3

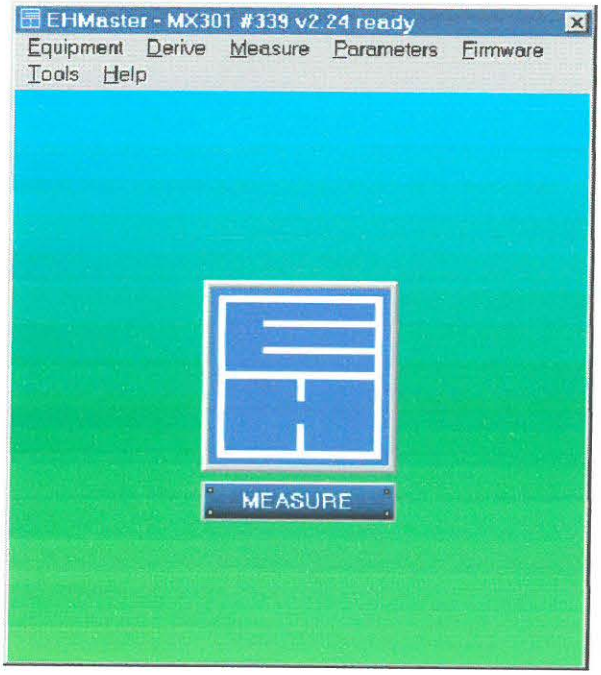
Maintenance Instruction
Robot

EH Master Online Help

Eichhorn + Hausmann

Welcome to the EHMaster online help

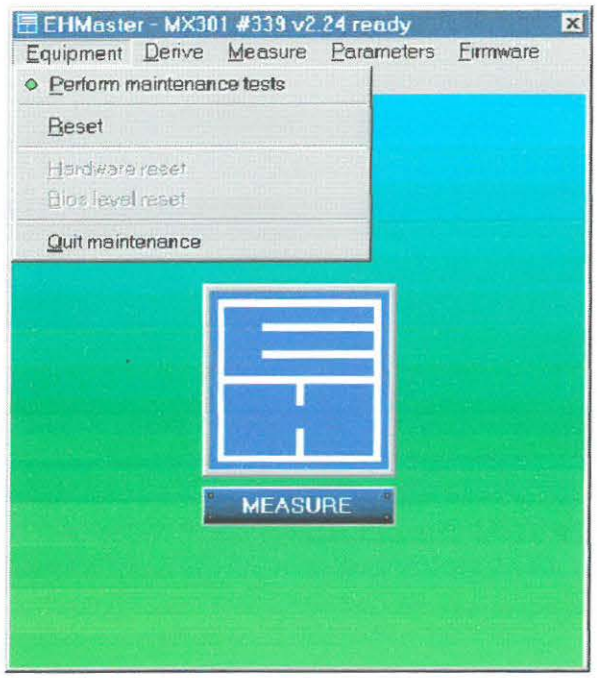
Main Window



Connection

The caption (=window title) shows the connection state of the equipment, i.e. if the equipment is connected at all, and if so, which equipment model, serial number and firmware version was detected.

Equipment



This main menu item contains the most important actions for the maintenance.

Perform maintenance test

The Perform maintenance tests menu item is used for real maintenance. Upon triggering it, two windows will open: the „sensors/signals form" on top and the „actions form" located below it. The upper one may be regarded as a kind of „TV" and the lower one as the associated „remote control".

The sensors/signals form on top consists of

- a so-called „light board", which contains the states of all ports (inputs and outputs = sensors and actors) of the equipment,
- indicators for the positions of all motors (if the equipment has any),
- fields displaying the raw measurement acquisition values, e.g. the DAC and the ADC,
- property indicators (if the equipment has any implemented) showing modelled state machine states of the equipment,
- special indicators, which depend on the equipment model.

The „light board" hereby indicates levels being logically L (low) with a red light at the bottom of the individual signal indicator and a level being logically H (high) with a green light at the top of the individual signal indicator. When the „light board" is not refreshed for a specific time, it will „freeze", i.e. it will become darkened to indicate, that the signal states it currently displays are not the actual ones, but the ones that were present before a specific time. When it is refreshed again, it will „unfreeze", returning to bright colours and displaying the actual states of the signals. It

depends on the action the equipment is currently busy with, at which times it is refreshed, e.g. if a complex motion is commanded, the equipment will be busy for a time and therefore not be able to respond to the status scan command associated with and repeatedly triggered for the „light board". At the end of the complex motion, the equipment will be idle and ready to respond to such scan status requests.

The actions form located below the sensors/signals form contains many buttons for special actions, e.g. motions of motors to specific positions, activation and deactivation of valves, special actions for raw measurement data acquisition etc. The commands which are associated with the buttons are always of one of the two following kinds: „pin controls" and „trajectories". The pin controls are rare and concern the direct switching/changing of valves without any further security checks. The trajectories are complex motions, which will attempt to put the equipment to a safe state before executing the action requested, thereby *attempting* to prevent crashes. It is very important to *have an idea, of what is going to happen* before triggering any action from this form and reading the button's caption precisely, because crashes can not be prevented in all cases by the equipment. Therefore the risk of triggering sensitive actions is completely up to the person performing the maintenance. Anyway, the equipment handbook should always be in reach and actions should be triggered with the utmost awakeness and care. To remember this, the actions form also contains also a calmly flashing (warning) panel indicating this absolute necessity.

Reset

The Reset menu item will cause a software reset of the equipment. Note, that the equipment could request eventually the removal of all material and the execution of a security motion before resetting, which should be generally granted, because the equipment might force a hardware reset of the complete system, causing valves to fall back to their reset state.

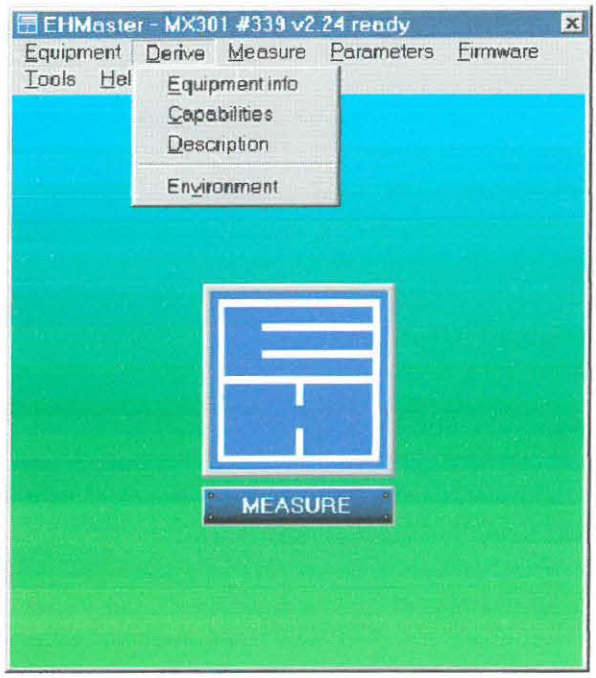
Hardware reset, Bios level reset

not available

Quit

The Quit maintenance menu item will finally close the maintenance (if MXNT is running) or terminate EHMaster (if EHMaster is running).

Derive



This main menu item contains actions useful for deriving information from the equipment and the running maintenance program or sub process.

Equipment info

The Equipment info menu item will show information about the equipment model, its serial number, main board type, firmware version etc.

Capabilities

The Capabilities menu item will show the model-dependant capabilities of the current equipment, e.g. the number of sensors implemented.

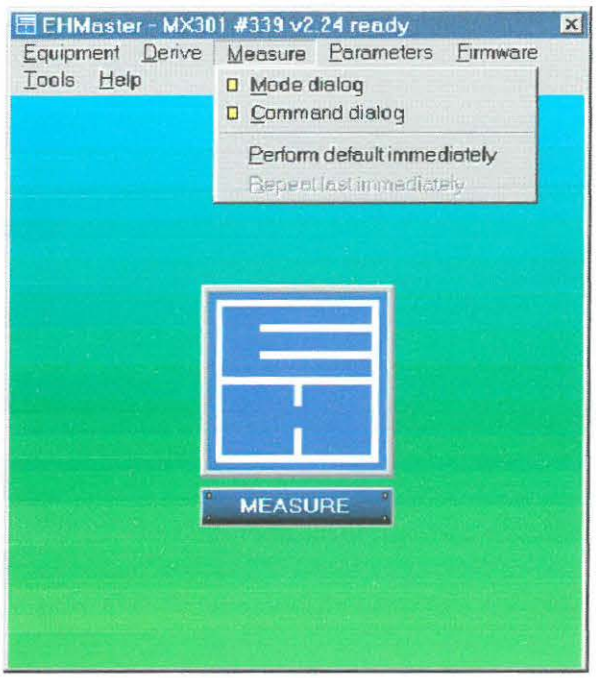
Description

The Description menu item will show a brief description of the equipment and is provided for compatibility with DOS versions only.

Environment

The Environment menu item will show information related to the running program, active directories, the serial port and the operator currently logged in.

Measure



This main menu item contains actions related to the measurement process.

Mode dialog

The Mode dialog menu item will open an equipment-specific window, on which the generic mode for succeeding measure commands may be once defined or modified. The menu will read the current mode from the equipment and provide functions to change it. The modified mode may then be sent back to the equipment by pressing the according button or aborted by the „Abort" button. The „To default" button will reset the mode to a predefined state.

Command dialog

The Command dialog menu item will also open an equipment-specific window, on which the measure command parameters may be defined or modified, if any available. These parameters mainly refer to data which is to be sent to the equipment with every measure command (and not once only, like the mode), e.g. the source and destination slots and carrier indexes for the MX303. The „Execute" button will transmit these parameters to the equipment and start a measurement, whereby the „Abort" button closes the window without triggering anything

Perform default immediately

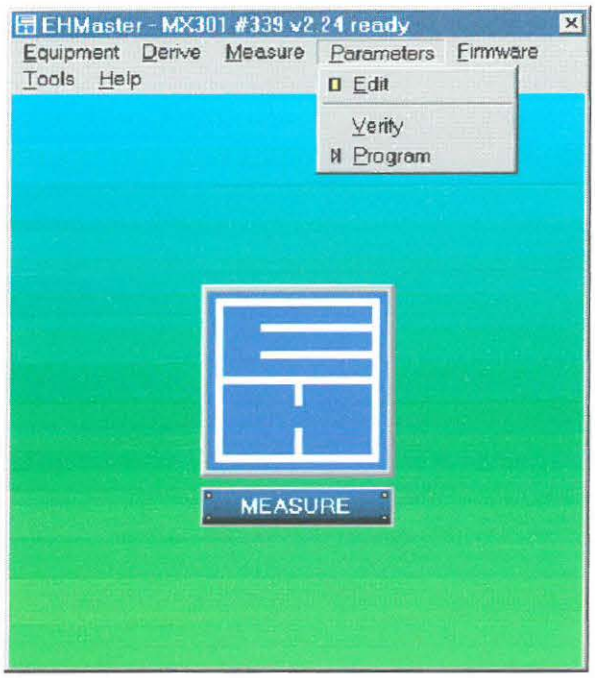
The Perform default immediately menu item is identical to triggering a measure command with all parameters reset to their default state and being executed immediately. Some equipment models

have also a blue „Measure“ button located under the maintenance's main window large E+H icon, which performs the same action than the „Perform default immediately“ menu item (this is provided for easier triggering of measure commands without having to open the menus).

Repeat last immediately

not available

Parameters



This main menu item contains features to verify, update and edit the equipment parameters (which are located together with the equipment firmware on a flash disk on the equipment's mainboard).

Edit

The parameters edit menu item will open a section select dialog, in which all equipment parameters are grouped in sections (e.g. „Globals", „Timing" etc.).

In order to edit a specific section, select it from the listbox and press <Enter> or double click it. When a section is opened, a window with a string grid will appear, in which the individual items may be modified by selecting them by the arrow keys or the mouse and pressing <Enter>. Note, that some very sensitive items can not be changed by the customer and the editing of some items could be proceeded by a warning window, that modifying the parameter is critical and can lead to severe damages of the equipment or material or even failures of the encapsulating control process (e.g. MXNT).

When editing is finished and changes were detected, the „Save to file" button on the section select dialog will become enabled. If the changes shall be kept, the button should be pressed, which will cause the new parameters to be saved on the PC's hard disk. After successful saving, the „Program" button will become enabled (which has the same function than the maintenance's main menu item <P>arameters|<P>rogram) and will thereby program (save) the parameters also to the equipment's flash disk. When the parameters programming operation is finished, the section select dialog may be closed by the „Finished" button and you may return to the maintenance main window.

If the changes made shall be aborted and thereby not become effective, the section select dialog may simply be closed by the „Finished" button without prior activation of „Save to file" or

„Program".

Important note: If you made changes and want them to become effective, make sure, that both the „Save to file" and the „Program" buttons are pressed after each other in order to prevent mismatches of the PC and equipment hard disk versions.

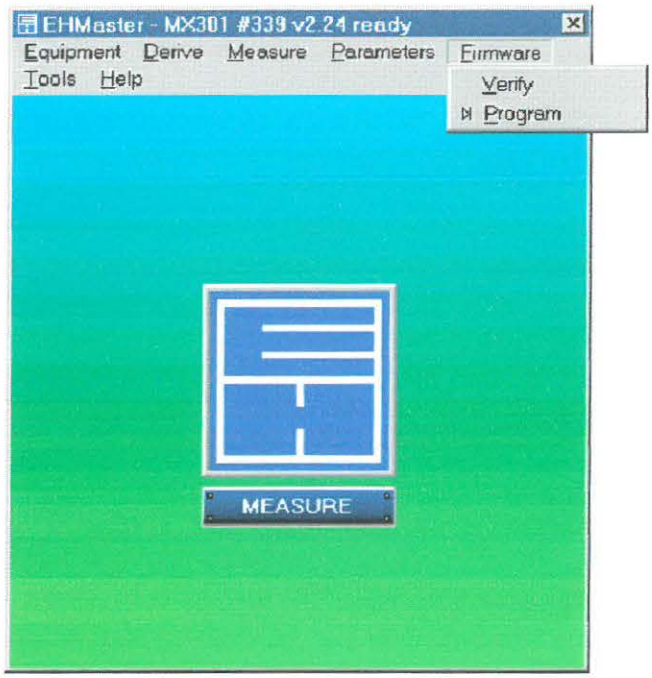
Program Parameters

The parameters programming process will program the PC's hard disk version into the equipment's flash disk and thereby update it. As common to all programming operations, the equipment could request eventually the removal of all material and the execution of a security motion before programming, which should be generally granted, because the equipment will force a hardware reset after programming (which could cause valves to fall back to their reset state).

Verify Parameters

The parameters verify process will compare the flash disk version to the version located on the PC's hard disk (which can be found in the root directory EH_APP, e.g. EH_APP\1007.SET) and report if either the two versions are matching or not. If mismatches are reported, it is recommended to reprogram the parameters (except the case, that the equipment's parameters should be kept because of a special reason or the hard disk version of the parameters is older than the flash disk version).

Firmware



This main menu item contains features to verify and update the equipment firmware (which is located together with the equipment parameters on a flash disk on the equipment's main board).

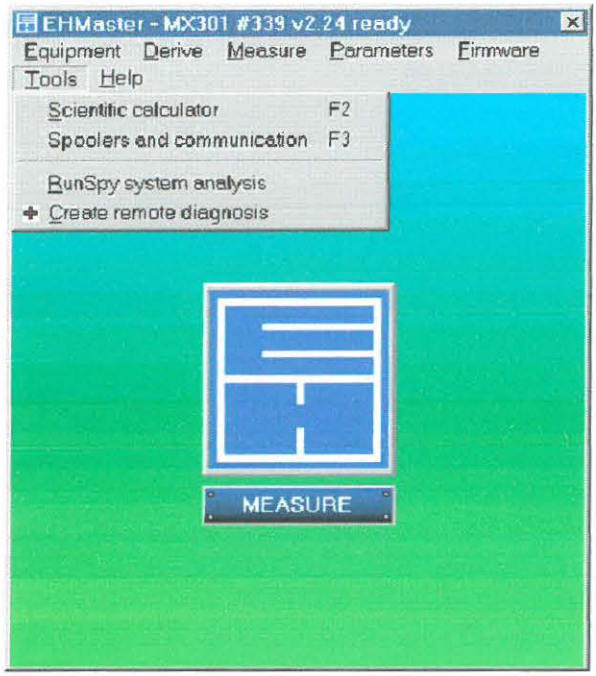
Verify Firmware

The firmware verify process will compare the flash disk version to the version located on the PC's hard disk (which can be found in the root directory EH_APP, e.g. EH_APP\MX102.BIN) and report if either the two versions are matching or not. If mismatches are reported, it is recommended to reprogram the firmware (except the case, that the equipment's firmware should be kept because of a special reason or the hard disk version of the firmware is older than the flash disk version).

Program Firmware

The firmware programming process will program the PC's hard disk version into the equipment's flash disk and thereby update it. As common to all programming operations, the equipment could request eventually the removal of all material and the execution of a security motion before programming, which should be generally granted, because the equipment will force a hardware reset after programming (which could cause valves to fall back to their reset state).

Tools



This main menu item contains tools for diagnostic actions and a scientific calculator.

Scientific calculator

The very comfortable scientific calculator evaluates while typing in, i.e. it shows errors of the input term in red, if any present, or the result in cyan, if the input term could be successfully evaluated. It follows the classical rules of junctor prioritization (^ > */ > + -) and contains some mathematical plug-in-functions. The complete list of functions may be derived by <H>elp|<L>ist_active_constants_functions_and_junctors.

Spoolers and communication

The spoolers and communication menu item opens four tool windows on top of the screen, which will provide information about the connection state of the equipment (RS 232 signals), the amount and kind of objects spooled and the equipment state (including the object flow controls). This menu item is normally not of interest to a client and is only needed in cases of diagnostics by a specialist.

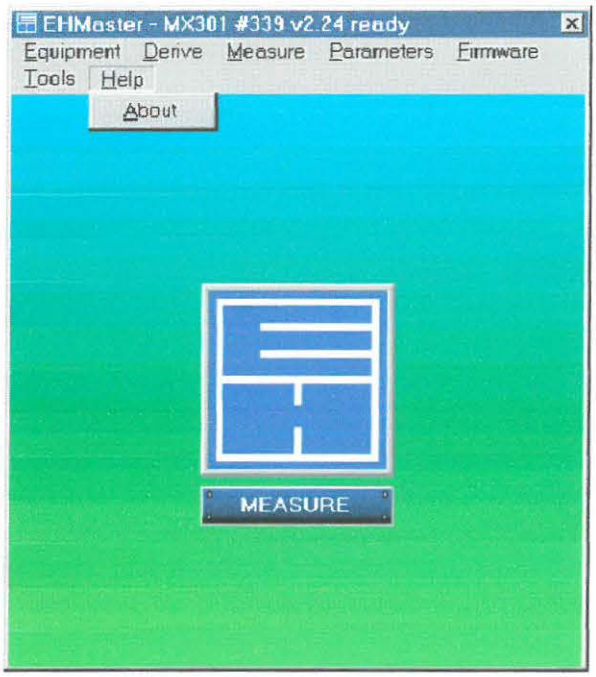
RunSpy and system analysis

The RunSpy system analysis will check your computer completely and display the results with the NotePad supplied with MS Windows. Information will be output about the Application, the memory available, the amount and kind of parallel processes, the disks etc.

Create remote diagnosis

The Create remote diagnosis is of special importance for remote diagnostics. You should have an empty removable disk medium with you, on which lots of information will be assembled, and which at the end shall be sent to the equipment manufacturer. The information contains information about the hard disk and flash disk firmware and parameter versions, log data etc.

Help



About

Information about the program.

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Valid diameters and delimiter states

... for diameter "Erroneous"	Diameter not supported
... for diameter "Default"	Diameter not supported
... for diameter "Autodetect"	Diameter not supported
... for diameter "50 mm"	Diameter not supported
... for diameter "100 mm"	Diameter not supported
... for diameter "125 mm"	Diameter not supported
... for diameter "150 mm"	All delimiters down
... for diameter "200 mm"	All delimiters down
... for diameter "300 mm"	Diameter not supported
... for diameter "75 mm"	Diameter not supported
... for diameter "Reserved_B"	Diameter not supported
... for diameter "Reserved_C"	Diameter not supported

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Mechanics timing

Generic sensors despike	200 polls
LED flash timer	7 rel
Drawer vacuum: Timeout	1000 ms
Drawer in/out actor: Timeout	2000 ms
Drawer up/down actor: Extra delay before up	50 ms
Drawer up/down actor: Timeout	1500 ms

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Head chuck methods

... for diameter "150 mm"	None
... for diameter "200 mm"	None

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GEO top linearization

Index	Raw DAC	Wanted value	Target	Gradient
Sector #0	0	0.00 µm	0	1.05859
Sector #1	1024	54.20 µm	1084	1.05151
Sector #2	2070	109.20 µm	2184	1.04565
Sector #3	3078	161.90 µm	3238	1.06055
Sector #4	4085	215.30 µm	4306	1.05737
Sector #5	5129	270.50 µm	5410	1.05933
Sector #6	6158	325.00 µm	6500	1.05908
Sector #7	7174	378.80 µm	7576	1.05566
Sector #8	8199	432.90 µm	8658	1.06226
Sector #9	9193	485.70 µm	9714	1.05640
Sector #10	10274	542.80 µm	10856	1.06104
Sector #11	11256	594.90 µm	11898	1.06250
Sector #12	12263	648.40 µm	12968	1.05542
Sector #13	13309	703.60 µm	14072	1.06323
Sector #14	14353	759.10 µm	15182	1.05688
Sector #15	15356	812.10 µm	16242	1.06421
Sector #16	16382	866.70 µm	17334	1.05933
Sector #17	17411	921.20 µm	18424	1.06152
Sector #18	18417	974.60 µm	19492	1.06543
Sector #19	19455	1029.90 µm	20598	1.05981
Sector #20	20476	1084.00 µm	21680	1.06714
Sector #21	21503	1138.80 µm	22776	1.06030
Sector #22	22546	1194.10 µm	23882	1.06543
Sector #23	23569	1248.60 µm	24972	1.05981
Sector #24	24556	1300.90 µm	26018	1.06470
Sector #25	25591	1356.00 µm	27120	1.06006
Sector #26	26672	1413.30 µm	28266	1.06519
Sector #27	27639	1464.80 µm	29296	1.06519
Sector #28	28681	1520.30 µm	30406	1.06006
Sector #29	29662	1572.30 µm	31446	1.06787
Sector #30	30709	1628.20 µm	32564	1.05762
Sector #31	31749	1683.20 µm	33664	1.05688
FULL-SCALE	32767	1737.00 µm	---	---

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GEO timing

Multiplexer delay	5 ms
Norm/Testmode delay	0 ms
Extra delay before WARP	0 ms
Extra delay before THK	500 ms

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GEO generic

Submodel type	MX204
Wiring scheme	Alpha200
Material handling	Semi automatic
Material detection	Not possible
Reference angle	0°
Acquisition subsystem	B187
Sensors per head plate	37
WARP scan mode	By calculation
THK scan mode	Top and bottom
Default sensor	Sensor #1
Default sensor in NormMode	False
Reference sensor	Sensor #1
Reference sensor kind	Not installed
Reference sensor measured	Before measuring wafer
Idle job	NOP

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GEO codes

Sensor #1	23h
Sensor #2	03h
Sensor #3	28h
Sensor #4	12h
Sensor #5	24h
Sensor #6	22h
Sensor #7	08h
Sensor #8	09h
Sensor #9	1Ah
Sensor #10	32h
Sensor #11	16h
Sensor #12	05h
Sensor #13	04h
Sensor #14	02h
Sensor #15	29h
Sensor #16	0Ah
Sensor #17	0Bh
Sensor #18	13h
Sensor #19	07h
Sensor #20	06h
Sensor #21	25h
Sensor #22	0Ch
Sensor #23	19h
Sensor #24	38h
Sensor #25	18h
Sensor #26	3Ah
Sensor #27	2Ah
Sensor #28	2Bh
Sensor #29	1Bh
Sensor #30	33h
Sensor #31	17h
Sensor #32	27h
Sensor #33	26h
Sensor #34	36h
Sensor #35	14h
Sensor #36	34h
Sensor #37	15h

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GEO bottom linearization

Index	Raw DAC	Wanted value	Target	Gradient
Sector #0	0	0.00 µm	0	1.03613
Sector #1	1023	53.00 µm	1060	1.05957
Sector #2	2063	108.10 µm	2162	1.05347
Sector #3	3075	161.40 µm	3228	1.05688
Sector #4	4095	215.30 µm	4306	1.06104
Sector #5	5111	269.20 µm	5384	1.05737
Sector #6	6140	323.60 µm	6472	1.06299
Sector #7	7173	378.50 µm	7570	1.05859
Sector #8	8197	432.70 µm	8654	1.06421
Sector #9	9210	486.60 µm	9732	1.06323
Sector #10	10239	541.30 µm	10826	1.05884
Sector #11	11257	595.20 µm	11904	1.06421
Sector #12	12270	649.10 µm	12982	1.05908
Sector #13	13320	704.70 µm	14094	1.06372
Sector #14	14326	758.20 µm	15164	1.05981
Sector #15	15347	812.30 µm	16246	1.06470
Sector #16	16382	867.40 µm	17348	1.06201
Sector #17	17399	921.40 µm	18428	1.06348
Sector #18	18422	975.80 µm	19516	1.06543
Sector #19	19447	1030.40 µm	20608	1.06689
Sector #20	20553	1089.40 µm	21788	1.06250
Sector #21	21528	1141.20 µm	22824	1.06250
Sector #22	22554	1195.70 µm	23914	1.06665
Sector #23	23544	1248.50 µm	24970	1.06323
Sector #24	24605	1304.90 µm	26098	1.07007
Sector #25	25605	1358.40 µm	27168	1.06201
Sector #26	26686	1415.80 µm	28316	1.06665
Sector #27	27676	1468.60 µm	29372	1.06250
Sector #28	28683	1522.10 µm	30442	1.06909
Sector #29	29697	1576.30 µm	31526	1.06592
Sector #30	30712	1630.40 µm	32608	1.06274
Sector #31	31749	1685.50 µm	33710	1.06299
FULL-SCALE	32767	1739.60 µm	---	---

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GEO acquisition core

DAC resolution	20 counts/µm
Acquisition mode	Constant time unfiltered tracking
Restart SAR when detecting	40 monotone tracks
Pretracking	1 cycles
THK cumulation	128 cycles
Postcumulative upscaling	2 leftshifts

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Equipment generic

Manufactured	12/2002
Testo/testu target mapping	PA76
Carrier detection sensor installed	False
Material detection sensor	Installed
Material detection in UP head DAC threshold	<0 bin (unlinearized, TM)
Delimiter carrier plate installed	False
Diameter delimiters kind	None
Drawer in/out actor installed	True
Drawer up/down actor installed	True
Drawer vacuum installed	True
Drawer vacuum actor polarity reversed	False
Head vacuum kind	None
Head vacuum sequencing	Default combinatorical
Head vacuum CHGVA multiplexer installed	False
Head up/down actor kind	None
Console switch kind	Pushbutton
Console display kind	Dual LED swapped
Console labels	Run and measure

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Globals

Submodel type	Standard MX608
Material handling	Semi automatic
Material detection	Not possible
Supported wafer diameter(s)	150mm..200mm
Reference angle	0°
THK subsystem type	Not installed
RES subsystem type	B204
RES head unit configuration	Dual LO and HI res
P/N unit installed	True
TEMP sensor installed	False
Drawer vacuum installed	True
Drawer resolution	8 steps/mm
Turner kind	Not installed
Turner vacuum installed	False
Console pushbutton installed	False
Material detection sensor installed	True
Unexpected material leads to error creation	False

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Ramping

Drawer: Minimum delay	950
Drawer: Maximum delay	30000
Drawer: Clipper maximum delay	2500

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Positions

Drawer absolute maximum position	2200 abs
Drawer position for wafer center under LO-RES head	1500 abs
Drawer position for wafer center under HI-RES head	1220 abs
Drawer position for RES air measurement	0 abs
Drawer position for P/N measurement	1220 abs

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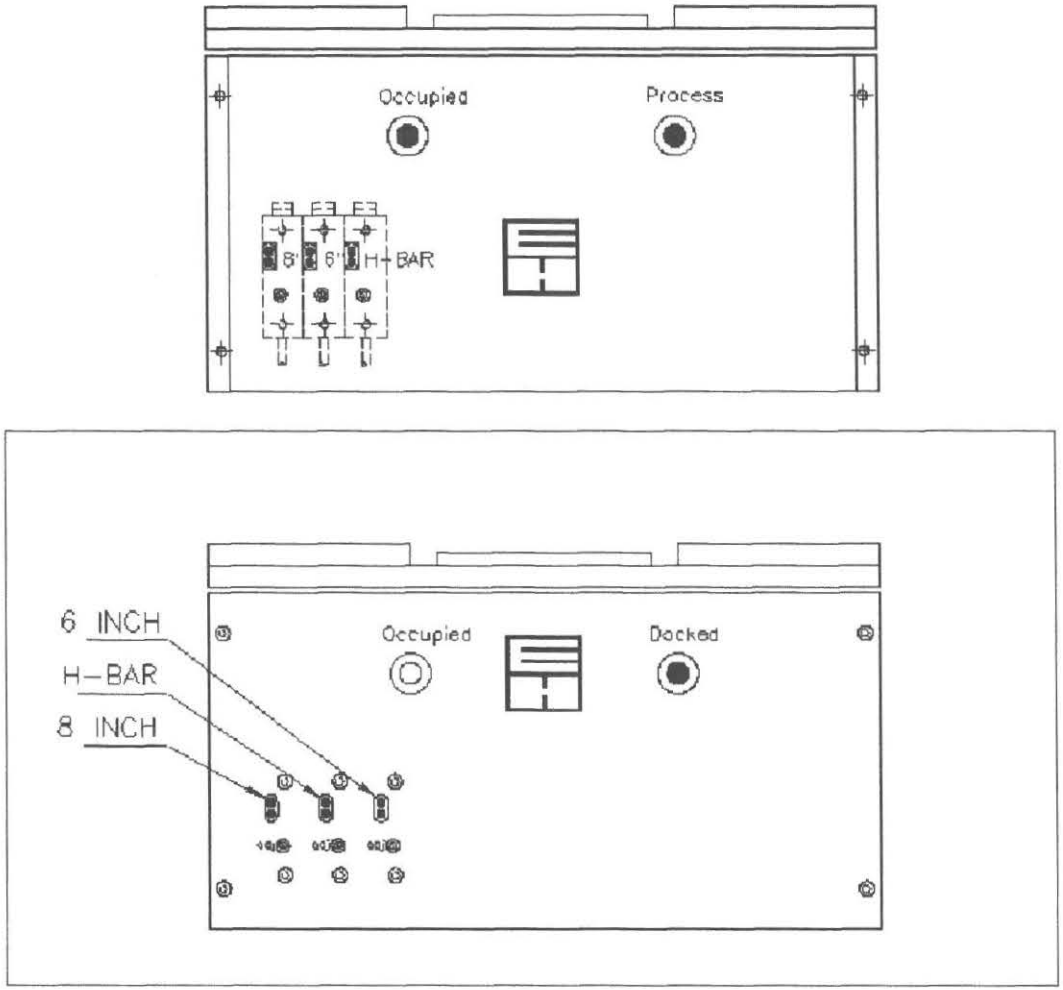
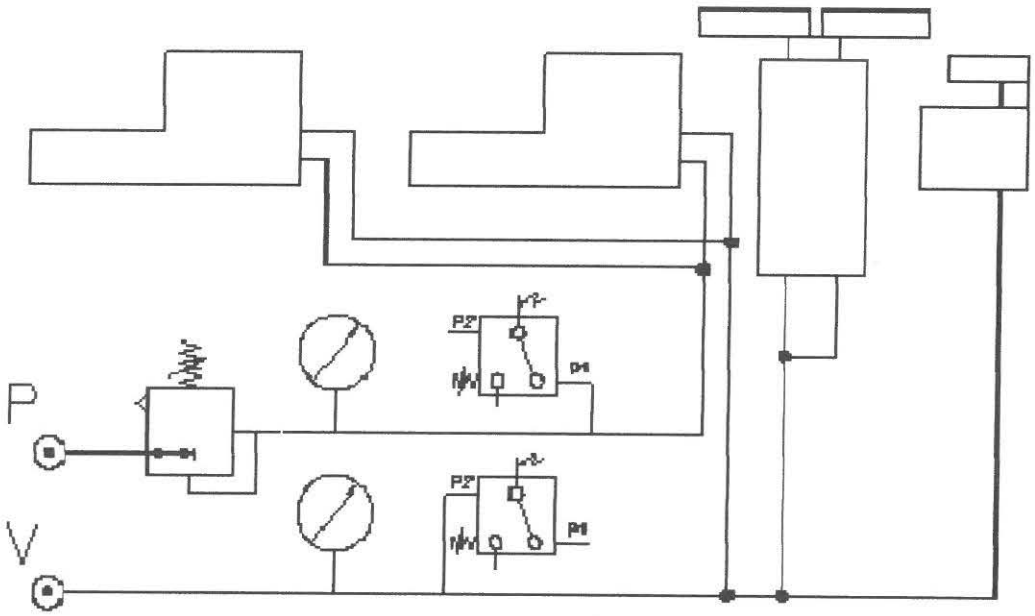
Timing

Generic sensors despike	10 polls
Despike home switches	10 polls
Drawer vacuum timeout	1000 ms
P/N pulse timeout	0 ms
P/N result timeout	1220 ms


Occupied
Process
8"
6"
H-BAR
6 INCH
H-BAR
8 INCH
Occupied
Docked

MX 204 MX 608 RobotAligner



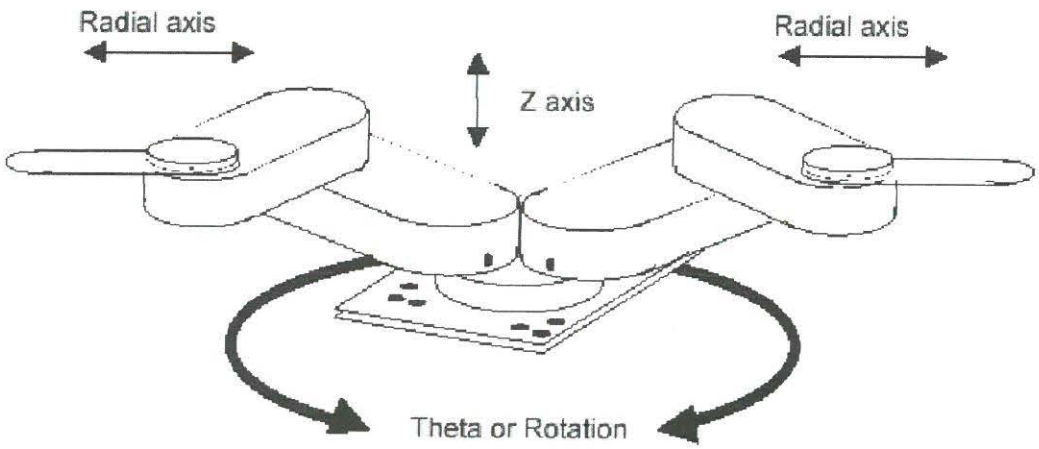
					Oberfläche	Maßstab 1:1	Position – Menge –
						–	–
				Datum	Name	MX 204-608-DRA-5C	
				Bearb. 25.10.2000	ng		
				Gepr.			
				Norm			
						Pneumatik-Schaltplan	Blatt – Bl
Zust.	Änderungen	Datum	Name	Dateiname Pneumatik-Schaltplan.dwg			

MX 204-608-DRA-5C
Robot Manual

This document is a short introduction for using and teaching the Robot.
For further details concerning the Equipe™ Robot see the PRI-Reference-Manuals

4000-0012 Rev. 1 (Software and Controller)
4000-0015 Rev. 1 (Atmospheric Pre-Aligner)
4000-0016 Rev. A (Atmospheric Single-Arm Robot)
4000-0017 Rev. 1 (User Interface Manual)
4000-0116 Rev. A (Atmospheric Dual-Arm Robot)

Robot Axis Conventions



The robot incorporates a aight-axis system of motion.

- T - axis (Theta) controls rotation of the arms.
- R - axis (Radial) controls the reaching and retracting of the upper arm.
- W - axis (Ratial) controls the reaching and retracting of the lower arm.
- Z - axis controls vertical movement of the both arms simultaneously.
- t - axis controls rotation of the pre-aligner chuck
- r - axis controls horizontal moving of the pre-aligner pins
- z - axis controls vertical movement of the pre-aligner pins

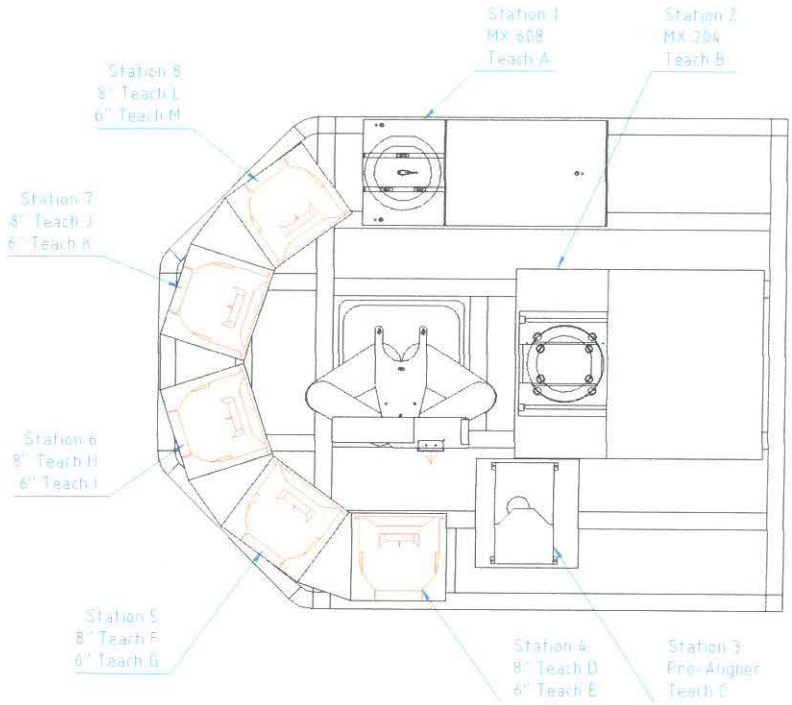
When axis parameters such as speed, acceleration, or current position are listed or modified by software commands, the parameter values for the three axes are always listed in the order T, R, Z. The fourth axis is stored in a separate file.

Station Naming Conventions

To issue commands, define each station with a one-character name or letter. For example, the robot might get a wafer for Station A and put it in a cassette named Station B. Station names can be any upper or lower case letter. For a cassette station, you need to teach only the first wafer slot. The controller will use the pitch for each station to determine the distance between slots in the cassette.

The following table shows the used types and the teach-positions:

Diameter	Type	Teach-Station	Application (example)
all	all	A	MX 608
all	all	B	MX 204
all	all	C	Pre-Aligner
8-Inch	7,1,1,1	D	Station 4
6-Inch	6,1,1,1	E	Station 4
8-Inch	7,1,1,1	F	Station 5
6-Inch	6,1,1,1	G	Station 5
8-Inch	7,1,1,1	H	Station 6
6-Inch	6,1,1,1	I	Station 6
8-Inch	7,1,1,1	J	Station 7
6-Inch	6,1,1,1	K	Station 7
8-Inch	7,1,1,1	L	Station 8
6-Inch	6,1,1,1	M	Station 8



Station convention

Station Sensoric

Cassette Detection

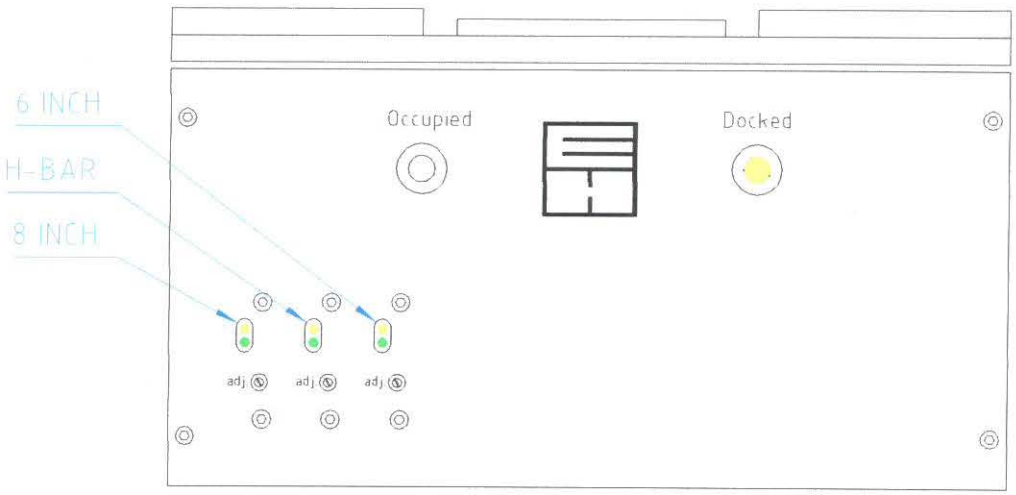
Each Station has three capacitive sensors for the detection of cassettes. One is on the placed on under the H-bar of the cassette, one on the left side to detect 8"-wafer and one on the right side to detect 6"-wafer. The amplifier of the sensors are placed on the frontpanel of each staton. The green LED shows that the sensor is idle, the yellow LED indicates the detection. You can adjust the sensors by the adjustment screw under the LED's. Turning clockwiese makes the sensor less sensitiv.

Occupied LED

The (white) LED labeled "Occupied" is on, when a casette is placed correctly on the station. If no cassette is detected on the station, the LED is of. If the LED is flashing the cassette in not placed correctly or the wrong cassette size is placed on the station.

Docking LED

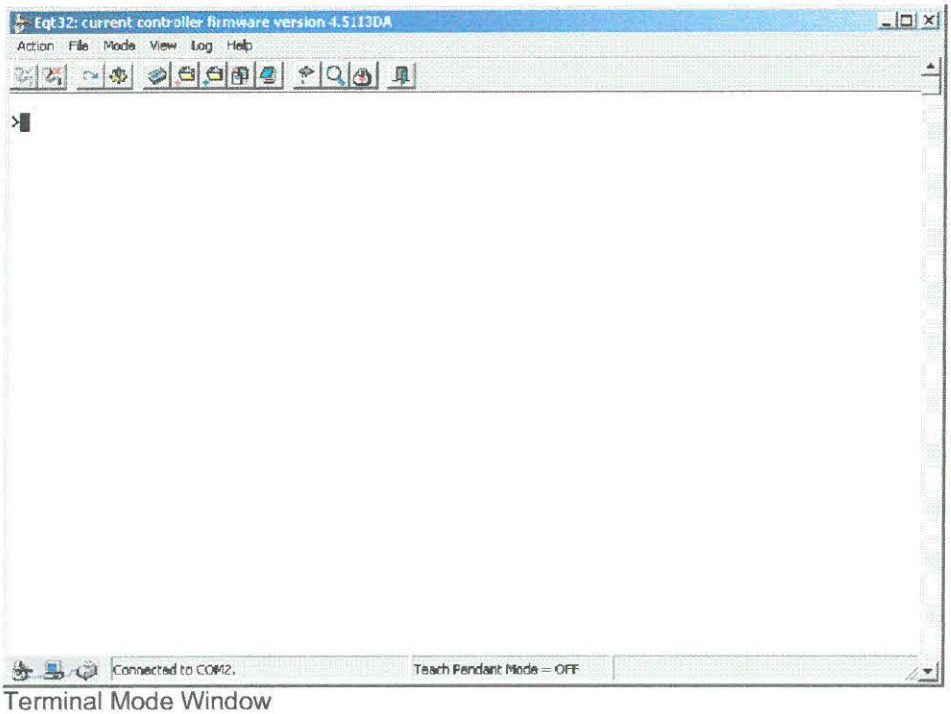
The (yellow) LED labeld "Docked" in on during the cassette is in use.



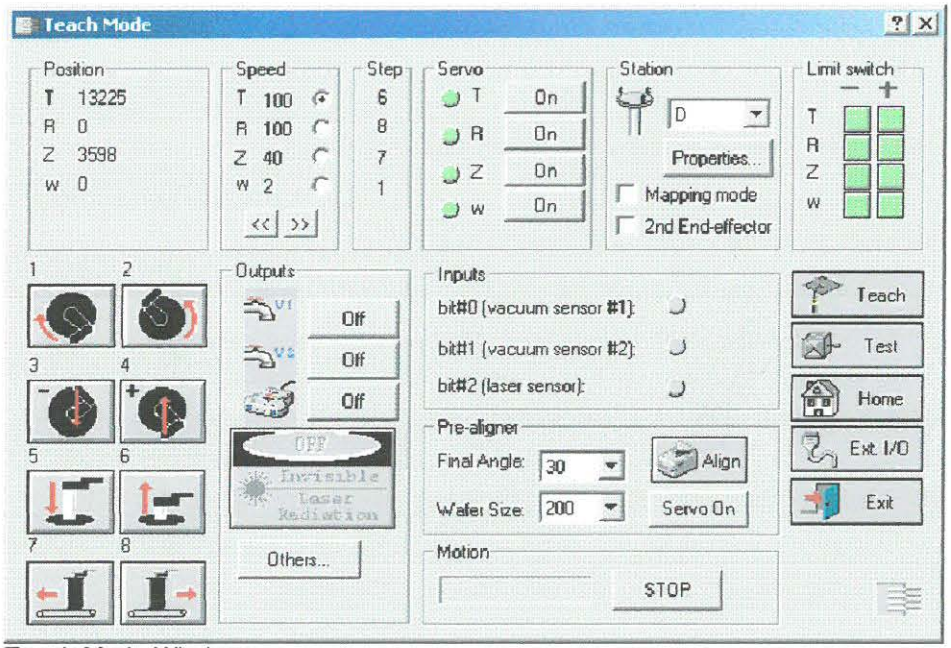
Front view of a Cassette Station

Using the Teach Mode

When you press the Teach button in the Terminal-mode window, the Teach window is displayed. The track motion control buttons and track axis parameters appear only for systems that include a track. The Pre-aligner box is enabled only for systems that include a pre-aligner.



Terminal Mode Window

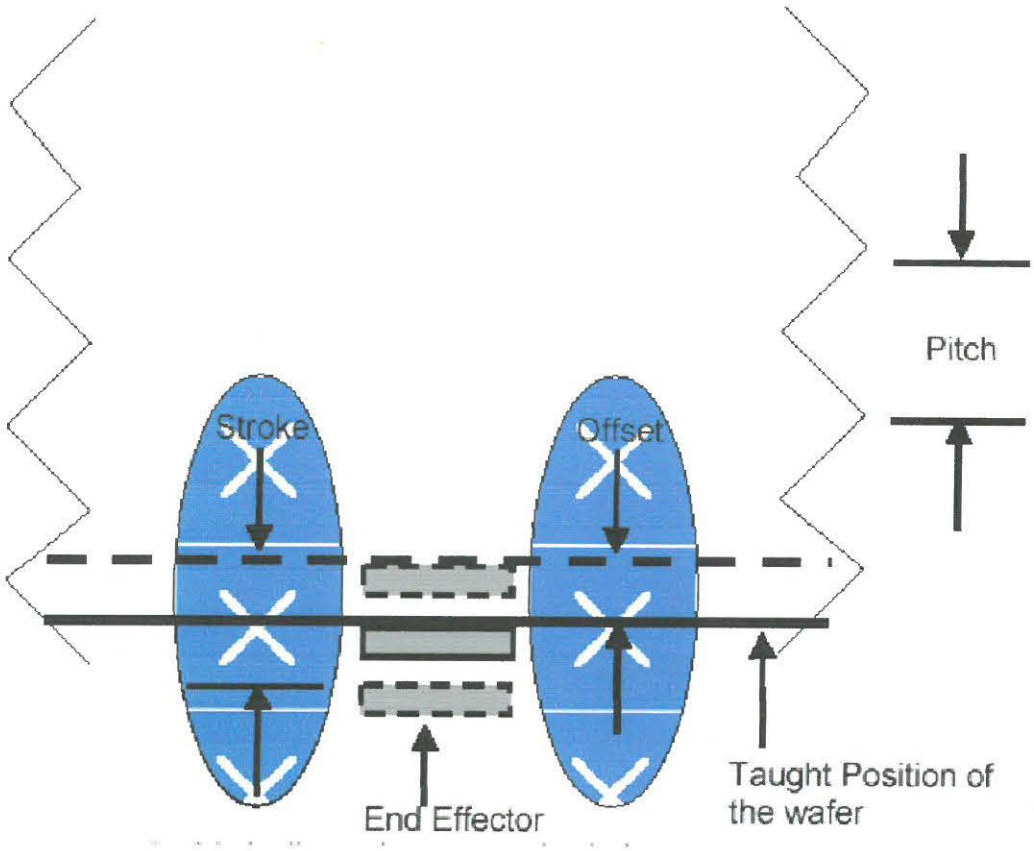


Teach Mode Window

Teaching Stations

For the Dual-Arm Robot you have only to teach the positions with the upper Arm (Axis R).

The distance between the upper and the lower arm is fixed in the macros.
Review the following figure and definitions before teaching stations.



To **GET** a wafer from a slot or to **PUT** a wafer in a slot, the movement of the end effector requires space above and below the final position of the wafer. When you teach a station, you are prompted for the *stroke* and *offset* parameters.

Taught Position of the Wafer sets the positions of the Theta and Radial axes such that the end effector is at the center of the wafer. The position of the Z axis is the basis for the Offset and Stroke values.

Offset sets the limit on Z travel *above* the taught position. This distance is required for placing a wafer in a slot or removing a wafer without touching the side of the cassette. The unit for offset is 0.001 inch.

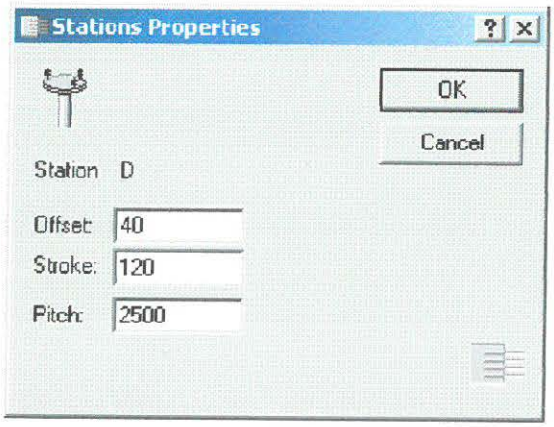
Stroke sets the limit on Z travel *below* the taught position for a given Offset. The unit for stroke is 0.001 inch.

Together, the Offset and Stroke provide sufficient Z travel within the cassette for GET and PUT movements without the wafer touching any part of the cassette. For example, if the taught position is 100, the offset is 35, and the stroke is 75, then the upper Z-travel limit is 135 (taught position + offset) and the lower Z-travel limit is 60 (taught position + offset - stroke).

Pitch sets the distance on Z travel *between* two slots (slot-to-slot-distance). The unit for pitch is 0.0001 inch.

Saving Station Properties

To save the station properties for the selected station, press the Properties... button. The Stations Properties dialog is displayed.
When you press the OK button, the displayed values are saved for this station in the coordinate file.



Teaching a Station

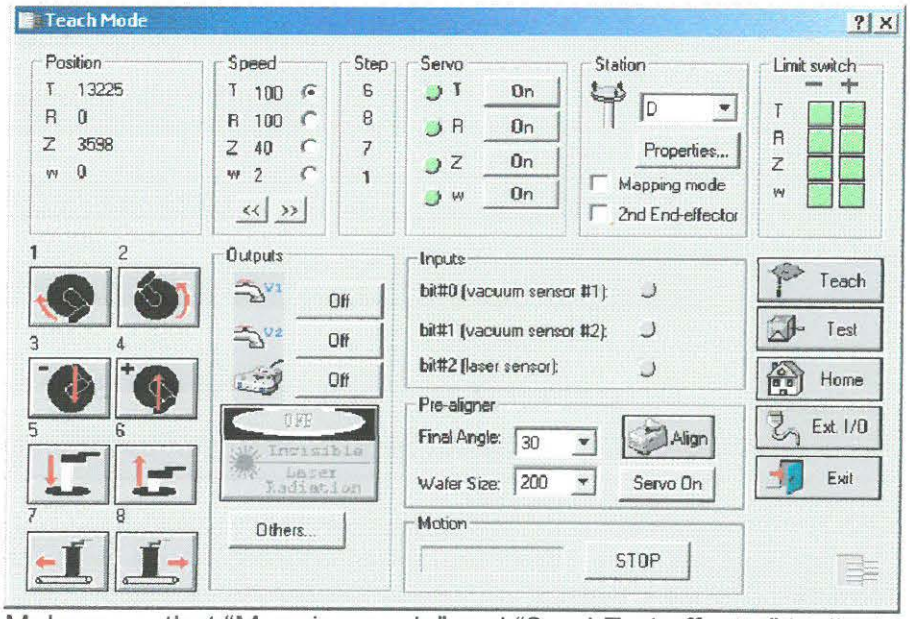
For the Dual-Arm Robot you have only to teach the positions with the upper Arm (Axis R).

Before teaching stations, make sure that all devices (robot, end effector, pre-aligner, track, and so on) in your system are level.

To demonstrate a typical teaching session, consider the simple case of a wafer cassette named Station D and a pre-aligner named Station C. The robot takes the wafer from Station D and places it on Station C. The pre-aligner aligns it and then the robot moves the wafer from Station C back to Station A.

In this case, you teach Station C first and then teach Station D. First align the wafer and teach the pre-aligner position. If you do not, the robot will try to put the aligned wafer in the same slot as it was before the aligning. The taught positions do not change, but the position of the wafer on the end effector will be different.

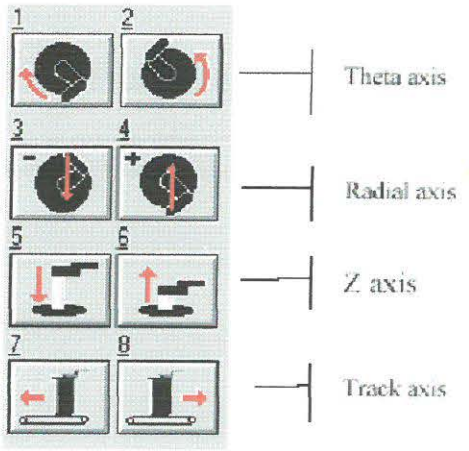
1. Access the Teach Mode window.



2. Make sure, that "Mapping mode" and "2end End-effector" is disabled
3. To teach Station C, turn all servo motors *off,* by clicking on all Servo axes:
4. Manually position the end-effector near the pre-aligner chuck. Place a wafer on the chuck.
5. Turn all servo motors on.
6. To home the robot or robot/pre-aligner, press the Home button. The Home button uses the command and timeout value specified in the HOME= line of the command section of the Eqt32.ini file.
7. Sometimes the robot moves slowly or only a short distance to home. To verify that the homing procedure is complete, watch the progress bar in the Motion box.
8. Before moving the robot, set the speed for each axis in the Speed box. For teaching and testing, it is better to use a relatively slow speed. Setting the speed in

Teach mode does not change the operational speed set in the parameter file. However, if you use a macro that includes a set speed command, that command overrides the speed you set in Teach mode. Note that as you set the speed, the corresponding Step is adjusted.

9. Use the motion control buttons to move the end-effector to the correct position:



Alternatively, you can use the number keys to move the robot.

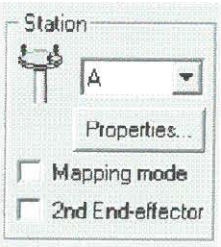
Press keys
1 and 2 for Theta in the – and + directions,

3 and 4 for Radial in the – and + directions,

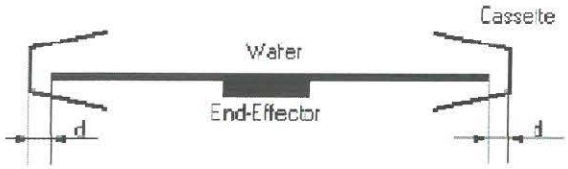
5 and 6 for Z in the – and + directions,and

7 and 8 for the Track in the – and + directions respectively.

10. On the Station selector list, press the down arrow to select Station C.



11. In the Station box, make sure that "Mapping" and the "2nd End-effector" in not selected.
12. Press the Teach button to save the Station C coordinates.
13. Move the end effector away from the pre-aligner.
14. In the Pre-aligner box, set the flatfinder alignment angle and wafer size options as needed. Then press the Align button. Wait while the wafer is aligned.
15. The GET command and slot 1 are selected by default. Press the Execute button. As the robot picks up the wafer from the pre-aligner, the progress is displayed in the progress bar in the Command box.
16. Turn the servo off.
17. With the wafer on the end-effector, manually move the robot arm to the cassette and carefully insert the wafer into empty slot 1.
18. Turn the servo on.
19. Using the motion control buttons, adjust wafer position so that the wafer is *not* touching the cassette:



20. Turn the vacuum off.
21. Move the Z-axis down until the end-effector is just below wafer, barely touching it:

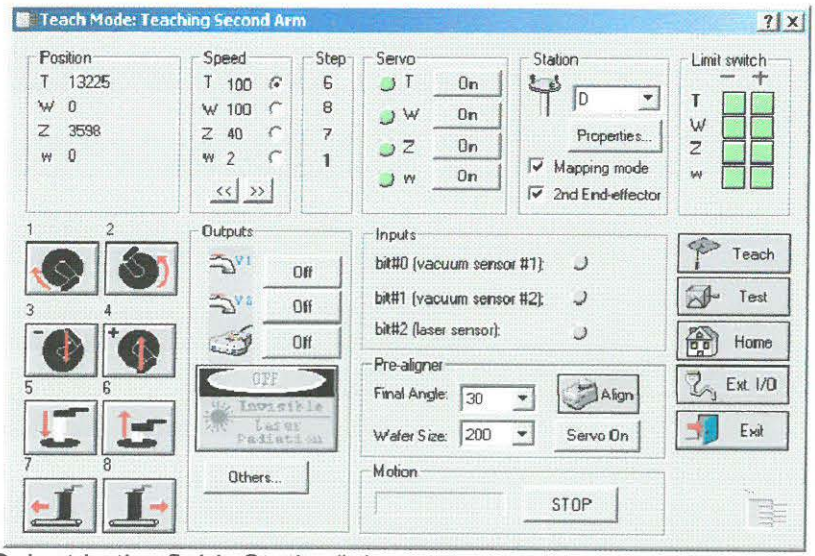
22. Select Station D and press the Teach button. Station D is saved and ready for testing.
23. Turn the servo motor off and manually retract in the R direction.
24. Select Station D, the GET command, and slot 1. Press the Execute button. Wait while the robot gets the wafer from slot 1.
25. Select Station C, the PUT command, and slot 1. Press the Execute button. The robot places the wafer on the pre-aligner.
26. Exit to the Teach mode and press the ALIGN button. The pre-aligner aligns the wafer.
27. Select the GET command and press the Execute button. Wait until the robot is finished.
28. Select the PUT command, Station D, and slot #1. Press the Execute button. The wafer in slot 1 is aligned.

Teaching the Scanner

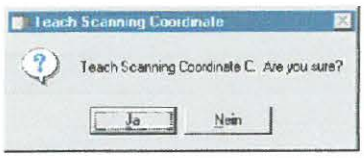
WARNING: Laser radiation emitted from the scanner could be hazardous. Do not view a laser beam directly. Laser beams can cause temporary or permanent damage to the eye.

Before teaching make sure that all devices (robot, end effector, pre-aligner, track, and so on) in your system are level.

a) Start EQT-32
b) Type DCSI <Station>, to set the scanning parameter for this station to default.
c) Start the Teach-Mode



d) Select in the field „Station" the station which you will teach
e) Select „Mapping Mode"
f) Select „2nd End-Effector
g) Move the scanner in front of the station. The distance between sacnner and wafer should be 40mm
h) Switch on the scanner
i) Move in Z until the beam hit the wafer in the first slot
j) Move in T until the beam hit the wafer in the middle
k) Move downwards, until the beam in under the first slot
l) Move slowly Z upwards, until the Value on the Sensor display gets his maximum
m) Move in W, until the Value on the Sensor display gets his maximum
n) Press „TEACH"



o) Confirm „Teach Scanning Coordinate.."

p) Quit the window „Position stored! Do you want to calibrate?" with NO
q) Quit the Teach-Menue
r) Reset the Speed by using the commands RSA and RSA W
s) Test the mapping by using MAP <Stationsnumber>
MAP sends the mapping result as follows
MAP <ErrorCode>,<Status>,>Stationsnumberr>, (<S1>,<S2>,...,<Sn>)

With S1 to Sn gives the mapping result for each slot as follows:
0 – not defined
1 – empty
2 – not empty
3 – correctly occupied
4 – double slotted or invalid
5 – cross slotted

t) If the result is ok, save the teaching with „SAV"

Remarks:
If the scanner reports „4" (double slotted) in an empty slot above a occupied slot, the the Z-Coordinate is to high. Reduce the teaching of the Z-coordinate and try again.

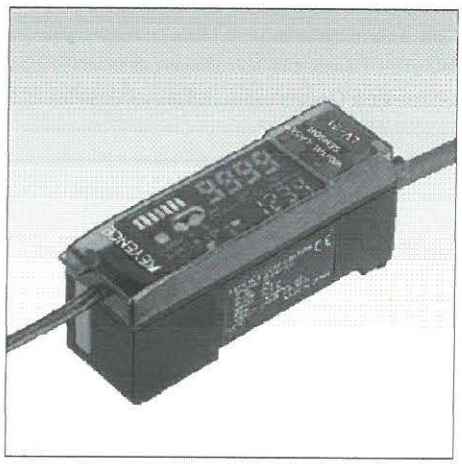
If the scanner reports „4" (double slotted) in an empty slot under a occupied slot, the the Z-Coordinate is to low. increase the teaching of the Z-coordinate and try again.

Digital Laser Optic Sensor LV Series
Instruction Manual

Laser Safety Precautions

Use of controls or adjustments,or the performance of procedures other than those specified herein,may result in hazardous radiation exposure.

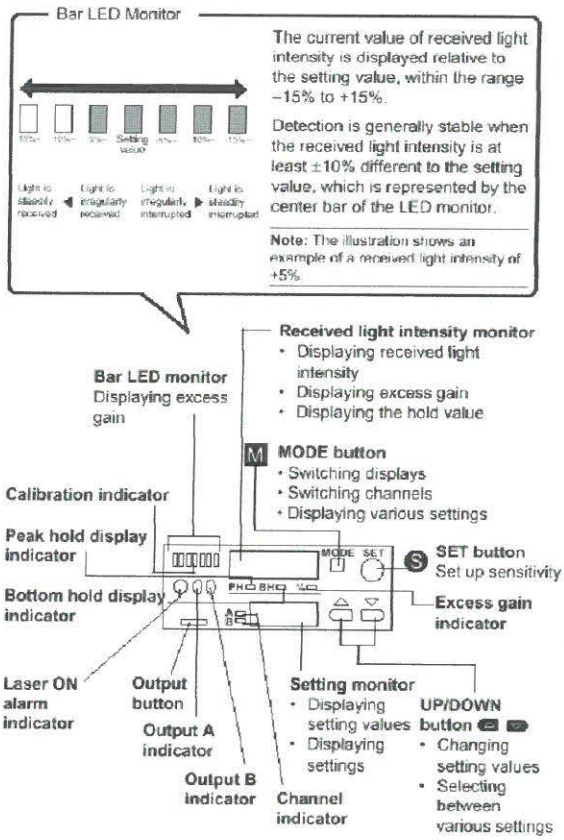
The laser beam is not harmful to the skin. There is,therefore,no danger in exposing arms or hands to the beam.The only possible health hazard is in exposing the eyes to the laser beam.Damage to the eyes can occur if the operator stares directly into the beam. Looking directly at the laser beam may result in serious eye injury.



Follow the safety precautions below to ensure operator safety:

- **Operate the LV Series only according to the procedures described in this instruction manual.**
  Otherwise, injury may occur due to exposure to the laser beam.
- **Do not disassemble the sensor head.**
  Laser emission from the LV Series is not automatically stopped if the sensor head is disassembled. If you disassemble the sensor head for inspection or repair, you may be exposed to the laser beam. If the LV Series malfunctions, contact KEYENCE immediately.
- **Do not look directly at the laser beam.**
  Looking directly at the laser beam may result in serious eye injury.
- **Protective enclosure**
  It is recommended that you install a protective enclosure around the sensor head to prevent any person from getting near the sensor head during operation.
- **Protective goggles**
  It is recommended that you wear protective goggles when using the LV Series.
- **Stop laser emissions before cleaning the laser emission port.**
  Failure to stop the laser emission may expose eyes or skin to the laser beam.
- **Check the laser beam path.**
  To prevent exposure to the laser beam due to specular or diffuse reflection, install a screen which offers the appropriate reflectance and temperature characteristics to interrupt the reflected laser beam. Do not install the LV Series in such a way that the laser beam passes at eye height.

Amplifier



Sensor Head

■ Bar LED monitor (sensor head)

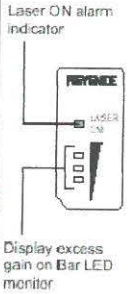
When A, which is closer to the amplifier, is ON, the monitor displays the excess gain of output A. When B is ON, the monitor displays the excess gain of output B.

Bar Graph LED monitor (Interlocked with amplifier)

Light is steadily received — +10% —
Setting value
Light is steadily interrupted — −10% —

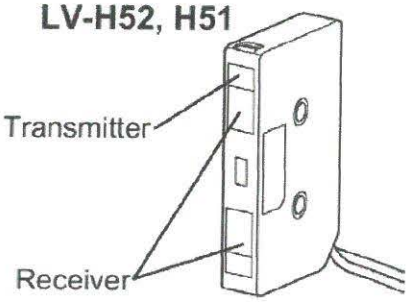
The indicator turns on according to the difference between the received light intensity and the setting value. The current level of detection stability can be determined from this difference.

If detection becomes unstable (light cannot be "steadily received" or "steadily interrupted") due to a change in the surroundings or the target, or for any other reason, readjust the sensitivity.

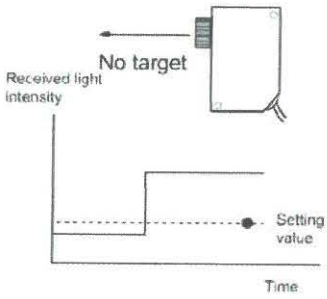


■ Dual-receiver port, area detection

LV-H52, H51



■ Maximum sensitivity setting



If there are any objects in the background, the sensitivity is set to the maximum value for which the background objects are not detected.

1. According to the directions on the left, press the S button for 3 seconds or more.

2. Confirm that the calibration indicator (orange LED) and setting monitor (green LED) are flashing.

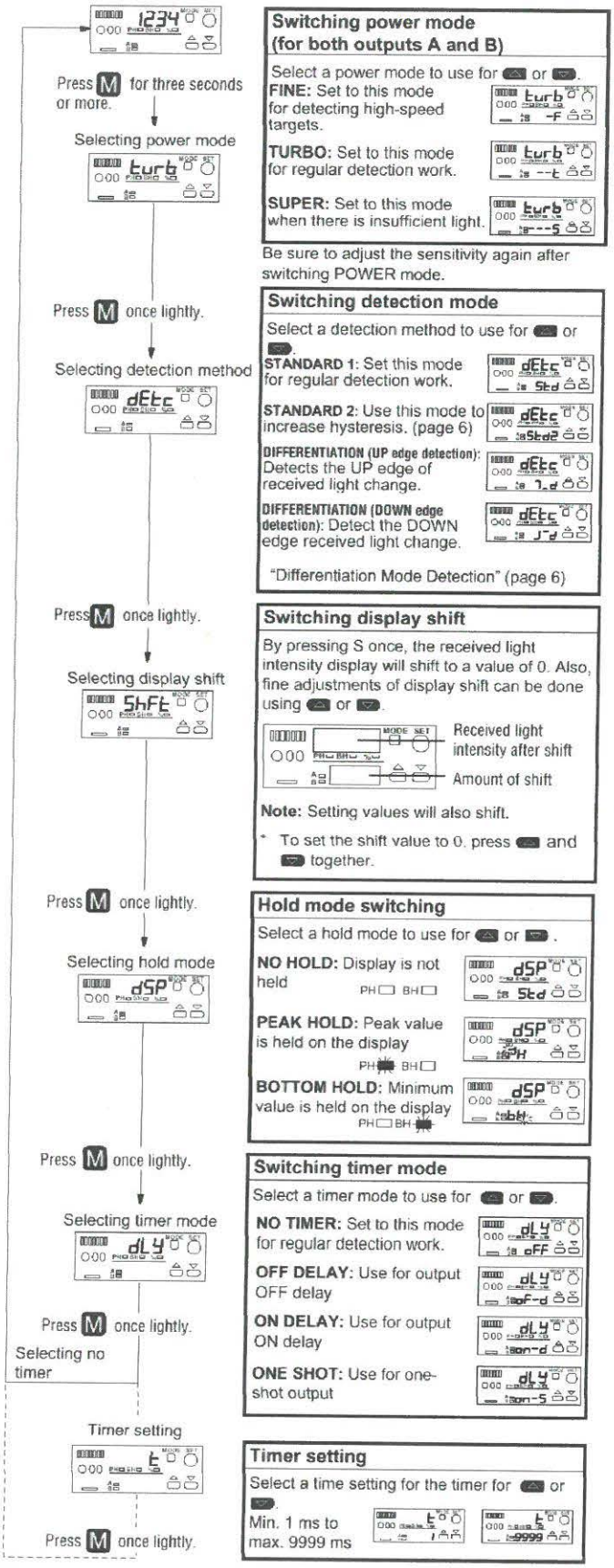
3. Release the S button.

Mode Setting

If you press the M button for three seconds or more when either Received light
or intensity is displayed, you can display the values of various settings. Each setting can be adjusted separately for channel A and channel B.

Reference: When the M button is pressed for 3 seconds or more during mode setting, the display returns to the received light intensity display.

*It is possible to perform detection work while changing mode settings.To do this,switch the monitor to display received light intensity.



Specifications

Amplifier

Model		LV-21A/21AP	LV-22A/22AP	LV-20A	LV-11A
FDA Class [1]		Class II			Class I
IEC Class [2]		Class 2			Class 1
Main unit/expansion unit		Main unit	Expansion unit (1 line)	Expansion unit (0 line)	Main unit
Response time		FINE: 80 µs TURBO: 500 µs SUPER TURBO: 4 ms		280 µs to 4.7 ms [2]	FINE: 500 µs TURBO: 2 ms SUPER TURBO: 8 ms
Operation mode		LIGHT-ON/DARK-ON (switch selectable)			
Output mode selection		1. A, B: L. ON; 2. A: L. ON, B: D. ON; 3. A, B: D. ON; 3-way slide SW			
Output		Red LED x 2ch			
Indicators	Digital LED monitor (light intensity monitor, setting monitor)	4 digits + 1/2, red 7-segment LED and green 7-segment LED Received light intensity (0 to 9999), Excess gain (0 to 9999)%, Set-up value display (0 to 9999) Negative values can be displayed when the display shift function is used. Peak hold and bottom hold switching			
	Bar LED monitor	Orange x 1, green x 6 (orange also used for tuning indicator)			
	Laser ON alarm indicator	Green LED			
Detection modes		STANDARD 1, STANDARD 2, UP edge, DOWN edge, separate settings for ch A/B			
Current value shift		±9999 variable, separate settings for ch A/B			
Timer function		OFF DELAY/ON DELAY/ONE SHOT, separate settings for ch A/B, timer 1 to 9999 ms variable			
Laser emission stop input		Non-voltage input, stop during laser radiation, input time: 20 ms min.			
Control output		NPN open-collector x 2 ch, max. 100 mA (40 V max.), residual voltage 1 max. [3] LV-21AP/22AP: PNP open-collector x 2 ch, max. 100 mA (30 V max.), residual voltage 1 max.			
Protection circuit		Reverse-polarity protection, overcurrent protection, surge absorber			
Power voltage		DC 12 to 24V ±10% max., Ripple (P-P) 10% max. [4]			
Power consumption (current consumption)		1.5 W max. (12V: 125 mA, 24V: 62.5 mA)			
Ambient temperature [5]		–10 to +55°C (14 to 131°F), No freezing			
Relative humidity		35 to 85%, No condensation			
Vibration resistance		10 to 55 Hz, 1.5 mm double-amplitude in X, Y, and Z direction, 2 hours per axis			
Materials		Main body & cover: Polycarbonate			
Weight (incl. 2-m cable)		Approx. 120 g	Approx. 75 g	Approx. 35 g	Approx. 120 g

1. Use LV-H32/H37/H42/H52/H62 for FDA Class II and IEC Class 2, and use LV-H41/H51 for FDA Class I and IEC Class 1.
2. For use with FS-R0 as main unit
3. No control output cable for LV-20A
4. The power for LV-20A/22A/22AP is supplied from the main unit.
5. With several units connected, the allowable ambient temperature range varies as follows.
   3 to 5 units connected: -10 to +50°C (14 to 122°F)
   6 to 7 units connected: -10 to +45°C (14 to 113°F)
   To connect several units they must be mounted on a DIN rail (metal DIN rail). Make sure that output current is 20 mA max. Note also that the expansion unit (LV-20A/22A/22AP) cannot be used as it is.

Sensor head

Model		LV-H32	LV-H37	LV-H42	LV-H52	LV-H62	LV-H67	LV-H41	LV-H51
Light source		Visible red semiconductor laser, Wavelength: 650 nm, 3 mW max., Pulse duration: 3.5 µs						Invisible infrared semiconductor laser Wavelength: 785 nm, 2.5 mW max., Pulse duration: 3.5 µs	
FDA Class [1]		Class II						Class I	
IEC Class [1]		Class 2						Class 1	
Detection distance	FINE	30 to 250 mm	70 ±15 mm	250 mm (Slit black: 150 mm) (Slit gray: 100 mm)	15 to 120 mm (Slit: 20 to 60 mm)	2 m	20 m	250 mm (Slit black: 150 mm) (Slit gray: 100 mm)	15 to 120 mm (Slit: 20 to 60 mm)
	TURBO	30 to 500 mm		500 mm (Slit black: 300 mm) (Slit gray: 200 mm)	15 to 180 mm (Slit: 20 to 80 mm)	5 m	30 m [2]	500 mm (Slit black: 300 mm) (Slit gray: 200 mm)	15 to 180 mm (Slit: 20 to 80 mm)
	SUPER	30 to 1000 mm		1000 mm (Slit black: 600 mm) (Slit gray: 400 mm)	15 to 240 mm (Slit: 20 to 100 mm)	7 m	30 m (Use OP-42196, 50 m)	1000 mm (Slit black: 600 mm) (Slit gray: 400 mm)	15 to 240 mm (Slit: 20 to 100 mm)
Beam spot shape		Detection distance: max. 300 mm Spot diameter: 0.8 mm max.	Detection distance: 70 mm Spot diameter: Approx. 50 µm	Detection distance: 150 mm Area width: approx. 37 mm (Slit black: approx. 19 mm) (Slit gray: approx. 7 mm) Thickness: 1 mm max.	Detection distance: 35 mm Area width: approx. 25 mm (Slit: approx. 9 mm)	Detection distance: 1 m or less Spot diameter: Approx. 1.5 mm max.	Detection distance: 20 m Approx. 10 x 3 cm Detection distance: 30 m Approx. 15 x 4 cm	Detection distance: 150 mm Area width: approx. 38 mm (Slit black: approx. 19 mm) (Slit gray: approx. 7 mm) Thickness: 1.3 mm max.	Detection distance: 35 mm Area width: approx. 25 mm (Slit: approx. 9 mm)
Indicator		Laser ON alarm indicator: gren LED, Label indicator: Green x 2, red x 1 (label indicator displays excess gain from 90 to 110%.)							
Ambient illumination		Incandescent light: 10,000 lux max. Sunlight: 20,000 lux max.							
Ambient temperature		–10 to +55°C (14 to 131°F), No freezing							
Relative humidity		35 to 85%, No condensation							
Vibration resistance		10 to 55 Hz, 1.5 mm double amplitude in X, Y, and Z directions: 2 hours per direction							
Materials		Case: Reinforced glass plastic, Lens cover: Polyarylate (Acrylic for LV-H32/H62/H67), Glass (Aperture of LV-H37 only) Slit (black/gray): Polyacetal (incl. with LV-H41/H42), Slit: Polyacetal (included for LV-H51/ H52), R-2 reflector: ABS (Main body), Acrylic (Reflective body), R-6/R-7 Reflector: Polycarbonate (Main body and phase-differential film), Acrylic (Reflective sheet)							
Weight (incl. 2-m cable)		Approx. 45 g	Approx. 45 g	Approx. 45 g	Approx. 55 g	Approx. 45 g	Approx.37 g	Approx. 45 g	Approx. 55 g

1. Use LV-20A/21A/22A/21AP/22AP for FDA Class II and IEC Class 2, and use LV-11A for FDA Class I and IEC Class 1.

Coordinate File (*.COR)

When you *teach a station*, you save the coordinates in a coordinate file. One *.cor file contains the coordinates of all taught stations. In addition, the coordinate file contains parameters that further define the stations, such as the pitch, stroke, and offset for the cassette and other Special Coordinate Items, such as the values used for a laser scanner, track, or flipper. Commands are provided to review and change the values, if needed.

Coordinate or Parameter	Command to read	Command to set
Station Coordinates	RCS	SPC
Offset for Stroke	ROF	SOF
Stroke	RST	SST
R-axis retract position	RRET	SRET
Distance between cassette slots	RPI	PITCH

The coordinate file contains the coordinates for positions or stations and cassette slot information. You can add more stations to the coordinate file or change the coordinates of the existing stations. That is, you place the robot in a position or station that you want the robot to remember. You then teach the station coordinates by saving the coordinates for that position or station in a coordinate file (*.cor) stored in NVSRAM.

```
SPC A,25495,10233,2891      Station A    coordinates T, R, and Z
SOF A,50                                 Offset
SST A,80                                 Stroke
SRET A,-5500                             R Axis retract position
PITCH A,2500                             Distance between cassette slots
SPSC A,7344,-12617,2831                  Scanning coordinates
SCSI A,0,50                              |
SCSI A,1,250                             |
SCSI A,2,5000                            |
SCSI A,3,5000                            |
SCSI A,4,5523                            — Parameters for scanning
SCSI A,5,2586680                         |
SCSI A,6,5000                            |
SCSI A,7,1993                            |
SCSI A,8,25                              |
SCSI A,9,75177                                 Data for track position
SCSI A,10,3                              Reserved – Not used
SCSI A,11,0                              Reserved – Not used
SCSI A,12,0                              Reserved – Not used
SCSI A,13,0                              |
SCSI A,14,0                              — Parameters for Flipper
SCSI A,15,25                             |
SPC B,25517,10269,2870      Station B    coordinates T, R, and Z
SOF B,50                                 Offset
...                                      ...
```

Note that T, Theta, is expressed in centidegrees (0.01°). R and Z are expressed in milliinches (0.001 in), Pitch is expressed in 0.1 milliinches (0.0001 in) .

Robot Parameter File (*.PAR)

CAUTION: Modification of parameter files can be dangerous and requires specific knowledge and training.

The robot parameters are stored in the *.par file. This file defines the robot parameters for the controller. Below is an example parameter file, annotated to show the line locations of the parameters. Your parameter file might have different values. Note that most parameters list three values. The first value for the T-axis, the second value is for the R-axis, and the last value is for the Z axis. For example, when the T axis is homed, a speed of 100 is used, but when the R axis is homed, a speed of 50 is used.

ATM-1111	Serial number of the robot
9600	Baud rate
100,50,20	**Home speed**
1000,400,50	Home acceleration
2000,2000,2000	Encoder resolution
0,0,0	Reserved – Not used
4300,3000,2000	Operational speed
10025,10012,14012	Operational acceleration
200,200,300	Error limit or following error
50,30,40	GN, Proportional gain
0,0,0	Servo acceleration forward
4,4,4	KI, Integral gain or Response to error
9999,9999,9999	TL – Torque limit
160,120,160	ZR, Derivative gain or Damping element
16896,16896,16896	Ramp value, controls radius of the S-curve
0,-4500,0	Customized home position
0,-31432,0	Home offset in encoder counts
9000,16775,3937	Mechanical ratio used in scaling
0,10460,0	Arm length, total of both arm links for R
4,1500,0	Parameters for optional Z-axis brake
1044,499,63	Operational deceleration
-1000,-10460,-1000	Negative software motion limit
36000,10460,13200	Positive software motion limit
0,0,0	Scanner offset
0,0,0	Reserved – Not used

Some parameters, such as the Customized home position, are set when you teach the station positions. You can reset other parameters, such as speed and acceleration with commands. You can also change parameters by editing the parameter file; refer to the *User Interface Manual*

Adjusting Robot Parameters

When your robot system is delivered, the robot parameter file contains recommended parameter settings. It is unlikely that you will need to change any parameters. However, your specific use may suggest that you use a faster or slower operational speed, or you may want to change the ramp value to provide a smoother S curve. To change robot parameters, such as speed or acceleration, send the command to set the new value in Terminal Mode. Then save the new value in NVSRAM by sending the SAV command. The commands for changing the robot parameters are summarized in the following table. For more information on each command, refer to the Equipe *Software Manual.*

Parameter	Command to read	Command to set
Home acceleration (.01 in / sec 2) Note that RAD returns home acceleration only if homing is in progress. Otherwise, RAD returns operational acceleration	RAD	None
Operational acceleration	RAD	SAD
Operational speed	RSP	SSP
Operational deceleration	RDL	SDL
Servo error limit	RER	ER
Positive software limit switch	RPSL	SPSL
Negative software limit switch	RNSL	SNSL
Ramp slope	RRM	RM
Torque Limit	RTL	TL

Most Often-Used Commands

Command	Example	Description
ABM	ABM	Abort motion of all axes in a system
HOME axis	HOME R	Home the R-Axis of the Robot
MOVA axis, position	MOVA Z,1000	Move Z-Axis to the absolute Position 1000
MOVR axis, position	MOVR Z,1000	Move Z-Axis 1000 steps relative to the current position
RAD axis	RAD A	Reads current acceleration and deceleration of all axis
RCP axis	RCP R	Reads the current position of the R-axis
RETH (station)	RETH B	Retract the radial axis for station B
RSP axis	RSP T	Read speed for axis T
SAD axis, acceleration	SAD T,5000	Set acceleration of the T-Axis
SAV	SAV	Store parameters, coordinate and calibration data in NVSRAM
SDL axis, deceleration	SDL W,8000	Set deceleration of the W-Axis
SMCR	SMCR	Store macro in NVSRAM
SSP axis,speed	SSP R,4000	Set the Speed of the R-axis
SVOF axis	SVOF A	Turn off the servo motor of all axes
SVON axis	SVON R	Turn on the servo motor for R-axis

E+H –Macros for Testing

In E+H macros the Waferdiameter is given by the Sensors of the Cassette-Station and the Wafertype by the TYPE-command.

Command	Example	Description
TRANS N,M,n,m *	TRANS 1,2,3,4	Transport a Wafer from Station 1,Slot 2 to Station 3, Slot 4
CVOF	CVOF	Switch off the Vacuum
CVON	CVON	Switch on the Vacuum
EVER	EVER	Shows the E+H macroversion
GRUND	GRUND	Moves the Robot to a secure position
GS station, slot *	GS 4,3	Moves the Robot in front of Station 4, Slot 3 (get-position) and switch of the servo of the R-axis
GSA station,slot *	GSA 5,17	Moves the Robot in front of Station 4, Slot 3 (put-position) and switch of the servo of the R-axis
TYPE diameter, type	TYPE 7,1,1	Set the Waferdiameter to 7 (8") the Cassettetype to 1 and the Waferhangtype to 1

*** In this Macros the Station must be defined by using the TYPE-Macro before you start the Macro**

For example: If you want to handle a 12-inch Wafer,Hang Type 1, from Station 2, Slot 17 of the Carrier to the Gauge and back to Station 2, Slot 4 you have to type the following commands:

```
TYPE 8,1,2
TRANS 2,17,1,1
TRANS 1,1,2,4
```

Setting the Z-Axis Brake

The Z-axis brake prevents the Z column from backdriving with the force of gravity. The OUTP 4 command controls the Z-axis brake. Line 20 of the Robot Parameter File lists the Z-axis parameters:

- First parameter is the numerical port ID used for turning the brake on or off. It is normally 4.
- Second parameter is the Z-axis Gain offset and is usually 0. This value sets the bias voltage in the motor output to counter gravity.
- Third parameter is always 0.

If the first parameter is set correctly, the controller engages the brake port automatically when the SVOF command is executed or disengages the brake when the SVON command is executed. The brake is activated when the Z-axis servo motor is turned off or a motor position error occurs. To *manually* engage or disengage the brake, send the OUTP command from the Teach Pendant or EQT command line, as shown in the following instructions.

CAUTION:
Make sure each end effector is clear of obstacles before turning off the brake and Z-axis servo motor. **The Z axis can drop under the force of gravity if the brake and the servo are off. Wafer and robot damage can result.**

1. To turn off the servo motor, enter the command: SVOF Z This causes the z-axis brake to turn on.

2. To turn on the brake, enter: OUTP 4,1

3. Manually move the Z column a short distance. The brake re-engages because a position error is registered.

4. Re-send the command OUTP 4,1 The brake should remain off. You can now move the Z column manually.

Troubleshooting

This chapter describes how to troubleshoot DBM robot problems. First review the section on Common Problems. If this does not solve the problem, use any applicable Diagnostic steps in the previous chapter to locate the problem. Then use the troubleshooting commands to interrogate the controller for status of DBM robotic system components. These commands are discussed in the section on Checking Robot Status.

Common Problems

The two most-common problems are that the DBM robot does not move or does not home.

If the DBM robot is not moving, check the following:

Is the power on? If not, connect it!

Are the servo motors turned on? If not, use the SVON command.

Is the robot homed? If not, use your homing macro or HOME command.

Is the signal cable correctly connected? If not, correct it.

If the DBM robot does not home, make sure the signal cable is correctly connected.

Checking Robot Status

To check controller connections and input/output connections, you can send various commands to the controller. The controller responds with the status. Use these commands for general troubleshooting:

Command	Purpose
AST 1	Check error status on communications port 1 (COM1)
AST 2	Check error status on communications port 2 (COM2)
GLST	Check status of the Galil motion control board
INPUT G	Read input port G
RLS	Read limit switches
RNCS	Read NVSRAM check-sum
STAT	Send status word
VER	Read firmware version number

You can send any of these commands in Terminal mode from the Teach Pendant. The response from the controller is displayed in hexadecimal format that you must convert to messages. The firmware recognizes the current axes and returns information for those axes. This section describes the robot information you can access by using these commands:

STAT Indicates if an axis is not homed or is in a servo-off condition

GLST Galil status indicates if a servo motor is off for any of the axes

RLS Reads limit switches, including track limit switches

STAT Command and Response

The STAT command indicates general status of the controller, including motor error on a robot axis, in a 16-bit word. Bit 14 in the STAT response can indicate multiple errors.
The response to a STAT command gives the following information.
Bits that are significant for the DBM robot are in **bold type**.

Bit	Meaning when bit is set to 1
0	Previous command not executed
1	Previous command invalid
2	Vacuum sensor is activated
3	Vacuum switch is ON
4	**Motor error on one or more axes**
5	**One or more limit switches are triggered. Use RLS command.**
6	**One or more axes are not homed yet.**
7	Pre-aligner error (Initialization only)
8	Running macro
9	**One or more axes are moving.**
10	**Servo motor is off on one or more axes.**
11	Error on COM2
12	Not used (always 1)
13	NVSRAM error
14	Controller error
15	Error on COM1.

GLST Command and Response

The Galil motion control board status is given in a 32-bit double word. For a four-axis system, bits 12 to 15, 20 to 23, and 28 to 31 are zeros. Bits for the lower arm are in **bold type**. If you have a 4-axis system, the lower arm is t. If you have an 8-axis system, the lower arm is W.

Bit	Meaning when bit is set to 1
0	Write or read time out
1	Responds with the ? prompt
2	Board is in debug mode
3	Galil command error
4	Integrator output exceeds torque limit (TL)
5	Always 0
6	Always 0
7	Always 0
8	Position error on robot theta axis
9	Position error on robot R axis
10	Position error on robot Z axis
11	**Position error on robot t axis (four-axis system)**
12	Position error on pre-aligner theta axis
13	Position error on pre-aligner R axis
14	Position error on pre-aligner Z axis
15	**Position error on robot W axis (eight-axis system)**
16	Robot theta axis is idle
17	Robot R axis is idle
18	Robot Z axis is idle
19	**Robot t axis is idle (four-axis system)**
20	Pre-aligner theta axis is idle
21	Pre-aligner R axis is idle
22	Pre-aligner Z axis is idle
23	**Robot W axis is idle (eight-axis system)**
24	Servo off on robot theta axis
25	Servo off on robot R axis
26	Servo off on robot Z axis
27	**Servo off on robot t axis (four-axis system)**
28	Servo off on pre-aligner theta axis.
29	Servo off on pre-aligner R axis
30	Servo off on pre-aligner Z axis
31	**Servo off on robot W axis (eight-axis system)**

RLS Command and Response

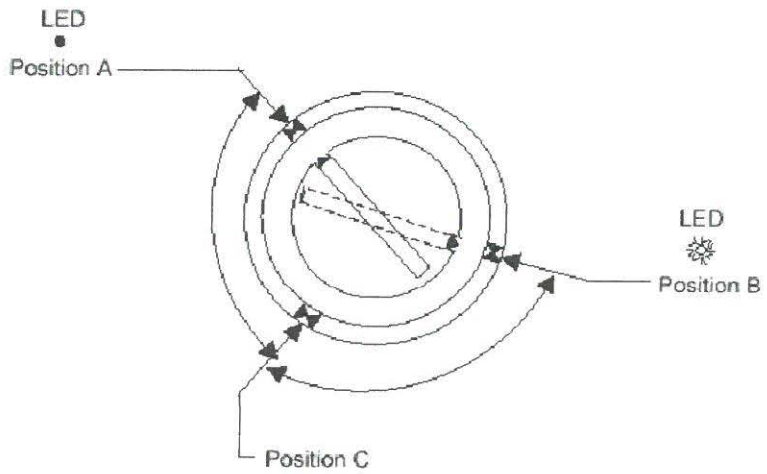
If Bit 5 of the response to the STAT command indicates that one or more limit switches are triggered, use the RLS command to find out the status of each switch. Bits 0 to 15 indicate which limit switch is currently turned on. Bits 16 to 31 indicate which limit switches have been triggered since the last time the limit switch status was read. Use this to determine which limit switch triggered an error condition, even if the switch is no longer activated. Bits for the lower arm are in **bold type**. If you have a 4-axis system, the lower arm is t. If you have an 8-axis system, the lower arm is W.

Bit	Meaning when bit is set to 1
0	Robot positive theta
1	Robot positive radial
2	Robot positive Z
3	**Robot positive t (four-axis system)**
4	Pre-aligner positive theta
5	Pre-aligner positive radial
6	Pre-aligner positive Z
7	**Robot positive W axis (eight-axis system)**
8	Robot negative theta
9	Robot negative radial
10	Robot negative Z
11	**Robot negative t (four-axis system)**
12	Pre-aligner negative theta
13	Pre-aligner negative radial
14	Pre-aligner negative Z
15	**Robot negative W (eight-axis system)**
16	Robot positive theta triggered
17	Robot positive radial triggered
18	Robot positive Z triggered
19	**Robot positive t axis triggered (four-axis system)**
20	Pre-aligner positive theta triggered
21	Pre-aligner positive radial triggered
22	Pre-aligner positive Z triggered
23	**Robot positive W axis triggered (eight-axis system)**
24	Robot negative theta triggered
25	Robot negative radial triggered
26	Robot negative Z triggered
27	**Robot negative t axis triggered (four-axis system)**
28	Pre-aligner negative theta axis triggered
29	Pre-aligner negative radial axis triggered
30	Pre-aligner negative Z axis triggered
31	**Robot negative W axis triggered (eight-axis system)**

Adjusting the Vacuum Sensor

An SMC Series ZSE2-T1-15 vacuum sensor is installed in the lower arm link of the robot. The functioning range of this sensor is from 0 to –30 in. Hg (0 to 101592 Pa). The robot vacuum sensor is set for detecting silicon wafers at –15 in. Hg (50796 Pa). If you use a stronger or weaker vacuum supply, you can adjust the sensor as follows:

1. Remove the cover to the lower arm link by unscrewing the screws that attach the arm cover to the arm. The sensor has a yellow potentiometer with High (H) and Low (L) marked above it. You will need a small screwdriver to turn the potentiometer.
2. Connect the vacuum line.
3. Install the end effector.
4. Open the vacuum valve using the EQT interface or by entering a command. For a single end effector or the first end effector, enter: OUTP 0,0
5. Without a wafer on the end effector, turn the potentiometer counter-clockwise until the red LED lights. Consider this position A.



6. With a wafer on the end effector, turn the potentiometer clockwise until the LED is turned off. Consider this position B.
7. Turn the potentiometer to a position midway between position A and position B.
8. Turn off the vacuum to the end effector using the EQT interface or with the command: OUTP 0,1

Robot Control LED's

To test the connections, plug in the power cord. The LEDs on the face of the controller will light:

- A green LED on indicates the +5 VDC power supply is functioning.
- A yellow LED blinks to indicate the CPU is running.
- A red LED light indicates an error, such as servo motors are off, I/O board is not ready, or there is a system error.

Maintenance

A. Cleanroom Environment

Operation	Interval	Tech.Memo P/N
1. Lubricate Robot leadscrew and ballspline*	Five years	4000-0924
2. Replace the air filter on the Controller fan.	as required	4000-0919
3. Replace the vacuum hose in the arm links.	Three years	4000-0918

B. Non-Cleanroom Environment

Operation	Interval	Tech. Memo P/N
1. Replace the air filter on the Controller fan.	as required	4000-0919
2. Lubricate Robot leadscrew and ballspline.*	Once every five years	4000-0924
3. Blow out the vacuum system with nitrogen. Max PSI should not exceed 10 PSI.	Once every three years	
4. Replace the vacuum sensor and solenoid.	Once every five years	
5. Replace the vacuum hose in the arm links.	Three years	4000-0918
6. Check the integrity of the belts in the Robot. 4000-0920	Five years	

***Use cleanroom compatible lubricant such as Kuroda C-Type or NSK LG2.**

Scanner Fine Tuning

WARNING: Laser radiation emitted from the scanner could be hazardous. Do not view a laser beam directly. Laser beams can cause temporary or permanent damage to the eye.

Global Informations:

a) For a good mapping it is absolutly necessary, that the robot and the scanner are in the same level

b) If the difference between the up and the down scan is ot high or there is a detection of a wafer in one scan the Slot will be marked as invalid occupied, so the MXNT software will not use this slot. This means no wafer will be taken out and no wafer will be placed in this slot.

c) Syntax of the mapping macro

MAP <Statin>, <ErrorCode>,<Status>,(MappingStatusSlot1, MappingStatusSlot2,...)

Example

MAP 6 70000 1000 (3,1,1,1,1,1,3,3,3,3,3,1,1,1,1,1,1,1,1,1,1,3,1,3)

d) Mapping Status:

0 – not defined
1 – empty
2 – not empty
3 – correctly occupied
4 – double slotted or invalid
5 – cross slotted

e) Station File

For every Station are the following Parameters used by the mapping macro:

Scanning Coordinates	SPSC <Station>,<T>,<R>,<Z>
Pitch	PITCH <Station> , <Value>
R axis offset	SCSI <Station> , 0 , <Value>
T axis offset	SCSI <Station> , 1 , <Value>
CrossSlot high threshold	SCSI <Station> , 2 , <Value>
CrossSlot low threshold	SCSI <Station> , 3 , <Value>
CrossSlot high/low threshold	SCSI <Station> , 4 , <Value>
First slot Z-offset	SCSI <Station> , 5 , <Value>
internal Parameter	SCSI <Station> , 6 , <Value>
First Wafer Position error	SCSI <Station> , 7 , <Value>

Default Values for the SCSI are:

SCSI	0	1	2	3	4	5	6	7
Value	50	250	75	30	30	(*)	(*)	(*)

You can set each Station to default setting by using the command **DCSI2 <Station>**

You can also try a scanning with alternative settings, thefore you can set the parameters with the command **DCSI <Station>**

Problem: The Scanner detect an invalid Wafer above occupied slots (in empty slots)

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Status	3	4	1	1	1	1	3	3	3	3	3	4	1	1	1	1	1	1	1	1	1	1	3	4	3

Possible Cause The teaching is to high

Proposal for Solution
Upload the Station Coordinates, decrease the Z-Coordinate of the Scanning by 50 steps, download the station coordinates and try again

If the result is the same decreease the Z-Coordinate of the Scanning by 100 steps download the station coordinates and try again

Possible Cause The difference between up and downscan is to high

Proposal for Solution

Increase the SCSI 1 Value
Decrease the SCSI 2 Value

Problem: The scanner detect an invalid wafer under occupied slots (in empty slots)

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Status	3	1	1	1	1	4	3	3	3	3	3	1	1	1	1	1	1	1	1	1	1	4	3	4	3

Possible Cause The teaching is to low

Proposal for Solution
Upload the Station Coordinates, increase the Z-Coordinate of the Scanning by 50 steps and try again
If the result is the same decreease the Z-Coordinate of the Scanning by 100 steps download the station coordinates and try again

Possible Cause The difference between up and downscan is to high

Proposal for Solution

Increase the SCSI 1 Value
Decrease the SCSI 3 Value

Problem: The scanner detect an invalid wafer in occupied slots

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Status	3	1	1	1	1	1	4	4	3	3	3	1	1	1	1	1	1	1	1	1	1	1	3	1	3

Possible Cause The difference between up and downscan is to high

Proposal for Solution

Increase the SCSI 1 Value
Decrease the SCSI 2 Value
Decrease the SCSI 3 Value
Decrease the SCSI 4 Value