PREPARED BY:	***Multiband Imaging Photometer***	NUMBER M11P20	
C. DAVIDSON	***for SIRTF***	TYPE PROCEDURE	
APPROVALS			
ENGINEERING	University of Arizona Steward Observatory, IR Group	DATE 07/09/97	
QUALITY	**SPECIFICATION**	SUPERSEDES SPEC. DATED	
PI/DEPUTY PI		REV. NEW	PAGE 1 of 10

TITLE

SAWING OF Ge : Ga WAFER INTO 1 X 34 DETECTOR STRIPS, PROCEDURE FOR

TABLE OF CONTENTS

1.0 SCOPE

This specification defines the equipment, materials and procedure for sawing a Ge: Ga wafer into individual 1x34 detector strips for use in the fabrication of the MIPS 32x32 Focal Plane Assembly.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the requirements of this specification and the documents calling out this specification, the requirements of this specification shall take precedence. Unless otherwise specified, the most recent revision of the documents identified herein shall apply.

Non-Government Documents

Disco Corporation Operation Manual & Technical Guide, Automatic Dicing Saw/Cutting Saw 300 Series, First Edition, July 1994

Drawings

- Drawing Number MIPSD-065, Detector Wafer
- Drawing Number MIPSD-067, 1x32 Detector

3.0 REQUIREMENTS

3.1 Equipment.1 Equipment.1 Equipment.1 Equipment.1 Equipment

Acceptable results are contingent upon the use the recommended equipment listed below or equivalent equipment. Equivalent equipment may be substituted for the recommended equipment if and only if effectiveness and accuracy are not decreased by its use.

Item	Quantity	Description
1	1 ea.	Automatic dicing saw, Disco Model DAD320, machine version 1.0, software version 1.095, machine no. X01308
2	as required	Dicing blade, Dynatex G2050
3	1 ea.	Flange
4	1 ea.	Hot plate; 4-inch diameter top surface, minimum
5	1 ea.	Thermometer, surface, temperature range 0^0 to 250^0F
6	1 ea.	Microscope, binocular, 10-70X magnification
7	1 ea.	Blow gun, nitrogen or air
8	1 ea.	Feed pump, Pulsafeeder, Model SR 110 with flow indicator, Mec-O-Matic Model 818980
9	1 ea.	Caliper
10	1 ea.	Ultrasonic cleaner, Branson, Model 2210

3.2 Materials

Item	Quantity	Description
1	1 ea.	Ge:Ga detector wafer, P/N MIPSD-065, mounted on silicon, photo resist pattern delineated, gold etched
2	as required	Scrap silicon or germanium mounted on silicon wafer, for dressing blade
3	as required	Nitric acid
4	as required	Nitric acid, fuming
5	as required	Hydrofluoric acid
6	as required	Trichloroethylene (TCE)
7	as required	Methyl alcohol (methanol)
8	as required	Isopropyl alcohol (isopropanol, 2-propanol)
9	as required	Lubricating fluid, Dynatex Kerf Aid
10	1 ea.	Tweezers, plastic
11	as required	Filter paper
12	1 ea.	Basket, plastic, with multiple holes
13	1 ea.	Wipes, clean room, Berkshire Surex 808
14	1 ea.	Beaker, Teflon, 250 ml
15	1 ea.	Beaker, glass, 600 ml
16	as required	Dish, petri, glass
17	as required	Gloves, PVC, clean room, powder free; or finger cots
18	as required	Cotton swab
19	as required	Clean room wipe
20	as required	Deionized water supply
21	as required	Nitrogen gas supply
22	as required	Air supply

4.0 PROCEDURE

4.0 PROCEDURE

4.1 Prepare Saw for Dicing

Notes:
1. This procedure is to be performed by an experienced operator familiar with the safety precautions and operation of the saw as described in the Disco Operations Manual and Technical Guide. The manual is to be retained in close proximity to the saw for ready access by the operator.
2. For convenience, the Basic Operating Procedures Section of the Disco Operations Manual, pages A-21 through A-31, is provided as Appendix A to this specification.

Important: In case of emergency push (EM-OFF) switch, a red mushroom-shaped switch mounted on the front right-hand side of the saw machine. This will move the z-axis to upper end, bring the x, y, and θ axes to an immediate stop, stop spindle rotation and shut off the power supply.

4.1.1. Install Saw Blade.

4.1.1.1 Under 10X-40X magnification, inspect the blade for particulates, chips and cracks.

Discard blade if extent of these is sufficient to potentially damage wafer and dressing of the blade is not expected to correct the problem(s).

4.1.1.2 Install blade on spindle per procedures described on pages A-131 through A-133 of Disco Saw Operations Manual..

4.1.2 Perform Pre-operational Checks. Perform the checks listed on page A-22 of the Disco Saw Operations Manual to ensure the machine is properly connected to the utilities and is in its normal condition.

4.1.3 Start Up Follow directions on pages A-22 to A-23 of Disco Saw Operations Manual to supply air, N_2 gas, wheel coolant with Kerf Aid, and spindle coolant. Verify power-receiving lamp (white) is illuminated then turn on power to machine: Turn circuit breaker switch to the ON position; insert key into POWER switch behind machine front right, turn key from OFF to ON position then to START position and release key. Verify display lamp (green) above key switch lights, that monitor display shows MAIN MENU following Disco logo display, and that signal tower lamp (yellow) lights.

Caution: When power is to be turned on again after power turn-off, allow at least one minute before turning on power. Turning on power immediately after power off may cause machine breakdown**.**

4.1.4 Initial Processing. Press the (SYS INIT) key on the saw keyboard, this will return all axes (x, y, z and θ) to their zero point positions.

4.1.5 Warm-up/Run-in (Y-axis Idling). Follow directions of paragraph 4.0 on page A-24 of Disco Saw Operations Manual to rotate the spindles at pre-selected cutting speeds, supply wheel coolant and bring the cutting chamber to thermal equilibrium.

Notes: 1. Verify wheel coolant supply rate is 4.5 liters/min. or higher.
2. Be certain to allow spindle to rotate a minimum of 30 minutes before cutting.

Set the number of y-axis idling operation to: 20; the x-axis travel speed at: 0.05 inch/sec.

4.1.6 Dress Blade. If a new blade has been installed, or if inspection of the blade shows material on the blade tip, dress the blade per directions and procedures on pages A-142 through A-148. Be certain to measure the total thickness of the silicon mounting wafer and wax. To this total thickness subtract 0.004 inch. The resultant value is the blade height (thickness of material to be left uncut in the z direction). Enter this value into Device Data (1). Set for A DOWN cutting mode. Here cutting is performed only when the chuck tables moves right to left. Note: The 0.004 inch subtracted from the total thickness of silicon mounting wafer and wax, provides for the blade to cut into the wax a depth of 0.004 inch (4 mil).

4.1.7 Setup. Follow the procedure for setup on pages A-26 of the Disco Saw Operations Manual to detect and set the reference position (setup point) for determining the work amount left uncut in the z-direction. Reference note in paragraph 4.1.5.

Confirm that on the chuck table setup screen (5.3.2) the blade outer diameter (OD) is:

55.560mm and the chuck table size is: six (6) inches.

4.1.8 Cutting Data Setup

Notes:
1. The Main Menu is the initial screen (0.0) displayed after power turn on.
2. The cutting parameters to be used for dicing the Ge:Ga wafer into 1x34 detector bars have been previously defined and need not be reset here, with the exceptions noted below. A unique device data number, DETBAR and device I.D., DET34, have been ascribed to this set of cutting parameters.

Press the (F3) key to call up the device data list screen, screen (3.0). Verify that DETBAR is listed under DATA No. and DET34 under DATA I.D. Press the (SHIFT) key and type "DETBAR." Press the (SHIFT) key again, then press the (ENTER) key. The device data (1) screen (1.2) shown in Figure 4.1.8-1 will appear.

DISCO DICER SERIES	<DAD320>			YY-MM-DD
[ ]				1.2
		DEVICE DATA (1)		
DEVICE DATA NO.	**DETBAR**		DEVICE I.D.	**DET34**
UNIT	**INCH**	RND WORK SIZE		**0.00000**
CUT MODE	**A**	SQR WORK SIZE	CH 1	**2.500000**
CUT SHAPE	**SQUARE**		CH 2	**2.500000**
		WORK THICKNESS		**0.052000**
BLADE HEIGHT	**0.01900**	Y INDEX	CH 1	**1.02100**
FEED SPEED	**0.04000 INCH/SEC**		CH 2	**0.08200**
BLADE WEAR ADJUSTMENT	**0.0/0.000**			
SPINDLE REVOLUTIONS	**30.000 RPM**			
PRECUT PROCESS NO.	**1**			
F1 : SELECT	F2:	F3: DATA	F4: PRECUT	PROC
F5 : KERF CHECK	F6: F_AUTO		F7: S_AUTO	
F8 : MEASURE	F9: PRECUT ON		F10: AUTO	SETUP

Figure 4.1.8-1. Representation of Device Data (1) Screen (1.2) with Input Parameters

NOTE: The screen display shown in the figure is only a representation of the actual screen display. The significant features of the figure display are the input values for the various parameters.

Verify that the device data in the display is the same as that shown in Figure 4.1.8-1.

Note: The measured thickness of the Ge:Ga wafer to be diced as well as the total thickness of

mounting silicon wafer and Wafer Grip mounting material under the detector wafer may require that the blade height and work thickness input data be changed. Reference Section V of the Disco Saw Manual for procedure to make these changes.

4.1.9 Set the Work

4.1.9.1 Make sure the chuck table (x-axis) is stopped. **Caution:** Since the spindle rotates in this state, do not put your hands in the cutting room. Remove water drops with the air injection gun wherever possible.

4.1.9.2 Place the mounted detector wafer onto the chuck table.

Notes: 1. If the work cannot easily be set due to the microscope or spindle shaft positioned above the work, move the y-axis with the manual axis operation key. 2. In positioning the wafer on the chuck table, consider which direction was identified as channel 1 and which as channel 2 when the Y index values were input, keeping in mind that cutting is carried out in the channel 2 then channel 1 order.

4.1.9.3 When the mounted wafer is properly positioned, press the (C/T VAC) key to let the chuck table vacuum retain the work.

4.1.10 Align the Detector Wafer

Notes: 1. Alignment of the wafer must be completed prior to cutting. Alignment defines the cutting position setup. 2. The wafer dimensions are too small to allow split screen viewing.

4.1.10.1 With the microscope, effect alignment of the channel 1 y axis and θ axis. Alignment is complete when the kerf line on the monitor tracks the wafer saw lane as travel is effected across the entire distance of the wafer. Once alignment is complete, verify the channel 1 y-index (or step value) displayed on the device data (1) screen 1.2 is correct by indexing, or stepping, from over to adjacent wafer saw lanes and confirming the dashed kerf lines on the monitor align to the wafer saw lanes. Follow procedures in Disco Saw Operations Manual to make any necessary adjustments.

Important: To eliminate backlash, be certain to complete y-axis positioning with the ($^{Y}\Delta$) key and θ-axis positioning with the ($^{\theta}\leftarrow$).

4.1.10.2 With the (INDEX) key on, rotate the θ axis with the ($^{\theta}\leftarrow$) key and similarly effect channel 2 alignment and verify the channel 2 y-index, or stepping value.

Note: 1. Only detectors at least 3mm inward from the detector wafer perimeter are usable.
2. Be certain to inspect the photo resist on the surface of the detector wafer for markings identifying regions of wafer not to be cut into 1x34 strips of detectors due to imperfections in the wafer metallization or the wafer itself. Adjust cutting start position, as necessary.

4.2 Initiate Cutting

Insert the Kerf Aid pump plug into an electrical outlet and press the (CUT WATER) key to let the Kerf Aid coolant flow over the wheel. Initiate cutting by pressing the (START/STOP) key. The cutting status screen then appears.

4.3 Remove Wafer from Chuck Table

When cutting is completed and the y axis has moved to the chuck table center and stopped, blow wafer off the wafer with the air injection gun. Turn off the vacuum to the chuck table and remove the wafer.

4.4 Shut Down Saw

4.4.1 Stop Operation - Press the (EXIT) key to return the system to the device data (1) screen (1.2). Press the (EXIT) key again to return the system to the main menu screen (0.0). Press the (CUT WATER) key to shut off the wheel coolant supply. Unplug the pump to the Kerf Aid.

Caution: Before stopping the spindle, idle the spindle with wheel coolant flowing for 5 to 15 minutes and with wheel coolant stopped for 15 to 20 minutes.

After idling, press the (SPINDL) key to stop spindle rotation

4.4.2 Turn Off Power and Close Main Valves - Verify machine function keys are off. Check that spindle is at rest, then turn the machine front right (POWER SW) key to "off" position.

Important: If the power is turned off during spindle rotation, the spindle system may enter the free-running state.

In sequence, turn off the breaker switch, then close the wheel coolant main supply valve, the spindle coolant main supply valve and the air main supply valve.

Caution: If the power is turned off without stopping the spindles, the spindles will seize up. Therefore, be sure to stop spindle rotation before shutting off the air supply.

4.5 Clean the Detector Strips

Note: Do not allow detector strips to dry prior to air or nitrogen blow off.

Submerge diced wafer in a beaker of trichloroethylene (TCE) and cover beaker. Allow wafer to soak until strips easily lift free from the silicon mounting wafer (minimum of 12 hours). Pour off TCE, then add more TCE to beaker. Using tweezers, remove detector strips from solvent and flush with TCE, then methanol and finally isopropanol. Blow dry with dry air or nitrogen gas.
Place detector strips in a petri dish or other container and transport to microscope. Inspect strips for chipping. Place acceptable die into clean container and cover until ready to perform post dicing etch.

4.6 Etch Detector Strips to Remove Palladium Metallization and Saw Damage.

Caution: Hydrofluoric acid (HF) is extremely hazardous in liquid and in vapor form and can cause severe burns which may not immediately be painful or visible. Due to the insidious nature of HF, be certain to wash hands thoroughly and rinse with copious amount of water, independent of whether gloves were worn while handling this acid. Nitric acid can also cause severe burns. These chemicals are to used only within an operating fume hood. Protective apparel including safety goggles, gloves, and apron must be worn when handling or otherwise working with these chemicals. Do **not** add water to an acid.

Prepare 300ml of germanium etchant by mixing in a Teflon beaker 7 parts by volume nitric acid to 2 parts by volume hydrofluoric acid to 1 part by volume fuming nitric acid.

4.6.1 Place one of the detector strips into a 100ml Teflon beaker. Carefully pour about 25 to 30ml of etchant into the beaker. For 22 ± 3 seconds, gently agitating the beaker to cause fresh etchant to continuously flow over the detector strip.

Quench the etch by carefully pouring methanol into the beaker to nearly fill the beaker. While being careful not to allow detector strip to flow out of beaker, pour quenched etchant into beaker of water in the fume hood sink into which water is flowing. With Teflon tweezers lift detector strip from residual quenched etchant while flushing strip with methanol from a squeeze bottle.

Place detector strip into a petri dish of methanol. Slowly swirl the dish for 15-20 seconds to allow methanol to flow over and around the strip. Using tweezers, remove strip from methanol and flush die with methanol followed by isopropanol. Blow strip dry with dry air or nitrogen.

4.6.2 Inspect detector strip under 10X to 30X magnification to verify edges are shiny and show no traces of saw marks and that the widthwise ends are not bowed. Note: Saw marks indicate the strip was not etched for a long enough time. Bowed ends indicate the etch time was too long.

If saw marks are visible, repeat paragraphs 4.6.1 to 4.6.2, reducing the etch time in accordance with the extent of the saw marks.

4.6.3 Using the results obtained on the first detector strip etched to adjust the etch time, if necessary, repeat paragraphs 4.6.1 through 4.6.2 for each of the remaining detector strips.

4.6.4 Once all detector strips have been etched and inspected, discard residual etchant by slowly pouring into appropriately labeled chemical disposal container.

Caution: Do not dilute acid by adding water to the acid.

4.7 Residual Gold from Detector Strip Edges

Note: Post-dicing etch of the germanium may result in undercutting of the gold metallization on the detector strips. These residual "flaps" of gold can potentially cause shorts during subsequent assembly build and must, therefore, be removed.

4.7.1 Place a detector strip into plastic basket. Place basket into beaker of isopropanol. Place beaker into ultrasonic cleaner.

4.7.2 Turn on ultrasonic cleaner and allow the detector strip to agitate for about 30 minutes.

4.7.3 Remove strip from beaker. Flush with isopropanol and blow dry with dry air or N_2. Repeat steps 4.7.1 – 4.7.3 for each detector strip.

4.7.4 Under microscope, inspect detector strips for removal of gold flaps. If flaps still present, return strips to basket in beaker of isopropanol and ultrasonically clean Periodically, repeat steps 4.7.1 through 4.7.4 until all gold flaps have been removed.

4.8 Inspect and Measure Detector Strips to Drawing MIPSD-067

.8 Inspect and Measure Detector Strips to Drawing MIPSD-067. Place acceptable strips in properly labeled container and store container on appropriately labeled shelf of clean room desiccator. Place failed strips in properly labeled container and store on shelf of desiccator labeled 'reject parts.' Sign and date the manufacturing traveler.