ELVEFLOW
PLUG & PLAY MICROFLUIDICS

Elveflow user guide

PLASMA BONDING PEN

Handheld PDMS bonder

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Important

Read these instructions carefully before assembling, installing and starting up the device.

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

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

INTRODUCTION

The plasma bonding pen enables a quick and easy surface treatment and has been approved for PDMS/glass and PDMS/PDMS bonding. It can also be used to modify the surface properties as in a traditional plasma chamber.

Safety

This device is built according to corresponding international standards.
Like with every technical product incorrect or not intended use can however be dangerous.

Follow the instructions in this operating manual in addition to the general safety regulations.

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

Residual risks

This device 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!
Only use the external power plug provided.
Danger from mains voltage. If the external power plug is visibly damaged:

- Do not use the damaged part.

- Have the damaged parts repaired by a qualified person or replace them.

Danger from sparks on the piezo element and the substrate to be treated:

- Do not reach into the area of the plasma discharge.

- Electrically conductive substrates must be grounded or protected against touching.

Attention – Emissions!
Dangerous amounts of the reaction gas ozone (O_3) may be produced during device operation.

- Volumes of ozone in excess of 0.2 mg/m^3 may be produced.

- Note that national health and safety measures must be observed when operating the device.

- Only use the device in well ventilated areas or in conjunction with a suitable extraction device.

- Do not leave the device running unattended.

- Do not point the device at people when in operation.

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 device 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 device will invalidate the operating license and the warranty. Exception: Such modifications are expressly authorized by the manufacturer.

Impermissible operating conditions

The device 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
At altitudes of more than 2.000 m above sea level
Where there are strong vibrations

Emissions

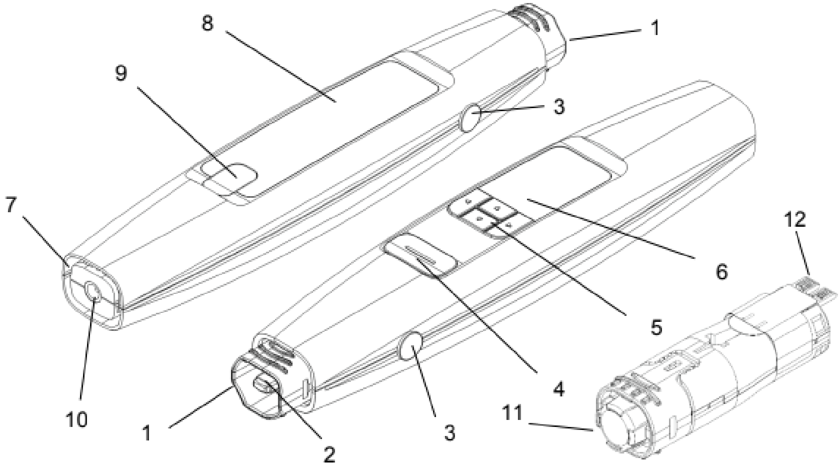
The connected device produces the following emissions:

- Ozone (O_3)

Plasma gas	Plasma flow	Ozone
Air	approx. 8 l/min	< 0,1 g/h

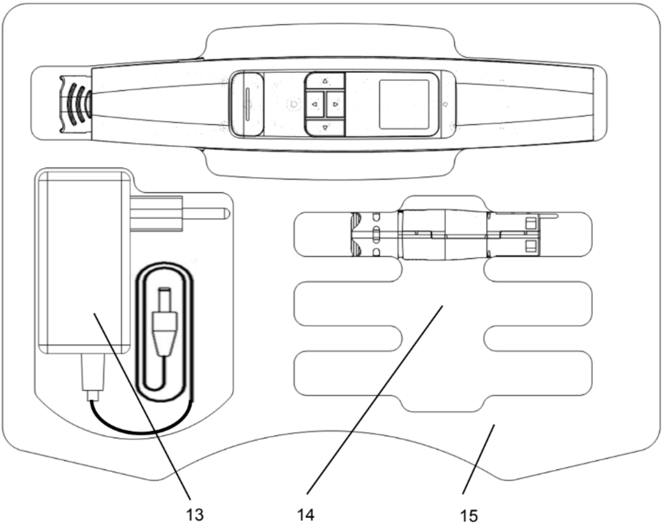
Note!
As a precautionary measure, we recommend an extraction system with about 100 m³/h in the direct vicinity of the plasma outlet.

Description of the device



No.	Component description
1	Module „Standard“ (inserted)
2	Piezo element in module (embedded in module)
3	Module release button (on both sides)
4	Start/Stop button

5	Menu buttons
6	Display
7	Air inlet
8	Type plate
9	Service port cover (only for service by Elveflow)
10	DC socket for plug-in power supply
11	Contact board on module



No.	Component description
13	Plug-in power supply
14	Compartments for optional modules
15	Foam insert

Attention!

The piezo element is an oscillating component that vibrates mechanically at high frequency. Due to its design, this component cannot be fixed rigidly. For this reason, the component can lie off-center in the interchangeable modules within certain limits. This is not an error or quality defect. Due to the vibration, audible frequencies may also occur under certain circumstances. This is also normal and not a fault or quality defect.

Technical data

Weight	110g
Length	215 mm
Diameter	27 to 38 mm
Power supply	110 V or 230 V ; 50/60 Hz
Power consumption	18 WI
Plasma temperature	< 50°C
Treatment distance	2 to 10 mm
Treatment area	5x5 to 20x20 mm^2 large

Transport / storage

Store the device in a dry place. This will prevent corrosion of the electrical contacts. It is best to use the provided case for storage and transport.
Protect the device from dirt and foreign objects.
Protect the device from falls or other hard impacts.

Installation

- Remove the device from the packaging.
- Use the external power plug to establish the power supply.
- Ensure that the workplace is well ventilated.

Operation

Inserting / removing the module

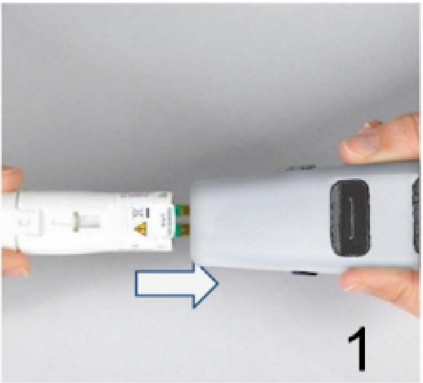
To insert a module, take it out of the packaging and hold it in the area of the nozzle outlet without touching the piezo element (picture 1).

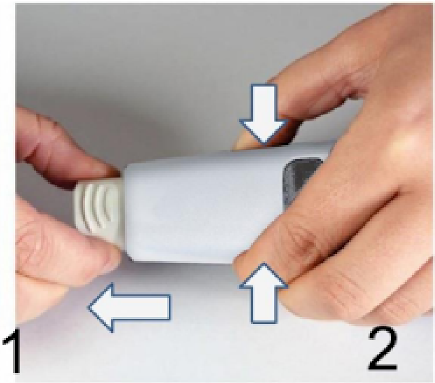
Please note that the contact board of the module must be on the same side as the display of the device to allow insertion.

Carefully insert the module into the device as shown in the picture without using force until the module locks into place.

When the device is switched on, the type of module detected is now shown in the display.

Hold the device in one hand, press both release buttons simultaneously and keep them pressed. With the other hand, hold the module in the area of the nozzle outlet without touching the piezo element and carefully pull the module out of the device (picture 2).



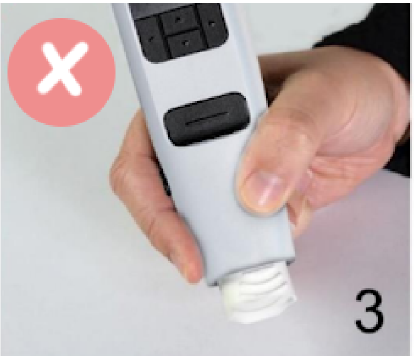


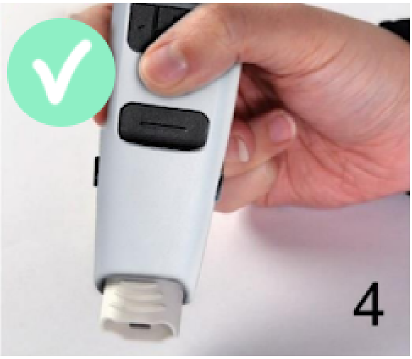
Caution – hot surface!
The exchange modules can become hot during operation. Do not touch them until they have cooled down and take care not to damage thermally sensitive surfaces when working with the exchange modules.

Attention – Damage to device!
Do not reach into the interior of the unit if no module is inserted and do not insert any objects into the opening of the unit other than the modules provided for this purpose. Hold the modules only in the front area as described above and avoid touching the contact board and the piezo element.
Insert and remove the modules carefully.

Installation

- Make sure that a module is inserted in the device.
- Make sure that the air inlet and nozzle outlet are not covered so that a sufficient flow of ambient air can be drawn in by the unit.
- Hold the unit only in the area of the button (picture 4), not in the area in front of it (picture 3).
- If the unit is to be mounted stationary, please observe the instructions below regarding electrically conductive objects (picture 5 to 8).
- Ensure that the ventilation / extraction of the working area is sufficient.
- Press the Start/Stop button to generate plasma.





The device stops plasma activation after 5 minutes at the latest and goes into standby mode (in the case of special modules, plasma activation can stop after a shorter period of time).

You can return to the active mode by simply pressing the Start/Stop button and restart the activation by pressing the Start/Stop button again.

Do not reach into the work area during plasma generation. This can disturb the plasma discharge and can also cause skin irritation or be perceived as slightly painful.

Attention - Damage to device!
The device can be damaged if it is operated without air supply.
This would interrupt the supply of the cooling medium required during operation. Never cover the air inlet and/or the nozzle outlet during operation.
The device can be damaged if electrically conductive objects are closer than 60 mm to the front third of the device during operation.

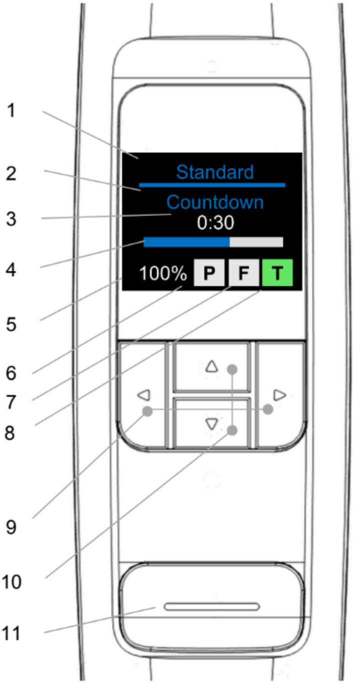
User menu

The device starts in the menu item "Home".
The home menu provides you with an overview of various pieces of information while you work with the device.

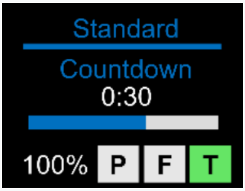
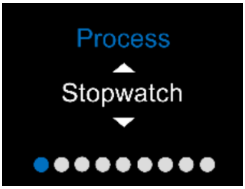
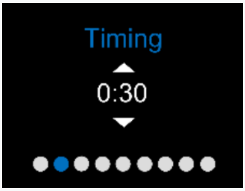
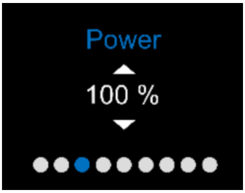
To navigate through the menu items, use the "<" (left) and ">" (right) buttons on the keypad.

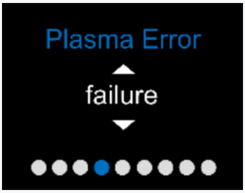
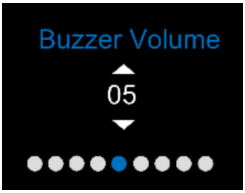
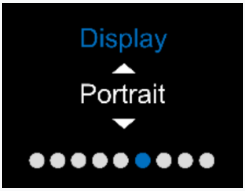
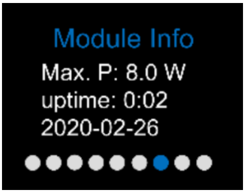
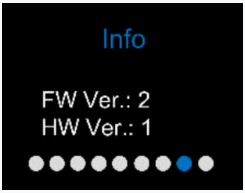
To change the settings in the menu items, use the buttons "^" (up) and "v" (down). In the menu items 3 to 8 you can return to the menu item "Home" by pressing the Start/Stop button.

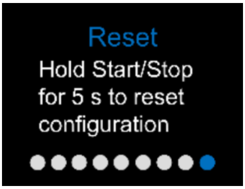
Please note that the direction of the arrow keys also changes accordingly when the display orientation is changed.



No.	Description	Function
1	Module type	Displays currently inserted module
2	Process tool mode	Displays selected process tool
3	Time value	Displays the current time value
4	Time bar	Graphical representation of the time lapse
5	Power setting	Displays currently selected power value
6	Status plasma	Grey: not active Green: OK Yellow: critical Red: Error
7	Status fan	Grey: not active Green: OK Yellow: critical Red: Error
8	Status temperature	Grey: not active Green: OK Yellow: critical Red: Error
9	Arrow keys left / right	Navigation through menu items
10	Arrow keys up / down	Setting within the menu items
11	Start/Stop button	Starts and stops plasma treatment; return to “Home”; confirm errors

#	Menu item/description	Settings	Display
1	Start: Device is booting and switches to the menu item "Home" when ready	-	-
2	Home: Overview: pressing the Start/Stop button starts or stops the plasma activation	-	 Standard Countdown 0:30 100% P F T
3	Process: Selection of the various process tools	- Stopwatch - Countdown - Metronome	 Process Stopwatch
4	Timing: Setting the duration for the selected process tool	1s to 5min in increments of 1s	 Timing 0:30
5	Power: Setting the plasma power	30% to 100% in increments of 5%	 Power 100 %

6	Plasma Error: Set the behavior of the device when a plasma error is detected. "failure": device stops / red error "warning": device does not stop / yellow warning	- failure - warning	 Plasma Error ▲ failure ▼
7	Buzzer Volume: Setting the volume of the acoustic feedback	0 to 5 in increments of 1	 Buzzer Volume ▲ 05 ▼
8	Display: Setting the display orientation	3 different orientations selectable	 Display ▲ Portrait ▼
9	Module Info: Information about the currently inserted module	-	 Module Info Max. P: 8.0 W uptime: 0:02 2020-02-26
10	Info: Information about the hardware and software version of the device	-	 Info FW Ver.: 2 HW Ver.: 1

11	Reset: By holding the Start/Stop button for 5 seconds, all device settings are reset to the factory settings	-	 Reset Hold Start/Stop for 5 s to reset configuration

Attention – Damage to device!
The setting in the menu "Plasma Error" is per default "failure". This stops the device to protect the module from situations that might damage the piezo element. It is also an indicator that the plasma discharge might be not suitable for this material causing a not satisfying surface activation.
Some materials (e.g. compound materials or liquids) might be difficult to treat with the "failure" setting. By switching to "warning" mode, be aware that the module might be damaged, depending on your material and or process parameters.

Process tools

The device provides various functions as tools to support the plasma treatment process.

- **Stopwatch**
  The device measures the duration of plasma generation in one second steps from start to stop triggered by pressing the Start/Stop button. The value measured last remains in the home menu until the next plasma generation is started. This function can be used, for example, as an aid in process development to record the different treatment times of different samples. The adjustability in the menu item "Timing" is deactivated in this mode (display "not applicable").

- **Countdown**
  In countdown mode, a duration of plasma generation can be pre-set via the menu item "Timing". The unit is started using the Start/Stop button but stops activation automatically after the set duration has elapsed. The plasma generation can be stopped by pressing the Start/Stop button. This function can be used, for example, if many samples are to be treated with plasma for the same amount of time.

- **Metronome**
  In this mode the plasma generation is not deactivated after the time has elapsed, as it is in the "Countdown" mode, but rather a regular acoustic signal is emitted. This function can be used, for example, when large substrates are treated in lines and each line should have approximately the same duration.

Working with module Standard

This module is used for various applications on non-electrically conductive substrates / materials such as plastics, ceramics, glass, natural fibers, leather, textiles etc. The range of the permissible working distance is approx. 2 to 10 mm. Electrically conductive substrates such as metals or conductive polymers cannot be reliably treated with this nozzle. When treating electrically conductive substrates / materials, arcing can occur if the distance is too small. In this case the unit will stop plasma generation after approx. 0.5 seconds.

How to perform PDMS bonding with the Plasma Bonding Pen

Start by cleaning both surfaces with Isopropanol or following your own cleaning process.

Three main parameters will impact the quality of your treatment:

- The distance between the nozzle and the surface, which is directly controlled by the user
- The processing time, which is also defined by the user and can be monitored using the menu item “Timing” described above
- The plasma power editable by going to menu item “Power”

For an effective bonding, we advise to use the equipment at 100% power by placing the nozzle at 0.5cm of the surface. We recommend scanning from 30 seconds to one minute for each surface (considering microscope glass slide size). You can use the menu “Timing” in Countdown or Metronome modes to monitor scanning time. Refer to page 19 for details.

Treat the two surfaces successively, applying it to the entire surfaces to be bonded and press them against each other. As with all plasma treatments, the effect is non-permanent, so the surface returns to normal after a few minutes. Thus, please be sure to proceed with the bonding soon after treatment.

A short thermal annealing of 5-10 minutes at around 80°C is also recommended to seal your chip definitively.

Your PDMS chip is ready to use with a maximum pressure of around 2 bars.

Switching off the device

Press the Start/Stop button again to stop plasma generation.
Disconnect the power supply once work is completed.

Maintenance

Cleaning

Make sure you disconnect the device from the power supply.
Clean the device only on the outside with a water-dampened cloth.
Never use solvents to clean the device!
Do not clean the piezo element.

Replacing a module

The modules can be subject to wear depending on the application and should be exchanged for consistent treatment results.

You can obtain replacement modules directly from your supplier. Please contact us if you experience any issues or replace modules for analysis.

Attention – Damage to device!
Never touch the piezo element at the front end of the device with sharp objects. This component can be damaged by improper handling.

Troubleshooting

Fault/error	Cause	Rectification
Device cannot be started or plasma extinguishes during operation.	Mains failure.	Check electrical power supply.
	Mains fuse triggered.	Check mains fuse.
	Mains plug not making contact correctly.	Make sure the mains plug is inserted correctly.
	Mains plug is defective.	Replace mains plug.
	There is an internal error.	De-energize device. Switch on again.
	Piezo element broken; the device is defective.	Contact customer service.
	Shutdown due to overheating.	Allow the device to cool down. Ensure that the air inlet is not covered so that enough ambient air can be drawn in.
Plasma extinguishes during operation and device emits several short acoustic signals	Device does not find a permissible operating frequency.	Piezo element broken. Remove the defective module and insert a new one.

Indication on the display: „Plasma-failure“	The module used seems not suitable to your substrate.	Check that there are no conductive materials near the treated area.
As explained above, indication on the display: “Fan-failure”	Fan is defective.	Contact customer service.
As explained above, indication on the display: “overheated”	The device reached an impermissible inner temperature.	Allow the device to cool down. Check whether the air inlet and the nozzle outlet are not covered.
Error message in display: „No module inserted“	Module was not detected.	Check whether the module is inserted deep enough in the device. If necessary, remove the module and reinsert it. If necessary, insert a new module.
Error message in display: „invalid module inserted“	The module used is not compatible with the device.	Please contact customer service.
Display turns off during operation.	When used under certain conditions, it might occur under some process parameters that the display turns off. The	Disconnect the power supply and reconnect after about 10 seconds.

	plasma process is not affected.	

Environment

Disposal

Consider the environment. Used electrical and electronic equipment must not be disposed of as household waste.

- The device contains valuable materials that can be recycled. Take the device to a suitable collection point.
- Please return defective or replaced modules to Elveflow for analysis.Please contact us in advance.

Conformity / standards

CE

We declare that this product conforms to CE standards.

FCC

We declare that this product conforms to FCC standards.
This device complies with Part 15 and Part 18 of the FCC rules.

Product standards

The device satisfies the following requirements and standards:

EMC	EN 55011:2018 + A1:2017 Group 2 Class A
	EN 61000-6-2:2019
	EN 61000-3-2:2019
	EN 61000-3-3:2014
LVD	EN 61010-1:2011
RoHS	EN 50581:2013-02
Protection grade IP20	EN 60529:2014-09
FCC	Part 15 and Part 18

Licenses

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