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WHITE PAPER

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Abstract

This white paper covers wafer sawing and handling best practices for F-RAM wafers purchased from Cypress Semiconductor Corp. It includes tips to help customers maximize their yield with this material. The recommendations provided in this paper are suggestions only and are based on Cypress's own learning.

Cypress accepts no liability in offering these suggestions.

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Best Practices for Sawing, Handling, and Packing of F-RAM Wafers

Cypress enters into business agreements with customers to sell F-RAM™ wafers on a very limited basis because the structural characteristics of F-RAM wafers require careful and experienced handling. F-RAM wafers have a low-κ (dielectric constant) inter-metal dielectric layer, which is more fragile than silicon dioxide and more susceptible to chipping and cracking during dicing. Also, Cypress recommends that strict care be taken when wafers are moved in the containers, moved to and from work tables, and transferred in and out of equipment.

This document offers Cypress's lessons learned and recommended best practices for sawing and handling F-RAM wafers.

F-RAM Wafer Sawing – Best Practices

The following are the proposed guidelines for laser grooving and then sawing low-κ F-RAM wafers. After reviewing this white paper, please contact your saw vendor for recommendations on cutting low-κ wafers with the specific model of saw that you plan to use.

Background

Low-κ F-RAM wafers are more difficult to saw than standard silicon wafers. These wafers have a higher chance of metal and passivation peeling, top-side and bottom-side chip-outs, and sidewall cracks. Standard silicon wafer sawing processes not modified for low-κ wafers can result in excessive yield loss.

Laser Grooving

Cypress recommends doing a 3-pass laser groove before performing the saw cut using a short pulse 355-nm UV laser. The laser should penetrate 20 to 30 µm into the bulk silicon with a kerf (notch) width of 30 to 40 µm.

Saw Cut Method

Cypress recommends a two-step saw process, with the first cut removing the top deposited layers and the second cut making the full bulk silicon cut. Either of the following dual-pass sawing methods is acceptable.

Step cut: Step cut is a dual-pass sawing method that uses two different blades. The first blade makes a single pass along each street at a cut depth of 10 to 25 percent of the wafer's thickness. The second blade is approximately 10 microns narrower than the first blade in width and is set so as not to touch either sidewall created by the first blade cut. The second blade completes the cut through the full wafer thickness in one pass along each street of the wafer.

Dual cut: Dual cut uses the same blade twice, or two identical blades on a twin-spindle saw. On the first pass, the blade makes a single pass along each street at a cut depth of 10 percent to 25 percent of the wafer's thickness. The same blade, or an identical twin blade, then completes the cut through the full wafer thickness in a second single pass along each street of the wafer.

Blade Selection

First-pass blade: The first-pass blade used in either the step-cut or the dual-cut method should have a ϕ3500 small to ϕ4000 fine grit size and a high 50 percent to 70 percent concentration of diamond grit. Cypress recommends the Disco ZH05 Series blade.

Second-pass blade: This step-cut second-pass blade can use a ϕ3500 small or ϕ3000 medium grit size. Again, the step-cut second-pass blade's cut width should be approximately 10 microns narrower than the first-pass blade's cut width.

Saw Settings

Spindle speed, cut rate (that is, feed rate), cut depth, the Keteca Diamaflow™ of the surfactant (which lowers the surface tension of the DI water), and deionized (DI) water flow rate are all critical parameters in defining an optimized sawing process. The following are Cypress's suggestions for each of these parameters.

Spindle speed: Spindle speed is defined as the revolutions per minute (rpm) of the blade; we recommend a spindle speed between 30,000 and 50,000 rpm, with a typical speed of 40,000 rpm. We have seen no issues with spindle speeds varying in this range for both the first- and second-pass blades.

Cut rate: A slower cut rate reduces chips and cracks. Cut rates for low-κ wafers that are too fast "load" up the blade with silicon residues between the diamond grits, which makes it a less effective sawing tool. We recommend that cut rates be kept below 25 to 30 millimeters per second (one inch per second) for F-RAM wafers for both the first-pass and second-pass cuts. Cypress has found that keeping the cut rate constant for each blade pass reduces chipping and cracking. We also have found that the cut rates can be slightly different between the first pass and second pass without any noticeable change in the yield loss.

Cut depth: For both the step-cut and the dual-cut methods, the first-pass cut depth should consume 10 to 25 percent of the total silicon wafer depth. The first-pass cut removes all metal and passivation from the streets. The second-pass cut is a full-thickness cut of bulk silicon only. The second cut should have no additional loading in the streets from top-layer metal that was not removed properly by the first cut or that was created by a misalignment with one of the sidewalls during the first cut.

DI water flow rate: Cypress highly recommends that the wafer-sawing process use a CO_2 bubbler with DI water resistivity set to <1 MΩ-cm^2. Cypress recommends a DI water flow rate of 1.5 to 2.0 liters per minute during both the first and second cuts to immediately push silicon or metal loading away from the blade. Cypress has found that a high DI flow rate during low-κ wafer sawing greatly reduces chipping and cracking occurrences.

F-RAM Wafer Handling – Best Practices

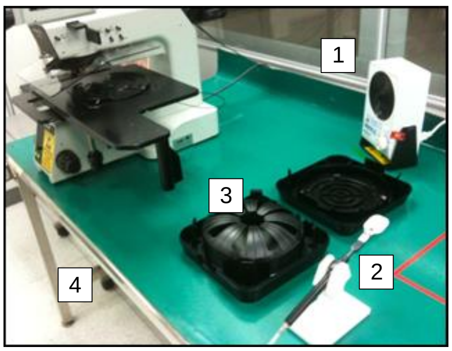
1. These best practices focus on keeping the wafers horizontally flat, minimizing contact between the wafer edge and wafer container, and using the vacuum wand as carefully as possible. Cypress enforces these F-RAM wafer-handling practices at all Cypress and Cypress subcontracting facilities and recommends that all customers follow these practices as well. The following steps describe these basic rules. If backgrind is required, leave the protective tape on the front side of the wafer after backgrind until frame mount at die attach to prevent any accidental damage to the front surface of the wafer.

2. The use of a contactless chuck is recommended when applying tape for wafer sawing to prevent any mechanical contact with the front surface of the wafer. Use of a contactless chuck during frame mount can prevent the need to leave on the protective backgrind tape.

3. Transport the F-RAM wafer container using a cart with an ESD chain whenever possible. Keep the lid side up and the container as flat as possible. Always handle the container with both hands when moving it between the cart and the workbench, keeping the container as horizontal as possible.

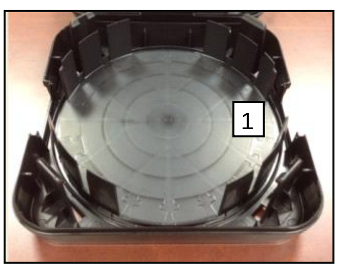


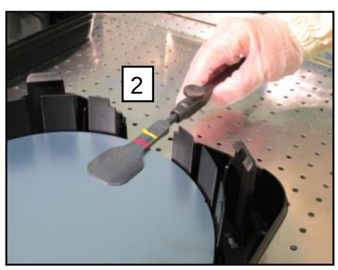
4. Open the F-RAM wafer container in a clean room area on a well-lighted work table. The area should have an ionizer running, and the operator must have a vacuum wand and ESD grounding.



1. Ionizer
2. Vacuum wand
3. F-RAM lot
4. Work table with ESD ground

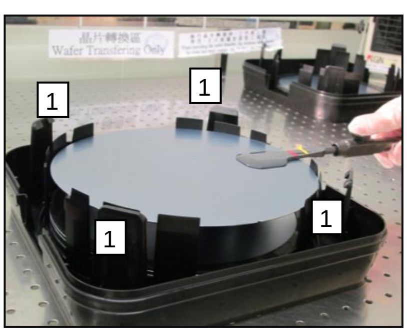
5. Carefully remove the lid and any top filler material. Note the exact removal order for any future container reuse. A vacuum wand must be used to extract the F-RAM wafer. Lower the wand handle over the grooved-edge container window to guarantee a solid connection with the wafer.





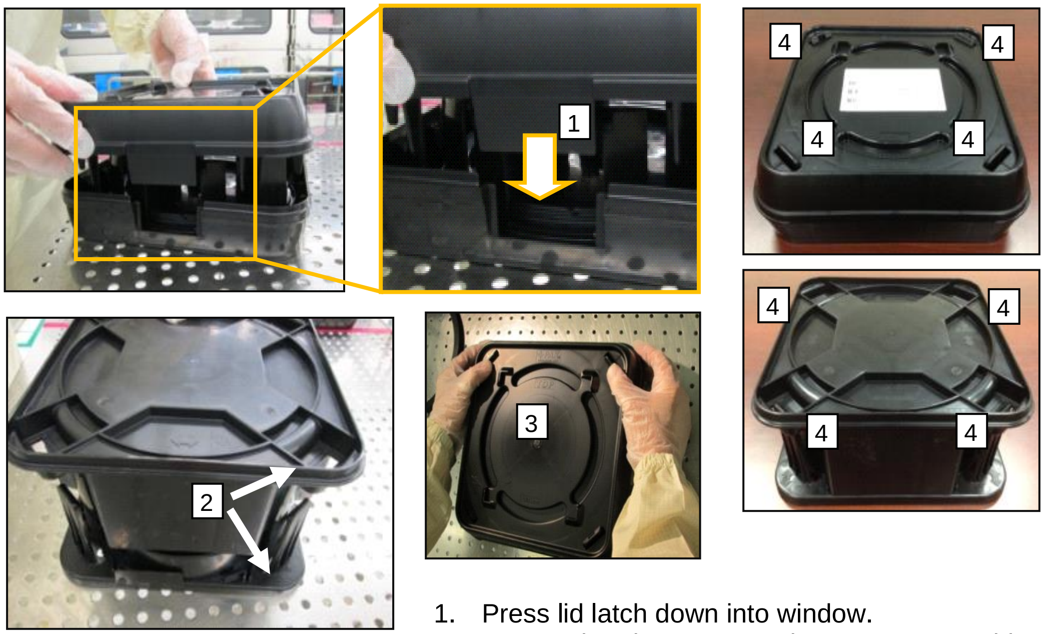
1. Container window
2. Place wand handle in container window to pick up or put down the wafer.

6. It is critical to ensure that the F-RAM wafer's active surface does not touch any of the corner edges of the container.



1. Container's corner edges:
   - Slowly pick up and return the wafer without touching any of the corner edges of the container.
   - Vertically lift or lower the wafer, keeping it as horizontal as possible throughout the working path of movement.

7. If you return the F-RAM wafer to the container for storage or transportation to another station, make sure that the stacking order of filler material and orientation of the wafer are identical to the original condition. Add extra fillers inside the container to prevent wafer movement, if needed. Relock the container lid clip for all station-to-station transportation.



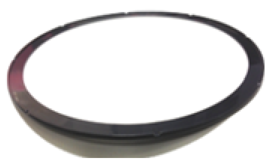
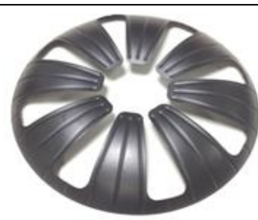
1. Press lid latch down into window.
2. Ensure that the arrow marks are on same side.
3. Lock the lid by pressing the clip on each corner.
4. Fully closed F-RAM container has all four corner clips locked.

F-RAM Wafer Packing – Best Practices

Cypress recommends the following guidelines, materials, and procedures for packing F-RAM wafers to avoid wafer scratches and breakages:

1. Use vacuum packing at 350 to 450 mm Hg with automatic N_2 purge of 28 psi to ensure that packing is not too tight,

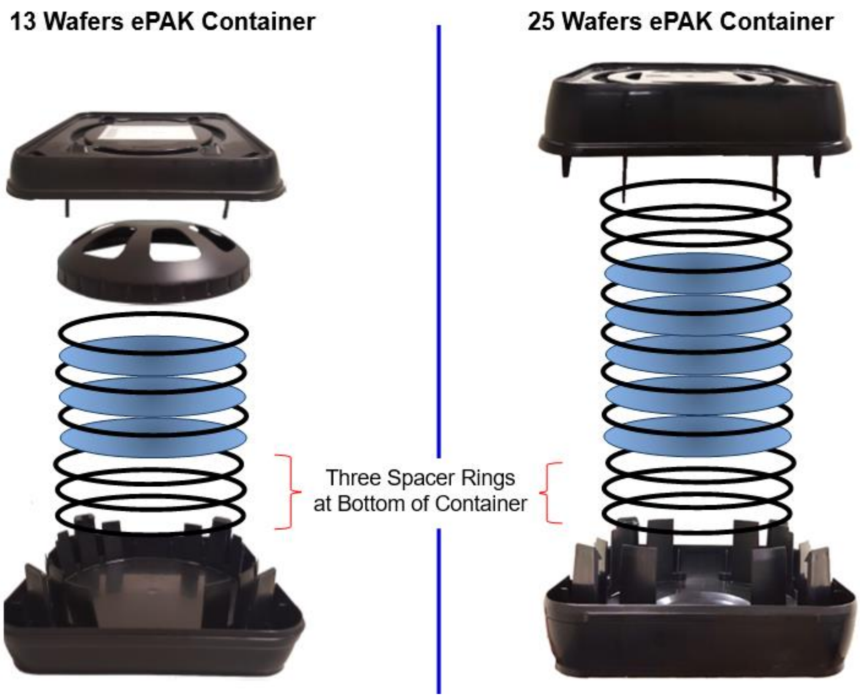
2. Use packing materials from supplier ePAK as follows:

ePAK Materials for 200-mm-diameter F-RAM Wafers	
Container for Maximum of 13 Wafers	
Container for Maximum of 25 Wafers	
Spacer Ring	
Closed Dome	
Open Dome	

ePAK Materials for 300-mm-diameter F-RAM Wafers	
Container	
Spacer Ring	
Compliance Ring	

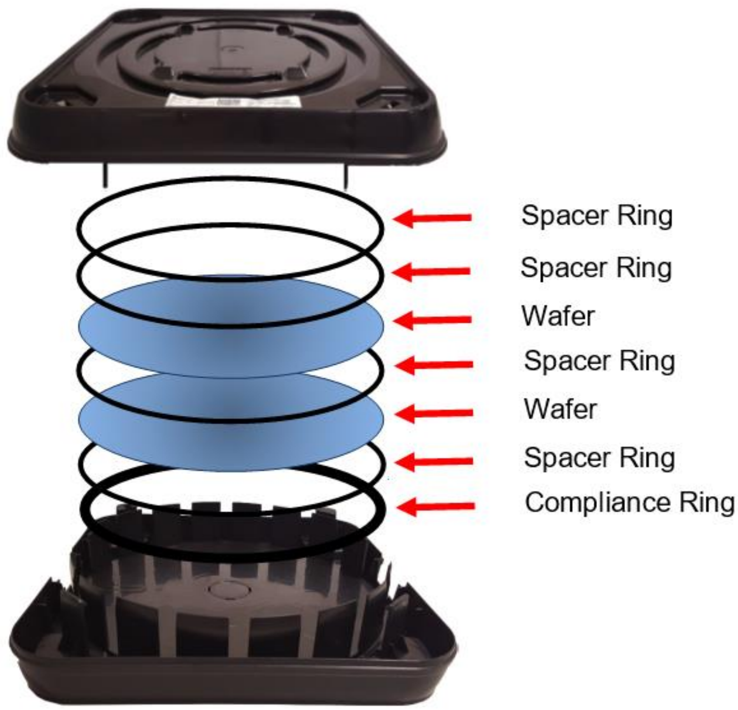
3. For packing 200-mm-diameter F-RAM wafers, use three spacer rings at the bottom of the container to prevent the bottom wafer from contacting the bottom wall of the container.

Quantity	Thickness	Type of Container	Spacer Rings at Bottom	Top Filler
1 to 7	Any	ePAK 13 wafers	3	Spacer ring and closed dome
8 to 13	Any	ePAK 13 wafers	3	Spacer ring and open dome
14 to 25	280 microns	ePAK 25 wafers	3	Fill with spacer rings to the upper lip of the container
14 to 25	> 280 microns	ePAK 25 wafers	3	Fill with spacer rings to the upper lip of the container



4. For packing 300-mm-diameter F-RAM wafers, use one compliance ring and one spacer ring at the bottom of the container to prevent the bottom wafer from contacting the bottom wall of the container.

Wafer Quantity	Wafer Thickness	Type of Container	Rings at Bottom	Top Filler
1 to 13	Any	ePAK	1 - Spacer Ring 1 - Compliance Ring	Fill with spacer rings to the upper lip of the container
14 to 25	Any	ePAK	1 - Spacer Ring 1 - Compliance Ring	Fill with spacer rings to the upper lip of the container



Summary

This white paper described best practices for sawing, handling, and packing F-RAM wafers. While they are recommendations only, following these best practices should reduce wafer and die losses during back-end processes.

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