SECTION III

OPERATION

3. General
Operational procedures for the 5110-CT system include pre-operational adjustments, process programming procedures, and operational procedures.

3.1 Pre-operational Adjustments
Pre-operational adjustments and procedures include Drain Pan and Splash Cover installation, Vacuum Chuck installation, Vacuum and Centering checks, and Motor Purge Pressure Interlock check.

3.1.1 Drain Pan & Splash Cover Installation
Prior to operation, place the drain pan into the spinner with the sump outlet fitting in the drain assembly. Then place the drain pan splash cover over the drain pan, making sure that the retaining tabs on the cover are lined up with the tabs on the drain pan.

3.1.2 Vacuum Chuck Installation
Vacuum chucks are provided with a Delrin insert in the hub to provide push-on installation and removal without the use of tools. The friction fit of the insert is adjusted at the factory to be loose enough to push on easily, but tight enough to prevent wobble. If a fit adjustment is required, a set screw in the hub of the chuck is provided to adjust the insert fit. An o-ring is provided in the bore of the hub to provide a vacuum-tight seal on the top of the spindle shaft. A pin on the shaft prevents rotation of the chuck when mated with the notch in the hub bushing. Operators must be careful to align the notch with the pin when placing a chuck on the shaft.

A Delrin skirt is provided on the chuck hub to prevent process liquids from reaching the spindle bearings. Liquids should not be used in the spinner without the skirt in place. When cleaning with solvents with the chuck removed, the Delrin spindle cap provided with the system should always be in place, on top of the spindle, to protect the spindle bearings. If the cap is missing, or a replacement is required, order part number 2953. If the skirt is missing or requires replacement, order part number 001792.

3.1.3 Vacuum and Centering Checks
Semiconductor wafers, substrates or masks are held on the chuck by vacuum during the processing sequences. To prevent danger to the operator, or loss of the substrate, it is necessary that the holding forces be greater than the centrifugal forces trying to throw the substrate off. Factors that affect the holding forces are: (1) Vacuum (measured in inches of mercury-designated as "Hg"); (2) Area of the chuck inside the O-ring (O-ring chucks only); and (3) The coefficient of friction between the substrate and the chuck.
Vacuum can be kept high (typically around 20" Hg) by keeping leaks to a minimum and by providing a pump or vacuum system that will maintain the needed vacuum at the existing leak volume. There should be no leakage on the face of the chuck while holding a wafer. If there is a leak, it is probably due to an improper contact between the chuck and the wafer. Flat chucks may leak if substrates are rough or bowed. Check the following items:

1. Burrs or cuts on the chuck.
2. Warped substrate.
3. Thin chuck O-ring.

The shaft seal is a spring retained Teflon lip seal and will not leak unless worn or damaged. Replacement seal part number is 2812. Refer to Section IV for further chuck inspection criteria.

Solitec recommends that a vacuum gauge be installed between the vacuum valve and the spindle, so that the operator can be alerted to a possible vacuum loss (which may result in either injury or product loss) during operation, and take corrective action should the chuck lose vacuum.

A vacuum interlock switch will prevent start-up until the desired vacuum is applied to the chuck. The amber "VACUUM" light on the controller is lit when there is insufficient vacuum.

*******WARNING: SEE SECTION IV BEFORE CONTINUING*******

To adjust the vacuum set-point, access the controller by removing the controller from the poly cabinet and remove the two screws securing the interlock side of the rear panel, and pivot the rear panel out.

Place a dummy wafer or substrate on the chuck, and apply vacuum by pressing the white "VACUUM" button on the controller, which energizes the vacuum solenoid. Turn the thumbwheel clockwise to increase the set point, or counterclockwise to decrease the set point. The black ring on the thumbwheel gives an approximate indication of the desired set point. To determine the precise vacuum set-point, a vacuum gauge should be inserted in-line with the vacuum interlock vacuum input. Place the edge of a wafer over the chuck vacuum line to cause a leak, and read on the gauge the vacuum at which the interlock trips.

When using O-ring chucks, the area of the chuck inside the O-ring should be as large as the substrate will allow. Since this area increases as the square of the diameter, the largest practical diameter chuck should be used. To keep the coefficient of friction high, keep the O-ring clean, elastic and verify that the O-ring contacts the substrate. Contact can be checked by placing a piece of flat glass on the chuck and verifying that the O-ring flattens against the glass.
If the substrate is heavy, such as thick glass or ceramic, the product must be accurately centered on the chuck. The spin speed should be as low as the process will allow. With an irregular shaped wafer, such as gallium-arsenide, the operator must develop the skill of judging where the center of gravity is and positioning it in the center of the chuck.

3.1.4 Motor Purge Pressure Interlock Check
The spindle drive motor is provided with a nitrogen purging system, whose main function is to prevent sparks (created by the brushes while the motor is turning) from igniting flammable solvent fumes, that may accumulate in the cabinet below the spinner (if the cabinet is not exhausted properly). An interlocked pressure switch associated with this protection scheme prevents the motor from running, if the pressure detected is less than 20 PSI (factory set).

Note: A scheduled safety check should be performed monthly to ensure that the interlock switch is operational. With the spin motor running in DRY RUN mode, reduce the pressure on the "MOTOR PURGE" supply regulator (located inside the process cabinet-rear panel). When the pressure drops below 20 PSI the spin motor should stop, and the amber "MOTOR PURGE" light on the control panel should illuminate.
3.2 Programming Procedure
The 5110-CT process includes pre-coat solvent clean, nitrogen blow spin dry, resist dispense, resist spread, and high speed spin drying (with or without dry nitrogen blowoff). See Figure 3-1 for location of front panel button, switches and indicators. Process functions, times, speeds and ramp are programmed prior to processing as follows:

a. Depress the CYCLE SELECT switches for functions desired. (See 3.2.1, 'Function Selection').

   NOTE: The function switch will light when the function has been selected. Functions that are de-selected will automatically be bypassed without loss of cycle time.

b. Set time for each process step by changing CYCLE TIME switches. (See 3.2.2, 'Function Time').

c. Set speeds for each process step. The spindle speed knob is locked into position by a locking ring tab on the lower right-hand corner of the knob. To set the speed knob, the locking ring tab should be pushed in the counter-clockwise direction. To lock the speed knob, the tab should be pushed in the clockwise direction. Repeat this for all selected functions as the system proceeds through process steps. (See 3.2.3, 'Spindle Speed').

d. Set acceleration ramp on RAMP dial knob. (See 3.2.4 'Acceleration Ramp').
FIGURE 3-1  
SOLITEC MODEL 5110-CT CONTROLLER FRONT PANEL

- PROCESS SYSTEM POWER / VACUUM / START / STOP SWITCHES, WITH VACUUM AND MOTOR PURGE INTERLOCK INDICATORS

- DIGITAL READOUT - ACTUAL SPEED IS RPM x 1000

- SERVO MOTOR RAMP SETTING DIAL INDICATOR (000 - FAST/008 - SLOW)

- PROCESS FUNCTION CYCLE TIMER (TIME LENGTH SELECT - TOTAL TIME MAX. OF 99.9 OR 999 SECONDS, DEPENDING ON CYCLE FUNCTION - SEE SPECIFICATIONS OR OPERATION SECTION)

- RESIST SELECT SWITCH (1 - RESIST PUMP 1 / 2 - RESIST CARTRIDGE PUMP 2)  
  NOTE: QUANTITY OF RESIST PUMPS ARE OPTIONAL

- DISPENSE SELECT SWITCH (AUTO - PROCESS RUN, LIQUID DISPENSE / OFF - PROCESS RUN, NO LIQUID DISPENSE)

- PROCESS HEAD SELECT SWITCH (UP - PROCESS HEAD UP - NO DISPENSE / DOWN - PROCESS HEAD DOWN - DISPENSE / AUTO - PROCESS HEAD WILL AUTOMATICALLY MOVE TO THE 'UP' OR 'DOWN' POSITION WHEN "RESIST 2" HAS BEEN SELECTED)

- SPINDLE SPEED CONTROL (0-999 SETTING EQUIVALENT TO 0-7999 RPM)

- PROCESS FUNCTION SELECT SWITCHES (WHEN DEPRESSED THE FUNCTION WILL BE SELECTED AND THE PUSUBUTTON WILL ILLUMINATE. PROCESS WILL START FROM THE LEFT AND MOVE TO THE RIGHT SUCCESSIVELY. THE 'SPIN' FUNCTION IS NON-DESELECTABLE.)
3.2.1 Function Selection
The process steps to be used are selected by depressing the appropriate function switches, which will light, indicating that that function will be included in the process cycle. Functions which are not selected will be automatically by-passed without loss of cycle time.

3.2.2 Function Time
The desired length of time for each selected function is programmed by setting the digital timer for that function. To increase time, raise the "+" actuator (under the digit you wish to increase) and press it. The "." actuator decreases the time when depressed.

3.2.3 Spindle Speed
The spindle speed can be set by switching the Dispense AUTO/OFF switch to OFF. This will by-pass the sprays while the speeds are being adjusted. Depress the "CYCLE SELECT" button to select the function whose speed you want to adjust. Place the wafer on the chuck, press the "VACUUM" button to apply vacuum to the chuck and then actuate the "START" button. Then adjust the speed by turning the spindle "SPEED" knob until the desired speed can be read at the digital readout.

3.2.4 Acceleration Ramp
A digital knob determines acceleration rate to spin speed. Shortest acceleration time (fastest acceleration) is achieved at the 000 setting. Longest acceleration time (slowest acceleration) is the 999 setting. When high acceleration is not required, a setting around 800 will minimize motor brush wear. To measure actual acceleration, a storage scope can record speed vs. time by plotting the voltage on test pin 11 (located on item 54, Schem. DWG 2993) on the Servo P.C. Board.

3.2.5 Process Sequence
Normal wafer coating sequence is: (1) solvent dispense; (2) nitrogen blow dry; (3) resist dispense; (4) resist spread; (5) spin dry, with or without Nitrogen jet.
3.3 Operational Procedures
Operational procedures for the 5110-CT include resist dispensing, processing, and drain bucket / waste disposal.

3.3.1 Resist Dispensing
Prior to operating the system, the operator will be required to perform some operational checks to verify that the resist pumps are clean and operational, and also that the switches on the front of the system controller are set for resist dispensing. The "RESIST DISPENSE" switch must be set to "RESIST 1" or "RESIST 2" to select the resist dispense type (this selects which resist pump will be used). The "DISPENSE SELECT" switch must also be in the "AUTO" position.

The system has interlocks to ensure that the standard resist dispense arm or cartridge dispense process head is in position over the spin chuck for dispensing. If not in position over the chuck, dispensing cannot take place due to an 'interlock' reed switch which is installed on the dispense function pneumatic cylinder to verify proper positioning.

3.3.1.1 Manual Resist Dispense
To dispense photoresist with the automatic resist dispense switch in the "OFF" position (controller front panel), proceed as follows:

1. After completing the start-up procedure and with the power, blower and vacuum on, place a substrate on the chuck, centering it as best as possible (if not using a loading paddle - optional).

2. Depress the VACUUM button to apply vacuum to the chuck.

3. Select the "SPREAD" cycle, by pressing the SPREAD function button, (should illuminate the button).

4. Set the desired time and speeds for the "SPREAD" and "SPIN" cycles.

5. Apply the desired amount of photoresist.

6. Press the START button.

7. After the SPREAD and SPIN cycles have been completed, and the spindle is stopped, release the VACUUM button and remove the substrate.
3.3.1.2 SOLITEC Crossflow Pump

The following describes the operation of the SOLITEC crossflow resist pump. Refer to DWG #0967. Dispensing pressure is applied under the Teflon diaphragm, forcing the resist or liquid being dispensed out through the check valve to the manifold on the spinner. The amount dispensed is determined by the pressure setting on the "DISPENSE PRESSURE" regulator and the time setting on the "COAT" or "RESIST" function on the controller.

**NOTE:** At the end of the dispense cycle the cavity over the diaphragm is refilled when the diaphragm is retracted by the refill cylinder. To prevent dripping, a small amount of liquid is drawn back through the dispensing tubes, using a suckback valve, while the pump cavity is being refilled.

3.3.1.2.1 Crossflow Resist Pump Cleaning

Before dispensing resist or other coatings, the pump should be flushed clean with a solvent using the following procedure:

1. Set the spindle speed during the dispense cycle to 1000 RPM.

2. Set the "DISPENSE" regulator pressure to 10 psi.

3. Set the "REFILL" regulator pressure to 40 psi.

4. Set dispense time to 5 seconds.

5. Turn "SPREAD" off and set spin time to 10 seconds with spin speed at 2000 RPM.

6. Insert the liquid supply tube in a container of appropriate solvent.

7. Place a dummy wafer on the chuck.

8. Cycle the pump by pressing the START button. Allow the cycle to run its course. Include the 'SPIN', since REFILL occurs during spin.

9. Repeat cycle until the solvent is clean. Continue to cycle until the pump is dry. Clean nitrogen can be applied to the liquid supply tube during cycling to speed up drying.
3.3.1.3 Cartridge Dispensing System

The Cartridge Dispensing System utilizes the patented Tridak™ Model 450 pinch valve to insure drip free dispensing of low to medium viscosity fluids. The dispensing system is modified by Solitec to employ disposable Bevaline™ tubing, where the value to be dispensed in a variety of applications may be a concern. As materials travel through the tube, its flow is stopped by the spring loaded piston pushing against the tube in its support, and thereby closing it off. When the flow stops, the material in the tube (after the pinch, and in the dispensing tip) is held in place.

3.3.1.3.1 Cartridge Dispense Priming/Adjustments

To adjust the dispense rate of the 'cartridge dispense' system, proceed as follows:

1. Select the "RESIST" function on the controller. De-select all other cycle functions.
2. Set the process time to allow for any adjustments to be made during priming.
3. Place a test wafer on the spin chuck. Depress the 'VACUUM' pushbutton ("VACUUM" interlock button should extinguish, indicating 'good' vacuum level).
4. Verify that all interlock conditions are met.
5. Check that pressure to the cartridge is approximately 40 PSI.
6. Close the micrometer on the cartridge dispense head until the micrometer reads '0'.
7. Press the "START" button on the controller front panel. The process head should descend over the process chuck immediately. If not, check that the 'Resist Select' switch is in the "2" position.
8. To check the rate of flow, open the micrometer 3 (three) full turns, then back off, or increase, until the desired flowrate is achieved.
9. To adjust speed of the shutoff valve on the cartridge dispense head, either open or close the flow control valve that is in-line to the head.
3.3.1.4 Resist Pump Start-Up

Needle valve settings, times, spindle speeds, and pressures are the same as above except dispense pressure will have to be increased with higher viscosity fluids, and spindle speed during dispense should be 'OFF'.

1. Insert the supply tube in a bottle (if using a bottle) of the coating fluid through a 1/4" hole in the bottle cap. Do not tighten cap down. If the cap is secured, this will create a negative pressure in the bottle, which would not allow the coating fluid to be drawn into the dispense mani-fold.

2. Cycle the pump, and adjust the dispense time and pressure, to apply the desired amount of resist in a constant stream.

3.3.1.3.1

Prime the resist pump using the steps outlined in 3.3.2.2.4, substituting the desired resist for the solvent and vary the dispense pressures to achieve a uniform flow. At the end of the dispense cycle, resist should be visible at the dispense tube tip, but should not drip. If the resist does drip, continue on to 'Resist Pump Draw-back Adjustment' (this section).

3.3.1.5 Resist Pump Draw-back ("MACE Valve") Adjustment

To prevent dripping after dispensing, the flow rate and the amount of draw-back must be adjusted. The draw-back flow rate is controlled by the 'Draw-back' air supply flow control valve.

- Open the valve to increase the velocity of draw-back.

- Close the valve to decrease the velocity of draw-back.

If the amount of draw-back is too great, air bubbles will be drawn in. After adjusting the draw-back flow rate, adjust the amount of draw-back.

Open up the "Draw-back/MACE" valve to increase the amount of draw-back. While the pump is refilling, draw-back is occurring at the same time, thus increasing the amount of draw-back.
3.3.2 Processing
To initiate processing on the 5110-CT, proceed as follows:

a. Perform the Resist Pump Pre-operational Priming Adjustments if the pump has not been operated or started previously.

b. Verify that the pump valve settings, process times, spindle speeds and ramps are set as desired.

c. Check that the time delay relay has been set to the desired time length (if any). See 3.3.2.1.

d. Load wafer/substrate on the chuck, and press the "VACUUM" button.

e. Press the "START" button to begin processing.

3.3.2.1 Time Delay Relay Adjustment
Refer to DWG #6331. Two time-delay relays are provided for the solvent/resist dispense process. Timer relay 'T6' provides a delay between the 'SOLVENT' dispense and 'NITROGEN' dispense. This delay is provided between these steps to ensure that the solvent dispensed will not be vaporized (misted), and sprayed when the nitrogen is turned on at the beginning of the 'NITROGEN BLOW-OFF' cycle. Relay 'T6' is factory set at 1 (one) second, but may be adjusted up to 10 seconds.

Timer relay 'T7' provides a delay between 'NITROGEN BLOW-OFF' and 'RESIST' dispense. This delay is provided between these steps to allow the spin chuck to stop spinning prior to photoresist dispensing (especially important for non-spinning 'static' dispenses). Relay 'T7' is factory set at 4 (four) seconds (allows for a wafer spinning at 4000 RPM to completely stop before the 'RESIST' dispense cycle begins; higher spin speeds may require a longer delay/lower spin speeds, shorter delay), and may be adjusted from 1-10 seconds. Relays 'T6' and 'T7' are located inside the system controller.

CAUTION: Refer to the maintenance section of this manual prior to accessing the internal components of the system controller.
3.3.3 Drain Bucket and Waste Disposal

The operator must check visually when the drain bucket should be emptied. When a high level of wastes are in the drain bucket, the drain bucket should be emptied.

Empty the drain bucket as follows:

1. Loosen the screw securing the drain pipe to the process bowl flange.
2. Remove the drain bucket, cover, and drain pipe from the system.
3. Loosen cover and remove from drain bucket.
4. Empty bucket into suitable container or drain (as recommended by customer facilities engineering), and clean bucket with appropriate solvents.
5. Install cover, position bucket beneath process bowl, and secure drain pipe to process bowl drain flange with securing screw.