

# Franklin Handler OCX based tuning procedure.

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## Overview

This document provides the full tuning procedure for the Franklin S-468 handler system. It assumes the handler system has been properly placed on an index plate or some other method of affixing the system at its expected operational position in relationship to the inspection microscope or other mechanical process. This procedure cannot be properly performed until the aforementioned criteria has been completed. Note: Only controls required to perform the tuning procedure are referenced in this procedure.

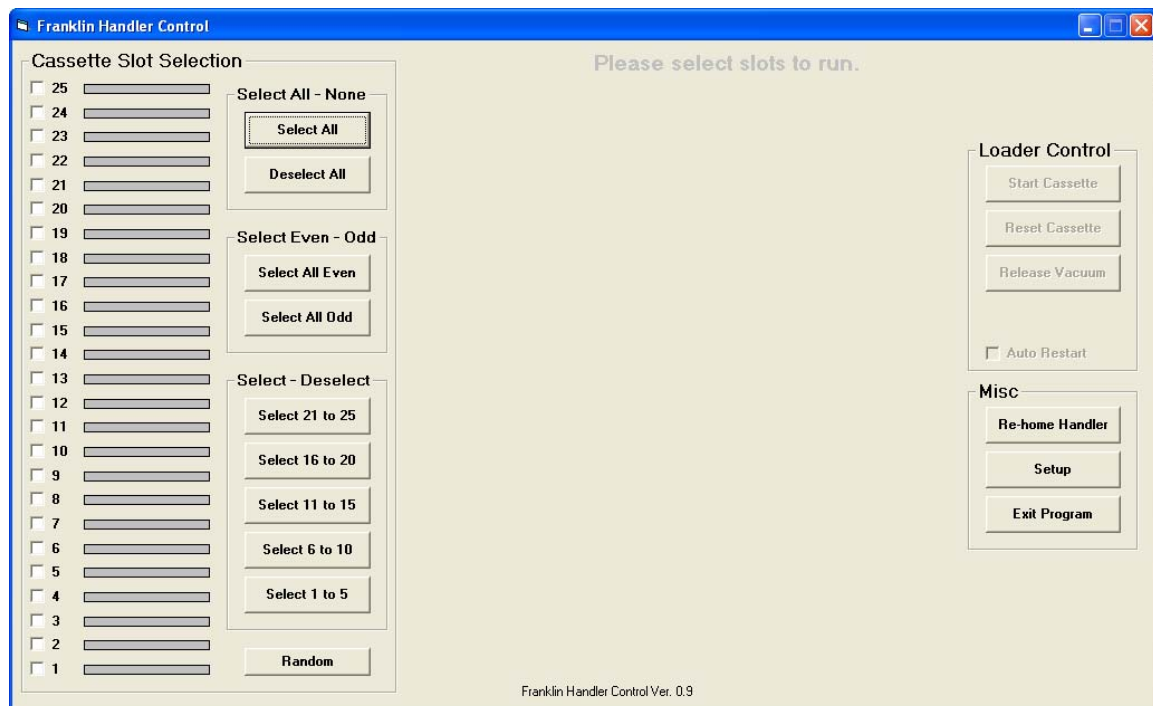
Several steps are required to properly tune the system, most of which are normally performed at the factory prior to shipment and should require only very minimal (if any) adjustment during the tuning of the system.

This is generally a one-time setup procedure and once completed, should not have a need to be revisited unless the elevator or robot assemblies are replaced or, it is desired to change the default wafer size.

## Accessing the Setup page

Start the Franklin handler control from either the desktop icon or the start button. After the initial mechanical setup of the handler system has been performed and the system has been initialized and homed properly, the main screen should look as shown below. The system can now be tuned to its operating environment.

To Begin, click the “Setup” button to bring up a dialog box, which asks for the setup password.



Enter five backslashes ( \ ) in the field and click “Ok”. The setup screen with three tabs at the top will appear.

## The “Positions” tab

Click the “Positions” tab to select the page shown below.

The screenshot shows the 'Loader Setup' window with the 'Positions' tab selected. The window has a blue title bar and a standard Windows-style interface. The main area is divided into several sections:

- Rotation (R):** Contains buttons 'Move to Stage', 'Move to Cassette', and 'Move Absolute'. To the right are input fields for 'Stage Position (Counts): -2000', 'Cassette Position (Counts): -111500', and 'Absolute Position (Counts): 0'.
- End Effector (T):** Contains buttons 'Move to Stage', 'Move to Cassette', 'Retract', and 'Move Absolute'. To the right are input fields for 'Stage Position (Counts): -622500', 'Cassette Position (Counts): -600000', 'Retract Position (Counts): 100', and 'Absolute Position (Counts): 0'.
- Up Down (Z):** Contains buttons 'Move Up', 'Move Down', and 'Move Absolute'. To the right are input fields for 'Up Position (Counts): 0', 'Down Position (Counts): -25000', and 'Absolute Position (Counts): 0'.
- Current Position:** A section on the right with input fields for 'Rotation (Counts):', 'End Effector(Counts): 100', 'Up Down Z(Counts):', 'Cassette Elevator (Counts): -1986551', and 'Elevator Encoder (Counts): -22928'.
- Elevator (6 Inch Wafer):** Contains input fields for 'Wafer Spacing (Counts): 96000', 'Stroke (Counts): 20000', 'Wafer #1 Z (Counts): 3494500', and 'Absolute Position (Counts): 0'. There is a 'Move Absolute' button below these fields.
- Move to Wafer:** Contains a 'Get Position' button (disabled), a 'Put Position' button (active), a 'Wafer #:' dropdown menu set to '1', and a 'Move To Wafer' button. There is also a text field containing '3494500'.

On the far right, there are four buttons: 'Home', 'Stop', 'Save Settings', and 'Exit Setup'.

Most all settings that need be adjusted are done from the controls located on this tab. The page is comprised of six sections and each will be discussed in some detail to give an understanding of what these setting do and their purpose.

The buttons labeled “Move Absolute” and fields labeled “Absolute Position (Counts)” are not used in the procedure and can be ignored.

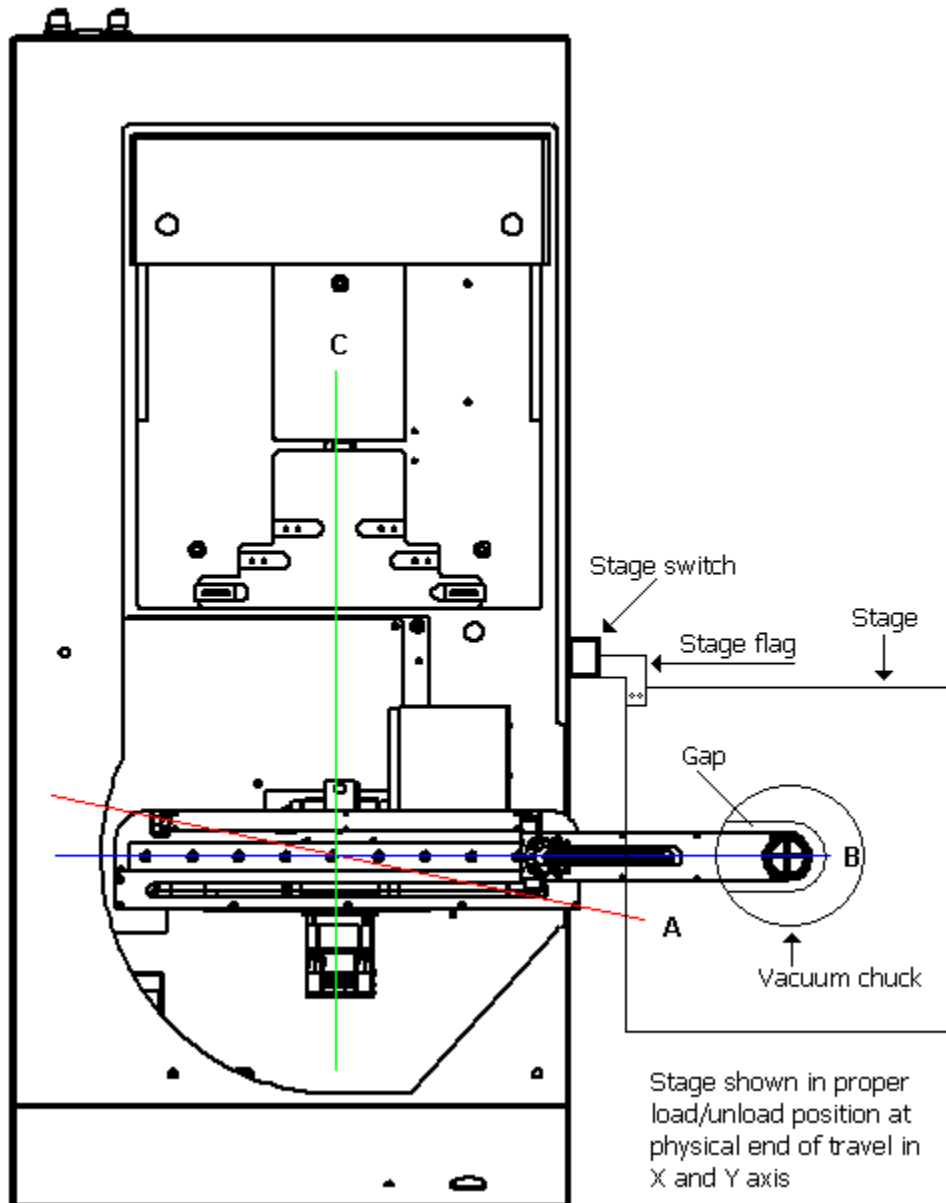
Use caution when clicking the controls on this page. Be sure the control that is intended to be clicked, is the one being clicked. Clicking on the “Move Absolute” button when the field to the right of the particular control contains zero as its value, will attempt to move the axis directly to its home position.

Note that positional information presented on these pages is in motor “steps” or “counts” as the handler system uses stepper motors throughout the system. Values shown in most of the various fields will reflect that of the contents of the ini file with exception of the fields contained within the “Current Positions” and “Move to Wafer” sections of the page.

The setup of the robot, Rotation, End Effector and Up Down functions follow and should be completed before the setup of the elevator and cassette(s). The settings of the cassette elevator will be performed later on in the procedure.

## End Effector to Stage – Rotation adjustment

Rotation causes the robot to turn to either the stage or the cassette positions depending on which of the two buttons are clicked. Next to the controls at the right, are fields that contain the number of steps *away from the home position* that represent the stage and cassette positions. Shown below are the three positions of the robot rotation mechanism which are, the home position, red line A, the stage position (also the “homed state” position), blue line B and the cassette position, green line C. Note that the “Homed state” is not always the same physical position as the “home position” for any of the axis within the system.



**Figure 1.**

Once the system has been initialized and homed, the rotation mechanism moves only between the stage and cassette positions, B and C respectively. Shown below in figure 2 is the control used to setup the positions of the robot rotation device.

Rotation (R)	
Move to Stage	Stage Position (Counts): -2000
Move to Cassette	Cassette Position (Counts): -111500
Move Absolute	Absolute Position (Counts): 0

Figure 2.

In the “homed” state, the handler system rotation device is pointing to the stage with the end effector in the retracted position. Figure 1 above shows the end effector in the extended “stage” position with the stage at the proper load/unload position and the stage switch being engaged. In the proper alignment of the handler system in relation to the wafer chuck, the chuck is perpendicular to the handler such that the rotation device is straight and at a right angle with the cassette while pointing to the chuck as shown in the drawing.

The End Effector control can be used to manipulate the end effector as necessary during the procedure and is show below.

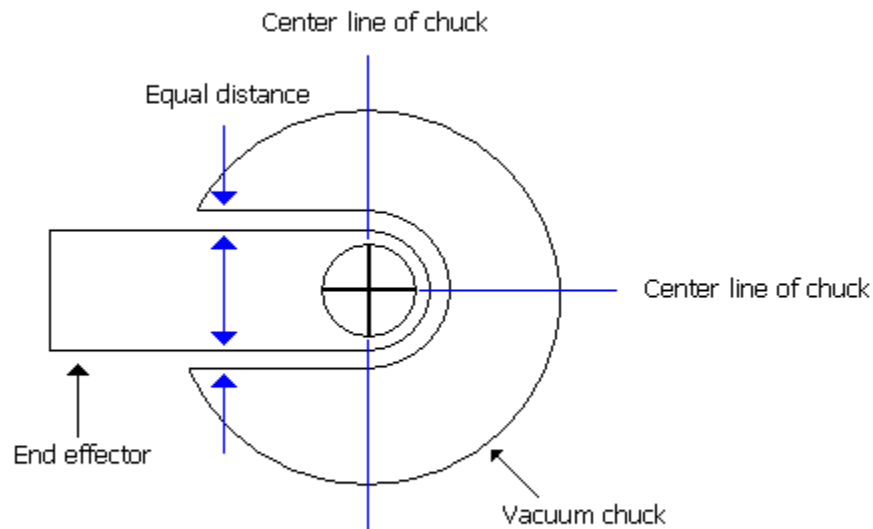
End Effector (T)	
Move to Stage	Stage Position (Counts): -622500
Move to Cassette	Cassette Position (Counts): -600000
Retract	Retract Position (Counts): 100
Move Absolute	Absolute Position (Counts): 0

Figure 3.

To begin the procedure of aligning the rotation and end effector devices to the stage chuck, ensure the stage is positioned fully rearward and fully to the right (away from the handler). Normally, there is enough of a gap between the bottom of the end effector and the top of the vacuum chuck (see the blue arrow on figure 8 below) such that the end effector clears the chuck by some distance. This may not hold true in every installation of the handler system and thus, moving the stage away from the handler will prevent the end effector from crashing into the stage or vacuum chuck inadvertently during the first few steps of the procedure if the gap does not exist.

Click the **Rotation** Move to Stage button on the panel to be sure the rotation device is indeed pointing to the position the Stage Position value represents. This should really do noting at all if the handler has just been homed. Next, click the **End Effector** “Move to Stage” button to extend the end effector outward towards the stage.

Move the stage to the left, towards the end effector, to the load/unload position and observe whether or not the end effector rotation is in alignment with the cutout of the stage chuck. Referring to figure 4, note the gap between the end effector and the stage chuck. Ideally, the gap distance should be even on both sides and with the “+” or cross lines of the end effector located at the center of the vacuum chuck as shown in figure 4.



**Figure 4.**

Depending on which direction the end effector is rotated (if out of proper alignment), determines if the “Stage Position (Counts)” value needs to be larger or smaller. Refer to figure 2 above and note that this value is a negative number. A larger value refers to a larger negative value and the opposite is true of that of a smaller value for this field. Figure 5 below, shows this relationship. This field is always a negative value.

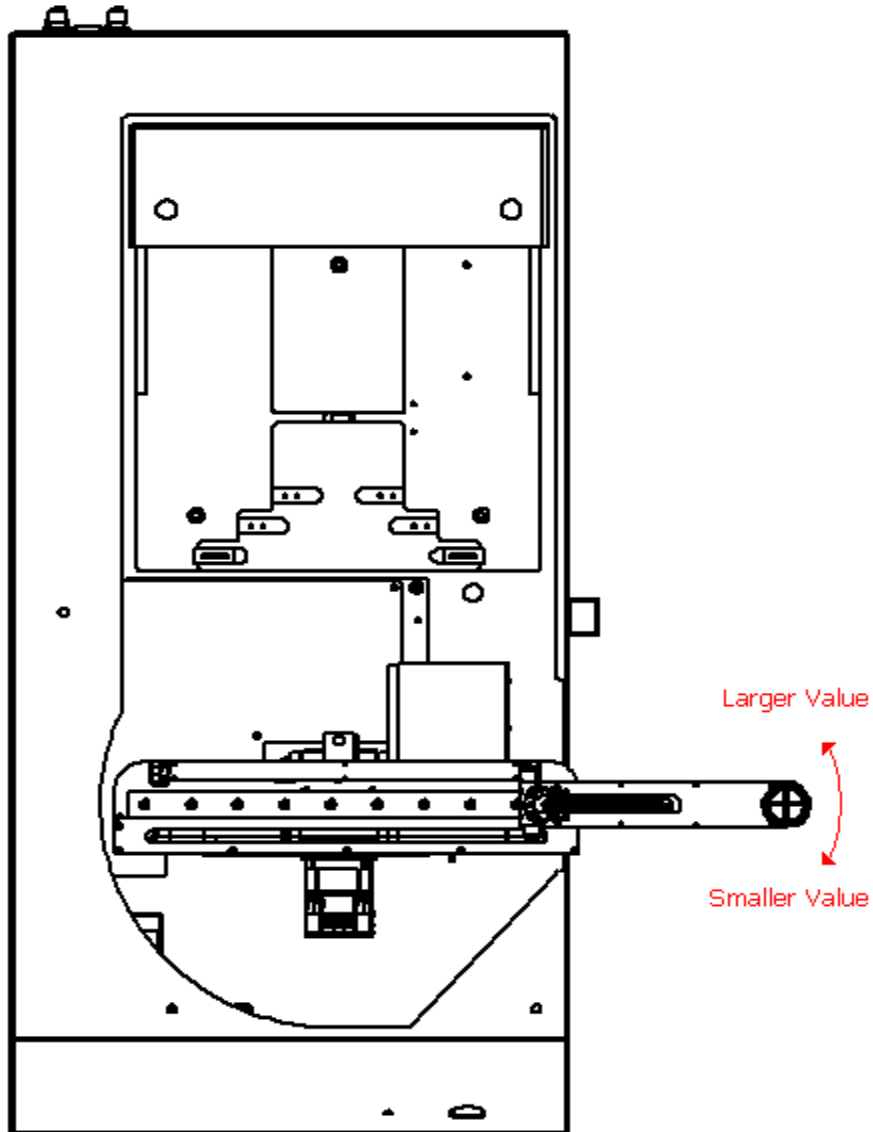


Figure 5.

If the rotation of the end effector is incorrect, proceed as follows. If the end effector needs to be positioned more towards the cassette elevator to align with the vacuum chuck, enter a slightly larger number in the Stage Position field of the **Rotation** control and click the “Move to Stage” button of the control. The robot will immediately move to the new location. Keep the changes small (a few hundred counts) as larger values can cause the rotation device to move an unexpected amount if entered in this field. A good value to start off with would be 300 to 500 counts. If the rotation needs to move further away from the cassette elevator to align with the stage vacuum chuck, reduce the value of this field slightly and click the “Move to Stage” button to reposition the rotation device. Ideally, the gap (as shown in figure 4) should be somewhat equal on both sides of the end effector in relation to the stage chuck. A small ruler can be used to check the gap size but can be done visually such that if it “looks good” when viewed from *straight down* as shown in figure 4, the adjustment is sufficiently close enough. Simply adjust the value as necessary to achieve the required position.

Once the rotation alignment is centered to the chuck, click the “Save Settings” button on the page to save the new setting to the ini file. This is good practice when making adjustments throughout the procedure.

## End Effector to Stage - Extension adjustment

Next, the extension of the end effector to the stage vacuum chuck can be performed. Referring to figure 3 above, use the **End Effector** control to position the center of the “X” on the end effector, to the center of the vacuum chuck as shown in figure 4. In a similar manner as aligning the rotation, alter the value of the “Stage Position (Counts)” field and click the “Move to Stage” button to reposition the end effector. The position of the end effector can be adjusted inwards (away from the chuck) using a lesser value or, outwards (closer to the chuck) using a larger value to align it to the center of the vacuum chuck. This value is always a negative value. An incremental value of 5000 to 10000 counts would be good to start with when adjusting the extension distance.

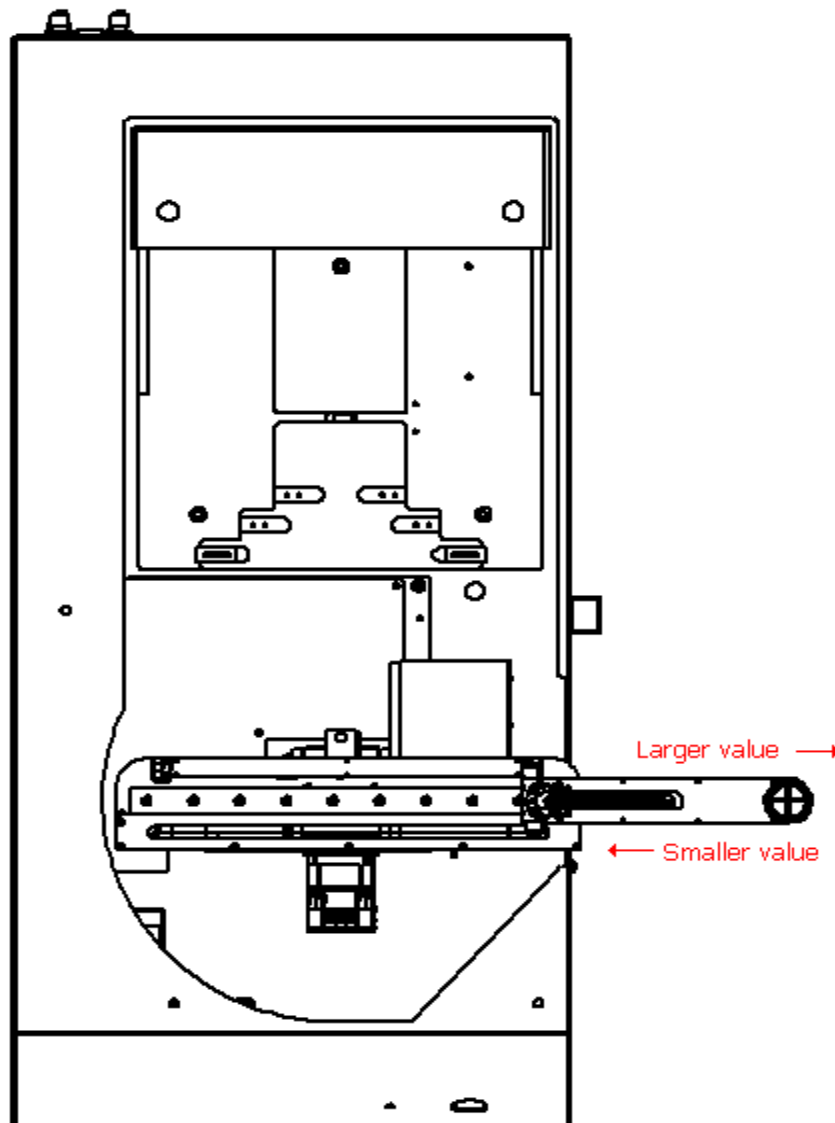
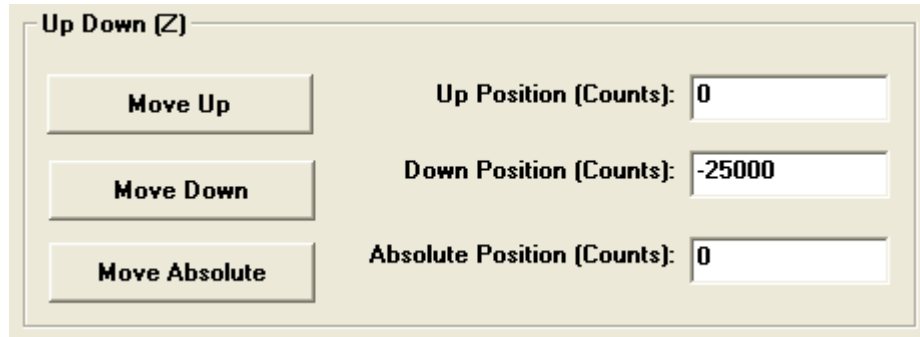


Figure 6.

When the correct position has been achieved, save the setting. Temporarily retract the end effector by clicking on the “Retract” button of the **End Effector** control.

## End Effector to Stage - Up/Down adjustment

The final step of the *end effector to stage* adjustment, is that of the up/down component of the robot. Figure 7 shows the control detail.



Up Down [Z]	
Move Up	Up Position (Counts): 0
Move Down	Down Position (Counts): -25000
Move Absolute	Absolute Position (Counts): 0

Figure 7.

The up down function of the robot is only used when transferring a wafer either to or from the stage vacuum chuck and not used during wafer transfers to or from the cassette. The home position of the end effector in this axis of the robot is always the “UP” position. Because the up position is defined as the “home” position and also coincident with the position sensor of the axis, the up value is considered the “Homed state” and always set to zero by default. Note that the up position is also at the end of travel at this position. In other words, the end effector cannot be raised any higher than this point, only lowered from this point. Also note that the travel of the up/down axis has one-quarter inch total (0.250”) movement. If additional height is required, use of the system leveling adjusters is warranted.

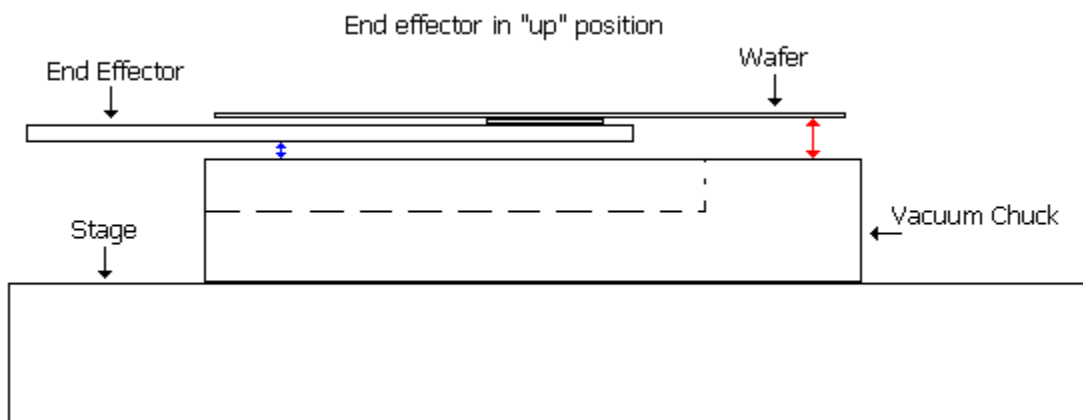
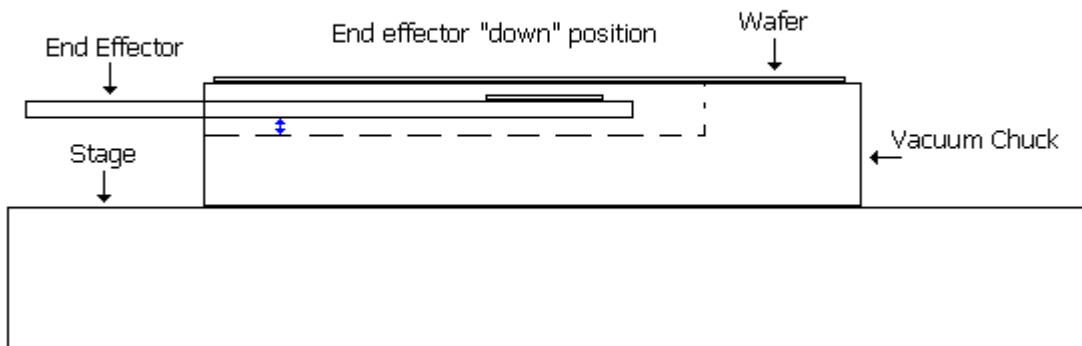


Figure 8.

Figure 8 and figure 9 show the relationship of the end effector with respect to the stage chuck in the up and down positions respectively. In the up position, the wafer must clear the chuck with enough distance that it does not touch the chuck in any way as the end effector moves between its retracted and extended positions. When in the down position, the end effector must travel far enough downward as to not touch the underside of the wafer in any way as it moves between its

extended and retracted positions and additionally, not so far down as to collide with the stage or chuck underneath it.

To check for proper clearance, manually place a scrap wafer on the wafer chuck and bring the wafer into focus as normal. Remove the wafer without altering the position of the focus. Next, position the stage at the proper load/unload position and extend the end effector out to the vacuum chuck using the **End Effector** "Move to Stage" control. Place a scrap wafer onto the vacuum section at the tip of the end effector. There should be ample clearance between the bottom of the wafer and the top of the chuck (see the red arrow in figure 8 above). Approximately 1/10 inch (0.100") is acceptable. Remove the scrap wafer.



**Figure 9.**

If the results of the above procedure are not acceptable, adjustment of the handler leveling screws and/or inspection stage may be necessary to achieve the desired results and should be completed before continuing with the procedure.

The next step is to check for the proper "down" position clearance. Using the **Up Down** control shown in figure 7, click the "Move Down" button to lower the wafer on to the vacuum chuck. The end effector will be lowered and should be positioned as shown in figure 9 above. The bottom of the end effector should not be touching the stage or wafer chuck (see blue arrow in figure 9) and low enough to not be touching the bottom side of the wafer.

To check the clearance on the under side of the wafer, move the stage to the right (not forward) just far enough to expose half of the vacuum section of the end effector. If the wafer moves at all, it's an indication of the end effector not being positioned low enough to clear the underside of the wafer. Visually check for enough clearance between the top of the end effector and bottom of the wafer. This distance should be approximately 1/10 inch (0.100")

The down position of the end effector can be adjusted if need be, to compensate for stage vacuum chucks having shallow end effector pockets by adjusting the value of the "Down Position (Counts)" field. As with other settings, use small changes to this setting. The up/down axis of the handler operates on a cam system so therefore, there is a limit to how far down the end effector can travel before it begins to move upwards again. Maximum travel is ¼ inch (0.250") The resolution of this motor in this axis is 51,200 steps per revolution. 25,600 steps yields one-half revolution and thus, is the maximum number of steps that can be assigned to this value before the end effector begins to rise on the opposite side of the cam. This value is always a negative value.

Assigning a smaller value in this field (something less than 25600) will result in the end effector being lowered a lesser amount when dropping off or picking up a wafer from the stage. Increments of 1000 counts can be used as a starting point if adjustment should be necessary.

As with the previous controls, enter a value in the “Down Position (Counts)” field and click the “Move Down” button of the **Up Down** control to adjust the down position of the end effector. This is not a particularly critical adjustment. As long as the end effector is not touching either the wafer or any part of the vacuum chuck or stage, the adjustment can be deemed satisfactory. When completed, save the new settings. Click the “Move Up” button of the **Up Down** control to raise the end effector. Remove the scrap wafer from the end effector. Click the “Retract” button of the **End Effector** control to retract the end effector.

Though the handler is designed to operate with wafers ranging in size from four to eight inches, the settings of the “Rotation”, “End Effector extension” and “Up Down” in relation to the stage vacuum chuck, are shared between all the different size wafers. Once properly set, no further adjustments are required except for the following reasons. The position of either the handler or the microscope or other mechanical process changes position in relation to the handler. Or, the handler system robot or end effector has been replaced.

This completes the alignment of the end effector to the stage vacuum chuck.

## End Effector to Cassette adjustment - Rotation

The next steps of the setup deal with the end effector alignment in relation to the cassette elevator. This is a relatively simple portion of the procedure in that only two adjustments are really made, the rotation of the end effector and the extension of the end effector in relation to the elevator cassette platform.

Begin by ensuring there is no cassette located on the elevator platform. Next, locate the **Elevator** control on the Positions page and shown here.

The screenshot shows a software interface for controlling a 6-inch wafer elevator. The interface is titled "Elevator (6 Inch Wafer)". It contains several input fields and buttons. The "Wafer Spacing (Counts)" field is set to 96000. The "Stroke (Counts)" field is set to 20000. The "Wafer #1 Z (Counts)" field is set to 3494500. The "Absolute Position (Counts)" field is set to 0. Below these fields is a "Move Absolute" button. Underneath is a section titled "Move to Wafer" which contains a "Get Position" button (with a green dot icon), a "Put Position" button (with a black dot icon), a "Wafer #:" dropdown menu currently showing "1", and a "Move To Wafer" button. A text box displaying "3494500" is located to the left of the "Move To Wafer" button.

In the section labeled, "Move to Wafer", ensure the drop down box contains the number 1 and then click the "Move to Wafer" button. The elevator should rise to where the system thinks the number 1 slot of the cassette is currently located. Raising the elevator in this manner makes it visually easier to perform the following adjustments.

Referring to the **Rotation** control shown again below, click the “Move to Cassette” button. The robot will turn the end effector towards the cassette elevator.

Rotation (R)	
Move to Stage	Stage Position (Counts): -2000
Move to Cassette	Cassette Position (Counts): -111500
Move Absolute	Absolute Position (Counts): 0

Next, click the **End Effector** “Move to Cassette” button to extend the end effector out over the elevator platform.

End Effector (T)	
Move to Stage	Stage Position (Counts): -622500
Move to Cassette	Cassette Position (Counts): -600000
Retract	Retract Position (Counts): 100
Move Absolute	Absolute Position (Counts): 0

Figure 10 below shows the proper alignment of the end effector in relations to the cassette elevator. The red cross lines represent the center of the wafer when the cassette is placed on the elevator. This holds true for all different cassette sizes the handler is designed to work with. No matter which size wafer cassette is placed on the elevator, the center of the wafer is always located at the point of the cross lines and therefore, only one setting is required for operation with any cassette size used with the handler.

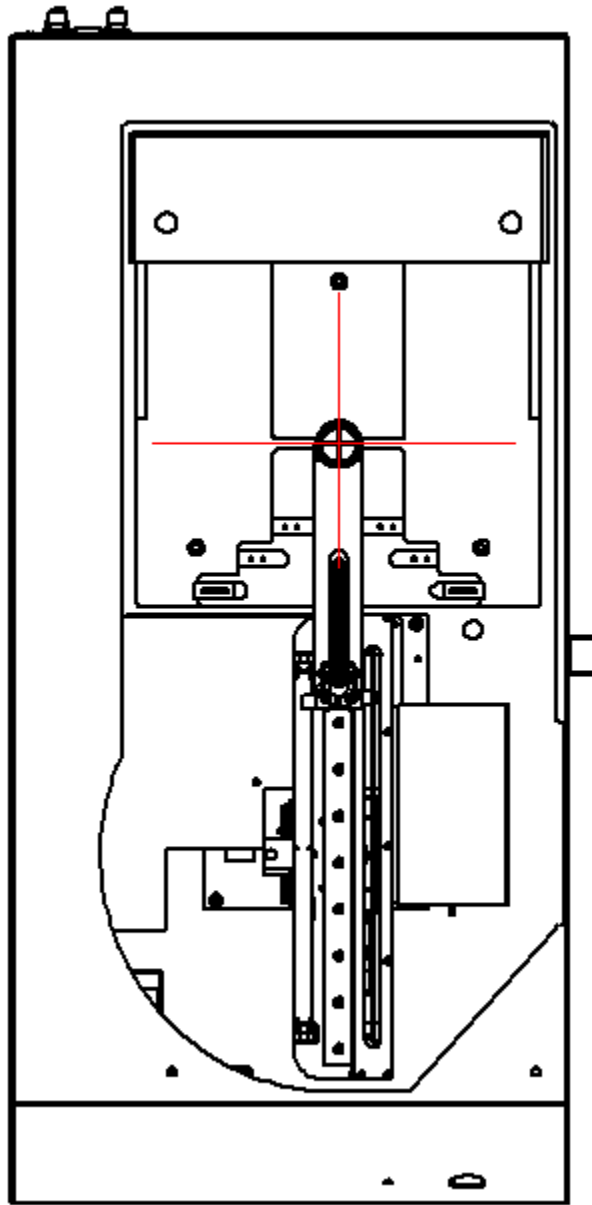


Figure 10.

In the same manner as was used above to align the rotation of the end effector to the stage, adjust the value of the "Cassette Position (Counts)" field of the **Rotation** control to move the end effector either clockwise, or anticlockwise as necessary, to position it at the center of the elevator platform as shown in figure 10, above. Larger values move the rotation device anticlockwise, lesser values move the end effector clockwise. This value is always negative. Save the setting when completed.

### End Effector to Cassette adjustment - Extension

As above with the extension of the end effector over the stage, and its associated adjustment, the extension of the end effector over the cassette elevator has its own setting and can be performed

the same way as was done earlier. Only now, use the “Move to Cassette” button and the “Cassette Position (Counts)” field of the **End Effector**” control to accomplish positioning the center of the end effector cross lines, in line with the alignment notch of the elevator as shown above. Larger values move the end effector towards the rear of the handler, lesser values move the end effector towards the front of the handler. Save settings when the proper alignment is accomplished.

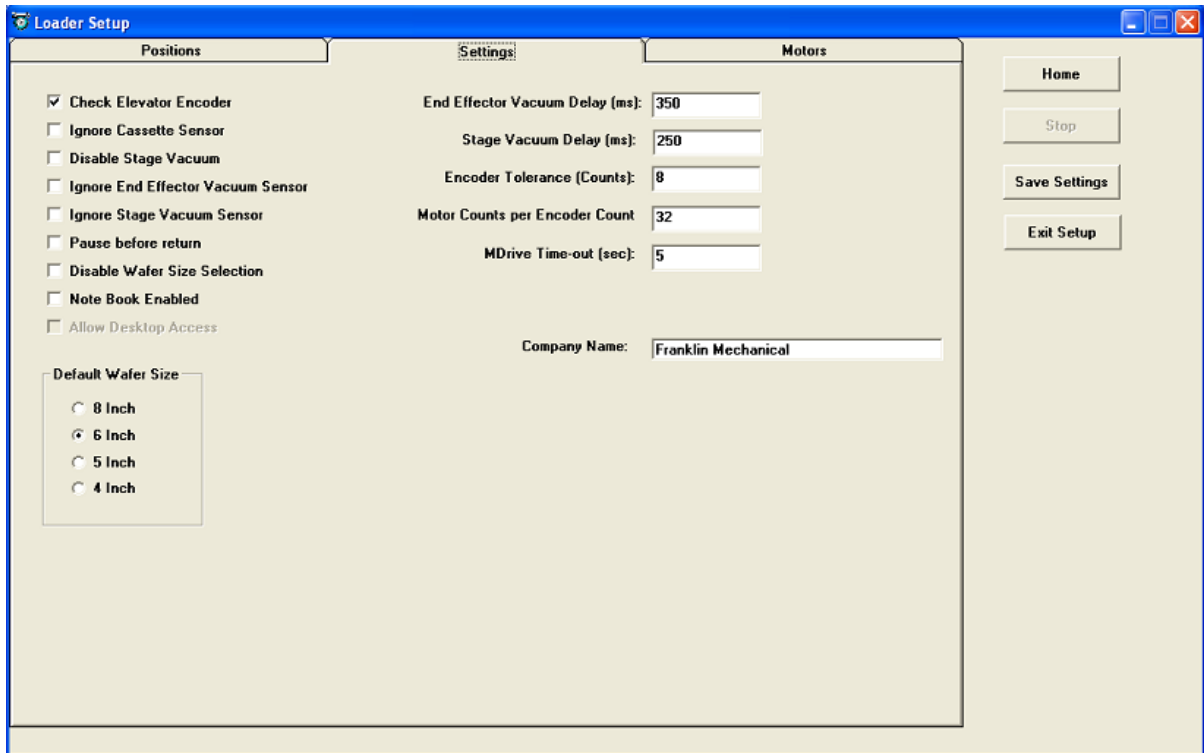
This completes the end effector to cassette adjustment. Click the “Retract” button of the **End Effector** control to retract the end effector to its home state.

Worthy of note is that the four, five and six inch wafer cassettes all typically share the same attributes as far as “first position” (slot one) and spacing between slots with the eight inch cassette being the exception. Therefore, once the setup procedure has been completed for any of the four, five or six inch size wafers, the same values can be normally be entered for the other two cassette sizes. This is not a requirement however, and if need be, can be setup individually to accommodate for possible variations of the different size cassettes. The eight-inch size wafer cassette must be setup individually.

## Setting the Default Wafer

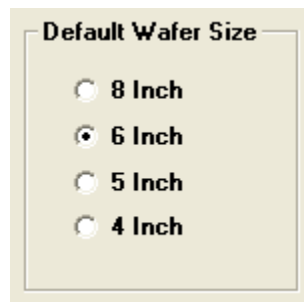
At this point, the setup of the cassettes themselves can begin. As mentioned earlier, the four, five and six inch wafer cassettes typically share the same dimensions as far as spacing between wafer slots and the position of the number one wafer. Because of this, when any one of these settings have been completed, the setting can be applied to the other two without the need to do the entire procedure for each one individually. In any case, the procedure remains the same for any of the different cassette sizes.

Click the “Settings” tab to show the settings page as seen below.



The screenshot shows the 'Loader Setup' application window with three tabs: 'Positions', 'Settings', and 'Motors'. The 'Settings' tab is active. On the left, there is a list of checkboxes: 'Check Elevator Encoder' (checked), 'Ignore Cassette Sensor', 'Disable Stage Vacuum', 'Ignore End Effector Vacuum Sensor', 'Ignore Stage Vacuum Sensor', 'Pause before return', 'Disable Wafer Size Selection', 'Note Book Enabled', and 'Allow Desktop Access'. Below these is a 'Default Wafer Size' section with four radio buttons: '8 Inch', '6 Inch' (selected), '5 Inch', and '4 Inch'. On the right, there are five text input fields: 'End Effector Vacuum Delay (ms): 350', 'Stage Vacuum Delay (ms): 250', 'Encoder Tolerance (Counts): 8', 'Motor Counts per Encoder Count: 32', and 'MDrive Time-out (sec): 5'. Below these is a 'Company Name' field with the text 'Franklin Mechanical'. On the far right, there are five buttons: 'Home', 'Stop', 'Save Settings', and 'Exit Setup'.

Choose a default wafer size using the radio buttons of the control located on the page.



This is a close-up of the 'Default Wafer Size' control. It features a title 'Default Wafer Size' and four radio buttons labeled '8 Inch', '6 Inch', '5 Inch', and '4 Inch'. The '6 Inch' radio button is selected, indicated by a black dot in the center of the button.

Click the Save Settings button and then click the Exit Setup button. This will close the setup page and return to the main control page. Click Exit Program to close the application.

The handler will position the cassette elevator and robot to default positions and then exit to the Windows desktop. *Do not power down the handler.*

Once the program has closed, re-launch it from the desktop icon or from the Windows start button if there is no desktop icon. This method of restarting the program ensures the settings for the selected default wafer size are read from the ini file.

The system will go through the normal initialization process of opening the comports, testing communications with the hardware, vacuum checks etc. and then will show a message stating the handler has already been homed with the options of re-homing the handler or skipping the homing operation. Click the “No” button to skip the homing operation as this is already done.

After the “Setup” button becomes enabled, click it and re-enter the setup page. The default Wafer Size control on the settings page should be set to the size that was just previously selected. Click the “Positions” tab. Ensure the elevator control shows the correctly selected wafer size on the frame caption line at the upper left corner of the control. In the instance shown below, it would be the six inch wafer size as the current default size.

The screenshot shows a software window titled "Elevator (6 Inch Wafer)". Inside the window, there are four input fields with their respective values: "Wafer Spacing (Counts): 96000", "Stroke (Counts): 20000", "Wafer #1 Z (Counts): 3494500", and "Absolute Position (Counts): 0". Below these fields is a "Move Absolute" button. A section titled "Move to Wafer" contains two radio buttons: "Get Position" (which is selected, indicated by a green dot) and "Put Position" (indicated by a black dot). Below the radio buttons is a "Wafer #:" dropdown menu showing "1". At the bottom of the "Move to Wafer" section is a text box containing "3494500" and a "Move To Wafer" button.

Figure 11.

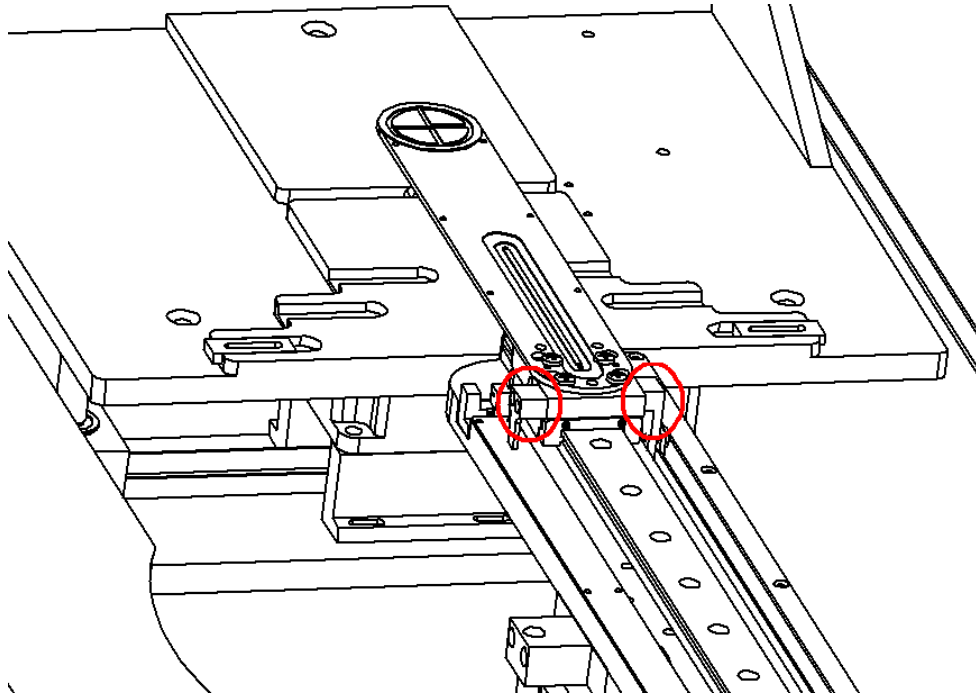
## Cassette to End Effector adjustment.

### Step 1.

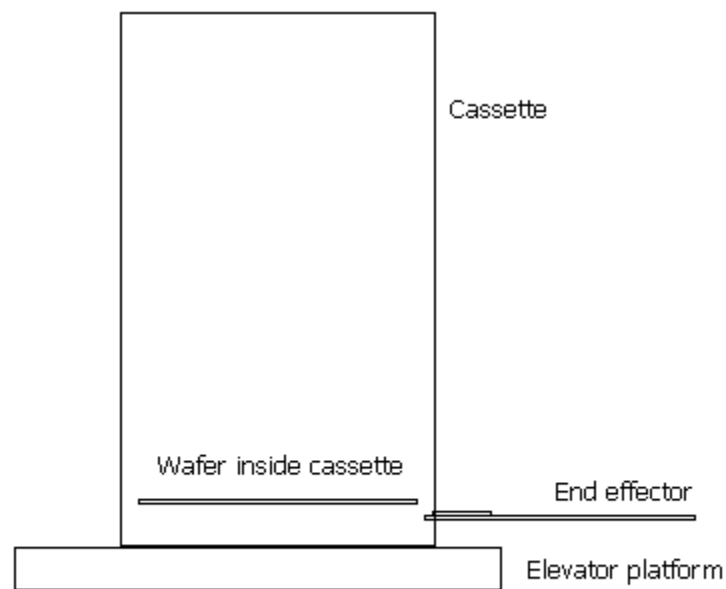
Place scrap wafers in slots 1, 2, 24 and 25 of a cassette. Place the cassette on the elevator at the proper location of the platform. Ensure the “Wafer #” drop down box of the “Move to Wafer” section of the **Elevator** control is set to wafer number one. Check that the dot next to the “Get Position” button is green. If not, click the “Get position” button. Click the “Move to Wafer” button. The elevator will move upwards slightly and stop. Click the “Move to Cassette” button of the **Rotation** control (if the robot is not already pointing towards the cassette) to correctly position the robot. Do *not* click the “Move to Cassette” button of the **End Effector** control at this time. The end effector must be manually positioned during the next steps to avoid crashing it into wafers.

Step 2.

Grasp the end effector at the points shown below and gently push the end effector forward from its retracted position. Try not to rotate the end effector in the process.



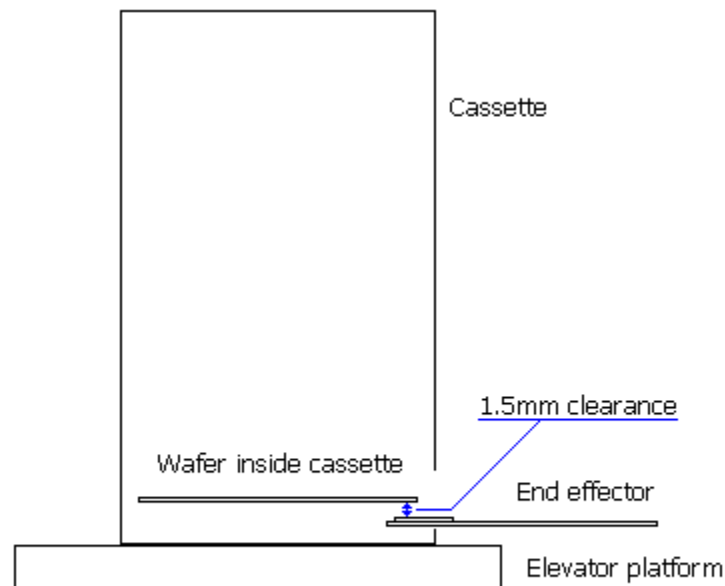
Position the tip of the end effector at the edge of the wafer and verify the position looks similar to the drawing shown below.



Side view of cassette, wafer and end effector

If the end effector is *below* the wafer, continue to position the end effector inwards so that about half the cross line vacuum area is positioned under the wafer. Otherwise leave the end effector in its current position.

A distance of approximately 1.5 millimeters or 0.060 inches from the top of the end effector to the bottom of the wafer is correct. A small rule with increments of 100ths can be used to check the distance. Be careful to not apply downward pressure on the end effector as it will flex and the measurement will be incorrect. Additionally, be careful to not scratch the surface of the end effector when using a rule to check the clearance.



Side view of cassette, wafer and end effector

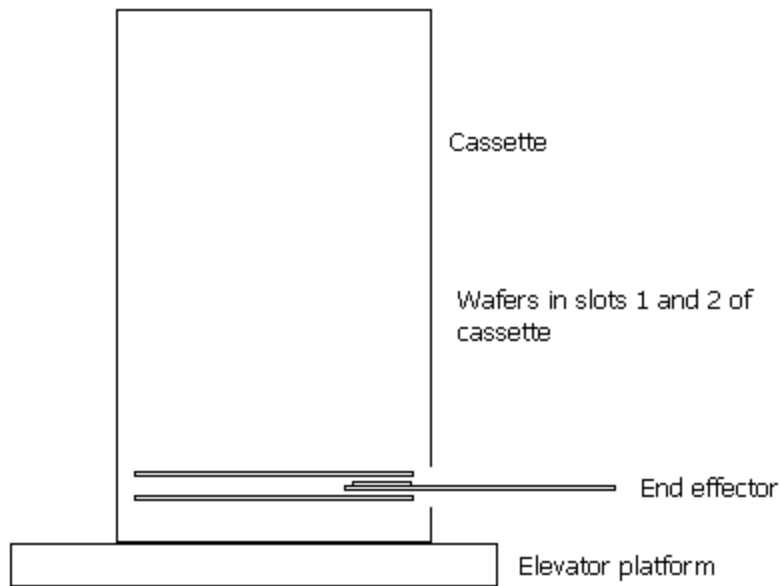
If the distance is correct, proceed to Step 3. Otherwise, proceed as follows.

NOTE: Always position the end effector completely away from the elevator when making these adjustments. This will keep the end effector and/or other components from being damaged in case a grossly incorrect value is entered in the adjustment field, or, the "Move Absolute" button is accidentally clicked which will send the elevator to its home position at the bottom of its travel. Reposition the end effector after the adjustment has been made to re-check any adjustments.

Using the **Elevator** control shown in figure 11, in the "Wafer #1 Z (Counts)" field, enter a larger value if the wafer is too low or a lesser value if the wafer is too high. Click the "Move to Wafer" button to readjust the height of the elevator. Somewhat large values can be entered in this field. Increments of 5,000 to 10,000 steps are a good starting point. This value is always positive. Go back to Step 2.

### Step 3.

Manually position the end effector so that it is clear of the cassette and the wafer inside. Use the dropdown control of the "Move to Wafer" section of the **Elevator** control and select the number two. Click the "Move to Wafer" button of the control. The elevator will position itself to the number two slot of the cassette and stop. The elevator should now be positioned such that when the end effector is again manually pushed forward, it should clear both the slot one and slot two wafers by an equal distance as shown in the drawing below. A small flashlight may prove helpful while checking the clearance between the wafers.



Side view of cassette, wafers and end effector during cassette setup procedure.

View shows wafer number 2 position

If the end effector is in the correct position, proceed to Step 4. Otherwise, continue.

If the end effector does not clear both wafers, then the adjustment of the wafer number one position may be incorrect. Move the end effector safely away from the cassette. Select 1 from the dropdown box. Click "Move to Wafer". Go back to Step 2 to recheck the clearance.

If, after rechecking the wafer 1 position for proper clearance and it is satisfactory, yet the wafer number two clearance is not, indicates the cassette has a different slot spacing than that of the default setting. The default setting of 96000 counts is for a cassette with a wafer spacing of 0.1875 inches. Franklin MCI currently uses cassettes with this spacing during testing of the handler and therefore is set as the default value.

The following formula is used to calculate the proper number of counts between adjacent cassette slots. The distance between two adjacent slots of the cassette must be known or accurately measured. That known distance is divided by the elevator step distance of, 0.000001953125 inches or 0.00004909375 millimeters. The result gives the number of counts between two slots of the cassette. For instance, a cassette with a known slot spacing of 0.1875 inches is being used. 0.1875 divided by 0.00001953125 equals 96000 counts and is the number to enter into the "Wafer Spacing (Counts)" field. Once the correct count value has been entered, click the "Save Settings" button and return to Step 3 to recheck the wafer clearance.

It should be noted that this setting is critical to the operation of the loader. If incorrect values are entered, the error is accumulative over distance. This means that, as the elevator moves to a higher slot number of the cassette, the error will become more pronounced and the end effector could crash into wafers that are located in the higher slots.

#### Step 4.

Move the end effector to a safe position. Select slot twenty-five using the dropdown control and click, "Move to Wafer". The elevator will lower the cassette to the slot twenty-five position and

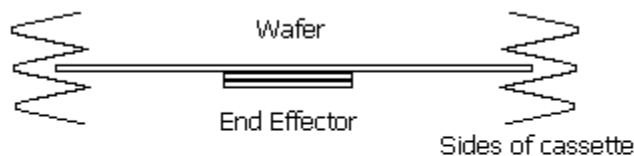
stop. Push the end effector forward towards the wafers. Its position should be between the two wafers, not touching either as in Step 3 above. If so, then continue to Step 5. Otherwise, repeat the procedure by restarting at Step 1.

#### Step 5.

The final step in the adjustment procedure is the “Stroke” adjustment. The stroke is defined as the distance the elevator is required to move when either dropping off or picking up a wafer from the end effector. As mentioned previously, the robot does not raise or lower the end effector when pointing towards the cassette. Instead, the cassette is lowered (to drop off) or raised (to pick up) a wafer from the end effector. The “Stroke (Counts)” field is used to adjust the distance the elevator moves, to position the cassette slot at the correct height for this operation.

With the elevator still positioned at wafer twenty-five, ensure the end effector is safely positioned away from the cassette. Remove the wafer from slot twenty-five and place it on the end effector approximately centered. Position the end effector such that the wafer is in close proximity to the cassette but not touching it. Re-position the wafer if necessary so that it is visually centered and in line with the cassette.

In the “Move to Wafer” section of the **Elevator** control, click the “Put Position” button and verify the indicator next to the button is green. Click the “Move to Wafer” button. The elevator will move slightly downward. Check the position of the elevator in relation to the wafer. Ideally the position should look as shown below.



View showing proper vertical stroke adjustment  
when looking straight into cassette

Note wafer centered within cassette slot

If the wafer is not positioned as shown, adjust the value of the “Stroke (Counts)” field slightly to get the wafer centered within the slot. Values between 20,000 and 45,000 counts are within the usable adjustment range of a standard cassette. Values near 30,000 are a good starting point. Smaller values reduce the amount of distance the elevator moves, which essentially raises the slot in relation to the wafer while larger values lower the slot. Step increments of 1000 are a good value to use. This value is always positive.

Click the “Move to Wafer” button after adjusting the value. When the clearance is satisfactory, click the “Save Settings” button.

This completes the handler tuning procedure and the system is ready to be operated normally with the type of cassette used during the procedure. Ensure the settings have been saved.

To begin operating the handler system, click the “Exit Setup” button on the setup page. On the main control page, click the “Exit Program” button. Power down the handler. After 5 seconds, power up the handler system and restart the handler control program. The control will initialize the handler and when completed the handler is ready for operation with the default cassette. If it is desired to setup another cassette size, return to the section “Setting the Default Wafer” and proceed from that point.