



Lab Manual

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SVGDEV 4" Photoresist Development Track

(svgdev)

1.0 Title

SVGDEV

2.0 Purpose

This document has specific information about the SVG photoresist develop track.

3.0 Scope

The SVGDEV is a positive photoresist development track with loading and unloading capability for up to 25 four-inch wafers. Up to nine complete programs of up to nine events each may be stored in the machine memory. It utilizes a constant temperature bath along with water-jacketed developer lines to provide $\pm 0.5^\circ\text{C}$ developer temperature control.

4.0 Applicable Documents

[Revision History](#)

5.0 Definitions & Process Terminology

5.1 Loading indexer platform and wafer cassette for 25 4" wafers.

5.2 Carriage transport.

5.3 Spindle station (dispenses and spins developer on wafers).

5.4 Interface ramp.

5.5 Hot plate station (used for post-exposure bake).

5.6 Cold plate (used for post-exposure bake).

5.7 Receiving indexer platform and wafer cassette.

5.8 Front control panels

6.0 Safety

Follow general safety guidelines in the lab as well as the specific safety rules as follows:

6.1 Do not operate the developer station with the protective cover off.

6.2 Do not place your hand(s) in the path of the track's moving parts or the indexer module.

6.3 Do not access the electronic and high power supplies inside the machine.

7.0 Statistical/Process Data

7.1 Equipment enable message on the WAND.

7.2 Problem and comment section under the equipment section of the WAND.

8.0 Available Process, Gases, Process Notes

The SVGDEV is currently set up to dispense two different developers:

8.1 OCG 934 2:1 positive resist developer for the OCG 825 g-line photoresist.

8.2 OPD 4262 positive resist developer for the OCG 10i i-line photoresist.

8.3 All of the above developers are premixed.

9.0 Equipment Operation

- 9.1 Enable the system (svgdev) on the WAND.
- 9.2 Verify that the power to the system is ON.
- 9.3 Verify that the svgdev is in AUTO mode; the LED next to the word AUTO will be illuminated. If not, press the switch to toggle through the other options (SINGLE and MANUAL) until AUTO is selected.
- 9.4 Select our desired developer program (see Appendix A.) Note that there are two separate display windows on the control panel: DEVELOPER and OVEN. To select the developer program the DEVELOPER display must be selected. When the developer display is selected, an asterisk appears at the left of the DEVELOPER display and when the OVEN display is selected, a plus sign appears to the left of the OVEN display. To toggle between the two stations, use the STATION SELECT button on the control panel on the control panel keyboard. With the developer display active, press the PROGRAM SELECT button on the control panel keyboard to toggle through the available programs (1-9). Alternatively, you can press the desired program number key followed by the PROGRAM SELECT button to select the program.

Note: The hot plate station is now used for post-exposure bake. If you are doing a develop, remember to set the bake program to #9, NO BAKE (see Appendix A) to avoid baking your developed wafers. Post-exposure bake is accomplished by setting the developer to program #8 and the oven program to #1 (standard 60 sec. 120°C bake.)
- 9.5 If necessary, press the INDEX RESET button to bring the indexers to their starting positions (fully UP). Note that if you press the INDEX RESET button, you must lift the cassette completely off the elevator(s) and then replace them in order to proceed; i.e. for the cassettes to go down.
- 9.6 Load an empty cassette onto the receive indexer (on the right) and the cassette containing your wafers on the send indexer (on the left). Make sure that the cassettes are properly seated on the indexers.
- 9.7 Press the START button. The receive cassette will lower and the send cassette will lower until it senses a wafer. The wafer will then be transported to the spindle station for the dispense procedure, then to the bake station (which will be skipped if you had selected NO BAKE) and finally to the cold plate and receive cassette. If the receive cassette does not lower, remove the cassette and then replace it. Hit START and the cassette should then lower.

Other Functions on the Control Panel

Besides the switch functions described above, i.e. Power, Processing Mode, Start, Index Reset, Station Select, and Program Select, there are other useful functions, which are described below:

Switch	Function
START INDEX	Depressing the START INDEX once will return the send indexer to the top position. The receive indexer will not reset until any wafer in process enters the receive cassette. Depressing the START INDEX twice will return the receive cassette to the top position immediately unless there is a wafer between the processing station and the receive cassette. The send cassette is not affected.
DEVELOPER STOP	Ends processing immediately. Pressing START will resume processing with the next operation programmed.
TRANSFER STOP	Immediately stops all indexer and carriage o-rings. Wafers in transit between stations will remain in place until the START command is given again. Wafers in process will complete processing and will come to the top position while waiting for the START command.
EVENT SELECT	Used to verify the sequence of operations and associate parameters for the selected program. The events will be shown in sequence, but a particular event can also be accessed by depressing the number followed by the EVENT SELECT key.

WAFER LOST	Allows the operator to resume wafer processing if a wafer is removed or broken during processing or if a sensor fails to see a transfer. The key is only functional when a wafer has not been received at its next station after a 6 second delay.
CLEAR	Used to resume processing when the machine is in programming, diagnostic, or the calibration mode. Also used to silence the WAFER LOST alarm.
DIAGNOSTIC SELECT	Used to access the machine and sensor state diagnostics. Machine state messages for the send indexer and processing station will be displayed in the upper display window. Machine state messages for the receive indexer are displayed in the lower display window. Sensor state messages are displayed in the top display window only. See next section for the listing of machine and sensor state codes.

10.0 Troubleshooting Guidelines

The svgdev is equipped with capacitive and optical sensors located in strategic locations to verify the machine state such that:

- a) The action called for has, in fact, occurred.
- b) The machine configuration anticipated by the action and required for the continuation of processing is present.
- c) The process wafer is online.

If a particular sensor condition is not satisfied before a certain time has elapsed an alarm will sound. The alarm can be silenced by pressing the CLEAR key on the control panel keyboard. The machine state can then be checked using the diagnostic feature as follows:

- 1) Press the DIAGNOSTIC SELECT key on the control panel. The display will show the following prompt: SELECT MODE 1-2.
- 2) Press **1** to display the present machine state. The machine state diagnostic messages for the upstream indexer and processing station are displayed in the upper display window. Machine state messages for the downstream sensors are displayed in the lower display window.

The following table describes the various machine state messages and their meanings.

PURGE PRESSURE LOST	Airflow used to purge motors of flammable vapors as a safety feature has been interrupted. Also displayed if process exhaust flow is below the minimum acceptable level.
PURGE RESUMED- START?	Air purge pressure or process exhaust flow is again within limits. Press START to resume operation.
SENDER CASSETE? RECEIVER CASSETTE?	Designated cassette is no longer detected by the cassette micro-switch. The cassette has been dislodged or removed while in process. Replace the cassette on the support.
SENDER STOP-START? RECEIVER STOP-START?	When the cassette has been placed on the indexer platform properly, one of these messages will be displayed: Press START to resume operation. Note: The cassette can be dislodged if the indexer wafer or index sensor does not see the wafer, causing the indexer to drive past the wafer.
SENDER- START? RECEIVER- START?	The micro switch does not sense the cassette on the designated indexer. Lift the cassette off the support and replace. The sender cassette is empty; receive cassette is full. Change cassette indicated. Press START to resume operation.

CLEAR WAFER- START?	Power-up has been performed with a wafer on the spindle chuck or chill plate; vacuum is turned on momentarily at these locations to check for a wafer. If a message is displayed, remove the wafer. If no wafer is present, the vacuum sensor needs to be reset to properly detect wafers.
STOP PROCESS- START?	DEVELOPER STOP switch has been depressed, terminating track in process. Press START to indicate the next programmed event.
TRANSFER STOP-START?	TRANSFER STOP button has been depressed. Press START to resume operation.
VACUUM BREAK- START? WFR LOST IN TRACK- START?	Vacuum detection of the wafer while it is on the spindle chuck has been interrupted. The top message is displayed pre-process. Either the wafer has been dislodged or removed from the chuck or the chuck vacuum switch is misadjusted or bad. Depress START to resume operation
SPEED OUT OF BAND- START?	Message is displayed if the spindle speed deviates beyond the limits of the spindle speed band. The next wafer is held at the spindle top position until START is depressed
COVER IN PLACE?	The process cover is not in place atop the carriage. Dispense operations will not take place until the cover is replaced
LO COOLANT FLUID	Fluid level in water bath is low. Alarm will sound until the bath is filled to the proper level. Send indexer will not discharge wafers while this condition persists. Notify the staff about this condition. If you need to fix this error yourself, see the instructions below.*
COOLANT TEMPERATURE OUT	Temperature of cooling bath water is not within 1°C of the set point. Alarm sounds until the temperature comes back into range. Send indexer will not discharge wafers while condition persists. Notify staff about the condition.

- * If you need to add water to the cooling water bath, go to the service chase, locate the cooling tank and the water hose that goes into the tank, open the valve of that hose until the level of the water reaches the top. The temperature control system should turn on by itself. Check the temperature reading and verify that the temperature is reaching the set point (20°C). When the temperature comes back into the $\pm 1.0^\circ\text{C}$ range (of the set point), the alarm will stop and you should be able to start processing.

Only the above simple troubleshooting and repairs should be attempted. In case of any doubt, check the staff. Do not try to solve the problem with brute force! If you are unable to solve a problem, report it promptly on FAULTS.

- * Reminder: Anytime a wafer is broken while being processed in the svgdev, it is ALWAYS considered to be a problem and MUST be recorded in FAULTS.

11.0 Figures & Schematics

N/A

12.0 Appendices**12.1 SVGDEV Programs****12.1.1 Developer Programs**

Prog	Developer(s)	Resist(s) Developed	Puddle	Dev. Time (sec)	Comments
*1	OPD 4262	OiR 10i	Single	60	Stand. I-Line Develop
*2	OCG 934 2:1	OCG 825	Double	2 × 30	Stand. G-Line Develop
3	OPD 4262	OiR 10i	Single	30	Half-Time I-Line Develop
4	OCG 934 2:1	OCG 825	Single	30	Half-Time G-Line Develop
5	OCG 934 2:1	OCG 825	Double	2 × 38	25% G-Line over-develop
6	Rinse	None	None	None	Rinse and Spin Dry
8 (PEB)	None	None	None	None	Post-Exposure Bake

*Standard Develop Programs

12.1.2 Bake Programs

Program (#)	Bake Temp. (°C)	Bake Time (sec)	Chill Time (sec)
1 (PEB)	120	60	6
2	120	90	6
3	120	120	6
9	No Bake	0	0

12.1.3 Dispenser Assignments

Developer	Resist	Dispenser	Toggle Position
OPD 4262	OiR 10i	Stream (DV-ST)	N. A.
OCG 934 2:1	OCG 825	Spray (DV-SP)	(not used)

12.2 Programs

12.2.1 Program #1 I-line

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	DV-ST	2.0	0.0	0.0
2	DV-ST	3.0	0.5	1.0
3	DV-ST	6.0	0.0	0.0
4	SPIN	60.0	0.0	0.0
5	SPIN	2.0	0.5	20.0
6	RINS 1	15.0	0.5	20.0
7	SPIN	15.0	3.5	20.0
8	END	0.0	0.0	0.0

12.2.2 Program #2 G-line

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	DV-SP	2.0	0.0	0.0
2	DV-SP	3.0	0.5	1.0
3	DV-SP	5.0	0.0	0.0
4	SPIN	30.0	0.0	0.0
5	DV-SP	5.0	0.5	1.0
6	DV-SP	5.0	0.0	0.0
7	SPIN	30.0	0.0	0.0
8	RINS	15.0	0.5	20.0
9	SPIN	15.0	3.5	20.0

12.2.3 Program #3

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	DV-ST	2.0	0.0	0.0
2	DV-ST	3.0	0.5	1.0
3	DV-ST	6.0	0.0	0.0
4	SPIN	30.0	0.0	0.0
5	SPIN	2.0	0.5	20.0
6	RINS 1	15.0	0.5	20.0
7	SPIN	15.0	3.5	20.0
8	END	0.0	0.0	0.0

12.2.4 Program #4

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	DV-SP	2.0	0.0	0.0
2	DV-SP	3.0	0.5	1.0
3	DV-SP	5.0	0.0	0.0
4	SPIN	30.0	0.0	0.0
5	RINS 1	15.0	0.5	20.0
6	SPIN	15.0	3.5	20.0
7	END	0.0	0.0	0.0

12.2.5 Program #5

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	DV-SP	2.0	0.0	0.0
2	DV-SP	3.0	0.5	1.0
3	DV-SP	5.0	0.0	0.0
4	SPIN	38.0	0.0	0.0
5	DV-SP	5.0	0.5	1.0
6	DV-SP	5.0	0.0	0.0
7	SPIN	37.0	0.0	0.0
8	RINS 1	15.0	0.5	20.0
9	SPIN	15.0	3.5	20.0

12.2.6 Program #6

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	RINS1	15.0	0.5	20.0
2	SPIN	15.0	4.0	20.0
3	SPIN	10.0	4.0	50.0
4	END	0.0	0.0	0.0

12.2.7 Program #7

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	END	0.0	0.0	0.0

12.2.8 Program #8

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	END	0.0	0.0	0.0

12.2.9 Program #9

Event	Operation	Time (sec)	Speed (krpm)	Acceleration
1	END	0.0	0.0	0.0

12.3 Refilling the Developer Tanks

Each photoresist used at the svgcoat1 and 2 has a developer specific to that resist; the developers are in pressurized tanks behind the svgdev in service chase CY-2.

12.3.1 Wafers coated with OiR 10i Positive Photoresist are developed with the I-line developer OPD 4262 Positive Resist Developer.

12.3.2 Wafers coated with OCG 825 Positive Photoresist are developed with the G-line developer OCG 934 2:1 Positive Resist Developer.

Each of these developers can be found in the yellow cabinet for developer located in Y2. Use them as they are, no mixing necessary, as they are pre-mixed.

The svgdev developer tanks each have a **low liquid level** sensor inside the tank; these sensors are connected to wall mounted **low liquid level** warning lights located to the right rear of the svgdev. A **light on** indicates a need to refill the tank(s) immediately before attempting to develop wafers.

The warning lights are arranged as follows:

Light #1: OCG 934 2:1 (G-line)

Light #2: Currently not in use

Light #3: Acetone (currently not in use)

Light #4: OPD 4262 (new I-line)

Light #5: DI chiller (maintained by staff)

When there is a need to refill any of the above tanks, please observe the following procedure:

Using a safety carrier, choose the correct developer from the yellow cabinet and transport it to service chase CY-2 (where the developer tanks are located.)

Note that each developer tank is slightly different, but they are essentially refilled the same way. Left-to-right, the tanks are Acetone (not in use), G-line, thick resist developer, and I-line. Each tank is clearly labeled.

To refill the G-line developer tank, first turn the black vent knob 180 degrees to vent the tank. Next, remove the lid to the tank, making sure that the O-ring does not stick to the lip of the tank. Refill the tank with OCG 934 2:1 Positive Resist Developer directly out of the bottle, replace the lid (making sure that it is seated correctly) and turn the black vent knob back to its original position.

To refill the I-line developer tank, first turn the black vent knob 180 degrees to vent the tank. Next, pull the **ring knob** on top of the tank lid to release pressure, then turn the large **nut** in the center of the tank top in order to open the lid to refill with OPD 4262 Developer directly out of the bottle. Replace the **nut** and tighten it, then turn the black vent knob back to its original position.

Note: On the wall directly behind the developer tanks are three pressure gauges, one for each developer tank. When the developer tanks have been refilled and the lids correctly positioned, the PSI for each tank should read **5** on the gauge. If the pressure reads **0**, the tank lid has not been seated correctly and must be resealed again.

* Do not leave empty developer bottles in the service chase. They must be properly rinsed and disposed of in the old lab. Please refer to [Chapter 1.2](#) for details.

SVG DEV Study Guide

Be sure to know...

1. What to check after enabling svgdev.
2. Selecting a display, toggling between stations.
3. How to avoid baking your wafers.
4. If the machine does not proceed from INDEX RESET.
5. If the receive cassette does not lower.
6. Hitting START INDEX twice.
7. What happens with TRANSFER STOP.
8. If the machine fails to **see** a wafer.
9. How to silence WAFER LOST alarm.
10. Reasons you will see PURGE PRESSURE LOST.
11. If the index sensor drives past a wafer.
12. What does CLEAR WAFER-START mean.
13. What WFR LOST IN TRACK-START means.
14. Error messages you must report to staff.
15. Temperature set point.
16. What to do if your wafer breaks.
17. When and how to refill developer.
18. Waste developer bottle disposal.
19. How to run a standard process.