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AUTOMATIC WAFER PROBER
OPERATION AND MAINTENANCE
MANUAL

Document No. A-100171-D



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Model 1034X Operation and Maintenance Manual
Model 1034X Basic Reference Drawing Manual
Model 1034X Card Cage Wire List

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MODEL 1134XT
AUTOMATIC WAFER PROBER
OPERATION AND MAINTENANCE MANUAL
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NOTE

The Model 1134XT Automatic Wafer Prober uses the same Operation and Maintenance Manual as the Model 1034X. Therefore, the Manual included under this cover is the Model 1034X Operation and Maintenance Manual, and all references to the Automatic Wafer Prober are designated Model 1034X.

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SECTION 1

GENERAL INFORMATION

1-0 INTRODUCTION

This technical manual contains the information necessary to install, operate, and maintain the ELECTROGLAS 1034X Automatic Wafer Prober. It is written to the level of an operator who is trained or experienced in the operation of electronically controlled electro-mechanical equipment and the maintenance technician qualified for servicing similar systems.

1-1 SYSTEM DESCRIPTION

The ELECTROGLAS Model 1034X Automatic Wafer Prober (Figure 1-1) is a precision instrument for testing and classifying semiconductor devices in wafer form. The Model 1034X is a self-contained system comprising two modules, a prober module and a power module. Both modules are designed for compact bench-top mounting; however, an interconnecting cable permits remote mounting of the power module when desired.

The 1034X is designed for operational simplicity and fast wafer throughput. The unique ELECTROGLAS/XYNETICS solid-state high-speed X-Y Positioning System permits simplified wafer loading and unloading outside the probe ring area with high-speed travel to and from the load position. Simplified manual and semi-automatic controls assure rapid wafer alignment by automatic gross positioning, simplified theta alignment, and precise device alignment by use of a multi-function joystick that provides 20 different manual commands in a single control. The high-speed automatic probing cycle provides automatic indexing, probing and inking of all devices on the wafer under preprogrammed indexing control, and automatic return to the load position when probing is complete. The system accommodates up to 4-inch (102 mm) wafers and provides indexing in either English or metric system units.

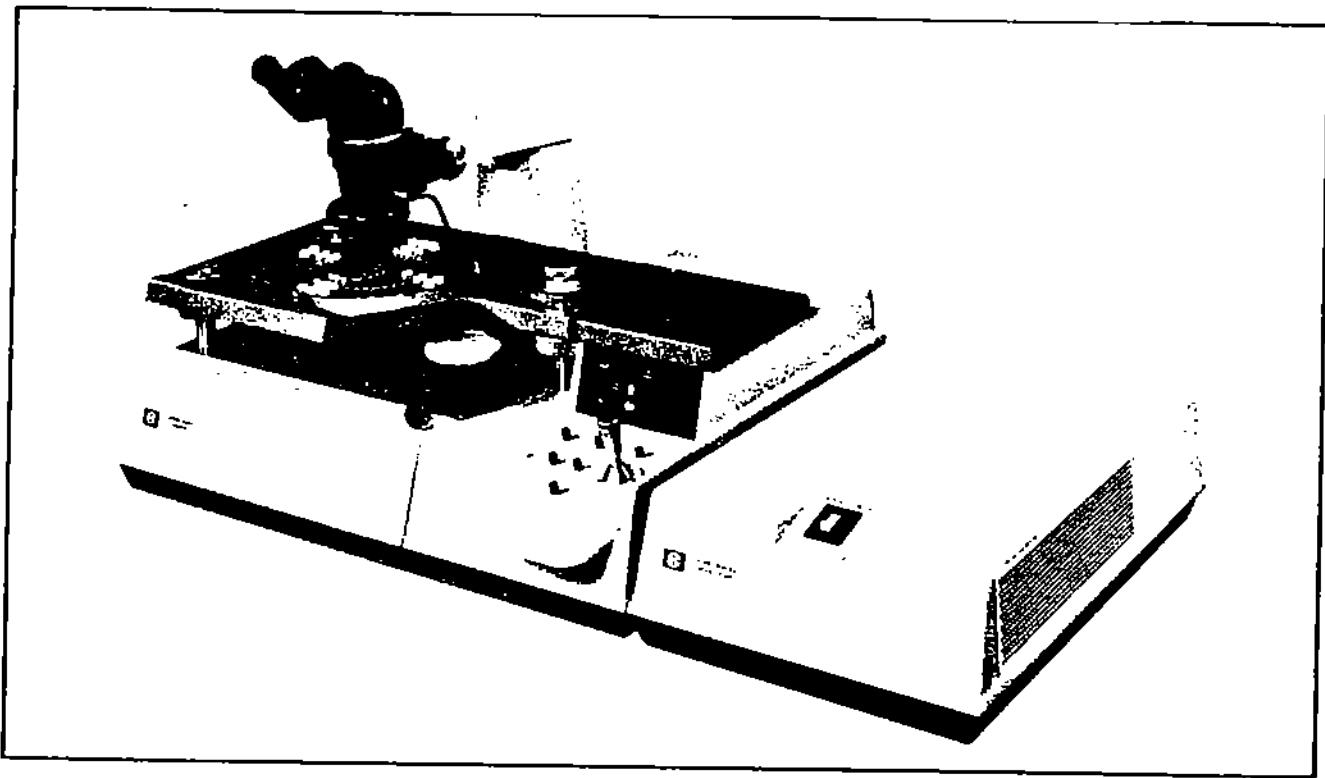


Figure 1-1. Model 1034X Wafer Prober System

1-2 MAJOR COMPONENTS

All of the 1034X major components, except the power module, are contained in the functionally designed prober module.

1-3 X-Y POSITIONING SYSTEM

The XYNETICS/ELECTROGLAS X-Y Positioning System is a dual-axis linear positioning system comprising a stationary ferromagnetic platen and a movable X-Y positioner that glides over the platen on a thin cushion of air. The positioner is a rectangular platform containing single-axis linear motors, an air-bearing suspension system, and mounting connections for the chuck that is installed on the positioner. Positioner motion may occur simultaneously on both the X and Y axes, but is individually controlled on each axis. Travel distance may be selected in either English or Metric units. (Figure 1-2)

1-4 CHUCK ASSEMBLY

The chuck assembly is the electro-mechanical mechanism that supports the wafer to be probed. The chuck assembly is mounted on the positioner of the X-Y Positioning System. Any one of various chuck options may be furnished with the 1034X as shown in the Chuck Configuration Chart on the Prober Base Assembly Drawing (D-100339). All chucks provide for positioning of the wafer, which is carried on the chuck top and held in place by vacuum control, on both the Z axis (up and down chuck travel) and the theta axis (chuck top rotation on the horizontal plane). Some of the choices of features offered by the various chuck options are:

- o Standard (pneumatic) or high-speed Z drive
- o Manual or electrical theta drive
- o Fixed or compensating Z travel

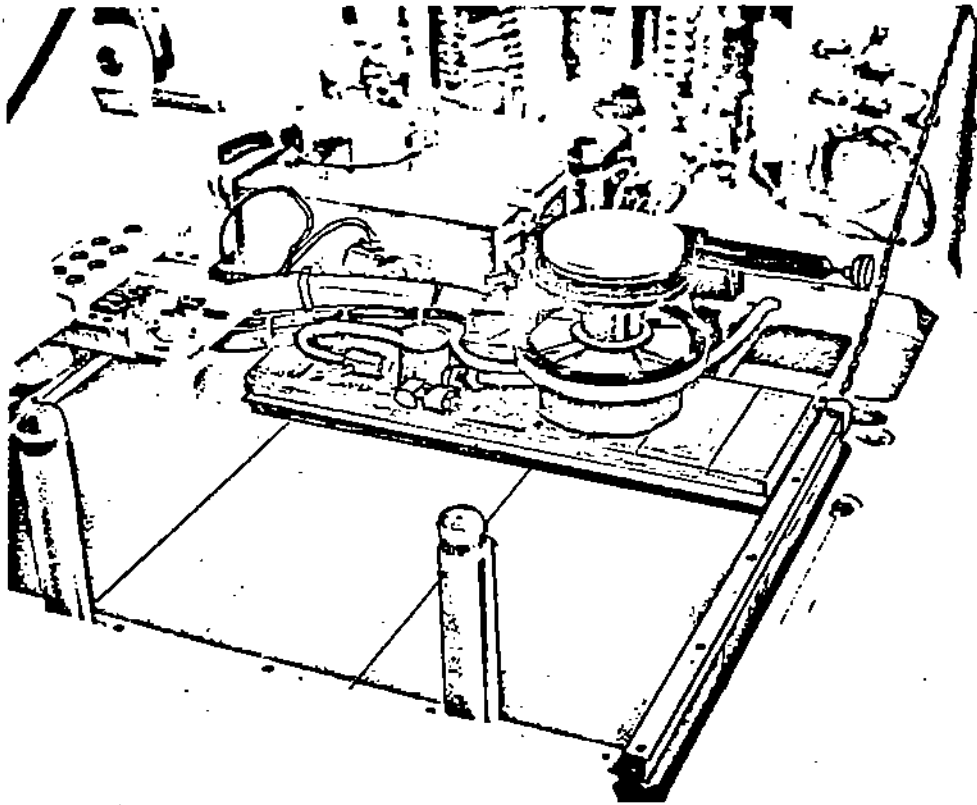


Figure 1-2. The Positioner at Home (Load Position)

1-5 Theta Drive

When the chuck option furnished includes the electrical theta drive, the Operator Panel includes a paddle switch designated θ DRIVE that is used to control theta motion. When the chuck option includes manual theta drive, theta motion is controlled by manually rotating a knurled knob on the chuck assembly. (Figure 1-3).

1-6 Programmable Chuck

The Model 1034X Programmable Chuck (PRG) options permit the preprogramming of Z-axis overtravel after probe tip-to-wafer contact for accurate probe pressure and scrub-factor control. Overdrive after contact with the wafer is controlled by selecting the number of steps desired by the positioning of DIP switches mounted on the Adaptive Z Control printed circuit board (PCB).

1-7 RING CARRIER ASSEMBLY

The Ring Carrier Assembly is an oversized plate (with extra room for special test circuitry) suspended on three precision alignment posts. The Ring Carrier incorporates quick-release knobs for instant accessibility. The Ring Assembly is used to mount the adjustable probe ring inserts, fixed-point probe card inserts, or special test heads.

1-8 MICROSCOPE POST ASSEMBLY

The Microscope Post Assembly provides the mounting capabilities for the desired optical system to permit either manual or video viewing of the probe tips and wafer in the probing area.

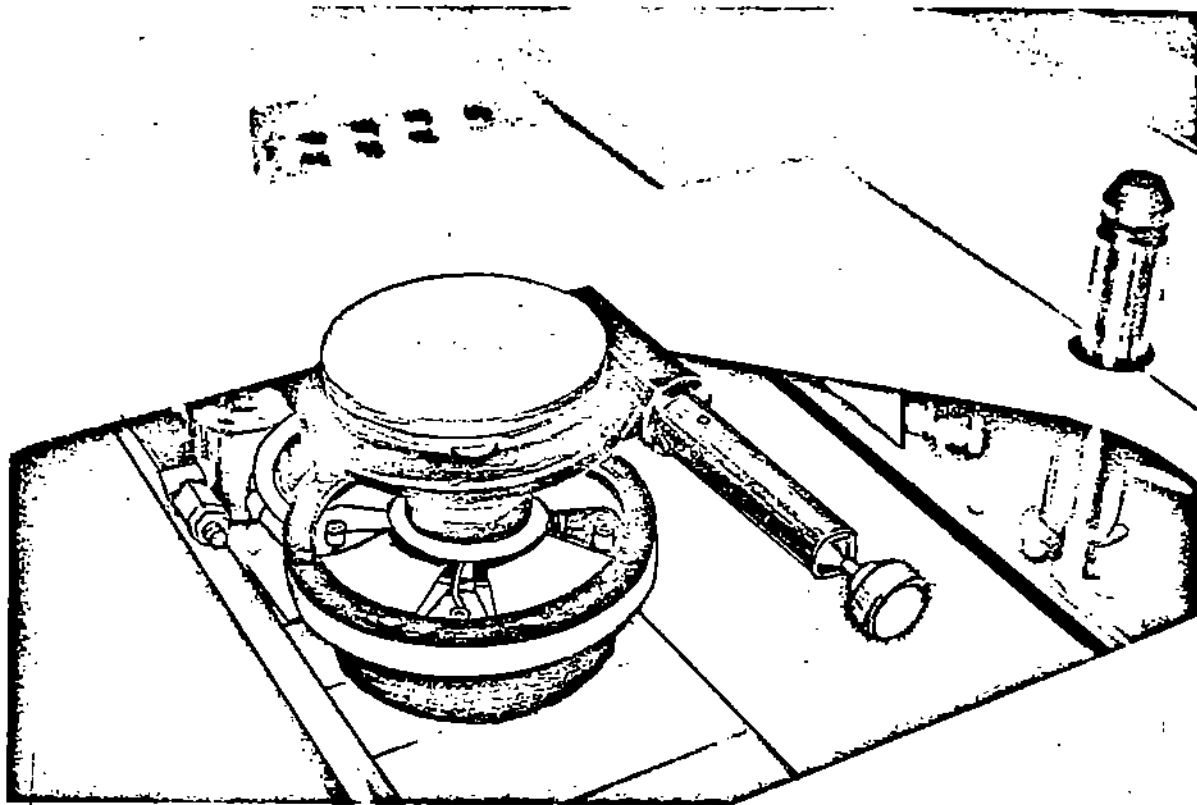


Figure 1-3. Theta Control

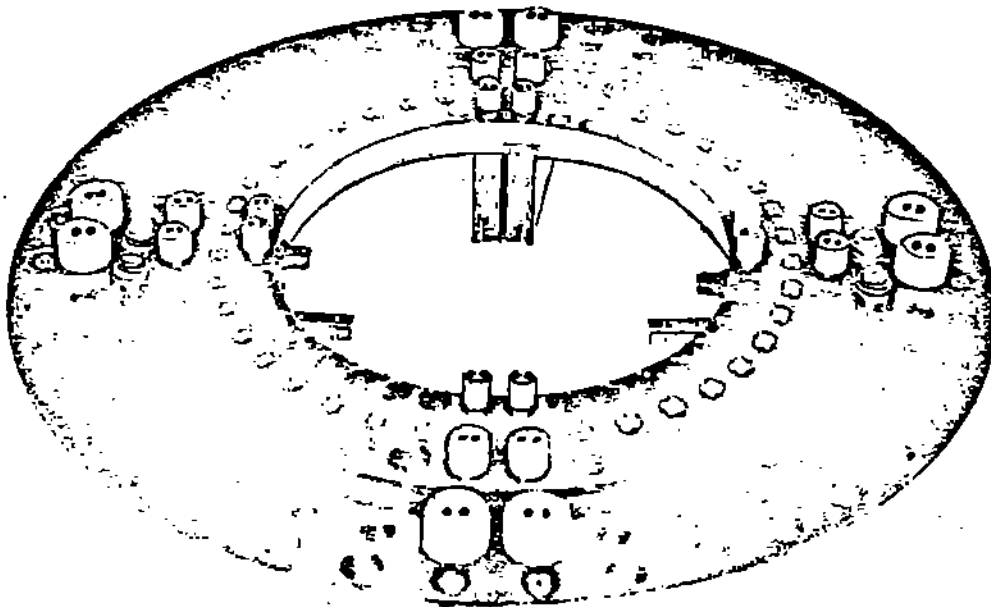


Figure 1-4. RI-40 Probe Ring Insert

1-9 CONTROLS AND INDICATORS

The 1034X controls and indicators are functionally grouped for simplified operation. An Operator Panel contains the multi-function joystick and the controls used for semi-automatic operation. A covered subpanel contains index programming digit switches and special-function controls. An indicator panel continuously displays current command status of the control logic. The system Main POWER switch is mounted on the Power Module. An Interface Connector Panel contains the positioner REALIGN pushbutton and all control and power interface connectors. The EXTERNAL I/F connector provides the interface for external control of the 1034X.

1-10 CONTROL ELECTRONICS

The 1034X control logic is contained on eight PCB's mounted in the Prober Base Card Cage Assembly. The entire right side of the prober module is hinged to swing completely clear of interior components to provide access to the card cage. The card cage assembly is easily removable with a screw driver.

1-11 POWER MODULE

The Power Module contains the system power supplies and the X-Y Positioning System drive components. These drive components consist of the high-voltage, constant-current power supplies for X-Y Positioning System operation and the digital-to-analog resolvers that convert the logic level stepping pulses that command stepping action on the X and Y axes into the drive currents necessary to accomplish the commanded motion.

1-12 SPECIFICATIONS

Table 1-1 is a list of Model 1034X specifications and other important ready-reference data.

Table 1-1. Specifications and Ready-Reference Data

Bench Space Dimensions

Prober Module	30" wide and 24" deep (762 mm x 610 mm), plus additional 10" (254 mm) side clearance for hinged cover opening
Power Module	15" wide and 24" deep (381 mm x 610 mm), plus additional 10" (254 mm) side clearance for opening hinged cover. (Connecting cable permits up to 8' vertical clearance between modules).

Shipping Information

Prober Module	Shipped in single carton, 38" x 30" x 21", (96.5 cm x 76.2 cm x 53.3 cm), weighing 185 lbs. (83 kg) approx
Power Module	Shipped in single carton, 30" x 21" x 12", (76.2 cm x 53.3 cm x 30.5 cm), weighing 60 lbs (27.2 kg) approx

Required Utilities

Electrical	110V/220V AC, 1-phase, 50/60 hz (1 kw maximum)
Air	2.5 cfm (0.07 m ³ /min) at 85 psi (5.95 kg/cm ²), filtered to 5 micron maximum, free from water and contaminants
Vacuum	18" to 25" (45.7 cm 63.5 cm) Hg

X-Y Positioning System

Travel Range	5.0 inches (127 mm) total during probing operation plus 5.0 inches additional travel to and from Load position
Travel Speed	5.0 inches (127 mm) per second (10,000 steps per second)
Acceleration	1 G
Index Range	English units selected: 0.0005" to 4.9995" with 0.0005" resolution Metric units selected: 0.005 mm to 99.95 mm with 0.005 mm resolution

Table 1-1. Specifications and Ready-Reference Data (Continued)

Accuracy	±.0005 in probe area
Repeatability	±0.0001" (±0.003 mm)
Minimum Resolution (Jog step)	0.00025" (English selection); 0.005 mm (Metric selection)

Inker Capacity

Control connectors for 6 inkers

- 2 in place
- 2 delayed by one
- 2 delayed by two

Edge Sense

One connector

Isolated available

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SECTION 2

INSTALLATION

2-0 GENERAL REQUIREMENTS

This section contains the procedures necessary to unpack the Model 1034X system and prepare it for initial operation. The Model 1034X has been tested for performance standards prior to shipment.

2-1 INSPECTION AND UNPACKING

The Model 1034X system is shipped in three separately packaged units consisting of (1) the mechanical systems, (2) the Power and Control Module, and (3) accessories. Upon receipt of the Model 1034X, the shipping containers should be inspected for damage or evidence of rough handling and any discrepancies reported immediately to the carrier and ELECTROGLAS, INC.

2-2 MECHANICAL SYSTEMS

The following steps are recommended for unpacking the shipping container containing the mechanical systems. (Figure 2-1)

1. Verify the container is rightside up.
2. Remove all bands from container.
3. Open top of container and remove cable assemblies, the operator's hand rest, and documentation from their cavity in the protective packing foam.
4. Remove the top packing foam.

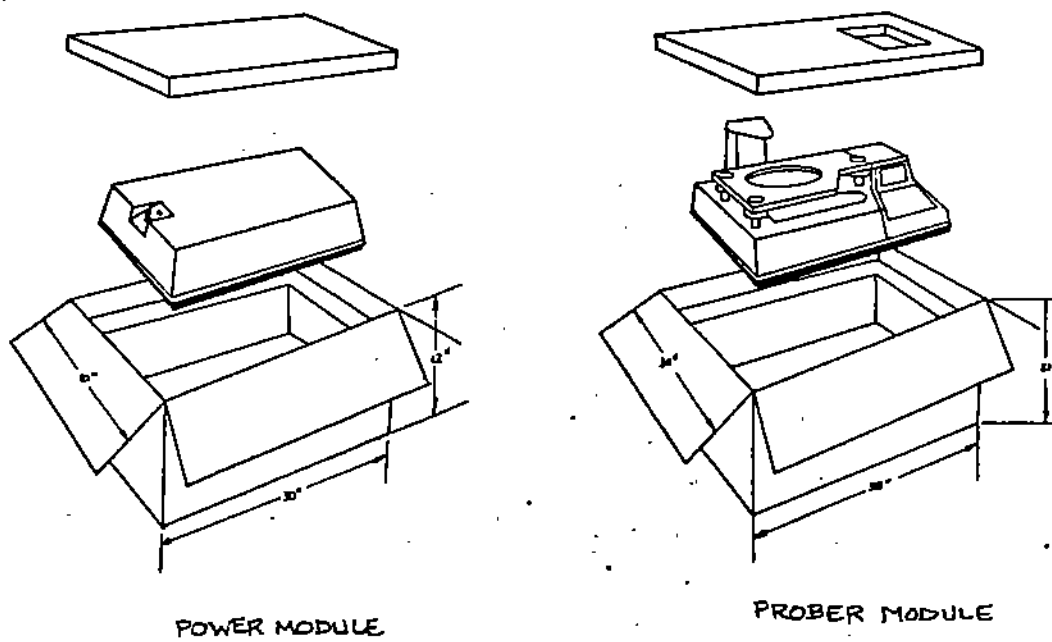


Figure 2-1. Unpacking the Prober Module

CAUTION

Do not attempt to remove X-Y Positioner Assembly from platen of Prober Base Assembly until directed to do so during installation procedure. (Paragraph 2-10).

5. Using two or more men, lift the Prober from its container by reaching through the handhold cutouts in the protective packing and firmly gripping the bottom of the base casting. Do not apply lifting force to any part of the Prober other than the base casting.
6. Verify the completeness of shipment against packing list.
7. Verify all contact pads are in their appropriate place on the Prober table.
8. Install Prober Main Assembly on Prober table.
9. Remove all plastic wrappings and tape.
10. Verify that all connectors and PCB's are in place and firmly seated in their respective receptacles.

2-3 POWER MODULE CONTAINER

The following steps are recommended for unpacking the Power Module.

1. Verify container is in upright position.
2. Open lid and remove top packing foam.
3. Remove cables.
4. Using two men, lift the Power Module from the container and place it adjacent to the Prober Module.

NOTE

The Power Module weighs approximately
85 lbs.

5. Remove all plastic wrappings and tape.
6. Check off all items against packing list.
7. Open cover and verify that all assemblies are secure and that PCB's are properly seated in their respective receptacles.

2-4 ACCESSORIES CONTAINER

The following steps are recommended for unpacking the Accessories.

CAUTION

Handle Accessories with the care afforded
all fine instruments.

1. Verify container is in upright position.
2. Open lid and remove top packing foam.
3. Remove individual cartons containing Accessories, unpacking each and checking off all items against packing list.

2-5 MECHANICAL INSTALLATION

Mechanical installation includes assembling and mounting the Model 1034X major assemblies in a suitable area accessible to the required utility connections.

2-6 SITE SELECTION

CAUTION

Wafers and prober elements such as probes, inkers, and microscopes are easily damaged. Appropriate bench and storage provisions should be provided.

The Model 1034X requires no special environmental considerations beyond those required for wafer testing and the test equipment used for such testing. The site must be firm and vibration-free. The Prober assembly must be mounted on a bench or table equivalent to the ELECTROGLAS Probe Table Assembly designed for the Model 1034X. The Power Module may be mounted adjacent to the Prober assembly or remotely mounted within the radius permitted by the interconnecting cable assemblies. The utility connections required at the site for Model 1034X operation are listed in Table 1-1. Ventilation should be provided for the Power Module for cooling purposes.

2-7 EQUIPMENT MOUNTING

Assemble and mount the Model 1034X in the following order:

1. Position Model 1034X on equipment table.
2. Position Power Module in convenient location.

2-8 INTERCONNECTING CABLES

Connector panels are located at the back of both the power module and the prober module on the 1034X Prober. (Figure 2-2). Figure 2-3 illustrates the interconnections between the prober module, the power module, the power supply, the external tester, and the auxiliary equipment.

CAUTION

Cables should be installed at appropriate connectors so that no tension or side loads exist on the connectors.

Connecting cables should be installed at the appropriate connection points on the rear panels and should be connected and disconnected several times to insure a clean contact. Table 2-1 identifies the connector pins and indicates their functions. (Figure 2-3).

NOTE

If external control option is not being used, the supplied jumper plug must be connected to J9.

Table 2-1. 1034X Prober Module and Power Module Connector Pins

PIN	DESCRIPTION
<u>Prober Module:</u>	
J1	TESTER INTERFACE; 24-pin Amphenol, female; External Tester Connector.
J2	LOGIC; 24-pin Deutsch, female; Power Signal Interface for J1 of Power Module (X-Y Logic).
J3	MOTOR POWER; 24-pin Deutsch, male; Power Signal Interface for J2 of Power Module (X-Y Power).
J4	AUXILIARY EQUIPMENT; 19-pin Deutsch, male; provides access to some internal signals for optional equipment.
J5	Special AC Power Cord: provides AC power to Prober Base from J3 of Power Module (Switched AC Power).
J6	Auxiliary power connector.
J7	Microscope Illuminator Connector.
J17	24-pin Amphenol: interconnects all DC power between Prober Module and Power Module (J5); 5V logic and ground, 60V, 12V and Power Ground.
J9	EXTERNAL INTERFACE; One 75-pin Winchester connector:
<u>Power Module:</u>	
J1, J2, J5, J3	See Prober Module Connector Pins above.
AC POWER IN	AC power line cord; connected to a 115V AC, 60 Hz source.

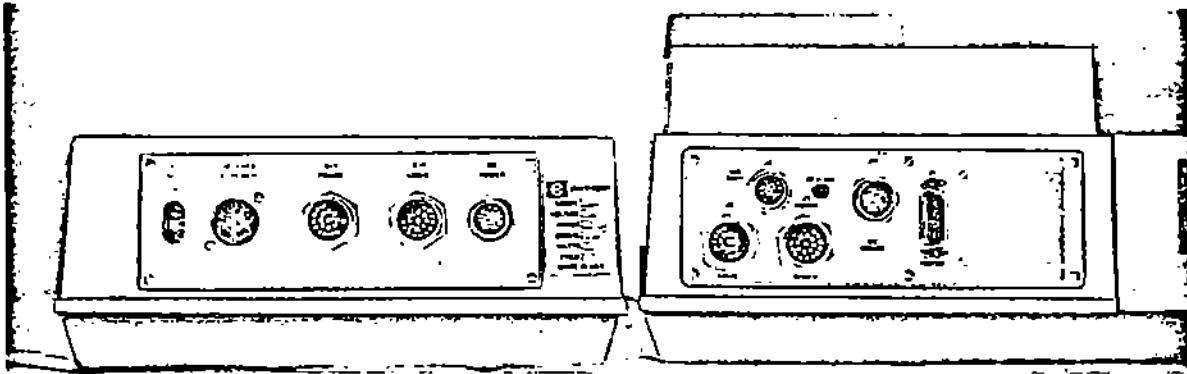


Figure 2-2. Rear Connectors

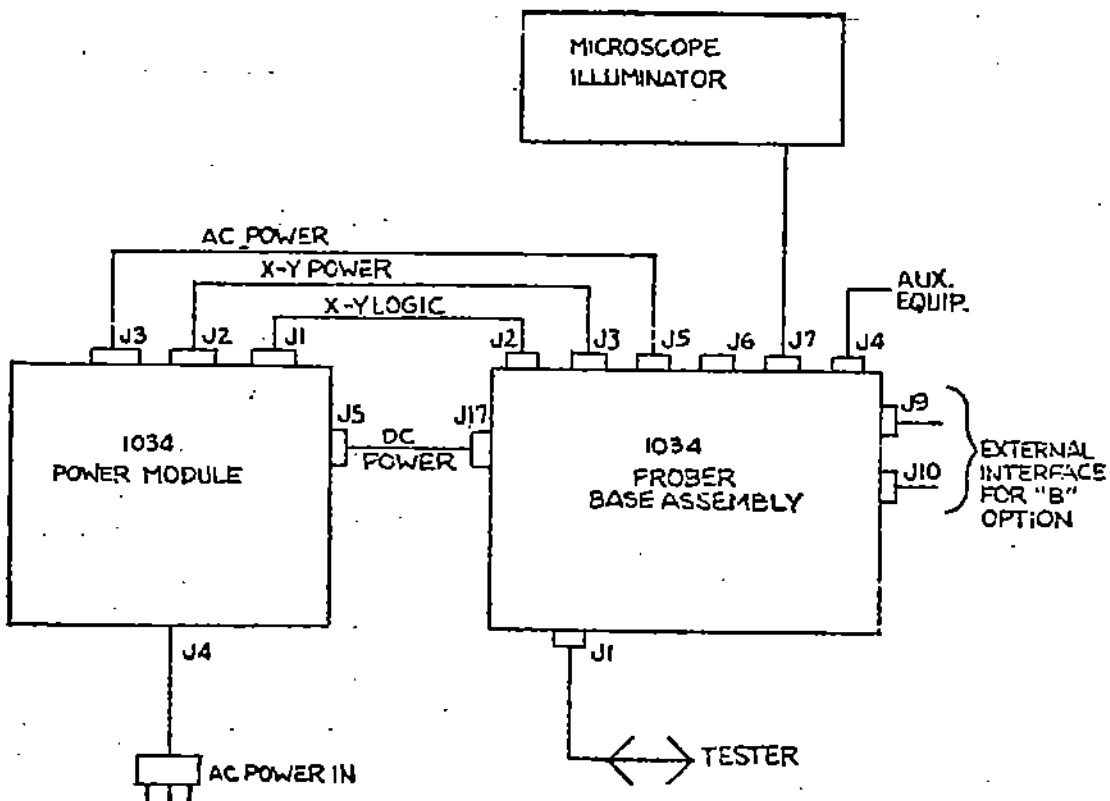


Figure 2-3. Interconnection Diagram

2-9 UTILITY CONNECTIONS

The following steps must be performed to connect and adjust utility inputs.

1. Connect tubing from the specified air pressure supply. (Refer to Table 1-1.)
2. Connect tubing from the specified vacuum source to the Pneumatic Control Assembly VACUUM connector.
3. Adjust control knob, if furnished, to obtain specified gauge indication (85 PSI on gauge on input regulator).
4. Connect AC Power Input Cable to Power Module Rear Panel Assembly (Connector J4), and connect AC plug at other end to specified AC power outlet (Figure 2-3; Table 2-1).

2-10 POSITIONING SYSTEM PREPARATION

A protective paper cover is placed between the X-Y Positioner and the platen to protect the platen during shipment. When the system is in the power-off condition, permanent magnets in the Positioner hold the Positioner against the platen with a force of approximately 150 pounds. When the air pressure is applied to the system, the Positioner air bearing provides an opposing force that causes the Positioner to "float" above the platen. The following steps should be performed to remove the protective paper covering from the platen.

CAUTION

Air pressure should always be applied when performing the procedure required to remove the Positioner from the platen to avoid the possibility of damage to the platen.

1. Loosen the three locking collars on Ring Carrier.
2. Remove the ring carrier assembly by lifting it from its supporting posts.

3. Open righthand cover.
4. Remove lefthand cover by lifting at lower edge on front or left side. Prober should now appear as shown in Figure 2-4.

NOTE

Lefthand cover is held in place with a
detent force of approximately 20 lbs.

5. Verify that pressurized air supply is connected to AIR input connector as directed in Paragraph 2-9, Step 1.
6. Verify that pneumatic control panel air pressure gauge indicates approximately 85 psi.
7. Insert motor-lifting lever under center of positioner lip. (Figure 2-5)

WARNING

Always raise and lower positioner with a
rolling, or hinge-type motion, using care
not to place fingers between underside of
positioner and platen to avoid injury to
fingers.

8. Apply leverage and tilt positioner upward and toward rear as increasing gap dimension relieves magnetic force between positioner and platen.
9. Remove protective paper cover from platen.
10. Clean platen using instructions in Paragraph 6-2.
11. Stand positioner on its left edge and position lifting lever at center of X-Y motor, under lip edge of motor.
12. Tilt positioner and lifting lever downward and use reverse lever action to bring positioner bottom into contact with platen surface.
13. Remove protective pad from wafer chuck.
14. Remove the two screws in front of righthand cover and install operator's handrest.
15. Replace lefthand cover and close righthand cover.

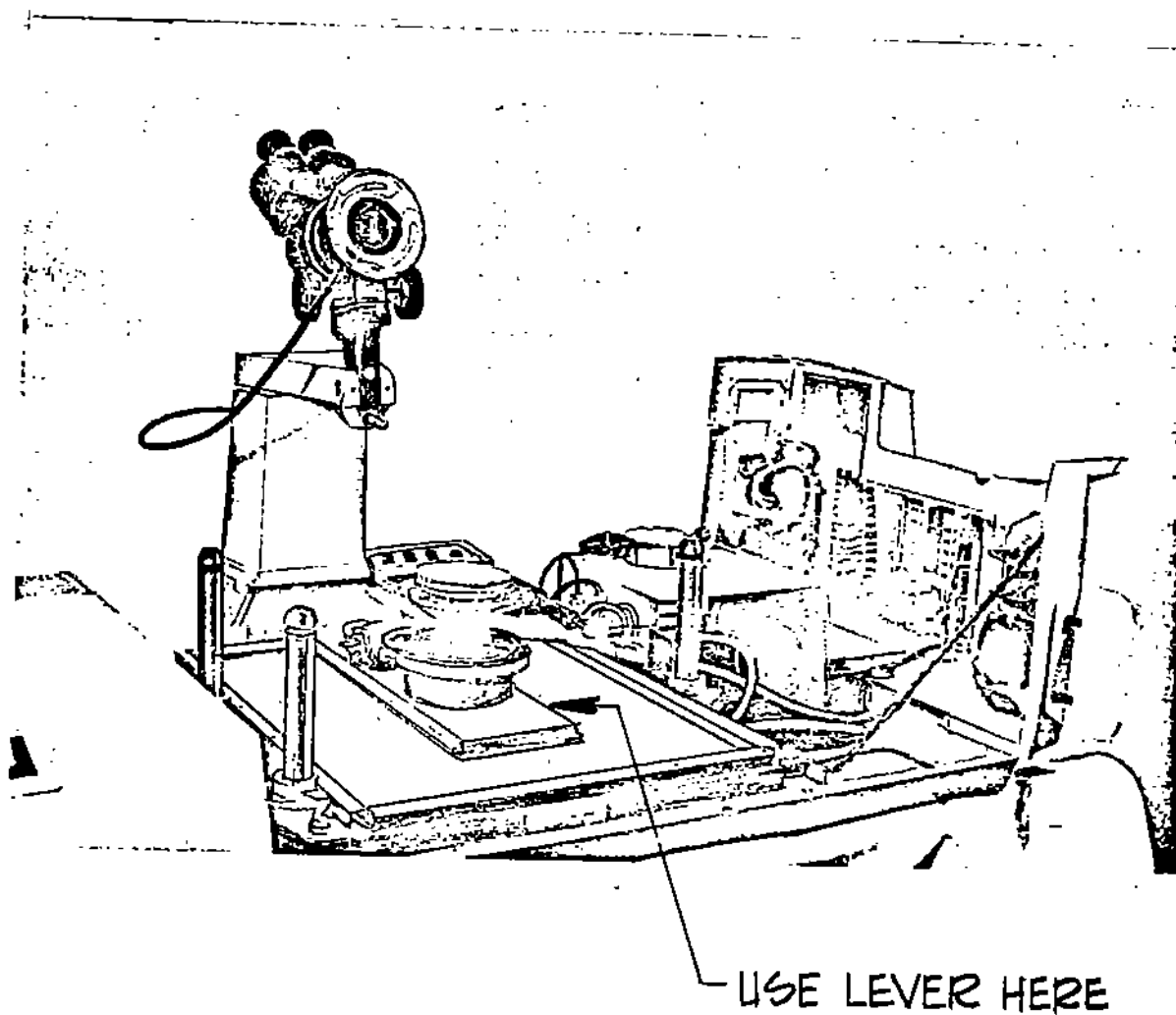


Figure 2-4. Prober with Cover Open

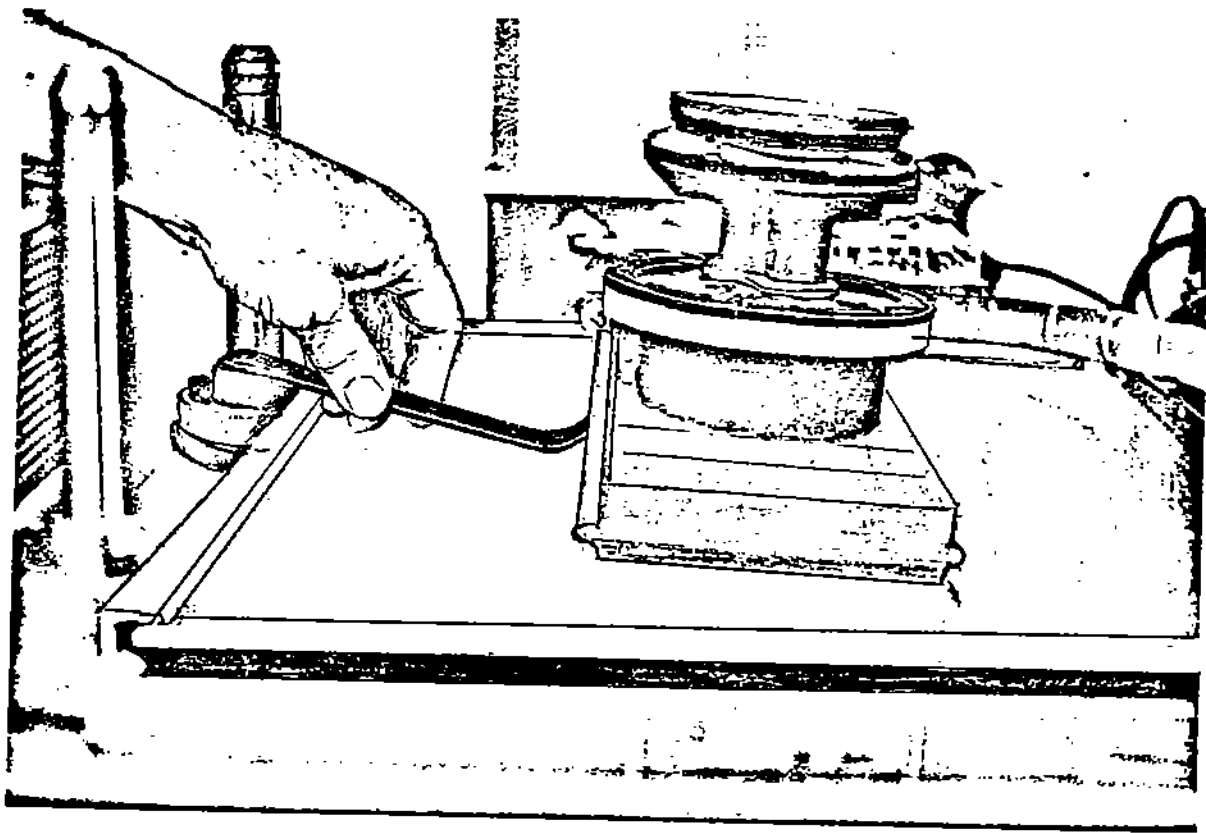


Figure 2-5. Lifting the Positioner

15. Replace Ring Carrier Assembly and tighten locking collars.

2-11 MICROSCOPE ASSEMBLY INSTALLATION

Various microscope assemblies may be furnished according to the purchase order; therefore, the installation procedure varies according to the particular microscope. In general, the microscope body is supported by a ring assembly with adjustment knobs and mechanism. The ring assembly either mates with or is an integral part of a bonder adapter that must be attached to the Model 1034X Microscope Arm Assembly by the microscope shaft which acts as a pivot to permit the microscope assembly to be rotated upward 90 degrees from the normal viewing position. If the bonder adapter is not an integral part of the ring assembly, it is factory-mounted on the microscope arm assembly. The microscope body may or may not already be mounted in the ring assembly. The following general steps are required to install the microscope assembly.

1. Remove microscope, illuminator, eye-pieces, and eye-guards from their shipping containers.
2. If a bonder adapter is not installed on the Microscope Arm Assembly, loosen set screws in microscope arm and remove microscope shaft, insert adapter on ring assembly into arm, insert microscope shaft through arm and adapter, and tighten both set screws.
3. If bonder adapter is factory-installed on Microscope Arm Assembly, mount ring assembly on bonder adapter and tighten thumb screw on underside of adapter.
4. If microscope body is not already installed in ring assembly, loosen thumb screw in ring assembly, install microscope body in ring, and tighten thumb screw.

NOTE

Some microscopes have a lens protector that must be unscrewed and removed prior to installing microscope body in ring assembly and then screwed back on when installation is complete.

5. Remove foam pad from between the eye-piece housings.
6. Rotate microscope assembly upward 90 degrees to view underside of microscope and unscrew objective lens or illuminator mounting nut, depending on type of microscope, to remove lens or nut.
7. Position illuminator assembly on bottom of microscope, with cable connection facing downward, and reinstall objective lens or mounting nut so it holds illuminator assembly in position.
8. Remove dust covers from microscope.
9. Install eye-pieces and guards.

CAUTION

Be sure power is off before connecting illuminator.

10. Set microscope illuminator switch on Operator Control Panel to OFF.
11. Plug illuminator cable plug into connector J7 on back of microscope post.

2-12 SYSTEM OPERATIONAL CHECKOUT

Before proceeding with the installation of the Ring Carrier Assembly and planarization procedures, the system should be checked for proper operation of all motion controls. This procedure consists of performing the Power On procedure in Section 3 and then individually actuating all of the control switches on the Operator Control Panel and, if furnished with the Motorized Theta Option, the Theta Control Switch (CW & CCW) on the Setup Control Panel,

to verify the designated operations occur as described in Section 3, Description of Controls and Indicators.

2-13 RING CARRIER ASSEMBLY

The Ring Carrier Assembly may contain the probe and inker holding arms or a Rucker and Kolls fixed-point probe-card adaptor. The assembly must be installed and locked in place with locking collars. The assembly is factory-set to be parallel to the chuck top within ± 0.0005 inches when the Micrometer Adjustment Knob is set at zero. The probe and inker holding arms are factory-set for maximum clearance above the chuck. The types of wafers under test and the type of tests determine the number and type of probes and inkers.

2-14 RING CARRIER INSTALLATION

The following steps are used to install the Ring Carrier Assembly.

1. Rotate all three locking collars, on underside of ring carrier, fully counterclockwise.
2. Position Ring Carrier Assembly so post holes are aligned with posts, and lower assembly onto posts.
3. Carefully rotate each locking collar clockwise until first indication of locking is felt; then, sequentially tighten each collar further until all three collars are firmly locked.

2-15 PROBE, INKER, AND EDGE SENSOR PLANARIZATION

The following steps are used to planarize the probes, inkers and edge sensor on the Standard Model 1034X.

1. Connect probes, inkers and edge sensor to their respective electrical connectors.
2. Set vacuum to OFF.
3. Place planarizing disc on chuck.
4. Set vacuum to ON.
5. Set joystick in Jog Mode.
6. Send positioner into Align Mode.

7. When chuck is centered under probe ring, press STOP pushbutton switch.
8. Use following steps to planarize probes.
 - a. Send chuck to Z UP position.
 - b. Connect ohmmeter, or any suitable signal-producing instrument, between J1-16 connector (chuck ground) and individual probes.
 - c. Using arm vertical adjustment, lower each probe until minimum contact is made with disc.
9. Use following steps to planarize edge sensor.
 - a. Verify chuck is in Z UP position.
 - b. While observing "On Wafer" signal on Display Panel, use sensor arm adjustment to lower sensor until minimum contact is made with disc.
10. Use following steps to planarize inkers.

NOTE

Several factors influence optimum dot size. These include ink characteristics, inker tip clearance above contact surface, pulse duration, and, when used, air pressure. Note that inker test control is only active for Inker 1 connector. It is necessary to use this connector for each inker while adjusting for dot size.

- a. Set chuck at Z UP position.
- b. Using pen holder height adjustment, lower non-activated pen tip to approximately .035 inch above planarizing disc.
- c. While observing through microscope,, activate inker-test control, and verify that plunger extends to just touch disc and retract.
- d. If no dot appears, lower tip a few thousandths of an inch and activate inker test control again.

- e. If an unsatisfactory dot appears, jog positioner to new spot on disc, adjust inker, and activate inker-test control again.
 - f. Repeat Steps d and e until desired dot is obtained.
 - g. Repeat Steps b through f for each inker.
 - h. Connect each inker to its desired channel for automatic cycling.
- 11. Verify probes, sensor, and inkers have their respective contact points parallel to chuck surface within approximately .0005 inch.
 - 12. Remove planarizing instrumentation.

The following steps are used to planarize the probes, inkers, and edge sensor on the Model 1034X with a Programmable Chuck.

- 1. Perform 1034X Power On procedure (Section 3, paragraph 3-12) and verify positioner is at Load position.
- 2. Install probe card in Ring Carrier Assembly.
- 3. Loosen Ring Carrier Assembly locking collar, on righthand Base Assembly Post on underside of ring carrier below height adjustment knob, to permit full height adjustment travel.
- 4. Rotate height adjustment knob to raise ring carrier to fully Up position and move locking collar handle to locked position.
- 5. Install planarization disc (or wafer) on chuck.
- 6. Set VACUUM switch to VACUUM (On).
- 7. Press REALIGN pushbutton on interface connector panel to release positioner for manual movement.
- 8. Moving positioner by hand, carefully guide chuck toward probe tips under ring carrier and visually check clearance between probe tips and planarization disc, or wafer.
 - a. If clearance appears insufficient to move chuck under probe tips without making contact, adjust probe card holder to provide greater clearance.
 - b. When clearance appears adequate, carefully move positioner until chuck is under probes and verify appropriate clearance.

9. Manually return positioner to Home position and perform Realignment procedure.
10. Press ALIGN pushbutton to initiate align operation and press STOP pushbutton to stop positioner when chuck is approximately centered under probes.
11. Press Z DRIVE pushbutton and verify Z UP indicator is lit.
12. Unlock ring carrier height adjustment knob locking collar, and while observing display panel, rotate height adjustment knob to lower Ring Carrier Assembly until ON WAFER indicator lights.
13. Press Z DRIVE pushbutton and verify Z DOWN indicator is lit.
14. Rotate ring carrier height adjustment knob to lower ring carrier an additional 15 mils and move locking collar handle to locked position.
15. Tighten Ring Carrier Assembly locking collar on righthand post.
16. Press LOAD pushbutton to terminate procedure.

2-16 CHECKOUT PROCEDURES

After the Probe, Inker, and Edge Sensor Planarization are complete (Paragraph 2-15), the system is ready for an initial checkout procedure. The following steps are used to perform the checkout procedure.

1. Use the following steps to perform the Vacuum Interlock checkout procedure.
 - a. Press ALIGN START pushbutton and verify that positioner does not move.
 - b. Verify Status Display Panel agrees with Figure 2-6.

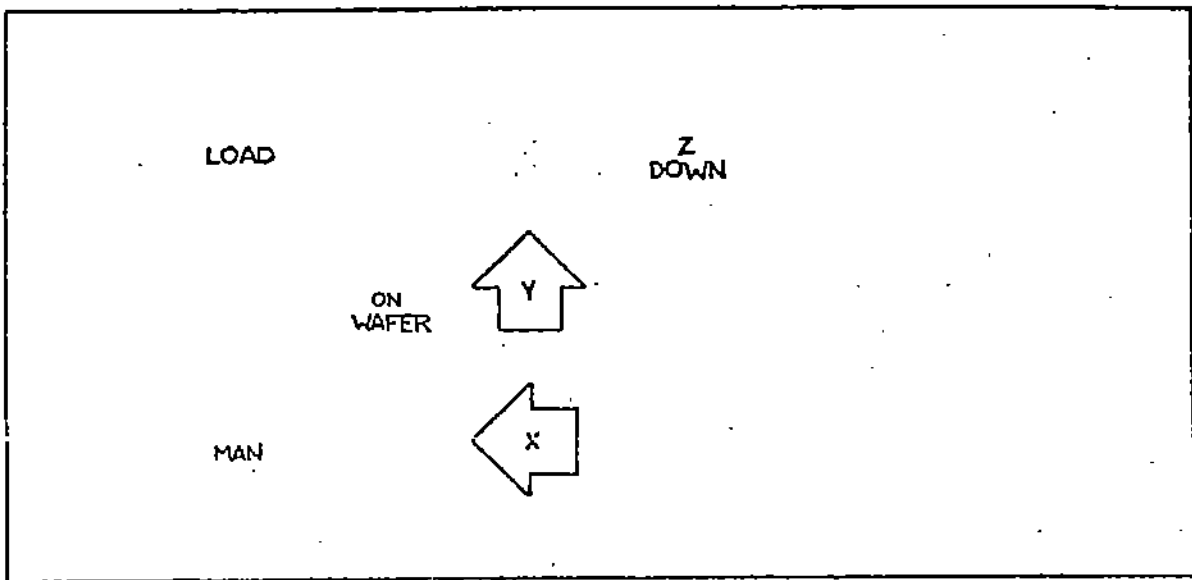


Figure 2-6. Display Panel

2. Use the following steps to perform the Align Mode checkout procedure.
 - a. Set VACUUM control switch to ON.
 - b. Press ALIGN START pushbutton to ON.
 - c. Verify positioner moves to focal center of ring carrier and cycles in X axis at a stroke of approximately 2 inches.
 - d. Verify Status Display Panel agrees with Figure 2-7.
 - e. Rotate ALIGN SPEED selector and verify speed increases from position 1 through position 3.

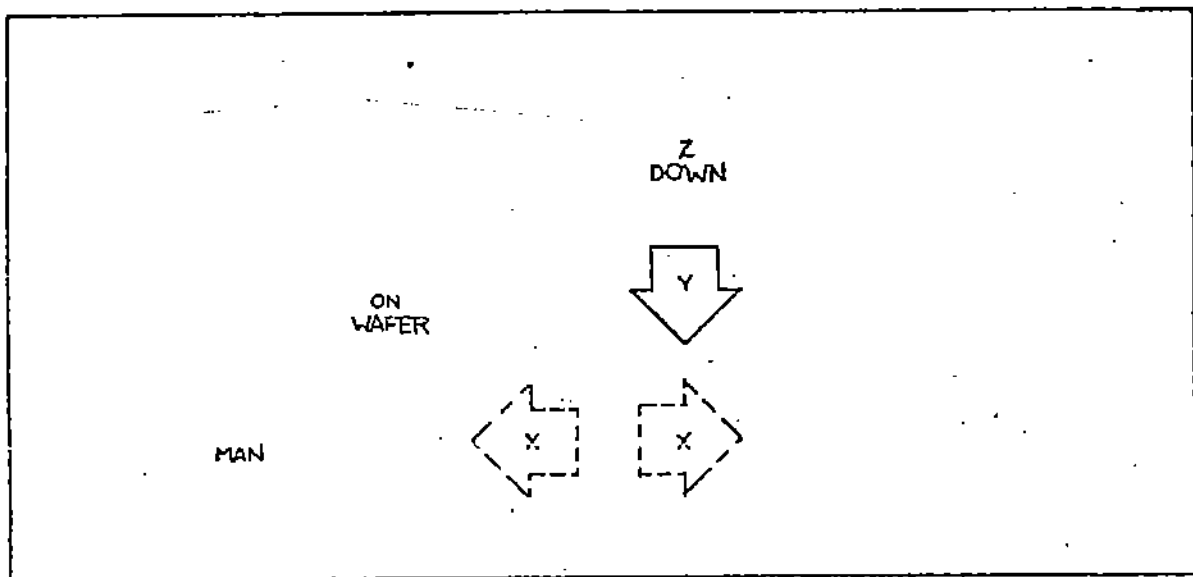


Figure 2-7. Display Panel (Align)

3. Use the following steps to perform the Stop Command checkout procedure.
 - a. Press STOP pushbutton and verify that Positioner stops.
 - b. Press ALIGN START pushbutton and verify Positioner resumes cycling.
 - c. Press STOP pushbutton and verify Positioner stops.
 - d. Verify Status Display Panel agrees with Figure 2-8.

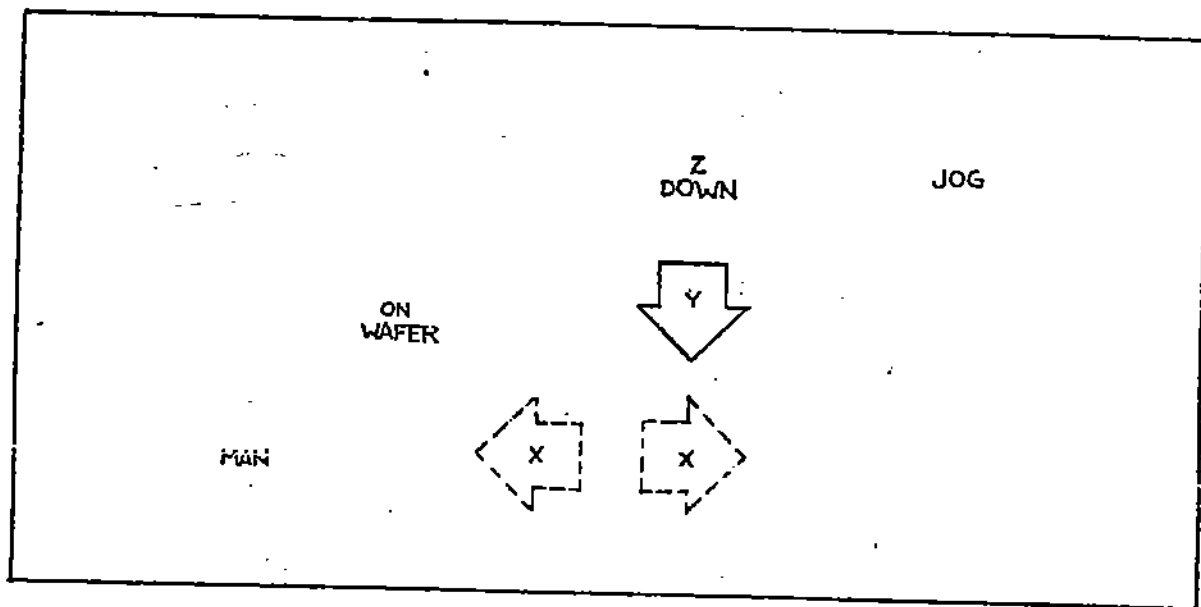


Figure 2-8. Display Panel (Stop/Load)

4. Use the following steps to perform the Load Command checkout procedure.
 - a. Press LOAD pushbutton and verify positioner moves to Home position (lower righthand corner).
 - b. Press ALIGN START pushbutton and verify positioner moves toward center of platen.
 - c. When positioner has moved to approximate center of platen, press STOP pushbutton and verify positioner stops.
 - d. Verify Status Display Panel agrees with Figure 2-6.
5. Use the following steps to perform the Joystick, Scan Mode checkout procedure.
 - a. Rotate Joystick extremely clockwise to SCAN position.
 - b. Move joystick up, down, right, and left, and verify direction arrows on Status Display Panel agree with each movement of joystick.

NOTE

Direction Arrows on Status Display Panel indicate opposite direction of actual positioner travel; i.e., probes, when viewed through the microscope, appear to be moving in direction of arrows on Status Display Panel.

- c. Verify speed of motion of positioner is constant in SCAN mode.
6. Use the following steps to perform the Joystick, Index Mode checkout procedure.
 - a. Set Vertical and Horizontal digit switches on Prober Sub Panel to 0100.
 - b. Rotate joystick counterclockwise to INDEX position and verify Status Display Panel indicates INDEX.
 - c. Push joystick up and verify that positioner moves one index increment and stops.

- d. Release joystick.
 - e. Push joystick down, left, and right, and verify that for each command, positioner moves one index increment and stops.
 - f. Press joystick pushbutton and while holding joystick in Up command, verify that positioner continues indexing.
 - g. Release joystick pushbutton and verify that positioner stops indexing.
 - h. Repeat Steps 6f and 6g for Down command, Left command, and Right command.
7. Use the following steps to perform the Joystick, Jog Mode checkout procedure.
 - a. Rotate joystick counterclockwise to JOG position and verify Status Display Panel indicates JOG.
 - b. Push joystick up, quickly release it, and verify positioner moves one jog step and stops.
 - c. While holding joystick in Up command, verify positioner moves one step, pauses, moves one step, and repeats.
 - d. Press joystick pushbutton, and while holding pushbutton down, verify positioner jog rapidly.
 - e. Release joystick pushbutton and verify positioner stops.
 - f. Repeat Steps 7b, 7c, 7d, and 7e for Down command, Right command, and Left command.
 8. Use the following steps to perform the Direction checkout procedure.
 - a. Press DIRECTION pushbutton on Operator's Control Panel.
 - b. While pressing DIRECTION pushbutton on Operator's Control Panel, simultaneously move joystick up, down, and left, and verify positioner does not move.
 - c. Verify direction arrows on Status Display Panel agree with direction commands in Step 8b.
 - d. Release DIRECTION pushbutton.
 9. Use the following steps to perform the Z Drive checkout procedure on the Standard or High-Speed Chuck Model 1034X.

- a. Press Z DRIVE pushbutton on Operator's Control Panel.
 - b. Verify chuck rises and Status Display Panel indicates Z UP.
 - c. Release Z DRIVE pushbutton.
 - d. Press Z DRIVE pushbutton to reactivate Z Drive.
 - e. Verify chuck goes down and Status Display Panel indicates Z DOWN.
 - f. Release Z DRIVE pushbutton.
10. Use the following steps to perform the Auto Cycle checkout procedure.
- a. Install jumper from Pin 'B' to Pin 'D' at Edge Sensor Connector, J21.
 - b. Set AUTO UNLOAD toggle switch on Prober Sub Panel to ON.
 - c. Command positioner to ALIGN mode using instructions in Paragraph 2-16, Step 2.
 - d. Press STOP pushbutton on Operator's Control Panel.
 - e. Press AUTO CYCLE/START pushbutton on Operator's Control Panel.
 - f. Verify positioner cycles 10 index steps in X axis, 1 index step in Y axis, and 10 index steps in reverse direction X axis.
 - g. Verify positioner moves to Load position and stops.
 - h. Verify Status Display Panel agrees with Figure 2-9.
 - i. Remove jumper between Pin 'B' and Pin 'D' at Edge Sensor Connector, J21.

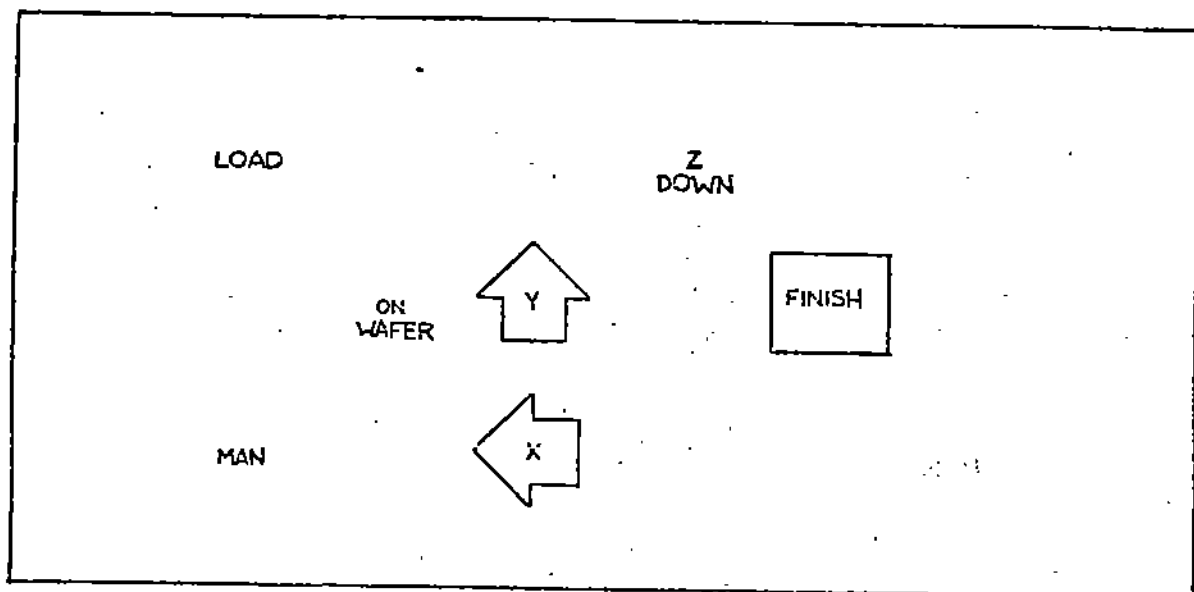


Figure 2-9. Display Panel (Auto)

1034X

SECTION 3

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SECTION 3

OPERATION

3-0 DESCRIPTION OF CONTROLS AND INDICATORS

The primary controls and indicators for the Model 1034X system are assembled on four separate panels. Three of the panels, the Sub Panel (Setup Panel), the Control Panel, and the Display Panel, are located at the front of the system. The fourth panel, the Interface Connector Panel, is located at the rear of the prober module. The MAIN POWER circuit-breaker switch is integrally located on the top front of the power module.

3-1 PROBER SUB PANEL (SETUP PANEL)

The Prober Sub Panel (Figure 3-1) is mounted on the righthand side of the prober and contains the controls used to communicate with the system logic for system setup prior to operation. Table 3-1 contains descriptions of the Prober Sub Panel controls.

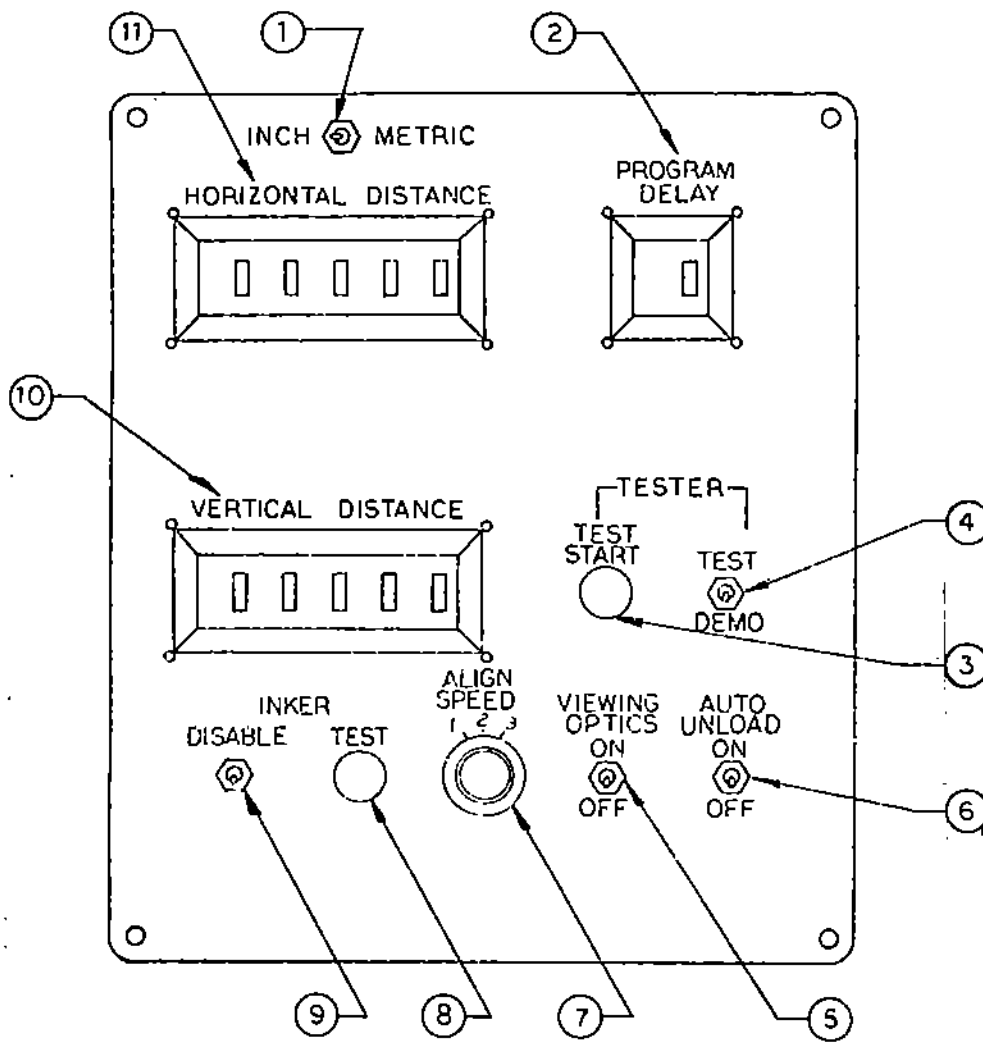


Figure 3-1. Prober Sub Panel

Table 3-1. Prober Sub Panel Controls

CONTROL	DESCRIPTION
(1) ENGLISH/METRIC	A two-position toggle switch used to set the system in English or Metric mode. (System must be re-aligned if mode is changed.)
(2) PROGRAM DELAY	A single-decade digit switch which controls the number of X index steps beyond the edge of the wafer during automatic cycling.
(3) TEST START	A pushbutton switch which, when actuated, delivers a start-test signal to the external tester interface channels.
(4) TEST/DEMO	A two-position toggle switch. "Test" is normal operation with external tester connected. "Demo" is used in servicing the machine since, in this position, external interface signals are inhibited or ignored, allowing the prober to cycle automatically in a demonstration mode.
(5) VIEWING OPTICS ON/OFF	A three-position toggle switch. During manual operation, it controls 115V AC 60 Hz power to connector J7, normally used for the microscope illuminator. During automatic operation, connector J7 is disabled. This control is normally in auto position. OFF = Off ON = On in Auto or Manual AUTO = Goes off in Auto
(6) AUTO UNLOAD ON/MANUAL	A two-position toggle switch. In AUTO CYCLE operation, this switch, set at AUTO UNLOAD ON, closes a circuit which responds to a wafer-test complete signal, causing the positioner to move to the load station. In the MANUAL position, the wafer-test complete signal causes the positioner to stop moving, requiring actuation of the LOAD control pushbutton on the Operator's Panel (Figure 3-2)

Table 3-1. Prober Sub Panel Controls (continued)

CONTROL	DESCRIPTION
	before the positioner will move to the load station.
(7) ALIGN SPEED	A three-position rotary switch used to select speed during ALIGN and SCAN.
(8) INKER TEST	A pushbutton switch, active during MANUAL mode for Inker 1 connector only. Actuation causes a single-shot cycle of the inker.
(9) INKER DISABLE	A two-position toggle switch. When the switch is set to "Disable" (up), all inker channels are off. When the switch is down, all inker circuits are enabled.
(10) VERTICAL DISTANCE	A five-decade digit switch used to establish the Y-axis index distance. The far right digit indicates 1/10 mils and is limited to 0 and 5. The remaining digit positions are standard multiples of ten and read from 0 to 9. Index steps may be programmed from 0.0000 to 4.9995 in increments of 1/2 mil in the English mode and from 0.000 mm to 9.995 mm in increments of 5 microns in the Metric mode.
(11) HORIZONTAL DISTANCE	A five-decade digit switch which performs the same function for the X-axis index distance as the VERTICAL DISTANCE digit switch does for the Y-axis index distance.

3-2 OPERATOR CONTROL PANEL

The Operator Control Panel (Figure 3-2) is mounted on the righthand side of the Prober System and contains the controls used to control system operation. Table 3-2 describes the Operator Control Panel controls.

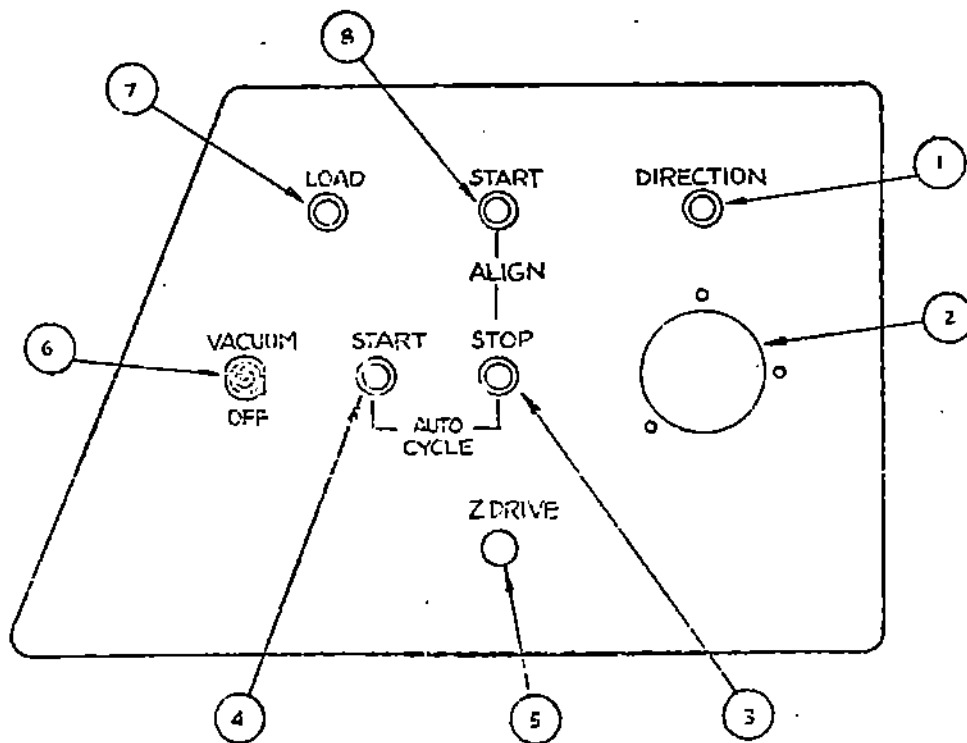


Figure 3-2. Operator Control Panel

Table 3-2. Operator Control Panel Controls

CONTROL	DESCRIPTION
(1) DIRECTION	A pushbutton switch. Active only in the manual mode, it permits a change of direction (commanded by joystick positioning) without motion by the positioner. Used for resetting probing direction after AUTO cycle has been initiated and stopped. (Section 5-2)
(2) JOYSTICK	A multi-function switching mechanism for manual mode commands. It is spring-loaded to neutral where no signals are initiated. Tilted from vertical, it closes circuits which causes the positioner to move in any desired X-Y direction. (Figure 3-3) Rotated clockwise about its vertical axis to its farthest detent position, it commands a scan mode of motion. Rotated to its farthest counterclockwise position, it commands a jog mode of motion. A central pushbutton provides a selection of positioner motion: Slow Jog, Fast Jog, Single-Index, and Multi-Index.
(3) STOP	A pushbutton switch used to stop automatic or aligning cycles. It causes the positioner to stop at the next index registration point. It also applies positioner power during magnetic alignment.
(4) AUTO CYCLE/START	A pushbutton switch used to start the automatic test cycle. It is inoperative when the positioner is in motion or in the load position.
(5) Z DRIVE	A pushbutton switch used to command the Z Up (contact) and Z Down (separate) positions of the chuck. It is operative only in the manual mode. Consecutive actuation causes alternate up and down motion. System logic permits jog or index motion with the chuck either up or down. The scan mode requires the chuck to be down.

Table 3-2. Operator Control Panel Controls (continued)

CONTROL	DESCRIPTION
(6) VACUUM ON/OFF	A two-position toggle switch which controls vacuum to the chuck. System logic will not permit the positioner to move from its load station unless the vacuum switch is on.
(7) LOAD	A pushbutton switch the actuation of which causes the chuck to go to its Z-Down position and the positioner to go to its load station.
(8) ALIGN/START	A pushbutton switch, operative from the load position or following a stop command in the manual mode only. Actuation causes the chuck to go to its Z-Down position and the positioner to move a programmed distance in the X and Y axes, then cycle in the X axis at a variable stroke. (Section 5-1) From the load position, this programmed X and Y travel brings the chuck center to the Y-axis center of the microscope and the probe ring. Joystick X-axis functions are disabled in the Align mode; joystick Y-axis functions are not disabled.

3-3 STATUS DISPLAY PANEL

The Status Display Panel (Figures 3-4, 3-5, 3-6, and 3-7) is mounted on the right-hand side of the Probe System above the Operator Control Panel. This panel displays the status of various system functions. Manual functions are blacked out when not operative. The Status Display Panel indicators are described in Table 3-3.

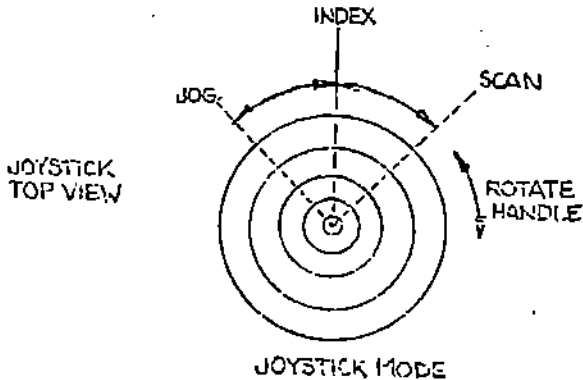
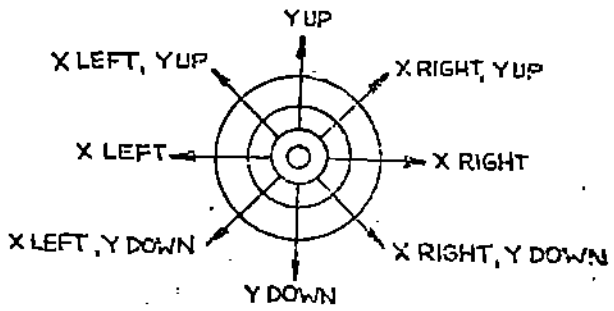
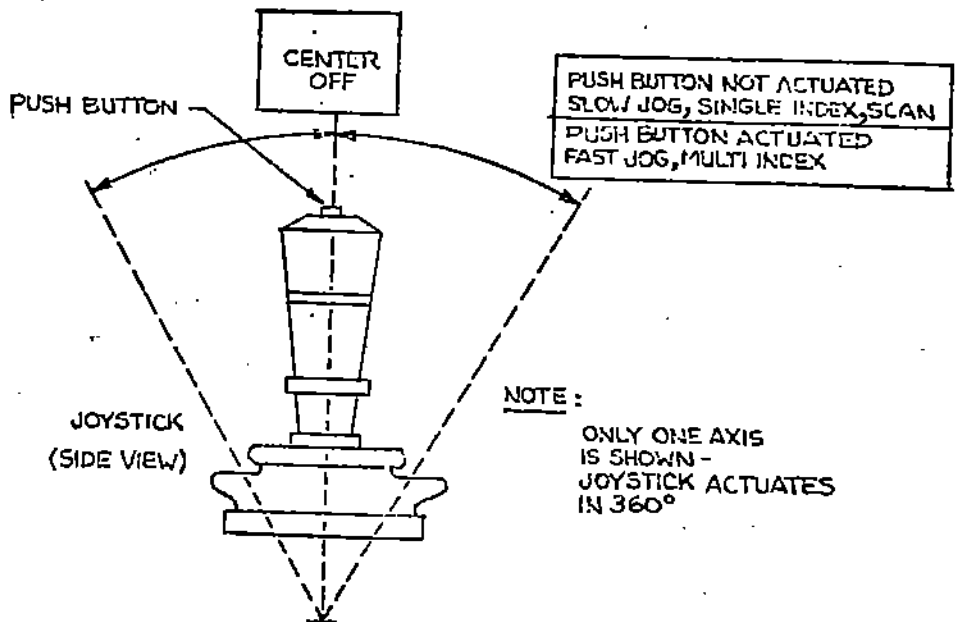


Figure 3-3. Joystick Operation

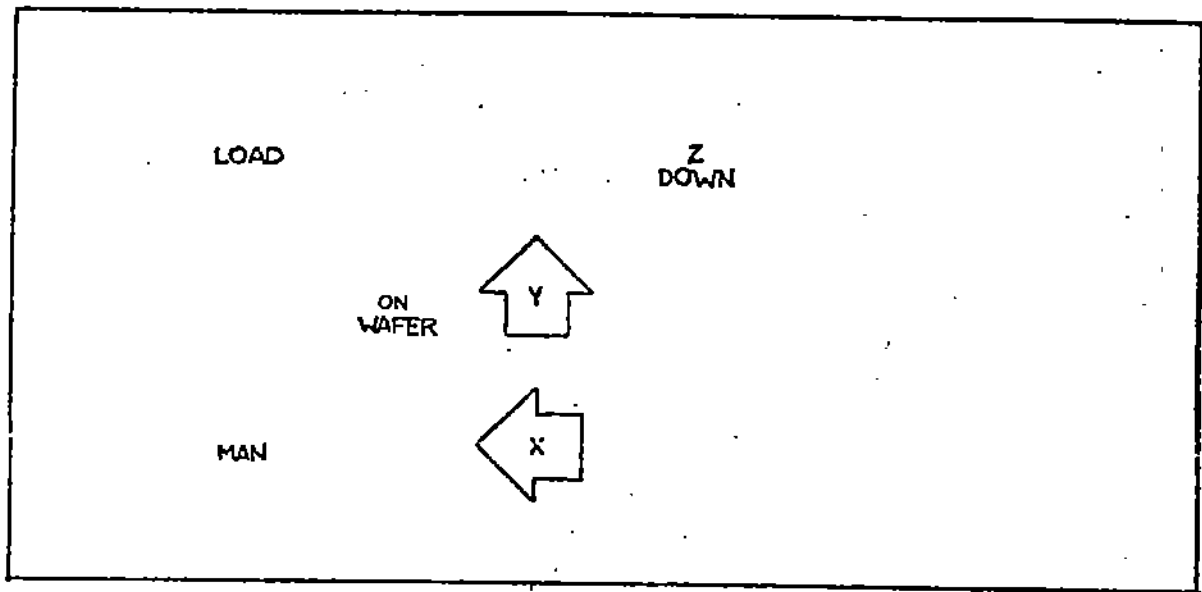


Figure 3-4. Display Panel

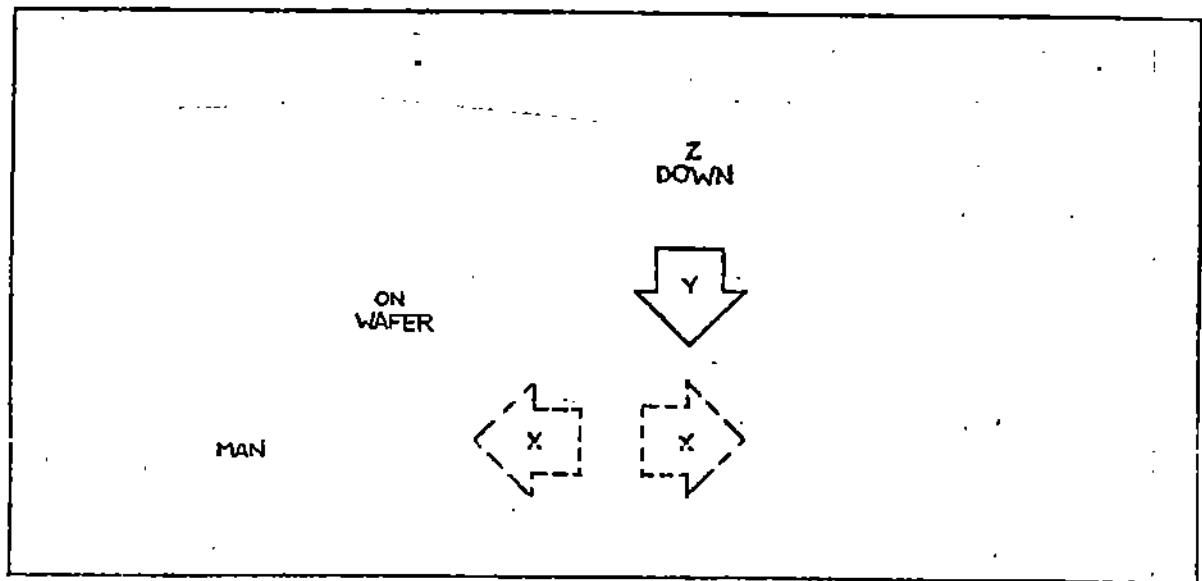


Figure 3-5. Display Panel (Align)

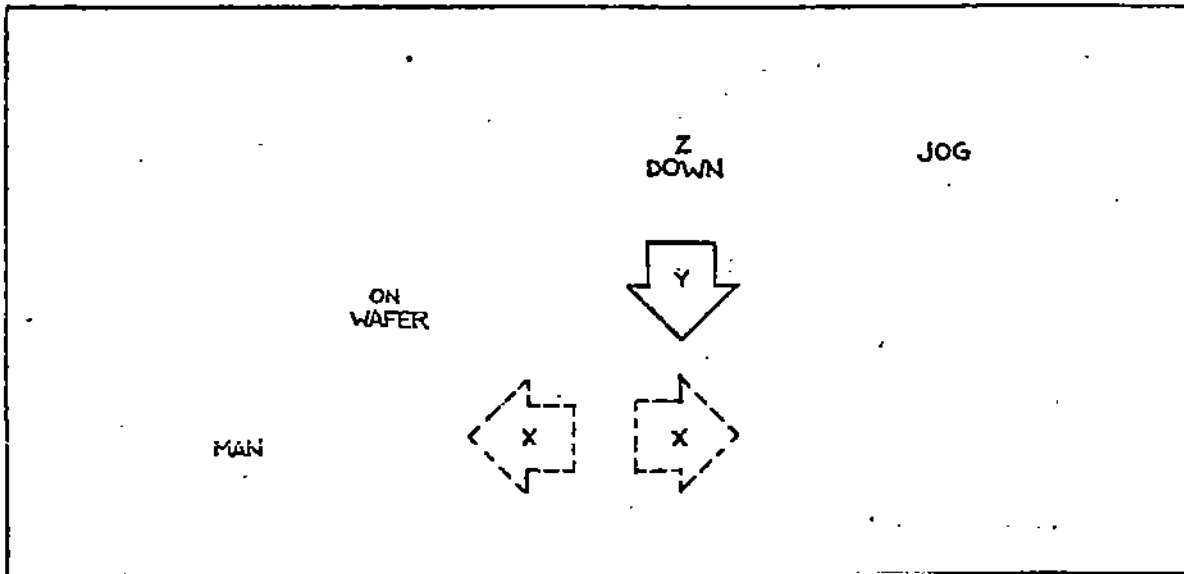


Figure 3-6. Display Panel (Stop/Load)

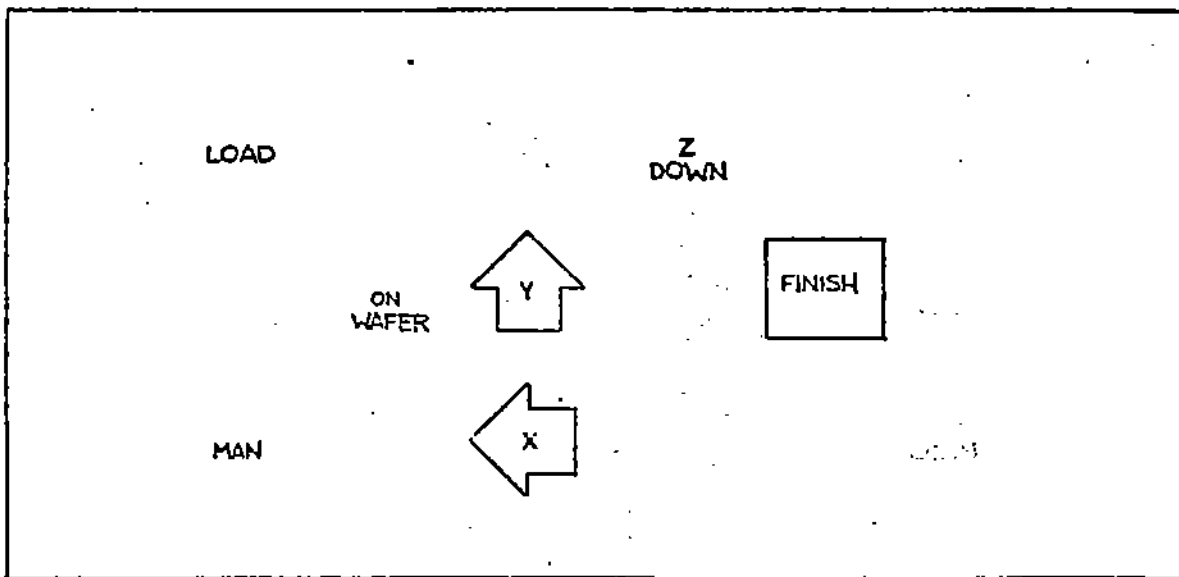


Figure 3-7. Display Panel (Auto)

Table 3-3. Status Display Panel Indicators

INDICATOR	DESCRIPTION
LOAD	This indicator is lit when the positioner is in, or has been commanded to go to, the load station. It is off when the system is in External Control.
AUTO	This indicator is lit only when the system is in its automatic cycle mode. It is off when the system is in External Control.
MAN	This indicator is lit only when system is in its manual mode (whenever the auto display is off). It is off when the system is in External Control.
ON WAFER	This indicator is lit when the edge sensor circuit is open; i.e., when a wafer is present or when edge sensor is disconnected from its panel connector.
Z UP	This indicator is lit when the chuck has reached its up (contact) position.
Z DOWN	This indicator is lit when the chuck has reached its down (separate) position.
DIRECTION ARROWS: X Left, X Right, Y Up, Y Down	Two arrows indicating the last commanded direction are lit during operation. They illuminate or "blackout" in response to signals from the joystick and the automatic-cycle logic. They indicate the <u>apparent</u> direction of motion of the <u>probes</u> when viewed through the microscope.
FINISH	This flashing red display is lit when the edge sensor indicates the wafer-test is complete. It continues flashing until the ALIGN START or the AUTO CYCLE START control is actuated.
JOG	This indicator is lit in response to a joystick command only when the system is in the manual mode.

Table 3-3. Status Display Panel Indicators

INDICATOR	DESCRIPTION
INDEX	This indicator is lit in response to a Joystick command only when the system is in the manual mode.
SCAN	This indicator is lit in response to a Joystick command only when the system is in the manual mode.

3-4 INTERFACE CONNECTOR PANEL

The Interface Connector Panel contains three connector points used to connect the Prober Module to the Power Module. (Figure 3-8) These connectors are J2 LOGIC, J3 MOTOR POWER, and J17 DC POWER. Connector J4, Auxiliary Equipment connector (AUX EQPT), provides additional signals for interfacing with customer equipment and options and access to various signals. Connector J9 is used for External Control Options. When External Control Options are not used, the supplied jumper is connected to Connector J9. Figures 3-9 and 3-10 list pin definitions and functions. The Tester Interface Connector is also located on the Interface Connector Panel.

The Interface Connector Panel contains one operator-controlled pushbutton switch, REALIGN. This switch, when actuated, interrupts power to the positioner and resets counters in the control logic, facilitating alignment of the positioner with the platen. Power is restored to the positioner by pressing the STOP pushbutton on the Operator Control Panel (Figure 3-2, Table 3-2).

3-5 POWER MODULE CONTROL

The Power Module contains one operator-controlled switch, MAIN POWER. This switch is a combination circuit-breaker/internal-light indicator. It is the ON/OFF switch for all power to the system.

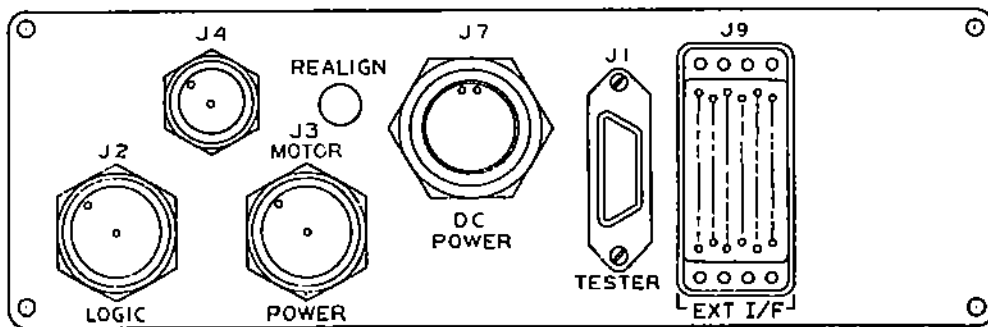


Figure 3-8. Interface Panel

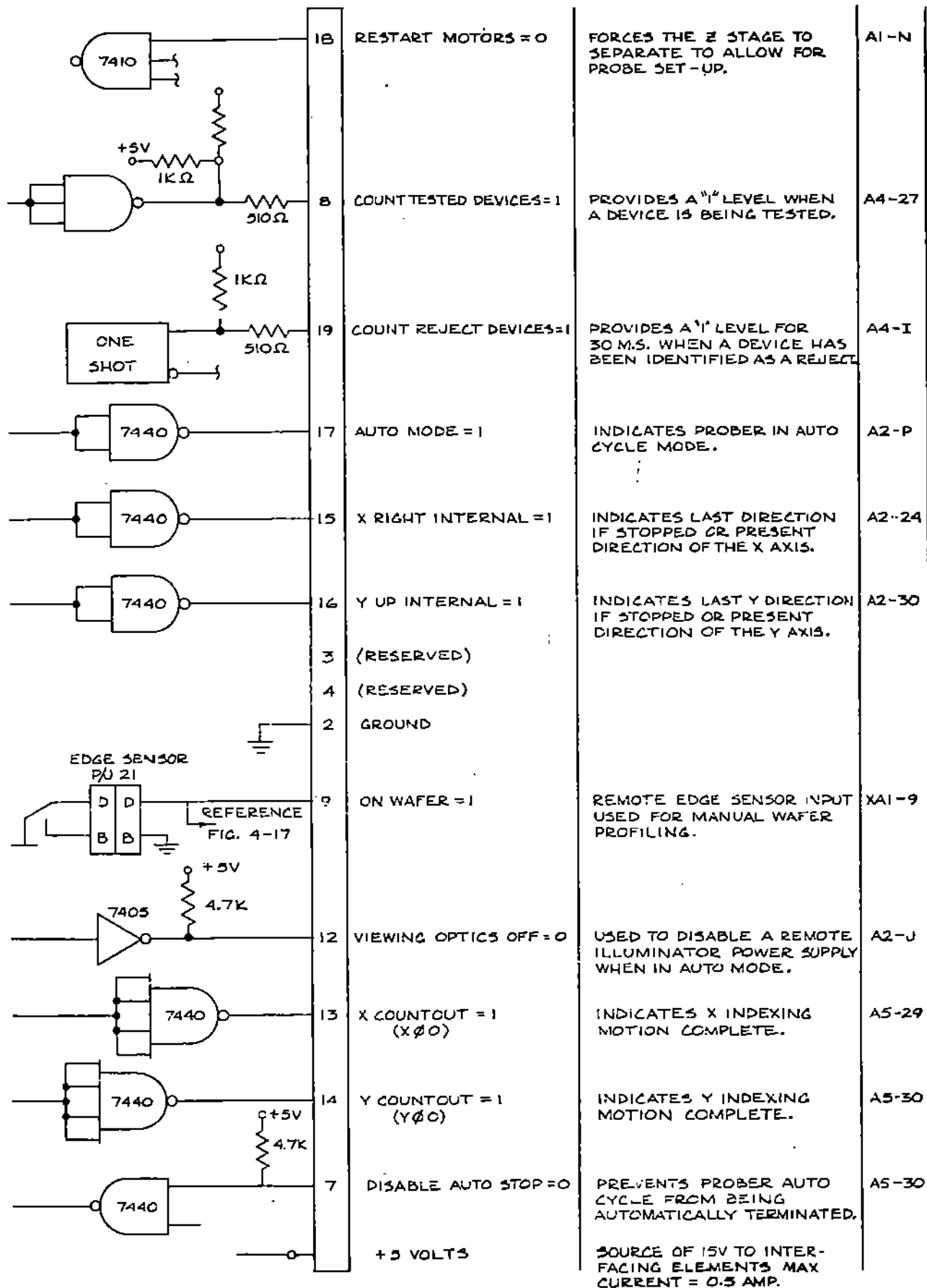


Figure 3-9. J4 Pin Definitions

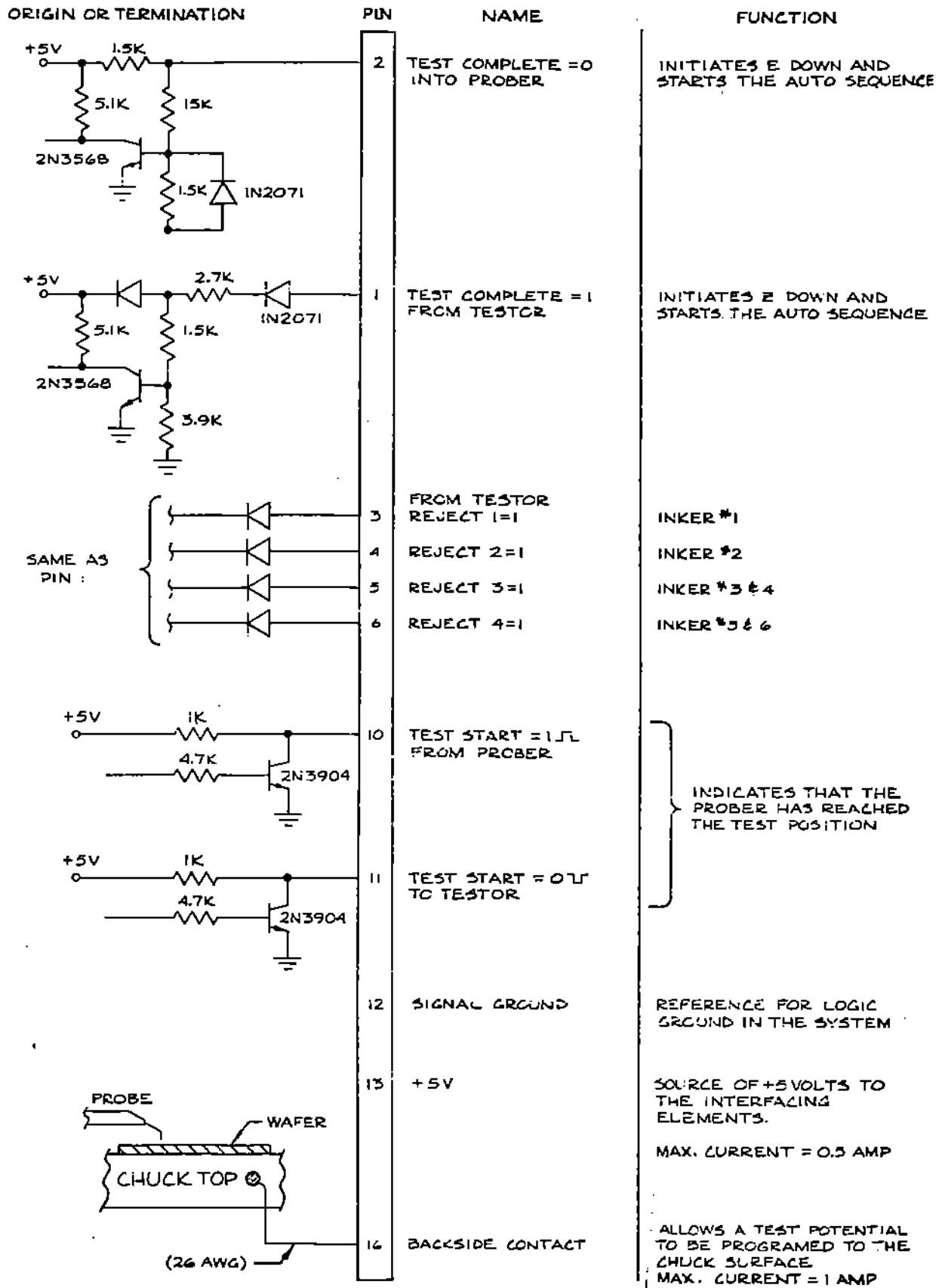


Figure 3-10. J1 Pin Definitions

3-6 INKERS

In addition to the inking action noted in Figure 3-11, there are three timing options; inking after test, (Z UP), inking during test, and inking after separate (Z DOWN).

1. Inking After Test. Inking after test is the standard inking option. This method prevent the inking operation from disturbing the device during test. (With Z UP)
2. Inking During Test. The inking during test option requires a jumper from PCB Connector XA4, Pin S to ground Pin 36.

NOTE

This inking method is not for use when ink channels 1 or 2 are employed simultaneously with ink channels 3 or 4.

3. Separate Inking. The separate inking option requires a jumper from PCB Connector XA7, Pin T, to ground Pin 36.

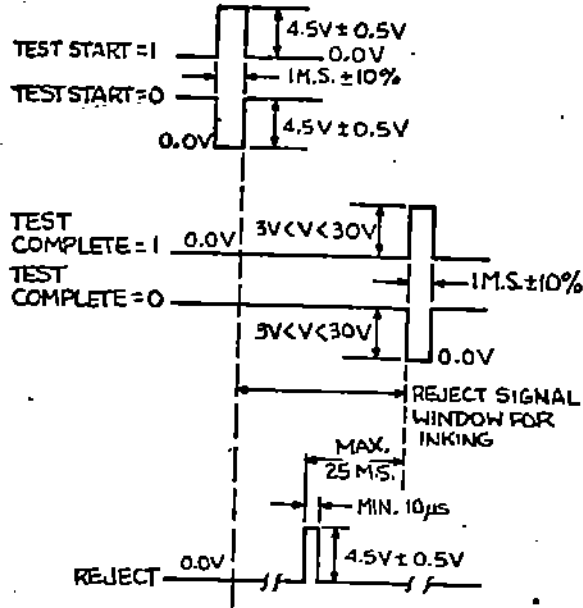
3-7 EDGE SENSOR

The Edge Sensor is essentially a precision switch. It is closed when the prober is OFF WAFER and open when the prober is ON WAFER.

NOTE

If test voltages are in excess of 50 volts and/or are enabled outside the testing window (i.e., outside contact time of the probes), additional edge sensor isolation circuitry may be required.

"1" LEVEL REPRESENTED BY THE MOST POSITIVE LEVEL



NOTE: SIGNALS SHOWN AS OBSERVED AT 1034X TESTER CONNECTOR J1.

Figure 3-11. Prober/Tester Interface Timing Signals

3-8 SYSTEM OPERATION SUMMARY

System operation is functionally divided into four major categories. The procedures comprising each category are grouped under the category heading in the following major subsections. The following is a brief description of each category.

- o System Initialization/Setup Procedures. These procedures consist of system initialization, prestart procedures, and power-on procedure. These procedures are prerequisites of the other three categories.
- o Manual Operations. These procedures consist of the manual operating procedures that may be performed by the operator, either alone or in conjunction with the other categories of operation.
- o Programmed Operations. These procedures consist of the steps required to initiate and augment the various automatic and programmed operation cycles performed by the system.
- o System Shutdown. These procedures are used to remove power from the system and to terminate system operations.

3-9 SYSTEM INITIALIZATION/SETUP PROCEDURES

The system initialization/setup procedures must be performed in the order presented. The purpose of these procedures is to verify that the system is ready to be placed in operation, to apply power to the system and initialize the X-Y Positioning System, and to verify system initialization is complete.

3-10 PRODUCTION SETUP

Prior to performing the Prestart Procedure, completion of the following procedures should be verified:

1. System setup (Section 2)

2. Functional Checkout (Section 2, Paragraph 2-16).
3. Installation of Accessories (Section 2, Paragraphs 2-11, 2-13 through 2-15)
4. Connection of External Tester Interface Connector (Section 2, Paragraph 2-8)
5. Probe contacts set as high as possible.

NOTE

Probe contacts are set high by adjusting ring carrier micrometer clockwise.

3-11 PRESTART PROCEDURE

The following steps must be performed in the order given to verify the system is ready for power-on operation.

1. Verify all interconnecting cables are connected as directed in Section 2.
2. Verify all utility connections are complete and pressure gauge indications are as specified (Section 2).
3. Perform visual inspection to verify system integrity for type of operations to be performed after start-up.
4. Open righthand cover and set Sub Panel Controls as indicated in the following steps.
 - a. Set English/Metric (EM) switch to units required by wafer type to be probed.
 - b. Set PROGRAM DELAY digit switch as required.
 - c. Set TEST/DEMO toggle switch to TEST.
 - d. Set VIEWING OPTICS toggle switch to ON.
 - e. Set AUTO UNLOAD toggle switch to ON.
 - f. Rotate ALIGN SPEED switch to 1.
 - g. Set INKER DISABLE toggle switch to DISABLE (up position).
 - h. Set VERTICAL DISTANCE digit switch as required.
 - i. Set HORIZONTAL DISTANCE digit switch as required.

NOTE

TEST START and INKER TEST switches require no action during Prestart Operation.

5. Set VACUUM ON/OFF toggle switch to OFF.

NOTE

The following switches require no action during Prestart Procedure: DIRECTION, STOP, AUTO CYCLE START, LOAD, ALIGN START, Joystick, and Z DRIVE.

3-12 POWER-ON PROCEDURE

The following steps must be performed in the order given to apply power to the system and place the X-Y Positioner in registration at the Home position.

1. Verify Prestart Procedure is complete.
2. Set MAIN POWER circuit-breaker switch to ON and verify switch indicator is lit.

NOTE

Setting MAIN POWER switch to ON releases X-Y Positioner from registration with platen, allowing it to float freely on air bearing.

3. Manually move Positioner to Home position (forward righthand corner of platen) and press it gently against both corner harbor rails.
4. Manually hold Positioner in its Home position and, while pressing STOP pushbutton on Operator Control Panel, release Positioner to lock it into registration with platen.
5. Verify Positioner is locked in registration with platen.

3-13 JOYSTICK OPERATION

The Joystick is a multi-function control device for controlling manual Positioner operations. Refer to Table 3-2 for detailed descriptions of Joystick functions. The following steps are required for Joystick operation.

1. Perform Auto Align operation. (Paragraph 3-15, Steps 3 and 9)
2. Press STOP pushbutton.

NOTE

Joystick is not active until after
Auto Align operation has been performed.

3. Check Status Display Panel to determine existing Joystick mode (INDEX, SCAN, or JOG).
4. Rotate Joystick handle to set Joystick in desired mode.

3-14 ALIGNMENT OPERATIONS

Alignment operations consist of positioning the wafer to be tested correctly for probing and verifying the alignment accuracy of the wafer, probe-pattern alignment, and inker-pattern alignment. Misalignment of the probes with the probe pads of the chips is corrected by fine adjustments with the Theta control (Figure 3-11) and the Joystick. This operation must be performed immediately prior to commencing automatic probing operations on all wafers. All necessary parameters must be entered into the system before this operation is performed.

3-15 Wafer Alignment

The following steps are used to correctly align the wafer to be tested.

1. Place wafer in center of chuck.
2. Set VACUUM ON/OFF switch to ON.
3. Press ALIGN START pushbutton to move Positioner to Align mode.
4. When chuck is centered under probes, press STOP pushbutton to stop Align cycle.
5. Press Z-DRIVE pushbutton switch to send chuck to Z UP position for Standard or High-Speed "Z" Model 1034X. For Model 1034X with

- Programmable Chuck, perform procedure outlined in Paragraph 2-15.
6. Adjust carrier micrometer counterclockwise to lower probes until edge sensor makes minimum contact with wafer.

NOTE

ON WAFER indicator on Status Display Panel lights when edge sensor makes contact with wafer.

7. Continue to lower probes approximately 2 to 3 mils to provide desired amount of overtravel.

NOTE

Each mark on carrier micrometer knob indicates movement of one mil at center of probe circle.

8. Verify proper probe contact with wafer by pressing Z-DRIVE pushbutton switch several times and verifying that ON WAFER indicator is lit for each Z UP position.
9. Press AUTO ALIGN pushbutton.
10. Observe movement of an X street on wafer relative to a probe tip through microscope, and adjust Theta control (Figure 3-11) until street is completely parallel to probe tip.
11. Press ALIGN/STOP pushbutton switch.

3-16 Probe-Card Alignment

Not Available at This Time.

3-17 Probe-Pattern Alignment

The following steps are used to assure correct probe-pattern alignment.

1. Verify system is in manual mode.
2. Using Joystick, "jog" Positioner until one die of wafer is approximately centered under probe tip and verify that this point is also in the center of the microscope field of vision.
3. Verify probes have been planarized (Section 2, Paragraph 2-15).
4. Adjust X and Y screws on each probe support arm until probe point is directly over desired contact pad.
5. If using adjustable probe arm array, verify all probe tips are aligned with desired contact pad if fixed probe card is used. If probe tips are not aligned, replace probe card.
6. Press Z DRIVE pushbutton switch to command chuck to Z-UP position.
7. Observe wafer and probe through microscope to verify proper contact.

NOTE

Proper contact of probe with contact pad may also be verified at external test console, provided external tester console indicates proper probe contact.

8. When proper contact pattern and pressure are satisfactory, press Z DRIVE pushbutton switch to command chuck to Z-DOWN position.

3-18 Inker-Pattern Alignment

The following steps are used to assure correct inker-pattern alignment.

1. Verify system is in manual mode.
2. Verify inkers have been planarized (Section 2, Paragraph 2-15).
3. Adjust X and Y screws on each inker support until inker tip is directly over desired contact point.
4. Connect inker to be tested to Inker-I Connector (Table 3-1).

NOTE

Step 4 is unnecessary if external tester has dot test provisions.

5. Press Z DRIVE pushbutton switch to command chuck to Z-UP position.
6. While observing wafer and inker through microscope, press INKER TEST pushbutton (Table 3-1, Figure 3-1).

CAUTION

If adjustment of dot size is necessary,
do not jog positioner to a new position.
Positioner should be indexed to a new
position to retain its registration
with platen.

7. If adjustment of dot size is necessary, see Section 2, Paragraph 2-15.
8. Disconnect tested inker from Inker-1 connector, if necessary.
9. Repeat Steps 3 through 8 for each inker to be tested.
10. Reconnect tested inkers to appropriate channels, if necessary.

3-19 Sensor X-Y Alignment

When the probe pattern is not overly crowded, the sensor contact is usually held close to the probe-contact pattern. When the probe pattern is crowded, or when desired for other reasons, the sensor may make its contact several devices from the probe. This phenomenon requires an appropriate setting of the PROGRAM DELAY Control (Table 3-1, Figure 3-1). The following steps are used to adjust the sensor X-Y alignment, if necessary.

1. Verify edge sensor has been planarized (Section 2, Paragraph 2-15).
2. Adjust X and Y screws on support arm of edge sensor until point of sensor is directly above desired location.

NOTE

Desired location should be a
a street or area not apt to
produce false signals to tester.

3. Verify sensor X-Y alignment is correct.
4. Press Z DRIVE pushbutton switch on Operator Control Panel to command chuck to Z-UP position.
5. Verify ON WAFER indicator on Status Display Panel is lit.

6. If ON WAFER indicator on Status Display Panel is not lit, verify that probe and inker contacts are satisfactory, and adjust sensor vertical control until ON WAFER indicator lights.

3-20 AUTOMATIC CYCLE OPERATION

When the System Initialization/Setup Procedures are complete, the prober is "in registration" and ready for operation. The following steps are used to operate the prober in the automatic cycle mode. They may also be used to verify the automatic cycle mode functions correctly.

1. Verify production setup operations (Paragraphs 3-10 through 3-19) are complete.
2. Rotate Joystick to INDEX mode.
3. Place first device to be tested under probes.
4. Verify that initial starting direction jumpers on Setup Auto Sequence PCB are correctly installed according to particular production requirements (Paragraph 5-8, Table 5-2).

NOTE

Direction arrows on Status Display Panel indicate opposite direction of actual positioner travel; i.e., if first device to be tested in in upper lefthand corner of wafer, X arrow points right and Y arrow points down.

5. Press AUTO CYCLE/START pushbutton on Operator Control Panel and verify chuck moves into Z-UP position, generating test-start signals.
6. Verify that when tester signals "test-complete, chuck immediately moves to Z DOWN, Positioner indexes to next device, and chuck returns to Z-UP position, again generating test-start signal.

NOTE

Reject signals may command inking during test or after one or two index delays.

6. Verify Automatic Cycle sequence (Steps 4 and 5) continues until sensor moves off edge of wafer, interrupting start-test signal.
7. Verify that in absence of test cycle, there is a noticeable increase in speed of motion during following operations, and at the same time, verify following operations occur in order indicated.
 - a. Positioner continues indexing in same direction and same row for number of index steps set in PROGRAM DELAY (Figure 3-1).
 - b. Positioner indexes one step in Y axis.
 - c. Positioner reverses its X-axis direction and indexes until it contacts first device in next row, generating start-test signal.
 - d. Positioner resumes cycle and test-cycle speed.

NOTE

If edge sensor does not contact wafer during ten consecutive "seek" steps, such as occurs at bottom edge of wafer, it receives signal that wafer test is complete.

- e. If Setup Panel switch allows, positioner moves to its load station and FINISH indicator on Status Display Panel flashes. Otherwise, positioner stops in probe area.
8. Set VACUUM control to OFF.
9. Remove tested wafer from chuck.
10. Place next wafer to be tested on center of chuck.
11. Set VACUUM control to ON.
12. Repeat Steps 2 through 11 for next automatic cycle sequence.

3-21 SYSTEM SHUTDOWN

To "shut down" the system, set MAIN POWER switch to OFF. No particular sequence or precautions are required for power shutdown of the Model 1034X.

T034X

SECTION 4

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SECTION 4

X-Y POSITIONING SYSTEM

4-0 INTRODUCTION

This section describes the XYNETICS/ELECTROGLAS Positioning System. The Positioning System consists of a linear stepping motor and its associated power supply module. The Positioning System moves the wafer prober chuck along horizontal X and Y axes. It is controlled by logic circuitry described in Section 5.

4-1 X-Y POSITIONING SYSTEM

The XYNETICS/ELECTROGLAS X-Y Positioning System provides the precise high-speed X-axis and Y-axis motion required for probing. The X-Y Positioning System, based on the patented Sawyer Principle, is a dual-axis linear stepping motor positioning system consisting of a stationary ferromagnetic platen and a moving platform called the positioner. The positioner contains both permanent and electromagnets and is supported above the platen by a thin cushion of air created by airbearing pads in the positioner base. Tangential electromagnetic forces drive the positioner over the platen with almost frictionless motion in precisely controlled high-speed linear stepping increments. The X-Y Positioning System control modules and power supplies are housed in the Power Supply Module.

4-2 Motion Generation

The simplest mechanization of the Xynetics motor is shown in Figure 4-1(A). As illustrated, the positioner consists of a permanent magnet, PM, and two electromagnets, EMA and EMB. The platen is made of ferromagnetic material with a tooth pattern of similar geometry to the positioner. The permanent magnet flux closes its path through the electromagnetic stacks and the platen. The electromagnet flux closes its path through the electromagnet stack and

the platen without flowing through the permanent magnet.

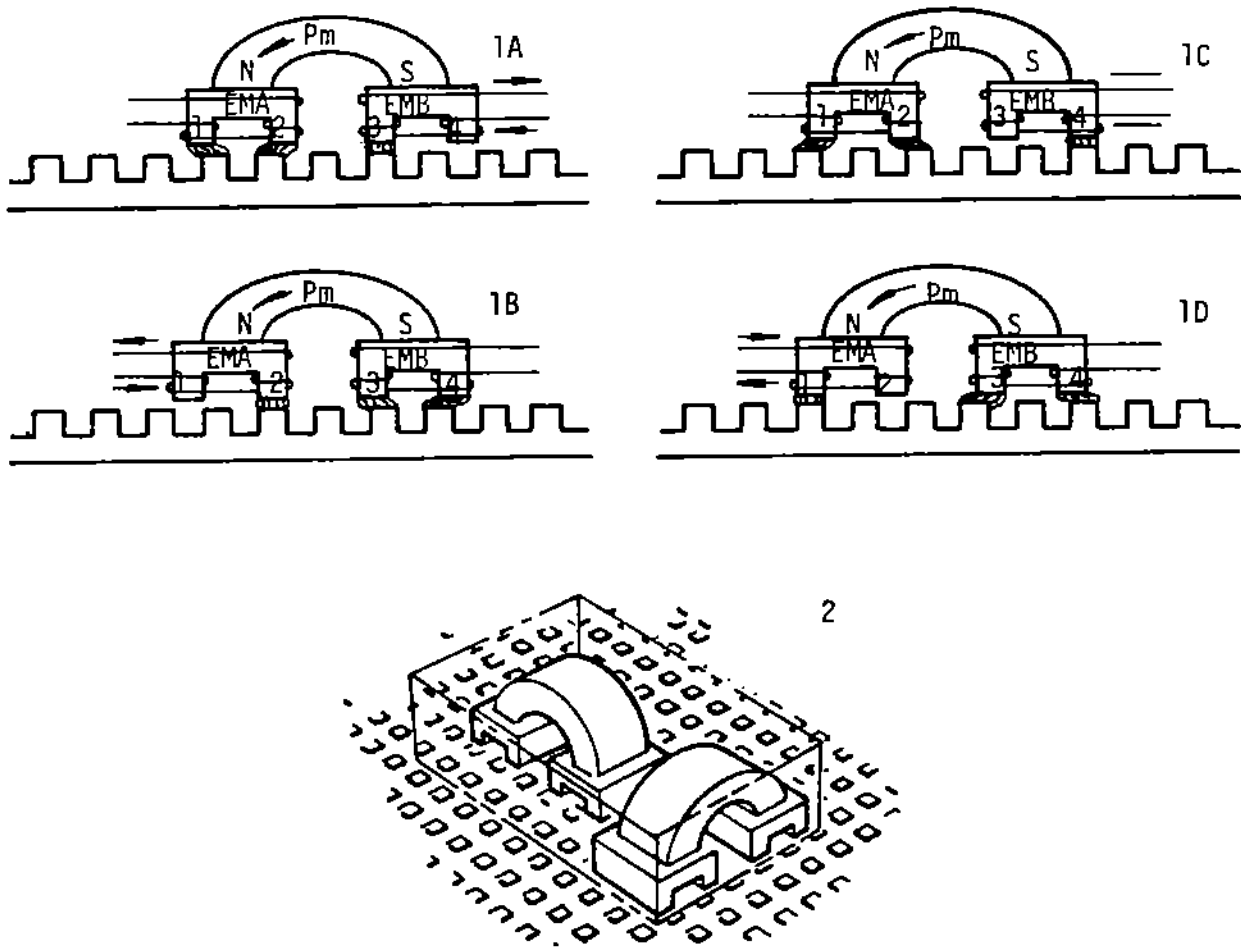


Figure 4-1. Full Cycle--Xynetics Motor

In the absence of current in either electromagnet coil, the permanent magnet flux flows as shown through both stack legs of electromagnet EMA, the platen, and back through stack EMB. The only net force exerted is perpendicular to the platen and positioner which is countered by air-bearing support. This is the normal attractive force. Tangential forces on each leg counterbalance each other, and no net lateral force is produced.

Excitation of electromagnet EMA opposes the flux through leg 1 and increases the flux through leg 2 to produce a net thrust force. Full current brings the air-gap density in that leg to a maximum, while the flux density of leg 1 is brought down to a negligibly small value. Leg 2 and the adjacent platen tooth have a side force which causes the motor to move one-quarter the distance between adjacent platen teeth, or one-quarter of a pole pitch. (Figure 4-1 (B))

When the currents in each coil are switched alternately and in alternating polarities as shown in Figure 4-1, the motor continues to move in quarter-pole increments. Figure 4-1 illustrates one complete cycle. Coil and drive currents of EMB are displaced 90 degrees with respect to EMA (Figure 4-2). If a Xynetics metric-spaced platen is used where center-to-center spacing is 0.004 mm, each electrical step (quarter-pole increment) causes a movement of 0.001 mm.

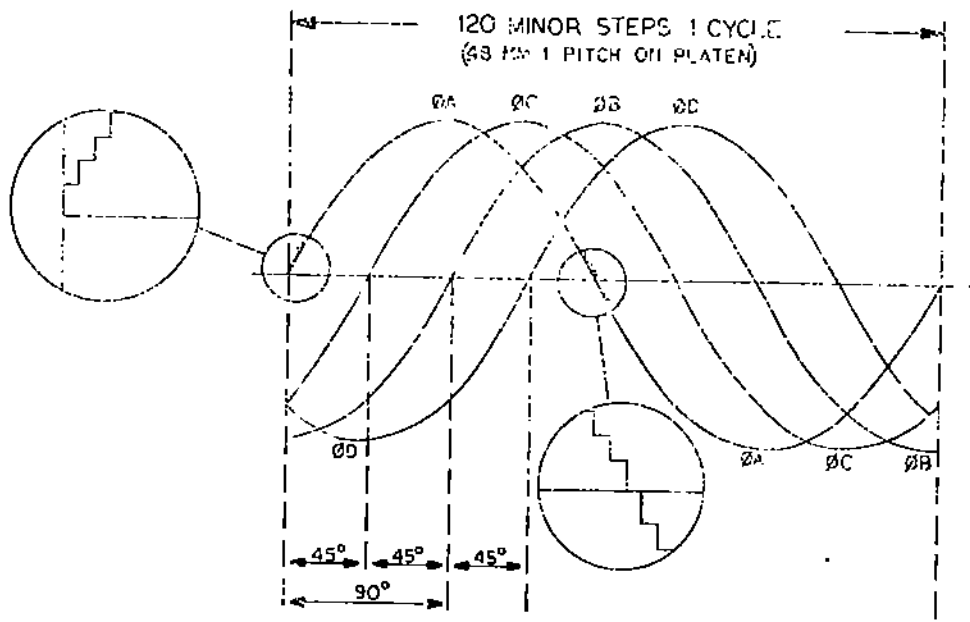


Figure 4-2. Motor Phase Relationships

4-3 Stepping Resolution

To step the forcer in less than quarter-pole increments, a scheme other than simple on-off coil-switching is required. The Xynetics system employs a Digital-to-Analogue Resolver (DAR) which similarly switches the coils, but in distinct, gradual increments of current; each step causes a minute change in position of the forcer. When the current in one coil has been incremented in this manner from full "off" to full "on", and from full "on" to full "off" in the other coil, the forcer will have moved an aggregate one-quarter pole pitch.

Each input pulse to the DAR causes a one-step movement of the positioner. As the DAR is stepped, the succession of current levels supplied to each coil appears as a staircased waveform which, to achieve proper positioning accuracies, is made sinusoidal rather than linear (Figure 4-2). As in simpler quarter-pole stepping schemes, the phase displacement between A and B is one-quarter cycle, or 90 degrees. (Table 4-1)

Table 4-1. 1034X Standard Model Resolution Specifications

<u>MODEL</u>	<u>TYPE</u>	<u>PLATEN PITCH</u>	<u>DAR</u>	<u>SINGLE-STEP RESOLUTION</u>
1034X-1	English	0.020 in.	40-point 80-point	0.0005 in. 0.00025 in.
1034X-2	Metric	0.48 mm	48-point	0.01 mm
1034X-3				
(Select) Eng		0.020 in.	80-point	0.00025 in.
(Select) Met		0.48 mm	96-point	0.005 mm

4-4 Forcer Configuration

In the Xynetics positioner, a second set of stator stacks is added to each axis. These are identical to the A-B set, but mechanically displaced one-eighth of a pole-pitch (45 degrees) from the latter. Two separate drive currents, C and D, are supplied by the same DAR; they have the same waveforms as

A and B, but are phased 45 electrical degrees from them. The advantage of this dual-motor arrangement in each axis is higher mean accuracy and greater positional stability. (Figure 4-2)

4-5 DAR (Digital-to Analogue Resolver)

The DAR PCB's are located in the Power Supply Module in the A2 and A3 card cage positions. They are identical and interchangeable except that the A2 PCB controls the X axis and the A3 PCB controls the Y axis.

The purpose of the DAR PCB's is to convert the direction and distance pulses of the motion control logic to four stepped sinusoidal signals which are displaced a specified number of electrical degrees. These signals, buffered by the motor drivers, drive the four coils (phases) of the linear motor (Figure 4-3). The following describes the existing phase relationship:

- Ø A leads Ø B by 90 degrees
- Ø C leads Ø B by 45 degrees
- Ø D lags Ø B by 45 degrees

All waveforms are identical except for the phase shift.

The platen pitch (ridge-to-ridge) of the Dual-Axis Positioning System is 0.48 mm. Because the DAR is 120-point, 120 steps (minor steps) are required to move one platen pitch (0.48 mm).

To achieve proper scaling, as specified by the system, the DAR PCB must advance one minor step, and frequently, two minor steps, when an input pulse occurs. The rate at which the extra minor step occurs is determined by switch settings (i.e., English or Metric mode), by mechanical spacing of the platen, etc. Mechanical errors in the platen can be corrected by further modifying this rate through switches located on the PCB.

4-6 Damper PCB

The Damper PCB is located in the Power Supply Module in the A4 card cage position. The characteristics of the linear motor are such that when the forcer completes a motion, in either axis, a decaying sinusoidal oscillation occurs about the desired endpoint. This oscillation may persist for as long as

DAR
100863

POWER AMP
703804

100254
DAMPER

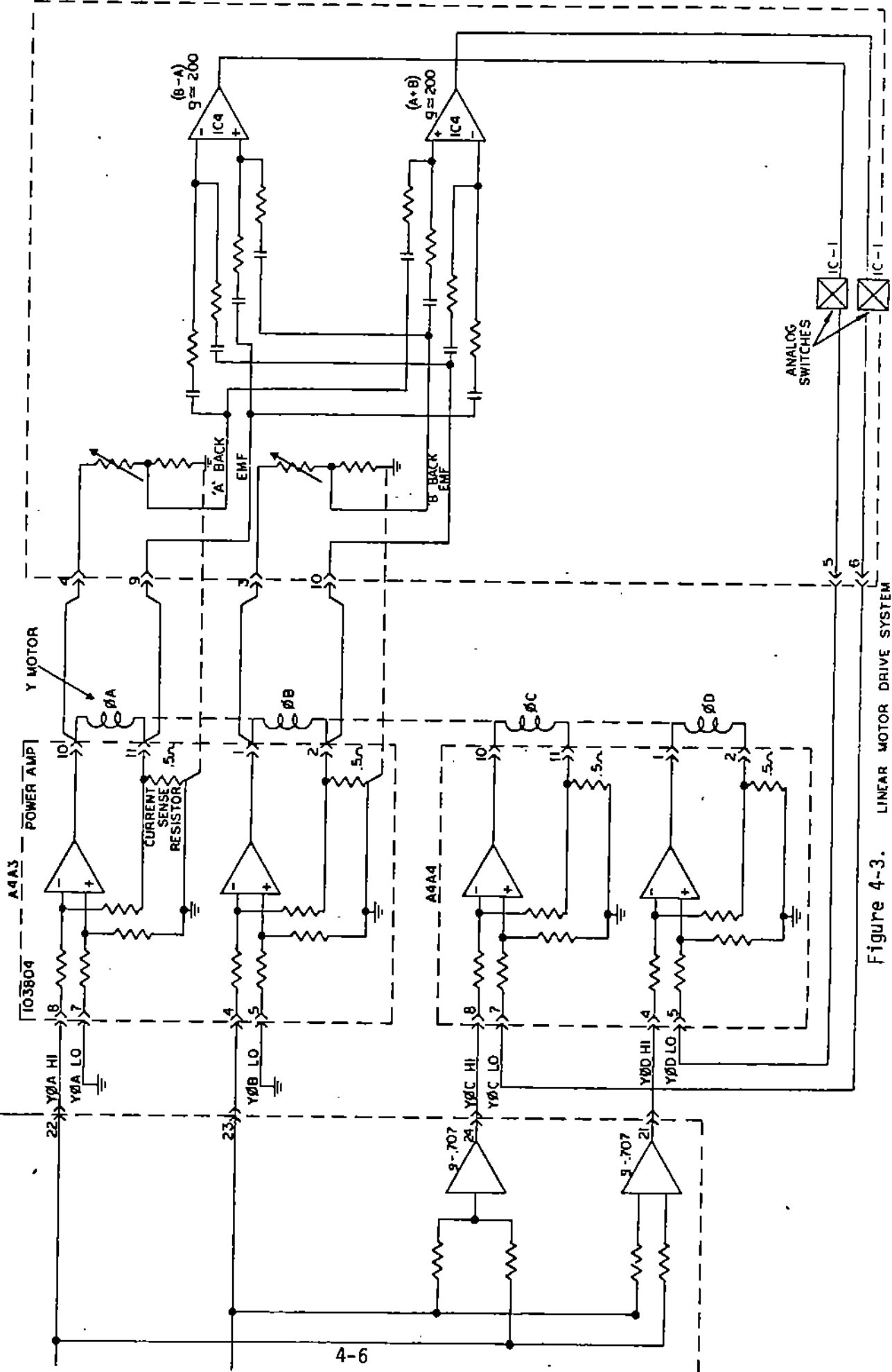


Figure 4-3. LINEAR MOTOR DRIVE SYSTEM

200 to 500 milliseconds. It is a result of the low tangential force holding the forcer in place. A damping network is incorporated into the positioning system to eliminate this undesirable oscillation. The Damper PCB is the primary element in this network (Figure 4-3).

The damping network operates on the principle that a motor is a generator and produces a back-electromotive force (EMF). This signal can be detected and amplified and then used in a closed-loop circuit to reduce the oscillation.

The back-EMF signal is a very small amplitude sinusoid riding on a comparatively large DC voltage. By summing an input-reference voltage with the coil-drive voltage, the DC (drive) component is subtracted, leaving only the back-EMF (AC) at the damper amplifier input. This is capacitively coupled to further block DC changes caused by drift or calibration. The gain of the damping amplifier is approximately 200.

Back-EMF is sensed from both A and B motor coils and applied to C and D coils. The technique used is essentially the same as that used in generating \emptyset C and \emptyset D drive signals (summing and differentiating A and B), except the signal is applied 180 degrees out-of-phase. Consequently, any change in the direction of the motor will be "bucked". This signal is only applied to the motor coils once the motor is commanded to come to rest.

NOTE

The damping network requires a potentiometer to balance offsetting reference voltage with coil-drive voltages since resistance of motor coils is not consistent from one motor to another.

4-7 ENGLISH/METRIC DAR PCB CORRECTION CAPABILITIES

The following procedure (for use on Model 1034X equipped with Eng/Met DAR PCB) allows user to correct for small errors in the system.

1. Verify following required equipment is available.
 - a. English alignment mask (P/N 242186A) or Metric alignment mask (P/N 242185A) or equivalent wafer.

- b. Eyepiece with crosshairs or needle, or very fine probe point on probe ring.
 - c. Schematic No. 100860 and Assembly Drawing No. 100863.
2. Read table of switch functions (Table 4-2).
 3. Place desired axis DAR PCB on extender.
 4. Place alignment mask or wafer on chuck.
 5. Set vacuum to "on".
 6. Place system in "ALIGN" mode.
 7. Very carefully adjust theta.

NOTE

Incorrectly adjusted theta will not produce correct end results.

8. Select axis to be corrected.
9. Position crosshair or probe needle on far side of axis to be corrected on line of alignment mask or edge of pod on wafer.
10. Select index length that traverses entire distance to be corrected (from one side of mask or wafer to other side).
11. Index machine to far side of alignment mask or wafer and determine if error is less than or more than selected index and set Switch 6 accordingly (Table 4-2).
12. After Switch 6 is set, continue to index from one side to other side of mask or wafer and, at the same time, set (open) correction switch (Table 4-2).

NOTE

Reference side of mask or wafer originally set in Step 11.

13. Repeat Steps 3 through 12 for opposite axis if required.
14. Reinsert DAR PCB.
15. If additional correction is necessary, contact Xynetics/Electroglas for instructions.

Table 4-2. English/Metric DAR PCB Switch Functions
(Dwg No. 100860 and Dwg No. 100863)

SWITCH NUMBER	FUNCTION
1 = $(1_2)^*$	1 correction step in 12.8 in. or 325.12 mm.
2 = $(2_2)^*$	2 correction steps in 12.8 in. or 325.12 mm.
3 = $(4_2)^*$	3 correction steps in 12.8 in. or 325.12 mm.
4 = $(8_2)^*$	8 correction steps in 12.8 in. or 325.12 mm.
5	Additional correction available with special PROM. This switch is always closed when using 100922 (Std) PROM.
6	Switch used to determine direction of correction; i.e.,: <u>OPEN</u> adds correction steps to correct negative accumulative error. <u>CLOSED</u> subtracts correction steps to correct positive accumulative error.
7	Selects platen. <u>OPEN</u> for Metric platen, <u>CLOSED</u> for English platen.
8	Parallels English/metric switch on top panel left <u>OPEN</u> on English/Metric machines. <ul style="list-style-type: none"> a. If used on English platen, machine <u>without</u> English/Metric switchover capabilities, switch to be left OPEN. b. If used on Metric platen, machine <u>without</u> English/Metric switchover capabilities, switch to be left CLOSED.

* Explanation of correction input switches, Switches 1, 2, 3, and 4:

- a. Each correction step equals one basic DAR step.
i.e., 1) English Platen $\frac{20 - \text{Base of Platen}}{120 - \text{Point DAR}} = .0001666 \text{ in.}$
- 2) Metric Platen $\frac{.48 \text{ mm} - \text{Base of Platen}}{120 - \text{Point DAR}} = .004 \text{ mm.}$
- b. All switches are normally CLOSED (no correction).

(continued)

Table 4-2. English/Metric DAR PCB Switch Functions (continued)

* Explanation (continued)

- c. Switches input correction PROMS as binary notation as follows:

Switch 1 OPEN = 1_2

Switch 2 OPEN = 2_2

Switch 3 OPEN = 4_2

Switch 4 OPEN = 8_2

NOTE

Up to 15 correction steps are possible if all switches are open.

- d. Base distance over which switches enter correction steps is 12.8 inches or 325.12 mm. If Switch 1 is open, circuits give one correction step in base distance. If Switch 2 is open, circuits give two correction steps in base distance, or one correction every 6.4 inches or 162.56 mm. If Switch 3 is open, circuits give four correction steps in base distance, or one correction in every 3.2 inches or 81.28 mm. If Switch 4 is open, circuits give eight correction steps in base distance, or one correction in every 1.6 inches or 40.64 mm.
- e. If all switches (1,2,3,4) are open, circuits give 15 correction steps in base distance, or one correction step in every 0.85 inches or 21.67 mm.
- f. Switches cause a certain number of correction pulses to occur over a base distance. They can be used in any combination to give up to 15 corrections over the base distance.

4-8 DAMPER ADJUSTMENT

Dampers are adjusted at the factory and should not require further adjustment except when a DAR PCB or a motor is changed. The following procedure is used to adjust the damper circuit of the power supply and Damper PCB, Card A4 of the power supply, P/N 100073 (Ref. Dwg No. 100251).

1. Set prober Main Power Switch to OFF.
2. Open top cover of power supply.
3. Attach oscilloscope probes (Channel 1 and Channel 2) to TP1 and TP2 respectively on damper PCB.
4. Set oscilloscope to "add" and invert Channel 2.
5. Adjust horizontal sweep of oscilloscope to 5 msec/cm and vertical gain to 0.50 volts/cm.
6. Perform following steps to adjust Y Axis.
 - a. Set prober Main Power Switch to ON.
 - b. Hold joystick in Y direction "SCAN" position.
 - c. Adjust trimpot R32 for minimum fluctuation (less than 10 millivolts).
 - d. Disconnect oscilloscope probes from TP1 and TP2 and attach (Channel 1) to TP3 and (Channel 2) to TP4.
 - e. Adjust trimpot R35 for minimum fluctuation (less than 10 millivolts).
7. Perform following steps to adjust X Axis.
 - a. Set prober Main Power Switch to ON.
 - b. Hold joystick in X direction "SCAN" position.
 - c. Disconnect oscilloscope probes from TP3 and TP4 and attach (Channel 1) to TP5 and (Channel 2) to TP6.
 - d. Adjust trimpot R37 for minimum fluctuation (less than 10 millivolts).
 - e. Disconnect oscilloscope probes from TP5 and TP6 and attach (Channel 1) to TP7 and (Channel 2) to TP8.

- f. Adjust trimpot R29 for minimum fluctuation (less than 10 millivolts).

4-9 POSITIONER MOTION CYCLES

Because the ΔP motor drive pulses correspond to distance travelled, the pulse repetition rate must change gradually, within the physical capabilities of the positioner to follow. A full index sequence comprises four motion phases. These are Phase 0, no motion or quiescent state; Phase 1, acceleration; Phase 2, constant speed at a selected velocity; and Phase 3, deceleration. Short index cycles comprise three of the preceding phases: Phase 0, 1, and 3. Non-index cycles may comprise either the former or the latter, depending on the distance travelled. The pulse repetition rate increases during Phase 1, remains constant during Phase 2, and decreases during Phase 3. During Phase 0, the electrical current levels in the motor coils, designated by the last pulse of Phase 3, remain constant, locking the motor to the platen at the stopping point.

4-10 FULL INDEX CYCLES

Full index motion cycles occur whenever the selected index distance, or distance to be travelled during the motion cycle, exceeds the distance required to accelerate to the selected maximum velocity plus the distance required to decelerate from maximum velocity to rest. These two distance are always equal. Figure 4-4 is a velocity profile of a full index cycle. Since each ΔP pulse corresponds to an increment of distance, pulse repetition rate in pulses per second equals positioner velocity in steps per second. Acceleration and deceleration rate is a selectable constant; therefore, an arithmetic operation is used to calculate the number of pulses that must occur at the acceleration rate during Phase 1 to achieve the selected velocity for Phase 2. A signal, R2QZ, becomes active when the Phase 1 pulse count equals the calculated value. This initiates Phase 2, causing the pulse repetition rate to remain constant at the value attained during Phase 1. Another pulse count signal, DIRO, becomes active when the number of pulses remaining to complete the motion cycle equals the pulse count attained during Phase 1. This initiates Phase 3, causing the pulse repetition rate to decrease, at the same rate it increased during acceleration, until it comes to rest with the final

pulse. When the final pulse occurs, the total pulse count equals the commanded index distance in steps and the signal DIQZ goes active to initiate Phase 0.

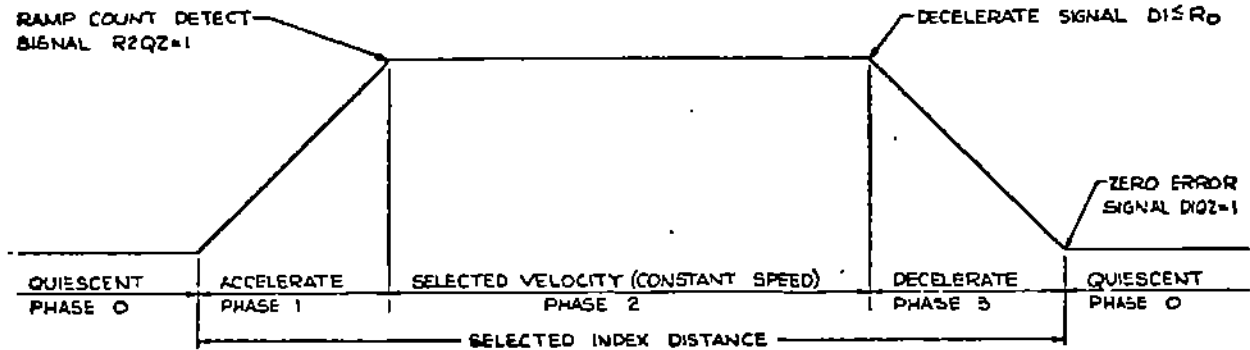


Figure 4-4. Velocity Profile--Full Index Cycle

4-11 SHORT INDEX CYCLES

When the distance to be travelled (index setting) is less than twice the distance required to reach maximum velocity, Phase 2 is eliminated. Counters determine when half the index setting has been reached and send the system directly into Phase 3. This constitutes a short index motion cycle. (Figure 4-5)

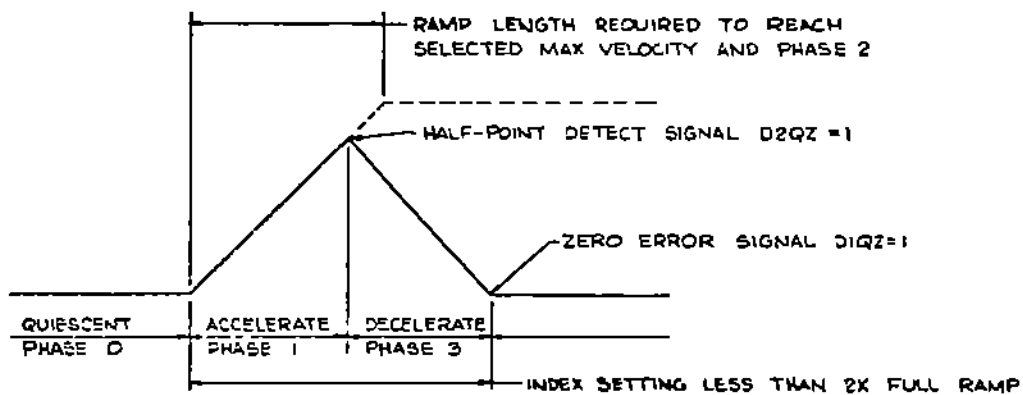


Figure 4-5. Velocity Profile--Short Index Cycle

4-12 NON-INDEX CYCLES

Any motion cycle that is regulated by the settings of the horizontal distance and vertical distance index digit switches is regarded as the normal mode of operation.

Non-Index, or auxiliary, modes maintain Phase 2 until the actuating signal is removed or, if the signal is removed before the selected velocity is reached, the motion goes directly from Phase 1 to Phase 3 (Figure 4-6).

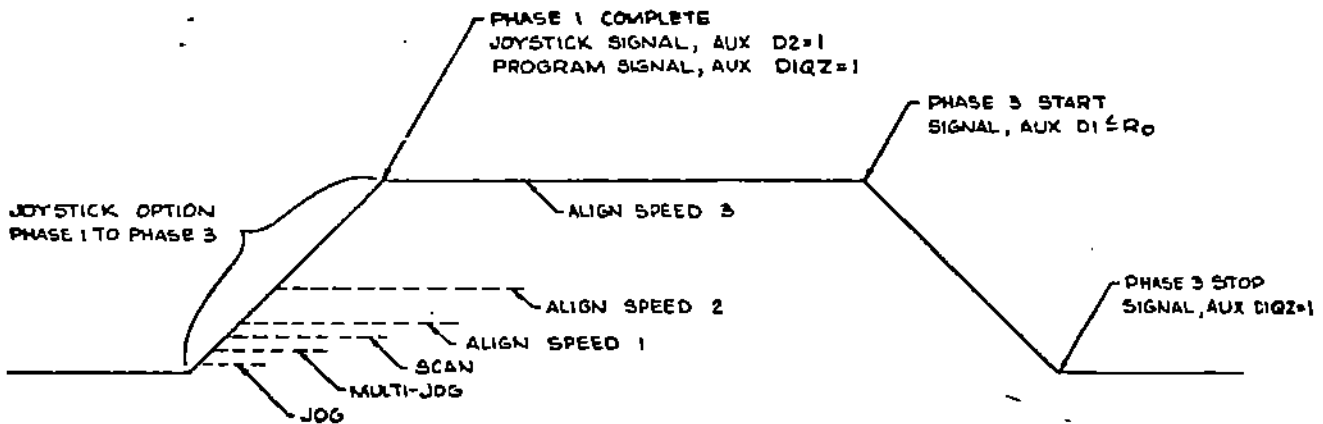


Figure 4-6. Velocity Profile--Non-Index Cycle

4-13 LINEAR MOTOR POWER SUPPLY

The power supply is contained in the power module described in Section 1, Paragraph 1-11. Drawing Number R-100172 is the wiring diagram for the power supply. The power supply receives drive pulses and direction commands from the probe logic circuits described in Section 5. Digital-to-Analog Resolvers (DAR's) convert these pulses and commands into the incremental sine/cosine waveforms.

Power amplifiers and attendant networks receive the waveforms, boost them to required levels, convert them to constant current outputs, and deliver them to the motor coils. Current feedback keeps the amplitude through the motor windings constant from direct current to maximum velocity frequencies. There is one power amplifier for each motor phase.

An oscillation damping circuit senses back-electromotive forces from the non-energized coils and converts them to signals delivered to the driving amplifiers or the energized coils. This produces a force in opposition to any tendency for the positioner to oscillate or ring.

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1034X

SECTION 5

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SECTION 5

SYSTEM LOGIC

5-0 INTRODUCTION

The Model 1034X Control Logic is contained on eight PC Boards mounted in the Prober Base Card Cage Assembly. Figure 5-1 is a functional block diagram of the major functions performed by the Control Logic.

5-1 RAMP SLOPE AND ALIGN LOAD CONTROL

The Ramp Slope and Align Load Control printed circuit board (PCB) is installed in the Prober Base Card Cage, Position A1. The logic for this board is shown on Drawing No. J 100037.

5-2 X-Y POSITIONING SYSTEM CLOCK

A 4.193 MHz crystal-controlled, astable multivibrator generates the nominal MHz clock. Two JK flip-flops divide this clock by four to generate the X/Y Positioning System 1.048-MHz system clock ΔF . The CONTACT SENSE signal inhibits ΔF whenever the Positioner chuck is in the Contact position. No Positioner X or Y motion can occur while ΔF is inhibited.

5-3 ABSOLUTE POSITION COUNTERS

The Absolute Position Counters (APC) consist of two 16-bit binary counters, one for each Positioner axis. The APC uses the ΔP step pulses from the Step Pulse Generators (paragraph 5-25) and the direction signals from the

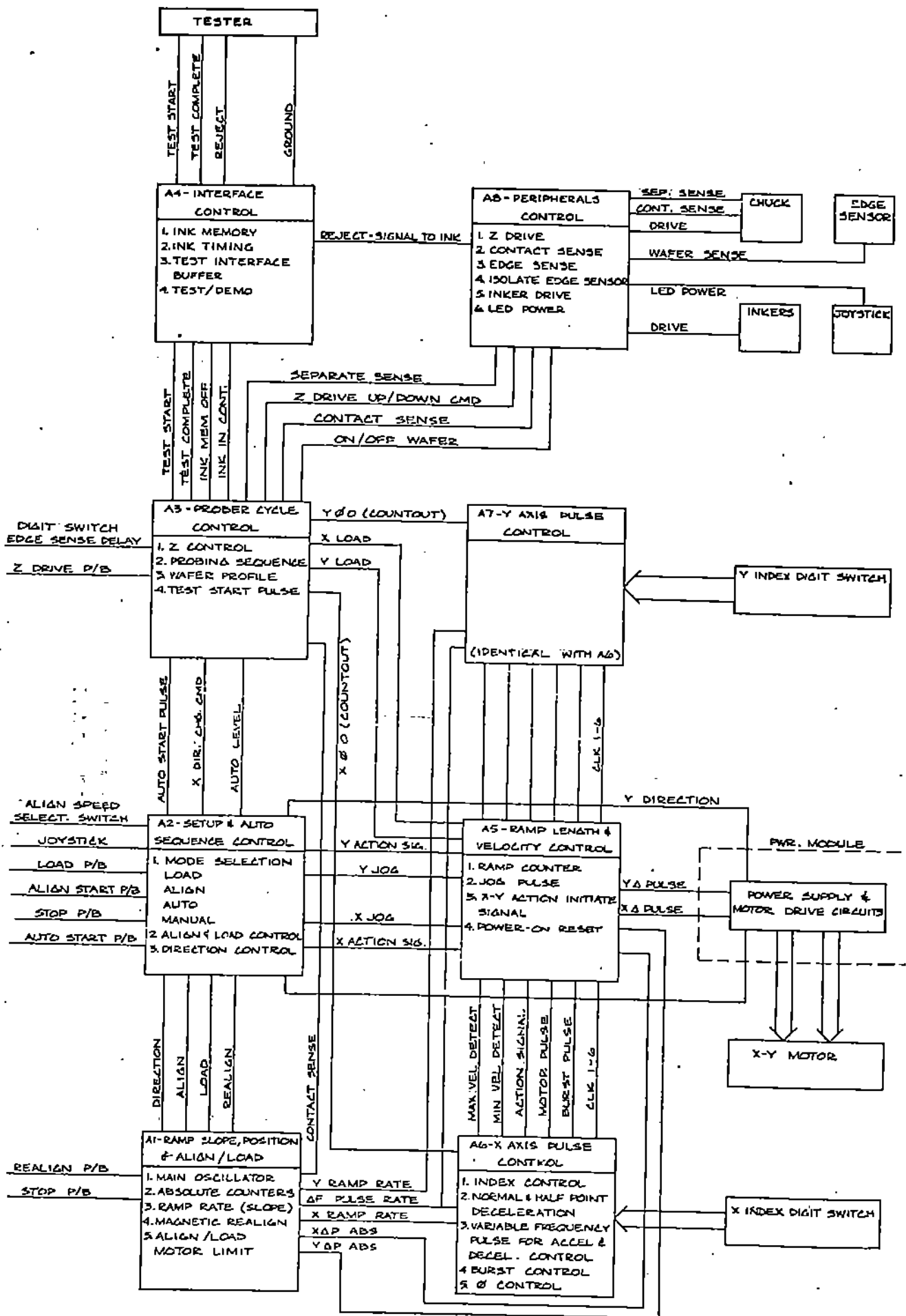


Figure 5-1. Logic Block Diagram

Set Up and Auto Sequence Control Logic (Paragraph 5-10) to continuously track the position of the X/Y Positioner on the platen surface. The home reference point for Positioner tracking is the Load position. The APC counters are reset to zero during the Positioner Initialization Procedure . (REALIGN) at which time the Positioner is placed in registration at the Load position. Whenever the Positioner is in registration, away from the Load position, the counter contents are grid coordinates of the Positioner, measured in steps from the Load position.

5-4 TRAVEL LIMIT CONTROL

Each axis has its own Travel Limit Control Logic consisting of a Zone Decoder and a Limit Decoder. The Travel Limit Control monitors the APC output for its respective axis and generates sense signals when the APC count corresponds to preprogrammed axis positions. The decoders are read-only memories (ROM) that are factory-programmed to provide the desired sense signals. The sense signals are gated to a hex D-type flip-flop circuit that generates appropriate Positioner command signals. These command signals control the Positioner in the Load and Align modes by establishing operational limits, and command Emergency Stop at platen travel limits. Switch SW1 is an eight-contact DIP switch mounted on the PCB (Drawing No. D 100040). These switches are described in the following three paragraphs.

5-5 English/Metric Switch

The English/Metric switch (SW1-4) permits use of this PCB in the Model 1034X-2 which uses a Metric-only Digital-to-Analog Resolver (DAR). When used in the Model 1034X-2, SW1-4 must be closed to generate a logical 0. For all other applications, including the Model 1034X-3, which has both English and Metric selection capabilities, SW1-4 must be set to OPEN.

5-6 Wafer Size Switches

Switches SW1-1 and SW1-2 permit variance of the X-axis travel distance during the Align-mode X-axis cycling operation (Paragraph 3-14) to accommodate different wafer sizes. Switches SW1-1 and SW1-2 are set as shown in the following table for designated wafer sizes.

Table 5-1. Switch Settings for Designated Wafer Sizes

<u>WAFER DIAMETER</u>	<u>SW1-1</u>	<u>SW1-2</u>
1 inch	Closed	Closed
2 inches	OPEN	Closed
3 inches	Closed	OPEN
4 inches	OPEN	OPEN

5-7 Speed Selection Switches

Switches SW1-5 and SW1-6 select the align-speed range. These switches are factory-set for the optimum align-speed range for a particular Positioner configuration. No operator adjustment is required of these switches. Speed selection within the set range is accomplished by the three-position ALIGN SPEED switch on the Operator Panel. (Table 5-2)

Table 5-2. Speed-Selection Switches

Not Available at This Time.

1, 3, 5, 6, 8 close
2, 4, 7 open

5-8 RAMP RATE GENERATOR

The Ramp Rate Generator consists of a ROM, a binary adder, and a shift register. The purpose of the generator is to generate the Ramp Rate (R RATE) signal used by the Ramp Slope Generator (Figure 5-6) to establish the acceleration and deceleration rates during Phases 1 and 3 of an X-Y Positioner motion cycle. Positioner acceleration is a function of an A_0 number. The ROM is programmed to contain four A_0 numbers, each of which represents a different acceleration rate required for specific operating modes. The four memory addresses are selected by the two binary inputs, SPD1 (LSB) and SPD2 (MSB). The Ramp Rate Generator output is the selected fixed-frequency pulse train (R RATE), the frequency of which is proportional to the selected A_0 number and F . (R RATE goes to the single-axis pulse control PCB's A6 and A7).

5-9 MAGNETIC REALIGNMENT

Magnetic realignment of the Positioner with the platen is accomplished by the Realign Motor Latch. (Figure 5-2) This latch is set by the Realign Motor pushbutton on the rear of the machine and reset by the Auto Align Stop pushbutton. When activated, it provides a signal to the Power Module, blanking the motor power and resetting motor-driver logic.

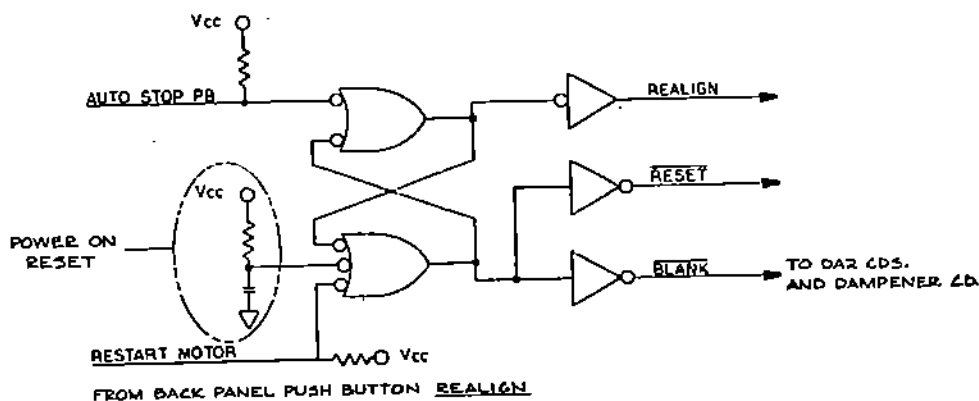


Figure 5-2. Magnetic Realignment

5-10 SETUP AND AUTO SEQUENCE CONTROL

The Setup and Auto Sequence Control PCB is installed in the Prober Base Card Cage, Position A2. The logic for this PCB is shown on Drawing No. R-100009.

5-11 MODE SELECTION AND START/STOP CONTROL

The four operating modes, Load, Align, Auto, and Manual, are selected by Operator Panel pushbuttons. Three latches control the operating modes. These latches are designated Load f/f, Align f/f, and Auto f/f. When none of these three latches are set, the control logic is in Manual mode. (Figure 5-3)

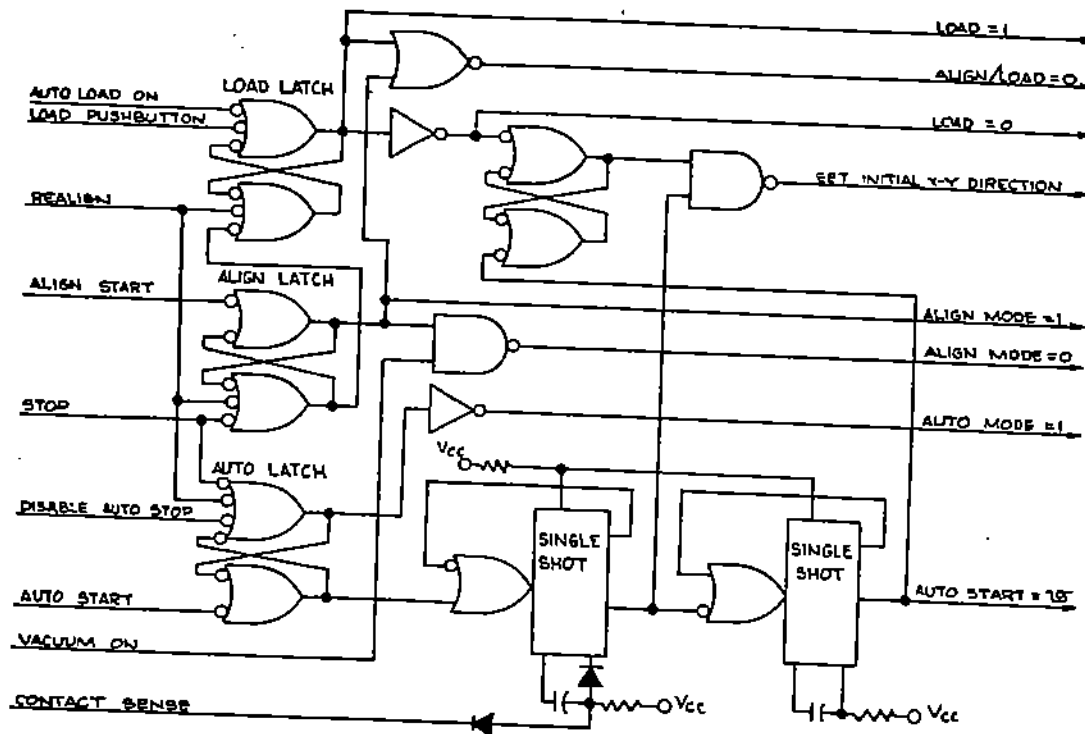


Figure 5-3. Mode-Selection Circuit

5-12 DIRECTION CONTROL LOGIC

The Direction Control Logic comprises two similar logic groups: one for X-axis direction control and the other for Y-axis direction control. Each logic group contains a direction flip-flop, a direction latch, and control and action logic.

5-13 Principles of Operation

The state of the direction flip-flop at the time of transition from Phase 0 to Phase 1 of a Positioner motion cycle determines the direction of Positioner motion on the associated axis. The direction flip-flops are JK-type flip-flops. Direction commands are gated to the direct set and direct clear inputs. The clear states of these flip-flops designate X-axis Right and Y-axis Up respectively, and the set states designate the converse. The outputs of the direction flip-flop control a direction latch that is latched to correspond with the direction flip-flop state when Phase 1 occurs at the start of a motion cycle. The latch remains latched throughout the motion cycle until the return to Phase 0, which occurs when the motion cycle is complete. The reverse-motor signal from the associated axis burst pulse generator appears as either X REV M or Y REV M and is gated with the direction latch output to accomplish motor reversal during burst-pulse generation used for deceleration.

NOTE

Direction signals designate X-Y Positioner true direction, not apparent direction as observed through the microscope and indicated by the Indicator Panel direction arrows.

5-14 Patching Options

Patching terminals 3 through 12 on the Setup and Auto Sequence Control PCB permit variations in the Auto Cycle probing pattern. The basic Auto Cycle sequence causes the Positioner to sequentially index on the X axis in the direction selected by the X-direction flip-flop until an off-wafer sense signal indicates the probes have moved off the wafer. The Positioner then indexes once on the Y axis in the direction selected by the Y-direction flip-flop and

X-direction change pulse is applied to the clock input of the X-direction flip-flop to initiate X-direction reversal. This alternating X and Y action continues until an off-wafer sense signal occurs following a Y index, which terminates Auto-Cycle operation. The condition of the two direction flip-flops at the time Auto Cycle is initiated, therefore, determines the probing pattern.

If the Y-direction flip-flop is in the Down condition (Set), Positioner indexing is down, causing the wafer rows to be probed from bottom to top, and vice-versa. If the X-direction flip flop is in the Right condition (Clear), Positioner indexing is right on each odd-numbered row (probing from right to left) and left on each even-numbered row, and vice-versa.

The patching options determine the method used to set the two direction flip-flops for auto-cycle operation. The two basic options are manual and automatic setting. These options are described in the following two paragraph and the required patching connections are given in Table 5-3.

The Manual setting option is used when frequent pattern changes are required. With this option, the Operator Panel DIRECTION pushbutton and the joystick must be used to manually set the direction flip-flops, by reference to the Indicator Panel direction arros, for each auto-cycle operation prior to pressing the AUTO CYCLE START pushbutton.

NOTE

Patches must be changes to manual operation. (Table 5-3)

The automatic setting option is used for fixed-probing patterns. With this option, the direction flip-flops are set to a preselected condition at the initiation of auto-cycle operation, resulting in a fixed-probing pattern that can be altered by manual intervention when desired. For the automatic option, the /SET INITIAL XY DIR signal is used to preselect the condition of the direction flip-flops. This signal is an active low pulse that occurs the first time the AUTO CYCLE START pushbutton is pressed following a load operation (auto-cycle initiation). This signal appears at patching terminals 3 (for Y-axis patching) and 6 (for X-axis patching) and may be patched to eiter the Set or Clear input gates of both direction flip-flops.

Table 5-3. Auto Cycle Probing Pattern Patching Options

<u>PATCHING OPTION</u>	<u>JUMPER TERMINAL CONNECTIONS</u>
Automatic initial X right	6 to 12 and 8 to 7
Automatic initial X left	6 to 7 and 11 to 12
Manual initial X selection	11 to 12 and 8 to 7
Automatic Y up	3 to 5 and 9 to 10
Automatic Y down	3 to 10, leaving 9 and 5 open
Manual Y selection	9 to 10, leaving 3 and 5 open

5-15 ALIGN/LOAD CONTROL (PCB A1)

The absolute position of the X and Y axes is tracked by two 16-bit binary counters, one for each axis. The counters are continuously updated by the motor-step pulses and direction-command signals. The output of these counters is decoded to define the limits of X and Y travel during load and align modes of operation. (Figures 5-4 and 5-5)

The load position of the motor is "home" or zero count. During commands to return to "load", a hard-wired number "SELECT UNLOAD DECELERATION", which defines the deceleration ramp is released by a comparator. This occurs when the absolute position count is equal to the hard-wired number.

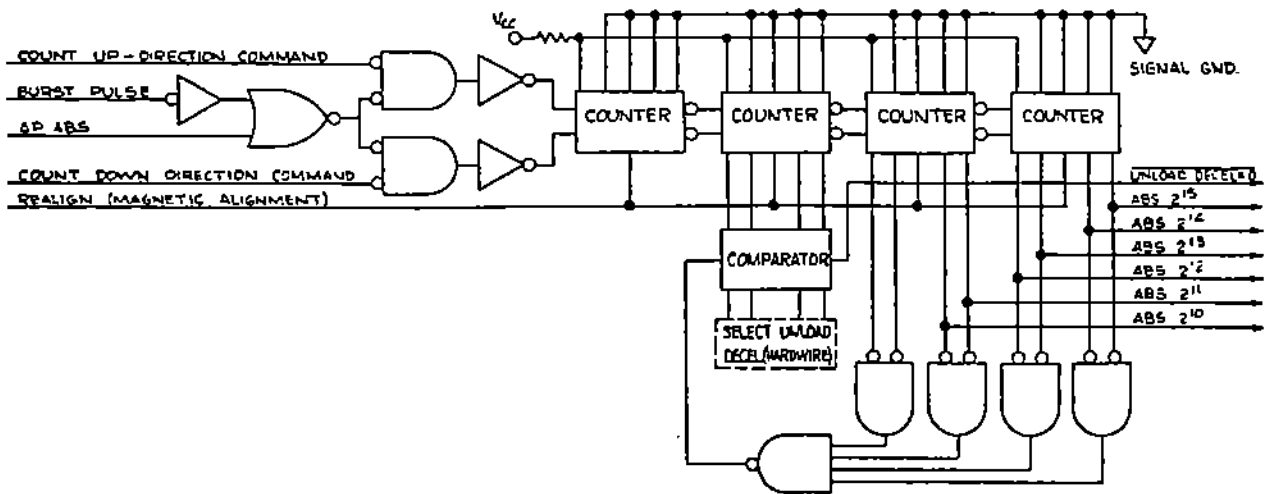


Figure 5-4. Absolute Position Counter

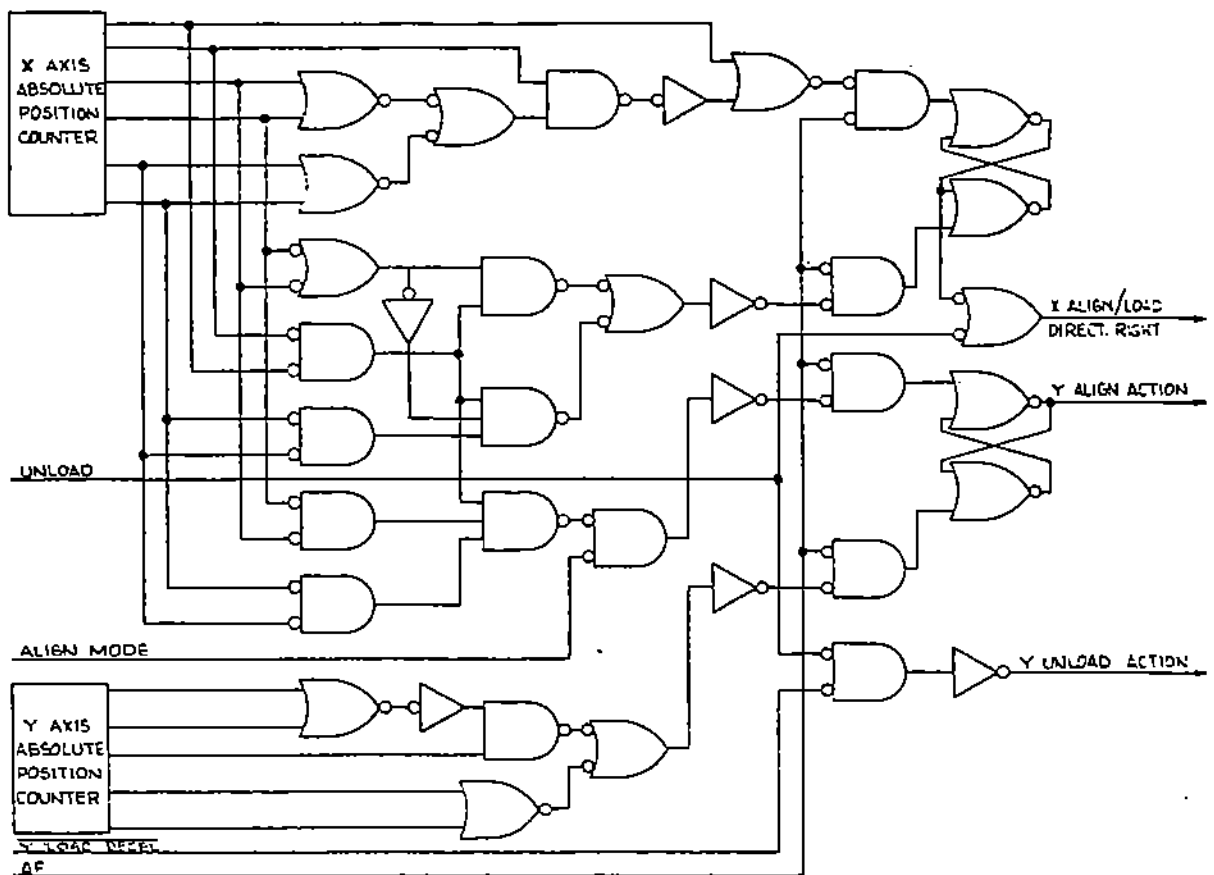


Figure 5-5. Align/Load Decoding Network

5-16 PROBER CYCLE CONTROL

The Prober Cycle Control PCB is installed in the Prober Base Card Cage, position A3. The logic for this PCB is shown on Drawing R-100013. The primary purpose of this logic is to control the auto-cycle sequence of operations. Figure 5-6 is a flow diagram of the operations performed during auto-cycle operation.

5-17 INTERFACE CONTROL

The Interface Control PCB is installed in the Prober Base Card Cage, position A4. The logic for this board is shown on Drawing R-100017.

5-18 TESTER AND INKERS INTERFACE

The Tester and Inkers Interface PCB functions as the interface between the Model 1034X Prober and the external tester and inkers. It contains the inker memories, inking cycle timing circuits, tester interface buffer, and circuits for the test demonstration. Figure 5-7 is a block diagram depicting the major functions of this PCB.

5-19 DIRECTION INDICATOR CONTROL

The Direction Indicator Control PCB also contains the Indicator Panel direction arrow-drive logic. This logic is shown in Figure 5-8. It provides the necessary inversion so that the arrows indicate opposite to the Positioner direction to show the apparent probing direction as observed through the microscope. The input signals, X RIGHT INTERNAL and Y UP INTERNAL, are generated by the direction-control logic (Paragraph 5-12). These two signals denote Positioner direction and equal X RIGHT/X LEFT and Y UP/Y DOWN, respectively.

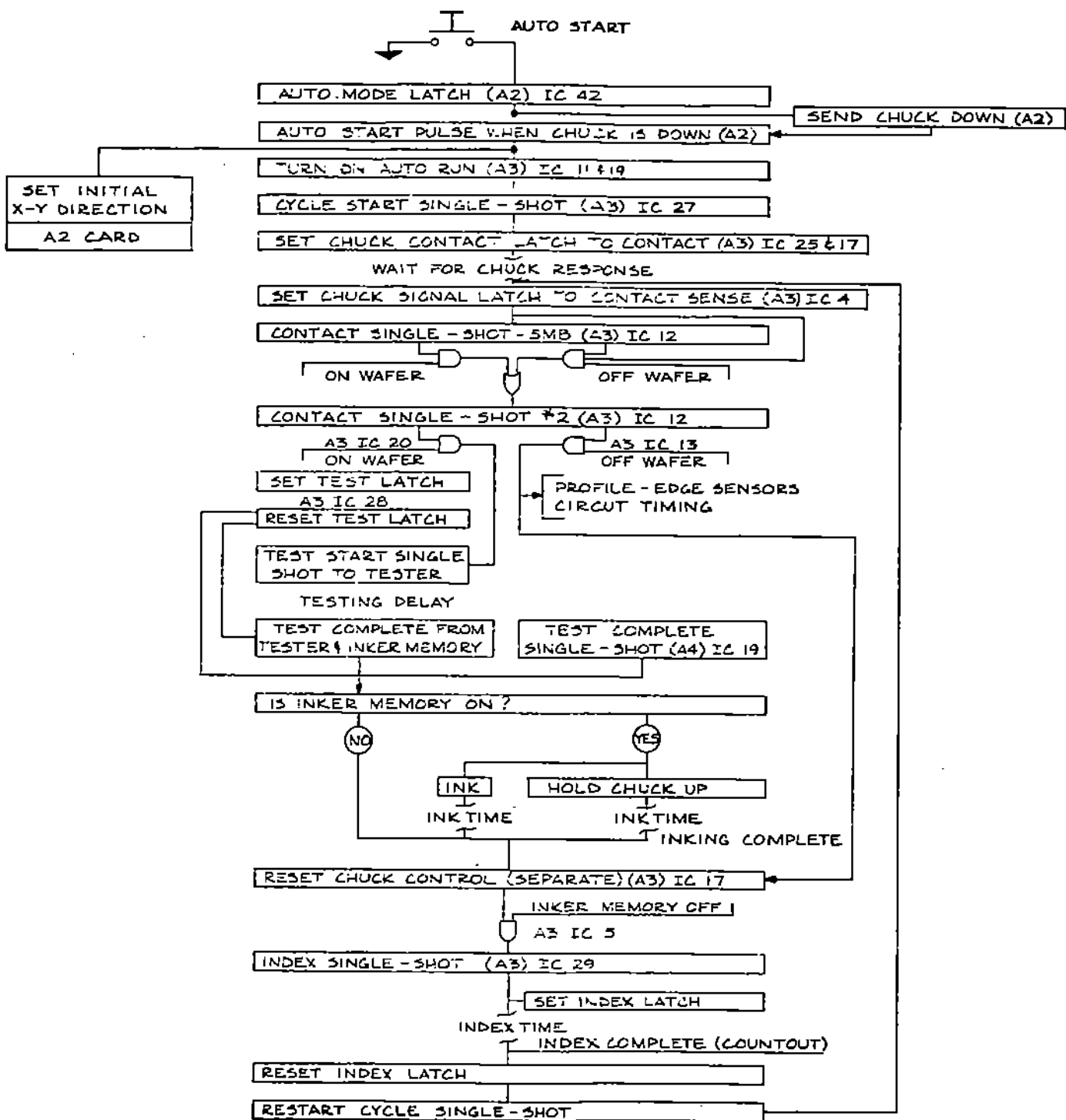


Figure 5-6. Prober Cycle Control Flow
5-12

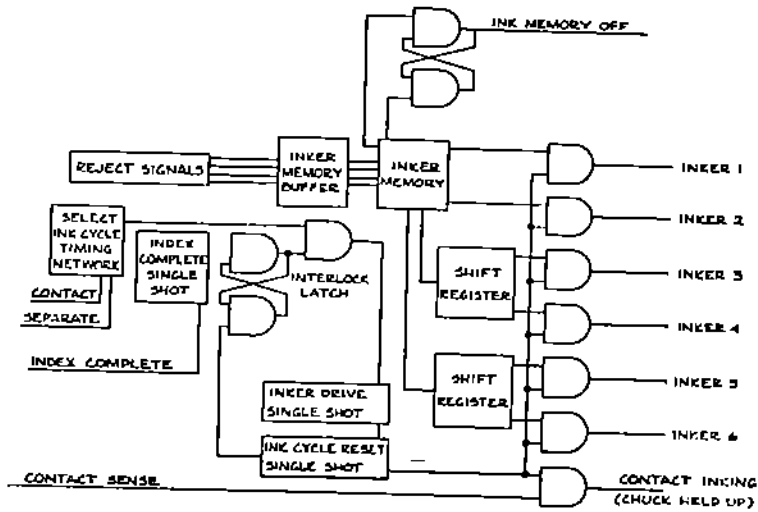


Figure 5-7. Inker Memory and Timing Circuits

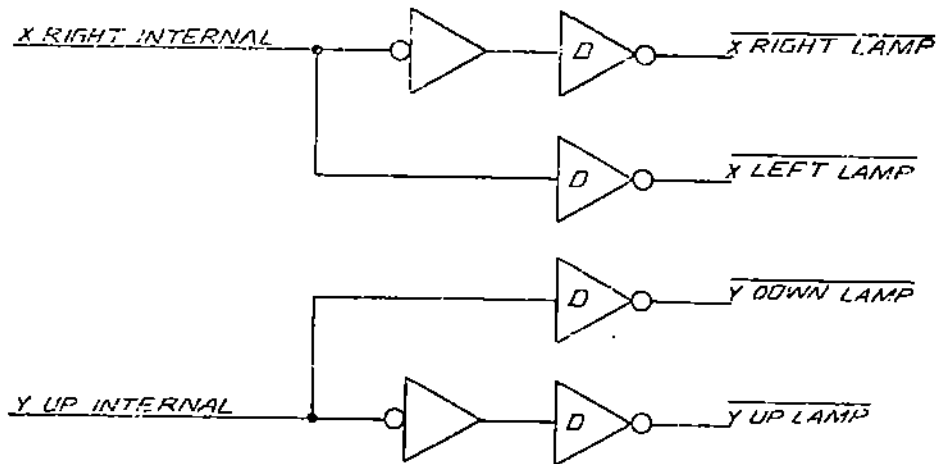


Figure 5-8. Direction Indicator Driver Logic

5-20 TEST START, TEST COMPLETE, and DEMO MODE

Not Available at This Time.

5-21 RAMP LENGTH AND VELOCITY CONTROL

The Ramp Length and Velocity Control PCB is installed in the Prober Base Card Cage, position A5. The logic for this PCB is shown on Drawing No. R-100029.

5-22 VELOCITY CONTROL

During Phase 2, the Positioner velocity is constant on each axis at a selected speed. This speed is controlled by two factors--ramp slope and ramp length. Ramp slope is determined by the rate of change in pulse frequency during acceleration, which is a function of the ramp-rate generator (Figure 5-9; Paragraph 5-8). Ramp length is determined by the number of pulses that occur during acceleration. This phenomenon is a function of the R_0 number. The velocity attained by acceleration during Phase 1 is the velocity traveled during Phase 2.

5-23 RAMP LENGTH CONTROL

The Ramp Length Control Logic is essentially the same for each axis. (Figure 5-10). The control logic determines velocity by counting motor-step pulses during acceleration and comparing the count with a number (R_0) that represents a predetermined velocity at the selected acceleration rate. The R_0 number is supplied to the comparator by a multiplex integrated circuit that has factory-jumpered pin connections to provide the correct R_0 number for the conditions selected by the velocity control logic. Sheet 2 of Drawing No. R-100029 shows the factory-jumpered options. When the R2 count, provided by the motor-step pulse counter, equals the programmed R_0 number, the R2QZ signal that terminates Phase 1 is generated. The R2 counter is used to signal the end of the deceleration ramp; that is, signal AUX D1QZ is generated. During all modes of operation other than Index, the signal AUX D1QZ is used by the phase control to advance from Phase 3 to Phase 0.

5-24 JOG SPEED CONTROL

The same ramp length is established for JOG and SCAN. However, in JOG modes, the normal motor pulses are disabled and replaced with the carry outputs of a 4-bit or 8-bit counter. In JOG, the motor-pulse frequency is divided by 256; in multi-JOG, it is divided by 16. (Figure 5-11)

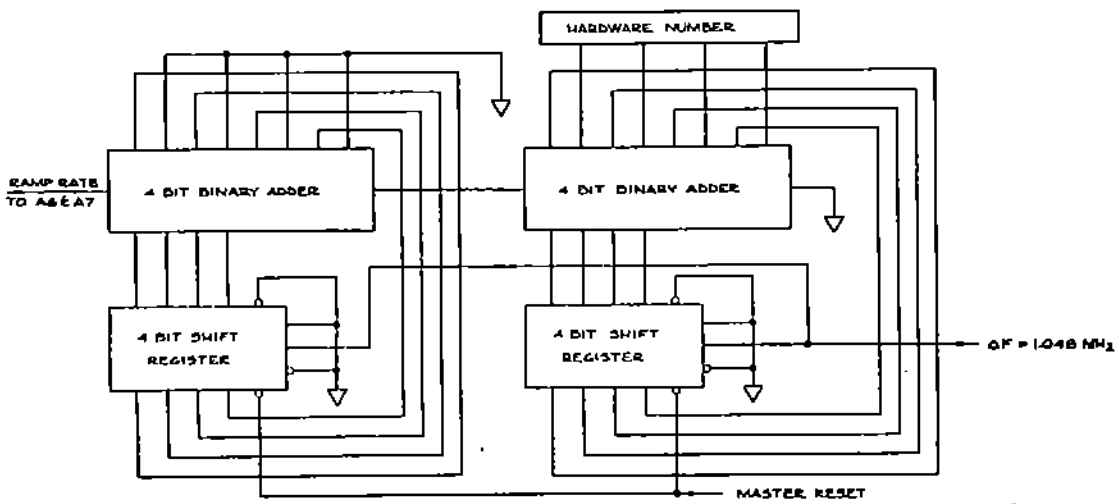


Figure 5-9. Ramp Slope Generator

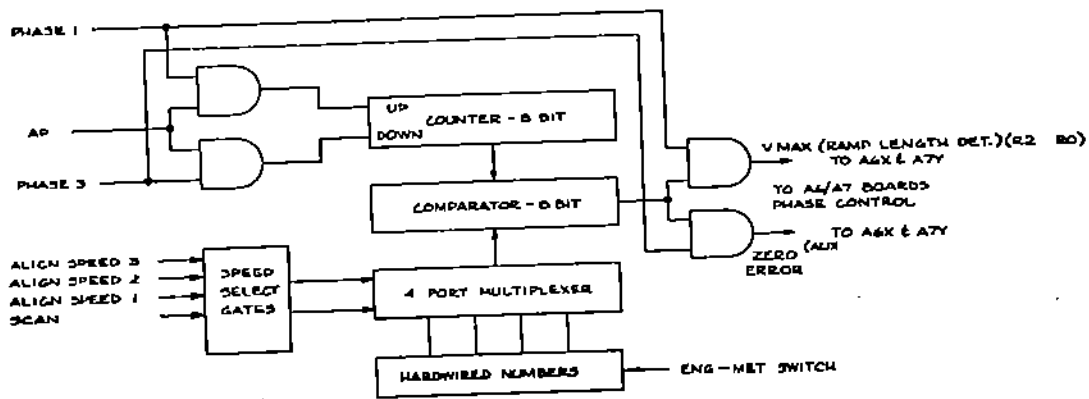


Figure 5-10. Ramp Length Control

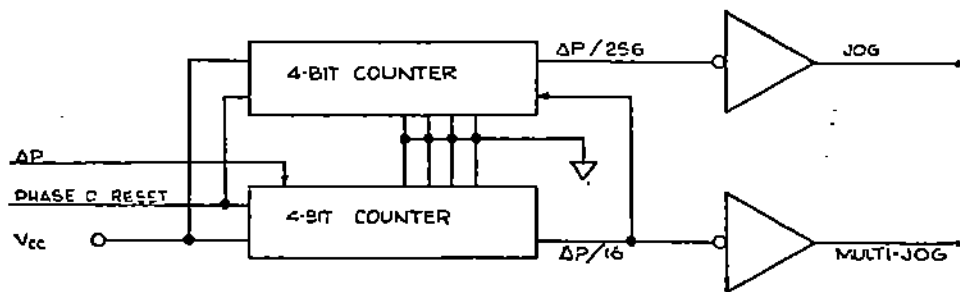


Figure 5-11. Jog and Multi-Jog Pulse Derivation

5-25 SINGLE-AXIS PULSE CONTROL

One Single-Axis Pulse Control PCB is used for each axis. (PCB A6 = X Axis, PCB A7 = Y Axis). The X-axis PCB is installed in the Prober Base Card Cage, position A6, and the X-axis PCB is installed in position A7. The logic for this board is shown on Drawing No. R-100001.

5-26 STEP PULSE GENERATOR

The motor Step Pulse Generator (Figure 5-12) is a rate multiplier that generates motor-step pulses (ΔP) by digital frequency division of the output of a velocity control counter. The velocity control counter clock input is the selectable frequency pulse train (R RATE) output of the Ramp Rate Generator (Paragraph 5-8). The counter counts up during acceleration (Phase 1), holds the attained count during constant speed (Phase 2), and counts down during deceleration (Phase 3). The ΔP frequency, or pulse-repetition rate, at the rate-multiplier output is proportional to the numerical value of the input (V) from the counter and ΔF .

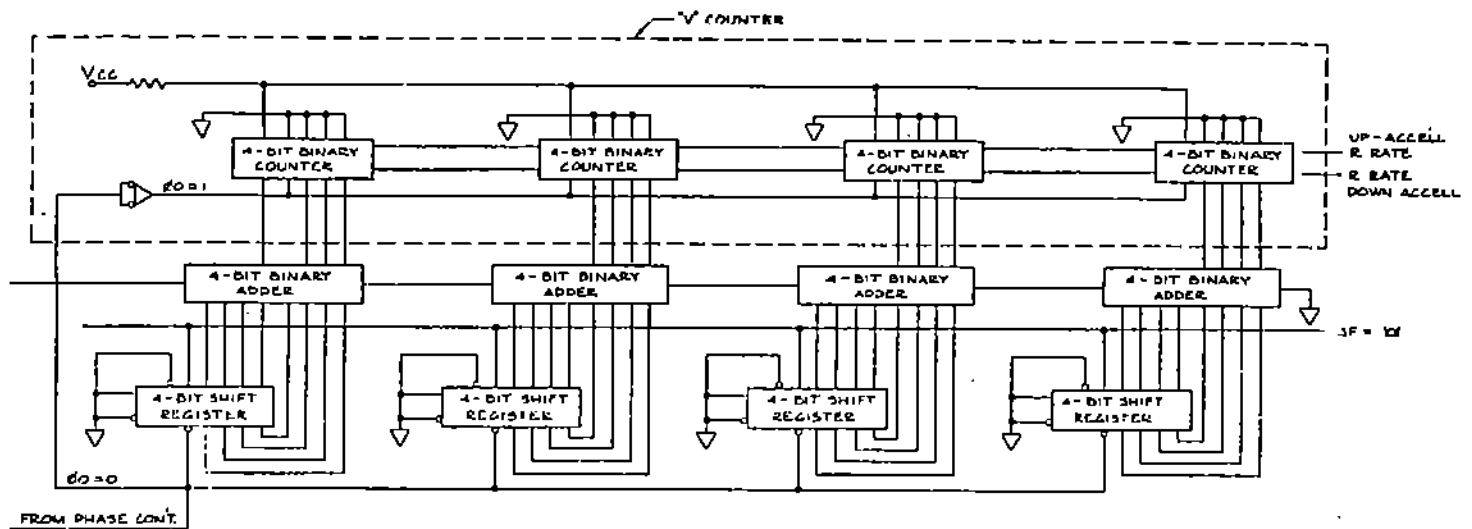


Figure 5-12. Motor Step-Pulse Generator

5-27 Rate Multiplier

The rate multiplier consists of a 16-bit binary adder and accumulator that is clocked by the fixed, 1.04 MHz, frequency ΔF clock. Each clock pulse increments the accumulator by the numerical value of V . The accumulator cycles iteratively through its 65,535-count capacity and generates a motor-step pulse (gated to become ΔP) once each cycle. The ΔP frequency, therefore, may be expressed as follows:

$$P = \frac{1.04 \text{ MHz}}{65,535} \times V$$

5-28 Velocity Control Counter

The 16-bit velocity control counter provides the frequency control (V) input to the rate multiplier. The counter is cleared during Phase 0 so that V equals 0. The selectable frequency clock input, $R \text{ RATE}$, remains constant at the selected frequency throughout any particular motion cycle. The $R \text{ RATE}$ signal is gated to the count-up input during Phase 1 and the count-down input during Phase 3 and is inhibited during Phases 0 and 2. During acceleration, therefore, V may be expressed as follows:

$$V = R \text{ RATE} \times t$$

Where t is the elapsed time of Phase 1 in seconds and $R \text{ RATE}$ is in Hz.

Equations 1 and 2 show that ΔP has a constant frequency determined by the value of V when V is a constant value (Phase 2) and an accelerating (Phase 1)

or decelerating (Phase 3) frequency when V is an accelerating or decelerating value.

5-29 BURST PULSES (PCB A6 and A7)

To provide rapid acceleration and deceleration, normal motor-drive pulses are supplemented with a short train of "burst" pulses delivered too quickly for the motor to immediately follow. This produces a magnetic tension or "torque".

The burst control circuit (Figure 5-13) includes a 4-bit comparator, an up-down counter, a gating network, and a predetermined hardwire number which controls the number of pulses in each train.

Phase 1 starts with an initiating-clock pulse which enables the train number to enter the up-down counter. The comparator, recognizing that A is greater than B, permits ΔF pulses to down-count the counter until A equals B and simultaneously releases advancing burst pulses to the motor.

A Phase 2 signal gates the train number to the comparator, making A less than B. ΔF pulses now up-count and are simultaneously released as reversing burst pulses.

A Phase 0 signal gates the train number, making A greater than B, releasing advancing burst pulses, and returning to the conditions of Phase 0.

NOTE

Burst pulses are not enabled during jog modes.

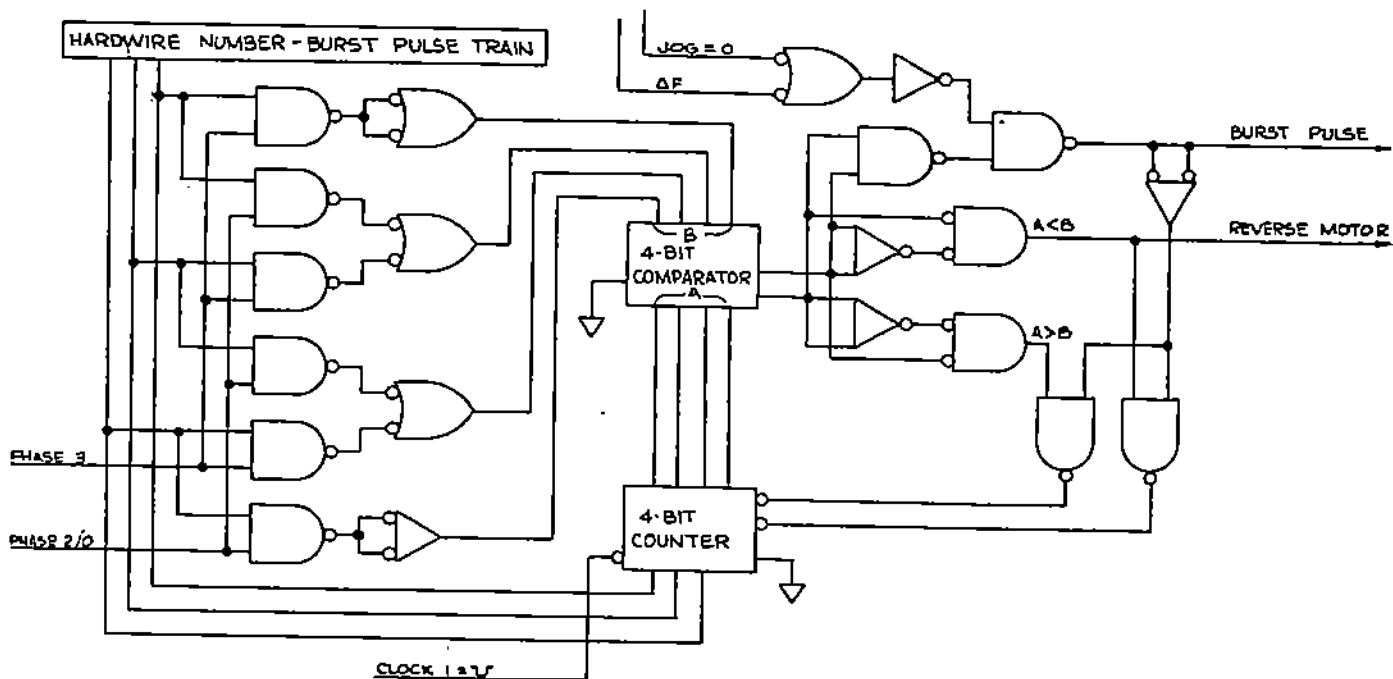


Figure 5-13. Burst Pulse Generator

5-30 PERIPHERALS CONTROL

The Peripherals Control PCB (Drawing No. D-100298) is used in Model 1034X probers furnished with nonprogrammable Model 90 and 180 High-Speed Chucks. (Refer to Chuck Configuration Chart on Prober Base Assembly, Drawing No. D-100339, for chuck option identification). When furnished, this PCB is installed in Prober Base Card Cage position A8. Probers furnished with a programmable chuck use the Adaptive Z-Control PCB in position A8.

5-31 PERIPHERALS DESCRIPTION

The functions performed by the Peripherals Control PCB logic include the following:

- o Inker drive power
- o Source of constant current for joystick LED's
- o High-Speed Chuck Z-motor drive control
- o Edge sensor electrical isolation
- o Chuck position contact sense signal generation
- o Chuck edge sensor On-Wafer and Off-Wafer signal generation

- o Source current for Z-motor LED's

5-32 CHUCK MOTOR-DRIVE LOGIC

The heart of the chuck motor-drive circuit is a gray-code ring counter which sequentially steps the four phases of the chuck motor. The step direction is reversible, providing clockwise or counterclockwise rotation. Figure 5-14 is a simplified diagram of the circuit.

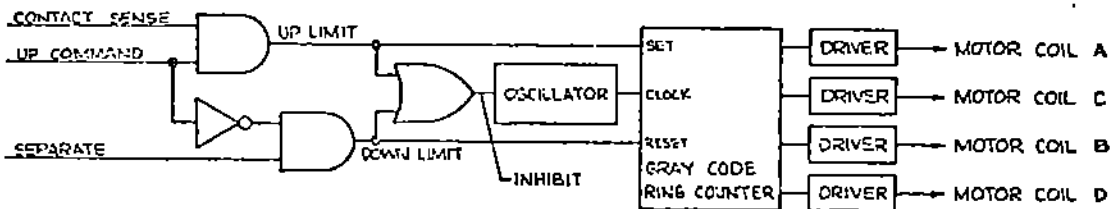


Figure 5-14. Z-Drive Circuit

Two photo-detectors on the shaft output are used to limit rotation in either direction by forcing the counter to a specific motor command when the limit is reached.

5-33 OVERTRAVEL CONTROL

Overtravel control is accomplished by four DIP switches mounted on the Adaptive Z Control PCB. These switches are designated SW1-1, SW1-2, SW1-3, and SW1-4, and select overtravel steps in inverted binary notation. Each programmed overtravel step increases overtravel by 0.001 inch over the 0.003-inch standard preload overtravel provided by the Up Travel Control logic. Setting any one of the DIP switches to OPEN generates a logical 1; closing a switch generates a logical 0. Table 5-4 shows the binary and decimal values of the switches with respect to overtravel step programming. Table 5-5 gives programming examples.

Table 5-4. Overtravel Programming

Switch SW1	-1	-2	-3	-4
Bit Value	2^3	2^2	2^1	2^0
Decimal Value	$\bar{8}$	$\bar{4}$	$\bar{2}$	$\bar{1}$

Table 5-5. Overtravel Programming Examples

Sw1	-1	-2	-3	-4	Programmed Overtravel Steps
	1	1	1	1	0
	1	1	0	1	2
	1	1	0	0	3
	0	0	0	0	15

Note: Switch set to OPEN = 1

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SECTION 6

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 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

SECTION 6

MAINTENANCE

6-0 INTRODUCTION

The Model 1034X Automatic Wafer Prober is designed for long, trouble-free service, but, like any precision mechanism, it must be protected from conditions that accelerate wear. Such conditions include improper lubrication, abrasive debris, moisture or corrosive agent contamination, damage from impact, and mechanical misalignment. This section includes the essential information required to properly maintain the Model 1034X.

6-1 PREVENTIVE MAINTENANCE

Preventive maintenance procedures are designed to eliminate the conditions conducive to accelerated wear. Table 6-1 is a Ready-Reference Maintenance Schedule for the Model 1034X.

6-2 WEEKLY MAINTENANCE

Weekly, the prober should be checked for malfunctions in normal operation. This is accomplished by operating the prober in the Demo mode with a wafer on the chuck and an edge sensor installed. Refer to Table 6-2, Troubleshooting Table, if any malfunctions appear. The platen surface should be inspected for evidence of corrosion or oil and foreign material deposits. Special care must be used to thoroughly clean the platen. The following steps should be performed to accomplish platen cleaning.

1. Remove any oil and gummy deposits with Ace Surface Plate Cleaner (or its equivalent) and a soft, lint-free cloth..

Table 6-1. Ready-Reference Maintenance Schedule

ITEM	MAINTENANCE SCHEDULE (FREQUENCY)
Air Supply Filters and Dehydrator	As often as required to maintain required utilities specified in Section 1, Table 1-1.
Normal Operation of Prober	Weekly (Paragraph 6-2).
Platen Surface	Weekly (Paragraph 6-2)
Air Leak Inspection	Weekly (Paragraph 6-2).
Light Bulbs	Weekly (Paragraph 6-2)
Cables and Interconnections	Monthly (Paragraph 6-3)
Platen Surface Protection	Monthly (Paragraph 6-3)
Joystick Constant Current Source Adjustment	Quarterly (Paragraph 6-4)
Air Passages	Quarterly (Paragraph 6-4)
Power Supply & Dampener Board Adjustment	Quarterly (Paragraph 6-4)
Chuck Planarization	Quarterly (Paragraph 6-4)
Chuck Planarization Gasket	Quarterly (Paragraph 6-4)
Oil Collector Pad	Quarterly (Paragraph 6-4)
Quad X Ring (Vacuum Insert Assembly)	Quarterly (Paragraph 6-4)
Prober	Quarterly (Paragraph 6-4)
Positioner Alignment	Anytime system power has been off
Fuses and Fuseholders	Repaired/replaced when necessary

Table 6-1. Ready-Reference Maintenance Schedule (continued)

ITEM	MAINTENANCE SCHEDULE (FREQUENCY)
Large & Small Oil Pads	Lubricate quarterly, when Oil Collector Pad is replaced (Paragraph 6-4)
Panel Light Bulb	Replace when required.
Lamp Driver Transistor	Replace when required.
Connector J9	Verify correct installation when necessary (See Table 6-2, Troubleshooting Table).
Microscope Illuminator Lamp	Replace when required.
Joystick Connector	Repair/replace when required.
Interface Cable to Tester	Repair/replace when required.
Printed Circuit Boards (PCB's)	Repair/replace when required (Table 6-2, Troubleshooting Table)
X-Y Positioner Power Amplifier Adjustment	When required (Table 6-2, Troubleshooting Table)
Flat Motor Cable Continuity	When required (Table 6-2, Troubleshooting Table)
X-Y Interconnecting Cable Continuity	When required (Table 6-2, Troubleshooting Table)
PCB A4, Dampening Circuit Adjustment	When required (Table 6-2, Troubleshooting Table).
Joystick	Repair/replace when required (Table 6-2, Troubleshooting Table)
5V DC Power Supply	Repair/replace when required (Table 6-2, Troubleshooting Table)
Z Drive Assembly Photocells	Replace when required (Table 6-2, Troubleshooting Table)
Manual Theta Drive Assembly Adjustment	When required (Table 6-2, Troubleshooting Table)

Table 6-1. Ready-Reference Maintenance Schedule (continued)

ITEM	MAINTENANCE SCHEDULE (FREQUENCY)
Z-Axis Overtravel Adjustment	When required (Table 6-2, Troubleshooting Table)
Warping	When detected (Paragraph 6-29)
Epoxy Undercut or Erosion	When detected (Paragraph 6-30)

Table 6-2. Troubleshooting Table

MALFUNCTION	MAINTENANCE PROCEDURES TO BE PERFORMED
Intermittent Misindexing	<ol style="list-style-type: none"> 1. Check and replace bad fuses. 2. Perform procedures in Paragraph 6-2, Weekly Maintenance. 3. Check for clogged air passages, and perform procedures in Paragraph 6-4. 4. Check X-Y Motor Power Amplifiers by performing procedures in Paragraph 6-7. 5. Check point-to-point continuity of Flat Motor Cable (Paragraph 6-8) and replace if defective. 6. Check point-to-point continuity of X-Y Interconnect Cable (Paragraph 6-9) and replace if defective. 7. Perform Dampening Circuit, A4, Adjustment (Paragraph 6-10). 8. If only X axis is misindexing, repair/replace PCB A6 in Base Module Card Cage (Paragraph 6-11). 9. If only Y axis is misindexing, repair/replace PCB A7 in Base Module Card Cage (Paragraph 6-11). 10. Repair/replace PCB A5 in Base Module Card Cage (Paragraph 6-12). 11. Repair/replace PCB A1 in Base Module Card Cage (Paragraph 6-13). 12. Perform magnetic alignment (Paragraph 6-6). 13. Repair/replace PCB A2 in Power Module Card Cage (Paragraph 6-16). 14. Repair/replace PCB A3 in Power Module Card Cage (Paragraph 6-17).
Misindexing	<ol style="list-style-type: none"> 1. Perform Steps 1-14 for intermittent misindexing (above). 2. Repair loose fuseholders.
Joystick Inoperative or Intermittent	<ol style="list-style-type: none"> 1. Repair/replace joystick (Paragraph 6-15). 2. Repair/replace PCB A2 in Base Module Card Cage (Paragraph 6-16). 3. Repair/replace PCB A8 in Base Module Card Cage (Paragraph 6-19). 4. Repair/replace 5V DC Power Supply (Paragraph 6-23). 5. Replace panel light bulb or lamp driver transistor. 6. Verify that Connector J9 is correctly installed. 7. Repair/replace joystick connector (Dwg No. 100345). 8. Repair/replace connector pertaining to joystick operation (Dwg No. 100345).
Blows Fuses ($\pm 28V$ DC)	<ol style="list-style-type: none"> 1. Check and replace bad fuses. 2. Check X-Y Motor Power Amplifiers (Paragraph 6-7). 3. Check point-to-point continuity of Flat Motor Cable (Paragraph 6-8) and replace if defective. 4. Check point-to-point continuity of X-Y Interconnect Cable (Paragraph 6-9) and repair/replace is necessary. 5. Repair/replace 5V DC Power Supply (Paragraph 6-23). 6. Repair loose fuseholders.

Table 6-2. Troubleshooting Table (continued)

MALFUNCTION	MAINTENANCE PROCEDURES TO BE PERFORMED
Loses Registration	<ol style="list-style-type: none"> 1. Perform procedures 1-12 for Intermittent Misindexing (Page 6-). 2. Repair loose fuseholders.
Does Not Go Into Align or Unload	<ol style="list-style-type: none"> 1. Perform procedures 1-12 for intermittent Misindexing (Page 6-). 2. Repair/replace PCB A2 in Base Module Card Cage (Paragraph 6-16).
X-Y Motor Hums When At Rest	<ol style="list-style-type: none"> 1. Check and replace bad fuses. 2. Check X-Y Motor Power Amplifiers by performing procedures in Paragraph 6-7. 3. Check point-to-point continuity of Flat Motor Cable (Paragraph 6-8) and replace if defective. 4. Check point-to-point continuity of X-Y Interconnect Cable (Paragraph 6-9) and replace if defective. 5. Perform Dampening Circuit, A4, Adjustment (Paragraph 6-10).
X-Y Motor Moves Intermittently With Z UP	<ol style="list-style-type: none"> 1. Perform procedures in Paragraph 6-2, Weekly Maintenance. 2. Repair/replace PCB A1 in Base Module Card Cage (Paragraph 6-13). 3. Repair/replace joystick (Paragraph 6-15). 4. Check and replace defective photocells in Z Drive Assembly (Paragraph 6-24). 5. Perform Z-Axis Overtravel Adjustment (Paragraph 6-27).
Intermittently Scruffed Probe Marks	<ol style="list-style-type: none"> 1. Check X-Y Motor Power Amplifiers by performing procedures in Paragraph 6-7. 2. Check point-to-point continuity of Flat Motor Cable (Paragraph 6-8) and replace if defective. 3. Check point-to-point continuity of X-Y Interconnect Cable (Paragraph 6-9) and replace if defective. 4. Perform Dampening Circuit, A4, Adjustment (Paragraph 6-10). 5. Repair/replace PCB A6 in Base Module Card Cage (Paragraph 6-11). 6. Check and replace defective photocells in Z Drive Assembly (Paragraph 6-24). 7. Perform Manual Theta Drive Assembly Adjustment (Paragraph 6-25). 8. Planarize chuck (Paragraph 6-26). 9. Perform Z-Axis Overtravel Adjustment (Paragraph 6-27).

Table 6-2. Troubleshooting Table (continued)

MALFUNCTION	MAINTENANCE PROCEDURES TO BE PERFORMED
No Manual Motion Other Than Align	<ol style="list-style-type: none"> 1. Repair/replace 5V DC Power Supply (Paragraph 6-23). 2. Verify that Connector J9 is correctly installed.
No Motion	<ol style="list-style-type: none"> 1. Perform steps 1 and 2 in "No Manual Motion Other Than Align" (above).
No "On Wafer" Indication (Edge Sensor and Z Up)	<ol style="list-style-type: none"> 1. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 2. Repair/replace PCB A4 in Base Module Card Cage (Paragraph 6-18). 3. Replace panel light bulb or lamp drive transistor.
Does Not Run In Auto, Runs in Demo	<ol style="list-style-type: none"> 1. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 2. Repair/replace PCB A4 in Base Module Card Cage (Paragraph 6-18). 3. Check switch that pertains to Auto operation (Dwg. No. 100345) and replace if defective.
Does Not Run In Auto or Demo	<ol style="list-style-type: none"> 1. Repair/replace PCB A2 in Base Module Card Cage (Paragraph 6-21). 2. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 3. Repair/replace PCB A4 in Base Module Card Cage (Paragraph 6-18). <i>OK PCB A5</i> 4. Check switch that pertains to Auto/Demo operation (Dwg No. 100345) and replace if defective.
No "Test Start" To Tester (Good Edge Sensor)	<ol style="list-style-type: none"> 1. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 2. Repair/replace PCB A4 in Base Module Card Cage (Paragraph 6-18). 3. Check switch that pertains to Auto/Demo operation (Dwg No. 100345) and replace if defective.
No Inking In Auto, Inker No. 1 Works Manually	<ol style="list-style-type: none"> 1. Repair/replace PCB A4 in Base Module Card Cage (Paragraph 6-18).
No Inking Any Mode, Good Inker	<ol style="list-style-type: none"> 1. Repair/replace PCB A8 in Base Module Card Cage (Paragraph 6-19).
Z Does Not Move Up Or Down	<ol style="list-style-type: none"> 1. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 2. Check switch that pertains to Z UP/DWN (Dwg No. 100345) and replace if defective.

Table 6-2. Troubleshooting Table (continued)

MALFUNCTION	MAINTENANCE PROCEDURES TO BE PERFORMED
No Z Indication, Prober Works	<ol style="list-style-type: none"> 1. Perform Dampening Circuit, A4, Adjustment (Paragraph 6-10). 2. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 3. Replace panel light bulb or lamp driver transistor.
Theta Adjustment Drifts	<ol style="list-style-type: none"> 1. Perform Manual Theta Drive Assembly Adjustment (Paragraph 6-25).
Intermittent Edge Sensing, Good Edge Sensor	<ol style="list-style-type: none"> 1. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 2. Repair/replace PCB A1 in Power Module Card Cage (Paragraph 6-20).
Probe Marks Deep One Side, Light On The Other	<ol style="list-style-type: none"> 1. Check point-to-point continuity of Flat Motor Cable (Paragraph 6-8) and replace if defective. 2. Check point-to-point continuity of X-Y Interconnect Cable (Paragraph 6-9) and replace if defective. 3. Planarize chuck (Paragraph 6-26).
No Panel Lights, Prober Does Not Work	<ol style="list-style-type: none"> 1. Check and replace bad fuses. 2. Repair/replace 5V DC Power Supply (Paragraph 6-23).
Illuminator Does Not Work	<ol style="list-style-type: none"> 1. Repair/replace PCB A2 in Base Module Card Cage (Paragraph 6-21). 2. Check Illuminator Switch operation and replace if defective. (Dwg No. 100345). 3. Replace Microscope Illuminator Lamp.
Cannot Set Direc- tion After First Auto Start	<ol style="list-style-type: none"> 1. Repair/replace joystick (Paragraph 6-15). 2. Repair/replace PCB A2 in Base Module Card Cage (Paragraph 6-21). 3. Check Auto Start Switch operation and replace if defective (Dwg No. 100345).
Misindexes Only In Auto Mode	<ol style="list-style-type: none"> 1. Repair/replace PCB A2 in Base Module Card Cage (Paragraph 6-21). 2. Repair/replace PCB A3 in Base Module Card Cage (Paragraph 6-17). 3. Repair/replace PCB A4 in Base Module Card Cage (Paragraph 6-18).

2. Turn cloth often and replace as required to pick up all dirt.
3. Burnish platen by carefully sliding a ceramic substrate or an equivalent grade whetstone across it. The rim of scratches which protrude above bearing surfaces should be smoothed in the same manner.

The Positioner should be inspected for air leaks. Perform the following steps to accomplish an air leak inspection.

1. Release magnetic action of Positioner by pressing Realign pushbutton.
2. Remove Positioner and place it on its side.
3. Using Ace Surface Plate Leak Detector, check for air leaks in Positioner.
 - a. If tubes leak, replace or reterminate tubing.
 - b. If leaks are found between barbed fittings and manifold or Positioner bodies, remove fitting and reinstall with an epoxy-type sealant.

All light bulbs should be checked and replaced if necessary.

6-3 MONTHLY MAINTENANCE

Every 30 days, all cables and interconnections should be checked and repaired, if necessary. All rust or corrosion and mold release should be removed from the platen and a teflon-based material applied for protection. The following steps should be performed to accomplish this procedure.

1. Apply a non-corrosive chrome cleaning agent or non-abrasive, chlorine-free cleaner. Wipe dry with a lint-free cloth.
2. Immediately spray cleansed surface with Mold Release Agent MS136, obtaining a thin, even coating. Do not wipe. Allow surface to dry for 2 minutes.
3. If surface whitens, coating is too thick; remove and respray.

6-4 QUARTERLY MAINTENANCE

Every 90 days, the Joystick constant current source should be adjusted. (See Drawing No. 100298). Air passages should be cleaned using the following procedure.

1. Release the magnetic action of the Positioner by pressing the Realign pushbutton.
2. Remove Positioner and place it on its side on a clean, lint-free cloth.
3. Shut off air pressure.
4. Remove air jets.

NOTE

The four jets in the center motor pad are a different diameter than those in the end pads. Keep them separate.

5. Remove the four screws from the manifold cover and disassemble the "O" Ring and the filter screen.
6. Spray all parts with safety solvent to loosen any oil or gummy deposits.
7. Blow dry with clean, dry air.
8. Repeat Steps 6 and 7 until all visible foreign materials are removed.

CAUTION

Use care to avoid enlarging or distorting orifices.

9. If jets require probing, use a soft wire or pin less than 0.010 inch in diameter.
10. Increase system air pressure to approximately 40 psi.
11. Place hand or cover over manifold to direct air flow into jet passages.
12. Let air flow through air passages approximately 30 seconds or until satisfied all passages are clean and dry.

13. Reduce air pressure to zero.
14. Assemble all parts.

NOTE

Note location of the jets. The index flange on the manifold cover faces toward the center.

15. Verify platen is clean, and, using lifting lever (P/N B-100270), lower the Positioner to platen.
16. Increase air pressure to 85 psi and verify that air passages function appropriately. If air passages function satisfactorily, record left characteristics (See Section 1, Table 1-1).

The Power Supply and Dampener Board (Drawing No. 100251) should be adjusted (See paragraph 6-10).

The chuck planarization should be checked and adjusted, if necessary.

CAUTION

Planarization gasket should be relocated in the same position as it was prior to resiliency testing.

Prior to planarization, the planarization gasket should be tested for resiliency and replaced, if necessary.

The Oil Collector Pad (P/N 243599) should be replaced with a new one which has been washed and dried with Acetone. The large and small oil pads should be relubricated at the same time this is done (Drawing No. 243470).

The Quad X Ring in the Vacuum Insert Assembly (P/N 243498) should be replaced, if required. The following procedure must be used to replace the Quad X Ring.

1. Remove retaining ring (Item 7).
2. Remove quad retainer (Item 3).
3. Insert new retaining ring in Vacuum Insert Assembly.
4. Insert new quad retainer in Vacuum Insert Assembly.

5. Reinstall Vacuum Insert Assembly in chuck housing by using the following procedure:
 - a. Electrically position shutter so that chuck plate is located in extreme down position.
 - b. Insert Vacuum Insert Assembly into base of housing until it contacts lower flange on spool lifter, then back of assembly 0.005 inch.
 - c. Tighten set screw (Drawing No. 243740, Item 19).

The Prober should be thoroughly checked. Any malfunctions should be corrected. (Figure 6-1, Troubleshooting chart).

6-5 ALIGNMENTS AND ADJUSTMENTS

The following mechanical alignment and adjustment procedures may be performed whenever the results of checkout procedures or troubleshooting suggest a maladjustment condition exists. It should be verified that the power connections are connected, the air supply connectors are connected to a 85 psi air supply, and a good edge sensor has been installed. Fuses should also be checked and replaced when necessary, and loose fuseholders should be repaired.

6-6 POSITIONER ALIGNMENT

Any time the system power has been off, the Positioner must be magnetically aligned with the platen. The following steps should be performed to accomplish this alignment.

1. Verify that cables are connected (Section 2, paragraph 2-8).
2. Perform Power On procedure (Section 3).
3. Verify that system is provided with air pressure according to specifications for required utilities (Section 1, Table 1-1).
4. Set following controls on Sub Panel (Figure 3-1) to position indicated.

Item	1	program delay	0
	2	test start	no action
	3	test/demo	demo

4	viewing optics	off
5	auto unload	manual
6	align speed	1
7	inker test	no action
8	inker disable	disable
9	vertical distance	00000
10	horizontal distance	00000

- Set following controls on Operator's Panel (Figure 3-2.) to position indicated.

Item	1	direction	no action
	2	joystick	jog
	3	stop	no action
	4	auto cycle start	no action
	5	Z drive	down
	6	vacuum	off
	7	load	no action
	8	align start	no action

- Set main power switch to OFF.
- Remove X-axis digital-to-analog resolver (DAR) PCB (A2) from X-Y Power Module Card Cage.
- Perform Power On procedure.
- Press STOP pushbutton.
- Align Y-axis motor by carefully rotating Positioner slightly until magnetic centering is felt.
- Repeat Step 9 several times to ensure alignment.
- Set air pressure to off.
- Set main power switch to OFF.
- Reinstall X DAR PCB
- Perform Power On procedure.
- Press STOP pushbutton.

17. Press ALIGN pushbutton and verify that display panel indicates logic is in align mode.
18. Press STOP pushbutton. Positioner should now be magnetically aligned with platen.
19. Set air pressure to ON.
20. Scan and jog positioner to approximately 0.010 inch from X-Y rails in lower righthand corner.
21. Set air pressure to OFF.
22. Loosen rail mounting screws.
23. Adjust rails until a 0.005 feeler gauge will slide between rail rivet heads and positioner, but a 0.010 feeler gauge will not.
24. Tighten rail screws.
25. Set air pressure to ON and press REALIGN pushbutton.
26. Hold positioner against rails and press STOP pushbutton.
27. Release positioner.
28. Verify that gap between rail rivet heads and Positioner agrees with adjustment in Step 23.
29. Verify alignment by operating Align and Load modes several times.

The following procedure must be performed to check out and adjust the X-Y Positioner Amplifiers.

1. Verify continuity of all interconnecting cables (Drawing No. 100345).
2. With power OFF, verify that all fuses are functioning. Replace fuses if necessary.

NOTE

If fuses continue to blow, trace fuse to its associated PCB (Drawing No. 100272).

Repair as necessary or replace entire PCB.

3. Perform Power On procedure (Section 3, paragraph 3-12).
4. Remove PCB A2 and PCB A3 from the Power Module Card Cage.
5. Press Reset button.
6. Verify that voltage from logic ground to output of power amplifier (collector of Q6 and Q12 on Drawing 103805) is $\leq 300\text{mV}$. If the voltage is less than 300 mV, the probable cause is a blown predriver transistor (Q3, Q4, Q9, Q10). Replace if necessary.
7. Set the X-Y Positioner out of alignment.
8. Tape the Joystick in the X-Y SCAN position.
9. Perform Power Off procedure.
10. Replace PCB A2 and A3.
11. Repeat Steps 5 and 6.
12. Observe each power driver output with an oscilloscope. The output should resemble Figure 4-4 with counter EMF spikes on the steps of the sinewave.
13. If the output is a square wave, there is an opening between the output and the return to the power amplifier. Check continuity of cabling (Drawing No. 100345).

14. If the output is flat or a dc level, with power OFF, interchange PCB A2 and PCB A3.
15. If output is correct, replace defective PCB A2 or PCB A3.
16. If output is still not correct, replace predriver transistor at that power driver output (Drawing No. 103805).

6-8 Flat Motor Cable Continuity

The point-to-point continuity of the Flat Motor Cable must be verified. (Drawing No. 100343). If it is defective, it must be replaced.

6-9 X-Y Interconnecting Cable Continuity

The point-to-point continuity of the X-Y Interconnecting Cable must be verified. (Drawing No. 100061). If it is defective, it must be replaced.

6-10 DAMPENING CIRCUIT, A4, ADJUSTMENT

The following procedure must be performed to adjust the Dampening Circuit, A4.

NOTE

A dual-trace oscilloscope is required for this adjustment.

1. Select Chop Mode on the oscilloscope.
2. Connect Channels A and B probes to the oscilloscope's calibration output.
3. Invert Channel B, then set the Vertical Gain of each channel to 0.5 volts/cm.
4. Using the Vertical Position Control, align the two traces, one atop the other.
5. Set the oscilloscope to Add Mode.
6. Adjust the oscilloscope's Horizontal Sweep to 5 ms/cm.
7. Perform Power Off procedure.
8. Remove top cover on the Prober Power Module to expose the Card Cage.

9. Remove IC-1 (AH 0015D) from its socket on the Dampener Board (Drawing No. 100254).
10. Perform Power On procedure.
11. Disable motor by stopping air.
12. Tape Joystick multi-jog pushbutton in the down (multi-jog) position.
13. Perform the following steps to verify that the Dampening Circuit functions correctly in the X axis.

NOTE

Refer to Drawings 100254 and 100251
for the location of specific components
and test points.

- a. Tape Joystick in any horizontal command position.
 - b. Connect the oscilloscope Channel A probe to test point 5 and Channel B to test point 6. (Figure 6-2)
 - c. Adjust trim-pot R37 until the waveform on the oscilloscope stabilizes the DC component.
 - d. Adjust waveform for minimum fluctuation.
 - e. Connect oscilloscope Channel A probe to test point 7 and Channel B to test point 8.
 - f. Adjust trim-pot R29 until the waveform on the oscilloscope stabilizes the DC component.
 - g. Adjust waveform for minimum fluctuation.
14. Perform the following steps to verify that the Dampening Circuit functions correctly in the Y axis.
 - a. Tape Joystick in any vertical command position.
 - b. Connect the oscilloscope Channel A probe to test point 3 and Channel B to test point 4. (Figure 6-2)

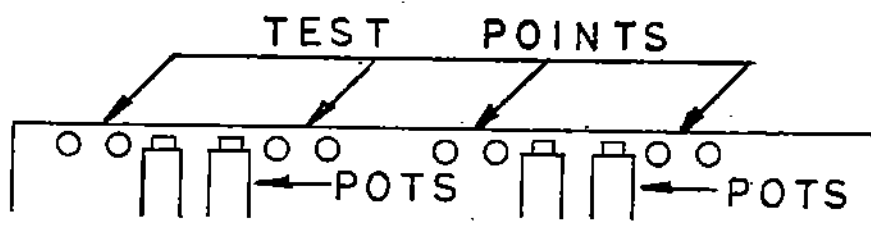


Figure 6-1. Testpoints

- c. Adjust trim-pot R35 until the waveform on the oscilloscope stabilizes the DC component.
 - d. Adjust waveform for minimum fluctuation.
 - e. Connect oscilloscope Channel A probe to test point 1 and Channel B to test point 2.
 - f. Adjust trim-pot R32 until the waveform on the oscilloscope stabilizes the DC component.
 - g. Adjust waveform for minimum fluctuation.
15. Perform Power Off procedure.
 16. Re-insert IC-1 into PCB A4.
 17. Re-insert PCB A4 into A4 position.
 18. Perform Power On procedure.
 19. Remove tape from multi-jog pushbutton and Joystick.
 20. Verify that machine functions properly.

6-11 INDEXING

If Positioning System does not index correctly in the X axis, repair or replace PCB A6 in the Base Module Card Cage (Drawing No. 100001). If Positioning System does not index correctly in the Y axis, repair or replace PCB A7 in the Base Module Card Cage (Drawing No. 100001).

6-12 PCB A5

Repair or replace PCB A5 in Base Module Card Cage (Drawing No. 100029).

6-13 PCB A1

Repair or replace PCB A1 in the Base Module Card Cage (Drawing No. 100021).

6-14 POSITIONER MAGNETIC ALIGNMENT

(See Paragraph 6-6)

6-15 JOYSTICK

Repair or replace Joystick (Drawing No. 242837 and Drawing No. 242840)

6-16 PCB A2

Repair or replace PCB A2 in Base Module Card Cage (Drawing No. 100009)

6-17 PCB A3

Repair or replace PCB A3 in Base Module Card Cage (Drawing No. 100013)

6-18 PCB A4

Repair and replace PCB A4 in Base Module Care Cage (Drawing No. 10017).

6-19 PCB A8

Repair or replace PCB A8 in Base Module Card Cage (Drawing No. 100298).

6-20 PCB A1

Repair or replace PCB A1 in Power Module Card Cage (Drawing No. 103809).

6-21 PCB A2

Repair or replace PCB A2 in Power Module Card Cage (Drawing No. 101973).

6-22 PCB A3

Repair or replace PCB A3 in Power Module Card Cage (Drawing No. 101973)

6-23 +5V DC POWER SUPPLY

Repair or replace +5V DC Power Supply (P/N 012937).

6-24 Z DRIVE ASSEMBLY PHOTOCELLS

Check and replace, if necessary, defective photocells in Z Drive Assembly.

6-25 MANUAL THETA DRIVE ASSEMBLY ADJUSTMENT

Perform the following procedure to adjust the Manual Theta Drive Assembly.

NOTE

The adjustment knob must have a turning torque of 5^{+2} ounce-inches.

1. Loosen screws sufficiently to allow adjustment of Theta Drive Assembly.
2. Rotate adjustment knob and verify proper engagement of worm gear and worm.
3. Apply sufficient hand-pressure force to housing to firmly mesh gears.
4. Using a torque wrench, rotate adjustment knob until 5^{+2} ounce-inches is obtained.
5. Tighten screws in Theta Drive Assembly to maintain the torque obtained in Step 4.
6. Tighten the Theta Adjustment and spread the protrusion on the bottom of the plate for a good fit (Drawing No. 242470).

6-26 CHUCK PLANARIZATION

The following steps must be performed to correctly planarize the chuck vacuum plate.

1. Use a grease pencil to inscribe a circle on top surface of chuck vacuum plate directly over each chuck assembly mounting screw.

2. Position dial indicator magnetic base stand and protective paper on platen so that forcer can be moved about platen surface to place dial indicator spindle in contact with grease pencil circles on chuck plate.
3. Verify that standard air pressure is applied to X-Y Positioner System and that Model 1034X Power On procedure is complete.
4. Press Interface Panel REALIGN pushbutton to blank forcer motor circuits and permit manual positioning of forcer on platen.
5. Position forcer to place one grease pencil circle under dial indicator spindle and perform appropriate following procedure to tighten corresponding mounting screw.
 - a. If bottom insulator is new, calibrate dial indicator to 0 and tighten mounting screw below circle to obtain dial indicator indication of 0.010 inch.
 - b. If bottom insulator has been previously installed, tighten mounting screw below circle with a torque wrench to obtain a torque indication of 3.0 ± 0.5 inch pounds and then calibrate dial indicator to indicate 0.010 inch.
6. Manually move forcer to position each of other two grease pencil circles in turn under dial indicator spindle and tighten corresponding mounting screws to obtain dial indicator indication of 0.010 inch.
7. Align forcer with harbor rails at Home position and press AUTO CYCLE STOP pushbutton to establish registration.
8. Use standard Model 1034X operating procedures (Section 3) to control forcer and sequentially position each grease pencil circle under dial indicator spindle. Make fine adjustments to all three mounting screws as required to obtain a maximum dial indicator variation of 0.0001 inch for all three reference circles.

6-27 Z-AXIS OVERTRAVEL ADJUSTMENT

The following procedure should be used to compensate for Z-axis overtravel.

1. Move travel stop (P/N 243846) sufficiently off mounting screws to enable it to be pushed up or down manually.
2. Electrically position shutter under Upper Optical Switch.

NOTE

Chuck plate is now located in extreme up position.

3. Slide travel stop down until it contacts surface of lower flange of spool lifter.
4. Press down on chuck top with approximately 1 pound of force to eliminate backlash, and, while maintaining this force, slide travel stop down until dial indicator shows a down motion of chuck top of 0.0001 (preload).
5. While maintaining dial indicator setting obtained in Step 4, tighten travel stop mounting screws.

6-28 MISCELLANEOUS ADJUSTMENTS

Some miscellaneous adjustments should be made when necessary. The panel light bulb or lamp driver transistor should be replaced when required. Verify that Connector J9 is correctly installed and check the switch which pertains to this operation; replace switch, if necessary. Replace Microscope Illuminator Lamp when required. Repair Joystick connector (Drawing No. 100345) and replace if necessary. Check the connector which pertains to this operation and replace if necessary.

The Joystick constant current supply should be checked and adjusted, if necessary (Drawing No. 100298).

Check and repair or replace the interface cable to tester, if necessary.

6-29 WARPING

Positioner warping can be caused by improper use of the lifting lever. Failure to insert the lever at the center of the Positioner together with no air pressure can produce severe stresses which can result in permanent distortion.

Warpage can be detected by using the following procedure.

1. Place Positioner on platen.
2. Remove air pressure.
3. Place a 0.0001 dial indicator on a corner of the platen.
4. Observe variation in dial indicator while applying finger pressure to each corner and at each side of center.
5. Move dial indicator to each corner and each side of center and repeat Step 4 at each location.

NOTE

The dial indicator should not move more than 0.0005 inch at each location.

6-30 EPOXY UNDERCUT OR EROSION

Epoxy undercut or erosion is generally due to the use of an abrasive or chlorinated cleaner. It can cause excessive airflow with an attendant loss of pressure between the platen and the Positioner. This condition can be detected visually, by fingerrail feel, under magnification, or with surface finish instrumentation.

Generally, only undercuts which form a long channel, permitting air to escape, become a problem. Field repairs, while sometimes possible, are not recommended except for temporary action. Contact your ELECTROGLAS Representative for advice.