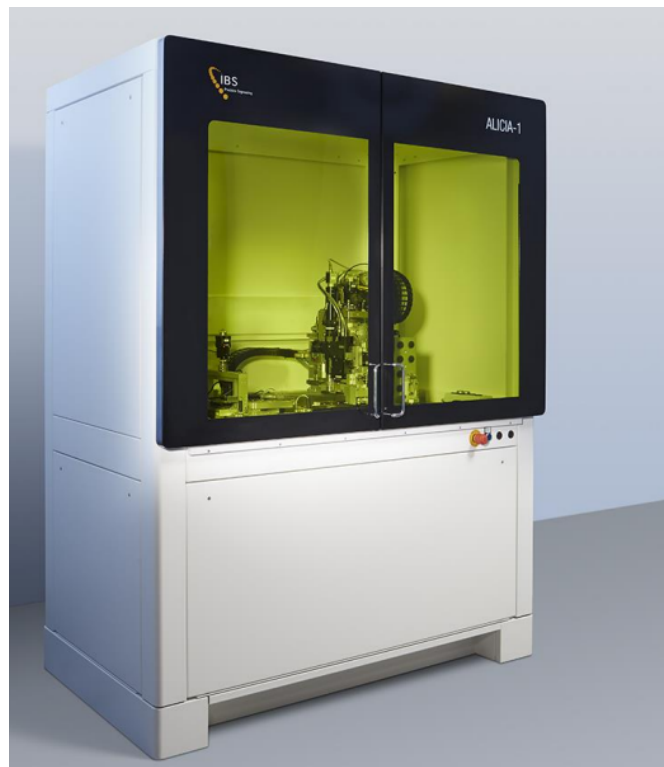


Technical Specification

ALICIA machine



1. Subject of the procedure

The purpose of the procedure is the sale for consideration, and in the state of preservation in which it is located, of the movable asset ALICE Integrated Circuit Inspection and Assembly machine no longer functional owned by the Bari Section of INFN.

The above asset is offered for sale in a single lot, in the state of fact and law in which it is currently located, with the impossibility of asserting any defect or vice that may be found by the successful bidder, subsequent to the award or withdrawal of the asset. The successful bidder will not be able to raise any exceptions in this regard, since the asset is being sold on a "seen and liked" basis, and therefore it will be the responsibility of the purchaser to bear any charges related to the possession and use of the asset in accordance with current regulations (any testing, retrofitting, etc.). Therefore, the transferring Administration is not responsible for the state of maintenance, use and operation of the asset and is exonerated from any warranty arising from art. 1490 e.e. Consequently, no claims or disputes may be made before and/or after the award.

All charges related to the transfer, such as also disassembly and packing activities, as well as all operations and costs, whether or not provided for in these Technical Specifications, shall be borne by the purchaser.

2. Person in charge of the proceedings

The person in charge of the procedure is Eng. Cosimo Pastore (Tel. +393204877938 e-mail cosimo.pastore@ba.infn.it - PEC cosimo.pastore@pec.infn.it).

3. Bidding base amount

The auction base amount is €86,000.00, of which interference charges are zero, plus taxes due according to current regulations in the purchasing state.

4. Criterion and method of award

The sale for consideration will be carried out after consultation with the economic operators who send in appropriate expressions of interest in this procedure, to be awarded by secret bid at the highest percentage increase over the base auction price in accordance with Article 73 letter c) and Article 76 of Royal Decree No. 827 of May 23, 1924, as amended and supplemented, with an increase that cannot be less than 1% of the base auction price.

5. Inspection

The property described in these specifications can be viewed up to the last day before the deadline for submission of the bid, following a request forwarded by email to the Single Project Manager, who will authorize the visit, according to the modalities and times required by the activities carried out at the Bari Section of the INFN.

6. Location of the asset

The asset is stored at the INFN Bari Section, Via Orabona No. 4, 70125 BARI, where it is to be picked up by the successful bidder.

It should be noted that the acquisition of the asset, provides, by the successful bidder, the work of disassembly, removal, loading and transport of the asset placed at the Bari Section of the INFN, once all the formalities required for the completion of the sale have been completed.

7. Duration of the work and deadlines for the transfer of movable property

The dismantling and removal of the asset shall be completed within 30 days from the date of signing the contract. The date of commencement of work shall be fixed in agreement with the RUP.

8. Security compliances

It should be noted that all asset disassembly and removal activities must be agreed in advance in terms of methods and timing with the RUP, in absolute compliance with the sector safety conditions and regulations and in compliance with the prescriptions and constraints in place at the facility where the asset is located. All documentation regarding safety compliance in accordance with T.U. 81/10 as amended and supplemented must be produced and delivered to the RUP.

9. Staff

The personnel employed in the performance of the disassembly work and in the relocation operations must be professionally qualified and in possession of the requirements necessary to carry out the above activities.

The Bari Section of the INFN reserves the right to request the exclusion, at any time, of company personnel who, in its sole discretion, are not suitable for carrying out the above operations.

10. Liability insurance

The company that will carry out the disassembly works and the transfer operations of the asset subject to the transfer procedure, must take out or prove that it has a policy against civil liability risks that expressly provides for insurance for direct and indirect damages resulting from the execution of the aforementioned activities, with a single limit of not less than € 500,000.00, valid for the entire duration of the contract.

11. Warranty accompanying the bid

The bid shall be accompanied by a guarantee, amounting to 2 percent of the base price indicated in the notice, in the form of a bond or surety bond, at the bidder's choice, intended to cover the failure to sign the purchase and sale contract due to the actions of the successful bidder.

The surety bond must expressly provide for the waiver of the benefit of prior enforcement of the principal debtor; the waiver of the exception referred to in Article 1957, paragraph 2, of the Civil Code, as well as the operability of the guarantee itself within 15 days, upon simple written request by INFN.

The guarantee covers charges for non-performance or inexact performance.

The company undertakes to keep the guarantee valid and effective for the duration of the contract and to reinstate it if INFN has made use of it, within 10 days of the request. In case of failure to reinstate, the contract shall be considered terminated, subject to compensation for damages. The guarantee must be valid for at least 180 days from the date of submission of the bid. Interested parties must produce as an attachment to the bid, under penalty of exclusion, the document proving

the establishment of the guarantee (in original or copy). Subsequent to the auction, unsuccessful or unsuccessful bidders will be issued a declaration of release of the guarantee or the deposited security will be returned.

12. Jurisdiction

Any dispute that may arise between the Contracting Authority and the Contractor regarding the interpretation, execution, validity or effectiveness of the contract will be referred to the judicial authority, Foro di Roma.

13. Data Processing

Pursuant to EU Regulation 2016/679 and Legislative Decree No. 196 of June 30, 2003, and ss.mm.ii, this information describes how the personal data conferred by individuals interested in participating in a procedure announced by INFN will be processed.

The data controller of the data conferred by participants is Istituto Nazionale di Fisica Nucleare (INFN) Via E. Fermi n. 40, Frascati (Rome), e- mail: presidenza@presid.infn.it; PEC: amm.ne.centrale@pec.infn.it.

The data protection officer can be reached at the e-mail address <mailto:dpo@infn.it>

14. Invoicing and payment

Payment will be made by the Company within 30 days of the issuance of the invoice by the INFN Administration, by bank transfer to the following "dedicated" current account:

Current account with: Single Treasury Bank of Italy

IBAN: IT 66 B 01000 03245 348300165771

15. System description

ALICIA is the acronym of **ALICE** Integrated Circuit Inspection and **Assembly** machine which allows large surface silicon dies pick and placement, with an accuracy of $\pm 5 \mu\text{m}$ at 3σ with respect to external reference features.

The ALICIA is used for placing selected chips of 15 mm x 30 mm (100 μm thickness) from the Tray (Fig.1) on to the Hybrid Integrated Circuit Assembly Table (HIC-AT) (Fig.2) with the required accuracy.

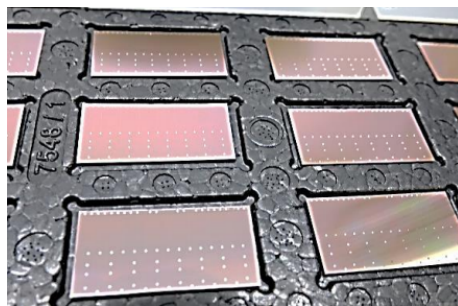


Fig. 1 Chips in tray which will be mounted on an FPC



Fig.2 View of central area of the machine, HIC assembly table and chips tray

15.1 Machine functionality

The machine relies on the metrology capability provided by a high-resolution vision system which measures the position of each chip with respect to reference fiducials. Based on this feedback, the chip can be manipulated with sub-micron accuracy. The same vision system is also used to check critical dimensions, cleanliness of chip contact pads and edge quality of the chips; chips with incorrect dimensions, cracks at the edges or dirty pads need to be rejected.

Machine Features:

- Placement of silicon chips from tray onto HIC Assembly table with an accuracy of $\pm 5 \mu\text{m}$
- Validation of chip placement using fiducial measurements
- Check chip edge integrity, chip dimensions and pad contamination.

16 System layout

The ALICIA is designed for high precision positioning of chips. To measure the chips position, a high resolution vision system is used. The vision system measures the position of markers on the chips and on the two vacuum chucks on which the chips are mounted: 1) A Pre-Position Chuck for testing and initial alignment of chips (Fig.3) and 2) the HIC Assembly Table for final assembly of the Hybrid Integrated Circuits (HICs). To manipulate the chips, a vacuum gripper is installed. Optionally, a laser system is available for connecting the chips to the FPC. The vision system, the gripper and the laser system are mounted on a three axes high precision movement frame: the Chip Handler.

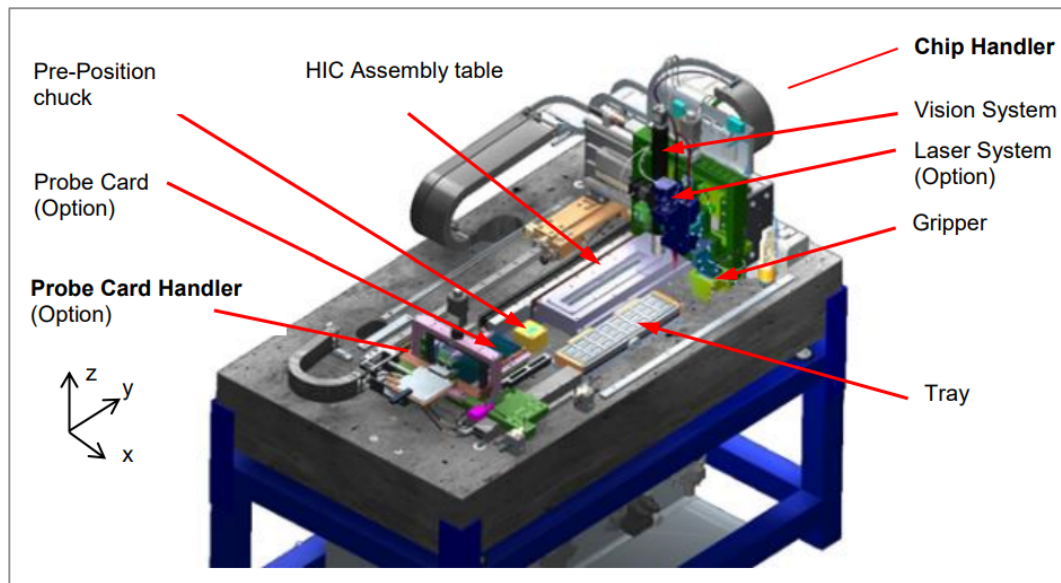


Fig. 3 System Overview: Sub-assemblies

A set of chips is inserted into the machine on a Tray. Using the gripper, chips are taken out of the tray and placed on the Pre-Position Chuck (PPC). Here, the chip orientation is measured and the chip quality is inspected by the vision system. When applicable, the chips electronics can be tested by means of the optional Probe Card Handler (PCH).

Next, using the gripper, chips of sufficient quality are placed on the HIC assembly table. Low quality chips are rejected and placed back into the tray.

16.1 Motion system overview and Coordinate system

The high precision movement frame contains two horizontal axes X1 and Y1 (Fig.4) and a vertical axis Z1. The X1 and Y1 axes are driven by linear motors. The Z1 position is controlled by a spindle motor. Moreover, chips can be rotated about the vertical axis (Rz), by a rotary actuator in the vacuum gripper assembly.

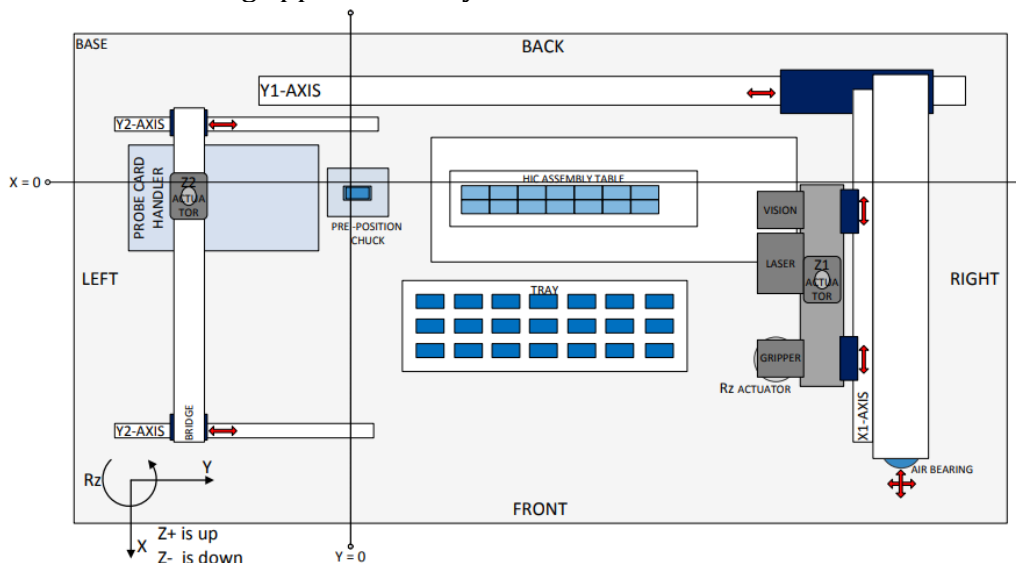


Fig. 4 Schematic overview of machine main components and coordinates

16.1.1 Chip positioning accuracy

Table 2.1: Main accuracy requirements chip positioning

NR	Specification	Value	Remark
1	Chip positioning accuracy (XY)	$\pm 5 \mu\text{m}$ (3σ)	With respect to external markers <i>A</i> and <i>B</i> , see section 2.5.3

The external markers are reference markers on the HIC assembly table, locally next to each chip.

16.1.2 Chip dimension measurements

Table 2.2: Main accuracy requirements chip dimension and defect detection

NR	Specification	Value	Remark
1	Chip dimension measurements	$\pm 5 \mu\text{m}$ (3σ)	The distances from <i>Edges to Marker</i> are measured on all four corners. The total chip dimension is calculated by adding the distance between the markers (known from lithography process)

16.1.3 Chip defect detection

Detection of defects is limited to the image processing functionality provided by the Labview IMAQ toolbox.

Table 2.3: Main accuracy requirements chip defect detection

NR	Specification	Criterion	Action	Remark	Ref
1	Defects on Edge/Corner	$\leq 10 \mu\text{m}$	OK and accept	For the inspection of edge of chips, there is a lower limit to the detection of defects due to: <ul style="list-style-type: none"> Resolution of vision system Edge contrast quality (black boxes, black frayed edge) 	[2.03], [12]
		$> 10 \mu\text{m} \ \& \ < 20 \mu\text{m}$	OR, operator decision		
		$> 20 \mu\text{m}$	NOK and reject		
5	Contact pad inspection: % surface cleanliness	$\geq 90\%$	OK and accept	Detect dust, any other pollution and cracks in the gold layer on chip contact pads	[2.03], [13]
		$< 90\% \ \& \ > 80\%$	OR, operator decision		
		$< 80\%$	NOK and reject		

Note that the limits are operator configurable settings, found in the configuration parameters.

16.3 Overview of main components

Sub assembly/ main component	Acronym	Description	
Pre-Position Chuck	PPC	An intermediate position between the tray and the HIC-assembly table where the chip is clamped by vacuum	•
HIC Assembly Table	HIC-AT	A board with a vacuum surface to clamp the chips	•
Chip Handler		A sub assembly with a Vision system, a Laser system (optional) and a Gripper. The Chip Handler is moved by a motorized system of an X guide and a Y guide.	•
Vision system		A 2D position sensor (vision system) to acquire position data of the markers on the chips and reference markers on the HIC assembly table	•
Laser		A laser system for soldering the FPC to the chips using soldering balls. The laser system has its own camera.	Optional
Gripper		A gripper based on a vacuum pad for chip handling. The gripper can be moved in Z-direction and can be rotation about the Z-axis (Rz) by means of actuators.	•

16.4 Overview of Sub-assemblies

16.4.1 Chip handler

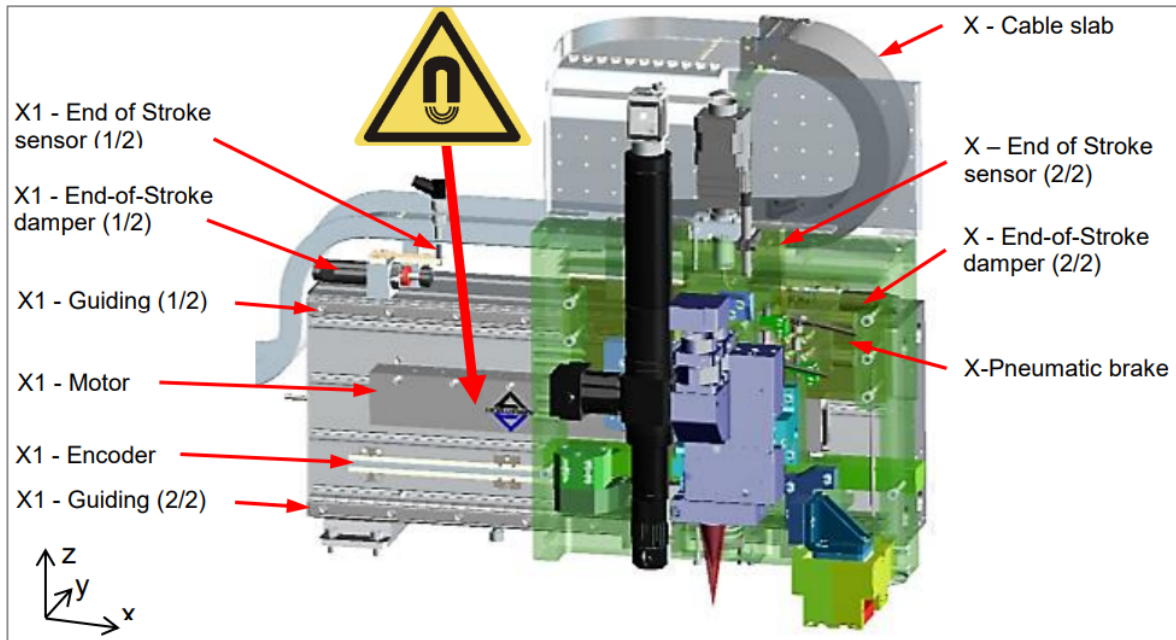


Fig.5 Overview of Chip Handler components. Frame of Z stage is set transparent

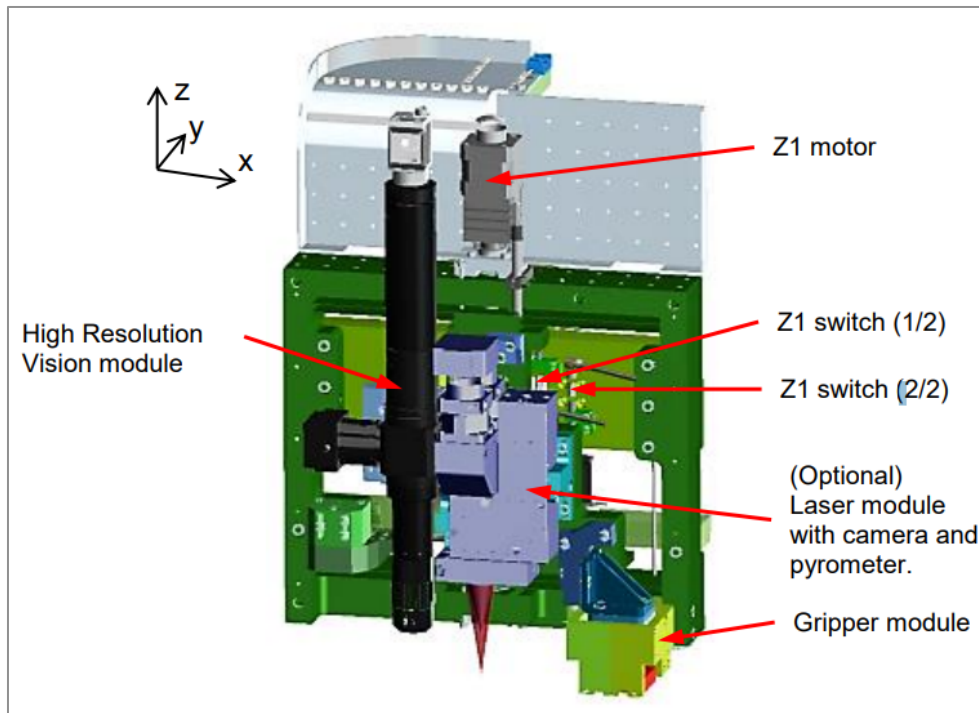


Fig.6 Z-stage of Chip Handler

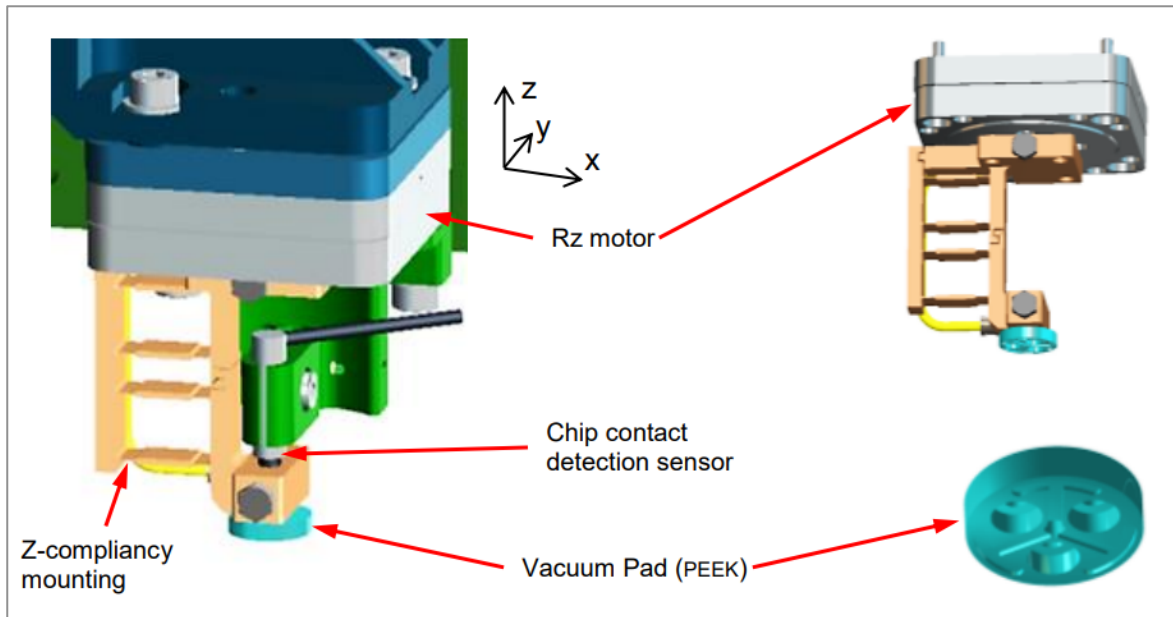


Fig.7 Gripper module

Components for displacing the Chip Handler in Y direction:

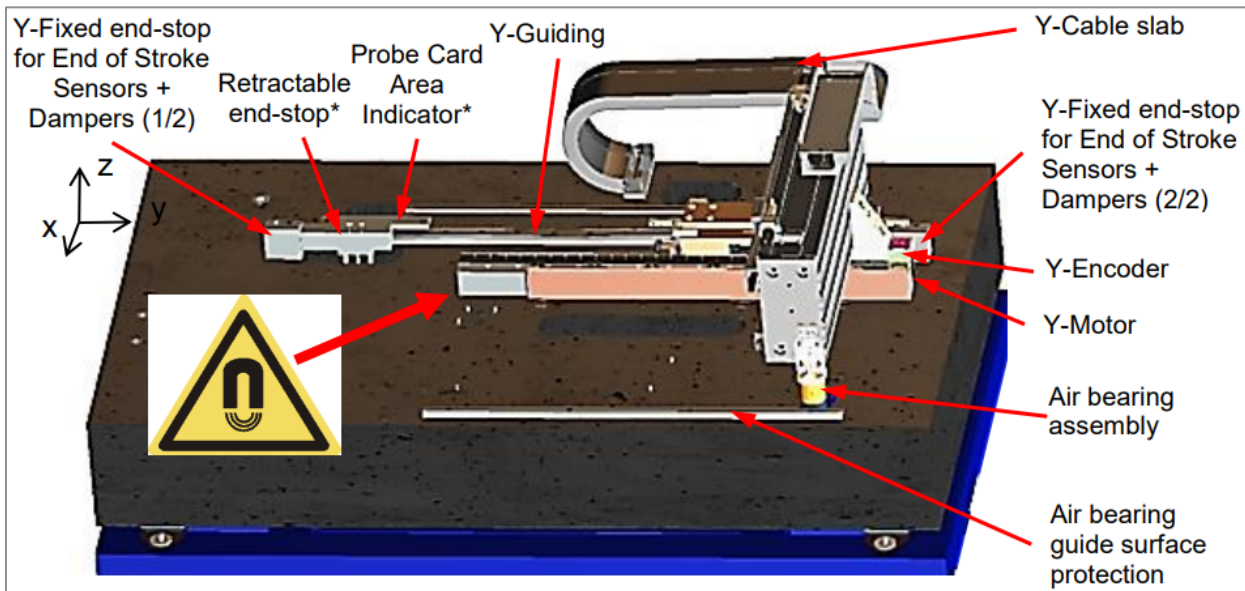


Fig.8 Overview of Y stage components. *The Retractable End-Stop and Probe Card Area indication are only present in machines with Probe Card Handler.

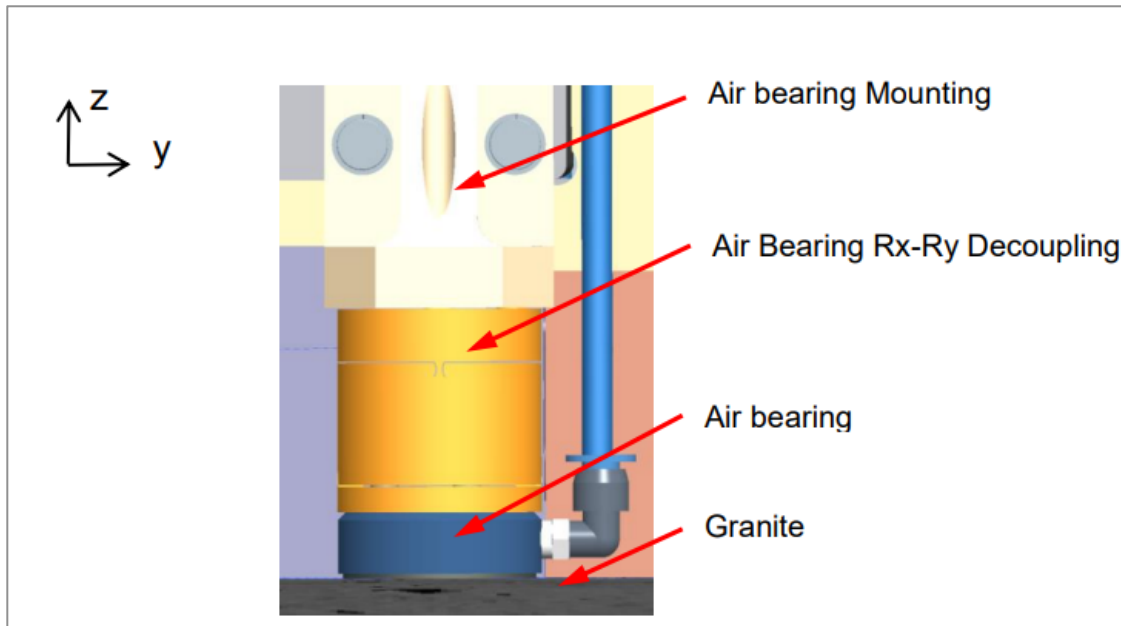


Fig.9 Sideview of Rx-Ry decoupling on the Air Bearing.

16.5 Overview of Peripherals

16.5.1 Ionizer

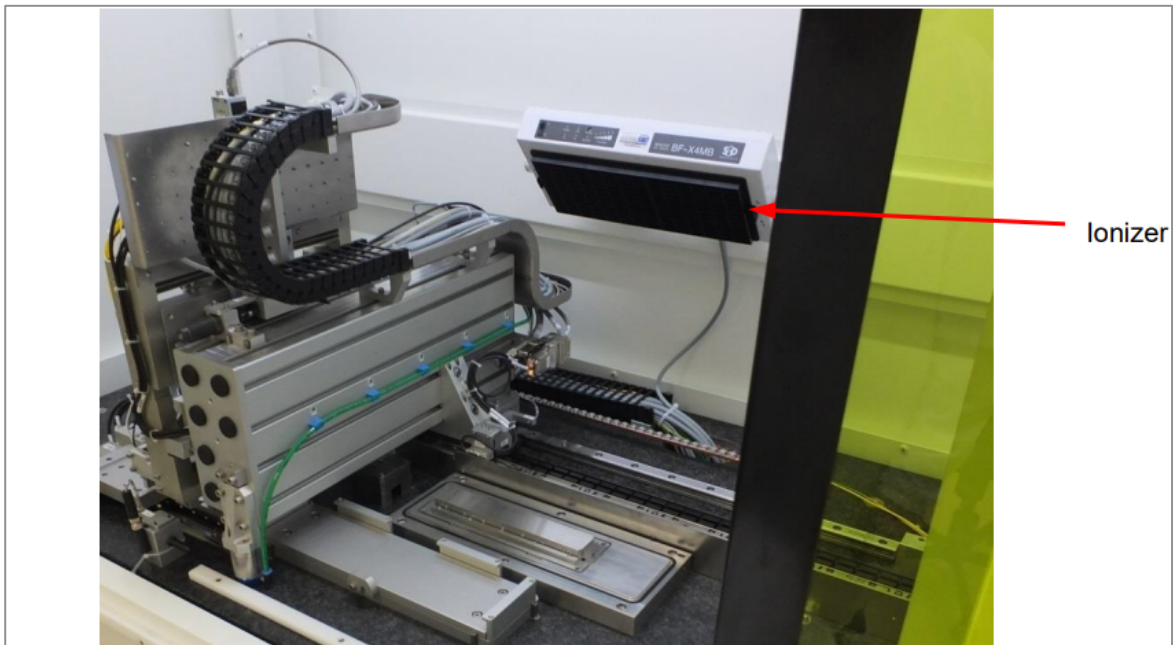


Fig.10 View inside the machine, showing the ionizer

An ionizer is mounted to the backside of the machine, for reducing static charge on components in the machine. On/off switch is located on the ionizer itself.

16.5.2 Vacuum / N2 Patch panel

On the outside of the machine, on the right hand side, a Vacuum / Nitrogen (N2) patch panel is provided (Fig. 11). The user of the machine may plug in its own equipment requiring vacuum or N2. The patch panel either supplies vacuum or supplies N2, dependent on the selection made by the user. To select N2 or Vacuum on the patch panel, the buttons on the control panel inside the machine must be used, see Figure 12.

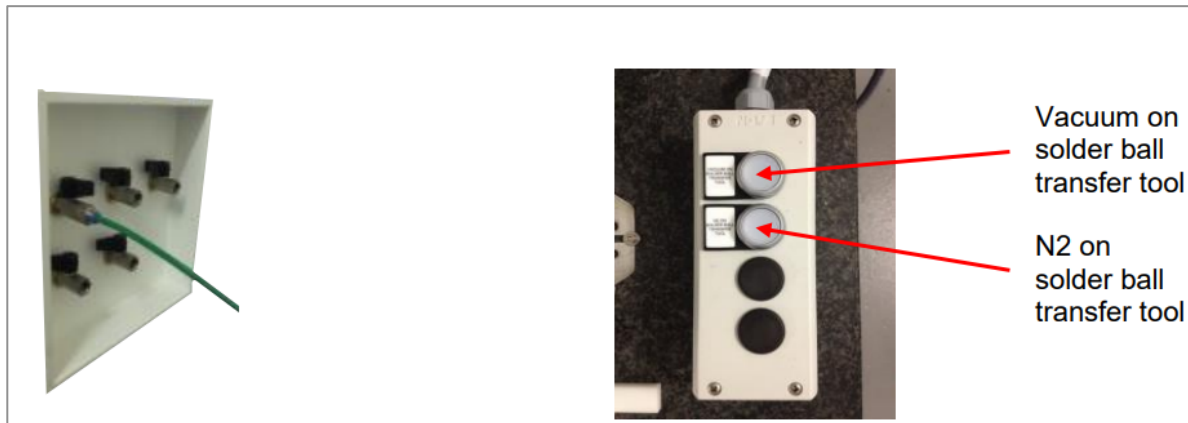


Fig. 11 Patch panel for Vacuum / N2

Fig. 12 Control panel inside the machine

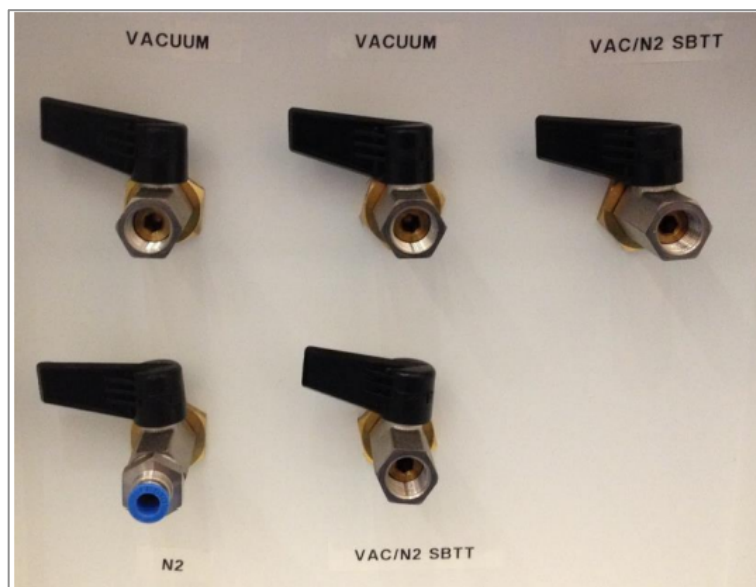


Fig.13 Connections on patch panel

The N2 connection on the patch panel is connected to the N2 input with the restriction similar as to be used for the SBTT (Fig. 13). This can be used at any moment. The vacuum connections first have to be enabled in the vacuum screen

16.6 Description of Pneumatic system

The pneumatic system provides pressurized air to the air bearing, to the X-pneumatic brake and the Y-pneumatic brake of the Chip Handler, to the Retractable End-Stop and optionally to the Ionizer. See Figure 14 for a Functional Overview of the pneumatic system.

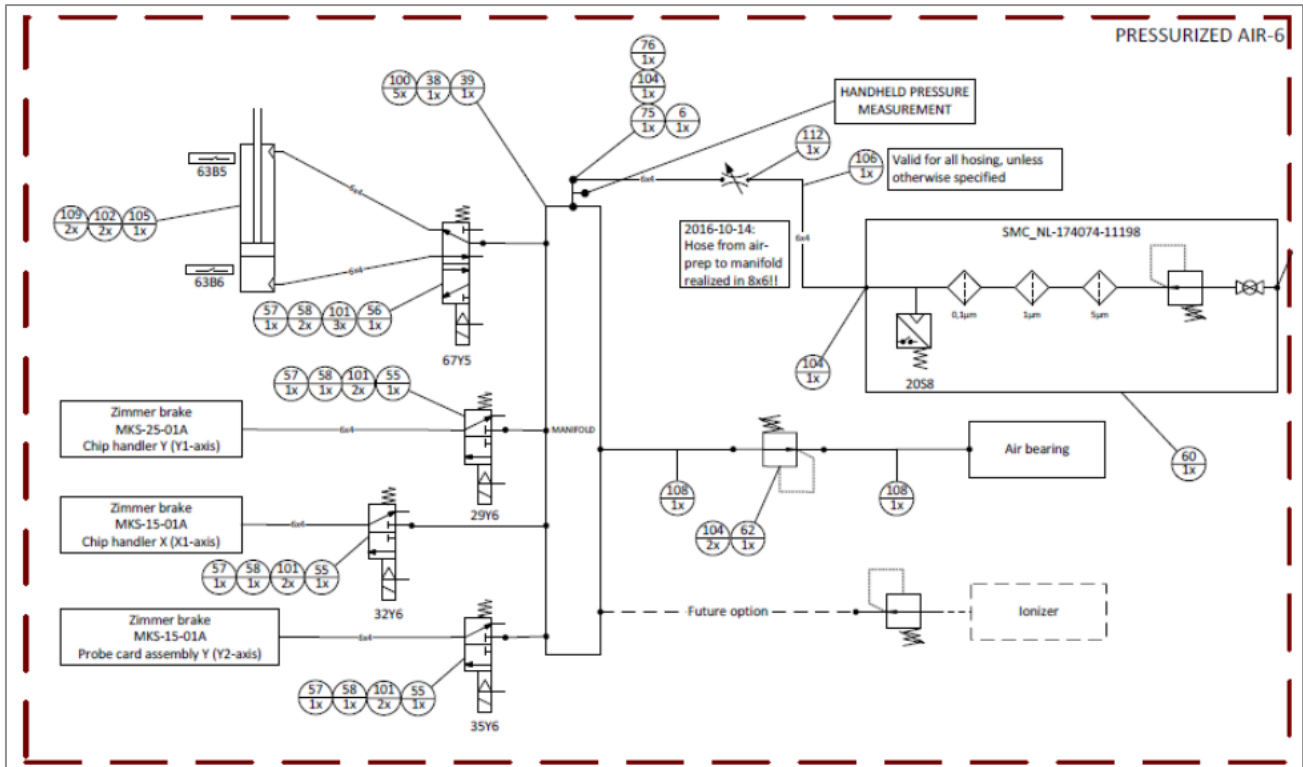


Fig.14 Functional Overview Pneumatic system

1. Via a manifold the pressurized air is distributed towards:
 - a. A pneumatically actuated 3/2 valve acting on the cylinder of the Retractable EndStop
 - b. A pneumatically actuated 2/2 valve acting on the brake for the Y-axis of the Chip Handler
 - c. A pneumatically actuated 2/2 valve acting on the brake for the X-axis of the Chip Handler
 - d. A pneumatically actuated 2/2 valve acting on the brake for the Y-axis of the Probe card Handler
 - e. The air bearing of the chip handler via a pressure regulator.

16.7 Description of Vacuum & N2 system

On the Vacuum Panel the vacuum & N2 system is mounted. The vacuum towards the panel is generated by a dry roots pump (Pfeiffer ACP15, 14 m³ /hr) In Figure 15 the vacuum panel is given. Yellow tubing is used for vacuum lines, green tubing for N2 (nitrogen) lines.

The vacuum system is needed for:

- Chip clamping on gripper, PPC and HIC-assembly tables (OB-, IB- and MFT)
- FPC clamping on IB-HIC-assembly table
- Vacuum towards the Vacuum / N2 Patch panel for tooling

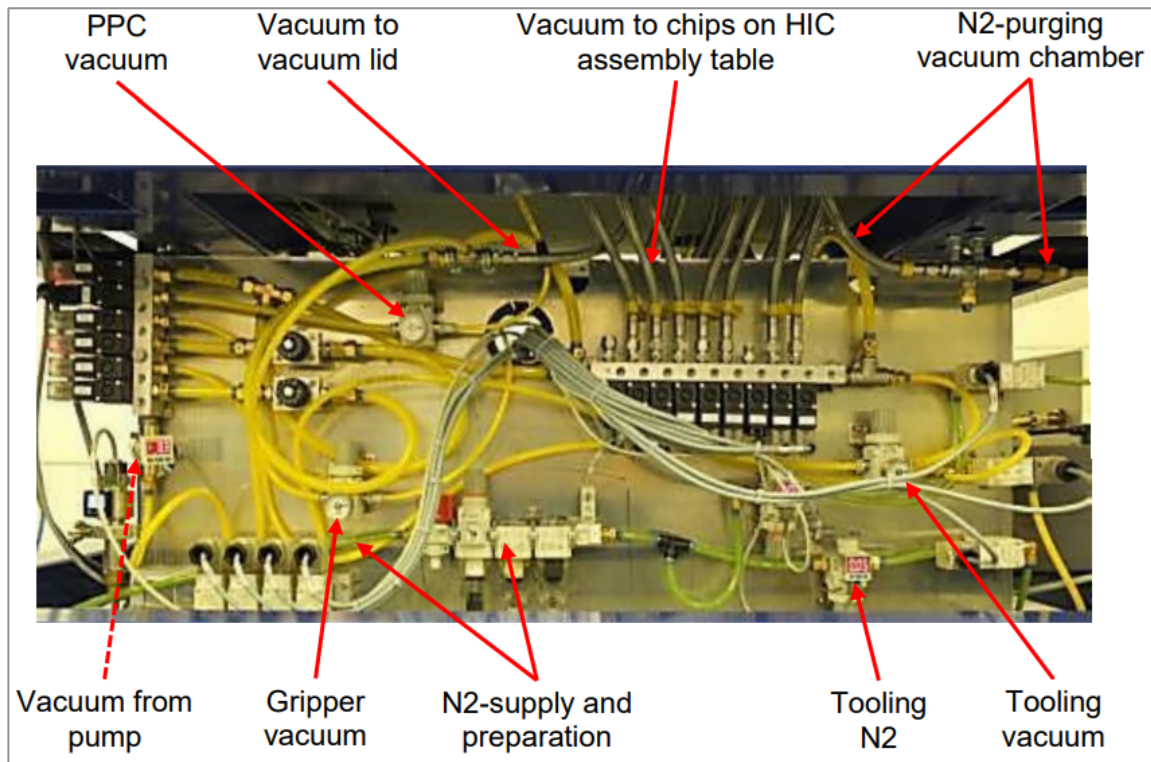


Fig. 15 Overview of the front side of the vacuum panel

The vacuum & N2 supply system can be divided into five sections, which are interconnected:

Table 2.4 Vacuum and N2 supply system

Vacuum & N2 supply system section
1. Central Vacuum
2. HIC-assembly table, Pre-positioning chuck & gripper
3. Pressure measurement
4. N2-system
5. Vac/N2-supply for tooling on the Patch Panel

16.7.1 Layout of the vacuum system

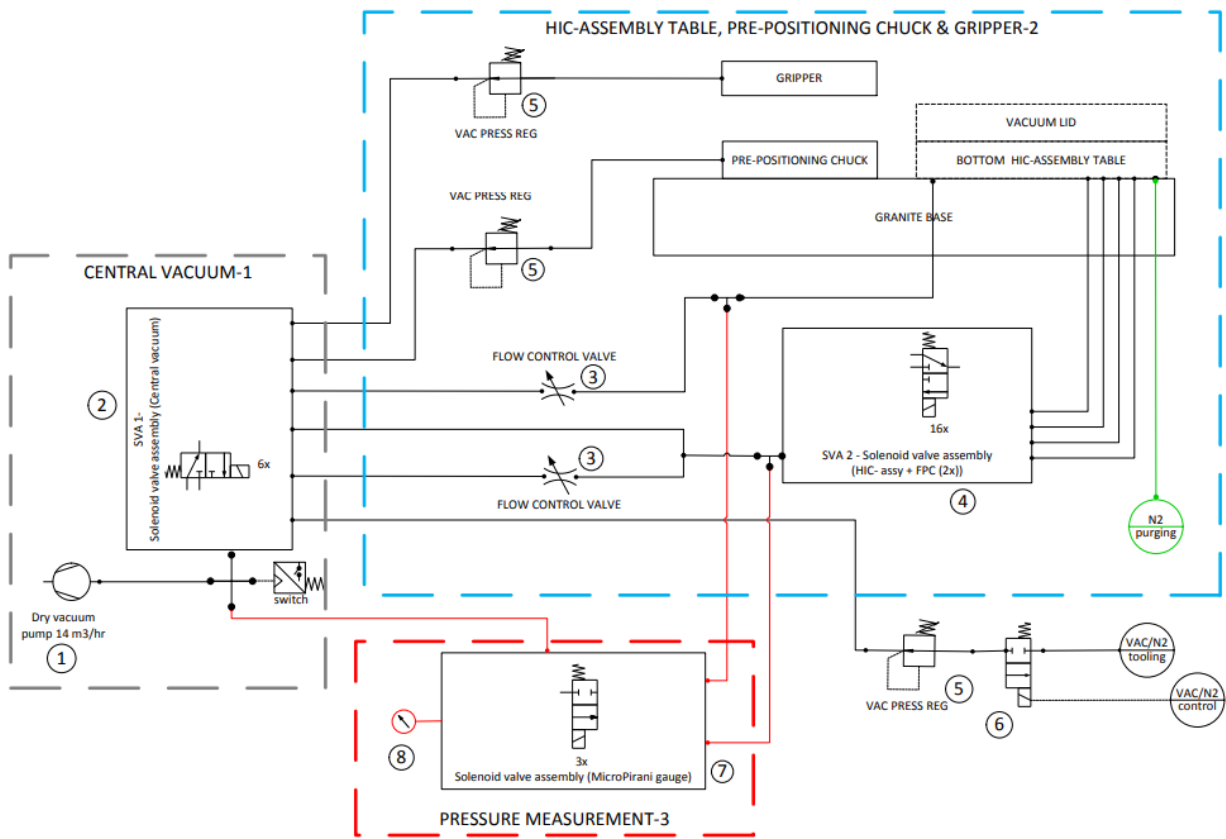


Fig. 16 Functional Overview Vacuum system

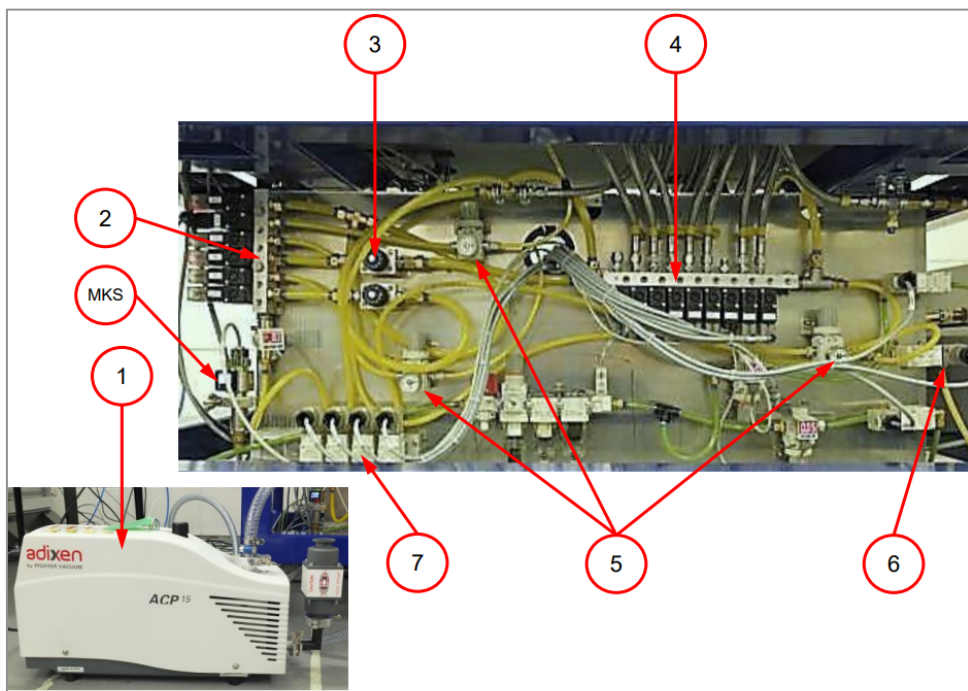


Fig. 17 Overview of realized Vacuum system, Frontside and Pump

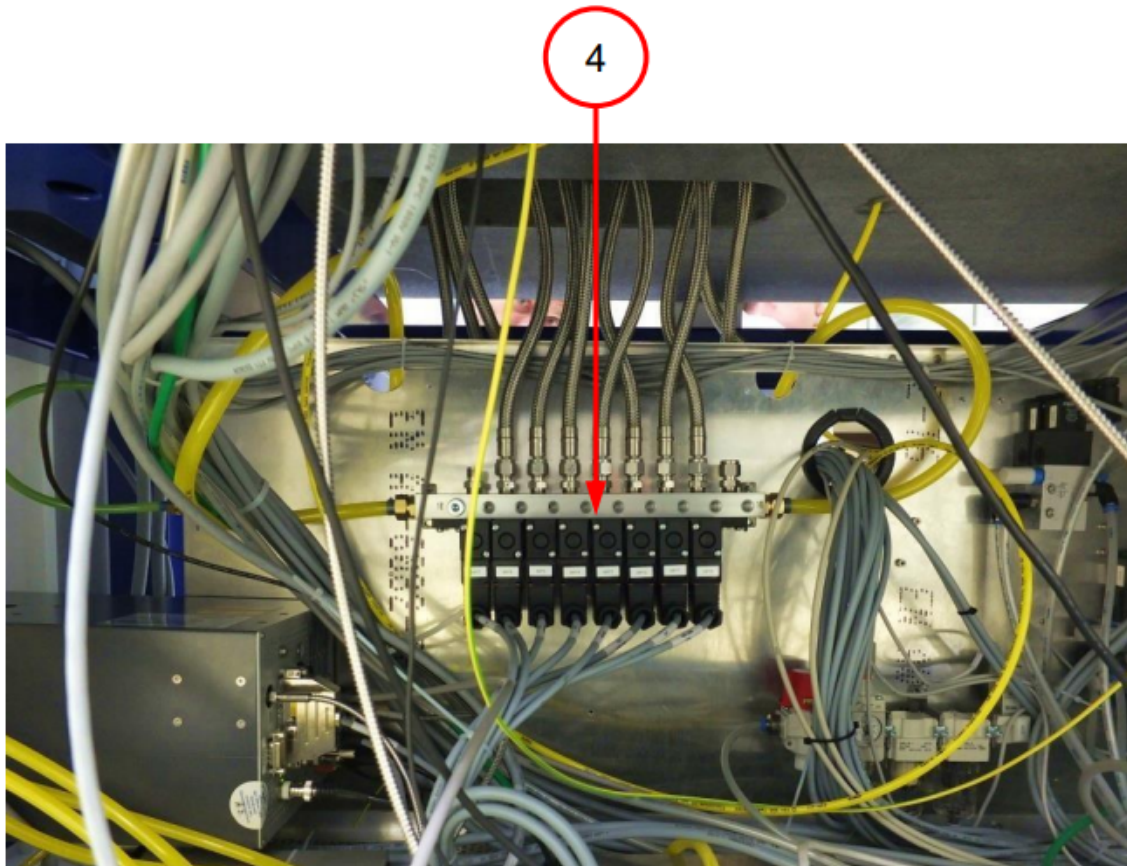


Fig. 18 Overview of realized Vacuum system, Backside

See Figure 16 for a Functional Overview of the vacuum system. Numbers in the photos of Figure 17 and Figure 18 correspond to numbers in Figure 16 and to the numbers in the text below:

A. Central Vacuum

- A vacuum pump 1 with a capacity of 14 m³ /hr and an end-pressure of 0,1 mbar (at 10 m³ /hr pumping speed) generates the vacuum at the entrance of the system
- Together with a solenoid valve assembly 2 (SVA-1) the vacuum pump forms the central vacuum. The SVA-1 has 6 valves for controlling the vacuum towards various functionalities of the system
- A vacuum switch, mounted on SVA-1 is used to detect if the vacuum is present

B. HIC-assembly table, Pre-positioning chuck & gripper

- Two vacuum lines connect SVA-1 with a second solenoid valve assembly 4 (SVA2) that controls 16 valves towards the HIC-assembly tables for chip and FPC vacuum
 - One line with a variable restriction 3 (Flow control valve) is used for chip and FPC clamping in ambient conditions. The Flow control valve can be used to adjust the needed vacuum level
 - Via vacuum pressure regulators 5 handling vacuum is supplied towards prepositioning chuck, gripper and the patch panel for vacuum/N₂ tooling. Vacuum towards the patch

- panel is controlled by the operator via the vacuum system tab in the GUI and pushbuttons on top of the granite acting on solenoid valve 6
- A N2-line towards the HIC-assembly table is present for purging during evacuation of the vacuum chamber

C. Pressure measurement

A solenoid valve assembly 7 enables pressure measurement at three points in the vacuum system. A MKS MicroPirani 925 pressure gauge is used for vacuum pressure measurement.

16.8 Layout of N2-system and Vac/N2-supply for tooling on patch panel

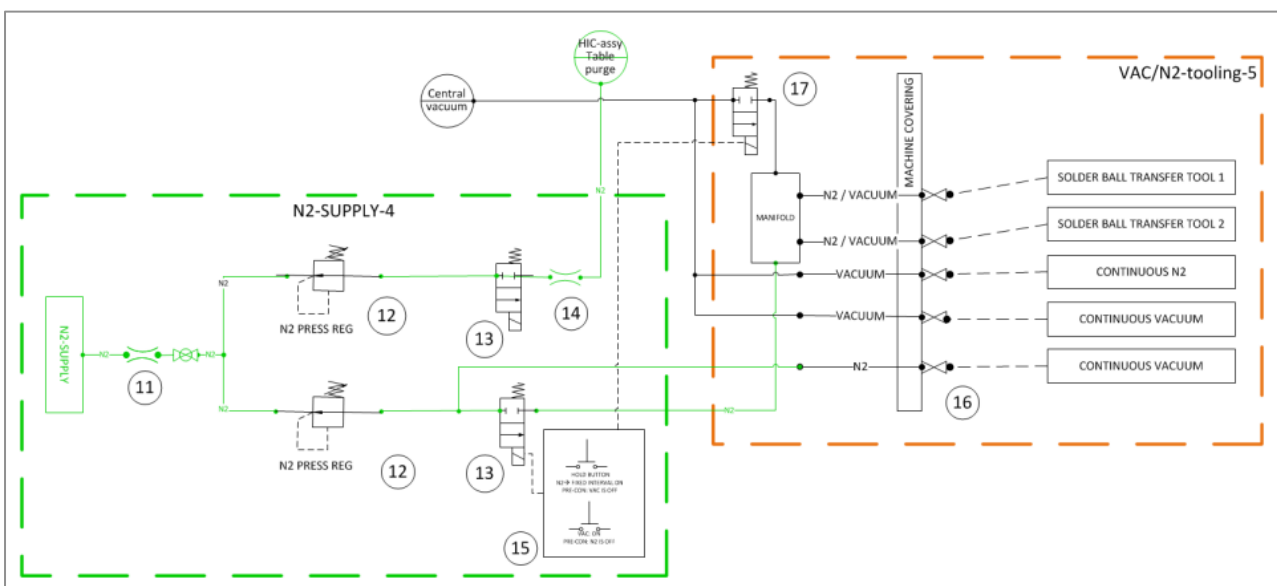


Fig.19 Functional Overview of N2 and Vac/N2 tooling system

D. N2-system

- A fixed restriction (11) of 1500 μm limits the maximum amount of Nitrogen gas (N2) that can enter the machine
- One N2-line enables N2-purging towards the HIC-assembly table. The N2 flow is controlled by means of a pressure regulator (12) and a fixed restriction (14) of 300 μm . A valve (13) controls the N2-supply for purging towards the HIC-assembly table.
- A second line supply N2-directly to a valve on the patch panel
- A third N2-line controls N2-supply towards the manifold for vacuum/N2 manifold for tooling, connected via the patch panel (Fig. 11). It is controlled by the operator via pushbuttons (15) on top of the granite acting on solenoid valve (13)

E. Vac and N2-supply for tooling on the patch panel.

- Via the vacuum system tab valve 52Y4 can be switched to supply continuous vacuum to two lines on the patch panel.

- On the manifold (Fig. 20) both vacuum and N2 are brought together. The pushbuttons (15) enable either vacuum (solenoid valve (17), N2 (solenoid valve (13) or no supply. Vacuum and N2 are excluded from each other
- Manual valves are present on the patch panel (16) for Vacuum/N2-supply towards:
 - 2x Solder Ball Transfer Tool/ Single Ball Transfer Tool
 - 2x continuous vacuum
 - 1x continuous N2

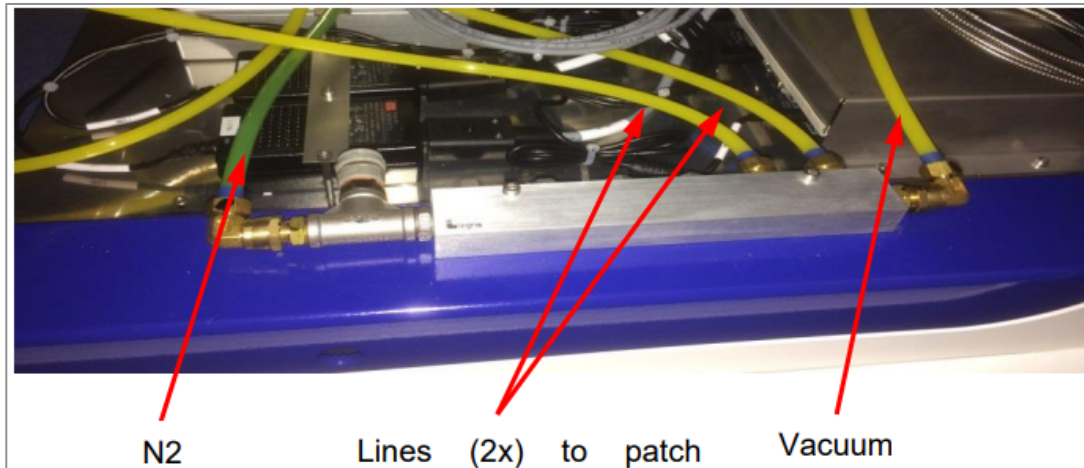


Fig. 20 Manifold for connecting N2 / Vacuum to the Patch Panel

17 Machine Mass

Table 3.1 Machine and covering

NR	Description	Value [kg]
1	Machine base (granite)	620
2	HIC-assembly table	25
3	Base frame	75
4	Chip handler	55
5	Probe card handler	14
6	Cabling	20
7	Other parts on machine base	40
8	Machine covering	285
9	Vacuum & gas system	16
TOT	Mass on machine feet	1150

Table 3.2 Total mass of machine, covering and peripherals

NR	Description	Value [kg]
SUB	Mass on machine feet	1150
1	Vacuum pump	25
2	Electrical cabinet	150
5	Margin	75
TOT	Machine mass	1400

The total mass to be transported is 1400 kg.

17.1 General layout

In Figure 21 the floor plan is shown.

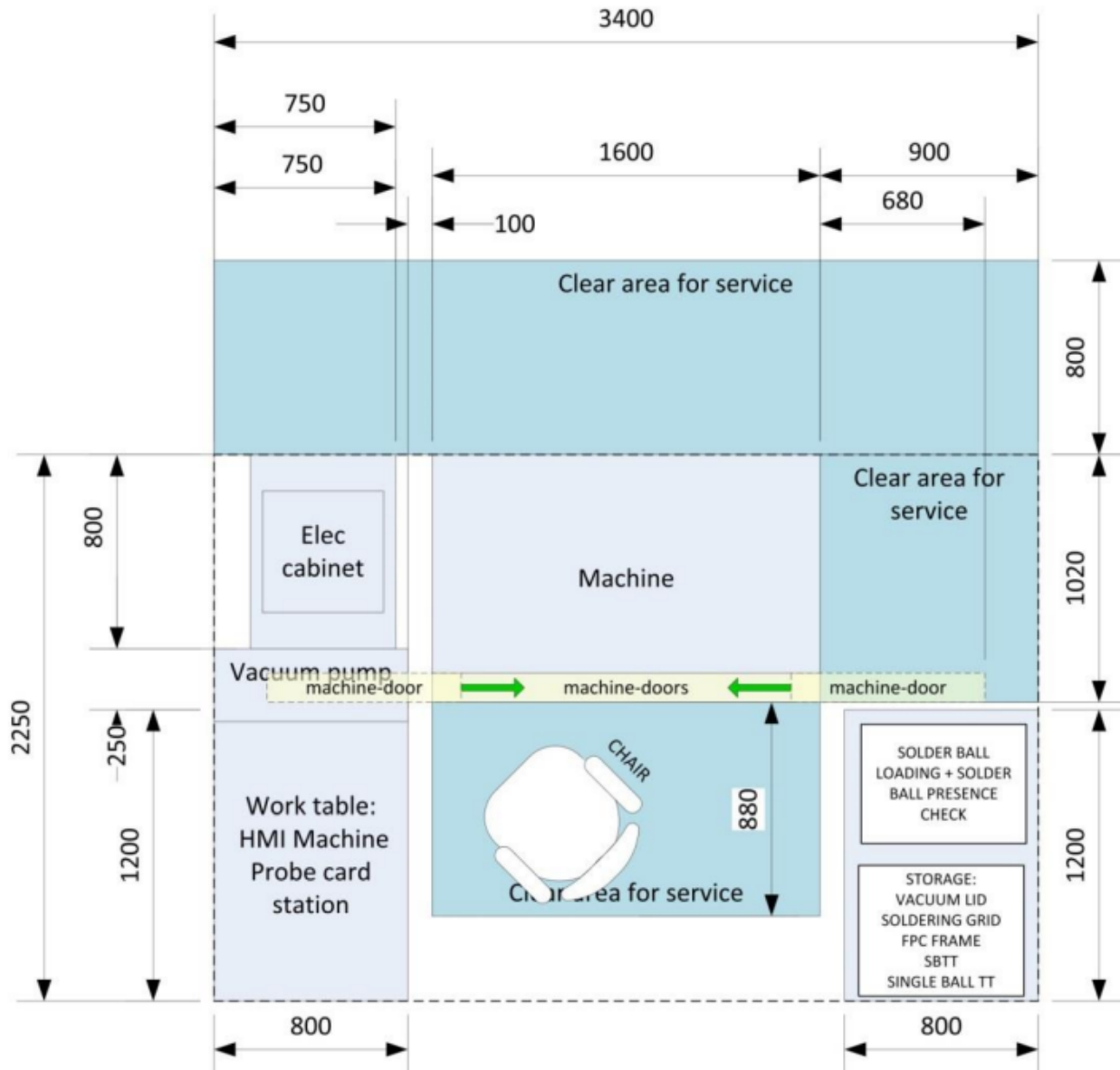


Fig. 21 Suggested floor plan for installation of the machine

17.2 Environment requirements

The system contains a large granite base, sensitive to large temperature changes. In case the temperature has gone outside the temperature range specified as environmental conditions, wait at least 24 hours before using the motion part of the system.

Do not place fluctuating heat spots below or near the granite. This will deform the granite which might cause errors (drift) during measurements.

Do not spill any liquids on the granite.

Table 4.2 Environmental conditions when using the machine:

NR	Description	Value
1	Temperature range	20 ± 2 °C
2	Relative humidity	30-60 %
3	Floor vibration level	compliant with vibration criterion C ¹
4	Heat in (to machine)	Machine should not be placed in vicinity of radiating heat sources
5	Heat out (of machine)	Not Applicable
6	Light out (of fully covered machine)	Class 1 laser system

17.3 Electrical Supply

Table 4.3 Electrical power HIC assembly machine

NR	Description	Value	Unit	Comment
	Electrical power	3P+N+G	-	3 phases +neutral + ground
1	Voltage	400	V	tolerance ±10%
1a	Frequency	50	Hz	±0,1 Hz; TBD
2	Current	16	AC	
3	Connector HIC assembly machine side	male	-	5 pins acc. to IEC 60309;
4	Connector plant side	female	-	5 pin acc. to IEC 60309;

17.4 Network Access

Table 4.4 Remote access connection

NR	Description	Value	Unit	Comment
1	Network access	RJ45 TCP/IP		External access allowed. Availability starting from machine installation

The ALICIA PC must be connected over TCP/IP to the following devices:

Table 4.5 Devices that are connected to the ALICIA PC over TCP/IP

Device	Type, Manufacturer	Connection
External Network	(provided by CERN)	RJ45 TCP/IP
CERN PC	(provided by CERN)	RJ45 TCP/IP
Laser Controller	Lascon, Mergenthaler	RJ45 TCP/IP (optional)
Vision Camera	Basler	RJ45 TCP/IP with POE
Motion Controllers	Ensemble, Aerotech	RJ45 TCP/IP

The High Resolution Camera of the Vision system (Basler) uses Power Over Ethernet (POE). All other devices have their own power source.

The figure below shows the slots on network connections section of the backplane of the ALICIA PC, which is marked with the red square in Figure 22.

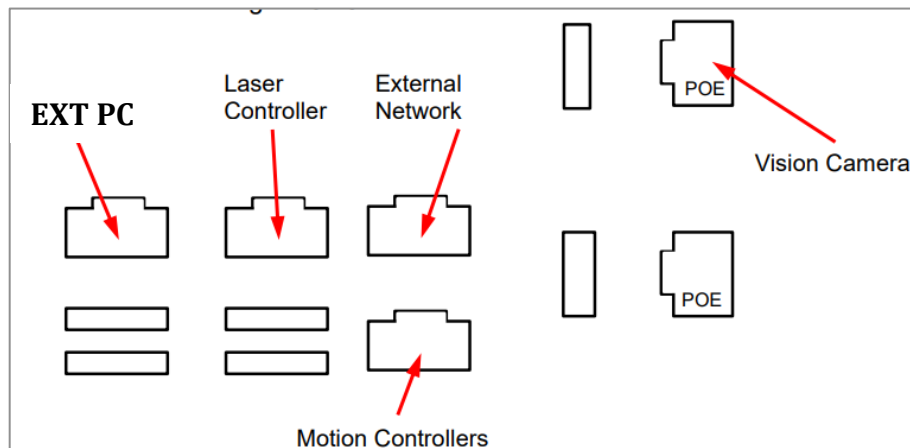




Fig. 22 Schematic view of network connections on the backside of the ALICIA PC

18.1 Type plate



Made in the Netherlands

Esp 201
5633AD, Eindhoven
The Netherlands
Telephone; +31 (0)40-290 1270
Fax; +31 (0)40-290 1279
E-mail; info@ibspe.com
Internet; www.ibspe.com



Machine name	ALICIA-XX
Serial number	22228
Year	2016
Weight	900 kg; electrocabinet 150 kg
Electrical connection / Phases	3~ 400 V
Air supply	6 bar
Vacuum connection	<2 mbara

EC DECLARATION OF CONFORMITY OF THE MACHINERY

Translated declaration according Directive 2006/42/EG Annex II.1.A (hereinafter referred to as Machine Directive).

We (manufacturer):

Business name: IBS Precision Engineering
Address: Esp 201, 5633 AD Eindhoven
Country: Nederland

declare for the machine described below:

Generic denomination: Assembly machine for hybrid integrated circuits
Commercial name: Alicia
Model: Alicia-1
Type: 22228
Serial number: 22228
Function: Alicia is suited for the assembly of hybrid integrated circuits. Chips are positioned precisely, inspected and subsequently soldered using a laser.

that all relevant provisions of the Machine Directive are fulfilled;

that the product also complies with the provisions of the following European Directives:

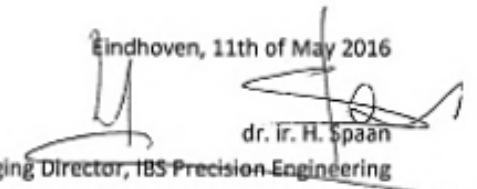
- Directive 2004/108/EG relating to electromagnetic compatibility (EMC directive)

that, where applicable, the following harmonised European standards have been used:

- NEN-EN-ISO 12100:2010 | Safety of machinery – General principles for design – Risk assessment and risk reduction
- NEN-EN-ISO 13849-1:2008 /AC:2009 | Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
- NEN-EN-ISO 13849-2:2012 | Safety of machinery – Safety-related parts of control systems – Part 2: Validation
- NEN-EN-IEC 60204-1:2006 /A1:2009 /AC:2010 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements
- NEN-EN-IEC 60825-1:2014 | Safety of laser products – Part 1: Equipment classification and requirements
- NEN-EN-IEC 61439-1:2011 | Low-voltage switchgear and controlgear assemblies – Part 1: General rules
- NEN-EN-IEC 61439-2:2011 | Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies

and that the following natural or legal person established in the EU is empowered to compile the technical file:

Business name: IBS Precision Engineering
Name and position: dr. ir. H. Spaan, Managing Director
Address: Esp 201, 5633 AD Eindhoven
Country: Nederland

Eindhoven, 11th of May 2016

dr. ir. H. Spaan
Managing Director, IBS Precision Engineering

Person in charge of the procedure

Eng. Cosimo Pastore
