PURCHASE CONTRACT No 2121/....../15

(hereinafter referred to as "Contract")

executed in observance of § 2079 and following Act 89/2012 Coll., (the Civil Code)

I.
The Parties

1.1. **Buyer:** **Západočeská univerzita v Plzni**

Registered address: Univerzitní 8, 306 14 Plzeň, Czech Republic

Represented by: doc. Dr. RNDr. Miroslav Holeček, rector

A person authorized to act on behalf of the buyer in contractual matters:

Ing. Petr Beneš, based on authorization

Bank contact: Komerční banka a.s., Plzeň

Account number: 4811530257/0100

Identification No: 49777513

Tax-payer ident. No: CZ49777513

(hereinafter referred to as "the Buyer")

and

1.2. **Seller: relyon plasma GmbH**

Registered address: Weidener Str. 16, 93057 Regensburg

Represented by: Dr. Stefan Nettesheim

Bank contact: Sparkasse Regensburg

Account No: BLZ 75050000

Identification No: HRB 8656

Tax-payer ident. No: DE221094180

(hereinafter referred to "the Seller")

(jointly also referred to as "the Parties", or singly as "the Party")

have concluded, based on the results of the tender proceedings concerning a small-scale public procurement entitled **"System for plasma activation and cleaning of substrates surface"**, the following contract:

II.
Subject of Contract

2.1. The Seller undertake to supply to the Buyer new, fully functional and complete equipment including control software and accessories (instruction manuals, cables.etc.) for plasma activation and cleaning of substrates surface (hereinafter referred to as "Equipment") and thereto related services under the conditions specified by this contract, and transfer to the Buyer the ownership rights to these Equipment. The detailed technical specification of the Equipment is given in **Annex 1** hereto forming inseparable part of the Contract.

2.2. The Equipment shall be supplied complete with the associated fully functional software including licence at least for one (1) personal computer to facilitate the Equipment's full utilisation by Buyer. The hardware and software of the Equipment component parts shall be fully compatible.

2.3. The Buyer undertake to accept the Equipment supplied by the Seller and pay the agreed purchase price in the manner and within the term specified by this Contract.

III.
Equipment delivery term and place

3.1. The Seller undertakes to deliver the subject of this Contract to the Buyer no later than one (1) month counted from the day when the Parties sign the Contract. In case of delay the Seller shall pay to the Buyer a penalty interest of 0.5% of the amount due for each if incomplete day of delay. The total penalty amount is not limited.

3.2. The acts of Equipment delivery by the Seller and acceptance by the Buyer shall be documented by a take-over certificate signed by the Parties.

3.3. The Equipment shall be delivered to Faculty of Electrical Engineering – RICE, University of West Bohemia in Plzeň, Univerzitní 8, 306 14 Plzeň, Czech Republic.

IV.
Contract price and payment conditions

4.1. The price payable for the Equipment specified in this Contract and delivered under conditions specified herein has been determined on agreement by the Parties taking into account the price quoted by the Seller and calculated in their tender for this Contract.

4.2. The Buyer undertakes to pay to the Seller for the Equipment specified in clause II above the following agreed purchase price:

- For delivery of System for plasma activation and cleaning of substrates surface, including accessories, **the purchase price of EUR 11.980,-- net of VAT.**

4.3. The purchase price has been mutually agreed to be the maximum price including any and all fees and other costs associated with execution of the subject of the Contract. The purchase price shall include, among other things, the Equipment transport and insurance costs (if any), administration fees, taxes, duties, the costs of approval proceedings, execution of the required tests, the compliance certificates, the required attests and transfer of proprietary rights.

4.4. The purchase price also includes the costs of software upgrade during the first year after the Equipment delivery.

4.5. The Buyer shall pay the purchase price in EUR based on the invoice issued by the Seller. Such invoice shall be issued and delivered to the Buyer within 15 days of the Equipment delivery, i.e. within 15 days of the Equipment acceptance by the Buyer and signing of the take-over certificate by the Parties.

4.6. Attached to the invoice shall be a copy of the Equipment take-over certificate signed by the Parties.

4.7. The invoice shall meet the formal requirements on accounting and tax documents including the provisions of Act 235/2004 Coll. (Value-Added Tax), as amended. Should the invoice fail to meet such requirements, the Buyer may return it to the Seller prior to expiry of the invoice-payment term and require that the latter fill in the missing information. Upon delivery to the Buyer of a new or duly completed invoice, a new payment term will start to run.

4.8. The invoice payment term shall be 30 days counted from the day of demonstrable delivery of the invoice to the Buyer.

4.9. The Buyer need not pay any advances on the purchase price.

4.10. Should the Buyer be in delay with payment of the invoiced sum, the Seller may claim payment of a penalty interest of 0.05% of the amount due for each if incomplete day of delay. This penalty shall not be applicable in cases where the delay in payment is due to delayed release of the state budget or funds.

4.11. The Buyer may, acting at his own discretion and without asking for the Seller's approval, deduct from the purchase price any penalty payable by the Seller.

V.
Parties' rights and obligations

5.1. The Seller shall deliver the contracted Equipment in the agreed quantity, quality and execution workmanship standards. The Equipment supplied according to this Contract shall meet the quality requirements specified herein.

5.2. The Seller shall deliver the Equipment to the Buyer free of any defects and in observance of the Contract conditions where the Equipment will be considered correctly delivered if accepted by the Buyer who confirm the Equipment delivery by adding their signature to the Equipment take-over certificate. Said certificate may only be signed upon completion of the Equipment delivery including the associated performance and services specified in the Contract.

5.3. The Seller shall supply the Equipment with the complete technical and other documentation needed for the proper Equipment application including equipment operation manuals in the English or Czech languages both in the electronic or printed form.

5.4. Upon the Equipment acceptance and signing the take-over certificate, the Buyer will assume the proprietary rights to the Equipment. At the same moment, the risk of damage to the Equipment will be transferred to the Buyer.

5.5. The Seller shall immediately inform the Buyer about any possible delays in the Contract performance and of any circumstances that might jeopardise the Contract execution.

5.6. Throughout the Contract term, the Seller shall hold and maintain their qualifications the possession of which they proved within the tender proceedings prior to the Contract signing. A failure to meet this requirement may result in the Buyer's withdrawal from the Contract.

5.7. The Seller shall not transfer their rights or obligations from this Contract to any third party unless the Buyer gives their prior approval to such step in writing.

5.8. The Seller agrees that they shall not, acting at their own discretion, assign or settle against other liabilities any of their receivables originating from this Contract.

5.9. The Seller shall be liable to the Buyer for any damage caused by breaching any of their contractual obligations or by failing to observe the generally binding legal regulations.

5.10. The Parties have agreed and the Seller have appointed to the position of their representative responsible for negotiations regarding the Contract and its execution the following person(s):

    Name: Birgit Zimmermann

    E-mail: b.zimmermann@relyon-plasma.com

    Tel.:   +49 941 600 98280

5.11. The Parties have agreed and the Buyer have appointed to the position of their representative responsible for negotiations regarding the Contract and its execution the following person:

    Name: Ing. Jan Řeboun, Ph.D.

    E-mail: jreboun@rice.zcu.cz

    Tel.:   +420 377 634 549

5.12. Any and all correspondence, directions, notices, requests, reports and other documents originating between the Parties in reference to or in connection with this Contract shall be in writing in the Czech or English languages and delivered in person, as registered letters, fax or E-mail messages to the delivery addresses of the persons acting for the Contract purposes as representatives of the Parties.

5.13. The Buyer acknowledge the fact that, in reference to §2, letter e) of Act 320/2001 Coll. (Financial Controlling in Public Administration), as amended, they are obliged to actively participate in the financial controlling activities. The management of the VaVpI Operation Programme will, within their controlling activities extended over the period of 3 years after the OP termination, have access to such parts of tender, contract and associated documents that are protected in reference to special legal regulations and concerning, among other things, trade secrets or confidential information provided that the respective legal provisions (such as Act 255/2012 Coll., Control, as amended) are duly observed. The management body of the VaVpI Operation Programme may also apply their controlling activities to the Seller's subcontractors, if any (see Annex 2 to the Manual for the applicants to and receivers of the VaVpI OP funds – Rules for Subcontractor Selection, http://www.msmt.cz/file/14585).

5.14. The Seller shall observe and maintain the VaVpI OP Visual Identity Manual (*see Annex 3 to the Manual for the applicants to and receivers of the VaVpI OP funds – Publicity Rules*) published on the web site of the Ministry of Schools, Youth and Physical Culture of Czech Republic, http://www.msmt.cz/file/14258. All Contract outputs shall contain publicity elements in accordance with this Manual (documents, reports and others).

5.15. The Seller shall file and maintain all documentation related to the Contract execution including the associated accounting documents, and that throughout the VaVpI OP term and at least three years after its termination, i.e. till 2021. Within this period, the Seller shall disclose information and make available documentation required by employees or agents of the VaVpI OP project controlling bodies and assist in execution of such controlling actions by creating suitable conditions for the Contract documentation review and by personal engagement therein.

5.16. If any part of the contracted Equipment is to be supplied by a subcontractor, the Seller shall specify the identification data on such subcontractor: x

Any intended change in the subcontractor entity specified in this Contract shall be subject to a prior approval in writing by the Buyer.

VI.
Equipment warranty

6.1. The Equipment delivered to the Buyer shall be subject to a minimum of 12-month on-site warranty. The warranty term shall start to run on the Equipment delivery date, i.e. on the day of signing the Equipment take-over certificate by the Parties.

6.2. The Buyer shall report any warranty defects to the Seller without any delay. The Seller shall execute the warranty repairs free of charge and within the shortest term, taking into account the type of Equipment defect.

6.3. Within the warranty period, the Seller shall repair the identified defects and make good any other irregularities in the Equipment claimed by the Buyer whereby, unless the Parties agree otherwise, the Seller shall be obliged to report at the Buyer's premises within 10 days of the defect notification by telephone or in writing, and proceed in consideration of the type and extent of the defect so that it can be removed or made good as soon as possible. The Seller is obliged to remove defect no later than within 20 working days from the arrival at the Buyer's premises to remove defects, unless otherwise agreed. In cases of warranty repair, the warranty term applicable to the defective part shall be extended by the time elapsed between the defect notification by the Buyer and removal of the same by the Seller.

6.4. Should the Seller be in delay in arrival at the Buyer's premises to remove defects notified by the Buyer in reference to section 6.3 hereof, the Seller shall pay to the Buyer a contractual penalty of 0.5 % of the purchase price of Equipment for each if incomplete day of delay. The total penalty amount is not limited.

6.5. Warranty claims can be placed no later than on the last day of the warranty period where a warranty claim dispatched on the last day of the warranty period shall be considered placed in time.

6.6. The Seller's warranty shall not be applicable to defects caused by incompetent handling or by mechanical damage of the equipment by the Buyer.

VII.
Contract validity and effectiveness

7.1 This Contract shall be valid and effective from the day of signing by the duly authorised representatives of the Parties.

7.2 A Party may withdraw from the Contract only in reference to reasons or circumstances stated in the Contract or the applicable laws.

7.3 A Party may withdraw from the Contract in reference to a material breach of the Contract conditions by the other Party where instances of such material breach, among others, are:

    a)   On the Buyer's side, failure to pay the purchase price according to the Contract within 60 days following the regular payment term of the invoice concerned;

    b)   On the Seller's side, failure to deliver the Equipment or any part thereof within the agreed terms;

    c)   On the Seller's side, failure to deliver the Equipment with parameters specified by the Seller in this Contract;

    d)   On the Seller's side, late arrival at the Buyer's premises for the purposes of defect removal in reference to the provisions of section 6.3 hereof.

7.4 Upon termination of the Contract effectiveness, the contractual liabilities of the Parties will cease to exist. However, effective termination of the Contract shall not affect any existing claims for damages, Parties' liabilities to pay penalties imposed for breaching the Contract conditions prior to termination of the Contract effectiveness, any liabilities that according to the Contract or in consideration of their nature shall survive the Contract termination or liabilities that shall remain effective according to the applicable legal regulations.

VIII.
Final provisions

8.1 Relationships between the Parties shall be governed by the Czech law. The Parties agree the location and matter jurisdiction of Czech judicial and administrative bodies. In matters about which the Contract is silent, the legal relationships between the Parties related to or originating from the Contract shall be governed by the applicable provisions of Act 89/2012 Call., (the Civil Code), as amended, and other generally binding legal regulations.

8.2 Any changes in or supplements to the Contract shall be based upon the Parties' agreement in writing. Any such agreement shall have the form of a dated and numbered amendment to the Contract signed by both Parties.

8.3 Should any Party establish that there are circumstances preventing such Party from a correct and proper Contract execution, they shall immediately inform the other Party accordingly and initiate negotiations between the Seller's and Buyer's representatives.

8.4 Should any Contract provision be found invalid, it shall be deemed to be such, unless from its nature, content or circumstances under which it had been agreed to follows that such provision cannot be separated from the balance of the Contract.

8.5 The parties undertake to resolve amicably any mutual disputes regarding the Contract. Should a conciliatory dispute resolution be not attained within 30 workdays following the first dispute notification between the Parties, each Party may submit their claim to the appurtenant court. Arbitration is excluded.

8.6 This Contract has been executed in 4 (four) counterparts, of which each counterpart is considered an original document. Each Party shall receive 2 (two) Contract counterparts. The Contract with supplier which has registered office outside the Czech Republic is executed in the English language.

8.7 Inseparable part of the Contract is:

Annex 1 – Detailed technical specification of the Equipment
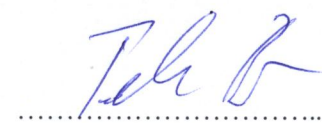
8.8 The Parties represent that, prior to signing the Contract, they had read the Contract text, that they agreed to it without any reservation and that the Contract wording expresses their true, real, free and serious will. To prove the correctness and truth of their above representations, the Parties had instructed their duly authorised representatives to add their signatures below.

In Plzeň, dated .... 2 6 -05- 2015   In *Regensburg* ...., dated *08. 06. 2015*

For the Buyer: For the Seller:

University of West Bohemia   **relyon plasma GmbH**

....

Ing. Petr Beneš   Dr. Stefan Nettesheim
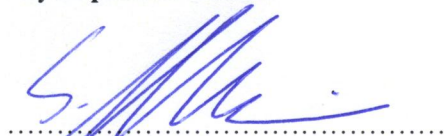
Západočeská univerzita v Plzni
kvestor

MŠMT
MINISTERSTVO ŠKOLSTVÍ,
MLÁDEŽE A TĚLOVÝCHOVY

EVROPSKÁ UNIE
EVROPSKÝ FOND PRO REGIONÁLNÍ ROZVOJ
INVESTICE DO VAŠÍ BUDOUCNOSTI

2007-13
OP Výzkum a vývoj
pro inovace

Annex 1 to the Contract – Detailed technical specification of the Equipment

- *Relyon plasma technology / Product booklet*
- *Operating instructions / Plasma generator PG 31*
- *Operating instructions / PS2000 power supply*
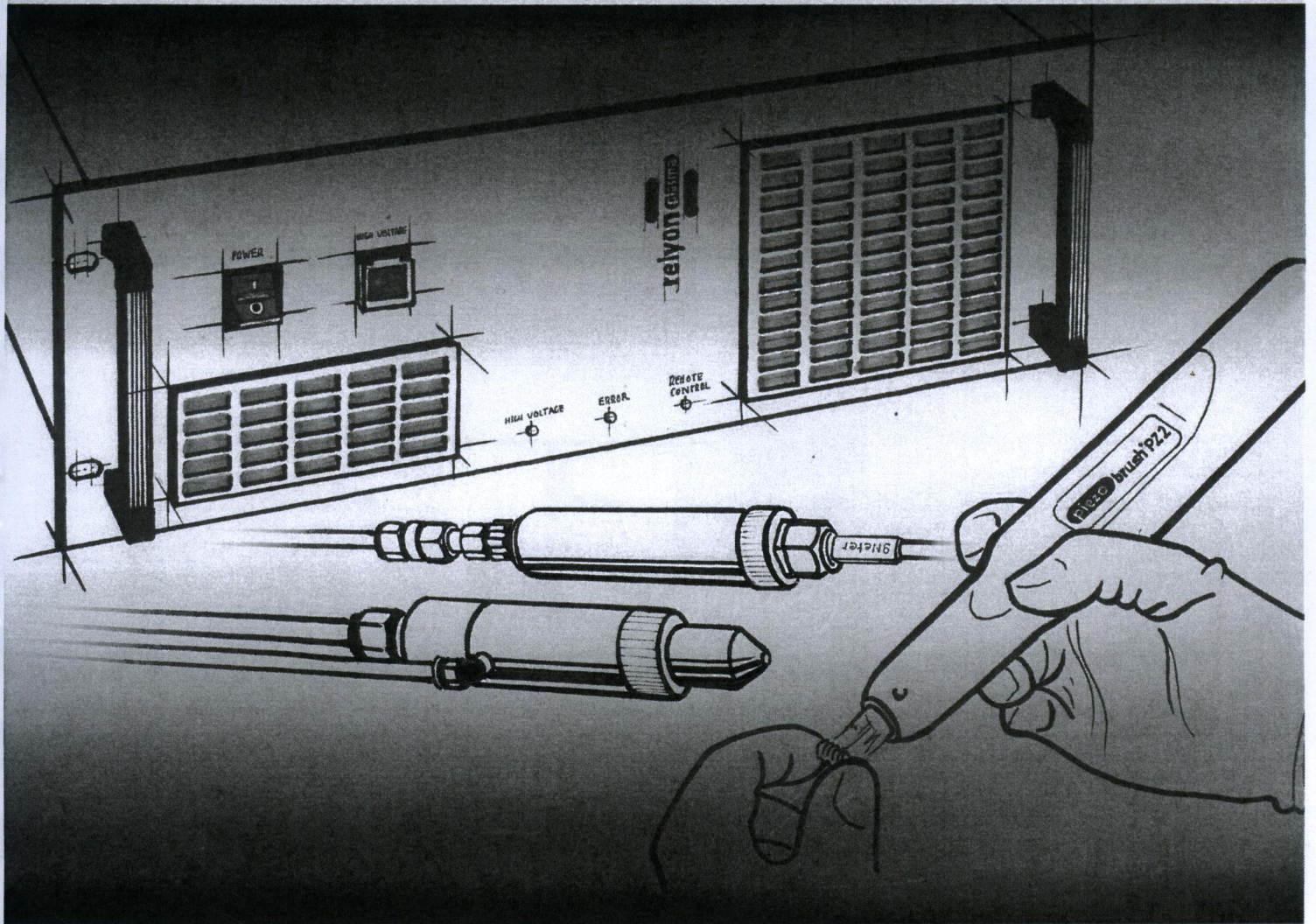
Innovative plasma products

Efficient and reliable

Our principle – advancing technology through safer processes

As a modern, technology-oriented company with a lean corporate structure, we deliver reliable plasma solutions which are "Made in Germany".

Our products have been tested both in practical applications and in our test laboratory in terms of their process capability and service life.

Every process stage is supported by consistent quality management in accordance with DIN EN 9001, which ensures maximum product functionality and safety.

– You can rely on plasma –

The relyon plasma management:
Dr. Stefan Nettesheim, Managing Director. Cynthia Kunu, Sales Assistant. Dipl.-Ing. Dominik Burger, Project Engineer. Dr. Dariusz Korzec, Process Technology. Jürgen Seissler, Sales Director. Birgit Zimmermann, Public Relations. Dipl.-Ing. Klaus Forster, Managing Director.

We focus on your plasma applications

With our professional sector expertise we are able to supply a broad spectrum of elegant series solutions, for instance, for atmospheric plasma surface treatment. We are experts in the activation and fine cleaning of a wide variety of technical materials, as well as sterilisation and tissue stimulation in laboratories and the medical sector.

On the following pages you can find the perfectly tailored plasma system for each of these applications.

Don't hesitate to contact us if you have any special technical requirements – our experts will be delighted to advise you.

Our plasma technologies

In accordance to a variety of different requirements, we have implemented 2 different technologies in our product portfolio.

Pulsed Atmospheric Arc Technology (PAA® Technology) for applications that require high performance and rapid processes.

Piezoelectric Direct Discharge Technology (PDD® Technology) for sensitive processes that require cold active plasma.

Our plasma products

Our technical platforms can provide you with a comprehensive modular system to suit your requirements.

Here, we are able to meet all your configuration needs - from an individual manual work station right through to a fully automated high speed system.

*piezo*brush® Cold active processes

Surface activation

Laboratory technology, dental technology
Model construction, precision engineering
Micromechanics, optics
Assembly technology, electronics
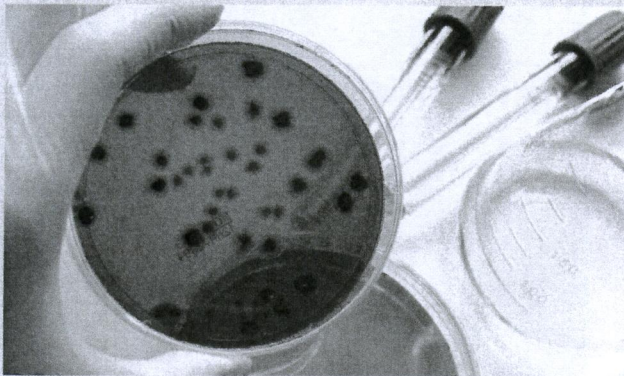
Germ reduction

Microbiology
Food technology
Medical technology
Microfluid technology
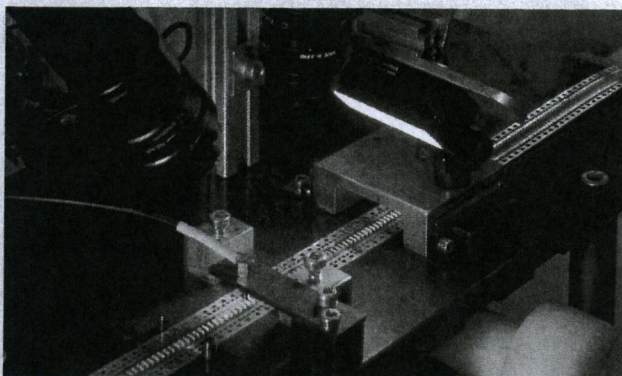
Automated processes, printing and labelling

Inkjet, pad printing
Coding, microfilling
Wetting behaviour of automated processes

plasmabrush® High performance processes
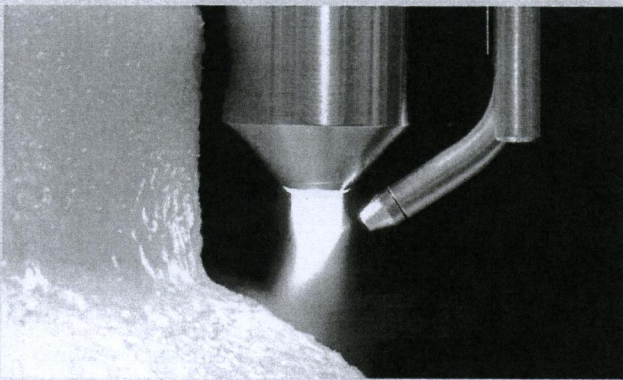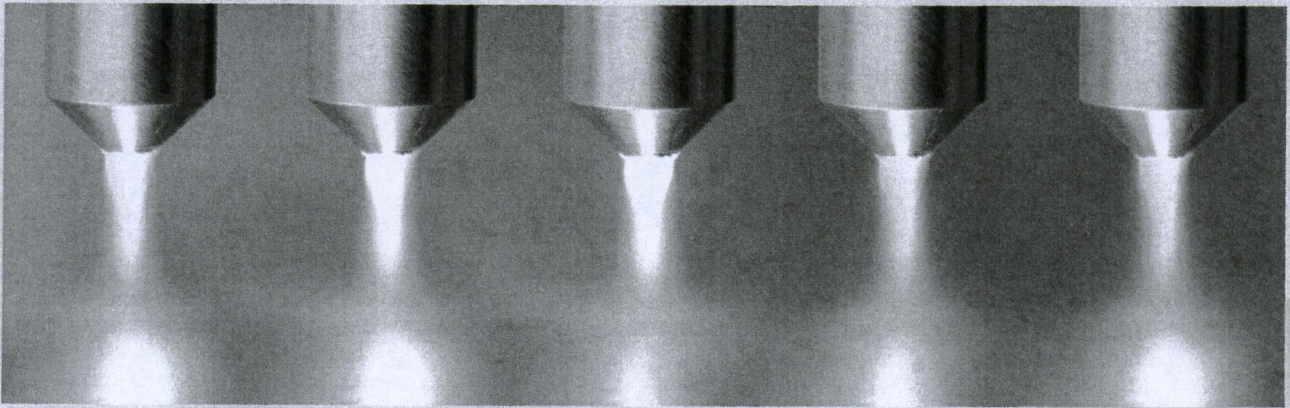
Coating processes

Hot melt coating as a highly active compound layer.

Cleaning electrical assemblies and application of fluxing agents before the soldering process.
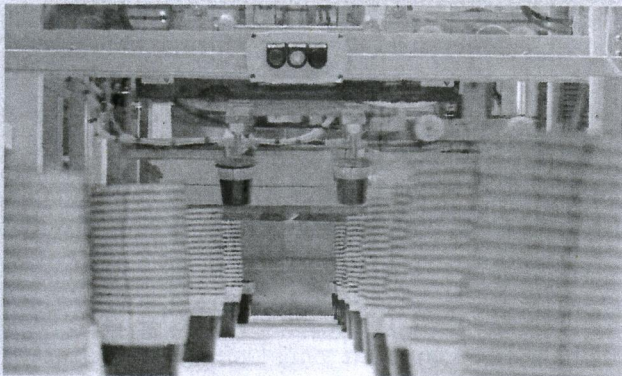
Activation processes

In the packaging industry at maximum processing speeds.

Sealing technology, coating, laminating, printing.

Cleaning processes

Removal of soldering residue, fluxing agents or release agents.

Removal of oxide layers.

piezo brush® Hand-held device for universal applicati

Technology

relyon plasma has developed PDD® Technology specially for plasma generation which is particularly compact. PDD® (Piezoelectric Direct Discharge) is based on direct electrical discharge via an openly operated piezo-electric transformer(PT).

With maximum efficiency, a low input voltage is transformed in such a way that very high electrical field strengths are created and the ambient process gas, typically air, is dissociated and ionised. In the case of PDD, the gas temperature of the plasma volume is inessential higher than ambient temperature.

Electron densities of approx. 10^{14} and 10^{16} per m^{-3} are achieved. In this way, PDD produces a typical "cold" non-equilibrium plasma.

The properties of PDD® therefore open up a multitude of application possibilities. PDD devices are used in medical research for germ reduction, odour reduction and in microbiology.

Typical industrial applications include surface activation for the optimisation of wetting and bonding properties in the case of plastics, e.g. in printing, coating and bonding processes.

Features

- Simple to use
- No external gas supply required
- Cold active plasma
- Maximum operational reliability
- Optimum efficiency
- Variable nozzles

Applications

- Medical research
- Microbiological processes, germ reduction, odour reduction
- The pharmaceutical industry
- Life science
- Food processing
- Surface activation for the optimisation of wetting and bonding properties in the case of plastics, e.g. in printing, coating and bonding processes.

on - it couldn't be any simpler ...
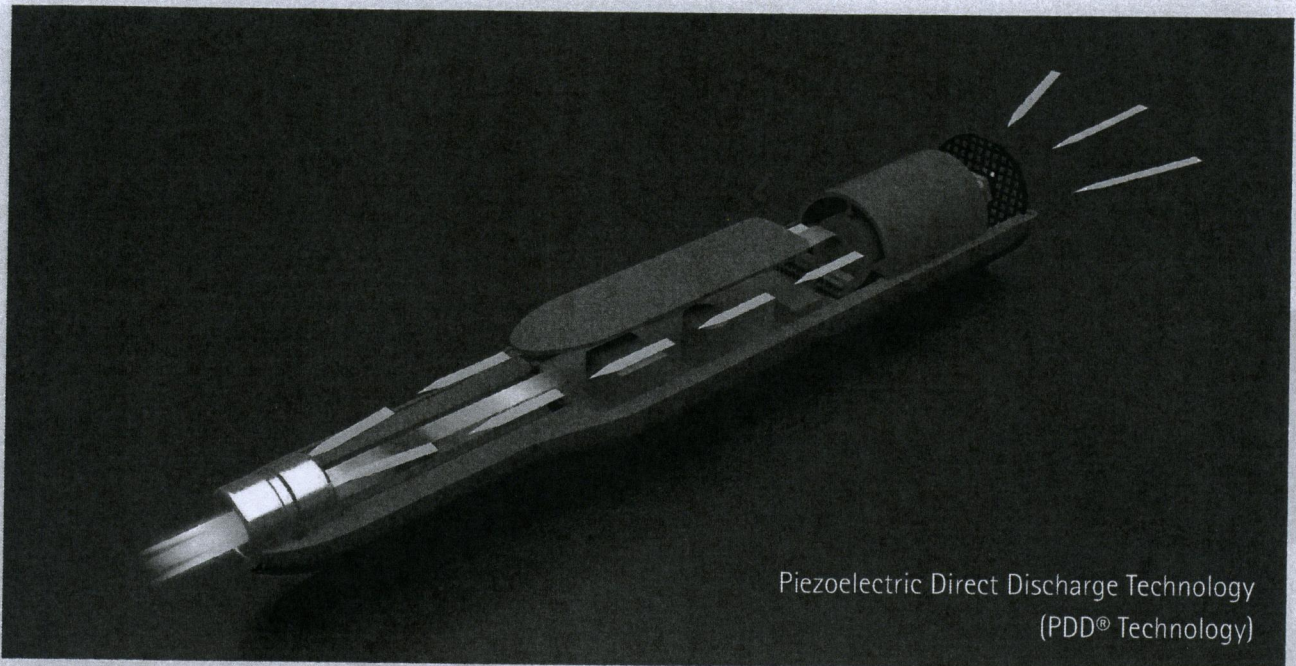
Piezoelectric Direct Discharge Technology
(PDD® Technology)

Technical Information

Electrical connection	110 - 240 V / 50 - 60 Hz 15 V DC
Power requirement	max. 30 W
Specification	Hand-held device with power supply unit, Integrated ventilator
Weight	170 g
Plasma temperature	< 50 °C
Typical treatment distance	5 - 10 mm
Typical treatment width	5 - 20 mm

Set contains:

- Multirange power supply unit
- Replacement nozzles
- Transport case

Ø 36
Ø 27
213
plezo brush® PZ2
Switch ON / OFF
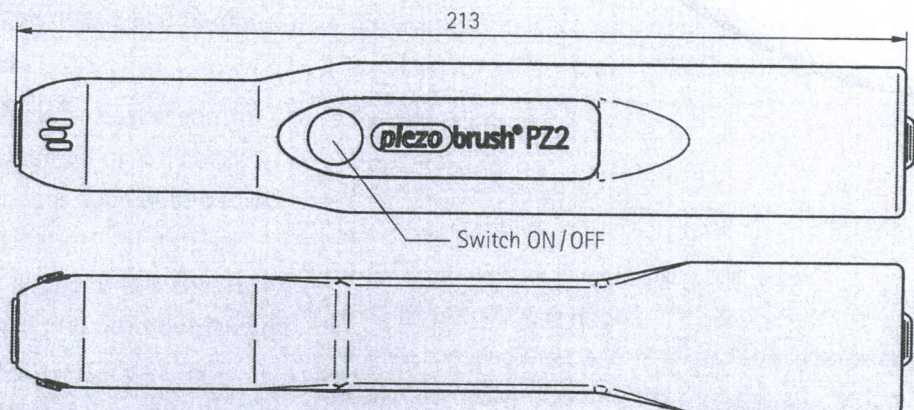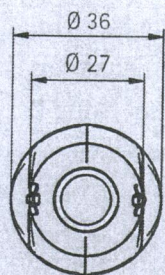
... plug in, switch on and it's ready to use

plasmabrush® High power Plasma generator for indus
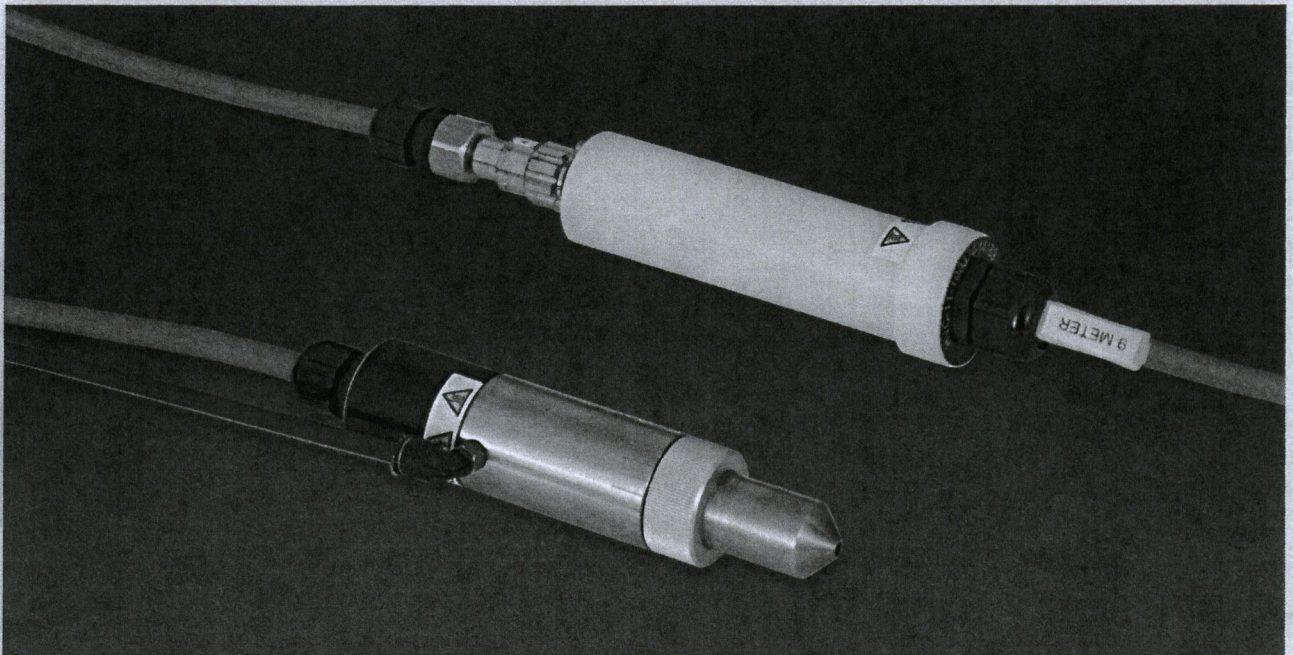
Technology

The nozzle-type plasma generators are particularly compact and have long-term stability due to the combination of a unipolar pulsed high voltage source and a vortex flow in the nozzle (PAA® Pulsed Atmospheric Arc Technology). In this dynamically controlled operating mode the arc is prevented from stabilising at a "hot spot" and nozzle erosion is minimised.

The arc rotates at a high frequency in the combustion chamber. Despite the high power density, there is only minimal warming of the nozzle and hardly any erosion of the electrodes.

A special advantage of the unipolar nozzle control is the asymmetrical thermal loading of the nozzle components. The interior anode is subject to a lower thermal load and also less oxidation. The exterior cathode has a larger surface area and this ensures good dissipation of heat. Therefore, no water cooling is required. In addition, the high frequency pulse excitation of the arc minimises the dielectric polarity reversal losses in the high voltage cables.

The plasma temperature can be freely adjusted in a wide range via variable nozzles, the gas flow and the pulsed energy. This increases the spectrum of process gases and process gas mixtures that can be used. Nitrogen, forming gas (N_2/H_2), argon/oxygen or argon/hydrogen can be used, even though most industrial applications are operated using compressed air.

Features

- Compact and robust
- Lengthy service life
- For compressed air, nitrogen and special gases
- Suitable for use with robots
- Wide operating range in terms of gas flow and temperature
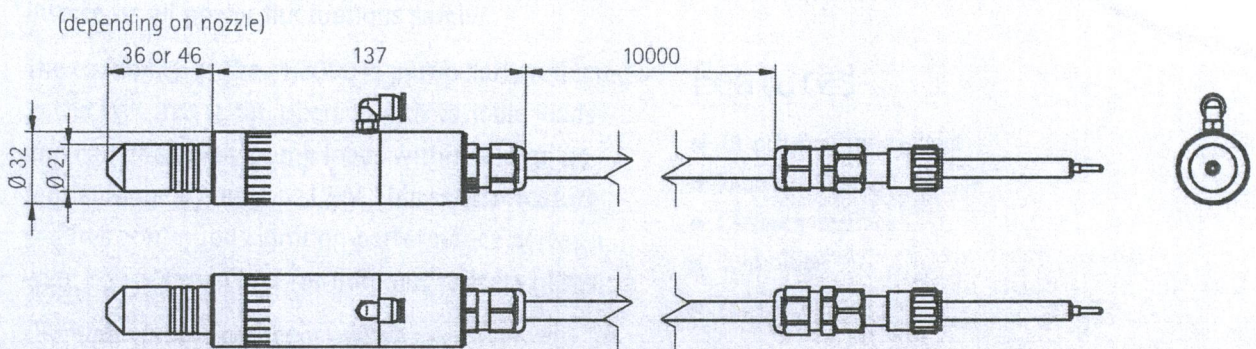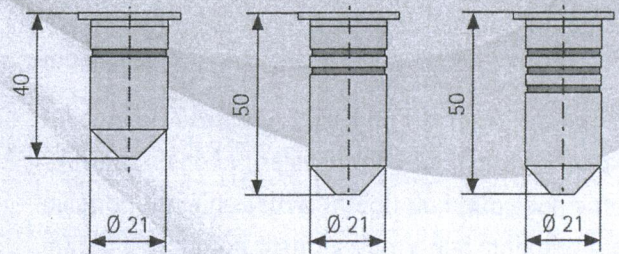- Minimal heating of the housing
- Variable nozzles
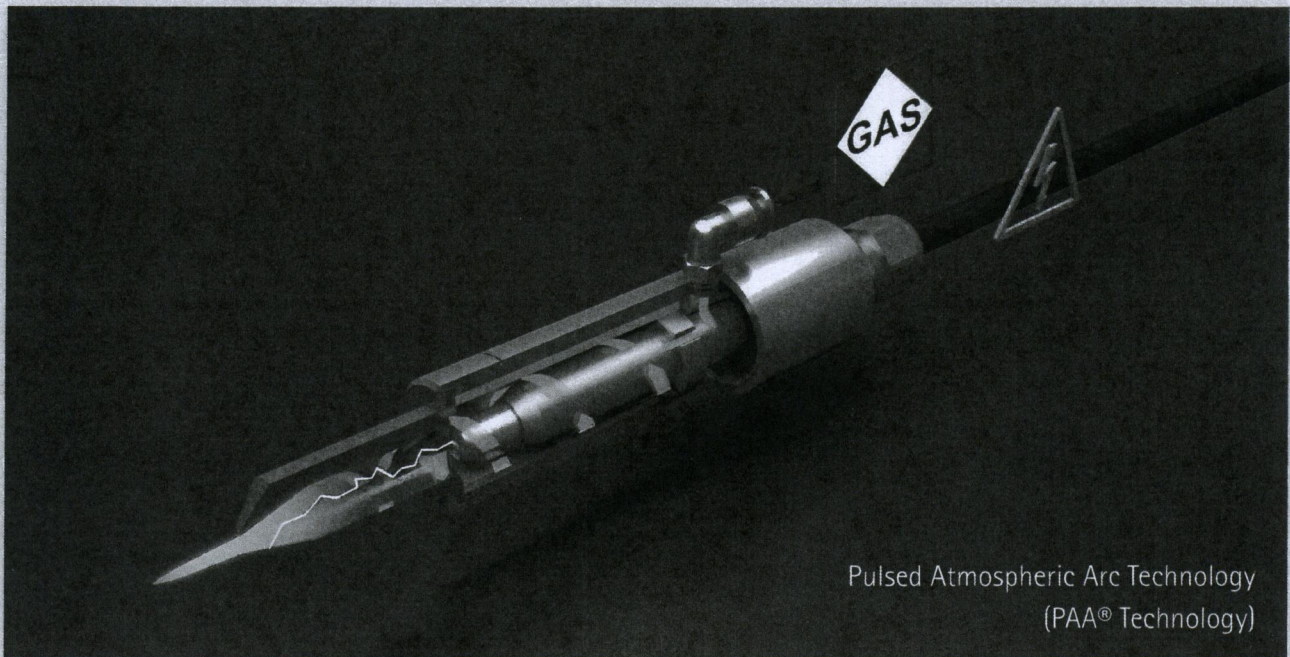
Pulsed Atmospheric Arc Technology
(PAA® Technology)

Technical Information

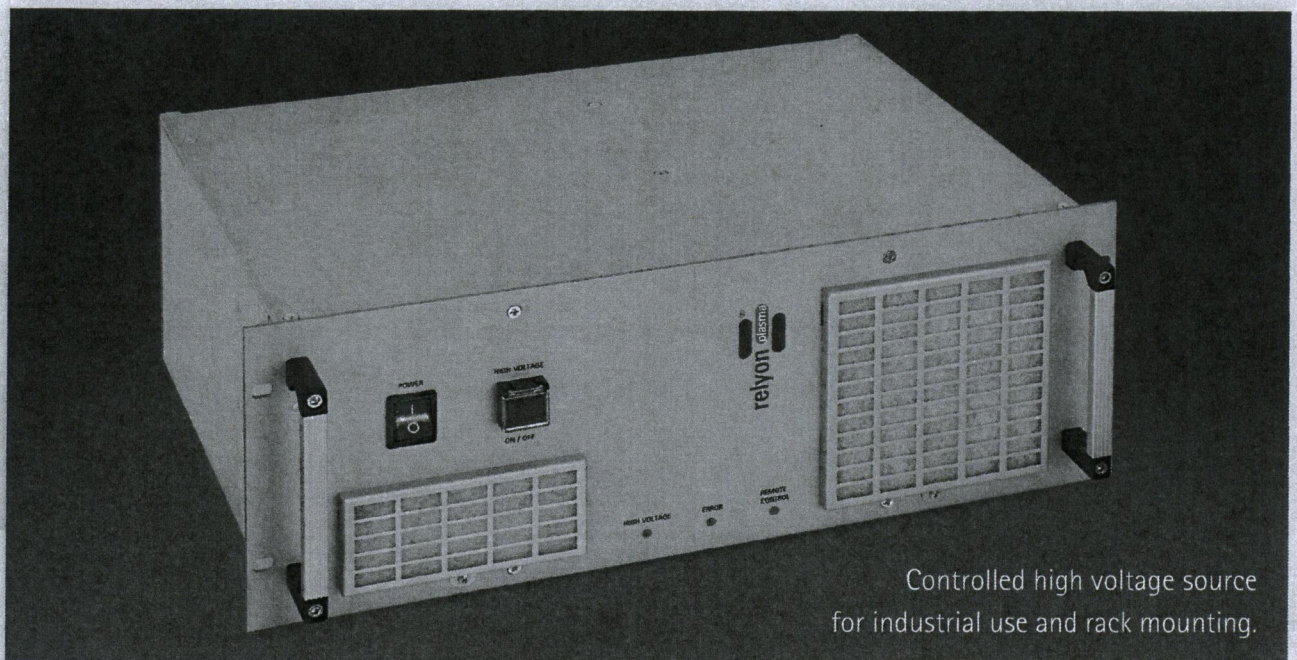|	
Flow range	30 to 70 L/min
Cable length	10 m
Weight	680 g
Diameter Ø	32 mm
Gas connector	6 mm
Typical treatment distance	10 – 25 mm
Typical treatment width	15 – 25 mm

to be operated with PS2000 and HV cable extension

PS2000 – the high voltage, high performance package ...

Controlled high voltage source for industrial use and rack mounting.

Technology

High voltage source optimised for Pulsed Atmospheric Arc Technology (PAA® Technology). Due to the use of a unipolar pulsed high voltage, the arc is prevented from stabilising at "hot spots" in the nozzle. The latest IGBT switching technology and the use of high quality, high voltage components ensure that the source is extremely reliable and **efficient**. Overloading is also not possible in continuous 24/7 operation. In the event of cable damage or short circuiting during critical operations the control unit intercepts all power fluctuations safely.

The capability of the PS2000 is particularly reflected in the fact that it can operate with variable loads and can effectively pump loads within a large potential range of up to > 12kV. This special feature ensures continuous ignition performance across a wide power range and for different process gases.

The high voltage source is switchable in a range of milliseconds at full load and therefore optimised for timed processes where highly precise timing is beneficial.

All communication is based on the reliable and fast CAN bus. Even in the event of a fault, the communication remains active. Integration into each automated production plant is simple and standardised, even in the case of several high voltage sources.

Features

- 19 inch industry standard
- Short circuit proof
- CANopen interface
- Controllable
- Variable working point
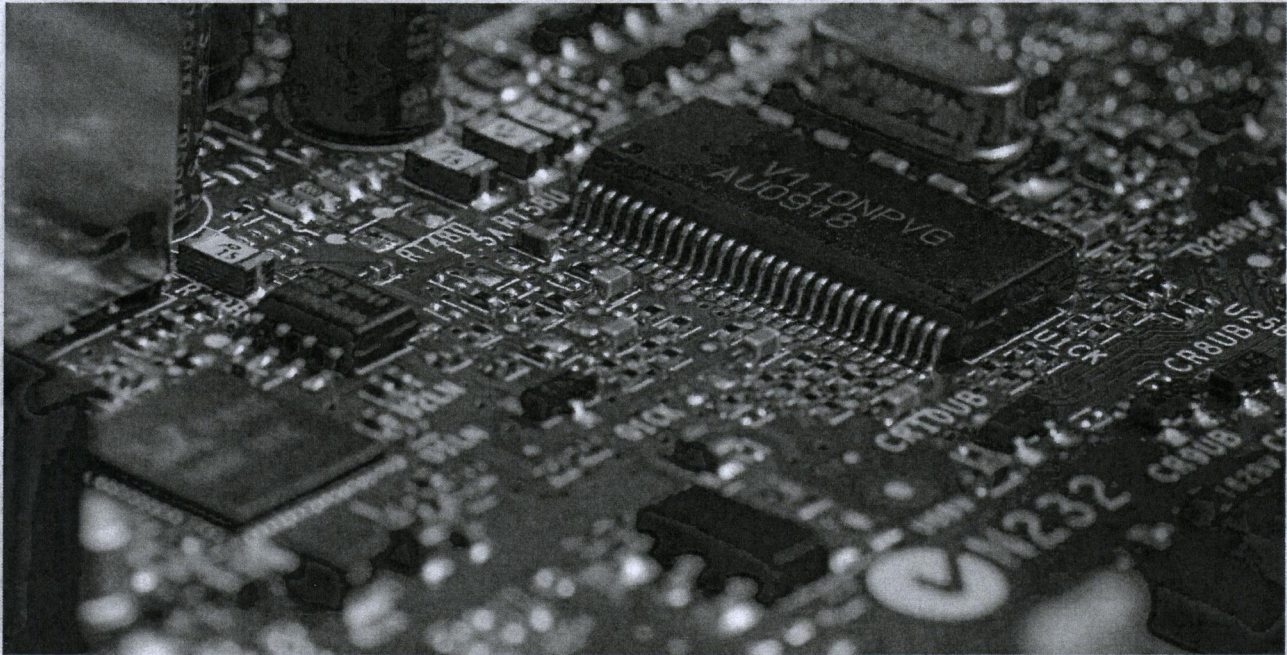
Technical Information

Input voltage	220V ~ 240V AC, 50 – 60 Hz
Max. input current	6 A
Fuses	6.3 A /500V AC time-lag
High voltage	Pulsed direct current (DC)
Power	0 - 1000 watt variable
Open circuit voltage	Up to 20 kV
Bus communication	CANopen format (CIA301)

Ambient conditions

Protection class DIN EN 60529	IP20
DIN EN 61440	Class I
Temperature	10°C - 40°C; 50°F – 104°F
Air humidity	< 80 % (non condensing)

Dimensions

Weight	18 kg
Dimensions	W=483 mm; H=177 mm; D= 430 mm (W=19"; H= 6.96"; D=16.93")

Front View

483

177/4 HE

Rear View
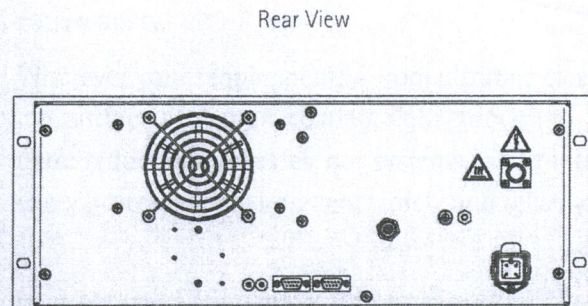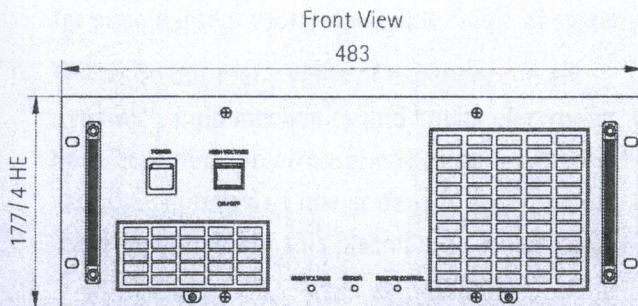
... for 19" rack integration
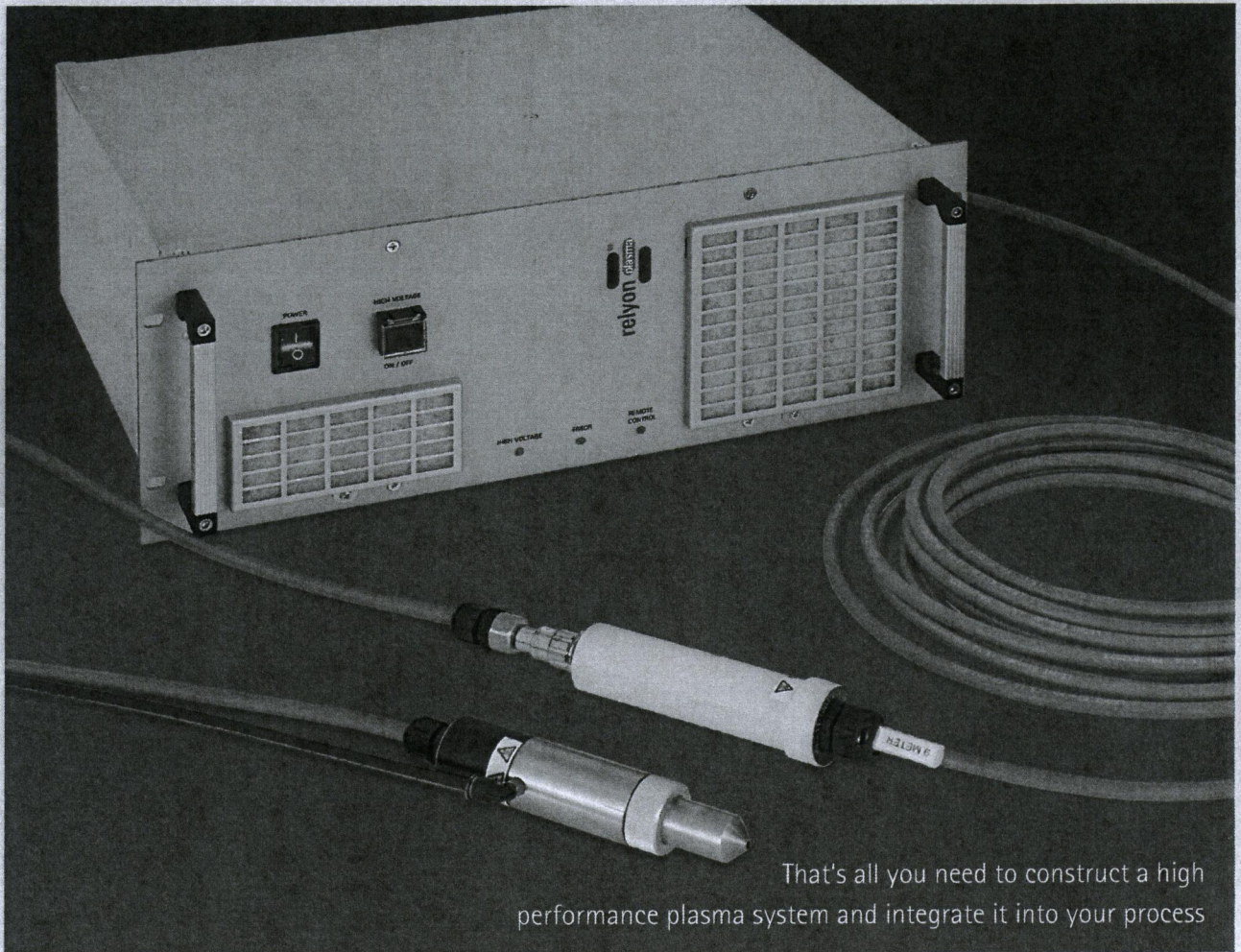
That's all you need to construct a high
performance plasma system and integrate it into your process

Atmospheric plasma system PB3 and PS2000

Perfectly tailored components in a robust industrial design: PS2000 19 inch high voltage unit and PB3 plasma generator connected with flexible 10 m cable for simple integration into a wide range of systems.

Thanks to our many years of experience in arc dynamics, fluid mechanics and power electronics, we have developed an atmospheric plasma system which is unique in terms of power density and function. In the development of this plasma unit which can be used for many different applications, ,we have placed the focus on easy integration into industrial processes with very effective user friendly communication abilty.

Whatever your requirements - from ultrafine cleaning, surface activation, coating, right through to germ reduction processes, our systems will fit into every processing environment: safely and reliably.
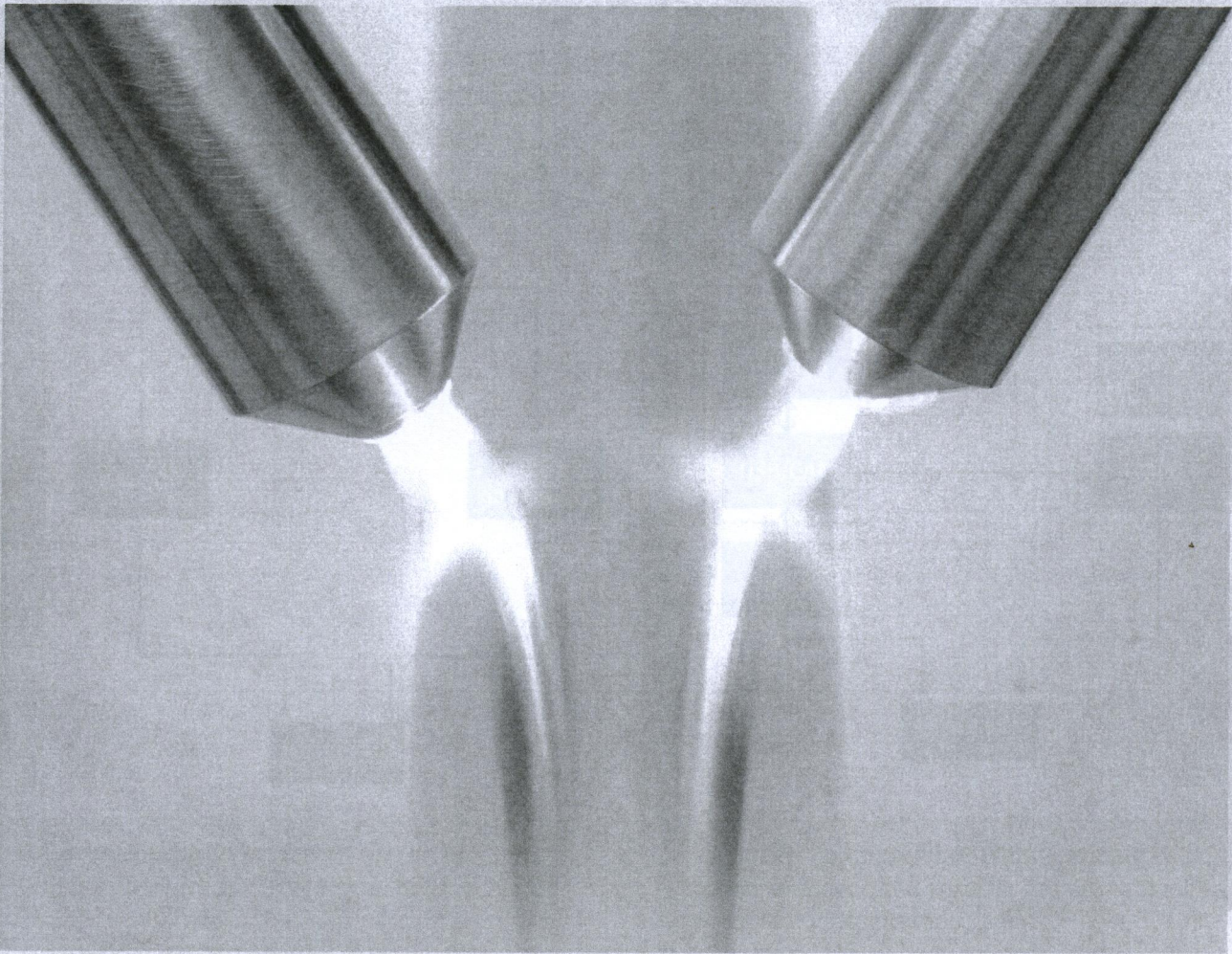
Features

- Compact design
- Simple integration
- Suitable for compressed air, nitrogen and other gases
- Variable output
- High start/stop dynamics
- Maximum operational reliability

Applications

- Fine cleaning
- Removal of oxide layers
- Surface functionalisation
- Activation prior to bonding, sealing, casting or printing
- Coating, laminating and sealing
- Germ reduction

Materials

- Thermoplastics PP, ABS, PE, PET, POM
- Elastomers
- Epoxide, polyester, CFK, GFK
- Fabrics
- Paper
- Metal
- Glass and ceramics
- Natural materials

... and it's ready to use

All you need: compressed air and an electrical socket. You can construct a complete plasma system in just a few steps. All parameters are controlled and visualised by our user-friendly software.

You always remain in control: from the simple laboratory solution with visualisation on the laptop right through to complete process control in multi-channel applications. Optional accessories
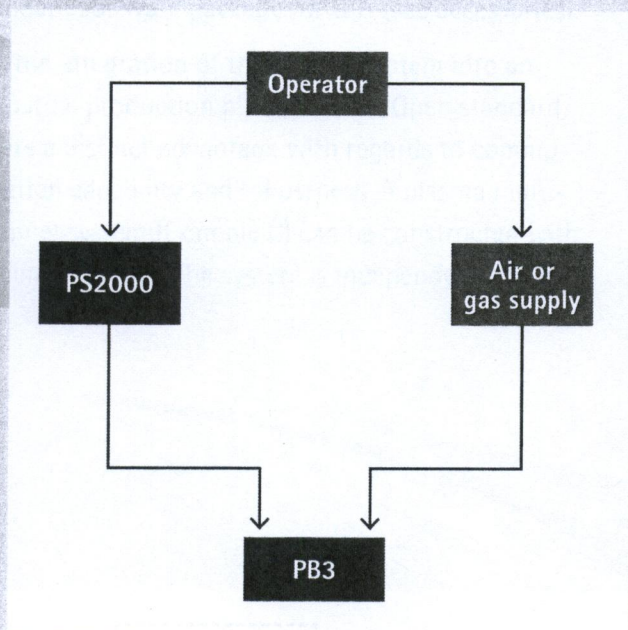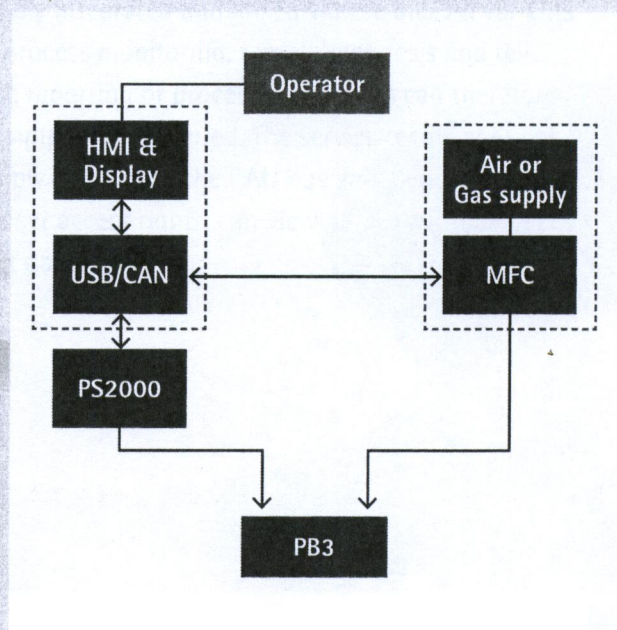
Example A: **Basic system:**
Start/stop with fixed parameter setting

Example B: **Computer-controlled system** with variable performance and variable gas flow as well as process data visualisation

The modular plasmabrush system is optimised at minimal expense for each application. At the same time, the typical requirements and industry standards are fulfilled completely. With reference to this, three typical system examples are described as follows:

In the simplest case (Example A), the user operates the basic system directly via an on/off switch, either on the front side of the high voltage power supply or via an externally connected switch. The gas or compressed air supply is set at a fixed value.

In the simplest case, with a constant system pressure, a 2/1-way valve and a fixed throttle are sufficient for the gas supply.

The system independently detects any misfiring caused by the gas flow having been set incorrectly or the high voltage cable having been disconnected. The electrical performance parameters of the high voltage source are in a typical basic setting (default setting). A new set of parameters can be configured offline or online via the CAN bus (see accessories).

A variable system with full flexibility is outlined in Example 2. Here the user controls all process parameters and operation via a graphic interface. For the real-time display of the operating status, the bidirectional functionality of the CAN bus is used, this is compatible with (CANOpen CiA301 Industrial Standard) all common industrial sensors and control components such as mass flow controllers (MFC).

nect ...

With a simple CAN to USB interface (see accessories), all standard laptops or PC´s can be connected via USB 2.0. In this way, there are no restrictions with regard to ease of operation, graphical real-time display or process data storage. relyon plasma GmbH offers a standard software package for this (see accessories).

For the integration of the plasma system into an industrial production plant, the CANOpen standard offers a distinct advantage with regards to communication capability and robustness. A plasma multi-channel system (Example C) can be constructed with minimum wiring. The system is independent of the selected control system and, regardless of whether SPC or an industrial PC is used, a fast and reliable communication system can be simply constructed to all system components. Mass flow controllers, pressure sensors, temperature sensors, etc. can also be simply integrated and linked via the bus. All variants of process monitoring, remote diagnosis and reliable reporting of process parameters can therefore be simply implemented. The service technicians can simply connect to the CAN bus and, depending on the set access rights, can view all historical and current data.
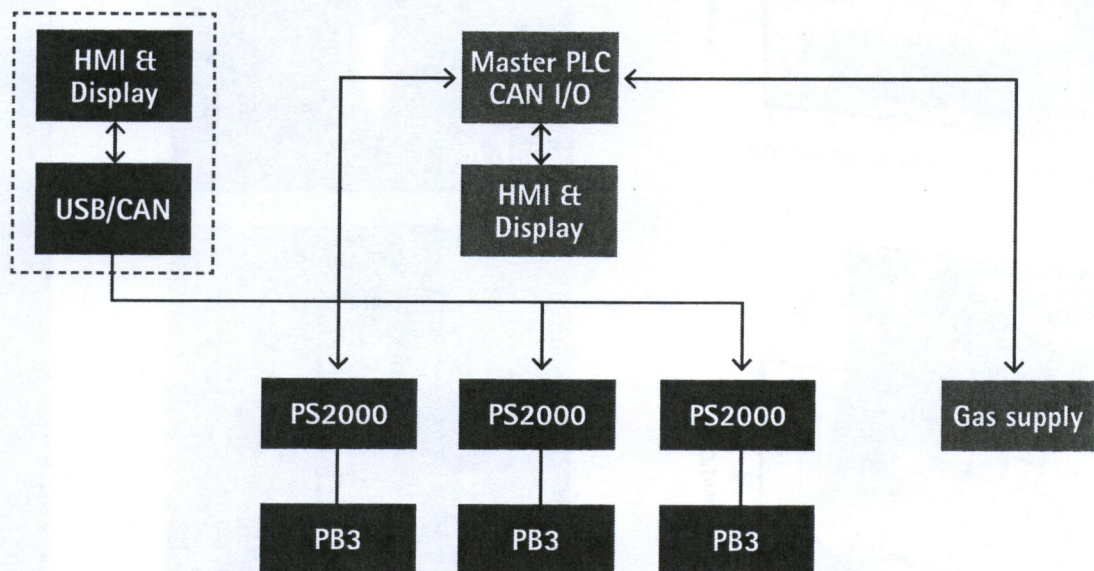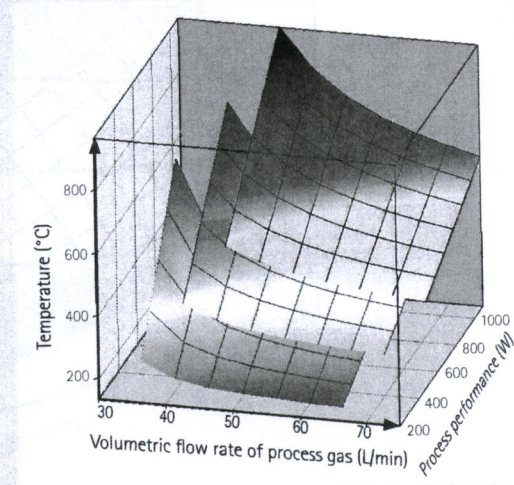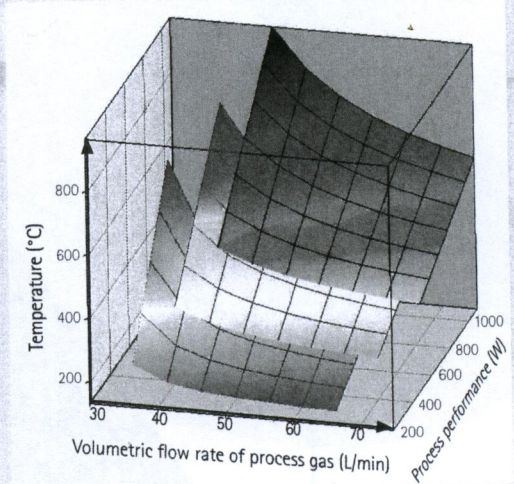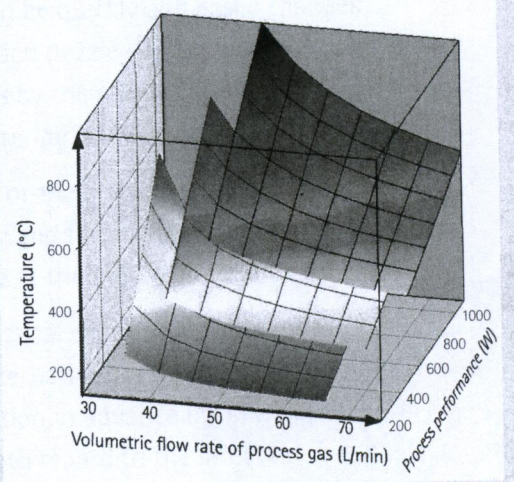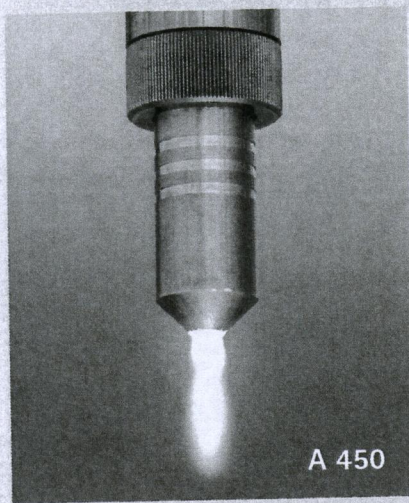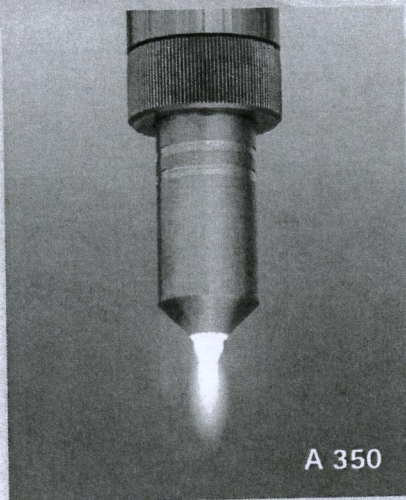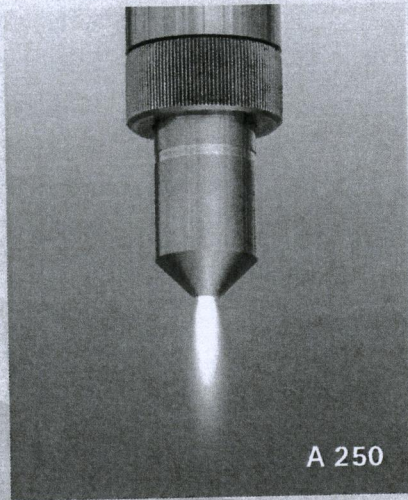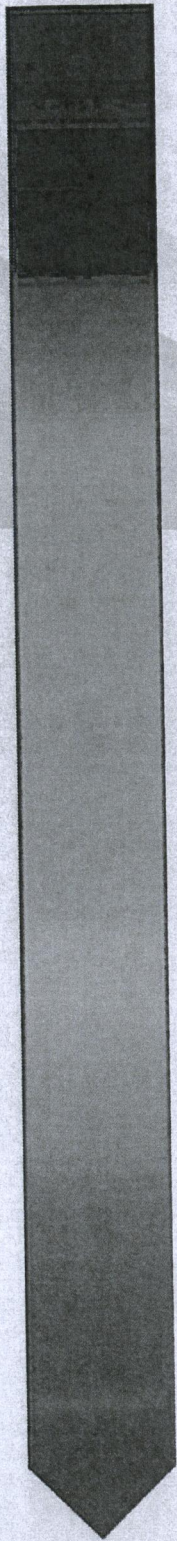

Example C: **Multichannel system** with full processing control, data visualisation and service interface with remote maintenance option

... and it's ready to use

A 250

A 350

A 450

A suitable nozzle for every process. The fine adjustment is derived from the characteristic diagrams which here depict the relationship between gas flow and input power.

e nozzles – tailored to your process ...

Process variability is the keyword leading to the success of surface treatment using the relyon plasma system. The processing of metals, glass, organic materials, textiles or polymers requires process control that is adapted to the specific application. An equally important feature is the range of possible applications, e.g. cleaning, activation, coating, bleaching or heating. Further parameters include the cycle time required by the application, process speed, product geometry and working distance.

For different applications, a variety of nozzle attachments can be selected, which enable the geometry and temperature range of the plasma flame to be preselected on an approximate basis.

All nozzles can be quickly and easily changed. In addition, each nozzle enables optimum adaptation to the process by the choice of the process gas, in the simple case "air", and mass flow setting.

A fine tuning of the process takes place via the pulsed energy and frequency, which can be set within a broad range at the high voltage source.

Extensive practical experience exists for most applications, or alternatively relyon plasma can provide a recommendation in advance using numerical process simulation with regard to the selection of suitable components and the optimum process control.
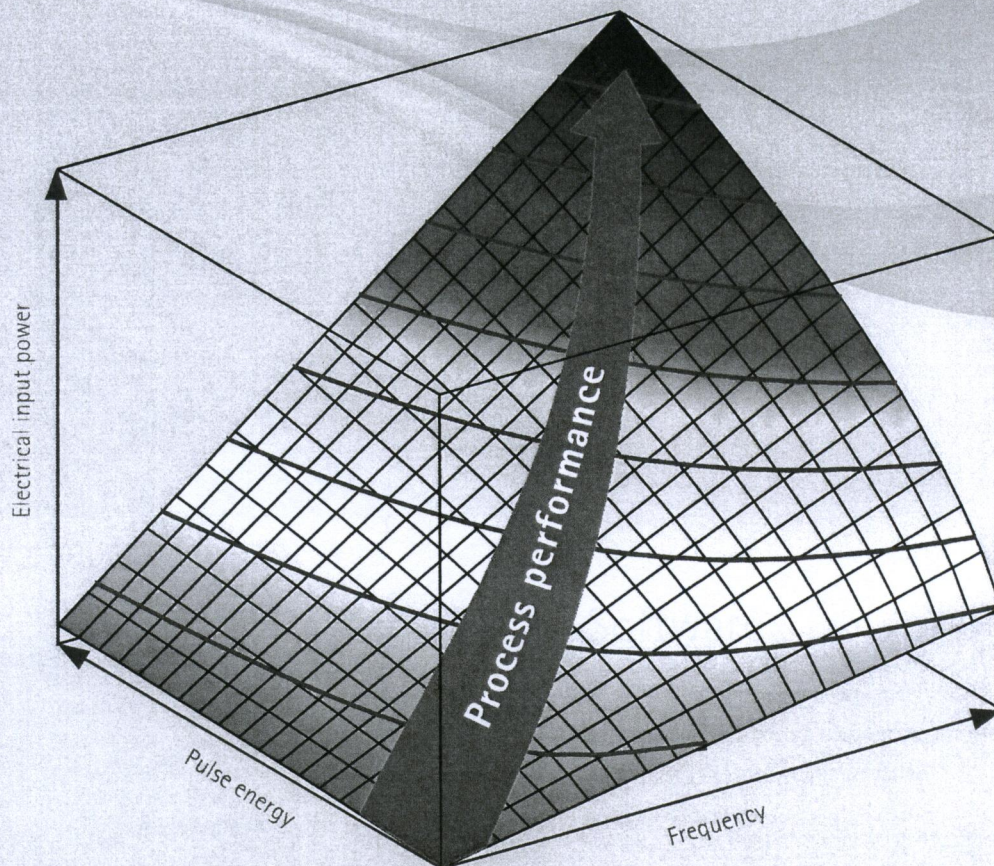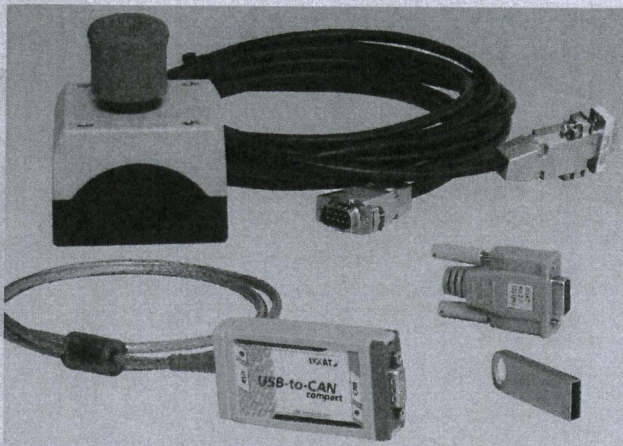

The characteristic diagram of power which is fed into the arc in relationship to pulse energy and frequency.

... optimised for maximum service life
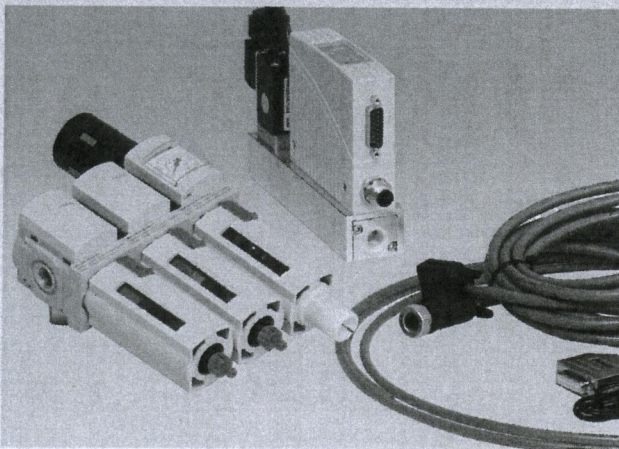
plasmabrush® System technology

Optional accessories and expert advice for your perfect plasma system

Electrical integration package

Optional kit consisting of:

- USB/CANopen interface
- Cable set/plug
- Windows® compatible software for system control, data visualisation, process control and data export function
- User manual

Gas supply package

Optional kit consisting of:

- Mass flow controller (MFC)
- Universal maintenance unit for compressed gas
- Communication cable
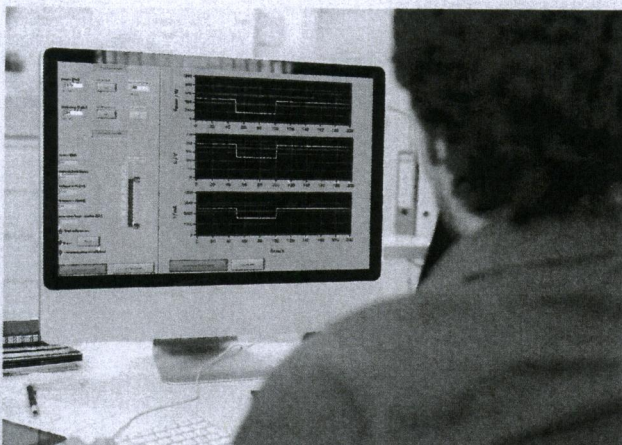
Software

- All system functions at a glance
- Suitable for servicing and remote maintenance
- Robust CANopen communication
- USB compatible

CANopen

Expert advice for your individual requirements ...

... in application technology

We will determine the optimum process parameters to meet your requirements.
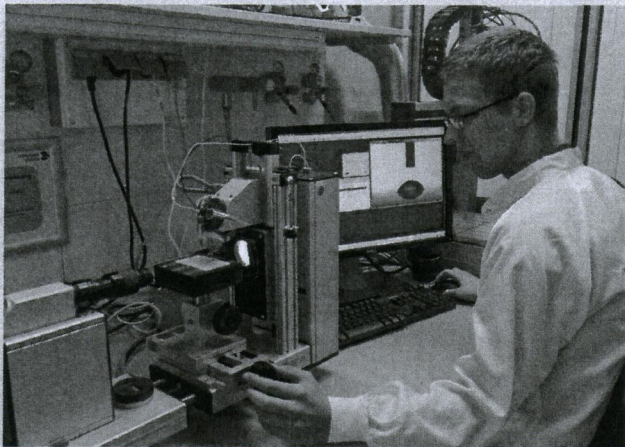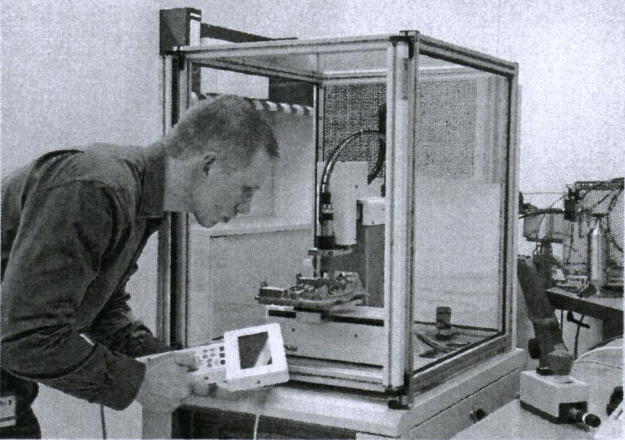

... in system technology

We will advise you on the configuration of the components required for implementation of the optimum process.

Our philosophy:
"KISS - Keep it simple and smart"

If you have already defined specific requirements in your system environment or in your equipment, we will be delighted to advise you on which solution will be the best and most cost-effective for you.

Your relyon plasma Management

relyon plasma

![relyon plasma logo]

*plasma*brush®

Operating instructions

PS2000 power supply

Thank you for buying a high-quality **relyon plasma** GmbH branded product.

To get the best from your machine, please read these instructions carefully.

i **Important!**
Read these instructions carefully before assembling, installing and starting up the machine!

Always follow the safety instructions! Failure to follow the safety instructions may result in accidents, serious injury and serious damage to the machine.

The PS2000 power supply may only be started up and operated by trained and qualified persons!

Train your staff! The operator / user is responsible for ensuring that personnel have fully understood the operation of the machine and the safety requirements.

Original Operating
Instructions

1 Safety

The PS2000 power supply was designed in accordance with the relevant international standards. However, as with any technical product, hazards may arise if the system is not used properly or is used for purposes other than its intended use.

Working with the PS2000 power supply can be dangerous and may result in serious or fatal injury. It is therefore essential to protect yourself and others.

In addition to the safety instructions in this document, you must also comply with general safety standards.

Caution - Danger!

When working with the machine, please note and observe the safety instructions and requirements in these operating instructions because non-compliance may result in serious or fatal injury.

1.1 Residual risks

This machine has been manufactured in accordance with the current state of the art. However, it is impossible to eliminate residual risks.

Always adhere to the following safety instructions:

Caution – Electrical voltage!

- Danger from high voltage
  - Never reach into the plasma beam of the connected plasma generator.
  - During operation never touch the workpiece in contact with the plasma beam or the fixture holding it.
  - Never touch the connected plasma generator when the system is in operation.
  - Never direct the plasma beam at people or animals.
  - Earth the plasma generator by fitting in a holding fixture.
- Danger: 230 V. If damage is visible on the electrical connection, mains cable or machine:
  - Do not start up the machine.
  - Have the damaged parts repaired by a qualified person or replace them.

Caution – Health hazard!

The machine operates at a high frequency (~ 40 - 65 kHz in plasma generator).

- As a precaution, persons with a pacemaker or hearing aid should observe the following:
  - Do not use the PS2000 power supply near the pacemaker or hearing aid.
  - Seek medical advice before working near the system.
- In hospitals and similar facilities, it is possible that the operation of the system may impair the function of electrical medical equipment, computer equipment, or other equipment
(such as ECG systems or PCs).
  - Make sure that the operator of such equipment or systems is aware of this possibility before starting up the machine.

Trip hazard!

Lay the connection cables and gas pipes in suitable cable trays. Lay cables such that they do not present a trip hazard.

> **!** **Attention – Damage to machine!**
> The machine may overheat. Do not cover the ventilation slots.

1.2 Information and obligations for the operator

- The machine may emit interference.
  - The system has been tested in accordance with EMC legislation.
  - The operator must verify and assure electromagnetic compatibility with other electrical and electronic equipment in the immediate vicinity of the system.
- Ensure that
  - operating personnel have read and understood these operating instructions.
  - anyone working near the machine is made aware of the dangers and is provided with the necessary protective equipment.
  - Repairs are only carried out by qualified persons.
- In particular, make operating personnel aware of the safety instructions in this document.
- Always keep the system in fully functional condition.
- Any modifications made to the machine will invalidate the operating licence and the warranty, unless such modifications are expressly authorised by the manufacturer.

1.3 Intended use

The PS2000 power supply is only intended for operation of a plasma generator from **relyon plasma** GmbH.

Coupled with a suitable plasma generator, the machine is intended solely for the plasma treatment of surfaces (metals, textiles, glass, plastics) to activate, clean, coat or remove residue at atmospheric pressure or in a low vacuum (up to 1 mbar).

Under no circumstances may the machine be used by non-trained persons.

1.4 Impermissible operating conditions

The machine must not be operated under the following conditions:

- In explosive (ex) zones
- In areas with severe build-up of dust
- In environments where the air humidity is too high (see technical data, page 11)
- At altitudes of more than 2000 m above sea level
- Where there are strong vibrations

1.5 Emissions

The connected plasma generator produces the following emissions:

- Small amounts of UV light
- Small amounts of ozone (O_3) and nitrogen oxide (NOx) The workplace limit value may be exceeded. Example:

Plasma gas	Gas flow	Ozone	NOx
Air	35 Nlm	1.5 mg/m³	3500 mg/m³
Nitrogen	35 Nlm	0.4 mg/m³	350 mg/m³

Please comply with the information in the operating instructions for the plasma generator.

i

Note!

As a precautionary measure, we recommend using an extraction system with a capacity of at least 500 l per minute in the direct vicinity of the plasma outlet.

2 Description of machine

2.1 Function

The PS2000 power supply forms part of an atmospheric-pressure plasma generator for the atmospheric plasma treatment or pretreatment of a wide range of surfaces.

It is intended for industrial applications where surfaces are activated or cleaned with plasma prior to printing, gluing or painting. It may also be used for surface-coating.

The housing is intended for installation in a control cabinet.

2.2 Overview of the machine

2.2.1 Machine
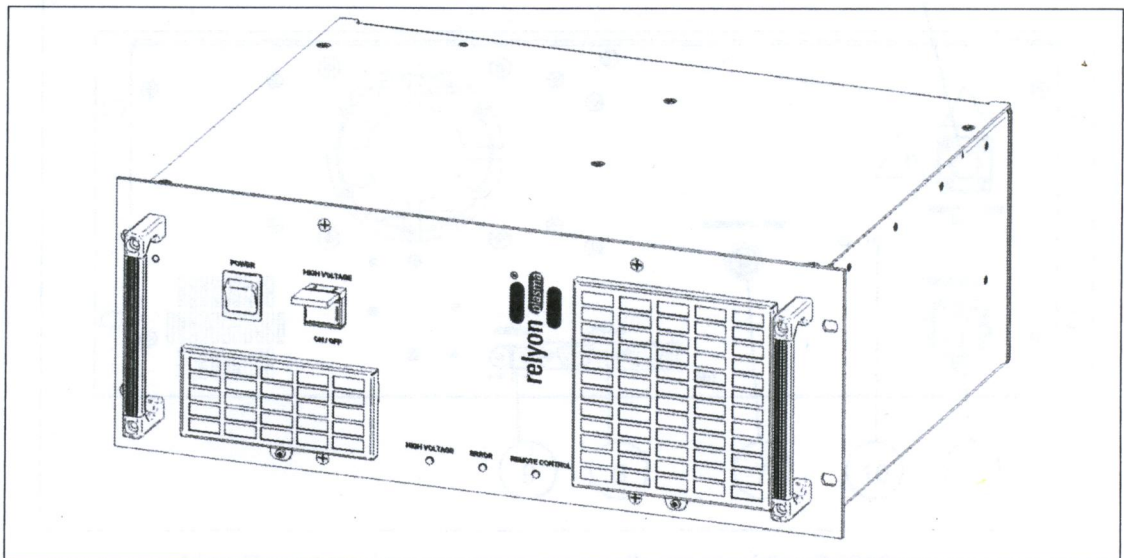
Component
PS2000 high-voltage power supply

2.2.2 Description and connections
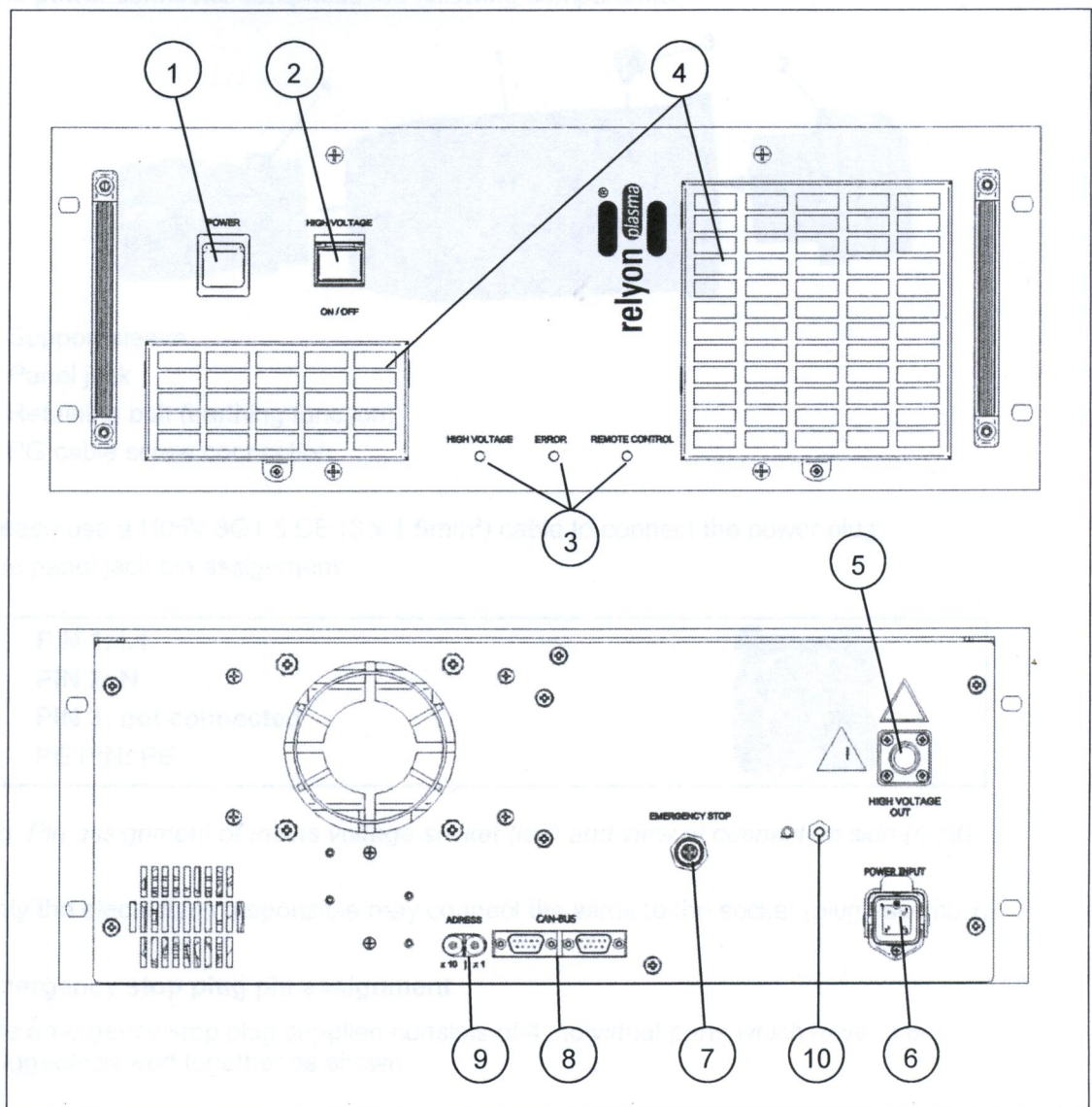
Fig.: Diagram of front (top) and rear (bottom) of the PS2000

No.	Component
1	Master switch I/O
2	Momentary contact "High voltage on/off" – "One push start" button with protective cover flap
3	Status LED
4	Ventilation grille with dust filter (class G2 coarse dust filter)
5	GES HB 30 PTFE high-voltage socket for connecting an HVC high-voltage cable
6	230V AC, 50Hz power connector (for cable type: H05V 3G1.5 CE (3 x 1.5mm²)) Harting HAN 3
7	Harting HAN M12 emergency stop plug connector
8	Communication (CAN bus) interface (sub D 9-pin) X21, X22
9	Address selector switch
10	Earthing connection

2.2.3 Power connector pin assignment

The power connector comprises the following components:
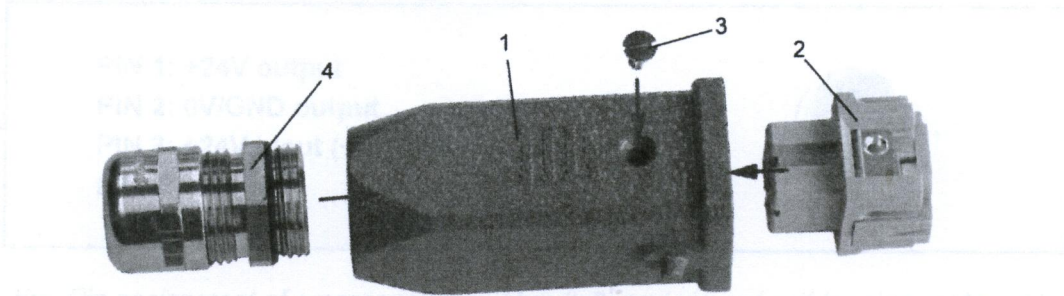
1: Support sleeve
2: Panel jack
3: Retaining bolt (earthing function)
4: PG cable screw connection

Please use a H05V 3G1.5 CE (3 x 1.5mm²) cable to connect the power plug.

The panel jack pin assignment:

PIN 1: L1
PIN 2: N
PIN 3: not connected
PE PIN: PE
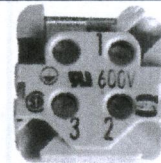
Fig. Pin assignment of mains voltage socket (left) and view of connection side (right)

Only the electricians responsible may connect the wires to the socket (plug assembly)!

2.2.4 Emergency stop plug pin assignment

The emergency stop plug supplied consists of 4 individual parts which have to be plugged/screwed together as shown.
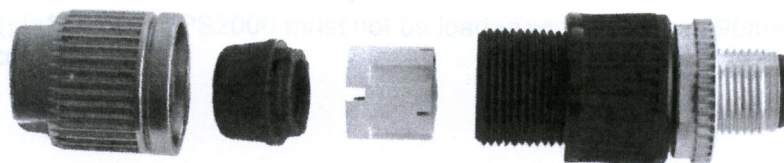
Emergency stop plug pin assignment:

PIN 1: +24V output
PIN 2: 0V/GND output
PIN 3: +24V input (+/- 10%)
PIN 4: 0V input

Fig. Pin assignment of emergency stop plug (left) and view of self-tapping cable guide (right)

Principle of connection to emergency stop circuit

Internal emergency stop circuit
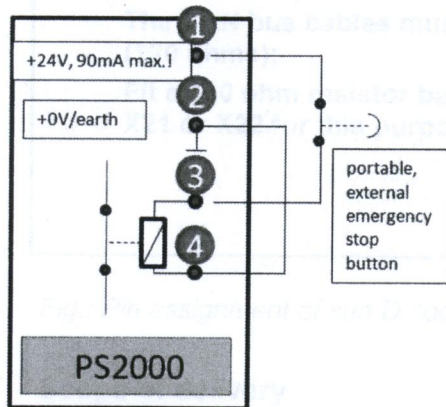
Integration in external emergency stop circuit
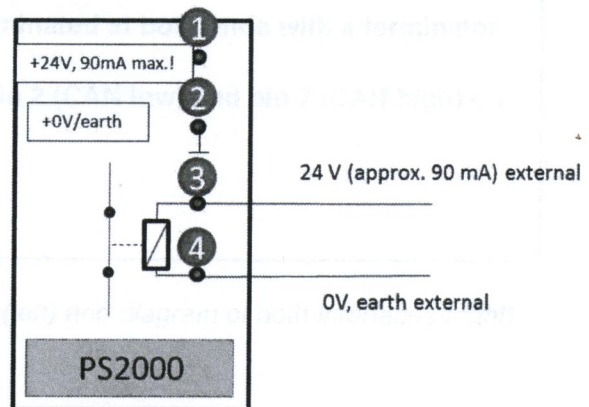
24V

If using an external voltage (integration in external emergency stop circuit), ensure that the voltage is 24V DC (+/- 10%) (load: approx. 90mA).

The output (pin1-2) of the PS2000 must not be loaded with more than 90mA under any circumstances.

Pin 1: not connected (X21&X22)

Pin 2: CAN Low (X21&X22)

Pin 3: CAN Ground (X21&X22)

Pin 4: not connected (X21&X22)

Pin 5: connected through (X21.5
<-> X22.5 – no function)

Pin 6: connected through (X21.6
<-> X22.6 – no function)

Pin 7: CAN High (X21&X22)

Pin 8: not connected (X21&X22)

Pin 9: connected through (X21.9
<-> X22.9 – no function)

The CAN bus cables must be terminated at both ends with a terminator (120 ohms):

Fit a 120 ohm resistor between pin 2 (CAN low) and pin 7 (CAN high) on X21 or X22 for this purpose.
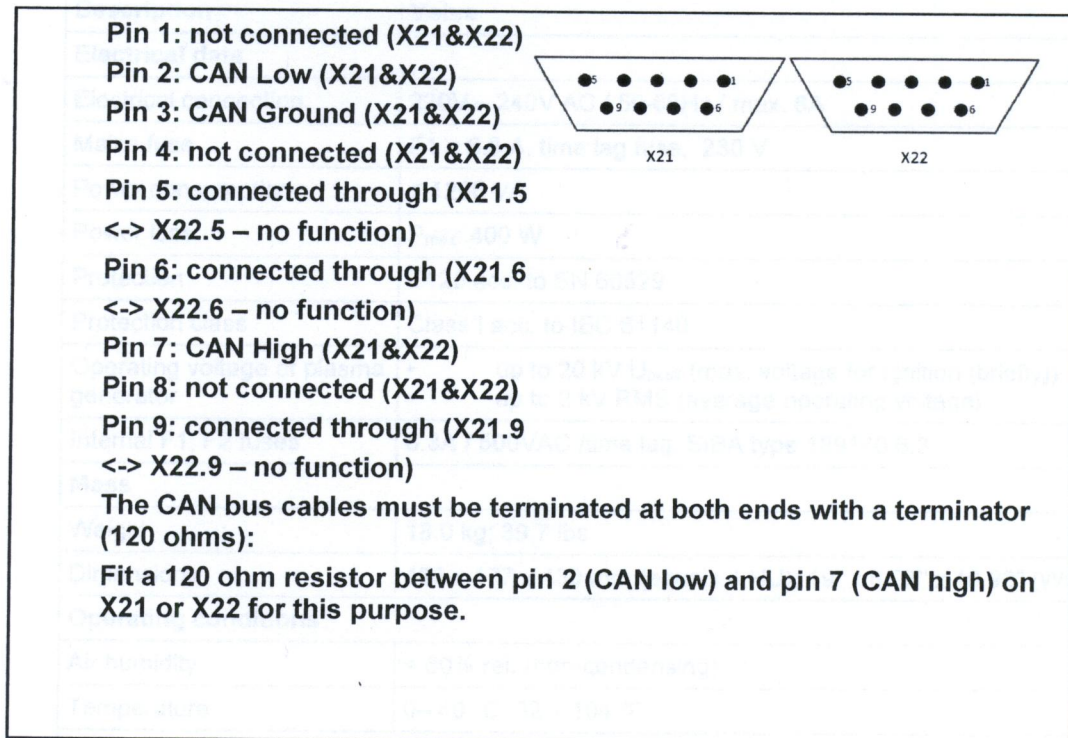
Fig.: Pin assignment of sub D socket/plug (left) and diagram of both interfaces (right).

2.3   Scope of delivery

The scope of delivery includes the following components:

- PS2000 power supply.
- Power connector for the electrical supply voltage connection, comprising sleeve support, socket insert and cable screw connection (Harting HAN 3).
- Round plug connector for connecting and integrating the PS2000 in internal or external emergency stop circuit (Harting HAN M12).
- Operating instructions.

3　Technical data

3.1　Technical data

Description	Value
Electrical data	
Electrical connection	220V – 240V AC / 50-60Hz / max. 6A
Mains fuse	F1 = 6.3 A, time lag fuse, 230 V
Power consumption	≤ 1200 VA
Power loss	P_{max}: 400 W
Protection	IP 20 acc. to EN 60529
Protection class	Class I acc. to IEC 61140
Operating voltage of plasma generator	• 　　up to 20 kV U_{peak} (max. voltage for ignition (briefly)) • 　　up to 2 kV RMS (average operating voltage)
Internal F1, F2 fuses	6.3A / 500VAC /time lag, SIBA type 189140.6.3
Mass	
Weight	18.0 kg; 39.7 lbs
Dimensions	483 x 177 x 430 mm (equals 4 HU); 19" x 6.97" x 16.93" (WxHxD)
Operating conditions	
Air humidity	< 80% rel. (non-condensing)
Temperature	0– 40 °C; 32 – 104 °F
Storage conditions	
Air humidity	< 80% rel. (non-condensing)
Temperature	0 – 60 °C; 32 – 140 °F
Noise emissions	
• 　Sound level	< 60 dB(A) at 1 meter away

3.2　Permissible operating parameters

The PS2000 power supply is used with a suitable plasma generator for the plasma treatment of surfaces (metals, textiles, glass, plastics) to activate, clean, coat or remove residue at atmospheric pressure. This plasma treatment produces significantly better results during subsequent gluing, painting, printing, coating, wetting, laminating and metallising.

All system components of the plasma generator must be earthed.

During operation, the specified limits must be observed:

Description	Value
Plasma on	Before activating the high voltage for plasma generation, the gas supply to the plasma generator must be switched on for at least 2 seconds.

4 Transport / storage

- Store the PS2000 power supply in a dry place. This will prevent corrosion of the electrical contacts.
- Protect the PS2000 power supply from dirt and foreign bodies.

5 Unpacking and installation

Caution – Electrical voltage!

Danger: 230 V and high voltage.

- Only electricians may connect the PS2000 power supply to the mains voltage supply and connect the plasma generator and HVC cable extension to the PS2000 power supply.

5.1 Unpacking

- Carefully open the PS2000's packaging. Note the information about directions provided on the packaging.
- Remove the PS2000 from the packaging by the two handles.
- After removing, check in particular the rear mains plug (see Part #6, page 7) to ensure that the O-ring is positioned correctly in the socket.

5.2 Installation requirements

Before installing the machine, the following must be true:
- There must be an appropriate gas supply.
- The machine must be fully intact.
- If the PS2000 communicates with a superordinate control unit, the pins for the CAN bus connection must be assigned following the requirements in these operating instructions (see page 10).
- If installing as a permanent installation or in a building, a suitable switch or circuit breaker that satisfies national safety requirements (in Germany: VDE 0100) must be fitted as an upstream all-pole cut-off device that will disconnect the machine from the power supply. This cut-off device should be fitted near the machine and must be easily accessible to the user. The switch must also be labelled as the cut-off device for the machine.

5.2.1 Installing and starting up one single PS2000

The PS2000 can be mounted horizontally or vertically. Ensure a sufficient distance between the nearest housing wall and the ventilation slots (>150mm).

To install the machine, perform the following steps in the order given:

1. Mount the machine in a 19" control cabinet intended for this purpose. To distribute the weight, use mounted support rails on which the PS2000 sits.

- Use fixing bolts to secure the PS2000 in the bracket. Use the four slots in the front plate (#11) provided for this purpose.

- Please ensure sufficient space between the control cabinet wall and front/rear (for electrical connections, dissipation of heat). This should not be any less than 150 mm.
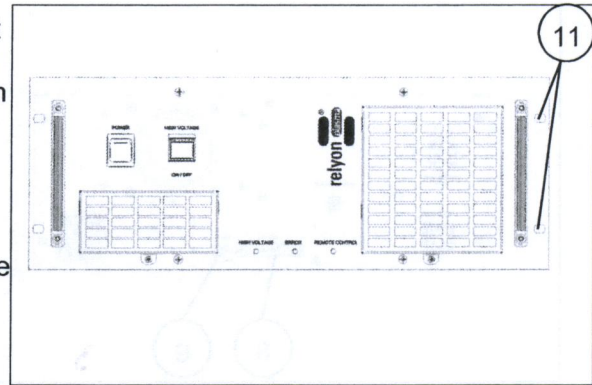
2. Establish high-voltage connection between HVC cable extension and connection socket (#5) on the PS2000.

3. Mount an appropriate plasma generator. Make sure that the screw connection is hand tight.
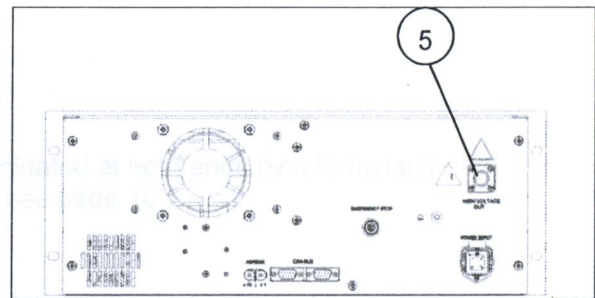
4. Establish power supply to PS2000 (#6).
   - 230 V / 50 Hz
     Cable type: H05V 3x1.5 mm^2

   Please ensure a safe electrical connection (especially PE conductor).

5. Also earth the PS2000 at the earthing connection (#10) (M5 thread)

6. Connect PS2000 with the emergency stop circuit using the relevant plug connection (#7).
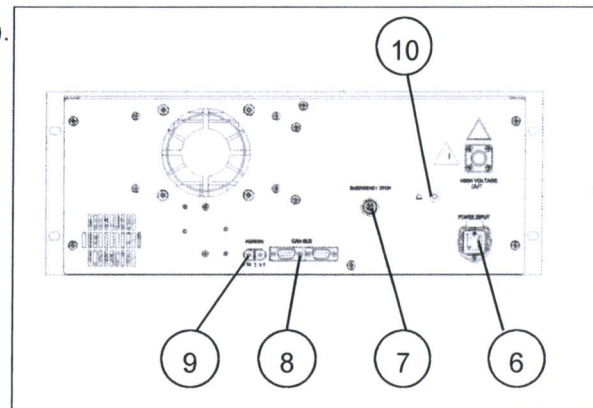
7. A CAN bus interface should be fitted with a terminator for individual PS2000 operation (see page 10)

✓ The machine is installed.

5.2.2 Installing and starting up several PS2000s running in parallel

To install and start up several PS2000s which are controlled in parallel by one control unit, please proceed as follows:

1. Perform steps 1-6 for starting up an individual PS2000
2. For each PS2000, set a separate machine address on the rotary switch (#9).
3. Connect all PS2000s in series with the communication bus (#8). Since there is a bus signal on both ports (X21&X22), you can connect the various PS2000s with one another. Make sure that a 1-1 cable is used for the connection between the PS2000s.
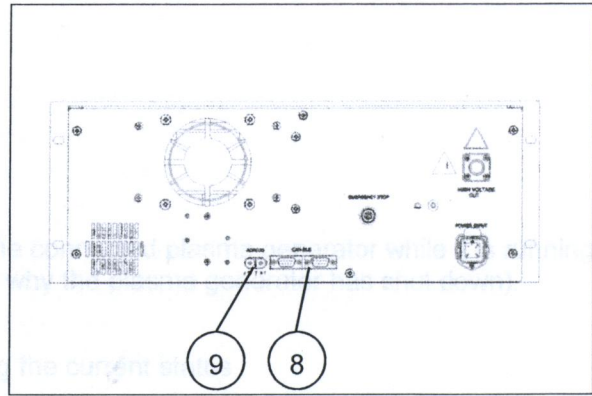
Terminator

Please ensure that the CAN bus cable is terminated at both ends by a terminator (120 ohms). (Terminating circuit / pin assignment: see page 10)

✓ The machines are installed.

6 Operation

6.1 Controls / displays

⚠️ **Caution – Electrical voltage!**

Danger of electric shock.

- Never reach into the area around the connected plasma generator while it is running or if it has shut down (e.g. to check why the plasma generator has shut down).

The PS2000 has signal lamps indicating the current status.
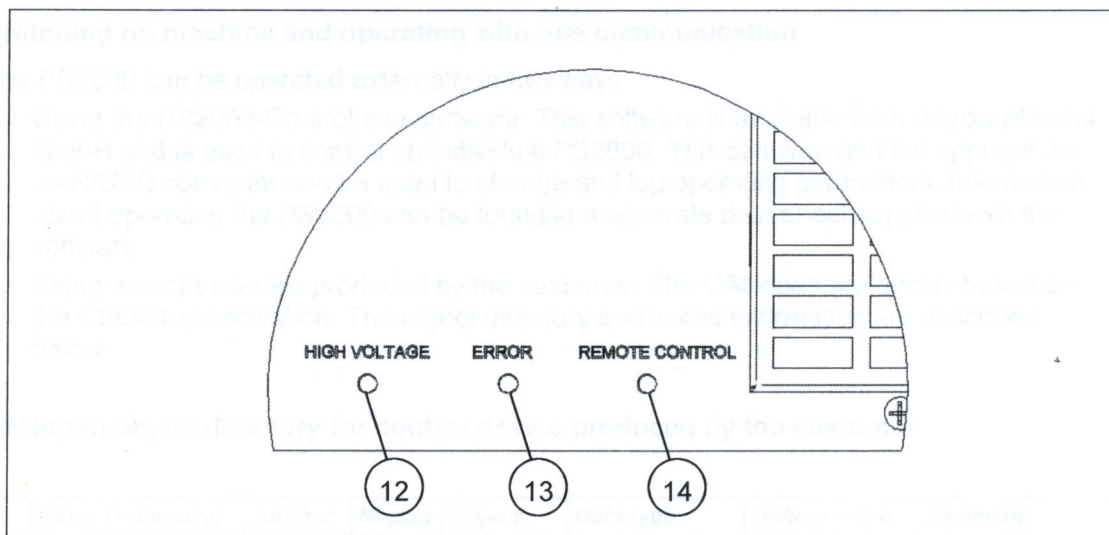
No.	Display	Function
12	High Voltage	There is high voltage at the output of the connection socket (#5).
13	Error	There is an error present. It can be read off via the CAN bus. PS2000 is not ready. The error must be acknowledged before the machine can be operated again.
14	Remote Control	Communication with superordinate control unit possible. The "one push start" button on the front (high voltage on/off) is not functional!

6.2 Switching on and operating machine

6.2.1 Switching on and operating machine without bus communication

❗ **Attention – Damage to machine!**

The plasma generator may be damaged if operated without gas, or with insufficient gas flow.

- Never switch on the high voltage before sufficient gas is flowing through the plasma generator!

To switch on the PS2000 WITHOUT bus communication, perform the following steps in the order given:

1. Switch machine on using master switch (#1).
- The master switch lights up green.
2. Ensure that a plasma generator is correctly connected to the PS2000 and that sufficient gas is flowing through the plasma generator.
3. Press the "one push start" button (high voltage on/off).
✓ The machine is switched on.

If the machine is operated WITHOUT bus communication, the electric parameters for plasma generation cannot be changed. When supplied, the PS2000 is operated with the following parameters: Frequency: 54kHz, nominal output: 100%

6.2.2 Switching on machine and operating with bus communication

The PS2000 can be operated externally in two ways:

a. Using the PS2000-Control.exe software: This software is available from **relyon plasma** GmbH and is used to control an individual PS2000. This software and the appropriate CAN/USB converter can be used to change and log operating parameters. Information about operating the PS2000 can be found in a separate data sheet supplied with the software.

b. Using a control device produced by the customer. The CANopen protocol is based on the CIA301 specification. The object directory and linked information are described below.

6.2.2.1 CANopen object directory for control device produced by the customer

Index hex	Sub-index hex	Name (reference)	Attribute	Mappable	Object type	Data type	Default value	Comment
1000	00	Device type	ro	n	VAR	UNSIGNED32	0x00000000	
1001	00	Error register	ro	y	VAR	UNSIGNED8	0x00	See "Error message"
1003		Pre-defined error field			ARRAY	UNSIGNED32		
	00	Number of errors	rw	n		UNSIGNED8	00_h	
	01	Standard error field	ro	n		UNSIGNED32	$0000\ 0000_h$	
	02	Standard error field	ro	n		UNSIGNED32	$0000\ 0000_h$	
	03	Standard error field	ro	n		UNSIGNED32	$0000\ 0000_h$	
	04	Standard error field	ro	n		UNSIGNED32	$0000\ 0000_h$	
1005	00	COB-ID SYNC message	rw	n	VAR	UNSIGNED32	$0000\ 0080_h$	
1008	00	Manufacturer device name	ro	n	VAR	VISIBLE_STRING	" PS2000"	
1009	00	Manufacturer hardware version	ro	n	VAR	VISIBLE_STRING	hardware version string,	
100A	00	Manufacturer software version	ro	n	VAR	VISIBLE_STRING	software version string, e.g. "V01.00"	
100C	00	Guard time	rw	n	VAR	UNSIGNED16	0000_h	0..32000 [ms]
100D	00	Life time factor	rw	n	VAR	UNSIGNED8	00_h	0..255 [factor] for guard time
1010		Store parameters			ARRAY	UNSIGNED32		
	00	Highest sub-index supported	ro	n		UNSIGNED8	04_h	

Index hex	Sub-index hex	Name (reference)	Attribute	Mappable	Object type	Data type	Default value	Comment
	01	Save all parameters	rw	n		UNSIGNED32	0000 0001h	Ascii "save" Complete object directory (incl. 2040-2043) is saved
	02	Save communication parameters	rw	n		UNSIGNED32	0000 0000h	"save" not supported
	03	Save application parameters	rw	n		UNSIGNED32	0000 0000h	"save" not supported
	04	Save manufacturer defined parameters	rw	n		UNSIGNED32	0000 0001h	"Burn in" set of parameters - Only objects 2040-2043 are saved
1011		Restore parameters			ARRAY	UNSIGNED32		
	00	Highest sub-index supported	ro	n		UNSIGNED8	00h	
	01	Restore all parameters	rw	n		UNSIGNED32	0000 0001h	Ascii "load" Complete object directory (NOT INCLUDING 2040-2043) is deleted.
	02	Restore communication parameters	rw	n		UNSIGNED32	0000 0000h	"load" not supported
	03	Restore application parameters	rw	n		UNSIGNED32	0000 0000h	"load" not supported
	04	Restore manufacturer defined parameters	rw	n		UNSIGNED32	0000 0001h	"Burn in" set of parameters is reset to factory settings
1014	00	COB-ID emergency message	rw	n	VAR	UNSIGNED32	80h + node ID	
1016		Consumer heartbeat time			ARRAY			
	00	Highest sub-index supported	ro	n		UNSIGNED8	03h	
	01	Consumer heartbeat time	rw	n		UNSIGNED32	0000 0000h	0..32000[ms]
	02	Consumer heartbeat time	rw	n		UNSIGNED32	0000 0000h	0..32000[ms]
	03	Consumer heartbeat time	rw	n		UNSIGNED32	0000 0000h	0..32000[ms]
1017	00	Producer heartbeat time	rw	n	VAR	UNSIGNED16	0000h	
1018		Identity object			RECORD	IDENTITY		
	00	Highest sub-index supported	ro	n		UNSIGNED8	04h	
	01	Vendor ID	ro	n		UNSIGNED32	0000 0000h	
	02	Product code	ro	n		UNSIGNED32	0000 0000h	
	03	Revision number	ro	n		UNSIGNED32	0000 0000h	
	04	Serial number	ro	n		UNSIGNED32	FFFF FFFFh	

Index hex	Sub-index hex	Name (reference)	Attribute	Mappable	Object type	Data type	Default value	Comment
1200		SDO server 1 parameter			RECORD	SDO_PARAMETER		
	00	Highest sub-index supported	ro	n		UNSIGNED8	02h	
	01	COB ID client -> server (rx)	ro	n		UNSIGNED32	0000 0600h + Node ID	
	02	COB ID server -> client (tx)	ro	n		UNSIGNED32	0000 0580h + Node ID	
1400		RPDO 1 comm. parameter			RECORD	PDO_COMMUNICATION_PARAMETER		
	00	Highest sub-index supported	ro	n		UNSIGNED8	02h	
	01	COB ID used by RPDO	rw	n		UNSIGNED32	0000 0200h + Node ID	
	02	Transmission type	rw	n		UNSIGNED8	FFh	"FF" asynchronous; "1" synchronous See CIA301
1600		RPDO 1 mapping parameter			RECORD	PDO_MAPPING		
	00	Number of mapped application objects in RPDO	ro	n		UNSIGNED8	Number of mapped objects (digital outputs)	5
	01	1st application object	ro	n		UNSIGNED32	2030 00 08	
	02	2nd application object	ro	n		UNSIGNED32	2040 00 08	
	03	3rd application object	ro	n		UNSIGNED32	2041 00 10	
	04	4th application object	ro	n		UNSIGNED32	2042 00 10	
	05	5th application object	ro	n		UNSIGNED32	2043 00 10	
1800		TPDO 1 comm. parameter			RECORD	PDO_COMMUNICATION_PARAMETER		
	00	Highest sub-index supported	ro	n		UNSIGNED8	05h	
	01	COB ID used by TPDO	rw	n		UNSIGNED32	0000 0180h + Node ID	
	02	Transmission type	rw	n		UNSIGNED8	FFh	
	03	Inhibit time	rw	n		UNSIGNED16	0000h	See CIA301 0..32000 [ms]
	05	Event timer	rw	n		UNSIGNED16	0000h	See CIA301 0..32000 [ms]
1A00		TPDO 1 mapping parameter			RECORD	PDO_MAPPING		
	00	Number of mapped application objects in TPDO	ro	n		UNSIGNED8	Number of mapped objects (digital inputs)	5
	01	1st application object	ro	n		UNSIGNED32	2010 00 08	
	02	2nd application object	ro	n		UNSIGNED32	2020 00 08	

Index hex	Sub-index hex	Name (reference)	Attribute	Mappable	Object type	Data type	Default value	Comment
	03	3rd application object	ro	n		UNSIGNED32	2021 00 10	
	04	4th application object	ro	n		UNSIGNED32	2022 00 10	
	05	5th application object	ro	n		UNSIGNED32	2023 00 10	
1F51		Program control			Array	UNSIGNED8		
	00	Highest sub-index supported	ro	n		UNSIGNED8	1	
	01	Program 1	rw	n		UNSIGNED8		Internal use - do not change!

Index hex	Sub-index hex	Name (reference)	Attribute	Mappable	Object type	Data type	Default value	Comment
2000	00	Error status	rw	n	VAR	UNSIGNED8		0 Rw: Delete error statuses, see "Error message": RPDO2, byte 1
2010	00	Status code	ro	j	VAR	UNSIGNED8		See "Status code": TPDO1, byte 1
2020	00	Power actual	ro	j	VAR	UNSIGNED16		TPDO1, byte 3,4
2021	00	Frequency actual	ro	j	VAR	UNSIGNED8		TPDO 1, byte 2
2022	00	Voltage RMS actual	ro	j	VAR	UNSIGNED16		TPDO1, byte 5, 6
2023	00	Current RMS actual	ro	j	VAR	UNSIGNED16		TPDO1, byte 7, 8
2030	00	High Voltage	rw	j	VAR	UNSIGNED8	Write: 0/1 Read: Corresponding status code 0x2010 (PlasmaOk)	RPDO1, byte 1
2040	00	Power set	rw	j	VAR	UNSIGNED8		0..100: RPDO1, byte 2
2041	00	Frequency set	rw	j	VAR	UNSIGNED16		RPDO1, byte 3, 4
2042	00	Voltage threshold	rw	j	VAR	UNSIGNED16		Internal error threshold - do not change! RPDO1, byte 5,6
2043	00	Current threshold	rw	j	VAR	UNSIGNED16		Internal error threshold - do not change! RPDO1, byte 7,8
2050		Temperature			Array			
	00	Highest sub-index supported	ro	n		UNSIGNED8	5	
	01	Temperature 1	ro	n		UNSIGNED8		TPDO2, byte 3
	02	Temperature 2	ro	n		UNSIGNED8		TPDO2, byte 4
	03	Temperature 3	ro	n		UNSIGNED8		TPDO2, byte 5
	04	Temperature 4	ro	n		UNSIGNED8		TPDO2, byte 6
	05	Temperature 5	ro	n		UNSIGNED8		
2060	00	Power-On time	ro	n	VAR	UNSIGNED16		TPDO2, byte 1, 2
2100	00	Internal use	wo	n	VAR	UNSIGNED32		Do not change!
2110	00	Internal use	ro	n	VAR	UNSIGNED16		

- Please always ensure that the operating parameters of the PS2000 are within the stated range of values:

Description	Adjustable value	Default values ("Burn in" set of parameters)
Frequency set [Hz]	40000-65000 (step width 200Hz)	54000 Hz
Power set [%]	0-100 (step width 1)	100
Voltage threshold	Internal error threshold - do not change!	250 V
Current threshold	Internal error threshold - do not change!	100 mA

- Default bit rate: 125 kbit. Bit rate can be changed via LSS protocol (defined using CIA305). Supported bit rates: 1MBit, 500kBit, 250kbit, 125kBit, 100kBit, 50kBit, 20kBit
- "Remote control" LED: To visualise communication via an illuminated "Remote control" LED, the "Operational" status must be set once in the CANopen state machine. (Network management command: 0x00 0x01 + corresponding node number of PS2000. (To reset to "preoperational": 0x00 0x80))
- The communication status should be continuously monitored via the "Guard" or "Heartbeat" telegram!
- If there is no communication, the PS2000 must switch off the high voltage!

!

Attention – Safety!

We would highly recommend querying and monitoring the "Heartbeat" or "Guard" telegram so that the PS2000 can still be switched in the event of e.g. loss of communication with the superordinate control unit.

!

Attention – Damage to machine!

Please only change the approved parameters! If incorrectly actuated, the PS2000 may display serious faults or be destroyed.

6.2.2.2 Error messages

Emergencies are transferred in the following form:

ID: 80h+NodeID data: 0x00 0xFF 0x81 0xyy 0x00 0x00 0x00 0x00

yy: Error code according to error status 1..16h

yy: 0x50 => Data received via RPDO are not within the valid range - valid parameters were transferred and invalid ones ignored.

The error codes have the following meanings:

Error address	Error message
01h	Error: switching circuit central
02h	Temp.: switching circuit central
03h	Error: auxiliary voltage 1
04h	Intermediate circuit voltage
05h	Error: controller
06h	Error: auxiliary voltage 2
07h	Is not used
08h	Temperature of switching circuit central/PCB too high
09h	Communication with controller interrupted
10h	Error: PFC
11h	Emergency stop activated
12h	Is not used
13h	Output voltage too low
14h	Overvoltage
15h	Error: fan
16h	Is not used

6.2.2.3 Status code

Status code	Bit	Description
01h	0	High voltage switched on
02h	1	Plasma ok
04h	2	Power pack ready
08h	3	Error

6.2.2.4 "Burn in" set of parameters

To change the "burn in" set of parameters, the following is undertaken with the current parameters (2040 Power set, 2041 Frequency set, 2042 Voltage threshold, 2043 Current threshold):

- 1010 sub-index 01 : all parameters are transferred and written
- 1010 sub-index 04: only the "burn in" parameters are transferred and written.

! **Attention – Damage to machine!**

Do NOT change the threshold values (voltage / current threshold) for the "burn in" parameters! If incorrectly actuated, the PS2000 may display serious faults or be destroyed.

6.3 Switching off the machine

Attention – Damage to machine!

The plasma generator connected may overheat if the system is switched off while gas is still flowing.

- Do not switch off the system while gas is still flowing (2 seconds).

To switch off, perform the following steps in the order given:

1. Switch off plasma generation.
- When operated WITHOUT bus communication, plasma generation is switched off using the "one push start" button and when operated WITH bus communication, this is done using the corresponding stop command.
- Plasma generation is stopped.
2. Switch off the gas feed (provided by customer).
3. Close the gas supply (provided by customer).
✓ The machine is switched off.

6.4 Error acknowledgement

When the PS2000 reports an error (error LED lights up), the reason for the error message can be read via the CAN bus communication (error code).

Please remedy the cause of the error. Please contact the customer service if anything is unclear.

Once the cause of the error has been remedied, the error message can be acknowledged. There are two ways of doing this:

a) Operation WITHOUT bus communication: Switch off the PS2000 at the master switch and switch on again around 5 seconds later. The error is acknowledged.

b) Operation WITH bus communication: Acknowledge the error using the control software provided or by acknowledging the error status: Enter "0x00" in the object index 0x2000/00

7   Taking out of service

⚠ Caution – Electrical voltage!

Danger: 230 V and high voltage.

- Only electricians may disconnect the power supply, plasma generator or HVC cable extension from the PS2000 power supply.

⚠ Caution – Electrical voltage!

Danger due to high voltage at output.

- After switching off the high voltage / supply voltage, there may still be high voltage on the output for up to 1 sec. Please remember this whenever working on the PS2000, high-voltage cable or plasma generator.

To take the machine out of service, perform in the following steps in the order given:

1. Switch machine off using master switch (#1).
2. Disconnect the PS2000 from the mains voltage supply: Disconnect the power connector (#6).
3. Remove the HVC cable extension and the plasma generator.
4. Remove the PS2000 power supply.

✓ The machine is out of service.

8 Maintenance

⚠️ **Caution – High voltage! Danger of death!**

High voltage is produced in the PS2000 power supply's power pack. This voltage is still present after the machine is switched off.

- It is forbidden to open the machine.
- Whenever undertaking maintenance or repair work on the PS2000 or its connected components, always disconnect the power supply to the PS2000.

❗ **Attention – Damage to machine!**

Opening the machine may cause it to be damaged.

- It is forbidden to open the machine.

With the exception of the dust filters used, the machine requires no maintenance.

Replace the filter mat at least every 5000 operating hours. If working in environments with high levels of dust, they may have to be replaced sooner. You can source the filter mats needed as spare parts from **relyon plasma** GmbH.

To change the dust filters, proceed as follows:

1. Disconnect the power supply to the PS2000.
2. Open the ventilation grille by loosening the screw stated (#x)
3. Take out the old dust filter and insert a new one (class G2 coarse dust filter).
4. Screw the ventilation grille with the new filter to the PS2000.
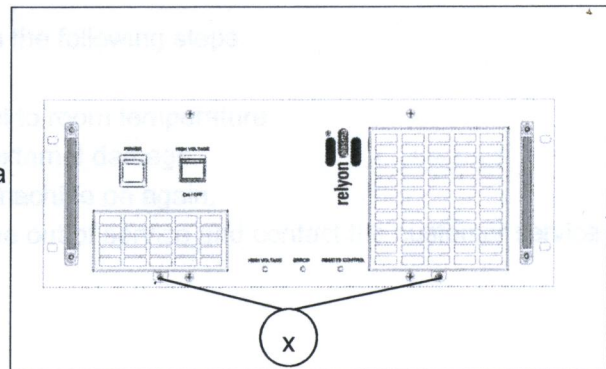
8.1 Cleaning

Only clean the outside of the PS2000 power supply.

- The PS2000 power supply must be switched off and disconnected from the mains voltage supply.
- Only dry clean the PS2000 power supply.

9 Troubleshooting

9.1 No plasma formation

Should the machine not be producing any plasma, start by checking the following:

- Is the mains voltage supply connected??
- Is the high voltage switched on ("High voltage on" LED (#12) lit up)?
- Is the error message ("Error LED" (#13)) lit up?
- Is the gas supply connected to the plasma generator (advance pressure 5 to 8 bar)?
- Is there a sufficient gas flow through the plasma generator?
- Gas flow: $\geq 35 - \leq 80$ Nl/min
- Is the HVC cable extension or gas supply damaged?
- Is the HVC cable extension or gas supply bent?

9.2 Operating faults

- Plasma goes out during operation.
- Parasitic discharge (discharge at undesired points, e.g. at plasma head cable connector. This may destroy the plasma head).
- Flashover

If this type of fault occurs, first perform the following steps:

1. Switch off the machine.
2. Allow the plasma generator to cool to room temperature.
3. Then check machine visually for external damage.
4. If there is no damage, switch the machine on again.

If the fault still occurs, take the machine out of service and contact the customer service team.

9.3 Customer service

If the machine is not working properly, return it to **relyon plasma** GmbH to be checked.

Customer service address:

- See end of operating instructions.

9.4   Overview of faults / errors

Fault / error	Cause	Rectification
Mains unit master switch (#1) not lit up	Fuse defective	Fuse in machine needs replacing -> Contact the customer service
	Power connector incorrectly connected	Check the mains unit connection
	No / incorrect voltage supply	Check the mains voltage supply.
"Error" LED lit up (#13)	There is an error, the machine is not ready	Read out the error (CAN bus) and acknowledge it – without CAN bus communication, switch the PS2000 off and then after 5 seconds on again.
		De-energise machine. Switch on again
		Problem cannot be fixed: Contact customer service.
No plasma is ignited on the plasma generator despite pressing the "one push start" button (#2)	"Remote control" LED (#14) lit up	The machine is controlled via the CAN bus. Operation via the "one push start" button is not provided for.
	"Error" LED lit up (#13)	See error message for "LED Error" lit up.
		Is there sufficient plasma gas flowing through the plasma generator?

10 Environment

10.1 Disposal

Consider the environment.

Used electrical and electronic equipment should not be disposed of along with normal waste.

- The machine contains valuable materials that can be recycled. Take the machine to a suitable collection point.

11 Conformity / standards

11.1 CE

We declare that this product conforms to CE standards.

The product name can be found on the name plate on the rear side of the housing.

11.2 Product standards

The machine satisfies the following requirements and standards:

2004/108/EC EC EMC Directive
Directive of the Council on the approximation of the laws of the Member States relating to electro-magnetic compatibility.
2006/95/EC   EC Low Voltage Directive
Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the approximation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.
EN 55011 (2007 + A2:2007) radiated emissions, limit value class / group 2, class A
EN 61000-6-2 (2005) immunity

Protection class IP20	IEC 60529

![relyon plasma logo]

plasmabrush®

Operating Instructions
Plasma generator PG31

We are pleased that you decided on a brand device from **relyon plasma** GmbH and thank you for the trust you have placed in our company. In order to make the best possible use of the device, please read through these Operating Instructions carefully.

i **Important advice!**

It is essential to read these Operating Instructions thoroughly prior to assembly, installation and commissioning.

It is essential to observe the safety instructions! Nonobservance of the safety instructions can result in accidents and cause serious injury and damage to property.

Commissioning and operation of the plasma generator must only be carried out by qualified and instructed technicians!

Provide instruction for your personnel. The operating company/user is responsible for ensuring that personnel fully comprehend how to operate the device and understand the safety regulations.

Translation Operating Instructions

1   Safety

The plasma generator has been built in accordance with the relevant international standards. As with every technical product, however, the system may be dangerous in the case of unauthorized or non-specified use.

In addition to the notes in these Operating Instructions, observe generally applicable safety instructions.

Work with the plasma generator can be dangerous and result in serious - in some cases even fatal - injuries. Therefore always protect yourself and others.

Caution – Danger!

Please mind and follow the safety advices and demands of this operation instructions, otherwise serious – in some cases even fatal – injuries may result of the use of this device.

1.1   Residual dangers

This device has been produced with state-of-the-art technology. Nevertheless, residual risk can never be totally excluded.

It is essential to observe the following safety instructions:

Caution – electrical voltage!

- Danger from high voltage
    - Never place your hands in the plasma jet.
    - Never touch the plasma generator during operation.
    - Never direct the plasma jet at persons or animals.
- Danger from 230 V. If damage is detected at the electrical connection, mains cable or at the device:
    - Do not put the device into operation.
    - Have the damaged parts repaired by a specialist or replace them.

Caution – health hazard!

The device operates at a high frequency (~ 50 to 60 kHz at the plasma generator).

- Persons with a pacemaker or hearing aid should take the following precautionary measures:
    - Never hold the plasma generator near a pacemaker or hearing aid.
    - Consult a doctor prior to working near the plasma generator.
- In hospitals or similar buildings, it is possible that operation of the system may impair the operation of electromedical, information technology and other devices (ECG, PC, ...).
    - Prior to commissioning the device, ensure that the users of such devices or systems have been informed of this possibility.

Caution – hot surface!

Temperatures of up to 200 °C are possible at the housing of the plasma generator.

- Wear protective gloves when handling the device.
- Wait until the device has cooled down.

Caution – nitrogen oxide and ozone (O₃)!

Ozone quantities and nitrogen oxides can be created at the device that are outside the currently applicable limit values.

- During operation, always stay at least 1 m away from the plasma generator.
- Ensure that the work area is well ventilated.
- Install an exhaust system.

Risk of stumbling!

Lay cable and gas line in suitable cable routes. Lay the cable so that there is no danger of stumbling.

Caution – UV/VIS light!

UV/VIS light is discharged at the device.

- Always stay at least 1 m away from the plasma generator.
- Use suitable UV eye preservers if you have to look at the plasma flame for long periods.
- Use a protective window (filter strength min. 2), if people work longer in the vicinity of the plasma generator
- Attach warning sign W09 "Warning of optical radiation"

Caution – gas bottles! Risk of explosion!

Gas bottles are highly pressurized and are a source of danger.

- Information on the correct handling of gas bottles is available from your gas supplier.
- Protect the bottles against direct solar radiation, open flame and high fluctuations in temperature (e.g. very low temperature).
- Ensure that the gas containers are in impeccable condition.
- Only use certified parts, such as tubes, couplings, pressure reducers, etc.
- Never lubricate the connections and fittings with oil or grease!

Caution – noise!

During operation of the plasma generator, depending on the application noise emission is generated that can cause hearing damage in the long term.

- During continuous operation, always wear adequate ear protection.
- Protect other persons working in the area.

Caution – damage to device possible!

The device may overheat.

- Do not cover the fan slots.

1.2 Information for the user / user obligations

- Emitted interference can always be expected at the plasma generator.
  - The system is tested in accordance with the EMC directive.
  - The user must check and ensure electromagnetic compatibility with other electric and electronic devices in the direct vicinity.
- The plasma generator must only be operated with the original plasma power supply and the original cable extension from **relyon plasma** GmbH.
- Ensure that:
  - The operating personnel have read and understood these Operating Instructions.
  - Persons near the plasma jet have also been informed of the hazards and have the necessary protective equipment.
  - Maintenance work is only carried out by qualified technicians.
- Provide instruction for operating personnel, in particular, on the safety instructions in these Operating Instructions.
- Always keep the system in perfect working order.
- Modifications to the device shall result in forfeiture of the operating license (US) and invalidation of the guarantee. Exception: The modifications are expressly permitted by the manufacturer.

1.3 Specified operation

The plasma generator is designed exclusively for plasma treatment of material surfaces (metals, textiles, glass, plastics) for activation, cleaning, coating or residue removal at atmospheric pressure.

Under no circumstances may the device be operated by untrained personnel.

1.4 Impermissible operating conditions

Device operation is impermissible under the following conditions:
- Use in potentially explosive areas (EX).
- strong dust deposition
- too high air humidity (see technical data, page 9)
- an installation location with an absolute altitude higher than 1.000 m
- strong vibrations

1.5 Emissions

The following emissions are discharged from the device:
- Small quantities of UV light.
- Small quantities of ozone (O_3) and nitrogen oxides (NOx). The relevant limit values (MAK, TRK, BAT) may be exceeded.

Plasmagas	Gasflow	Ozone	NOx
Air	35 Nlm	1,5 mg/m³	3500 mg/m³
Nitrogen	35 Nlm	0,4 mg/m³	350 mg/m³

i **Note!**

As a precautionary measure, an exhaust system with a delivery volume of at least 500 liters/minute is recommended.

2 Device description

2.1 Function

The plasma generator is a part of an atmospheric pressure plasma generator used for atmospheric plasma treatment or pretreatment of a very wide variety of material surfaces.

It is designed for industrial applications where, for example, surfaces are activated with plasma and cleaned prior to printing, bonding or painting. The application of surface coatings is also possible.

The device is also suitable for laboratory operation by instructed personnel.

2.2 Device overview

2.2.1 Device
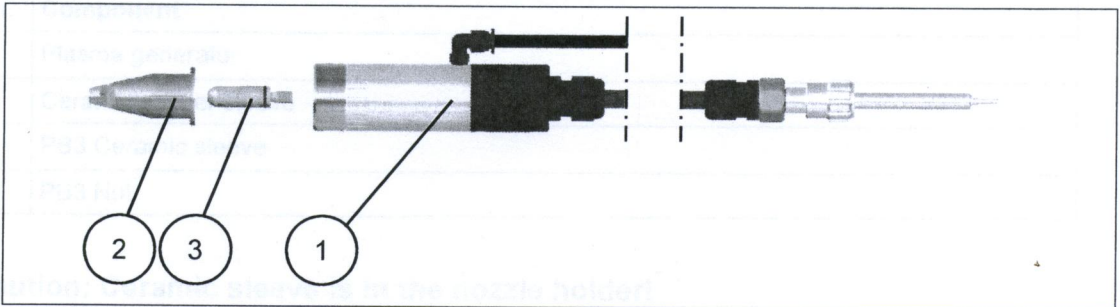
No.	Component
1	Plasma generator
2	Plasma nozzle (outer electrode) – not included – (shape may vary depending on application)
3	Plasma electrode (inner electrode)

2.2.2 Connections
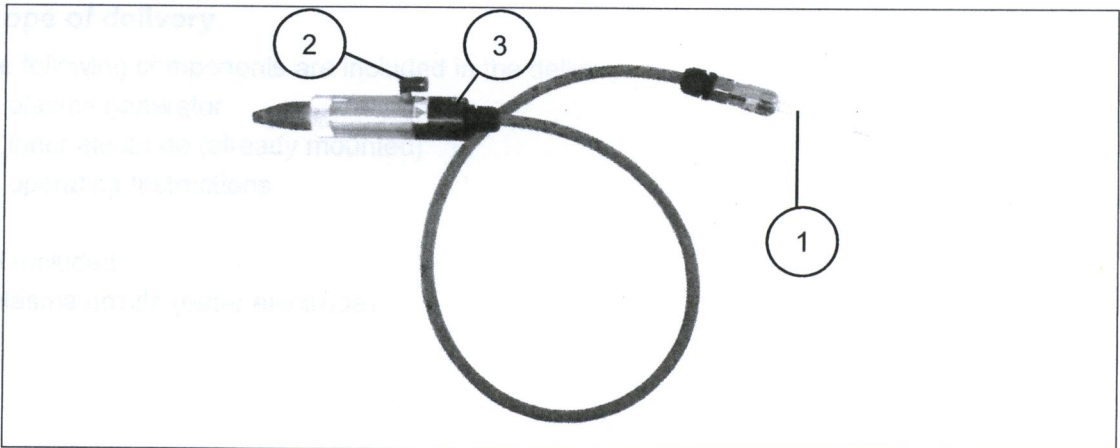
No.	Component
1	High-voltage plug
2	gas connection
3	ground connection

2.2.3 Spare parts
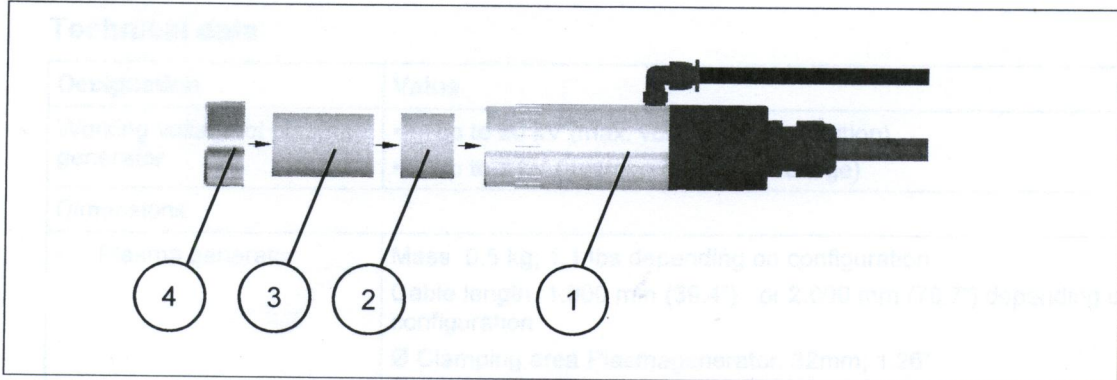
No.	Component
1	Plasma generator
2	Ceramic spacer sleeve
3	PB3 Ceramic sleeve
4	PB3 Nut

i

Caution: Ceramic sleeve is in the nozzle holder!

1. Note: ceramic barriers (2 and 3) are inserted into the plasma generator (1).

2. **Ensure that the barrier sleeves (2 and 3) are inside the plasma generator (1) in correct order**. A lack of barrier sleeve (2 and 3) or incorrectly inserted barrier sleeve (2 and 3) leads to the destruction of the plasma generator.

3. The barrier sleeve (2 and 3) consists of ceramic – warning of breakage.

2.3 Scope of delivery

The following components are included in the delivery:

- plasma generator
- inner electrode (already mounted)
- operating Instructions

Not included:

- plasma nozzle (outer electrode)

3 Technical data

3.1 Technical data

Designation	Value
Working voltage of plasma generator	• up to 20 kV (max. voltage during ignition) • up to 2 kV (average operating voltage)
Dimensions	
• Plasma generator	Mass: 0.5 kg; 1.1 lbs depending on configuration Cable length: 1.000 mm (39.4") or 2.000 mm (78.7") depending on configuration Ø Clamping area Plasmagenerator: 32mm; 1.26" Ømax HV-Plug: 22mm; 0.87
• Minimum bending radius of HV cable	120 mm; 4.72"
• Maximum torsion cable extension	±180°/2m
Limit temperature	
• Plasma generator	≤ 200 °C; 392 °F
Operating conditions	
• Air humidity	< 80% rel. (non-condensing)
• Temperature	10 – 40 °C; 50 – 104 °F
Storage conditions	
• Air humidity	< 80% rel. (non-condensing)
• Temperature	0 – 60 °C; 32 – 140 °F
Noise emission	
• Sound pressure level at distance of 1 meter	> 85 dB(A) with a gas flow > 40 Nlm
Gas connection	
• Gas types	Compressed air (purified, free of oil and lubricants) Nitrogen (tech. gas, free of particles and oil) Other types only by agreement with **relyon plasma**.
• Gas flow	35 – 80 Nlm
• Quality	Compressed air 1.4.1 according to ISO 8573.1 Nitrogen 2.8 (N2) according to DIN EN ISO 14175:N1
• Connection	6 mm quick-action coupling

3.2 Permissible operational settings

The plasma generator system is designed for plasma treatment of material surfaces (metals, textiles, glass, plastics) for activation, cleaning, coating or residue removal at atmospheric pressure. This type of plasma treatment produces significantly improved results during subsequent gluing, painting, printing, coating, wetting, lamination, metalizing and bonding of surfaces.

All system components in the working area of the plasma generator must be grounded.

The specified limit values must always be observed during operation:

Designation	Value	
Gas flow	Air:	≥ 35 – ≤ 80 Nlm
	Nitrogen:	≥ 35 – ≤ 80 Nlm
Working distance (plasma generator to substrate)	> 6 mm; 0.236" (on surfaces)	
Safety distance (persons to plasma generator outlet opening)	1000 mm; 39.37"	
On-load factor	100%	
Plasma on	The compressed air supply must be switched on at least 2 seconds, before turning the high voltage for plasma generation.	
Work space	All components in contact with the plasma must be fixed electrically isolating (electric strength 15 kV/mm)	

Caution – electrical voltage!
- Danger from high voltage
  - During operation, never touch the substrate to be treated.

Caution – damage to device possible!
The unit can be damaged if more than one attached cable extensions HVC is in use.
- The plasma generator must be operated only with one cable extension HVC.

3.3 Setting the gas flow volume

The required quantity of gas is 35 up to 80 Nlm and must not deviate. Deviations lead to the destruction of the plasma generator. Recommended Gas inlet pressure 5.0 bar - 8.0 bar.

4 Transport/storage

- Store the plasma generator in a dry location. This prevents the electrical contacts from corroding.
- Protect the plasma generator and the gas connection against contamination and foreign bodies.

5 Installation

5.1 Device

Caution – electrical voltage!

Danger from 230 V and high voltage.

- The connection to the current supply and the connection of the plasma generator or HV cable extension to the media supply must only be made by qualified electricians.

Before installing the device, the following conditions must be met:

- A suitable gas supply must be available.
- The device must be undamaged.
- In the permanent installation or in the electrical installation of the building has to be a suitable upstream all-pole switch or circuit breaker according to the requirements of national security (Germany: VDE 0100) to disconnect the device from the supply voltage. This separating device must be located close to the device and must be easily accessible for the user. In addition, this switch has to be designated as a breaker for the device.

To install the device, carry out the following steps in the specified sequence:

1. Install the plasma generator in a suitable support.
   - The clamping force on the housing of the plasma generator must not exceed 200 N punctual.
   - The plasma generator must only be installed in the designated clamping range (1).
2. Connect the plasma generator to the HVC cable extension.

3. Make sure, the gas supply is mounted properly.
4. Ground the plasma generator at the designated grounding point (2).
5. Open the gas supply (customer provided).
   - The gas inlet pressure must be between 5 and 8 bar.
✓ The plasma generator is installed.
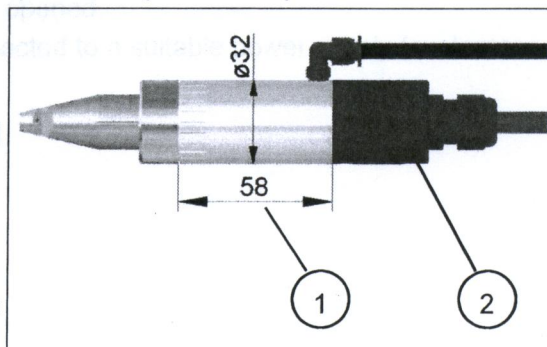
5.2 EMERGENCY-STOP function

The device will be integrated on site in the EMERGENCY-STOP function of the higher-order main system.

- If the device voltage supply is cut off as a result of the EMERGENCY-STOP function of the higher-order main system, the power supply and compressed air supply of the device is disconnected.
- Prior to switching on again, a safe initial state must be established by the higher-order main system.

⚠ **Caution – electrical voltage!**
Danger from high voltage

- It is important to ensure that both control voltage and the mains is disconnected for the device in emergency stop.

6 Operation

6.1 Switching on device

❗ **Caution – damage to device possible!**
The plasma generator can be damaged if it starts up without gas.

- Never switch the plasma generator on before the gas flow is switched on (2 seconds).

To switch on, carry out the following steps in the specified sequence:

1. Ensure that the gas supply is connected and opened.
2. Make sure that the plasma generator is connected to a suitable power supply (customer provided).
2. Switch the device on (customer provided).
3. Switch on the plasma generation.
✓ The device is switched on.

6.2 Treating surfaces

❗ **Caution – damage to device possible!**
If operating conditions are not satisfied, this can result in damage to the device.

- When operating the device, the limit values specified in the technical data must be observed, see pages 9 and 10.

The effect of the treatment depends on the gas flow, default setting and working distance and varies according to process gas, treatment duration and the material being treated.

Examples of plasma treatment can be obtained directly from the **relyon plasma** GmbH.

6.3 Switching off device

! **Caution – damage to device possible!**

The plasma generator can overheat if the system is switched off during the gas after-flow period.

- Never switch off the system during the gas after-flow period (2 seconds).

To switch off, carry out the following steps in the specified sequence:

1. Switch off the plasma generation (customer provided).
2. Switch off the power supply (customer provided).
3. Switch off the gas flow.
4. Close the gas supply.
✓ The device is switched off.

7 De-commissioning

Caution – electrical voltage!

Danger from 230 V and high voltage.

- The disconnection of the current supply and the disconnection of the plasma generator from the media supply must only be carried out by qualified electricians.

To de-commission the device, carry out the following steps in the specified sequence:

1. Switch off the media supply.
2. Disconnect the gas supply.
3. Disconnect the power supply.
4. Disassemble the plasma generator.
✓ The device is not in operation.

8   Maintenance

Caution – high voltage! Danger to life!

High voltage is generated in the unit of the plasma generator. It is still present after the device has been switched off.

- Opening the device is prohibited.
- Always disconnect the power supply to the device prior to care, maintenance and repair work and before opening the plasma generator.

Caution – damage to device possible!

Opening the device may result in it being damaged.

- Opening the device is prohibited.

8.1   Cleaning

Caution – hot surface!

Temperatures of up to 100 °C are possible at the housing of the plasma generator.

- Wear protective gloves when handling the device.
- Wait until the device has cooled down.

Note!

The plasma nozzle and electrode are subject to wear.

If the plasma nozzle has a thick oxide layer and the electrode has large penetration cavities, the ignition properties deteriorate and the temperature of the plasma flame increases.

Parts then have to be replaced.

Only clean the plasma generator externally.

- Only dry clean the plasma generator.
- The media supply must be switched off.
- The plasma generator must be cooled down.

8.2 Replacing electrode and nozzle

The electrode and nozzle of the plasma generator must be replaced in specific intervals depending on the application.

For changing and for the changing intervals of the electrode or nozzle, use the according Datasheet.

i **Note!**

Depending on the application different nozzles and electrodes can be used. Please follow the instructions in the operating and maintenance instructions for each nozzles sets.

! **Caution – damage to device possible!**

By loosening certain threaded connections the plasma generator can be destroyed.

- Please follow the instructions in the operating and maintenance instructions for each nozzles sets.
- Loosening connections other than for the change of nozzle and electrode explicitly stated is prohibited!

9 Correction of faults

9.1 No plasma formation

If the device does not create plasma, check the following items first:

- Is the current supply connected?
- Is the power supply operated correctly?

- Is the gas flow volume sufficient?
    - $\geq 35 - \leq 80$ Nlm
- Is the HV cable and gas line undamaged?
- Is the HV cable and gas line kinked?

9.2 Operation malfunctions

- Plasma ceases during operation.
- Parasitic discharges (discharges at undesired positions, e.g. at the plasma generator cable connection. It can be destroyed).
- Sparkovers

If such operation malfunctions occur, first carry out the following steps:

1. Switch off the device, see page 12.
2. Allow the device to cool down to ambient temperature.
3. Then check the device visually for external damage.
4. If no damage is visible, switch the device on again.

If the device still does not operate trouble-free, shut down the device and contact After Sales Service.

9.3 After Sales Service

If the device does not work correctly, send it to **relyon plasma** GmbH for examination.

After Sales Service address:

- see rear side of Operating Instructions.

9.4　Overview of malfunctions / faults

Malfunction / fault	Cause	Remedy
plasma cannot be switched on or plasma ceases during operation	Current supply	(customer provided)
	An internal fault has occurred	De-energize the device. Switch on again
	Mains fuse has tripped	Check mains fuse, provide more powerful fusing if necessary
	Mains cable interrupted	Check mains cable
	Wear of nozzle and electrode	Check nozzle and electrode for wear, replace if necessary
	Short-circuit, the plasma generator is defective	Contact After Sales Service
	Cable breakage	Check HV cable from media supply to the plasma generator for possible cable breakage
		Problem cannot be eliminated: Contact After Sales Service

10   Environment

10.1   Disposal

Do not forget environmental protection.
Used electrical and electronic devices must not be disposed of together with household waste.

- The device contains valuable raw materials that can be recycled. Always hand in the device therefore to an appropriate acceptance point.

11   Conformity / standards

11.1   CE

Our EC Declaration of Conformity.
The marking is on the type plate on the bottom side of the device housing.

11.2   Product standards

The device complies with the following provisions and standards:

2004/108/EC EC-EMC Directive
Guideline of the European Council for harmonization of the legal specifications of the member states with regard to electromagnetic compatibility.
2006/95/EC   EC Low Voltage Directive
Directive 2006/95/EC of the European Parliament and Council dated December 12th, 2006 for harmonization of the legal requirements of the member states with regard to electric equipment for use within specific voltage limits.
EN 55011 (2007 + A2:2007) transient emissions, limit group 2, class A
EN 61000-6-2 (2005) Immunity from disturbance

Type of protection IP20	IEC 60529

12   Spare parts

Item-no	product description
77043402	PB3 PLASMAGENERATOR PG-31 (2m)
78879101	PB3 PLASMAGENERATOR PG-31 (1m)
77071600	SPACER CERAMIC BUSH
74532300	PB3 CERAMIC BUSH
77071900	PB3 COUPLING NUT

Service Hotline: +49-941-60098-120