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RAYTHEON CO WALTHAM MASS SPECIAL MICROWAVE DEVICES  
MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING HIGH-EFFICIENCY--ETC(U)  
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MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING  
HIGH-EFFICIENCY, HIGH-POWER GALLIUM ARSENIDE  
READ-TYPE IMPATT DIODES.

Volume II.

FINAL REPORT.

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SECTION II

PROCESS SPECIFICATIONS

↙ This <sup>volume</sup> section includes all of the process specifications for the High-Power, High-Efficiency Gallium-Arsenide IMPATT Diode. The detailed process sheets are grouped in accordance with the particular process area where they are used. A flow chart for each group shows the interrelationship of operations. Applicable drawings are also included in Section II. The following is included in this section:

- SECTION IIA - WAFER FABRICATION PROCESS
- SECTION IIB - DICE FABRICATION PROCESS
- SECTION IIC - DIODE ASSEMBLY & TEST PROCESS
- SECTION IID - APPLICABLE DRAWINGS

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## SECTION II-A

### WAFER FABRICATION PROCESS

The sequence of operations for wafer fabrication is shown in Figure IIA-1. The detailed process specifications are as follows:

#### 1.0 BOULE RECEIPT AND QUALIFICATION

Purpose: To ascertain the incoming boules' adherence to various specifications necessary for production of GaAs Read IMPATT wafers.

##### 1.1 Equipment

- 1.1.1 Vickers microscope.
- 1.1.2 Tungsten-carbide-tipped glass marking scribe.
- 1.1.3 Chemical fume hood.
- 1.1.4 Tweezers; Techni-Tool, stainless steel.
- 1.1.5 Dispenser, tilting, 40 ml capacity, reservoir capacity 2000 ml; Kontes glass No. K-7593.
- 1.1.6 16 oz. polyethylene bottle.
- 1.1.7 100 ml teflon beaker.
- 1.1.8 Pipet, straight tip with rubber bulb.
- 1.1.9 Face-shield/headgear; American Optical.
- 1.1.10 O'Haus, Cent-O-Gram triple beam balance.
- 1.1.11 10 ml nalgene graduated cylinder.
- 1.1.12 Teflon stir bar.
- 1.1.13 Corning hot plate/stirrer.
- 1.1.14 Raytheon etch assembly.

**BOULE RECEIPT AND QUALIFICATION**

Visual Examination

Microscopic Examination

Defects and Precipitates  
Etch Pit Density

Crystallographic Orientation

X-Ray Transmission

**SUBSTRATE PREPARATION**

Sizing  
Cleaning  
Mounting  
Inspection  
Storage

**EPITAXIAL DEPOSITION**

Pregrowth Reactor Preparation  
Deposition  
Unloading

**WAFER QUALIFICATION**

Layer Thickness Measurements

Schottky Evaluation

Photolithography  
Etching  
Metallization  
Liftoff

Electrical Characterization

Figure IIA-1 Wafer Fabrication Flow Chart

- 1.1.15 Glass thermometer.
- 1.1.16 250 ml teflon beaker.
- 1.1.17 Sonogen-Z ultrasonic agitator, Branson Instruments, Type ATH-610-6.
- 1.1.18 25 mm micrometer; Starrett No. 436.
- 1.1.19 Raytheon Hall apparatus.
- 1.1.20 Type 575, transistor curve tracer.

## 1.2 Materials

- 1.2.1 Filter circles; Whatman, hardened ashless.
- 1.2.2 Deionized (D.I.) water >15 megohms.
- 1.2.3  $H_2SO_4$  - electronic grade; B + A Code 108-2679.
- 1.2.4  $H_2O_2$  - electronic grade; B + A Code 109-6503.
- 1.2.5 Filtered  $N_2$ .
- 1.2.6 Polyethylene gloves.
- 1.2.7 Glass microslides - utility grade 25 x 75 mm.
- 1.2.8 Double-faced tape; Permacel Co.
- 1.2.9  $AgNO_3$  - reagent grade .
- 1.2.10  $CrO_3$  - reagent grade.
- 1.2.11 HF - electronic grade; B and A Code 194-2753.

## 1.3 Safety Precautions

- 1.3.1 Prepare chemical solutions in fume hood.
- 1.3.2 Wear polyethylene gloves and headgear while handling concentrated chemicals.

## 1.4 Visual Examination Procedure

- 1.4.1 Examine each wafer macroscopically for defects.

1.4.2 Measure the depth of each defect using an interference microscope where, in the interference fringe image, the difference in retardation experienced by the T1 beam between two interference fringes is equal to half the wavelength ( $5350.5/2$ ) of the T1 light. Record findings on run sheet.

1.5 Microscopic Examination Procedure - Defects and Precipitates

1.5.1 Place sample to be evaluated on two (2) circles of filter paper.

1.5.2 Using glass scribe, cleave a 2-3 mm wide sample for inspection.

1.5.3 Place a 1 x 2 cm piece of double-faced tape on the center of a glass microslide.

1.5.4 Place sample on tape with cross section parallel to microslide's surface.

1.5.5 Examine the entire etched sample under 100X magnification for the occurrence of precipitates or occlusions.

1.5.6 Locate the one mm area of greatest density of defects and count. Record findings on run sheet.

1.5.7 Measure the three largest precipitates or occlusions. Record findings on run sheet.

1.6 Microscopic Examination Procedure - Etch Pit Density

1.6.1 Prepare Abrahms-Buiocchi etch as follows: Weigh out 8 mg  $\text{AgNO}_3$  and 1 gm  $\text{CrO}_3$ . Using 10 ml graduate, pour 2 ml deionized water into a 100 ml teflon beaker. Place teflon magnetic stir bar in beaker and place on stir-plate. Turn on stirring and add  $\text{AgNO}_3$ . Add  $\text{CrO}_3$ . Using 10 ml graduate, pour in 1 ml HF.

1.6.2 Place etch assembly in Abrahms-Buiocchi etch beaker.

1.6.3 Raise temperature of etch to  $65^\circ\text{C}$ .

1.6.4 Stir etch.

1.6.5 Place wafer in etch assembly and etch at  $65^\circ\text{C}$  while stirring for ten minutes.



1.6.6 Photolithographically define counting area using the procedure in Section 5.4, mask series 7.

1.6.7 Place sample under 100X magnification and count etch pits visible in the nine areas defined. Record on log sheet.

### 1.7 Crystallographic Orientation

One wafer from each boule is sent as received to Raytheon's X-ray lab for Laue X-ray patterns to confirm orientation.

### 1.8 X-Ray Transmission

1.8.1 Anomalous X-ray transmission (by Research Division X-ray Lab) is used to give a quantitative estimate of dislocations and strain present in a slice.

1.8.2 Prepare sample utilizing substrate polishing procedure 2.6.

1.8.3 Repeat procedures 2.6.1 to 2.6.30 for opposite side of wafer.

1.8.4 Fill a 250 ml beaker one-quarter full with 7:2:1 prepared according to procedure 5.4.10.

1.8.5 Place wafer to be measured in beaker and place in ultrasonic agitator for 30 seconds.

1.8.6 Decant 7:2:1 into waste container.

1.8.7 Fill beaker one-half full with D.I. water and decant. Repeat four times.

1.8.8 Remove sample from beaker and blow dry with N<sub>2</sub>.

1.8.9 Cleave a 1.0 x 1.0 cm sample from wafer.

1.8.10 Attach Sn contacts to the four corners of the sample according to 5.4.14.

1.8.11 Attach Au leads to Sn contacts according to 5.4.17.

1.8.12 Place sample in Hall measurement sample holder.

- 1.8.13 If sample proves ohmic, proceed to make measurements listed on semiconductor Hall measurement form using Hall apparatus.

## 2.0 SUBSTRATE PREPARATION

Purpose: To prepare a single-crystal substrate of dimensions, finish, and cleanliness suitable for the production of GaAs Read IMPATT wafers.

### 2.1 Equipment

- 2.1.1 500 ml separatory graduated funnel with stopper and teflon stopcock plug.
- 2.1.2 Polishing apparatus; Geoscience Instruments Corp., Model PA100.
- 2.1.3 Large clamp, vinylized jaws.
- 2.1.4 Clamp holder.
- 2.1.5 Type No. 124 quartz discs, ground and polished, 4-in. diameter, 1-in thick, parallel faces, optically flat.
- 2.1.6 16 oz. polyethylene bottles.
- 2.1.7 Pyroceram hot plate; Corning DC-100-RC.
- 2.1.8 250 ml teflon beakers.
- 2.1.9 Sonogen-Z ultrasonic agitator; Branson Instruments, Type ATH-610-6.
- 2.1.10 25 mm and 50 mm micrometers; Starret No. 436.
- 2.1.11 Tweezers; Techni-Tool, stainless steel, nonmagnetic, teflon coated.
- 2.1.12 Tungsten-carbide-tipped glass marking scribe.
- 2.1.13 Chemical fume hood, polypropylene.
- 2.1.14 Dispenser, tilting, 40 ml capacity, reservoir capacity, 2000 ml; Kontes glass No. K-75 9300.
- 2.1.15 50 ml graduated cylinder, Pyrex.
- 2.1.16 Face shield/headgear; American Optical.

## 2.2 Materials

- 2.2.1 Trichlorethylene, electronic grade: B and A code 167-2787.
- 2.2.2 Acetone, electronic grade; B and A code 119-2750.
- 2.2.3 Methanol, electronic grade; B and A code 119-2757.
- 2.2.4 D.I. water > 15 megohms.
- 2.2.5 Pan W. Pads 10 in. round; The Mosher Co., Inc.
- 2.2.6 Cotton-tipped applicators.
- 2.2.7 Whatman No. 1 qualitative filter circles.
- 2.2.8 Fluorescent lamp with magnifying glass; Dazor floating fixture Model M-1470.
- 2.2.9 Plastic, screwtop boxes; Fluoroware; H-22-15, H-22-151.
- 2.2.10 "Polish data" sheet.
- 2.2.11 Polyethylene gloves.
- 2.2.12  $H_2SO_4$ , electronic grade; B and A code 108-2679.
- 2.2.13  $H_2O_2$ , electronic grade; B and A code 109-6503.
- 2.2.14 Filtered  $N_2$ .
- 2.2.15 Stacking wax, No. 4G; Universal Shellac Co.

## 2.3 Safety Precautions

- 2.3.1 Wear polyethylene gloves and face shield during all chemical handling.
- 2.3.2 Handle concentrated chemicals in fume hood.

## 2.4 Sizing Procedure

- 2.4.1 Cleave substrate by placing scribe perpendicular to the flatest edge.
- 2.4.2 Place wafer on scribing chuck and, using the cleaned edge as reference, scribe a 2.1 x 2.1 cm square.

- 2.4.3 Using the Ade machine (procedure thickness gauging 4.2), measure wafer for flatness at its four corners and center. Record findings on polish sheet.
- 2.4.4 Reject any wafer whose flatness across the wafer varies less than 12  $\mu\text{m}$ .
- 2.4.5 Replace wafer in glassine envelope.
- 2.4.6 Repeat steps 1-5 for five additional wafers. Caution: Wafer-to-wafer variation should not exceed 15  $\mu\text{m}$ .
- 2.4.7 From excess substrates, cleave three 1 x 1 cm wafers.

## 2.5 Cleaning Procedure

- 2.5.1 Pour 125 ml trichlorethylene into two 250 ml teflon beakers labeled TCE-1 and TCE-2.
- 2.5.2 Pour 125 ml acetone and 125 ml methanol into two 250 ml teflon beakers labeled ACE and MEOH, respectively.
- 2.5.3 Place all four beakers on hot plate and heat to approximately 85°C.
- 2.5.4 Remove wafer from glassine envelope with tweezers.
- 2.5.5 Insert wafer in TCE-1 and place this beaker in ultrasonic agitator for one minute.
- 2.5.6 Remove wafer from TCE-1 and place in TCE-2 (tweezer held) for 15 seconds.
- 2.5.7 Remove wafer from TCE-2 and place in ACE (tweezer held) for 15 seconds.
- 2.5.8 Remove wafer from ACE and place in MEOH (tweezer held) for 15 seconds.
- 2.5.9 Remove wafer from MEOH and run under D.I. water for 15 seconds. Place on filter paper and blow dry with  $\text{N}_2$ .
- 2.5.10 Pour approximately 50 cc of 7:2:1  $\text{H}_2\text{SO}_4:\text{H}_2\text{O}_2:\text{H}_2\text{O}$  (prepared per 5.4.10) into a clean teflon beaker.

- 2.5.11 Place wafer in acid solution and swirl wafer for 30 seconds.
- 2.5.12 Add D.I. water to acid solution and decant into waste container.
- 2.5.13 Fill beaker half full with D.I. water and decant. (Repeat 10 times.)
- 2.5.14 Remove wafer from beaker, place on filter paper, and blow dry with N<sub>2</sub>.
- 2.5.15 Repeat this procedure for all six 2.1 x 2.2 cm wafers and all three 1 x 1 cm wafers.

## 2.6 Mounting Procedure

- 2.6.1 Place wafer, poorest surface up, on an optical flat marked for position.
- 2.6.2 Record vendor's wafer number on data sheet according to wafer's position/number on optical flat.
- 2.6.3 Repeat steps 1 and 2 for five additional wafers.
- 2.6.4 Place the three 1 x 1 cm wafers between the three pairs of larger wafers.
- 2.6.5 Place a second clean optical flat on an 85°C hot plate and heat for approximately 15 minutes.
- 2.6.6 Melt wax in a circular pattern from the edge to a radius of 2 cm on the 85°C optical flat.
- 2.6.7 Transfer wafers from dummy optical flat, maintaining positions noted on "polish" data sheet.
- 2.6.8 Remove optical flat from hot plate and cool to room temperature.
- 2.6.9 Heat (85°C) a half-full 250 ml beaker of trichlorethylene.
- 2.6.10 Wet cotton-tipped applicators with warmed trichlorethylene and remove excess wax from around wafers.
- 2.6.11 Replace optical flat with wafers on hot plate (85°C) and place the dummy flat directly on top of the wafers (15 minutes).

- 2.6.12 Remove flat from top of wafers, remove wafered flat from hot plate, and cool to room temperature.
- 2.6.13 Repeat steps 2.6.9 and 2.6.10.
- 2.6.14 With 50 mm micrometer, measure the thickness of the three 1 x 1 cm wafers as mounted and record on "polish" data sheet.
- 2.6.15 Place wafered flat on 85°C hot plate. After wax has melted, remove each wafer individually and clean according to cleaning procedure 2.5.

### 2.7 Inspection Procedure

- 2.7.1 Inspect wafers for any gross physical defects such as pits, polish lines, scratches, or haze. Note defects on box label.
- 2.7.2 Measure the thickness of wafers on the Ade machine according to procedure 4.2 and record thickness range on box label and "polish" data sheet.

### 2.8 Storage Procedure

- 2.8.1 Store each wafer in a labeled plastic box. Label will contain boule number, boule vendor, wafer number, polish lot number, and red color code dot.

## 3.0 EPITAXIAL DEPOSITION

Purpose: To deposit epitaxial layers of GaAs upon a single-crystal substrate which results in wafers from which high-performance Read IMPATT devices can be fabricated with good yield.

### 3.1 Equipment

- 3.1.1 Pyroceram hot plate, DC-100-RC.
- 3.1.2 Three 16 oz. polyethylene bottles.
- 3.1.3 Three 250 ml teflon beakers.
- 3.1.4 Tweezers; Techni-Tool, stainless steel, non-magnetic, teflon-coated.

- 3.1.5 Chemical fume hood, polypropylene.
- 3.1.6 Dispenser, tilting, 40 ml capacity, reservoir capacity 2000 ml; Kontes glass No. K-7593.
- 3.1.7 Raytheon epitaxial production reactor.
- 3.1.8 Laminar flow hood; Laminair.
- 3.1.9 Potentiometer; Rubicon Instruments.
- 3.1.10 Face shield/headgear; American Optical.
- 3.1.11 Quartzware cleaning tube.

### 3.2 Materials

- 3.2.1 Methanol, electronic grade; B and A Code 119-2757.
- 3.2.2 Filter circles; Whatman, hardened ashless.
- 3.2.3 Deionized water > 15 megohms.
- 3.2.4  $H_2SO_4$ , electronic grade; B and A Code 108-2679.
- 3.2.5  $H_2O_2$ , electronic grade; B and A Code 109-6503.
- 3.2.6 500 ppm  $H_2S$  in  $H_2$ , electronic grade.
- 3.2.7  $H_2$ , electronic grade.
- 3.2.8  $AsCl_3$ , 6N Purity, M Series; Metal Specialties, Inc.
- 3.2.9 He, electronic grade, 99.9995 percent min purity.
- 3.2.10 Ga, 99.999 percent pure, 50 g ingots.
- 3.2.11  $SiH_4$ , 100 ppm in high purity  $H_2$ .
- 3.2.12 Filtered  $N_2$ .
- 3.2.13  $HNO_3$  electronic grade; B and A Code 108-2677.
- 3.2.14  $HCl$ , electronic grade; B and A Code HX-603.
- 3.2.15  $HF$ , electronic grade; B and A Code 194-2753.
- 3.2.16 Polyethylene gloves.

3.2.17 Filter papers; VWR Grade No. 613, Cat. No. 28311-029.

3.2.18 "Run data" sheets.

### 3.3 Safety Precautions

3.3.1 Handle all chemicals in the chemical fume hood.

3.3.2 During chemical handling, wear polyethylene gloves and face shield.

### 3.4 Procedure

3.4.1 Select, according to the run sheet, properly doped polished substrate(s) from N<sub>2</sub> dry box.

3.4.2 Prepare aqua regia solution:

a. Pour 3 liters HCl into cleaning tube.

b. Pour 1 liter HNO<sub>3</sub> into same cleaning tube.

3.4.3 Label substrate box(es) with epitaxial growth run number (from run sheet) it will be used in. If more than one wafer is included in a single run, use an additional letter A through C turning to counterclockwise positions on the sled, beginning at 12:00.

3.4.4 Turn on He purge 15 minutes before loading reactor; then proceed to load reactor as follows:

a. Fill a 250 ml beaker one-third full with methanol.

b. Remove substrate from plastic box with tweezers and place it, polished side up, in methanol.

c. Place tips of tweezers in methanol.

d. Warm methanol, which contains the substrate and tweezers, to approximately 50°C.

e. Remove tweezers from methanol and place on filter paper.

f. Decant methanol.



- g. Half fill beaker with D.I. water and decant. Repeat four times.
  - h. Add approximately 50 cc of 7:2:1 H<sub>2</sub>SO<sub>4</sub>:H<sub>2</sub>O<sub>2</sub>:H<sub>2</sub>O solution (process 5.4.10). Agitate for three minutes.
  - i. Add approximately 100 cc D.I. water to acid solution.
  - j. Decant 7:2:1 - water solution.
  - k. Fill beaker one-half full with D.I. water. Decant and repeat ten times.
  - l. Envelope the wafer with a few drops of D.I. water and carry the wafer in this configuration to the reactor.
  - m. Remove vent line from end cap and remove end cap from reactor tube.
  - n. Remove wafer from beaker with methanol-cleaned tweezers and place on filter circles.
  - o. Blow wafer dry with N<sub>2</sub>.
  - p. Place wafer in sled. Replace end cap on reactor tube and vent line on end cap.
  - q. Shut off He purge 15 minutes after the wafer is loaded.
- 3.4.5 Purge reactor with H<sub>2</sub> for 30 minutes post-load. Roll furnace into growth position (see run sheet for exact position), and close end sealers.
- 3.4.6 Stabilize temperature of reaction zone for one hour.
- 3.4.7 During stabilization period, program computer, set flows, and check AsCl<sub>3</sub> temperature according to run sheet.
- 3.4.8 Push wafer into growth position (see run sheet for specific position) and actuate process enable switch.
- 3.4.9 Record gas flows, and source, substrate, and AsCl<sub>3</sub> bubbler temperatures at each step.

- 3.4.10 At termination of growth program, turn on reactor tube cooling fans, open end sealers, and roll furnace out of growth position.
- 3.4.11 Turn on He purge 15 minutes, post roll off.
- 3.4.12 30 minutes post-termination, turn off laminar flow blower, withdraw sled head into end cap, remove vent line from end cap, and remove end cap and sled from reactor tube.
- 3.4.13 Remove wafer from sled with tweezers and place on filter circles.
- 3.4.14 Remove dump tube from reactor and replace with a clean one.
- 3.4.15 Place spare end cap on reactor, replace vent line, and turn on laminar flow blower.
- 3.4.16 Remove dump tube, sled, and end cap to cleaning hood and place in aqua regia.
- 3.4.17 Cleave a 6 mm-wide sample from the right side of the wafer. (Orientation is defined as the wafer faces the vapor stream.) From the top of this sample cleave a 6 x 6 mm sample for thickness determination.
- 3.4.18 Place characterization sample (the large 6 mm-wide sample) in plastic box which has been labeled with the wafer number and the designation "Schottky".
- 3.4.19 Place thickness sample in a plastic box which has been labeled with the wafer number and the designation "thickness".
- 3.4.20 Replace remainder of wafer in substrate box and place in inspection drawer.
- 3.4.21 Replace filter paper in laminar flow hood with fresh paper.
- 3.4.22 After 15 minutes, remove quartzware from aqua regia, rinse well under flowing D.I. water, rinse well enough with methanol to remove all water, blow dry with N<sub>2</sub>, and place on stand in laminar flow hood.

## 4.0 WAFER QUALIFICATION

**Purpose:** To measure those properties of single-drift Read wafers necessary to qualify them for processing into IMPATT devices with good yield and high performance.

### 4.1 Equipment

- 4.1.1 Tungsten-carbide-tipped glass marking scribe.
- 4.1.2 Tweezers, Techni-Tool, stainless steel, non-magnetic, teflon coated.
- 4.1.3 Two dropping bottles, polyethylene.
- 4.1.4 500 ml polyethylene wash bottle.
- 4.1.5 Vickers microscope.
- 4.1.6 1000 ml beaker, nalgene.
- 4.1.7 Three 16 oz. polyethylene bottles.
- 4.1.8 100 ml polypropylene graduated cylinder.
- 4.1.9 Chemical fume hood.
- 4.1.10 100 ml teflon beaker.
- 4.1.11 Pipet, straight tip with rubber bulb.
- 4.1.12 O'Haus, cent-o-gram triple beam balance.

### 4.2 Materials

- 4.2.1 Whatman No. 1 qualitative filter paper.
- 4.2.2 Deionized water > 15 megohms.
- 4.2.3 Glass microslides, utility grade, 25 x 75 mm.
- 4.2.4 Double-faced tape; Permacel Co.
- 4.2.5 KOH, reagent grade.
- 4.2.6  $K_3 [Fe(CN)_6]$ , reagent grade.

- 4.2.7 Air-it.
- 4.2.8 Filtered N<sub>2</sub>.
- 4.2.9 H<sub>2</sub>SO<sub>4</sub>, electronic grade; B and A code 108-2679.
- 4.2.10 H<sub>2</sub>O<sub>2</sub>, electronic grade; B and A code 109-6503.
- 4.2.11 Polyethylene gloves.
- 4.2.12 "Epitaxial layer thickness" form.

#### 4.3 Safety Precautions

- 4.3.1 Prepare stock solutions in chemical fume hood.
- 4.3.2 Wear polyethylene gloves while handling concentrated chemicals.

#### 4.4 Layer Thickness Measurement

- 4.4.1 Prepare etchant solution as follows:
  - a. Using a triple-beam balance, weigh out 5 g K<sub>3</sub> [Fe(CN)<sub>6</sub>] and 5 g KOH.
  - b. Using a 100-ml graduate, dispense 100 ml D.I. H<sub>2</sub>O into a 16-oz. bottle.
  - c. Add the weighed chemicals to the 100 ml D.I. H<sub>2</sub>O.
  - d. Place cap on bottle and shake to form solution.
- 4.4.2 Dispense approximately 25 ml of etchant solution into a dropping bottle.
- 4.4.3 Place sample, epitaxial layer side down on two (2) circles of filter paper.
- 4.4.4 Using glass scribe, cleave a 1-2 mm wide sample for inspection.
- 4.4.5 Place a 1 x 2 cm piece of double-faced tape on the center of a glass microslide.
- 4.4.6 Place sample on tape with cross section parallel to microslide's surface.

- 4.4.7 Drop one drop etchant solution on sample, making sure that the sample is totally immersed.
- 4.4.8 Leave solution on sample for approximately 25 seconds and rinse with D.I. water from wash bottle (wastewater should drain into a 1000 ml beaker).
- 4.4.9 Blow dry sample with filtered N<sub>2</sub> or Air-It.
- 4.4.10 Place sample under microscope at 400X magnification. If no epitaxial layers are visible, repeat steps 4.4.5 through 4.4.6.
- 4.4.11 Shear each visible line (epitaxial layer) twice; forward from 000 (increasing from 001) and reverse (decreasing from 999). Record readings on "epitaxial layer thickness" form.
- 4.4.12 Calculate thickness:
- $$\frac{\text{Shear 1} - \text{Shear 2}}{2} \times \mu/\text{division}$$
- 4.4.13 Calculate growth rate (additional information):
- $$\frac{\text{Calculated Thickness}}{\text{Growth Time}}$$

## 5.0 SCHOTTKY PHOTOLITHOGRAPHY AND ETCHING

### 5.1 Equipment

- 5.1.1 Photoresist spinner; Headway Research Model RC100-CBIS-10 in.
- 5.1.2 Tweezers; Techni-Tool, stainless steel, nonmagnetic teflon-coated.
- 5.1.3 Oven; Blue M, Model OV-BA.
- 5.1.4 Mask sequence.
- 5.1.5 Ultraviolet light assembly; Preco, Model 620-6-ZI.
- 5.1.6 Mask aligner; Preco, Model 610VHS-45.
- 5.1.7 Spray developed; Paasche, Model 2503.
- 5.1.8 100-ml teflon beaker.

- 5.1.9 Constant temperature recirculating cooler; Brinkman Instruments; Lauda Thermostat, Type K2-R.
- 5.1.10 Insulated 1000-ml beaker.
- 5.1.11 Thermometer; Weston, Model 2261.
- 5.1.12 Ultrasonic agitator; Branson 2.
- 5.1.13 250 ml teflon beaker.
- 5.1.14 Vacuum evaporation assembly; CVC, Model BCN-42.
- 5.1.15 Timer; Kodak.
- 5.1.16 Pyrometer; Simpson, Model 29.
- 5.1.17 Thermometer; VWR, 61016-208.
- 5.1.18 Refrigerator.
- 5.1.19 Vacuum pump; Cast Mfg. Co., Model 0211-V36n-G8C.
- 5.1.20 Microscope; Bausch and Lomb, Zoom 0.7 X to 3 X.
- 5.1.21 Constant Voltage Supply; Sola, Type CVS, Cat. No. 23-24-17S.
- 5.1.22 Chemical fume hood; 4 ft. polypropylene.
- 5.1.23 16 oz. polyethylene bottle.
- 5.1.24 32 oz. polyethylene bottle.
- 5.1.25 500 ml polyethylene wash bottle.
- 5.1.26 60 ml amber glass dropping bottle.
- 5.1.27 500 ml polypropylene graduated cylinder.
- 5.1.28 100 ml polypropylene graduated cylinder.
- 5.1.29 Dispenser; tilting, 40 ml capacity, reservoir capacity 2000 ml; Kontes Glass, Cat. No. K-75930.
- 5.1.30 Polypropylene beaker holder.
- 5.1.31 Digital Counter; Fluke, Model 408.
- 5.1.32 Scissors.

- 5.1.33 Soldering iron (variable voltage).
- 5.1.34 Pyroceram top hot plate; Corning.
- 5.1.35 Hall furnace (strip heater).

## 5.2 Materials

- 5.2.1 Deionized water > 15 megohms.
- 5.2.2 Photoresist; Shipley AZ-1350B.
- 5.2.3 Photoresist developer; Shipley AZ-1350.
- 5.2.4 Filter circles; Whatman No. 1, qualitative.
- 5.2.5 Dry filtered N<sub>2</sub>.
- 5.2.6 H<sub>2</sub>SO<sub>4</sub>, electronic grade; B and A, Code 108-2679.
- 5.2.7 H<sub>2</sub>O<sub>2</sub>, electronic grade; B and A, Code 109-6503.
- 5.2.8 Acetone, electronic grade; B and A, Code 119-2750.
- 5.2.9 Methanol, electronic grade; B and A, Code 119-2757.
- 5.2.10 Aluminum, very pure; MRC, 90 mg clips.
- 5.2.11 Gold, very pure; MRC, Wire - Diameter 0.030 in.
- 5.2.12 19 in. x 19 in. sheets lint-free paper.
- 5.2.13 Polyethylene gloves.
- 5.2.14 Glass projector slides 3-1/4 in. x 4 in; Kodak.
- 5.2.15 4 percent ±1/2 percent Mn balance Ag alloy, Martz grade purity, 225-250 mg; Materials Research Corporation.
- 5.2.16 Tungsten evaporation coil; R.D. Mathis Co., Cat. No. ME16A-3 x 0.025 in. W.
- 5.2.17 Tungsten evaporation coil; R.D. Mathis Co., Cat. No. B143 x 0.030 in. W.
- 5.2.18 Alumina coated boat; R.D. Mathis Co., Cat. No. S2BAO.

- 5.2.19 Au wire; .003 in. diameter 99.99 percent pure; Sigmund Cohn Co.
- 5.2.20 Indalloy, InSn solder; Indium Corp. of America.
- 5.2.21 Blue flux.
- 5.2.22 D-400.
- 5.2.23 Sn spheres .010 in. diameter 99.999 percent pure; Semi-Alloys, Inc.
- 5.2.24 Hydrazine monohydrobromide, 50 percent solution; K and K Labs.
- 5.2.25 Forming gas, 5 percent H<sub>2</sub>, 95 percent N<sub>2</sub>.

### 5.3 Safety Precautions

- 5.3.1 Handle all chemicals (excluding AZ1350B photo-resist application) in a polypropylene fume hood.
- 5.3.2 During chemical handling (excluding AZ1350B application) wear polyethylene gloves.

### 5.4 Procedure

- 5.4.1 Prepare 7:2:1, H<sub>2</sub>SO<sub>4</sub>:H<sub>2</sub>O<sub>2</sub>:H<sub>2</sub>O solution as follows:
  - a. Dispense, using tilting dispenser, 280 ml H<sub>2</sub>SO<sub>4</sub> into a 500 ml polyethylene bottle.
  - b. Dispense, using 100 ml graduated cylinder, 40 ml D.I. H<sub>2</sub>O into the H<sub>2</sub>SO<sub>4</sub>.
  - c. Dispense, using 100 ml graduated cylinder, 80 ml H<sub>2</sub>O into the H<sub>2</sub>SO<sub>4</sub>/H<sub>2</sub>O solution.
  - d. Shake solution in bottle for 5 seconds and place in flowing water bath for 10 minutes.
  - e. Repeat procedure (d) until no heat is generated after shaking.
- 5.4.2 Prepare AZ-1350 developing solution as follows:
  - a. Dispense, using a 500 ml graduated cylinder, 450 ml AZ-1350 developer into a 32 oz. polyethylene bottle.



- b. Add 450 ml D.I. water to developer bottle.
  - c. Replace cap on solution bottle and shake vigorously for approximately 5 seconds.
- 5.4.3 Dispense AZ-1350B photoresist as follows:
  - a. Dispense approximately 20 ml AZ-1350B photoresist into an amber-glass dropping bottle.
  - b. Replace stock and dispensed photoresist in refrigerator.
- 5.4.4 Dispense acetone into wash bottle.
- 5.4.5 Dispense methanol into wash bottle.
- 5.4.6 Photoresist application.
  - a. Line photoresist spinner well with lint-free paper.
  - b. Set RPM dial on spinner to 4000 and timer to 20 seconds (Ref. graph t vs. spin speed).
  - c. Set toggle switch on spinner to auto position.
  - d. Place sample over vacuum hole in spinner well.
  - e. Drop sufficient photoresist on sample to cover entire surface.
  - f. Push start button.
  - g. After spin-on is complete, remove sample to filter paper.
- 5.4.7 Photoresist bake.
  - a. Preheat oven to 90-100°C.
  - b. Place sample on evaporating dish in oven and bake for 10 minutes.
- 5.4.8 Pattern exposure.
  - a. Place specified\* mask in aligner mask holder and activate mask hold vacuum.  
(\*on "wafer characterization" sheet).

- b. Place sample(s) on aligner chuck and align with chuck recessed from mask face.
- c. Raise chuck to mask face, depress slice vacuum, and mask frame.
- d. Set UV light timer for 1.5 minutes.
- e. Depress expose button for constant-voltage supplied UV light.
- f. Disengage slice vacuum and mask frame, recess chuck from mask face, and remove sample.

5.4.9 Pattern development.

- a. Fill spray developer bottle with AZ-1350 developer solution.
- b. Set  $N_2$  pressure to approximately 10 psi.
- c. Hold sample with tweezers by upper left corner (of mask as viewed by operator).
- d. Spray sample, traversing its length approximately once per second for 10 seconds.
- e. Rinse sample under running D.I. water for approximately 5 seconds.
- f. Repeat step (d).
- g. Rinse sample under running D.I. water for approximately 15 seconds.
- h. Place sample on filter paper, secure with tweezers to eliminate movement, and blow dry with filtered  $N_2$ .
- i. Place sample on evaporating dish and place in oven for 10 minutes.

5.4.10 Step etch with 7:2:1,  $H_2SO_4:H_2O_2:H_2O$ .

- a. Fill insulated beaker with 1:1 methanol: $H_2O$  solution.
- b. Place recirculator coil in bath (preset to  $0^\circ C$ ) and beaker holder over the top of insulated beaker.

- c. Fill 100 ml teflon beaker to 1/2 in. below the top with 7:2:1 solution and place in methanol-water bath using holder.
- d. Using a glass thermometer, periodically check that the etching solution is maintained at 0°C. Bath temperature should be constantly monitored with a Weston stainless steel thermometer to be slightly below 0°C.
- e. Immerse sample in etching solution and agitate at a rate of approximately 2 RPS for prescribed\* length of time.  
\* On "wafer characterization" sheet.
- f. Remove sample from etch and immediately place it under running D.I. water for approximately 15 seconds.
- g. Place sample on filter paper, secure with tweezers, and blow dry with filtered N<sub>2</sub>.
- h. Repeat procedures 5.4.10, Steps e through g, as specified on "wafer characterization" sheet.

5.4.11 Photoresist removal (post-etching)

- a. Pour about 65 ml acetone into a 250 ml beaker.
- b. Place beaker in water in ultrasonic agitator. (Water should afford no buoyancy of acetone beaker.)
- c. Place sample in acetone for 15 seconds.
- d. Decant acetone, replace with methanol and replace in ultrasonic for 15 seconds.
- e. Decant methanol, replace with D.I. H<sub>2</sub>O and replace in ultrasonic agitator for 15 seconds.
- f. Remove sample to filter paper, secure with tweezers and blow dry with N<sub>2</sub>.
- g. Place sample on filter paper and place in oven for 10 minutes.

5.4.12 Repeat procedures 5.4.10, Steps e through g for metallization pattern.

5.4.13 Schottky Formation (Metallization)

Caution: Be sure roughing and gate valve are off.

- a. Vent bell jar to atmospheric pressure.
- b. Remove shielding and place two 90-mg clips of aluminum in tungsten coil designated for aluminum evaporation and approximately 8 cm of gold wire in the tungsten coil designated for it. The first tungsten coil should be used for two evaporations of this kind, and the latter may be used indefinitely, barring contamination or overheating.
- c. Place sample(s) at a vertical distance of 20 cm below the evaporation coil.
- d. Shield coil and assemble glass plate for viewing evaporation.
- e. Seal system from atmosphere (close vent).
- f. Close foreline valve.
- g. Open roughing valve and pump to 100  $\mu$ m.
- h. Close roughing valve.
- i. Open foreline valve.
- j. Open gate valve.
- k. Turn on ion gauge and degas switch.
- l. After 30 seconds, turn off degas switch.
- m. Pump system to  $2.0 \times 10^{-5}$  torr.
- n. Evaporate aluminum by gradually building to 6 amps. (1200 $\text{\AA}$  corresponding to 1000 Hz on evaporation monitor.)
- o. Evaporate gold by gradually building to 6 amps. (180 $\text{\AA}$  corresponding to 1000 Hz on evaporation monitor.)
- p. Turn off ion gauge.

- q. Close gate valve.
- r. Vent system to atmosphere and remove sample(s).
- s. Follow procedures 5.4.13(e) through 5.4.13(i).
- t. Advance to procedure 5.4.15.

5.4.14 Clean sample for Sn sphere metallization.

- a. Pour about 25 ml D-400 into a 100 ml beaker and heat to 50-60°C.
- b. Place sample in solution for approximately 60 seconds.
- c. Pour about 25 ml methanol into a 100 ml beaker.
- d. Remove sample from D-400 and place in methanol.
- e. Decant methanol.
- f. Replace methanol with D.I. water. Swish for 10 seconds. Remove sample, place on filter paper, and blow dry with N<sub>2</sub>.

5.4.15 Apply Sn sphere.

- a. Place sample on heating strip in Hall furnace.
- b. Hold a Sn sphere with tweezers and immerse it in a 100-ml beaker of hydrazine monohydrobromide solution. Remove immediately and blot excess liquid from sphere with filter paper.
- c. Place sphere at extreme corner of sample and repeat steps 5.4.15(b) and 5.4.15(c).
- d. Securely close the Hall furnace and turn on forming gas for two minutes (6CFH).
- e. Slowly heat sample to 225°C and hold for 30 seconds.
- f. Cool to less than 100°C under forming gas purge.
- g. Turn off forming gas and open furnace to remove sample.

5.4.16 Lift-Off Excess Metallization.

- a. Pour about 65 ml acetone into a 250-ml beaker.
- b. Place beaker in water in ultrasonic agitator. Water should afford no buoyancy of acetone beaker.
- c. Place sample in acetone until all unwanted metallization has been removed.
- d. Decant acetone and replace with methanol, and replace in ultrasonic agitator for 10 seconds.
- e. Decant methanol and replace with D.I. water. Place in ultrasonic agitator for 10 seconds.
- f. Remove sample to filter paper and blow dry with  $N_2$ .

5.4.17 Au-lead application AgMn contacts (Hall sample).

- a. Heat soldering iron to  $117^{\circ}C$ .
- b. Wet metal contacts with blue flux.
- c. Cut four 3-cm-long pieces of Au wire.
- d. Hold one length of Au wire with tweezers in one hand and soldering iron in other.
- e. Collect a small amount of Indaloy on iron.
- f. Drop solder onto Au wire and immediately drop these onto one metal contact on sample.
- g. Repeat steps 4 to 6 for the other three contacts.
- h. Rinse sample with D.I. water and blow dry with  $N_2$ .

6.0 ELECTRICAL CHARACTERIZATION (RP-76-006)

6.1 Equipment

6.1.1 Raytheon profilometer.

- 6.1.2 Type 575 transistor curve tracer; Tektronix or equivalent.
- 6.1.3 Tweezers; Techni-Tool, stainless steel, teflon-coated, nonmagnetic.
- 6.1.4 Calibration sample.

## 6.2 Materials

- 6.2.1 Doping ( $N, \text{cm}^{-3}$ ) vs. depletion depth ( $X, \mu\text{m}$ ) semilog paper.
- 6.2.2 Capacitance (C) vs. voltage (V) graph paper.
- 6.2.3 Voltage (V) vs. depletion depth ( $X, \mu\text{m}$ ) graph paper.
- 6.2.4 "Wafer characterization" work sheet.

## 6.3 Safety precautions

- 6.3.1 This procedure is not hazardous.

## 6.4 Procedure

- 6.4.1 Place sample on copper block.
- 6.4.2 Put ground probe on ground plane of sample.
- 6.4.3 Place sample probe just above Schottky to be measured and check zero reading of capacitance bridge on X 1 scale. Adjust to 3/4 scale deflection.
- 6.4.4 Adjust compensation to maximum deflection on capacitance scale.
- 6.4.5 Adjust capacitance to zero reading.
- 6.4.6 Measure samples as specified on "wafer characterization" sheet.
- 6.4.7 Place sample probe on Schottky to be measured.
- 6.4.8 Adjust capacitance scale (Boonton) and "cap scale" toggle switch to (1) position. For all full-scale capacitance readings which are multiples of 3, move "cap scale" switch to (3) position.

- 6.4.9 Set X range switch to desired range.
- 6.4.10 Set diameter setting to that which corresponds to the mask used in photolithography of the sample.
- 6.4.11 Set log offset to -1 (base range line  $10^{15} \text{cm}^{-3}$ ), 0 (base range line  $10^{14} \text{cm}^{-3}$ ), or 1 (base range line  $10^{13} \text{cm}^{-3}$ ).
- 6.4.12 Set Y-gain switch for graph paper being used: 3-1/3V/decade (normal operation) 3 decades/10 in. for X-Y recorder settings at X 1V/in. and Y-1V/in. 1V/decade, 1 decade/10 in. for same X-Y recorder settings.
- 6.4.13 Set V-bias limit to 100 V for all normal applications.
- 6.4.14 To read doping (N) place mode switch in auto position and read  $0.3 \log N + \log (10^{15}, 10^{14}, \text{ or } 10^{13})$  corresponding to log offset -1, 0, and 1, respectively.
- 6.4.15 To read depletion depth (S), place mode switch in manual position and read: X/X Range (0.1).
- 6.4.16 To read capacitance, place mode switch in manual position and read C/100.
- 6.4.17 To read voltage applied, place mode switch in manual position and read V directly.
- 6.4.18 To read current, mode switch may be in either position and is directly read.
- 6.4.19 Record on "wafer characterization" sheet for Read profile wafers (DVM) the following information:
- a. Readings at  $V_{\text{BIAS}} = 0$ .
  - b. Readings at peak doping.
  - c. Readings at 1/2 peak doping, before and after peak.
  - d. Readings at minimum or a doping of  $1 \times 10^{16}$ , whichever is higher.
  - e. Readings at any matchup points that are needed to contribute to calculate the total charge contained under the doping spike.



- f. Calculate  $Q = \frac{\Delta E}{1.4475 (X_p)} X_p =$   
depletion depth at peak doping.

$$\Delta E = \sum \frac{\Delta V_{BIAS}}{V_{X_1} + V_{X_2}}$$

- Adding pieces: a)  $X_0$  to 1/2(+) to peak.  
b) 1/2(+) peak to peak.  
c) peak to 1/2(-) peak.  
d) 1/2(-) peak to min.

#### 6.4.20 N-X plot.

- a. Set scales on X-Y recorder according to information derived from digital voltmeter.
- b. Place mode switch in automatic position and select switch to N/X.
- c. Set polarity (most N type samples) to (-) and turn on  $V_{BIAS}$  switch.
- d. Depress fast-ramp button for five seconds and apply voltage to Schottky until breakdown almost occurs or leakage (I) exceeds 0.01. An estimation of plot will occur here with recorder pen in up position and recorder in on position.
- e. Turn off  $V_{BIAS}$  toggle switch.
- f. Place recorder pen switch in down position (checking that the pen is properly zeroed) and turn on  $V_{BIAS}$  toggle switch to plot graph.

#### 6.4.21 C vs V Plot

- a. Set scales on X-Y recorder according to information derived from digital voltmeter.
- b. Place mode switch in manual position and selector switch to C/V position.

- c. Repeat procedures 6.4.20(c) through 6.4.20(f).
- 6.4.22 V vs X plot.
- a. Set scales on X-Y recorder according to information derived from digital voltmeter.
  - b. Place mode switch in manual position and selector switch to V vs X plot.
  - c. Repeat procedures 6.4.20(c) through 6.4.20(f).

## SECTION II-B

### DICE FABRICATION PROCESS

The sequence of operations for dice fabrication is shown in Figure IIB-1. The detailed process specifications are as follows.

#### 1.0 PURCHASE WAFER (MS-SP-098)

##### 1.1 Procedure

- 1.1.1 Obtain a copy of wafer specification 892049 entitled, "GaAs Epitaxial Wafer - Read Profile".
- 1.1.2 Consult drawing for wafer specification for device type to be manufactured (Section IID).
- 1.1.3 Initiate purchase requisition for quantity of wafers required.

#### 2.0 LOT DOCUMENTATION (MS-SP-132)

##### 2.1 Procedure

- 2.1.1 Receive wafer with packing slip, Quality Assurance Sheet, and Doping Profile Graph.
- 2.1.2 Xerox packing list and file copy. Deliver original to Purchasing Department.
- 2.1.3 File Quality Assurance sheet.
- 2.1.4 File Doping Profile Graph.
- 2.1.5 Log in wafer in Wafer Log Notebook Index Sheet.
- 2.1.6 Log in wafer and sketch wafer outline on first blank page of book.
- 2.1.7 Document lots as follows:
  - 2.1.7.1 Wafer Identification (Assigned by Research Division)

<u>OPERATION</u>	<u>PROCEDURE</u>
Purchase Wafer	MS-SP-098
Incoming Inspection	QC-SP-001
Lot Documentation	MS-SP-132
Wafer Preparation I	MS-SP-153
Sputter Front Schottky Barrier Metal	MS-SP-154
Metallization Adherence Test	QC-SP-002
Protective Au Plate	MS-SP-155
GaAs Flat Lap	MS-SP-102
Inspect Measurement	QC-SP-003
Wafer Preparation II	MS-SP-103
Heat Sink Gold Plating	MS-SP-104
Wafer Preparation III	MS-SP-105
Trim Edges	MS-SP-122
Gold Lap	MS-SP-106
Inspect Gold Lap	QC-SP-014
Wafer Preparation II	MS-SP-103
GaAs Back Lap	MS-SP-107
Inspect Back Lap Measure	QC-SP-015
Wafer Preparation II	MS-SP-103
GaAs Etch I	MS-SP-108
Photo Step I (Grid Mask)	MS-SP-109
GaAs Etch II (Grid Etch)	MS-SP-110
Strip Photo Resist I	MS-SP-111
GaAs Etch III (Thin Etch)	MS-SP-112
GaAs Thickness Measurement	QC-SP-004
Sputter Top Contact Metallization	MS-SP-153
Gold Plate Top Contacts	MS-SP-118
Photo II	MS-SP-115
Gold Etch	MS-SP-116
Strip Photo Resist II	MS-SP-117
Presputter Clean	MS-SP-103
Sputter Etch Back Metallization	MS-SP-158
Electrical Evaluation	QC-SP-005
Photo III	MS-SP-119
GaAs Mesa Etch IV	MS-SP-120
Strip Photo Resist I	MS-SP-111
Mechanical Inspection	QC-SP-006
Electrical Evaluation	MS-SP-156
Spray Dice Wafer	MS-SP-157

Figure IIB-1 Dice Fabrication Flow Chart (MS-FC-011)

Five digit number with following significance:

Ex:

40540A

Reactor No.: 4  
Run No.: 0540  
Position: A

2.1.7.2 Read Dice Lots

Ex:

R41415B

Significance same as 2.1.7.1. Wafers are processed as whole wafers. Use run sheet attached. Use prefix "R" on all lot numbers to signify Read diodes.

2.1.7.3 Read Diode Lots

Use run sheet attached. Use prefix "R" on all lots to signify Read diodes. Process in lots of 25 to 100 units, and add sequential lettering A through Z to identify assembly lot. Number diodes in lot 1-100.

Ex:

R41415BA39

R41415B - Significance as in 2.1.7.2.  
A - First diode lot assembled.  
39 - Diode #39 of lot A.

3.0 WAFER PREPARATION I - PRESPUTTER CLEAN (MS-SP-153)

3.1 Equipment

- 3.1.1 Plastic Beaker (150 ml. Nalgene VWR 1201-0150)
- 3.1.2 Beaker (Pyrex) (150 ml VWR 13912-182)
- 3.1.3 Hot Plate (Thermolyne HPA 1915B VWR)

RUN SHEET J PLATED HEAT SINK

PEM READ WAFER

Slice Supplier	_____	Run #	_____
Slice Lot #	_____	Job #	_____
Carrier Conc.	_____	Date	_____
Expected $V_B$	_____	PPVD	_____
Diode Type	_____	Flow Chart #	_____

STEP #	OPERATION	SPECIFICATION	OP	DATE	DATA
1	PURCHASE WAFER	MS-SP-098			
2	INCOMING INSPECTION	QC-SP-001			
3	PRESPUTTER CLEAN (WAFER PREP I)	MS-SP-153			
4	SPUTTER SCHOTTKY METAL	MS-SP-154			Thickness: Pt- _____ Ti- _____ Au- _____
5	ADHERENCE TEST	QC-SP-002			
6	PROTECTIVE GOLD PLATE	MS-SP-155			Time _____
7	MEASURE WAFER	MS-SP-102			Thickness _____
8	MOUNT WAFER	MS-SP-102			
9	LAP WAFER	MS-SP-102			Time _____
10	DISMOUNT WAFER	MS-SP-102			
11	CLEAN WAFER	MS-SP-102			
12	MEASURE WAFER	MS-SP-102			Thickness _____
13	INSPECT MEASUREMENT	QC-SP-003			Thickness _____

STEP #	OPERATION	SPECIFICATION	OP	DATE	DATA
14	CLEAN FOR PLATING (WAFER PREP II)	MS-SP-103			
15	MOUNT FOR AU PLATE	MS-SP-104			
16	PLATE AU	MS-SP-104			Time _____ Current _____
17	MEASURE AU	MS-SP-104			Thickness _____
18	DISMOUNT WAFER	MS-SP-104			
19	WAFER PREP III	MS-SP-105			
20	TRIM EDGES	MS-SP-122			
21	MEASURE WAFER	MS-SP-106			Thickness _____
22	MOUNT WAFER	MS-SP-106			
23	LAP AU	MS-SP-106			Time _____
24	DISMOUNT WAFER	MS-SP-106			
25	CLEAN WAFER	MS-SP-106			
26	QC INSPECT	QC-SP-114			Thickness _____
27	WAFER PREP II	MS-SP-103			
28	LAP GaAs	MS-SP-107			Time _____
29	DISMOUNT WAFER	MS-SP-107			
30	CLEAN WAFER	MS-SP-107			
31	QC INSPECT	QC-SP-115			Thickness _____

STEP #	OPERATION	SPECIFICATION	OP	DATE	DATA
32	WAFER PREP II	MS-SP-103			
33	ETCH WAFER	MS-SP-108			
34	PHOTO I	MS-SP-109 Line ____ Ctr ____			
35	ETCH GRID	MS-SP-110			Time _____
36	STRIP PHOTORESIST I	MS-SP-111			
37	MEASURE PADS	MS-SP-112			Ht. _____
38	THIN ETCH	MS-SP-112			Time _____
39	MEASURE PADS	MS-SP-112			Ht. _____
40	QC MEASURE	QC-SP-004			Ht. _____
41	PRESPUTTER CLEAN	MS-SP-154			
42	SPUTTER PLATINUM	MS-SP-154			Time _____ Thickness _____
43	PLATE GOLD	MS-SP-118			Time _____ Current _____
44	PHOTO II	MS-SP-115 Dia. ____ Ctr ____			
45	ETCH GOLD	MS-SP-116			Time _____
46	STRIP PHOTORESIST II	MS-SP-117			
47	PRESPUTTER CLEAN	MS-SP-103			
48	PLATINUM SPUTTER ETCH	MS-SP-158			Time _____ Power _____
49	QC ELECTRICAL INSPECTION	QC-SP-005			V <sub>B</sub>



STEP #	OPERATION	SPECIFICATION	OP	DATE	DATA
50	PHOTO III	MS-SP-119			
51	MESA ETCH	MS-SP-120			Time _____
52	STRIP PHOTORESIST	MS-SP-111			
53	MECHANICAL EVALUATION	QC-SP-006			Mesa Dia. _____ Pad Dia. _____
54	ELECTRICAL EVALUATION	MS-SP-156			V <sub>B</sub> _____ C <sub>TO</sub> _____
55	MOUNT FOR DICING	MS-SP-157			
56	SPRAY WAFER	MS-SP-157			
57	DISMOUNT DICE	MS-SP-157 ____ X _____			
58	CLEAN DICE	MS-SP-157			

PEM READ DIODE  
RUN SHEET

Part No.: MS-50371/50372  
 Cust SCS: SCS-481  
 Flow Chart: MS-FC-013  
 ATP: MS-50371/2-1-ATP  
 Dice: MS-FC-011

Lot No.: \_\_\_\_\_  
 Date: \_\_\_\_\_

OPERATION	SPECIFICATION	GR	NET	OP	DATE	TIME		COMMENTS
						ON	OFF	
INSPECT	MS-SP-123							COLLET SIZE _____
MOUNT DICE	MS-SP-185							CHUCK SET _____ GAS SET _____ COLLET SIZE _____
QC INSPECTION	QC-SP-007 QC-SP-012							
WELD RIBBON	MS-SP-138							
QC INSPECTION	QC-SP-017							
BOND RIBBON	MS-SP-125							
QC INSPECTION	QC-SP-008 QC-SP-013							
ETCH	MS-SP-187							
QC INSPECTION	QC-SP-022							
CLEAN & BAKE	MS-SP-128							
WELD LIDS	MS-SP-039							
GROSS LEAK	MS-SP-143							
BURN-IN	MS-SP-139							
RF TEST	MS-SP-137 MS-50371/2-1-ATP							
FINAL TEST PER ATP	MS-50371/2-1-ATP							

- 3.1.4 Tweezers (Dumont 3C Hub Material)
- 3.1.5 Cotton Swabs (6" Wood Handle Otis Clapp)
- 3.1.6 TCE (Trichlorethylene (Electronic Grade #167-2787 Allied Chemical)
- 3.1.7 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 3.1.8 D.I. Water (10 megohm min.)
- 3.1.9 10% HF, 90% D.I. Water Solution (Electronic Grade #194-2753 Allied Chemical)

### 3.2 Procedure

- 3.2.1 Place wafer in beaker against a pair of tweezers.
- 3.2.2 Pour TCE into the beaker.
- 3.2.3 Place beaker on hot plate and boil for 3 minutes.
- 3.2.4 Remove the wafer from the boiling TCE using tweezers and gently swab the GaAs.
- 3.2.5 Repeat 3.2.1 and 3.2.4.
- 3.2.6 Place wafer back into beaker and boil again for 2 minutes in TCE.
- 3.2.7 Rinse wafer down in acetone 2-3 times after.
- 3.2.8 Rinse wafer in D.I. water for 2 minutes.
- 3.2.9 Pour 10% HF and 90% D.I. water solution into plastic beaker.
- 3.2.10 Place wafer into solution for 1 minute.
- 3.2.11 Rinse wafer in D.I. water for 3 minutes.
- 3.2.12 Blow dry.

## 4.0 SPUTTER SCHOTTKY BARRIER (MS-SP-154)

### 4.1 Equipment and Materials

- 4.1.1 Materials Research Corp. Sputtering System Model #8800.

- 4.1.2 Cylinder of Argon Gas with Needle Valve (Ultra-High Purity - Matheson)
- 4.1.3 Cylinder of Liquid Nitrogen with Automatic Feed
- 4.1.4 Platinum Target (Marz Grade 6" dia. Materials Research Corp.)
- 4.1.5 Titanium Target (Marz Grade 8" dia. Materials Research Corp.)
- 4.1.6 Gold Target (Marz Grade 8" dia. Materials Research Corp.)
- 4.1.7 Dec-Tac Surface Measuring Device Model 900050.
- 4.1.8 GaAs Wafers - Cleaned from MS-SP-153.
- 4.1.9 Glass Slide (Corning #48300-160 VWR)

#### 4.2 Procedure

- 4.2.1 Make certain wafers are cleaned as per MS-SP-153 and that platinum has been precoated on pallet in system before loading wafers.
- 4.2.2 Load samples; start roughing pump.
- 4.2.3 When bell jar reaches 50 microns pressure, open high vacuum valve.
- 4.2.4 Monitor chamber pressure at 20°C.
- 4.2.5 When inside vacuum pressure reaches  $3.6 \times 10^{-6}$  torr, start heater.
- 4.2.6 Heat from room temperature to 330°C max.; total time is 23 minutes.
- 4.2.7 When temperature reaches 330°C, cut heater power; allow temperature to drop to 265°C.
- 4.2.8 Start heater air flow for cooling until internal pressure reaches  $3 \times 10^{-6}$  torr.
- 4.2.9 Presputter Pt onto shield; use 7 microns Argon pressure, 150 watts power for 3 minutes.

- 4.2.10 Sputter 200 Angstroms Platinum on wafer; use 7 microns Argon pressure, 150 watts power, pallet temperature @ 250°C for 1.5 minutes.
- 4.2.11 Cool pallet and wafers down to 180°C by turning on air cooler.
- 4.2.12 When temperature reaches 180°C, turn on water cooler until pallet temperature reaches 100°C.
- 4.2.13 Presputter titanium onto shield; use 7 microns Argon pressure, 700 watts power for 5 minutes.
- 4.2.14 Drop pallet temperature to 40°C; use 7 microns Argon pressure, 700 watts pressure, open shield and sputter titanium wafer for 5 minutes.
- 4.2.15 Sputter gold immediately on surface of wafers using 7 microns Argon pressure, 150 watts power for 8 minutes.
- 4.2.16 Shut down Argon flow, shut off water cooling, vent system to atmosphere and remove samples.
- 4.2.17 Measure sample using Dek-Tac to determine thickness of deposited metal. Record on run sheet.

## 5.0 PROTECTIVE GOLD PLATE (MS-SP-155)

### 5.1 Equipment and Materials

- 5.1.1 Tweezers (Dumont 3C Hub Material)
- 5.1.2 Beaker 600 mil (Pyrex #13912-240 VWR)
- 5.1.3 Glass Slide (Corning #48300-160 VWR)
- 5.1.4 Hot Plate (Thermolyne Type 1000) and Stirrer VWR
- 5.1.5 Platinum Electrode (1" x 3" .005 foil Materials Research Corp.)
- 5.1.6 Teflon Holding Fixture
- 5.1.7 Timer (Gralab #62371-001 VWR)
- 5.1.8 Constant Current Supply (Model 151B) (Quan-Tech Laboratories)
- 5.1.9 Cotton Swabs (6" Wood Handle Otis Clapp)

- 5.1.10 Beaker (150 ml #13912-182 VWR)
- 5.1.11 Apiezon Wax (#59336-002 VWR)
- 5.1.12 Technic Orotemp 24 Plating Solution
- 5.1.13 TCE (Electronic Grade #167-2787 Allied Chemical)
- 5.1.14 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 5.1.15 D.I. Water (10 megohm min.)

## 5.2 Procedure

- 5.2.1 Place the glass slide on the hot plate and melt black wax liberally on slide surface.
- 5.2.2 Place the wafer with gold side up on the wax trying to make a flat contact on all four sides as close to the top of the wafer as possible. This can be done by gently moving the wafer with cotton swab back and forth, and side to side.
- 5.2.3 Remove the glass slide from the hot plate and allow it to cool.
- 5.2.4 Pour 500 cc of Technic Orotemp 24 Plating Solution into a 600 ml beaker.
- 5.2.5 Place beaker on hot plate and raise temperature of the solution to  $68^{\circ}\text{C}$  to  $\pm 2^{\circ}\text{C}$ . Maintaining the proper temperature is very important to avoid uneven plating.
- 5.2.6 Connect the anode of the power supply to the platinum electrode and place the slide onto the teflon holding fixture.
- 5.2.7 Put holding fixture into the plating bath. Adjust the holder of the holding fixture such that the wafer is covered.
- 5.2.8 Attach the cathode to the stainless steel post extending from the holder.
- 5.2.9 Set power supply current according to the wafer size  $5 \text{ MA/cm}^2$ .

- 5.2.10 Plate 10 minutes. Switch wafer position 180° after first 5 minutes.
- 5.2.11 Remove wafer from glass slide by placing the glass slide on the hot plate and slowly melt the wax.
- 5.2.12 Rinse with TCE, acetone, and D.I. water.

## 6.0 GaAs FLAT LAP (MS-SP-102)

### 6.1 Equipment and Materials

- 6.1.1 Lapping Block - Ceramic Ring Stainless Steel Block - Speed FAM 12B.
- 6.1.2 Quik-Stik Adhesive (#910 Maker Products Inc.)
- 6.1.3 Rubber Stopper (#14 VWR #56380-482)
- 6.1.4 Lapping Machine (Speed FAM Model 12B)
- 6.1.5 Dial Indicator Thickness Gauge (Starret #656-211 Hub Material)
- 6.1.6 Cotton Swabs (6" Wood Handle, Otis Clapp)
- 6.1.7 Tweezers (Dumont 3C Hub Material)
- 6.1.8 Watch Crystal (Pyrex #66110-043 VWR)
- 6.1.9 5 Micron Aluminum Oxide Grit (The Mosher Co.)
- 6.1.10 205 Oil Base Vehicle (The Mosher Co.)
- 6.1.11 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 6.1.12 Trichloroethylene (Electronic Grade #167-2787 Allied Chemical)

### 6.2 Procedure

- 6.2.1 Perform thickness measurements on the wafer at 4 scattered points across the wafer.
- 6.2.2 Set the lapping block at 10.5 mils.

- 6.2.3 Mount the wafer, platinum side down, on the lapping block using Quik-Stik adhesive.
- 6.2.4 Using a rubber stopper, gently press the wafer into the adhesive and hold for about five seconds. This allows any bowing to be taken out of the crystal and relative flat readings to be obtained.
- 6.2.5 Place the lapping block on the lapping machine.
- 6.2.6 Using a 5 micron aluminum oxide grit and 205 oil base vehicle, lap the wafer. Pour an additional amount of lapping fluid onto the lapping block while lapping to prevent the block from becoming dry.
- 6.2.7 Visually monitor the block while lapping. A black streak will appear immediately and will disappear the moment 10.5 mils is obtained. (approximately 1-1/2 mins.)
- 6.2.8 Remove the block from the machine; then stop lapping.
- 6.2.9 Use the height gauge to determine that the desired 10.5 mils, or slightly under, has been attained. Continue lapping if necessary.
- 6.2.10 Using acetone moistened cotton swabs, gently remove any grit that may be embedded around the outer peripheral edges of the wafer. This step is important in that if any grit remains when the wafer slides across the block the platinum side of the wafer will become scratched.
- 6.2.11 Remove the wafer from the block, using tweezers and swab, then place it into a beaker of hot trichlorethylene.
- 6.2.12 Allow it to boil in trichlorethylene for a short period of time.
- 6.2.13 Remove the wafer from the hot trichlorethylene and swab gently until grit and oil disappear.
- 6.2.14 Place back in hot TCE and boil the wafer in TCE for three to five minutes.
- 6.2.15 Remove the wafer from the trichlorethylene and rinse it in acetone and then dry.



- 6.2.16 Measure the wafer flatness at 4 scattered points. The deviation of these readings must be no greater than 0.2 mils (0.1 mil is desired flatness; 0.2 mils is acceptable).
- 6.2.17 If the deviation is greater than 0.2 mils, it will be necessary to repeat the flat lap operation except with the height of the block reduced approximately 0.1 mil.
- 6.2.18 When the wafer does meet specifications, have Q.C. verify the measurement and sign off the run sheet.

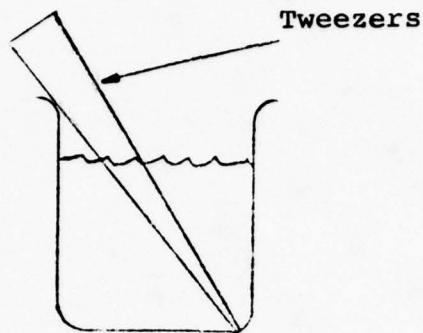
## 7.0 WAFER PREPARATION II - CLEAN (MS-SP-103)

### 7.1 Equipment and Materials

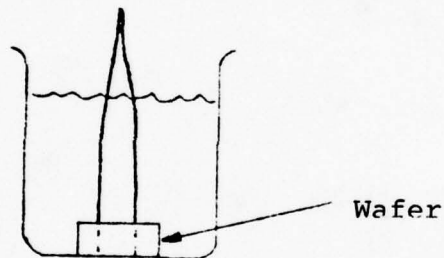
- 7.1.1 Hot Plate (Thermolyne 6 " x 6" #HPA1915B VWR)
- 7.1.2 Beaker - 50 ml (Pyrex #13912-149 VWR)
- 7.1.3 Tweezers (Dumont 3C Hub Material)
- 7.1.4 Cotton Swabs (6" Wood Handle Otis Corp.)
- 7.1.5 Compressed Nitrogen System (High Purity)
- 7.1.6 Petri Container (Falcon #25369-022 VWR)
- 7.1.7 Trichlorethylene (Electronic Grade #167-2787 Allied Chemical)
- 7.1.8 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 7.1.9 D.I. Water (10 megohm min.)

### 7.2 Procedure

- 7.2.1 Place the 50 ml beaker on the hot plate with at least 40 ml of trichlorethylene.
- 7.2.2 Increase the temperature of the hot plate to bring the trichlorethylene to a boil.
- 7.2.3 Place the tweezers into the beaker as shown:



- 7.2.4 Carefully place the wafer into the boiling trichlorethylene against the tweezers as shown:



- 7.2.5 Expose the wafers to the boiling trichloroethylene for approximately 5 minutes.
- 7.2.6 Remove the wafer from the beaker.
- 7.2.7 Wipe both sides of the wafer using a trichloroethylene moistened cotton swab.
- 7.2.8 Continue cleaning until all traces of dirt are gone and cotton swabs remain clean.
- 7.2.9 Rinse the wafer in a beaker of acetone.
- 7.2.10 Remove the wafer from the acetone and clean using acetone moistened swabs.
- 7.2.11 Rinse the wafer using D.I. water.
- 7.2.12 Blow the wafer dry using the compressed nitrogen system.

7.2.13 Store the wafer in a petri container.

## 8.0 GOLD PLATING (MS-SP-104)

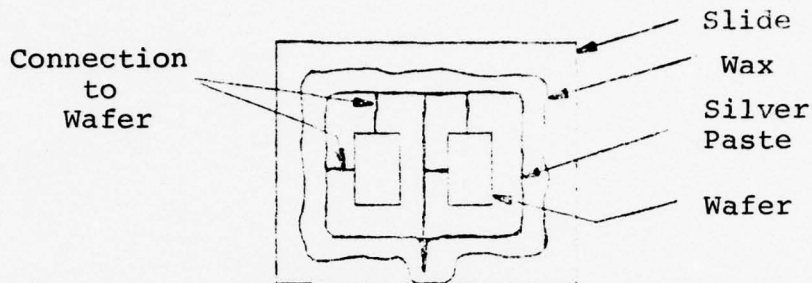
### 8.1 Equipment and Materials

- 8.1.1 Glass Slide (Corning #48300-160 VWR)
- 8.1.2 Hot Plate (Thermolyne Type 1000 VWR)
- 8.1.3 600 ML Beaker (Pyrex #13912-240 VWR)
- 8.1.4 Plating Equipment (Current Supply Model 151B Quan-Tech Laboratories)
- 8.1.5 Teflon Holding Fixture
- 8.1.6 Timer (Gralab #62371-001 VWR)
- 8.1.7 Thermometer (#61013-040 VWR)
- 8.1.8 Apiezon Wax (#59336-002 VWR)
- 8.1.9 Technic Orotemp 24 Plating Solution
- 8.1.10 Trichlorethylene (Electronic Grade #167-2787 Allied Chemical)
- 8.1.11 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 8.1.12 D.I. Water (10 megohm min.)
- 8.1.13 Silver Print Conductive Paint (GC Electronics Co. Cat. #22-246)

### 8.2 Procedure

- 8.2.1 Scribe the glass slide to an approximate size of 2" x 2".
- 8.2.2 Place the slide on the hot plate and melt Apiezon wax liberally on the slide surface.
- 8.2.3 Place the two wafers platinum side up, on the wax trying to make a fairly flat contact with the wax oozing up on all four sides as close to the top as possible without overflowing. This can be done by gently moving the wafer back and forth and side to side.

- 8.2.4 Remove the glass slide from the hot plate and allow it to cool.
- 8.2.5 Paint the slice using conductive paste as shown below. Allow the paste to cure for one hour at room temperature before plating.



- 8.2.6 Pour 500cc of Technic Orotemp 24 plating solution into a 600 ml beaker.
- 8.2.7 Place the beaker onto a hot plate and raise the temperature of the solution to  $65^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Maintaining the proper temperature is very important to avoid varying degrees of brownish-gold bumpy-gold.
- 8.2.8 Connect the anode of the power supply to the platinum electrode and place the slide into the teflon holding fixture.
- 8.2.9 Immerse the holding fixture into the plating bath. Adjust the immersion depth such that the slices are covered, but the silver paste electrode contact is above the solution.
- 8.2.10 Attach the cathode to the stainless steel post extending from the holder.
- 8.2.11 Set the power supply current at approximately 20 milliamps (check with Process Engineer).
- 8.2.12 Plate the slices for approximately 6-7 hours to attain 3 mils of gold.
- 8.2.13 Add  $\text{H}_2\text{O}$  to solution when evaporation is observed so that plating will not burn.
- 8.2.14 Observe the plating every 10-15 minutes to be sure conductive paste has not melted and contact is broken.

- 8.2.15 Monitor temperature and keep at 68°C. If slices are removed before 6 hours for any reason, rinse with H<sub>2</sub>O thoroughly.
- 8.2.16 Using clean razor blade, cleave the connections midway between the silver paste and the wafer.
- 8.2.17 Remove the wafer from the glass slide by placing the slide on the hot plate and heating the wax.
- 8.2.18 Place the wafer in hot trichlorethylene until the residue wax is removed.
- 8.2.19 Rinse the wafer in acetone and then D.I. water.
- 8.2.20 Allow the wafer to dry.
- 8.2.21 After cleaning cycles are completed, measure to determine the height of the gold. At least 3 mils of gold must be deposited on the wafer before plating is complete.

## 9.0 WAFER PREPARATION III - CLEAN (MS-SP-105)

### 9.1 Equipment and Materials

- 9.1.1 Beaker (150 ml Pyrex #13912-182 VWR)
- 9.1.2 Hot Plate (Thermolyne HPA 1915B VWR)
- 9.1.3 Tweezers (Dumont 3C Hub Material)
- 9.1.4 Cotton Swabs (6" Wood Handle Otis Clapp)
- 9.1.5 Distilled Water (10 megohm min.)
- 9.1.6 Liquidnox (#21837-027 VWR)
- 9.1.7 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 9.1.8 Trichlorethylene (Electronic Grade #119-2750 Allied Chemical)
- 9.1.9 D.I. Water (10 megohm min.)

### 9.2 Procedure

- 9.2.1 Place a plated heat sink wafer in a beaker.

- 9.2.2 Pour 50 cc of distilled water and 2 cc of Liquidnox into the beaker.
- 9.2.3 Put the beaker onto the hot plate and bring the soap solution to a low boil.
- 9.2.4 Allow the solution to boil for two minutes; then remove the beaker from the hot plate.
- 9.2.5 Transfer the wafer to a beaker of cool distilled water.
- 9.2.6 Rinse the distilled water several times.
- 9.2.7 Rinse the water from the beaker and pour in acetone to remove the water.
- 9.2.8 Remove the acetone from the beaker and replace it with trichlorethylene.
- 9.2.9 Place the trichlorethylene filled beaker on the hot plate and boil the wafers for five minutes.
- 9.2.10 Remove the wafers from the boiling trichlorethylene using tweezers and gently swab the gallium-arsenide side to remove the grit still contaminating the top surface.
- 9.2.11 If the swab remains clean, rinse wafers with acetone; then rinse with water and gently pat dry.

## 10.0 TRIM EDGES (MS-SP-122)

### 10.1 Equipment & Materials

- 10.1.1 Model #2007 (Laster Technology, Inc. Wire Saw)
- 10.1.2 Thermolyne Hot Plate (Model #HP-2305B VWR)
- 10.1.3 Baush & Lomb Microscope w/10X Lens (#41433-053 VWR)
- 10.1.4 Apiezon Black Wax (#59336-002 VWR)
- 10.1.5 Ceramic Squares (1" Square x 1/4" Thick)
- 10.1.6 Deionized Water (10 megohm min.)
- 10.1.7 Filter Paper Squares (3-1/2" x 3-1/2" Aldar Paper)

## 10.2 Safety

- 10.2.1 Do not run the wire saw at speeds higher than 20.
- 10.2.2 Care should be used when handling the .005 mil diamond impregnated wire; it is very fragile.

## 10.3 Procedure

- 10.3.1 Turn hot plate up to 600 on the heat setting.
- 10.3.2 Place the mounting block for the dicer and a clean ceramic square on the hot plate.
- 10.3.3 Heat for approximately 7 minutes or until the black wax melts on the ceramic.
- 10.3.4 Wax the mounting block and put the ceramic block on top of the wax.
- 10.3.5 Gently press the slice onto the ceramic block and remove the block so that it may cool.
- 10.3.6 Place on cutting mount station on wire saw and secure the mounting block with the brass ring.
- 10.3.7 At this point, you now have the mounting block with a square ceramic mounted on it and your slice mounted on top of the ceramic. All of this is sitting on top of the wire saw mount station and now you are ready to start the machine.
- 10.3.8 Plug in all electrical plugs to the wire saw.
- 10.3.9 Fill the water container with D.I. water and slowly unscrew the needle valve until water begins to drip at a steady rate.
- 10.3.10 Set the cutting force dial at 2-1/2.
- 10.3.11 Set the power box on automatic cut.
- 10.3.12 You are now ready to align your saw cut.
- 10.3.13 The mounting station rotates on an X, Y, and Z axis so that alignment can be made easily.

- 10.3.14 The mounting station sits on a teflon well which drains the cutting water. This well is connected via pulleys to an X axis "stepper". Each step on the pulley moves the block approximately 5 mils to either the right or the left.
- 10.3.15 Utilizing the stepper and the Z rotation, the wire saw can be aligned to cut down the edges of the wafer.
- 10.3.16 Once again, the alignment depends on the edge quality and cracks on the slice you are cutting.
- 10.3.17 Once you are sure your alignment is good, start the saw and turn the speed control to 15.
- 10.3.18 Observe the cut under the microscope to see that the blade does not wobble.
- 10.3.19 Remember that the objective is to cut off the overhanging gold on the edges as well as eliminating any cracks or chips that may hamper, or hinder future lapping operations.
- 10.3.20 Dismount the crystal by placing ceramic block on hot plate and removing excess material.
- 10.3.21 Gently slide wafer off to side of block using tweezers.
- 10.3.22 Clean wafer by boiling for 10 minutes in trichlor.
- 10.3.23 Remove wafer, swab gently with trichlor moistened swabs and place in petri dish.

## 11.0 GOLD LAP (MS-SP-106)

### 11.1 Equipment and Materials

- 11.1.1 Lapping Block (Ceramic Ring Stainless Steel Block Speed Fam 12B)
- 11.1.2 Quik-Stik Adhesive (#910 Maker Products, Inc.)
- 11.1.3 Rubber Stopper (#14 VWR #56380-482)



- 11.1.4 Lapping Machine (Speed Fam 12B)
- 11.1.5 Height Gauge (Starrett #656-211 Hub Material)
- 11.1.6 Cotton Swabs (6" Wood Handle Otis Clapp)
- 11.1.7 Glass Slide (Corning #48300-160 VWR)
- 11.1.8 Tweezers (Dumont 3C Hub Material)
- 11.1.9 10 Micron Aluminum Oxide Grit (The Mosher Co.)
- 11.1.10 205 Oil Base Vehicle (The Mosher Co.)
- 11.1.11 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 11.1.12 Trichlorethylene (Electronic Grade #167-2787 Allied Chemical)

11.2 Procedure

- 11.2.1 Perform measurements of the wafer thickness at four scattered points.
- 11.2.2 Compare these measurements with those taken of this wafer at Flat Lap MS-SP-102 to determine the gold thickness.
- 11.2.3 The purpose of this operation is to lap the gold to a thickness of 2.0-2.5 mils, so set the block accordingly. This measurement will be determined by adding the original wafer thickness to the desired gold thickness (2.0-2.5 mils).
- 11.2.4 Mount the wafer, gallium arsenide down, on the lapping block using Quik-Stik adhesive.
- 11.2.5 Using a rubber stopper, gently press the wafer into the adhesive and hold for about five seconds. This allows any bowing to be taken out of the crystal and relative flat readings to be obtained.
- 11.2.6 Place the lapping block on the lapping machine.
- 11.2.7 Using a 10 micron aluminum oxide gr t and 205 oil base vehicle, lap the wafer.
- 11.2.8 Lap until all areas of the wafer's gold surface

have showed some form of mechanical lapping (gold surface is flat and smooth rather than bumpy). Usually about 15-20 minutes.

- 11.2.9 Using acetone moistened swab, gently remove any grit that is embedded on the outer edges or on the surface of the slice. This step is a precleaning step before dismounting.
- 11.2.10 Wet the wafer with acetone, and using cotton swab, gently press either of the long edges of the wafer until it breaks free from the adhesive.
- 11.2.11 Remove it from the block, using tweezers, and place it into a beaker of acetone.
- 11.2.12 Allow it to soak in acetone for a short period of time.
- 11.2.13 Remove the wafer from the acetone and place it into a beaker of trichlorethylene.
- 11.2.14 Boil the wafer in TCE for three to five minutes.
- 11.2.15 Remove the wafer from the trichlorethylene and rinse it in acetone and the water.
- 11.2.16 Measure the wafer flatness at four scattered points. The deviation of these readings must be no greater than 0.1 mils.
- 11.2.17 If the deviation is greater than 0.1 mils, it will be necessary to repeat the lapping operation.
- 11.2.18 When the wafer does meet specifications, have Q.C. verify the measurement and sign off the run sheet.

## 12.0 WAFER PREPARATION II - CLEAN (MS-SP-103)

- 12.1 Refer to 7.0. Same procedure is used.

## 13.0 GaAs BACK LAP (MS-SP-107)

- 13.1 Equipment and Materials

- 13.1.1 Lapping Block (Ceramic Ring Stainless Steel Block Speed Fam 12B)
- 13.1.2 Quik-Stik Adhesive (#910 Maker Products, Inc.)
- 13.1.3 Rubber Stopper (#14 VWR #56380-482)
- 13.1.4 Lapping Machine (Spead Fam 12B)
- 13.1.5 Height Gauge (Starrett #656-211 Hub Material)
- 13.1.6 Cotton Swabs (6" Wood Handle Otis Corp.)
- 13.1.7 Glass Slide (Corning #48300-160 VWR)
- 13.1.8 Tweezers (Dumont 3C Hub Material)
- 13.1.9 5 Micron Aluminum Oxide Grit (The Mosher Co.)
- 13.1.10 205 Oil Base Vehicle (The Mosher Co.)
- 13.1.11 Acetone (Electronic Grade #119-2750 Allied Chemical)
- 13.1.12 Trichlorethylene (Electronic Grade #167-2787 Allied Chemical)

## 13.2 Procedure

- 13.2.1 The wafer thickness at this point is approximately 12 mils. It is necessary to reduce the GaAs thickness from approximately 10 mils to 2 mils.
- 13.2.2 Set the mounting block to 2 mils plus the gold thickness measurement as measured after Gold Lap, MS-SP-106. The gold thickness should be from 2.0-2.5 mils so the block will be set at 4.0 to 4.5 mils.
- 13.2.3 Mount the wafer gold side down on the lapping block using Quik-Stik adhesive.
- 13.2.4 Using a rubber stopper, gently press the wafer into the adhesive and hold for about five seconds. This allows any bowing to be taken out of the crystal and relative flat readings to be obtained.

- 13.2.5 Place the lapping block on the lapping machine.
- 13.2.6 Using a 5 micron aluminum oxide grit and 205 oil base vehicle, lap the wafer. Pour an additional amount of oil and grit on the plate while lapping to eliminate scratches.
- 13.2.7 Visually monitor the block while lapping. A black streak will appear immediately and will disappear the moment proper thickness is obtained.
- 13.2.8 Stop lapping and remove the block from the machine.
- 13.2.9 Wet the wafer with acetone, and using a cotton swab as a tool, gently press either of the long edges of the wafer until it breaks free from the adhesive.
- 13.2.10 Remove it from the block, using tweezers, and place it into a beaker of acetone.
- 13.2.11 Allow it to soak in acetone for a short period of time.
- 13.2.12 Remove the wafer from the acetone and place it into a beaker of trichlorethylene.
- 13.2.13 Boil the wafer in TCE for three to five minutes.
- 13.2.14 Remove the wafer from the trichlorethylene and rinse it in acetone and then water.
- 13.2.15 Measure the wafer flatness at 4-5 scattered points. The deviation of these readings must be no greater than 0.1 mils.
- 13.2.16 If the deviation is greater than 0.1 mils, it will be necessary to repeat the lapping operation except with the height of the block reduced approximately 0.2 ml.
- 13.2.17 When the wafer does meet specifications, have Q.C. verify the measurement and sign off the run sheet.
- 13.2.18 It is important to maintain a clean lapping machine to prevent scratches to the wafer and to exercise care when handling the wafer to prevent damage.

14.0 WAFER PREPARATION II - CLEAN (MS-SP-103)

14.1 Refer to 9.0. Same procedure is used.

15.0 GaAs ETCH I (MS-SP-108)

15.1 Equipment and Materials

- 15.1.1 Beaker (Pyrex 150 ml #13912-182 VWR)
- 15.1.2 Thermometer (#61013-040 VWR)
- 15.1.3 Water Heat Sink
- 15.1.4 Teflon-Coated Etching Bath
- 15.1.5 Magnetic Hot Plate and Stirrer (Thermolyne Type 1000 VWR)
- 15.1.6 Timer (Gralab #62371-001 VWR)
- 15.1.7 Height Gauge (Starret #656-211 Hub Material)
- 15.1.8 Sulphuric Acid (Electronic Grade #108-2679 Allied Chemical)
- 15.1.9 Hydrogen Peroxide 30% (Electronic Grade #109-6502 Allied Chemical)
- 15.1.10 D.I. Water (10 megohm min.)

15.2 Procedure

- 15.2.1 Prior to etching, cleaning must be performed per "Wafer Preparation I, MS-SP-153". Prolong boiling in TCE to be certain that no films, stains, etc., remain on the surface. The gallium-arsenide surface should have a whitish-gray appearance.
- 15.2.2 Mix 90 cc sulphuric acid, 30 cc peroxide, and 30 cc water.
- 15.2.3 The solution when mixed will rise to a temperature of 100°C.
- 15.2.4 Cool the solution in a water bath to 35°C.

- 15.2.5 Pour the solution into the teflon-coated etching bath which is controlled with a magnetic stirrer.
- 15.2.6 Place the etching bath on a magnetic stirring hot plate. The hot plate is kept at 35°C.
- 15.2.7 Energize the magnetic stirrer and set it so that the currents are sent up through the holes in the teflon holder to help decrease the deviation caused during etching.
- 15.2.8 Wet the wafer with water and place it in the teflon holder in the area with no holes.
- 15.2.9 The etching time should be established by experimentation; for example, 3:1:1 bath at 35°C etches 5 microns per minute.
- 15.2.10 An approximate etching time of 5 minutes to etch the wafer 1 mil will be required.
- 15.2.11 Mechanically measure the wafer to determine that 0.5 mil has been removed. If additional etching is required, be sure to clean the wafer after contact with the measuring gauge.
- 15.2.12 It is advantageous to flat lap the wafer to 1.6-1.8 mils, therefore, allowing you to only etch off 0.5 mils of material before performing grid mask.

## 16.0 PHOTO I (MS-SP-109)

### 16.1 Equipment and Materials

- 16.1.1 Aluminum Pan (#25433-008 VWR)
- 16.1.2 Oven @ 70°C (Blue M)
- 16.1.3 Timer (Gralab #62371-001 VWR)
- 16.1.4 Headway Spinner with Vacuum Chuck (Model EC101)
- 16.1.5 Eye Dropper (#16362-124 VWR)
- 16.1.6 K&S Aligner (Model 686)
- 16.1.7 Photo Resist Mask (Light Field 20 MIL Center, 2 MIL Line)

- 16.1.8 Microscope 200X (Nikon #63757)
- 16.1.9 Development Station
- 16.1.10 Bake Oven @ 100°C (Blue M)
- 16.1.11 Methylene Chloride (Electronic Grade #167-6410 Allied Chemical)
- 16.1.12 Waycoat I.C. Resist
- 16.1.13 I.C. Developer (#802439 P.A. Hunt Chemical)
- 16.1.14 N-Butylacetate (Electronic Grade #119-2659 Allied Chemical)
- 16.1.15 D.I. Water (10 megohm min.)

16.2 Procedure

- 16.2.1 Bring the wafer to the photo resist area.
- 16.2.2 Place the wafer on a vacuum chuck on the Headway spinner.
- 16.2.3 Using an eye dropper, apply methylene chloride to the wafer surface.
- 16.2.4 Spin the wafer at 4000 RPM for 30 seconds.
- 16.2.5 Apply Waycoat I.C. resist to the wafer and spin at 4000 RPM for 30 seconds. Apply additional I.C. resist and repeat the spin cycle.
- 16.2.6 Remove the wafer from the vacuum chuck and place it into the aluminum pan, GaAs side up.
- 16.2.7 Place the pan into a 70°C oven for 30 minutes.
- 16.2.8 Bring the wafer to the K&S aligner.
- 16.2.9 Place the photo resist mask in the specified holder on the aligner.
- 16.2.10 Place the wafer on the vacuum chuck on the aligner and rotate it into position.
- 16.2.11 Clamp the mask to the wafer and expose the wafer for 10-12 seconds.

- 16.2.12 Remove the wafer from the aligner and place it on the vacuum chuck of the development station.
- 16.2.13 Spray develop the wafer for 30 seconds using I.C. developer.
- 16.2.14 Spray with Butylacetate for 30 seconds.
- 16.2.15 Spray the wafer dry.
- 16.2.16 Visually inspect the grid pattern under a microscope at 100X magnification to ensure the proper application of photo resist.
- 16.2.17 Bake the wafer in an oven set to 120°C for 30 minutes.

#### 17.0 GRID ETCH (MS-SP-110)

##### 17.1 Equipment and Materials

- 17.1.1 Beaker
- 17.1.2 Microscope 50X - 100X
- 17.1.3 Beaker (Pyrex 600 ml VWR 13912-240)
- 17.1.4 Thermometer (VWR 61013-040)
- 17.1.5 Water Cooling Bath (to fit beaker)
- 17.1.6 Magnetic Hot Plate and Stirrer (Thermolyne HPA 1915B)
- 17.1.7 Timer (Gralab 62371-001)
- 17.1.8 Sulphuric Acid (BA Electronic Grade 108-2679)
- 17.1.9 Hydrogen Peroxide (BA Electronic Grade 2775, 30% Stabilized - 109-6502)
- 17.1.10 D.I. Water (10 megohm min.)
- 17.1.11 Dry Nitrogen

##### 17.2 Procedure

- 17.2.1 Mix 90 cc sulphuric acid, 30 cc peroxide, and 30 cc water.



- 17.2.2 The solution when mixed will rise to a temperature of 100°C.
- 17.2.3 Cool the solution in a water bath to 35°C.
- 17.2.4 Pour the solution into the teflon-coated etching bath which is controlled with a magnetic stirrer.
- 17.2.5 Place the etching bath on a magnetic stirring hot plate. The hot plate is kept at 35°C.
- 17.2.6 Energize the magnetic stirrer and set it so that the currents are sent up through the holes in the teflon holder to help decrease the deviation caused during etching.
- 17.2.7 Wet the wafer with water and place it into the teflon holder in the area with no holes.
- 17.2.8 The etching time should be established by experimentation; e.g., 5:1:1 bath at 35°C etches 5 microns per minute.
- 17.2.9 During the 5-7 minutes of time that will be required to etch down to the platinum, continuously tap the edges of the wafer to release any bubbles that may collect at the surface and cause preferential etching.
- 17.2.10 The etching process can be visually monitored with the naked eye after the operator has gained some experience, or can be checked on a minute-to-minute basis under 50X to 100X magnification to determine when the grid is etched down to the platinum.
- 17.2.11 When the etching is complete, remove the wafer from the bath.
- 17.2.12 Rinse the wafer in D.I. water.
- 17.2.13 Blow the wafer dry using dry nitrogen.

## 18.0 STRIP PHOTORESIST (MS-SP-111)

### 18.1 Equipment and Materials

- 18.1.1 Tweezers (Dumont #3C Hub Material)

- 18.1.2 Beaker (Pyrex 150 ml - VWR 13912-182)
- 18.1.3 Microscope 100X
- 18.1.4 Timer (Gralab 62371-001)
- 18.1.5 Hot Plate (Thermolyne Type 1000 VWR)
- 18.1.6 A20 Stripping Solution (BA 186-2695)
- 18.1.7 D.I. Water (10 megohm min.)

## 18.2 Procedure

- 18.2.1 Heat a beaker of A20 stripping solution to 80°C.
- 18.2.2 Immerse the wafer into the A20 stripping solution for approximately 15 seconds.
- 18.2.3 Remove the wafer from the solution and rinse it in D.I. water.
- 18.2.4 Visually inspect the wafer to determine if additional stripping is necessary.
- 18.2.5 Repeat steps 18.2.2 through 18.2.4 until it appears that all photoresist has been stripped.
- 18.2.6 Verify that all photoresist has been removed by visual inspection with the aid of a 100X microscope.
- 18.2.7 If any residue photoresist is present, repeat steps 18.2.2 through 18.2.6.

## 19.0 GaAs ETCH III (MS-SP-112)

### 19.1 Equipment and Materials

- 19.1.1 Teflon Etching Pan
- 19.1.2 Microscope 50-400X with vertical measuring scale capable of one micron resolution.
- 19.1.3 Beaker (Pyrex 600 ml - VWR 13912-240)
- 19.1.4 Thermometer (VWR 61013-040)

- 19.1.5 Water Cooling Bath (size to hold beaker)
- 19.1.6 Magnetic Hot Plate and Stirrer (Thermolyne HPA 1915B VWR)
- 19.1.7 Timer (Gralab 62371-001)
- 19.1.8 Sulphuric Acid (Electronic Grade 108-2679 Allied Chemical)
- 19.1.9 Hydrogen Peroxide (Electronic Grade 109-6502 Allied Chemical)
- 19.1.10 D.I. Water (10 megohm min.)

## 19.2 Procedure

- 19.2.1 Mix 90 cc sulphuric acid, 30 cc peroxide, and 30 cc water.
- 19.2.2 The solution when mixed will rise to a temperature of 100°C.
- 19.2.3 Cool the solution in a water bath to 40°C.
- 19.2.4 Pour the solution into the teflon coated etching bath which is controlled with a magnetic stirrer.
- 19.2.5 Place the etching bath on a magnetic stirring hot plate. The hot plate is kept at 45°C.
- 19.2.6 Energize the magnetic stirrer and set it so that the currents are sent up through the holes in the teflon holder to help decrease the deviation caused during etching.
- 19.2.7 Wet the wafer with water and place it in the teflon holder in the area with no holes.
- 19.2.8 The etching time should be established by experimentation; e.g., 5:1:1 bath at 45°C etches 5 - 7 microns per minute. Check with the Production Engineer for the etching time required for the particular wafer being processed.
- 19.2.9 Monitor the etching by eye and continually move the slice in the etching bath to prevent surface bubbles from hampering the etch process.

- 19.2.10 If uneven etching is observed, the slice should be rinsed in D.I. water and slowly etched by having only those parts of the wafer that need etching dipped in the etching bath.
- 19.2.11 When etching is complete, rinse the wafer in running water.
- 19.2.12 Measure the pad height, using vertical measuring scale on microscope, in approximately three places to determine whether specifications have been met.

## 20.0 SPUTTER TOP CONTACT METALLIZATION (MS-SP-153)

- 20.1 See 3.0. Same procedure is utilized.

## 21.0 GOLD PLATE TOP CONTACT (MS-SP-118)

### 21.1 Equipment and Materials

- 21.1.1 Beaker (Pyrex 600 ml - VWR 13912-182)
- 21.1.2 Hot Plate (Thermolyne Type 1000 VWR)
- 21.1.3 Thermometer (VWR 61013-040)
- 21.1.4 Plating Equipment (Raytheon design)
- 21.1.5 Timer (Gralab 62371-001)
- 21.1.6 Wafer Holding Fixture (Raytheon design)
- 21.1.7 Plating Solution (Technic Orotemp 24)
- 21.1.8 D.I. Water (10 megohm min.)

### 21.2 Procedure

- 21.2.1 Pour 500 cc of Technic Orotemp 24 into a beaker.
- 21.2.2 Place the beaker on a hote plate and raise the temperature of the solution to  $65^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Maintaining proper temperature is very important.

- 21.2.3 Place the platinum electrode, which is connected to the power supply, into the solution.
- 21.2.4 Mount wafer back side down on black waxed glass slide. Allow to cure for 5 minutes.
- 21.2.5 Wet the wafer with water and place it in the standard holding fixture which is connected to the cathode of the power supply.
- 21.2.6 Immerse the wafer into the solution.
- 21.2.7 Adjust the current of the power supply to 15 milliamps.
- 21.2.8 Plate for 35-40 minutes making sure to rotate wafer 90° periodically to insure even plating.
- 21.2.9 After removing the wafer from the solution, a visual inspection under a microscope will help to determine whether adequate plating has been deposited.

## 22.0 PHOTO II (MS-SP-115)

### 22.1 Equipment and Materials

- 22.1.1 Tweezers (Dumont 3C Stainless Steel Hub Material)
- 22.1.2 Spinner (Headway)
- 22.1.3 Resist Bowl (Headway)
- 22.1.4 Spinner Chuck (Headway)
- 22.1.5 Oven (Blue M Stabil Therm 0-300°C)
- 22.1.6 Aligner (K&S Model 1383)
- 22.1.7 Microscope (Nikon Model 70919)
- 22.1.8 Developer Chuck (K&S)
- 22.1.9 Exposure Chuck (K&S)
- 22.1.10 Oven (Blue M Stabil Therm 0-300°C)
- 22.1.11 Resist (Shipley AZ-1350J)

- 22.1.12 Methylene Chloride (Electronic Grade 167-6410 Allied Chemical)
- 22.1.13 Aluminum Pan (size as appropriate)
- 22.1.14 Developer (Shipley AZ-1350)
- 22.1.15 D.I. H<sub>2</sub>O (10 megohm min.)

22.2 Procedure

- 22.2.1 Place wafer on Headway spinner vacuum chuck.
- 22.2.2 Spin wafer at 4000 RPM while slowly dropping methylene chloride on it for 30 seconds.
- 22.2.3 Spin Shipley Photoresist 1350J over the wafer at 2000 RPM.
- 22.2.4 Prebake the wafer for 15 minutes.
- 22.2.5 Place the appropriate contact mask in the aligner and the wafer in the chuck.
- 22.2.6 Align the wafer centered directly in the square pad of GaAs.
- 22.2.7 Expose the wafer for 25 seconds.
- 22.2.8 Develop the wafer in 50% 15/50 developer and 50% D.I. water for 45 seconds.
- 22.2.9 Allow wafer to dry.
- 22.2.10 Return the wafer to laboratory area.
- 22.2.11 Perform visual inspection using a 30X microscope. If resist is acceptable, proceed to next step.

23.0 GOLD ETCH (MS-SP-116)

23.1 Equipment and Materials

- 23.1.1 Tweezers (Dumont 3C Stainless Steel Hub Material)
- 23.1.2 Microscope (Nikon Model 70919)
- 23.1.3 Beaker (100 ml Pyrex 13910-165)

23.1.4 Conductor Etchant (C-35 Film Microelectronics Company)

23.1.5 D.I. H<sub>2</sub>O (10 megohm min.)

23.2 Procedure

23.2.1 Holding the wafer with tweezers, immerse it in C35 wafer etchant for approximately one minute. The immersion time varies according to the plated thickness. The usual method is to dip and withdraw at frequent intervals while observing the gold removal.

23.2.2 When the desired amount of gold has been removed, rinse the wafer in water.

23.2.3 Inspect the contact pad under a 30X microscope to determine that the desired size and conditions of gold etching has been achieved.

24.0 STRIP PHOTORESIST II (MS-SP-117)

24.1 Equipment and Materials

24.1.1 Tweezers (Dumont 3C Stainless Steel Hub Material)

24.1.2 Beaker (100 ml 13910-165 VWR)

24.1.3 Hot Plate (Thermolyne Model HP-A195B Type 1900)

24.1.4 Trichlorethylene (Electronic Grade 167-2787 Allied Chemical)

24.1.5 Stripping Solution (A-20 BA 186-2695)

24.1.6 Cotton Swabs (Puritan #205)

24.1.7 D.I. H<sub>2</sub>O (10 megohm min.)

24.2 Procedure

24.2.1 Spray the wafer with acetone for a period of five to ten seconds.

24.2.2 Rinse thoroughly in D.I. water.

24.2.3 Inspect the wafer under a 30X microscope to determine that the pad areas are clean of resist.

25.0 PRESPUTTER CLEAN (MS-SP-103)

25.1 Refer to 9.0. Same procedure is used.

26.0 SPUTTER ETCH BACK METALLIZATION (MS-SP-158)

26.1 Equipment and Materials

26.1.1 Materials Research Corp. Sputtering System  
(Model SES-8632)

26.1.2 Tweezers (Dumont 3C, Stainless Steel, non-  
magnetic Hub Material)

26.1.3 Argon Gas (99.98% Pure)

26.2 Procedure

26.2.1 Load wafers onto sputter etch station of the  
Materials Research Sputtering System.

26.2.2 Pump system down to a pressure of  $3 \times 10^{-6}$  torr.

26.2.3 Turn on sputter etch cooling water.

26.2.4 Set panel controls to sputter etch mode.

26.2.5 Bleed Argon gas into system until pressure  
rises to 7 microns.

26.2.6 Sputter etch for 6 minutes at 100 watts to remove  
200 Angstroms of platinum.

26.2.7 Vent system to atmospheric pressure and remove  
wafers.

27.0 PHOTO III (MS-SP-119)

27.1 Equipment and Materials

27.1.1 Tweezers (Dumont 3C Stainless Steel Hub Material  
Company)

27.1.2 Spinner (Headway)

27.1.3 Resist Bowl (Headway)



- 27.1.4 Spinner Chuck (Headway)
- 27.1.5 Oven (Blue M Stabil Therm 0-300°C)
- 27.1.6 Aligner (K&S Model 1383)
- 27.1.7 Microscope (Nikon Model 70919)
- 27.1.8 Developer Chuck (K&S)
- 27.1.9 Exposure Chuck (K&S)
- 27.1.10 Resist (Waycoat IC 802785)
- 27.1.11 Methylene Chloride (Electronic Grade 167-6410)
- 27.1.12 Aluminum Pan (size as appropriate)
- 27.1.13 Developer (Waycoat IC 802439)
- 27.1.14 N-Butyl Acetate (Electronic Grade 119-2659)
- 27.1.15 D.I. H<sub>2</sub>O (10 megohm)

27.2 Procedure

- 27.2.1 Place the wafer in a 100°C oven for five minutes.
- 27.2.2 Remove the wafer from the oven and move it to the photoresist area.
- 27.2.3 Spin Waycoat I.C. resist on the wafer at 3000 RPM for 20 seconds.
- 27.2.4 Place the wafer in a 70°C oven for thirty minutes.
- 27.2.5 Place the wafer on the aligner along with the appropriate wafer mask.
- 27.2.6 Align the mesa mask symmetrically around the contact pad.
- 27.2.7 Expose the wafer for 10 seconds.
- 27.2.8 Develop the wafer in Waycoat I.C. developer for 10 seconds; Butyl acetate for 25 seconds.
- 27.2.9 Return the wafer to the laboratory area.
- 27.2.10 Inspect the wafer using a 3X microscope.

28.0 GaAs MESA ETCH (MS-SP-120)

28.1 Equipment and Materials

- 28.1.1 Tweezers (Dumont 3C Stainless Steel - Sub Material)
- 28.1.2 Teflon Etching Bath
- 28.1.3 Thermometer (VWR 61013-040)
- 28.1.4 Timer (Gralab 62371-001)
- 28.1.5 100 ML Graduated Cylinder (VWR 24776-086 or equivalent)
- 28.1.6 Hot Plate (Thermolyne Type 1000 VWR)
- 28.1.7 Microscope (100X)
- 28.1.8 Sulphuric Acid  $H_2SO_4$  (Electronic Grade 108-2679 Allied Chemical)
- 28.1.9 Hydrogen Peroxide 30% Stabilized (Electronic Grade 109-6502 Allied Chemical)
- 28.1.10 D.I. Water (10 megohm min.)

28.2 Procedure

- 28.2.1 Mix: 1 part  $H_2O$  (pour into the beaker first)  
2 parts  $H_2O_2$  (pour into the beaker second)  
3 parts  $H_2SO_4$  (pour into the beaker third)

The solution when mixed will rise to a high temperature.

- 28.2.2 Cool the solution in water bath to 35°C.
- 28.2.3 Pour etching solution into the teflon etching bath which is controlled with a magnetic stirrer.
- 28.2.4 The hot plate is kept at 35°C.
- 28.2.5 Place the wafer into the etching bath in the area where there are no holes.
- 28.2.6 Adjust the magnetic stirrer and set it so that the currents are sent up through the holes in the teflon etching bath to help decrease the deviation caused during etching.

- 28.2.7 Etch the wafer and pad until they are exactly the size of the mesa mask which was used. Generally, the GaAs thickness of wafers 15-20 thick should take about 4-5 minutes to etch. The suggested method is to etch 1 minute, rinse in D.I. water, blow dry, and inspect under a microscope. Repeat as many times as necessary.
- 28.2.8 Rinse wafer in D.I. water thoroughly and blow dry.
- 28.2.9 Inspect the wafer under microscope to determine that the etching is complete.

29.0 STRIP PHOTORESIST (MS-SP-111)

- 29.1 See 11.0. Same procedure is used.

30.0 ELECTRICAL EVALUATION (MS-SP-156)

30.1 Equipment and Materials

- 30.1.1 Wentworth Labs. Multiprobe Station with X (Horiz) and Y (Vert) Axis Micrometers.
- 30.1.2 Baush and Lomb Microscope with 15X Optics
- 30.1.3 Tektronics Model 575 Transistor Curve Tracer
- 30.1.4 Boonton Electronics Capacitance vs Voltage Plotter with Model 52-9A Recorder, 72-B Capacitance Meter, and Model 16-B Ramp Generator
- 30.1.5 C vs V Plotting Paper M.F.E. Part #90059007
- 30.1.6 Digitec Model 2120 Multimeter
- 30.1.7 Tweezers (Dumont 3C, Stainless Steel)
- 30.1.8 Wafer Matrix Data Sheet
- 30.1.9 Wafer Characterization Sheet
- 30.1.10 Initial Wafer Thickness Sheet

## 30.2 Procedure

### 30.2.1 Calibration of C vs V Plotter.

- a. Place wafer holding fixture under probe and lower probe head so it sits just above holder.
- b. Press 3 power on buttons and allow recorder to warm up.
- c. Put selector switch on ramp in linear mode.
- d. Turn knob to Cal. 1 position and zero both the ramp and the recorder.
- e. Turn now to Cal. 2 position and set recorder on 1.0 pF/in scale.
- f. Switch capacitance meter to 1 pF scale and zero meter.
- g. Set variable knobs so that trace will fit on chart paper.
- h. Set ramp limit so that ramp will trace only up to desired voltage.
- i. Place mode selector on step and make one sample trace.

30.2.2 Place wafer on wafer holding fixture.

30.2.3 Locate diode which coincides with data box on the Matrix data sheet.

30.2.4 Lower probe head onto gold pad of diode.

30.2.5 Set probe station on scope and set curve tracer on 5 volt/div. scale and .2 ma/div. scale.

30.2.6 Apply voltage to the diode until breakdown is observed.

30.2.7 Read voltage at 1 ma position and enter that number into space provided on Matrix for  $V_B$ .

30.2.8 Switch probe station selector to  $C_0$  position, and set the capacitance meter on 30 pF scale.

30.2.9 Read the capacitance at 0 volts and enter that number on Matrix sheet box marked  $C_0$ .


- 30.2.10 Switch capacitance meter to 10 pF scale.
- 30.2.11 With ramp still in step mode, activate the recorder and make your C vs V plot.
- 30.2.12 When recorder reaches the end of its travel, it will stop at that predetermined voltage. This stop point was determined in step 30.2.1(h).
- 30.2.13 At this point, take the capacitance reading at that voltage and enter it into the Matrix box marked  $C_V$ .
- 30.2.14 Press the activate button again and reset the plotter back to 0 volts.
- 30.2.15 Remove the probe from that individual diode to the next designated diode on the Matrix chart.
- 30.2.16 Move the (X,Y) recorder zero upward so that the 2 traces will not overlap.
- 30.2.17 Mark the row # and diode # on each trace for traceability purposes.
- 30.2.18 Continue to trace each row on a separate sheet until entire wafer is probed.
- 30.2.19 After traces are completed, calculate all  $V^*$  measurements and place them in last remaining Matrix boxes.
- 30.2.20 After Matrix papers are complete, transfer information on  $V_B$ ,  $C_O$ ,  $C_V$ , and  $V^*$  on separate wafer characterization sheets and staple all sheets to the run sheet.
- 30.2.21 Return wafer to Production Engineer.

### 31.0 SPRAY DICING (MS-SP-157)

#### 31.1 Equipment and Materials

- 31.1.1 1000 ml Poly Beaker with Cover (VWR-13890-148 or equivalent)
- 31.1.2 Atomizing Nozzle (Type 1/8"G-PVC5)
- 31.1.3 Fittings for Nozzle and Recirculation Tubes (as required)

**WAFER CHARACTERISTICS MAP**  
**EPI SIDE DOWN**

	1	2	3	4	5	6	7	8	9	10
<b>9-1</b>	1									
	2									
	3									
	4									
	5									
	6									
	7									
	8									
	9									
<b>9-9</b>	10									

VBR \_\_\_\_\_

WAFER NO. \_\_\_\_\_

V\* \_\_\_\_\_

TYPE X: \_\_\_\_\_ K: \_\_\_\_\_

Cto \_\_\_\_\_

OPERATOR \_\_\_\_\_

Ctv \_\_\_\_\_

DATE \_\_\_\_\_

Cto/Ctv \_\_\_\_\_

	1	2	3	4	5	6	7	8	9	10
ROW 1	2-2	6-2	10-2	14-2	18-2	22-2	26-2	30-2	REF. COR.	
ROW 2	2-6	6-6	10-6	14-6	18-6	22-6	26-6	30-6		
ROW 3	2-10	6-10	10-10	14-10	18-10	22-10	26-10	30-10	34-10	38-10
ROW 4	2-14	6-14	10-14	14-14	18-14	22-14	26-14	30-14	34-14	38-14
ROW 5	2-18	6-18	10-18	14-18	18-18	22-18	26-18	30-18	34-18	38-18
ROW 6	2-22	6-22	10-22	14-22	18-22	22-22	26-22	30-22	34-22	38-22
ROW 7	2-26	6-26	10-26	14-26	18-26	22-26	26-26	30-26	34-26	38-26
ROW 8	2-30	6-30	10-30	14-30	18-30	22-30	26-30	30-30	34-30	38-30
ROW 9	2-34	6-34	10-34	14-34	18-34	22-34	26-34	30-34	34-34	38-34
ROW 10	2-38	6-38	10-38	14-38	18-38	22-38	26-38	30-38	34-38	38-38

**LEGEND**

1 (Column No.)

2-2	
$V_{Br}$	$C_{T_o}$
$V^*$	$C_{T_v}$

Diode #  
x=2, y=2

Wafer No. \_\_\_\_\_

Type: X: \_\_\_\_\_ Ku: \_\_\_\_\_ Other: \_\_\_\_\_

Operator: \_\_\_\_\_

Date: \_\_\_\_\_

- 31.1.4 Oscillating Pump with Variac Controller (VWR 54902-102 or equivalent)
- 31.1.5 Mounting Discs (Corning 25 mm square .006" Thick)
- 31.1.6 Clear Wax (Picolastic E-100)
- 31.1.7 Cotton Swabs (Puritan #205 or equivalent)
- 31.1.8 Knife (Exacto)
- 31.1.9 Resist (Shipley AZ-1350J)
- 31.1.10 Developer (Shipley AZ-1350)
- 31.1.11 Photoresist (Kodak PKP-1)
- 31.1.12 Hot Plate (Thermolyne HPA 1915B or equivalent)
- 31.1.13 Stoddard Solvent
- 31.1.14 Isopropyl Alcohol (Electronic Grade 119-2758 Allied Chemical)
- 31.1.15 Potassium Iodide (Resublimed Crystals) Type CB-1161
- 31.1.16 Iodine Crystals (Resublimed Crystals) Type CB-435
- 31.1.17 Stripping Solution (A-20 BA186-2695)
- 31.1.18 Trichlorethylene (Electronic Grade 157-2787 Allied Chemical)
- 31.1.19 Acetone (Electronic Grade 119-2750 Allied Chemical)

## 31.2 Procedure

- 31.2.1 Observe heat sink side of wafer to see that gold surface is clean and free from all surface contamination.
- 31.2.2 If stains appear on heat sink, mount face down on glass slide and etch and swab surface continually until surface is clean.
- 31.2.3 Prepare to mount wafer by placing a 1" square corning glass slide on the hot plate.



- 31.2.4 Heat for approximately 2 minutes while applying Picolastic E-100 wax evenly on the surface.
- 31.2.5 Gently place the wafer face down on the wax being careful not to trap any air bubbles under the wafer.
- 31.2.6 Depress with a Q-tip or other soft object until wafer is relatively flat, close to the slide with sufficient wax to protect but not obstruct alignment vision, and free from air bubbles.
- 31.2.7 Remove from heat, cool, and inspect for air bubbles under a microscope.
- 31.2.8 Proceed to scrape excess wax off of slide using exacto knife.
- 31.2.9 Boil some trichlor and gently swab gold surface until all wax is dissolved from gold.
- 31.2.10 If any wax remains on edges, the cutting effect of the gold etch crystals will be hampered.
- 31.2.11 Be careful not to dissolve wax under wafer while swabbing with the hot trichlor.
- 31.2.12 Rinse wafer with acetone, swab glass on both sides to prepare for Photo Step #1.
- 31.2.13 Place wafer gold side down on spinner chuck.
- 31.2.14 Apply two coats of Shipley 1350JAZ @ 4000 RPM for 30 seconds on the glass slide.
- 31.2.15 Place in aluminum dish and place in bake oven @ 75°C for 15 minutes.
- 31.2.16 Remove after 15 minutes, place on aligner and align 2 mil light field grid mask on the glass. Expose for 22 seconds.
- 31.2.17 Tank develop for 40 seconds in 1 part 1350 developer to 1 part D.I. water.
- 31.2.18 Rinse for 30 seconds in D.I. water.
- 31.2.19 Inspect alignment on microscope by focusing down through the glass slide to the front side of the wafer.

31.2.20 If alignment is satisfactory, proceed to Photo II.

Photoresist Step #2

31.2.21 Prebake wafer for 5-10 minutes @ 75°C.

31.2.22 Place glass slide on chuck so that heat sink side is facing upwards.

31.2.23 Spin 1 coat of PKP photoresist @ 4000 RPM for 30 seconds on surface of wafer.

31.2.24 Place in aluminum dish and prebake for 30 minutes @ 75 C.

31.2.25 Remove from oven, place same mask used in Photo I and align both grids using the areas around the edge of the glass mounting slide for focus.

31.2.26 Once aligned, expose for 10 seconds. Develop for 1 minute by spraying Stoddard solvent on the wafer. Rinse for 1 minute using Isopropyl Alcohol.

31.2.27 Post bake for 1 hour @ 100°C.

Etching Technique

Gold etch mixture instructions:

Combine: 63.0 grams of KI crystals, 96.25 grams of Iodide crystals, 350 ml of D.I. water. Mix in large beaker on Magnister hot plate, and let sit overnight at room temperature.

31.2.28 Place gold etch solution in holding tank and turn on pump for approximately 2 minutes to circulate etchant through tubing.

31.2.29 Add additional etchant if needed.

31.2.30 Place wafer on holder inside of beaker and begin the etching cycle.

31.2.31 Time required to cut through the gold will depend on gold thickness, and freshness of etch. Typically, a 2.1 mil wafer will etch in 3-1/2 minutes.

- 31.2.32 Remove when etching is completed, rinse in D.I. water, and dry.
- 31.2.33 Spray glass slide with acetone to remove all Shipley photoresist.
- 31.2.34 Heat some A-20 photoresist stripper to approximately 75°C.
- 31.2.35 Dip wafer in A-20 for approximately 2 minutes to remove PKP resist.
- 31.2.36 Rinse in D.I. water; dry with nitrogen.
- 31.2.37 Place wafer in beaker of hot trichlor and boil until individual dice begin to fall off of glass slide.
- 31.2.38 Change the trichlor 2 times and continue boiling until dice are clear of all wax.
- 31.2.39 Rinse chips in acetone.
- 31.2.40 Boil in transene for approximately 5 minutes. Decant the transene. Dry chips and store in clean petri dish.

## SECTION II-C

### DIODE ASSEMBLY & TEST PROCESS

The flow chart MS-FC-013 shown in Figure IIC-1 describes the sequence of operations for diode assembly and test. A detailed process description for each of the steps follows. The parts drawings are included following the process description.

#### 1.0 INSPECT DICE (MS-SP-123)

##### 1.1 Equipment and Material

1.1.1 Microscope (Bausch & Lomb (Stereozoom @ 20X).

##### 1.2 Procedure

1.2.1 With the aid of a 200X microscope, visually inspect the following:

- 1.2.1.1 Mesa must be centered in the center of the chip within  $\pm 0.005$ .
- 1.2.1.2 There must be no cracks on chips.
- 1.2.1.3 There must be no evidence of residual photoresist.
- 1.2.1.4 There must be no evidence of previous plating.
- 1.2.1.5 No hanging gold is allowed.
- 1.2.1.6 Ensure that the gold dots are intact and round.
- 1.2.1.7 Inspect dimensions per drawing for applicable part. When indicated on drawing for individual part, identify collet size to be used in die mounting. Enter collet size on run sheet.

#### 2.0 MOUNT DICE (MS-SP-185)

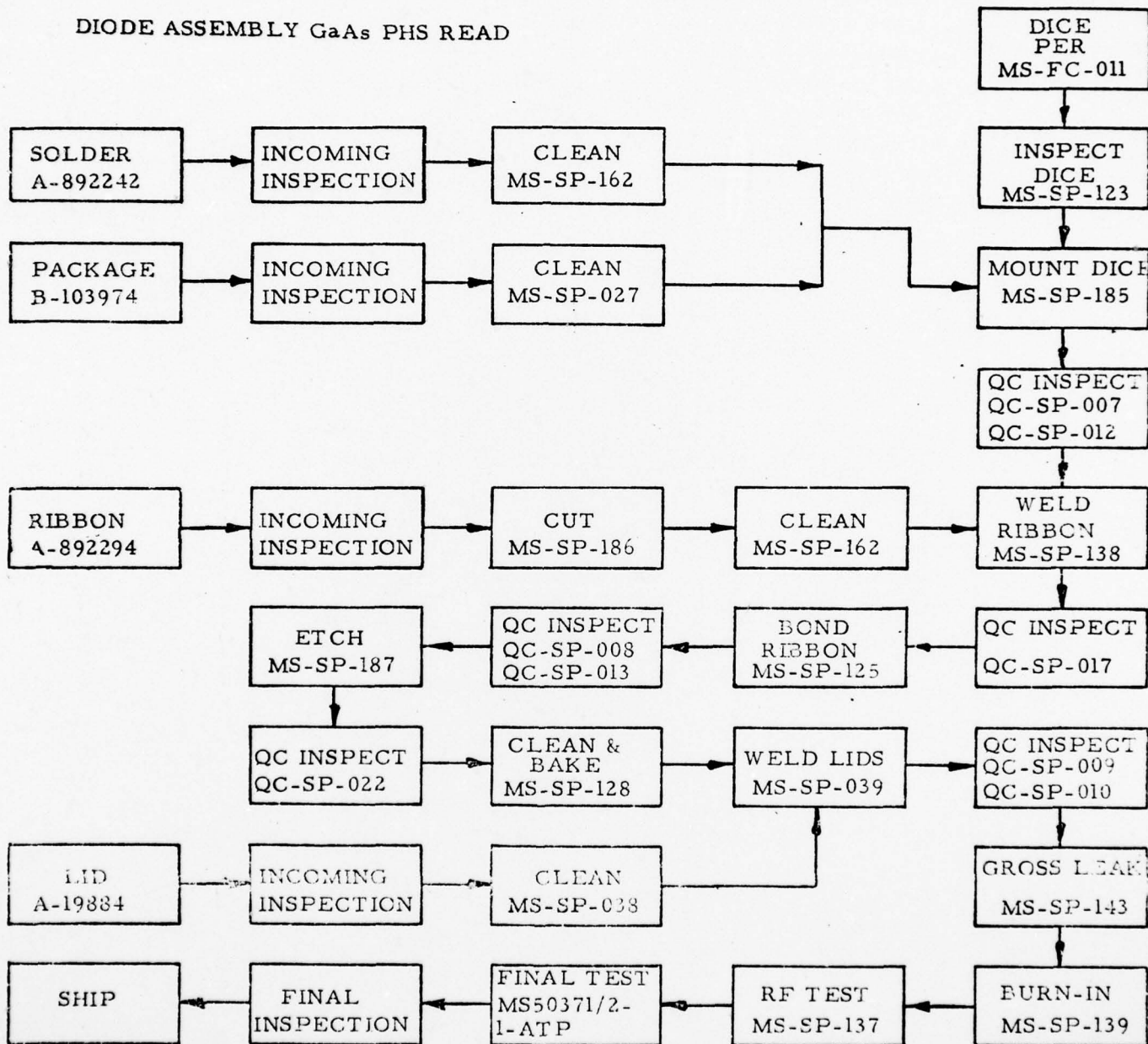
##### 2.1 Equipment and Materials

2.1.1 Microscope 10X Power.

RAYTHEON COMPANY  
S M D O  
FLOW CHART

REV.	APPROVAL/DATE
0	<i>Adolfson</i> 7/1/77

DIODE ASSEMBLY GaAs PHS READ



REVISION NO. 0	PROCESS	SHEET 1 OF 1
First Issue	MS-FC-013	Figure IIC-1
Eng. App.	<i>[Signature]</i>	Date
Mfg. App.	<i>[Signature]</i>	Date 7/1/77
Q. C. App.	<i>[Signature]</i>	Date 7/1/77

- 2.1.2 Microscope Light No. 31-33-53.
- 2.1.3 Mech-El Hot Gas Die Bonder Model 701HG.
- 2.1.4 Tweezers, Dumont 3C, S.S., Non-magnetic.
- 2.1.5 Needle Holder, Howe & French 30-090.
- 2.1.6 Vacuum Pump - Central System.
- 2.1.7 Model 604 Die Collets with Pocket Sizes (.016 x .016 to .022 x .022)- Drawing A-892297.
- 2.1.8 Model 604 Die Collet A-892296.
- 2.1.9 Aluminum Carrying Tray - 25 Positions.
- 2.1.10 Gummed Labels, Type Avery S508.
- 2.1.11 Plastic Box, Type Creative Packing Co. 125-01-000.
- 2.1.12 Micro-Wipes, Type 05310.
- 2.1.13 Liquinox Cleaning Solution.
- 2.1.14 De-ionized Water (10 megohm min.).
- 2.1.15 Acetone (Electronic Grade #119-2750, Allied Chemical).
- 2.1.16 Dice as specified by Flowchart MS-FC-011.
- 2.1.17 80 Au/20 Sn Solder Discs, Drawing A-892242.
- 2.1.18 Packages B-103974.

## 2.2 Safety

- 2.2.1 Bonder/hot gas reservoir and hot stage are set to 400<sup>o</sup> and 250<sup>o</sup>C respectively, and care should be used to prevent burns.

## 2.3 Procedure

- 2.3.1 Set hot gas reservoir temperature to about 400<sup>o</sup>C or 62% on the dial.
- 2.3.2 Set hot stage temperature to about 250<sup>o</sup>C or 475 on the dial.
- 2.3.3 Set forming gas pressure to 25 lbs.

- 2.3.4 Turn on vacuum pump.
- 2.3.5 Insert proper die collet (see run sheet and A-892297).
- 2.3.6 Set the weight on the bonding area to 40 gr.
- 2.3.7 Place chips and preforms onto the mirror plate.
- 2.3.8 Place package on the hot stage.
- 2.3.9 Using a filter paper directly under the die collet, check the location of hot spot. (The burnt spot should be around the edges of die collet).
- 2.3.10 Pick up preform with the die collet and place it in the center of the package.
- 2.3.11 Pick up chip and place it on the preform.
- 2.3.12 With the die collet held down, step on foot switch that turns on the hot gas.
- 2.3.13 As soon as the solder melts, scrub the chip with a slight circular motion of the collet linkage arm.
- 2.3.14 Release foot switch and die collet, remove the package and repeat steps 2.3.10 thru 2.3.14 for the balance of the lot.

### 3.0 CLEAN SOLDER (MS-SP-162)

#### 3.1 Equipment and Material

- 3.1.1 Hot Plate SGA-H-3235.
- 3.1.2 Pyrex Beaker 20 ml SGA-B-3873-5(2).
- 3.1.3 Petri dish and cover.
- 3.1.4 Tweezers, Dumont Dumoxel #3C, stainless steel, non-magnetic.
- 3.1.5 Trichlorethylene (Electronic Grade #167-2787). Allied Chemical).
- 3.1.6 Acetone (Electronic Grade #119-270, Allied Chemical).
- 3.1.7 De-ionized water (10 megohms min.).
- 3.1.8 Nitrogen gas (Central System).

### 3.2 Procedure

- 3.2.1 Fill one-half a 250 ml beaker with trichlorethylene.
- 3.2.2 Add parts to be cleaned.
- 3.2.3 Place beaker on hot plate and boil for 5 minutes.
- 3.2.4 Place beaker in ultrasonic bath for 30 seconds at full power.
- 3.2.5 Repeat Steps 3.2.1 thru 3.2.4 two more times.
- 3.2.6 Rinse in acetone two times and dry under nitrogen gas.
- 3.2.7 Rinse completely in running deionized water for ten minutes.
- 3.2.8 Fill a 250 ml beaker with acetone (use separate beakers for acetone and trichlorethylene).
- 3.2.9 Soak parts approximately 30 seconds.
- 3.2.10 Repeat Steps 3.2.7 thru 3.2.9.
- 3.2.11 Dry parts with nitrogen gas.
- 3.2.12 Place parts in petri dish and cover and store in dry box of welder.

## 4.0 CLEAN PACKAGE (MS-SP-027)

### 4.1 Equipment and Material

- 4.1.1 Ultrasonic-bath-Bronson Ultrasonic cleaners, Model LG40, Serial #178.
- 4.1.2 200 ml Pyrex beakers SGA B-3875-5.
- 4.1.3 Tweezers Dumont Dumoxel #3C, stainless steel or equivalent.
- 4.1.4 Trichlorethylene (Electronic Grade #167-2787, Allied Chemical).
- 4.1.5 Sulphuric acid (Electronic Grade #108-2679, Allied Chemical).
- 4.1.6 Acetone (Electronic Grade #119-2750, Allied Chemical).



4.1.7 Deionized water (10 megohm min.).

4.1.8 Nitrogen.

4.1.9 Package B-103974.

4.2 Procedure

4.2.1 Pour trichlorethylene (TCE) in beaker.

4.2.2 Place parts to be cleaned in TCE.

4.2.3 Place beaker in ultrasonic bath.

4.2.4 Rinse 30 seconds and decant.

4.2.5 Repeat steps 4.2.1 through 4.2.4 two more times. Then dry units under nitrogen gas.

4.2.6 Fill 200 ml beaker approximately 1/3 full with deionized water.

4.2.7 Add sulphuric acid until beaker is about 2/3 full. This results in approximately 50% acid/water solution.

4.2.8 Place parts in solution.

4.2.9 Soak 10 minutes in acid solution and decant.

4.2.10 Rinse completely in running deionized water for 10 minutes and decant.

4.2.11 Fill beaker with acetone.

4.2.12 Rinse parts approximately 30 seconds and decant.

4.2.13 Repeat steps 4.2.11 and 4.2.12.

4.2.14 Dry parts with nitrogen.

4.2.15 Identify parts with gummed label and place parts in plastic box.

4.2.16 Proceed to next operation or store in inventory cabinet.

5.0 CUT GOLD RIBBON (MS-SP-186)

5.1 Equipment and Material

- 5.1.1 Tweezers, Dumont, 3C, stainless steel, non-magnetic.
- 5.1.2 Razor blades, single edge industrial.
- 5.1.3 Filter paper SGA-F-2650.
- 5.1.4 Finger Cots.
- 5.1.5 Gold ribbon A-892294.

5.2 Procedure

- 5.2.1 Unroll several inches of gold ribbon from the spool.
- 5.2.2 By holding the free end with a tweezer, tighten the ribbon against a mound of filter paper.
- 5.2.3 Cut 200 mil lengths pieces by using a sharp razor blade.
- 5.2.4 Do not handle the gold ribbon with bare fingers. Use finger cots.

6.0 CLEAN GOLD RIBBON (MS-SP-162)

6.1 Equipment and Material

- 6.1.1 Hot plate SGA-H-3235.
- 6.1.2 Pyrex beaker 20 ml SGA-B-3873-5(2).
- 6.1.3 Petri dish and cover.
- 6.1.4 Tweezers, Dumont Dumoxel #3C, stainless steel, non-magnetic.
- 6.1.5 Trichlorethylene (Electronic Grade #167-2787, Allied Chemical).
- 6.1.6 Acetone (Electronic Grade #119-270, Allied Chemical).
- 6.1.7 Deionized water (10 megohms min.).
- 6.1.8 Nitrogen gas (central system).

6.2 Procedure

- 6.2.1 Fill one-half a 250 ml beaker with trichlorethylene.

- 6.2.2 Add parts to be cleaned.
- 6.2.3 Place beaker on hot place and boil for 5 minutes.
- 6.2.4 Place beaker in ultrasonic bath for 30 seconds at full power.
- 6.2.5 Repeat Steps 6.2.1 thru 6.2.4 two more times.
- 6.2.6 Rinse in acetone two times and dry under nitrogen gas.
- 6.2.7 Rinse completely in running deionized water for ten minutes.
- 6.2.8 Fill a 250 ml beaker with acetone (use separate beakers for acetone and trichlorethylene).
- 6.2.9 Soak parts approximately 30 seconds.
- 6.2.10 Repeat Steps 6.2.7 thru 6.2.9.
- 6.2.11 Dry parts with nitrogen gas.
- 6.2.12 Place parts in petri dish and cover and store in dry box of welder.

## 7.0 WELD RIBBON (MS-SP-138)

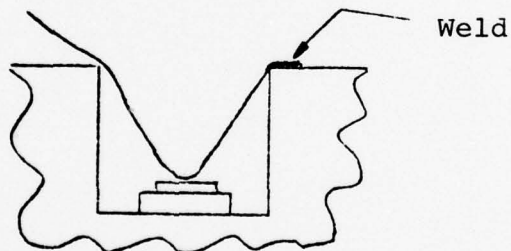
### 7.1 Equipment and Material

- 7.1.1 Unitek welder Model 1-128-01.
- 7.1.2 Unitek Weldmatic Head.
- 7.1.3 Unitek electrode 13-003-04-20.
- 7.1.4 Microscope Stereo Zoom 7X to 30X.
- 7.1.5 Tweezers Dumont 3C, non-magnetic, stainless steel.
- 7.1.6 Needle tip in pin vise.
- 7.1.7 Gold wire.

### 7.2 Procedure

- 7.2.1 Set the welder as follows:
  - 7.2.1.1 Power setting - 10 watts/second.

- 7.2.1.2 Meter setting - 12 watt/second.
- 7.2.1.3 Pulse -1
- 7.2.2 Set the weldmatic head pressure to 3 lbs.
- 7.2.3 Place the diode package into the weldmatic holder (base).
- 7.2.4 Pick up a precut gold wire ribbon (1/4" long) with the tweezers and place it across the package flange centered over the mesa.
- 7.2.5 Depress the foot pedal causing the weldmatic head electrode to move down and weld the ribbon to the flange opposite the operator.
- 7.2.6 After the weld has been completed, use tweezers to break away the excess gold ribbon.
- 7.2.7 Using the needle pin vise, push the gold wire into the package to form a loop resembling a "V". The lowest part of the "V" must be positioned just over the mesa and must not make contact with any other part of the chip.



- 7.2.8 Rotate the package 180° such that the unwelded flange is opposite the operator.
- 7.2.9 Depress the foot pedal to weld the ribbon to the flange.
- 7.2.10 Using the tweezers, break away the excess gold ribbon.
- 7.2.11 Rotate the package 90° and install the second gold ribbon by following steps 7.2.4 thru 7.2.10.

## 8.0 BOND RIBBON (MS-SP-125)

### 8.1 Equipment and Material

- 8.1.1 Mech-El Bonder Model Tacker 700.
- 8.1.2 Tungsten carbide bonding wedge.
- 8.1.3 Stainless steel tweezers, 3C Dumont, non-magnetic.
- 8.1.4 B&L Zoom microscope, 60X power.
- 8.1.5 Precision indicating pyrometers (2).

### 8.2 Procedure

- 8.2.1 Set the base heater dial to  $350^{\circ}\text{C}$  and the tip dial to 6.
- 8.2.2 Wait until the indicating pyrometer for the tip reads  $450^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and the indicating pyrometer for the base reads  $200^{\circ}\text{C} \pm 20^{\circ}\text{C}$ .
- 8.2.3 Place the unit to be bonded into the hole provided in the heated base.
- 8.2.4 Rotate the unit until the chip is square facing you and the bottom wire is horizontal.
- 8.2.5 Move the probe down into the package and push the ribbons into alignment in center of mesa.
- 8.2.6 Bond the ribbon.
- 8.2.7 Remove the package from the holder and place it into the tray.

## 9.0 DIODE ETCH (MS-SP-187)

### 9.1 Equipment and Material

- 9.1.1 Boonton capacitance bridge, Model 750.
- 9.1.2 Multimeter Fairchild Model 7050 or equivalent.
- 9.1.3 Capacitance fixture.
- 9.1.4 Hot plate thermolyne HP 2305B.
- 9.1.5 Tweezers, 3C stainless steel, Dumont, non-magnetic.

- 9.1.6 Deionized water circulator stand.
- 9.1.7 Tektronix curve tracer Model 575.
- 9.1.8 Power supply Kepco Model #HB-2M.
- 9.1.9 Kodak timer.
- 9.1.10 Deionized water (10 megohm).
- 9.1.11 Sulphuric acid - BA Electronic Grade 108-2079.

9.2 Procedure

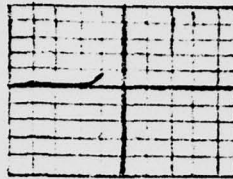
- 9.2.1 Mix 60 cc of sulphuric acid, 20 cc of hydrogen peroxide and 20 cc DI water.
- 9.2.2 The solution when mixed will rise to a temperature of 100°C.
- 9.2.3 Cool the solution in a water bath to 40°C.
- 9.2.4 Set the hot plate temperature to about 110°C.
- 9.2.5 Set the curve tracer vertical sensitivity to 10 mA/div and the horizontal sensitivity according to:

Device	Horizontal Sensitivity
MS-925 MS-50371	10V/div.
MS-927 MS-928 MS-50372	5V/div.

- 9.2.6 Set the trace dot on the extreme right vertical line and center horizontal line.
- 9.2.7 Pick up a diode, using tweezers, and place in the curve tracer fixture.
- 9.2.8 Apply 50 mA (5 divisions) of avalanche current through the diode for about 3 seconds.



- 9.2.9 Decrease current to about one quarter of a division, read, record the breakdown voltage at this "knee" of the curve.



- 9.2.10 Place diode in capacitance jig, measure and record, and compare the capacitance at  $V_R$  according to:

<u>Device</u>	$V_R$ <u>Volts</u>	$C_T @ V_R$
MS-50371	25	1.7-2.0
MS-50372	10	1.6-1.8

- 9.2.11 If the capacitance is above specification, hold the diode under D.I. water circulator for 5 seconds.
- 9.2.12 Immerse wet unit into the etching solution while constantly agitating (air bubbles escaping the package is an indication of etchant getting into the package, hence to the diode).
- 9.2.13 Etching time is established experimentally. It depends on the original capacitance and also etching history. The closer the capacitance is to spec. the faster the etch rate.
- 9.2.14 After etching, rinse diode under flowing D.I. water for 15-20 seconds.
- 9.2.15 Blot dry on filter paper.
- 9.2.16 Place unit on hot plate for 15-20 seconds.
- 9.2.17 Read and record  $C_T @ V_R$ .
- 9.2.18 If needed, repeat steps 9.2.10 to 9.2.15 varying the etch time as necessary until  $C_T @ V_R$  meets specification.
- 9.2.19 When lot is completed, proceed without delay to the next step.

## 10.0 STABILIZATION BAKE (MS-SP-128)

### 10.1 Equipment and Material

- 10.1.1 Ultrasonic cleaner, Sonogen Model LG40.
- 10.1.2 Beaker (600 ml Pyrex #13912-240 VWR).
- 10.1.3 Vacuum oven Blue M Model 1555.
- 10.1.4 Aluminum holding tray.
- 10.1.5 100 position diode tray.
- 10.1.6 Aluminum foil.
- 10.1.7 Sink.
- 10.1.8 Demineralized water (15 megohms min.).
- 10.1.9 Acetone (Electronic Grade #119-2750, Allied Chemical).
- 10.1.10 Trichlorethylene (Electronic Grade #167-2787, Allied Chemical).

### 10.2 Procedure

- 10.2.1 Clean the diode tray by boiling in trichlorethylene followed by a rinse in acetone then rinse in demineralized water.
- 10.2.2 Place diodes into the tray, then place the tray into a clean beaker.
- 10.2.3 Fill the beaker with demineralized water and agitate ultrasonically for 5 seconds. Decant.
- 10.2.4 Place the beaker in a sink which has demineralized water available.
- 10.2.5 Insert the tubing from the demineralized water supply into the beaker.
- 10.2.6 Cover the beaker with aluminum foil.
- 10.2.7 Turn the water on at a moderate flow rate. As the beaker fills, allow the excess to spill into the sink.
- 10.2.8 Maintain this flow for 30 minutes.



- 10.2.9 Pour off water and rinse with acetone.
- 10.2.10 Preheat the vacuum oven to 175°C.
- 10.2.11 Remove the units from the beaker and allow to dry.
- 10.2.12 Place the units in an aluminum holding tray and place the tray into the oven as quickly as possible.
- 10.2.13 Close the vent, open the vacuum lever and activate the pump.
- 10.2.14 Allow the pump to run for 10 minutes, then turn it off and allow the units to sit under vacuum for 30 minutes.
- 10.2.15 Turn off the temperature switch on the oven and open the vent to allow the oven to return to atmospheric pressure.
- 10.2.16 Move the units to the hermetic sealing area of the dry box.

#### 11.0 CLEAN LIDS (MS-SP-038)

##### 11.1 Equipment and Material

- 11.1.1 Hot plate SGA-H-3235.
- 11.1.2 Pyrex beaker 20 ml SGA-B-3873-5(2).
- 11.1.3 Petri dish and cover.
- 11.1.4 Tweezers, Dumont Dumoxel #3C, stainless steel, non-magnetic.
- 11.1.5 Trichlorethylene (Electronic Grade #167-2787, Allied Chemical).
- 11.1.6 Acetone (Electronic Grade #119-270, Allied Chemical).
- 11.1.7 Deionized water (10 megohms min.).
- 11.1.8 Nitrogen gas (central system).

##### 11.2 Procedure

- 11.2.1 Fill one-half of a 250 ml beaker with trichlorethylene.
- 11.2.2 Add parts to be cleaned.

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MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING HIGH-EFFICIENC--ETC(U)  
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- 11.2.3 Place beaker on hot plate and boil for 5 minutes.
- 11.2.4 Place beaker in ultrasonic bath for 30 seconds at full power.
- 11.2.5 Repeat Steps 11.2.1 thru 11.2.4 two more times.
- 11.2.6 Rinse in acetone two times and dry under nitrogen gas.
- 11.2.7 Rinse completely in running deionized water for ten minutes.
- 11.2.8 Fill a 250 ml beaker with acetone (use separate beakers for acetone and trichlorethylene).
- 11.2.9 Soak parts approximately 30 seconds.
- 11.2.10 Repeat Steps 11.2.7 thru 11.2.9.
- 11.2.11 Dry parts with nitrogen gas.
- 11.2.12 Place parts in petri dish and cover and store in dry box of welder.

## 12.0 WELD LIDS (MS-SP-039)

### 12.1 Equipment and Material

- 12.1.1 Sealing electrodes, Raytheon Drawing ES-19515 and ES-19516.
- 12.1.2 Thomson AC welder with nitrogen dry box.
- 12.1.3 Timer, Kodak.
- 12.1.4 Tweezers, #3C Dumont, stainless steel, non-magnetic.
- 12.1.5 Five dummy packages.

### 12.2 Procedure

- 12.2.1 Verify dew point and proceed if less than -60.
- 12.2.2 Place bottom electrode in bottom electrode holder and screw holding nut hand tight.
- 12.2.3 Place upper electrode in upper holder and screw holding nut hand tight.

- 12.2.4 Turn Robotron control switch to "off" and turn all other electrical switches to "On".
- 12.2.5 Turn electrode cooling water valve on.
- 12.2.6 Adjust the setting to the values specified in process variables for type desired.
- 12.2.7 Place dummy package in bottom electrode with flange up.
- 12.2.8 Place a cover on the package with projection ring down.
- 12.2.9 Check seating.
- 12.2.10 Turn pressure regulator to 0 pounds pressure.
- 12.2.11 Press the two lowering switches simultaneously to activate downward motion of upper electrode.
- 12.2.12 Slowly increase pressure to bring upper electrode down onto cover (approximately 2 psi) and check for level contact.
- 12.2.13 Press electric discharge switch to raise upper electrode.
- 12.2.14 Repeat Step 12.2.12 two more times to verify contact.
- 12.2.15 Set pressure to 15 pounds.
- 12.2.16 Turn "weld-no-weld" switch to weld.
- 12.2.17 Repeat Step 12.2.11.
- 12.2.18 Wait five seconds.
- 12.2.19 Repeat Step 12.2.13.
- 12.2.20 Remove welded unit from electrode and place in aluminum tray.
- 12.2.21 Repeat Steps 12.2.7, 12.2.8, 12.2.9, 12.2.11, 12.2.18, 12.2.19, and 12.2.20.
- 12.2.22 Remove five dummy packages from welder and submit to Q.C. for gross leak test.
- 12.2.23 Upon approval, proceed to weld available material according to Step 12.2.21.
- 12.2.24 Proceed to next operation or store in inventory cabinet.

13.0 GROSS LEAK TEST (MS-SP-143)

13.1 Equipment and Material

- 13.1.1 Pressure bomb with tray.
- 13.1.2 200 ml beaker (SGA-B-3873-5 or equivalent).
- 13.1.3 100 ml beaker (SGA-B-3873-5 or equivalent).
- 13.1.4 Thermometer,  $-20^{\circ}\text{C}$  to  $+150^{\circ}$  (SGA-T-3291 or equivalent).
- 13.1.5 Microscope, Baush & Lomb @ 20X.
- 13.1.6 Tweezers, Dumont #3C, or equivalent.
- 13.1.7 Paper towels.
- 13.1.8 Hot plate (SGA-H-3235 or equivalent).
- 13.1.9 FC-78 Fluorocarbon Solution 3M Inc.
- 13.1.10 FC-43 Fluorocarbon Solution 3M Inc.

13.2 Procedure

- 13.2.1 Place diodes to be tested into 200 ml beaker.
- 13.2.2 Pour enough FC-78 solution into beaker to completely cover packages in liquid.
- 13.2.3 Place beaker into pressure bomb and seal.
- 13.2.4 Apply air pressure of 70-80 psi. Allow diodes to remain two hours minimum.
- 13.2.5 Pour FC-43 solution into 100 ml beaker until approximately  $\frac{3}{4}$  full.
- 13.2.6 Place beaker on hot plate under microscope.
- 13.2.7 Heat to  $125 \pm 5^{\circ}\text{C}$ .
- 13.2.8 Close air pressure valve.
- 13.2.9 Open exhaust valve and allow vessel to reach atmospheric pressure.
- 13.2.10 Open bomb and remove beaker.
- 13.2.11 With tweezers, remove diode from FC-78 solution.

- 13.2.12 Blot on paper towel to remove excess FC-78 on outside of package.
- 13.2.13 Lower diode into FC-43 solution.
- 13.2.14 Observe diode in solution through microscope (microscope should be prefocused to location of diode). If a continuous stream of bubbles emanate from diode, this indicates a gross leak.
- 13.2.15 Repeat Steps 13.2.11 thru 13.2.14 for all diodes to be tested.
- 13.2.16 Record results on run sheet.

14.0 BURN-IN (MS-SP-139)

14.1 Equipment and Material

- 14.1.1 Oven, Blue M OV-490 or equivalent.
- 14.1.2 Thermometer, 0-200°C.
- 14.1.3 Pyrex Tray
- 14.1.4 Asbestos gloves.
- 14.1.5 12" x 12" x 1/4" aluminum cooling plate.

14.2 Procedure

- 14.2.1 Turn on oven and set per Table 1.
- 14.2.2 Place diodes in Pyrex tray and place tray in oven.
- 14.2.3 Enter start date and time on run sheet.
- 14.2.4 Allow to remain in oven per Table 1.
- 14.2.5 Using asbestos gloves, remove tray and place on cooling plate on bench.
- 14.2.6 Enter date and time on run sheet.

Table 1

MS-50399	155 ±5°C 24-72 hours
MS-50371/2	203 ±3°C 168 hours minimum

15.0 RF TEST (MS-SP-137)

15.1 Equipment

15.1.1 Test setup per MS-50371/2-1-ATP.

15.2 Procedure

15.2.1 Select appropriate test setup based on frequency band of unit to be tested.

15.2.2 Install diode into test cavity.

15.2.2.1 Remove the chuck from the block.

15.2.2.2 If the diode to be tested is threaded, screw it into the chuck hand tight. Using a small screwdriver through the center of the chuck, further tighten the diode.

15.2.2.3 If the diode is not threaded, use appropriate chuck and simply fit the diode in place.

15.2.2.4 Assemble the RF choke, nylon nut and screw together as one assembly.

15.2.2.5 Screw the chuck (with diode installed) into the block finger tight.

15.2.2.6 Install the R.F. choke assembly into the block but do not tighten.

15.2.2.7 Slide the hat through the waveguide opening and seat it on the diode or screw it into the R.F. choke, depending upon which style hat is being used.

15.2.2.8 Hand tighten the nylon nut to ensure good electrical contact between the diode and the hat.

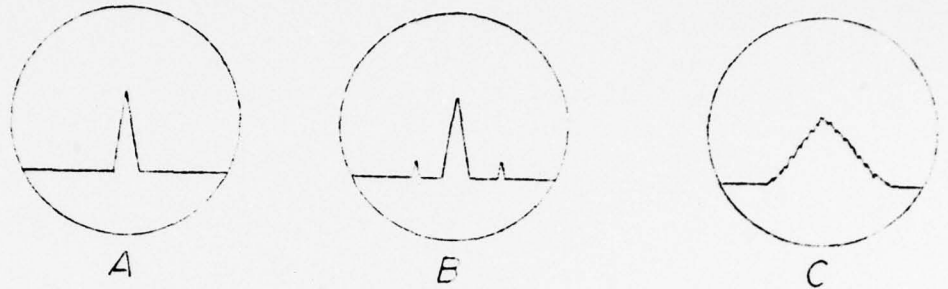
15.2.3 Install the test cavity into the microwave test setup.

15.2.4 Connect the clip lead to the terminal on top of the cavity.

15.2.5 Turn the D.C. power supply up to 1 ma and record the voltage. This is "Breakdown Voltage" at 1 ma.

15.2.6 Increase the output of the D.C. power supply until 20 ma is attained.

- 15.2.7 Vary the adjustable short circuit for maximum output power as monitored on the power meter and spectrum analyzer.



- 15.2.7.1 Figure 1A is a typical spectrum indicating that the diode is operating properly.
- 15.2.7.2 Figure 1B indicates that the adjustable short circuit is not tuned properly or the hat selected at Step 15.2.2.7 is too large. Adjust the short circuit and/or try a smaller hat size until a display similar to Figure 1A is attained.
- 15.2.7.3 Figure 1C indicates that the hat size is too small. Try a larger hat size until a display similar to Figure 1A is attained. Caution: Continued operation with a bad spectrum will lead to diode failure.
- 15.2.8 If the diode does not oscillate at 20 ma, increase the output of the D.C. power supply to 40 ma and repeat Steps 15.2.6 and 15.2.7.
- 15.2.9 Determine the frequency of the oscillation by using the wavemeter to find the null as indicated on the power meter. The null is the furthest deflection to the left of the power meter needle.
- 15.2.10 Read the frequency of the null directly from the wavemeter and record it on the Diode Evaluation Record 39-1555.
- 15.2.11 After taking the reading, change the wavemeter to some lower frequency setting.



- 15.2.12 Record the power voltage and current on data sheet.
- 15.2.13 Adjust the spectrum analyzer until the spike is displayed in the center of the scope.
- 15.2.14 Increase the D.C. power supply 20 ma and tune the adjustable short circuit for maximum power output as monitored on the power meter and spectrum analyzer.
- 15.2.15 Repeat Steps 15.2.9 thru 15.2.13.
- 15.2.16 Repeat Steps 15.2.1 and 15.2.1 increasing in 20 ma steps until maximum power is attained.
- 15.2.17 Turn the D.C. power supply down to zero.
- 15.2.18 Remove the test cavity from the waveguide system.
- 15.2.19 Remove the diode from the test cavity.

## 16.0 FINAL TEST

### 16.1 Materials

- 16.1.1 Acceptance Test Procedure MS-50371/2-1-ATP (Section IID).
- 16.1.2 Diode Specification.

### 16.2 Procedure

- 16.2.1 Consult diode specification for sequence of testing to be performed.
- 16.2.2 Perform testing in accordance with procedure as specified in acceptance test procedure.

SECTION II-D

DRAWINGS

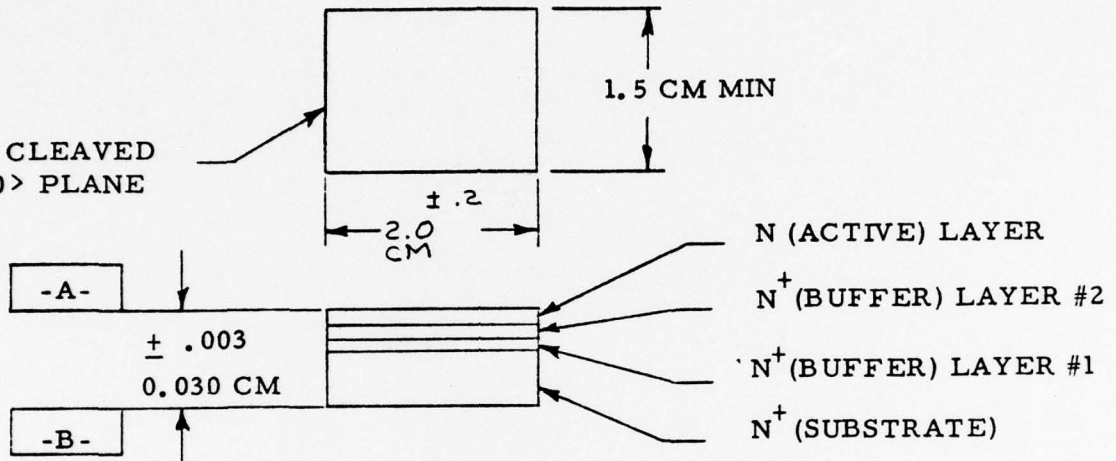
The following drawings or specifications are included in this section:

<u>Title</u>	<u>Drawing Number</u>
GaAs Epitaxial Wafer-Read Profile	A892049
Acceptance Test Procedure	MS-50371/2-1-ATP
Diode Package	103974
Die Collet	A892297
Die Collet	A892296
Solder	A892242
Lid	A-19884
Electrode	ES-19515
Electrode	ES-19516
Ku-Band Test Fixture (THK-8000)	ESM-22941
X-Band Test Fixture (THX-8000)	ESM-22937

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
		1	REVISED EXTENSIVE CHG. SEE OBSOLETE FILE FOR PREVIOUS REV	9-11-75	
		2	PARAMETER 4.6 $1.0 \times 10^{16} \pm 10\%$ WAS $7.5 \times 10^{15} \pm 10\%$ <sup>100</sup>	12/15/75	
		3	REV. EXTENSIVELY PER ENG MARK UP	12-17-76	
		4	REV. PER ENG. MARKUP	3-15-77	AC 5/3/77
		5	REV. Sheet 4, Par..4.5 "S" added.	6/14/77	AC 6/14/77

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTR NO.		<b>RAYTHEON</b>	RAYTHEON COMPANY		
	DR. R. <i>Silva</i> 3-5-77			LEXINGTON, MASS. 02173		
	TOLERANCES: ANGLES $\pm$	CHK <i>F. Yegorov</i> 3-31-77	DRAWING TITLE			
	FRACTIONS $\pm$	A <i>Richardson</i> 12-20-76				
3 PLACE DECIMALS $\pm$	D <i>M. L. ...</i> 12-22-76	GaAs EPITAXIAL WAFER READ PROFILE PEM DIODE				
2 PLACE DECIMALS $\pm$		APPROVED	SIZE <b>A</b>	CODE IDENT NO. <b>49956</b>	DRAWING NO. 892049	
1 PLACE DECIMALS $\pm$		BY DIRECTION OF	SCALE —	Rev. 5	SHEET 1 OF 5	
MATERIAL:						

EDGES CLEAVED  
ON  $\langle 110 \rangle$  PLANE



NOTES:

1. Usable area -  $3.0 \text{ cm}^2/\text{min}$ .
2. Fifty (50) percent of the wafers grown shall have eighty (80) percent, (minimum area  $3.0 \text{ cm}^2/\text{wafer}$ ) of usable material. The term usable defines material which meets specifications for dislocation density, doping profile and is capable of producing diodes meeting specification SCS-481, 23 September 1974.

SIZE A	CODE IDENT NO. 49956	DRAWING NO. 892049
SCALE	REV 5	SHEET 2 of 5

↓

SPECIFICATIONS

1. SUBSTRATE

- 1.1 Resistivity:  $2 \times 10^{-3}$  ohm-cm max.
- 1.2 Carrier Concentration:  $1 - 4 \times 10^{18}/\text{cm}^3$
- 1.3 Dopant: N-Type
- 1.4 Etch Pit Density:  $10^4/\text{cm}^2$  max.
- 1.5 Orientation:  $2 \pm 1/2^\circ$  off  $\langle 100 \rangle$  towards  $\langle 110 \rangle$  plane.

2. BUFFER LAYER #1

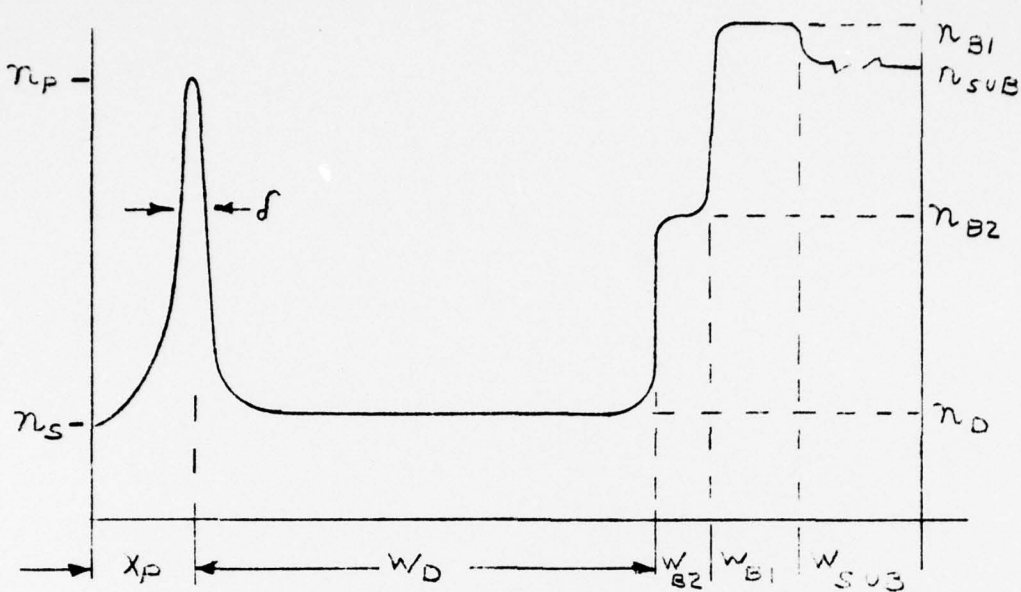
- 2.1 Resistivity:  $2 \times 10^{-3}$  ohm-cm max.
- 2.2 Carrier Concentration:  $1 - 4 \times 10^{18}/\text{cm}^3$
- 2.3 Dislocation Density:  $1000/\text{cm}^2$  max.
- 2.4 Dopant: Silicon
- 2.5 Thickness:  $4.0 - 10.0 \mu\text{m}$

3. BUFFER LAYER #2

- 3.1 Carrier Concentration:  $3 - 10 \times 10^{16}/\text{cm}^3$
- 3.2 Dislocation Density:  $1000/\text{cm}^2$  max.
- 3.3 Dopant: Silicon
- 3.4 Thickness:  $1 \mu\text{m} \pm 0.5 \mu\text{m}$

SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	892049
SCALE	REV 5	SHEET 3 of 5

4. ACTIVE LAYER: Per Table I



TABLE

PARAMETER	SYMBOL	PART NUMBER		UNITS
		-1	-2	
4.1 Nominal Operation Freq. Range		X-Band	Ku-Band	
4.2a Carrier Concentration at $X_0$	$N_0$	$1.0 \times 10^{17}$ ref.		$\text{cm}^{-3}$
4.2b Zero Bias Depletion wd.	$X_0$	0.20 ref.		$\mu\text{m}$
4.3 Peak Depth	$X_p$	$0.24 \pm .02$		$\mu\text{m}$
4.4 Total charge in spike per unit area	$Q$	$2.4 \times 10^{12} \pm 0.4$		$\text{coul}/\text{cm}^2$
4.5 Spike width max. at half height	$\delta$ Max.	0.06 max.		$\mu\text{m}$
4.6 Drift Space Doping	$n_D$	$5 \times 10^{15} \pm 10\%$	$1.0 \times 10^{16} \pm 10\%$	$\text{cm}^{-3}$
4.7 Active Layer Thickness	$W_D$	$5.0 \pm 0.5$	$4.0 \pm 0.5$	$\mu\text{m}$
4.8 Spike Depletion Voltage	$V^*$	$8.3 \pm 1.0$		Volts

SIZE <b>A</b>	CODE IDENT NO. <b>49956</b>	DRAWING NO. 892049
SCALE	REV 5	SHEET 4 of 5

5. SURFACE "A" FINISH

- 5.1 Surface "A" to be mirror-like with no hazy frosty appearance.
- 5.2 Surface "A" of wafer (exclusive of 1.5mm wide edge) to have a maximum of four gross defects (pits or mounts). Each defect shall be less than 1/2 mm in diameter and shall have a maximum height of 1  $\mu$ m.

6. DATA REQUIREMENTS (EACH WAFER)

- 6.1 Identify substrate vendor and supply vendor crystal number.
- 6.2 Supply vendor data on 1.1, 1.2, 1.4 and best estimates on 2.1, 2.2, 2.3, 2.5, 3.1, 3.2, 3.4, 4.2 - 4.8.

SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	892049
SCALE	REV 5	SHEET 5 of 5


APPLICATION		REVISIONS				
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED	

PART NAME: High Power Impatt Diode

CUSTOMER: U.S. Army Electronics Command

RAYTHEON P/N: MS50371 & MS50372

SHEET NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
ISSUE LTR.	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  TOLERANCES: ANGLES ± FRACTIONS ± 3 PLACE DECIMALS ± 2 PLACE DECIMALS ± 1 PLACE DECIMALS ±  MATERIAL:	CONTR NO.		RAYTHEON COMPANY LEXINGTON, MASS. 02173		
	DR. I. Langlois		DRAWING TITLE		
	CHK	A <i>Relia/...</i> 9/30/75 P <i>B.L. James</i> 9/30/75 D		ACCEPTANCE TEST PROCEDURE	
	APPROVED	SIZE A	CODE IDENT NO. 49956	DRAWING NO. MS50371/2-1-ATP	
BY DIRECTION OF	SCALE	REV. B	SHEET 1 of 22		

10-0700 (5/68) VELLUM  
 10-0701 (5/68) GRID VELLUM  
 10-0702 (5/68) FILM

PRINTED IN U.S.A.



REVISIONS

Issue Ltr.		Approval/Date
B	Updated to reflect new method of testing and combined two procedures into one.	<i>Dull</i> 4/1/77

SIZE A	CODE IDENT NO. 49956	DRAWING NO. MS50371/2-1-ATP
SCALE	REV B	SHEET 2

↓

TABLE OF CONTENTS

<u>PAR.</u>		<u>SHEET NO.</u>
	Cover Sheet	1
	Revision Sheet	2
	Table of Contents	3
1.0	Scope	4
2.0	Reference Documents	4
3.0	General Conditions	4
4.0	Test Equipment	5
5.0	Test Equipment Configuration	6
6.0	Test Procedure	10

←      →

SIZE <b>A</b>	CODE IDENT NO. <b>49956</b>	DRAWING NO. MS50371/2-1-ATP
SCALE	REV B	SHEET 3

↑

1.0 SCOPE

1.1 This procedure contains the testing methods of a High Efficiency, High Power, Gallium Arsenide Read-Type Impatt Diode.

2.0 REFERENCE DOCUMENTS

2.1 Electronics Command Specification SCS-481 Type 1 and 2.

3.0 GENERAL CONDITIONS

3.1 Ambient conditions shall be  $25^{\circ} \pm 3^{\circ}\text{C}$  and humidity shall be room ambient unless otherwise specified in the individual test paragraph.

3.2 Safety precautions shall be in accordance with normal Raytheon safety practices. Care should be taken during the handling, inspection and testing of the unit to prevent any damage to the devices and/or injury to test personnel.

3.3 Prior to submission of units for customer acceptance, aforesaid units shall be previously tested by Raytheon in strict accordance with the procedure contained herein.

SIZE A	CODE IDENT NO. 49956	DRAWING NO. MS50371/2-1-ATP
SCALE	REV B	SHEET 4

4.0 TEST EQUIPMENT

The following list of test equipment or equivalent shall be used.

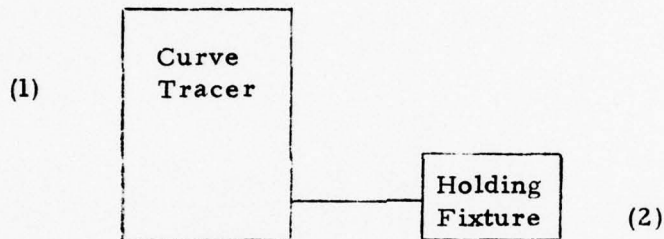
- (1) Curve Tracer - Tektronix Type 575
- (2) Holding Fixture - Raytheon Lab Model
- (3) Capacitance Bridge - Booton Model 75D
- (4) Holding Fixture - Raytheon Lab Model
- (5) Digital Voltmeter - Systron Donner Model 7030
- (6) Selector Box - Raytheon Lab Model
- (7) Power Supply - Heathkit Model 1P-17
- (8) Power Meter - H/P Model 431C
- (9) 20 dB Coupler - H/P Model X752D
- (10) Frequency Meter - FXR X410A
- (11) D.C. Power Supply - Harrison Lab Model 890A
- (12) Spectrum Analyzer - H/P Model 8551B
- (13) Precision Attenuator - H/P Model X382A
- (14) Slide Screw Tuner - H/P Model X870A
- (15) Test Cavity - Raytheon Lab Model THX-8000 or THK8000
- (16) Adjustable Short Circuit
- (17) Current Regulator - Raytheon Lab Model
- (18) Ammeter - H/P Model 428B
- (19) Power Supply - Kepco Model HB4A
- (20) Pulse Generator - H/P Model 214A
- (21) Temperature Controller/Indicator - Doric Type 400
- (22) Digital Volt/Ampmeter - NLS Series X-3
- (23) Digital Voltmeter - NLS Series X-2
- (24) Selector Switch - Raytheon Lab Model
- (25) Heat Sink - Raytheon Lab Model
- (26) Oscilloscope - Tektronix Type 585A  
Plug-In - Tektronix Type 82
- (27) Power Supply - Lambda, Model 615
- (28) Digital Voltmeter - NLS Model LM-4
- (29) Milliampmeter - Simpson Panel
- (30) Raytheon Diode Holder Fixture, #BETA-1
- (31) Manual Scanner 1 thru 25
- (32) Thermal Resistance Tester, Sage Labs, Model Theta 120
- (33) Raytheon Diode Holder Fixture, Raytheon RTP-1
- (34) Carrier Noise Analyzer - Raytheon Model CNA-20J
- (35) X-Y Recorder - H/P Model 7035B
- (36) Spectrum Analyzer - H/P Model 141T/8553B/8550A
- (37) Oven - Blue M- Model OV-8A

SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV B	SHEET 5

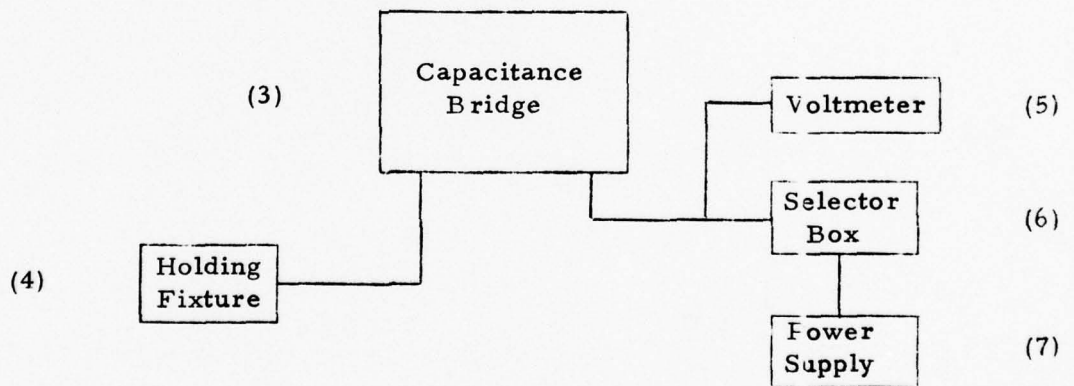
The following test equipment configuration shall be used to perform the electrical test described in Section 6.0.

5.0 TEST EQUIPMENT CONFIGURATION

5.1 Breakdown Voltage Test Setup

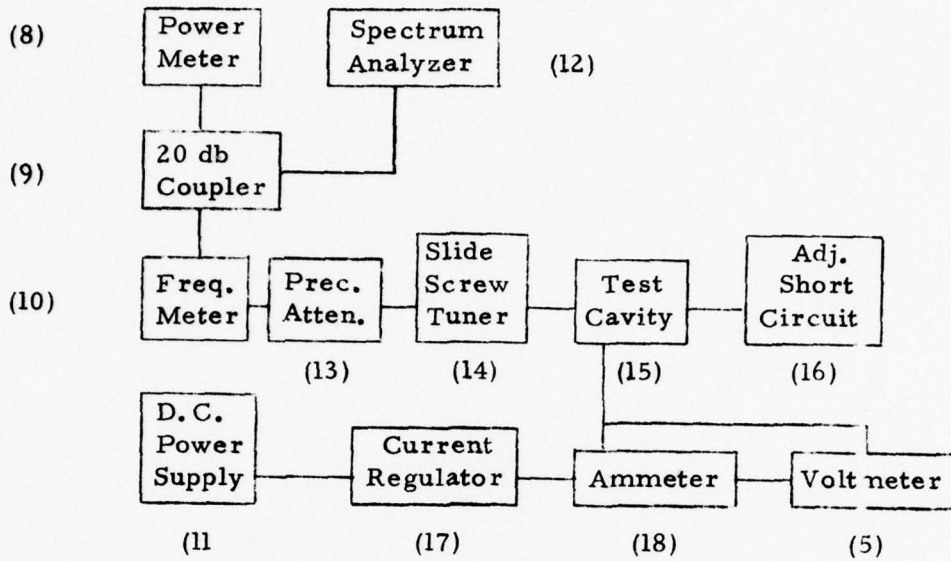


5.2 Capacitance Test Setup

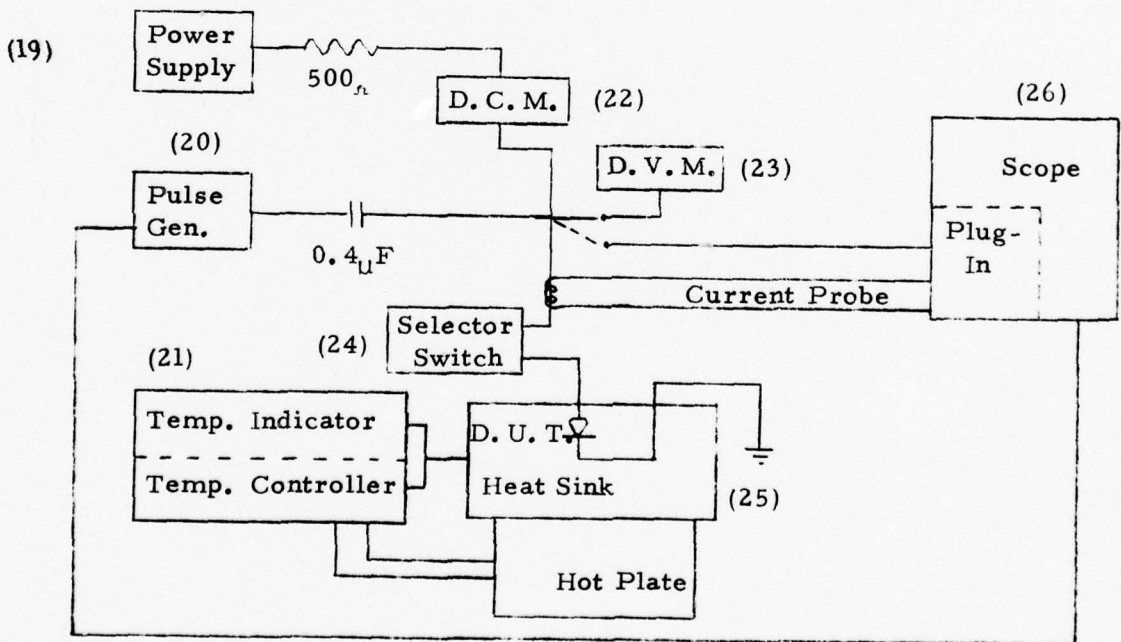


SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV B	SHEET 6

5.3 R. F. Test Setup

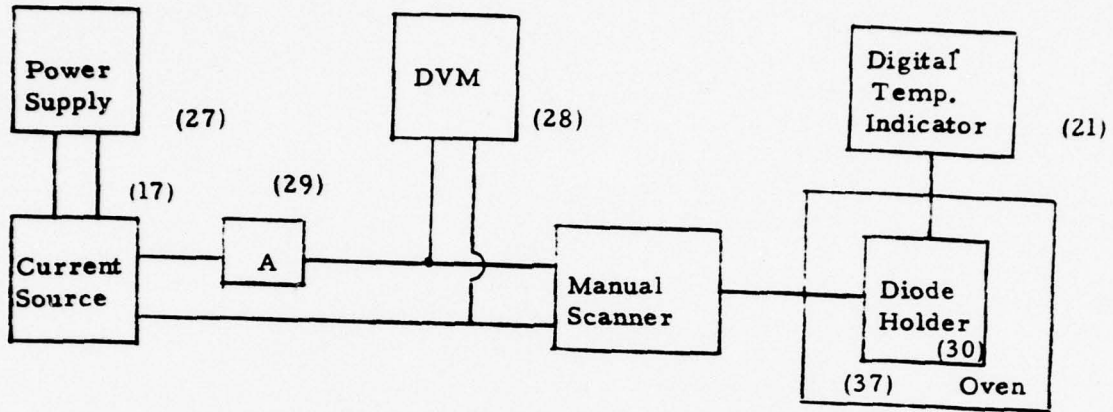


5.4 Thermal Resistance

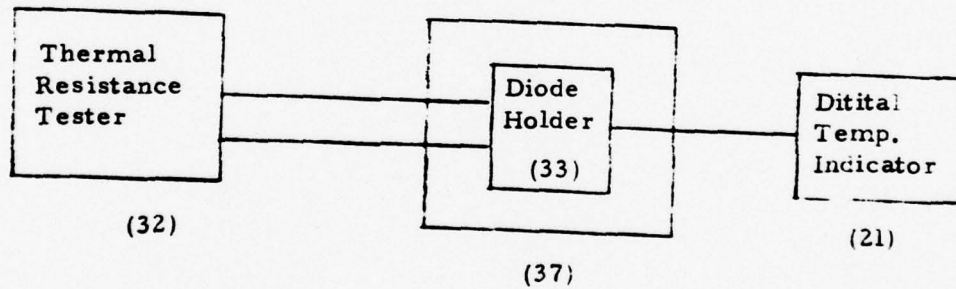


SIZE <b>A</b>	CODE IDENT NO. <b>49956</b>	DRAWING NO. <b>MS50371/2-1-ATP</b>
SCALE	REV <b>B</b>	SHEET <b>7</b>

5.5 "B" Factor Calibration



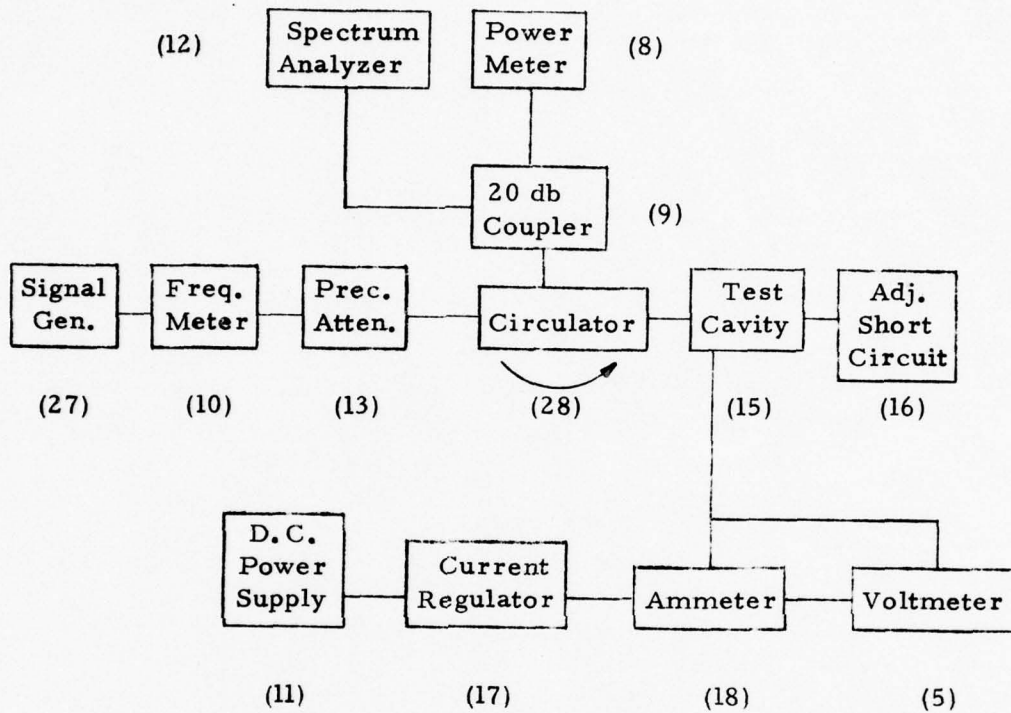
5.6 "Sage" Thermal Resistance Tester



SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV	SHEET

5.7

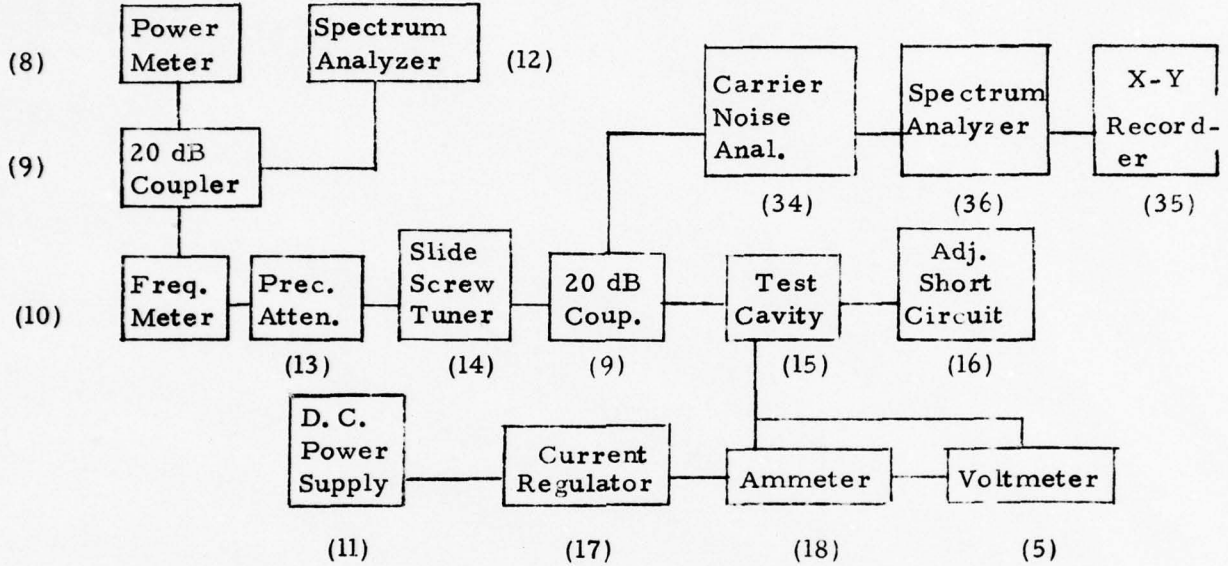
"Q" External



SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-AT P
SCALE	REV B	SHEET 9



5.8 AM-FM Noise



SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV B	SHEET 10

6.0 TEST PROCEDURE

6.1 Breakdown Voltage (Reference Test Setup 5.1)

6.1.1 Initial settings of curve tracer shall be as follows: Peak Volts Range: 0-200V; Peak Volts: 0V; Polarity: (-) Negative; Vertical Current: 0.2 mA; Horizontal Voltage: 10V for the 50371 and 5V for the 50372.

6.1.2 Place the diode into the holder threaded side up and slowly lower the probe until contact is made with the diode.

6.1.3 While observing the scope, increase the peak volts dial until breakdown occurs (break sharply down). Measure and record the breakdown voltage.

6.2 Capacitance (Reference Test Setup 5.2)

6.2.1 Set the selector switch to capacitance and null the system. Measuring the standard diodes and comparing results against previous results.

6.2.2 Set the capacitance multiplier selector switch to 0.1 and D.C. bias to external.

6.2.3 Place the diode under test into the holding fixture. Measure and record the diode capacitance ( $C_{T0}$ ) at 0 volts.

6.2.3 Increase bias ( $V_R$ ) to 25V for the 50371 and 15V for the 50372. Measure and record  $C_{TVR}$  and  $V_R$  on the data sheet.

SIZE A	CODE IDENT NO. 49956	DRAWING NO. MS50371/2-1-ATP
SCALE	REV B	SHEET 11

6.3 RF Test (Reference Test Setup 5.3)

- 6.3.1 Place the diode under test into the test cavity. Install hat onto the bias choke. Record hat identification number onto the data sheet. Install the test cavity into the microwave test setup.
- 6.3.2 Simultaneously increase the D.C. current, varying the slide screw tuner and adjusting the short circuit until the diode's maximum output power is obtained. Record the power output level on the data sheet.

(Specification: 3.5 watts min. for the 50371)  
2.5 watts min. for the 50372)

- 6.3.3 Using the frequency meter, measure and record the diode's frequency, DC bias voltage, and the DC current on the data sheet.
- 6.3.4 Calculate and record the oscillator's efficiency using the following formula.

$$\text{Power Efficiency} = \frac{\text{Power Output (RF)}}{\text{Power Input (DC)}} \times 100$$

SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV B	SHEET 12

- ↓
- 6.4      Thermal Resistance (Reference Test Setup 5.4)
- 6.4.1    Install diodes (up to 12 diodes) into the heat sink using heat sink compound to ensure a thermal connection.
- 6.4.2    Using the temperature controller, increase the temperature of the heat sink to 100°C, as monitored on the temperature indicator.
- 6.4.3    Apply a bias current of 2 ma. Measure and record the breakdown voltage ( $B_V$ ).
- 6.4.4    Use the selector switch to measure and record  $B_V$  of the remaining diodes (the heat sink will accept up to 12 diodes).
- 6.4.5    Repeat steps 6.4.3 and 6.4.4 at temperatures of 110°C, 120°C and 130°C.
- 6.4.6    Plot a graph for each diode tested of  $B_V$  vs temperature.
- 6.4.7    Turn the temperature controller off and allow the heat sink to return to room temperature.
- 6.4.8    Increase the bias current until the reading on the digital voltmeter is equal to  $V_B @ 130 \pm 10^\circ\text{C}$  (reference the graph step 6.4.6). Apply a pulse with the following characteristics; pulse width 400 ns, rep. rate 1 KHz. Adjust the pulse amplitude until the current (as monitored on the scope) equals 2 ma. Record the amplitude ( $V_P$ )
- 6.4.9    Increase the bias current until the diode voltage ( $V_D$ ) equals  $V_B @ 130^\circ\text{C}$  plus pulse amplitude ( $V_P$ ) recorded in par. 6.4.8. Apply a pulse with the following characteristics; pulse width 400 ns, rep. rate 1 KHz. Adjust the pulse amplitude until the current (as monitored on the scope) equals 2 ma. Record the amplitude ( $V_P$ ).
- 6.4.10   Record the ambient temperature of the diode ( $T_A$ ) directly from the temperature indicator, the D.C. current ( $I_{DC}$ ) from the digital current meter, the D.C. voltage ( $V_{DC}$ ) from the digital voltmeter.

SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV B	SHEET 13

- 6.4.11 The difference between the D.C. voltage and pulse amplitude is the breakdown voltage at the junction temperature ( $T_J$ ):

$$V_B @ T_J = V_{DC} - V_P$$

Note: Refer to the graph per step 6.3.4 to find the  $T_J$  value that corresponds to the  $V_B$ .

- 6.4.12 Calculate and record thermal resistance ( $R_{TH}$ ) using the following formula:

$$R_{TH} = \frac{T_J - T_A}{I_{DC} V_{DC}}$$

- 6.4.13 Repeat paragraphs 6.4.9 thru 6.4.12 for each diode in the heat sink.

SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV B	SHEET 14

6.5 "B" Factor Calibration

- 6.5.1 Install diodes (up to 25 diodes) into the heat sink using heat sink compound to ensure a thermal connection.
- 6.5.2 Measure and record the heat sink ambient temperature ( $T_0$ ).
- 6.5.3 Set the current source so that the maximum output will not exceed 1 ma.
- 6.5.4 Adjust the output of the power supply until the current measured on the milliamp meter reads 1 ma. Measure and record the voltage on the DVM ( $V_B$ ).
- 6.5.5 Repeat paragraph 6.5.3 and 6.5.4 for each diode in the heat sink.
- 6.5.6 Adjust the temperature controls of the oven to  $+125^{\circ}\text{C}$  and allow the diodes to stabilize at  $+125^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .
- 6.5.7 Repeat paragraph 6.5.3 and 6.5.4 for each diode in the heat sink while maintaining a temperature ( $T_H$ ) of  $+125^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .
- 6.5.8 Utilizing the formula below, calculate the B of each diode.

$$B = \frac{V_B(T_H) - V_B(T_0)}{T_H - T_0} \cdot \frac{1}{V_B(T_0)}$$

SIZE	CODE IDENT NO.	DRAWING NO.
A	49956	MS50371/2-1-ATP
SCALE	REV B	SHEET 15

6.6 Sage Thermal Resistance Test

- 6.6.1 Dial in the calculated B factor (reference par. 6.5.8) into the BETA Instrument.
- 6.6.2 Insert the diode with the test fixture and set the "Safe" heat current ( $I_H$ ) to 100 ma.
- 6.6.3 Depress the "start" button and allow the BETA Instrument to complete its measurement cycle. Green light will illuminate when completed.
- 6.6.4 Monitor the  $T_J$  and repeat par. 6.6.2 and 6.6.3 (increasing  $I_H$  in small increments) until  $T_J = 100 \pm 5^\circ\text{C}$ .
- 6.6.5 Measure and record the thermal resistance of the diode.

SIZE	CODE IDENT NO.	DRAWING NO.	
A	49956	MS50371/2-1-ATP	
SCALE	REV	B	SHEET 16

6.7 "Q" External

- 6.7.1 Install the diode under test into the test cavity and tune per R. F. test section 6.3 of this procedure. The frequency displayed on the spectrum analyzer will be referred to as  $F_0$ .
- 6.7.2 Adjust the signal generator to display a signal on the spectrum analyzer at a frequency close to  $F_0$ . Record the frequency of this signal and the precision attenuator setting.
- 6.7.3 Change the frequency of the signal generator in a direction toward  $F_0$ . Record the frequency of the signal and the precision attenuator setting. Continue to change the frequency in steps (record frequency and attenuation at each step) until a frequency band symmetrical to  $F_0$  corresponding to an attenuation change of at least 6 dB has been covered.
- 6.7.4 Plot a graph of attenuation vs frequency. Determine from the graph the frequency 3 dB down from peak attenuation ( $F_1$  and  $F_2$ ).
- 6.7.5 Calculate and record "Q" external using the following formula:

$$Q \text{ Ext.} = \frac{F_0}{F_2 - F_1}$$

SIZE <b>A</b>	CODE IDENT NO. <b>49956</b>	DRAWING NO. MS50371/2-1-ATP
SCALE	REV B	SHEET 17



6.8 AM Noise Measurement

- 6.8.1 Tune the diode to maximum output power in accordance with par. 6.3.1 and 6.3.2.
- 6.8.2 Set the controls on the Carrier Noise Analyzer as follows: Detector Selector to AM; Modulation Selector to OFF; Power Level Set as required; Detector Balance to fully clockwise; Crystal Bias to OFF (RF Input power level -3 dBm) or ON (RF Input power level -3 dBm). Set the RF Power Level to 50 A as indicated on the RF Level Meter. Detune the Frequency Balance Control.
- 6.8.3 Set the RF Discriminator Balance Control on the Carrier Noise Analyzer for a minimum reading as indicated on the RF Power Level Meter and a maximum positive reading on the Discriminator Balance Meter.
- 6.8.4 Reset the RF Power Level to the appropriate setting obtained from the AM calibration data. Slowly sweep the Spectrum Analyzer over the frequency range of  $F_0$  to  $F_0 + 200$  MHz and record the AM noise measurements on the X-Y recorder.
- 6.8.5 Repeat paragraphs 6.8.1 thru 6.8.4 for each diode in the lot.

SIZE A	CODE IDENT NO. 49956	DRAWING NO. MS5037 /2-1-ATP
SCALE	REV B	SHEET 18

6.9 FM Noise Measurement

6.9.1 Tune the diode to maximum output power in accordance with par. 6.3.1 and 6.3.2.

6.9.2 Set the controls on the Carrier Noise Analyzer as follows: Detector Selector to FM; Modulator Selector to OFF; Power Level Set as required; and Frequency Balance to detune. Set the RF Power Level to 50 A as indicated on the RF Level Meter. Set the Detector Balance Control Maximum clockwise.

6.9.3 Set the RF Discriminator Balance Micrometer for a "0" reading on the Discriminator Balance Meter. Tune the Frequency Balance Micrometer for a fire null as evidenced by a rapid swing of the Discriminator Balance Meter.

6.9.4 Adjust the power level to that level required in accordance with FM Calibration chart provided with the Carrier Noise Analyzer.

6.9.5 Repeat paragraphs 6.9.3 and 6.9.4 until fine balancing is obtained.

Note: The current level on the RF Power Level meter is a reference level which must be maintained during the entire measurement.

6.9.6 Slowly sweep the Spectrum Analyzer over the frequency range of  $F_0$  to  $F_0 + 200$  MHz and record the FM Noise measurement on the X-Y recorder.

Note: The X-Y FM Recorder data shall be recorded on the same data sheet as the AM recorded data (reference par. 6.8.4).

6.9.7 Repeat paragraphs 6.9.1 thru 6.9.6 for each diode in the lot.

SIZE A	CODE IDENT NO. 49956	DRAWING NO. MS50371/2-1-ATP
SCALE	REV B	SHEET 19

6.10 Junction Temperature

- 6.10.1 Calculate the junction temperature of each diode utilizing the formal listed below and the previously recorded data.

$$T_J = (V_{OP} I_{OP} - P_O) R_{TH} + 25$$

6.11 Mechanical Tuning (Reference Test Setup 5.3)

- 6.11.1 Tune the diode to maximum power output in accordance with par. 6.3.1 and 6.3.2. Measure the frequency output on the Frequency Meter.
- 6.11.2 Adjust the Adjustable Short Circuit and verify a shift in frequency on the spectrum analyzer and a drop in power on the Power Meter.
- 6.11.3 Retune utilizing the slide screw tuner for maximum power output. Measure the frequency output on the Frequency Meter.

Note: Frequency may slightly change.

- 6.11.4 Repeat paragraphs 6.10.2 and 6.10.3 in order to demonstrate the mechanical tuning capability of the diode.

(Specification:  $\pm$  250 MHz from  $F_O$ )

SIZE A	CODE IDENT NO. 49956	DRAWING NO. MS50371/2-1-ATP
SCALE	REV B	SHEET 20

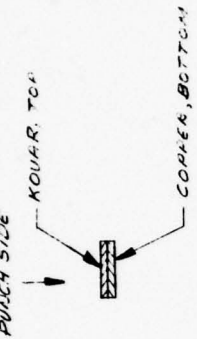
DATA SHEET  
MS50371  
SCS-481 TYPE 1

CHARACTERISTIC	BY		C <sub>TO</sub>		C <sub>TVR</sub>		V <sub>R</sub>	R <sub>TH</sub>	P <sub>O</sub>	F <sub>O</sub>	V <sub>OP</sub>	I <sub>OP</sub>	η	Mech. Tun.	HAT	T <sub>J</sub>	Q <sub>Ext.</sub>	ΔF <sub>RMS</sub>	(N/S)AM	
	I <sub>ma</sub>	V=O	V <sub>F</sub>	V=V <sub>R</sub>	P <sub>F</sub>	Volts	°C/W	Watts	GHz	Volts	ma	%		°C				Hz	db	
LIMITS									3.5	9	70	500	20	+ 250		200	200	50	115	
	MIN.																			
MAX.																				
Serial No.	Diode I. D. Number																			

DATA SHEET  
MS50372  
SCS-481 TYPE 2

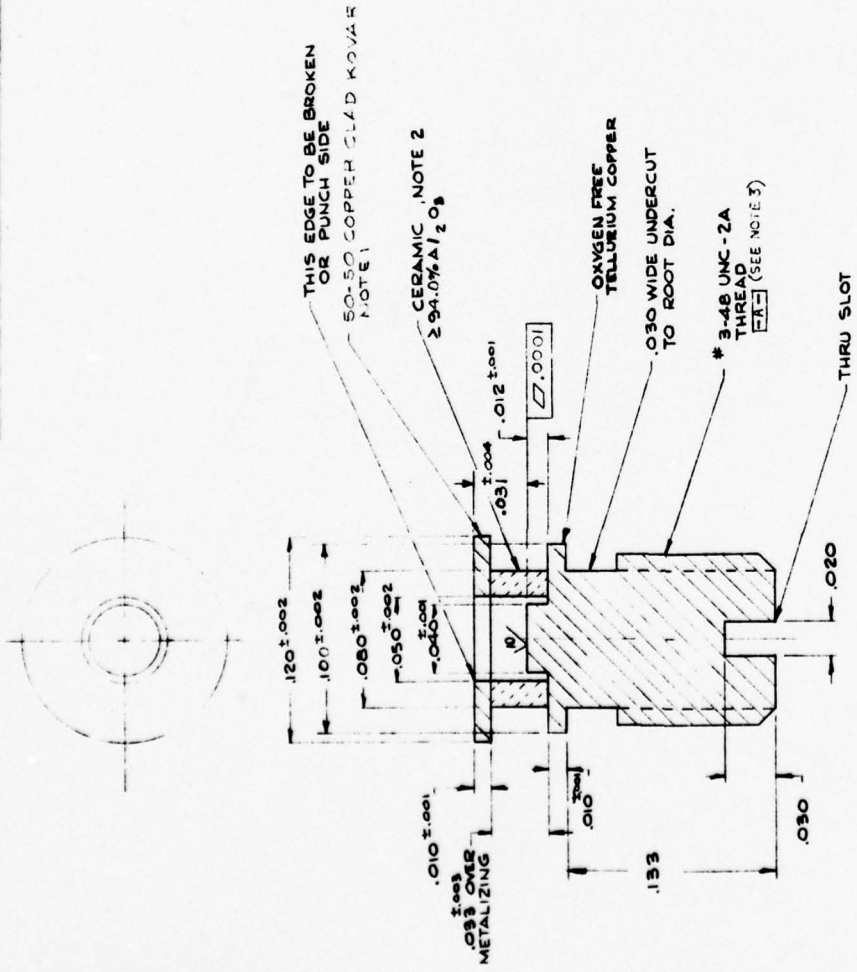
CHARACTERISTIC	BV	C <sub>TO</sub>	C <sub>TVR</sub>	V <sub>R</sub>	R <sub>TH</sub>	P <sub>o</sub>	F <sub>o</sub>	V <sub>OP</sub>	I <sub>OP</sub>	η	Mech. Tun.	HAT	T <sub>J</sub>	Q <sub>Ext.</sub>	ΔF <sub>RMS</sub>	(N/S)AM
	Ima Volts MIN. MAX.	V=0 PF	V = V <sub>R</sub> PF	Volts C/W	°C/W	Watts	GHz	Volts	ma	%			°C		Hz	db
TEST CONDITION						2.5	14	70	500	20	+250		200	200	50	-115
Serial No.																
Diode I. D. Number																

ZONE	LTR	DESCRIPTION	DATE	APPROVED
1		110 GRM WAS 100 JALM (100 GRM) 51.3-28.70 WAS 2 MAX 10% NBS 8 WAS 15.7% B. G. LAMINATE 4/4 100% T.E.R. CORRECT DIMENSION 1.133 LOCATION CALCULATED 2.94-0% AU203 WAS 2.955% AU203	4/13/71	RSP
2		ADD 50-50 CERAMIC CLAD KOUVAR TO 1.133 CH. 1.133 1.164 2.002 WAS 1.110 2.1002 NOTE 4 WAS 1.133 CHANGE TO BE TO 1.133 CH. 1.133 1.164 2.002 WAS 1.110 2.1002	6/17/71	afp
3		100% GRM WAS 100 JALM (100 GRM) 51.3-28.70 WAS 2 MAX 10% NBS 8 WAS 15.7% B. G. LAMINATE 4/4 100% T.E.R. CORRECT DIMENSION 1.133 LOCATION CALCULATED 2.94-0% AU203 WAS 2.955% AU203	8-19-71	afp
4		CERAMIC WAS 1.133 6-25-71	8-19-71	afp



- NOTES:
- 1- ASSY TO BE HERMETICALLY SEALED TO  $1 \times 10^{-8}$  STD. CC/SEC (MIN) MEASURED ON A MASS SPECTROMETER.
  - 2- ASSY TO WITHSTAND 151b. PUSH TEST TO  $2 \frac{1}{2}$  % A. Q.
  - 3- ALL DIA'S. TO A .005 DIA.
  - 4- FLANGE TO BE 1 TO 2 OF PIN TO  $1 \frac{1}{2}$  MAX.
  - 5- GOLD PLATE PER A.350023.
  - 6- DIMENSIONS APPLY AFTER PLATING.

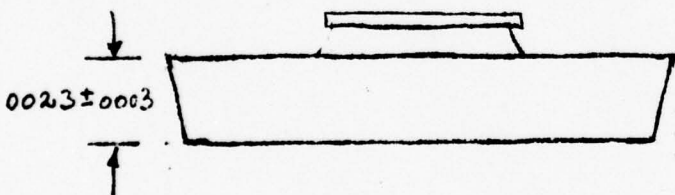
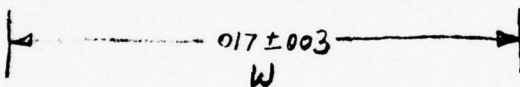
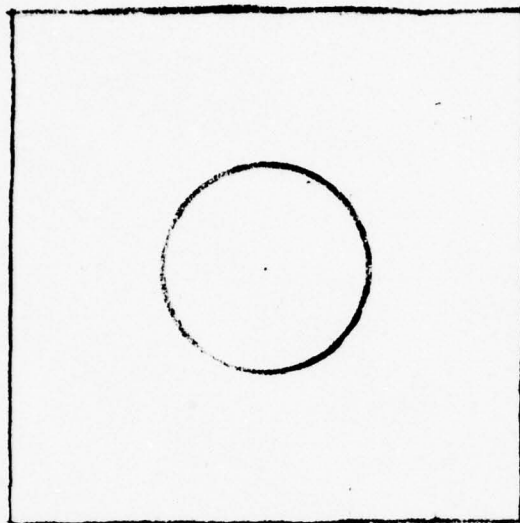
5 ADD DIM .031 2.304



QTY RECD	ITEM NO.	REF DESIGNATION	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION
				LIST OF MATERIALS		
				CONTRACT NO. 3724-10		
				DRAWN R. Mack	DATE 4-5-68	
				CHECKED R. Mack	DATE 4-5-69	
				MATERIAL		
				UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		
				TOLERANCES ON:		
				FRACTIONS DECIMALS ANGLES		
				— — — — —		
				FINISH		
				DESIGN ACTIVITY APPD. G. P. 6/2/71	DATE 6-2-71	
				SCALE	WEIGHT	SHEET
				C 14830	103974	
				THE micro state electronics corp.	A SUBSIDIARY OF RAYTHEON COMPANY 152 FLORAL AVE. MURRAY HILL, N. J.	
				TYPE 16 PACKAGE		

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APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
		0	ORIGINATED	PC	7/5/77

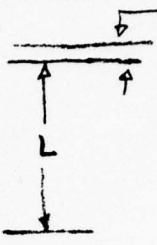
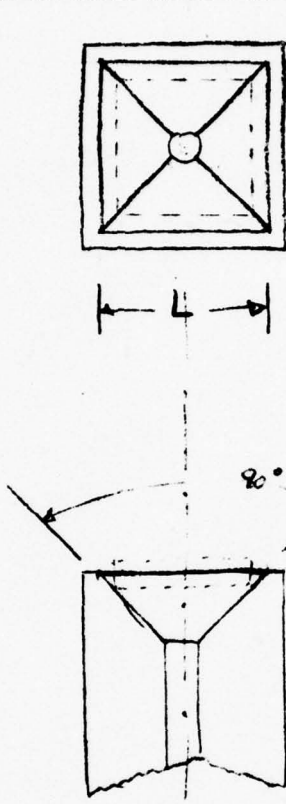
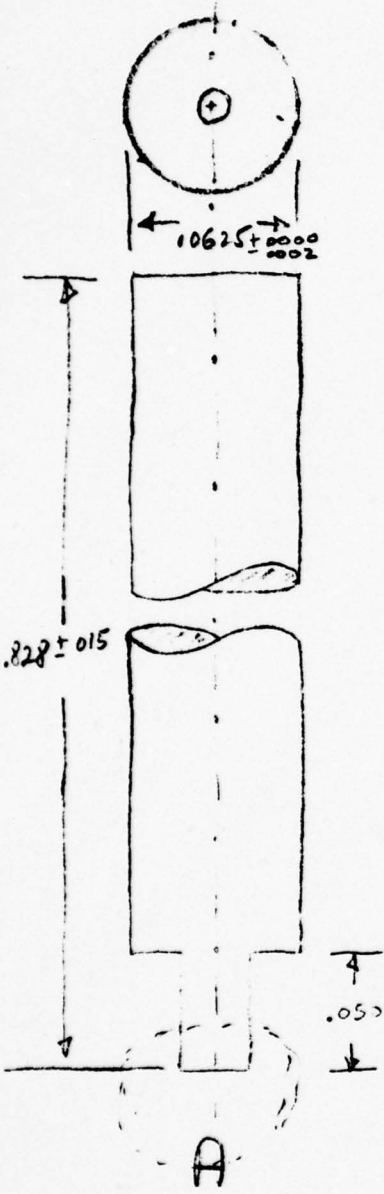


DIE SIZE W	DIE COLLET POCKET SIZE
020 X 020	022 X 022
019 X 019	021 X 021
018 X 018	020 X 020
017 X 017	019 X 019
016 X 016	018 X 018
015 X 015	017 X 017
014 X 014	016 X 016

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTR NO.		<b>RAYTHEON</b>	RAYTHEON COMPANY LEXINGTON, MASS. 02173	
	DR			DRAWING TITLE	
TOLERANCES: ANGLES ±	CHK		MODEL 604 DIE COLLETS WITH POCKET SIZES		
FRACTIONS ±	A P P D		SIZE	CODE IDENT NO.	DRAWING NO.
3 PLACE DECIMALS ±	APPROVED		A	49956	892297
2 PLACE DECIMALS ±	BY DIRECTION OF		SCALE		SHEET 1 OF 1
1 PLACE DECIMALS ±	MATERIAL:				

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
		0	ORIGINATED	PC.	7/5/77



BEST AVAILABLE COPY

NOTE:

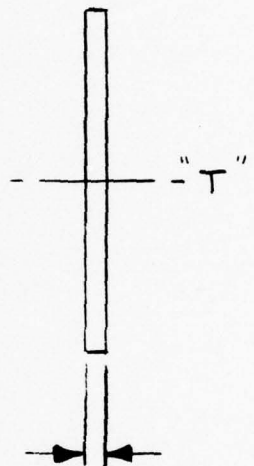
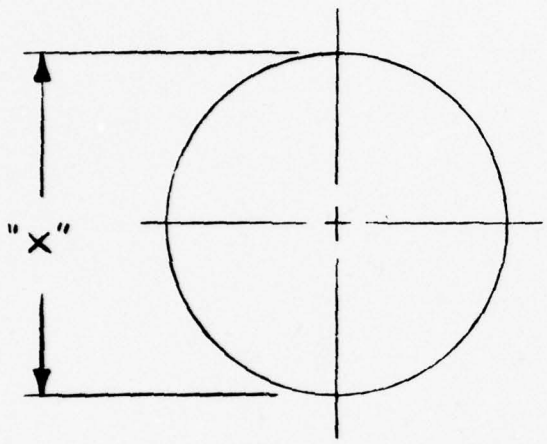
1. L IS THE DIE COLLET "POCKET" SIZE, AND IT IS DETERMINED ACCORDING TO DICE SIZE PER TABLE PER DRAWING NO.
2. MATERIAL IS TUNGSTEN CARBIDE

DETAIL A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  TOLERANCES: ANGLES ± FRACTIONS ± 3 PLACE DECIMALS ± 2 PLACE DECIMALS ± 1 PLACE DECIMALS ±  MATERIAL:	CONTR. NO.		RAYTHEON COMPANY		
	DR		LEXINGTON, MASS. 02173		
	CHK	DRAWING TITLE			
	A <i>W. Chalifa</i> 8/4/77 P P D	MODEL 604 DIE COLLET			
APPROVED	SIZE	CODE IDENT NO.	DRAWING NO.		
BY DIRECTION OF	A	49956	892296		
	SCALE		SHEET 1 OF 1		



APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
		0	ORIGINATED		
		1	DIM. TABULATED, -2 PART ADDED	7-5-77	



NOTES:

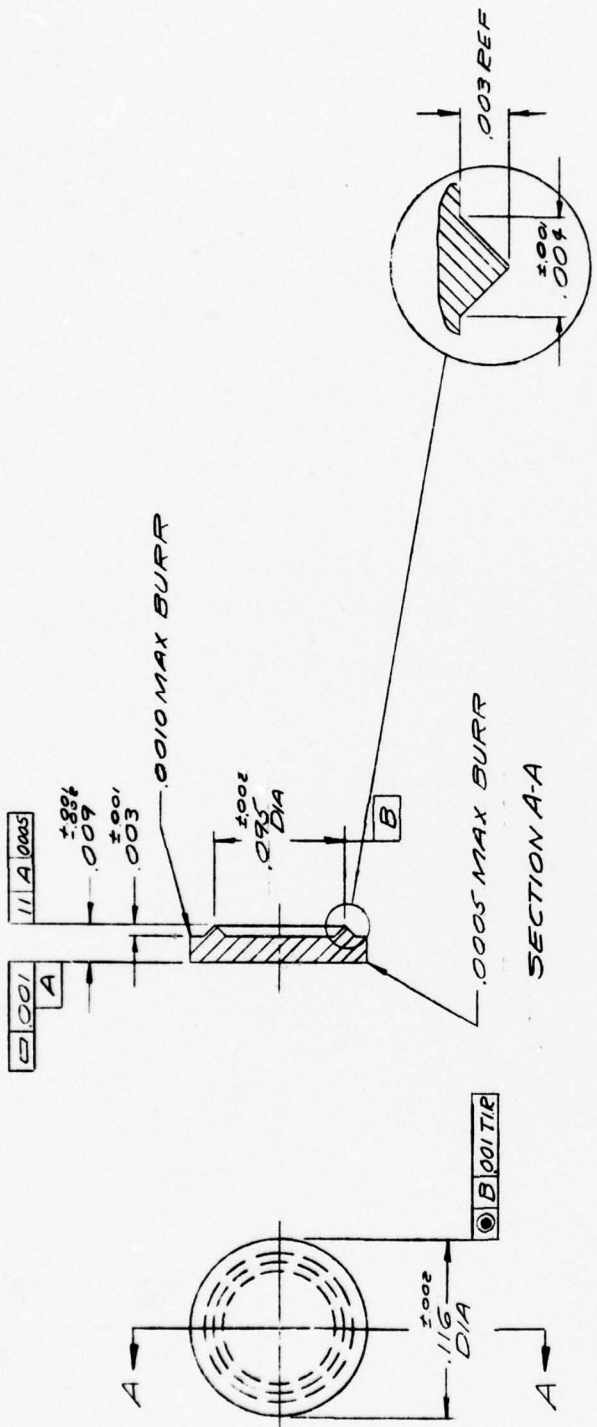
1. MATL: GOLD-TIN ALLOY (80% Au - 20% Sn)  $\pm 1\%$
2. MAX BURRS .0005 EITHER SIDE
3. PARTS SHALL BE FLAT WITHIN .001
4. ALLOY MUST BE 99.97% PURE
5. ALL LOTS MUST BE IDENTIFIED WITH VENDORS MFG LOT NUMBER

P#	DIA. "X"	THICKNESS "T"
-1	.040 $\pm$ .001	.0025 $\pm$ .0002
-2	.020 $\pm$ .002	.001 $\pm$ .0002

SOURCE:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	CONTR NO.	<b>RAYTHEON</b>	RAYTHEON COMPANY	
	DR <i>S. Shuman</i> 28 APR 77		LEXINGTON, MASS. 02173	
TOLERANCES: ANGLES $\pm$	CHK	DRAWING TITLE		
FRACTIONS $\pm$	A <i>Archifon</i> 8/4/77	<b>PREFORMS</b>		
3 PLACE DECIMALS $\pm$	P			
2 PLACE DECIMALS $\pm$	D	SIZE	CODE IDENT NO.	DRAWING NO.
1 PLACE DECIMALS $\pm$	APPROVED	A	49956	892242
MATERIAL:	BY DIRECTION OF	SCALE	NONE	SHEET 1 OF 1
<b>SEE NOTE 1</b>				

ZONE	LTR	DESCRIPTION	DATE	APPROVED

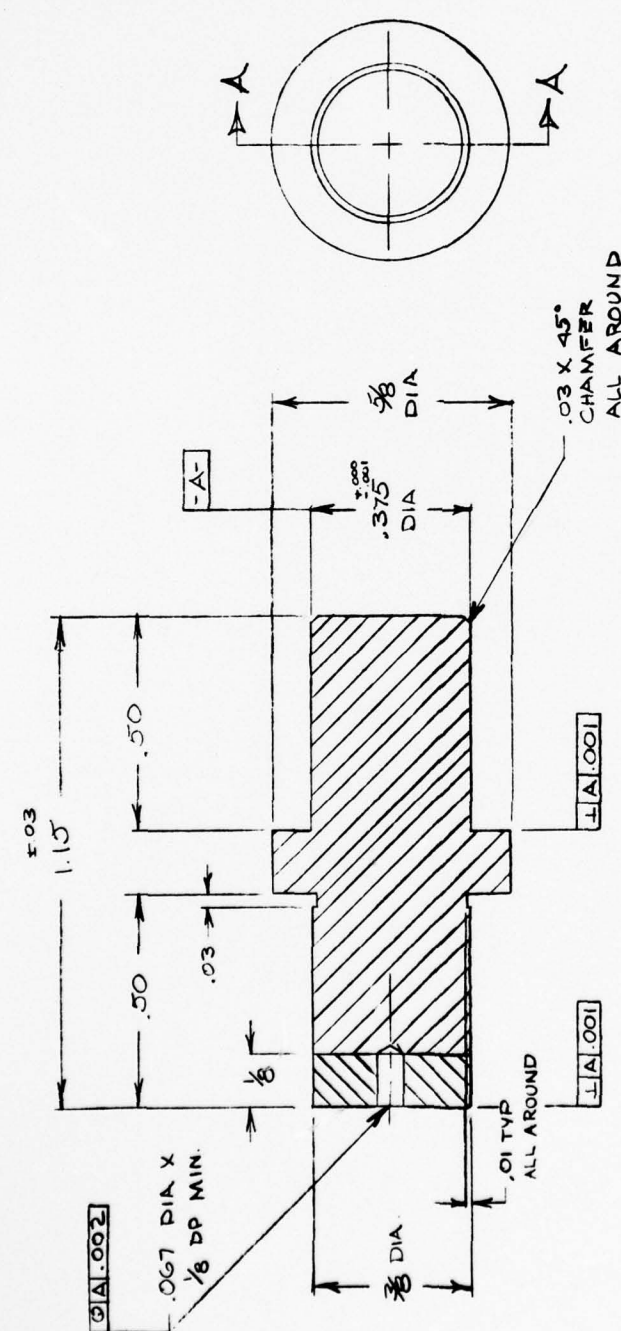


NOTES  
1. FINISH. REFER TO DWG 350023-1

QTY	CODE	PART NO. OR IDENTIFICATION NO.	DRAWING OR SPECIFICATION NO.	NOMENCLATURE OR DESCRIPTION	FIND NO
PARTS LIST					
CONTR NO.			RAYTHEON		
DR. Williams			RAYTHEON COMPANY		
9-9-72			LEKINGTON, MASS 02173		
CHK			DRAWING TITLE		
A			COVER-DIODE		
P			SIZE CODE IDENT NO. DRAWING NO.		
D			C 49956 E5M19884		
APPROVED			SCALE		
BY DIRECTION OF			A		
MATERIAL:			SHEET / OF		
GRADE A					
SOFT NICKEL					
APPLICATION					
NEXT ASSY					
USED ON					

5 4 3 2 1

REVISIONS			
ZONE LTR	DESCRIPTION	DATE	APPROVED

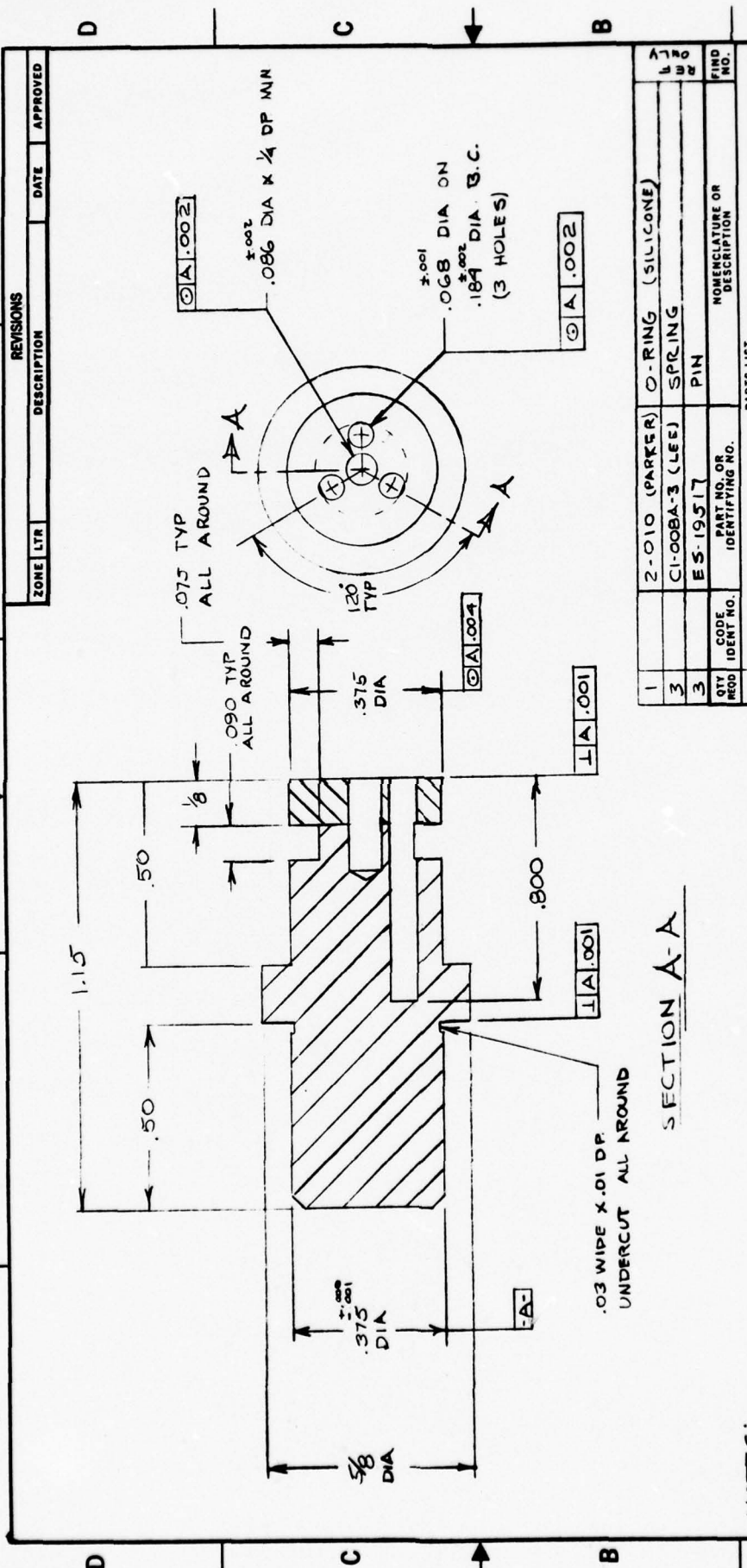


SECTION A-A

NOTES:  
 1 MATERIAL:  
 OFHC COPPER  
 MALLORY ELKONITE 10W3 OR 20W3  
 2 SILVER BRAZE PER RAYTHEON SPEC 296-1236 GR VII

QTY	CODE	RECD	IDENT NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	REV	IND NO.
					RAYTHEON COMPANY LEXINGTON, MASS. 02173		
PARTS LIST							
CONTR NO.							
DR	JNS						
CHK							
A							
P							
D							
DRAWING TITLE							
UPPER ELECTRODE							
SIZE	B	CODE IDENT NO.	DRAWING NO.				
		49956	ES-19515				
SCALE	1/1	SHEET					
APPROVED							
BY DIRECTION OF							
MATERIAL: SEE NOTES							
NEXT ASSY APPLICATION							
USED ON							

5 4 3 2 1



REVISIONS		DATE	APPROVED
ZONE	LTR	DESCRIPTION	

1	2-010 (PARKER)	O-RING (SILICONE)	QTY	1
3	CI-008A-3 (LEE)	SPRING	QTY	1
3	ES-19517	PIN	QTY	3

QTY				

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TOLERANCES: ANGLES ± 1°	
FRACTIONS ± 1/32	
3 PLACE DECIMALS ± .005	
2 PLACE DECIMALS ± .01	
1 PLACE DECIMALS ± .1	

CONTR. NO.	
DR. NO.	
CHK.	
APPROVED	
BY	
DATE	

PARTS LIST	
RAYTHEON COMPANY LEXINGTON, MASS. 02173	
DRAWING TITLE LOWER ELECTRODE	
SIZE	CODE IDENT NO.
B	49956
SCALE	DRAWING NO.
4/1	ES-19516
SHEET	

NOTES:

1 MATERIAL

OFHC COPPER

MALLYORY ELKONITE 10W3 OR 20W3

SILVER BRAZE PER RAYTHEON SPEC 296-1236 GR VII

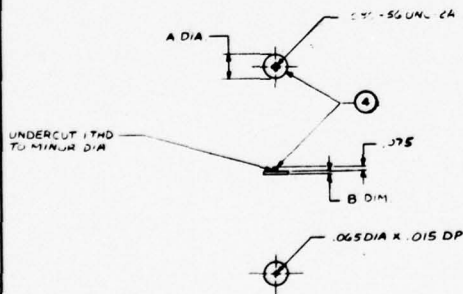
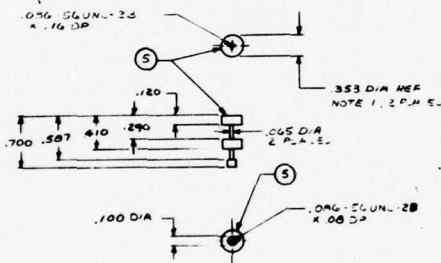
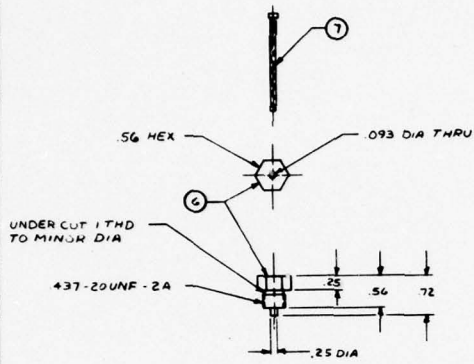
SECTION A-A

.03 WIDE X .01 DP UNDERCUT ALL AROUND

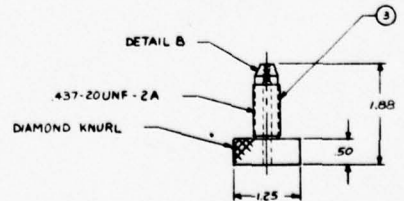
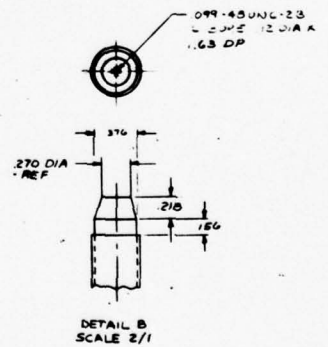
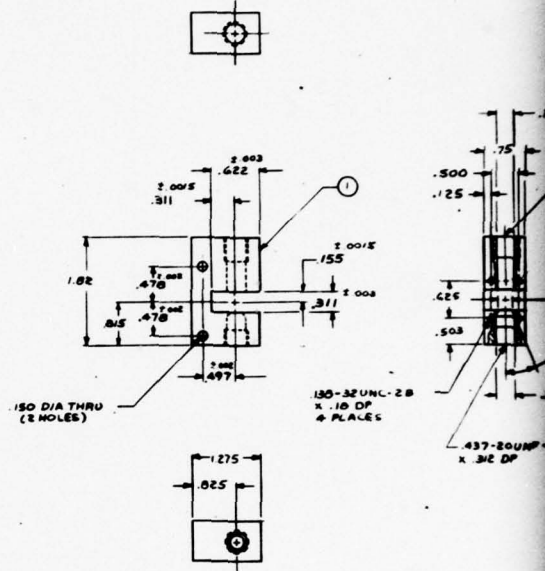
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- NOTES:
1. THRU TO THRU
  2. REVERSE
  3. ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED
  4. UNLESS OTHERWISE SPECIFIED
  5. ASSEMBLY

H  
G  
F  
E  
D  
C  
B  
A

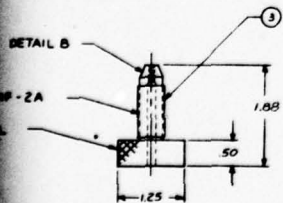
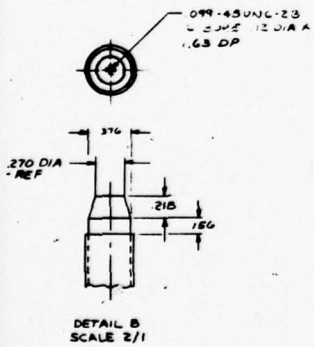
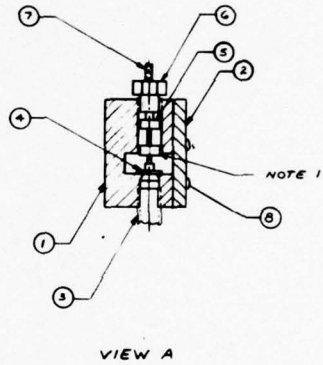
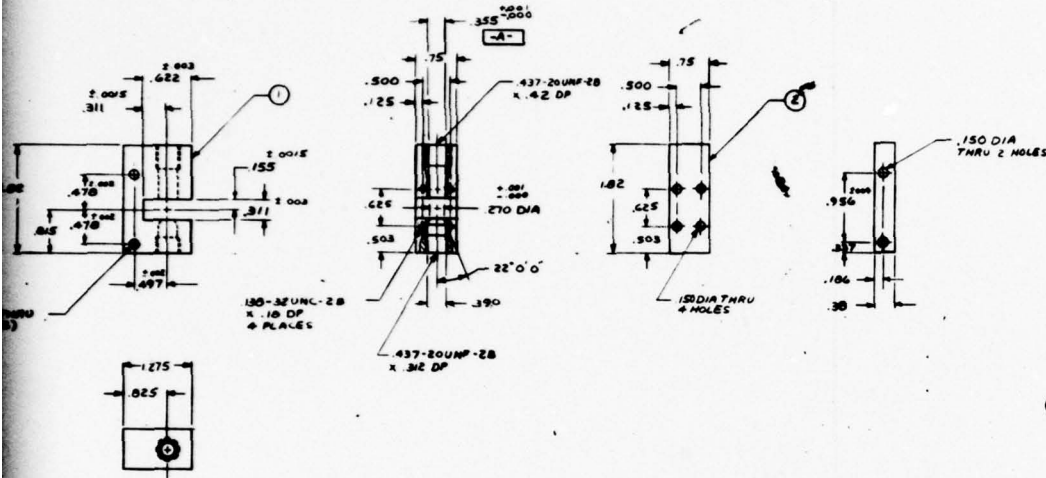


P.W.	A	B
1	.350	.040
2	.300	.035
3	.250	.035



REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

- NOTES:
1. THE TWO .353 REF DIAMETERS ON ITEM 5 TO BE WRAPPED WITH .15 WIDE X .001 THICK TEFLON TAPE (ONE LAYER). THE RESULTING .355 DIAMETER TO BE A SLIDING FIT WITH HOLE MARKED A- (ITEM 1)
  2. REMOVE BURRS + BREAK SHARP EDGES, ALL MACHINED PARTS.
  3. ALL INTERNAL CORNERS .005 R MAX, ALL MACHINED PARTS.
  4.  $\phi$  ALL OVER, ALL MACHINED PARTS.
  5. ASSEMBLE PER VIEW A.



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QTY	CODE	PART NO. OR IDENTIFICATION NO.	DRAWING OR SPECIFICATION NO.	NOMENCLATURE OR DESCRIPTION	FIND NO.
4				SST 6-32 X 1/2 LG PAN HD SCREW	8
1				SST 2-56 X 1 1/4 LG PAN HD SCREW	7
1				DELRIN ADJUSTING SCREW	6
1				BRA-ALLOY 360 1/4M PER QQ-B-626 TWO SECTION SHORT	5
1				BRA-ALLOY 360 1/4M PER QQ-B-626 HAT	4
1				COPPER PER QQ-C-576 DIODE HOLDER	3
1				AL 6061-T6 PER QQ-A-225/B KU BAND CAVITY (SIDE)	2
1				AL 6061-T6 PER QQ-A-225/B KU BAND CAVITY	1

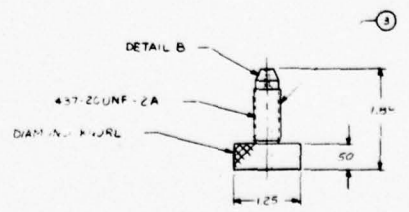
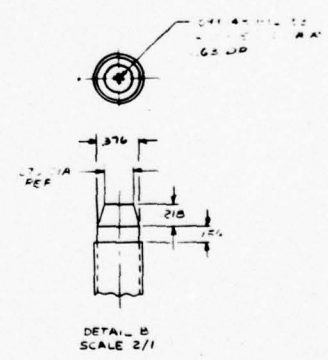
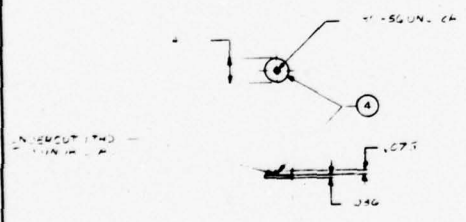
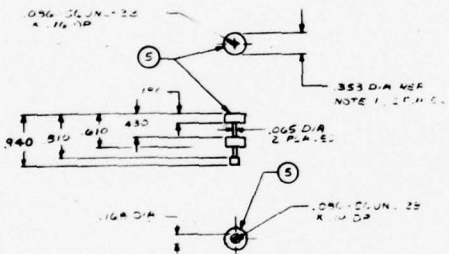
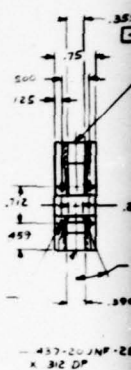
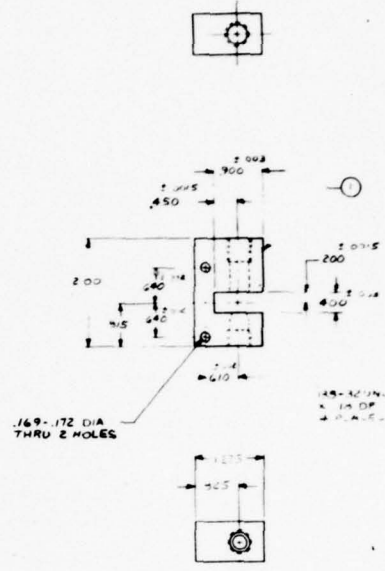
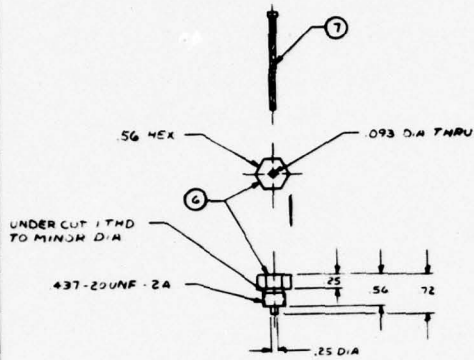
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTR NO.		RAYTHEON RAYTHEON COMPANY LEXINGTON, MASS 02173	
TOLERANCES: ANGLES $\pm$ .015		DR R. S. ... 8-20-75		DRAWING TITLE	
FRACTIONS $\pm$		CHK ...		Ku BAND TEST FIXTURE MODEL TNK-8000	
3 PLACE DECIMALS $\pm$ .005				APPROVED	
2 PLACE DECIMALS $\pm$ .01				BY E 49956	
1 PLACE DECIMALS $\pm$				DATE CODE IDENT NO DRAWING NO. ESM 22941	
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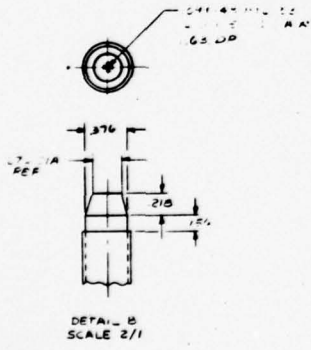
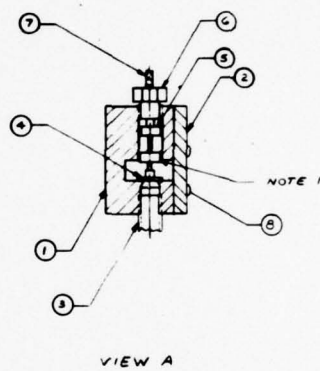
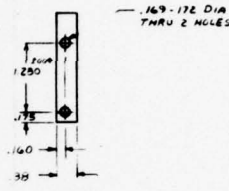
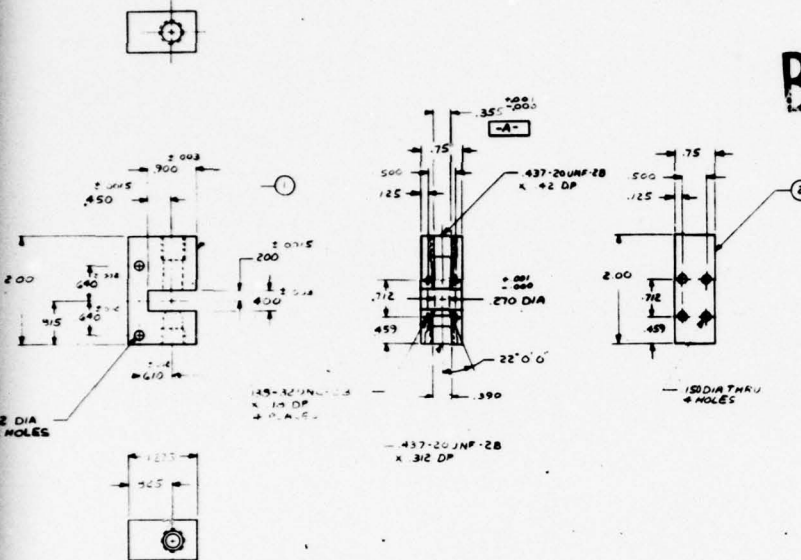
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REVISIONS			
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- NOTES:
1. THE TWO .353 REF DIAMETERS ON ITEM 5 TO BE WRAPPED WITH .15 WIDE X .001 THICK TEFLON TAPE (ONE LAYER). THE RESULTING .355 DIAMETER TO BE A SLIDING FIT WITH HOLE MARKED A- (ITEM 1)
  2. REMOVE BURRS & BREAK SHARP EDGES. ALL MACHINED PARTS
  3. ALL INTERNAL CORNERS .005 R MAX. ALL MACHINED PARTS
  4.  $\sqrt{R}$  ALL OVER. ALL MACHINED PARTS
  5. ASSEMBLE PER VIEW A.

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QTY	CODE	PART NO. OR IDENTIFICATION NO.	DRAWING OR SPECIFICATION NO.	NOMENCLATURE OR DESCRIPTION	FIND NO.
4		6-32 X 1/2 PAN HD SCREW			8
1		2-56 X 1/2 PAN HD SCREW			7
1		DEL RIN			6
1		DEL RIN			5
1		DEL RIN			4
1		DEL RIN			3
1		DEL RIN			2
1		DEL RIN			1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	DATE NO.	RAYTHEON	RAYTHEON COMPANY
TOLERANCES ANGLES $\pm .005$	DR P. 601 8-10-76	DRAWING TITLE	LEXINGTON, MASS 02133
FRACTIONS $\pm .005$	CHK <i>W. Kelly</i>	X BAND TEST FIXTURE	
3 PLACE DECIMALS $\pm .005$		MODEL THX-2000	
2 PLACE DECIMALS $\pm .01$			
1 PLACE DECIMALS $\pm .05$			
MATERIAL:	APPROVED	SIZE CODE IDENT NO. DRAWING NO.	
	BY SECTION OF	E 49956	ESM 22937
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2



### SECTION III

#### QUALITY CONTROL MANUAL

In-process inspection procedures are detailed in the following section. Production rates and yields are summarized in Section I of the report along with diode data for 1000 diodes manufactured on the program.

Detailed procedures contained in this section are listed in Figure III-1.

1.0	Surface Quality Inspection	RP-76-007
2.0	Thickness Gauging	
	Nominal Thickness	
	Bow Measurement	
	Taper Measurement	
3.0	Wafer Incoming Inspection	QC-SP-001
4.0	Metallization Adherence Test	QC-SP-002
5.0	Wafer Flatness Measurement	QC-SP-003
6.0	GaAs Thickness Measurement	QC-SP-004
7.0	Electrical Evaluation - Breakdown Voltage	QC-SP-005
8.0	Mechanical Inspection	QC-SP-006
9.0	Dice Inspection	QC-SP-007
10.0	Ribbon Bond Inspection	QC-SP-008
11.0	Dew Point Test	QC-SP-009
12.0	Gross Leak Test	QC-SP-010
13.0	Die Mount Inspection	QC-SP-012
14.0	Ribbon Bond Visual Inspection	QC-SP-013
15.0	Inspect Gold Lap	QC-SP-014
16.0	Back Lap Inspection	QC-SP-015
17.0	Ribbon Weld Test	QC-SP-017

Figure III-1 Inspection Procedures

## SECTION III

### QUALITY CONTROL MANUAL

#### 1.0 SURFACE QUALITY (INSPECTION RP-76-007)

##### 1.1 Equipment and Materials

- 1.1.1 Tweezers; Techni-Tool, stainless steel, nonmagnetic teflon coated.
- 1.1.2 High-intensity lamp; Bausch and Lomb, Cat. No. 31-35-39.
- 1.1.3 Fluorescent lamp/magnifying glass, dazor floating fixture, Model M-1470.
- 1.1.4 Centimeter scale.
- 1.1.5 Lens tissue (cut in 1-1/16 in. squares).
- 1.1.6 Filter papers; VWR Grade No. 613, Cat. No. 28311-029 (cut in 1-1/16 in. squares).
- 1.1.7 Sponge, 1-1/16 in. x 1-1/16 in. x 1/8 in., red, Foamcraft.
- 1.1.8 Clear polystyrene boxes, 0.5 in. x 1-1/4 in. x 1-1/4 in.; Bradley Industries.
- 1.1.9 "Wafer Inspection" form.
- 1.1.10 Polyethylene gloves.

##### 1.2 Safety Precautions

- 1.2.1 This procedure is not hazardous.

##### 1.3 Procedure

- 1.3.1 Record all substrate data on form.
- 1.3.2 Observe wafer under fluorescent lamp.
  - 1.3.2.1 Note any and all defects and their intensity on the form.
- 1.3.3 Observe wafer under high intensity lamp for any haze which may not be visible under normal lighting.

- 1.3.3.1 This lamp should be focused on the wafer to a circle of lighting approximately one centimeter in diameter.
- 1.3.3.2 Note findings on form.
- 1.3.4 Measure wafer size and note on form.
- 1.3.5 Sketch wafer and its major physical defects in space provided on form. This sketch should be indicative of the wafer's orientation in the reactor during growth.
- 1.3.6 Prepare storage boxes (all materials must be handled with gloves).
  - 1.3.6.1 In polystyrene box, place:
    - a) sponge, red.
    - b) filter paper.
    - c) wafer (to be placed at storage time).
    - d) lens tissue.
    - e) two sponges.
- 1.3.7 Store wafers.
  - 1.3.7.1 With tweezers, place the substrate side of the wafer on the filter paper layer in the box.
  - 1.3.7.2 Close box with epitaxial side facing the lens tissue.
  - 1.3.7.3 Transfer labeling from growth lab box to face of storage box.
  - 1.3.7.4 With marker, write wafer number of 0.5 in x 1-1/4 in. side of box.
  - 1.3.7.5 Store box with wafer number side up in storage cabinet.

## 2.0 THICKNESS GAUGING

### 2.1 Equipment and Material

- 2.1.1 Wafer gauging station; Ade Corp., Model 6031 (includes "Quick-Sort Anvil" mentioned in this procedure).
- 2.1.2 Tweezers; Techni-Tool, stainless steel, nonmagnetic, teflon coated.

2.1.3 Teflon wafer holder.

2.1.4 "Wafer Inspection" form.

2.2 Safety Precautions

2.2.1 This procedure is not hazardous.

2.3 Procedure

2.3.1 Calibrate wafer gauging system according to service manual prior to beginning operation (warm-up time is 1/2 hour).

2.3.2 Set tolerances for thickness measurement.

2.3.2.1 Set range to "Set tol" position.

2.3.2.2 Set mode switch to "A + B" position.

2.3.2.3 Set readout to read 320 microns (or other dimensions as purchaser specifies) with "set reading" knob.

2.3.2.4 Turn "+ Tolerance" knob until "H" light illuminates.

2.3.2.5 Set readout to read 280 microns (or other dimensions as purchaser specifies) with "set reading" knob.

2.3.2.6 Turn "- Tolerance" knob until "LO" light illuminates.

2.3.3 Proceed to measure thickness following Steps 2.3.4 to 2.3.12.

2.3.4 With tweezers, place wafer to be measured on "Quick Sort Anvil".

2.3.5 Using teflon wafer holder, move wafer so that the probes are situated on the center of the wafer.

2.3.6 Set mode switch to "A" position and using "A" zero knob, set readout to zero.

2.3.7 Set mode switch to "B" position and using "B" zero knob, set readout to zero.

2.3.8 Set range switch at "A" position.

2.3.9 Record digital readout reading on wafer inspection form.

- 2.3.10 If "HI" or "LO" light is illuminated, record as reason for rejection of wafer.
- 2.3.11 Remove wafer to its box.
- 2.3.12 Repeat Steps 2.3.4 through 2.3.11 for additional wafers.
- 2.3.13 Set tolerances for bow measurements.
  - 2.3.13.1 Set range switch to "Set tol" position.
  - 2.3.13.2 Set mode switch to "Bow" position.
  - 2.3.13.3 Set readout to read in accordance with specification with "set reading" knob.
  - 2.3.13.4 Turn "+ Tolerance" knob until "HI" light illuminates.
  - 2.3.13.5 Set readout to read in accordance with specification with "set reading" knob.
  - 2.3.13.6 Turn "- Tolerance" knob until "LO" light illuminates.
- 2.3.14 Proceed to measure bow following Steps 2.3.15 to 2.3.25.
- 2.3.15 Place wafer to be measured on "Quick Sort Anvil".
- 2.3.16 Set range switch to "A" position.
- 2.3.17 Using teflon wafer holder, move sample so that the probes are situated in a corner 1 mm from each side of the wafer.
- 2.3.18 Depress foot switch (digital readout should go to 000 microns).
- 2.3.19 Using teflon wafer holder, move wafer so that the probe will traverse a path 1 mm from the left edge of the wafer.
- 2.3.20 Stop movement at 1 mm from the bottom of the wafer.
- 2.3.21 Repeat Steps 2.3.19 and 2.3.20 for 5, 10, 15, and 20 mm from the left edge.
- 2.3.22 Record digital readout (Bow x2) on inspection.
- 2.3.23 If "HI" or "LO" light illuminates, record as reason for rejection of wafer.

- 2.3.24 Remove wafer to its box.
- 2.3.25 Repeat Step 2.3.24 for any additional wafers.
- 2.3.26 Set tolerances for taper measurement:
  - 2.3.26.1 Set range switch to "Set Tol" position.
  - 2.3.26.2 Set mode switch to "Taper" position.
  - 2.3.26.3 Set readout to read according to specification with "set reading" knob.
  - 2.3.26.4 Turn "+ Tolerance" knob until "HI" light illuminates.
  - 2.3.26.5 Set readout to read according to specification with "Set reading" knob.
  - 2.3.26.6 Turn "- Tolerance" knob until "LO" light illuminates.
- 2.3.27 Measure taper following Steps 2.3.28 to 2.3.38.
- 2.3.28 Place wafer to be measured on "Quick Sort Anvil".
- 2.3.29 Set range switch at "A" position.
- 2.3.30 Using teflon wafer holder, move sample so that the probes are situated in a corner 1 mm from each side of the wafer.
- 2.3.31 Depress foot switch (digital readout should go to 000 microns).
- 2.3.32 Using teflon wafer holder, move wafer so that the probe will traverse a path 1 mm from the left edge of the wafer.
- 2.3.33 Stop movement at 1 mm from the bottom of the wafer.
- 2.3.34 Repeat steps 2.3.32 and 2.3.33 for 5, 10, 15, and 20 mm from the left edge.
- 2.3.35 Record digital readout (taper X2) on inspection form.
- 2.3.36 If "HI" or "LO" light illuminates, record as reason for rejection of wafer.
- 2.3.37 Remove wafer to its box.

2.3.38 Repeat Steps 2.3.28 through 2.3.38 for any additional wafers.

3.0 WAFER INCOMING INSPECTION (QC-SP-001)

3.1 Equipment and Material

3.1.1 Microscope (Bausch & Lomb Stereozoom or equivalent).

3.1.2 I.R.C. - Inspection Record Card.

3.1.3 Wafer Specification 892049.

3.2 Procedure

3.2.1 Record receiving data on I.R.C. card.

3.2.2 Visually inspect the wafer under microscope (30X) for surface imperfections such as roughness, cracks, chips, etc.

3.2.3 Any imperfections shall be brought to the attention of Q.C. Engineer for disposition.

3.2.4 Review test data supplied by vendor for conformance to wafer purchase specification.

4.0 METALLIZATION ADHERENCE TEST (QC-SP-002)

4.1 Equipment and Material

4.1.1 Glass Slide (Corning #48300-160 VWR or equivalent).

4.1.2 Scotch Tape (3M Company).

4.1.3 Apiezon Wax (#59336-002 VWR).

4.1.4 Trichlorethylene (Electronic Grade #167-2787 Allied Chemical).

4.1.5 Acetone (Electronic Grade #119-2750, Allied Chemical).

4.2 Procedure

4.2.1 Mount the wafer, platinum side up, to a glass slide using Apiezon wax.

4.2.2 Place a piece of Scotch tape directly on the platinum layer and press down firmly with a finger nail.

4.2.3 Rip the tape off in an effort to remove the platinum.



- 4.2.4 If any platinum adheres to the tape, it is considered to be rejected and should be indicated as such on the run sheet.
- 4.2.5 If no platinum appears on the tape, the wafer is accepted and should be signed off as such on the run sheet.
- 4.2.6 Remove the wafer from the glass slide.
- 4.2.7 Clean the wafer in trichlorethylene and acetone thoroughly to remove the residual adhesive.

## 5.0 WAFER FLATNESS MEASUREMENT (QC-SP-003)

### 5.1 Equipment and Materials

- 5.1.1 Dial indicator height gauge (Starrett #656-211 or equivalent).

### 5.2 Procedure

- 5.2.1 Measure the wafer flatness at nine scattered points using the dial indicator height gauge.
- 5.2.2 The deviation between these readings must be no greater than 0.2 mils.
- 5.2.3 Verify wafer thickness at this point as recorded on run sheet.
- 5.2.4 If the wafer successfully meets this specification, sign off the run sheet.

## 6.0 GaAs THICKNESS MEASUREMENT (QC-SP-004)

### 6.1 Equipment and Material

- 6.1.1 Microscope 50-400 X with vertical measuring scale capable of one micron resolution.

### 6.2 Procedure

- 6.2.1 Measure the pad height using the vertical measuring scale on the microscope in approximately three places.
- 6.2.2 Determine that the pad height is within specifications.

6.2.3 Visually inspect using 60X microscope. Surface pitting, stress cracks, overetched pads, any lifting of metallization and any staining of the pad must be brought to the attention of the process engineer.

## 7.0 ELECTRICAL EVALUATION - BREAKDOWN VOLTAGE (QC-SP-005)

### 7.1 Equipment and Materials

7.1.1 Wentworth Labs. Multiprobe Station with X (Horizontal) and Y (Vertical) axis micrometers.

7.1.2 Baush and Lomb microscope with 15X Optics.

7.1.3 Tektronics Type 575 transistor curve tracer.

7.1.4 Tweezers (Dumont #3C, stainless steel).

### 7.2 Safety

7.2.1 Keep current levels at 0.1 ma to 1.0 ma and voltage levels below 200V to prevent shocks to operators.

### 7.3 Procedure

7.3.1 Place water on brass platform of probe station.

7.3.2 Connect wire leads to the curve tracer from the probe station. Set voltage at 0.

7.3.3 Using the microscope to align the slice, rest one of the probe needles on a gold dot region of the slice. There are approximately 200 individual dots on the average slice.

7.3.4 Making sure the current level is 1 ma, apply voltage in the reverse direction until a breakdown occurs.

7.3.5 Breakdown is recognized when the tracer shows a point on the X axis where the curve drops sharply down the Y axis. At this point, no further voltage can be applied at this current level. This is known as an avalanche breakdown.

7.3.6 Probe at least one dot in every corner of the slice to determine if breakdown is within spec.

## 8.0 MECHANICAL INSPECTION (QC-SP-006)

### 8.1 Equipment and Material

8.1.1 Nikon Model 70919 microscope or equivalent.

8.2 Procedure

8.2.1 Place the wafer under the inspection microscope.

8.2.2 Determine whether or not the mesa is the proper diameter.

8.2.3 Determine that the proper mesa mask and contact mask were used by comparing the sample against the specification.

8.2.4 Observe the surface condition of the mesa noting any defects. Consult the Process Engineer and/or Q.C. Engineer, if necessary, to determine whether surface condition is acceptable.

9.0 DICE INSPECTION (QC-SP-007)

9.1 Equipment and Material

9.1.1 Metallurgical microscope, Reichert No. 328126.

9.1.2 Tweezers, #3C, Dumont, nonmagnetic, stainless steel.

9.2 Procedure

9.2.1 Observe mounted die under microscope at 30X.

9.2.2 Reject if gold meniscus extends above the mesa or on the gold dot.

9.2.3 Reject if die is cracked or broken on the mesa or gold dot.

9.2.4 Reject if gold does not have appearance of complete flow.

9.2.5 Reject if package gold plating shows evidence of flaking or blistering.

9.2.6. Reject if gold dot is not complete and intact.

10.0 RIBBON BOND INSPECTION (QC-SP-008)

10.1 Equipment and Material

10.1.1 Stainless steel tweezers, #3C Dumont, nonmagnetic.

10.1.2 B&L Zoom microscope, 60X power.

10.1.3 Pull gauge, Scherr-Tumico.

10.2 Procedure

10.2.1 Bond three units before starting production.

10.2.2 Submit the three units to Q.C. for pull test.

10.2.3 Q.C. records pull test results in log book, including point of failure.

10.2.4 If any bond does not pull at greater than 3 grams, the lot is rejected. A new sample of five units shall be bonded and tested as often as necessary until bonding conditions are optimized.

10.2.5 When the pull test has been successfully completed, the operator is allowed to complete the bonding of the lot if it can be completed in one day.

10.2.6 Every day of bonding requires bond testing evaluation.

10.2.7 Every change of setup requires bond testing evaluation.

11.0 DEW POINT TEST (QC-SP-009)

11.1 Equipment and Material

11.1.1 Alnor Dew Pointer Model 7000U.

11.1.2 Alnor Dew Point Calculator.

11.1.3 Dry box.

11.2 Procedure

11.2.1 Open the purging valve (ccw).

11.2.2 Set the toggle switch to AC.

11.2.3 Operate the pump 20 times minimum.

11.2.4 Depress and hold the "Unity Adjuster Push Gauge Valve". Vary the unity adjuster until the red indicator is on 1.

11.2.5 Close the purging valve (cw).

11.2.6 Operate the pump until the red indicator is at 0.3.

- 11.2.7 After 15 seconds, depress the operating valve while visually monitoring the fog chamber. If smoke is visible, repeat this procedure except with Step 11.2.6 set to 0.4.
- 11.2.8 If the fog chamber is clear, repeat procedure with setting at 0.35.
- 11.2.9 Continue to repeat procedure until the minimum reading without smoke is attained.
- 11.2.10 Using this minimum reading and the temperature from the dew pointer, calculate the actual dew point utilizing the dew point calculator.

## 12.0 GROSS LEAK TEST (QC-SP-010)

### 12.1 Equipment and Material

- 12.1.1 200 ml beaker, SGA-B-3873-5.
- 12.1.2 Thermometer, 20°C to +150°C, SGA-T-3291 or equivalent.
- 12.1.3 Microscope, Baush & Lomb @ 20X.
- 12.1.4 Tweezers, Dumont, #3C or equivalent.
- 12.1.5 Hot plate, SGA-H-3235 or equivalent.
- 12.1.6 Fluorocarbon-43.

### 12.2 Procedure

- 12.2.1 Pour FC-43 into a 200 ml beaker to a depth of 2-1/2".
- 12.2.2 Heat the beaker of mineral oil to 125°C <sup>+5°</sup> -0 .
- 12.2.3 Immerse the sealed packages into the FC-43 so that the lid is downwards (major axis in horizontal). The FC-43 must cover packages by 2 inches.
- 12.2.4 Allow the samples to soak for 30 seconds while visually monitoring them under a microscope.
- 12.2.5 A single bubble emanating from the samples is considered a reject.

13.0 DIE MOUNT INSPECTION (QC-SP-012)

13.1 Equipment and Materials

13.1.1 Microscope (Bousch & Lomb or equivalent at 20X).

13.1.2 Cotton swab (Otis Clapp - 6" wood handle).

13.2 Procedure

All inspection to be performed under 20X magnification.

13.2.1 Inspect the unit to ensure that the die is centered on the pedestal.

13.2.2 Determine that the solder has properly been wetted and has formed a proper bond between the die and the pedestal.

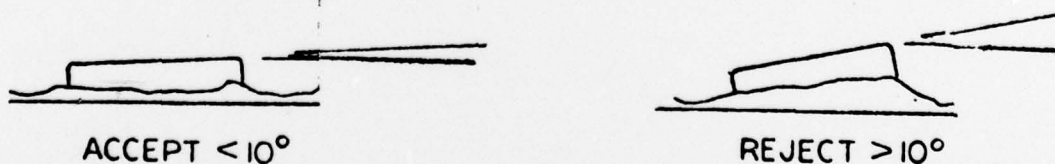
13.2.2.1 Voids in the die bond which exceed 25% of the perimeter of the die are cause for rejection.

13.2.2.2 Voids in the die bond which exceed more than 25% on any one side are cause for rejection.

13.2.3 Determine that all residue flux and solvents have been removed ensuring a clean unit.

13.2.4 Inspect the unit to ensure that no metal bridging occurs between the pedestal and the wall.

13.2.5 The die shall be parallel with the mounting plane. See Figure 1.



Die not parallel with mounting plane.

Figure 1

13.2.6 Inspect for excessive mounting material. See Figure 2.

13.2.6.1 Excessive mounting material adjacent to the die which has a height greater than the die thickness is cause for rejection.

13.2.6.2 Excessive mounting material away from the die greater than the height of the die is cause for rejection.

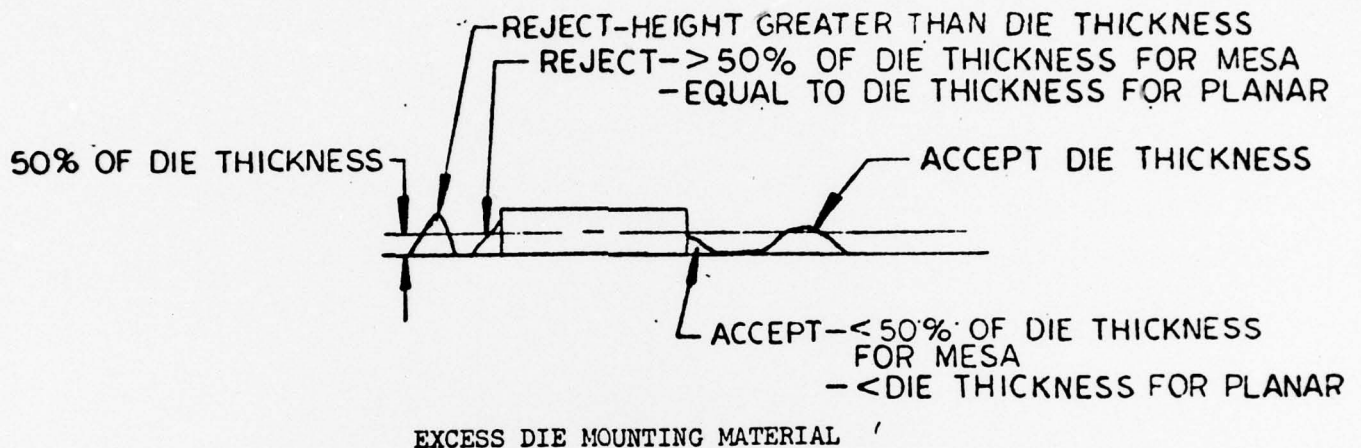


Figure 2

14.0 RIBBON BOND VISUAL INSPECTION (QC-SP-013)

14.1 Equipment

14.1.1 Microscope (Bausch & Lomb Stereozoom at 60X).

14.2 Procedure

14.2.1 Examine under a 60X microscope. No device shall be acceptable which exhibits the following:

14.2.1.1 Bonds on the die or package post that are less than 1.2 times and more than 3.0 times the wire diameter in width or which are less than 1.5 and more than 5.0 times the wire diameter in length.

14.2.1.2 Bonds where less than 50 percent of the bond is within the bonding pad area or bonds on the package post which are not completely within the boundaries of the package post when viewed from above.

14.2.1.3 Each unit shall be touched with probe to verify bond.

15.0 INSPECT GOLD LAP (QC-SP-014)

15.1 Equipment and Material

15.1.1 Height gauge (Starett #656-211, or equivalent).

15.2 Procedure

15.2.1 Measure the wafer thickness at nine scattered points.

15.2.2 Compare these measurements with those taken at "Flat Lap MS-SP-102".

15.2.3 Determine that the gold thickness is 0.4 mils.

15.2.4 Verify that the deviation between the nine scattered readings is no greater than 0.2 mils.

16.0 BACK LAP INSPECTION (QC-SP-015)

16.1 Equipment and Material

16.1.1 Height gauge (Starett #656-211, or equivalent).

16.2 Procedure

16.2.1 Using the height gauge, determine that the wafer thickness is 6 mils.

16.2.2 Measure the wafer flatness at nine scattered points. The deviation of these readings must be no greater than 0.2 mils.

16.2.3 Inspect the wafer for cleanliness. There must be no scratches on the platinum side, no adhesive present, and no evidence of grit present.

17.0 RIBBON WELD TEST (QC-SP-017)

17.1 Equipment and Material



17.1.1 Stainless steel tweezers, #3C Dumont, nonmagnetic.

17.1.2 B&L Zoom microscope, 60X power.

17.1.3 Pull gauge, Scherr-Tumico.

17.2 Procedure

17.2.1 Weld three units before starting production.

17.2.2 Submit the three units to Q.C. for pull test.

17.2.2.1 Record pull test results in log book, including point of failure; e.g., at wire/at weld.

17.2.2.2 If any weld does pull apart at a reading of less than 5 inch/ounces, a new sample of five units shall be bonded and tested.

17.2.3 When the pull test has been successfully completed, the operator is allowed to complete the welding of the lot if it can be completed in one day.

17.2.4 Every day of welding requires weld testing evaluation.

17.2.5 Every change of mechanical electrical setup required weld testing evaluation.

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