Non-Contact Integral Wafer™

User Manual

SensArray

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UM-INT- 2007.04

Important Notices

Warranty

Integral Wafer System Hardware

SensArray Corporation warrants that the contact style or non-contact style Integral Wafer Systems ("Products") sold will be free from defects in material and workmanship, and perform to SensArray's applicable published specifications for a period of 12 months after shipment for the Docking Station. The Integral Wafer is warranted for 6 months or a specified number of operating hours, whichever occurs first. Refer to the specification provided with your wafer for the exact warranty terms. The Products that comprise the System shall include the Docking Station. The liability of SensArray hereunder shall be limited to replacing or repairing, at its option, any defective Products that are returned F.O.B. to SensArray's plant in Santa Clara, CA. In no case are Products to be returned without the purchaser first obtaining SensArray's permission and Returned Materials Authorization [RMA] number. In no event shall SensArray be liable for any consequential or incidental damages. Products that have been subject to abuse, misuse, accident, alteration, neglect, or unauthorized repair or installation are not covered by this warranty. SensArray will make the final determination as to the existence and cause of any alleged defect. SensArray is not responsible for maintaining or supplying any consumable materials used in conjunction with this hardware. No warranty is made with respect to any customized equipment or Products supplied with Integral Wafer systems where produced to Purchaser's specifications except as specifically stated in writing by SensArray in the contract for such Products. The purchaser will pay the shipping costs of returned materials to SensArray; SensArray will pay the cost of shipping repaired/replaced material to Purchaser. This Warranty is the only warranty made by SensArray with respect to the Product delivered hereunder and may be modified only by a written instrument that is signed by a duly authorized officer of SensArray and accepted by Purchaser. Except as provided above, SensArray makes no warrantees, expressed or implied, including any warranty of merchantability for a particular purpose.

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SensArray Corporation warrants that (a) Integral Wafer software (Software) will perform substantially in accordance with the accompanying written materials for a period of 12 months after shipment, and (b) the medium on which the Software is recorded will be free from defects in materials and workmanship under normal use and service for a period of 12 months after shipment.

Faults caused by unauthorized modification, misuse or abuse of products, or problems due to software not supplied by SensArray, are not covered by this Warranty. During the Warranty Period, the purchaser may return failed Software to SensArray for repair or replacement, at SensArray's option. SensArray does not warrant that the operation of the Software shall be uninterrupted or error free. The purchaser will first notify SensArray of the nature of the problem and obtain a Returned Materials Authorization [RMA] number. The purchaser will pay the costs of shipping returned Software to SensArray; SensArray will pay the cost of shipping repaired/replaced Software to the purchaser. No other warranty is expressed or implied. SensArray specifically disclaims the implied warranty of merchantability and fitness for a specific application.

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Some of the technology used in this product is acquired under license from the management and operating contractor of the Oak Ridge National Laboratory on behalf of the U.S. Department of Energy.

Radio Frequency Interference Compliance

Applies to the Storage Cases and RF Carrier Station

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

For the RF Carrier Station, only the USB cable supplied with the equipment is authorized for use with this device; any other cable is not authorized and may cause undesired interference, etc. Refer to Chapter 3 for product installation.

RF Carrier Station USB Cable

Product Modifications

Applies to the Storage Cases and RF Carrier Station

Changes or modifications to this equipment not expressly approved by KLA-Tencor may void the user's authority to operate the equipment.

English	French
This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.	Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Using This Manual

Overview

This manual consists of the following sections.

- Chapter 1, Overview—Discusses features, components, and configurations of the Non-contact Integral Wafer System.
- Chapter 2, System Setup—Discusses unpacking the system components, preparing the equipment for the cleanroom, and connecting the system cables.
- Chapter 3, Using the Charge and Communication Carrier Station— provides an easy means to prepare the wafer for data acquisition and to perform data retrieval.
- Chapter 4, Using the Integral Wafer Controller Software— Discusses acquisition setup, acquisition features, and how to retrieve the measurement data using the Carrier Stations.
- Appendix A, Reference Information- Wafer sensor location information.

What You Need to Know

This user manual assumes that you are familiar with the version of the Windows operating system installed on your computer and can perform—as a minimum—the following tasks.

- Start (boot) the computer
- Log on to Windows
- Select from menus
- Select and open files
- Use a mouse or pointer, including how to point and click to select objects and operate controls such as buttons
- Use standard window controls such as scroll bars

Conventions Used in this Manual

Several standard conventions are used in the text of this manual to make the information presented a little clearer and easier to understand. Every attempt is made to be consistent in the application of these conventions.

Note:	Highlights important information.
Bold	Bold text indicates button names, icon names, and menu items.
italic	Italic text indicates the section and/or chapter name in a cross-reference. For example: See the *Using the Acquisition Setup Window* section of Chapter 3, *Acquiring Data*, for more information. Italic text can also be used to emphasize a word or phrase.
`Courier Typeface`	Courier typeface indicates file names, directories, and text that you enter. For example: The file is located in the `C:\Sensarray\Configs` directory.
<Key>	A word offset by angle brackets indicates a key on the computer keyboard. For example: After you specify the parameters, press the <Enter> key.
»	The twin arrow symbol indicates menu navigation. For example: Select **Acquisition»Acquire** on the Thermal MAP Analysis window to open the Acquisition Setup window. This tells you to click on **Acquisition** on the menu bar and then click on the **Acquire** option from the drop-down menu.
	Indicates important safety information. The icon is usually associated with a Warning or Caution in the document describing potential for product damage or personal injury. Other international standard icons specific to a particular hazard or action may be used in place of the exclamation mark.

Chapter 1 Overview

The Integral Wafer User Manual is designed to document the setup and use of the Integral Wafer system in conjunction with the Integral Wafer Controller software. This manual will discuss only the non-contact version of the Integral Wafer. The results of the measurement run may be analyzed using the Thermal MAP Analysis Software included with the system.

The Thermal MAP Analysis software program is documented in the *Thermal MAP Analysis Software User Manual*. A PDF version of this manual may be found in the `C:\Sensarray\Documents` folder on your computer's hard drive.

This chapter discusses the features of the non-contact Integral Wafer system.

The Integral Wafer System

The Integral Wafer has a complete measurement system embedded in the wafer to record thermal surveys in semiconductor processing equipment without the need for wired connections. Embedding the components within the wafer allows it to be treated like a production wafer in most equipment, as long as it is within the operating temperature range of the wafer.

The Integral Wafer system consists of an Integral Wafer, a carrier station for communicating with and recharging the wafer, a USB cable, a laptop computer, and a CD containing the software and drivers needed by the system.

The Integral Wafer system is delivered with a SensArray-provided laptop computer pre-loaded with all software. As an option, existing Thermal MAP laptop computer systems may be upgraded to run the Integral Wafer software as long as you are running Windows 2000 or higher, and have an available USB port.

Integral Wafer systems are available in 200 mm and 300 mm versions, with different carrier station options. The systems can acquire data from 1 to 64 analog channels, depending on the model. The analog channels are divided into banks. Each bank is made up of up to 8 wafer sensors.

Measurements taken by the sensors are converted from analog to digital signals within the onboard electronics.

Acquiring Data

Utilizing the Integral Wafer to acquire temperature data in your equipment is a simple process. Measurement parameters, such as sensors to be used, scan rate, time delay, etc., are set up using the Controller software. The wafer is then transferred to the measurement chamber from a FOUP or cassette via robotic arms, and the thermal measurement survey data is acquired. After the survey is complete, the wafer is returned to the Carrier station and the data can be retrieved from the onboard memory. The data may then be analyzed using Thermal MAP Analysis Software.

Analyzing Data

The data files acquired by the Integral Wafer may be analyzed using Thermal MAP Analysis Software to view XY graphs, contour maps, surface maps, animations, and data tables. For more information on the use of the Analysis portion of the Thermal MAP 3 software, please refer to the *Thermal MAP 3 Analysis Software User Manual* included on the CD.

The data can be viewed and evaluated in table form if desired. A row in the table is called a sample or a single-timed sampling of all of the sensors on the wafer. You use the sample number to identify the table row of measurements collected at the sample time.

The first column in the table is the sample number. The second column is the time point at which the sample was acquired. For example, as shown in Figure 1-1, sample 93 has a time of 93 seconds. The remaining columns in the table are the temperatures of the sensors within the wafer. Additional columns of data can be present if calculated values have been logged.

pre74 2006-03-07_10-41-19.xls Table

Sample #	Time (s)	A01	B02	B03	B04	B05	C06	C07	C08	C09	D10
93	93	37.265	36.943	37.494	38.131	37.119	38.438	35.949	37.751	36.017	36.218
94	94	37.297	36.969	37.525	38.165	37.145	38.478	35.984	37.771	36.047	36.251
95	95	37.323	36.997	37.555	38.200	37.173	38.474	36.008	37.784	36.067	36.271
96	96	37.356	37.021	37.567	38.235	37.205	38.507	36.034	37.817	36.096	36.304
97	97	37.383	37.052	37.605	38.251	37.241	38.513	36.066	37.843	36.120	36.323
98	98	37.402	37.080	37.639	38.276	37.260	38.539	36.099	37.876	36.146	36.343
99	99	37.432	37.091	37.661	38.296	37.291	38.563	36.110	37.883	36.193	36.379
100	100	37.458	37.125	37.697	38.327	37.309	38.578	36.135	37.915	36.196	36.395
101	101	37.491	37.155	37.725	38.355	37.323	38.598	36.158	37.958	36.221	36.415
102	102	37.518	37.168	37.746	38.384	37.358	38.627	36.175	37.957	36.238	36.445
103	103	37.530	37.180	37.768	38.403	37.394	38.644	36.194	37.987	36.269	36.458
104	104	37.549	37.211	37.800	38.425	37.405	38.680	36.214	38.010	36.278	36.484
105	105	37.572	37.242	37.816	38.453	37.434	38.696	36.255	38.030	36.333	36.510
106	106	37.601	37.279	37.826	38.465	37.461	38.709	36.270	38.053	36.337	36.530
107	107	37.627	37.295	37.839	38.489	37.476	38.735	36.277	38.065	36.355	36.559
108	108	37.646	37.313	37.860	38.511	37.492	38.755	36.317	38.102	36.387	36.579
109	109	37.674	37.347	37.889	38.530	37.511	38.774	36.326	38.124	36.398	36.592
110	110	37.699	37.369	37.913	38.558	37.536	38.794	36.354	38.121	36.426	36.625
111	111	37.723	37.378	37.947	38.582	37.557	38.807	36.371	38.148	36.444	36.638
112	112	37.752	37.405	37.958	38.613	37.583	38.837	36.412	38.187	36.467	36.655
113	113	37.967	37.669	38.215	38.917	37.851	39.167	36.635	38.502	36.679	36.961
114	114	38.575	38.332	38.873	39.686	38.514	40.033	37.247	39.320	37.327	37.708
115	115	39.275	39.013	39.626	40.444	39.191	40.976	37.851	40.111	37.985	38.451
116	116	39.741	39.442	40.102	40.959	39.631	41.542	38.197	40.575	38.372	38.869

Figure 1-1. Sample Data Table from an Integral Wafer

During acquisition, Integral Wafer performs computations on acquired data, such as determining the minimum, maximum, mean, range (max-min), and standard deviation of all wafer sensor values for the sample, and logs the results in columns. These computed values are referred to as *calculated* values.

After acquiring, linearizing, and storing the sensor data, you can display or print the data as a line plot graph, as shown in Figure 1-2. In addition, you can display data in a table or as a wafer map.

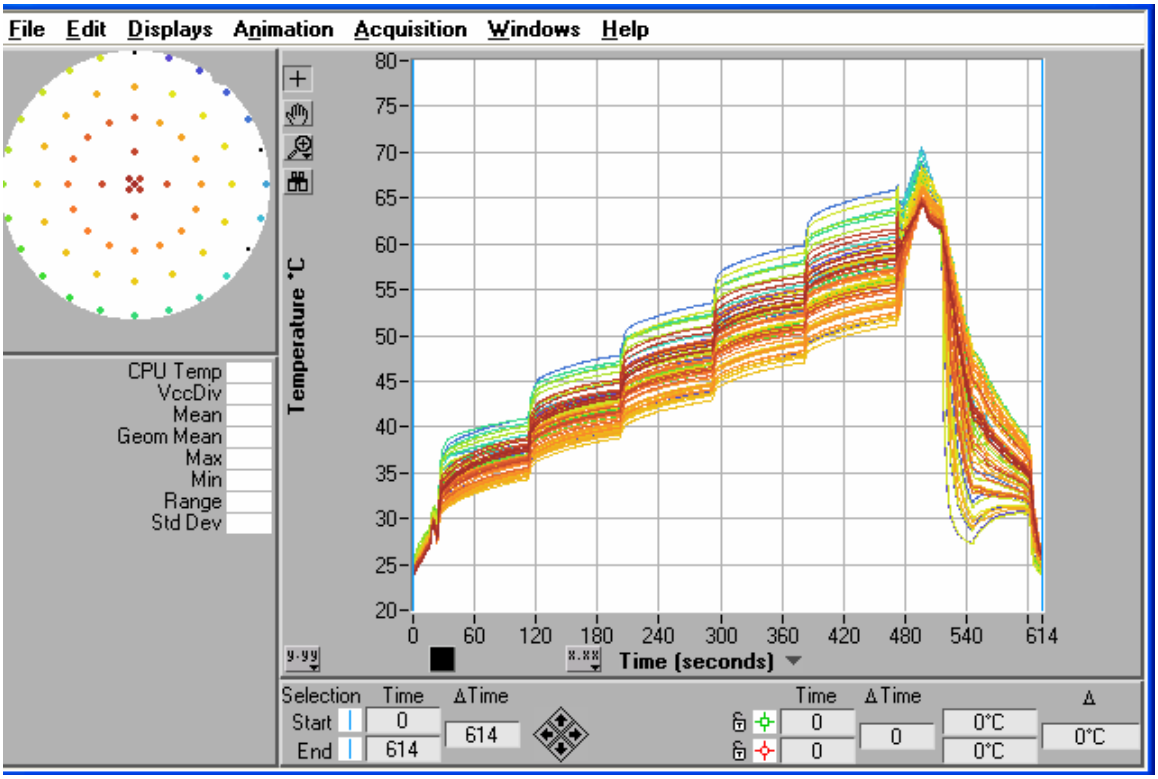


Figure 1-2. Displaying Data on a Line Plot Graph

You can also create a two-dimensional color contour map as shown in Figure 1-3 or a three-dimensional surface map as shown in Figure 1-4 of a single sample point.

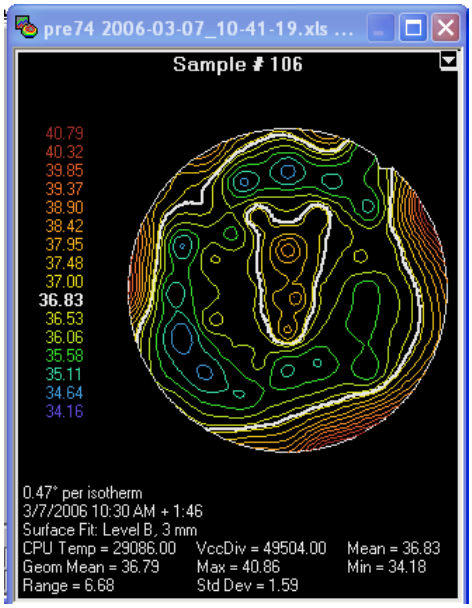


Figure 1-3. 2-Dimensional Color Contour Map

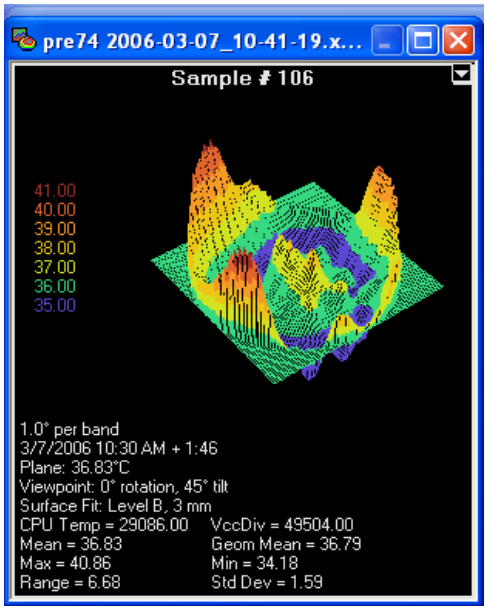


Figure 1-4. 3-Dimensional Surface Map

With the Animation feature, an animation of the survey data can be created. The animation can be set for a particular range of the acquired samples, saved to a standard AVI file, and replayed at any time. The AVI file can be sent to other computers not running the Thermal MAP software and played using the Windows Media Player or other compatible video players.

Data may also be exported to a spreadsheet program, edited in the spreadsheet, and loaded back to Thermal MAP for further analysis.

Chapter 2 System Setup

Before you can begin working with the non-contact Integral Wafer system, you need to unpack the system components, prepare the equipment for transfer to the cleanroom, and charge the wafer batteries.

Before You Begin

Before using the Integral Wafer, there are several safety and handling precautions that should be noted. Please read the information provided in this manual and become familiar with the Integral Wafer before attempting your first thermal survey.

- Operation of Integral Wafer outside of its specified temperature range could result in unreliable readings and/or damaged wafers. Please review the recommended operating range for your particular model of Integral Wafer.
- Rotational speeds up to 5000 rpm have been tested and found to be safe. While it is possible that even higher rotational speed might be reached without damage to the wafer or spin plate, SensArray cannot provide any guarantees above 5000 rpm.

Proper Wafer Handling Procedures.

While the Integral Wafer is designed to survive in a semiconductor fabrication environment, reasonable care must be taken to prevent damage to the components on the wafer, or breaking the wafer.

- Always wear gloves whenever you handle the wafer.
- Hold the wafer by the edges only or support from the backside of the wafer with your hand or with a vacuum wand. In some situations, you may have to grasp the edge of the wafer with your gloved fingers to prevent dropping the wafer, as when you try to insert the wafer into your equipment or a carrier station.
- Never place the wafer on an uneven surface. A small downward pressure on the wafer applied at the right point could cause the wafer to break or cause cracks within the silicon.

Unpacking Your System

Inventory all items and compare to the packing list included with the shipment.

Retain all packaging materials for the system. This is required for the return of the Integral Wafer for repairs or recalibration.

If any parts are missing or damaged, contact SensArray immediately. Be prepared to provide a list of the missing and/or damaged components, the Purchase Order Number, and the SensArray Sales Order Number.

NOTE: Do not return components without contacting SensArray first and obtaining a Return Material Authorization. When returning components to SensArray, you must repack the equipment in the original packing material. Failure to properly pack the components may result in additional damage to the equipment.

Removing the Wafer from the Storage Case

The non contact Integral Wafer storage case is designed to keep the Integral Wafer batteries charged to the optimum level for an extended period of 1 to 2 years. This is done by periodically checking the status of the batteries and recharging the batteries when their voltage drops below a threshold.

CAUTION: The storage case is not designed to be used to recharge wafers after acquiring data. The storage case may not be used as a carrier station. It is used only to store a wafer when the wafer is not in use.

The wafer will be maintained in the storage case until it is needed. To use the wafer, place the horizontal wafer shipper case right side up on a clean work surface and open the latches on the case, as shown in Figure 2-1. Remove the lid. Locate the Charge and Communication (C/C) Carrier Station near the storage case.

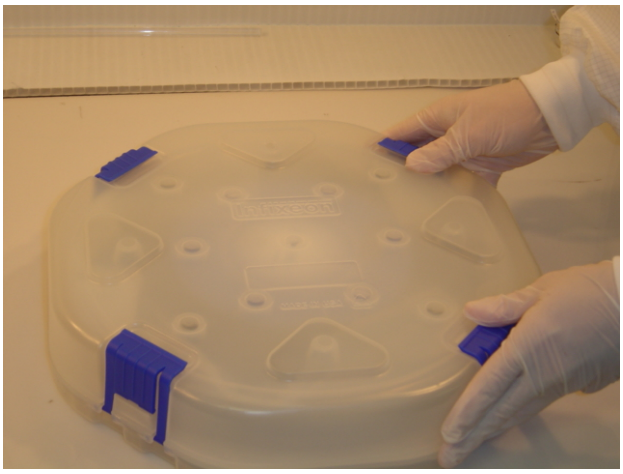


Figure 2-1. Opening the 300mm storage case

The maintenance module is placed on top of the wafer to allow for wireless maintenance. The module is enclosed and sealed in a clean room compatible plastic bag. Do not remove the maintenance module from its bag. It is there to ensure that the surface the wafer comes into contact with is clean.

There is an LCD screen that indicates the wafer serial number and battery voltage. A blinking blue LED also indicates that the wafer is good. If the wafer is not viable, the screen will indicate 'no wafer present'. The maintenance module must be reset to force it to search for a wafer by pressing the reset button. The module will then spend approximately 15 seconds looking for a wafer in its presence. If a wafer is present (centered and against the coil) and the module is unable to detect the wafer, try to place the wafer in the carrier station to check the wafer state. If wafer looks healthy in the carrier, the storage case may be problematic. Contact SensArray technical support for help.

To remove the wafer from the storage case, remove the aluminum liner from the case to expose the maintenance module. Lift the maintenance module out of the case and place it in a clear area on the work surface. Carefully remove the wafer from the case and place it in the C/C carrier station.

Figure 2-2. Lifting maintenance module

Figure 2-3. Remove wafer from case

Place maintenance module back into case, flip RF shield back over module and replace lid. Save case for future use.

Charging the Equipment Before Use

Place the Integral Wafer into the carrier station shipped with the unit to maintain the charge on the internal batteries. Please see *Using the Charge and Communication Carrier Station* for more information on inserting and removing the wafer to and from the carrier stations.

Plug the laptop into the AC power supply and fully charge the laptop battery.

Setting Up the Software

The Integral Wafer system normally includes a SensArray qualified laptop computer that has been prepared with all needed software to setup, run, and retrieve data from the Integral Wafer. However, if you are upgrading an existing Thermal MAP 3 system, please follow these directions.

Before using the Integral Wafer, the USB driver for the carrier stations and wafer, the Integral Wafer Controller Software, and the wafer calibration files must be loaded onto the host computer. The software has been tested under Windows 2000 and Windows XP.

1. Place the Integral Wafer CD in the host computer CD drive.
2. Using Windows Explorer or My Computer, navigate to the \INTEGRATEDWAFER.INSTALL folder and run INtegratedWaferController v2.x.x.exe. Follow the onscreen directions of the installer program. Do not change any default directories; this could cause problems when the program is run.
3. Connect the USB cable between the host computer and the carrier station. Wait until the **Found New Hardware** dialog begins.
4. Follow the Windows directions on screen to complete the new hardware setup. When requested to locate the driver for the new hardware, select the **CD-ROM drives** option and click **Next**. The wizard will automatically locate the correct driver. There are two drivers that will load, just follow the onscreen directions. If you are using Windows XP, ignore the "**this is not a Windows certified driver**" warning.

	If you are installing Thermal MAP on your computer for the first time, follow the directions in step 5. If you are installing the Integral Wafer on a system that already has the full Thermal MAP program, do not install the Analysis only version found on the Integral Wafer CD. This will cause your existing version to lose the Acquisition feature. Skip step 5 and use the provided upgrade Thermal MAP CD to install the full version. Insert the CD and follow the onscreen directions. Then continue with Step 6.

5. Using Windows Explorer or My Computer, navigate to the \THERMAL MAP.INSTALL folder and run the installer program. Follow the onscreen directions of the installer program. Do not change any default directories; this could cause problems when the program is run.
6. Remove the Integral Wafer CD from the CD drive.
7. Insert the Wafer Configuration CD and run the setup.exe program on the CD. This will install the calibration file for your wafer into the proper directory on the computer. When completed, remove the Wafer Configuration CD from the drive.

NOTE: If you are upgrading the calibration files later, they will be installed in the same folder as the existing calibration/configuration files.

Preparing Equipment for the Cleanroom

Cleaning the Equipment

When installing a computer and an Integral Wafer system in the cleanroom, follow industry standards, including wiping down the computer and the exterior of the carrier station with cleanroom wipes dampened with deionized (DI) water and/or isopropyl alcohol. Wipe down the Integral Wafer itself.

Cleaning the Integral Wafer.

Significant efforts are made to keep wafers clean during the manufacturing process. Due to the nature of some processes and demands by customers for cleaner wafers, the Integral wafer is now offered as a cleaned product. It has gone through a SC1 and SC2 cleaning process to remove metals and organics. The cleaned wafer is packaged in a clean room compatible zip lock bag to prevent contamination until it is ready to be used.

Despite our best efforts, the Integral Wafer may pick up contaminants from repeated handling. The ideal method of cleaning surface contaminants from the wafer is to blow a gentle stream of CDA or inert nitrogen across the surface. However, some forms of surface contamination cannot be removed this easily.

The wafer can be cleaned with IPA or DI water and a cleanroom cloth. Due to the design nature of the Integral Wafer, scratches in the coating on the backside of the wafer may exist. This has not been shown to cause degradation in the performance of the wafer.

A gentle stream of DI water or IPA may be used to loosen surface contamination, then use CDA or inert nitrogen to blow the surface dry.

Never place the wafer in an ultrasonic cleaning bath. The vibration set up by the ultrasonics may damage the electronics inside and render the wafer inoperable.

Cleaning the Carrier Station.

The carrier station is easily cleaned by wiping the surfaces with a cleanroom cloth dampened with IPA. Nothing harsher is needed to remove contamination from the surface. Be sure to clean the interior of the carrier station. Debris on the surface may cause stress points on the Integral Wafer when the lid is closed. To avoid damage to the Integral Wafer, only clean the interior of the carrier when the wafer is not present.

Recharging and Storing Integral Wafer

The carrier station contains removable, rechargeable lithium-ion batteries. The carrier station batteries should maintain a charge on the wafer batteries for up to three years. The carrier station batteries can be charged via USB or with the provided power adapter.

Very Important! Keep the wafer stored in a carrier station when not making thermal surveys. This will help ensure the maximum lifetime for the onboard wafer batteries.

When storing the wafer in the carrier for extended periods of time, confirm that the LCD display reads 'Wafer Ready'. This indicates that the carrier station has established proper contact with the wafer and ensures that the wafer battery charge is being maintained.

Chapter 3 Using the Charge and Communication Carrier Station

The Carrier Station is available in both 200 and 300mm versions and provides a method of charging and communicating with the wafer through an RF signal rather than a set of contact pins.

Using the Carrier Station

The carrier station protects the Wafer and maintains the battery charge during storage. It also provides the communication link between the Wafer and the host computer.

The carrier station provides an easy, non-contact means of preparing the wafer for data acquisition and to perform data retrieval. It is important to follow proper procedures in removing and inserting the wafer in the carrier station to avoid damaging the wafer.

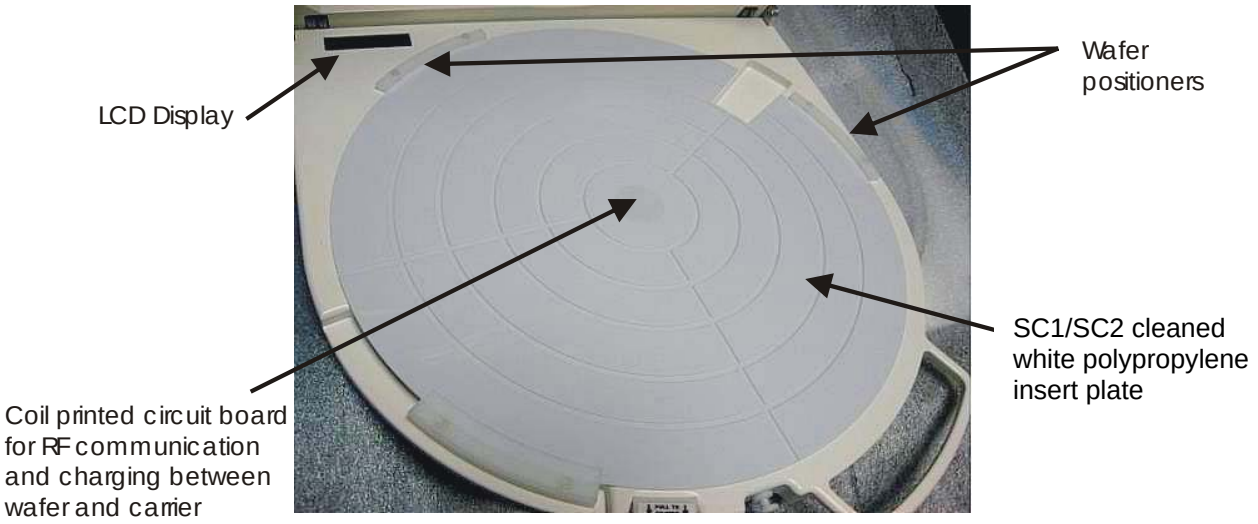


Figure 3-1. C/C Carrier Station Components

Figure 3-2 shows the C/C carrier station with USB port plug in. There are four LEDs on the left side of the carrier base, as referenced in Table 3-1. The green LED comes on when the USB cable is connected and there is communication between the host computer and the carrier station. The yellow LED will flicker when transferring data to and from the wafer. The red LED is on when the batteries are charging. When the red LED is flashing rapidly and solid, the unit is actively charging the batteries on the Wafer. It should typically take less than 10 minutes to fully charge the batteries. If it is flashing slowly, the battery charge is being maintained. Though the carrier will continue to maintain the batteries on the wafer, the red LED will flicker every 10 to 20 seconds when the USB cable is not connected to a power source. The blue LED blinks when a wafer is detected and communicating with the carrier.

Table 3-1: LED status indicators

LED color	Indicates
Green	Successful USB connection to computer
Yellow	USB communications activity
Red	Wafer Charging
Blue	Communication received from wafer
Red/Blue alternating	Wafer measurement has been initiated

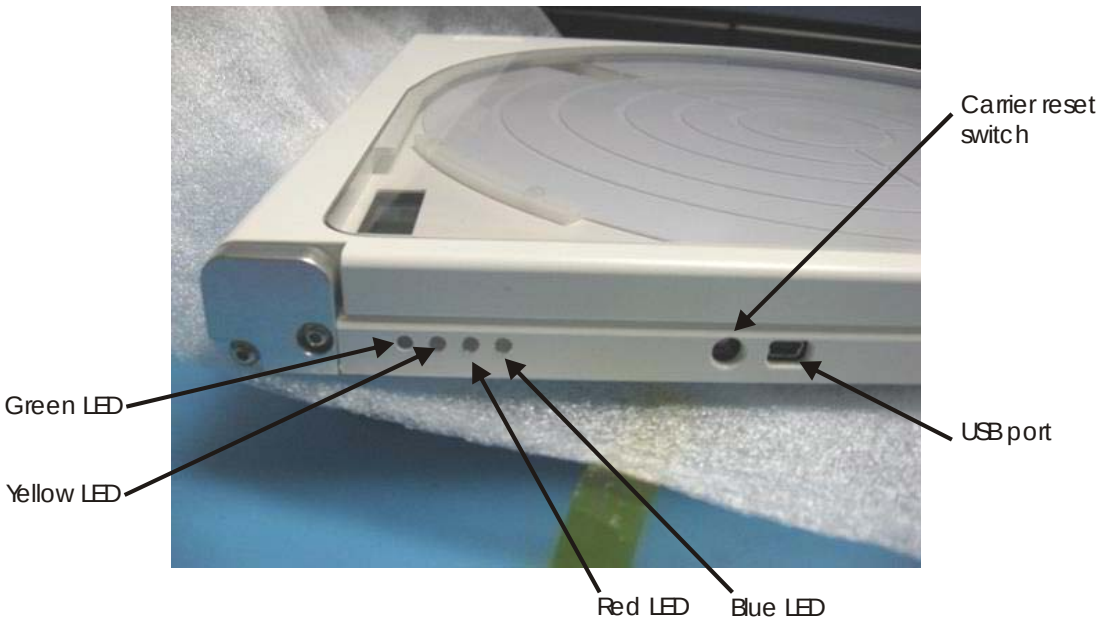


Figure 3-2. Connections and LED Indicators

Figure 3-3. Backside of C/C Carrier

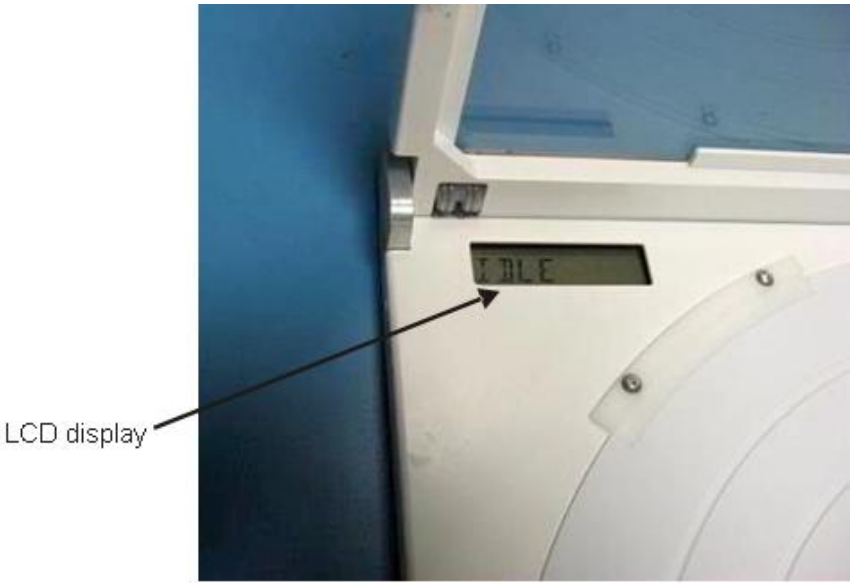


Figure 3-4. LCD Display

Figure 3-5. C/C Carrier Station Closed

To open the carrier station and gain access to the wafer, push in the white Delrin cover latch button as shown in Figure 3-6 and lift the handle attached to the lid.

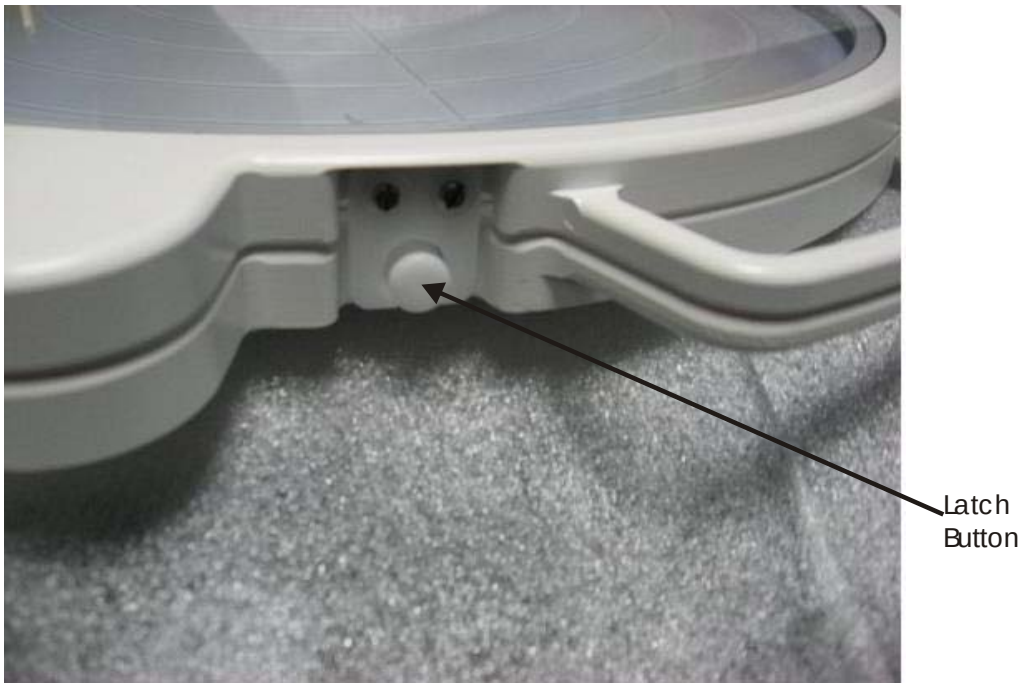


Figure 3-6. Unlatching the Carrier Station

Once the lid is raised completely, spring tension will keep it open.

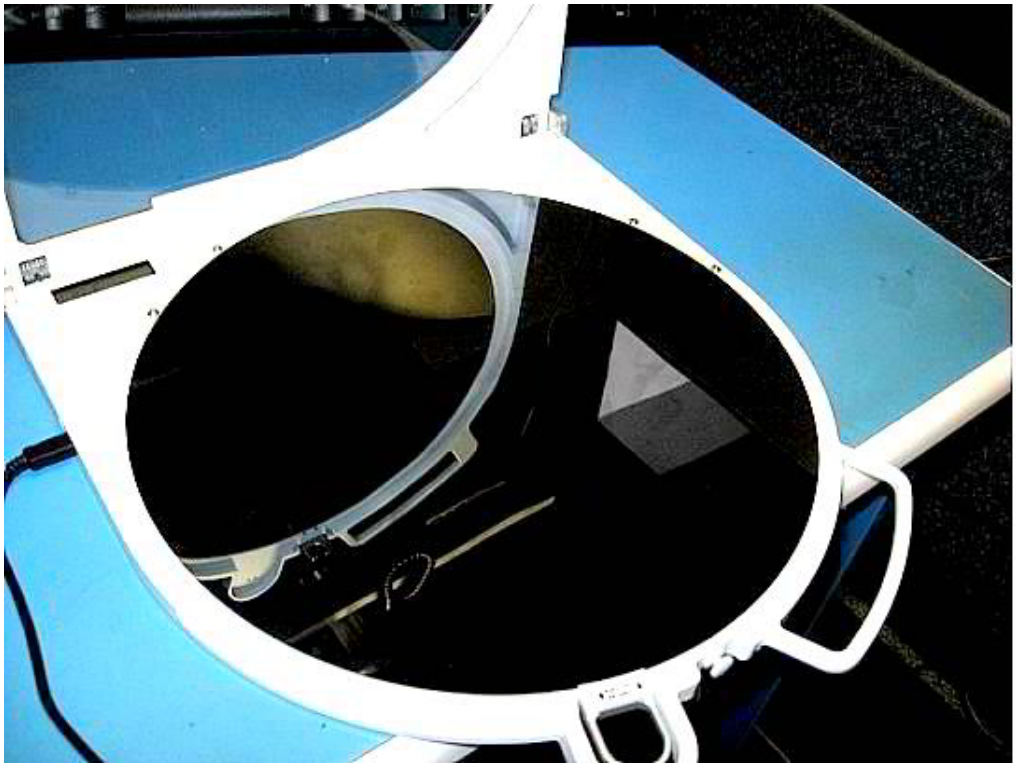


Figure 3-7. Carrier Station Open

CAUTION: Only handle the Wafer on the edges with gloves on.

The wafer is locked to the surface of the white plastic insert on the carrier station by a spring-loaded clamp mounted to the side of the carrier station. To unclamp the wafer, pull the wafer clamp straight out until it clears the side of the wafer carrier. Then press down until it aligns with the recess in the side of the carrier station. Allow the clamp to slide forward into the recess.

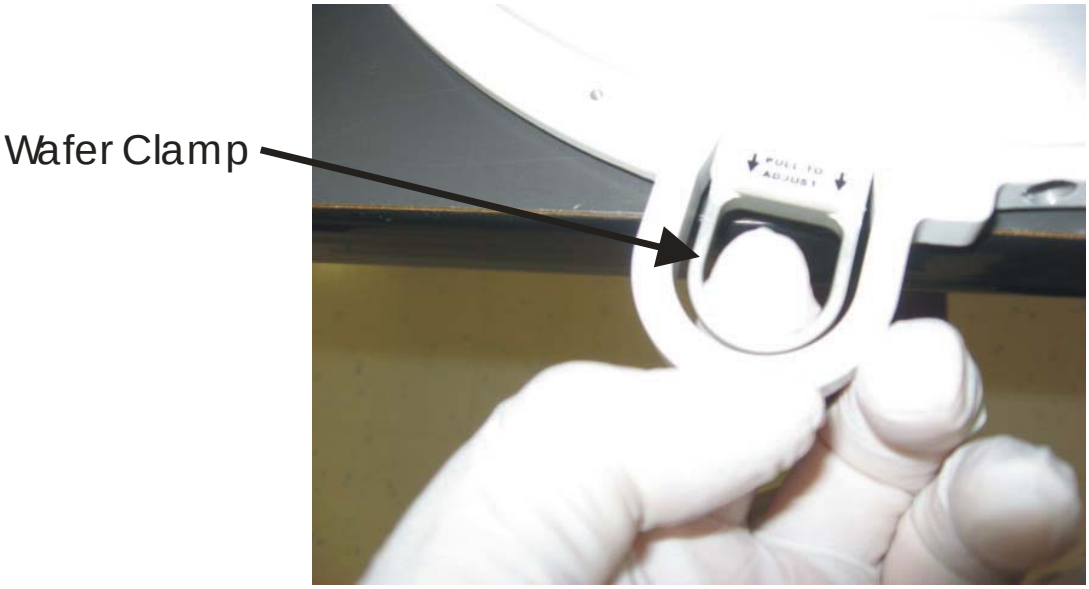


Figure 3-8. Wafer Clamp

Removing the Wafer from the Carrier Station

While the Lid is opened, you can slide the wafer off the carrier plastic insert surface. A groove is provided on the right-hand side of the carrier station surface to allow you to get your finger below the side of the wafer as shown in Figure 3-9. Slide the wafer to the left until there is enough of the wafer free of the carrier plastic insert surface to put your other hand or a vacuum wand under the wafer. Remove the wafer completely. Do not pull the wafer too quickly off the plastic insert surface. Static attraction between the bottom of the wafer and the plastic insert surface may place undue stress on the Wafer and result in breakage.

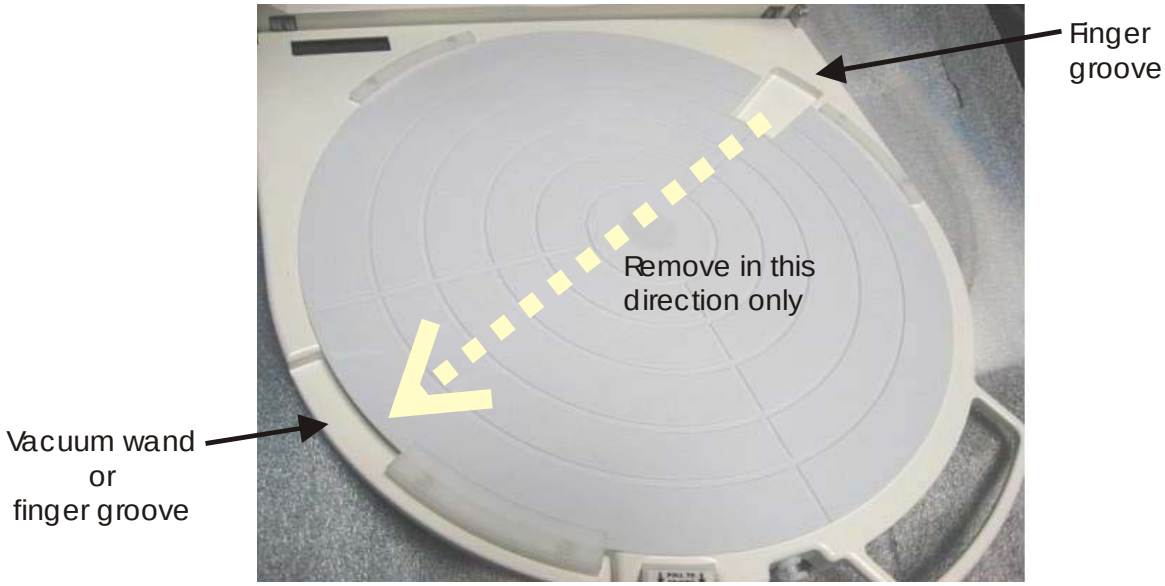


Figure 3-9. Wafer Removal Points

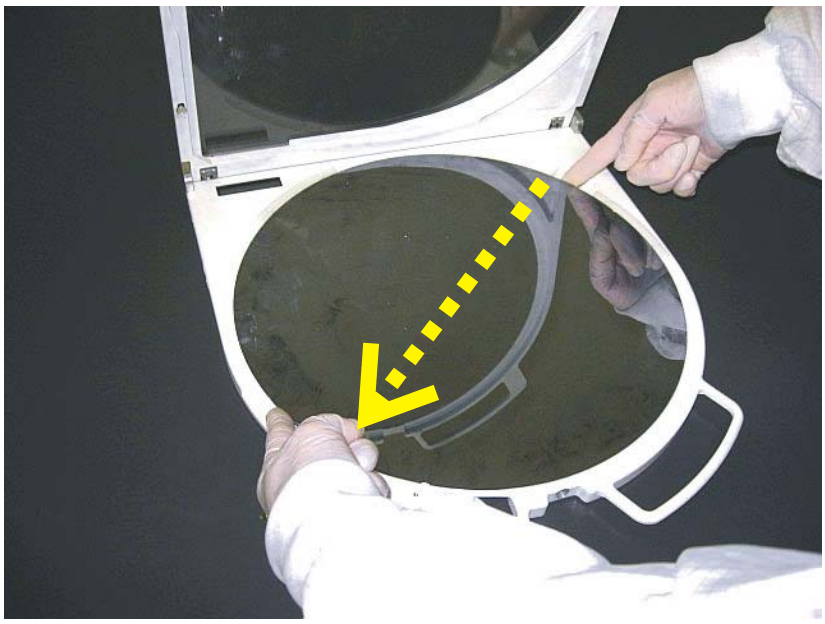


Figure 3-10. Removing the Wafer from the Carrier Station

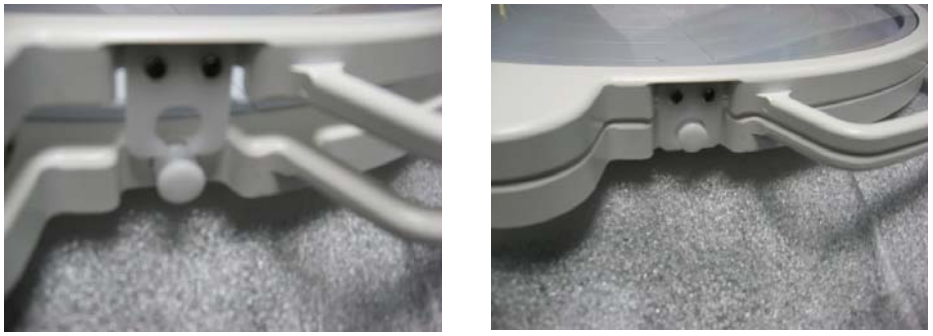
You can now place the wafer in a wafer cassette or other loading mechanism to perform the thermal survey.

CAUTION: Only handle the wafer from the bottom or by the edges as much as possible. Always ensure the backside of wafer is cleaned of any particle or any other materials.

Using the Wafer with the Carrier Station

To place the wafer on the carrier station, first open the lid of the carrier station. Slide the wafer onto the plastic insert surface and slightly push the wafer against the wafer positioners. Make sure the edge of the wafer slides under the top surface of the positioners. Once the wafer is positioned correctly, pull the wafer clamp out from the recess, lift it up, and slowly slide the clamp forward until it presses against the wafer. Release the clamp.

Lower the lid until the latch contacts the locking pin. Press the locking pin in and lower the lid until the locking pin pops out as shown in Figure 3-11. The lid is now secure.



Unlatched Latched

Figure 3-11. Lid Locking Pin

The C/C carrier has an LCD on top left corner. When lid is opened, the message **System Idle** should be displayed.

Figure 3-12. Idle Message Displayed

When wafer is present and lid is closed, the LCD will display **Loading Wafer.** Once the wafer is detected, the message **Wafer Ready** will display and the blue LED will blink.

Figure 3-13. Wafer Ready Displayed

If you close the LID and no wafer is inside the carrier, you will see the message **No Wafer detected**.

There may be a delay between the carrier LCD display messages and the system controller application message on your laptop. Do not use the wafer until you actually see the message display on the system controller application.

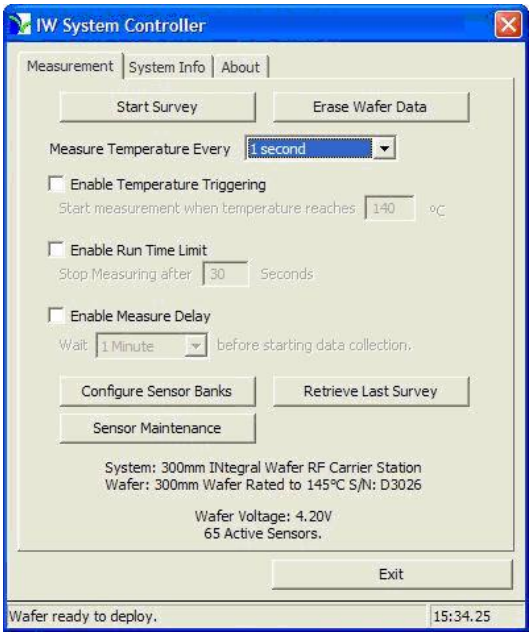


Figure 3-14. System Controller Software Screen

Chapter 4 Using the Integral Wafer System Controller Software

The Integral Wafer System Controller is a software program that communicates with the Integral Wafer through the 200 mm and 300 mm carrier station. It monitors the status of the system, retrieves data from completed thermal surveys, and sets up the parameters for the next set of surveys.

Before using the controller software, please read instructions on using the Carrier Station. See the *Using the Carrier Station* section of Chapter 2 for more information.

Starting the Program

Connect the carrier station to the computer with the USB cable. Start the IW System Controller program by double-clicking the desktop icon. The program starts. The program automatically locates the connected station and establishes communication.

If no carrier station is connected, the software will still start but displays the message "Looking For iWafer System…". Once you have connected the system, the software will then establish communication and display the **Measurement** tab.

Figure 4-1 shows an example of the startup screen with the default **Measurement** tab selected. The screen shows the system connected to a 300mm carrier station.

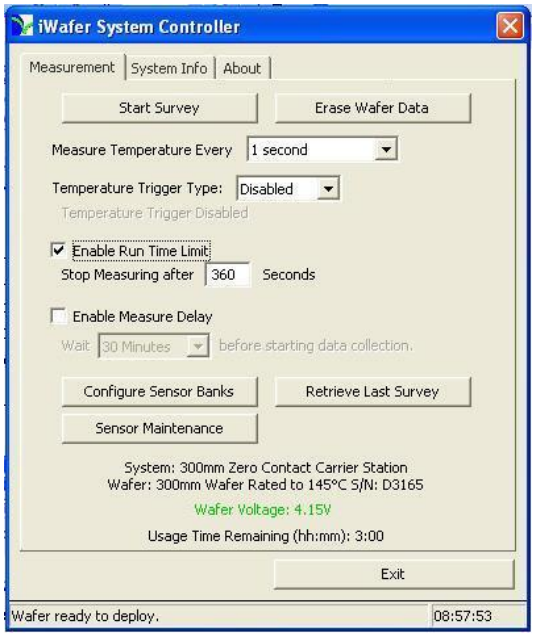


Figure 4-1. Measurement Tab Screen

Verify that the wafer and carrier station type listed below the **Sensor Maintenance** button is the correct wafer type and carrier station.

NOTE: If the program cannot locate the Integral Wafer or the carrier station, verify that the carrier station is connected to the computer, the wafer is correctly aligned inside the carrier station with lid closed and that the appropriate calibration file for the wafer is loaded onto the computer.

If the carrier station is connected but no wafer is present, you will see the screen in Figure 4-2.

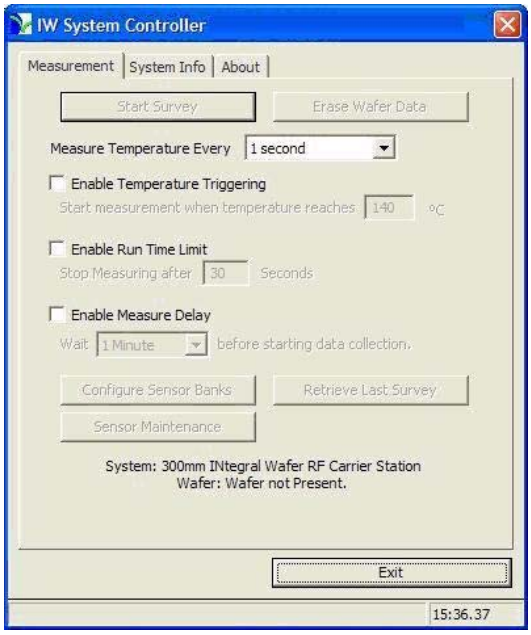


Figure 4-2. No Wafer Present

The **Measurement** tab screen displays by default when the program is first started. Most of the operations performed will be done from this screen. The wafer voltage is displayed directly below the **Sensor Maintenance** buttons.

The actual voltage of the two batteries imbedded between wafers is displayed along with the charging condition. When the battery voltage is above 4.15 volts, the wafer battery is fully charged. Always wait until the wafer is fully charged before sending the wafer out on survey. A partially charged battery may cause the wafer to stop collecting data before the end of the run. If the voltage reading drops below 4 volts, the batteries are considered to have insufficient charge to complete a survey and the software will not allow the measurement with the wafer to start. The **Start Survey** button is disabled until battery voltage exceeds 4 volts. If the voltage drops below 3.00 volts, the batteries are no longer able to hold a charge. Figure 4-3 shows an example of a wafer with insufficient voltage to perform a survey.

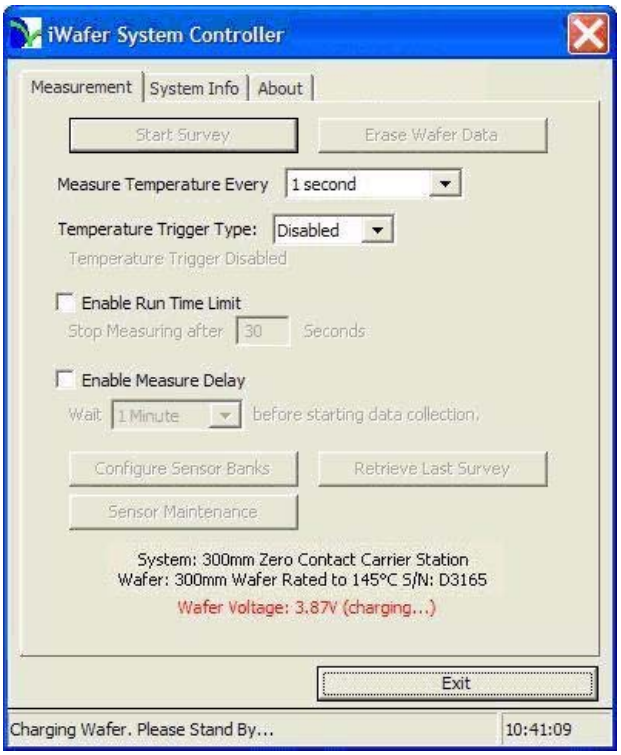


Figure 4-3. Wafer Voltage Too Low

At the very bottom of the screen, a small box displays status messages for actions performed by the software.

Clicking the **Exit** button at any time will cause the program to end and return you to Windows.

The **System Info** tab screen shows the vital information for the carrier station, and the wafer. When the carrier station is attached, it also displays the voltages of the Carrier CPU and Main Battery.

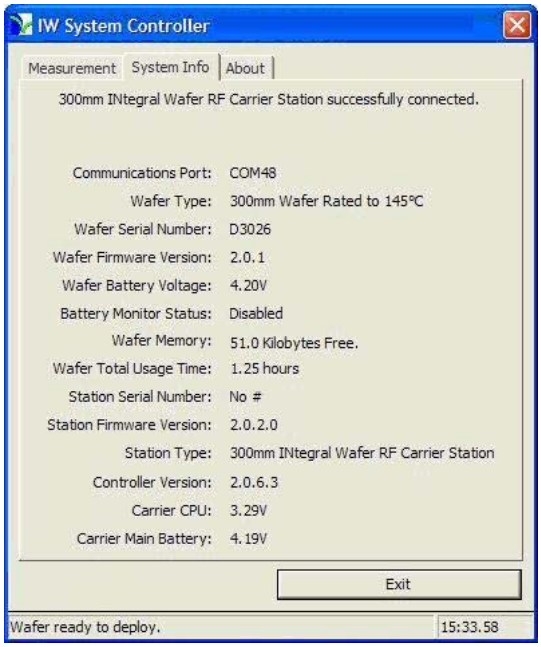


Figure 4-4. System Info Tab Program Screen

The Wafer Type section shows the model and serial number of the wafer currently connected, as well as the firmware version. It also shows the current wafer voltage and status of the wafer battery monitor (enabled or disabled).

The Station Type section shows the model and serial number of the docking station currently connected, as well as the firmware version. It also displays the controller software version.

The **About** tab screen shows the vital information for the base station or carrier software versions and the licensing status of the program.

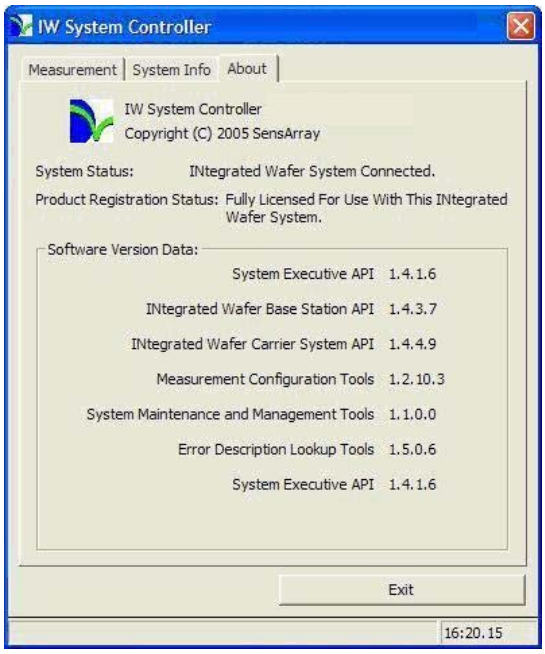


Figure 4-5. The About Tab Screen

If the program is not properly licensed, the about screen will show the message No Valid License Found in the **Product Registration Status** area. The program will not make a measurement unless it is properly registered.

Improper registration can occur if a fresh installation was performed on the computer after a system crash or other similar occurrence or if the license key file was accidentally deleted.

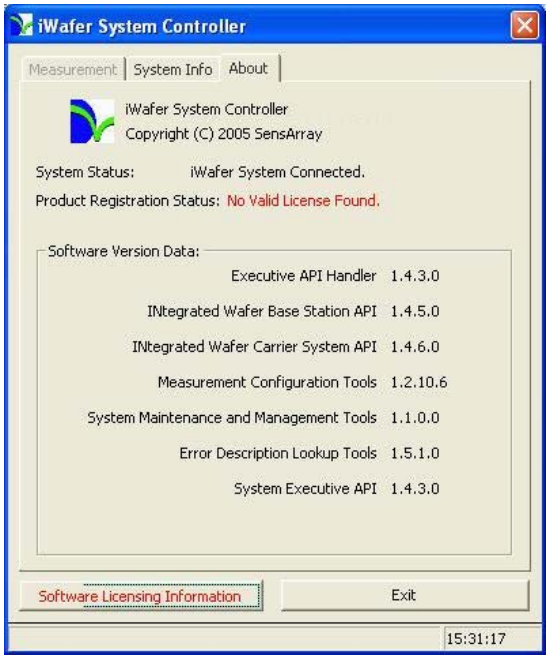


Figure 4-6. Software License Not Valid

Click on the **Software Licensing Information** button at the bottom of the screen to open an information box. The box will display a unique registration key that is specific to your computer.

Figure 4-7. Registration Key Dialog

Copy the text displayed in the **Registration Key** box exactly as it appears. Send an email to SensArray or the Sales representative you purchased the software from and include the text from the registration key. You will receive a file from SensArray that contains the unlock key for your software.

When you receive the file, copy it into the C:\SensArray\LICENSES folder on your hard drive. When you restart the program, the licensing information should now be valid.

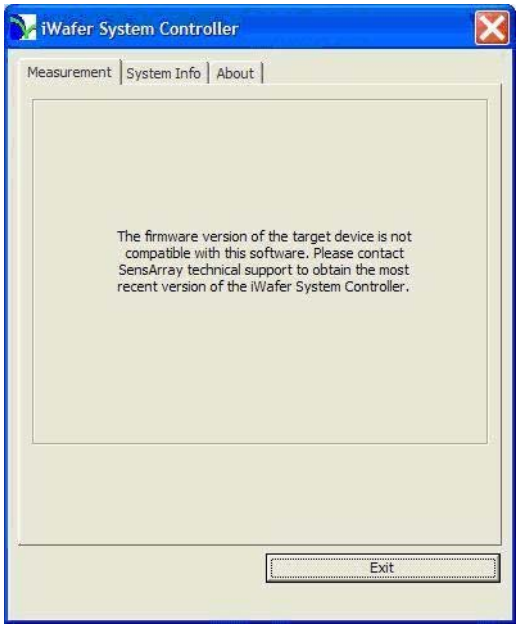


Figure 4-8. Incompatible Firmware

If the program is not up to date, the **Measurement** tab screen will display the message shown in Figure 4-8. If you have recently replaced your wafer and/or carrier it may contain updated firmware that is not recognized by older releases of the Controller program. Use the Integral Wafer CD that was provided with your new wafer to ensure that the latest version of the Controller program is installed. See the *Setting Up the Software* section of Chapter 2 for more information.

Wafer Time Limit Feature

To ensure optimum performance, as well as to help prevent possible structural or mechanical wafer failures, Integral Wafers that are intended for use in certain processes or applications are equipped with a built-in time limit feature. When the maximum recommended operating time has been reached, the wafer will automatically cease to operate. Refer to your wafer's specifications for environmental operational limits and allotted usage hours.

The **Measurement** tab portion of the Controller program displays the remaining usage time available to your wafer as shown in Figure 4-9.

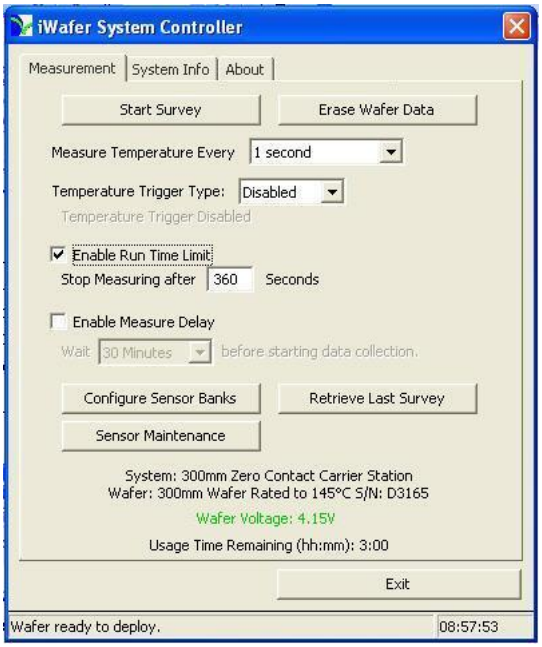


Figure 4-9. Usage Time Remaining

When a wafer is approaching its final deployment, an alert box will appear indicating that the maximum recommended operating time has almost elapsed. As long as there is available usage time left, the Controller program will allow you to start a survey and deploy the wafer for a normal measurement activity.

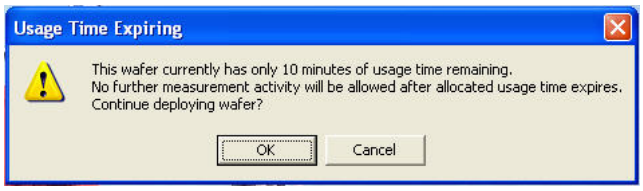


Figure 4-10. Usage Time Expiring

When the available usage time has elapsed, the **Measurement** tab will no longer display any wafer deployment options.

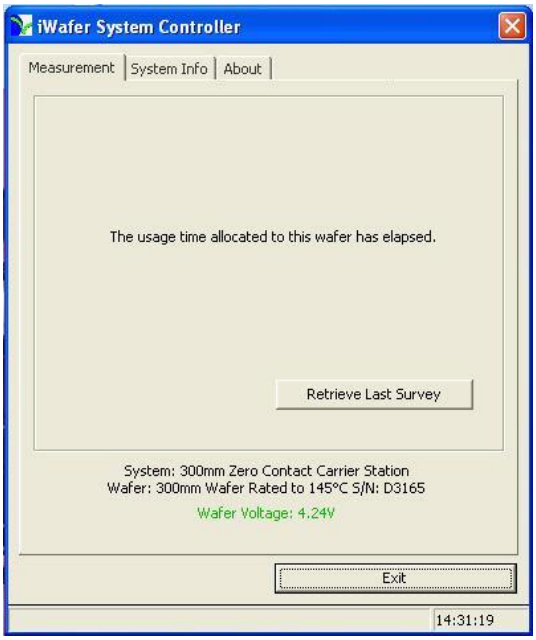


Figure 4-11. Usage Time Elapsed

Defining a Survey

1. From the **Measurement** tab, click on the **Configure Sensor Banks** button to setup the measurement parameters. The number of banks and sensors displayed on the configuration screens depends on the size of the wafer.
2. If you note sensor locations on the sensor display that are marked with an **X**, these are sensors that are disabled. You cannot enable or disable individual sensors using this program, only banks of sensors.

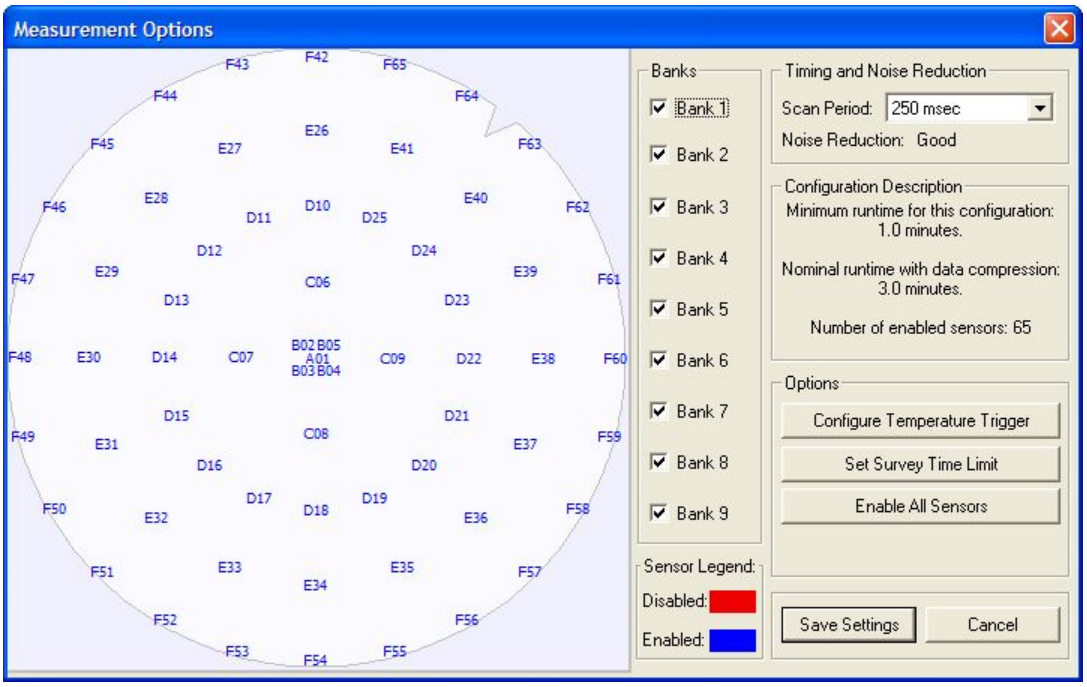


Figure 4-12. Measurement Options- 300mm Wafer

3. Select the bank or banks with which you wish to measure by clicking on the bank label or check box, or by clicking on an individual sensor on the sensor map. As you place your mouse cursor over a bank number in the **Banks** column or an individual sensor on the sensor map, the sensors that make up that bank are highlighted. When a sensor bank is disabled, it will be displayed in red.
4. Clicking the **Enable All Sensors** button cancels any previous changes and re-enables all available sensors.
5. If you need to disable or enable individual sensors within a bank, click on the **Sensor Maintenance** button on the main controller window. A new window appears that allows individual sensor selection.
6. Click on the sensor that you wish to enable or disable. When enabled, the sensor number is displayed. When disabled, the sensor number is displayed in a light gray color.

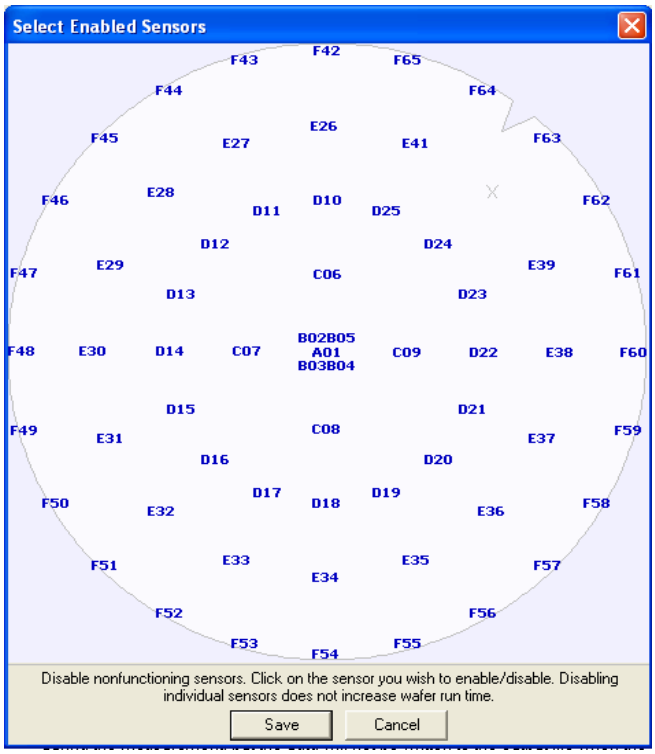


Figure 4-13. Select Enabled Sensors Window

7. Click the **Save** button when finished to save the new configuration to the Integral Wafer. The window closes and returns you to the **Measurement Options** window

NOTE: The disabled sensors will be noted in the Integral Wafer memory. Data will still be taken during the measurement, but the data will not be written to the output file when the data is transferred from the wafer. Disabling an individual sensor does not increase the run time.

8. Select the scan period for your measurement by clicking on the drop down list in the **Measure Temperature Every** section. The minimum and nominal runtime settings will update with changes in the settings. You should note that the faster the scan period, the greater the noise introduced into the measurement. For best result, consider a scan period of 1 second or longer.

NOTE: The runtime is based on a calculation of the available memory on the Integral Wafer, the number of banks selected, and number of scans per second. The longer the period between scans and the fewer sensor banks enabled, the longer you can take data.

9. Clicking the **Temperature Trigger Type** button allows you to set an absolute or transient temperature point as a trigger to start the measurement. No measurements will be taken until the trigger point is reached. This allows you to put the carrier station in place and transfer the wafer into the test chamber without having to set a precise delay time to start the measurement. This condition allows more useful available measurement time.

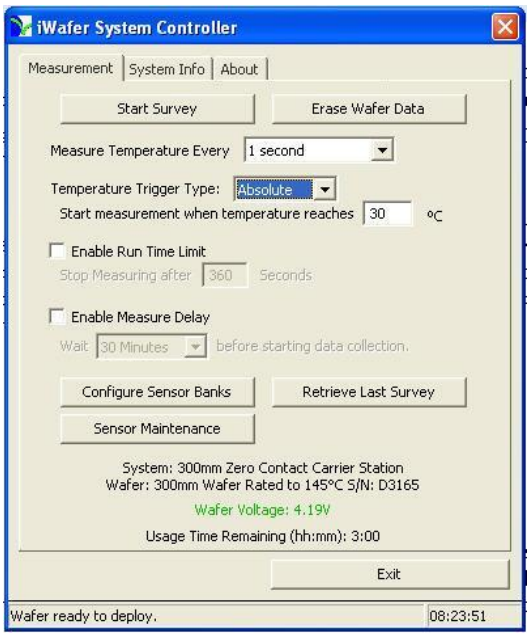


Figure 4-14. Selecting Temperature Trigger Type

10. Select **Absolute** from the drop down list next to **Temperature Trigger Type**. Enter the desired trigger temperature into the box in degree Celsius. Your Trigger is now set. If the trigger temperature is unknown or varies from run to run, selecting **Transient** from the drop down list may be a preferred option. With the temperature trigger set to transient, a 0.35°C per second gradient will activate the wafer. To cancel either function, select **Disable** from the option list.

11. Clicking the **Enable Run Time Limit** check box allows you to set a maximum time that the survey will run. Enter the desired run time into the box in second intervals.

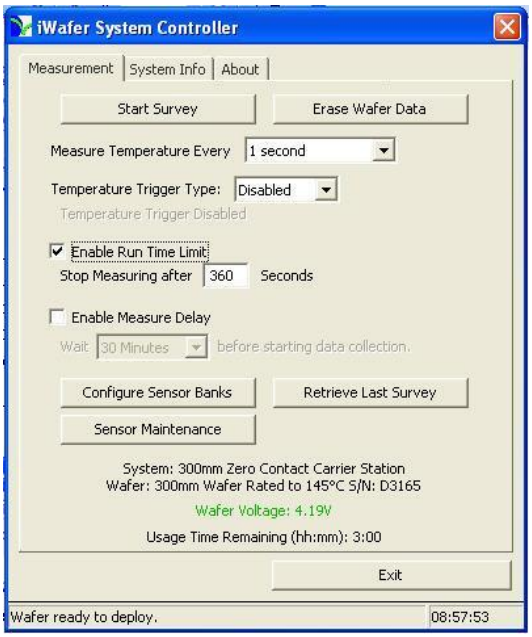


Figure 4-15. Set Survey Time Limits Dialog

12. Click on the **Enable Measure Delay** check box to allow setting a measurement delay. Click on the down arrow on the drop-down box and select the amount of delay desired before the measurement starts. You can only select the fixed values (from 1 minute to 1 hour) in the drop-down list, typing a custom time value will not work.

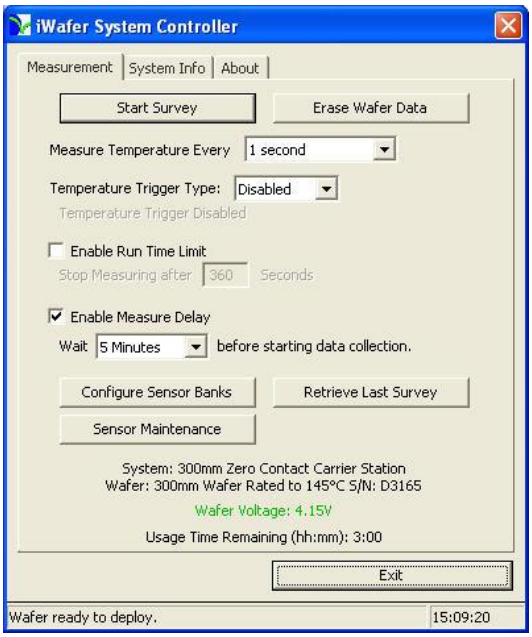


Figure 4-16. Setting Measurement Delay

NOTE: Using the "Measurement Delay" prevents data recording until you have time to physically place the Integral Wafer into the system to be measured. No data is recorded during the "Measurement Delay" period. However, the battery is still running.

13. Click the **Start Survey** button.

14. The **Start Survey** button will change to read **Abort Survey**. Pressing this button before the wafer has left the dock will cancel the survey and reset to the Start Survey. The parameters for the survey may then be changed and the survey started once again. Once the wafer has left the carrier station, the button will dim and no longer function. If the carrier station is unplugged from computer, the program screen reverts to the message 'Looking for iWafer System…".

15. Move the carrier station into position for transferring the wafer into the test chamber.

Transferring Wafer Data

1. Connect the carrier station to the computer with the USB cable. The program will automatically recognize the wafer.

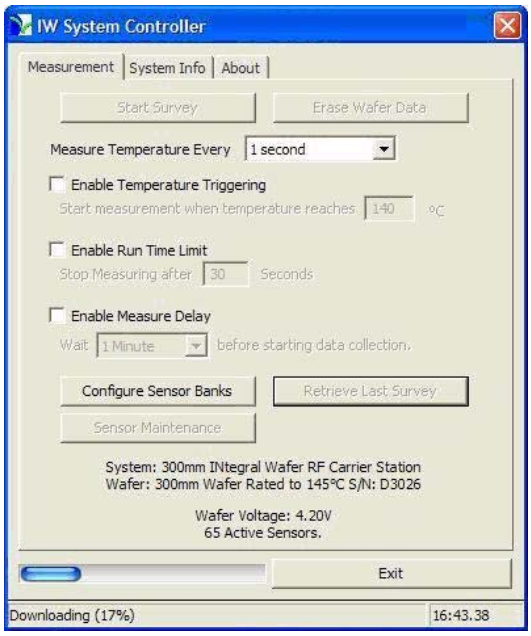


Figure 4-17. Getting Wafer Data

NOTE: If you are connected to the wafer through a carrier station, and there is data on the wafer, a message appears for you to download the data.

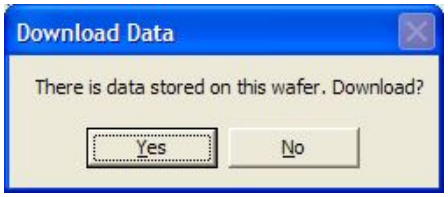


Figure 4-18. Download Data

Click **Yes** to download the data or **No** to ignore it. Clicking **Yes** has the same effect as pressing the **Retrieve Last Survey** button.

2. Once the button is active, click the **Retrieve Last Survey** button to transfer the latest survey file to your computer.
3. A **Name File and Enter Comment** dialog box opens. Enter any comments you wish to make about the file in the **Comment** box.
4. Click the **OK** button.

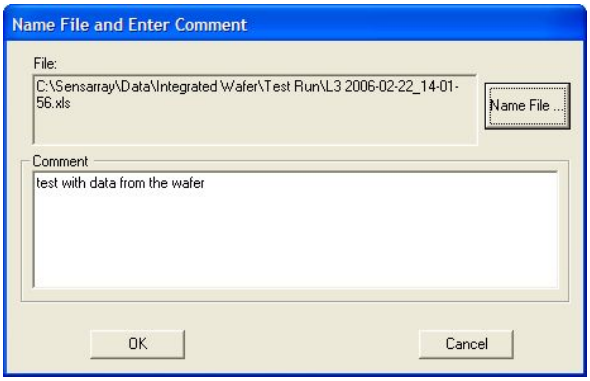


Figure 4-19. File Transfer Dialog Box

5. The **Save As** dialog box appears. This is a standard Windows dialog box.
6. Type the new name for the file in the **File name:** box or select an existing file name from the list.

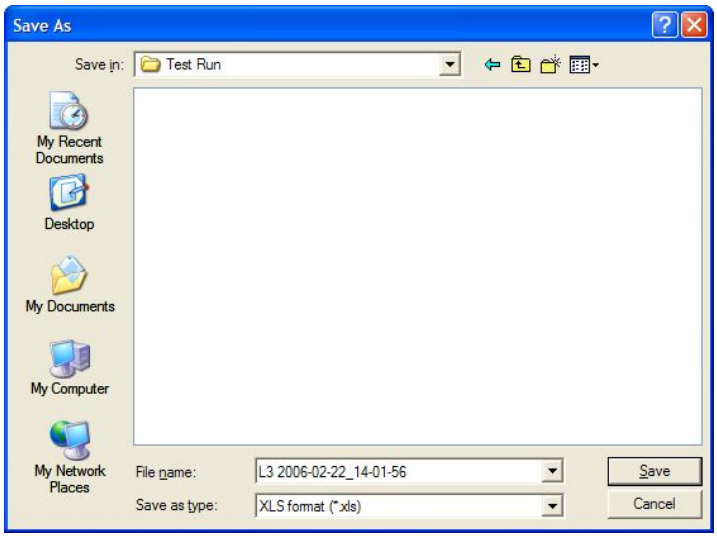


Figure 4-20. Selecting the Folder

7. Select the directory to place the file into in the **Save in:** dropdown and click the **Save** button to start the download. You may create a new folder, if needed, by clicking the new folder icon.
8. The main program window appears and starts transferring the wafer data to the host computer.
9. The program displays a progress bar showing the percentage of the measurement data transferred.
10. Once the data is transferred to memory, the program applies the calibration coefficients to the wafer data.
11. Once the calibration is applied, the screen displays a message showing the file(s) was decoded successfully.
12. As soon as the data is transferred, the Thermal MAP Analysis program (if installed) opens and displays the data in an Analysis window. For information on using the

program, please read the Analysis Software User Manual located in the C:\SensArray\Documentation folder on the host computer or use the Help file in the Thermal MAP Program.

NOTE: If the Thermal MAP Analysis does not start automatically, this normally means that the program was not upgraded on your computer. You can start Thermal MAP from the desktop icon or click **Start»Programs»SensArray»Thermal MAP** from the start menu. Verify that the version is 3.0.6 or higher. If not, install the upgrade provided with your Integral Wafer system.

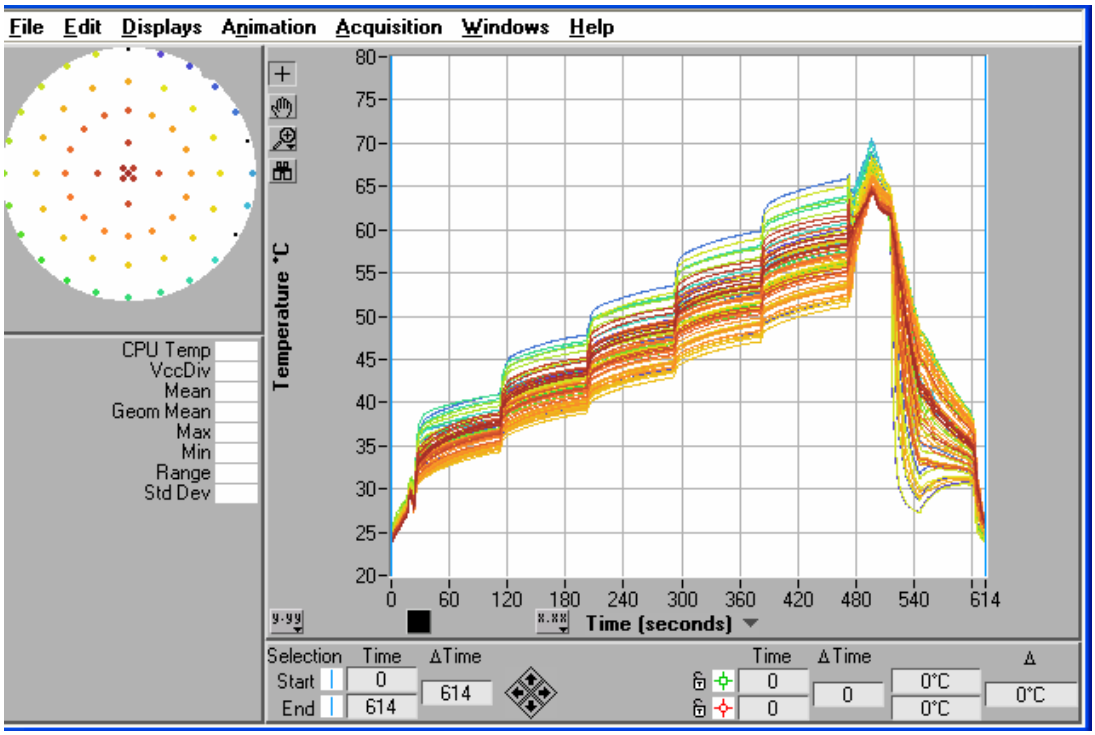


Figure 4-21. Thermal MAP Analysis Window Example

13. When you are finished, you may exit Thermal MAP and the Integral Wafer Controller software.

Appendix A Reference Information

Sensor Bank Reference

Tables 1 and 2 detail the sensors that make up each bank for 200mm and 300mm wafers.

Table 1. 200mm Bank Definitions for 53 Sensors

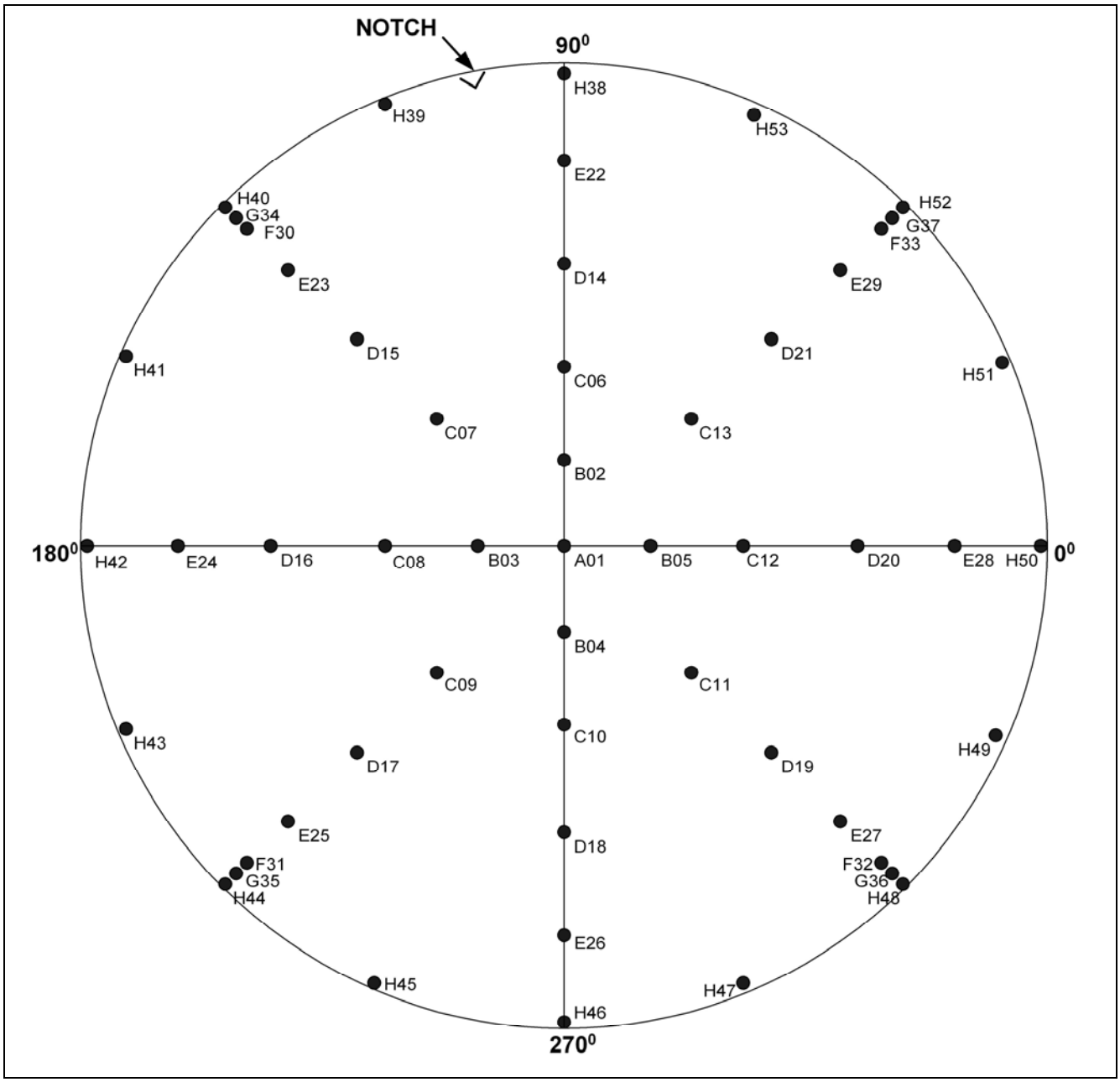
Bank	Sensors							
1	C07	C11	F30	F32	G34	G36	H40	H48
2	C09	C13	F31	F33	G35	G37	H44	H52
3	C08	C12	D16	D20	E24	E28	H42	H50
4	C06	C10	D14	D18	E22	E26	H38	H46
5	H39	H41	H43	H45	H47	H49	H51	H53
6	D15	D17	D19	D21	E23	E25	E27	E29
7	B02	B03	B04	B05	A01			

Table 2. 300mm Bank Definitions for 65 Sensors

Bank	**Sensors**							
1	C06	C08	D10	D18	E26	E34	F42	F54
2	C09	C07	D22	D14	E38	E30	F60	F48
3	B05	B03	D24	D16	E40	E32	F63	F48
4	B02	B04	D12	D20	E28	E36	F45	F57
5	D25	D17	E41	E33	F64	F52	F65	F53
6	D23	D15	E39	E31	F61	F49	F62	F50
7	D11	D19	E27	E35	F43	F55	F44	F56
8	D13	D21	E29	E37	F46	F58	F47	F59
9	A01							

Correlating Sensor Coordinates

Use the R, theta coordinates listed in tables 3 and 4 along with the layout drawings in figures 1 and 2 to match the sensor position on the wafer to the matching position on your hotplate or surface.



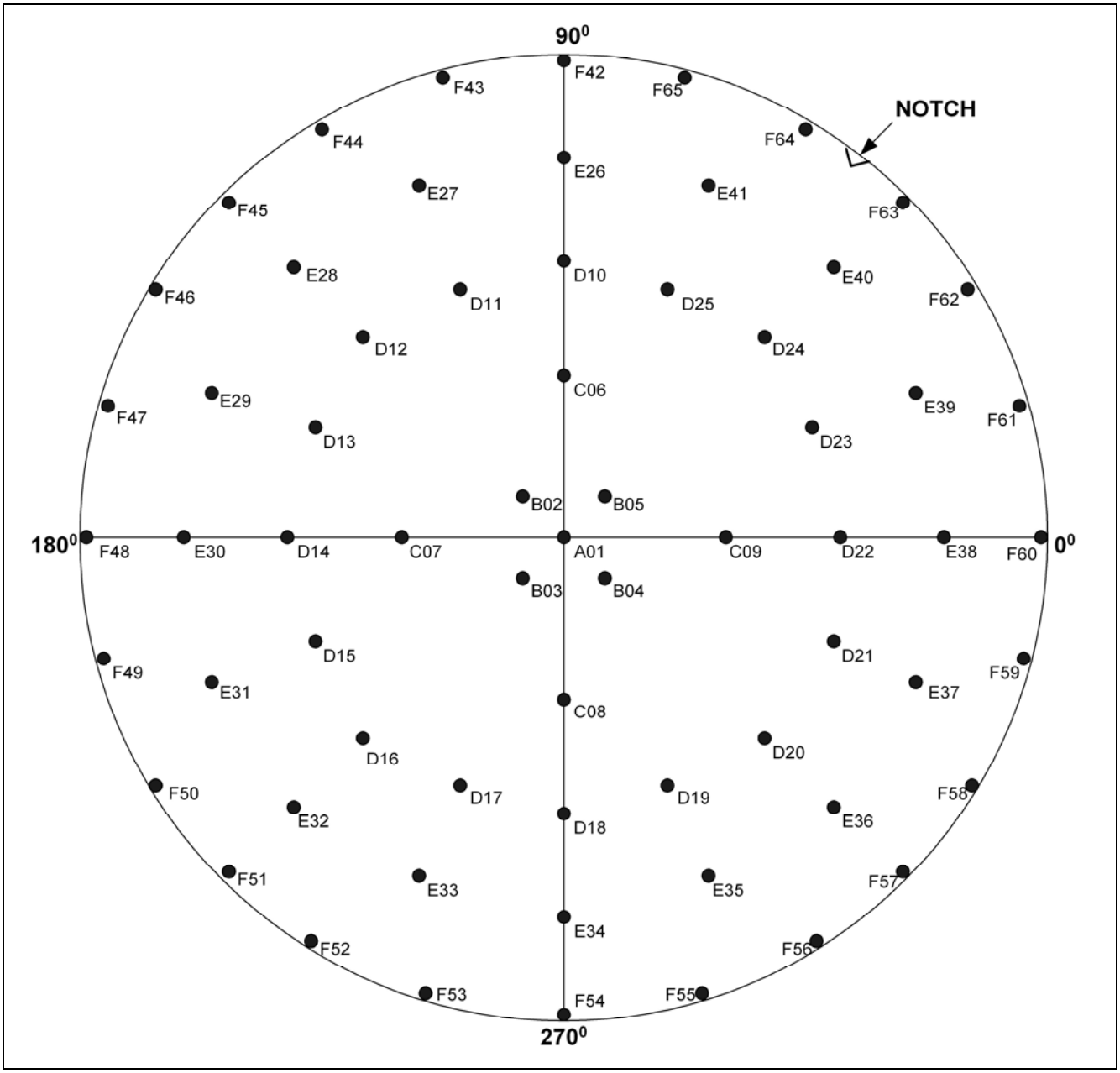
For reference only. Drawing not to scale.

Figure 1. 200mm Sensor Layout

Table 3. 200mm Integral Wafer Sensor Positions

Sensor	Radius (mm)	Theta
A01	0	0
B02	14	90
B03	14	180
B04	14	270
B05	14	0
C06	35	90
C07	35	135
C08	35	180
C09	35	225
C10	35	270
C11	35	315
C12	35	0
C13	35	45
D14	56	90
D15	56	135
D16	56	180
D17	56	225
D18	56	270
D19	56	315
D20	56	0
D21	56	45
E22	77	90
E23	77	135
E24	77	180
E25	77	225
E26	77	270

Sensor	Radius (mm)	Theta
E27	77	315
E28	77	0
E29	77	45
F30	90	135
F31	90	225
F32	90	315
F33	90	45
G34	94	135
G35	94	225
G36	94	315
G37	94	45
H38	97	90
H39	97	112.5
H40	97	135
H41	97	157.5
H42	97	180
H43	97	202.5
H44	97	225
H45	97	247.5
H46	97	270
H47	97	292.5
H48	97	315
H49	97	337.5
H50	97	O
H51	97	22.5
H52	97	45
H53	97	67.5



For reference only. Drawing not to scale.

Figure 2. 300mm Sensor Layout

Table 4. 300mm Integral Wafer Sensor Positions

Sensor	Radius (mm)	Theta
A01	0	0
B02	9	135
B03	9	225
B04	9	315
B05	9	45
C06	37	90
C07	37	180
C08	37	270
C09	37	0
D10	74	90
D11	74	112.5
D12	74	135
D13	74	157.5
D14	74	180
D15	74	202.5
D16	74	225
D17	74	247.5
D18	74	270
D19	74	292.5
D20	74	315
D21	74	337.5
D22	74	0
D23	74	22.5
D24	74	45
D25	74	67.5
E26	110	90
E27	110	112.5
E28	110	135
E29	110	157.5
E30	110	180
E31	110	202.5
E32	110	225
E33	110	247.5

Sensor	Radius (mm)	Theta
E34	110	270
E35	110	292.5
E36	110	315
E37	110	337.5
E38	110	0
E39	110	22.5
E40	110	45
E41	110	67.5
F42	147	90
F43	147	105
F44	147	120
F45	147	135
F46	147	150
F47	147	165
F48	147	180
F49	147	195
F50	147	210
F51	147	225
F52	147	240
F53	147	255
F54	147	270
F55	147	285
F56	147	300
F57	147	315
F58	147	330
F59	147	345
F60	147	0
F61	147	15
F62	147	30
F63	147	45
F64	147	60
F65	147	75