User Guide 2025

MediPlas Evaluation Kit

Operating instructions (V1)

MediPlas

www.tdk-electronics.tdk.com

MediPlas Evaluation Kit
Operating instructions (V1)

We are pleased that you have chosen a branded device from **relyon plasma GmbH** and thank you for the trust you have placed in us. Please read the operating instructions carefully so that you can use the device to its full potential.

Important!

Please read these instructions carefully before assembly, installation, and commissioning!

Instruct the personnel!

The operator/user is responsible for ensuring that the personnel have fully understood the operation of the appliance and the safety regulations.

Always observe the safety instructions!

Failure to observe the safety instructions can lead to accidents and cause serious damage to people and the machine.

Original operating instructions

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Content

MediPlas Evaluation Kit
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1. Safety

The components of the MediPlas Evaluation Kit are built in accordance with relevant international standards. However, as with any technical product, the components may pose hazards if used improperly or not as intended.

In addition to the information in these operating instructions, observe generally applicable safety regulations.

CAUTION! Danger

Please observe and follow the safety instructions and requirements in these operating instructions, as failure to do so could result in serious and possibly fatal injuries when handling the appliances.

1.1 Residual hazards

Always observe the following safety instructions:

CAUTION! Electrical voltage

- Only use a suitable power supply unit with 24 V and at least 100 W rated power. Ensure the correct polarity when connecting to the evaluation kit.
- Danger due to mains voltage
  If damage is visible on the MediPlas Kit:
  - Do not operate the appliance.
  - Have the damaged parts repaired or replaced by a specialist.
- Danger due to high voltage:
  The MediPlas Reactor is connected to the dielectric barrier discharge (DBD) driver with a high-voltage cable. If the cable is damaged, there is a risk of high voltage shock.

CAUTION! Emissions

Hazardous quantities of the reaction gas ozone (O_3) may be produced during operation of the appliance.

- Ozone concentrations of more than 0.2 mg/m³ can occur.
- Please note that national health and safety measures must be observed when using the appliance.
- Only use the appliance in conjunction with a suitable extraction device or filter.
- Do not leave the appliance running unattended.
- Ensure that all gas connections between the MediPlas Reactor and the process reactor are tight (see section 6.3).

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1. Safety

1.1 Residual hazards

ATTENTION! Device for use in industrial environments

Due to both conducted and radiated interference, it may be difficult to ensure electromagnetic compatibility in other environments in conjunction with the components of the MediPlas Kit.

CAUTION! Hot surface

The MediPlas Reactor, the components of the DBD driver and the diaphragm pumps can become hot during operation. Do not touch them until they have cooled down and take care not to damage thermally sensitive surfaces when working.

The plasma gas receiver may also heat up due to the plasma process, depending on the process parameters. If necessary, allow it to cool down before touching it.

CAUTION! Health risk for wearers of pacemakers

The high-frequency electromagnetic fields generated by the DBD driver and used by the MediPlas Reactor can, under certain circumstances, disrupt the function of pacemakers. This can jeopardize the health of the pacemaker wearer.

1.2 Instructions and obligations for the operator

- Interference emissions must always be expected

  The operator must check and ensure electromagnetic compatibility with other electrical and electronic devices in the immediate vicinity.
- Make sure that:
  - the operating personnel have read and understood these operating instructions,
  - persons in the vicinity of the appliance are also made aware of the dangers and provided with the necessary protective equipment, and
  - maintenance work is only be carried out by qualified specialist personnel.
- Instruct the operating personnel in particular about the safety instructions in these operating instructions.
- Always keep the appliance in good working order.
- Modifications to the appliance will invalidate the operating license.
  Exception: The modifications are expressly authorized by the manufacturer.

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1. Safety

1.3 Impermissible operating conditions

Operation of the appliance is not permitted under the following conditions:

- use in potentially explosive atmospheres (EX),
- for heavy dust deposits,
- if the humidity is too high (see chapter 3. Technical data),
- at installation altitudes higher than 3,000 m above sea level and
- with strong vibrations.

1.4 Emissions

Depending on the process gas and the set operating parameters, the MediPlas reactor produces the following emissions:

- Ozone (O_3)
- Nitrogen oxides (NO_x)
- Different concentrations of NO_2, N_2O, N_2O_4, and N_2O_5 were detected.
- Nitrogen acids (HNO_2 and HNO_3)
- Hydrogen peroxide (H_2O_2)

IMPORTANT!

As a precautionary measure, it is advisable to extract the process gases downstream of the planned experiment. Place the extraction system near the outlet of the process reactor (see section 6.3) or the MediPlas Reactor (operation without process reactor). Alternative methods such as catalytic destruction or activated carbon filters must be adapted to the respective experimental requirements.

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2. Device description

2.1 Intended use

The MediPlas Kit enables the MediPlas Reactor 1 to be tested and characterized for customer-specific applications. It is shown in the photos in section 2.3. Through the gas outlet 7, the MediPlas Reactor supplies a plasma gas with a high concentration of ozone or RONS (reactive oxide nitrogen species).

Such a plasma gas can be used for numerous processes (see section 6.1) that require a strong oxidizing effect. To avoid exposing the users of the kit to harmful gases, the plasma gas must be used in a closed process reactor (see section 6.3) equipped with an appropriate device to neutralize the oxidizing gases.

2.2 Scope of delivery

MediPlas Reactor (1000 674 800)

The scope of delivery includes the following components (the numbers in brackets refer to the picture in section 2.3):

- HV electrode in an enclosure
- Peltier cooling module with connections
- Heat sink
- Fan with connections
- Gas lines for gas inlet 5 and gas outlet 7
- Temperature sensor of the heat sink with connections

DBD driver V6 (1000 679 300)

The scope of delivery includes the following components:

- Resonant high-voltage generator
- High-pass filter for POK signal
- HV transformer 3
- HV cable 5
- Cable connection between the PCB of the kit and the driver 17

MediPlas Kit board

The scope of delivery includes the following components:

- Kit-PCB 18 equipped with, among other things, the microcontroller
- 3.5-inch display 11
- Sensor for determining the air flow, humidity, and air temperature 9
- Slow-blow 2-A fuse T2L 12
- Push button for menu navigation 14
- Firmware uploaded for kit operation

MediPlas Kit carrier

The scope of delivery includes the following components:

- Support plate with rubber feet 27
- Cover plate 28
- Mounting elements

Set of diaphragm pumps

The scope of delivery includes the following components:

- 2 diaphragm pumps 6
- Connecting hoses with a Y-piece
- Electrical connections
- Mechanical brackets
- 2 dust filters 22 with silicone hoses 23

MediPlas Evaluation Kit
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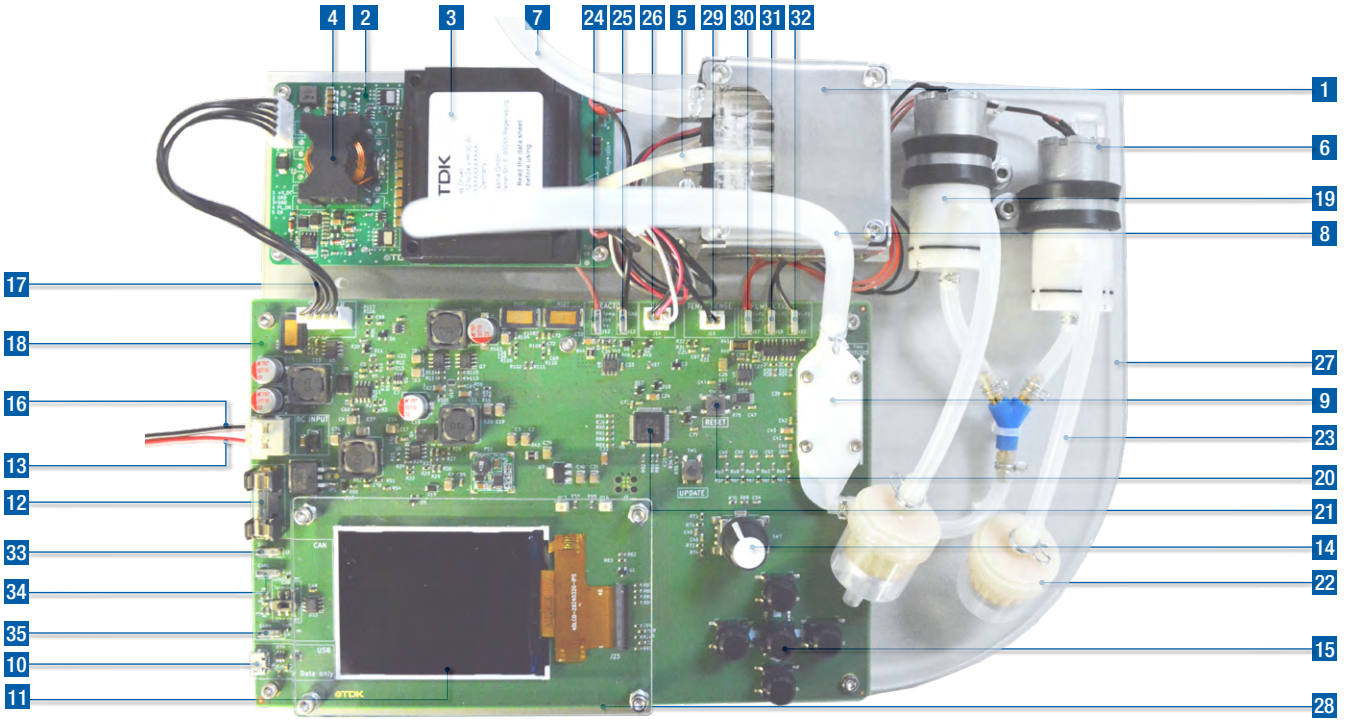
2. Device description

2.3 Kit hardware components

The individual parts of the kit are named and numbered below. Reference is made to these designations in the appropriate sections in the operating instructions.



No	Component designation
1	MediPlas Reactor
2	DBD driver circuit board
3	HV transformer
4	PlasmaOK high-pass filter
5	HV cable
6	Diaphragm pump
7	MediPlas gas outlet
8	MediPlas gas inlet
9	Temperature, gas flow, and humidity sensor
10	USB socket for communication with a PC
11	HMI display
12	Fuse
13	24-V connection
14	HMI pushbutton
15	HMI menu buttons
16	DC earthing
17	MediPlas Driver connector
18	Kit board

No	Component designation
19	Gas connection for dust filter
20	RESET button
21	Microprocessor
22	Dust filter
23	Silicone hose
24	Peltier module supply voltage
25	Peltier module Earthing
26	Fan connections
27	Carrier plate
28	Cover plate
29	Electrical connection of the heat sink temperature sensor
30	Power supply for the two pumps
31	Earthing the first diaphragm pump
32	Earthing the second diaphragm pump
33	Earthing the CAN interface
34	Signal "low" of the CAN interface
35	Signal "high" of the CAN interface

MediPlas Evaluation Kit Operating instructions (V1)

2. Device description

2.4 Kit description

The centerpiece of the MediPlas Kit is the MediPlas Reactor 1. In this reactor, a hybrid dielectric barrier discharge (HDBD) is ignited between a metal electrode and a dielectric barrier. The metal electrode is supplied with high voltage between 2 and 6 kV in the frequency range of 20 to 40 kHz by the DBD driver transformer 3 via an HV cable 5. Gas is fed through the HDBD zone. In this version of the MediPlas Kit, the gas is ambient air. It is drawn in from the environment through a dust filter 22 and pumped to the MediPlas Reactor by two diaphragm pumps 6 connected in parallel. The output of the diaphragm pumps is controlled based on the gas flow measured by the gas flow sensor 9. This ensures that the specified gas flow setpoint is reached.

The MediPlas Reactor is equipped with a Peltier cooling module whose supply voltage is provided by the electronic kit board via a connection 24 25. The cooling capacity of the Peltier module can be varied by the set current. Depending on the operating mode of the DBD driver, the MediPlas Reactor is supplied with continuous or intermittent power. Both the voltage of the DBD driver and the duty cycle of intermittent operation (PWM, pulse width modulation) can be set and are provided by the electronic circuit board via the connection cable 17.

The DBD driver supplies a PlasmaOK signal via the same connection, which can be used to diagnose the operating status of the gas discharge. The PlasmaOK signal is generated from the current signal of the HDBD discharge with the aid of a PlasmaOK high-pass filter that allows signals in the MHz range to pass through. These high-frequency signals are generated by the demolding of the ideal sinusoidal current signal by the micro discharges of the HDBD. The PlasmaOK signal, which is represented by a DC voltage in the range of hundreds of mV, is proportional to the power effectively coupled into the discharge. Therefore, if the PlasmaOK signal is below a certain threshold it means that no plasma is generated.

The “brain” of the MediPlas Kit is the electronic kit board 18 with a programmable microprocessor 21 and firmware written into a programmable memory chip. The most important functions of the kit board with firmware version V1 are

- Setting the DBD driver parameters (input voltage, frequency, duty cycle of the PWM)
- Stabilization of the output of diaphragm pumps in a control loop to stabilize a set airflow.
- Setting the Peltier module current
- Measurement and display of the driver and Peltier module power
- Measurement and display of the PlasmaOK signal from the DBD driver
- Communication with the operator using an HMI (human-machine interface), as described in detail in section 7.1
- Communication with a PC via a USB interface
- Operation of the reactor in timer mode

Further functions are planned with firmware version V2. These include:

- Communication with an automation environment via a CAN interface
- Fault diagnostics of the system based on all available actual values
- Processing the temperature of the heat sink of the MediPlas Reactor
- Processing the information from the sensor (temperature, humidity, gas flow)
- Switching on the fan in the MediPlas Reactor
- Monitoring the thermal status of the Peltier module
- Use the Peltier module to selectively heat the discharge chamber. The Peltier module currents then have a negative sign.
- Analyzing the PlasmaOK signal from the DBD driver for diagnostic purposes

It is planned to supply the MediPlas Reactor with compressed dry air (CDA) or synthetic air in a later firmware version. This requires a change to the tubing, deactivation of the air pumps, and the gas flow control algorithm. The regulation of the gas flow then remains the task/responsibility of the kit operator.

3. Technical data

Electrical data	
Supply voltage [V] (DC) [1)]	24
Max. power consumption [W]	100
Execution	Desktop unit
Dimensions	
Weight [g]	1160
Width [mm]	297
Depth [mm]	210
Height [mm]	64
Display [inch]	3.5
Gas supply	
Standard gas	Ambient air
Gases without pump	Synthetic air, dry compressed air
Airflow of the pumps [L/min]	0.5 … 5.5
Max. measurable gas flow [L/min]	10
MediPlas gas inlet	Hose connection Ø 6 mm
MediPlas gas outlet	Hose connection Ø 6 mm
Maximum ozone concentrations of the plasma gas	
Synthetic air [ppm]	3500
CDA [ppm]	3000
Ambient air [ppm]	2500
Operating conditions	
Relative humidity [%]	< 80 (non-condensing)
Temperature [°C; °F]	+10 … +40; +50 … +104
Maximum operating height above sea level [m]	3000
Storage conditions	
Relative humidity [%]	< 80 (non-condensing)
Temperature [°C; °F]	0 … +60; +32 … +140

1) A supply voltage below 24.0 volts restricts the maximum supply voltage range of the MediPlas Driver.

4. Transport

- Store the MediPlas Kit in a dry place. This protects the kit from corrosion of the electrical contacts. It is best to use the supplied packaging for storage and transport.
- Protect the appliance from dirt, water splashes, and foreign objects.
- Protect the device from falls or other hard knocks.

5. Installation

- Remove the MediPlas Kit from the packaging.
- Place the MediPlas Kit on a flat surface.
- Connect the gas outlet 7 of the MediPlas Reactor to the process reactor using the silicone tubing supplied.
- Connect the silicone hoses 23 of the two dust filters 22 to the gas supports 19 of the diaphragm pumps 6.
- Ensure that the process gases are neutralized.
- Establish the power supply using a power source that supplies 24 V/100 W.

ATTENTION! Damage to the appliance

To avoid damage to the appliance, please observe the operating instructions in chapter 7.

6. Special instructions for using plasma gas

6.1 General description

The plasma gases produced in the MediPlas Reactor have a strong oxidizing effect and can be used for numerous applications. Some typical examples are listed below:

- Disinfection
- Sterilization
- Odor reduction
- Decomposition of organic contaminants in the air
- Improving the germination of seeds
- Pest control
- Bleach
- Creation of passivation layers
- Treatment of drinking water
- Neutralization of wastewater
- Generation of PAW (Plasma Activated Water)

Typical factors influencing the composition of the plasma gas are:

- The relative humidity of the air used for the HDBD
- The HV voltage, which is controlled by the input voltage of the DBD driver
- The effective power that can be set by adjusting the PWM duty cycle
- Gas flow that can be regulated for the ambient air by the output of the diaphragm pumps
- The Peltier cooling, which is adjustable by the current of the Peltier module

6.2 Initial operating parameters

The following operating points and their characteristic properties can be used as starting points for the evaluation of your experiment:

Characteristic	TEC current [A]	PWM duty cycle [%]	Gas flow [slm]
Ozone maximum	**2**	**30 … 40**	**0.5 …1**
Mixed operation	**2**	**80%**	**0.5 …1**
Nitrogen oxides/“acid”	**0**	**100%**	**1 … 2**

Further information on applications and publications can be found on the website www.relyon-plasma.com.

6. Special instructions for using plasma gas

6.3 A process reactor for the utilization of MediPlas plasma gases

A plasma gas is typically added to a process reactor that is not included in the scope of delivery. The design of a process reactor can follow different concepts. The two most common architectures are:

- A continuous reactor in which the used plasma gases must be neutralized throughout the entire process.
- A batch reactor, which is filled with plasma gas in the first process step, and in the last process step, the process gases are released from the process reactor through a neutralization device.

The simplest version of a batch process reactor is a sealed bag made from a polymer that is resistant to oxidizing gases (e.g. FEP). However, high-quality stainless-steel chambers, vessels made of quartz or Pyrex glass, or boxes made of transparent polymers are also possible. The design of the process reactor depends primarily on the function it should fulfill. The size of the reactor depends on the desired concentration of the oxidizing species and the desired process time. The lower the gas flow through the MediPlas Reactor, the higher the achievable concentration, but the longer it takes to fill a certain volume with the plasma gas.

Calculation examples can be requested directly from **relyon plasma GmbH**.

6.4 Measures to neutralize the plasma gases

The plasma gases introduced into a process reactor are toxic and cannot be released into the environment. Appropriate equipment is required to neutralize them.

CAUTION! Emissions

Oxidizing gases, including ozone, are generated during the plasma process. Leaky connections between the MediPlas Reactor and a process chamber or ineffective or defective exhaust gas neutralization can lead to the release of these gases. In the event of an odor-detectable emission of ozone, the operation of the MediPlas Kit must be interrupted immediately, and the cause of the emission must be checked and eliminated.

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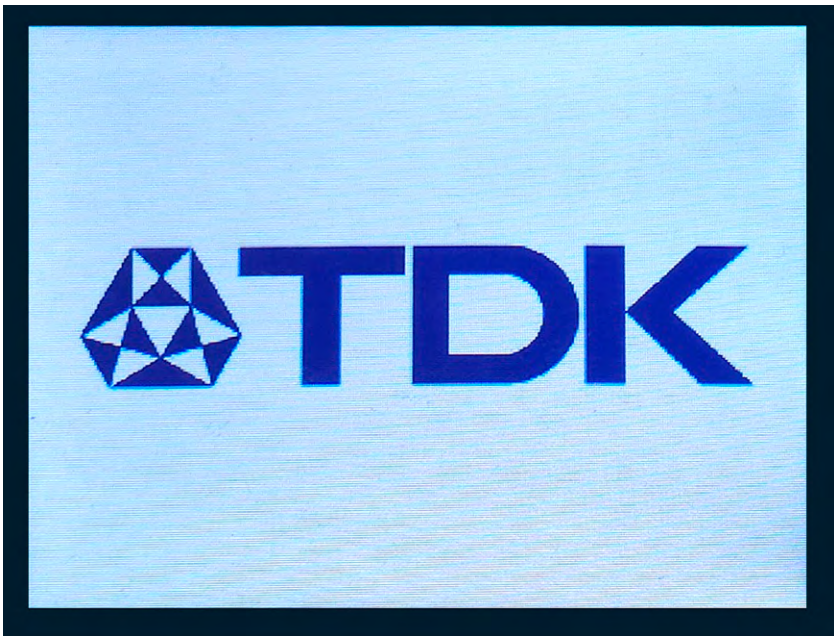
7. Operation

7.1 The concept of the HMI interface

The HMI consists of a 3.5-inch screen 11, a push button 14, and five menu buttons 15. Firmware version V1 only uses the push button. The menu buttons have no function. The screen shows different menus (forms). Within a menu, you navigate from field to field by turning the push button. The selected menu field is marked with a red frame. Pressing the push button selects this menu field. In the first six menu fields, the settings can be selected by turning the push button. Repeatedly pressing the push button ends the procedure for setting a value and navigation within the menu can be continued.

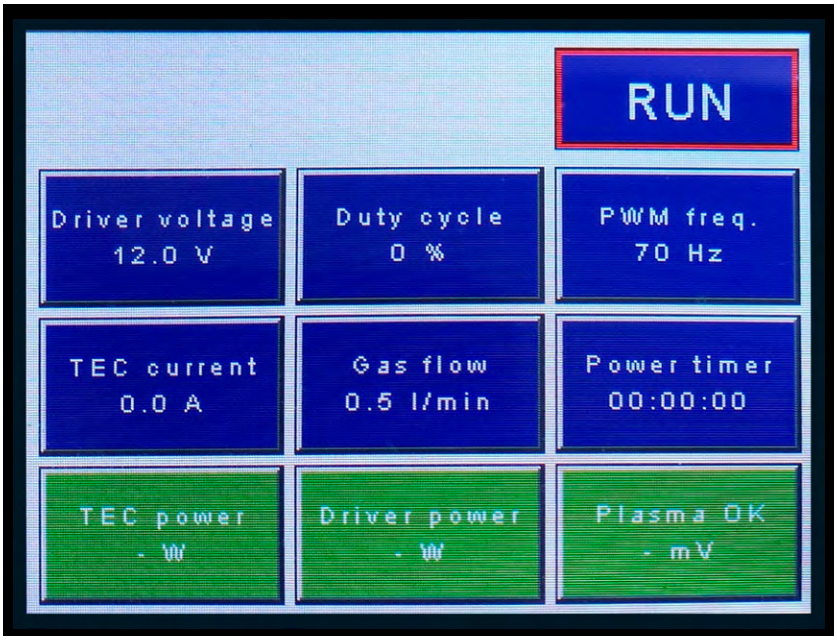
7.2 Logo screen



After switching on the 24 V kit supply voltage or pressing the reset button 20, an image with the TDK logo appears on the screen for a short time (see on the left side).

7. Operation

7.3 Start screen



The start screen (see screenshot on the left side) shows a start menu. A plasma process can be started by clicking the “RUN” field.

Before starting the process, it is possible to navigate from the “RUN” field to the desired setting field by turning the push button. Pressing the push button illuminates the setting value. In this state, turning the push button changes the set point within the permissible limits (see table). After pressing this button again, the setting value lasts until the next change.

The six blue fields of the start menu show the start values of the settings that always appear after switching on the kit voltage source again. They are not suitable for starting a plasma process immediately because the “Duty cycle” setting 0% means that the high voltage for the MediPlas Reactor is switched off. The plasma process can only be started after selecting the “RUN” field if the “Duty cycle” is set to a value greater than zero.

The desired duration of a plasma process can be set using the “Power timer” field. This option is only available in the start menu, but not in the process menu. The “Power timer” setting cannot be changed during the process. If the plasma process is interrupted, the current value of the timer is retained. The default setting of the “Power timer” of 00:00:00 means that the plasma process does not automatically end after a set time but must be stopped manually.

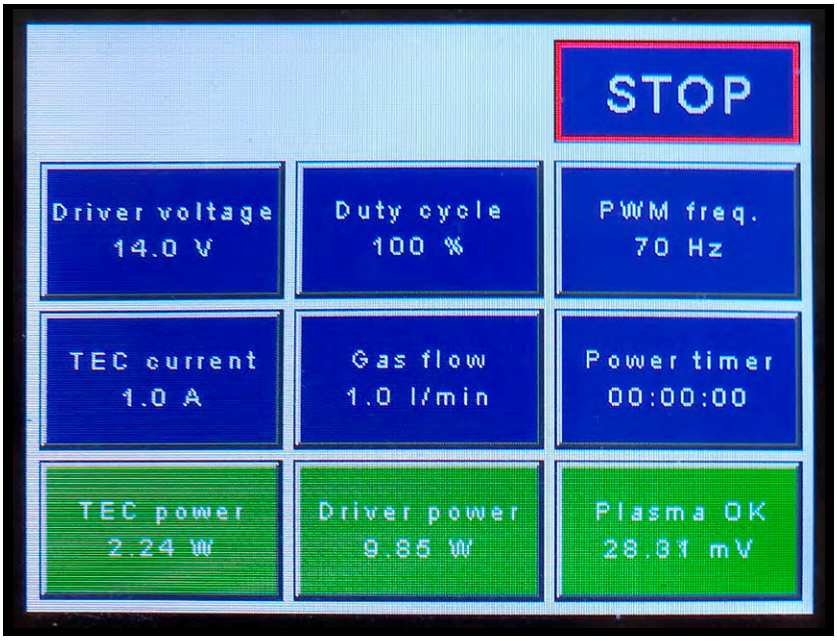
Value	Setting range	Setting step	Start value
Driver voltage [V]	12 … 20	0.1	12
Duty cycle [%]	0 … 100	5	0
PWM frequency [Hz]	20 … 100	70	5
TEC current [A]	0.0 … 3.0	0.1	0.0
Gas flow [L/min]	0.5 … 5.0	0.1	0.5
Power timer [s]	0 … 300 (5 min)	1	00:00:00

The green fields cannot be selected using the push button because they are only intended to display three process values: the driver power, the Peltier module power and the PlasmaOK signal. If plasma is not switched on, dashes appear in place of the process values.

The table summarizes the setting values together with their starting values, setting ranges and setting steps.

7. Operation

7.4 Process screen



After selecting the “RUN” menu item in the start menu, the screen changes to the process menu with the “STOP” field circled in red. A screenshot is shown on the left side.

The values displayed in the setting fields are used to control the plasma process. The gas flow set in the “Gas flow” field is stabilized by the control of the diaphragm pumps implemented in the microprocessor program. The operation of the diaphragm pumps can be heard as a slight vibration from a gas flow of more than 1 l/min.

ATTENTION! Damage to the appliance

The diaphragm pumps can be overloaded if the gas outlet or inlet is blocked, or the air filter is clogged.

The settings can also be changed in the plasma process operating mode, except for the “Power timer” field. The MediPlas Kit reacts immediately to these changes.

7.5 Exiting the operating mode

If the “Power timer” value has been set in the start mode, the plasma process ends after the preset time. Otherwise, a plasma process lasts until the push button is pressed when the “STOP” field is selected. The start menu appears on the screen. The value settings correspond to those set last. To return to the default setting, switch the power supply to the MediPlas Kit off and on or press the “Reset” button.

7.6 Working with other gases

The MediPlas Reactor can work with gases other than ambient air. This option is not available with firmware version V1.

Please contact the manufacturer and observe the local regulations for the use of special gases in your environment (e.g. chemical protection, fire storage regulations, etc.).

8. Decommissioning

- Select the “STOP” field with the push button and press it.
- Disconnect the power supply of the kit board after finishing work.

9. Maintenance

9.1 Cleaning

- Only clean the outside of the appliance.
- Make sure that the device is disconnected from the power supply.
- Clean the appliance only with a cloth moistened with water. Do not use solvents to clean the appliance!
- Do not clean the electronic kit board and driver board. Dust should be blown away with a rubber bulb dust blower.

9.2 Replacing a fuse

The fuse may blow if the power consumption is too high. It can be replaced after disconnecting the MediPlas Kit from the power supply.

ATTENTION! Damage to the appliance

Dropping electrically conductive objects on live electronic circuit boards and connections or splashing them with water can damage the device.

9.3 Replacing a dust filter

The dust filters can become clogged in a dusty environment. This can impair the pump function. To prevent such a situation, the clogged dust filters should be replaced. Replacement filters are available from relyon plasma GmbH.

10. Troubleshooting

Fault / error	Cause	Elimination
The device cannot be switched on and the display remains black.	The power supply is faulty.	Check the power supply.
	The mains fuse has tripped.	Check the mains fuse.
	The mains plug is not making correct contact.	Check the position of the mains plug.
	The mains plug is defective.	Change the mains plug.
	The power supply does not correspond to the spec.	Change the power supply unit or adjust settings.
	The electronic circuit board is defective.	Please contact customer service.
	The kit fuse has blown.	Replace the fuse on the kit board.
In operating mode, the reactor does not produce any reactive gases.	The PWM duty cycle is set to 0%.	Set a duty cycle > 0%.
	The HV connection cable is defective or not plugged in correctly.	Please contact customer service.
	Short circuit within the MediPlas Reactor	Please contact customer service.
	The PlasmaOK connection cable between the DBD driver and the electronic circuit board is not OK.	Plug in the connecting cable correctly.
The reactor fan does not switch on in operating mode.	There is no electrical connection between the reactor fan and the kit board.	Check the electrical connections between the reactor fan and the kit board.
	The fan is defective.	Please contact customer service.
The reactor becomes very hot during operation.	The reactor has reached an unacceptably high temperature inside.	Allow the appliance to cool down. Check if the air inlet/outlet is blocked during operation.
Despite a set TEC current of more than zero, the TEC power remains zero in operating mode.	The TEC cooling module is defective or not connected.	Check whether the connections between the DBD driver and the TEC module are OK. Insert a new DBD driver if necessary.
The driver power equals zero in operating mode.	The MediPlas Reactor is not installed or is defective.	Please contact customer service.
	The DBD driver is defective or not included.	Check that the connections between the electronic circuit board and the DBD driver are OK.
The set gas flow cannot be achieved.	The dust filter is clogged.	Replace the dust filters.
	The diaphragm pump(s) is (are) defective.	Please contact customer service.
The display turns off during operation.	During operation with certain process parameters, a display fault may occur. The plasma process is not affected by this.	Disconnect the kit board from the supply voltage and reconnect it after approx. 10 seconds.

If the problem cannot be solved by these procedures, please contact relyon plasma GmbH.

11. Environment

11.1 Waste disposal

Think about protecting the environment.

Used electrical and electronic appliances must not be disposed of with household waste.

- The appliance contains valuable raw materials that can be reused. You should therefore return the appliance to an appropriate collection point.
- Please return defective or replaced components to relyon plasma GmbH for analysis. Please contact us in advance.

12. Conformity / Standards

12.1 CE

We **do not** declare CE conformity of the prototype.

12.2 Licences

- ARM CMIS
- CAN BUS tools in Python 3
- Littlefs
- SCPI Parser
- STM32 USB Device Library
- STM32G4xx HAL Driver
- UGUI

13. Spare parts

In the event of a defect, please contact the manufacturer.

Do you already know our other products?

piezobrush® PZ3-i

The **PiezoBrush PZ3-i** is an extremely small plasma system that can be easily integrated into existing industrial and production systems. This enables simple and cost-effective treatment with cold active plasma 24/7 in your production process.

plasmabrush® PB3

The **PlasmaBrush PB3** is a high-performance plasma system for fast inline processes that require maximum performance. The PlasmaBrush PB3 is widely used in the automotive, packaging, and printing sectors.

plasmatool

The **PlasmaTool** is designed as a high-performance hand-held device for the plasma treatment of workpieces that cannot be machined due to their size or mobility. Plasma treatment is therefore possible at any location.

plasmabrush® PB3 Integration

The **PlasmaBrush PB3 Integration** is a complete system that has been developed for stationary use in production plants. It is controlled either via a remote control or by connecting it to a higher-level control system.

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