relyon plasma

A TDK GROUP COMPANY

# plasmabrush® PB3

## Operating instructions

PS2000 power supply


BA-PS2000_EN / F0307903

Thank you for buying a **Relyon Plasma** GmbH branded product. To get the best from your machine, please read these instructions carefully.

## 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.

**Also comply with the information relating to the plasma generator during operation!**

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 that holds the workpiece.
  - 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.
  - Replace the damaged parts or have them repaired by a qualified person.

**Caution – Health hazard!**

The machine operates at a high frequency (40 – 65 kHz at the 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.

**Attention – Emissions!**

Dangerous amounts of the reaction gas ozone ($O_3$) may be produced **at the plasma generator** during machine operation (see the operating instructions for the plasma generator).

- Ozone concentrations of more than 0.2 mg/m³ can occur.
- Note that compliance with national health and safety measures is mandatory when operating the machine.
- Only use the machine in well vented areas or in conjunction with a suitable exhaust system.
- Do not leave the machine running unattended.
- Never point the machine at people during operation.

**Tripping hazard!**

Lay connection cables such that they do not present a tripping hazard.

**Attention – Damage to machine!**

The machine may overheat. Do not cover the ventilation slots.

## 1.2 Information and obligations for the operator

- The system 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.
  - Installations and 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 a fully functional condition.
- Any modifications made to the machine will invalidate the operating licence and the warranty. Exception: 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.

The machine is only intended for plasma surface treatment in combination with a suitable plasma generator.

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

The machine is intended for installation in a control cabinet.

## 1.4 Impermissible operating conditions

The machine must not be operated under the following conditions:

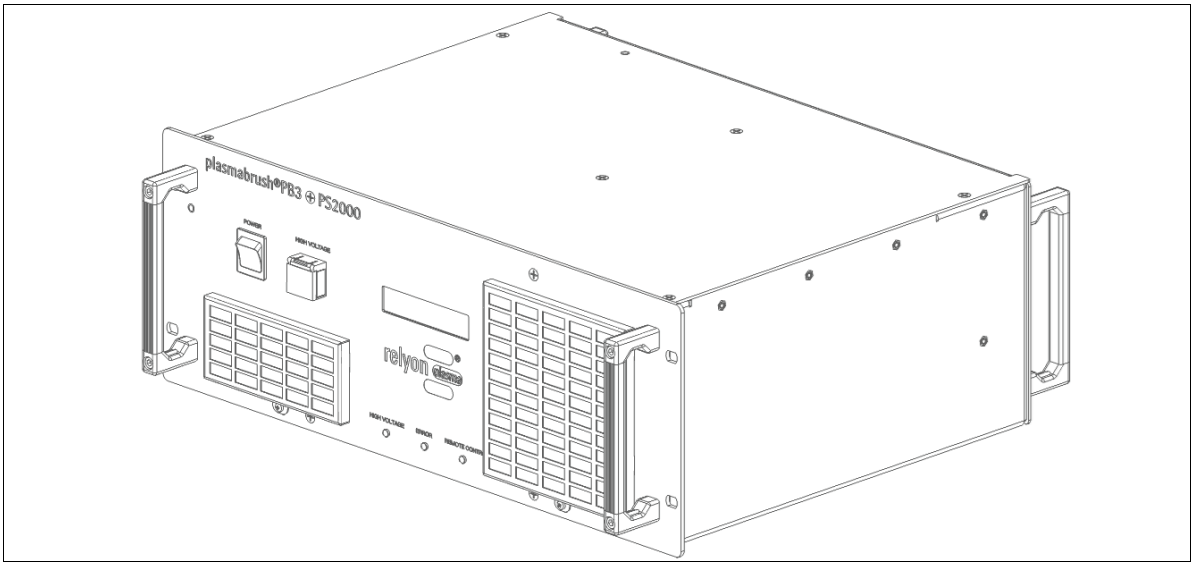
- In explosive (EX) zones
- In areas with severe build-up of dust
- In environments where the humidity is too high (see section 3: Technical data)
- At altitudes of more than 2000 m above sea level
- Where there are strong vibrations

## 1.5 Emissions

The connected plasma generator produces emissions. Please comply with the operating instructions for the plasma generator.

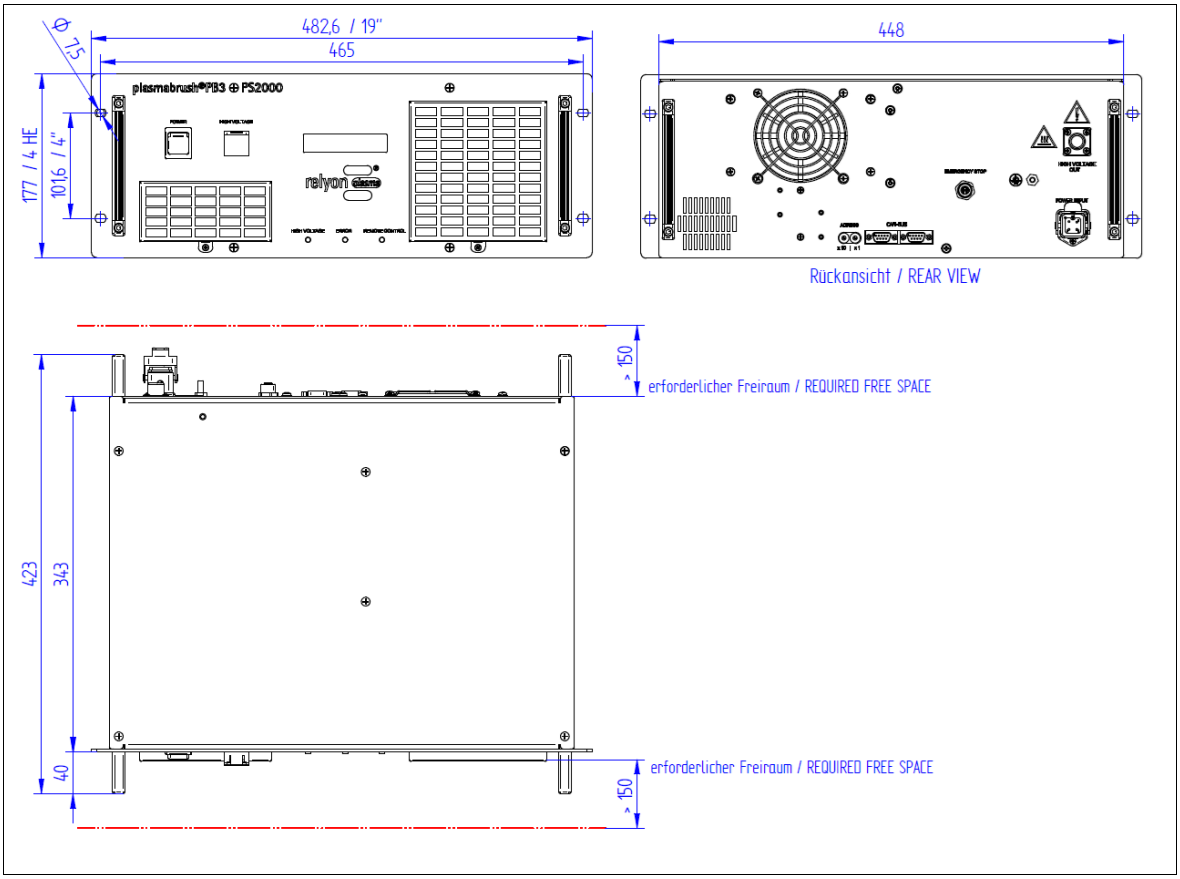
# 2 Description of machine

## 2.1 Overview of the machine




| Component |
|---|
| PS2000 high-voltage power supply |

## 2.2 Installation dimensions



## 2.3 Description and connections

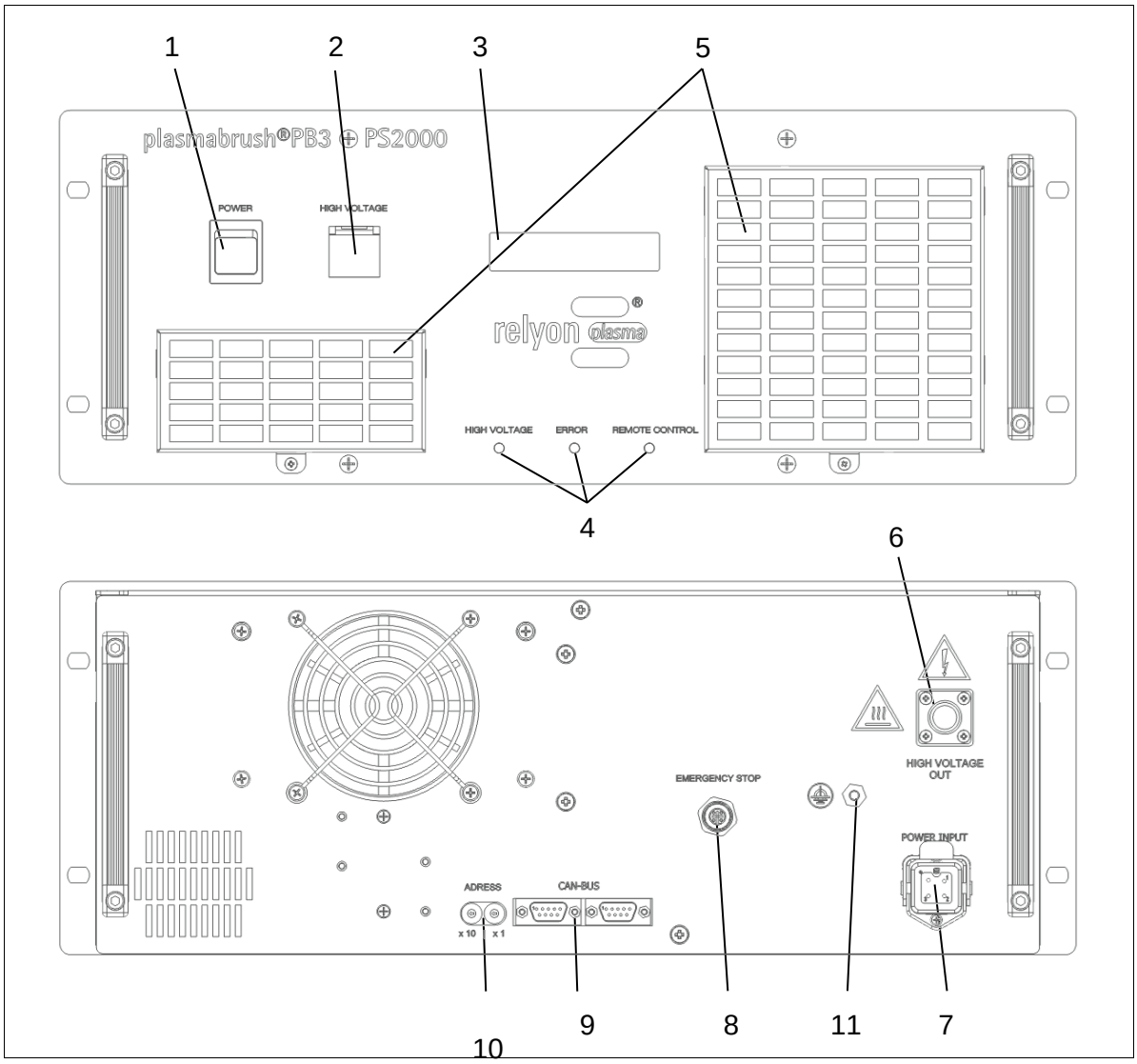
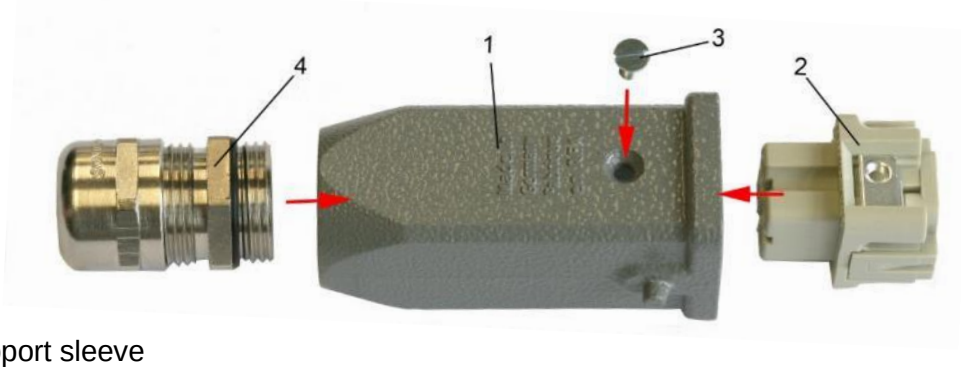



*Fig.: Diagram of front (top) and rear (bottom)*

| No. | Component |
|---|---|
| 1 | Master switch I/O |
| 2 | Momentary contact “High voltage on/off” – “One push start” button with protective flap |
| 3 | Display |
| 4 | Status LED |
| 5 | Ventilation grille with dust filter (class G2 coarse dust filter) |
| 6 | GES HB 30 PTFE high-voltage socket for connecting an HVC high-voltage cable |
| 7 | 230 V AC, 50 Hz power supply socket (for cable type: H05V 3G1.5 CE (3 x 1.5 mm²)) Harting HAN 3 |
| 8 | Harting HAN M12 emergency stop plug connector |
| 9 | Communication (CAN bus) interface (sub D 9-pin) X21, X22 |
| 10 | Address selector switch for bus communication |
| 11 | Earthing connection |

## 2.4 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

Use a H05V 3G1.5 CE (3 x 1.5 mm²) 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)!

## 2.5 Pin assignment of emergency stop plug

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

Pin assignment of the emergency stop plug:

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


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

The emergency stop circuit consists of a two-channel version. Channel 1: PIN 1 – PIN 3 and channel 2: PIN 2 – PIN 4. So various connections are possible.

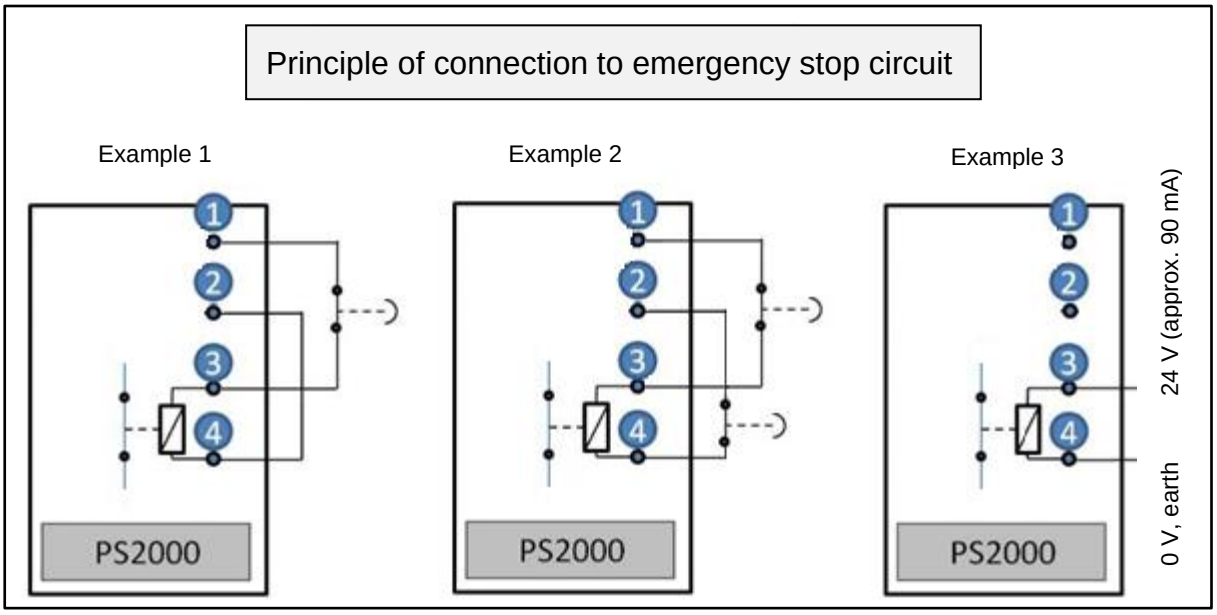


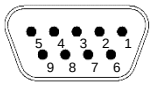

*Fig.: Emergency stop assignment and various connection options*

**Attention – Damage to machine!**

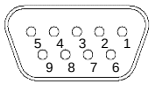
If using an external voltage (integration in external emergency stop circuit), ensure that the voltage is 24 V DC (+/- 10%) (load: approx. 90 mA).

The output (PIN 1 – 2) of the PS2000 must not be loaded with more than 90 mA under any circumstances.

## 2.6 Pin assignment of CAN bus socket / plug (9-pin sub D socket / plug)




X21




X22

PIN 1: 24 V input for external control (X21 & X22)
PIN 2: CAN Low (X21 & X22)
PIN 3: CAN Ground (X21 & X22)
PIN 4: GND input for external control (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 cable 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)*

## 2.7 Scope of delivery

The scope of delivery includes the following components:

- PS2000 power supply.
- Power connector for electrical connection of power supply (not mounted).
- 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 | 220 V – 240 V AC / 50 – 60 Hz / max. 6 A |
| Mains fuse | F1 = 6.3 A / 230 V AC / time lag |
| Power consumption | ≤ 1200 VA |
| Power loss | Pmax: 450 W |
| Protection | IP20 acc. to EN 60529 |
| Protection class | Class I acc. to IEC 61140 |
| Operating voltage of plasma generator | • up to 20 kV Upeak (max. voltage for ignition (briefly))<br>• up to 2 kV RMS (average operating voltage) |
| Internal F1, F2 fuses | 6.3 A / 500 V AC / time lag, SIBA type 189140.6.3 |
| **Dimensions** | |
| Weight | 18.0 kg; 39.7 lbs |
| Dimensions | 483 x 177 x 423 mm (corresponds to 4 HU); 19” x 6.97” x 16.65” (W x H x D) |
| **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 |
| **Emissions** | |
| • Sound level | < 60 dB(A) at 1 metre away |
| • Waste heat | Pmax: 450 W |

# 4 Transport / storage

- Store the PS2000 power supply in a dry place. This will prevent the electrical contacts from corroding.
- 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 packaging. Note the information about directions provided on the packaging.
- Take the PS2000 out of the packaging.
- After removing, check in particular the rear power supply socket (#7, see page 8) to ensure that the O-ring is positioned correctly in the socket.

## 5.2 Installation requirements

Before installing the machine, the following points must be met:

- 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 11).
- 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.

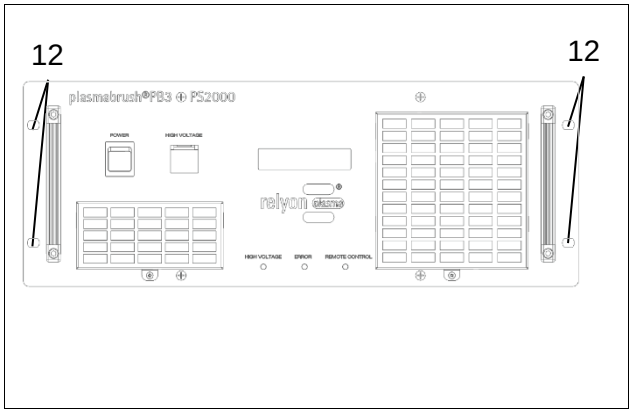
### 5.2.1 Installing and starting up one single PS2000

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

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

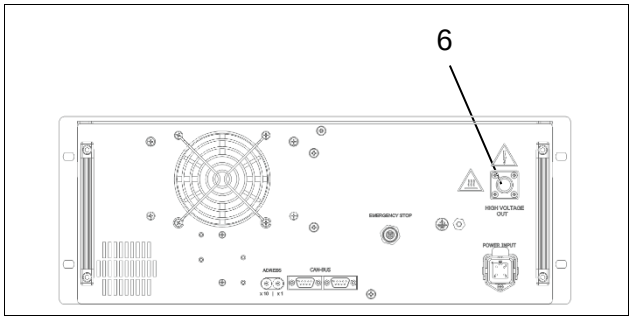
1. Mount the machine in a 19” control cabinet intended for this purpose. Only use the support rails on which the PS2000 is mounted to distribute the weight.

- Use fixing bolts to secure the PS2000 in the bracket. Use the four slots in the front plate (#12) provided for this purpose.
- Please ensure sufficient space between the control cabinet wall and front/rear (for electrical connections, dissipation of heat). This must not be any less than 150 mm.




2. Establish high-voltage connection between HVC cable extension and connection socket (#6) on the PS2000.

3. Mount an appropriate plasma generator. Make sure that the screw connection is hand tight.



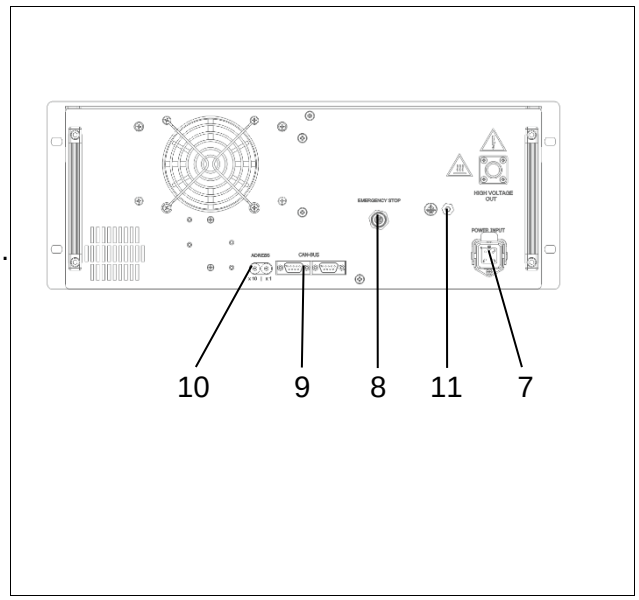
4. Also earth the PS2000 at the earthing connection (#11; M5 thread).

5. Connect the PS2000 with the emergency stop circuit using the socket (#8).

6. Establish power supply to the PS2000 (#7).
   - 230 V / 50 Hz
     Cable type: H05V 3x1.5 mm$^2$

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

7. For control via a 24 V switching signal or bus communication, connect the communication line(s) and, if necessary, a terminator (#9; see page 11).

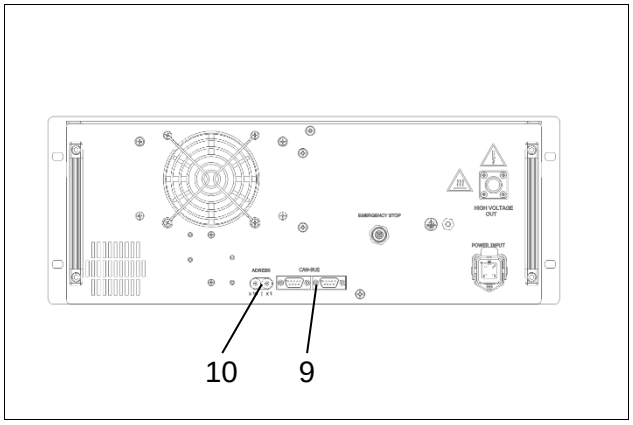



✓ The machine is installed.

### 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 (#10).
3. Connect all PS2000s in series with the communication bus (#9).
   Since there is a bus signal on both ports (X21&X22), you can connect the various PS2000s with one another.
   Make sure that a suitable 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) (resistor configuration / PIN assignment: see page 11).

✓ The machines are installed.

# 6 Special notes on using the plasma process

## 6.1 General description

Treating surfaces with atmospheric plasma has several advantages. Examples include an increase in surface energy to achieve better surface wetting. Optimum surface wetting is the first and often most decisive step to achieving a good imprint, a uniform coating, a consistent coat of lacquer or an integrally bonded adhesive application. The bond at this boundary layer often determines the longevity and adhesive strength of this material pairing.

Atmospheric-pressure plasma increases throughput in many industrial processes, while at the same time saving the costs of solvents or chemical primers.
We have successfully integrated our plasma products into the following application fields:

- Ultra-fine cleaning of metal, glass and plastics
- Surface activation and surface functionalisation for optimised wettability
- Plasma-assisted laminating processes
- Plasma-assisted adhesive bonded joints
- Plugging and sealing
- Plasma-induced reduction of metal surfaces
- Chemical-free bleaching of textiles
- Treatment of food products to improve quality and shelf life
- Multi-component injection moulding

Practically all technical material classes can be efficiently processed under atmospheric pressure:

- Metals and metal alloys
- Plastics and composite materials
- Glass, ceramics, inorganic composites and natural stone
- Natural leather and synthetic leather
- Natural fibres, wood and paper

Since the plasma treatment is always just a single part of the entire process, it is important that the additional parameters are known in order to achieve an optimum result.

Typical influencing variables could be:

- Plasma process: distance from the substrate, speed, design of the modules
- Substrate/workpiece: material composition, contamination, electrical conductivity, thermal conductivity, moisture content
- Workpiece treatment: contamination before or after the plasma process, the time elapsed between the plasma process and the follow-up process

Additional information on applications, as well as publications, can be found on the website at www.relyon-plasma.com.

## 6.2 Carrying out surface treatment

Depending on the type and condition of your substrate, pre-cleaning before the plasma process can improve the overall outcome.

The effect of the treatment depends on the **working distance, treatment time, speed and consistency of movement, as well as the material to be treated.**

## 6.3 Measures to take after the surface treatment

To achieve an optimum result, it is important that as little time as possible elapses after the plasma treatment and that the treated surface is not touched or contaminated.

Cleaning the surface AFTER the plasma treatment is not recommended.

Since the workpiece may heat up depending on the type and duration of the plasma process, it may be necessary to allow the workpiece to cool down first before the next process step is executed. This is to ensure that the process will not be negatively impacted by the introduction of heat (e.g. in certain bonding processes).

**Caution – Hot surface!**

The workpiece to be treated may be heated up by the plasma process, depending on the process parameters. If necessary, allow the workpiece to cool down before handling it.

# 7 Operation

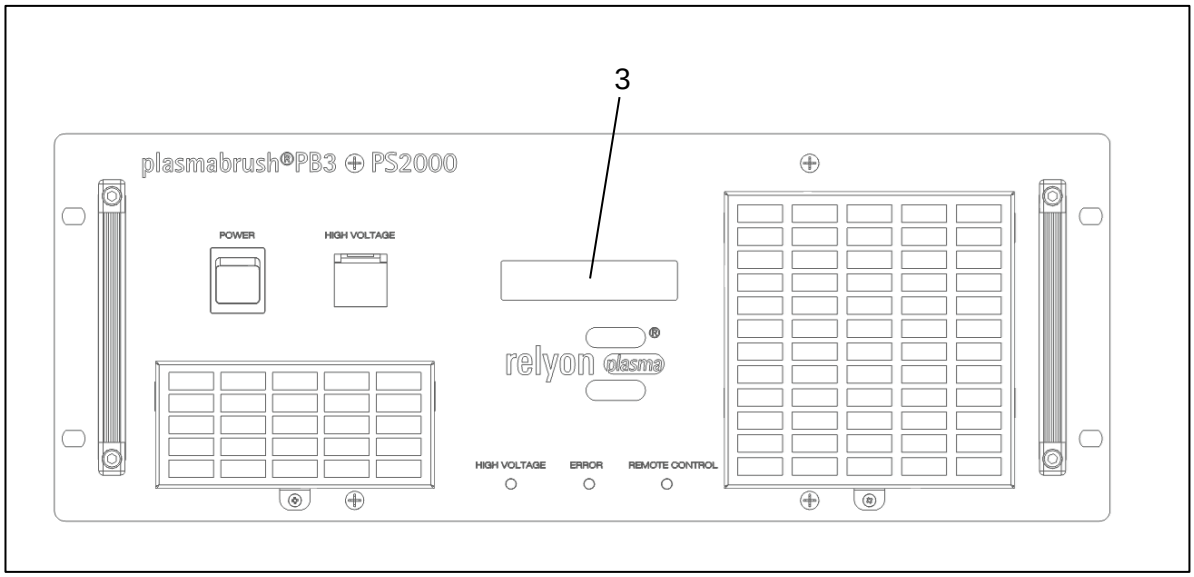
## 7.1 Controls / displays

**Caution – Electrical voltage!**

Danger of electric shock.

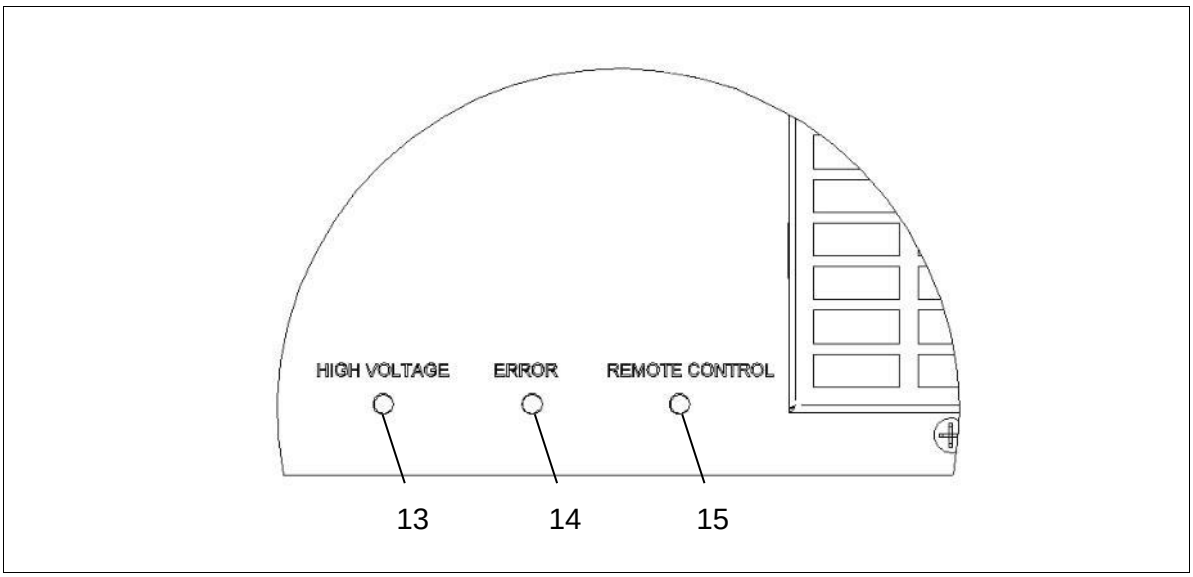
- Never reach into the area around the connected plasma generator while it is running or if it has shut down (e.g. to check why the plasma generator has shut down).

The PS2000 has a display (#3) on which the output values for plasma generation can be read. The display values appear one after the other in pairs with a display duration of 3 seconds each.




| Display value | Function |
|---|---|
| Power | Electrical output in watts (W). |
| Frequency | Frequency at the high-voltage output in kilohertz (kHz). |
| Voltage | Output voltage in volts (V). |
| Current | Electrical current in milliamperes (mA). |
| Bit rate | Set CANopen baud rate in kilobits per second (Kbit/s). |
| Software version | Version of the installed software. |

The PS2000 has LEDs indicating the current status.




| No. | Display | Function |
|---|---|---|
| 13 | High Voltage | There is high voltage at the output of the connection socket (#6). |
| 14 | Error | There is an error present. It can be read off via the CAN bus. The PS2000 is not ready. The error must be acknowledged before the machine can be operated again. |
| 15 | Remote Control | Communication with superordinate control unit possible. The power supply cannot be switched on in this operating mode via the 24 V start signal. The “one push start” button on the front (#2; high voltage on/off) is not functional! |

## 7.2 Switching on and operating the machine

**Attention – Damage to machine!**

The machine must only be operated with the plasma generator connected.

The plasma generator may be damaged if it is operated with no gas or too little gas.

- Never switch on the high voltage before sufficient gas is flowing through the plasma generator! Please comply with the information in the operating instructions for the plasma generator.

The machine can be switched on in three different ways:

- Manual switching of the machine using the “one push start” button (#2) on the front
- Communication via the 24 V switching signal
- CANopen bus communication

The switching signal of the “one push start” button and the 24 V switching signal are equivalent and can be used in parallel. However, to avoid operating errors during communication via the 24 V signal, in this case we recommend covering the button on the front with the protective flap and, if necessary, clearly labelling it as “not for use” with a sealing sticker.

When using bus communication, the “Remote control” LED (#15) lights up on the front. This deactivates the other two switch-on options.

### 7.2.1 Switching on and operating the machine using the “one push start” button

To switch on the PS2000 using the “one push start” button on the front, perform the following steps in the order given:

1. Switch the machine on using the 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 (#2; 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: 54 kHz, nominal output: 100%.

### 7.2.2 Switching on and operating the machine using the 24 V switching signal

To switch on the PS2000 using the 24 V switching signal, perform the following steps in the order given:

1. Switch the machine on using the 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. Connect 24 V at PIN 1 to the plug X21 or X22 (GND is PIN 4).

✓ 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: 54 kHz, nominal output: 100%.

### 7.2.3 Switching on and operating the machine with bus communication

The PS2000 can be operated in bus communication mode in two ways:

a. Via the “plasma control” software: This software is available from **Relyon Plasma** GmbH in the Downloads section of the website 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. Via 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.

### 7.2.4 CANopen object directory for control device

| *Index (hex)* | *Sub-index (hex)* | *Name (reference)* | *Attribute* | *Data type* | *Default value* | *Comment* |
|---|---|---|---|---|---|---|
| **Input** | | | | | | |
| 2010 | 00 | Status code | ro | UNSIGNED8 | 4 | 4,7,8:<br>4: Plasma off,<br>7: Plasma on,<br>8: Error |
| 2020 | 00 | Power actual | ro | UNSIGNED16 | | 0..1045 (W) |
| 2021 | 00 | Frequency actual | ro | UNSIGNED8 | 54 | 40..65 (kHz) |
| 2022 | 00 | Voltage RMS actual | ro | UNSIGNED16 | 0 | 0..1500 (V) |
| 2023 | 00 | Current RMS actual | ro | UNSIGNED16 | | 0..1000 (mA) |
| 2050 | | Temperature | | | | |
| | 00 | Highest sub-index supported | ro | UNSIGNED8 | | |
| | 01 | Temperature 1 | ro | UNSIGNED8 | | 0..90 (°C) |
| | 02 | Temperature 2 | ro | UNSIGNED8 | | 0..90 (°C) |
| | 03 | Temperature 3 | ro | UNSIGNED8 | | 0..90 (°C) |
| | 04 | Temperature 4 | ro | UNSIGNED8 | | 0..90 (°C) |
| 2060 | 00 | Power-On time | ro | UNSIGNED16 | | 0..65535 (hours) |
| **Output** | | | | | | |
| 2000 | 00 | Error status | rw | UNSIGNED8 | 0 | 0/1 (error reset with falling edge) |
| 2030 | 00 | High voltage | rw | UNSIGNED8 | 0 | 0/1 (0: Plasma off, 1: Plasma on) |
| 2040 | 00 | Power set | rw | UNSIGNED8 | 100% | 75..100 (%) (minimum step width: 1%) |
| 2041 | 00 | Frequency set | rw | UNSIGNED16 | 54000 | 40000..65000 (Hz) (minimum step width: 1000 Hz) |
| 2042 | 00 | Voltage threshold | rw | UNSIGNED16 | 500 V | Internal error threshold – do not change! |
| 2043 | 00 | Current threshold | rw | UNSIGNED16 | 100 mA | Internal error threshold – do not change! |

- Standard baud rate: 500 kbit/s. Baud rate can be changed via LSS protocol (defined using CIA305). Supported baud rates: 1 Mbit/s, 500 kbit/s, 250 kbit/s, 125 kbit/s.
- “Remote control” LED: To visualise communication via “Remote control”, the “Operational” status must be set once in the CANopen State Machine.

| *Object* | *Index (hex)* | *Data (hex)* | *Comment* |
|---|---|---|---|
| All Nodes OPERATIONAL | 0000 | 01 **00** 00 00 00 00 00 00 | 01 h \| **Node ID**<br>(Node ID=0→ All Nodes) |
| Node 10 OPERATIONAL | 0000 | 01 **0A** 00 00 00 00 00 00 | 01 h \| **Node ID: 10**<br>(10 d = 0A h) |
| All Nodes PREOPERATIONAL | 0000 | 80 **00** 00 00 00 00 00 00 | 80 h \| **Node ID**<br>(Node ID=0→ All Nodes) |
| Reset Node | 0000 | 02 **00** 00 00 00 00 00 00 | 02 h \| **Node ID**<br>(Node ID=0→ All Nodes)) |

- 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!

A complete CANopen object directory is available in the annex.

**Attention – Safety!**

We would highly recommend querying and monitoring the “Guard” or “Heartbeat” 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 develop serious faults or be destroyed.

### 7.2.5 Error messages

Unexpected events are transmitted via the CANopen bus in the following form:

ID: 80h+NodeID data: 0x00 0xFF 0x81 0x**yy** 0x00 0x00 0x00 0x00

**yy**: Error code according to error status 1..15h

**yy**: 0x50 → Data received via RPDO is not within the valid range – valid parameters were adopted and invalid ones ignored.

The error codes have the following meanings:

| ***Index* (hex)** | **Error message** | ***Comment*** |
|---|---|---|
| 01h | Error: switching circuit central (Defective sensors / microcontroller) | Send in the plasma source for repair. |
| 02h | Temperature: switching circuit central (insufficient cooling of the plasma source) | Check the cooling of the plasma source. Check whether fan is working / replace air filter (send plasma source in for repair if necessary). |
| 03h | Error: auxiliary voltage 1 (DC voltage 1 for peripheral devices such as fans) | Send in the plasma source for repair. |
| 04h | Intermediate circuit voltage (Defective sensors / microcontroller) | Send in the plasma source for repair. |
| 05h | Error: controller (Defective sensors / microcontroller) | Send in the plasma source for repair. |
| 06h | Error: auxiliary voltage 2 (DC voltage 2 for peripheral devices such as fans) | Send in the plasma source for repair. |
| 07h | Is not used | |
| 08h | Temperature of switching circuit central/PCB too high | Check the cooling of the plasma source. Check whether fan is working, replace air filter if necessary (send plasma source in for repair if necessary). |
| 09h | Communication with controller interrupted (CAN bus error. Bus offline) | Check communication / cabling. |
| 10h | PFC error (PFC microcontroller defective) | Send in the plasma source for repair. |
| 11h | Emergency stop actuated | Check whether the emergency stop is properly connected / cable breakage. |
| 12h | Is not used | |

| | | |
|---|---|---|
| 13h | Output voltage too low<br>(Plasma does not ignite; PG31 goes into short circuit) | Check whether sufficient gas is available. Check the PG31 for damage. |
| 14h | Overvoltage<br>(Plasma does not ignite; arc cannot be formed) | Check whether too much gas is set. Check the PG31 for damage. |
| 15h | Error: fan | Check whether fan is working; replace air filter if necessary. |

### 7.2.6 "Burn in" set of parameters

The PS2000 comes with a preset set of parameters:

Power set: 100, Frequency set: 54000, Voltage threshold: 500, Current threshold: 100

It is possible to change the parameters, but they are reset to their "Burn in" values as soon as the machine is restarted. A permanent change to the "Burn in" parameters can only be made by the manufacturer (**Relyon Plasma** GmbH).

**Attention – Damage to machine!**

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

## 7.3 Switching off the machine

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

1. Switch off plasma generation.
2. Switch the machine off using the master switch (#1).

✓ The machine is switched off.

## 7.4 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 interface (error code).

Potential troubleshooting steps are described in section 10.

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 approximately 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 (falling edge).

# 8 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 second. Please be aware of this whenever working on the PS2000, high-voltage cable and plasma generator.

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

1. Switch the machine off using the master switch (#1).
2. Disconnect the PS2000 from the mains voltage supply: Disconnect the power connector (#7).
3. Remove the HVC cable extension and the plasma generator.
4. Remove the PS2000 power supply.

✓ The machine is out of service.

# 9 Maintenance and cleaning

## 9.1 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.

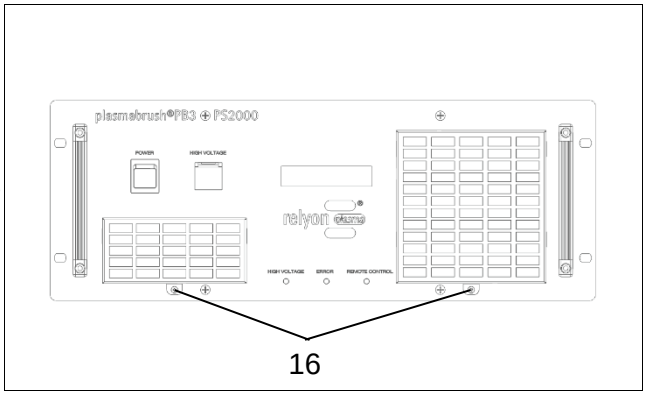
- It is forbidden to open the machine.

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 (#16).
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.




## 9.2 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.

# 10 Troubleshooting

## 10.1 Overview of faults / errors

| Fault / error | Cause | Rectification |
|---|---|---|
| Master switch (#1) does not light up | Fuse defective. | Fuse in machine must be changed. Contact customer service. |
| | Power connector incorrectly connected. | Check the mains unit connection. |
| | No / incorrect voltage supply. | Check the mains voltage supply. |
| “Error” LED (#14) lit up | There is an error, the machine is not ready. | Read out (CAN bus), rectify and acknowledge the error.<br><br>Without CAN bus communication, switch the PS2000 off, wait 5 seconds then switch it back on. |
| | | De-energise the machine. Switch on again. |
| | | Problem cannot be fixed:<br>Contact customer service. |
| Even though the 24 V start signal is present, plasma is not being ignited at the plasma generator. | “Remote control” LED (#15) lit up. | The machine is controlled via the CAN bus. Operation via the 24 V start signal is not possible in this operating mode. |
| | “Error” LED (#14) lit up | See error message for “Error LED lit up”. |
| | | Check whether there is a sufficient flow of gas in the permissible range through the connected plasma generator (see the data sheet for the nozzle used or operating instructions for the PG31 plasma generator). |
| | | Check that the HV cable and gas supply pipe are correctly connected, and are undamaged and not buckled. |
| The plasma cannot be stopped in 24 V mode or in manual mode. | Both switch-on signals are present | If both switch-on signals are applied by mistake, the plasma can only be stopped by removing both signals (see section 7.2). |
| Parasitic discharge (discharge at undesired points, e.g. at plasma generator cable connector) | Machine or high-voltage cable damaged | Take the machine out of operation and contact customer service. |
| Flashover (e.g. on machine parts) | Faulty earth connection | Check that all earth connections have been established correctly. |

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

# 11 Environment

## 11.1 Disposal

**Be mindful of the environment.**

Used electrical and electronic equipment must 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.

# 12 CE conformity

CE

**We declare that this product conforms to CE standards.**

The product name is to be found on the name plate on the back of the housing. The declaration of conformity can be viewed in the Downloads section of the **Relyon Plasma** website.

# 13 Spare parts

| Item number | Description |
|---|---|
| 79134200 | Filter mat |

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# Annex: Complete CANopen object directory

| *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, | |
| 100 A | 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 | $04_h$ | |
| | 01 | Save all parameters | rw | n | | UNSIGNED32 | 0000 $0001_h$ | Ascii “save”<br>Complete object directory (incl. 2040 – 2043) is saved |
| | 02 | Save communication parameters | rw | n | | UNSIGNED32 | 0000 $0000_h$ | “save” not supported |
| | 03 | Save application parameters | rw | n | | UNSIGNED32 | 0000 $0000_h$ | “save” not supported |
| | 04 | Save manufacturer defined parameters | rw | n | | UNSIGNED32 | 0000 $0001_h$ | “Burn in” set of parameters – Only objects 2040 – 2043 are saved |
| 1011 | | Restore parameters | | | ARRAY | UNSIGNED32 | | |
| | 00 | Highest sub-index supported | ro | n | | UNSIGNED8 | $00_h$ | |
| | 01 | Restore all parameters | rw | n | | UNSIGNED32 | 0000 $0001_h$ | Ascii “load”<br>Complete object directory (not including 2040 – 2043) is deleted. |
| | 02 | Restore communication parameters | rw | n | | UNSIGNED32 | 0000 $0000_h$ | “load” not supported |
| | 03 | Restore application parameters | rw | n | | UNSIGNED32 | 0000 $0000_h$ | “load” not supported |

| *Index (hex)* | *Sub-index (hex)* | *Name (reference)* | *Attribute* | *Mappable* | *Object type* | *Data type* | *Default value* | *Comment* |
|---|---|---|---|---|---|---|---|---|
| | 04 | Restore manufacturer defined parameters | rw | n | | UNSIGNED32 | 0000 0001$_h$ | “Burn in” set of parameters is reset to factory settings |
| 1014 | 00 | COB-ID emergency message | rw | n | VAR | UNSIGNED32 | 80$_h$ + node ID | |
| 1016 | | Consumer heartbeat time | | | ARRAY | | | |
| | 00 | Highest sub-index supported | ro | n | | UNSIGNED8 | 03$_h$ | |
| | 01 | Consumer heartbeat time | rw | n | | UNSIGNED32 | 0000 0000$_h$ | 0..32000 [ms] |
| | 02 | Consumer heartbeat time | rw | n | | UNSIGNED32 | 0000 0000$_h$ | 0..32000 [ms] |
| | 03 | Consumer heartbeat time | rw | n | | UNSIGNED32 | 0000 0000$_h$ | 0..32000 [ms] |
| 1017 | 00 | Producer heartbeat time | rw | n | VAR | UNSIGNED16 | 0000$_h$ | |
| 1018 | | Identity object | | | RECORD | IDENTITY | | |
| | 00 | Highest sub-index supported | ro | n | | UNSIGNED8 | 04$_h$ | |
| | 01 | Vendor ID | ro | n | | UNSIGNED32 | 0000 0000$_h$ (Bosch Rexroth AG Pneumatics – ship engineering) | |
| | 02 | Product code | ro | n | | UNSIGNED32 | 0000 0000$_h$ | |
| | 03 | Revision number | ro | n | | UNSIGNED32 | 0000 0000$_h$ | |
| | 04 | Serial number | ro | n | | UNSIGNED32 | FFFF FFFF$_h$ | |
| 1200 | | SDO server 1 parameter | | | RECORD | SDO_PARAMETER | | |
| | 00 | Highest sub-index supported | ro | n | | UNSIGNED8 | 02$_h$ | |
| | 01 | COB ID client -> server (rx) | ro | n | | UNSIGNED32 | 0000 0600$_h$ + Node ID | |
| | 02 | COB ID server -> client (tx) | ro | n | | UNSIGNED32 | 0000 0580$_h$ + Node ID | |
| 1400 | | RPDO 1 comm. parameter | | | RECORD | PDO_COMMUNICATION_PARAMETER | | |
| | 00 | Highest sub-index supported | ro | n | | UNSIGNED8 | 02$_h$ | |
| | 01 | COB ID used by RPDO | rw | n | | UNSIGNED32 | 0000 0200$_h$ + Node ID | |
| | 02 | Transmission type | rw | n | | UNSIGNED8 | FF$_h$ | “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 |

| *Index (hex)* | *Sub-index (hex)* | *Name (reference)* | *Attribute* | *Mappable* | *Object type* | *Data type* | *Default value* | *Comment* |
|---|---|---|---|---|---|---|---|---|
| | 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 | $05_h$ | |
| | 01 | COB ID used by TPDO | rw | n | | UNSIGNED32 | $0000\ 0180_h$ + Node ID | |
| | 02 | Transmission type | rw | n | | UNSIGNED8 | $FF_h$ | |
| | 03 | Inhibit time | rw | n | | UNSIGNED16 | $0000_h$ | See CIA301 0..32000 [ms] |
| | 05 | Event timer | rw | n | | UNSIGNED16 | $0000_h$ | 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 | |
| | 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! |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2000 | 00 | Error status | rw | n | VAR | UNSIGNED8 | | 0 Rw: Delete error statuses, see “Error message”; RPDO2; Byte1 |
| 2010 | 00 | Status code | ro | j | VAR | UNSIGNED8 | | See “Status code”; TPDO1; Byte1 |
| 2020 | 00 | Power actual | ro | j | VAR | UNSIGNED16 | | TPDO1; Byte3,4 |
| 2021 | 00 | Frequency actual | ro | j | VAR | UNSIGNED8 | | TPDO1; Byte2 |
| 2022 | 00 | Voltage RMS actual | ro | j | VAR | UNSIGNED16 | | TPDO1; Byte5,6 |

| *Index (hex)* | *Sub-index (hex)* | *Name (reference)* | *Attribute* | *Mappable* | *Object type* | *Data type* | *Default value* | *Comment* |
|---|---|---|---|---|---|---|---|---|
| 2023 | 00 | Current RMS actual | ro | j | VAR | UNSIGNED16 | | TPDO1; Byte7,8 |
| 2030 | 00 | High voltage | rw | j | VAR | UNSIGNED8 | Write: 0/1<br>Read: Corresponding status code 0x2010 (PlasmaOk) | RPDO1; Byte1 |
| 2040 | 00 | Power set | rw | j | VAR | UNSIGNED8 | | 0..100; RPDO1;Byte2 |
| 2041 | 00 | Frequency set | rw | j | VAR | UNSIGNED16 | | RPDO1; Byte3,4 |
| 2042 | 00 | Voltage threshold | rw | j | VAR | UNSIGNED16 | | Internal error threshold – do not change!<br>RPDO1; Byte5,6 |
| 2043 | 00 | Current threshold | rw | j | VAR | UNSIGNED16 | | Internal error threshold – do not change!<br>RPDO1; Byte 7,8 |
| 2050 | | Temperature | | | Array | | | |
| | 00 | Highest sub-index supported | ro | n | | UNSIGNED8 | 5 | |
| | 01 | Temperature 1 | ro | n | | UNSIGNED8 | | TPDO2; Byte3 |
| | 02 | Temperature 2 | ro | n | | UNSIGNED8 | | TPDO2; Byte4 |
| | 03 | Temperature 3 | ro | n | | UNSIGNED8 | | TPDO2; Byte5 |
| | 04 | Temperature 4 | ro | n | | UNSIGNED8 | | TPDO2; Byte6 |
| | 05 | Temperature 5 | ro | n | | UNSIGNED8 | | |
| 2060 | 00 | Power-On time | ro | n | VAR | UNSIGNED16 | | TPDO02; Byte1,2 |
| 2100 | 00 | Internal use | wo | n | VAR | UNSIGNED32 | | Do not change! |
| 2110 | 00 | Internal use | ro | n | VAR | UNSIGNED16 | | |