HW-T40-50F

USER MANUAL

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Chapter 1

HW-T4-50F user manual

1.1 Introduction to the HW-T4-50F

The Huawei T4-50F is an 50 feeder / 4 nozzle pick and place machine. It can be operated manually or via pick and place csv files generated by the user's EDA suite of choice.

1.1.1 Hardware overview

- The pick and place arm

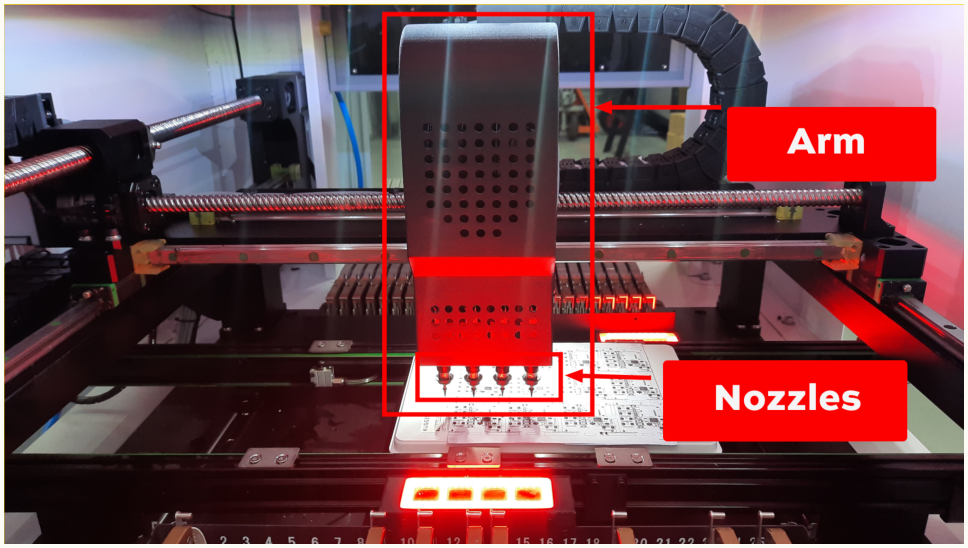


Figure 1.1: HW-T4-50F pick and place arm

The HW-T4-50F's main component is the pick and place arm. It allows movement across the XY plane, and contains 4 placement heads equipped with 4 nozzles.
It is also home to the **Mark Cam**, **Mark Light** and **Mark LED**.

- The cameras

The mark cam is a camera installed on the pick and place arm of the HW-T4-50F, it is most often used for calibration and fiducial mark recognition purposes.

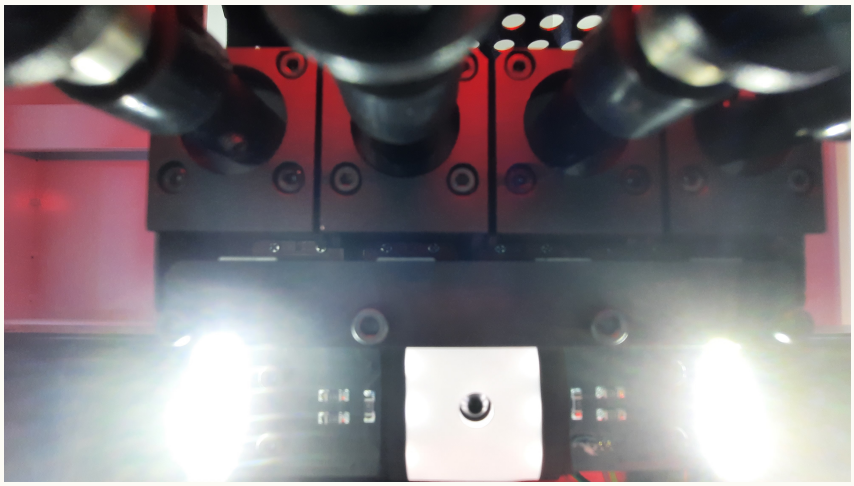


Figure 1.2: Mark Cam

The fast cam is mounted on the HW-T4-50F chassis. It is comprised of four cameras, one for each nozzle.
The fast cam's main role is component visual inspection.

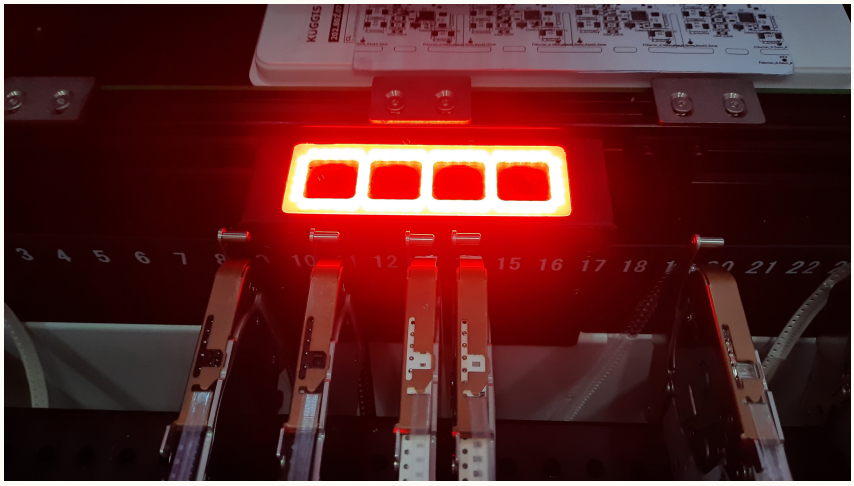


Figure 1.3: Fast Cam

The high cam is mounted on the HW-T4-50F chassis. It's a single camera used for component visual inspection.

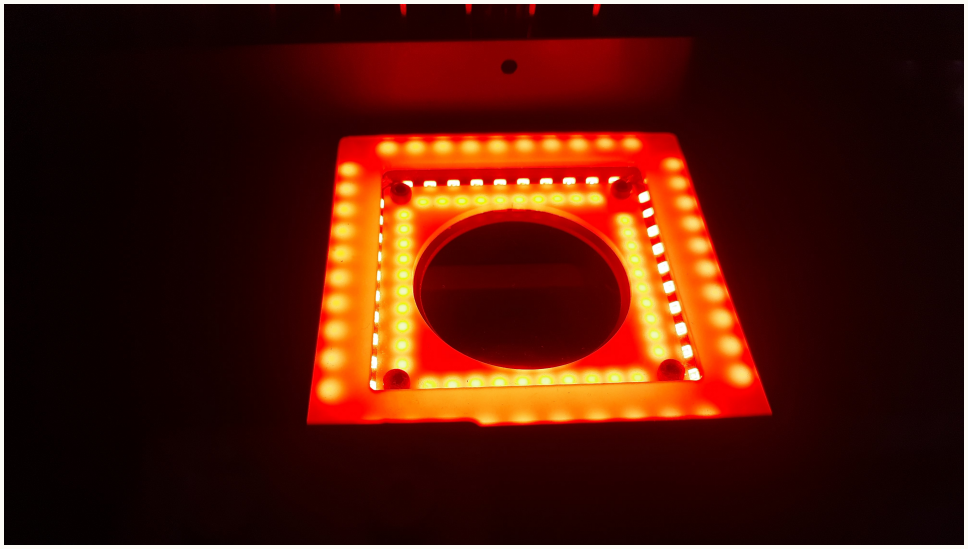


Figure 1.4: High Cam

1.2 Terminology

- **PCB Array:** A PCB array (also called a PCB panel) is a PCB grid containing multiple smaller boards **identical** in design.
- **Coupled PCB Array:** A PCB array in a 2xN or Nx2 shape, which may or may not be mirrored.
- **Arm:** In the document, the arm is the part of the pick and place machine that contains the **Mark Cam**, placement heads and nozzles.
- **Reel:** The reel is a circular spool around which the carrier tape is wound.
- **Carrier tape:** The carrier tape is a continuous strip that holds the electronic components. It consists of a series of pockets or cavities where individual components are placed. The tape also includes sprocket holes along its edges for precise alignment and advancement through the pick and place machine.
- **Cover tape:** A translucent film that holds the components inside the Carrier tapes' pockets.
- **Pick up height:** The height to which the nozzle must come down to pick up a component.
- **Place height:** The height to which the nozzle must descend to place a component on the pcb.

1.3 Relevant product specifications

1.3.1 Relevant product specifications table

Placement head count	4
Number of feeder slots	50
Positioning Accuracy	0.01mm
Repeated Mounting Accuracy	0.02mm
Range of Mounting Speed	7000-8000Pcs/h
Supported Maximum Area of PCB	350*190mm
Applicable components	0201, 0402, 0603, 0805, diode , triode, SOT and QFP , BGA with lead pitch $\geq 3mm$
Maximum Height of Components	$\leq 7mm$
Mark Positioning	manual / automatic
Maximum Step Length of XY Axis	629mm*679mm
Maximum Step Length of Z Axis	20mm
Power Supply	220V 50/60Hz
Average Power	600W

1.3.2 Specification details

Placement heads

In the context of P&P machines, placement heads use nozzles to pick up and hold components.
Nozzles use a vacuum system to pick components of the feeder and place them on the pcb. The HW-T4-50F possesses 4 placement heads.

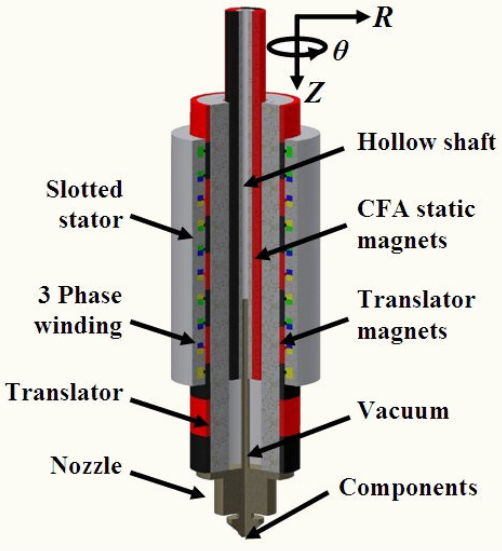


Figure 1.5: A P&P placement head

Component Type	Designation	Length (µm)	Width (µm)	Nozzle Type
Flat Chip				
	0201	600	300	501
	0402	1000	500	502
	0603	1600	800	503
	0805	2000	1250	503
	1206	3200	1600	504
	1210	3200	2600	505
	2010	5000	2500	505
	2512	6300	3100	505
MELFs				
	2000	ϕ1350	-	510
	3200	ϕ1750	-	510
	3500	ϕ1550	-	510
	5900	ϕ2400	-	511
Tantalum Capacitors, Inductors, Potentiometers				
Potentiometer	3000	3400	1500	505
	3800	4500	1650	506
	4000	4500	2400	506
Inductor Chip	2500	2000	1800	504
	3200	2500	2200	505
	4000	4300	4300	506
Tantalum Capacitor	2000	1250	1200	503
	3200	1600	1600	504
	3400	2600	1900	505
Electrolytic Capacitors				
	3300	ϕ3000	5400	505
	4300	ϕ4000	5400	506
	5300	ϕ5000	5400	506
	6600	ϕ6300	5400	506
	6600	ϕ6300	7900	506
	8300	ϕ8000	6200	507
	8300	ϕ8000	10200	507
	10300	ϕ10000	10200	508
Transistors, Diodes				
Transistor SC90	1600	800	700	503
Transistor SOT323	2000	1250	900	503
	2000	1250	1100	503
	2900	1300	950	503
	2900	1600	950	504
	2900	1600	1100	504
Transistor DPAK	9900	6500	4700	506
Diode SOD123	3700	1550	1400	504
Diode SOD323	2500	1250	1200	503

Table 1.1: SMT Nozzle Selection Guide

Small Outlines				
SO6 * 1.27p	3800	6000	1450	506
SO8 * 1.27p	4900	6000	1550	506
SO14 * 1.27p	8650	6000	1550	506
SO16 * 1.27p	10000	6000	1600	506
SO8L * 1.27p	8000	10300	2500	508
SO14L * 1.27p	9100	10320	2500	508
SO16L * 1.27p	10280	10300	2500	508
SO18L * 1.27p	11550	10300	2500	508
SO20L * 1.27p	12800	10325	2500	508
SO24L * 1.27p	15400	10325	2500	508
SO28L * 1.27p	18000	10300	2450	508
SO32L * 1.27p	21000	10600	2670	508
SO40L * 1.27p	26600	11800	2900	508
SOJ24 * 1.27p	15880	8660	3500	507
SOJ26 * 1.27p	17150	8660	3500	507
SOJ28 * 1.27p	18410	8660	3500	507
SOJ32 * 1.27p	20960	8510	3500	507
TSOP24 * 0.5p	16000	6000	1200	506
TSOP32 * 0.5p	20000	8000	1000	507
TSOP40 * 0.5p	20000	10100	1200	508
SSOP8 * 0.65p	3000	7800	1800	507
SSOP14* 0.65p	6200	7800	1800	507
SSOP16 * 0.65p	6200	7800	1800	507
SSOP18 * 0.65p	7200	7800	1800	507
SSOP20 * 0.65p	7200	7800	1800	507
SSOP22 * 0.65p	9200	7800	1800	507
SSOP24 * 0.65p	9200	7800	1800	507
SSOP28 * 0.65p	10200	7800	1800	507
SSOP30 * 0.65p	10200	7800	1800	507
SSOP34 * 0.65p	118100	10250	2600	508
SSOP36 * 0.65p	15600	10350	2600	508
SSOP38 * 0.65p	12600	7800	1800	507
SSOP44 * 0.65p	17900	10300	2515	508
SSOP48 * 0.65p	15880	10310	2590	508
SSOP56* 0.65p	18400	19350	2600	508
SSOP64 * 0.65p	26300	14250	2100	508
Plastic Leaded Chip Carriers				
PLCC20 *1.27p	9850	9850	4350	507

Table 1.2: SMT Nozzle Selection Guide

- Feeders

A feeder is the system responsible for supplying the P&P placement head with components. Feeders are usually divided into 4 main categories:

- **Tape Feeders**
  - **Description:** Use reels of carrier tape holding components in pockets.
  - **Types:**
    - ⋆ **Embossed Tape Feeders:** For larger or irregularly shaped components.
    - ⋆ **Paper Tape Feeders:** For small, lightweight components.
  - **Advantages:** High component density, suitable for high-speed placement.
  - **Use Case:** Widely used for a variety of surface-mount devices (SMDs).
- **Tube Feeders**
  - **Description:** Components stored in tubes and fed one by one.
  - **Types:**
    - ⋆ **Vibratory Tube Feeders:** Use vibration to move components to the pick position.
    - ⋆ **Mechanical Tube Feeders:** Use mechanical pushers to move components.
  - **Advantages:** Simple and reliable for specific component shapes.
  - **Use Case:** Used for ICs, transistors, and connectors.
- **Tray Feeders**
  - **Description:** Components stored in trays (JEDEC trays) and presented in an organized manner.
  - **Types:**
    - ⋆ **Manual Tray Feeders:** Trays manually loaded and unloaded.
    - ⋆ **Automatic Tray Feeders:** Trays automatically managed by the machine.
  - **Advantages:** Suitable for larger components and sensitive components.
  - **Use Case:** Used for large ICs, BGA, and QFP components.
- **Bulk Feeders**
  - **Description:** Components stored in bulk and fed using vibratory/centrifugal mechanisms.
  - **Advantages:** Efficient for high volumes of small components.
  - **Use Case:** Suitable for small components like capacitors, resistors, and LEDs.

Tape/Reel feeders are reserved for smaller components ($\leq 1mm$) while tray feeders are generally reserved for larger chips like microcontrollers and GSM modules.

The HW-T4-50F has 50 feeder slots. It is important to take into account that vibratory tube feeders occupy **5 slots**, and tray feeders must be put in a position within the pick and place arms' reach.

Figure 1.6: Reel feeder

- Positioning accuracy

Positioning accuracy refers to the ability of the pick-and-place machine to place a component at a specified location on the PCB with precision. It is a measure of how close the actual placement of the component is to the intended placement coordinates.
The HW-T4-50F's positioning accuracy is 0.01mm.

- Repeated mounting accuracy

Repeated mounting accuracy, also known as repeatability, refers to the ability of the pick-and-place machine to consistently place components at the same location on the PCB over multiple cycles. It is a measure of the machine's consistency and reliability in placing components.
The HW-T4-50F's repeated mounting accuracy is 0.02mm.

1.4 Interfacing with the machine

1.4.1 Front controls

On the front of the machine are three toggle buttons.

- **Power:** to toggle the machine's power.
- **Lighting:** to turn on the machine's internal lights.
- **Emergency stop:** which stops the machine immediately in the case of an emergency

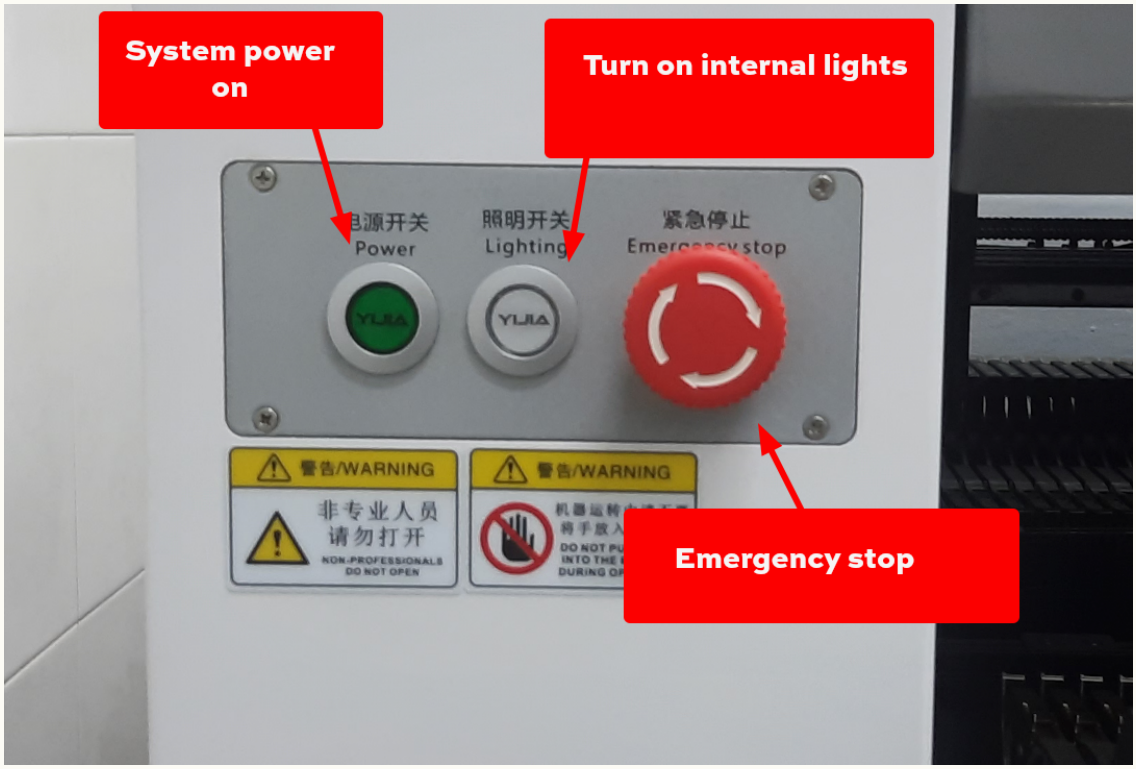


Figure 1.7: HW-T4-50F's face controls

1.4.2 Human Machine Interface

Powering the HW-T4-50F is a windows 7 computer, containing the needed software, which can be interfaced with via the provided monitor (Keyboard/Mouse arent usually included).

Figure 1.8: HW-T4-50F's human machine interface

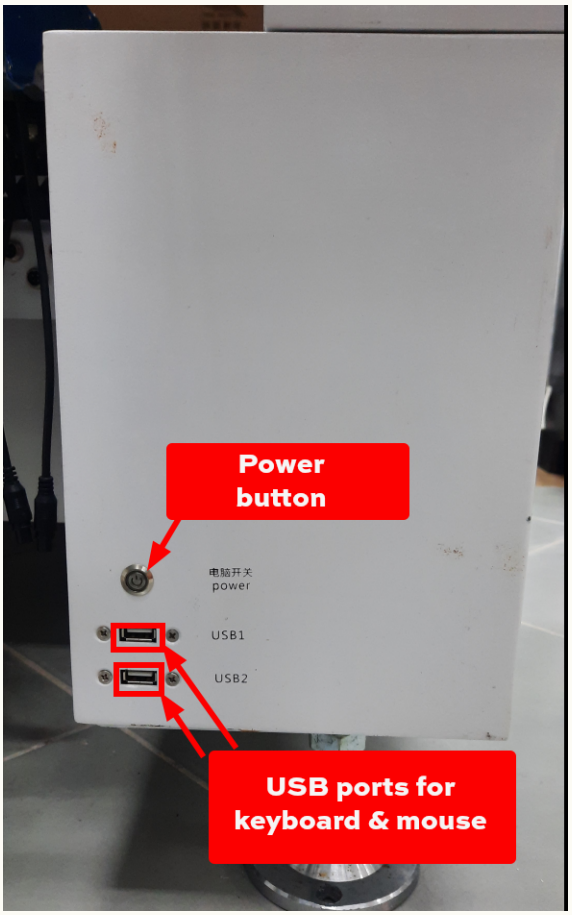


Figure 1.9: HW-T4-50F's central computer

1.5 Introduction to the software

The HW-T4-50F comes shipped with a graphical user interface that can be used to configure and operate the machine. The user interface contains camera controls, arm controls and pick up head controls. As well as a live camera view.

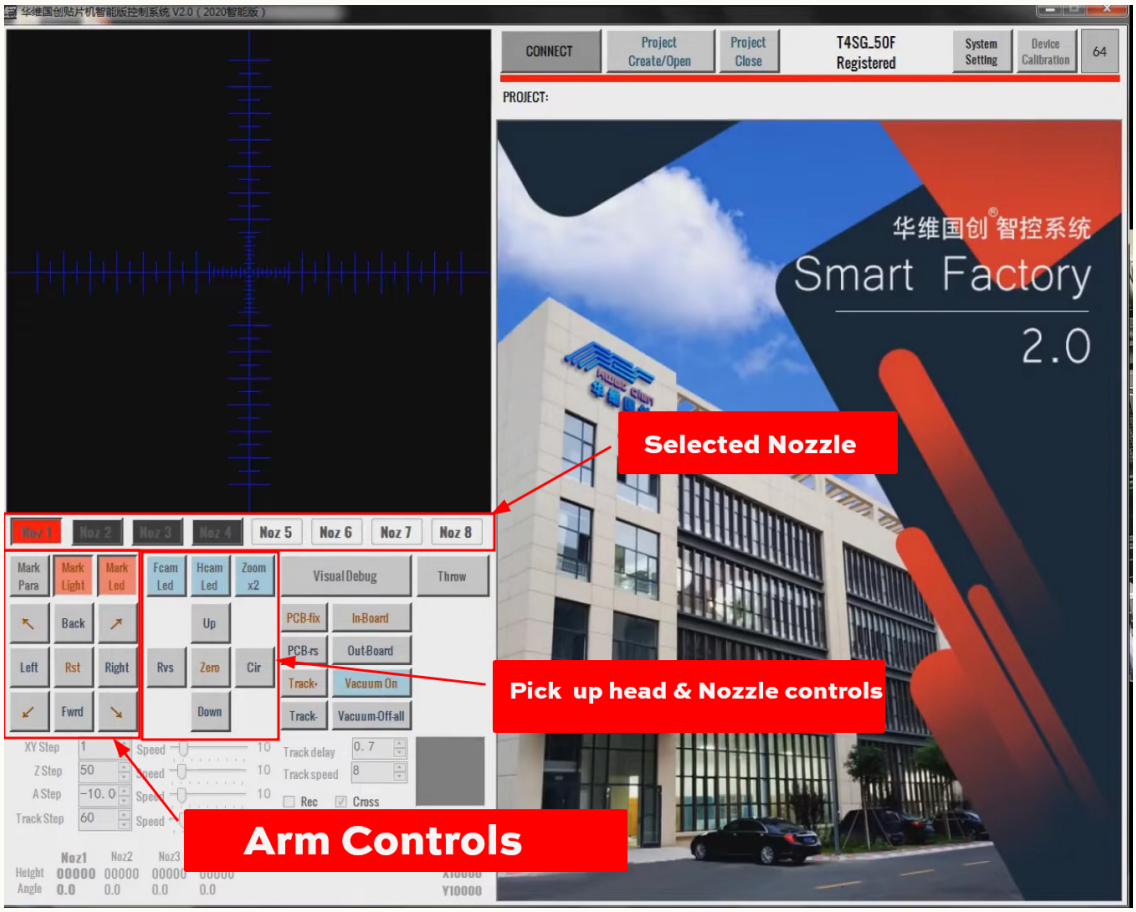


Figure 1.10: A tour of the software

1.6 Registration and software updates

A user must register the software using the unique ID on the machine's body in order to update to the latest version.

1.7 Pick and Place modes

The software supports two modes:

- **Manual:** where the user manually picks where components are placed.
- **Automatic:** where the user provides the machine with a pick and place file (usually a CSV file) and lets the machine automatically determine component placement after a calibration process.

Note: even if the dialog says "PCB file" the software only takes pick and place files.

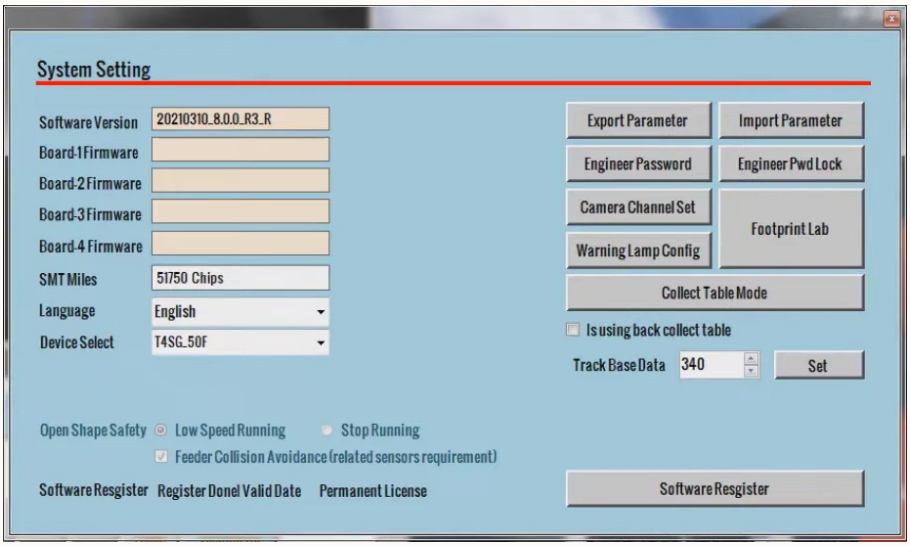


Figure 1.11: Software registration and configuration window

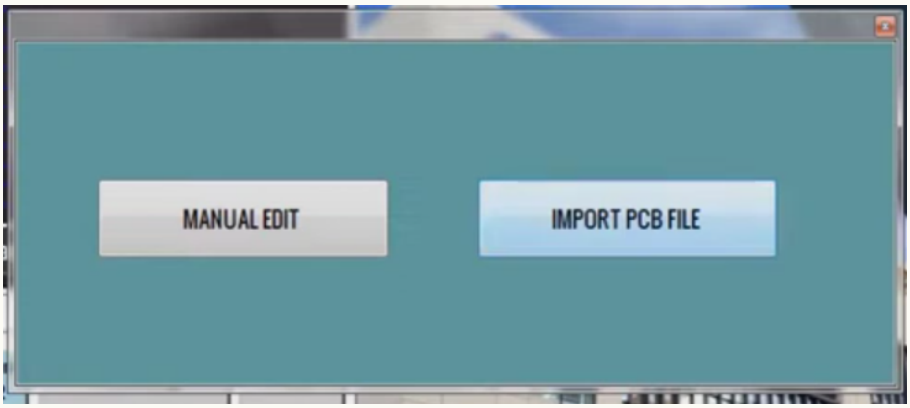
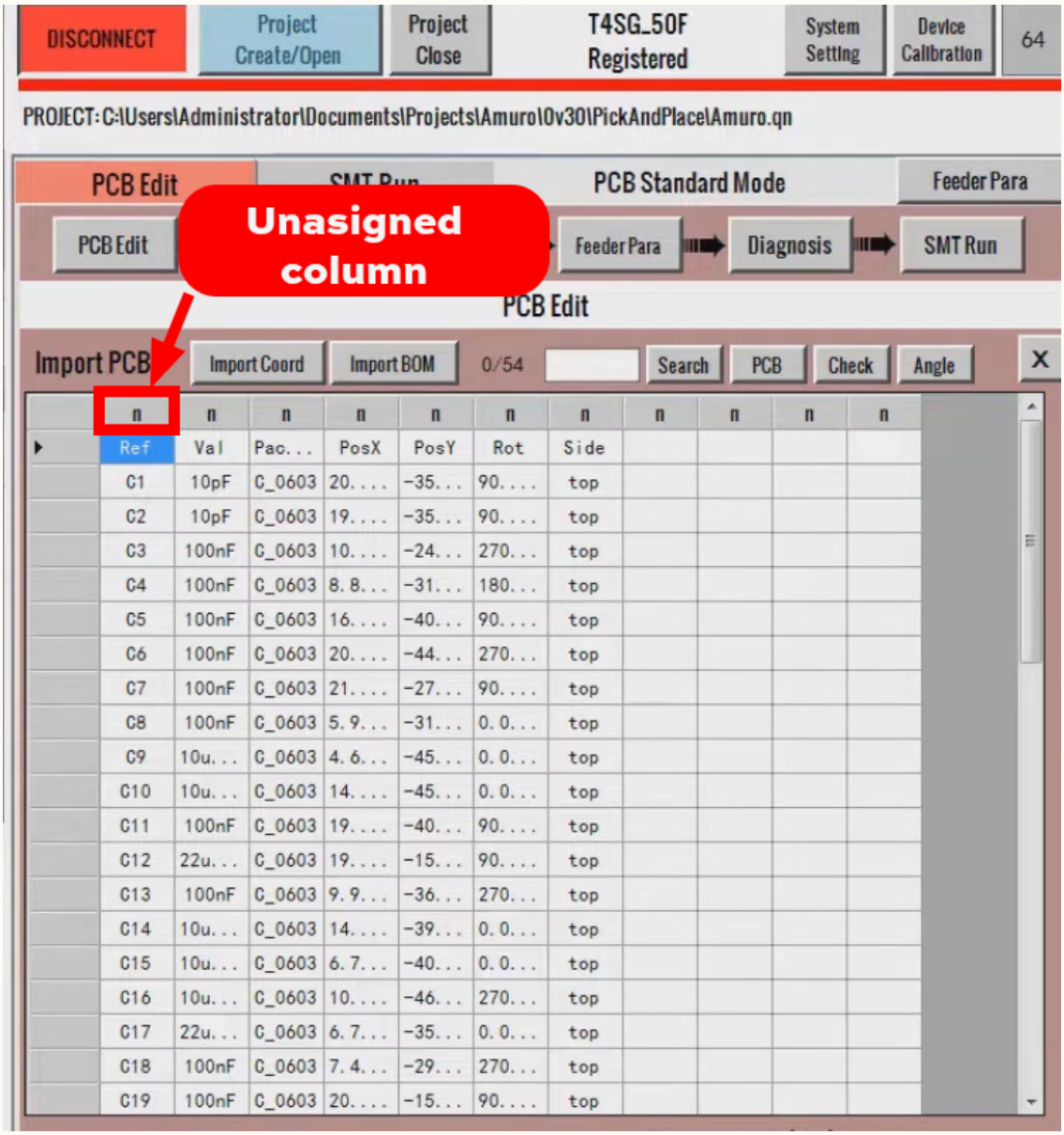


Figure 1.12: Software registration and configuration window

1.8 Pick and place files

When a pick and place file is imported, all of its columns are **Unassigned**, the user must manually asign each one.

Right clicking on the column shows a context menu, selecting an option will assign it to the column



n	n	n	n	n	n	n	n	n	n	n
Ref	Val	Pac...	PosX	PosY	Rot	Side				
C1	10pF	C_0603	20....	-35...	90....	top				
C2	10pF	C_0603	19....	-35...	90....	top				
C3	100nF	C_0603	10....	-24...	270...	top				
C4	100nF	C_0603	8.8...	-31...	180...	top				
C5	100nF	C_0603	16....	-40...	90....	top				
C6	100nF	C_0603	20....	-44...	270...	top				
C7	100nF	C_0603	21....	-27...	90....	top				
C8	100nF	C_0603	5.9...	-31...	0.0...	top				
C9	10u...	C_0603	4.6...	-45...	0.0...	top				
C10	10u...	C_0603	14....	-45...	0.0...	top				
C11	100nF	C_0603	19....	-40...	90....	top				
C12	22u...	C_0603	19....	-15...	90....	top				
C13	100nF	C_0603	9.9...	-36...	270...	top				
C14	10u...	C_0603	14....	-39...	0.0...	top				
C15	10u...	C_0603	6.7...	-40...	0.0...	top				
C16	10u...	C_0603	10....	-46...	270...	top				
C17	22u...	C_0603	6.7...	-35...	0.0...	top				
C18	100nF	C_0603	7.4...	-29...	270...	top				
C19	100nF	C_0603	20....	-15...	90....	top				

Figure 1.13: Unassigned pick and place file

Essential columns that must be assigned before any pick and place operation are:

- **Label**
- **Chip Value**
- **Footprint**
- **X coordinate**
- **Y coordinate**
- **Rotation angle**

These columns are strictly required, but there are other optional columns such as **Layer** etc...

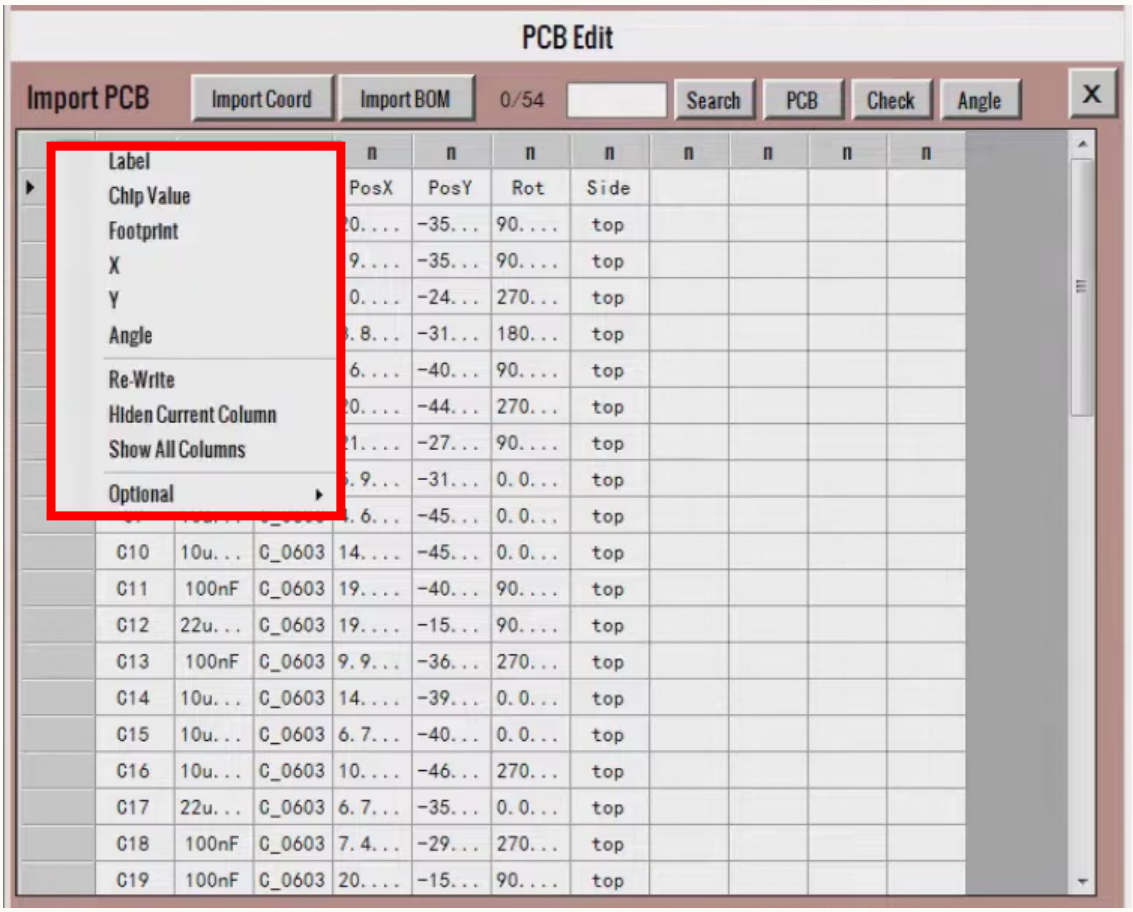


Figure 1.14: Unassigned pick and place file

Important note: The user must delete any row that doesn't contain valid component information, including logo and fiducial marks.

1.9 Fiducial marks and calibration

1.9.1 Calibrating a PCB

The caliration of the pick and place machine starts at the pcb design, designers must include fiducial mark that will help the machine calibrate its coordinate system to the board.

The calibration process starts by picking the fiducial marks from the pick and place table, the user may only use 2 marks, but 4 are recommended for improved precision. By default only 2 marks are available, the user may change them to 4 by checking the **"Precise mode"** box

To choose a fiducial mark the user must right click on the appropriate row and click "set as Sign" from the context menu. Sign is just another word for fiducial mark and each PCB has 4 signs (in precise mode). Signs are picked in order and according to the PCB's orientation.

Note: for PCB Arrays, the user only needs to load the pick and place files of a single pcb.

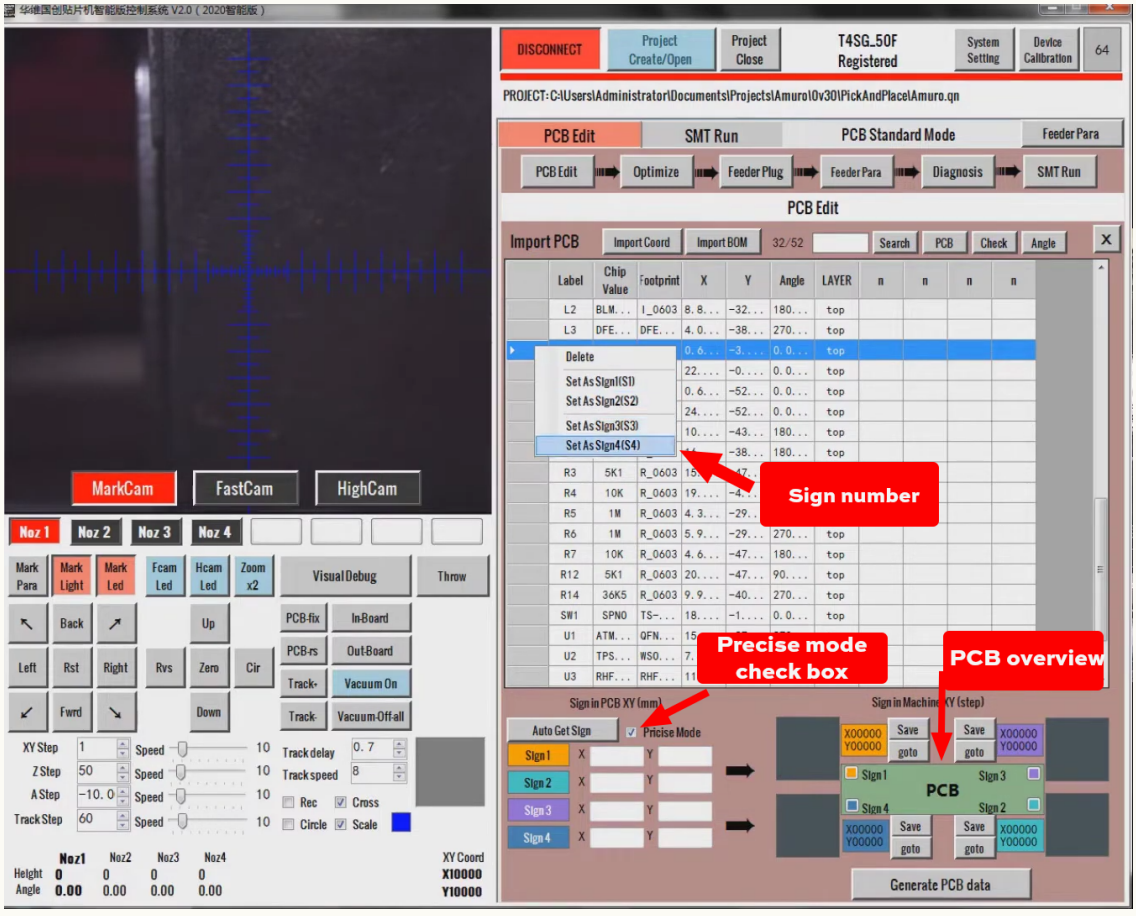


Figure 1.15: Fiducial marks from the pick and place table

After pointing the **Mark Cam** at a fiducial mark, using the directional arrows, the user must click **”Save”** in order to save its coordinates.

Clicking on **”goto”** will displace the camera to a saved mark.

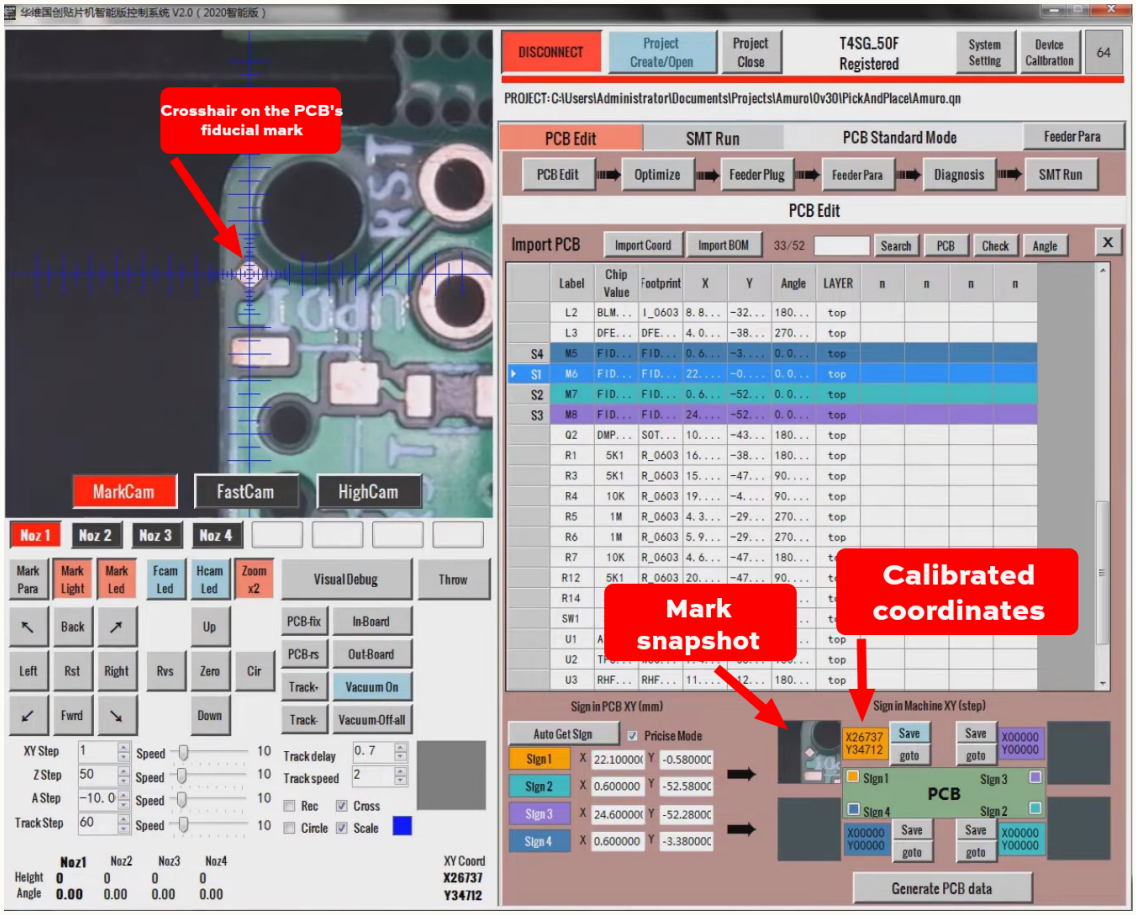
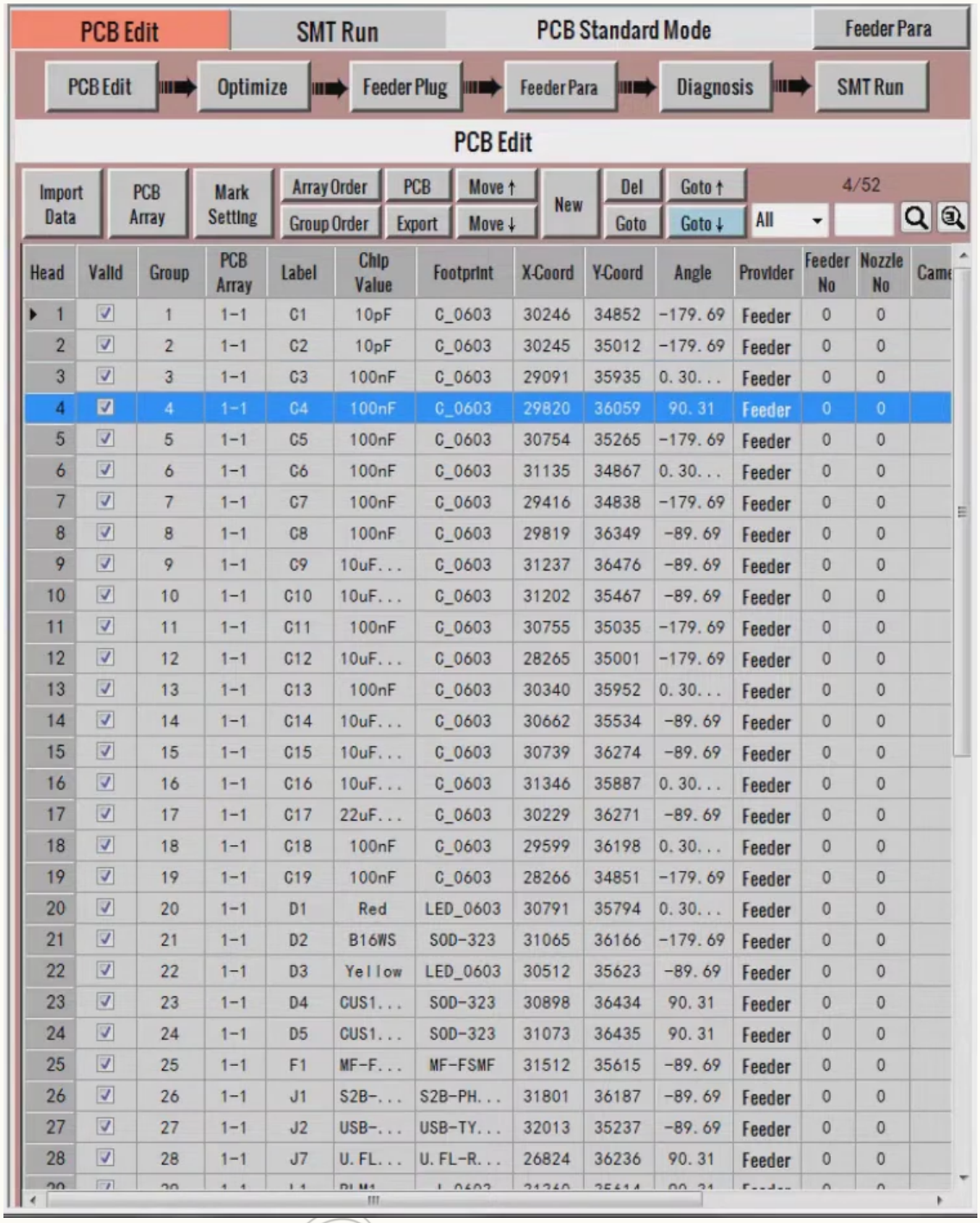


Figure 1.16: First fiducial mark calibration

The last step is clicking on the ”Generate PCB Data” button to create a table of traversable points in the PCB on which components will be placed. The ”Goto” buttons are useful for traversing each point and verifying the accuracy of the calibration.



Head	Valid	Group	PCB Array	Label	Chip Value	Footprint	X-Coord	Y-Coord	Angle	Provider	Feeder No	Nozzle No	Came
1	☑	1	1-1	C1	10pF	C_0603	30246	34852	-179.69	Feeder	0	0	
2	☑	2	1-1	C2	10pF	C_0603	30245	35012	-179.69	Feeder	0	0	
3	☑	3	1-1	C3	100nF	C_0603	29091	35935	0.30...	Feeder	0	0	
4	☑	4	1-1	C4	100nF	C_0603	29820	36059	90.31	Feeder	0	0	
5	☑	5	1-1	C5	100nF	C_0603	30754	35265	-179.69	Feeder	0	0	
6	☑	6	1-1	C6	100nF	C_0603	31135	34867	0.30...	Feeder	0	0	
7	☑	7	1-1	C7	100nF	C_0603	29416	34838	-179.69	Feeder	0	0	
8	☑	8	1-1	C8	100nF	C_0603	29819	36349	-89.69	Feeder	0	0	
9	☑	9	1-1	C9	10uF...	C_0603	31237	36476	-89.69	Feeder	0	0	
10	☑	10	1-1	C10	10uF...	C_0603	31202	35467	-89.69	Feeder	0	0	
11	☑	11	1-1	C11	100nF	C_0603	30755	35035	-179.69	Feeder	0	0	
12	☑	12	1-1	C12	10uF...	C_0603	28265	35001	-179.69	Feeder	0	0	
13	☑	13	1-1	C13	100nF	C_0603	30340	35952	0.30...	Feeder	0	0	
14	☑	14	1-1	C14	10uF...	C_0603	30662	35534	-89.69	Feeder	0	0	
15	☑	15	1-1	C15	10uF...	C_0603	30739	36274	-89.69	Feeder	0	0	
16	☑	16	1-1	C16	10uF...	C_0603	31346	35887	0.30...	Feeder	0	0	
17	☑	17	1-1	C17	22uF...	C_0603	30229	36271	-89.69	Feeder	0	0	
18	☑	18	1-1	C18	100nF	C_0603	29599	36198	0.30...	Feeder	0	0	
19	☑	19	1-1	C19	100nF	C_0603	28266	34851	-179.69	Feeder	0	0	
20	☑	20	1-1	D1	Red	LED_0603	30791	35794	0.30...	Feeder	0	0	
21	☑	21	1-1	D2	B16WS	SOD-323	31065	36166	-179.69	Feeder	0	0	
22	☑	22	1-1	D3	Yellow	LED_0603	30512	35623	-89.69	Feeder	0	0	
23	☑	23	1-1	D4	CUS1...	SOD-323	30898	36434	90.31	Feeder	0	0	
24	☑	24	1-1	D5	CUS1...	SOD-323	31073	36435	90.31	Feeder	0	0	
25	☑	25	1-1	F1	MF-F...	MF-FSMF	31512	35615	-89.69	Feeder	0	0	
26	☑	26	1-1	J1	S2B-...	S2B-PH...	31801	36187	-89.69	Feeder	0	0	
27	☑	27	1-1	J2	USB-...	USB-TY...	32013	35237	-89.69	Feeder	0	0	
28	☑	28	1-1	J7	U.FL...	U.FL-R...	26824	36236	90.31	Feeder	0	0	

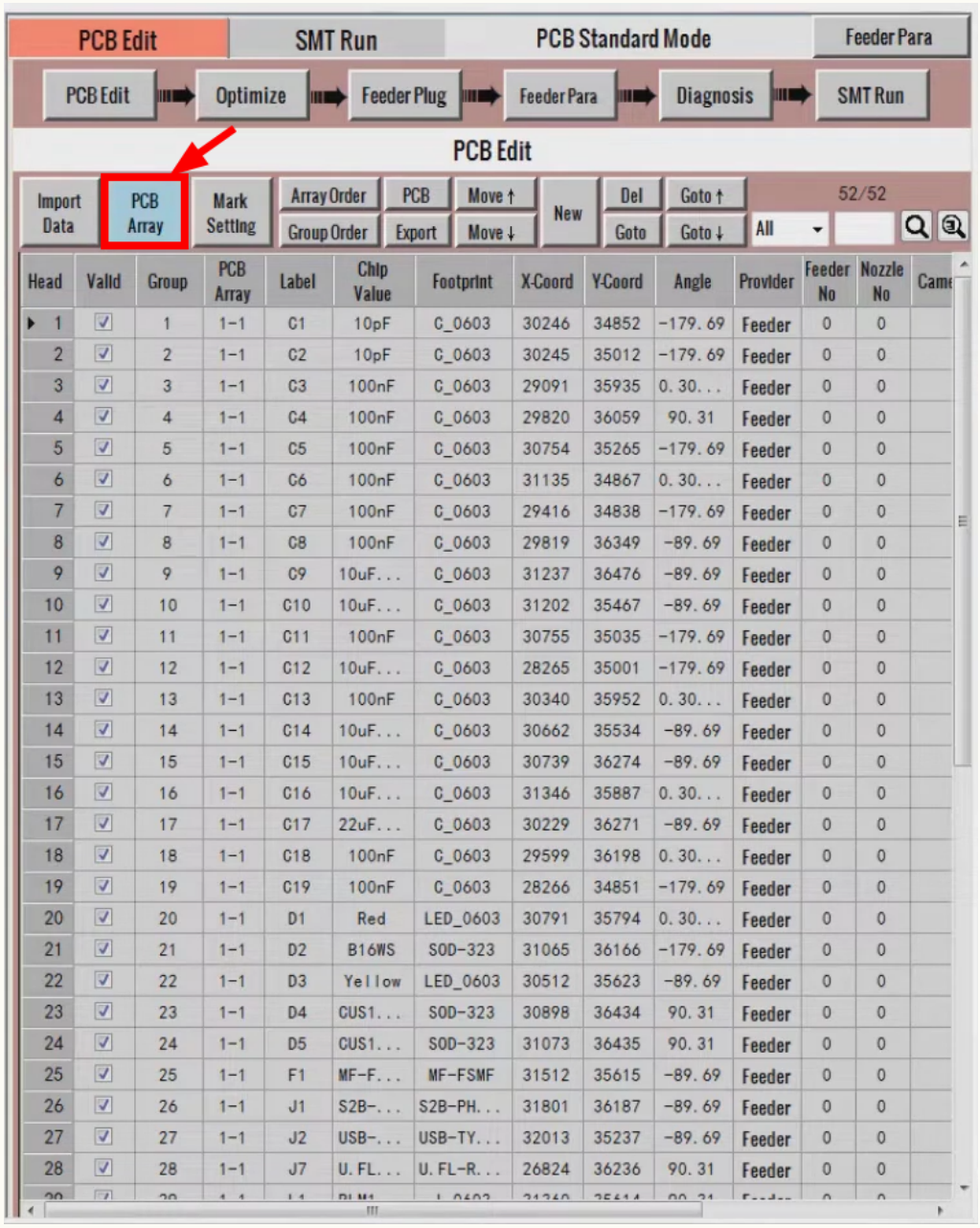
Figure 1.17: Generated PCB data

Note: For Single PCB designs, steps in **section 1.9.2 and section 1.9.4** can be skipped.

1.9.2 Calibrating coupled PCB arrays

The HW-T4-50F can be configured to handle PCB Arrays (also called **Panels**) with relative ease.

After following the instructions in the **previous section**, the user must click the **"PCB Array"** button to begin the PCB Array calibration process.



Head	Valid	Group	PCB Array	Label	Chip Value	Footprint	X-Coord	Y-Coord	Angle	Provider	Feeder No	Nozzle No	Came
1	☑	1	1-1	C1	10pF	C_0603	30246	34852	-179.69	Feeder	0	0	
2	☑	2	1-1	C2	10pF	C_0603	30245	35012	-179.69	Feeder	0	0	
3	☑	3	1-1	C3	100nF	C_0603	29091	35935	0.30...	Feeder	0	0	
4	☑	4	1-1	C4	100nF	C_0603	29820	36059	90.31	Feeder	0	0	
5	☑	5	1-1	C5	100nF	C_0603	30754	35265	-179.69	Feeder	0	0	
6	☑	6	1-1	C6	100nF	C_0603	31135	34867	0.30...	Feeder	0	0	
7	☑	7	1-1	C7	100nF	C_0603	29416	34838	-179.69	Feeder	0	0	
8	☑	8	1-1	C8	100nF	C_0603	29819	36349	-89.69	Feeder	0	0	
9	☑	9	1-1	C9	10uF...	C_0603	31237	36476	-89.69	Feeder	0	0	
10	☑	10	1-1	C10	10uF...	C_0603	31202	35467	-89.69	Feeder	0	0	
11	☑	11	1-1	C11	100nF	C_0603	30755	35035	-179.69	Feeder	0	0	
12	☑	12	1-1	C12	10uF...	C_0603	28265	35001	-179.69	Feeder	0	0	
13	☑	13	1-1	C13	100nF	C_0603	30340	35952	0.30...	Feeder	0	0	
14	☑	14	1-1	C14	10uF...	C_0603	30662	35534	-89.69	Feeder	0	0	
15	☑	15	1-1	C15	10uF...	C_0603	30739	36274	-89.69	Feeder	0	0	
16	☑	16	1-1	C16	10uF...	C_0603	31346	35887	0.30...	Feeder	0	0	
17	☑	17	1-1	C17	22uF...	C_0603	30229	36271	-89.69	Feeder	0	0	
18	☑	18	1-1	C18	100nF	C_0603	29599	36198	0.30...	Feeder	0	0	
19	☑	19	1-1	C19	100nF	C_0603	28266	34851	-179.69	Feeder	0	0	
20	☑	20	1-1	D1	Red	LED_0603	30791	35794	0.30...	Feeder	0	0	
21	☑	21	1-1	D2	B16WS	SOD-323	31065	36166	-179.69	Feeder	0	0	
22	☑	22	1-1	D3	Yellow	LED_0603	30512	35623	-89.69	Feeder	0	0	
23	☑	23	1-1	D4	CUS1...	SOD-323	30898	36434	90.31	Feeder	0	0	
24	☑	24	1-1	D5	CUS1...	SOD-323	31073	36435	90.31	Feeder	0	0	
25	☑	25	1-1	F1	MF-F...	MF-FSMF	31512	35615	-89.69	Feeder	0	0	
26	☑	26	1-1	J1	S2B-...	S2B-PH...	31801	36187	-89.69	Feeder	0	0	
27	☑	27	1-1	J2	USB-...	USB-TY...	32013	35237	-89.69	Feeder	0	0	
28	☑	28	1-1	J7	U.FL...	U.FL-R...	26824	36236	90.31	Feeder	0	0	

Figure 1.18: PCB array button on the generated PCB data window

To begin calibrating a coupled PCB layout, check the **"CouplePCB"** box.

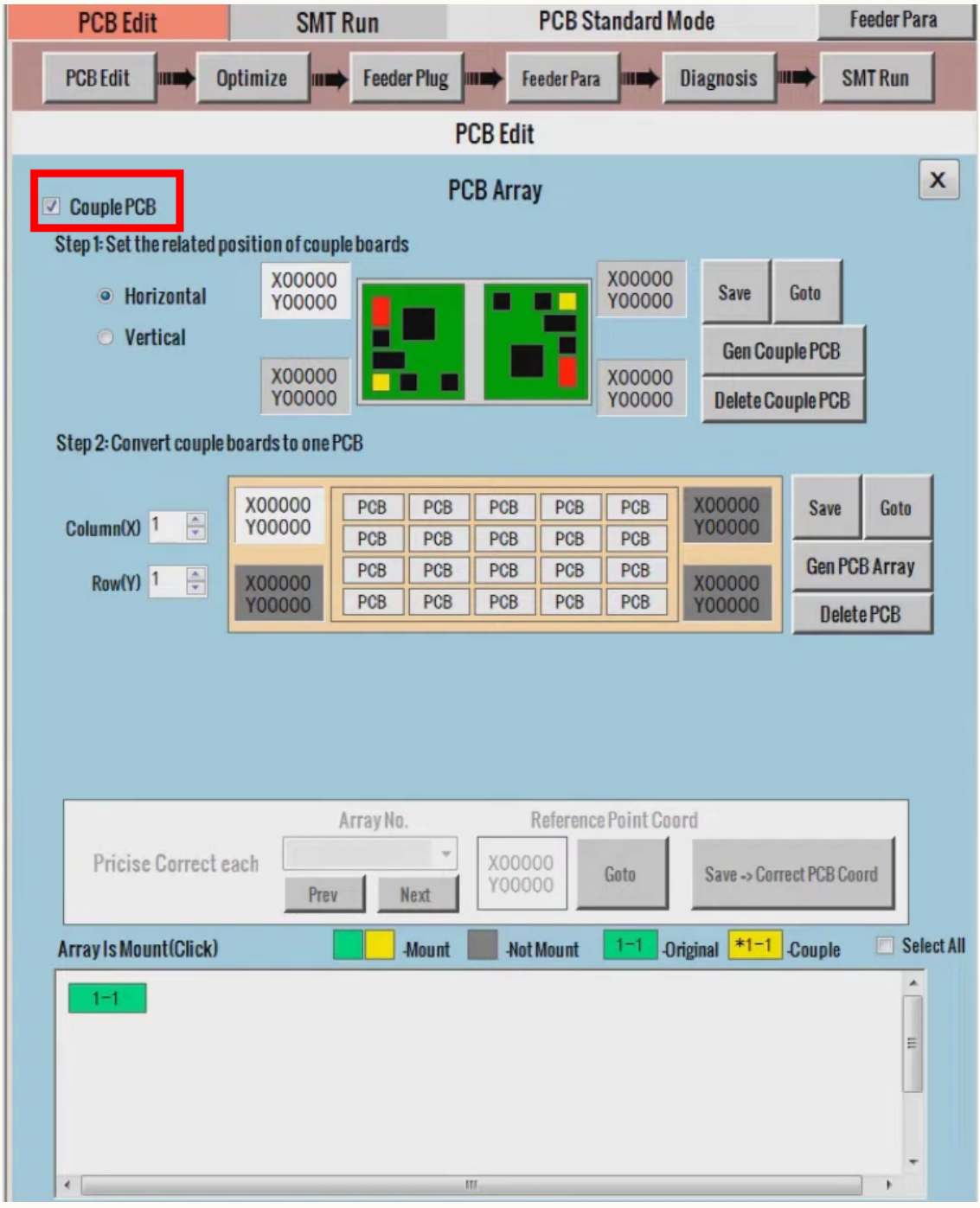


Figure 1.19: PCB array button on the generated PCB data window

Select homologous points from the PCBs as specified in the drawing.
To calibrate a row (or a column in a horizontally mirrored couple PCB). After Calibrating, click **”Generate Couple PCB”**.

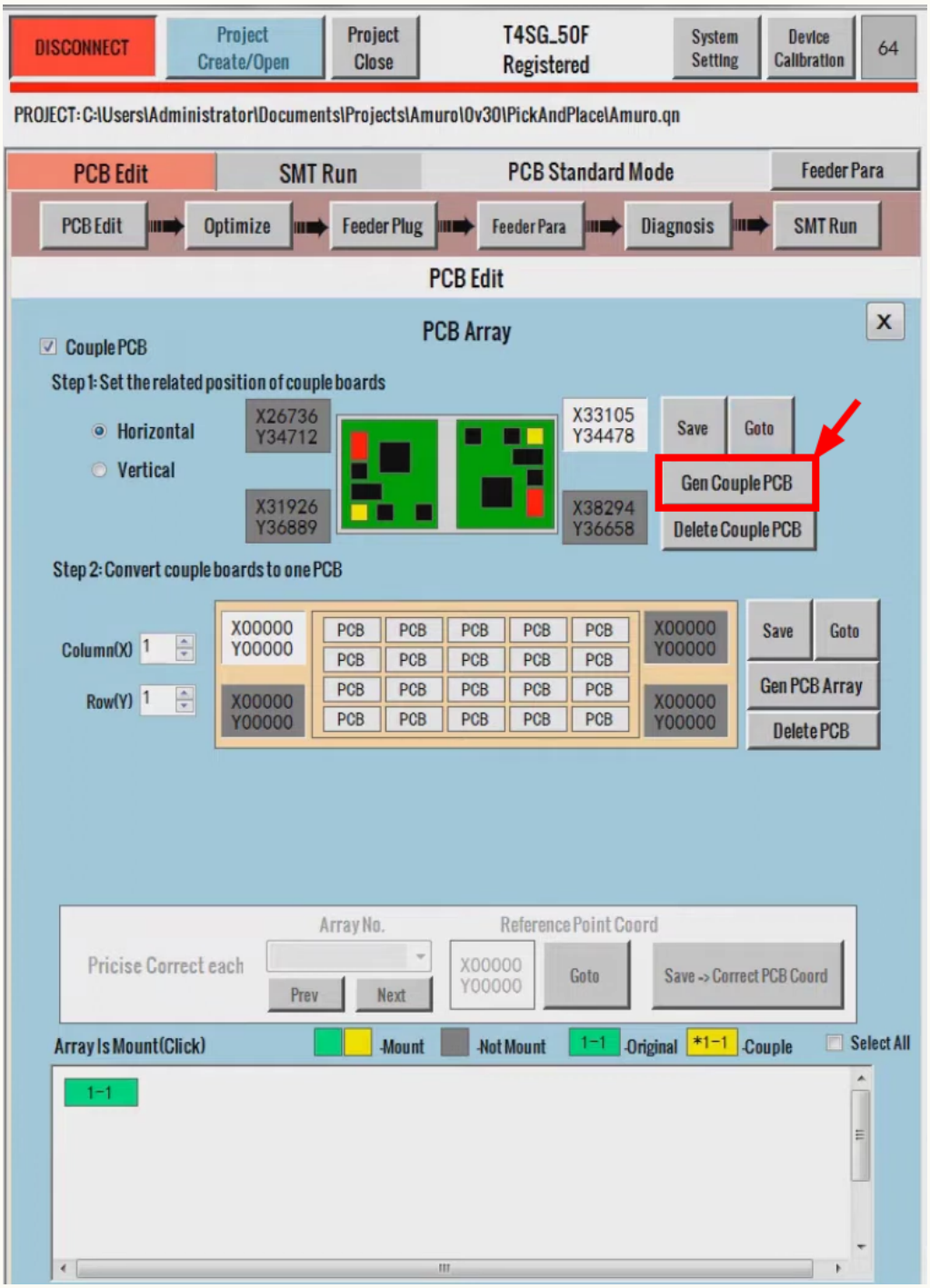


Figure 1.20: Generating a coupled PCB

In this example, the generated couple is a full row (with two columns). The number of rows / columns is configured via the corresponding textboxes.

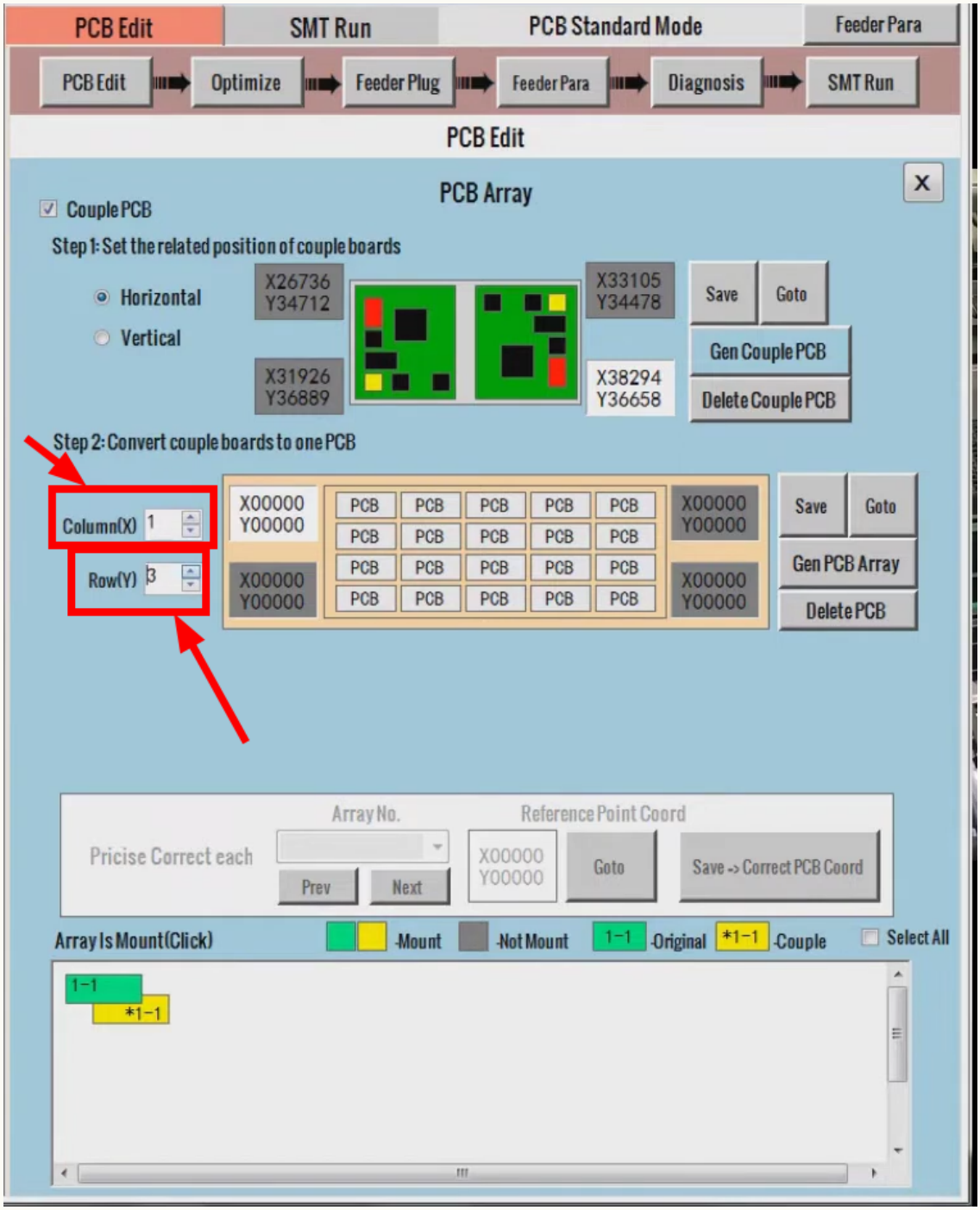


Figure 1.21: Column / Row count textboxes

After selecting the PCB array's edges the software will generate the rest of the array automatically.

1.9.3 Working with non coupled PCB arrays

PCB arrays shaped other than 2xN or Nx2 (Non coupled), require extra attention from the user.

In this section, we will work on a 3x4 pcb array. But the same steps apply to any other array shape.
The user must calibrate the pick and place machine using the four corner PCBs of the PCB array .
Corner marks are fiducial marks selected from corner PCBs. The sole criteria for corner mark selection is that selected fiducial marks must remain consistent across all four PCBs (**e.g:** If the user selects fiducial mark 1 on the first corner PCB, they must use fiducial mark 1 for the remaining 3) .
Consider the following PCB array:

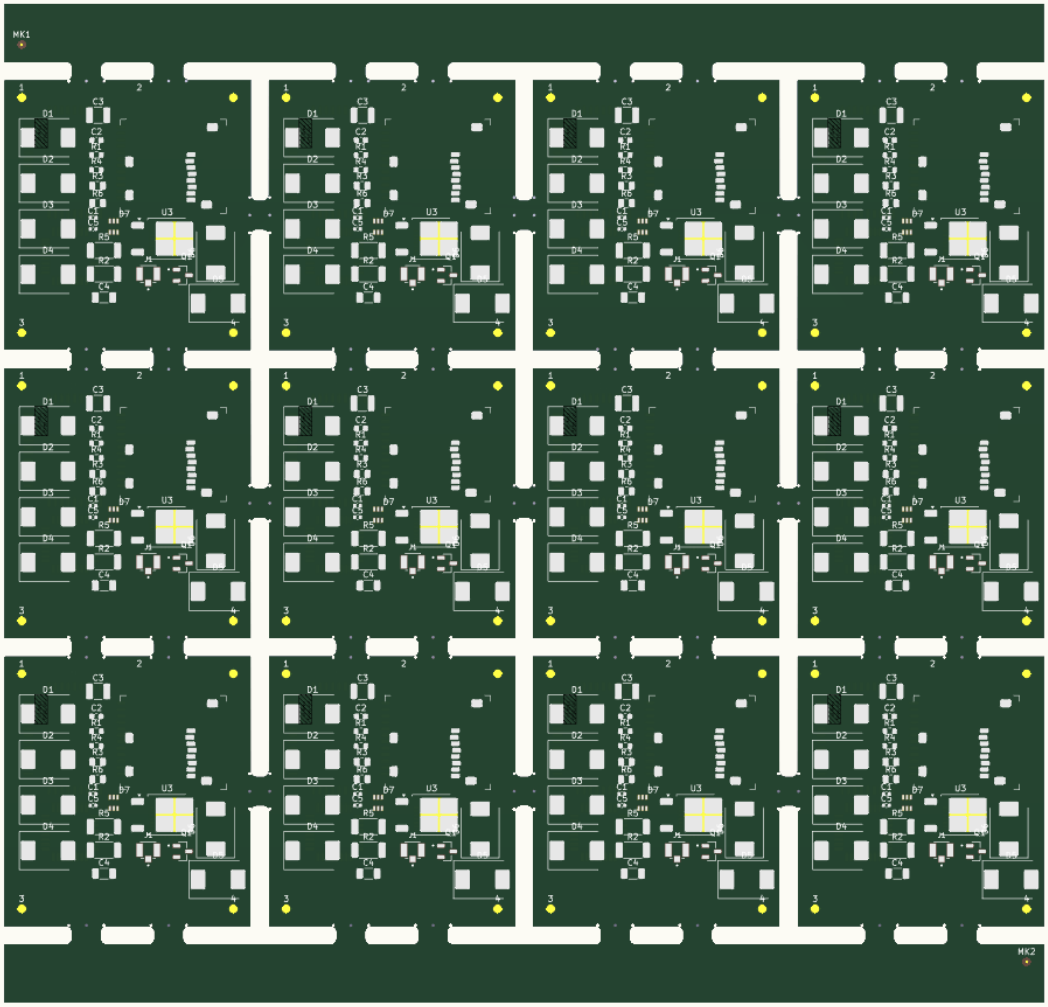


Figure 1.22: Example 3x4 PCB array

In order to calibrate the machine, the user must select consistent fiducial marks across the four corner PCBs.

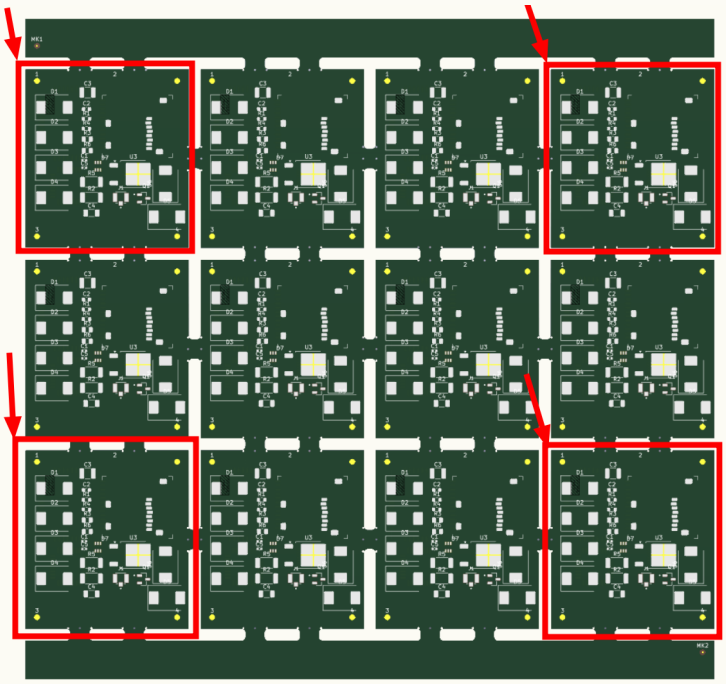


Figure 1.23: Corner PCBs

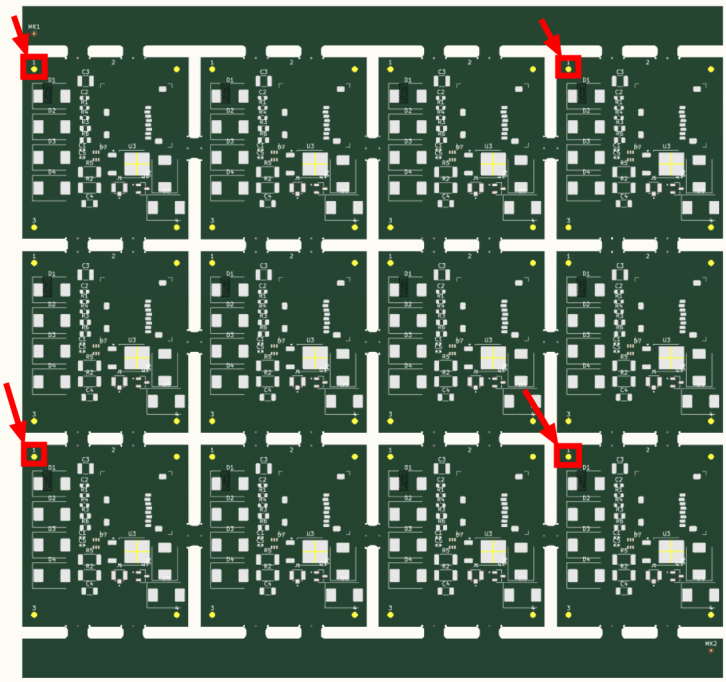


Figure 1.24: Example corner marks

After pointing the **Mark Cam** at the selected point, the user must select the corresponding corner on the PCB Array configuration panel and hit the **"save"** button.

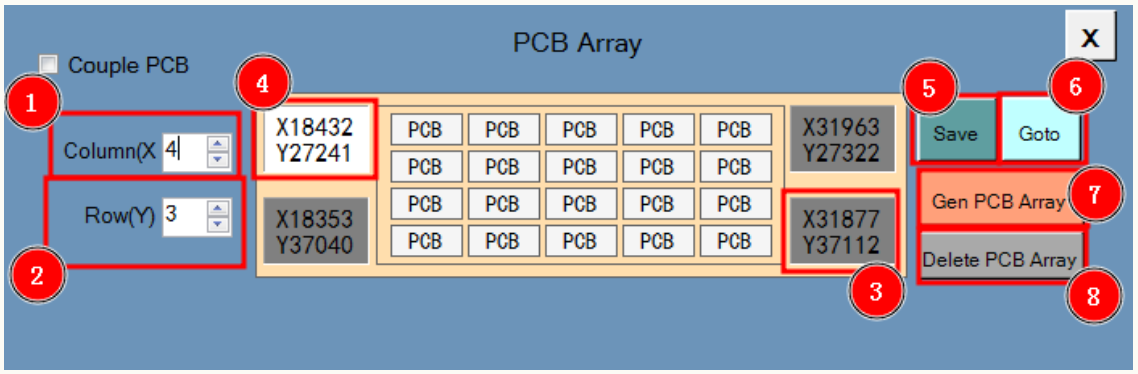


Figure 1.25: PCB Edit tab: Corner mark calibration

- **1:** Column count
- **2:** Row count
- **3:** Saved corner coordinates
- **4:** Selected corner
- **5:** Save **Mark Cam** coordinates to selected corner
- **6:** Move **Mark Cam** to selected corner coordinates
- **7:** Generate PCB array
- **8:** Delete current PCB array.

Once the user has picked the four corner coordinates, the PCB Array can be generated by clicking the **"Gen PCB Array"** button.

Once generated, PCBs on the PCB array should be automatically recognized as **Cells** of the array. On the **PCB Edit** tab the user can also browse and adjust the array cells:

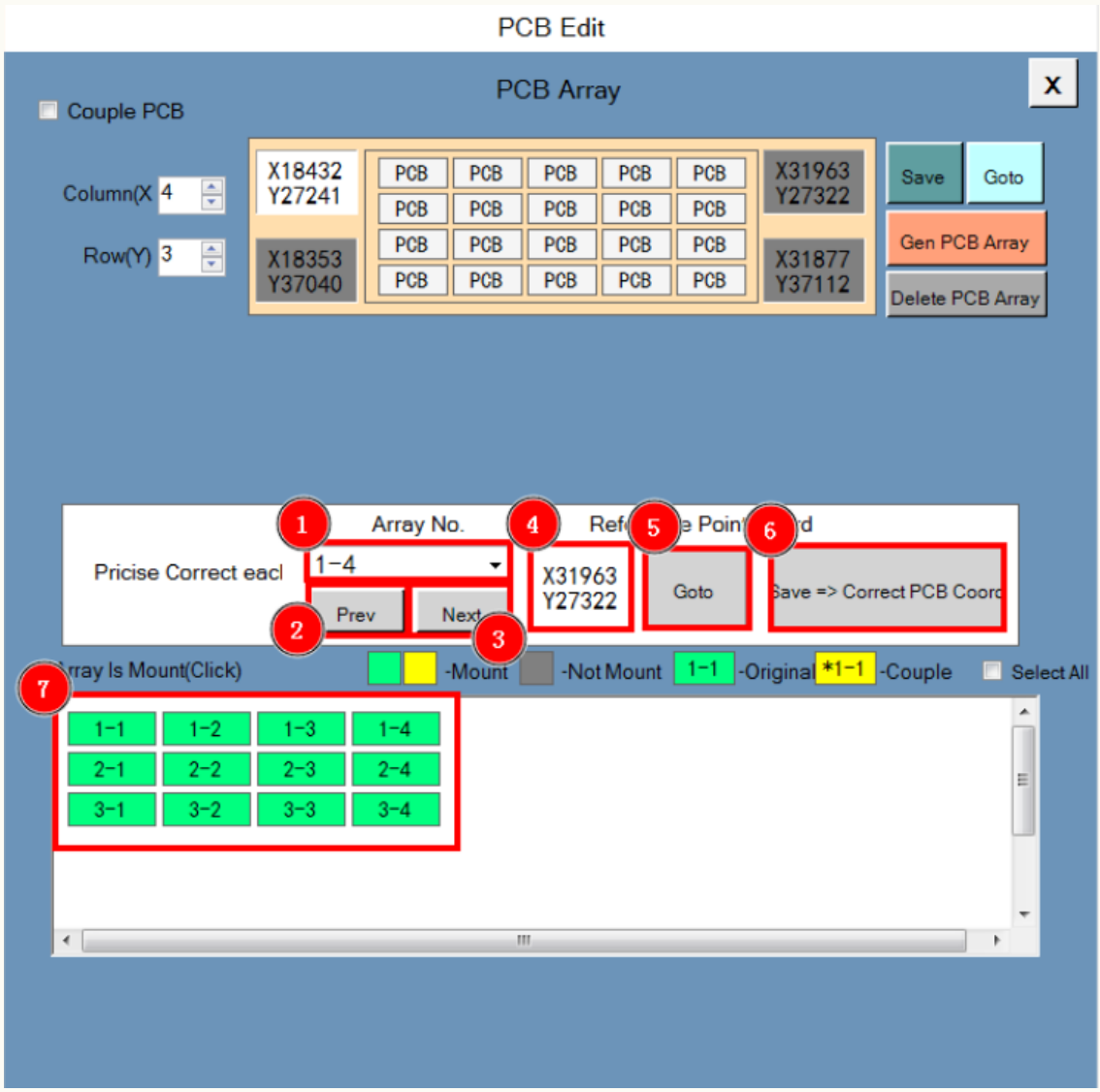


Figure 1.26: PCB Edit tab: PCB array verification

- **1:** Selected cell
- **2:** Previous cell
- **3:** Next cell
- **4:** Cell mark coordinates
- **5:** Move **Mark Cam** to cell mark
- **6:** Save **Mark Cam** coordinates to cell mark
- **7:** PCB array overview

1.9.4 Mark calibration

After going through the previous steps the user must configure panel marks. Panel Marks are fiducial marks found on the PCB Panel rails.

Panel marks are also called **global fiducial marks** as opposed to local fiducial marks that are found on the individual PCBs which we used to calibrate the machine in **section 1.9.2**.
Clicking on the **"Mark Setting"** button will open the Panel Mark calibration menu.

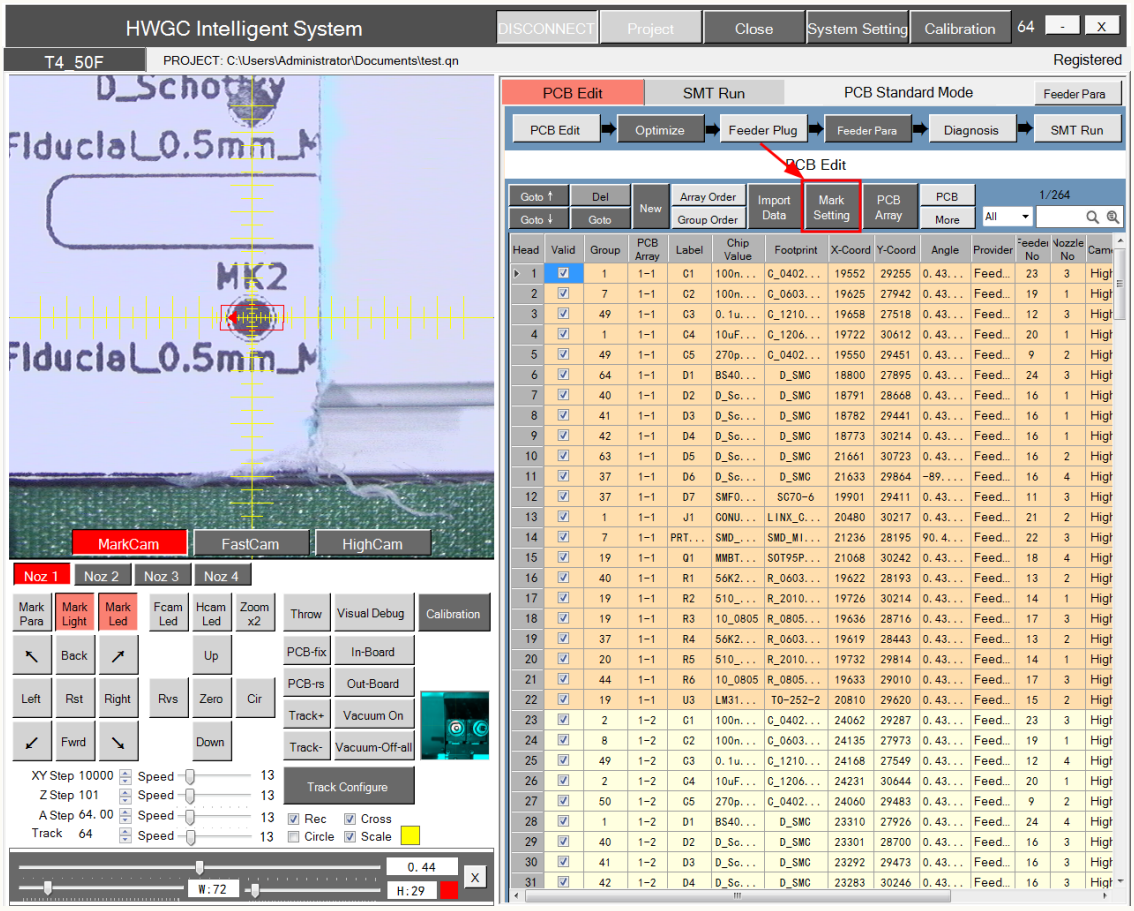


Figure 1.27: PCB Edit tab: Mark Setting button

Following the same logic as local fiducial mark calibration, the user must point the **Mark Cam** at the two fiducial marks on the PCB Panel rails. The marks must be on opposite ends of each other.

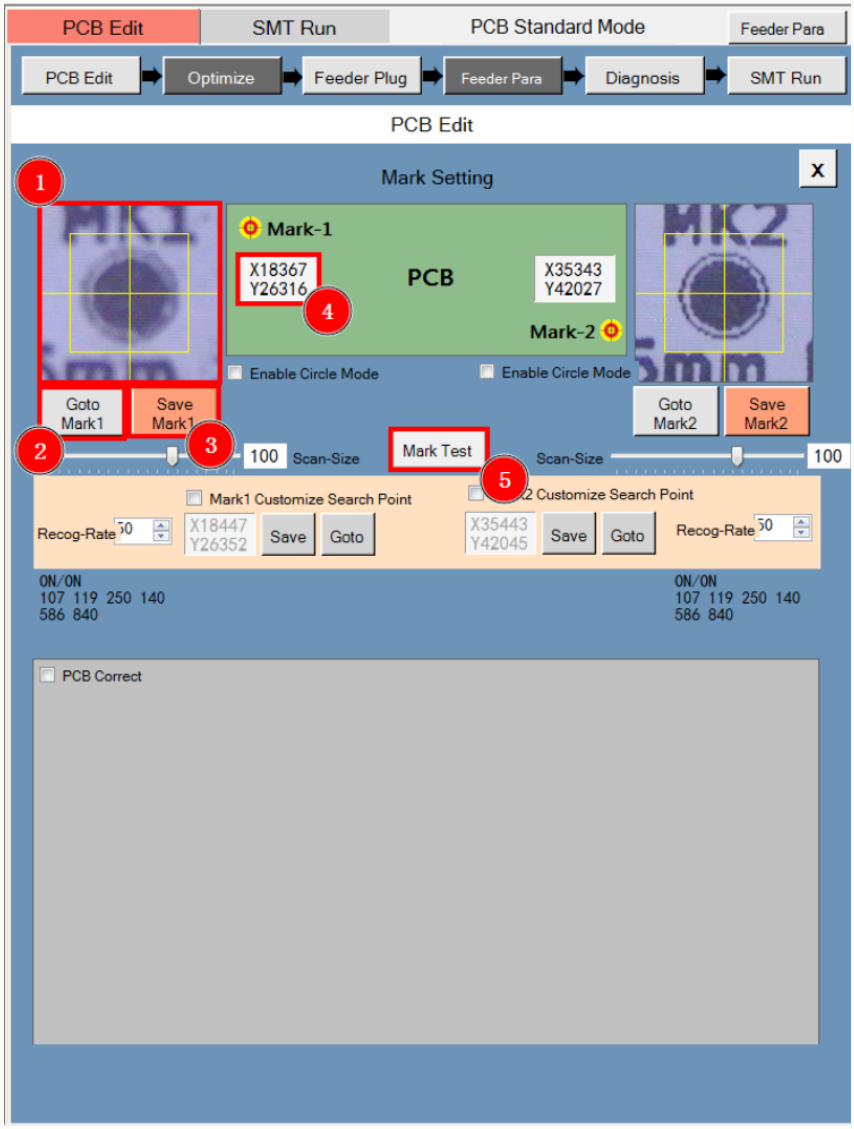


Figure 1.28: PCB Edit tab: Panel Mark calibration

- **1:** Mark snapshot
- **2:** Go to mark
- **3:** Save **Mark Cam** coordinates to mark
- **4:** Mark coordinates
- **5:** Initiate Mark test

Mark test

The **Mark test** is an automated test that allows the user to verify mark config, this is particularly useful when reloading the project for subsequent use.

1.10 Feeder setup and calibration

1.10.1 How to setup a tape feeders

Throughout this section we will be using the **YMH-EF8-0000** Electric feeder. The pick and place machine sends the same signals to both pneumatic and electric feeders so we don't need to worry about differences between the two.

Figure 1.29: The YMH-EF8-0000

Step 1: Choosing the right tape

Every feeder setup starts with picking the right tape. Our feeder is compatible with 8mm tape. For components that only come in larger tapes, we might have to pick another feeder. Standard tape sizes are:

- **8 mm Tape:** This is the most common size and is typically used for small passive components like resistors, capacitors, and small ICs (Integrated Circuits).
- **12 mm Tape:** Used for slightly larger components such as larger capacitors, ICs, and connectors.
- **16 mm Tape:** Suitable for medium-sized components, including larger ICs and some connectors.
- **24 mm Tape:** Used for even larger components, such as large ICs, connectors, and modules.
- **32 mm Tape:** This size is often used for large connectors, power components, and some mechanical parts.
- **44 mm Tape:** Suitable for very large components and mechanical parts.
- **56 mm Tape:** Used for very large components, modules, and certain mechanical assemblies.
- **72 mm Tape:** For extra-large components and assemblies, though less common in standard pick and place operations.
- **88 mm Tape and above:** These are used for special applications and very large components, and their use is less common.

Figure 1.30: 8mm capacitor tape

Step 2: Peeling the cover tape

Start by peeling around 37cm of the cover tape (The translucent film covering the carrier tape). This will serve to help the feeder automatically pull the cover tape back as it advances the **carrier tape**.

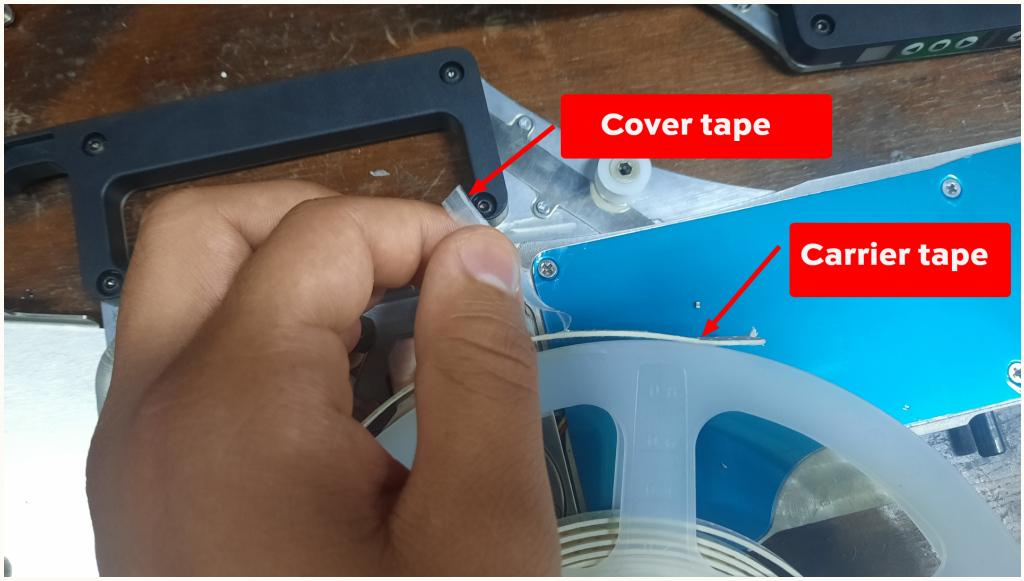


Figure 1.31: Peeling the cover tape

Step 3: Installing the reel in the feeder's base

Install the reel in the feeder's base, it should be supported by a roll axis which helps it smoothly roll when the tape advances forward.

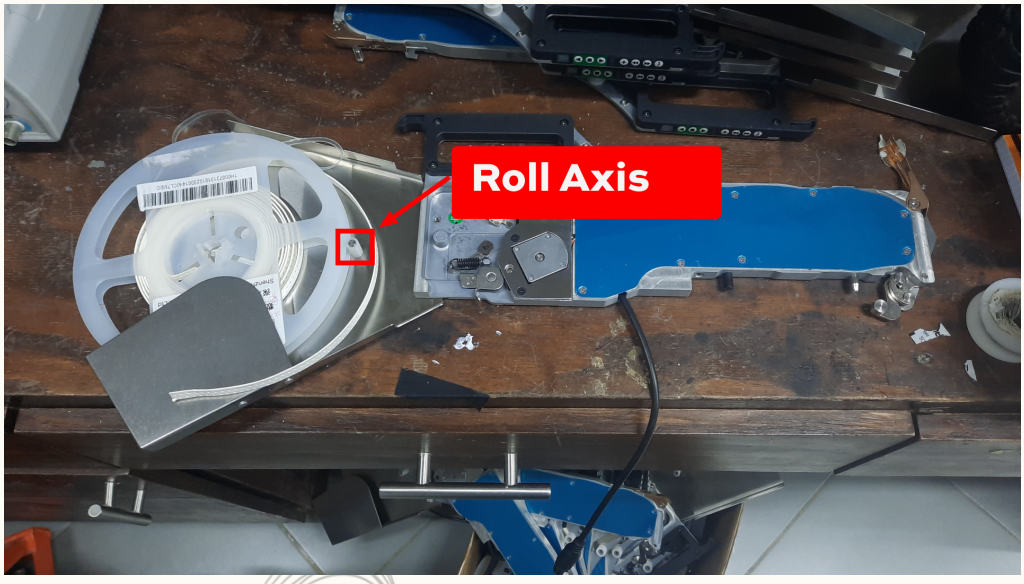


Figure 1.32: Installing the reel in the feeder's base

Step 4: Open the front latch

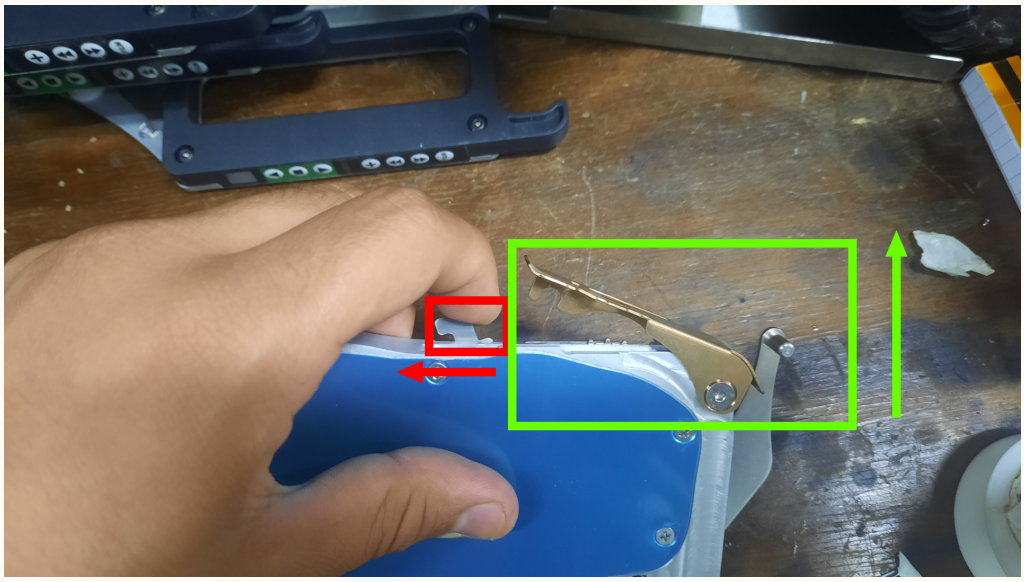


Figure 1.33: Opening the front latch

Step 5: Pass the carrier tape through the latch

Figure 1.34: Passing the carrier tape through the latch

Step 6: Close the front latch

Note: It is important to pass the cover tape by the opening shown in the photo

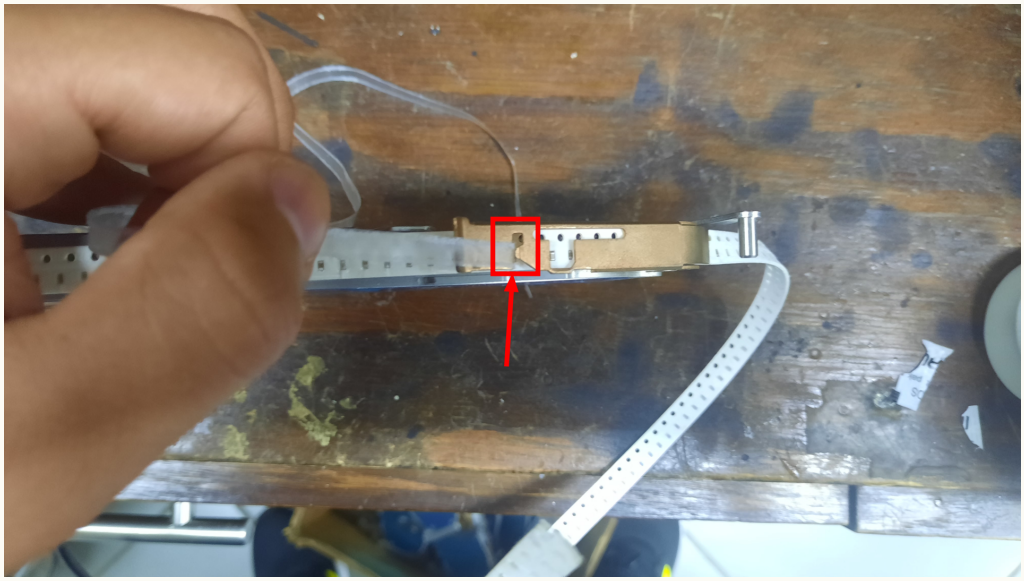


Figure 1.35: Closing the front latch

Step 7: Loop back the cover tape

The cover tape must be looped back to the cover tape peeling mechanism (the tape must be enclosed between the two gears).

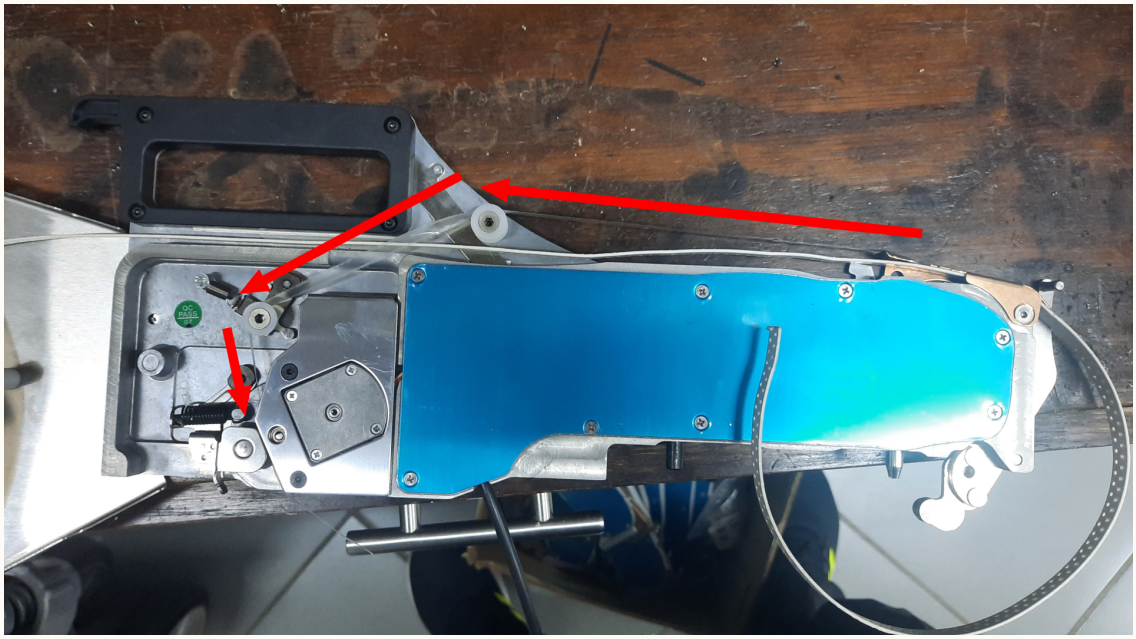


Figure 1.36: Cover tape loopback trajectory

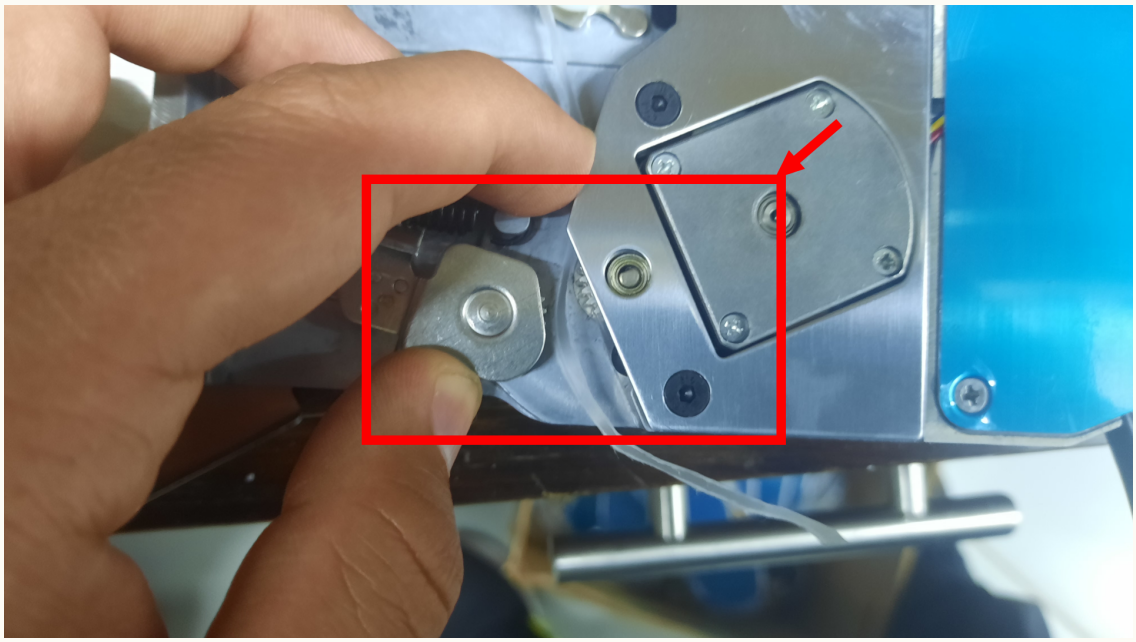


Figure 1.37: Cover tape peeling mechanism

Step 8: Mount the feeder

Place the two alignment pins in the corresponding holes on the pick and place machine to mount it in the chosen slot.

Figure 1.38: The feeders' alignment pins

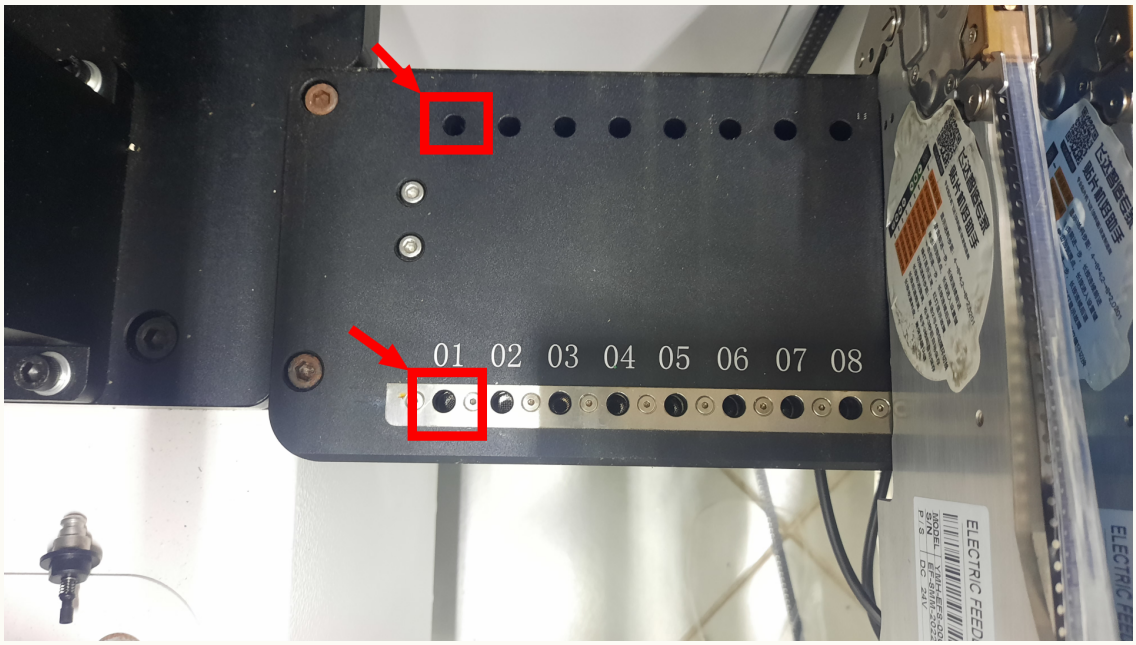


Figure 1.39: Feeder slot 1 alignment holes

Step 9: Lock in the feeder

Push the locking latch in the direction indicated by the photo to lock the feeder in.

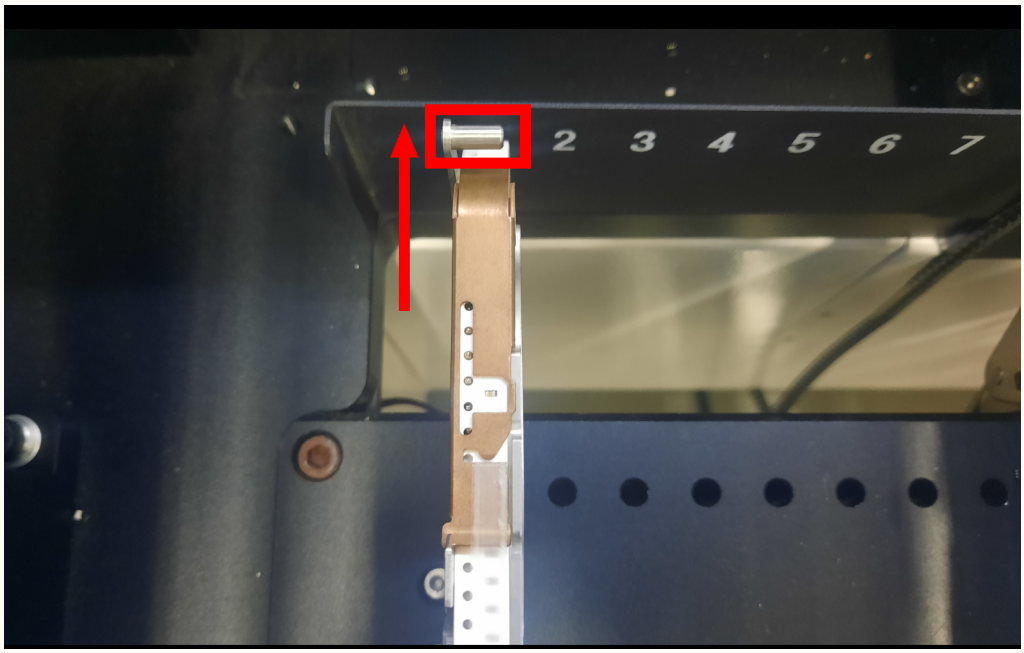


Figure 1.40: Locking in the feeder

Step 10: Plug the feeder in

Note: It is important to connect the feeder to the plug corresponding to its slot in the pick and place machine. The plugs for even numbered slots are placed high, and odd numbered slot plugs are placed low.

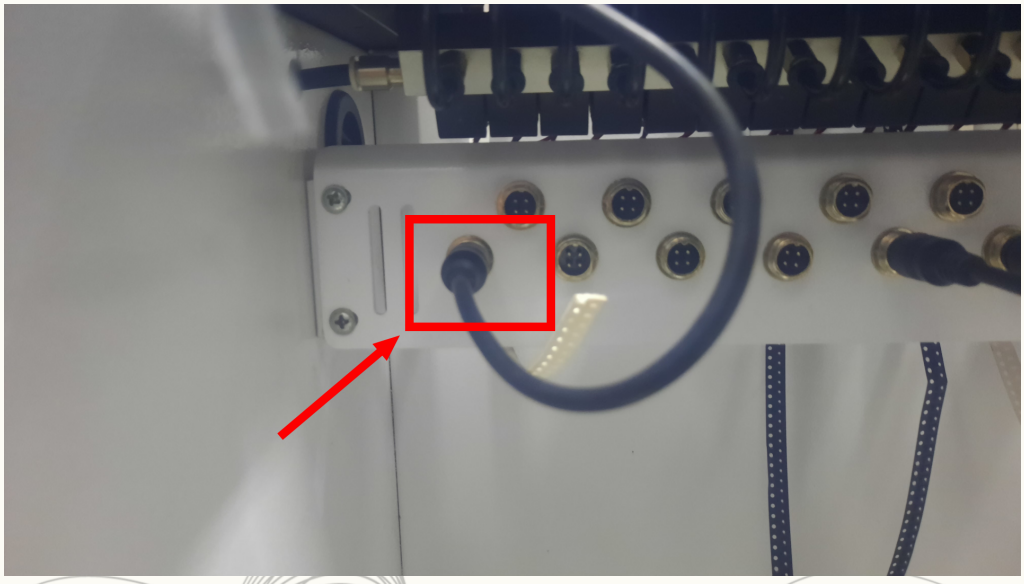


Figure 1.41: Plugging in the feeder in the feeder

1.10.2 Feeder controls

Figure 1.42: Feeder front controls

- **1:** Current step mode (4: full step, 2: half step)
- **2:** Step forward
- **3:** Center carrier tape
- **4:** Step backward
- **5:** Switch step mode
- **6:** Micro step forward (advances tape slowly)
- **7:** Micro step backward
- **8:** Pull cover tape

1.10.3 Feeder optimization

By clicking on **"Optimize"** a feeder optimization dialog pops up.
The user must fill the **Provider**, **Noz** , **Camera**, **Visual** and **Loop Mode**. Let's explain what some of these columns are:

- **Provider:** Meaning the type of feeder that will be providing the component.
- **Noz:** The nozzle size compatible with the component's package.
- **Camera:** The camera responsible for component recognition.
- **Loop Mode:** Refers to the control algorithm used for the pick and place process.

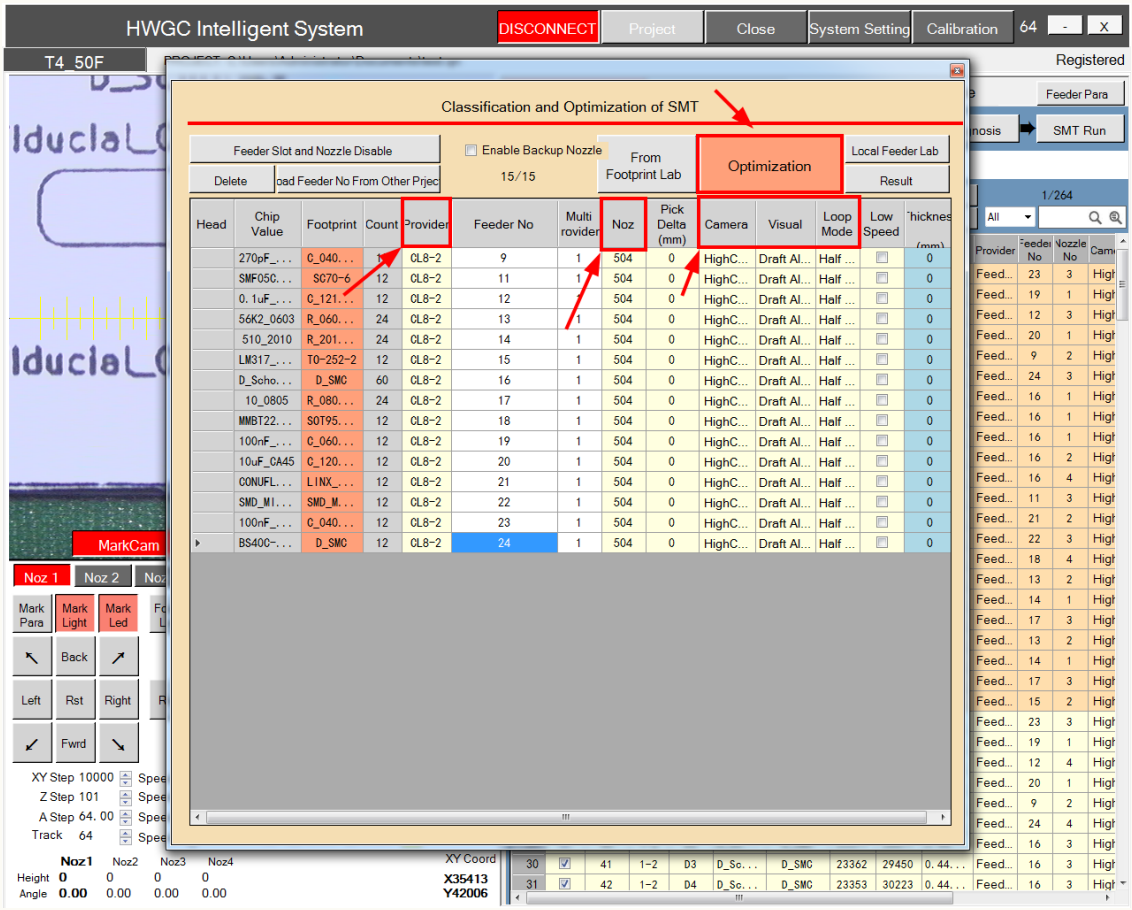


Figure 1.43: Feeder optimization window

Clicking on the **"Optimization"** button will associate each component feeder with an optimal feeder slot, to miminize travel distance and pick time.

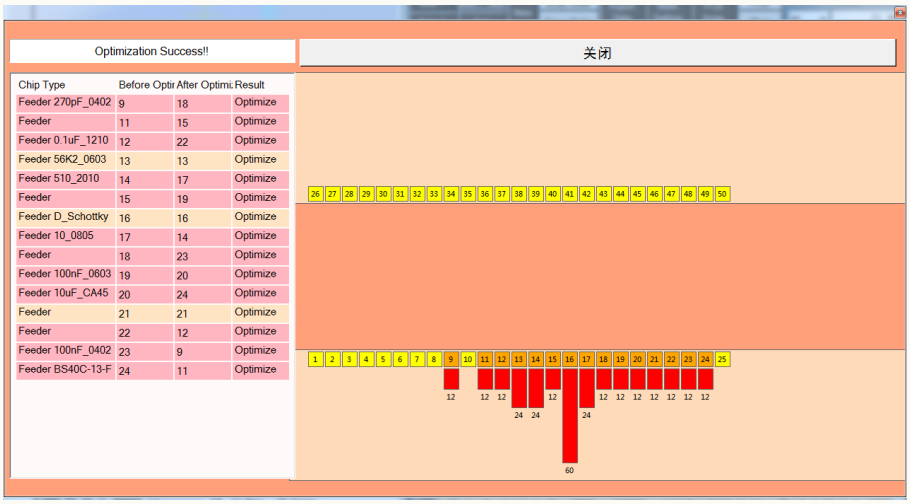


Figure 1.44: Generated feeder/slot association

Closing this window, the table will be updated with the new feeder/slot values. The

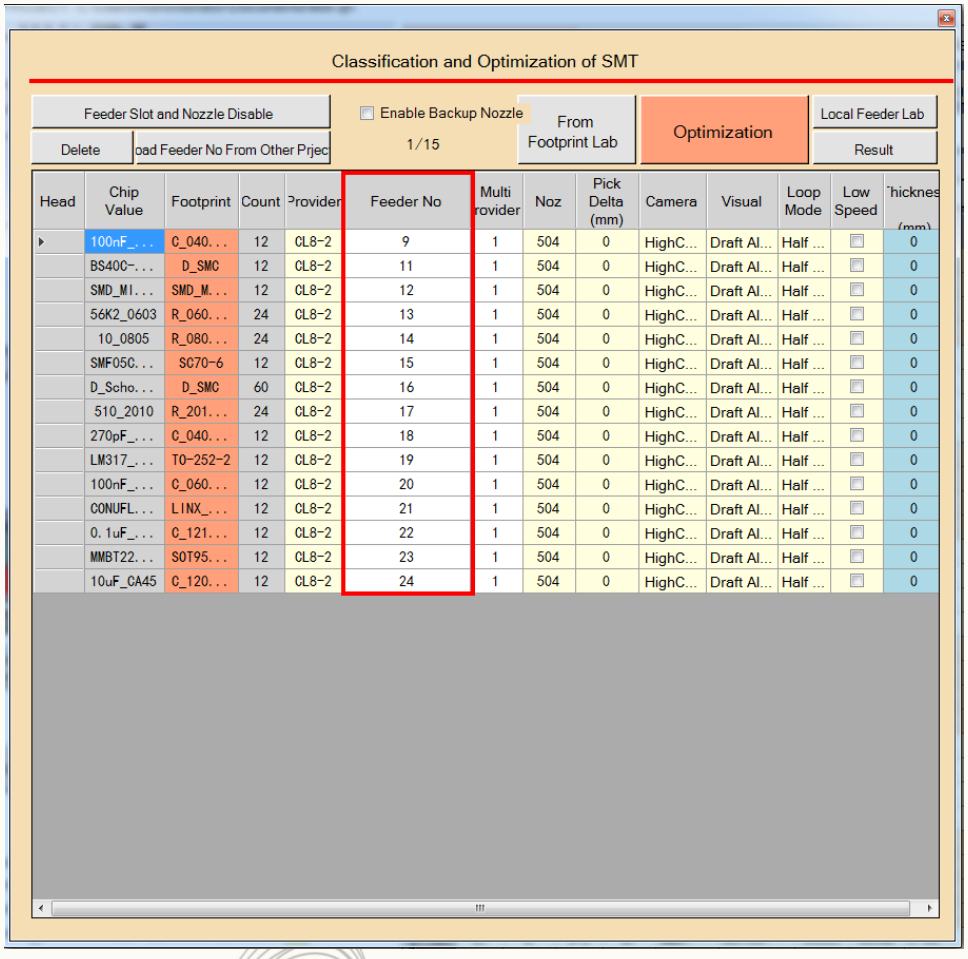


Figure 1.45: Feeder optimization table

user must then manually insert every feeder into the appropriate slot.

1.10.4 Feeder calibration

After clicking on the **"Feeder Para"** button the user will be presented with the following configuration window.

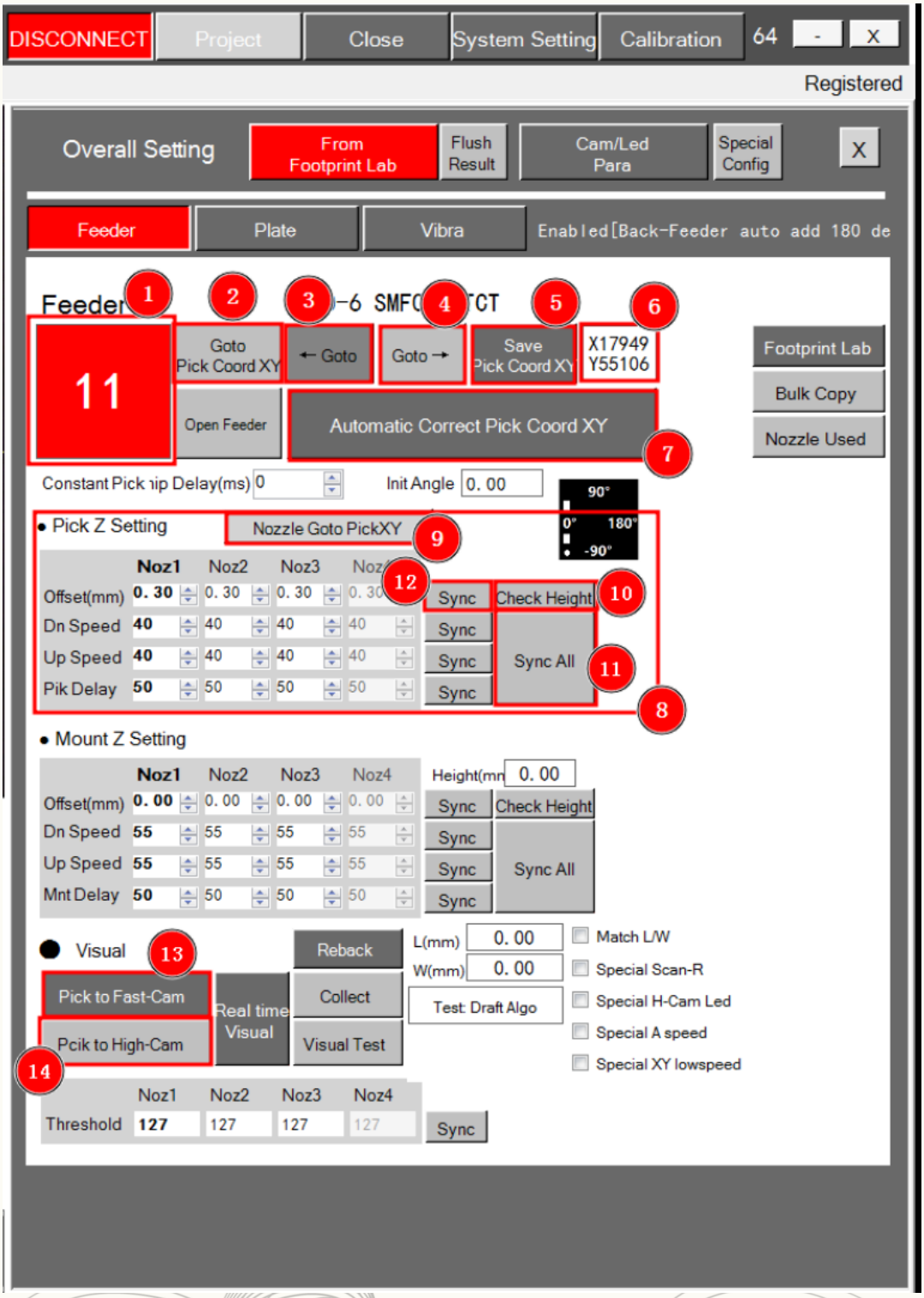


Figure 1.46: Feeder calibration tab

Here's a quick rundown on some important items labeled 1 to 14 on the image:

- **1:** Current feeder
- **2:** Move **Mark Cam** to feeder coordinates.
- **3:** Go to previous feeder.
- **4:** Go to next feeder.
- **5:** Set current **Mark Cam** coordinates as feeder coordinates.
- **6:** Feeder coordinates.
- **7:** Automatic feeder coordinate calibration helper.
- **8:** Placement head pick up height settings.
- **9:** Move current nozzle to feeder coordinates.
- **10:** Descend nozzle to configured pick up height
- **11:** Sync all fields across nozzles.
- **12:** Sync field across nozzles.
- **13:** Pick up component to **Fast Cam** for visual inspection.
- **14:** Pick up component to **High Cam** for visual inspection.

The feeder calibration process is relatively straight forward. If the machine's calibration hasn't been tampered with, only minor adjustments are necessary.

Step 1: Verifying the feeder's XY coordinates

To verify the feeder's XY coordinates, the user must click on the **"Goto Pick Coord XY"** button to go. This should move the **Mark Cam** to where the component is on the feeder. If your feeders' pick coordinates are well calibrated, your **Mark Cam** view should look like this:

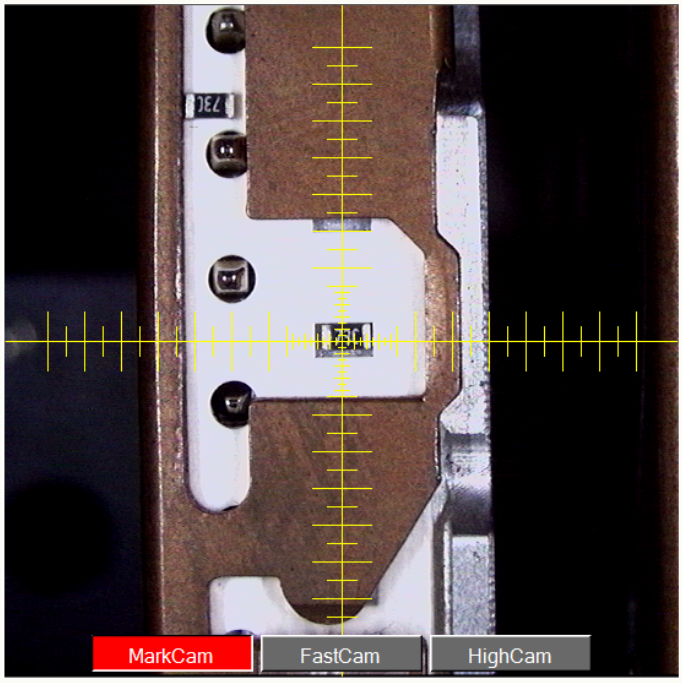


Figure 1.47: A well calibrated feeder XY pick coordinates

If your XY coordinates are slightly off, you can use the automatic feeder coordinates calibration helper. All you need to do is specify the tape's color.

Figure 1.48: The automatic feeder coordinates calibration helper

Just press the **"Stack X Feeder"** (X being the stack's slot number in this case 13). Hit **"save"** when the **Mark Cam**'s crosshair is centered on the component and your feeder should be calibrated.

Step 2: Visual inspection

In the ”Visual” section of the feeder calibration tab. The user can setup and run visual inspections using either the **High Cam** or the **Fast Cam**.

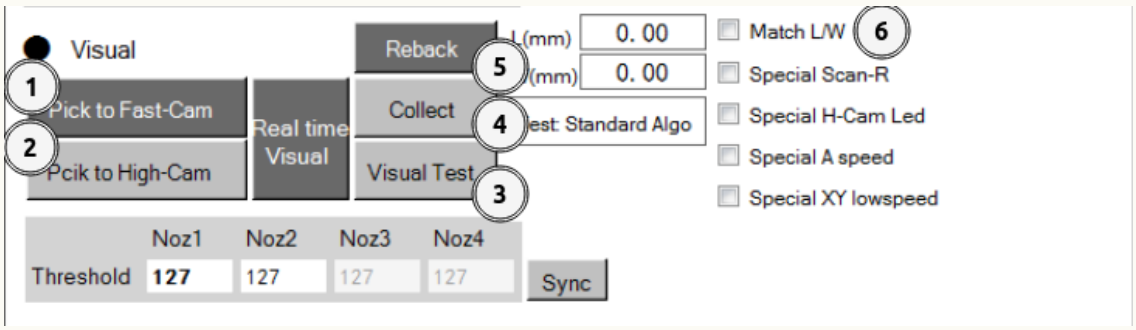


Figure 1.49: The ”Visual” section

- **1:** Start **Fast Cam** component inspection.
- **2:** Start **High Cam** component inspection.
- **3:** Run inspection.
- **4:** Pick up component from feeder.
- **5:** Put component back into feeder.
- **6:** Assert matching between component and footprint dimensions.

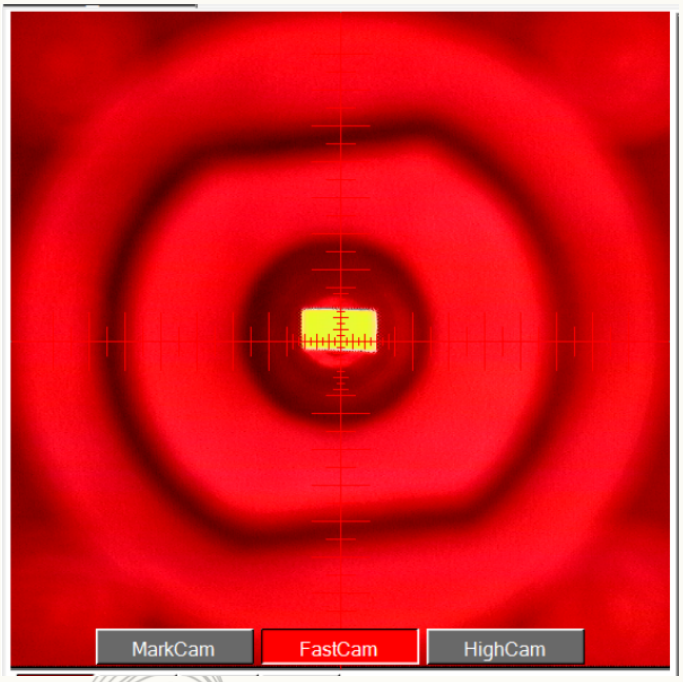


Figure 1.50: Visual inspection example

If your visual inspection fails, try changing the scan radius, threshold and camera light levels in camera settings.

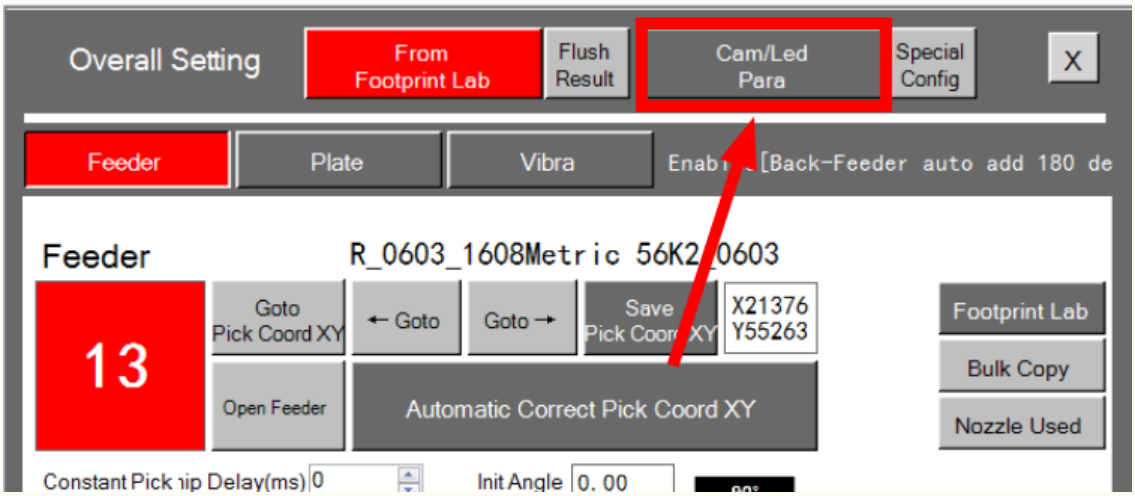


Figure 1.51: Camera configuration button

By clicking on the snapshot you can view the visual inspections' result. This is especially helpful when trying to diagnose a failed visual inspection.

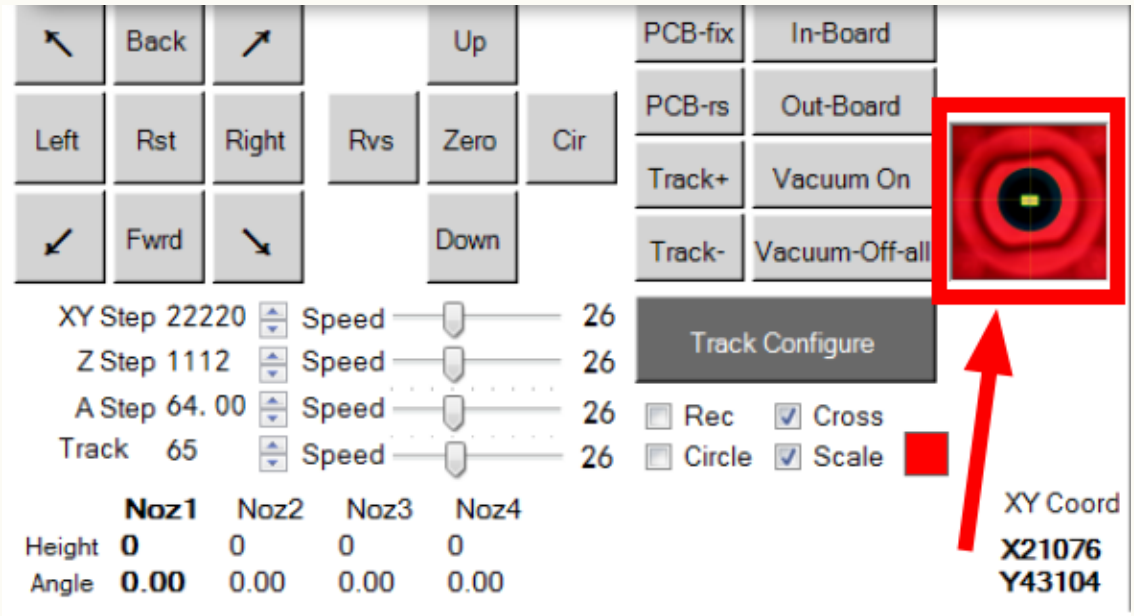


Figure 1.52: Visual inspection snapshot

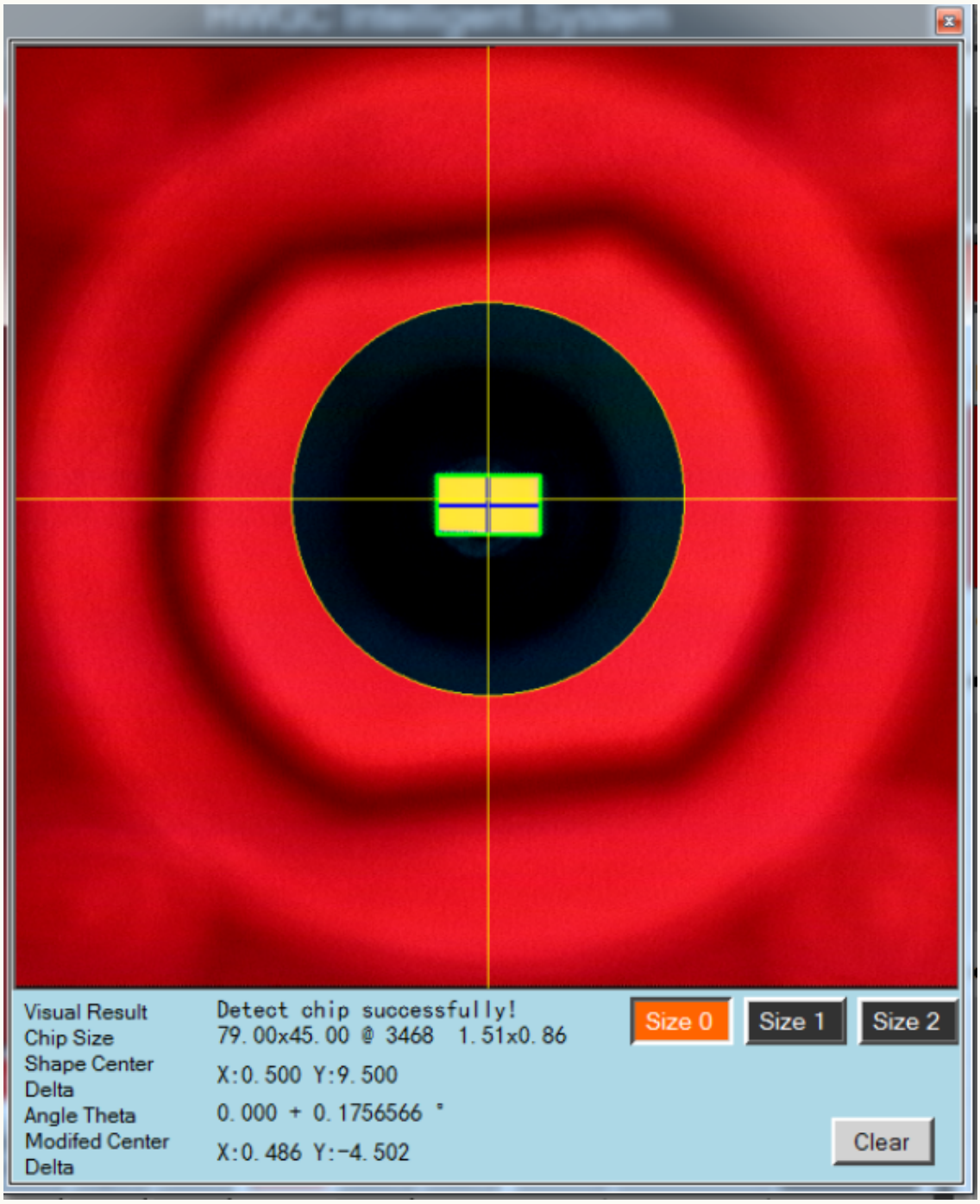


Figure 1.53: Successful visual inspection result

You can click on **"Size 0"**, **"Size 1"** and **"Size 2"** to switch between zoom levels. After the visual inspection succeeds the feeder is good to go.

1.10.5 Calibrating PCB height

Lower the nozzles until they touch the PCB then hit **"Save"** to calibrate PCB height

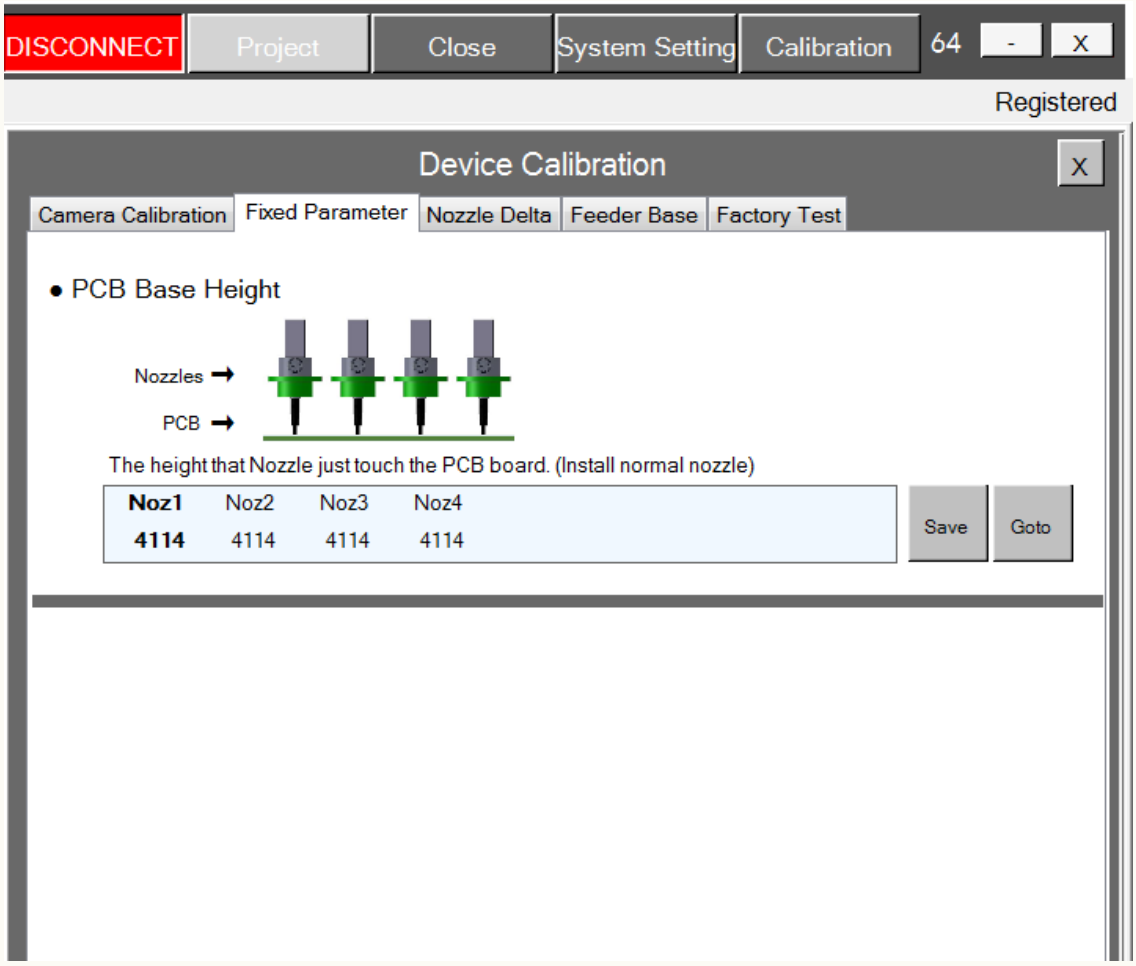


Figure 1.54: PCB Height Calibration

1.10.6 Running jobs

To navigate to jobs tab click on **”SMT Run”**.

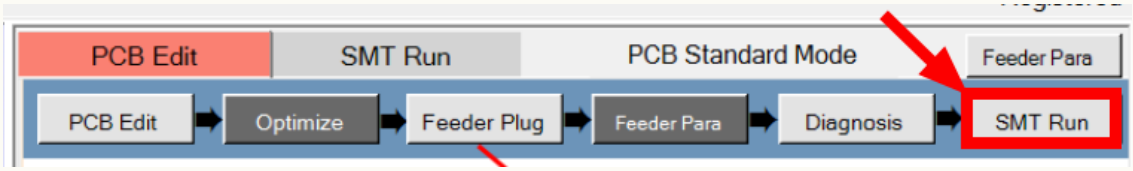


Figure 1.55: The **”SMT Run”** button

This should take you to the job tab, on which you can configure different parameters relating to your pick and place jobs, and launch/stop a job.

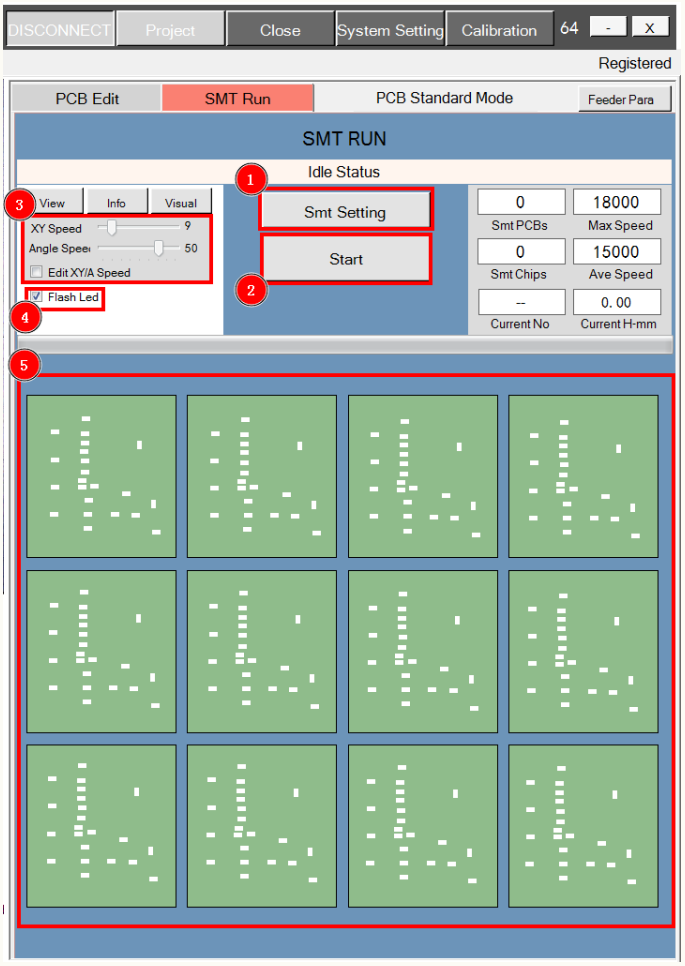


Figure 1.56: The job tab

- **1:** Configure job.
- **2:** Start job.
- **3:** Change pick and place arm speed & nozzle rotation speed.
- **4:** **Fast Cam** & **High Cam** LEDs only turn on when a visual inspection is ongoing.
- **5:** PCB preview.

To configure the job before starting it click on **"Smt Setting"**, the following window will pop up:

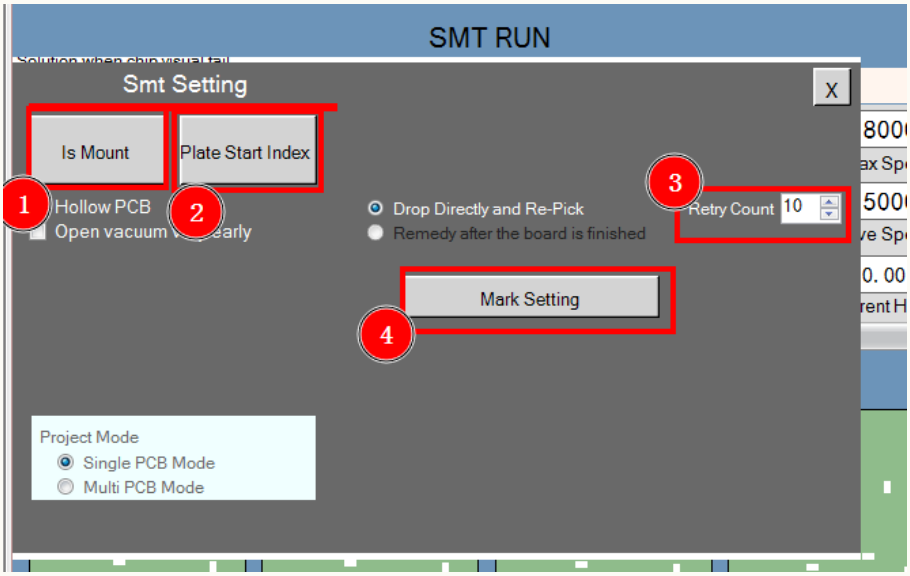


Figure 1.57: The job configuration window

- **1:** Select which feeder is mounted.
- **2:** Select plate feeder start index.
- **3:** Set the number of retries after a failed visual inspection.
- **4:** Set panel mark settings.

Sometimes not every feeder is mounted, which is accounted for in the Feeder selection window that is accessible by clicking the **"Is Mount"** button.
Check the box next to each feeder to mark it as mounted.

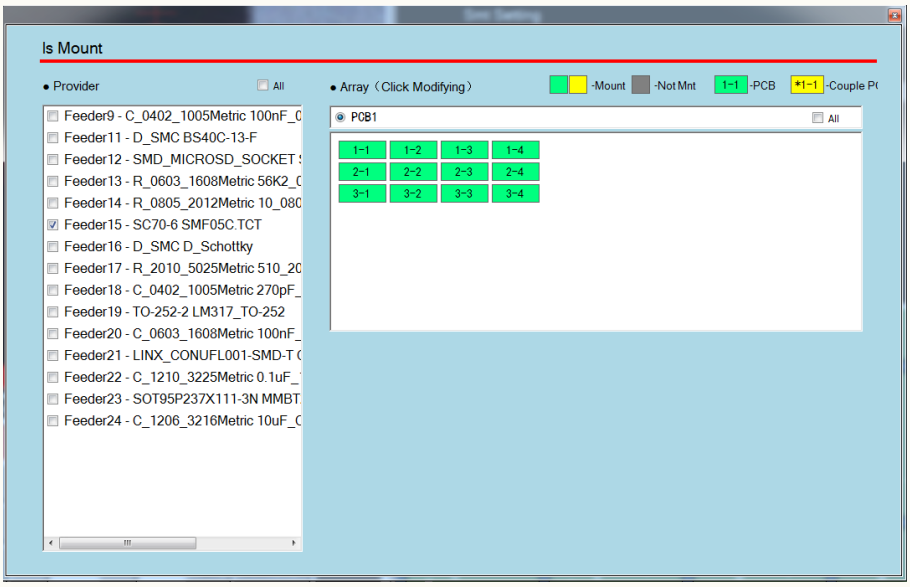


Figure 1.58: The feeder selection window

As for plate feeders. If the plate has been used in a previous pick and place job, the first component wont be on row 1 column 1 of the plate, hence the need for a configurable start index. This configuration window can be accessed by clicking the **"Plate Start Index"** button.

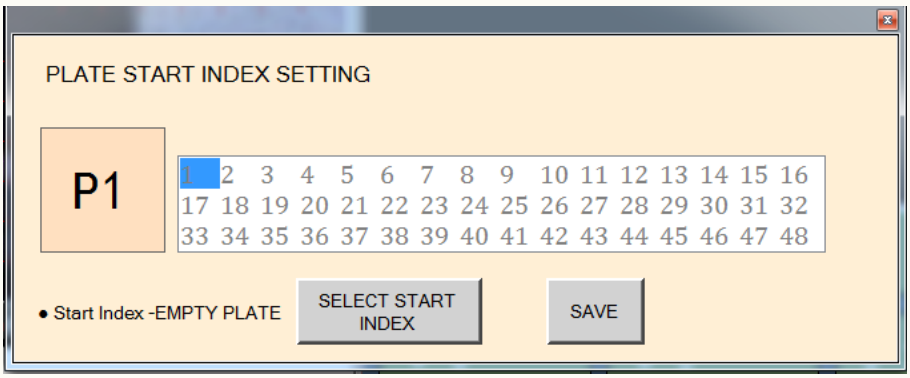


Figure 1.59: The plate start index configuration window

1.11 Troubleshooting

In this section we will go over commonly encountered problems and how to approach them.

Nozzles not picking up components (especially nozzle 3 and nozzle 4)	Check the supplied pressure, the HW-T4-50F requires 100psa (or roughly 6 bars) for proper function
Feeder not advancing automatically	Most likely a compressor pressure issue, make sure the machine is being fed the aforementioned 100psa of pressure
One or more nozzles go to the incorrect feeder Pick XY coordinates despite the mark cam being calibrated properly	Nozzle Delta calibration issue, check the next section for details
There is an offset when picking to High/Fast Cam	Fast/High Cam calibration issue, check next section for details
Chip detection fails	Adjust the Camera Led intensity, range and threshold in the cam settings until it succeeds
Chip detection succeeds in feeder config but fails at SMT Run	Uncheck Match L/W in the feeder config window
High Cam doesn't show anything	Run visual test, click on fast or mark cam then switch back to high cam

1.12 Calibration and drift correction

1.12.1 Nozzle Delta calibration

The following procedure is used to correct drift between one or more nozzles and **Mark Cam**.

Step 1: install 503 or 504 nozzles on all placement heads

Step 2: Place a blank A4 paper

Place a blank A4 paper on the PCB track, support it with either an empty PCB or a tray so it wont cave in during calibration.

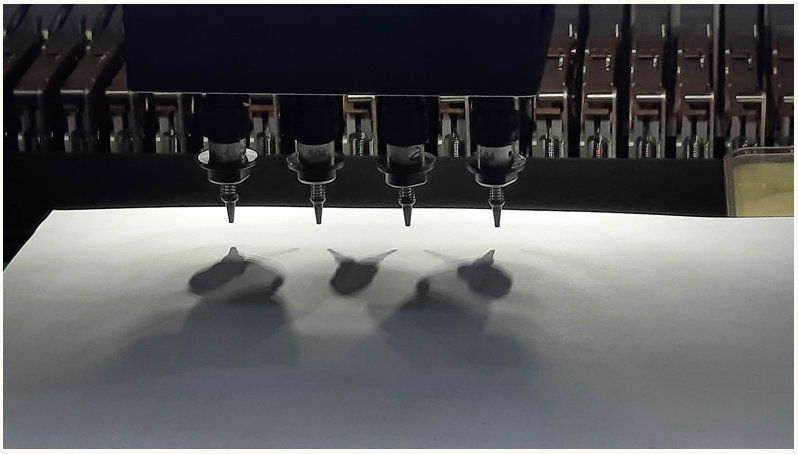


Figure 1.60: The A4 paper placed on the PCB track

Step 3: Place the ink pot

Place the inkpot at a place reachable by both the pick and place arm and nozzles.

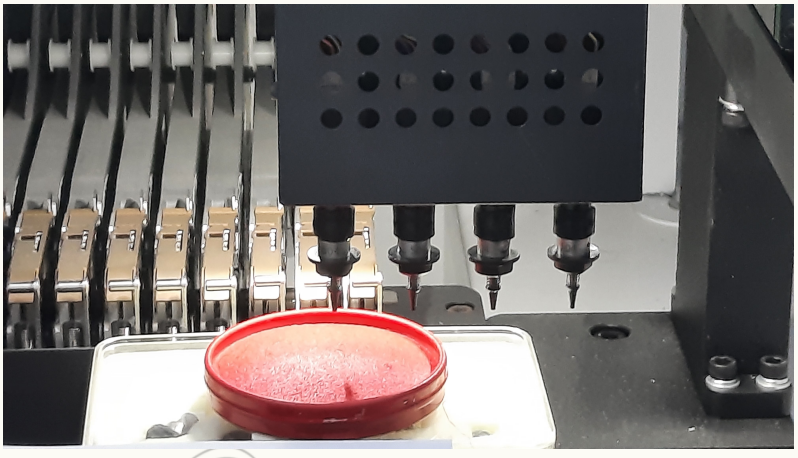


Figure 1.61: The inkpot placed on top of the High Cam

Step 4: Calibrate the write point and dip-ink coordinates

Place nozzle 1 at the center of the ink pot to get the **Dip-Ink Coord**. Then lower the nozzle until it touches the ink to get the **Dip-Ink Height**.
Then move nozzle 1 to the top left of the a4 (by a 10mm margin) to get the **Write-Point XY** and lower the nozzle until it touches the paper to get the **Write-Point H**.
You can sync the height across all nozzles by clicking the the **"Gen All Write-Point Height"** for **Write-Point H** and the **"Gen All Dip-Ink Height"** button for **Dip-Ink Height**.

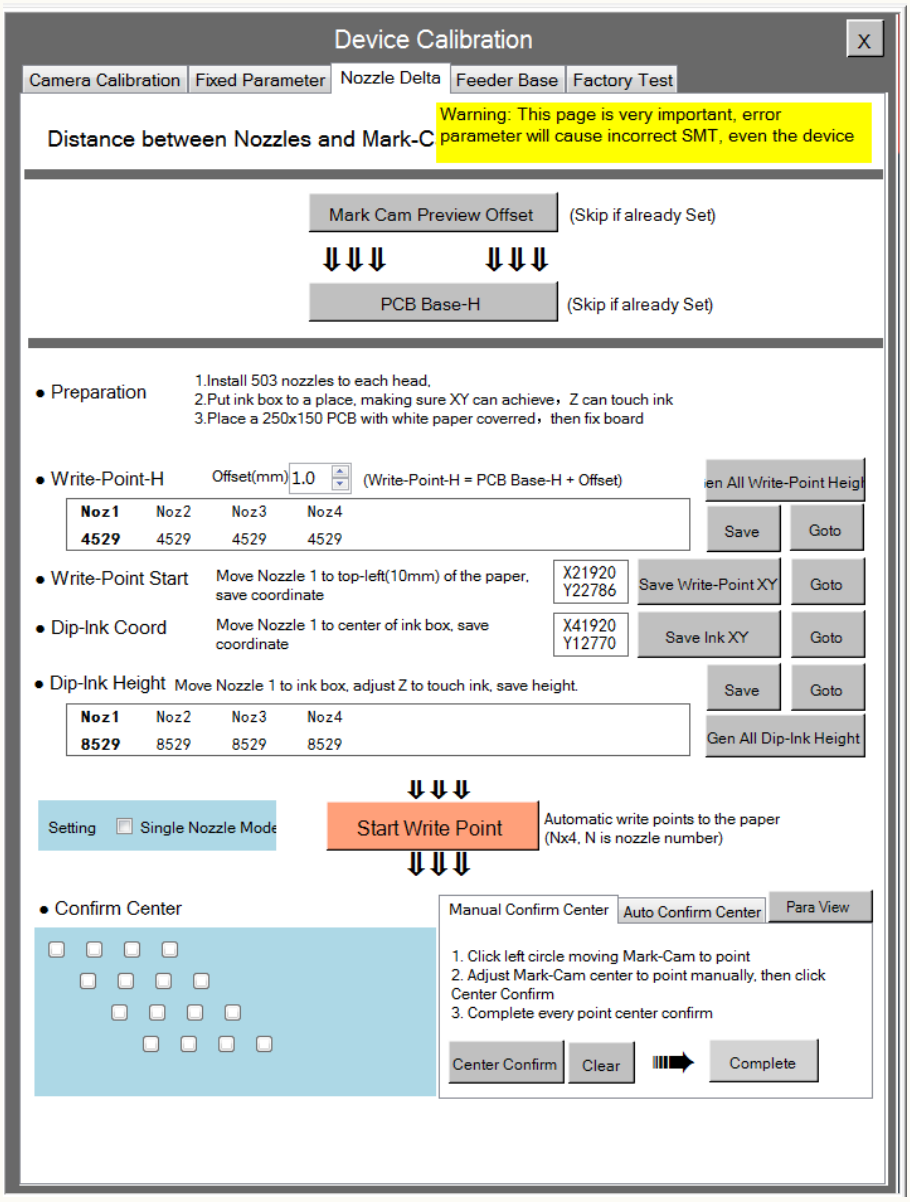


Figure 1.62: The Nozzle Delta calibration window

Step 5: Click ”Start Write Point”

This will start the calibration process, where each row of circles will be redrawn four times, the squares in the **Confirm Center** box will start fading to red. Wait until all rows are finished before proceeding

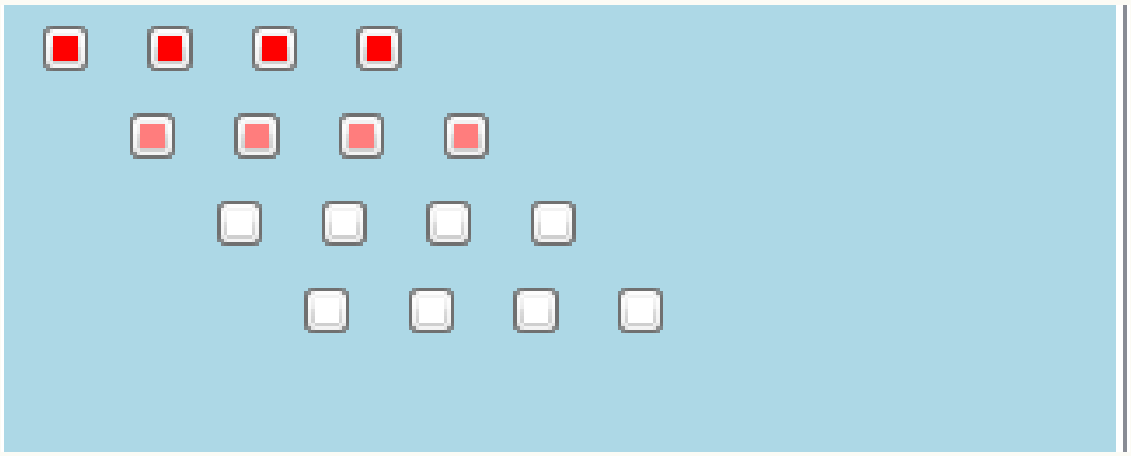


Figure 1.63: The Confirm Center box

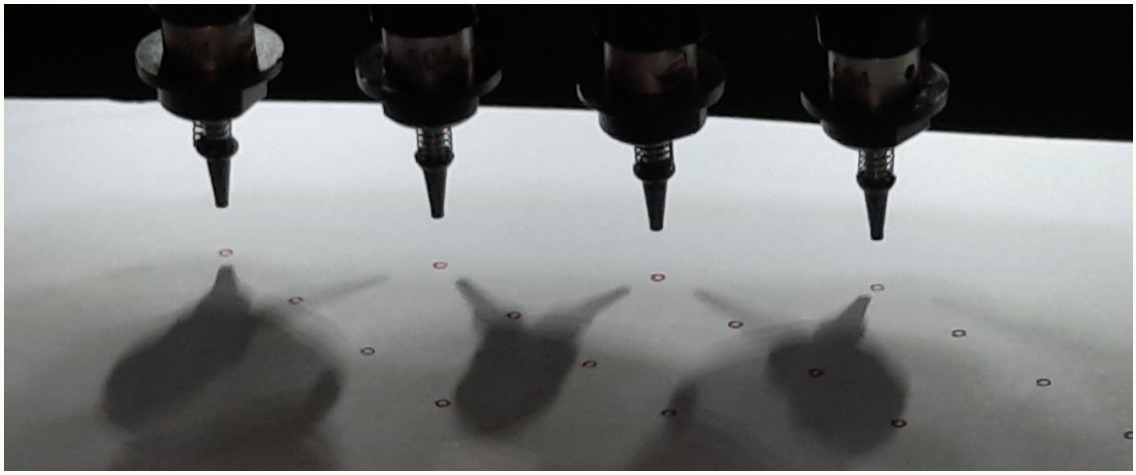


Figure 1.64: The circles drawn on the paper

Step 6: Center Confirm

Once the machine had stopped. The user must point the **Mark Cam** at the center of each circle.
Click on the uncalibrated (red) square to move the mark cam to where it thinks the corresponding circle is, then correct the offset by pointing the camera at the center of the circle. After doing so click on **"Center Confirm"**, the square will turn **green**, then move on to the next uncalibrated (red) square.

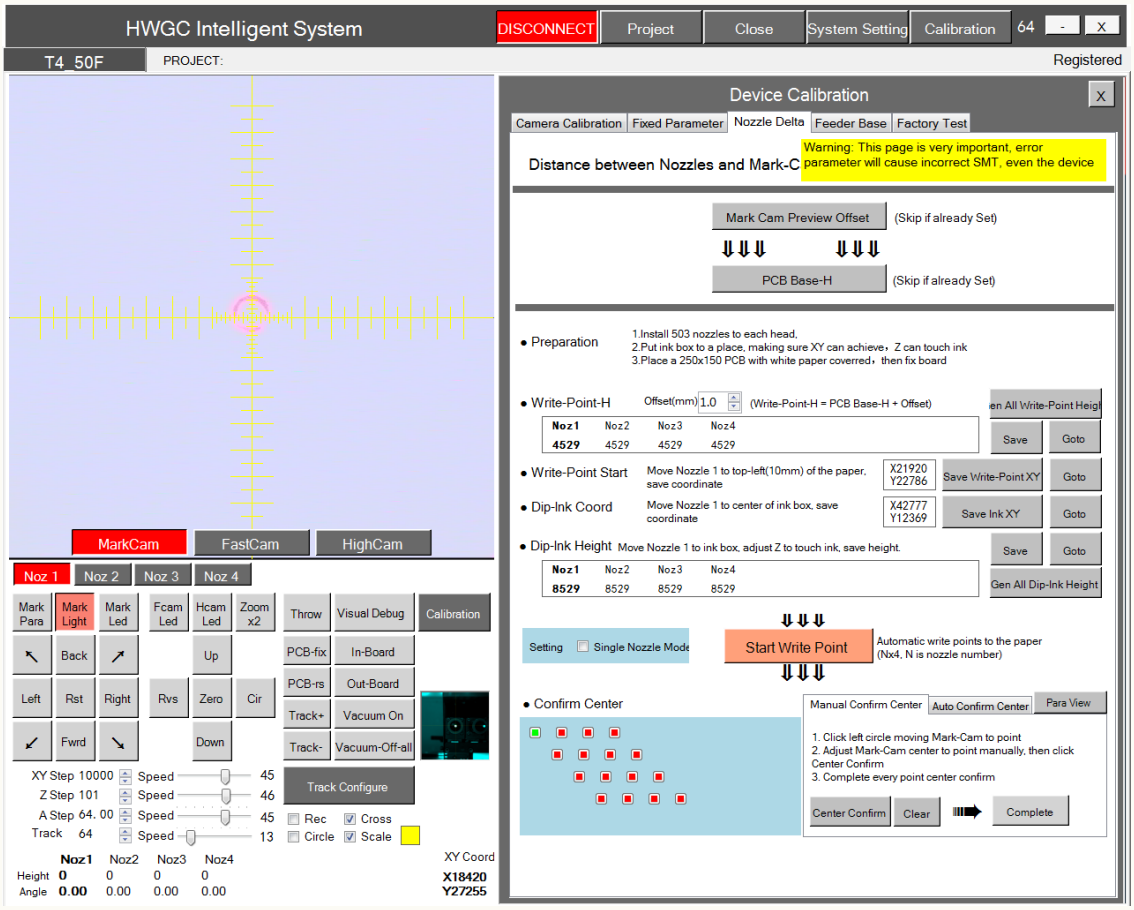


Figure 1.65: Nozzle Delta calibration

After calibrating all the points hit **"Complete"** to finish the Nozzle Delta calibration process.

1.12.2 High Cam/Fast Cam calibration

To correct the offset between nozzles and cam centers first start by installing **solid nozzles** on each of the placement heads. Solid nozzles are a special type of nozzle (with no spring or vacuum hole) used for calibration.

Figure 1.66: A solid nozzle

For the **High Cam**, calibration may be done on a per nozzle basis. Or in an automated manner.
For per nozzle calibration, place the desired nozzle near the **High Cam**s' cent and click **"Noz X Calibration"** with X being the selected nozzle number.
For auto calibration place nozzle 1 near the **High Cam**s' center and click **"Auto Calibration"**. This will calibrate all four nozzles without manual intervention.

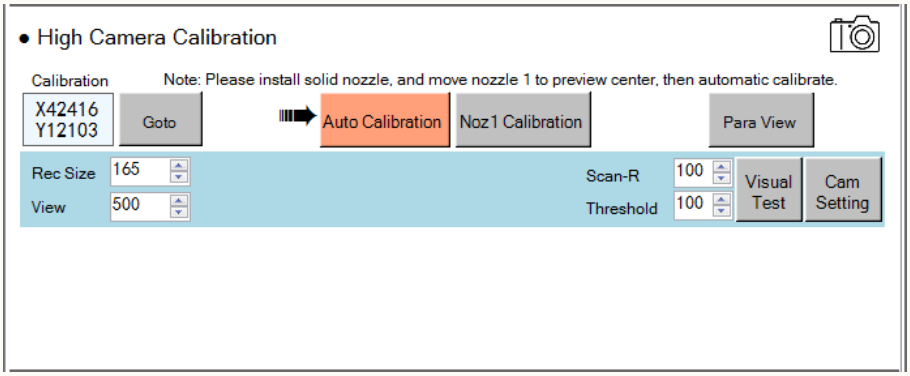


Figure 1.67: High Camera calibration

To calibrate the **Fast Cam** place nozzle 1 at the center of its' corresponding **Fast Cam** crosshair and click **"Auto Calibration"**.

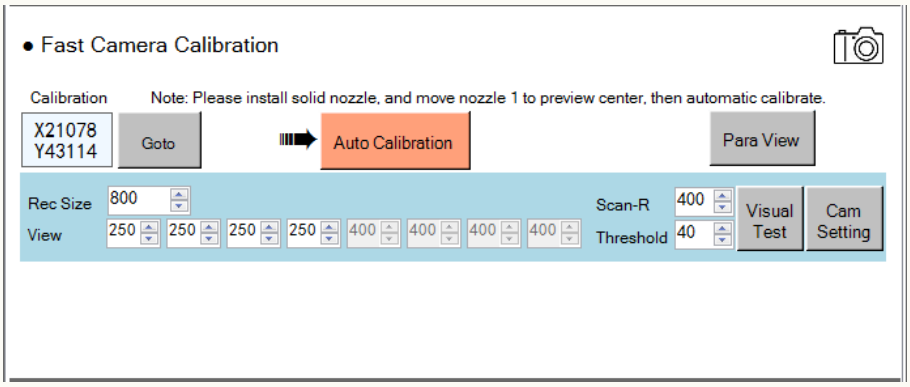


Figure 1.68: Fast Camera calibration

Note: Each nozzles takes around 2 and a half minutes to calibrate.