NEODEN USA

Neoden 4

CONFIGURATION/OPERATION MANUAL

Introduction and Overview

Please read this manual in its entirety before working on the machine.

1. INTRODUCTION

This manual covers installation, setup, customization, and operation of the Neoden 4 pick-and-place machine. Populating PCBs with surface mount technology (SMT) can be as challenging as the circuit design itself, and the Neoden 4 provides the user with all the tools necessary to work with a wide variety of components in a wide variety of packaging. The Neoden 4 is not a knock-off. It is an original design that has been engineered from the ground-up to provide simple, precise and flexible pick-and-place functionality. It is ideal for prototyping and small runs but is equally up to the task of producing large quantities of boards: the PCBs in all Neoden machines are made using a single Neoden 4. At its own factory, Neoden mills its own precision metal parts, winds its own motors for the feeders and peelers, writes its own proprietary software and assembles machines covered by over 50 patents. With ISO 9001 certification in pick-and-place quality control, Neoden rigorously tests each machine for days before shipping.

1.1. Design principles. At its core, the Neoden 4 is a 4-axis Windows-controlled CNC with four separate vacuum nozzles, each connected to its own vacuum pump. The machine employs a single X-Y coordinate system covering the entire movement range of the head, which is 310x500 mm. With resolution of .01 mm (10 μm) and repeatability of .02 mm (20 μm), any X-Y coordinate can be identified as the location of a feeder, the start of an array of components in a tray or short tape, a fiducial mark or the location at which a component is to be placed on a circuit board.

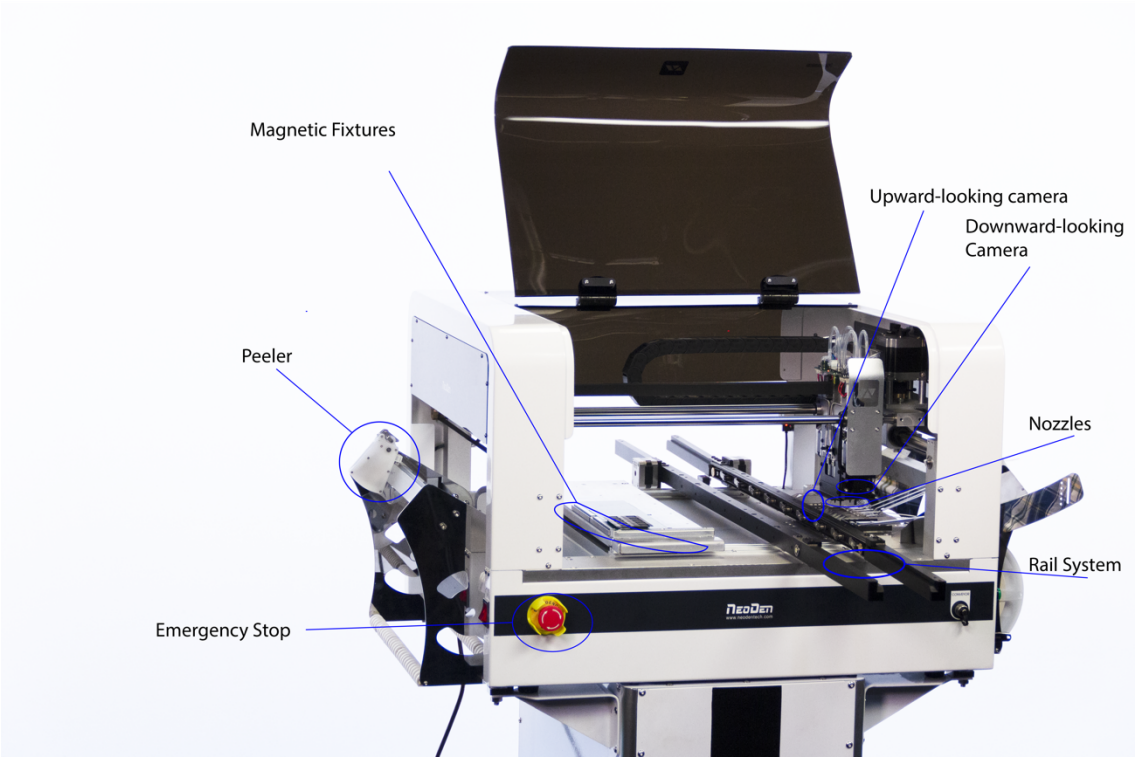


Figure 1

1.2. Feeders and Nozzles. Electric tape-and-reel feeders, vibration feeders and virtual tray feeders are all supported. Because of the flexibility of the architecture, and the need to work with affordable quantities of parts, short tapes can also be configured on the machine's bed. Any size nozzle can be installed in any of the four locations in the head, so a single machine can handle all of the necessary components without the need for nozzle changes.

The spring-loaded nozzles simply snap in and pull out of the head. Your Neoden 4 comes supplied with a nozzle kit containing a variety of sizes. The following nozzles are recommended for various component sizes:

	CN03	(0201)
	CN040	(0402)
	CN065	(0402, 0603)
	CN100	(0805, 1206, diodes transistors)
	CN140	(1206,1210,2512,3528 ,5630)
	XN22	(5050, SOP-8, SOIC)
	XN40	(TQFP ICS)
	XN75	(1 WATT LED)

Figure 2

1.2.1. Number of Feeders. The Neoden 4 can accommodate up to forty-eight 8 mm tape-and-reel feeders on its left and right rails, and any size feeder (8, 12, 16 and 24 mm) can be installed in any combination or order on the left and right sides of the machine. The electric feeders are inexpensive but sophisticated microprocessor-controlled units paired will tape peelers. In addition, the vibration feeder (included) can handle up to five separate tubes. The amount of space available for tray-fed components and short tapes depends on the available real estate on the table. Any area of the table may be used for components awaiting placement, or for the board under manufacture.

1.2.2. Component Thickness Limitations. When using tray-fed and short-tape components, the maximum allowable component height is 5 mm. When using tape-and-reel components, we recommend a maximum thickness of 1.8 mm for reliable operation.

1.3. Rail System. Machines equipped with the auto-loading rail system can accommodate boards from 15 mm to 270 mm in width, and 1500 mm in length. Even when the rail system is installed, any space left over on the table is still available for trays and short tapes. (The left rail can be moved to accommodate wide boards by removing the left table extension. In this case, a block of material should be affixed to the table base to raise the tray or short tape to the approximate height of the extension). The rail system allows automatic feeding of PCBs, automatic alignment of the board with the camera, and automatic ejection from the front of the machine or the rear. Rear-ejection is useful when the machine is connected to an optional conveyor that can deliver the finished board directly to the reflow oven or to another Neoden 4.

1.4. Vision System. The Neoden 4 features a high-precision, two-camera vision system. The cameras are made by Micron Technology and are precisely aligned to the nozzles using the single unified configuration/operation application that loads on power-on.

1.4.1. The **downward-looking camera** on the head is used for precision location of feeders and PCB placement points. The downward-looking camera also verifies proper board placement (and compensates for minor board-position inaccuracies) by auto-aligning the nozzles to multiple fiducial points on the board before

beginning actual pick-and-place operations. Once the coordinates are established, the semi-closed-loop stepper motors are able to repeat these locations to 20 μm accuracy without further need for this camera.

1.4.2. The **upward-looking camera** is located on the right side of the machine. When enabled, this camera first ensures that a component is attached to the proper nozzle. If the camera detects the absence of a component, the machine will make up to two additional attempts to pick a component before asking the user for further instructions. Once a component has been verified as "picked," the camera verifies its position relative to the nozzle. Because SMDs are small and light, and are held only loosely in their packaging, there can be a great deal of variation in the actual position of the component when it arrives in "pick" position and is lifted by the nozzle. The vision system computes the difference between the ideal and actual position (both X-Y and rotational), and then corrects for any error before precisely placing the component. Because the vision system continually corrects for even small errors in component position on the nozzle, very fine-pitch components (down to 0201) can be placed with repeatable accuracy once the correct coordinates are identified.

With these basic understandings, the following images reveal the basic components of the Neoden 4:

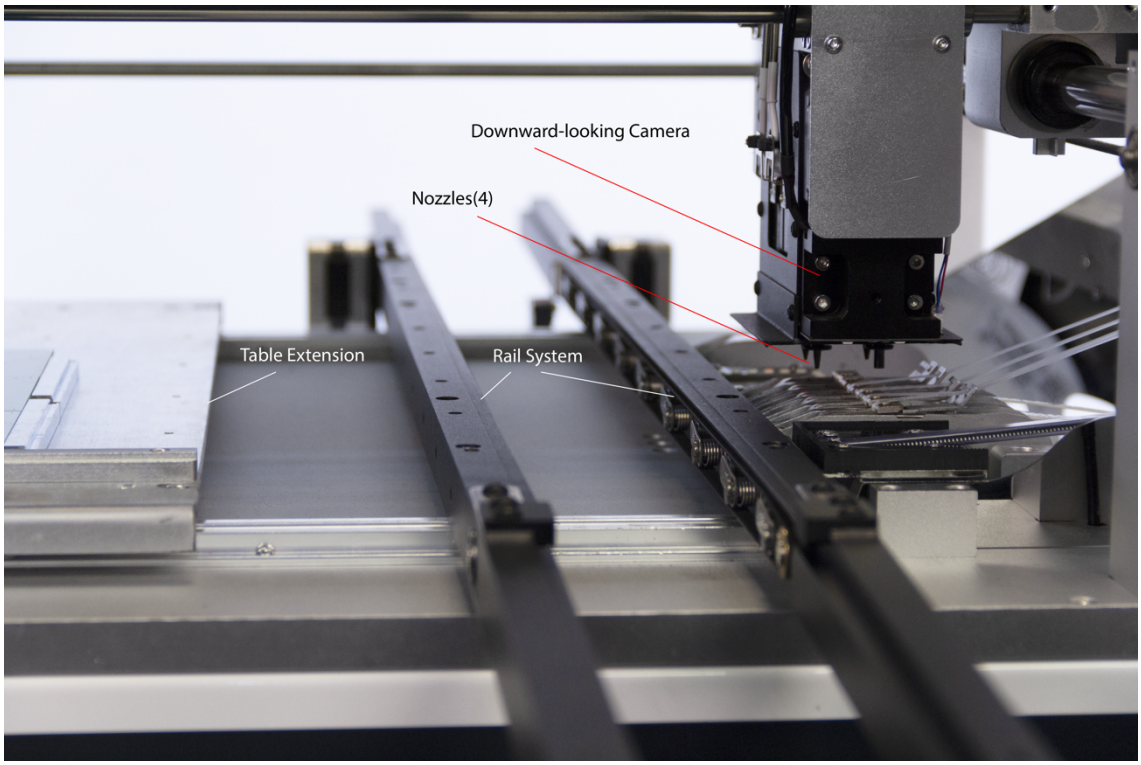


Figure 3

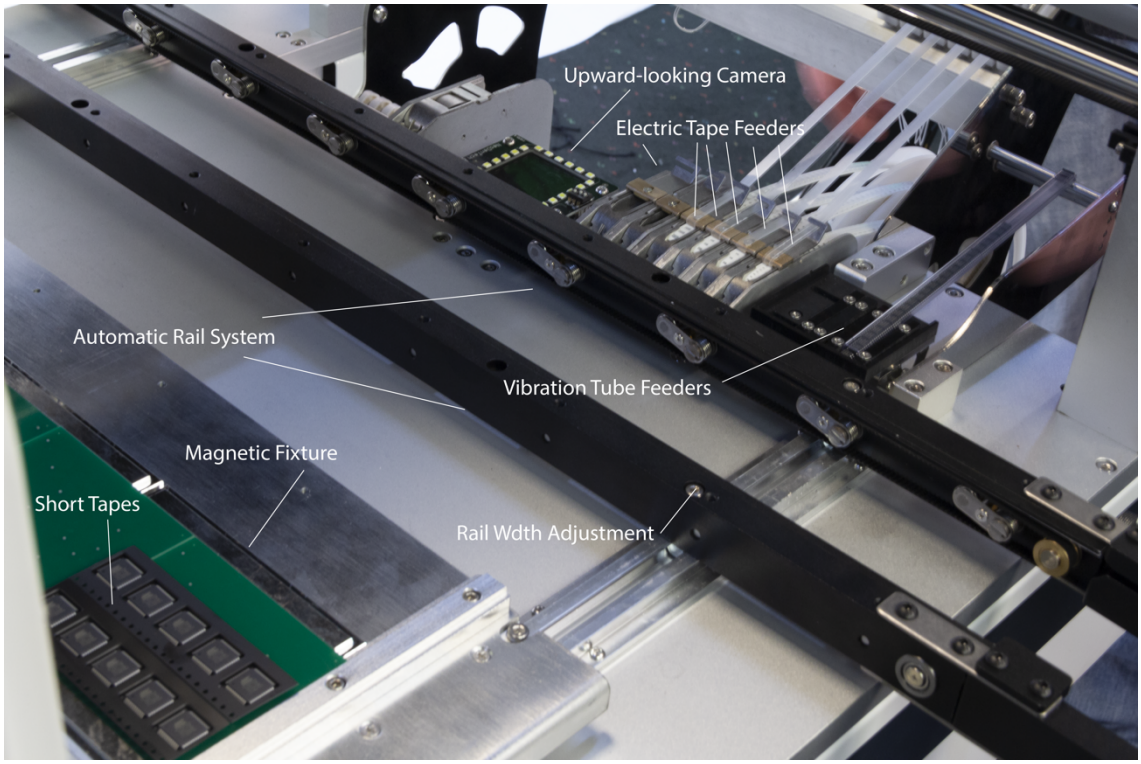


Figure 4

SOFTWARE INTERFACE AND HARDWARE SETUP

The entire operation of the Neoden 4 is controlled by a single application that runs automatically after the operating system boots. Despite the enormous flexibility of the machine, only 7 basic screens are needed to set up feeders, calibrate the vision system and program pick-and-place operations. This section contains a brief description of the various commands and parameters in the screens. Section 5 contains a recommended workflow to set up, program and operate the machine.

2. SYSTEM SETUP PAGE

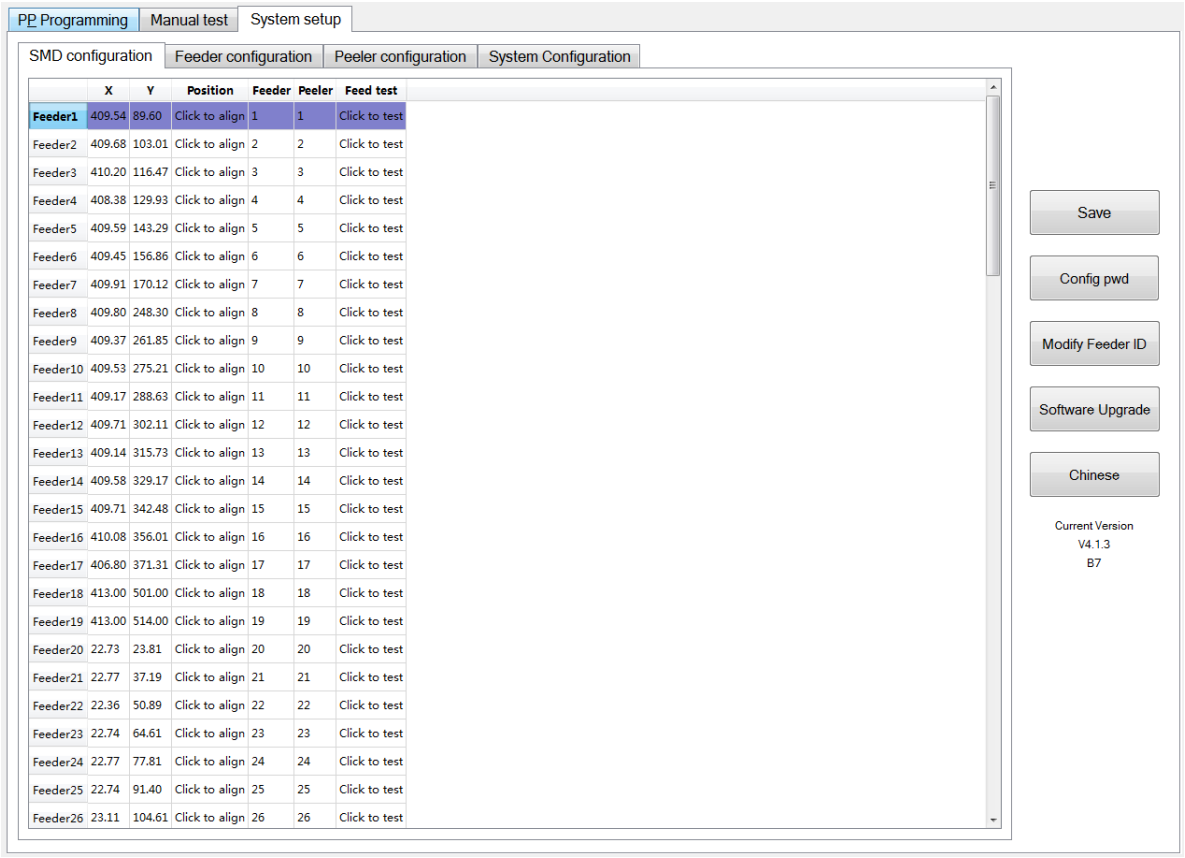


Figure 5

2.1. The four tabs in this section allow full configuration and calibration of the Neoden 4. While no calibration of the machine itself is usually necessary after unboxing, configuration of the feeders and peelers is critical to proper operation.

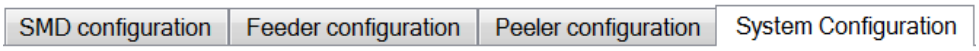


Figure 6

Machines purchased from NeodenUSA come with feeders preinstalled to the buyer's specifications. This manual also covers the steps needed to add or reconfigure additional feeders. When setting up a new machine and loading feeders with components, be prepared to spend some time in this interface.

2.1.1. Five buttons on the right side of the screen are common to all four tabs of the System setup page.

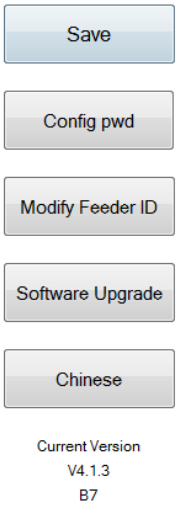


Figure 7

2.1.2. **"Save"** saves any changes to configuration to the internal SSD.

2.1.3. "Config pwd" is only used on the "System configuration" tab. Pressing this Button and then pressing "OK" (with no password entered) allows access to the nozzle alignment functions and other settings. Normally, there is no need for a user to enter these functions.

2.1.4. "Modify Feeder ID" allows the user to change any feeder's software ID to any value.

2.1.5. "Software Upgrade" will enable the user to upgrade the system software to the newest version when a new file is available on the USB drive.

2.1.6. "Chinese" changes the system language to Chinese. **DO NOT PRESS THIS BUTTON**. To restore the language to English, a unique password must be generated at the factory for each unique motherboard.

2.2. FEEDER AND PEELER INSTALLATION

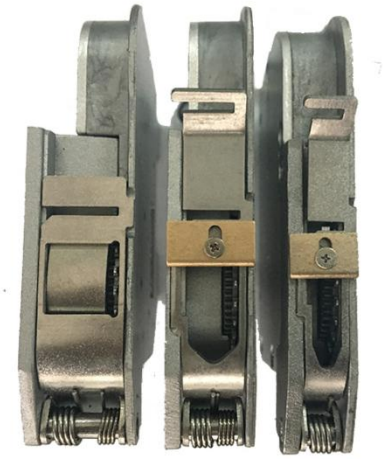


Figure 8

2.2.1. Feeders and peelers are easy to install but working in the area of the feeder reels becomes difficult when components are installed in adjacent feeders. Machines purchased from NeodenUSA come equipped with all feeders in the owner's order pre-installed. But if additional feeders are selected before setup we strongly recommend

installing them according to the procedures below before attempting any configuration. The process of installing new feeders is easier when there are no reels loaded nearby.

2.2.2. The feeders are installed on the lower rails, and the peelers are installed on the upper rails. Each is attached with a single Allen screw, and connected with a single cable. The feeders are connected with 4-pin cables and are addressed digitally over a data bus. It therefore does not matter which feeder is plugged into which port—the feeder ID code determines which feeder will be activated. On the other hand, peelers are addressed with analog power signals. Therefore, activation of a peeler depends entirely on the 2-pin port to which it is connected. The software interface allows the user to assign different combinations of peeler and feeder IDs when it is desired to use a feeder with a certain ID in a position that corresponds to a different peeler ID.

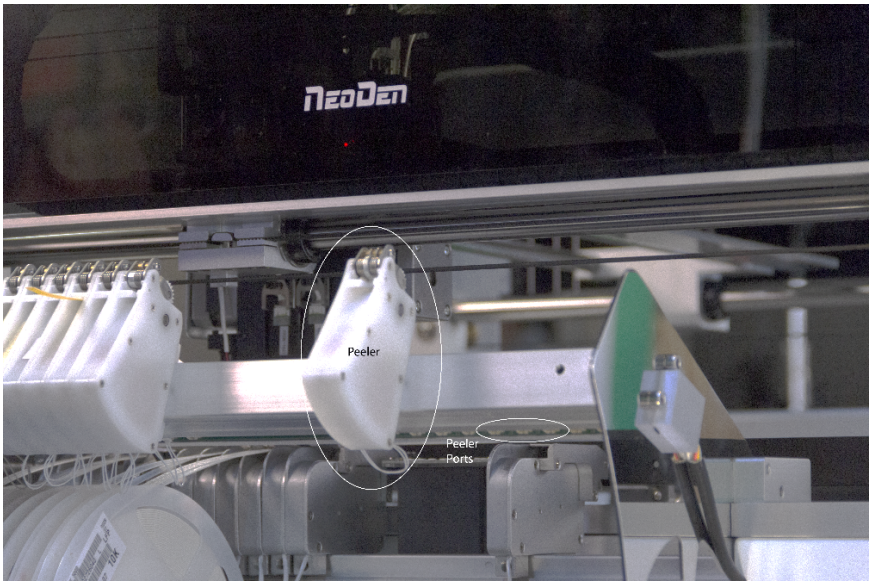


Figure 9

2.2.3. When installing new feeders, it is necessary to assign it an ID using the "Modify Feed ID" button. New feeders come with an assigned ID of 50, which cannot be used in pick-and-place operations. By using the "Modify Feed ID" button, any feeder ID can be changed to any other ID. This is a powerful tool, and can

quickly create confusion if not used carefully. For this reason, we recommend the following steps be followed without variation or exception:

1) install a *single* feeder;
2) change its ID (usually from 50) to the intended value;
3) calibrate the feeder and verify its intended operation;
4) install the related peeler;
5) test the peeler;
6) test the feeder-peeler in combination;
7) proceed to the next feeder.

Important: ***Install feeders and set their ID codes one at a time. Please do not attempt to set ID codes with more than one unassigned feeder plugged into the machine!***

2.2.3.1. Physical installation of feeders:

Figure 10

1) Using a short 3 mm Allen wrench (supplied in the toolkit included with every machine), loosen the bolt in back of the feeder a few turns.

2) Select a data port for the feeder. Plug the 4-pin connector into the port (the side of the connector with visible pin detents faces up).

3) Place the feeder on the lower rail (feeders can be placed touching each other).

4) Tighten the Allen screw until snug (do not overtighten).

5) In the System Setup Interface (on any of the four screens), press the Modify Feed ID button. Using the menus, change Feeder ID 50 to the desired ID. The interface should report that the ID was successfully changed.

6) If the interface reports that the change failed, check for the following:

   - ✓ Feeder is not plugged in correctly.

   - ✓ Feeder ID was not set to 50 when installed. Proceed to the Feeder Configuration page, and test various feeder IDs to activate the feeder. If the feeder was installed so that it inadvertently shares an ID with another feeder, both will activate.

   - ✓ If the feeder has a unique ID other than 50, change it to the desired value.

   - ✓ If the feeder shares an ID, unplug one of the feeders. This will enable the change of ID on a single feeder.

   - ✓ Once satisfied that the new feeder has been assigned the correct ID, go to the Feeder Configuration page, and

press "calibrate feeder." The feeder should run continuously for several seconds. Repeat this step to verify smooth operation of the feeder.

2.2.3.2. Physical installation of peelers:

Figure 11

1) Using a short 3 mm Allen wrench, loosen the bolt in back of the peeler a few turns.

2) Plug the 2-pin connector into a numbered power port (the side of the connector with visible pin detents faces up).

3) Place the peeler on the upper rail (peelers can be placed touching each other).

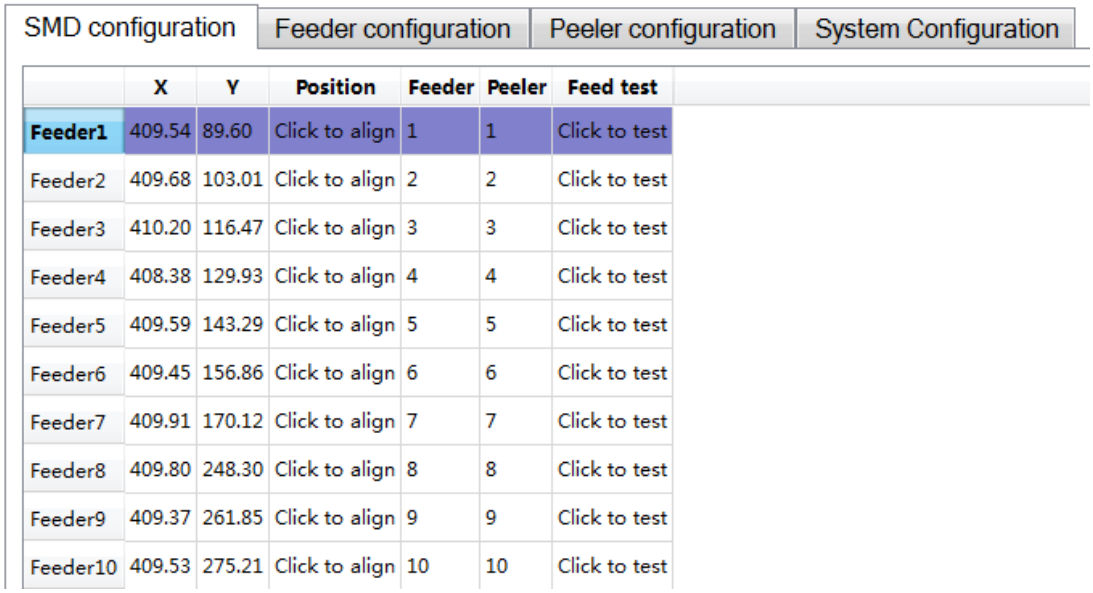
4) Line up the peeler so that it is parallel with the tape path in the feeder.

5) Tighten the Allen screw until snug (do not overtighten).

6) Go to the Peeler Configuration page, and press Click to Test. The peeler gears should turn, and the peeler motor should be audible.

7) If both feeder and peeler tests are successful, proceed to the SMD Configuration page.

2.3. SMD CONFIGURATION PAGE



	X	Y	Position	Feeder	Peeler	Feed test
Feeder1	409.54	89.60	Click to align	1	1	Click to test
Feeder2	409.68	103.01	Click to align	2	2	Click to test
Feeder3	410.20	116.47	Click to align	3	3	Click to test
Feeder4	408.38	129.93	Click to align	4	4	Click to test
Feeder5	409.59	143.29	Click to align	5	5	Click to test
Feeder6	409.45	156.86	Click to align	6	6	Click to test
Feeder7	409.91	170.12	Click to align	7	7	Click to test
Feeder8	409.80	248.30	Click to align	8	8	Click to test
Feeder9	409.37	261.85	Click to align	9	9	Click to test
Feeder10	409.53	275.21	Click to align	10	10	Click to test

Figure 12

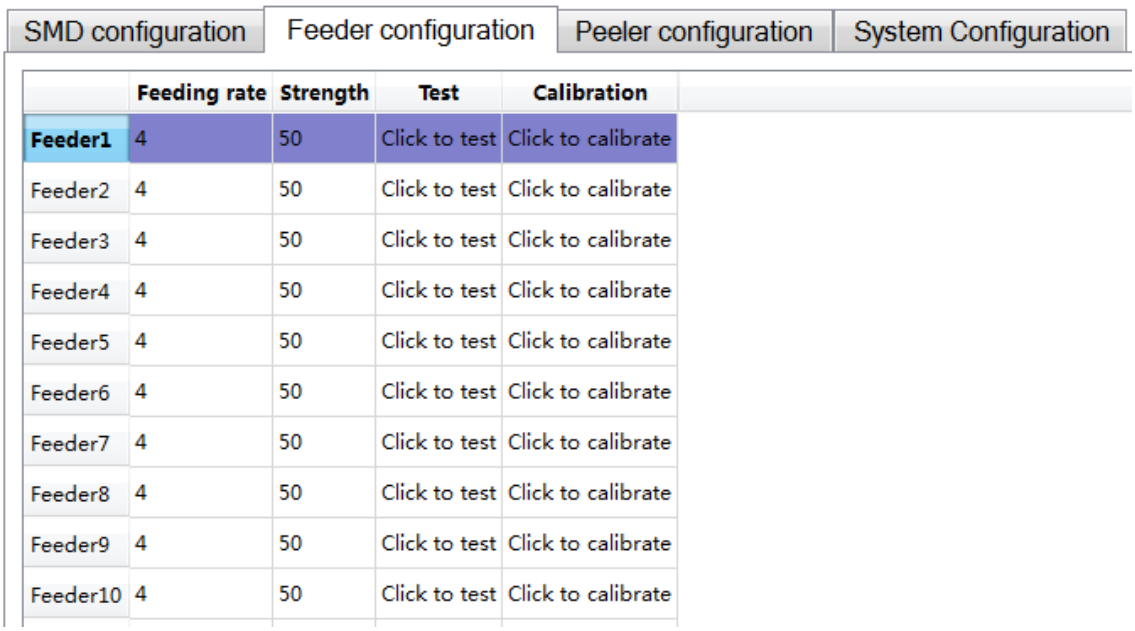
2.3.1. This page contains the master configuration settings for the feeder/peeler combinations. Use this page for the electric feeders (1-48). It is not necessary for the special feeders (49-98). Following is a description of the data displays and functions of the screen.

2.3.2. For each feeder, the X-Y coordinates of the component location are listed. These coordinates should be set by pressing the "Click to align" button to center the crosshairs in the pocket in the tape, not necessarily the center of the component. This is because components shift significantly in the tape, and any errors in component positioning can be corrected by the upward-looking camera during pick-and-place operations.

2.3.3. The **"Feeder" and "Peeler"** columns contain dropdown menus that allow the user to assign any combination of feeder and peeler to serve as the numbered feeder indicated in the leftmost column. By default, the Feeder and Peeler numbers are set to the same values.

2.3.4. The **"Click to test"** button activates both the feeder and peeler assigned to the numbered feeder, and each will advance according to the parameters defined in the Feeder Configuration and Peeler Configuration pages.

2.4. FEEDER CONFIGURATION PAGE



	Feeding rate	Strength	Test	Calibration
Feeder1	4	50	Click to test	Click to calibrate
Feeder2	4	50	Click to test	Click to calibrate
Feeder3	4	50	Click to test	Click to calibrate
Feeder4	4	50	Click to test	Click to calibrate
Feeder5	4	50	Click to test	Click to calibrate
Feeder6	4	50	Click to test	Click to calibrate
Feeder7	4	50	Click to test	Click to calibrate
Feeder8	4	50	Click to test	Click to calibrate
Feeder9	4	50	Click to test	Click to calibrate
Feeder10	4	50	Click to test	Click to calibrate

Figure 13

2.4.1. Feeding Rate. For each feeder, this dropdown menu allows the user to set the distance in mm that the feeder advances. For 0402 and 0201 components, this value is normally set at 2. For components including 0603, 0805 and 1206, the value is normally set at 4. Certain larger components will require larger values.

2.4.2. Strength. Determines the torque applied to the component tape. Values from 50-80 are common, but the value should be adjusted so that the tape feeds consistently and smoothly.

2.4.3. Test. Clicking "Test" for any feeder on this screen will advance the feeder (but not the peeler) by the distance set in the Feeding rate column.

2.4.4. Calibration. "Click to calibrate" advances the feeder continuously for several seconds. This function verifies the smooth operation of the feeder motor and transmission. Because the feeder advances quite far, it is best to avoid clicking this button when components are present in the feeder. The button can be useful if needed to exhaust a long section of leader that contains no components.

2.5. PEELER CONFIGURATION PAGE

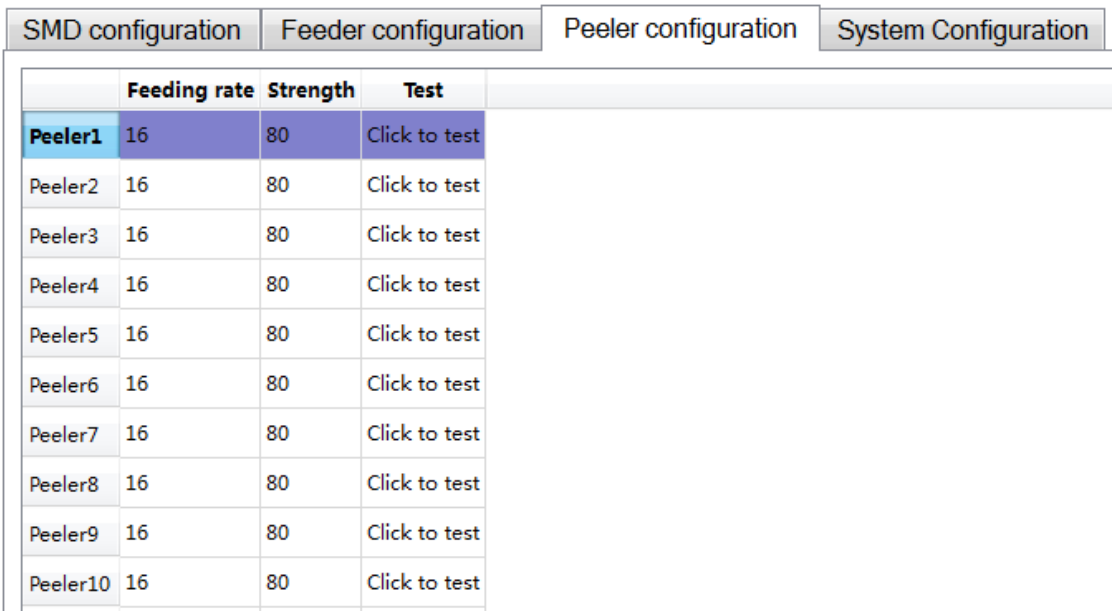


Figure 14

2.5.1. "Feeding rate" determines the approximate distance that the peeler will attempt to peel the cover tape. The default value for this setting is 16, and there is often no need to reduce it the distance that the feeder advances. The cover tape normally can slip inside the moving gears of the peeler, and a larger peeling distance helps keep the cover tape taut and out of the way of the components that have advanced into the pick position inside the feeder.

2.5.2. **"Strength"** adjust the power applied to the motor in each peeler. Smaller values (*e.g.*, 50) result in quieter operation, and are often adequate for smooth peeling.

2.5.3. **"Test"** activates the peeler (but not its associated feeder). This function, when activated, should leave the cover tape stretched tightly between the feeder and peeler, with no loose tape slop over the components to be fed. If the cover tape does not advance when the peeler is activated, check the installation. For proper operation, the tape must lie flat between the peeler gears; it must not be wrinkled, stretched to deformity or twisted. The tape also must not be installed so that any part lies outside the width of the gears. Tapes with long leaders make peeler installation much easier.

2.6. SYSTEM CONFIGURATION PAGE

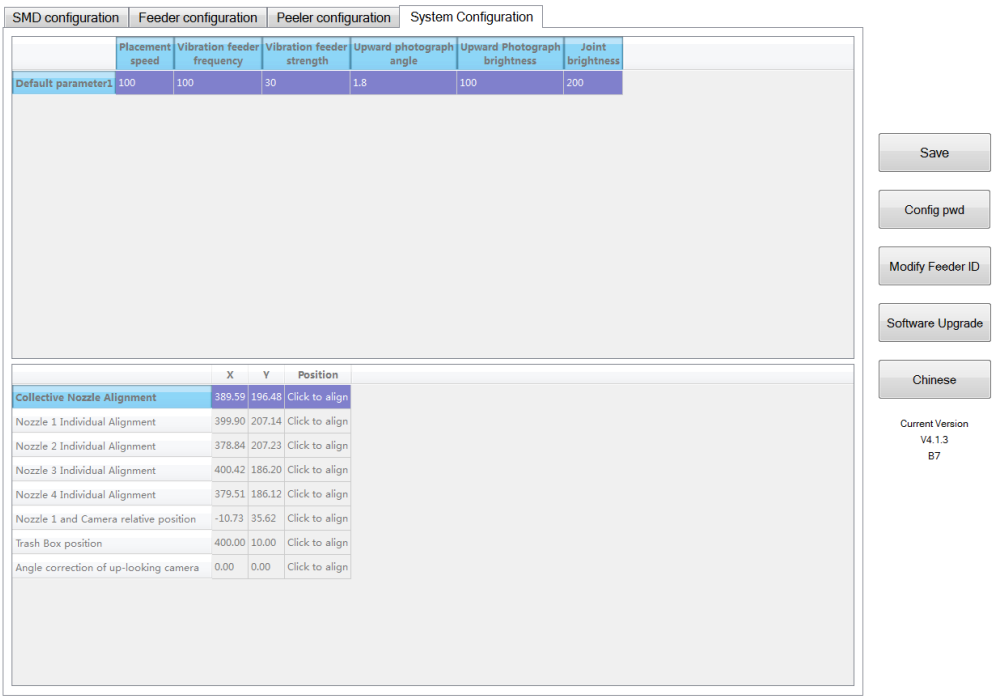


Figure 15

2.6.1. When used in combination with the **"Config pwd"** button, this page allows the user to set the machine's default movement speed, the frequency and strength of the vibration feeders, and brightness of the camera lighting systems. Default values normally

require no change. The interface also contains sophisticated nozzle alignment routines. Because these are set at the factory, there is normally no need to access them and any use of these functions should be done in cooperation with NeodenUSA tech support.

3. INSTALLING SMT COMPONENTS

Three basic component setups are possible: (1) Electric tape and reel feeding (2) Tube feeding and (3) tray/short tape feeding. This section will cover the physical setup of each type of component. Software setup of the various feeder types is covered in Section 4.

3.1. Installing tape and reel components.

(1) Lift the angled tab on the feeder, and insert the tape so the sprocket holes rest on the tooth of the gear.

(2) Pull the end of the cover tape through the large feeding slot in the feeder, over the brass block.

(3) Allow the spring to pull the feeder cover over the tape.

(4) Lift the silver tab on the peeler to separate the gears.

(5) Thread the cover tape through the slot on the angled tab, and through the gears on the peeler *until the tape extends through the back slot of the peeler*. If the tape does not extend through the whole peeler before the gears are closed, it will likely jam.

(6) Allow the spring in the peeler to close the plastic feeding gears.

Figure 16 illustrates the proper installation of tape feeders.

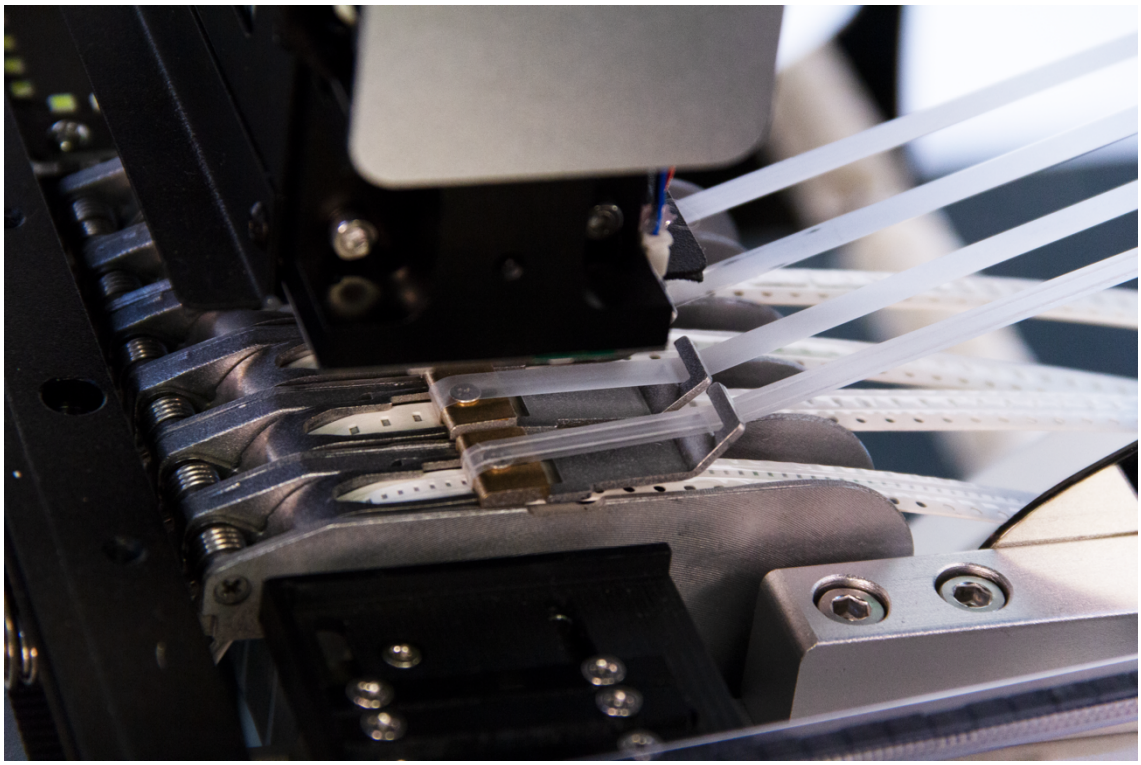


Figure 16

3.2. Installing tube-fed components. Install the tube feeder guide. This polished steel guide is included with the machine and bolts to the table with two Allen screws (included).

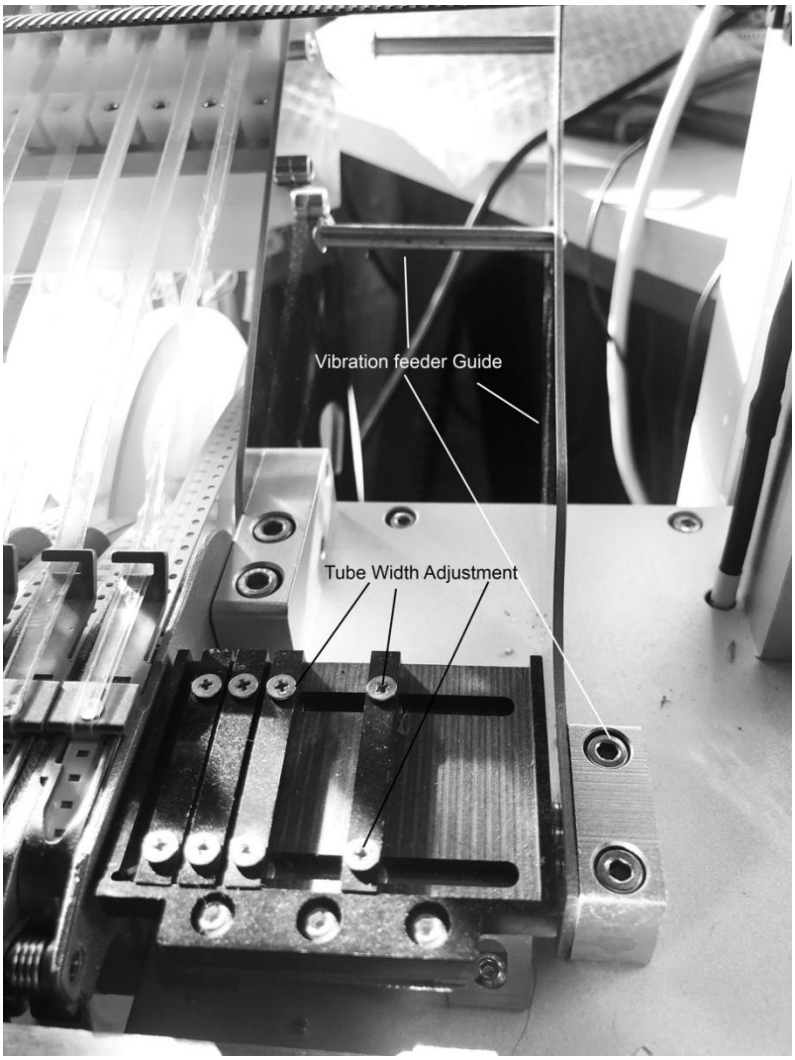


Figure 17

Screw the round horizontal tube guides into the plate as shown. These round guides will hold pressure on the tube to maintain a good feeding angle and prevent movement.

Adjust the width of the black vibration feeder guides as necessary for each tube. If the tubes hold very small components, it may be beneficial to use tape to cover the front slots between the black guides.

3.3. Installing trays and short tapes. Trays and short tapes can be placed anywhere on the table that is not in the space or path required by the board. If the width of the rail setting necessitates removal of the left steel table

extension (**See Figure 3**), first install a piece of metal or plastic sufficient to raise the height of the table to roughly the height of the extension. If the table extension is installed, simply affix the tray or tape to the extension using double-sided tape or any other suitable method. It is important that the components be placed in a reasonably straight horizontal or vertical orientation, and that the tray or tape is placed flat to avoid variations in pick height.

Figure 4 shows an example of a simple short tape/tray configuration.

4. MANUAL TEST PAGE

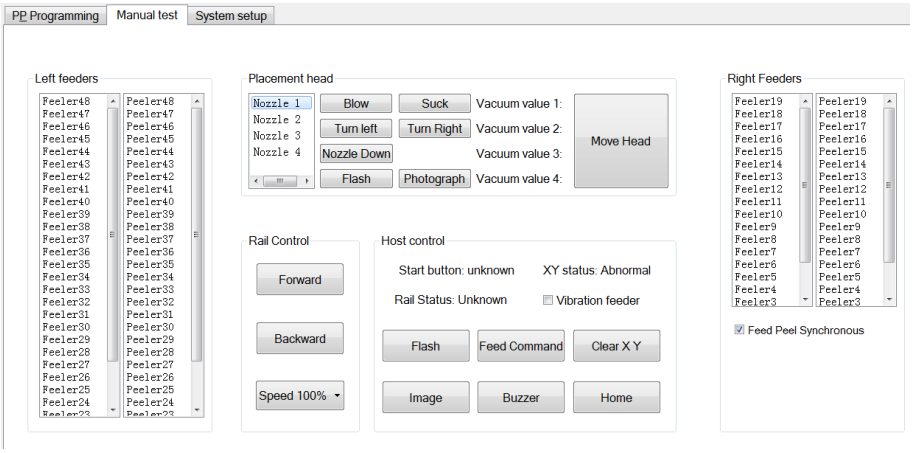


Figure 18

4.1. The second tab at the top of the interface opens the manual test screen. This screen contains a convenient selection of tools to verify the operational status of most components of the Neoden 4. Most functions of the manual test screen can also be accessed from other areas of the interface.

4.2. Feeder/Peeler. Arranged on the left and right sides of the screen are feeder and peeler IDs that correspond graphically to a typical arrangement of feeders on the Neoden 4. Clicking on any feeder or peeler will activate the assigned feeder/peeler combination (assuming, of course that a unit is configured and connected for the ID clicked). Use these tests conservatively when parts are loaded, because the feeder will advance, and a component will be ejected from the tape.

4.3. Placement Head. This section contains tools to verify the proper operation of the head, head movement system and nozzles. To use these tools, first select the nozzle of interest.

4.3.1. The **"Blow"** button will release a brief jet of air from the selected nozzle. Place a finger under the nozzle to verify operation. A small increase in positive value should appear on the screen.

4.3.2. The **"Suck"** button will engage vacuum for the selected nozzle. Place a finger over the nozzle to block airflow, and press the button. If the unit is operating correctly, you will feel the vacuum, and the "pressure" indicator will change from a positive to a significant negative value while vacuum is present.

4.3.3. The **"Turn left"** and **"Turn right"** buttons activate the rotational axis of the selected nozzle. Because rotation of the smooth black nozzles is difficult to observe, it is easiest to verify function by watching the motion of the vacuum tubes at the top of the head.

4.3.4. The **"Nozzle Down"** button will lower the selected nozzle by the full 12 mm travel. Releasing the button causes the nozzle to return to its upper position.

4.3.5. The **"Flash"** button activates the lighting for the downward-looking camera. Press once for the inner lights, again for the outer lights, again for both, and a fourth press will turn the lights off.

4.3.6. The **"Photograph"** button verifies operation of the downward-looking camera by moving the head back and displaying a photograph of the table.

4.3.7. The **"Move Head"** button allows repositioning of the head in three ways.

4.3.7.1. By using the **"Visual field"** method, the head can be moved precisely by clicking on the portion of the screen relative to the center crosshairs, which indicate the current position of the camera. Because of the extreme closeup vision of the camera, only small moves are possible with each click.

4.3.7.2. With the **"Mouse Vectors"** setting, the screen turns grey, and represents the entire area of movement possible over the table. Clicking in any region of the screen allows rapid, coarse movement of the head. This can be convenient for speeding alignment, as well as for moving the head to a more convenient general location for the task being performed.

4.3.7.3. The **"Keyboard Jog"** method allows movement in of the head along the X-Y axes in .1 mm increments. Additional keyboard controls are noted on the screen. To exit this mode, press the Escape key.

4.3.8. Z Axis. When in an alignment screen, the default "camera" setting allows the visual check of X-Y coordinates. But the selection of one of the nozzles as an alignment method allows the manual extension of the nozzle along its 12 mm Z-axis travel. This feature is useful not only to verify operation of the Z-axis motor, but to determine the best values for "pick height" and "place height" in the feeder settings of a P&P program.

4.3.9. In addition, when using feeders too far back for the camera to align, (*e.g.*, usually 17-19 on the right-hand side) this method allows the user to position a nozzle and test to ensure that it descends onto the component in the feeder. While this method is less convenient that camera alignment, it allows the user to make the greatest use possible of the available table real estate by installing additional feeders.

4.3.10. The **"Rail Control"** button allows a simple means of moving the rail system forward and backward to verify operation.

4.4. In the "Host Control" section, seven controls complete the manual test interface.

4.4.1. The **"Flash"** button activates the lighting system for the upward-looking camera. A second press turns off the lights.

4.4.2. The **"Image"** button verifies operation of the upward-looking camera by displaying an image on the screen. Because the camera focus is set to take very sharp pictures of the nozzles and any

components they are carrying, pressing this button may produce only a blurry image unless an object (like the head) is present over the camera at the correct height. Pressing "Cancel" returns the user to the main screen. (The Lens Rotation and Save buttons are used for nozzle alignment purposes, and perform no valuable function in the Manual Test context).

4.4.3. The **"Feed Command"** activates the rail system for those units so equipped.

4.4.4. The **"Buzzer"** button sounds the internal warning tone for as long as it is pressed.

4.4.5. The **"Clear X-Y"** button should only be used to correct an error condition displayed in the "XX Status" annunciator position. When the status reads "Idle," the system is functioning normally and there is no need to use this button.

4.4.6. The **"Home"** button causes the X-Y drives to return the head to the machine's home position, and reset the X-Y geometry based on the physical limit switches in the unit. Use this button to verify operation of the limit switches, and also to restore the home position in the event of an accidental head crash into an object inadvertently left on the table.

4.4.7. The **"Vibration feeder"** check-box will activate the vibration feeder motor when checked. Leave the box unchecked except for this brief test.

5. P&P PROGRAMMING PAGE

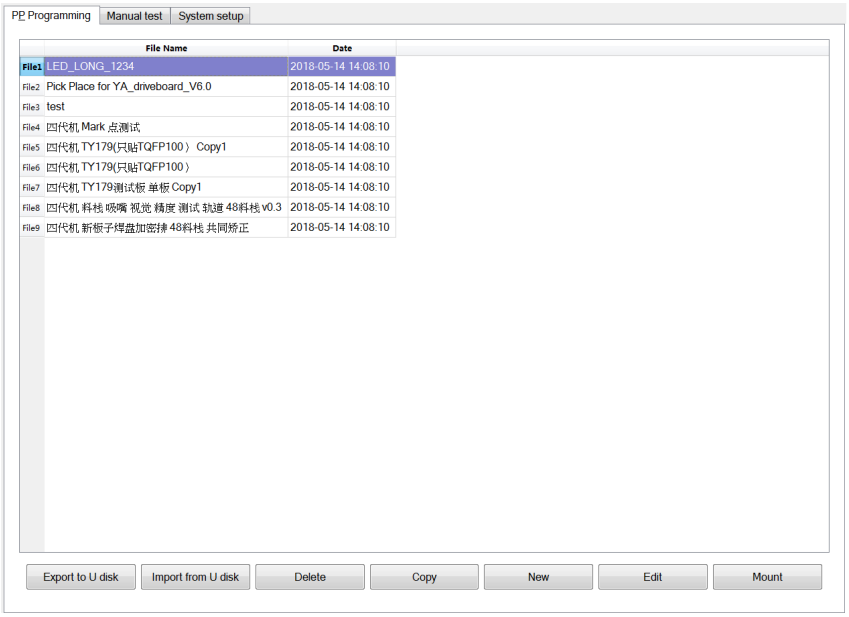


Figure 19

This screen contains a list of available programs stored in the internal SSD, and is the screen from which production operations are launched. The Neoden 4 is shipped with several factory test programs installed, and these can either be kept, deleted or stored separately on an external USB drive for later use.

Available commands on this screen include:

5.1.1. Export to U Disk. This command will copy the program file selected on the main screen to a USB drive inserted into any of the four USB ports on the machine. It is recommended that files on the SSD be backed up to a USB drive.

5.1.2. Import from U Disk. This command will copy a program from an external USB drive to the Neoden 4 and store it on the internal SSD. Programs are run from the internal SSD only.

5.1.3. Delete. This command will permanently delete the selected program file from the internal SSD.

5.1.4. Copy. This command will copy the selected program file, allow the entry of a name for the copied file, and store it on the

internal SSD. The command is useful for creating alternative versions of programs.

5.1.5. New. Creates a new, blank program file.

5.1.6. Edit. This command opens the main programming interface for the machine. All parameters needed to complete a finished board are entered in the two screens of this interface. A detailed discussion is contained in Section 6.

5.1.7. Mount. This command loads a program from the internal SSD in preparation for automatic or stepped operation.

6. P&P PROGRAMMING EDIT FUNCTION

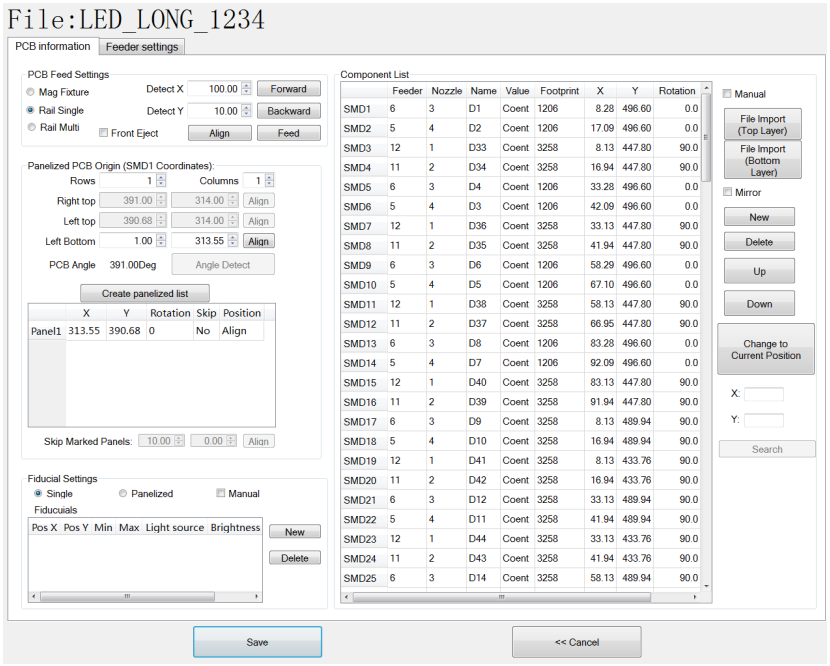


Figure 20

This screen is the heart of the programming interface. It has two tabs: "PCB Information" and "Feeder Settings." In the following sections, this manual will describe each of the functions on the two pages. Finally, it will recommend some basic procedures for programming the machine to manufacture finished boards.

6.1. PCB INFORMATION PAGE

6.1.1. PCB Feed Settings. This section determines the manner in which the PCBs will be sent to the machine for pick-and-place operations. On machines with the rail system installed, the "Mag fixture," "Rail Single," and "Rail Multi" are available. On machines without the rail system, always select "Mag Fixture."

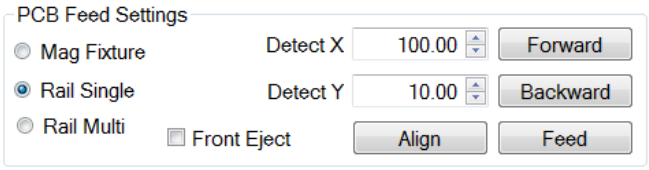


Figure 21

6.1.2. Mag Fixture. This option assumes that the user will place the board in a location determined by the placement of the magnetic fixture blocks (supplied) on the table. This is a simple and reliable system, but the accuracy of a program depends upon the magnetic fixtures being installed to ensure that the placement of the board is essentially the exact placement that existed at the time the program was created.

TIP: Users relying on the magnetic fixtures for several different boards should place fixtures on the table to ensure that the lower left corner remains in the same place for all boards. This will ensure that the origin of each board remains constant with respect to the machine coordinates. The remaining fixtures can then be varied to ensure stable placement of different-size boards.

6.1.3. Rail Single. This option is the most frequently used on machines equipped with the rail system. Checking this box will cause the machine to feed a single board (or panelized board) to the appropriate location and then commence fiducial recognition and component placement.

6.1.4. Rail Multi. This option is used when boards (or panels) longer than the machine table are to be populated. In this mode, the machine will place components between the first set of fiducials, then advance the board automatically to place components between the next set of fiducials, and so on.

6.1.5. Front Eject. When this box is ticked, the rail system will eject the PCB from the machine toward the front when the program has completed running.

6.1.6. "Forward" and **"Backward."** These buttons manually move the PCB within the rail system. When setting up a new program, use these buttons to move the PCB to a suitable position for placement operations. Follow the instructions to complete the program *without moving the board until the program is completed, verified and saved*.

6.1.7. "Align." This button activates the camera. Once a board has been placed in the desired location using the "Forward" and "Backward" buttons, press "Align." Move the head so that the crosshairs are centered on the leading edge of the board. The X-Y coordinates of the aligned location will be displayed in the "Detect X" and "Detect Y" fields. Though the user can enter values manually to change the feed location, this should rarely be necessary.

TIP: When running a program, the board will advance slightly farther than the edge identified with the "Align" command. This is normal, and the machine will proceed to recognize fiducials to properly place components.

6.1.8. "Feed." Unlike the "Forward" button, "Feed" will automatically advance the board to the position identified with the "Align" command. It is not necessary to use this feature in normal operations. However, if a PCB is moved before programming is completed, verified and saved, this feature can be useful in restoring the board to its proper position.

6.1.9. Panelized PCB Origin. A fundamental principle of the Neoden 4 software is that the origin of a file is the X-Y coordinates of the first component to be placed (expressed as absolute machine coordinates). Even when single (not panelized) boards are being produced, the machine treats the board as a part of a panel (with one row and one column equaling one board). Therefore, the X-Y coordinates of the first component must be entered in the *Left Bottom*

X-Y fields. Components entered in the component list must identify the locations of components on the left bottom PCB in a panel. A single PCB will be treated as if it is the left bottom board in a panel.

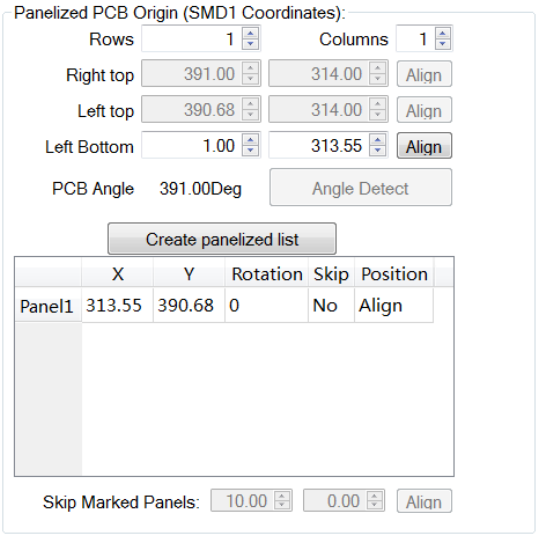


Figure 23

For a single board, leave the number of rows and columns set at "1." For a panel of multiple boards, enter the number of rows and column in the drop-down menus.

If the number of columns and rows is greater than 1, the machine will then require entry of coordinates for the first part as it appears under the camera for the right top and left top panels. With these values, the machine can extrapolate the size of the panels and compute the location of every component on each panel.

6.1.10. Create Panelized List. This button automatically creates component lists and their coordinates for each board in a panel (or for a single board) based upon the number of columns and rows entered for the panel in the Panelized PCB Origin field(s).

6.1.11. Fiducial Settings. Fiducials are circular marks (1 mm diameter works well), which are either silkscreened on the board or etched. These marks should be easily visible with high contrast, so the machine can easily locate and center them when running a

program. Each board should have at least two fiducial marks, preferably on opposite corners.

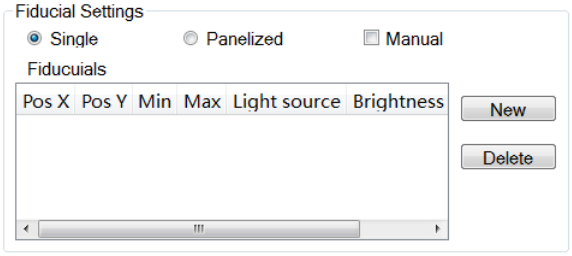


Figure 24

In this section, first select **"Manual," "Panelized," or "Single."** For almost all situations, **"Single"** is best. This setting will allow the machine to recognize and correct for fiducial locations automatically. The **"Panelized"** option will force the machine to recognize every fiducial on an entire panel before beginning pick-and-place operations. While not detrimental to the process, this is more time consuming than necessary for accurate operation. The **"Manual"** is reserved for boards that lack fiducial marks that can readily be recognized by the machine. Selecting **"Manual"** will require the user to manually recognize substitute marks on the board before the machine will proceed to place components.

With the board in its final intended location in the rail system or on the magnetic fixtures, click **"New"** to add a fiducial to the list. Then press **"Align"** to locate the fiducial with the camera. Finally, press **"Auto Align"** to locate the center of the fiducial precisely. Save the value and repeat the process to add the second fiducial.

6.1.12.Component List. The component list is the heart of the pick-and-place program. It contains the location and rotation of every component, along with other identifying information about the components. There are two ways to create this list:

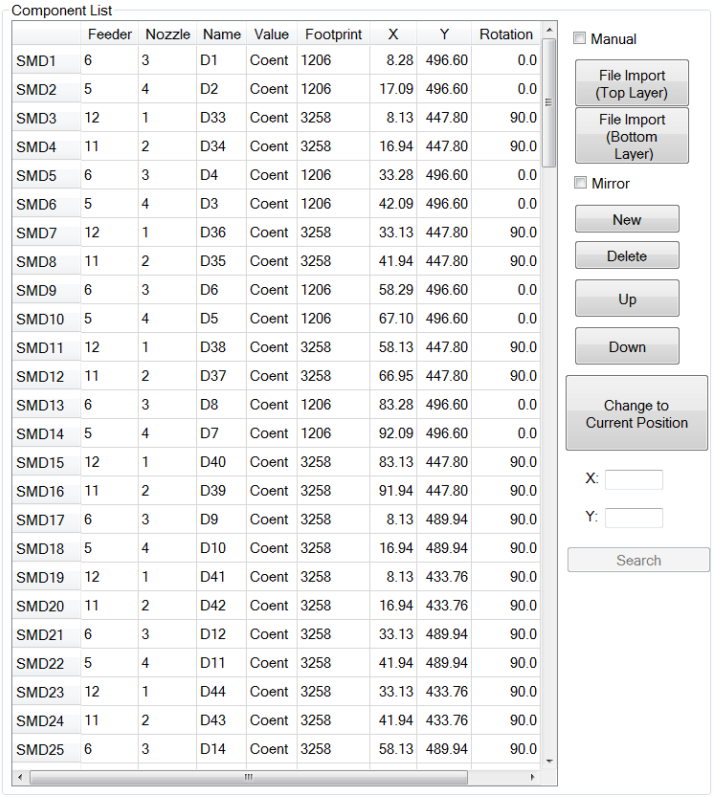


Figure 25

6.1.12.1. File Import. This is the simplest method to create a map of placement locations and angles for your board. This method will quickly create a valid component list from a .CSV file, *as long as* the *coordinates in the file are computed with reference to the location of the first component in the list*. In other words, before generating and exporting the .CSV file, the PCB design software must be supplied with the location of the first component in the list as determined by the Neoden 4 camera with the board in place. The appropriate export routine will compute the coordinates of the remaining components relative to this user-supplied origin point.

Coordinates must be specified in millimeters, to two-decimal precision. Export routines for the Neoden 4 are available for popular PCB design software, including Eagle and Altium. To use this feature, insert a USB drive containing the exported .CSV file into any port on the Neoden 4, and press Import (with the "manual" box unchecked). The system will locate available

.csv files in on the USB drive, and clicking **"Save"** after selecting a file will import the list.

To edit the list after import, check the **"Manual"** box. This allows the user to check and correct individual components with the camera by pressing **"Align."**

6.1.12.2. Change to current position. This is a powerful feature that will change the coordinates of the entire component list if the board is placed in a different position on the table than the position that was used to compute the original origin. To use this feature, locate the first fiducial with the camera. Press **"Cancel,"** and press **"Change to current position."**

The machine will locate both fiducials and compute the offset from the original program. It will then change the values in the component list to conform to the new board location. After this process is complete, it is necessary to ensure that the new coordinates for the first component are entered in the "Left Bottom" location, and that the **"Create Panelized List"** button is pressed so that the X-Y coordinates of the first component appear in all three locations on the screen.

6.1.12.3. "New," "Delete," "Up," and "Down." When the "Manual" box is checked, these buttons allow modification of the component list. The user can create additional components using the **"New"** button, remove components using the **"Delete"** button, or reorder components with the **"Up"** and **"Down"** Buttons.

The reordering of components can dramatically increase the speed of pick-and-place operations by ordering the components to provide for sequential use of nozzles and pickup of components in feeders located in close proximity to one another. When running the program, the Neoden 4 will pick components in the order they appear in the list. If four components arranged sequentially in the list use four different nozzles, then the machine will pick up all four components before returning to the PCB to place them, yielding significant speed advantages. On the other hand, if components are

arranged so that several components in a sequence use the same nozzle, the machine will pick a component, verify its position and place it before proceeding to the next component. This arrangement will work, but with a significant efficiency penalty. Skillful users will optimize the component list to group the use of different nozzles together.

6.2. FEEDER SETTINGS SCREEN

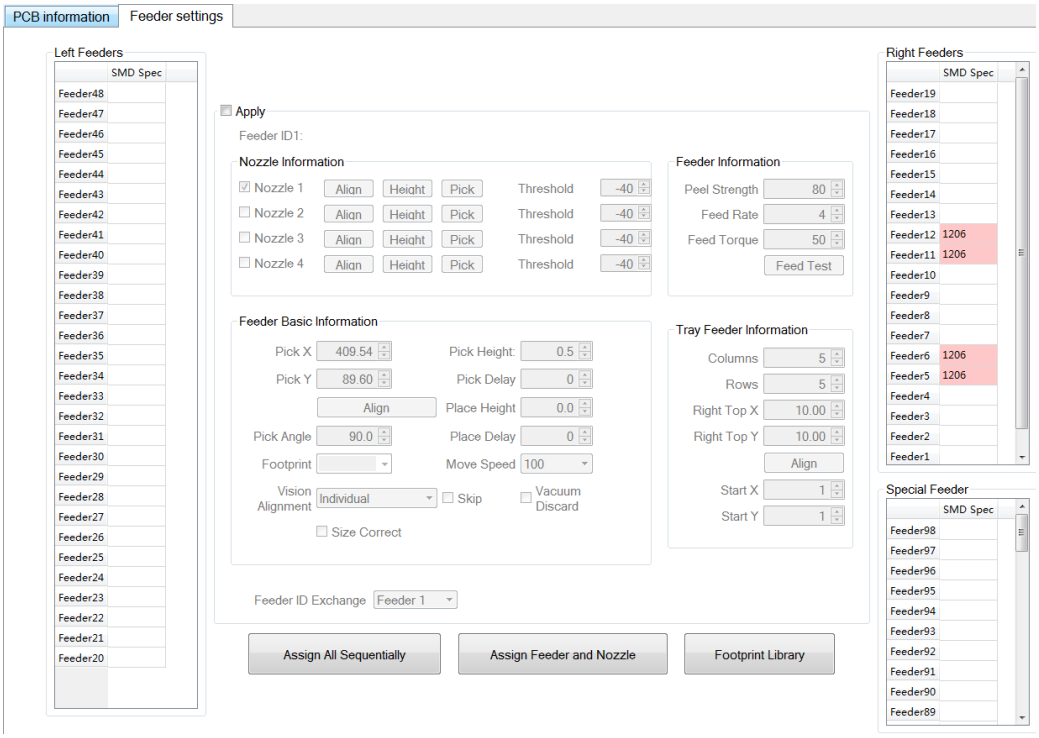


Figure 26

6.2.1. The Feeder settings screen is critical to the successful operation of any program. Setting the many parameters on this screen *for each feeder* is the most time-consuming part of preparing the Neoden 4 for production, but careful attention to detail in this section will assure trouble-free operation and the best results in the finished boards.

TIP: Though the Neoden 4 will work without precise data in the Value and Footprint fields, several powerful automatic functions that can greatly speed programming require that each instance of

the same component in the component list contain identical entries in the Value and Footprint fields.

6.2.2. Feeder Layout. One of the important functions of the Feeder Settings screen is the assignment of discrete components to individually-numbered feeders. This can be accomplished manually or automatically. The Neoden 4 supports programs with components placed randomly in feeders all over the machine. While random placement works, it is always not the most efficient means of programming the machine.

If components are assigned in the order in which the first appear in the component list, automatic assignment is possible. In other words, if the first component in the list physically resides on Feeder 1, the next different component in Feeder 2, etc., then the user need only press **"Assign All Sequentially."** Each feeder will then be assigned the appropriate value and footprint.

In many cases, however, components will be installed without regard to their relative position in the component list. In that event, the user should first click on the dropdown menus next to each feeder and select the component that corresponds to that feeder. (The contents of the dropdown menus are derived from the data in the component list).

6.2.3. Feeder Basic Information. To edit information for each feeder, first check **"Apply."** Next, press **"Align"** in the Feeder Basic Information section. This will move the camera to the location of the components in the feeder. As in Section 2.3.2, center the crosshairs in the hole in the tape where components sit – not the center of any given component. Using this method, the Neoden 4 will be able to use any of its four nozzles to pick parts from the feeder.

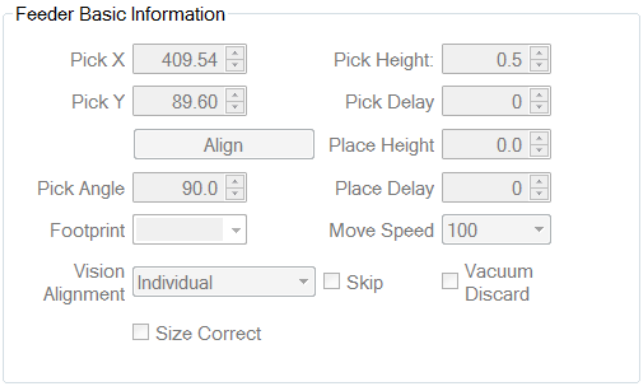


Figure 27

NOTE: For feeders installed in the far back of the machine (often feeders 18 and 19 on the left side) the camera, which is mounted on the front of the head, will not be able to be moved far enough to view the necessary location. For these feeders, after clicking **"Align,"** select the desired nozzle as the "Alignment method" on the right side of the screen. Then use the mouse to move the nozzle to the desired pick location, and slowly pull the vertical slider down to lower the nozzle. Continue to fine-tune the location of the nozzle until it is centered in the hole in the tape. Click **"Save."**

6.2.4. After aligning the feeder (or nozzle) to the camera, ensure that the remaining data in the Feeder basic information section is correct.

6.2.4.1. The **Pick Angle** setting normally does not need to be changed because the machine automatically sets this value based on the feeder's location on the left or right rail. For trays and sort tapes, however, this value may need to be changed to 0 or 180.

6.2.4.2. The **Footprint** setting should contain the footprint of the component in the feeder. If the correct size is not in the menu, it is possible to create new footprints by entering the footprint library.

6.2.4.3. The **Vision Alignment** setting is normally set at **"Individual."** This setting directs the Neoden 4 to transport each "picked" component to the upward-looking camera to ensure that a component is attached to the nozzle and analyze

its position to compensate for X-Y and rotational errors before traveling to place the component on the board. For large ICs, choose "large component" in this field.

6.2.4.4. The **Vacuum Discard** function should be left unchecked. This feature measures the vacuum level at the nozzle after a part is picked up, and discards the component if the vacuum is insufficient. Though faster than the camera, this feature is less accurate and can result in wasted parts. We therefore do not recommend its use except in special circumstances.

6.2.4.5. The **Pick Height** setting is critical to reliable operation. The nozzles offer 12 mm of total downward travel from their resting position in the head. The value entered in this field represents the distance in millimeters from the maximum extension. Therefore, smaller values indicate greater downward travel. The best way to choose this value is to press **"Align,"** ensure the camera is properly centered over a component, and then select an appropriate nozzle as the alignment method. Drag the vertical slider down until the nozzle gently touches the component, and note the value shown—this is the value to be entered in the **"pick height"** field. Should you notice repeated failures to pick a part, the pick height may need to be reduced.

6.2.4.6. The **Pick Delay and Place Delay** settings allow a short pause after a nozzle comes into contact with a part, and before it leaves contact. This small pause allows for stable vacuum and cessation of any vibration from the rapid movement of the head that might cause imprecise placement. We recommend entering a value from 100-300 in these two fields for every feeder.

6.2.4.7. The **Place Height** setting determines the extension of the nozzle when the component is released into the solder paste. Proper setting of this parameter is important to protect components and nozzles, and to ensure accurate placement. We recommend the following procedure:

1) Mount a PCB in the rails or magnetic fixtures.

2) In the **"Nozzle Information"** area, check the nozzle (or nozzles) appropriate for the component in the feeder.

3) Press **"Pick."**

4) The Head will move to the feeder and the designated nozzle will pick up a part. Verify visually that a part is attached to the nozzle.

5) Go to the PCB Information page, and click **"Align"** on any component. Select the nozzle holding the picked component as the Alignment Method. The component should now be held by the nozzle, suspended above the PCB.

6) Slide the vertical slider down slowly until the component barely makes contact with the PCB—usually, you will hear a small click when the component touches down.

7) Note the value shown by the slider display and enter it in the Place Height field.

6.2.4.8. The **Move Speed** setting has a default value of 100. This is a very fast setting, and users are advised to start with a slower setting, *e.g.*, 70 for each feeder to verify proper operation of a program. Once satisfied with the program and its accuracy, faster settings may be attempted. For very large components, start with a much slower setting, *e.g.*, 30.

6.2.5. Nozzle Information. For each feeder, check the nozzle(s) that are sized appropriately for the component installed in the feeder. We recommend leaving the threshold settings at their default values, because the vacuum detection feature to which these settings relate is rarely needed or used when the vision system is active.

Figure 28

6.2.5.1. The **Align** button will move the selected nozzle over the component in the feeder.

6.2.5.2. The **Height** button will drop the nozzle down to the assigned pick height, without picking up a part.

6.2.5.3. The **Pick** button will move the head to the necessary location and pick up a part. After this feature is activated, the part should be removed from the nozzle with a finger or tweezers. Remember to load a new part by clicking **"Feed."**

7. FINAL PROGRAMMING STEPS

7.1. After completing the setup of each feeder, it is time to assign components to feeders and nozzles in the component list. The simplest way to do this is to press **"Assign Feeder and Nozzle"** in the Feeder Settings screen. If all values are correctly and consistently entered in the component list, and appropriate nozzles have been enabled in the Feeder Settings interface, the Neoden 4 will automatically select the appropriate feeder and nozzle for each component in the component list.

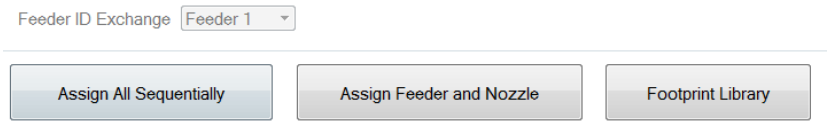


Figure 29

7.2. If the data in the component list contains inconsistencies, omissions or small errors, the program will still work, but the automatic assignment

feature will not. In such cases, the user can manually enter the desired feeder and nozzle for each component.

7.3. Save the program and you're ready to run!

8. RUNNING THE PROGRAM

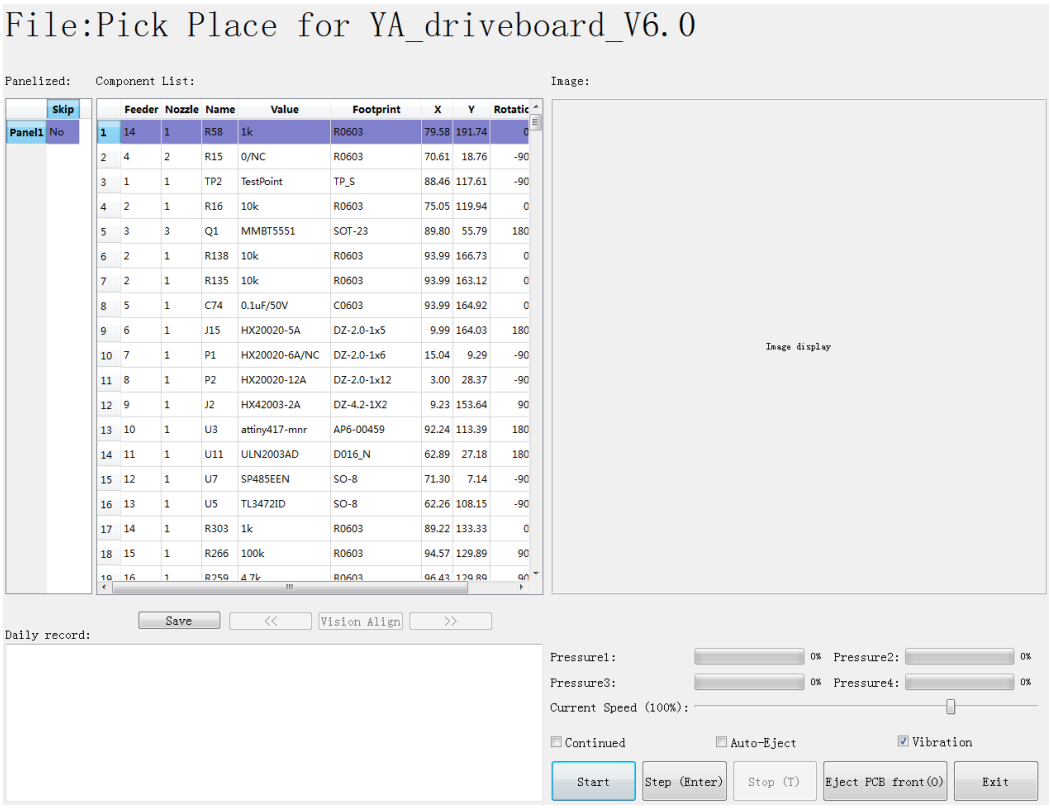


Figure 30

8.1. On the pick-and-place programming page, select the program you wish to run and press **"Mount."**

8.2. If the vibration feeders are needed, activate them with the checkbox.

8.3. Place a PCB on the magnetic fixtures or load one into the rail system so that the PCB is in snug contact with the guide belts.

8.4. There are two ways to run a program: Step Mode and Continuous Mode. Pressing **"Step"** will cause the Neoden 4 to execute the program

one move at a time. This can be helpful in troubleshooting or double-checking the integrity of a program before letting the machine run free. Pressing **"Continuous"** will cause the program to run on its own. The Neoden 4 will first check each nozzle called for by the program. It will the locate the fiducials on the board and begin placement operations.