Adjustment of the plasma voltage (only with CAN-Bus ON)

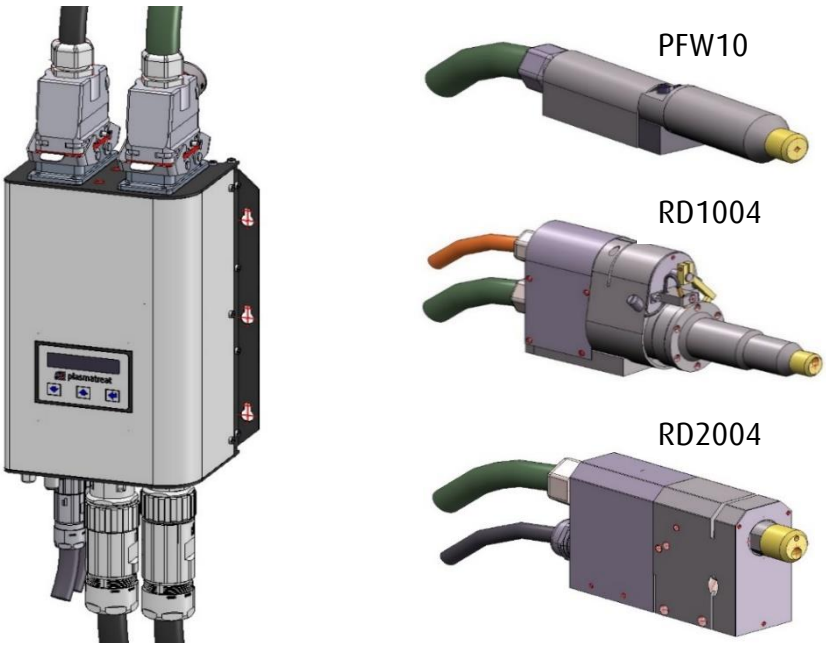


Fig 4-18: single PCU with jet examples

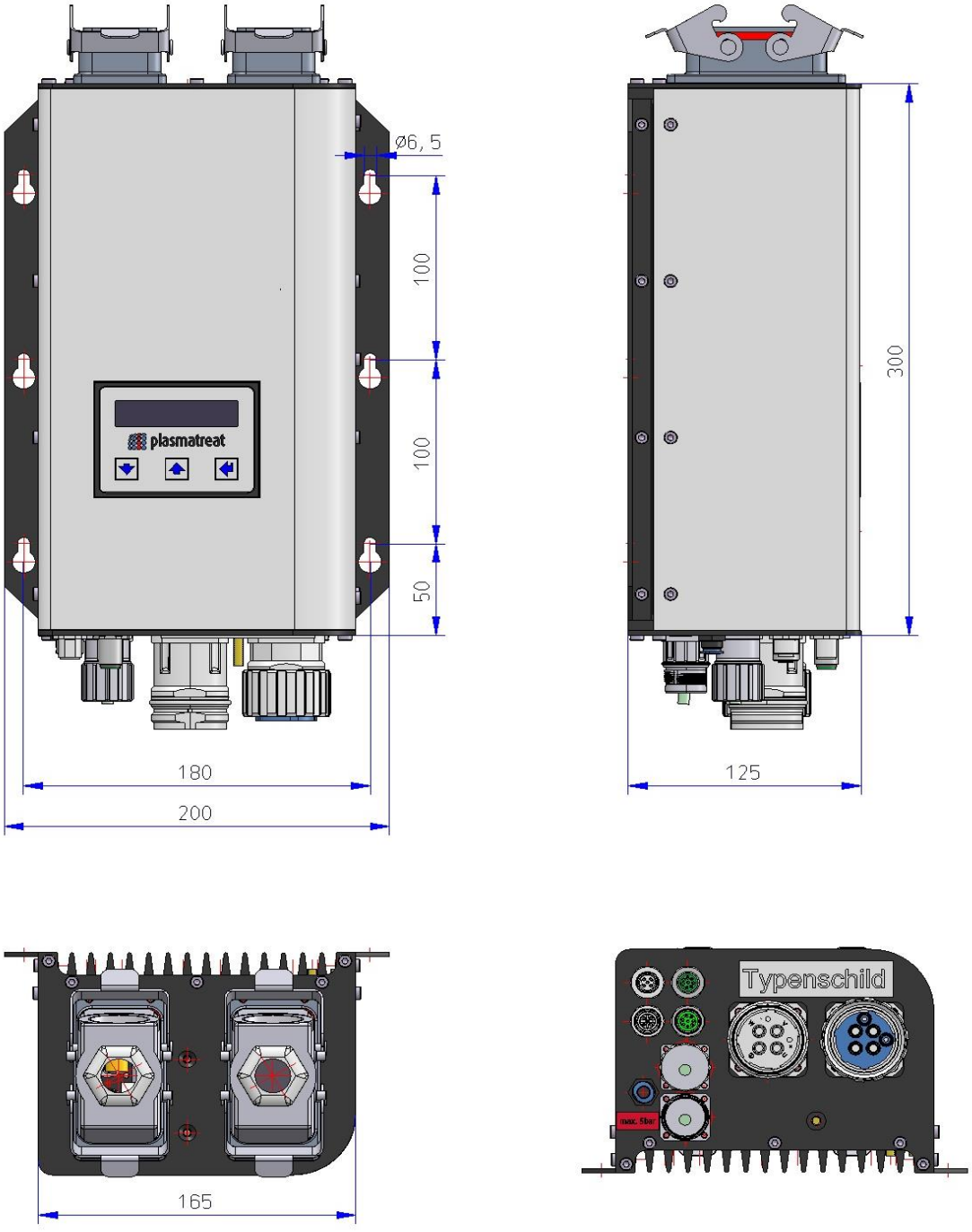


Fig 4-19: PCU - Plasma Control Unit

4.5.1 Connections PCU1604

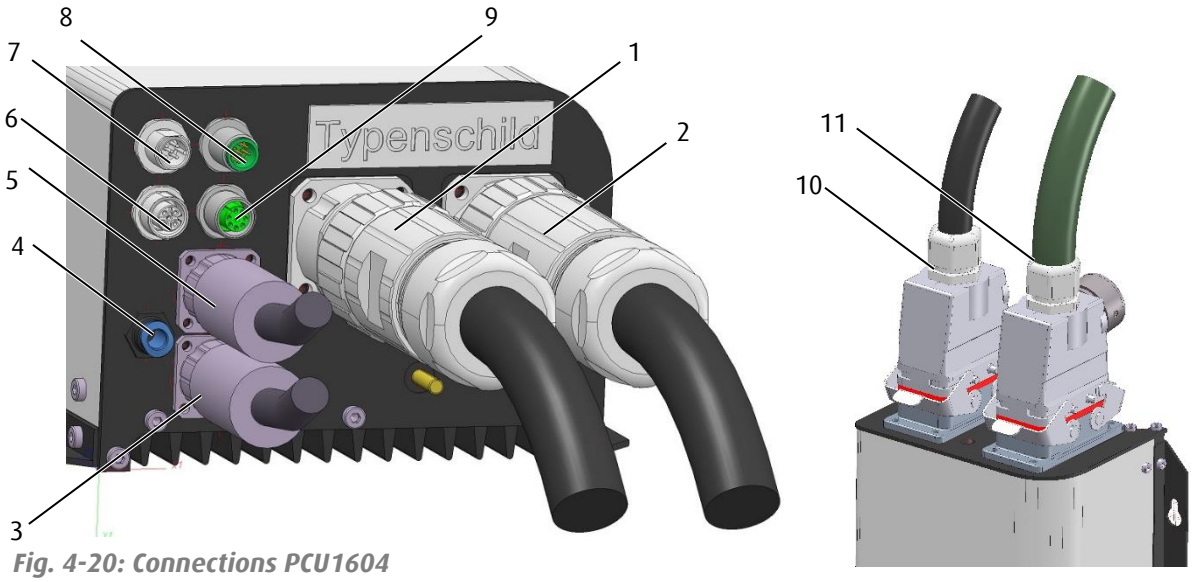


Fig. 4-20: Connections PCU1604

Pos.	Plug	Connection
1	X91	Input primary voltage from the generator to the transformer
2	X93	Output primary voltage to the next PCU (otherwise dummy plug)
3	X103	supply for next PCU (otherwise blind plug)
4	AIR	Input process gas (compressed air)
5	X101	Rotary motor supply from the generator
6	CAN_OUT	CAN bus output to the next PCU (otherwise dummy plug)
7	CAN_IN	CAN bus input from the generator
8	X31	Input control from the generator
9	X33	Output control to the next PCU (otherwise blind plug)
10	X102	Output supply and monitoring rotary motor
11	X92	Output supply plasma jet

The double PCU (PCU-D) has two high voltage transformers and is only suitable for double rotationjets.

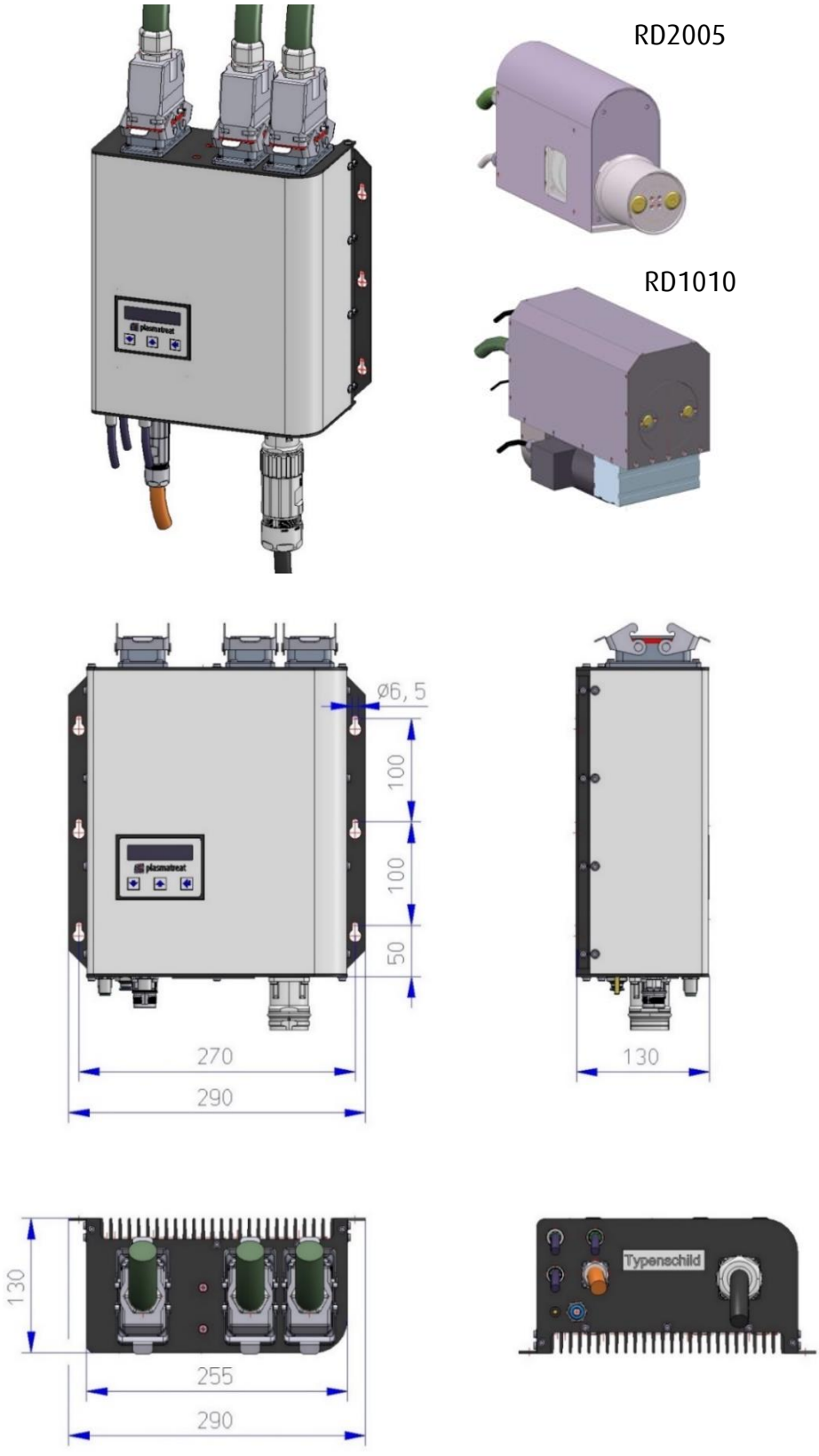


Fig. 4-21: PCU-D with jet examples

4.5.2 CONNECTIONS PCU1710

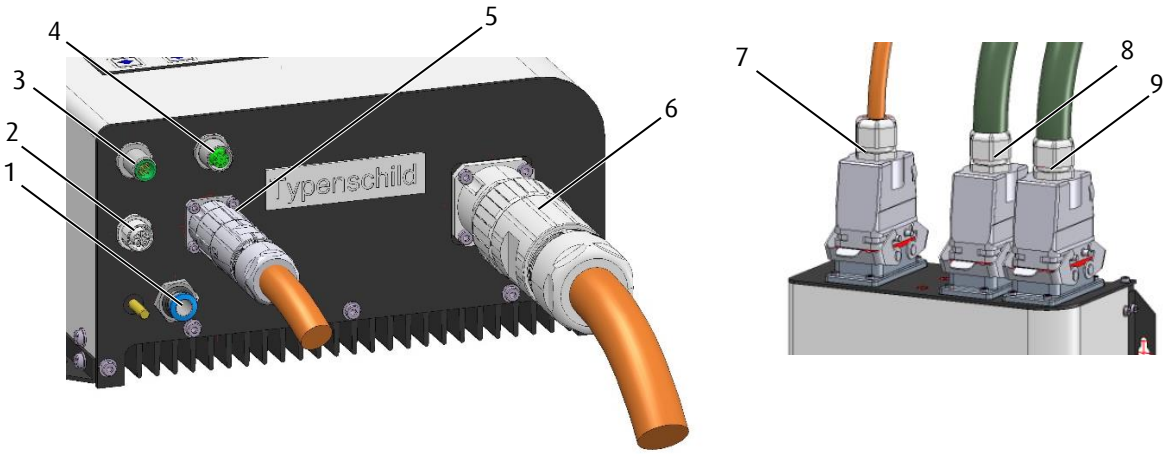


Fig. 4-22: Connections PCU1710

Pos.	Plug	Connection
1	AIR	Input process gas (compressed air)
2	CAN_OUT	CAN bus output to the next PCU (otherwise dummy plug)
3	CAN_IN	CAN bus input from the generator
4	X31	Input control from the generator
5	X101	Supply from the generator
6	X91	Input primary voltage from the generator to the transformer
7	X102	Output supply and monitoring rotary motor
8	X92	Output supply plasma jet (EMC 1)
9	X93	Output supply plasma jet (EMC 2)

4.5.3 HIGH-VOLTAGE TRANSFORMERS OF THE PCU

There are three different high-voltage transformers available. These transformers each cover another performance range for various applications.

The name of the PCU indicates which transformer is installed.

- PCU-L: Low with a performance range of 200 to 400W
- PCU-M: Mid with a performance range of 400 to 600W
- PCU-H: High with a performance range of 600 to 800W

The performance range for the transformer has to be fixed by the trials of application technology.

4.5.4 MONITORING FUNCTIONS OF THE PCU

In addition to the LCM-, RCM- und PCM-monitoring (chapter 4.3), the PCU offers two additional monitoring functions.

4.5.4.1 FLOW CONTROL MODUL (FCM)

With the flow control, the volume flow of the ionization gas can be controlled in the PCU. The volume flow of the ionization gas is an additional performance parameter for the system. This replaces the pressure control.

4.5.4.2 PLASMA POWER MODUL (PPM)

The PPM records the electrical power at the plasmajet. Plasma power is a comparable parameter for the use of multiple plasma pre-treatment systems. Plasma power helps to ensure that the same form of treatment is maintained at different facilities.

4.6 PLASMAJET

The plasma jet directed at the material serves to generate and distribute the plasma. The plasma is generated inside the plasma jet with high voltage between the stator and the rotor and blown out through the jet head using the working gas that is fed in. The plasma strikes the surface to be treated. There is a fine cleaning / activation.

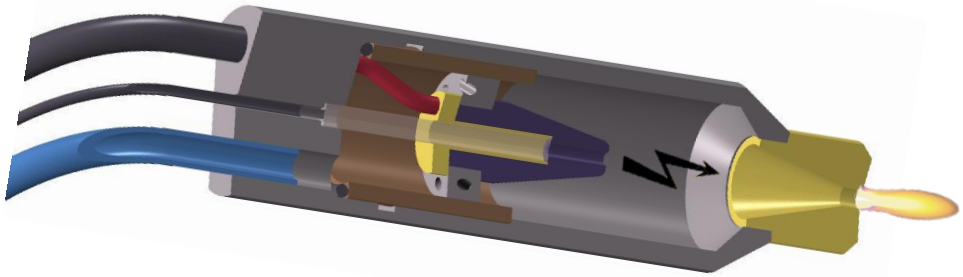
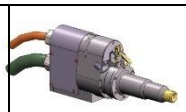
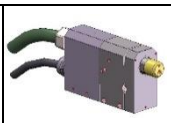
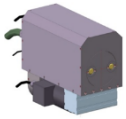


Fig. 4-23: Plasmajet

The table compared the different properties of the plasmajets.

					
Typ	PFW10	RD1004	RD2004	RD2005	RD1010
Category	Static	Rotation	Rotation	Double Rotation	Double Rotation
Relative speed [V] in m/min to the material	Up to 900	app.22	app.22	app.35	app.30
Treatment width [S] in mm	4-20	Up to 50	Up to 40	50	100
Ionization gas air [Q] in m^3/h	2,0	2,5	2,5	4,5	4,5
Weight [M] without connecting cable in kg	1,0	4,2	1,8	4,9	27
Standard speed [RPM] in rpm/min	---	2800	2800	2500	1450
90° option	✓	✓	✓	✘	✘

Static nozzles are suitable for narrow pretreatment widths and high relative speeds to the material to be treated.

In single-rotation jets, a nozzle opening arranged eccentrically to the center is set in rotation. This results in an increase in the plasma exit angle.

In dual-rotation jets, two static nozzles with a fixed pitch are set in rotation.

The nozzles are therefore rotatably mounted relative to the holder and are driven by a DC motor or three-phase motor or slip rings with a toothed belt. The electrical contact takes place via carbon brushes.

Depending on the speed, the material to be treated, and the distance of the nozzle to the component surface, a different activation of the surface of the component is achieved.

The installation of the plasma jet(s) must be carried out as described in chapter 5 "Preparation and implementation of commissioning".

INFORMATION!

- • The operator is responsible to arrange and attach the plasma jets.
- • Handle jets with care, they contain fragile ceramic and glass components.
- • Information on this can be obtained from Plasmatreat GmbH.

The nozzle head is available in different design variants with different plasma exit angles.

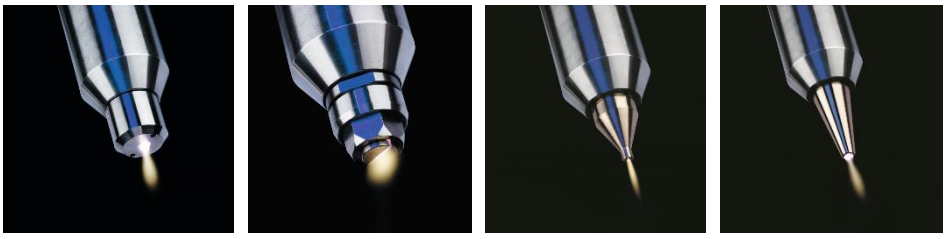


Fig. 4-24: different nozzles on PFW10



Fig. 4-25: different nozzles on RD1004

4.6.1 HVC-PLUG (HIGH-VOLTAGE CONTACTOR)

DANGER!

Danger of electric shock! / Risk of burns!

- Operation oft he plaswma jet only with plugged HVC plg!
- Do not disconnect the plug during operation!

Plasma jets thats connected to a PCU have always an HVC connector. Optionally the HTR12/22 can also be connectable via HVC.

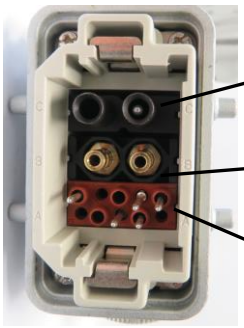


Fig. 4-26:HVC-Plug

The HVC connector has a high voltage contact, two air connections and max. 10 further connections for signal transmission.

In the HVC connector ist he LCM1606.

The HVC connector is available in a straight type (0 °), which is the standard or angled version (90 °). Each HVC connector has the label with the warning "DO NOT DISCONNECT WHILE ENERGIZED".

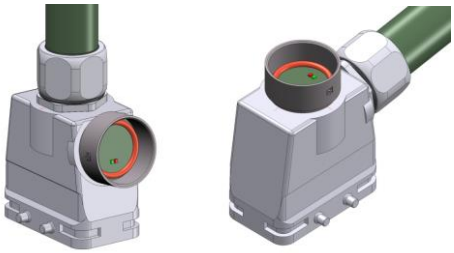


Fig. 4-27: HVC straight and angled



Fig.4-28: HVC-Connector

If the system is equipped with a plug-in HTR12 / HTR22 and a rotary jet with the X100 plug (RD1004), it will also be disconnected from the transformer and attached to an extra bracket.

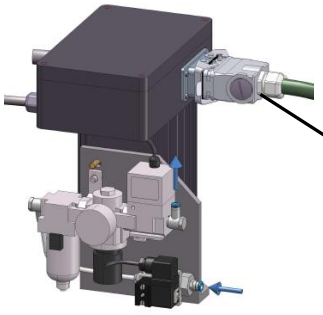


Fig. 4-29: HTR12 streckbar mit HVC

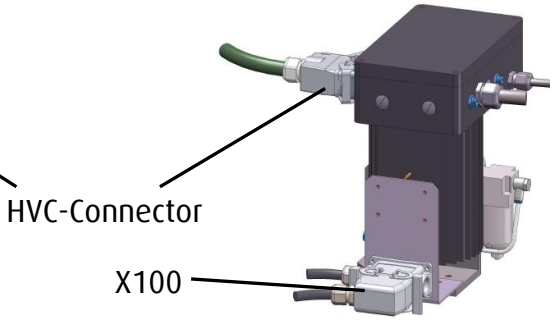


Fig. 4-30: HTR12 steckbar für Rotationsdüse

4.6.2 MOUNTING PLATE FOR PLASMAJETS

Optionally, with the system for plasma treatment, the following mounting plate for attaching the plasmajets is available. The mounting plate fits the PFW10, RD1004 and RD2004.

It is attached according to the number of jets on the delivered unit.

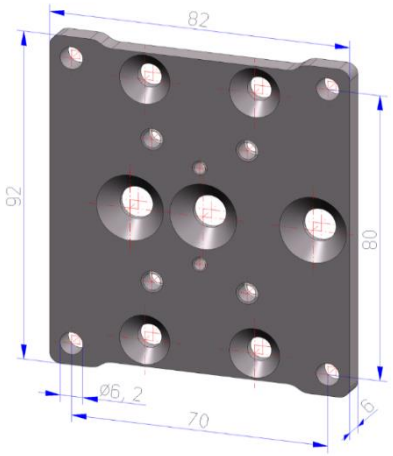


Fig. 4-31: Mounting plate for Plasmajets

4.6.3 WARNINGS FOR PLASMAJETS

DANGER!

Danger of electric shock! / Risk of burns!

- Jets carries high voltage!

WARNING!

Danger of burns!

- Plasmajets are very hot during and after operation!
- Let the jet cool down before it is touched!

Additional Warning for rotary jets (RD1004/RD2004/RD2005/RD1010)

WARNING!

Rotating components, danger on injury!

- Never touch the jet during operation!

4.6.4 PFW10/PFW10R

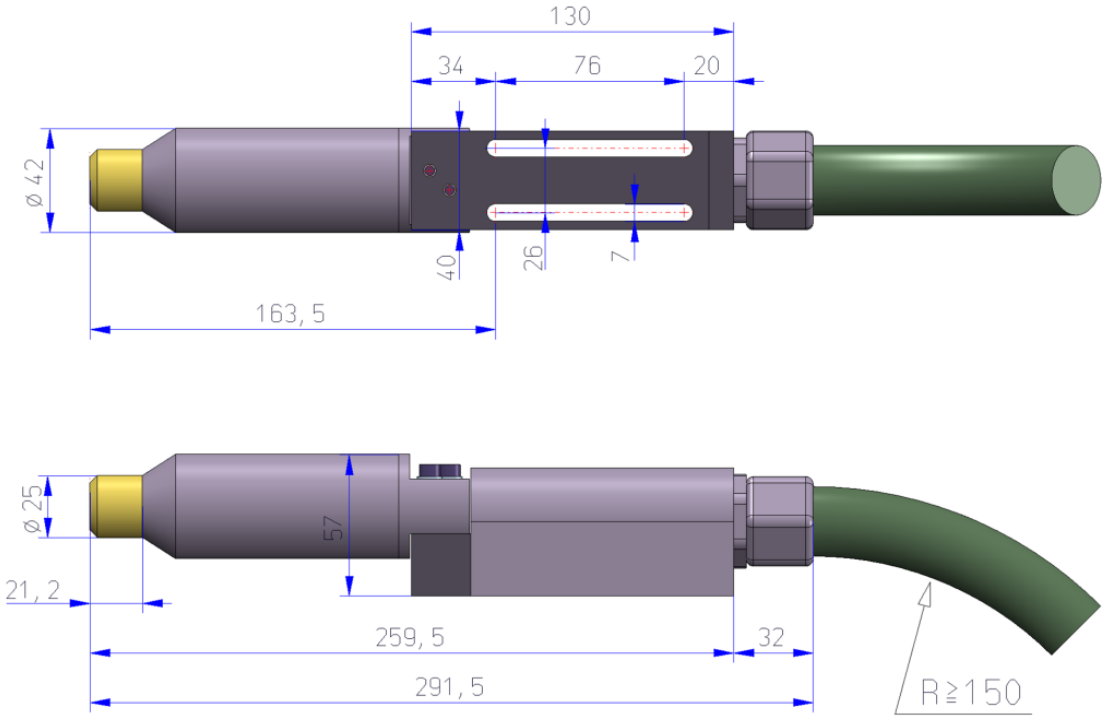


Fig. 4-32: PFW10 with straight supply line

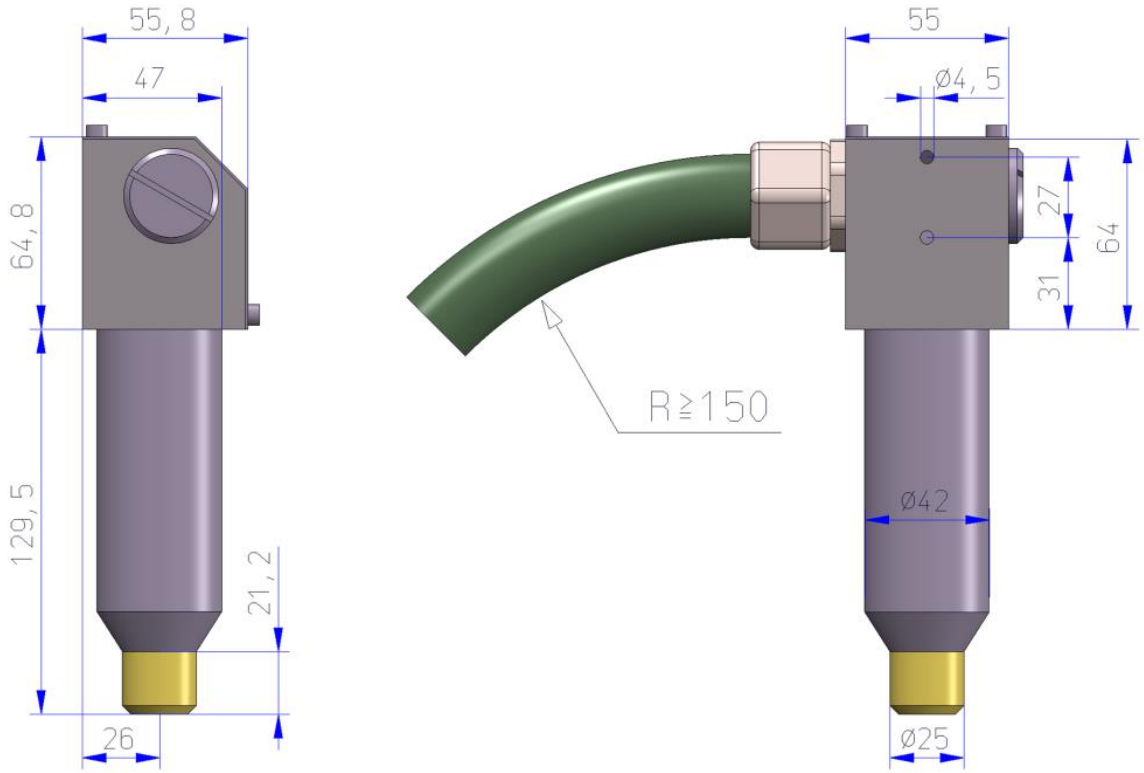


Fig. 4-33: PFW10R with supply line at an angle

4.6.5 RD1004 / RD1004R

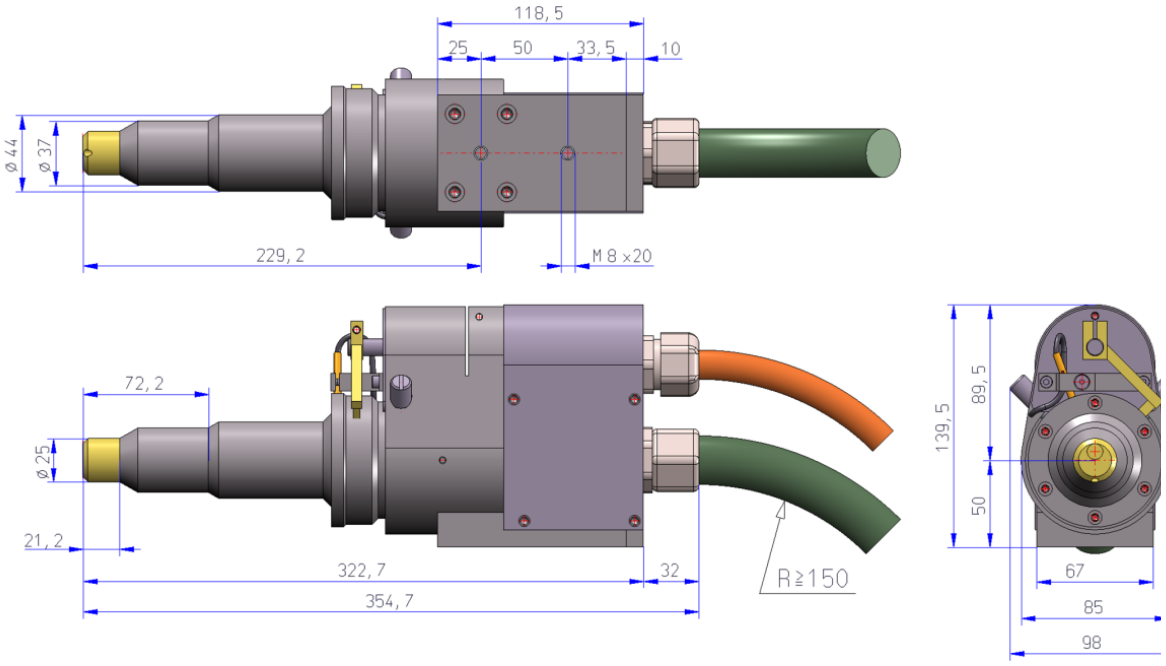


Fig. 4-34: RD1004 with straight supply lines

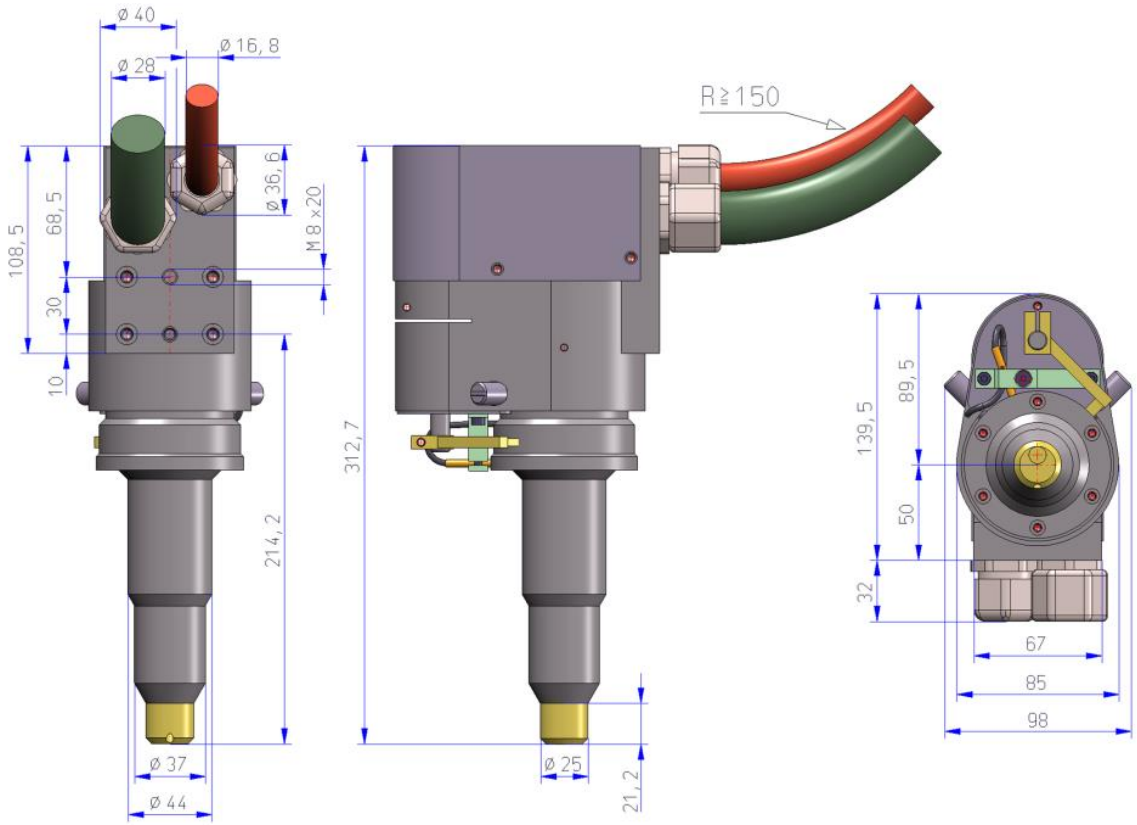


Fig. 4-35: RD1004R with 90° angle supply lines

4.6.6 RD2004 / RD2004R

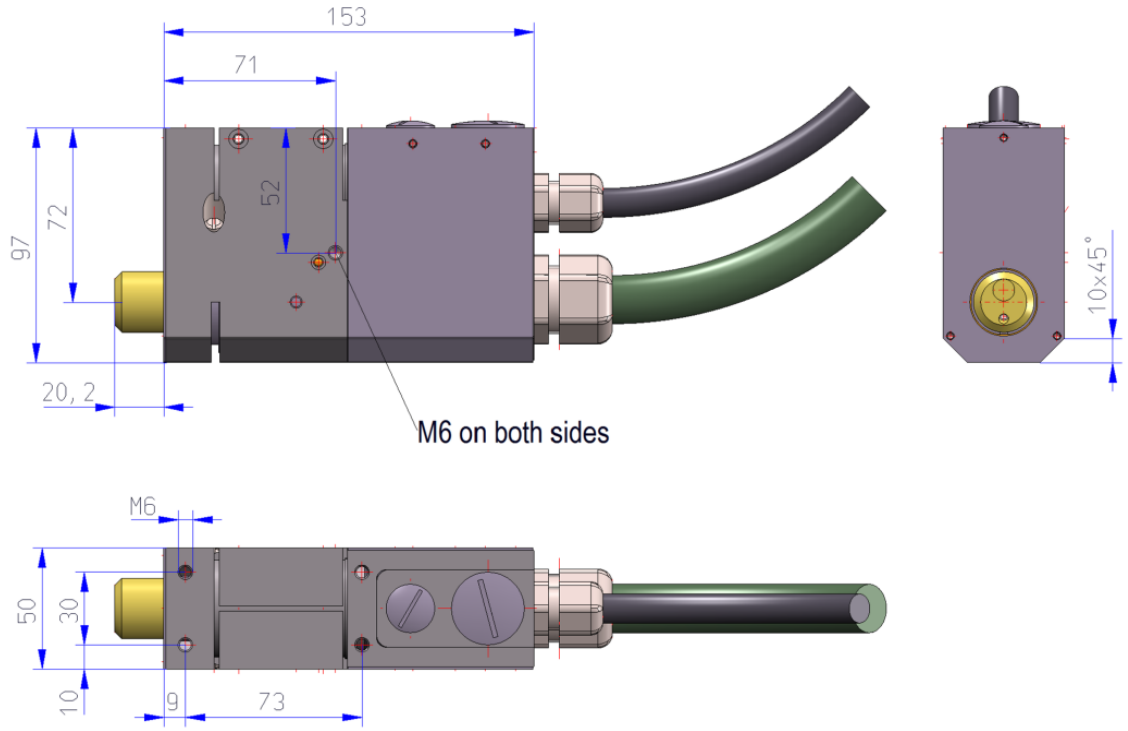


Fig. 4-36: RD2004 with straight supply lines

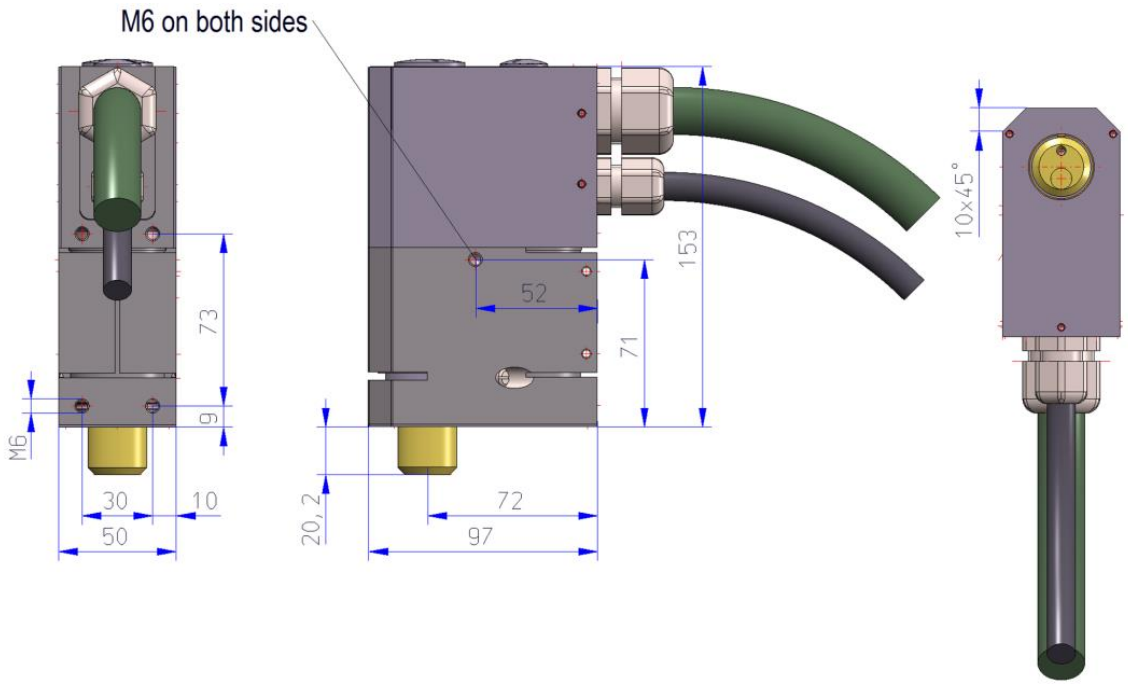


Fig. 4-37: RD2004R with 90°angle supply lines

4.6.7 RD2005

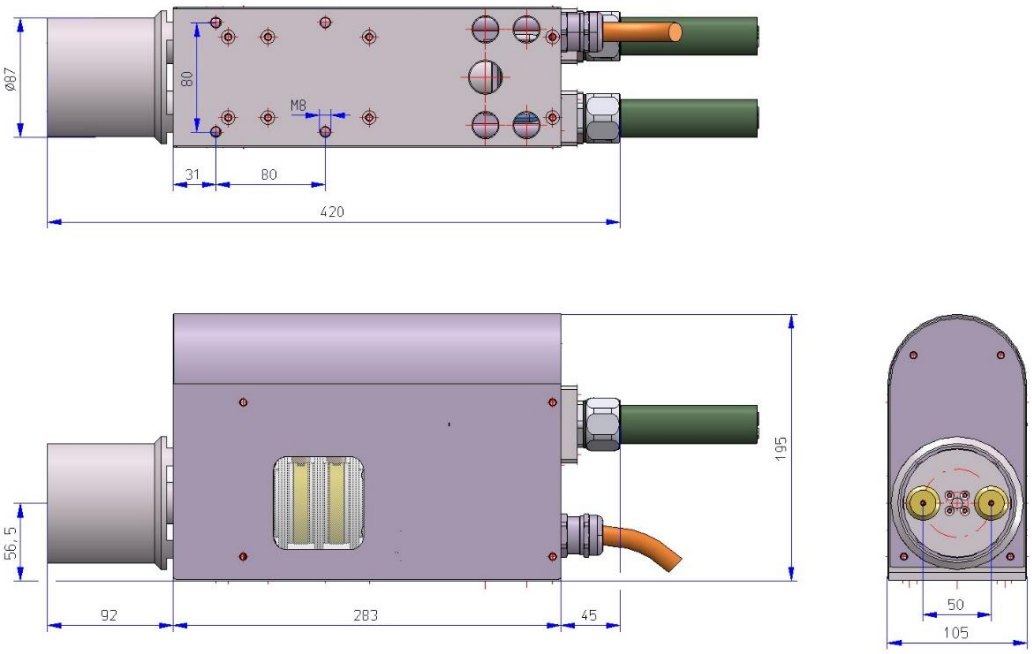


Fig. 4-38: RD2005

4.6.8 RD1010

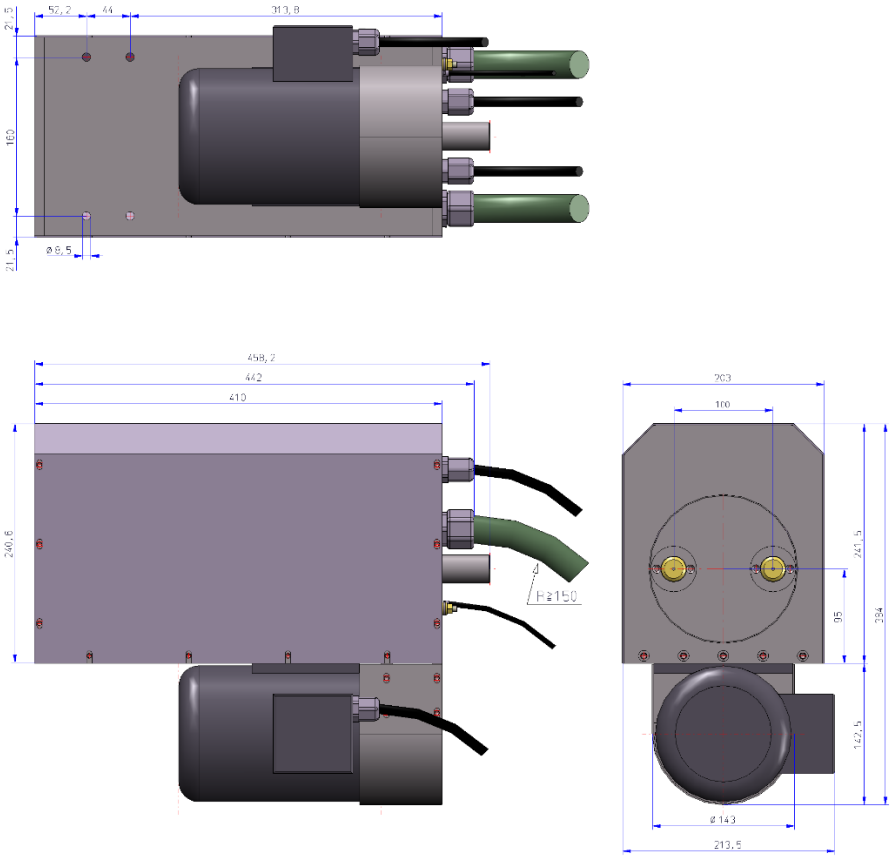


Fig. 4-39: RD1010

5 PREPARATION AND REALISATION OF COMMISSIONING

The components for plasma treatment shall be integrated in a treatment station with the respective safety regulations. In particular in the area of the plasma jets there is an increased risk of accident and injury (see Chapter 7.1), which is to be ruled out by taking the appropriate constructional measures.

If the facility is realised in compliance with CE conformity, fulfil the following requirements at the time of deployment:

- Compliance with all directives and standards listed in the declaration of incorporation (see Chapter 11.2)
- Compliance with all local laws, standards and regulations

If the facility is realised in compliance with UL Standards, the facility shall comply with the following provisions and standards at the time of deployment:

- UL / CSA regulations for machines
- Low Voltage Directive
- Electromagnetic compatibility
- Facility safety
- Safety provisions for pneumatic systems
- Local laws, standards and regulations

5.1 TRANSPORT

The delivery of the device for plasma treatment is carried out in a transport box/palette. The supplied transport box is to be used for any transportation of the device. For transportation purposes over short distances, a lift truck or forklift can be used.

INFORMATION!

- Only suitable and inspected handling equipment and lifting gear are to be used for transportation.
- The transport shall be carried out by qualified personnel only.

5.2 CONNECTORS ON THE GENERATOR

All connections at the generator are pluggable, and thanks to the rectangular connectors are designed in such a manner that the connections can be neither twisted nor interchanged.

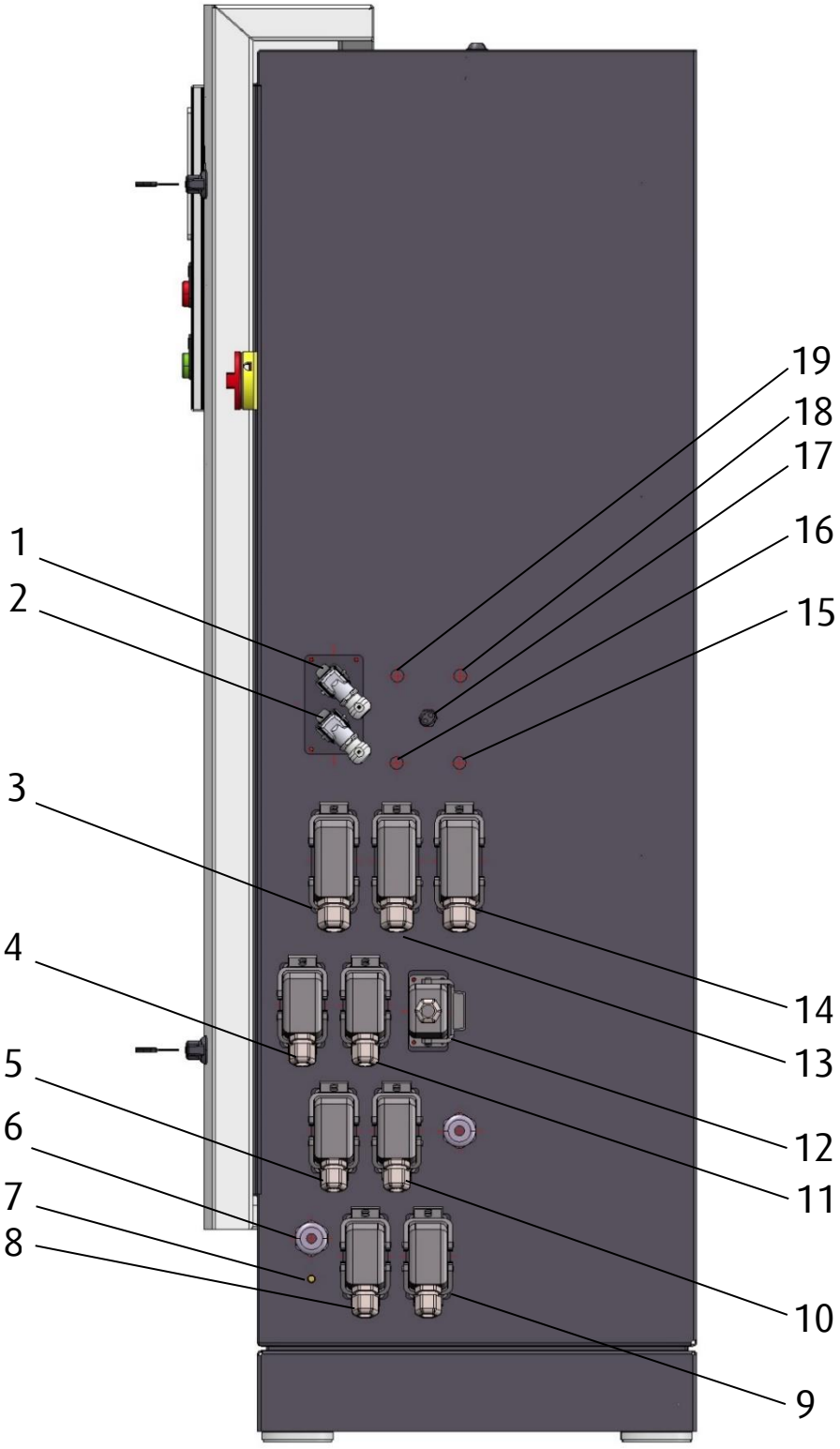


Fig. 5-1: Connectors FG5002S/FG5005S

Pos.	Element	Purpose
1	-XPROFINET -XETHERCAT -XETHERNET	Communication via Profinet Communication via Ethercat Communication via Ethernet
2	-XPROFINET -XETHERCAT -XETHERNET	Communication via Profinet Communication via Ethercat Communication via Ethernet
3	-X30	Control 1. PCU / HTR (LCM / Air control)
4	-X100	Supply 1. PCU / Rotation
5	-X300	Supply 3. PCU / Rotation
6	-100X1	Supply
7	Grounding bolt	Potential equalization between generator and HTR
8	-X90	Primary line 1. PCU / HTR
9	-X190	Primary line 2. PCU / HTR
10	-X400	Supply 4. PCU / Rotation
11	-X200	Supply 2. PCU / Rotation
12	-XPROFI -XMODBUS -X50	Communication via Profibus Communication via Modbus Power supply RD1010
13	-X130	Control 2. PCU / HTR (LCM / Air control)
14	-X40	Customer connection 40-pole For the connection to the machine control of the customer, and the integration of the plasma treatment facility in the safety chain
15	-560BP2	backpressure 2. Plasmajet
16	-560BP1	backpressure 1. Plasmajet
17	-XCAN	CAN-BUS- connection to PCU
18	-560BP4	backpressure 4. Plasmajet
19	-560BP3	backpressure 3. Plasmajet

5.3 INSTALLATION AND COMMISSIONING



Fig. 5-2: Sample configuration FG5002S with PCU and PFW10

DANGER!

Danger of electric shock! / Risk of burns!

- Only carry out installation when the device is fully de-energised. For all works, pull out the power plug and switch off the main disconnect switch, secure against unexpected switching on!
- Work on electrical components is to be carried out exclusively by electricians.
- All feed lines and connections must be installed in such a manner to ensure that they are protected against mechanical damages!

INFORMATION!

- Only operate the facility with air supply: Air ensures, among other things, the removal of heat from the jets. Before switching on the facility, always check the air supply. Damages may occur otherwise to the facility due to overheating.
- The operation with other process gases requires the approval from the manufacturer.
- The maximum distance between the generator, transformer, compressed air supply unit and treatment station is predetermined by the prefabricated cables and shall not be altered.
- Transformers are to be installed vertically. The cable connections of the transformers shall always be located on top, do not tilt!

INFORMATION!

- Observe applicable VDE and EVU regulations if the facility for plasma treatment fulfils the CE requirements.
- The applicable UL and CSA provisions shall be observed if the facility for plasma treatment is UL-certified.

⚠ WARNING!

- Plasma pretreatment components must be integrated into a pre-treatment station that complies with safety regulations. Especially in the nozzle area there are increased risks of accidents and injuries (see chapter 4.6.3) which can be excluded by constructional and constructional measures.

INFORMATION!

- The electrical connectionwork for the system may only be performed in accordance with circuit diagrams by qualified electricians!
- The system must comply with the following guidelines and standards at the time of use:
  - ➢ All guidelines and standards listed in the Declaration (chapter 11.2)
  - ➢ Observe valid VDE and RU regulations as well as local regulations
- Observe the clockwise rotating field of the power supply!
- All parts of the system must be inspected before installation for transport and functional damage as well as completeness!
- Install all supply wires and connections in such a way that they are protected against mechanical damages!

The following explanations describe the minimum structural and design requirements for your system.

5.3.1 TRANSFORMER (HIGH VOLTAGE UNIT)

- Do not tilt transformer or high voltage unit
- Install firmly onto pre-treatment station or in its vicinity in a vertical position (dependent on cable length)

5.3.2 GENERATOR

- Do not tilt generator
- Set up near pre-treatment station (dependent on cable length)

5.3.3 AIR SUPPLY

- Oil and water free compressed air supply of 4 to 6 bar

5.3.4 CUSTOMER INTERFACE X40

The X40 plug serves as a connection to the machine control of the customer and for the integration of the plasma pre-treatment plant into the safety chain.

The scope of delivery of the X40 connector includes the plug housing with male insert, M32 screw connection and 40 pin contacts with the corresponding crimping tool. In addition, the contact extraction tool is also provided. The circuit diagram is in chapter 11.3.

Pos.	Element	Connection (PIN)	Comment
1	Emergency stop channel 1	3A/4A	
	Emergency stop channel 2	5A/6A	
2	Button generator off	7A/8A	
3	Safety switch (safty door)	3B/4B 5B/6B 7B/8B	
4	Button reset fault	1B/10B	
5	Button generator on	3C/4C	
6	Plasma 2 OK	5C/6C	Only at FG5005S
7	Release plasma 2	7C/8C	Only at FG5005S
8	Release plasma 1	9C/10C	Potential-free contact
9	Lamp emergency stop OK	1D/2D	Potential-free contact
10	Lamp plasma ready	3D/4D	Potential-free contact
11	Lamp no fault	5D/6D	Potential-free contact
12	Lamp warning	7D/8D	Potential-free contact
13	Lamp plasma 1 OK	9D/10D	Potential-free contact
-	-	1A	+24V
-	-	2A	0V
-	-	9A/10A	Reset Emergengystop

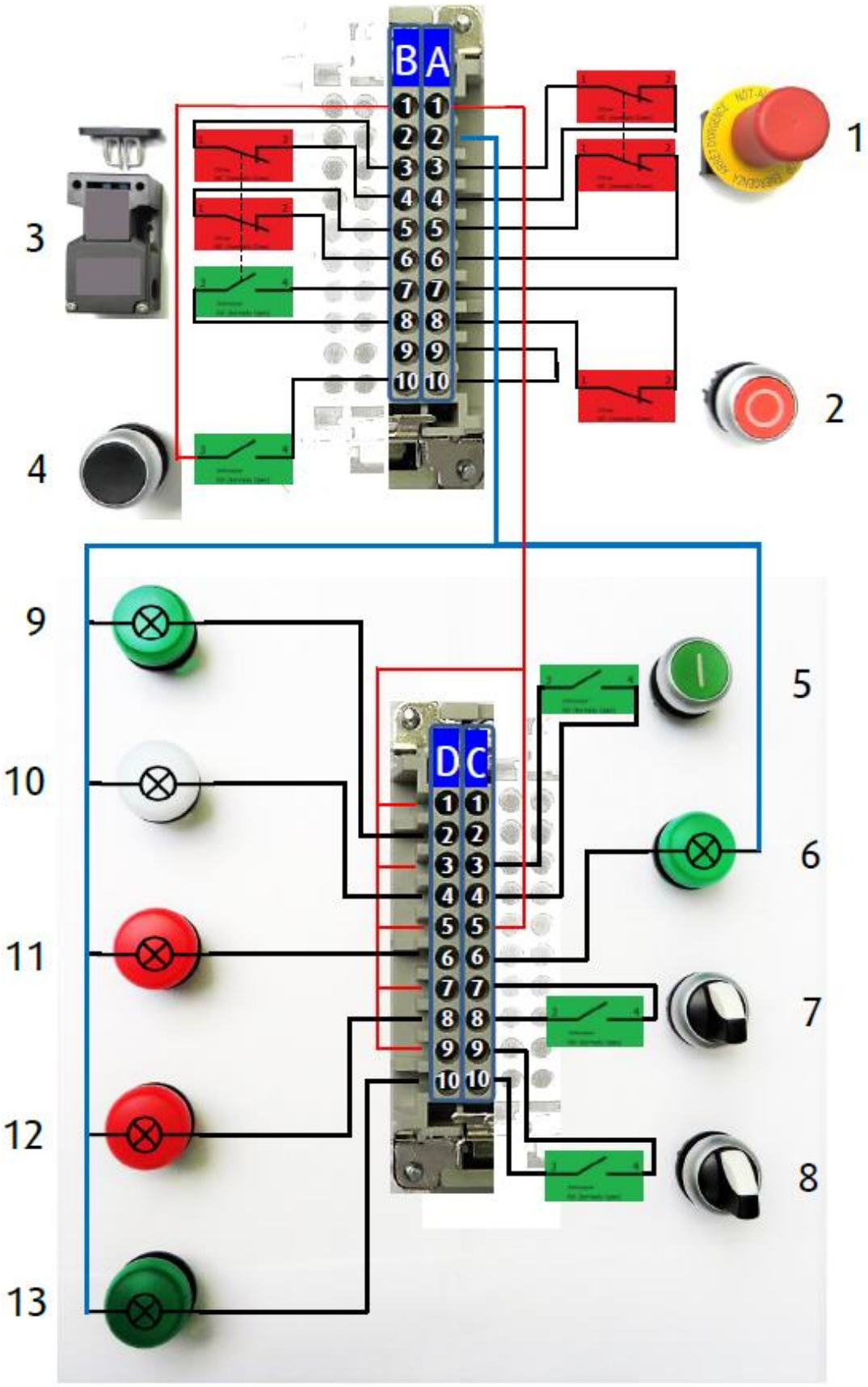


Fig. 5-3: Connection X40

5.3.5 COMMISIONING

1. All parts and components of the facility are to be checked before installation for transport and functional damages as well as for completeness.

2. Place the generator straight on a stable level surface. Unvenness in the floor can be compensated by height adjustment of the feet.

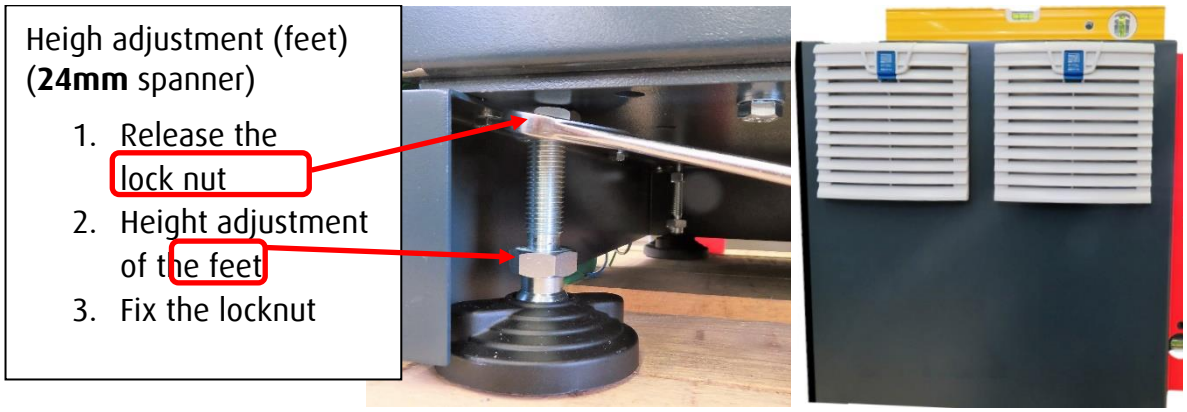


Fig. 5-4: Orientation of the generator

It is important to ensure sufficient distance to other objects (at least 30cm). The ventilation slots must not be blocked, covered or contaminated/glued. The generator must be placed near the treatment station (Jets). The maximum distance is determined by the length of the connecting lines.

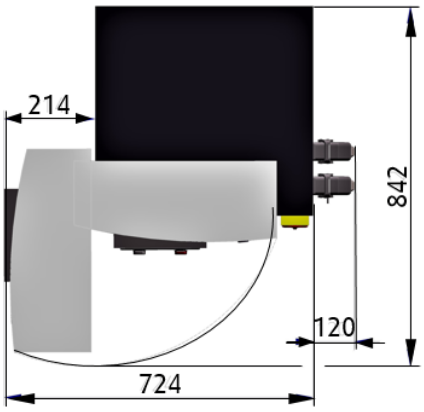


Fig. 5-3: FG5002S/FG5005S on top view with open door

3. All screw connections and ports must be checked in the control cabinet and on the transformer or on the PCU before commissioning.

4. Place the pre-treatment station, consisting of the plasma jets and the protective cover, in the correct position at and at right angles to the material inlet. The jets must be permanently installed.

5. Set the jets in line with the material.

6. Connect factory provided compressed air supply with the connecting pipe on the pressure control valve (DVE20) or optionally with the compressed air preparation (DAE10).

7. Make the connections from the generator tot he HTR12 or HTR22.

8. If a PCU is used, connect the pressure control valve or compressed air preparation to the PCU. The operating pressure oft he PCU is between 4 and 6 bar.

9. The treatment station must be equipped with an extraction system by the operator. Its capacity has to be such that at least ten times the amount of untilized ionisation gas can be sucked off. The amount of quantity of the ionisation gas is given in the technical data of the jet(s) used in your equipment in Chapter 4.6. The extraction is to be done dependent on the system and the work piece to be treated.

10. Connect the generator, the high-voltage transformer / the PCU as well as the treatment station with ground bonding according to local regulations.

11. Put the power supply on between generator and the transformer / the PCU via the plug connections (plug – X90/X190). Observe the labels on the plug.

    If a PCU is operated on the equipment, in addition the EMV cable of the plasma nozzle has to be connected with the PCU.

    - The plug-in connections are fixed with coding pins, no mix-up possible.
    - Activate the locking mechanism of the connectors!

12. Connect the control line of the DVE20 compressed air unit or the PCU (plug – X30/X130) with the generator.

13. The transformer and the compressed air supply unit are connected by the green EMC protective tubing with the plasma jet.

14. For rotating plasma jets, the generator must also be connected with the plug X100/X200/X300/X400 directly with the jet.

15. If a PCU is utilized, make the connection between the Generator and the PCU (X100), and connect the X100 line of the plasma jet to the PCU.

16. Make the following signals with the machine with the plug – X40 (customer interface) – observe information sheet on personal safety! It is in Chapter 11.1
    - Emergency off function of superordinate safetychain
    - Enabling contact (potential-free) of the central machine
    - Various fault contacts (potential-free) on central machines
17. Establish the power supply of the generator on with the public network. The power supply of the generator ensues via a mains plug. It is to have a protection of 32A and 360V-510V AC 50/60Hz. The correct voltage level is to be controlled.

INFORMATION!

- The maximum distance between the generator and the plasma pre-treatment station is set as a result of the prefabricated cable and must not be altered without consulting Plasmatreat GmbH.

6 OPERATION OF THE CONTROL UNIT

The interfaces for the operator / service and maintenance personnel enable quick and user-friendly processes. A detailed description of the functions and operation of the control panel is described in chapter 10.

6.1 CONTROL PANEL ON THE GENERATOR FG5002S/FG5005S

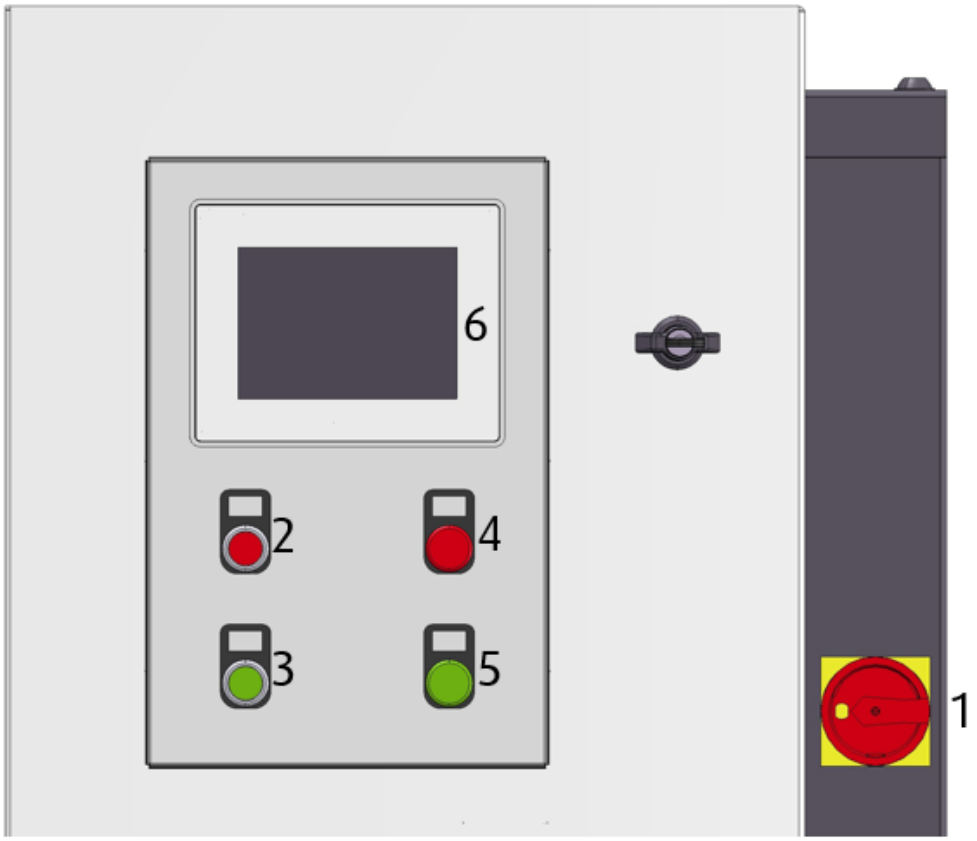


Fig. 6-1: Operating panel FG5002S/FG5005S

Pos.	Element	Purpose
1	Main switch	Switches the mains and control voltage on and off
2	Button generator off	Turns off the generator
3	Button generator on Indicator lamp	Switches on the generator Illuminates if the Generator is turned on.
4	Indicator lamp fault	Illuminates up in case of a fault
5	Indicator lamp Plasma ready	Illuminates after plasma is turned on, and plasma is OK
6	Control panel (Touch)	See chapter 10

6.2 CONTROL PANEL ON THE PCU

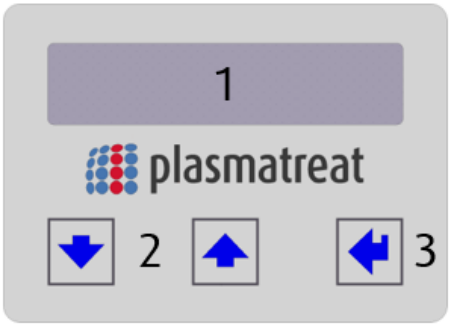


Fig. 6-2: Operating panel PCU

Pos.	Element	Meaning
1	**Textdisplay**	Shows the status of the PCU as well as the parameters and the settings
2	**Arrow buttons**	With simultaneous activation of both cursor keys, the currently shown parameter is kept and the parameter cycling is stopped. The down arrow key releases the stop again and the parameters again cycle through the text display.
		In the parameter setting, the parameters are changed with the arrow keys.
3	**Enter button**	Starts function of setting parameters. With the enter key, the various parameters can be called up and saved.

6.3 PARAMETER SETTING IN THE TEXT DISPLAY OF THE PCU

Parameter display	Plasma ON / Plasma OFF		
	Actual RPM [rpm]		
	Backpressure [mbar]		
	Power [W]		
	Flow [l/min]		
		PCU	PCU-D
Parameter settings	RCM [rpm]	1.000 – 2.800 rpm	1.000 – 2.500 rpm
	FCM [l/min]	0 – 85 l/min	0 – 150 l/min
Data Save			

6.4 OPERATION OF THE PCU1604

Switch-on

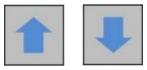
After connecting the supply voltage to X101, the PCU display show some information

CAN-Bus-address of the HMI board

Software versions of the HMI, PPM and RPM board (only with CAN-bus disabled)

Display mode

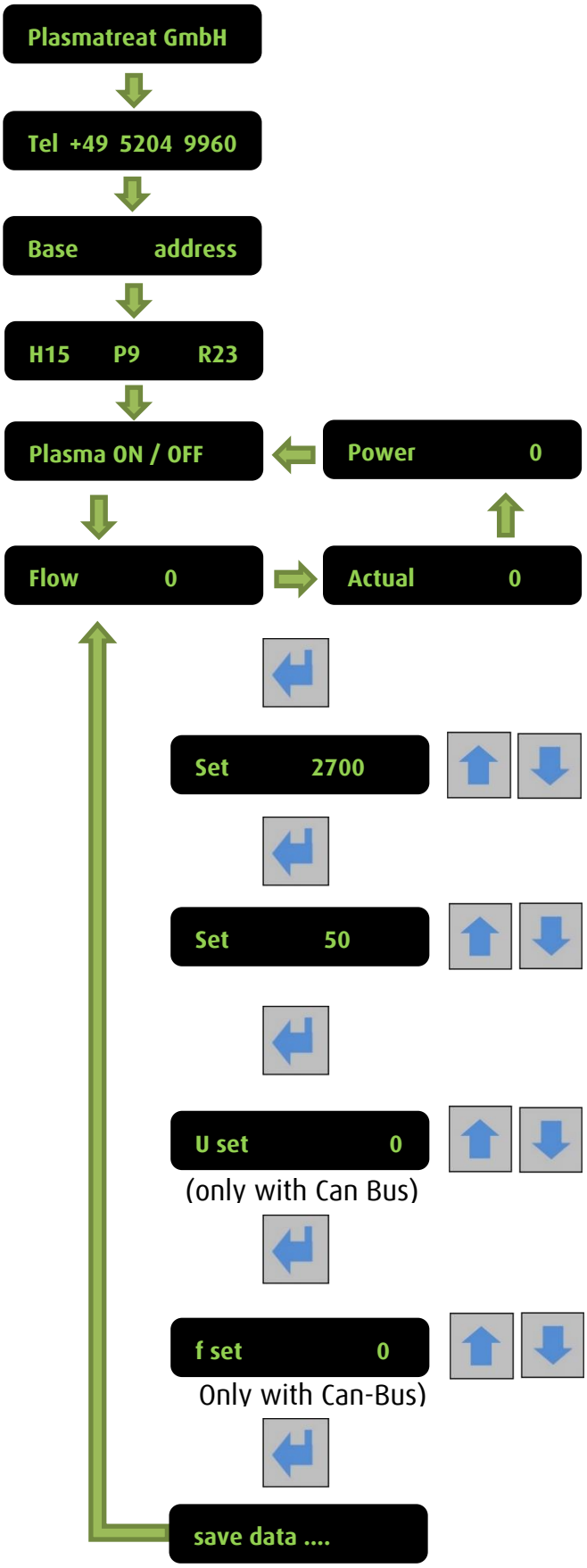
Actual parameters appear one after the other on the display.

 pressed simulaneously, stops cycling of the parameters in the current display

 pressed, starts parameter cycling again

Input mode

 Parameters can be called and changed one after the other. After the last parameter, the changes are accepted and PCU returns to the display mode.



7 PRODUCTION PROCESS – STANDARD CONTROL UNIT

The facility shall only be switched on if:

- it is in an assembled and operation-ready state
- all protective and safety-related devices, e.g. removable protective devices, are available and functional
- no changes (including changes in the operating behaviour) to the facility can be established within the scope of the daily visual inspection
- the infeed and outfeed work areas of the facility are kept free

7.1 SAFETY INFORMATION REGARDING THE AUTOMATIC OPERATION OF THE PLASMA TREATMENT FACILITY

DANGER!

High voltage, danger of life!



- Operate the plasmajets only when in a fully assembled state, do not stick any objects into the plasma jets!
- Never touch the plasma jet stream while in operation, the plasma jets carry high voltage (20kV) during plasma discharge.
- Risk of burning from an HF arc.
- Do not stick any metallic, conductive objects (screwdriver, pencil, ballpoint pen etc.) into the plasmajets.
- Grounding, control and high voltage lines of the plasma jets are to be laid in such a manner that they do not get damaged (driven over, clamped or pinched, external influences etc.)

DANGER!

Malfunction of pacemakers due to pulsed voltage!





- Pulsed voltage is used in the facility. As a result, it is possible that the RF construction parts and / or supply lines of the facility can result in danger to life for wearers of pacemakers or comparable life supporting devices due to malfunction.
- The responsibility for informing the affected persons is borne by the operator of the facility.

WARNING!

Risk of burning!



- Never touch the plasma jet stream in operation.
- Plasma jets are very hot on the outside during operation, even after switching off
- Never direct the plasma jets at persons, animals. Risk of burning.
- The facility operator shall install a fixed, separating safety device around the jets / transformers. This shall contain a protecting door secured via a safety switch!

WARNING!

Rotating components, risk of injury!



- The plasma jets RD1004 / RD1004R and RD2004 / RD2004R / RD2005 and RD1010 rotate. Never touch the jets while in operation.
- The plasma jets can rotate even when the plasma is not switched on, it is therefore essential to make sure that the facility is switched off and the main disconnect switch is secured against unintentional switching back on.

INFORMATION!

Risk of overheating! Risk of fire!



- Only operate the facility with compressed air supply.
- Never press the plasma jets directly onto the material to be treated
- Maintain minimum distance

ATTENTION!

Risk of poisoning by working gas!



- An extraction unit must be installed by the operator. It shall hereby be ensured from a control point of view that the operation of the plasma treatment facility is not possible in case of extraction failure.
- The volume flow of ionizing gas per plasmajet can be found in chapter 4.6 for the respective plasmajet used. The volume flow of the extraction must be higher than the supplied ionizing gas to the plasmajet. Plasmatreat GmbH recommends a factor of 10!
- Ensure that the facility area is well ventilated.
- The operator of the facility is responsible for the adherence to TRC/TLV limit values and the respective national regulations regarding possible workplace concentrations.
- In case of extraction failure, immediately ventilate the working rooms thouroughly!

7.2 INTERRUPTING PRODUCTION, SWITCHING OFF FACILITY

7.2.1 SWITCHING OFF VIA „EMERGENCY OFF“

The generator can be switched off via an external EMERGENCY OFF switch. If the facility has been integrated into the EMERGENCY OFF circuit of the whole facility, the generator can also be switched off at other locations.

7.2.2 SWITCHING OFF VIA „PLASMA OFF“

Press the “Generator OFF” button in order to switch off the generator and the plasma jets, or use the “Control OFF” function using the – X40 interface via a superordinate facility control unit.

For more on the configuration of the – X40 customer interface, please refer to Chapter 11.1 and 0 Leaflet Personal protection and X40 interface.

If the facility is to be switched off completely, subsequently switch the main disconnect switch to the “0“position.

7.2.3 PRODUCTION OPERATION

The exact production process depends on the specific requirements of the product. This is a general description of the production process.

1. Switch on the generator with the main switch.
2. Wait until the startup screen appears.
3. With the button "please press" you will access the main menu.
4. If faults are present, these must be remedied (see chapter 10.7.1).
5. Check that the nozzle and the material are in the basic position.
6. Verify compressed air is available and ready.
7. Start the generator with the "Generator On" button on the control panel or the external "Generator On" function via the X40 interface. The green indicator light will illuminate. The display now shows the set voltage value.
8. Enable the plasma release by closing the contact of the X40 interface to start the treatment process. This must be provided by a switch / automated contact in the factory by the operator. When the plasma release is enabled and plasma is operatimg, other parameters will be displayed on the control panel.
9. Wait for the pre-treatment procedure.
10. When the enable contact opens, the plasma shuts off. The air switches off after the delay time. If there is a rotation, this will continue according to the delay time parameter.
11. If another workpiece is being treated, continue with step 8.
12. If no further workpiece is to be banded, switch off the control using the "Generator Off" button. The green indicator light will extinguish.
13. Turn off the main switch.

7.2.4 FLOW CHART

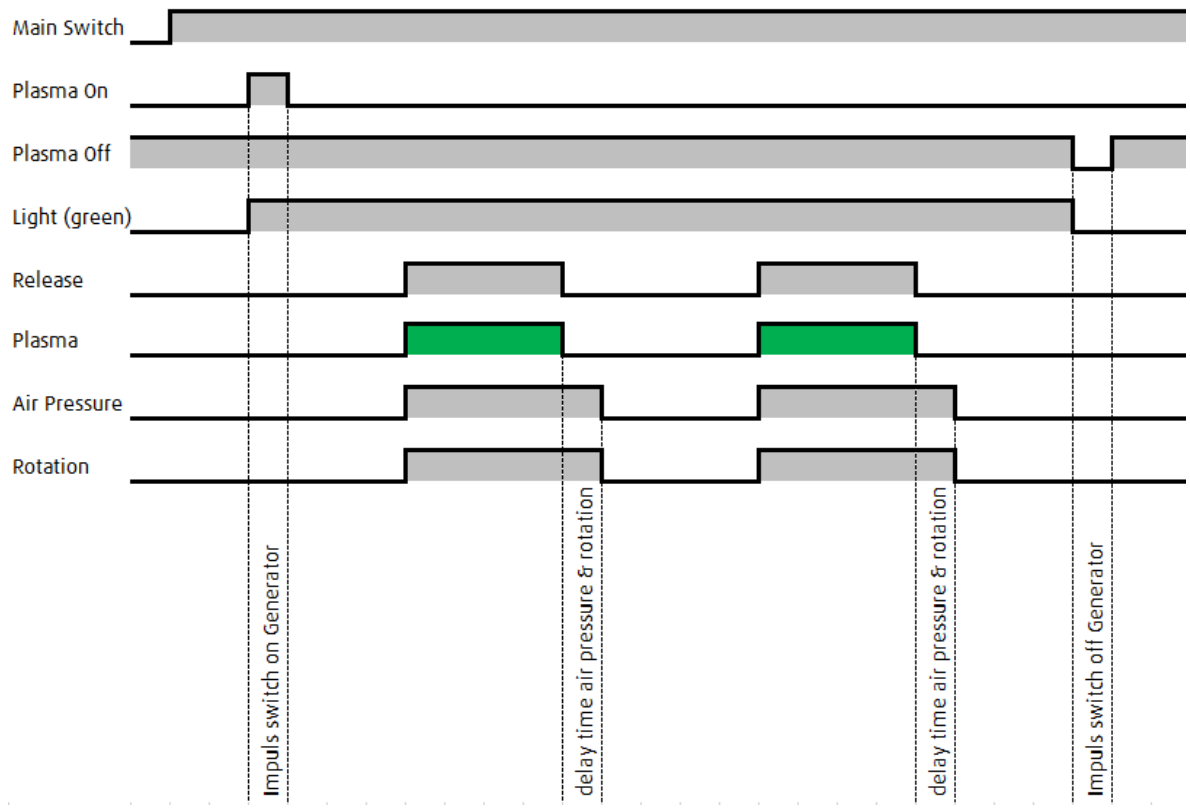


Fig. 7-1: Flow chart

When the plasma system gets the release signal via the customer plug X40, the air supply will be turned on using a pressure control valve. If rotation jets are installed its motors start as well. After the air pressure has reached its target value, the generator activates the plasma.

After the plasma's ignition, the air pressure inside the jet increases sharply and can be supervised by an optional PCM (Pressure Control Module). An LCM (Light Control Module) supervises the light intensity of the plasma and outputs the signal "Plasma OK" in the case of freedom from defects.

The system is delivered with default parameters in order to secure a proper system startup. By determining upper and lower limits, the parameters can be changed while keeping the system stable.

3 seconds after switching on the system, the compressed air starts to be monitored. If the pressure value over- or underruns the limits, the magnetic valve stops the air flow.

7.3 DECOMMISSING AND DISPOSAL

7.3.1 DECOMMISSING

If the facility is to be decommissioned, the applicable laws and regulations for disposal at that time are to be observed.

It is recommended to check which components of the plasma treatment facility can be recycled, and to do so where applicable.

During the operation, maintenance or servicing of the facility, various substances and liquids will be used. They need to be disposed of appropriately and under observation of the legal regulations.

7.3.2 DISPOSAL

During the disposal of auxiliary, work and operating materials, the guidelines in the data sheets / safety data sheets shall always be observed. The data sheets / safety data sheets shall be provided to you by the suppliers of the auxiliary and operating materials.

8 MAINTENANCE AND SERVICING OF THE FACILITY FOR PLASMA TREATMENT

By following the information on maintenance and servicing on your plasma treatment device, a long service lifemay be achived. Downtimes and spare part costs can be reduced through preventative measures and the profitability of the device thus increased. Maintenance and repair instructions on individual components are to be observed. Deadlines that are prescribed or that have been stated in the user manual for recurring checks/inspections must to be observed.

8.1 SAFETY INFORMATION FOR THE MAINTENANCE, SERVICING AND FAULT CLEARANCE OF THE DEVICE FOR PLASMA TREATMENT

DANGER!

High voltage, danger to life!





- Maintenance and servicing works are to be carried out only when the facility is fully de-energised. For all works, switch off the main disconnect switch, pull out the mains plug and secure against unexpected switching on, using lock-out/tag-out produres.
- Maintenance on electrical equipment shall only to be performed by authorised electricians!

WARNING!

Rotaiting components, risk of injury!



- The plasma jets RD1004 / RD2004 / RD2005 and RD1010 rotate. Never touch the jets when in operation.
- The plasma jets can also rotate without the plasma being switched on, therefore make sure that the facility is switched off and secured against unintended switching on, using lock-out/tag-out procedures.
- For all work, pull out the mains plug, switch off the main disconnect switch and secure against unexpected switching on.

INFORMATION!

- The maximum distance between the generator, transformer, compressed air supply unit and treatment station is determined by the prefabricated cables and shall not be changed.

Before starting any maintenance, servicing or fault clearance work the following safety precautions measures shall always be performed:

- The maintenance area is to be widely cordoned off where necessary!
- Stop and switch off the facility,
- Switch off the main disconnect switch and use appropriate lock out and tag out procedures in accordance with NFPE.
- Let the facility cool off sufficiently,
- Press the EMERGENCY OFF button,
- Mount a warning sign at the control/operating panel.

For the execution of maintenance measures, it is absolutely essential that the workshop is suitably equipped for the work to be carried out. The facility, and here in particular its connections and screw joints, are to be cleaned of oil, fuels, contaminants and care products upon commencement of maintenance/repair work. When replacing heavy facility parts, only use suitable and perfectly functioning load handling equipment and lifting gear. When carrying out maintenance and repair works, loosened screw joints shall always be re-tightened!

If it is necessary to disassemble safety devices during setup, maintenance and repair works, the assembly and inspection of the safety devices shall be carried out immediately after completion of the maintenance and repair works!

8.1.1 SAFETY INFORMATION ON ACCORDANCE WITH MACHINERY DIRECTIVE 2006/42 EG

Work for maintenance, servicing and troubleshooting must only be carried out by qualified specialist personnel. The operating personnel must be informed prior to commencement of maintenance and repair work. There must be a designated supervisor.

When carrying out maintenance, repair and troubleshooting work, observe applicable general safety and accident prevention regulations.

8.1.2 WARNING IN ACCORDANCE WITH UL 508A / NFPA 79 / NFPA70E / NFPE

Maintenance, repair and / or servicing works at the switch cabinet shall only be carried out by trained, qualified, experienced and authorised electricians. These electricians shall have at their disposal suitable and safe work practices when handling electrical devices. Including suitable personal protective equipment, approved tools, methods and exact drawings of the switch cabinets concerned (NFPA 70E requirements).

Prior to maintenance, repair or servicing works, the required switching off procedures and methods protecting against unexpected switching on are to be carried out. This applies to all forms of dangerous energy (not only electrical, if other sources are also involved). It shall be checked whether the energy source is isolated. Use suitable safety distances for the voltages concerned. Circuitry or modules that can become hot require a permit including a signature (s), see regulation (NFPA 70E; Article 130.2(B))

Follow the described method for switching on after the maintenance, repair or servicing works have been carried out.

8.2 DAILY VISUAL INSPECTION OF THE DEVICE

Inspect the generator switch cabinet, the transformer, the plasma jet, and all cables and hoses by means of a visual inspection with regards to damages. If any component or performance changes occur, please contact our technical customer service.

8.3 MONTHLY INSPECTION, REPLACEMENT

Inspect the jet head for contamination and wear. Clean the jet head with a wire brush and replace the jet head if necessary in case of heavy wear.

Check the electrodes (rotor) for soiling and wear. Clean the rotor or replace it if necessary if there is strong burn up.

The contact carbon brushes for rotational plasma jets are worn if one can see the copper contact on the inside. For the inspection of the state, the contact carbons shall be disassembled. The plasma jets each have two contact carbons.

To check the condition the carbon brushes have to be removed. There are at least two contact carbons on each plasma nozzle.

The carbon brushes on the RD1004 rotation plasma nozzle are worn when the copper contact is visible on the inner side.

The carbon brushes on the RD2004 rotation plasma nozzle are worn when they are shorter than 5mm.

The carbon brushes on the RD2005 rotation plasma nozzle are worn when they are shorter than 15mm.

The carbon brushes on the RD1010 rotation plasma nozzle are worn when they are shorter than 16mm.

In Chapter 8.6 you can find image-supported maintenance instructions for the different plasma jets with information on how to replace the components and assembly groups with regards to the respective plasma jets. In Chapter 11.4-11.9 the common spare and wear parts are listed for the different plasma jets.

INFORMATION!

- Use copper paste before screwing in the jet head at the external thread.
  Type OKS 240, Plasmatreat #11022

8.4 QUARTERLY INSPECTION, REPLACEMENT

8.4.1 GENERATOR

Check the functionality of the ventilator in the generator switch cabinet and vacuum clean the ventilators. The whole generator switch cabinet shall be cleaned and vacuumed.

Inspect the power components in the generator switch cabinet with regards to fire residue, electrical flashovers or charred connections. If this shall be the case, the affected construction parts shall be replaced in order to prevent further damages to the device. Please contact our technical customer service.

All terminal screws at the generator switch cabinet shall be inspected and tightened if necessary

8.4.2 TRANSFORMER HTR12 / HTR22

Open the cover of the transformer and check the transformer for fire residue and high voltage flashovers, and whether the insulation material in the housing has run out. If this shall be the case, the affected construction parts shall be replaced in order to prevent further damages to the device. Please contact our technical customer service.

All terminal screws at the transformer shall be inspected and tightened if necessary.

8.4.3 COMPRESSED AIR SUPPLY UNIT DVE20 / FILTER UNIT DAE10

Check the filter of the compressed air supply unit DVE20. If the device is equipped with an additional compressed air preparation unit DAE10, additionally check the filter of this unit. In case of contamination, or if the flow rate is still low despite the pressure setting being increased, check whether oil has collected in the housing of the fine filter of the compressed air supply unit. If this shall be the case, the filter needs to be replaced, and the hoses with all joints and connections to the plasma jet and the plasma jet itself shall be completly cleaned of oil.

8.4.4 PLASMA JETS PFW10 / RD1004 / RD2004 / RD2005 / RD1010

Inspect the O-ring seal and replace it if necessary.

Inspect the ceramic insert with regards to damages. Clean the ceramic insert or replace it in case of heavy contamination.

In Chapter 8.6.1 you can find image-supported maintenance instructions for the different plasma jets with information on how to replace the components and assembly groups with regards to the respective plasma jets. In Chapter 11.4-11.9 the common spare and wear parts are listed for the different plasma jets.

INFORMATION!

- If you have two identical plasma jets, the rotors shall have the same length after being replaced, as otherwise the ignition behaviour of the individual jets can vary.
- Regularly replace the carbon brushes! Otherwise, the leakage current will flow through the bearings of the jets, which can lead to the destruction of the bearings. The warranty expires prematurely in this event!

8.4.4.1 ADDITIONAL MSINTENANCE MEASURES FOR ROTATING JETS RD1004 / RD2004 / RD2005 / RD1010

Clean plasma jet thoroughly of carbon dust from the carbon brushes.

The carbon brushes on the plasma nozzles have to be replaced at the latest every quarter year. There are at least two carbon brushes on each plasma nozzle.

To locate the carbon brushes on your respectively installed jet, please refer to Chapter 8.6.

8.5 SEMI-ANNUAL INSPECTION, REPLACEMENT

8.5.1 PLASMA JETS RD1004 / RD2004 / RD2005 / RD1010

Firstly, ensure the smooth running of the rotating assembly group in the plasma jet. If this shall not be the case or if a smooth and consistent rotary movement is not possible, the rotating assembly group shall be replaced.

Inspect the pulley and the drive belt with regards to abrasion and wear. In the event of a high degree of abrasion, the drive belt and / or the pulley at the motor or rotating assembly group shall be replaced.

Inspect the tension of the drive belt. If this can be turned approx. 90° by hand, the pulley tension is correctly set. If the angle is lower, the tension is too high, in case of a larger angle of twist is possible the tension is too low.

Check the pulley and the toothed belt / the ribbed belts regarding abrasion and wear. In the case of increased abrasion, the toothed belt or the pulley on the motor or the rotation assembly group has to be replaced.

8.6 PLASMA NOZZLE MAINTENANCE

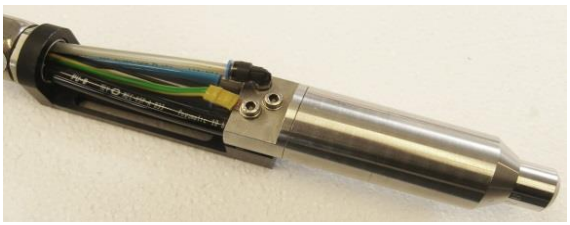
On the following pages you will find an image supported description of the maintenance for each Plasma jet. This should be assistance for trained and qualified personnel. If there are any questions about it or if you are not sure in every issue please you should contact our technical service. For contact details see chapter 9.2.

INFORMATION!

- You will find beginning in chapter 11.4-11.9 more detailed description of the parts shown in the following maintenance instructions. There you will find the article number for the most recent spare- and wear-parts.
- Use only original spare and wear parts.
- When assembling the plasma nozzle make sure the glass rod is properly inserted into the connector housing.
- When attaching the stator, make sure the rotor does not turn.
- Before screwing the nozzle head in place, apply copper paste to the outside thread. Type OKS 240, Plasmatreat #11022. Use copper paste on the external threads of the nozzle head and the housing, not in the inner part of the nozzle!

8.6.1 PLASMA JET PFW10 / PFW10R

1. First unscrew the nozzle head. When reattaching the nozzle head please apply copper paste to the outside thread. Type OKS240.



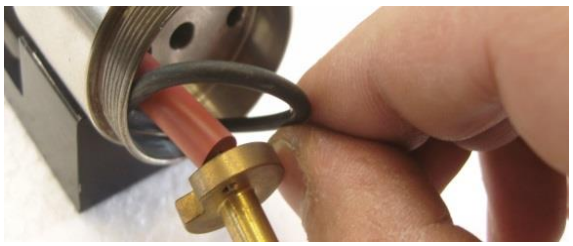

2. Now twist off the stator from the nozzle housing. When unscrewing the stator make sure the internal components including rotor, ceramic insulator and connector pin do not rotate. Otherwise there is a risk of breaking the glass rod. Rotation of the internal components can be prevented with a bolt or socket wrench by lightly pressing against the rotor in the opposite direction.




3. Using a hex wrench, loosen the hex screw on the side of the rotor (SW 1.5). Then carefully pull the ceramic piece with the central electrode (rotor) from the plasma nozzle housing.




4. Now carefully pull the glass rod straight out of the housing and the plasma nozzle connector pin. The gasket can now be removed from the housing.

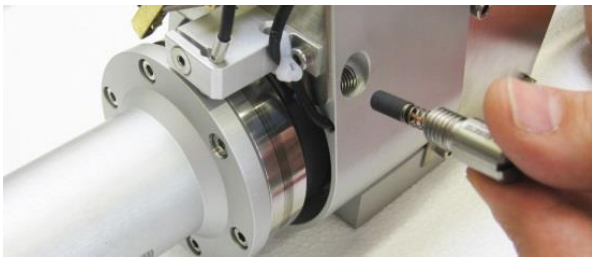



8.6.2 PLASMA JET RD1004/RD1004R

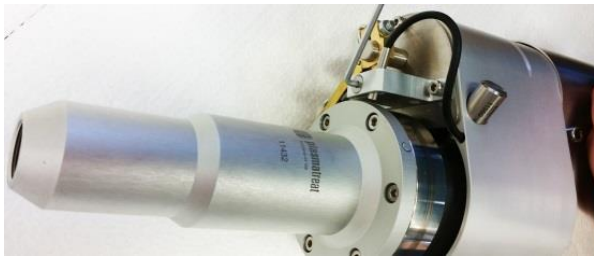
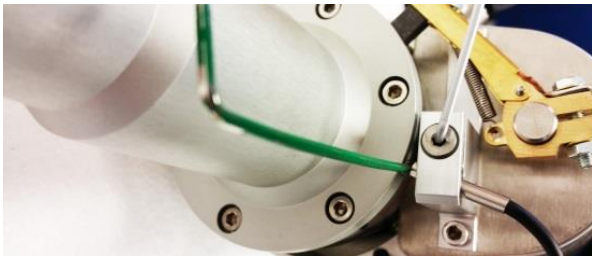
1. Unscrew the cover plate from the plasma nozzle as well as the nozzle head. When reattaching the nozzle head please apply copper paste to the outside thread. Type OKS240.



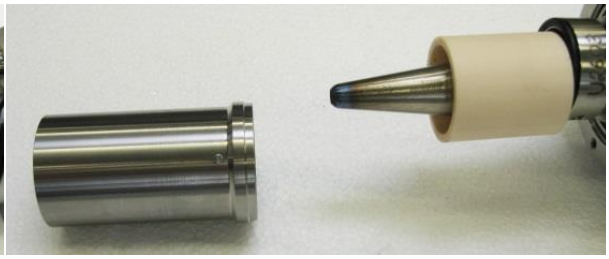

2. To replace the carbon brushes remove the screws from the side mount of the small carbon brushes and the rounded carbon brush holder on the side of the rotation nozzle. (The rounded carbon brush is located behind the brush holder)

3. To remove the rotation sensor loosen the mounting screw and pull it out of the holder at the nozzle. When installing the rotation sensor make sure it is fastened at a suitable distance to the plasma nozzle sleeve. This can be done by using a hex wrench SW2 during adjustment.

4. Remove the plasma nozzle sleeve by loosening the 6 screws, remove the metal gaskets. Loosen the two hex screws then remove the insert nut.

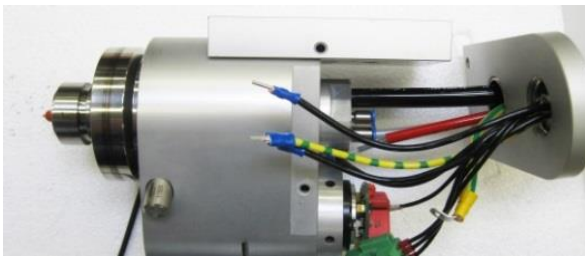
5. Now loosen the rotor screws, twist the rotor out of the ceramic, and remove both. Loosen the high voltage line terminal screw from the connecting pin and carefully remove the pin and the glass rod. The o-ring can also be removed.



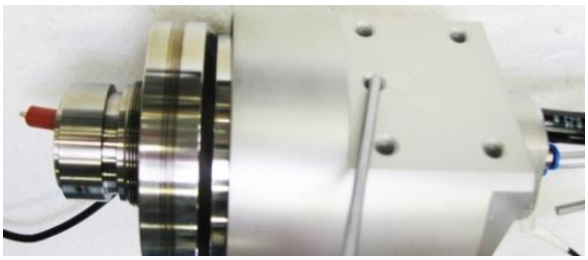

6. For motor and rotary assembly maintenance remove the bottom cover plate. Loosen the grounding screw and motor connections, and unscrew the connector plug from the initiator.



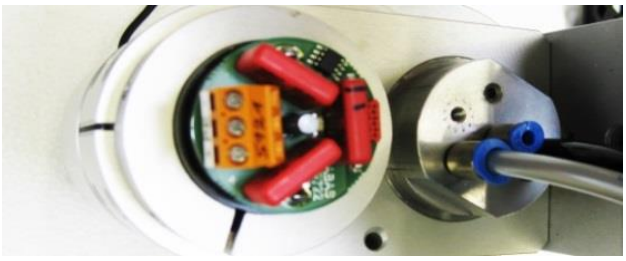
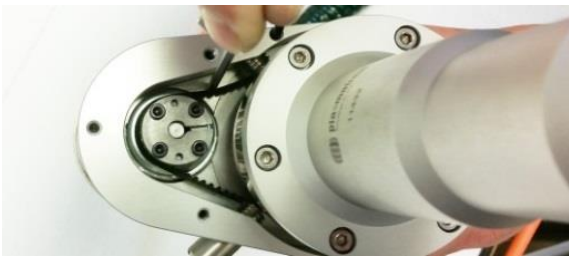

7. Remove both screws securing the top connector plate of the nozzle housing, and the four screws on the side of the nozzle mounting plate. Loosen the motor tension screws.



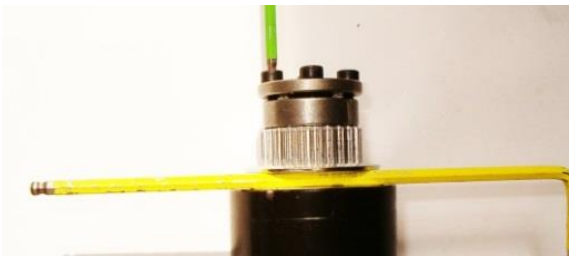

8. Pull the eccentric ring over the motorand out of the housing. The drive belt and motor can then be removed. The rotary assembly can be held in place by inserting a hex wrench into the drilled hole. The rotary assembly can now be removed.

9. Important: During assembly using the eccentric ring adjust the belt tension such that no tension is applied to the motor shaft!

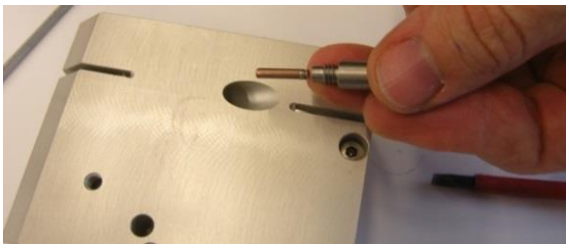
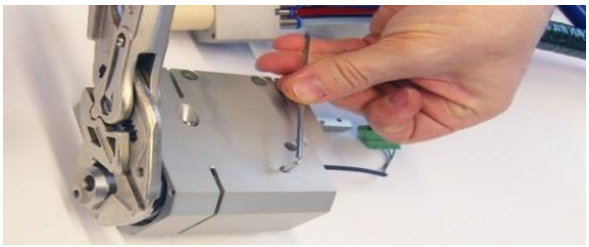



10. Belt Pulley Replacement: Remove the pulley from the motor. The distance between the motor and pulley can be adjusted with a hex wrench SW3 during assembly.

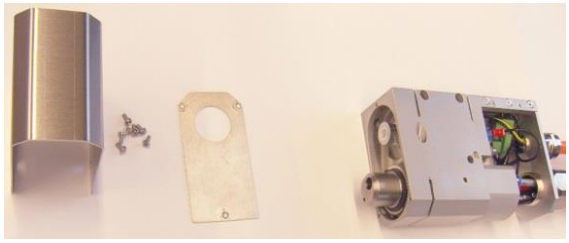
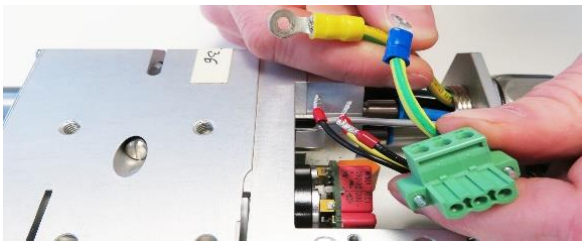



8.6.3 PLASMA JET RD2004 / RD2004R

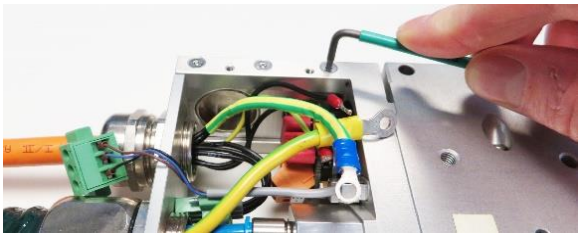
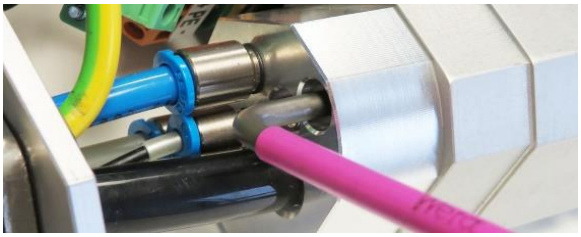
1. To replace the carbon brushes remove the screws from both sides of the rotation nozzle. To disassemble the nozzle head, remove the side cover screw (hex screw M4) and block any rotation with a hex wrench while loosening the nozzle head with flat-nosed pliers. When reattaching the nozzle head please apply copper paste to the outside thread. Type OKS240.

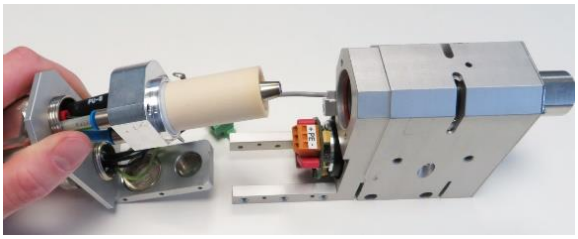
2. Unscrew both cover plates from the plasma nozzle. Remove the grounding screw and motor connections, and unscrew the connector plug from the initiator.

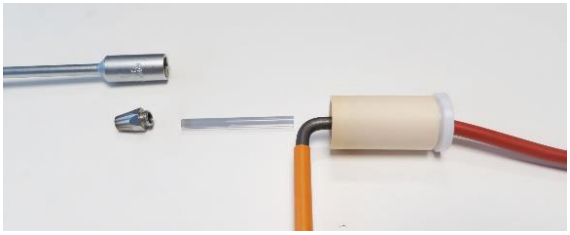
3. Loosen the screws securing the connector plate, as well as both screws on the nozzle housing.

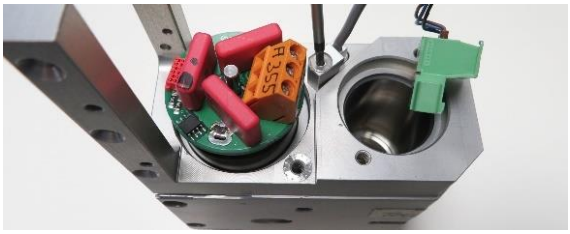
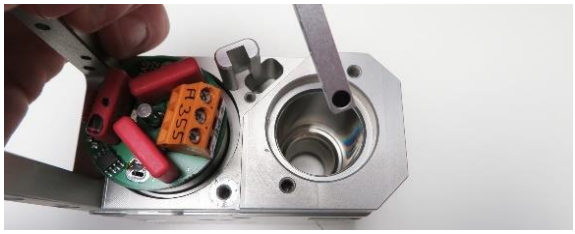
4. Now separate the connector plate with the nozzle housing from the rotation of the nozzle. In order to remove the nozzle's internal components, remove the three screws on the nozzle housing.



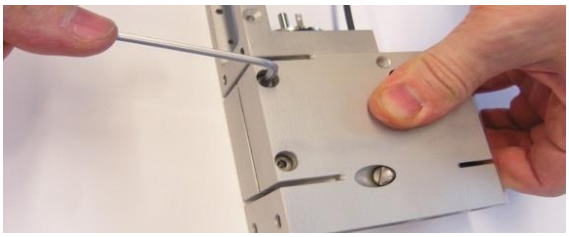

5. Loosen the electrode on the ceramic and screw it out of the nozzle casing with an Allen key size 4 and then remove the glass rod very carefully. Remove the connection bolt of the high voltage line.



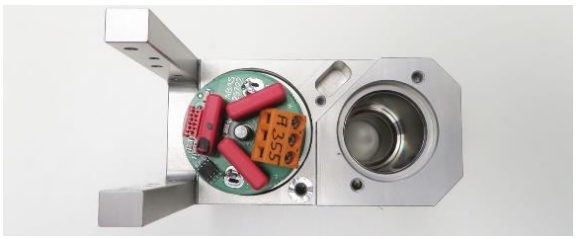

6. To remove the rotation sensor loosen the mounting screw and pull from the rotation of the nozzle. When installing the initiator make sure it is pushed into the drilled hole just far enough so that the LED is still visible.

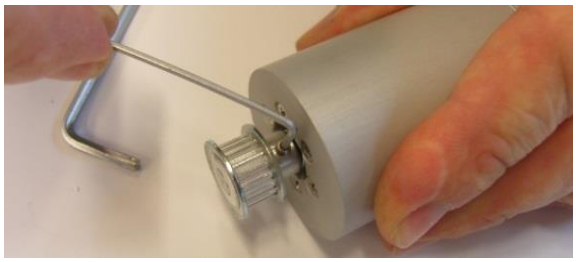
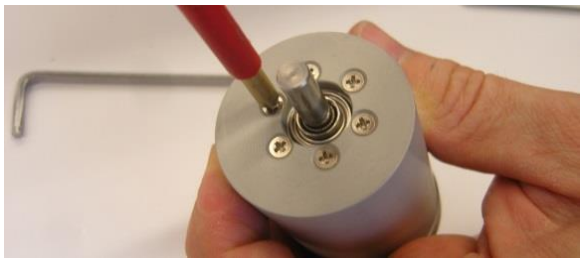
7. Loosen the motor tension screws and rotate the motor with the eccentric ring such that the gear belt has as little tension as possible. The gear belt and motor can then be removed.




8. Important: During assembly, belt tension is adjusted using the eccentric ring such that no tensile tension is applied to the motor shaft!

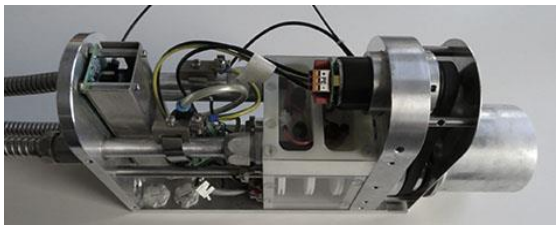
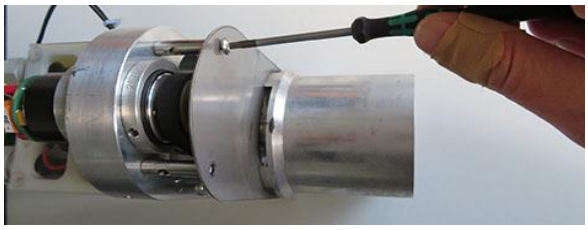



9. Remove the pulley and the eccentric ring from the motor.

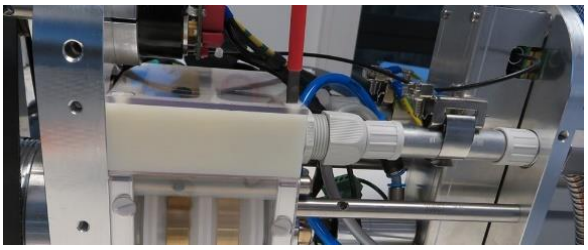
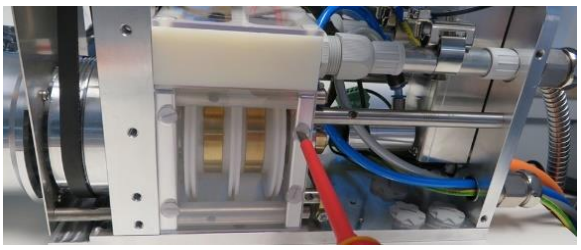



8.6.4 PLASMA JET RD2005

1. First screw off the two cover plates of the plasma jet.

2. In the next step, dismantle the polycarbonate discs above and on the side of the rotation assembly group. Clean the rotation assembly group over the side windows with the aid of compressed air free of oil and water

3. To replace the earthing brushes proceed as follows: On the upper single-leg holder (left on the picture) remove the screw which holds the carbon brush. On the lower single-leg holder (right on the picture) remove the rear fixing screw of the complete Single-leg holders and pull the bracket down from the stud bolt. Finally remove the fixing bolt of the carbon brush.




4. In replacing the high voltage carbons, first remove the caps which are under the upper polycarbonate disc. (According to design there are one or two carbon brushes per slip ring). After opening the locks, the carbon brushes have to be pulled by the contact springs form the guide. The carbon brushes must not be shorter than 15mm.




5. To replace the nozzle heads, screw them out of the stator sleeve with the aid of the face spanner #21755 and take off the front cover sheet. When assembling the nozzle head again, please use copper paste on the external thread. Type OKS240.



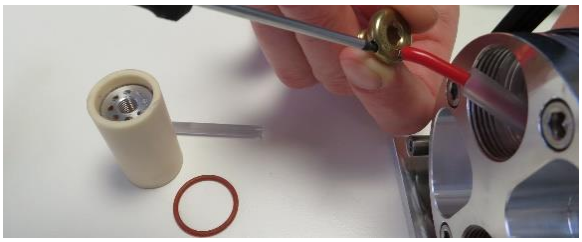

6. To be able to exchange the electrodes for the plasma nozzle, in the next step the stator sleeves have to be removed with a ring spanner #23289. Finally, the two electrodes can be screwed out of the ceramic isolator with an 8mm socket spanner. The ceramic isolator is to be fixed by hand.



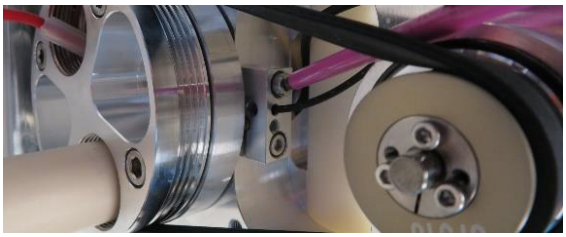

7. In order to replace the glass rod, the ceramic or the O ring, the ceramic isolator must be pulled forward with one hand - now very carefully so that the glass rod is not broken, the connector pin must be removed from the ceramic isolator with an Allen key size 6. Finally, push the connector pin on the glass rod back and take the glass rod out of its bracket. In mounting the glass rod is first put by the side. Put the ceramic isolator and the connector pin over the Allen key and again screw them together. After this the glass rod can be put in. It has to be pushed into its bracket up to the stop against the resistance of its bracket.



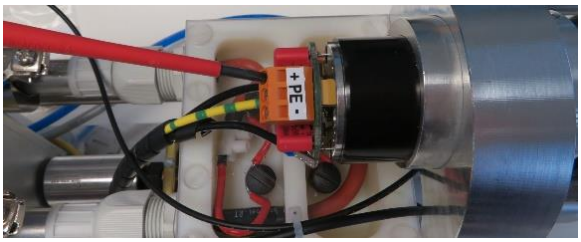

8. Now the O ring can be taken out of the slot of the stator sleeve and the connector pin can be removed with a 1.5 Allen key.

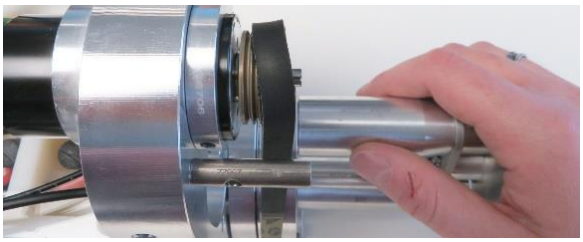



9. The rotation sensor of the the rotation for the rotation monitoring (RCM) and the lens for the light guide monitoring und (LCM) are mounted in a bracket. This is behind the drive belt and underneath the motor. For the replacement, merely both fixing screws have to be removed. The light guide has to be pulled from the circuit board on the upper cover plate, before this push off the circlip and the rotation sensor can be removed from the terminal contacts in the back part of the nozzle. Now the mounting block including wiring can be taken out of the nozzle. The rotation sensor can be individually exchanged. The light guide is moulded with the block. In mounting afterwards, it must be observed that the rotation sensor is positioned in the distance of exactly 2 mm to the rotating pulley of the plasma generator.

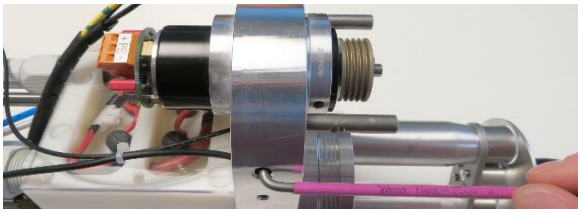



10. For the replacement of the drive motor of the rotation, first remove the cables from the connection terminal on the circuit board on the motor. Then remove the drive belt on the side with one hand, with simultaneous turning of the large pulley, from the motor pulley.





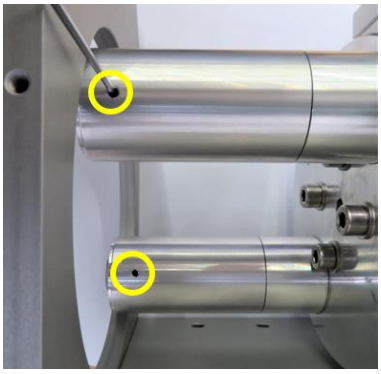
11. Now the drive motor can be removed from its mounting. For this remove the two set screws right and left of the motor. The motor can now be pulled out of the bracket with the eccentric clamp. With an exchange of the motor, the toothed belt disc has to be fixed with a distance of 1mm to the front ball bearing on the motor shaft. For the assembly of the motor afterwards, it has to be put into the eccentric clamp again. The eccentric clamp is then put into the bracket intended for it up to stop. Now the drive belt is mounted in reverse sequence. Finally tension the drive belt by turning the eccentric clamp. In so doing make sure that the belt lies parallel. This parallel position of the belt is to be checked with a suitable measuring instrument and can be influenced by the slot position of the motor in the eccentric clamp. When this has occurred, the motor has to be fixed again over the side setscrews.



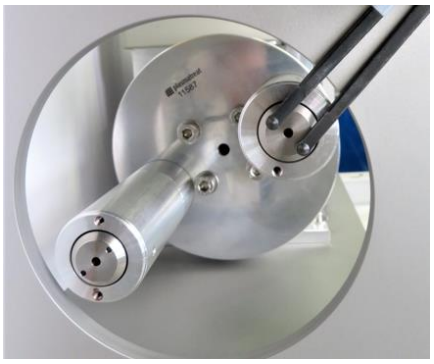

8.6.5 PLASMA JET RD1010

1. Remove the screws that holds the cover disc.
   Loose the screws that hold the jet-head in the stator.

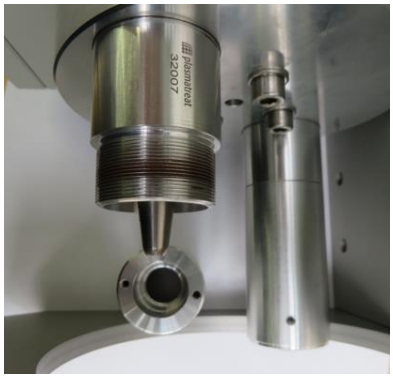


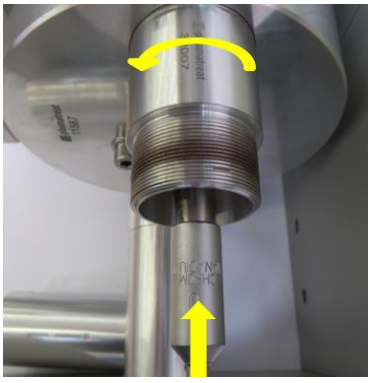


2. To replace the nozzles, screw them out with using the face spanner #21755. When installing the nozzle use copper paste on the external thread Type OKS240 #11022.

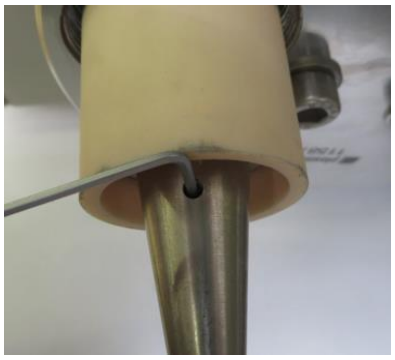


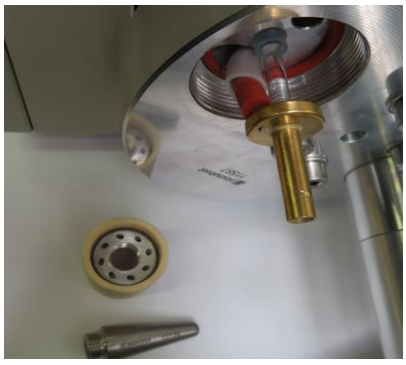
3. Unscrew the upper part of the stator. Then hold the electrodes with an 8 mm inside Hexagon screwdriver and unscrew the lower part of the stator by turning it.



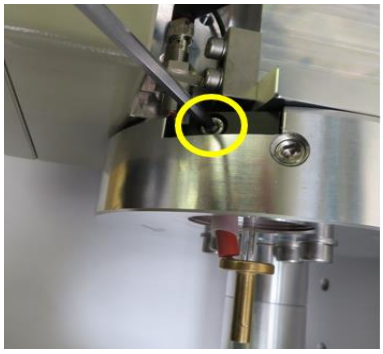


4. Loose the holding screw of the rotor and remove the ceramic part.



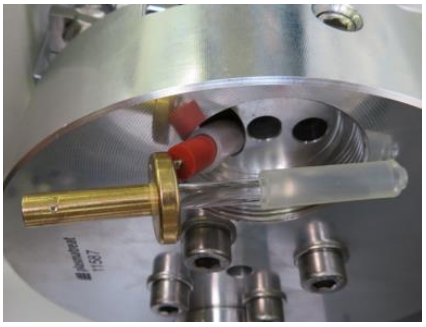


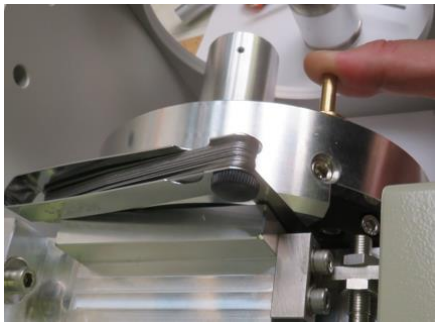
5. To replace the glass rod loosen the fixing screw with a hexagon socket. Carefully remove the glass rod and remove the O-ring.
6. Clean the parts with industrial cleaner. Replace defective and worn parts.



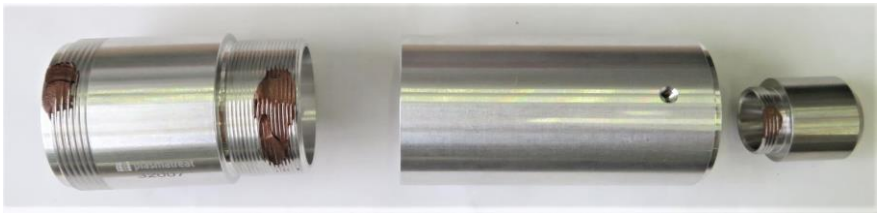


7. Operate the steps 5 to 1 in reserve order. Note the distance between the glass rod and the lens. The distance must be 0,3 mm. Use a feeler gauge while fixing the retaining screw.





8. Before remounting the stator, put a drop copper paste on the outside threads oft he stator and the nozzle.



9. To replace the carbon brushes remove first the cover from the iso block and open the flap of the brush holder.

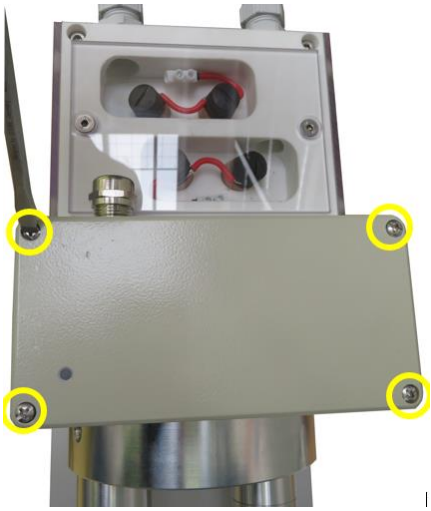




10. Remove the carbon brush and replace it when worn.



11. The ground carbon brush is located under the LCM module. Loosen the four screws of the cover. Remove the LCM by removing the four screws ans remove the carbon brush cap.



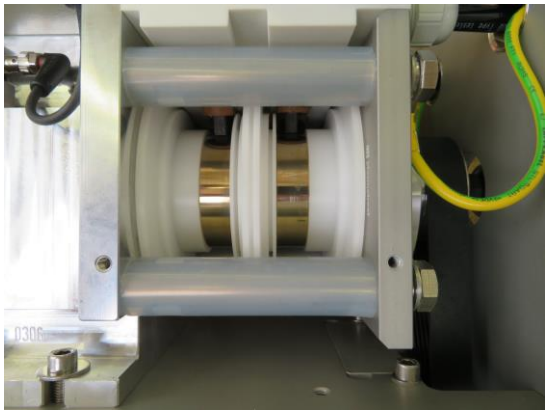




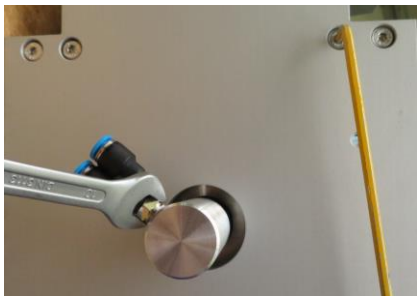
12. Replace the carbon brush if it is worn.



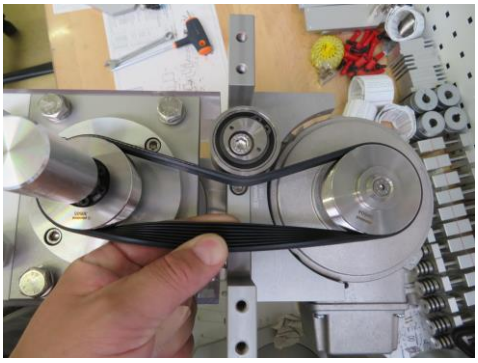
13. Open the cover of the slip ring area and clean it with compressed air.



14. To service the drive belt, remove the air connection of the rotary and remove the back plate.



15. Check the belt for abrasion and check the position of the belt on the V-belt disc. Adjust the belt tension at the deflection pulley.





16. If a belt tension gauge is availible, check the tension.
The vibration frequency at the large belt side should be between 90 and 100 Hz

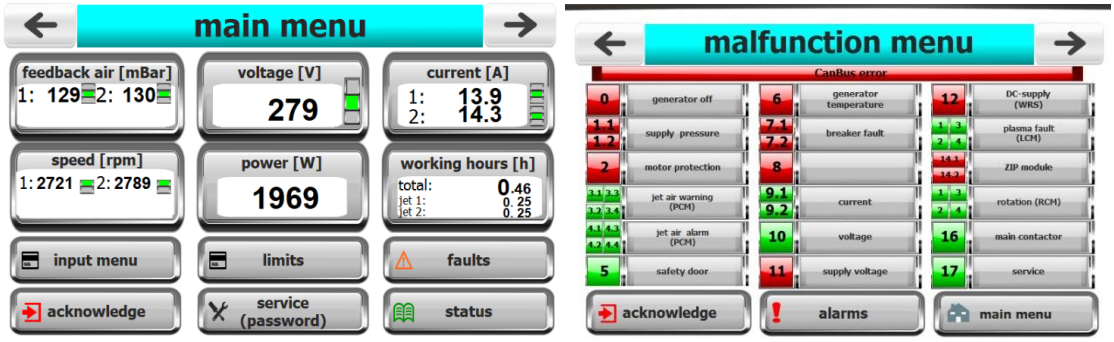


9 PROBLEMS AND ERROR MESSAGES

Most faults are displayed with a corresponding message on the control panel. An optional rotary beacon or horn can also be installed as an additional signal for malfunctions or faults.

9.1 FAULT MESSAGE ON THE CONTROL PANEL

If there is a fault, this is indicated by the flashing red field around the fault menu button. In the fault menu, the error message is displayed.



9.2 SERVICEKONTACT

If the cause of the error cannot be determined or the error cannot be fixed, contact the customer service of Plasmatreat which is responsible for your region:

Region	Phone-No	Mail
Amerika	+1 905 8162 350	service@plasmatreat.com
Europe	+49 5204 9960 1400	service@plasmatreat.de
Asia Pacific	+65 6562 8970	service.singapore@plasmatreat.com
Japan	+81 3 3244 0041	service@plasmatreat.jp
China	+86 21 61940 100	service@plasmatreat.com.cn

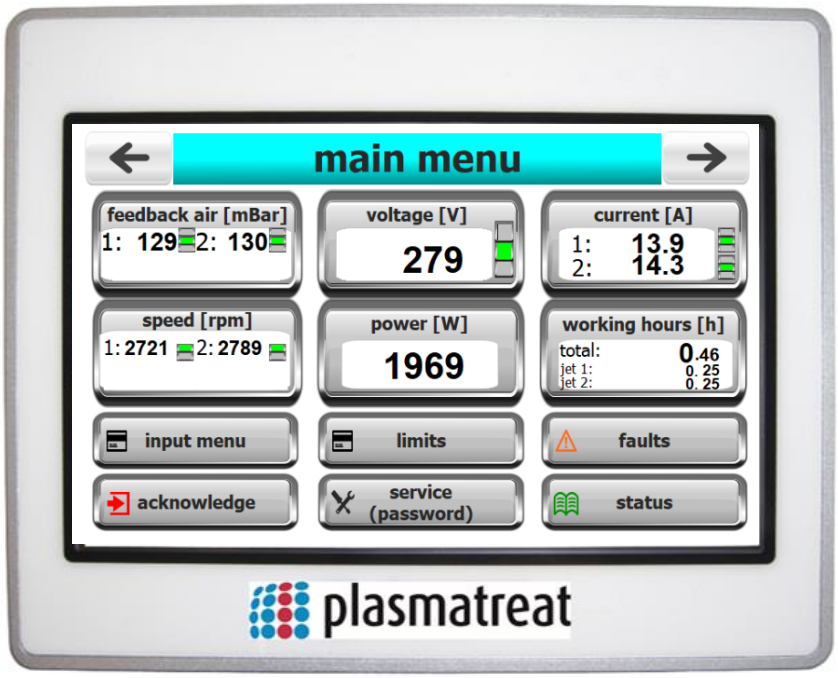
10 USER MANUAL CONTROL PANEL

User manual
Control panel

FG5002S/FG5005S

V7.0

16.04.2019



DANGER!

High Voltage!

- Please observe the instructions for handling high voltage systems as in the previous manual sections as appropriate.

10.1 SWITCHING ON THE CONTROL PANEL

To turn on the control panel, perform the following steps in the following order.

- Switch on the main switch
- Wait until the initialization has finished and the start screen appers
- Touch the "please press" button to enter the Main Menu.

The images in this manual are based on a FG5005S with two transformers (HTR12) and two rotating jets (RD1004).

10.2 START-UP SCREEN

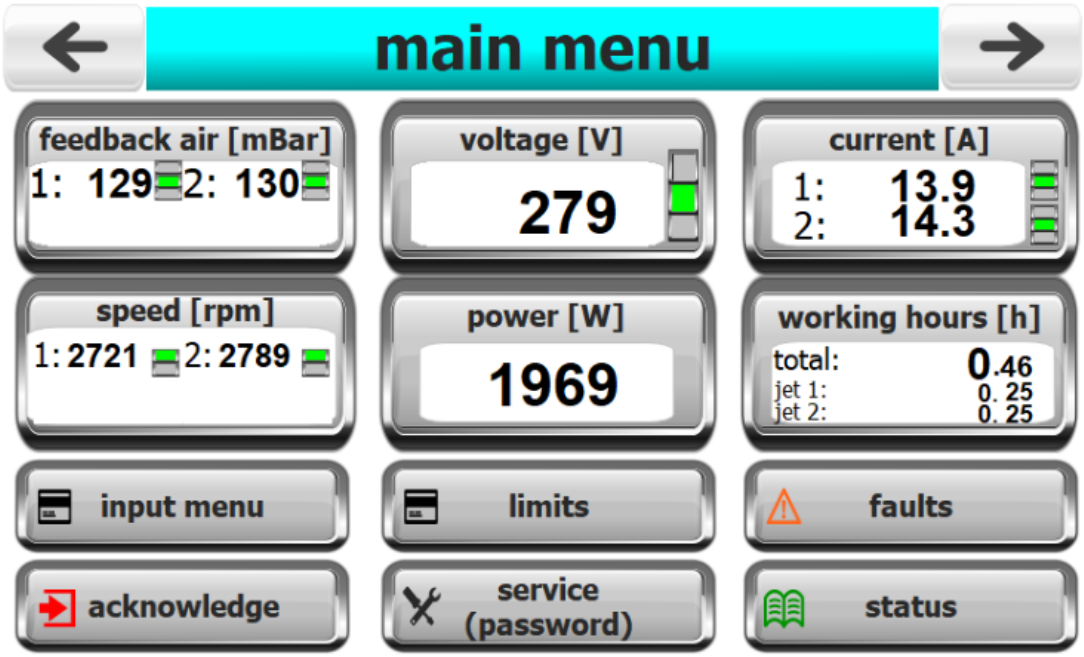
After switching on the system the software gets initialized and the start-up screen appears. This screen contains basic information about the manufacturer Plasmatreat. It displays the address, the phone and fax number and the e-mail address of Plasmatreat. In addition the current date, time and program version is displayed.



10.3 MAIN MENU

The active process data are displayed in the upper six display areas. By touching the particular areas you can change into the diagram view to see value trends.

By touching one of the lower six buttons you can open the respective menu. In the following chapters you will find detailed information about these menus.

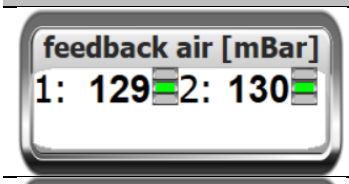
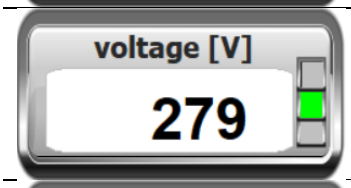
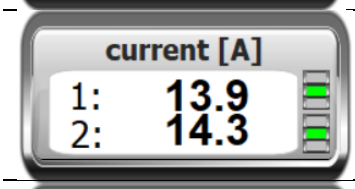
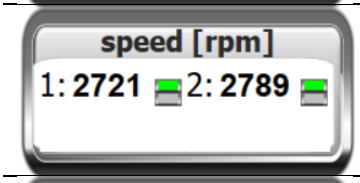
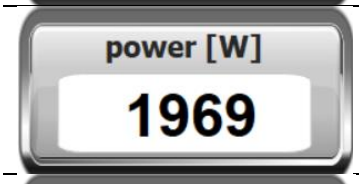
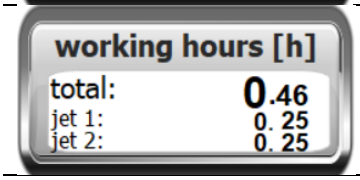
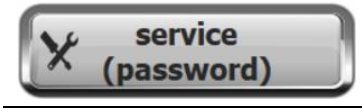


The green and red lights next tot he parameters indicated if the value is

within the limit

or not in the limits

The display area “speed [RPM]” will be only displayed if a rotating jet is attached.

Display Area	Purpose
	Displays the jet's air pressure (in mbar)
	Displays the WRS module's output DC bus voltage (in V)
	Displays the WRS module's output current (in A)
	Displays the rotation jet's speed (in rpm) (only displayed if rotation jet is used in system)
	Displays the system's total power (in W)
	Displays the system's/jet's working hours
	Opens the input menu
	Opens the limit menu
	Opens the malfunction menu
	Acknowledges all faults
	Opens the service menu, a password is required
	Opens the status menu

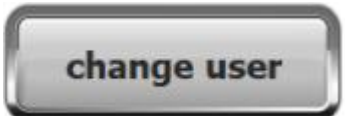
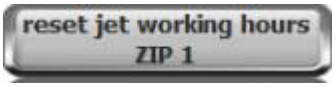
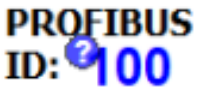
10.4 SERVICE MENU

The service menu displays the power, the total working hours and the jets' working hours. Moreover you can change the language and the user type. If you are logged in as a "Master" more options will be available in the service menu



The following table shows the change rights that you have as operator, master or without login.

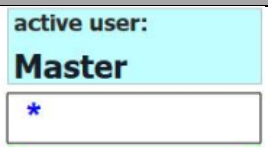
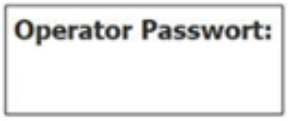
	User		
Parameter	**None**	**Operator**	**Master**
Change language	✔	✔	✔
Change user	✔	✔	✔
Turn off LCM1/2	✘	✘	✔
Permanent air jet 1/2	✘	✘	✔
Reset jet working hours. ZIP 1/2	✘	✘	✔

Button	Purpose
	Opens the user management menu (Ch. 10.4.1)
	Opens the service I/O menu(Ch. 10.4.2)
	Resets the jets‘ working hours
	Opens the configuration menu (Admin/Plasmatreat access only)
	Allows change of the Profibus address of the control panel
	Turns off the LCM1/2/3/4 (Light Control Module)
	Air is permanently on
	Language selection
	Opens the main menu

10.4.1 USER MANAGER MENU

You can log in as an "Operator", a "Master" or you can stay logged out. As a "Master", you are able to change every adjustable value including the "Operator's" password. As an "Operator", you can change a restricted set of parameters. If you are not logged in, you will not be able to change any parameter. Please find the exact setting options for the users in the respective Chapter. Please find the passwords in Chapter 11.11



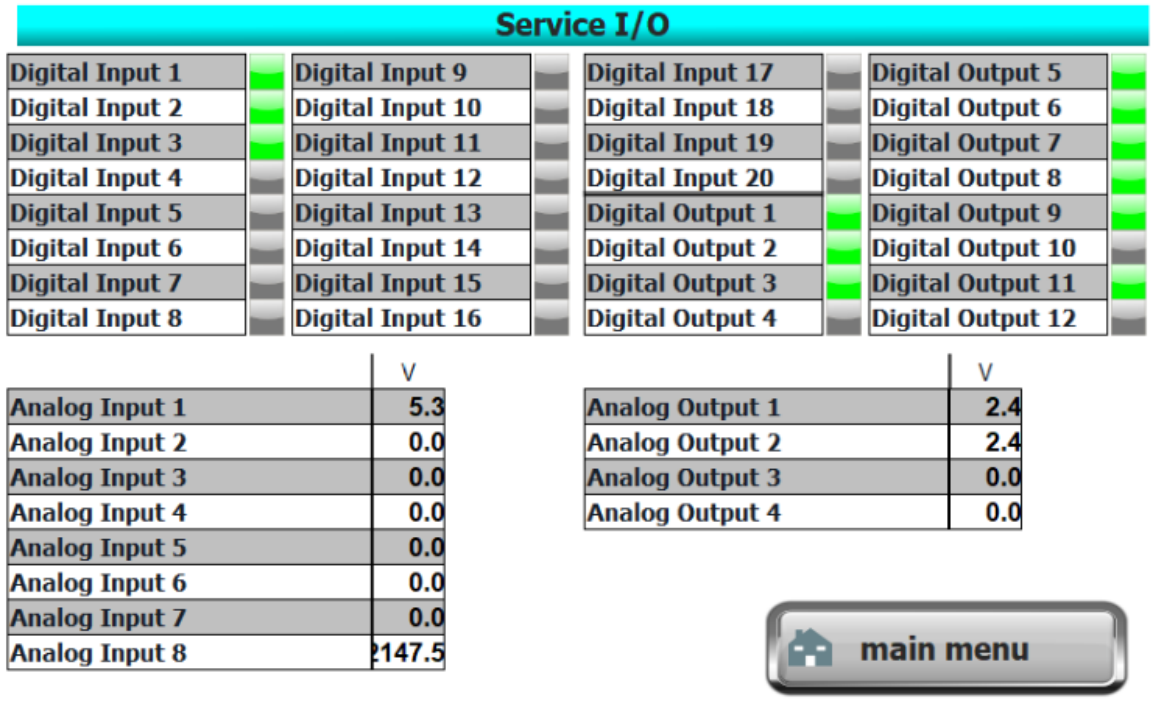
Button	Purpose
	Displays the current user / password input
	By tapping the button you remain logged in as Master until the system is switched off. If you do not select the option, you will be automatically logged out after 3 minutes
	Changes the Operator password. It is important that the Operator password is never set to be the same as the Master password.

10.4.2 SERVICE I/O

The service I/O menu displays the in- and outputs' statuses. The digital and analog in- and outputs are physically located on the rear of the touch panel.

= In- / Output active

= In- / Output inactive

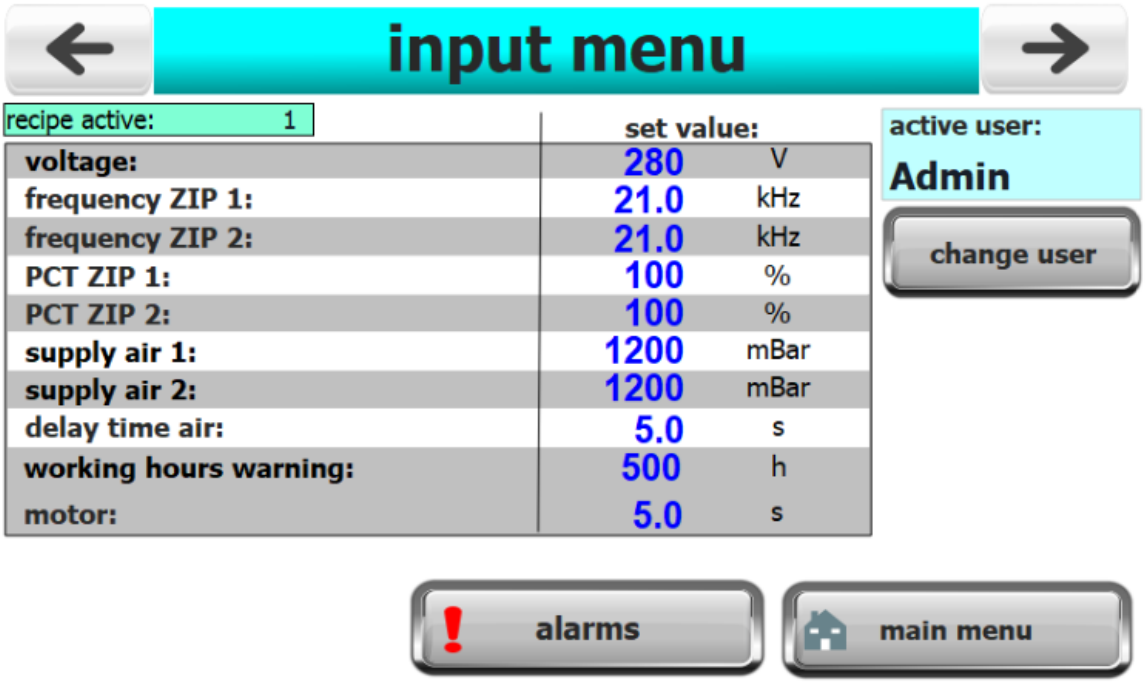


10.5 INPUT MENU

The input menu displays the active set values. If you are logged in as an “Operator” or “Master” you will be able to change several parameters. The user status is displayed in the upper right corner. Set values are activated immediately, even if the system is currently active and producing plasma.

The values are stored as recipes, with the active recipe displayed in theupper left corner.

The following table depicts the rights to change values dependent of the logged in user type. For more details concerning user management look at Chapter 10.4.1



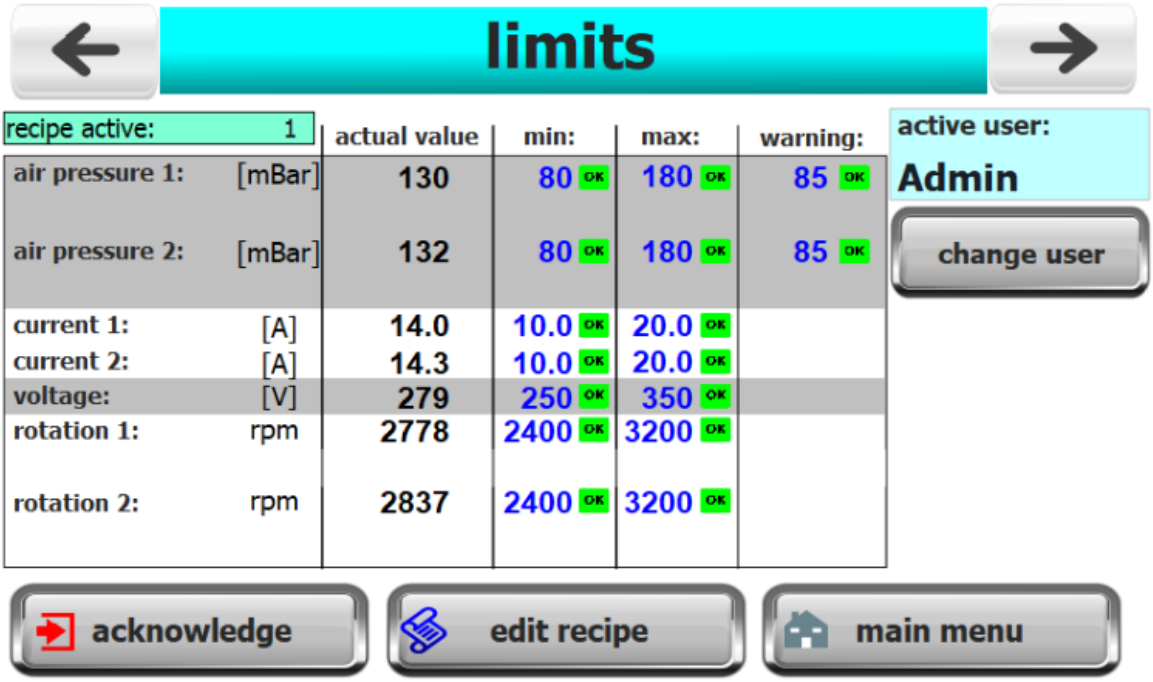
Parameter	User None	Operator	Master
Voltage	✘	✔	✔
Frequency ZIP	✘	✔	✔
PCT ZIP	✘	✔	✔
Supply Air	✘	✔	✔
Delay time air	✘	✘	✔
Working hours warning	✘	✘	✔
Motor overrun	✘	✘	✔

10.6 LIMIT MENU

The Limits menu gives an overview of the upper and lower limits of the plasma treatment parameters. If the actual value is above or below the limit values, a fault is generated and the plasma is switched off.

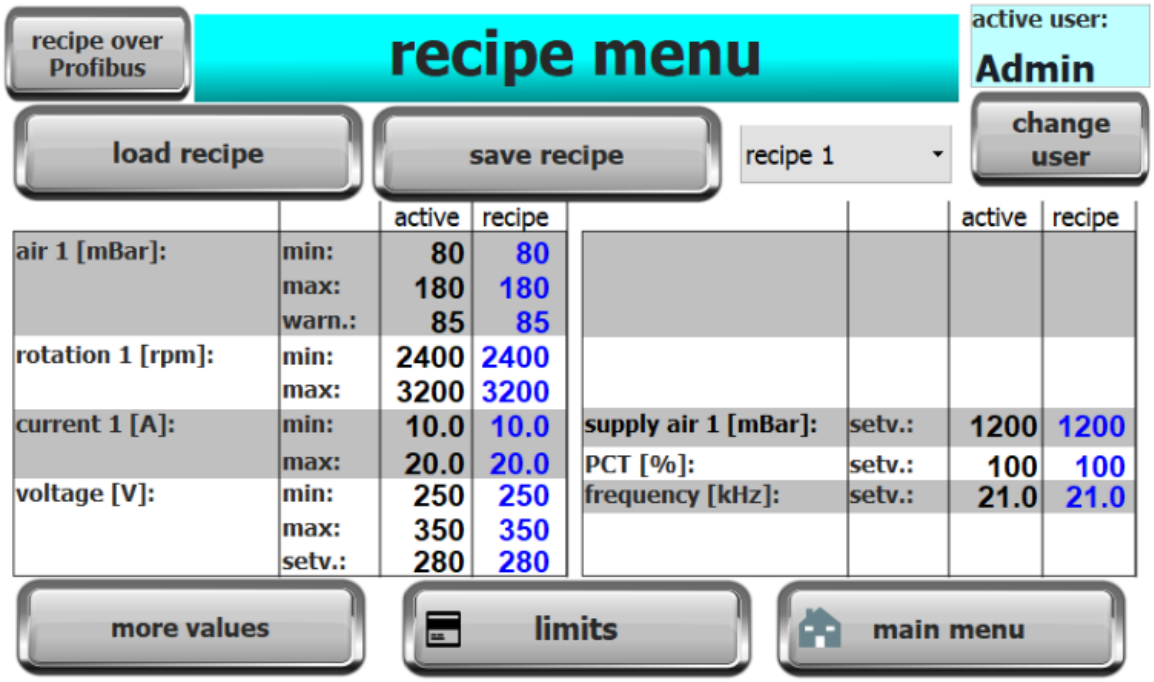
For some parameters, a warning can be generated whose limits are narrower than in the event of a fault. A warning is generated, but you can continue working with the system. The warning indicates that action is required at the next opportunity, for example replacing a worn nozzle head.
The limits can only be changed if you are logged in as master.

If you are logged in as master, the "Edit recipe" button appears.



10.6.1 RECIPE MENU

In the recipe menu you can load preset parameter sets or save modified parameter sets. The blue parameters in the column “recipe” correspond to the values of the selected recipe. The black parameters in the column “active” correspond to the active parameters. At the recipe menu’s first page there are the values of the first and second jet. If more jets are installed the respective parameters can be viewed by touching the button “more values”.



Button	Purpose
load recipe	Activates the selected recipe’s values, transfers the values in the column “recipe” into the column “active”
save recipe	Saves the active values into the selected recipe, transfers the values in the column “active” into the
recipe 1	Dropdown menu for recipe selection
more values	Displays for parameters for jet 3 and 4
recipe over Profibus	Enables the recipe selection via Profibus (extern)

10.6.1.1 SAVE RECIPE

1. Change values in the input and limit menu
2. Open the recipe menu
3. Select a recipte in the dropdown menu
4. Touch the button „ save recipe“
5. The active values are saved into the selected recipe

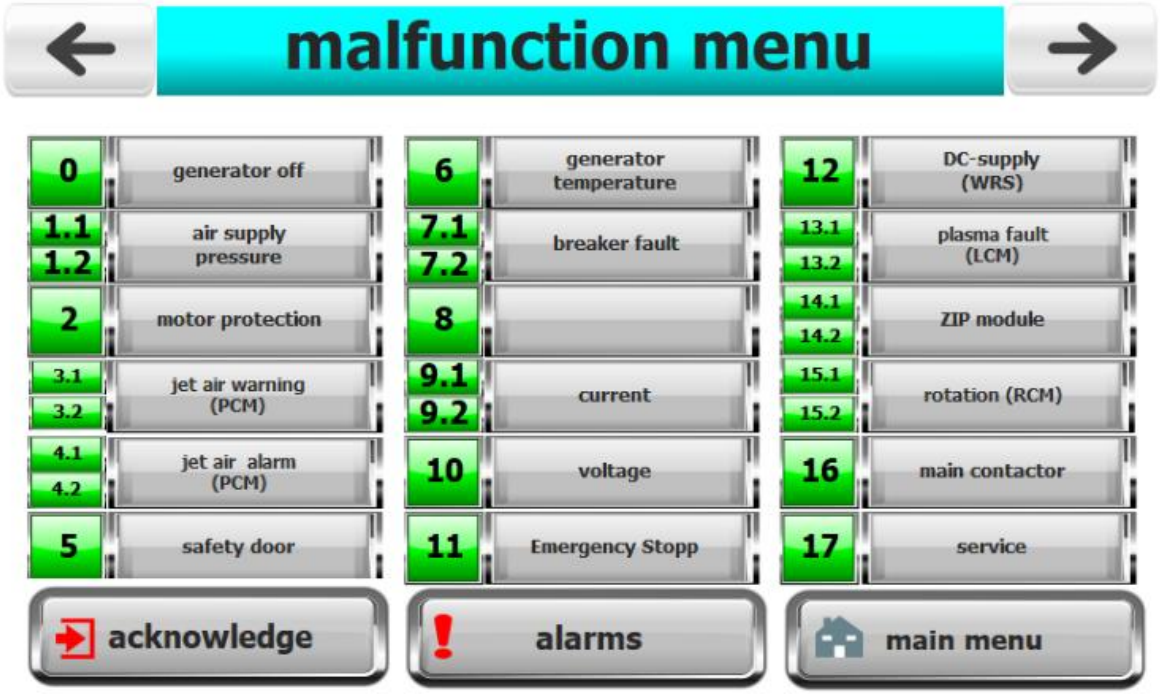
10.6.1.2 LOAD RECIPE

1. Open the recipe menu
2. Select a recipe in the dropdown menu
3. Touch the button „load recipe“
4. The selected recipe’s values are activated

10.7 MALFUNCTION MENU

The malfunction menu displays potential malfunctions of several components. The cause and solution can be displayed by touching the malfunction button of the respective component.

9	Green display area	=	no malfunction
0	Red display area	=	Malfunction



10.7.1 MALFUNCTION CAUSE AND SOLUTION

By tapping the buttons in the fault menu, you can view the cause of the malfunction and the remedy.

Message	Green	Red
generator off	System in "generator ready" state DC bus voltage present. Generator is waiting for release.	System in "Generator off" state No DC link voltage present. If there is no fault and the emergency stop circuit is closed, the generator can be started.
air supply pressure	The dynamic pressure measured in the plasma nozzle (directly after switching on) is higher than the "plasma starting air" indicated in the "Configuration menu"	The dynamic pressure measured in the plasma nozzle (directly after switching on) is lower than the "plasma starting air" stated in the "Configuration menu ➢ Check compressed air supply ➢ Feedback hose connected? (blue PUN6)
motor protection	The safety chain through the auxiliary contacts of the motor protection switch is closed.	A motor protection switch has tripped ➢ Determine cause of excessive current flow (short circuit, defective motor) ➢ To high temperature in the control cabinet?

jet air warning (PCM)	 The dynamic pressure measured in the plasma jet is higher than the "air pressure warning" indicated in the limit menu.	 The dynamic pressure measured in the plasma nozzle is lower than the "air warning" indicated in the limit menu. The system will continue to function, but the warning should be addressed as soon as possible: ➢ Check the nozzle for wear ➢ Check the compressed air system for smal leaks
jet air alarm (PCM)	 The dynamic pressure measured in the plasma jet is higher than the "air pressure wa" specified in the limit menu and lower than the "air pressure max".	 The dynamic pressure measured in the plasma nozzle is lower than the "air pressure min" or higher in the limit menu than the "air pressure max" ➢ Check the nozzle for wear ➢ Check the compressed air fo leaks ➢ Actual value when starting in the main menu ➢ Setpoint in the input menu ➢ Setpoint when starting the digital pressure regulator
safty door	 Safety doors and control cabinet doors with safety switches are closed.	 Protective door or control cabinet door with safety switch is open

generator temperature	Temperature in the generator lower than set on the sensor (in the generator) or lower than specified in the limit menu, for systems so equipped.	Temperature in the generator higher than set on the sensor (in the generator), or higher than specified in the limit menu. Locate and correct cause of overheating.
breaker fault	The auxiliary contacts of all circuit breakers are closed.	The auxiliary contact of a circuit breaker has tripped. Find and correct cause of excessive current.
current	The primary current through the high voltage transformer (see main menu) is within the limits specified in the limits menu	The Primary current through the high voltage transformer (see main menu) is outside the limits specified in the limits menu. ➢ To smal: X90 plugged in correctly? ➢ To large: Check nozzle parts and high-voltage transformer and cabling for wear and defects.
voltage	D The generated DC link DC voltage (see main menu) is within the limits specified in the limits menu.	The generated DC bus DC voltage (see main menu) is outside the limits specified in the limits menu. ➢ Check DC-DC function

<table>
<tr>
<td>DC-supply (WRS)</td>
<td> WRS fully functional.</td>
<td> WRS has an error message. 4 status LEDs generate an error code
<table>
<tr><th>D</th><th>C</th><th>B</th><th>A</th><th>STATUS</th></tr>
<tr><td>○</td><td>○</td><td>○</td><td>○</td><td>NO FAULT</td></tr>
<tr><td>●</td><td>●</td><td>●</td><td>●</td><td>RESET</td></tr>
<tr><td>○</td><td>○</td><td>○</td><td>●</td><td>CAN BUS FAULT</td></tr>
<tr><td>○</td><td>○</td><td>●</td><td>○</td><td>FAULT IGBT DRIVER</td></tr>
<tr><td>○</td><td>○</td><td>●</td><td>●</td><td>OVERSHOT OUTPUT VOLTAGE</td></tr>
<tr><td>○</td><td>●</td><td>○</td><td>○</td><td>OVER TEMP 70°C</td></tr>
<tr><td>○</td><td>●</td><td>○</td><td>●</td><td>OUTPUT SHORTCIRCUT</td></tr>
<tr><td>○</td><td>●</td><td>●</td><td></td><td>3 PHASE LOSS</td></tr>
<tr><td>○</td><td>●</td><td>●</td><td>●</td><td>1 OR 2 PHASE LOSS</td></tr>
<tr><td>●</td><td>○</td><td>○</td><td>○</td><td>NO PHASE AFTER RELEASE</td></tr>
</table>
</td>
</tr>
<tr>
<td>plasma fault (LCM)</td>
<td> The LCM module has detected plasma at the jet and reports "Plasma OK" to the controller.</td>
<td> The LCM module has detected an interruption in the optical monitoring of the plasma jet and reports "plasma errors" to the controller.
➢ Check the interior of the nozzle for wear and damage
➢ Check the optical fiber for damage</td>
</tr>
<tr>
<td>ZIP modul</td>
<td> ZIP fully functional.</td>
<td> The ZIP module has shut down either of the high temperature on the board or too high current at the output to the high voltage transformer.</td>
</tr>
<tr>
<td>main contactor</td>
<td> The main contactor is functioning properly.</td>
<td> The main contactor did not apply during switch-on.</td>
</tr>
</table>

rotation (RCM)	The number of revolutions of the rotary nozzle (see main menu) is higher than the "RPM min" specified in the limit menu and lower than the "RPM max".	The number of revolutions of the rotating nozzle (see main menu) is lower than the "RPM min." Or higher than the "RPM max." Indicated in the limit menu. ➢ Motor, toothed: Check the smooth running oft he bearings ➢ Check function and distance of sensor
service	The operating hours of the nozzles are lower than the "operating hours warning" indicated in the limit menu	The operating hours of the nozzles are higher than the "operating hours warning" indicated in the limit menu
emergency stopp	The Emergency stop switches on the system are not actuated.	An emergency stop switch has been actuated.

10.7.2ALARMLIST

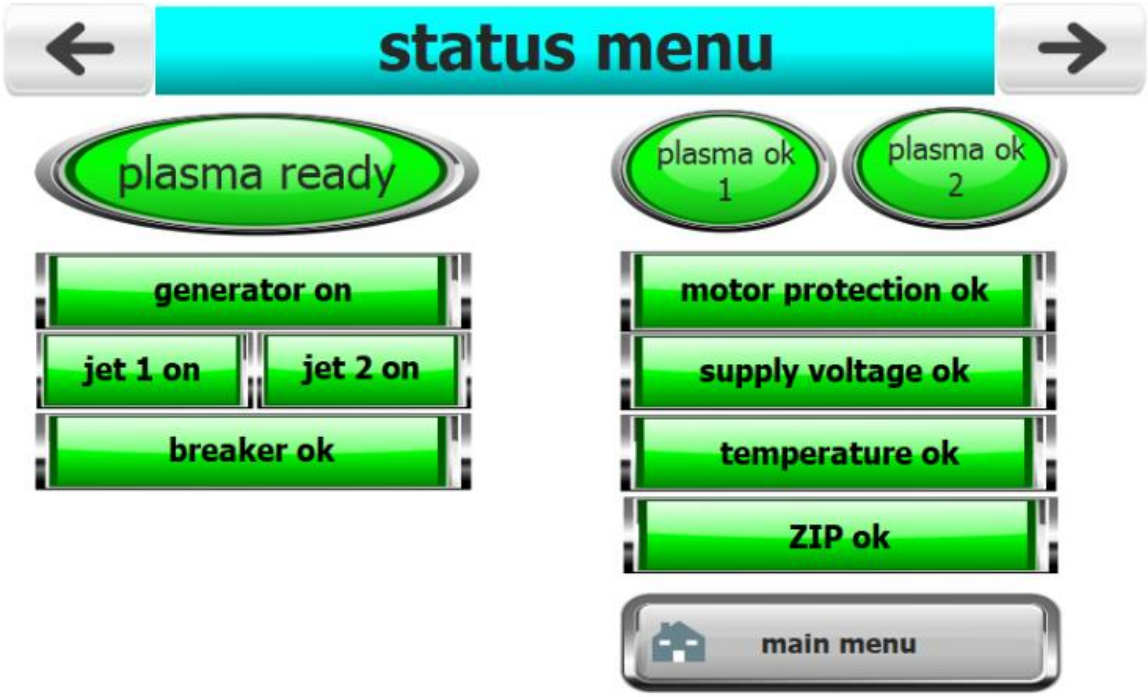
The alarmlist displays current alarms in chronological order.



Button	Purpose
5 Mins	Dropdown menu to select the period of the displayed alarms
Refresh	Refreshes the alarmlist
Backward	Opens the alarm list's previous page
Forward	Opens the alarm list's following page

10.8 STATUSMENU

The status menu shows you the status of the complete system, which consists of different components, such as control technology and plasma-specific modules. If you are logged in as Master, an additional button will appear via which you can call up the Status CAN bus menu.



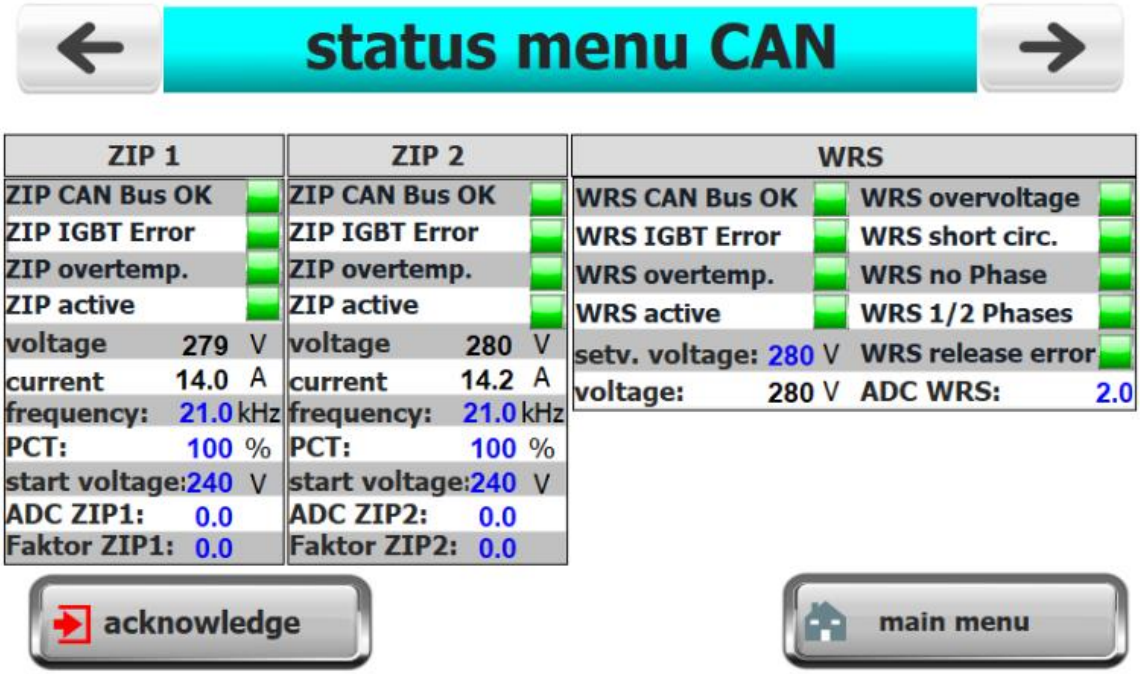
10.8.1STATUSMENU CAN

This status menu displays the CAN Bus' status and transmitted values. Furthermore, you can adjust the frequency, PCT and set voltage.

= Status OK

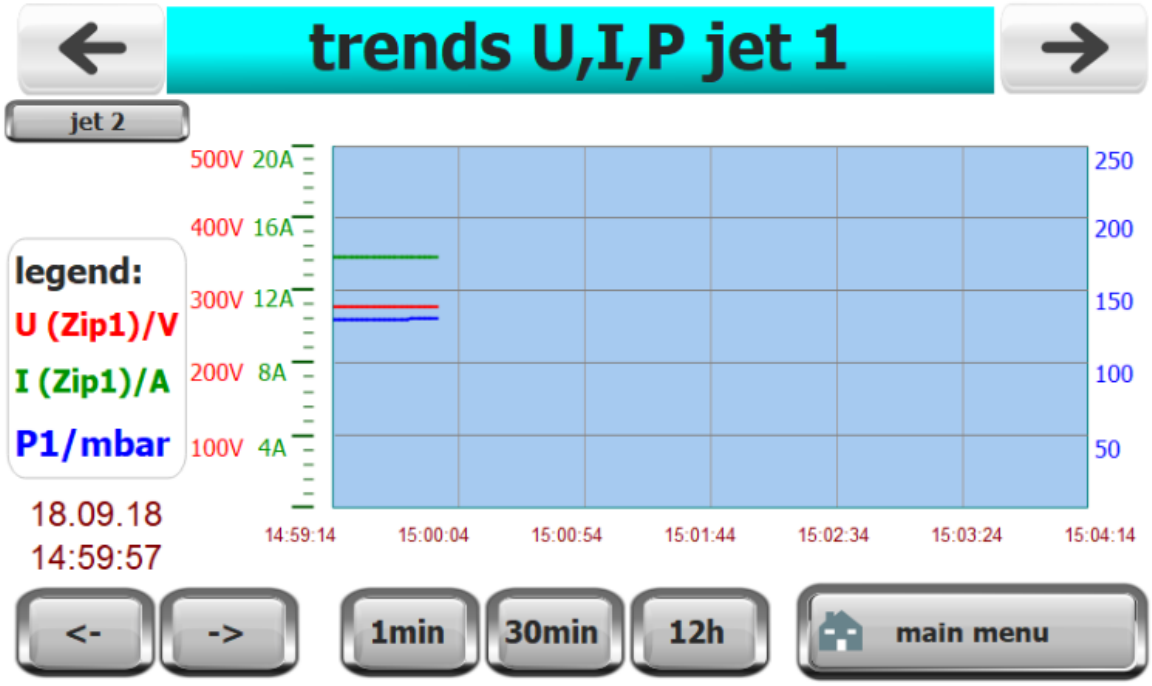
= Status not OK

= No release available



10.9 CHART VIEW

The chart view shows the graph of voltage, current and compressed air over time. These 3 parameters are shown together for a jet together in a diagram. You can use the jet 2/3/4 button to call up the chart view of the additional jets. The speed is shown in a separate chart if your system is equipped with rotary jets.



Button	Purpose
<-	Shifts left the time axis
->	Shifts right the time axis
1min	Adjusts the displayed period to 1 minute
30min	Adjusts the displayed period to 30 minutes
12h	Adjusts the displayed period to 12 hours
jet 2 jet 3 jet 4	Opens the diagram of the respective jet

10.10 PROFIBUS/PROFINET/ETHERCAT (OPTIONAL)

A Profibus, Profinet or EtherCAT interface can optionally be integrated into the system. The interface allows monitoring of generator and jet parameters of the plasma treatment system, as well as the selection of recipes.

To configure the Profibus, Profinet or EtherCAT system, please find the respective files for download at the following link:

https://cloud.plasmatreat.de/index.php/s/ZlPg0v6aRVTg1qP

You can find the mappings containing detailed information about the transmitted data packages. Additionally, a sample GSD / GSDML / XML file is provided to configure the bus system.

11 APPENDIX

11.1 APPENDIX A – SPECIFICATION PERSONAL PROTECTION

Specification Personal Protection

Personal protection in connection with the machine types listed below is only guaranteed if a hardware-actuated switch-off of the safety circuit is done from external limiters at the terminal points listed below, e.g., by means of an emergency switch or maximum limit switch.

The Start/Stop function of the generator only actuates an electronic switch-off and is not related to safety.

Generator type	Terminals, safety circuit	Terminals, limit switch circuit	Terminals, electronic Start/Stop function
FG5002S FG5005S	-X40 terminal 3a through 10a	-X 40 terminal 3b through 8b	-X40 terminal 7c and 8c, 9c and 10c

x stands for all further variants

The safety-related integration of the machine into the overall facility is to be done by the customer. In the event that this has not been done or has been done only insufficiently, every guarantee of Plasmatreat Ltd. expires.

The accident prevention regulations in particular are to be heeded when carrying out maintenance and service work on the machine.

Only carry out maintenance and repair tasks when the machine is shut down and with the main switch set at "0" (OFF). Secure the machine against accidental restarting.

The relevant accident prevention regulations and the other generally recognized industrial medical regulations are to be heeded.

The generator cabinet and the flume station had to be connected with the earthing system from the general machine.

Version 19.0, 17.04.2019

11.2 APPENDIX B – DECLARATION OF INCORPORATION

DECLARATION OF INCORPORATION

In accordance with EC Machinery Directive 2006/42/EC, Appendix II,1B

Product: "Incomplete machine for plasma treatment"

For treatment of surfaces using the Openair®-plasma process.

Manufacturer: Plasmatreat GmbH
Queller Straße 76-80
D-33803 Steinhagen

Company representatives authorized to compile the technical documents are Mr. Markus Thiel and Mr. Guido Marks.

The manufacturer hereby declares with regard to the incomplete machine that:

- The machine meets the essential requirements of Directive 2006/42/EC.
- The technical documentation has been prepared according to Appendix VII, Part B.
- System start-up is prohibited until it has been installed in accordance with start-up instructions contained in this manual, and an EC Declaration of Conformity for the whole machine in accordance with Directive 2006/42/EC is present.
- The manufacturer committed, on justified request, to submit the special technical documentation of the incomplete machine in paper or electronic form to the competent national authorities.

Applied Standards and Regulations:

2006/42/EC	EC-rules for machines
2014/35/EU	Low voltage directive
2014/30/EU	Electromagnetic compatibility field regulations
DIN EN ISO 12100:2011-3	Safety of machinery
DIN EN 60204-1:2019-06	Electrical equipment of machines
DIN EN ISO 13850:2016-05	Emergency stop installations
DIN EN ISO 4414:2011-04	Pneumatic fluid power systems
DIN EN 50178:1998-04	High voltage current system
DIN VDE 0100-410:2007-06	Low voltage system
DIN EN 55016-2-3:2010	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements (CISPR 16-2-3:2010 + A1:2010 + A2:2014); German version EN 55016-2-3:2010+A1:2010 + AC:2013 + A2:2014

The machine operating instructions / EC declaration of conformity is available:

In the original language German.

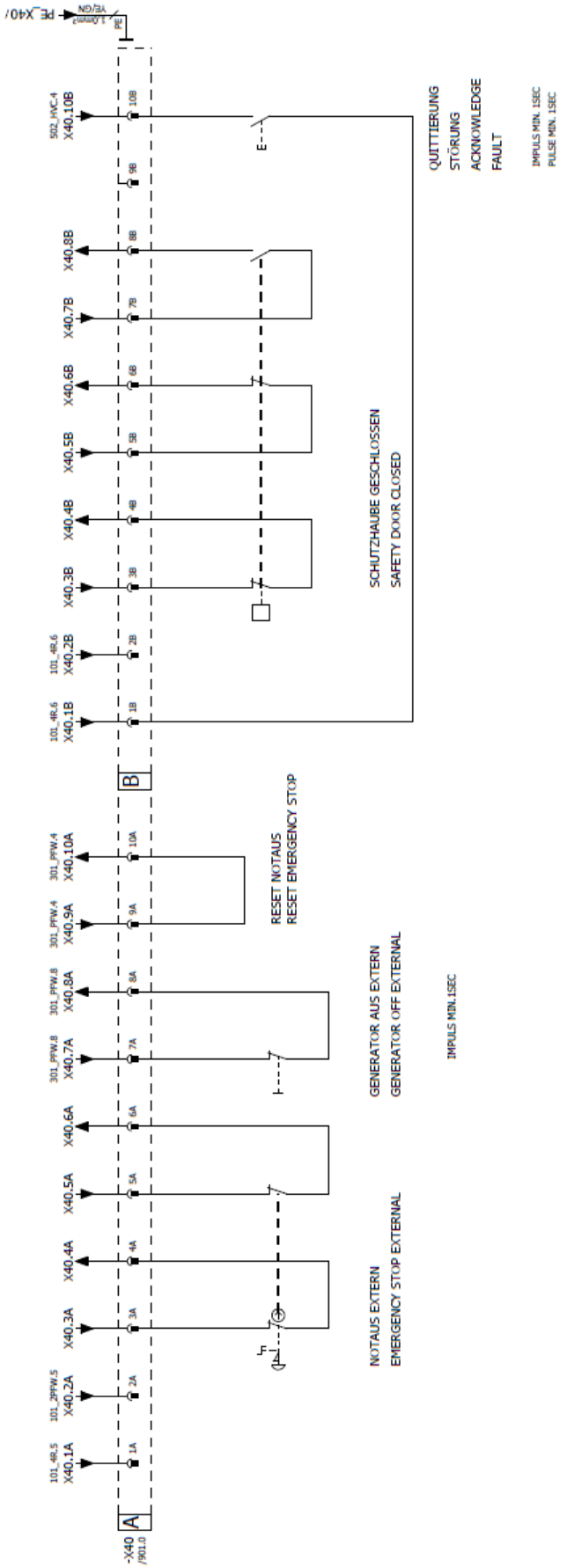
Steinhagen, 17.04.2019
Place and date of issue


Management, C.Buske

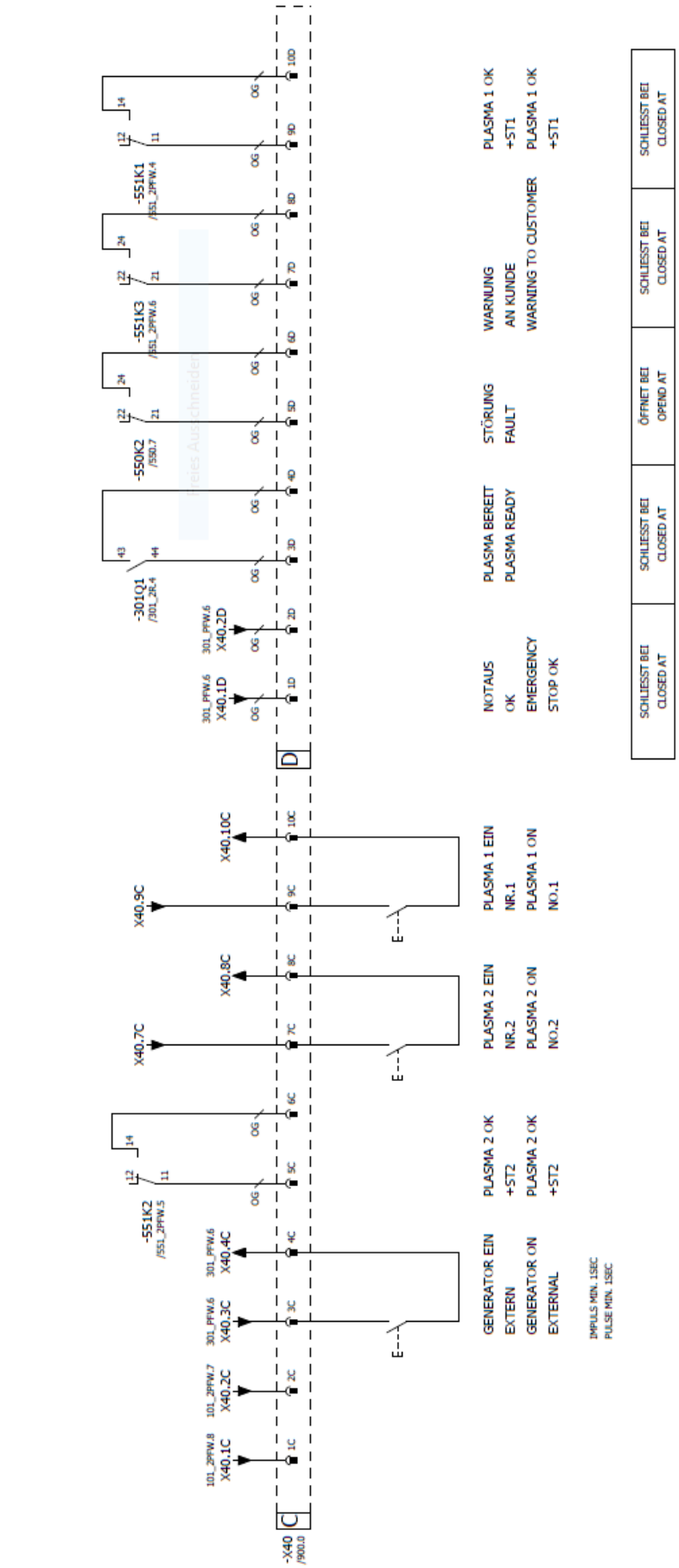
i.A. M.Thiel
Structure, i.A. M.Thiel

11.3 APPENDIX C X40 INTERFACE

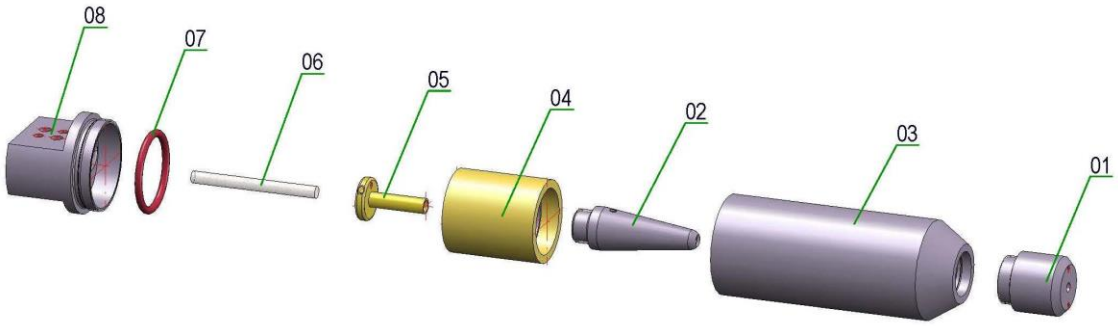
Schematic representation of the client connection by plug -X40:



Schematic representation of the client connection by plug -X40:



11.4 APPENDIX D PARTLISTS PFW10 / PFW10R



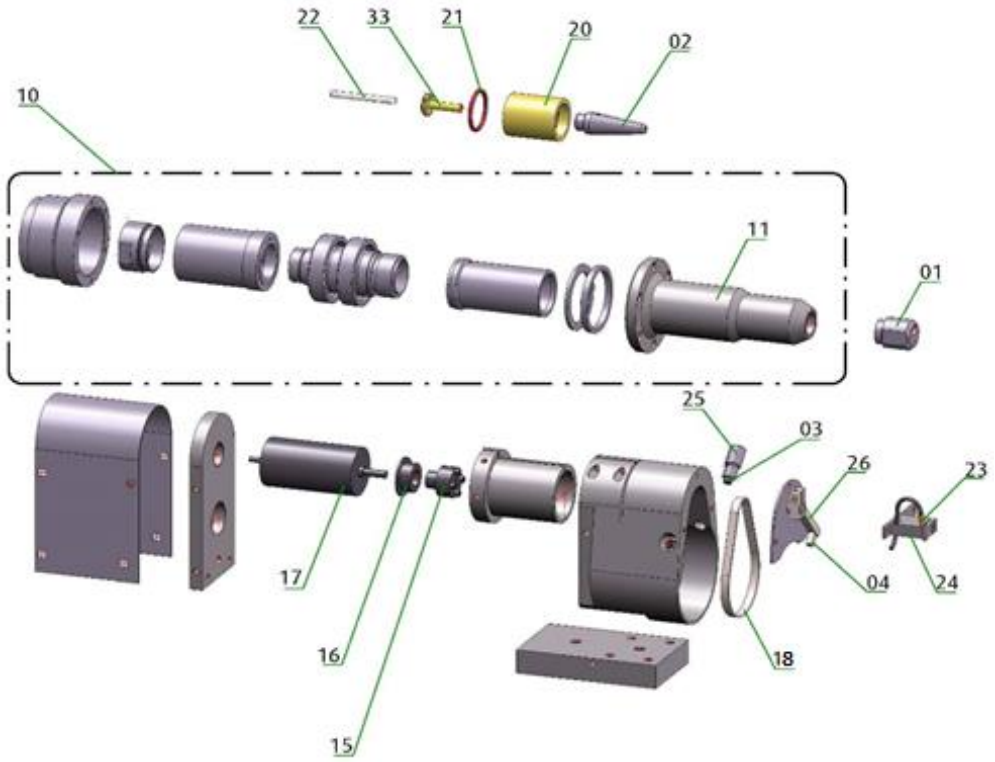
Wear parts

Position no.	Item-no.	Description
01	XXXXX	Nozzle static
02	10139	Rotor, 53 mm

Spare parts

Position no.	Item-no.	Description
03	10144	Stator
04	31930	Ceramic insulator
05	30954	Connector Pin
06	10836	Glass rod 55 mm
07	29460	O-ring
08	10008	Housing

11.5 APPENDIX E PARTLISTS RD1004 / RD1004R



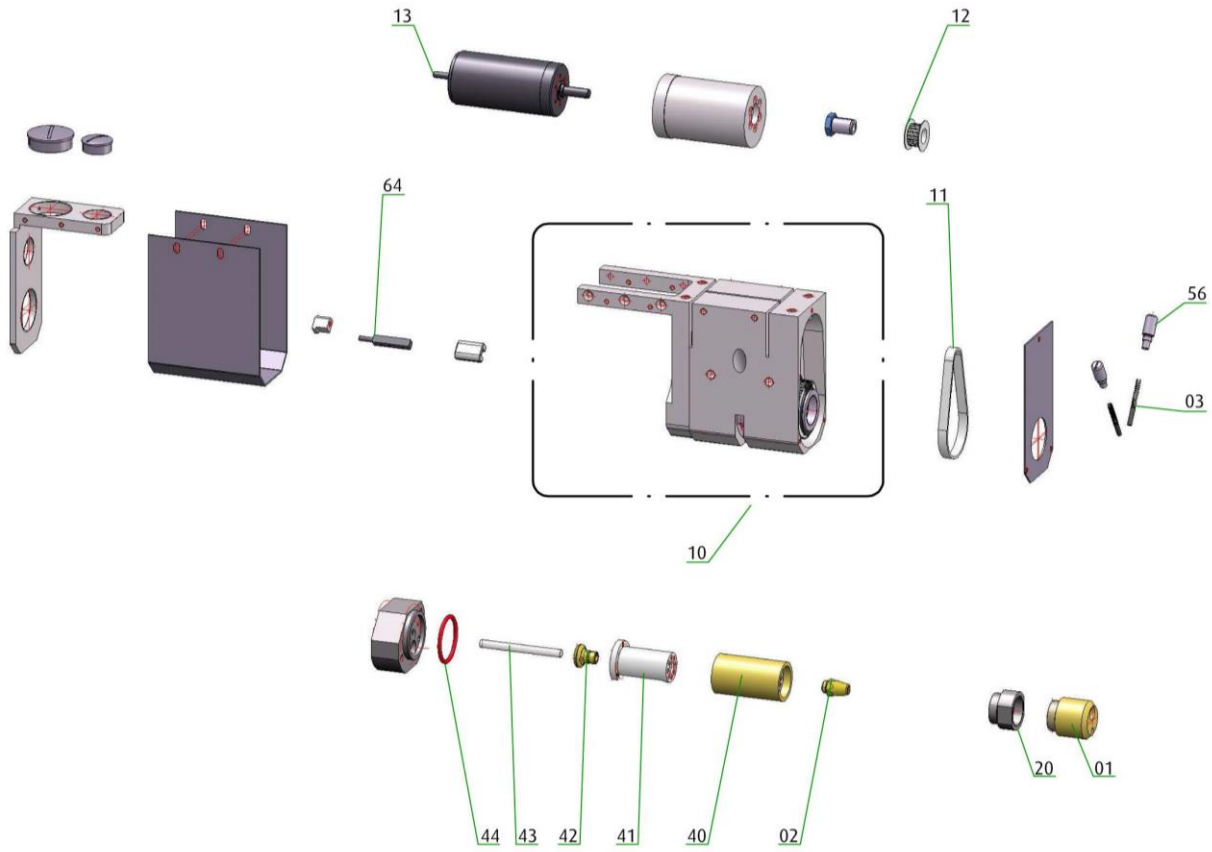
Wear parts

Position no.	Item no.	Descriptiom
01	XXXXX	Nozzle head - rotating
02	10139	Rotor, 53 mm
03	11083	Rounded carbon brush, internal
04	11084	Small carbon brush, external
10	12655	Rotating assembly complete for RD1004 / RD1004R
15	34881	Clamping set
16	11562	Motor pulley
17	32846	DC motor, D: 40mm, 24V
18	10379	Gear Belt

Spare parts

Position no.	Item no.	Description
11	11432	Stator
20	31930	Ceramic insulator
21	29460	O-ring
22	10839	Glass rod, length: 184 mm for RD1004
	12071	Glass rod, length: 174 mm for RD1004R
23	16615	Initiator / proximity switch
24	14053	Holder for initiator
25	31985	Holder for rounded carbon brushes
26	11082	Side holder small carbon brushes
33	30954	Connector Pin

11.6 APPENDIX F PARTLISTS RD2004 / RD2004R



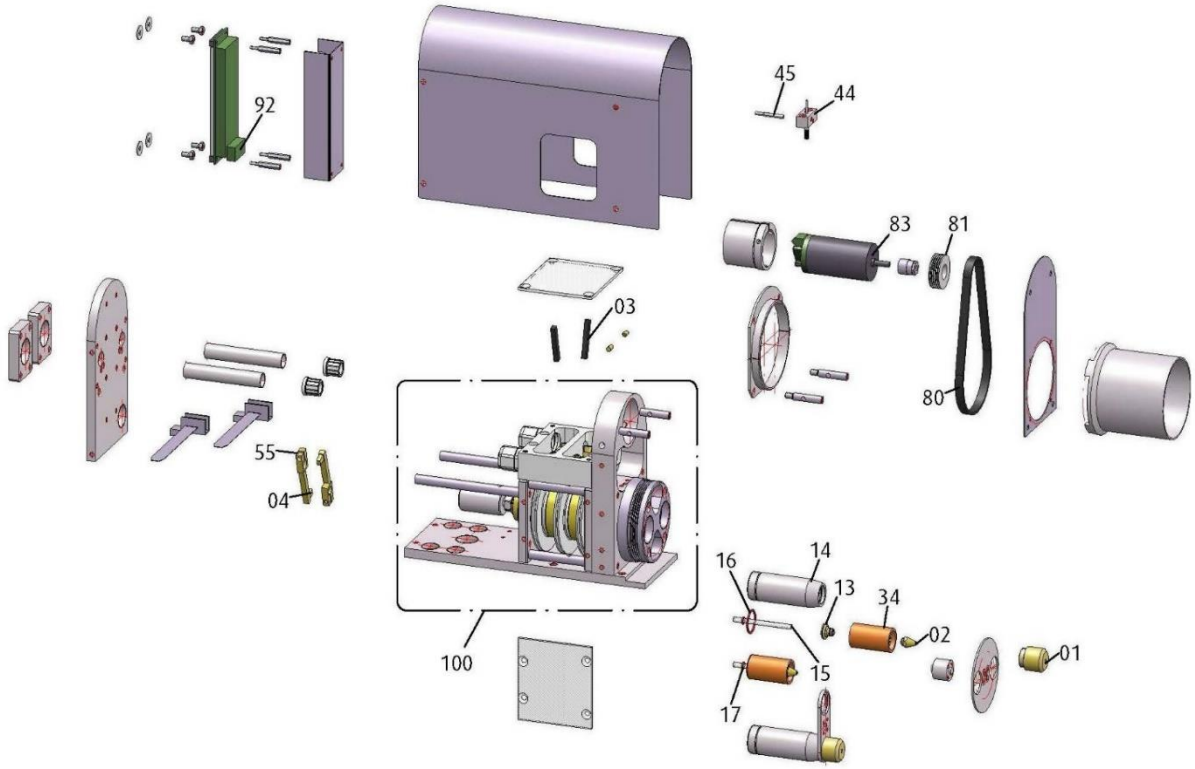
Wear parts

Position no.	Item no.	Description
01	XXXXX	Nozzle head
02	37538	Rotor, 17 mm
03	38638	Carbon brushes
10	40480	Rotating assembly complete
11	39474	Gear Belt
12	37743	Toothed motor pulley
13	35885	DC motor, D: 35mm, 24V

Spare parts

Position no.	Item no.	Description
20	23451	Extension
40	28056	Ceramic insulator
41	30588	Sleeve
42	37720	Connector screw
43	33758	Glass rod, length: 55mm
44	34518	O-ring
64	34521	Initiator / proximity switch
56	38847	Carbon brush holder

11.7 APPENDIX G PARTLISTS RD2005



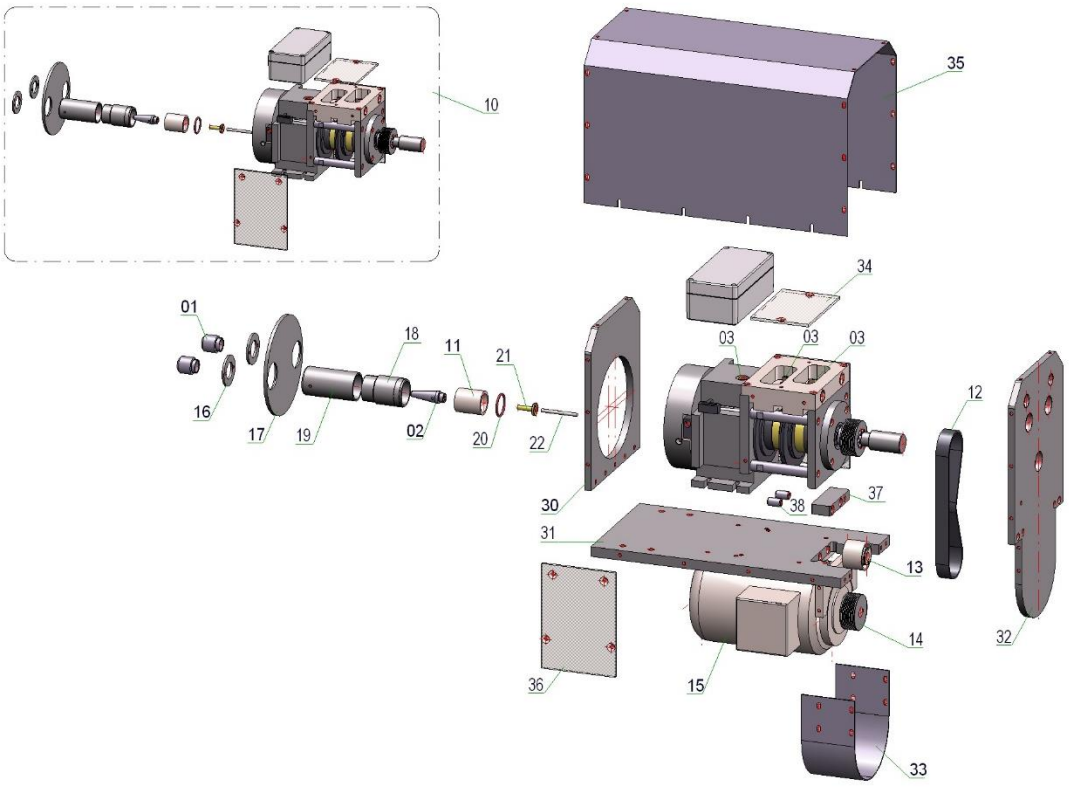
Wear parts

Position no.	Item no.	Description
01	XXXXX	Nozzle head
02	37538	Rotor, 17 mm
03	37661	Carbon brush
04	11084	Carbon brush
80	35287	Ribbed belt, 406 mm
81	37518	Serrated washer, D = 30 mm
83	32846	DC-Motor, 24V

Spare parts

Position no.	Item no.	Description
13	35068	Connection screw
14	26738	Stator
15	33820	Glass rod
16	30140	O-ring
17	35019	O-ring
34	28056	Ceramic isolator
44	32266	LCM unit
45	16615	Proximity sensor
55	11082	Single-leg holder
92	38283	LCM-board

11.8 APPENDIX H PARTLISTS RD1010



Wear parts

Position no.	Item no.	Description
01	XXXXX	Nozzle head
02	10139	Rotor, 53 mm
03	11085	Carbon brush
10	27272	Rotation assembly group, complete for RD1010
11	20604	Ceramic isolator
12	25260	Ribbed belt
13	18912	Serrated washer
14	24937	Tooth disc
15	10984	DC-Motor, 24V
16	10700	disc
17	11589	Cover disc
18	18108	Stator
20	29460	O-Ring
21	30954	Connection pin
22	10838	Glass rod

Spare parts

Position no.	Item no.	Description
30	11775	Front panel
31	33549	Baseplate
32	27266	Backplate
33	26613	Sheet metal hood
34	21585	Blanking cap
35	14400	Tin hood
36	25225	Blanking cap

11.9 APPENDIX I – SELECTION OF STANDARD NOZZLES

11.9.1 NOZZLES FOR STATIC PLASMA JETS

Nozzle	Item-no.	Description	Treatment width
	10145	Opening: 4 mm	ca. 8 mm
	42417	Opening: 4 mm	ca. 8 mm
	42418	Length: 40 mm; opening: 4 mm	ca. 8 mm
	11570	Length: 70 mm; opening: 2 mm	ca. 8 mm
	10148	Length of front part: 54 mm; Ø: 9 mm; opening: 3,0 mm	3 - 4 mm
	15231	Length nozzle body: 37 mm	
	15356	Length of front part: 27 mm; opening: 4 mm	5 – 6 mm
	18510	Length of front part: 64 mm; opening: 4 mm	5 – 6 mm
	15029	Length of nozzle body: 30 mm, low potential	
	20976	Straight front part: L = 10 mm; opening: 4 mm	4 – 5 mm
	18127	Straight front part: L = 25 mm; opening: 4 mm	4 – 5 mm
	19935	Straight front part: L = 30 mm; opening: 4 mm	4 – 5 mm
	17572	Straight front part: L = 50 mm; opening: 4 mm	4 – 5 mm
	36602	Nozzle body	
	36603	Cap nut	
	17345	Wide slit insert	bis zu 14 mm
	15458	Wide slit nozzle head; length: 29 mm	bis zu 25 mm
	31445	Opening: 4 mm; low potential 8 hole variant	7 – 8 mm
	24896	Opening: 4 mm;	7 – 8 mm
	10173	Opening: 4 mm;	6 – 7 mm
	13815	Öffnung: 1,5 mm; Potentialarme 6-Loch-Variante	3 – 4 mm

11.9.2 NOZZELS FOR ROTATING PLASMA JETS

Nozzle	Item-no.	Description	Treatment width
	28326	Opening: 4 mm; exit angle: 3°	app . 8 mm
	22824	Opening: 4 mm; exit angle: 5°	app . 10 mm
	26551	Opening: 4 mm; exit angle: 8°	app . 15 mm
	28743	Opening: 4 mm; exit angle: 3°	app . 8 mm
	19334	Opening: 4 mm; exit angle: 5°	app . 10 mm
	44180	Opening: 4 mm; exit angle: 8°	app . 15 mm
	22826	Opening: 4 mm; exit angle: 14°	app . 22 mm
	24975	Opening: 4 mm; exit angle: 17°	app . 25 mm
	36312	Opening: 4 mm; exit angle: 19°	app . 28 mm
	22889	Opening: 4 mm; exit angle: 20°	app . 30 mm
	22890	Opening: 4 mm; exit angle: 25°	app . 35 mm
	22894	Ø nozzle body: 37 mm; exit angle: 25°	app . 40 mm
	22893	Ø nozzle body: 37 mm; exit angle: 28°	app . 50 mm
	22892	Ø nozzle body: 37 mm; exit angle: 32°	app. 55 mm
	32011	Opening nozzle mouth: 3 mm	
	31300	Opening nozzle mouth: 4 mm	
	10178	Length of front part: 67 mm; Ø: 9 mm; opening: 2,5 mm; angle: 90°	
	15231	Length of nozzle body: 37 mm	
	15536	Straight front part: L = 64 mm; opening: 2,5 mm; angle: 45°	
	15499	Straight front part: L = 64 mm; opening: 4,0 mm; angle: 35°	
	15480	Straight front part: L = 64 mm; opening: 4,0 mm; angle: 45°	
	15029	Length of nozzle body: 30 mm; low potential	
	18126	Bent front part L = 25 mm: opening 4 mm	
	15812	Bent front part: L = 30 mm; opening: 4 mm	
	15811	Bent front part: L = 38 mm; opening: 4 mm	
	15029	Length of nozzle body: 30 mm; low potential	
	25188	Front part extension: L = 10 mm: Ø = 6 mm	
	23431	Front part extension L = 18 mm: Ø = 6 mm	
	15030	Front part extension: L = 40 mm: Ø = 6 mm	
	21838	Front part extension: L = 70 mm: Ø = 6 mm	

	23432	Front part extension: L = 10 mm: opening: 2 mm; angle: 20°	
	15000	Front part extension: L = 10 mm: opening: 2 mm; angle: 45°	
	36602	Nozzle body (picture on next page)	
	36603	Cap nut (picture on former page)	
	17857	Insert; exit angle: 60°	
	22850	Insert; exit angle: 90°	
	39496	Opening: 3 mm; exit angle: 5°	app.. 10 mm
	39495	Opening : 3 mm; exit angle : 8°	app.. 13 mm
	31906	Opening : 3 mm; exit angle : 11°	app.. 19 mm
	11731	Einstellschraube	

11.10 APPENDIX J MAINTENANCE

Preventative Maintenance Single Rotating Plasma Jet RD1004

The guarantee of the single rotating Plasma jet RD1004 is only valid with the following preventative maintenance plan.

1. Every 1,500 hours of operation or at least once in six months

1.1. Visual control for external damage

1.2. Exchange of the carbon brush with original parts (KK469B and KK458E).

The carbon brush is designed for transmitting current through the jet. If they are not exchanged regularly, the current flows through the bearing. This leads to the eventual destruction of the bearing and makes the guarantee void.

2. Yearly

2.1. Visual control for external damage

2.2. Check ease of rotation of bearings by hand.

2.3. Visual control of belt disk and belt for wear and tear

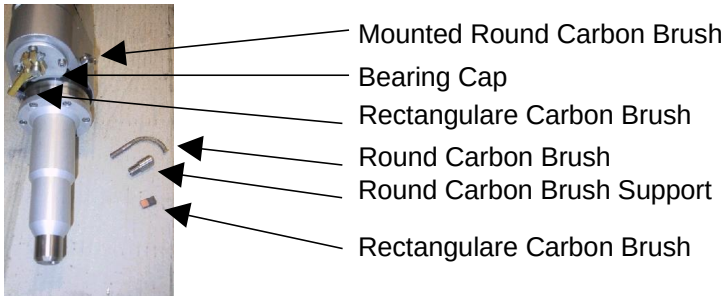
2.4. Tension of the belt
It should be possible by hand to twist the belt by about 90° while it is in place

The bearing cap needs to be removed for point 2.3 and 2.4.

The exchange of the belt disk or of the belt has to be performed by qualified personnel.

3. After 7000 hours

3.1. Maintenance check at Plasmatreat.



Make sure safety regulations are followed during maintenance. Only ever do maintenance with the generator switched off and locked. Please follow local work place safety regulations.

Preventative Maintenance Single Rotating Plasma Jet RD2004

The guarantee of the single rotating Plasma jet RD2004 is only valid with the following preventative maintenance plan.

1. Every 1,500 hours of operation or at least once in six months

1.1. Visual control for external damage

1.2. Exchange of the carbon brush with original parts (KK469B and KK458E).

The carbon brush is designed for transmitting current through the jet. If they are not exchanged regularly, the current flows through the bearing. This leads to the eventual destruction of the bearing and makes the guarantee void.

2. Yearly

2.1. Visual control for external damage

2.2. Check ease of rotation of bearings by hand.

2.3. Visual control of belt disk and belt for wear and tear

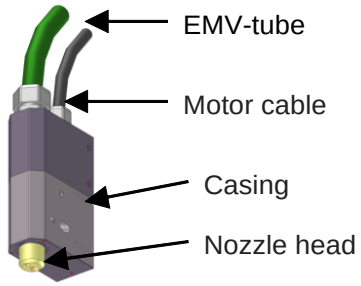
2.4. Tension of the belt
It should be possible by hand to twist the belt by about 90° while it is in place

The bearing cap needs to be removed for point 2.3 and 2.4.

The exchange of the belt disk or of the belt has to be performed by qualified personnel.

3. After 7000 hours

3.1. Maintenance check at Plasmatreat.



Make sure safety regulations are followed during maintenance. Only ever do maintenance with the generator switched off and locked. Please follow local work place safety regulations.

Preventative Maintenance Single Rotating Plasma Jet RD2005

The guarantee of the single rotating Plasma jet RD2005 is only valid with the following preventative maintenance plan.

1. Every 1,500 hours of operation or at least once in six months

1.1. Visual control for external damage

1.2. Exchange of the carbon brush with original parts (KK469B and KK458E).

The carbon brush is designed for transmitting current through the jet. If they are not exchanged regularly, the current flows through the bearing. This leads to the eventual destruction of the bearing and makes the guarantee void.

2. Yearly

2.1. Visual control for external damage

2.2. Check ease of rotation of bearings by hand.

2.3. Visual control of belt disk and belt for wear and tear

2.4. Tension of the belt
It should be possible by hand to twist the belt by about 90° while it is in place

The bearing cap needs to be removed for point 2.3 and 2.4.

The exchange of the belt disk or of the belt has to be performed by qualified personnel.

3. After 7000 hours

3.1. Maintenance check at PlasmaTreat.



Make sure safety regulations are followed during maintenance. Only ever do maintenance with the generator switched off and locked. Please follow local work place safety regulations.

Preventative Maintenance
Single Rotating Plasma Jet RD1010

The guarantee of the single rotating plasma jet RD1010/1013 is only valid with the following preventative maintenance plan.

1. Every 400 hours of operation or at least once in 4 weeks (carry in maintenancelist)
   1.1. Visual control for external damage. (nozzlepeek, rotation, change if needed)
   1.2. Exchange of the carbon brush with original parts.
   1.3. Remove the cover of carbon brush and clean the bearing room. (extraction fan)
   1.4. Check corbon rings about abrasion, change if needed.

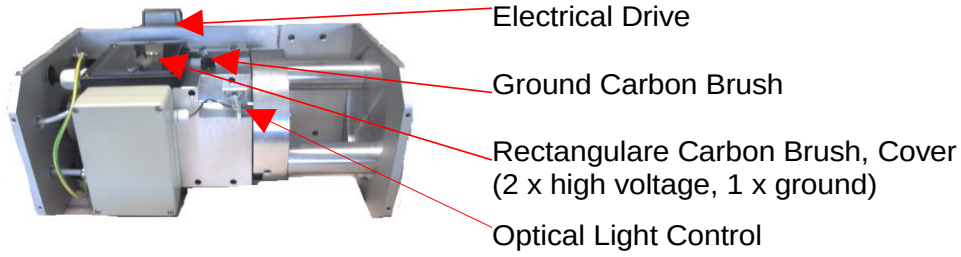
The carbon brush is designed for transmitting current through the jet. If they are not exchanged regularly, the current flows through the bearing. This leads to the eventual destruction of the bearing and makes the guarantee void.

2. Yearly
   2.1. Visual control for external damage
   2.2. Check ease of rotation of bearings by hand.
   2.3. Visual control of belt disk and belt for wear and tear
   2.4. Tension of the belt
   It should be possible by hand to twist the belt by about 90° while it is in place

The bearing cap needs to be removed for point 2.3 and 2.4.

The exchange of the belt disk or of the belt has to be performed by qualified personnel.

3. After 7000 hours
   3.1. Maintenance check at PlasmaTreat.



Make sure safety regulations are followed during maintenance. Only ever do maintenance with the generator switched off and locked. Please follow local work place safety regulations.

Table of Maintenance

ATTENTION !

The function of rotation is guaranted only by regular servicing of coal.

Serviceing on:

No.1:	No.11:
No.2:	No.12:
No.3:	No.13:
No.4:	No.:14
No.5:	No.:15
No.6:	No.16:
No.7:	No.17:
No.8:	No.18:
No.9:	No.19:
No.10:	No.20:

Table of Maintenance

ATTENTION !

The function of rotation is guaranted only by regular servicing of coal.

Serviceing on:

No.1:	No.11:
No.2:	No.12:
No.3:	No.13:
No.4:	No.:14
No.5:	No.:15
No.6:	No.16:
No.7:	No.17:
No.8:	No.18:
No.9:	No.19:
No.10:	No.20:

11.11 APPENDIX K PASSWORDS

Please keep this section seperated from the remaining manual

Default password at delivery

User: Operator

Password: 8888

Master can change variable Operator password

User: Master

Password: 9999

Specification
Personal Protection

Personal protection in connection with the machine types listed below is only guaranteed if a hardware-actuated switch-off of the safety circuit is done from external limiters at the terminal points listed below, e.g., by means of an emergency switch or maximum limit switch.

The Start/Stop function of the generator only actuates an electronic switch-off and is not related to safety.

Generator type	Terminals, safety circuit	Terminals, limit switch circuit	Terminals, electronic Start/Stop function
FG5002S FG5005S	-X40 terminal 3a through 10a	-X 40 terminal 3b through 8b	-X40 terminal 7c and 8c, 9c and 10c

x stands for all further variants

The safety-related integration of the machine into the overall facility is to be done by the customer. In the event that this has not been done or has been done only insufficiently, every guaranty of Plasmatreat Ltd. expires.

The accident prevention regulations in particular are to be heeded when carrying out maintenance and service work on the machine.

Only carry out maintenance and repair tasks when the machine is shut down and with the main switch set at "0" (OFF). Secure the machine against accidental restarting.

The relevant accident prevention regulations and the other generally recognized industrial medical regulations are to be heeded.

The generator cabinet and the flume station had to be connected with the earthing system from the general machine.

Version 19.0, 17.04.2019

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP