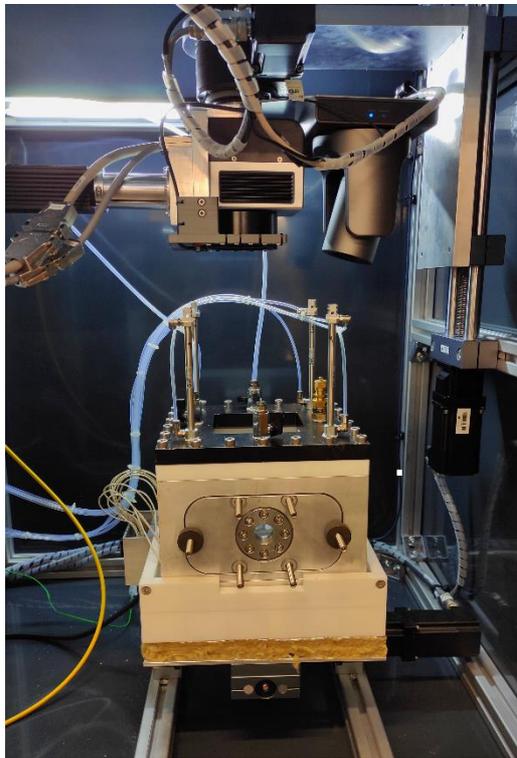


# PIXEL VOLTAIC

SPIN<sup>o</sup>FF FEUP

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## Laserbox



## Pixel Voltaic, Lda

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## Principal Features:

- Laser-assisted hermetic encapsulation of solar cells
- Sealing below 65 °C under inert or dry atmosphere
- Proprietary user interface to control the machine

## Concept and Design

Laser-Assisted Glass Sealing is a novel patented method for hermetic encapsulation of solar cells. Developed in the Faculty Engineering of University of Porto, this method can be efficiently used to encapsulate Perovskite Solar Cells and Dye-Sensitized Solar Cells in-between two glass substrates, protecting the devices from leakage and harm from moisture or air. The hermeticity complies with the Mil-Std-883H and was proven to be more durable than the use of polymeric sealants as Surlyn or Epoxy resins.

The Laserbox is the first commercial version from Pixel Voltaic to seal circular or square-shape solar cells. The ability of sealing at low temperatures (down to 65 °C) and controlled atmosphere (Window Box) is ideal for Dye-Sensitized Solar Cells and Perovskite Solar Cells. The Laserbox possesses controllable compression to hold the two substrates and allows precise power adjustments. High resolution PTZ Camera allows precise initial alignment and to record sealing videos.

## Standard Specifications:

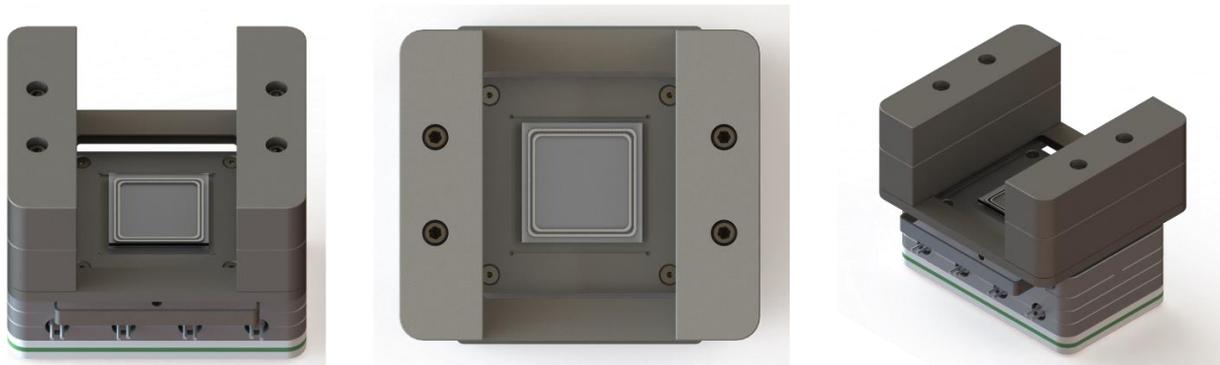
Machine Dimensions	2000 mm x 1000 mm x 2000 mm
Max. Working Area (Device Size):	300 mm x 300 mm
Operating Temperature:	65 - 200 °C
Laser Source:	CW Nd:YAG. Power: 100W
Optional Characteristics:	
Controllable Sealing Atmosphere	YES (Dry Air, Nitrogen, Argon, etc.)
Camera	High resolution camera with optical zoom

Double Head sealing	To allow sealing at 65 °C
Semi-automatic alignment	
Software SAMLigth/Waverunner	
Axis	Motorized axis to align the patterns and to seal big patterns
Power Consumption	5000 W

## Principal systems and software:

### ➤ Hot plate and sample holder

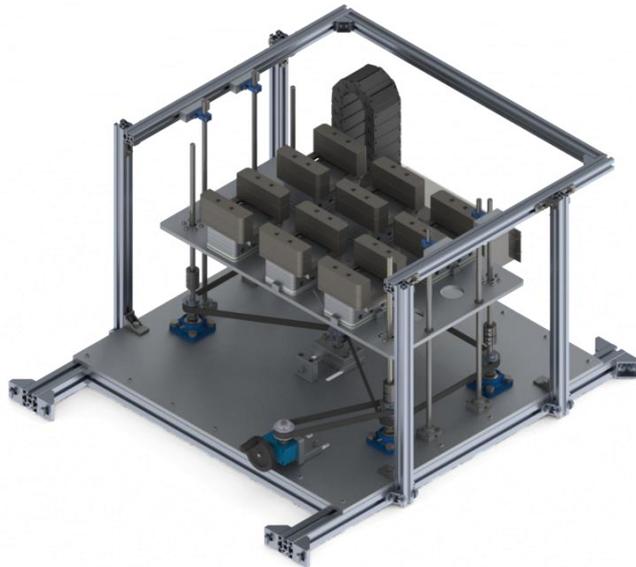
The new sample holder and hot plate were redesigned to improve the number of samples that the machine can seal at the same time. The hot plate has a temperature controller to pre-heat the devices. Additionally, there is a sample holder where the samples are placed and that can be easily adapted for different quantities and sizes. The sample holder allows the cooling to be done outside the sealing area to increase the output of sealed samples. Each sample will have its own force system to allow the cooling to be done under compression and prevent mechanical damages on the devices. Each hot plate will have their own insulation system to deliver a better temperature distribution and minimizing heat losses.



### ➤ Vertical system

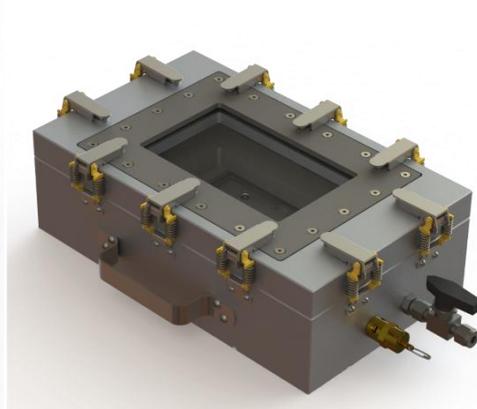
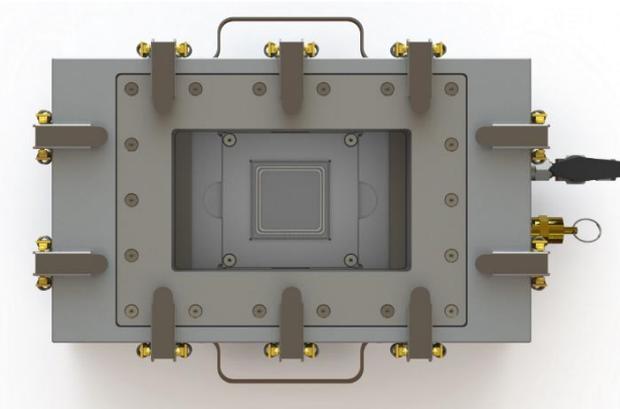
The machine will have a manual vertical system to change the focal point of the laser beam. The system to be regulated to reach the optimal focal point. It will include a graduated ruler with distance from the sample to the f- theta lens. The movement will be done with a calibrated rotary handle. To improve the system precision was added a worm-screw gearbox into the transmission.

The vertical system will have six hot plates to allow sealing six samples at the same time. These hot plates can be moved to a different configuration to allow the sealing of larger devices or to fit a Window Box to encapsulate under controlled atmosphere. All systems were designed to be user friendly and flexible in terms of configuration.



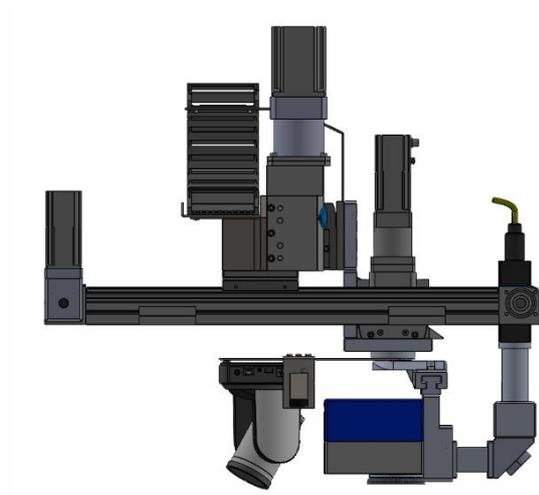
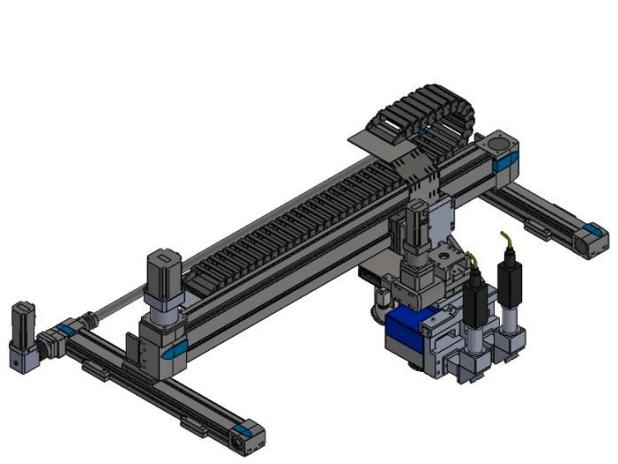
### ➤ Window Box

To prevent contact with oxygen and moisture or electrolyte leakage the Window Box was designed to allow sealing under controlled atmosphere. It can fit inside a normal glove box to protect the device from their fabrication till their hermetic sealing. On the top, a quartz mirror allows the laser to seal samples with constant and controllable beam diffraction. The Window Box is designed to be positioned on top of the hot plates to heat up the sample. It is equipped with spring clamps to be easy to open and close. It is also equipped with a gas inlet and a safety valve to avoid dangerous pressure build-up.



## ➤ Movement system

To align the galvanometric system with the glass frit, the machine is equipped with a cartesian robot. Attached to the cartesian robot is a rotation axis to allow the alignment of square samples. The scan head and the collimator are assembled on the axis using machined parts. The collimator is placed in vertical position to make the machine more compact. To align the samples, the machine incorporates a video camera with optical zoom and vision sensor. All axes will be motorized with CNC control. The main objective of the CNC is to use the robot to seal large-area devices (up to 300 mm x 300 mm).



## ➤ User Interface

The Laserbox is fully controlled on a normal computer using our customized interface.

