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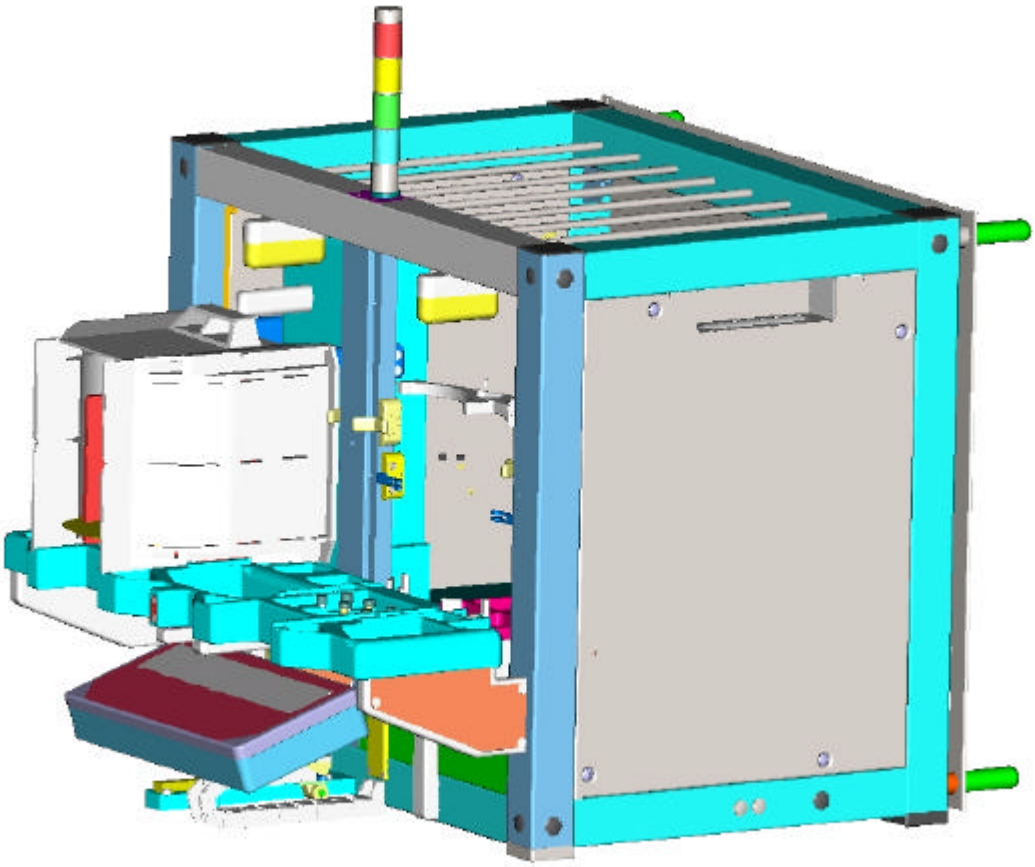
SPP200A43

LEVEL 1 OPERATOR TRAINING MANUAL:

Version 1.0.0



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CONTENTS:

1. COURSE INTRODUCTION

The goal of this manual is to familiarize SPP200A43 (Single Pick & Place 200mm model A43) operators with the tool. The manual is intended to complement the course. The main points are resumed in the performance objectives given to the operator at the start of the course.

The automated wafer manipulations made available by the tool are described and the operator should know how to set them in motion.

At the end of the course, the operator will know how to use the tool to carry out mono transfer, lot and scribe identification, sorting and alignment of 200-mm wafers. Also described are the emergency procedures.

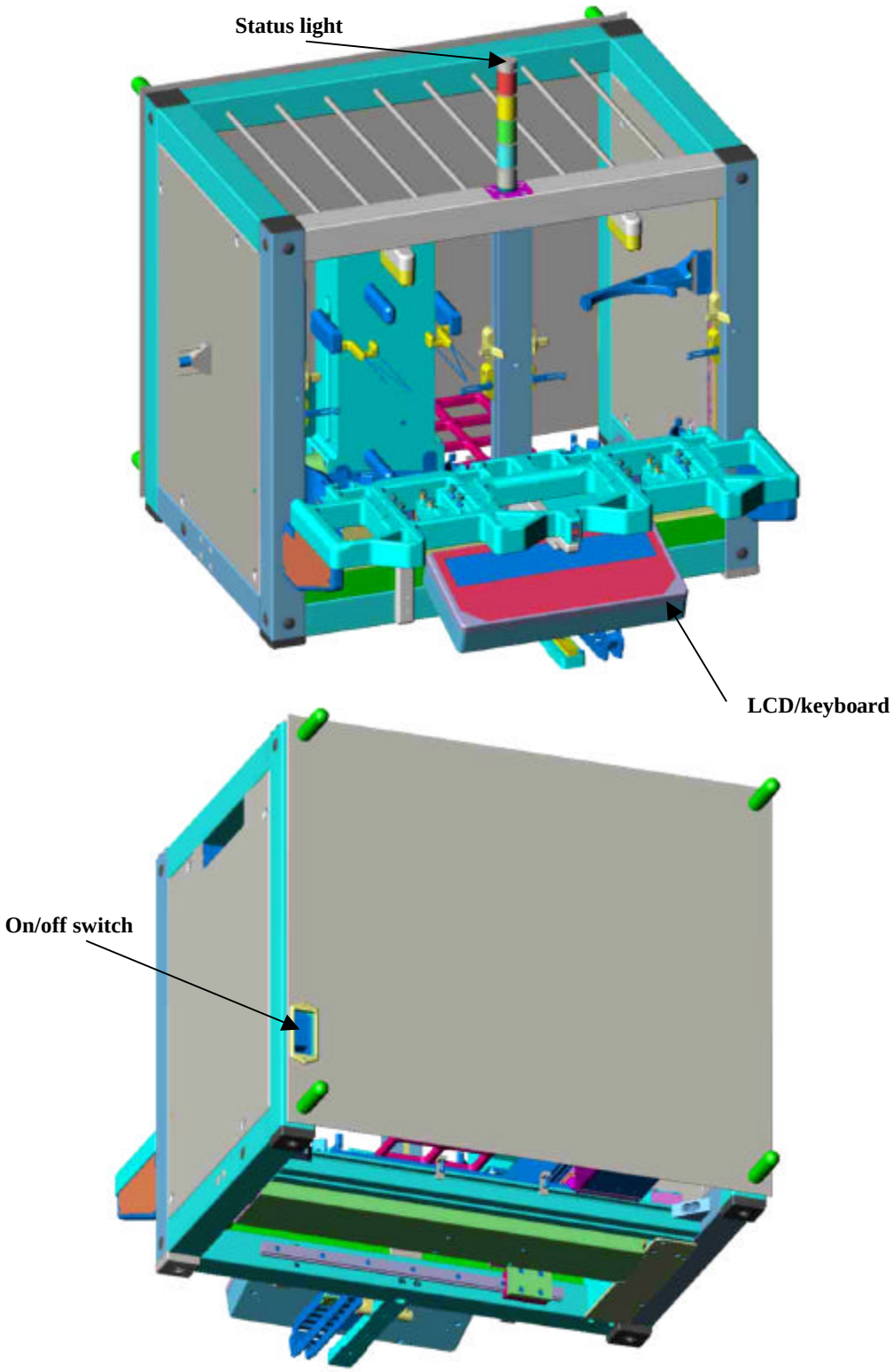
2. TOOL INTRODUCTION

The tool is intended for wafer identification and manipulation. The tool makes available mono transfer, lot and scribe identification, sorting and alignment of 200-mm wafers. A wafer is picked from a source carrier, identified and placed to a destination carrier. Source and destination carrier and slot (position within the carrier) may be the same. The carriers used are 200mm cassettes containing 200mm wafers. The tool can process up to 2 cassettes at the same time.

Operator control and feedback are available via the MMI used to select, start, interrupt and stop operations and to indicate the tool's status. Labels are used to indicate the function of each control and indicator and to provide hazard warnings.

2.1. THE TOOL'S OPERATING FEATURES

The tools' main features are shown on the following drawing and detailed thereafter.



2.1.1. THE LCD/KEYBOARD

A combined LCD/keyboard assembly provides the user interface. The interface can be used to start a cycle and monitor its progress, start maintenance programs and for tool calibration.

The keyboard's keys are used to input information prompted by messages on the LCD.

The keyboard has 26 keys for each carrier loading stage, a program key, a start key, F1 key, F2 key and a stop key.

The keyboard offers operator feed back via 3 LEDs:

- "On line" When lit, indicates that the tool is switched on.
- "Cassettes" When lit, indicates the presence of at least one carrier.
- "Defect" When lit, indicates an alarm that will be echoed by the status light.

The LCD offers 2 lines of 40 characters.

2.1.1.1. THE ON/OFF SWITCH

The on/off switch is used to switch the tool on or off, the on state is indicated by the keyboard's "On line" LED.

2.1.1.2. THE STATUS LIGHT

The status light indicates the following:

- Flashing red: Alarm state (also indicated by the "Defect" LED).
- Orange: Cycle in progress.
- Alternate orange/green: User defined operation expected.
- Green: Tool idle.

2.2. SAFETY HAZARDS

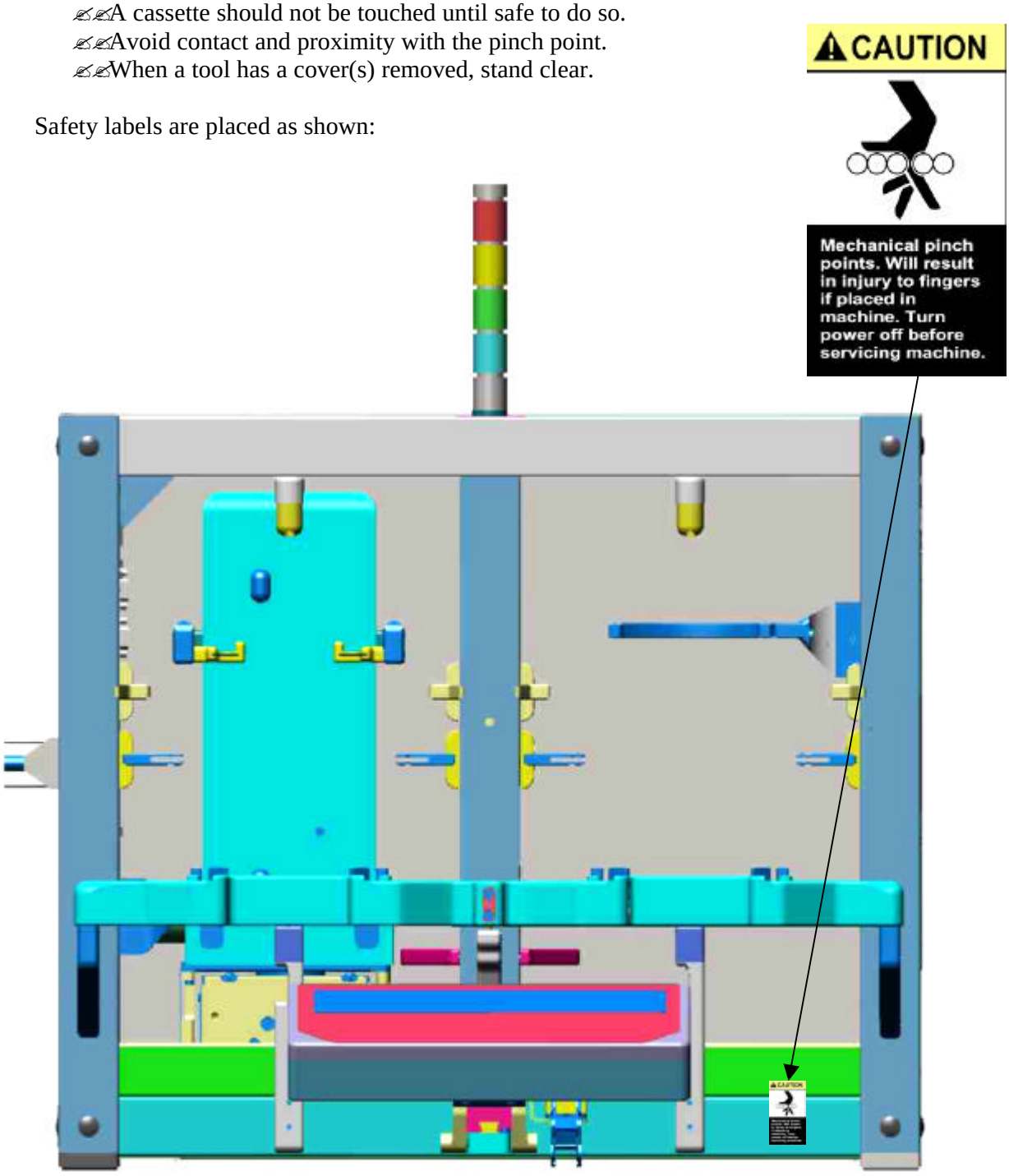
Labels positioned near to the hazard indicate the safety hazards:

- Pinch-point hazard around the carrier resting plane.

The following precautions are to be taken:

- A cassette should not be touched until safe to do so.
- Avoid contact and proximity with the pinch point.
- When a tool has a cover(s) removed, stand clear.

Safety labels are placed as shown:



3. DESCRIPTION OF THE TOOL'S OPERATING PRINCIPLE

The tool carries out a process by combining a series of coordinated movements under micro-controller program control. The movements are:

- Antenna up/down.
- Transfer forward/backward.
- Transfer left/right.
- Transfer Up/Down.

The movements and feedback acquisition are described hereafter:

3.1. THE BATTERY

The tool is equipped with a battery. In case of mains failure the LCD will show "No power input to tool". If a cycle is in progress, it will be completed. No new commands will be accepted.

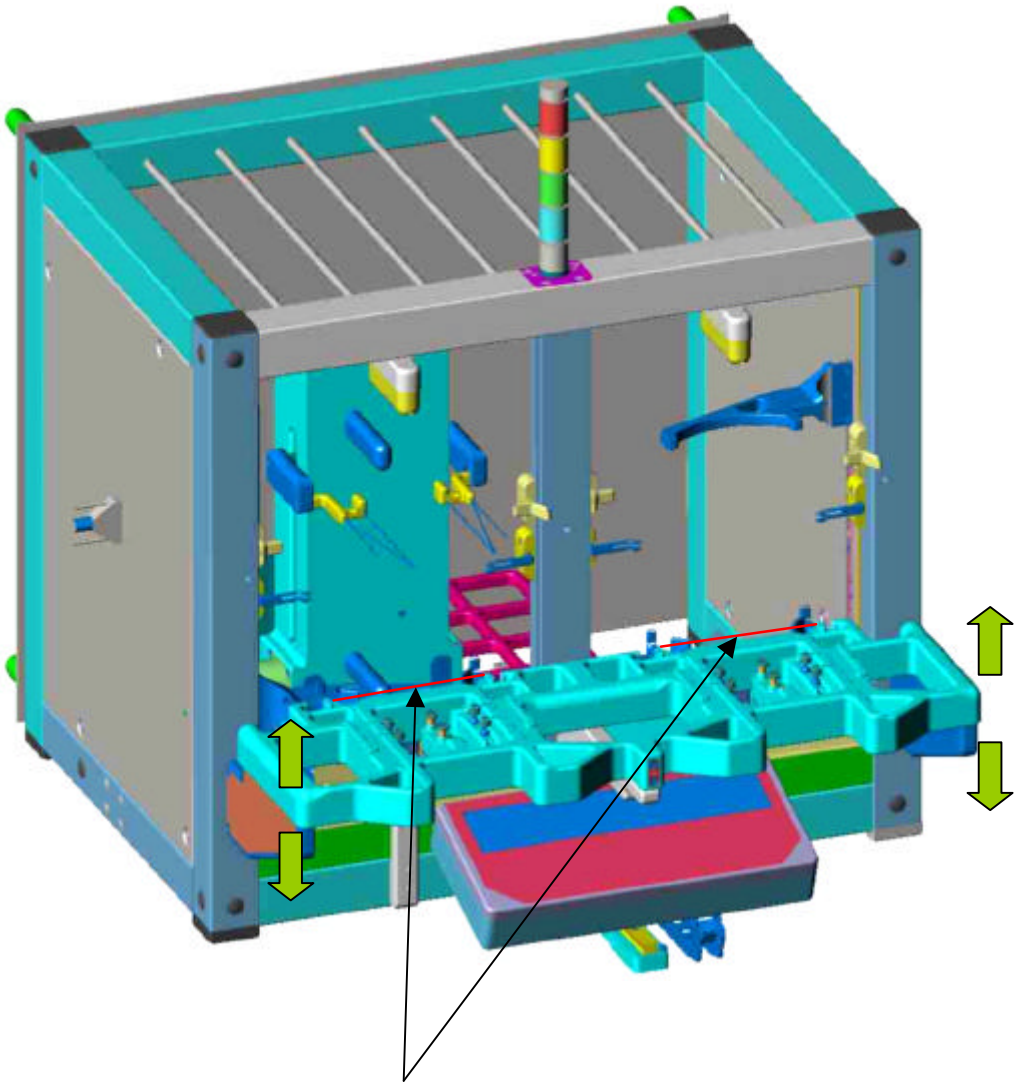
If the tool was carrying out a transfer at the moment of mains loss, when mains is restored, the tool will prompt the operator to initialize. If the tool was not carrying out a transfer at the moment of mains loss, when mains is restored, the tool will start as per usual.

3.2. THE TOOL MOTIONS

Motor/belt/pulley transmission devices drive the motions. A number of movements are possible (shown in the drawings hereafter) and typically all occur during a transfer, the order being dependant on the transfer requested.

3.2.1. THE UP/DOWN ANTENNA MAPPING UNITS

Each loading stage offers a mapping antenna. Mapping is automatically carried out following the loading of the carrier loading stages. A mapping antenna is driven up and down by a motor and associated transmission. A mapping antenna is made up from a LED/phototransistor pair, wafer presence is detected as the reduced passage of light. Using an initialization position sensor, position encoder and the correct setting up of the tool, the tool records the status of each slot.



Wafer Mapping Optical Barriers

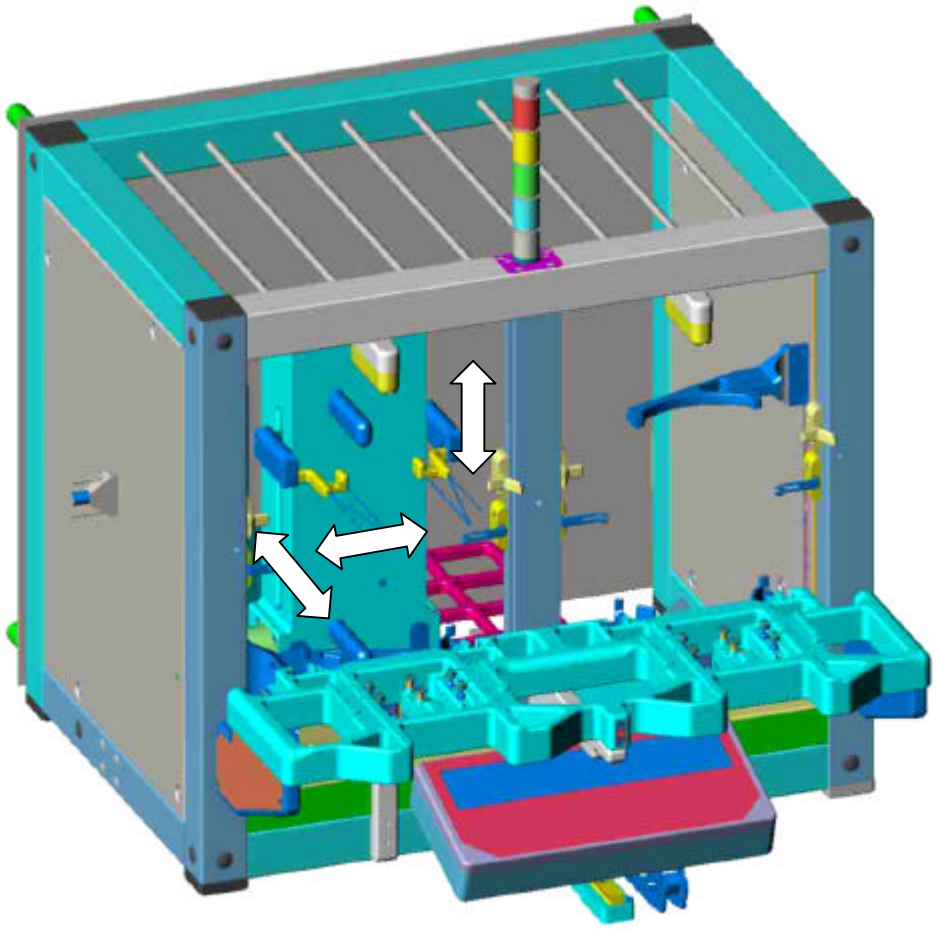
3.2.2. THE TRANSFER MOTIONS

The transfer mechanism offers 3 axe of movement. Movements of the 3 axes are combined to achieve the required 3D movement. Each motion is detailed hereafter and shown in the drawing on the following page.

- The forward/backward motion is driven by a motor and associated transmission. Using an initialization position sensor and position encoder, the tool monitors the transfer assembly forward/backward position. The forward/backward motion is used to move the mono transfer arm into/out of the carrier.

- The left/right motion is driven by a motor and associated transmission. Using an initialization position sensor and 2 position encoders, the tool monitors the transfer assembly left/right position. The left/right motion is used to move the mono transfer arm left or right.

- The up/down motion is driven by a motor and associated transmission. Using an initialization position sensor and encoder, the tool monitors the transfer assembly up/down position. The up/down motion is used to move the mono transfer arm up or down.



3.3. THE INITIALIZATION SENSORS

The transfer mechanism offers 3 axe of movement:

- Forward/backward
- Left/right
- Up/down

Movements of the 3 axes are combined to achieve the required 3D movement. For each axe, position sensors of the LED/phototransistor pair type are used to detect initialization positions.

The initialization sensor is made up from a LED/phototransistor pair. The carriage initialization position is detected as no light falling on the phototransistor. An actuator strategically fixed to the carriage provokes the phototransistors absence of presence.

3.4. THE POSITION ENCODERS

The transfer mechanism offers 3 axe of movement:

- Forward/backward
- Left/right
- Up/down

Movements of the 3 axes are combined to achieve the required 3D movement. For each axe, position encoders are used to provide movement feedback in real time. The following description is to aid understanding and figures used are illustrative.

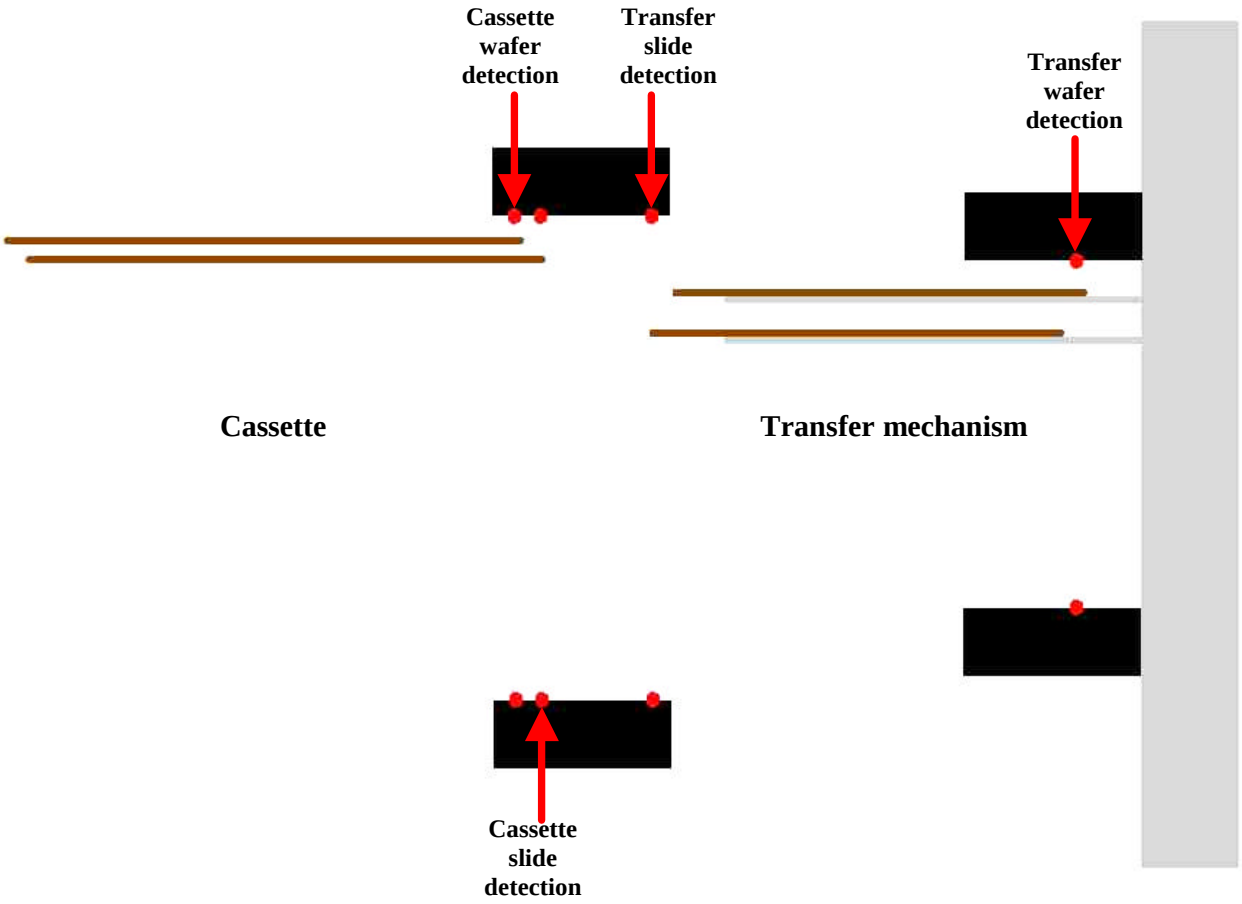
When an initialization sensor indicates home, we zero a counter. An encoder pulse from the position encoder increments the counter. If a mechanism moves $1/100^{th}$ of a mm for each pulse, we know that for each 100 indicated by the counter our mechanism has moved 1mm. These pulses, as indicated by the counter, are known as encoder points.

The encoders are of the 2-channel phase type with differential outputs, ChA/ChB phase encoding is used. Feedback from the encoder is used to implement motor management for intelligent motor control.

3.5. WAFER SLIDE & WAFER DETECTION OPTICAL BARRIERS

LED/phototransistor pairs are used to form wafer detectors. A wafer is detected as no light falling on the phototransistor. Depending on the tools state, wafer presence or absence is expected.

The following diagram demonstrates the principle:



For illustrative purposes, the diagram shows 2 wafers on the transfer mechanism.

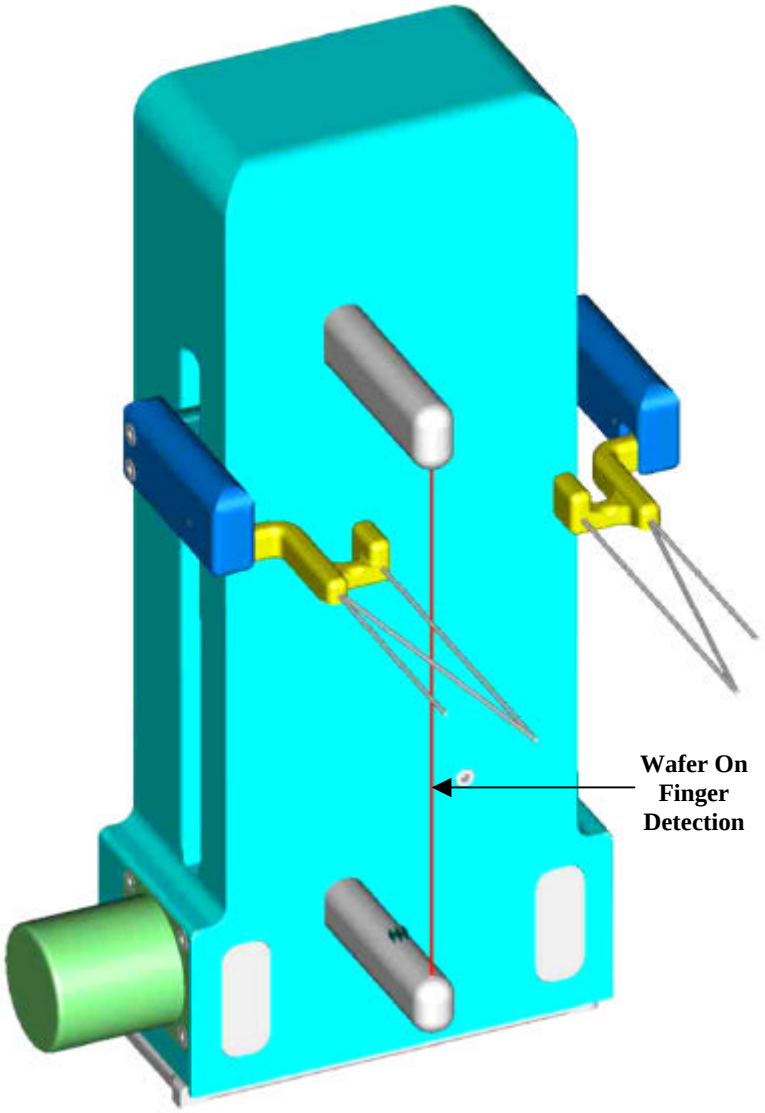
- ✍✍The upper wafer is seated correctly, it obstructs the transfer wafer detection and does not obstruct the transfer slide detection.
- ✍✍The lower wafer is seated incorrectly, it does not obstruct the transfer mechanism wafer detection and obstructs the transfer slide detection.

For illustrative purposes, the diagram shows 2 wafers in the cassette.

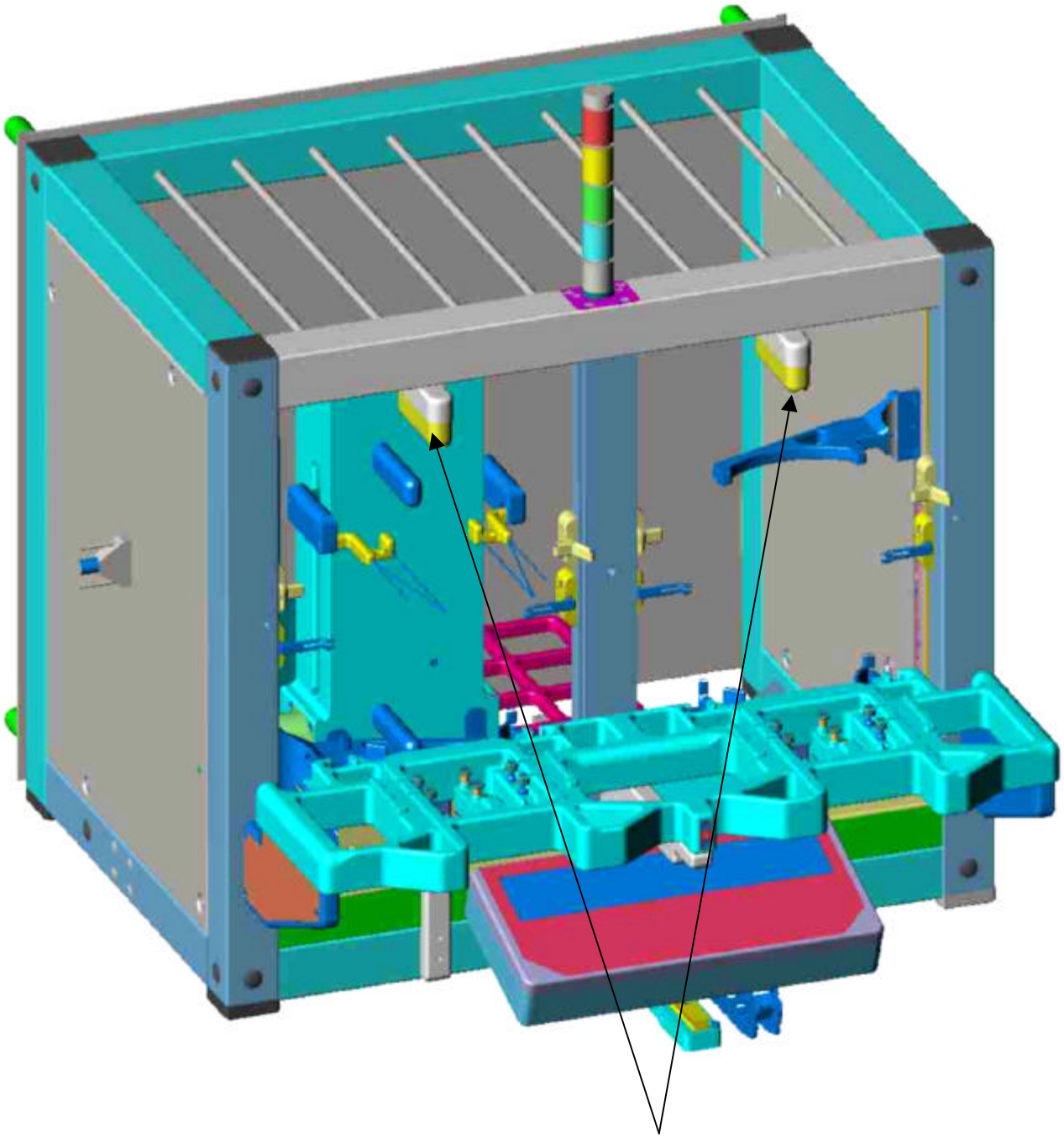
- ✍✍The upper wafer is seated correctly, it obstructs the cassette wafer detection and does not obstruct the cassette slide detection.
- ✍✍The lower wafer is seated incorrectly, it does not obstruct the transfer mechanism wafer detection and obstructs the transfer slide detection.

3.5.1. TRANSFER WAFER DETECTION

An optical barrier is provided for on finger wafer detection.



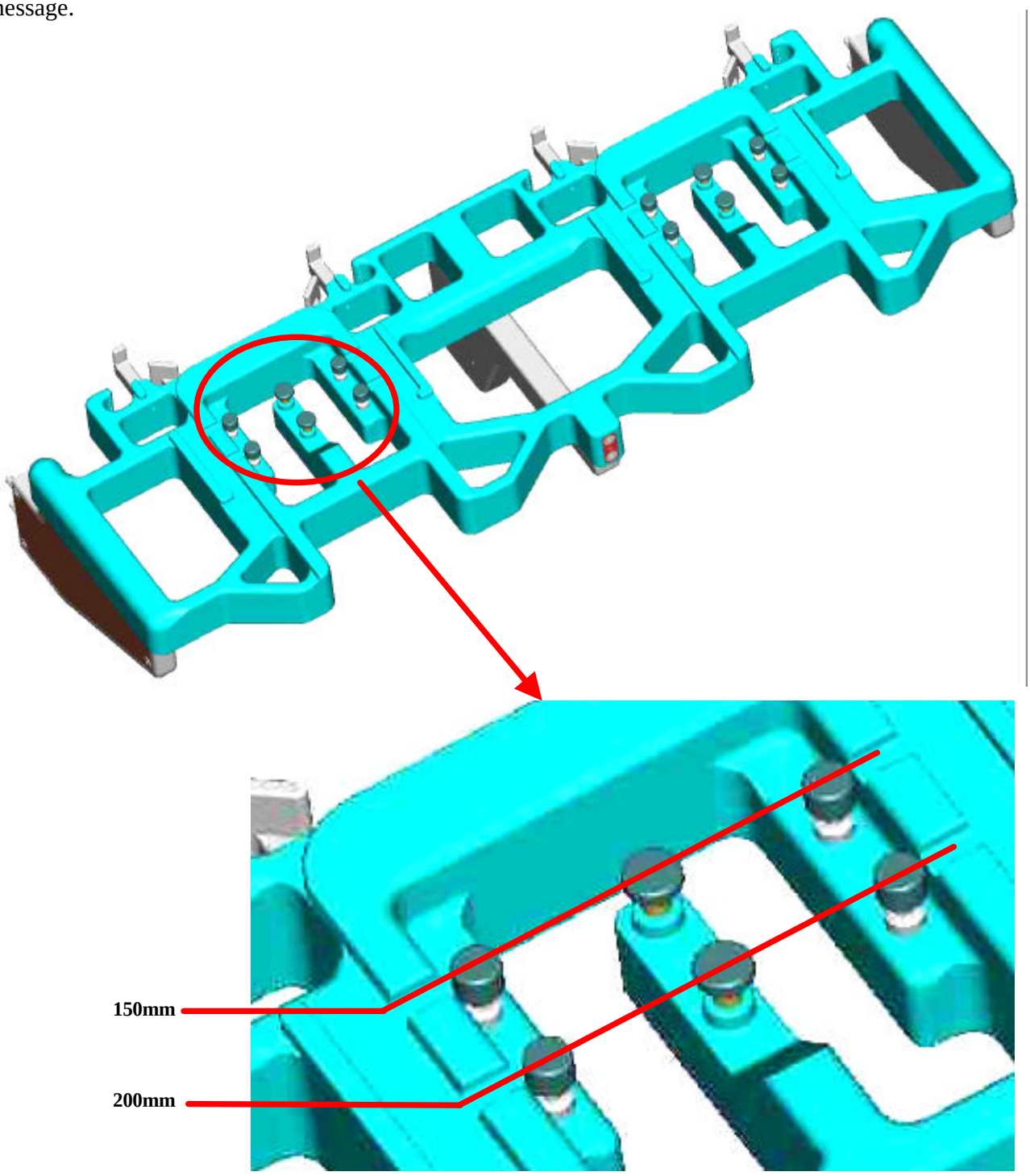
3.5.2. TRANSFER SLIDE, CASSETTE WAFER AND CASSETTE SLIDE DETECTION



Transfer slide, cassette wafer and cassette slide detection

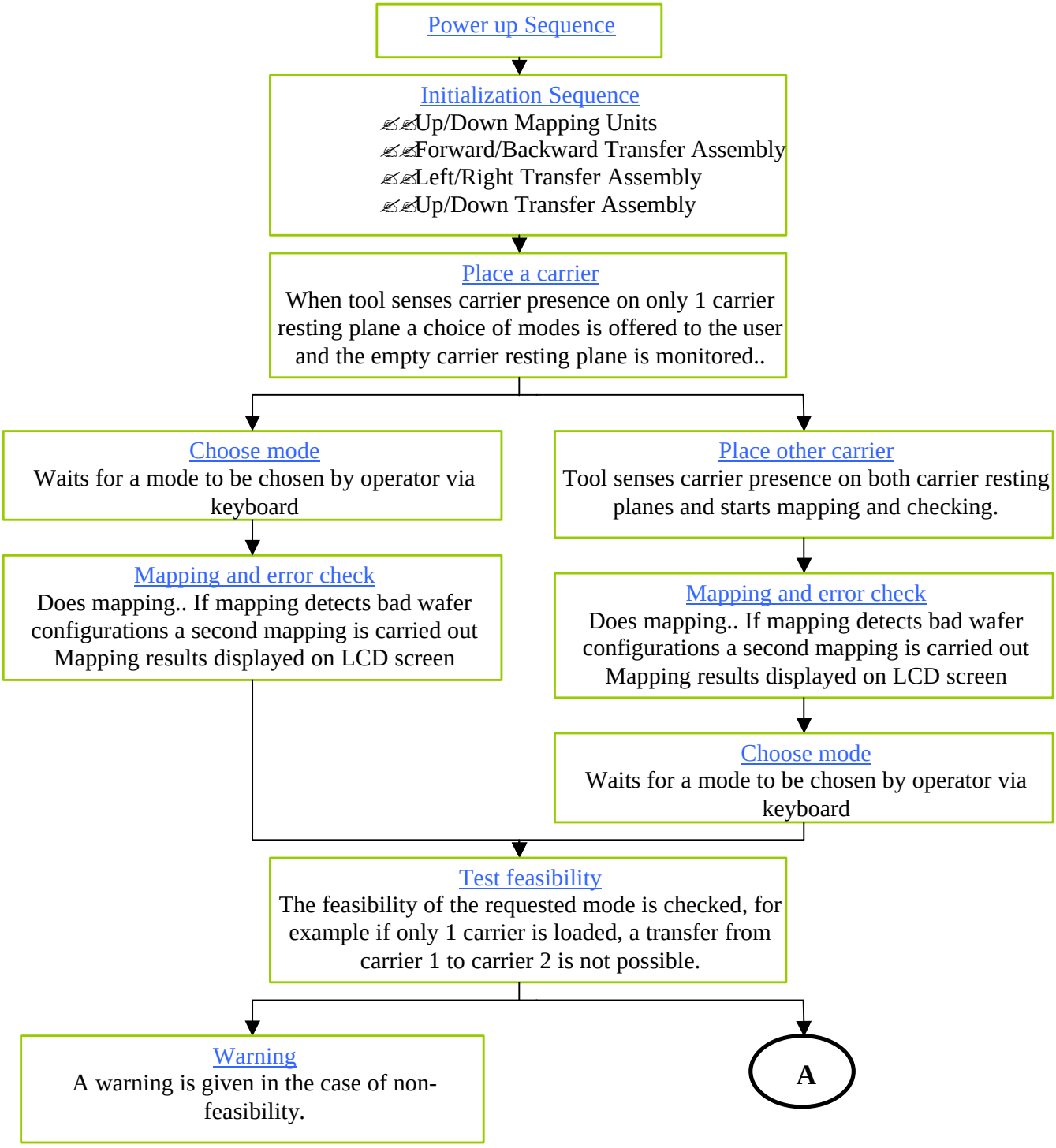
3.6. CASSETTE DETECTION

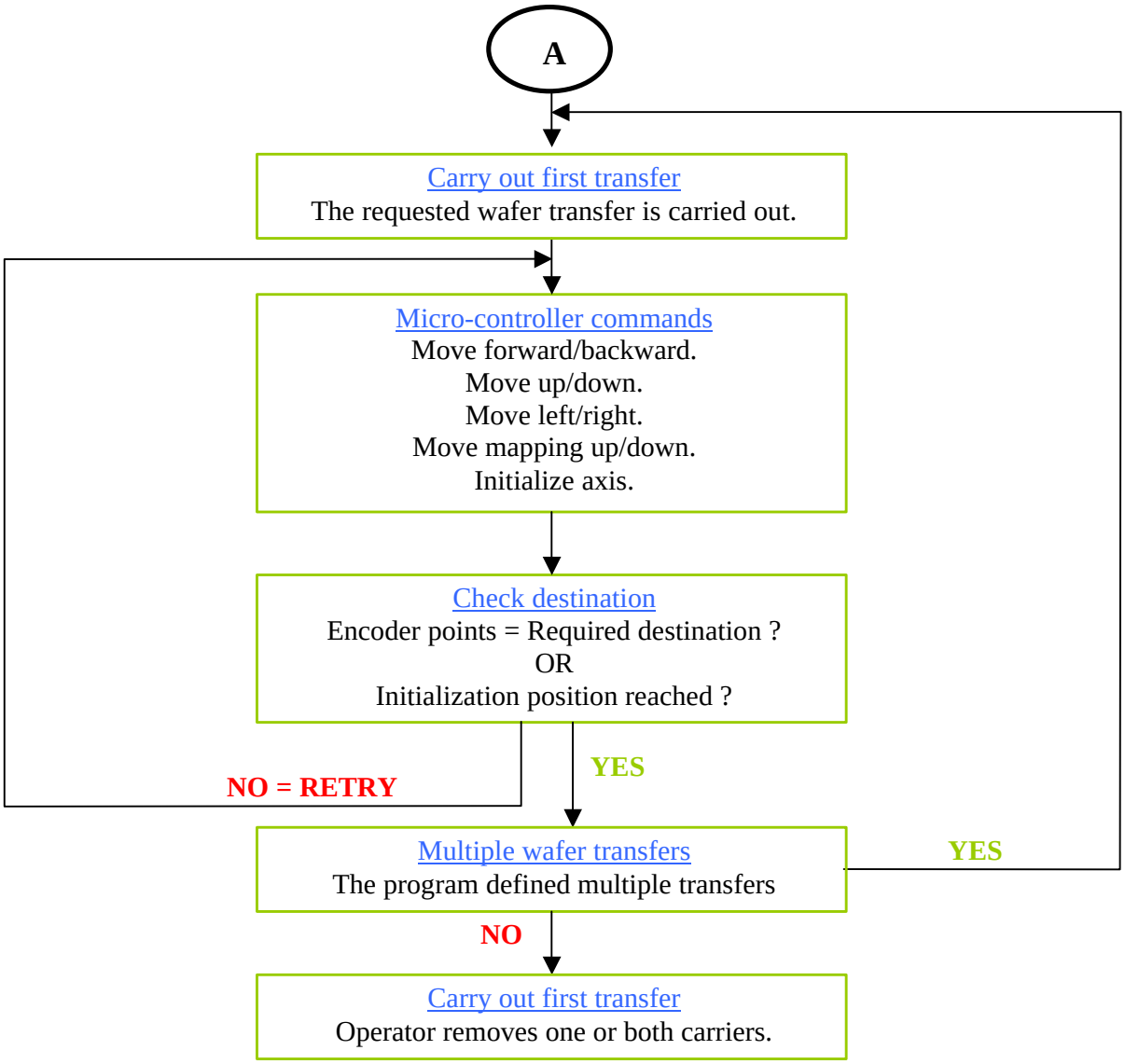
The tool can handle 150mm or 200mm cassettes. Each cassette must apply pressure to the three cassette detection sensors. If any of the sensors fail to register cassette presence no cycle can be started. If when carrying out a cycle cassette presence is lost, an error is flagged and the cycle stops with an error message.



4. *TOOL OPERATION FLOWCHART*

The basic operations carried out by the tool are described and summarized in the flowchart that follows. The flowchart shows all the steps that may be carried out by a tool during an error free process program and is not specific to a particular process program.





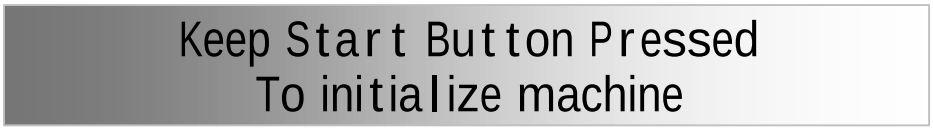
5. THE TOOL OPERATIONS

The user tool interface described here can be used to select, change, and run modes on the tool tool and to enter information when required by the mode running on the tool.

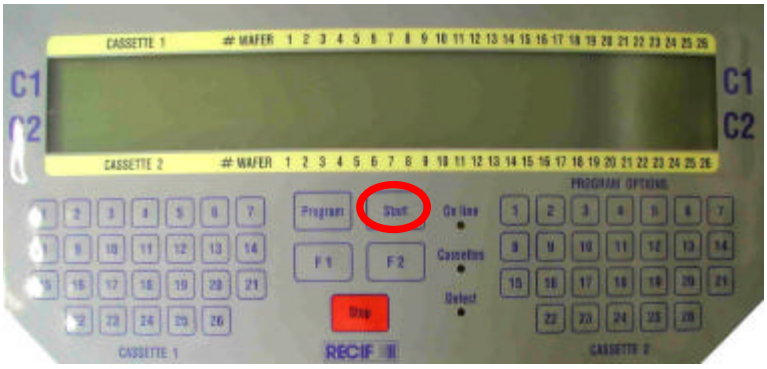
The user interface is provided by a combined screen/keyboard assembly. The interface is used to give commands to, and receive messages from, the tool.

5.1. TOOL POWER UP SEQUENCE

✍✍Shortly after being switched on, the tool will prompt:



Initialize the tool by pressing Start for longer than 3 seconds.



✍✍Initialization will begin and the tool will display:

✍✍If at the end of initialization, the tool senses a wafer present on the finger, it will prompt:

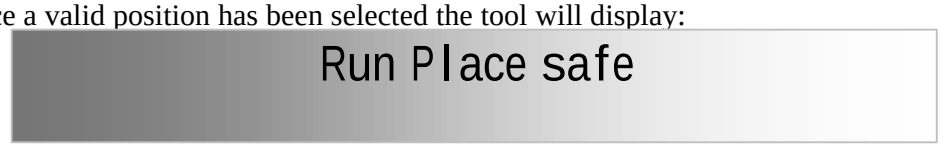
✍✍The operator selects either the place safe or F1 or F2.

A place safe is an empty slot. The tool needs a place safe to unload the wafer on its' finger, said wafer will be placed in the place safe leaving the tool free to carry out its' mode.

If the initialization was carried out before any transfers, the tool will only accept a slot number in response to this prompt.

If the initialization was carried out following a transfer, F1 instructs the tool to use the last source slot as place safe and F2 the last destination slot. These slots should logically be free.

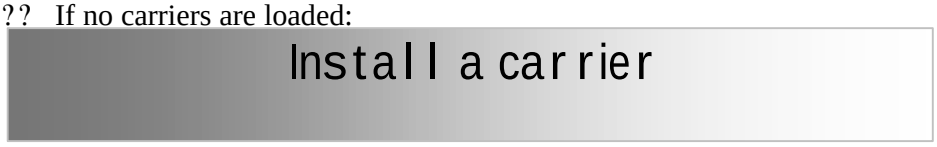
Once a valid position has been selected the tool will display:



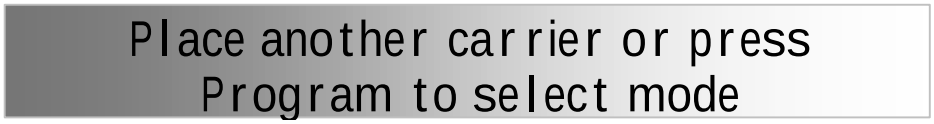
The tool will place the wafer in the selected slot. All tool movements will be much slower than normal to give the operator a chance to press Stop in case the place safe is already occupied.

✍✍When initialization is complete, 1 of 3 prompts will be displayed.

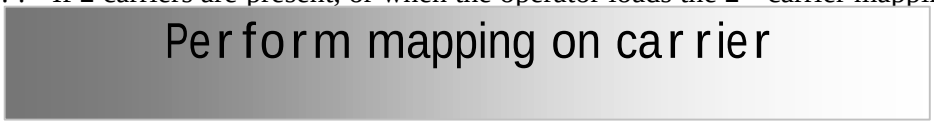
?? If no carriers are loaded:



?? If 1 carrier is present or when the operator loads the 1st carrier the message will be:

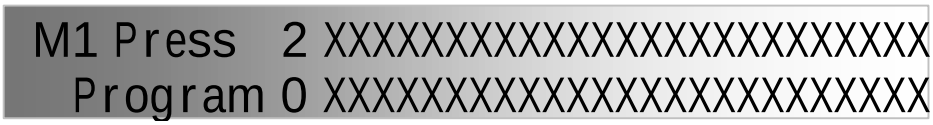


?? If 2 carriers are present, or when the operator loads the 2nd carrier mapping will start:



5.2.MAPPING RESULTS

Mapping results are presented thus:



This display is more easily understood if we divide it into 4 fields:

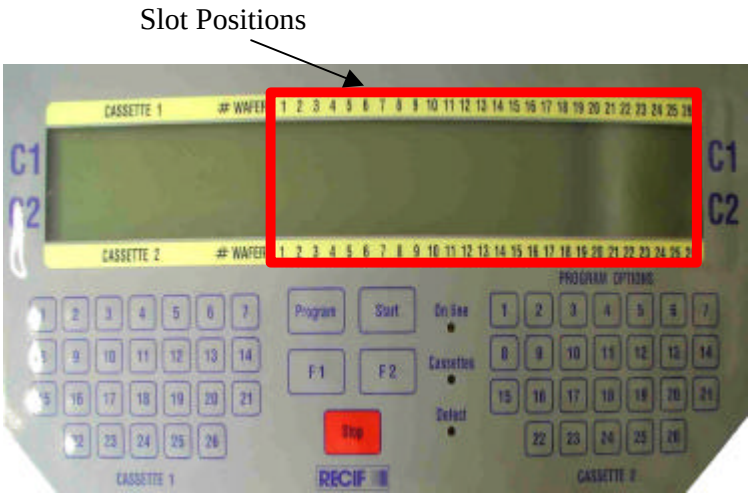
For the purposes of this explanation we will name each field as per its' color as above.

✍✍Red Field
The red field shows the last mode run.

✍✍Green Field
The green field is used to show operator prompts.

✍✍Blue Field
The blue field shows the total number of wafers found in each carrier. The upper figure shows carrier 1 total and the lower figure shows carrier 2 total.

✍✍Yellow Field
The yellow field shows the wafer distribution in each carrier. The upper line represents carrier 1 and the lower line represents carrier 2. The left most position represents slot 1, the second slot from the left slot 2 etc, to the right most position representing the highest numbered slot. While 26 slots are shown by the displays' legend, only the slots programmed as present in the tools' setup are considered The presence of a wafer is indicated by a "1", while a "0" indicates no wafer present.



5.3. POST MAPPING CHOICES

When the mapping is complete and displayed as in paragraph 5.2, the operator has three options from which to choose.

1 Press Start to re-run the last mode run by the tool, as displayed in the red field.
2 Press Program to run a mode.
3 Press simultaneously F1 and Program to program a transfer.

5.3.1. RE-RUN THE LAST MODE

Press Start to re-run the last mode run by the tool, as displayed in the red field. The yellow field will indicate the 1st transfer programmed. A flashing capital letter will be shown to indicate the source slot, while a flashing non-capital letter will be shown to indicate the destination slot.

Press stop to stop the mode and the screen will display as paragraph 5.2.

5.3.2. RUN A TRANSFER MODE

Press Program to run a transfer mode. When program is pressed the operator will be prompted to choose a mode.

After choosing the mode, the red field will echo the mode chosen, the blue and yellow fields will indicate the present carrier state and the yellow field the 1st transfer programmed. A flashing capital letter will be shown to indicate the source slot, while a flashing non-capital letter will be shown to indicate the destination slot.

Press Start to run the mode as echoed in the red field.

Press stop to stop the mode and the screen will display as paragraph 5.2.

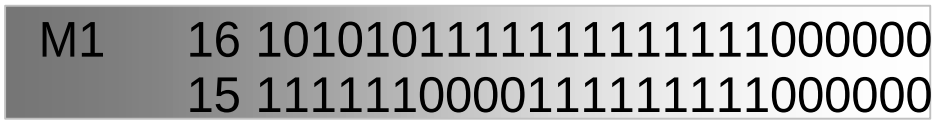
5.3.2.1. MODES AS FACTORY DEFINED

Note: The programming modes may vary from customer to customer as requested.

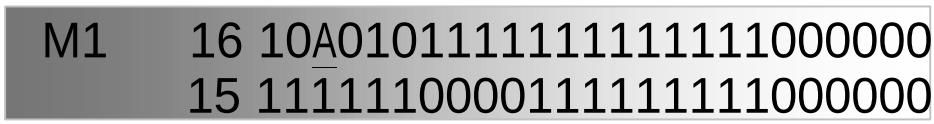
✍✍The modes are selected using the C2 part of the keyboard.
✍✍The stop key discards the last selection
✍✍The stop + F1 combination resets the tools

5.3.2.1.1. MODE 1: SINGLE TRANSFER

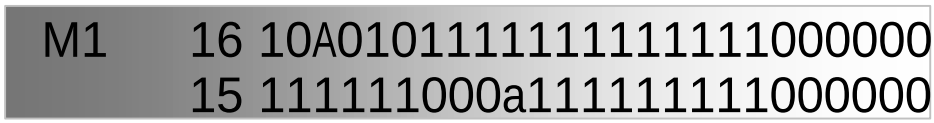
?? Once the mapping sequence has been carried out, the mapping results are displayed on the LCD screen as shown hereunder



?? The source wafer needs to be selected using the C1/C2 part of the keyboard depending on its location (cassette 1 or cassette 2). The wafer selected for transfer is represented on the screen by an A (in upper case)



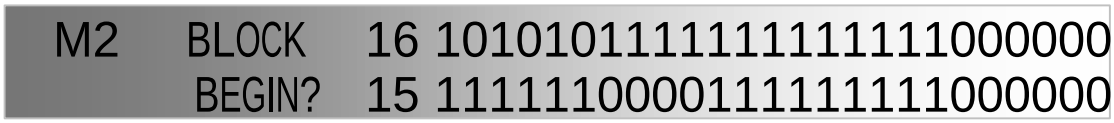
?? The destination wafer needs to be selected using the C1/C2 part of the keyboard depending on its location (cassette 1 or cassette 2). The empty slot selected for transfer is represented on the screen by an a (in lower case)



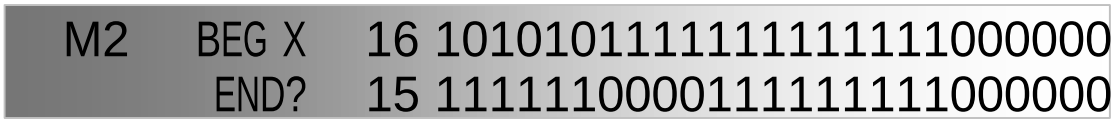
?? In the event of multiple transfers, the following transfers will be represented by the following letters of the alphabet (B, C, D, …)
?? The transfers are started as soon as the start button of the keyboard has been activated by the operator

5.3.2.1.2. MODE 2: BLOCK TRANSFER

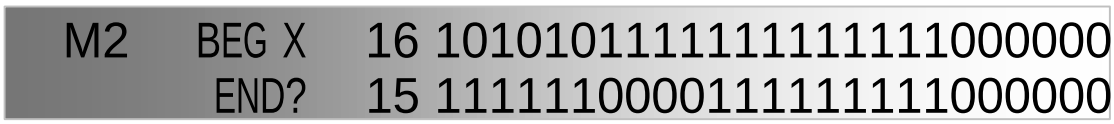
?? Once the mapping sequence has been carried out, the mapping results are displayed on the LCD screen as shown hereunder



?? The operator must select the slot corresponding to the start of the block of wafers to be transferred (Slot X) by using the C2part of the keyboard



?? The operator must then select the slot corresponding to the end of the block of wafers to be transferred (Slot Y) by using the C2part of the keyboard



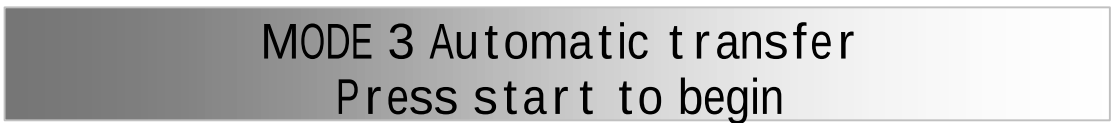
Note : Empty slots can be included in the block of wafers to be transferred.

?? The transfers are started as soon as the start button of the keyboard has been activated by the operator. The selected wafers will be transferred using a compress to bottom mode.

5.3.2.1.3. MODE 3: AUTOMATIC TRANSFER

The tool sequentially transfers all available wafers from carrier 1 to carrier 2, starting with the lowest occupied source slot and the lowest available target slot. The process completes when the source is empty or the target is full.

?? Once the mapping sequence has been carried out, the mapping results are displayed on the LCD screen as shown hereunder



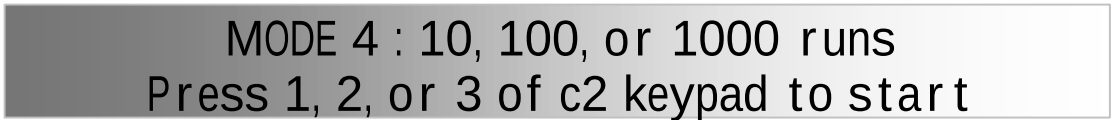
?? The transfers are started as soon as the start button of the keyboard has been activated by the operator. The selected wafers will be transferred using a compress to bottom mode. The transfer sequence ends as soon as the destination carrier is full.

5.3.2.1.4. MODE 4:TEST MODE

Mode 4 offers operational testing following preventive maintenance, repair etc…

- Maps both carriers
- Alternates transfers between carrier 1 as source – carrier 2 as destination and carrier 2 as source – carrier 1 as destination. Five transfers of randomly chosen wafers from each carrier.

The number of times the transfer sequence are to be performed is selected by the operator upon display of the screen shown hereunder.



In the event of an error being triggered during the cycle, the tool will re-initialize all the mobile assemblies and start the mode over until the sequence is either completed successfully or three consecutive errors have occurred. (The error information is saved to the error log part of the software interface.

5.3.2.1.5. MODE 5: BOTTOM COMPRESSION

Sequentially transfers wafers using carrier 2 as source and destination, starting with the uppermost slot, all lower slots are filled as available.

5.3.2.1.6. MODE 6: TOP COMPRESSION

Sequentially transfers wafers using carrier 2 as source and destination, starting with the uppermost slot, all upper slots are filled as available.

5.3.2.1.7. MODES 7 TO 18 AS PER MODE 1

5.3.2.1.8. MODES 19 TO 26 PROGRAMMABLE MODES

5.3.3. PROGRAMMING A MODE

A mode is a transfer program or series of wafer transfers. Up to 26 modes can be defined. Each mode is identified by a number from 1 to 20 inclusive. A mode is selected by pressing the appropriately numbered key on the keyboard. At the time of writing, 6 factory defined modes (numbered 1 to 6) are preprogrammed.

While programming a mode, except when the display indicates otherwise:

- Pressing the Stop button will take the menu to the previous step. Note however, that this does not undo any changes made to the mode.
- Pressing the Program button will cause the screen to display as paragraph 5.2.

- Press simultaneously F1 and Program to program a mode. The tool will prompt:

- The operator selects a mode from 1 to 20 inclusive.
  - He may choose a mode which is already programmed or a mode that is not programmed.
    - If an already programmed mode is chosen, it will be modified.
    - If a non defined mode is chosen, it will be created for the operator to program.

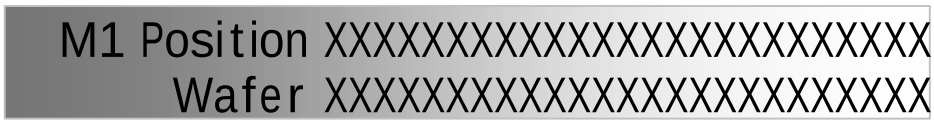
5.3.3.1. PROGRAMMING

✍✍The tool will prompt:

✍✍The operator makes her choice.

5.3.3.1.1. PROGRAMMING SINGLE TRANSFERS

When choosing to program single transfers the following will be displayed (as per paragraph 5.2 without the blue field):



✍✍The operator selects the source slot, if a wafer is present in the source slot, the operators selection is echoed by a capital letter flashing in the slot position. If the source slot is empty the display will not change.

✍✍The operator selects the destination slot, if the destination slot is empty, the operators selection is echoed by a non-capital letter flashing in the slot position. If a wafer is present in the destination slot the display will not change.

The tool will prompt:

✍✍Pressing start will program this step of this mode to display the transfer feasibility test error message if applicable as paragraph 5.4.

✍✍Pressing any other button (except program – which will take you out of programming) will cause this step of this mode not to display the transfer feasibility test error message, however the test is still carried out and only the feasible transfers will be attempted.

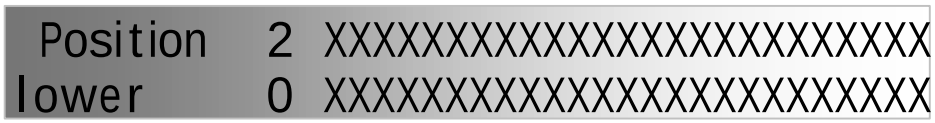
The tool will prompt:

✍✍The operator chooses Start if she has more steps to program and the procedure is repeated from paragraph 5.3.3.1.

✍✍The operator chooses Stop if she has no more steps to program and the display as per paragraph 5.2 is shown.

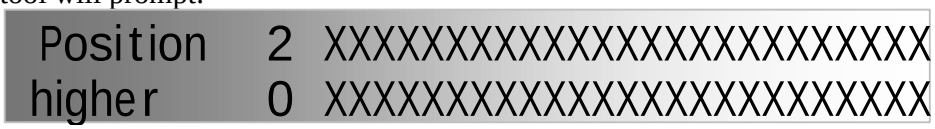
5.3.3.1.2. PROGRAMMING BLOCK TRANSFERS

When choosing to program block transfers the following will be displayed:



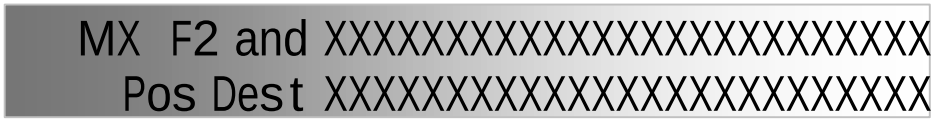
✍✍The operator selects the "Lo Wafer, that is, the wafer in the lowest slot from which the block transfer is required.

The tool will prompt:



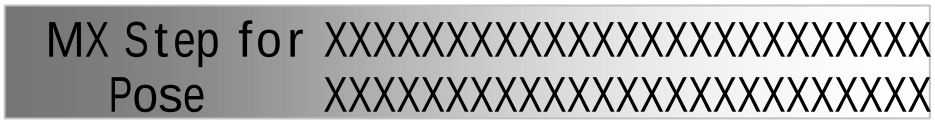
✍✍The operator selects the "Hi Wafer, that is, the wafer in the highest slot from which the block transfer is required. The block is defined as the wafers from the lo wafer to the high wafer inclusive.

The tool will prompt:



✍✍The operator selects the destination slot which is the lowest in the required block.

The tool will prompt:



✍✍The operator enters the place interval. For example, a value of 1 will place wafers into adjacent slots, whereas for a value of 2 every other slot will be used and a value of 6 will leave 5 empty slots between wafers.

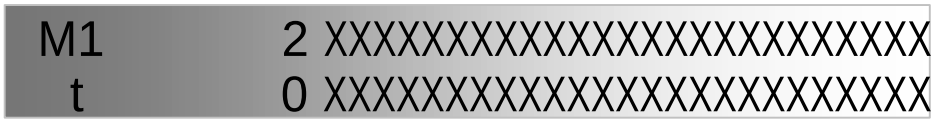
The tool will prompt:

✍✍The operator chooses Start if she has more steps to program and the procedure is repeated from paragraph 5.3.3.1.

✍✍The operator chooses Stop if she has no more steps to program and the display as per paragraph 5.2 is shown.

5.3.3.1.3. DISPLAY DURING TRANSFERS

During transfers the display will show as paragraph 5.2:



Except that:

- t is the estimated time before the test completes.
- The current source slot is shown by a flashing capital letter and the current destination slot is shown by a flashing non capital letter.

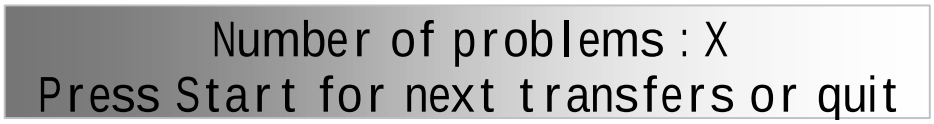
When all transfers are complete, the display as per paragraph 5.2 is shown.

5.4. TRANSFER FEASIBILITY

When the operator presses start to start a mode, the tool verifies the feasibility of the required transfers, for example: Are all the source slots occupied? Are all the destination slots empty? etc.

If no conflicts are identified the mode will be run.

If any number of conflicts are identified, the tool, if using an appropriately programmed mode, prompts:



Where X is the number of conflicts identified.

- If the operator presses Start, the mode will be run, but only the cycles with no conflict will be carried out.
- If the operator presses Stop, the mode will not be run and the screen will display as paragraph 5.2.

6. OPERATOR PREVENTIVE MAINTENANCE

The tool's preventive maintenance includes procedures to be carried out by the operator.

The operator preventive maintenance procedures are to be carried out on a monthly basis or after 25000 runs/cycles whichever comes first.

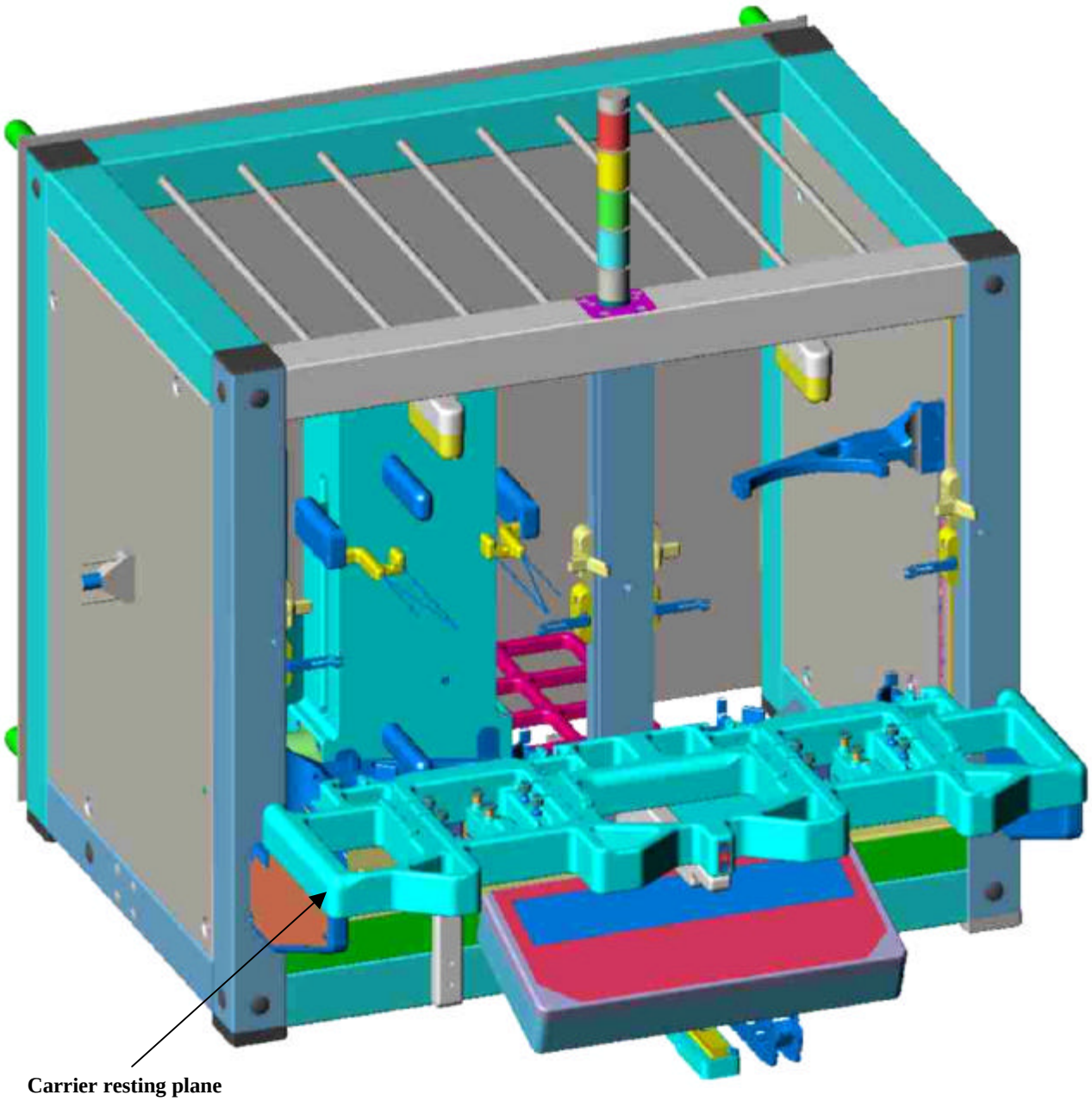
The cleaning procedures must be thorough and it is important not to stress the parts cleaned.

The operator preventive maintenance procedures are carried out in the bay and only on the front side of the tool and require at least one operator, a certified level 2 (or higher) technician and the following supplies:

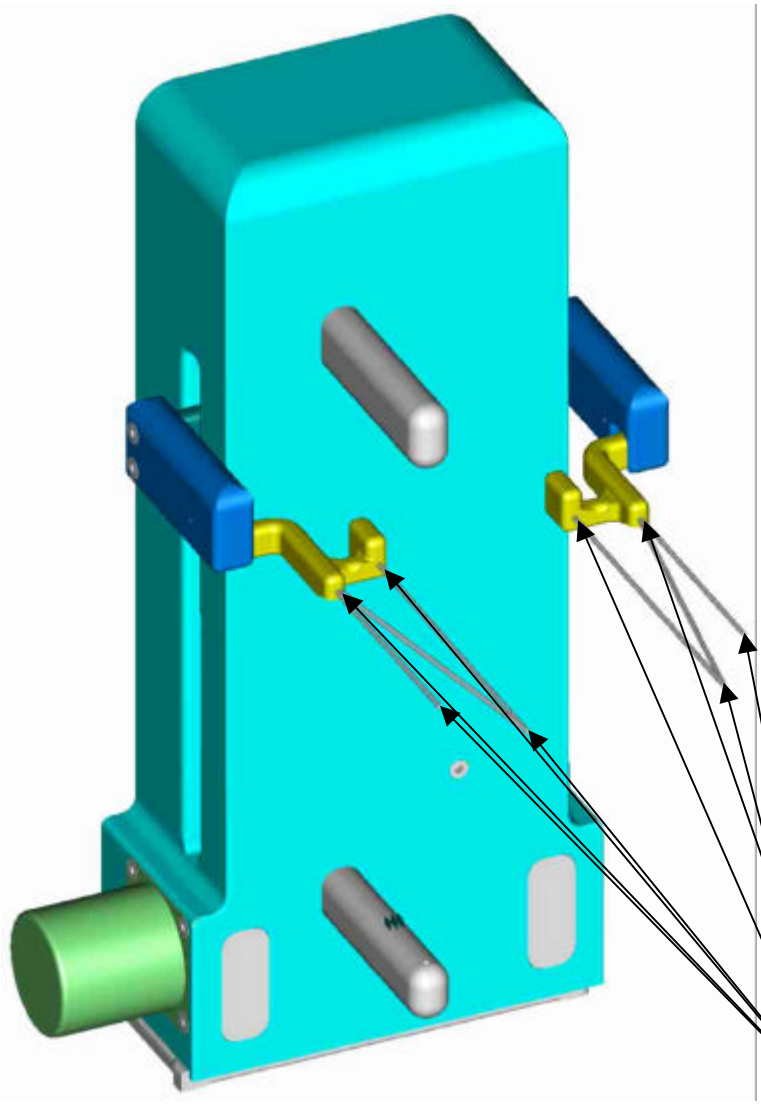
- 1 bottle of 6% IPA.
- A bag of clean room wipes.

The preventive maintenance cleaning procedures are the following:

1 Dampen and maintain damp the clean room wipe throughout the PM.
2 Clean the carrier resting plane as shown on the following drawing.


Carrier resting plane

3 Clean all possible wafer contact points as shown:



Possible contact points

7. OPERATOR SAFETY INSTRUCTIONS

The tool handles and manipulates wafers. It is essential that the operator follows the safety instructions to prevent tool/host tool damage and operator generated errors.

The tool is controlled via the MMI, the following must be observed:

- Keep hands clear of the carriers except to place/remove them as required by the tool.
- The tool must not be leaned on at any time.
- EMO buttons are only to be used in case of emergency.
- The operator must monitor the status lights at all times.
- The operator must follow the instructions displayed on the LCD.

8. EMERGENCY SAFETY INSTRUCTIONS

In case of emergency the following instructions are to be respected:

- The operator must immediately contact a certified level 2 (or better) technician.
- The operator must not attempt to remove the carrier.
- The operator must take note of the stage of the process and all error messages.
- The operator must take note of the status light state.
- The operator must take note of the time and date of the error.