ATLAS SCT
The ATLAS Semiconductor Tracker
RAL PPD

WIREBONDING OF ASSEMBLED ATLAS SCT MIDDLE FORWARD MODULES.

<u>ESD PROTECTION INSTRUCTIONS.</u>

WEAR WRIST-STRAP CONNECTED TO GROUND-GUARD.

ENSURE GROUND GUARD SHOWS GREEN LED ILLUMINATED.

UNPACK DEVICES ON DISSIPATIVE SURFACE.

ENSURE "VISITORS" OBSERVE THE SAME INSTRUCTIONS.

GENERAL OVERVIEW

STAGE 1: Acceptance of Module.
- 1.1 Database
- 1.2 Inspection.

STAGE 2: Module Mounting.

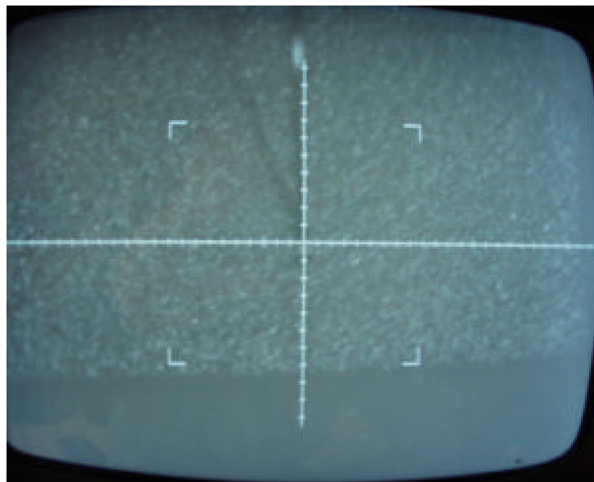
STAGE 3: Mounting onto K&S 1470

STAGE 4: Wirebonding.
- 4.1 1470 Bonding Program Map & Module Wirebonding Progress Card.
- 4.2 Bias: - hybrid to fan-in [Top Face].
- 4.3 ABCD3T to fan-in [Top Face].
- 4.4 Detector to Fanin [Top Face].
- 4.5 Detector to detector [Top Face].
- 4.6 Module Bottom Face.

STAGE 5: Dispatch of Module.
- 5.1 Database.
- 5.2 Inspection.
- 5.3 Dispatch.

MODULE TIMEWALK:

The following operating procedure is written assuming a K&S 1470 wire bonding machine is to be used. The calibration of the bonder is assumed to be such that the crosshairs are at the bondfoot. Any deviation from this should be taken into consideration when aligning the reference points.



Stage 1: Acceptance of Module.

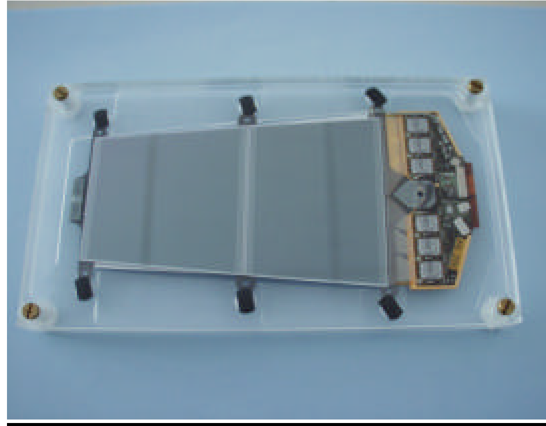
1.1 Database.

Upon receipt of a module the database has to be updated by the institute's designated person. This must ensure that the institute accepts delivery and becomes the owner of the module until such time that the module is forwarded to a test facility.

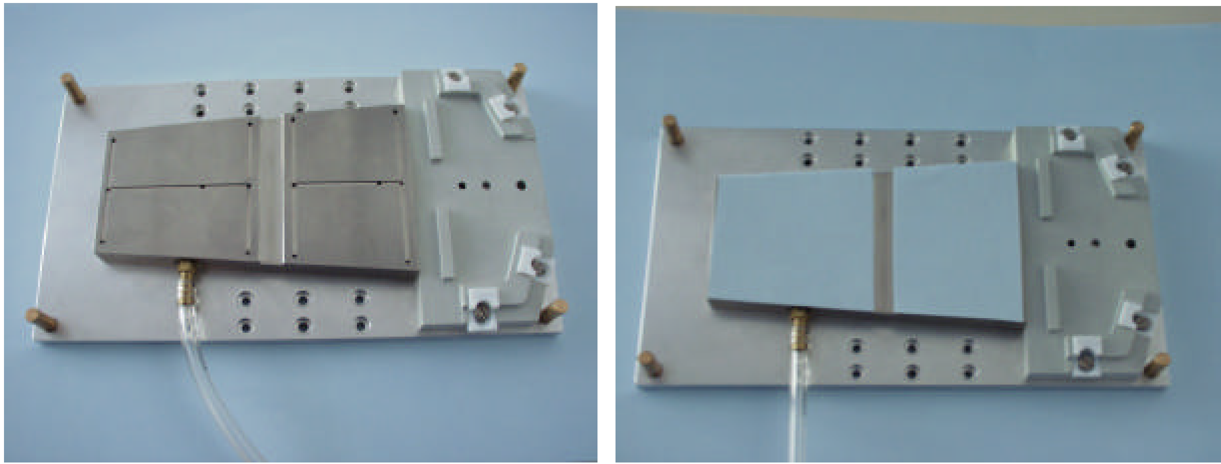
1.2 Inspection.

Prior to wirebonding, module must be inspected to determine whether there has been any surface damage to the detectors or damage to the hybrid wirebonding during module assembly.

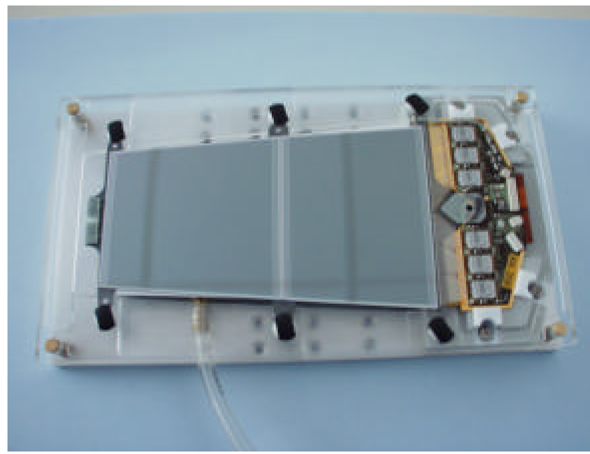
Stage 2: Module Mounting.



The module is held, by six clips, into the bonding frame and protected by a top and bottom plate.

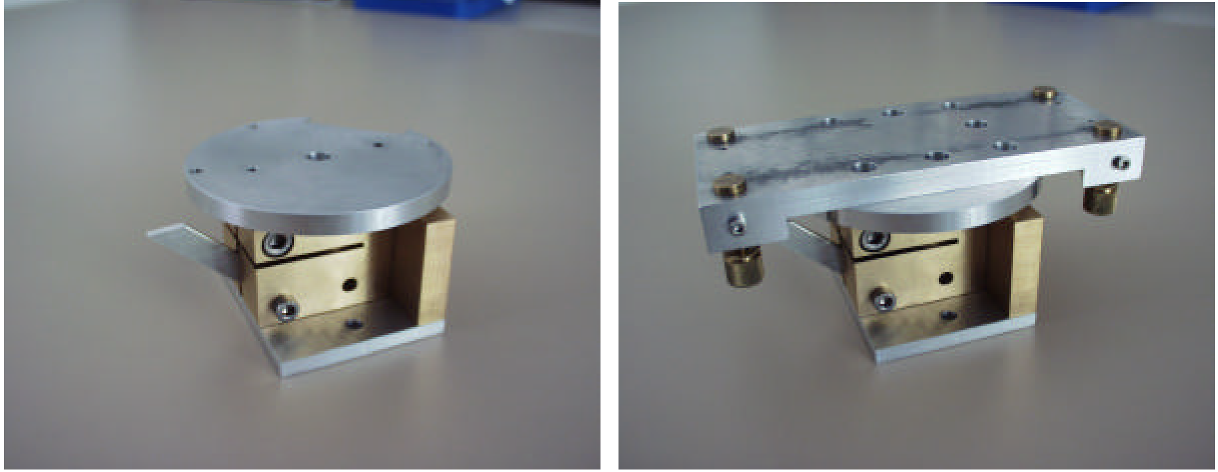


Cleanroom paper is used on the vacuum surfaces of the bonding jig to protect the detector faces.

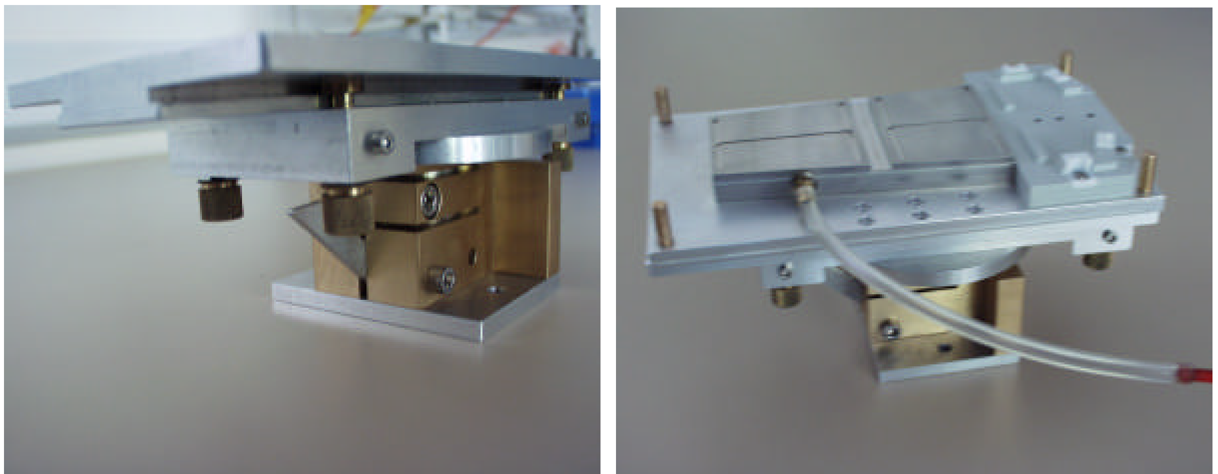


Remove the module, in the bonding frame and carefully align the four corner holes with the four corner posts. Lower the frame onto the vacuum faces and apply vacuum. Check that the vacuum supplied, to the jig, is better than 100Torr. Lightly clamp the hybrid using the four PTFE slide clamps and screws.

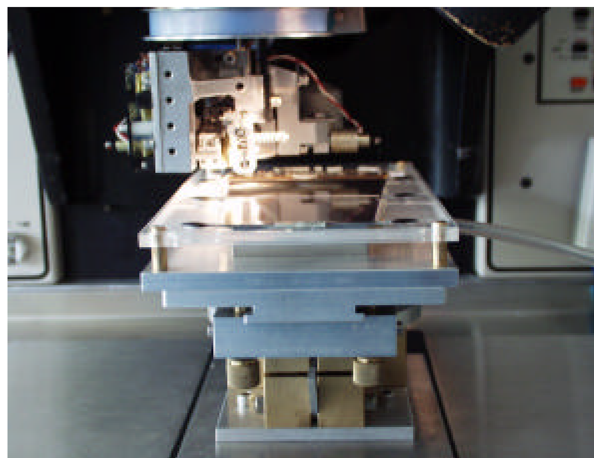
Stage 3: Mounting onto K&S 1470



The slideclamp is mounted onto the K&S 1470 workholder.



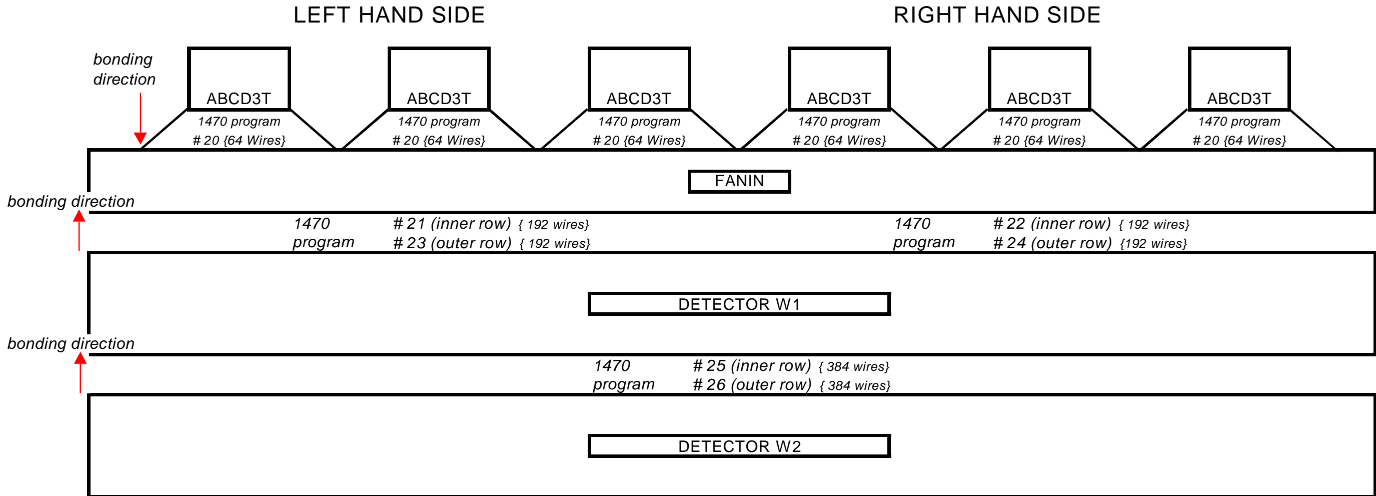
The slideplate, with the bonding jig, is clamped onto the slideclamp.



The module, in the bonding frame, is held under vacuum to the bonding jig and can be slid onto the workholder and clamped. This enables the module to be mounted and demounted from the bonding jig safely at an adjacent workarea and away from working under the 1470 bondhead.

Stage 4: Wirebonding.

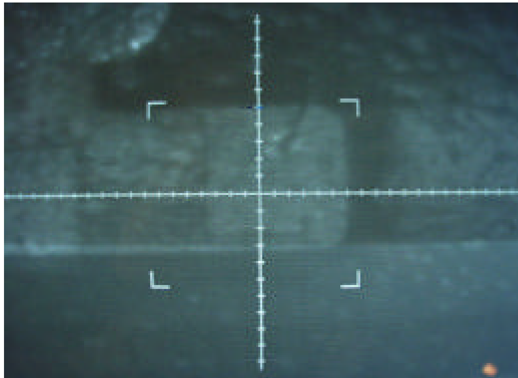
4.1 1470 Bonding Program Map.



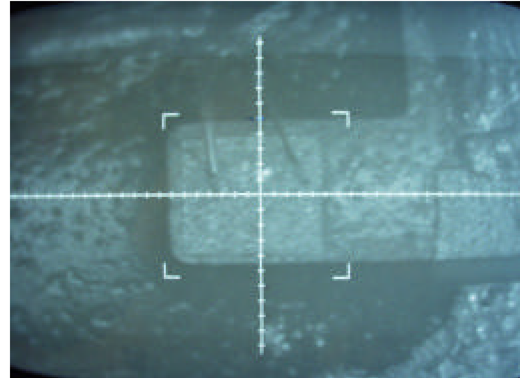
Module Wirebonding Progress Record Card.

4.2 Bias: - hybrid to fanin [Top Face].

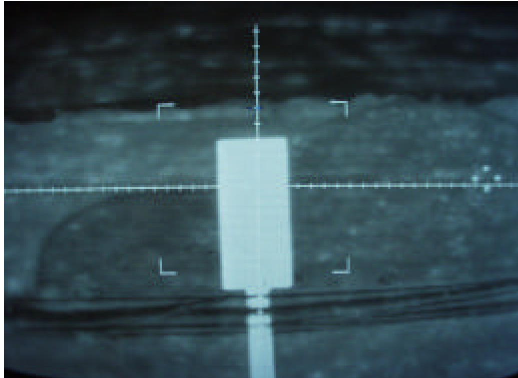
1. Set 1st bond power to 2.6 and 2nd bond power to 2.1
2. Set CVL1=CVL2=6
3. Set Loop Height to 60 in LHT mode.
4. Bond two wires from hybrid bias pad to fanin bias pad at both left hand and right hand sides of the module.

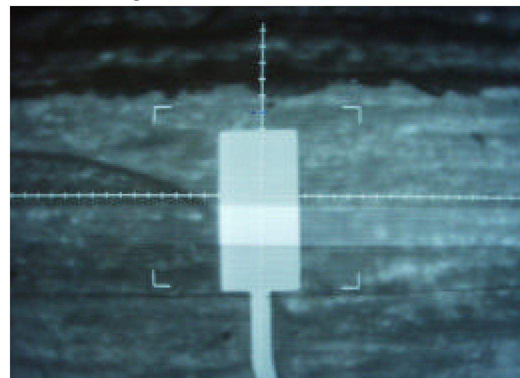


Left hand side



Right hand side

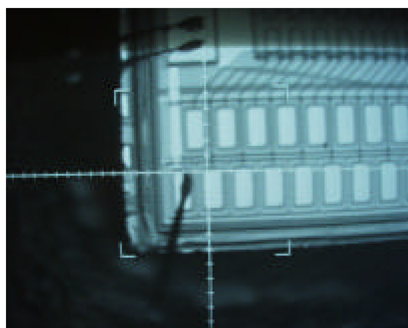




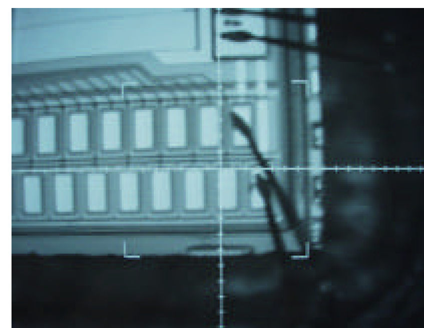
4.3 ABCD3T to Fanin [Top Face].

4.3.1 First row.

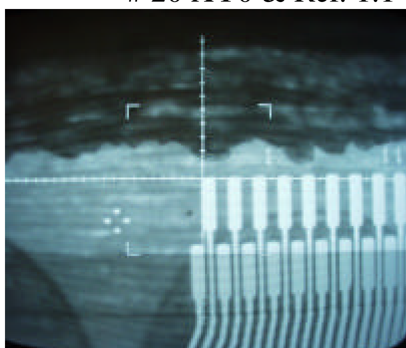
1. Load 1470 program # 20 [Atlas Forward Module Middle; ABCD3T - Fanin]
2. Move module under bondhead so that M0 is the first chip to be bonded.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on ABCD3T chip)
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.



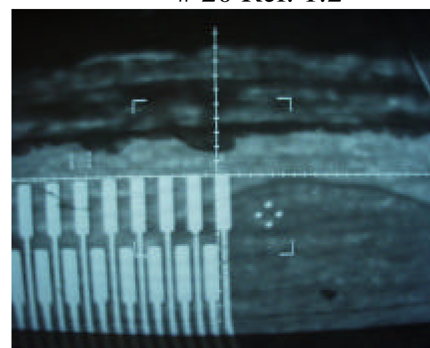
20 XY0 & Ref. 1.1



20 Ref. 1.2



20 Ref. 2.1



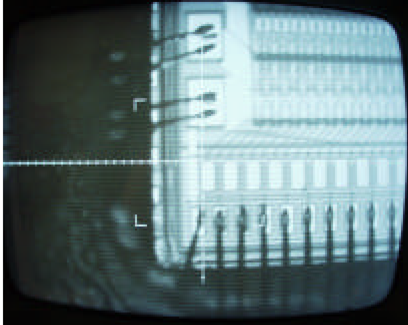
20 Ref. 2.2

6. Check CVL1=CVL2=6
7. Check Loop Height=50 and in LHT mode.
8. Set 1st bond power to 2.2 and 2nd bond power to 2.2
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from ABCD3T to Fanin and as such the bonding operation cannot be observed using the stereo microscope. Until 64 wires are bonded, and the missing wire is operational, it is worth stopping after say 20 and 40 wires and observing that the bonding is correct.
12. Bond all first row channels of each device and note on the module progress card the bond quality parameters for the last 64 wires on completing chips S2 and E5.

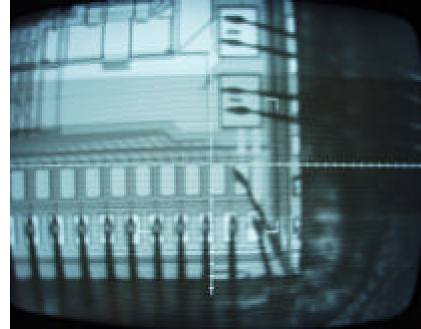
	S2	E5	S10	E13
CHIP	55 : 5			
FANIN	65 : 4			

4.3.2 Second row

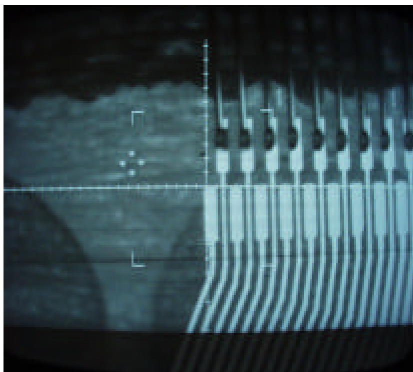
1. Load 1470 program # 20 [Atlas Forward Module Middle; ABCD3T - Fanin]
2. Move module under bondhead so that M0 is the first to be bonded.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on ABCD3T chip)
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.



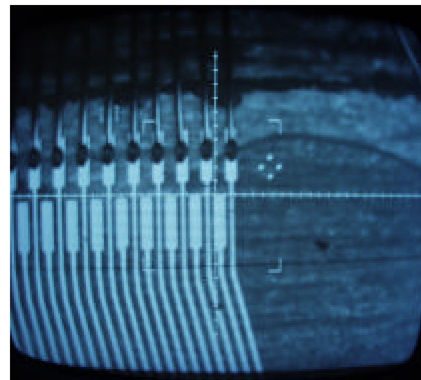
20 XY0 & Ref. 1.1



20 Ref. 1.2



20 Ref. 2.1



20 Ref. 2.2

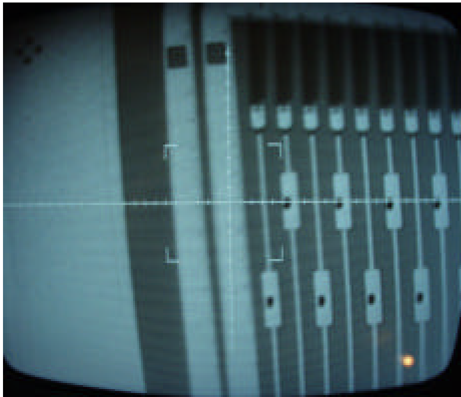
6. Check CVL1=CVL2=6
7. Check Loop Height=80 and in LHT mode.
8. Set 1st bond power to 2.2 and 2nd bond power to 2.2
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from ABCD3T to Fanin and as such the bonding operation cannot be observed using the stereo microscope. Until 64 wires are bonded, and the missing wire is operational, it is worth stopping after say 20 and 40 wires and observing that the bonding is correct.
12. Bond all second row channels of each device and note on the module progress card the bond quality parameters for the last 64 wires on completing chips S2 and E5.

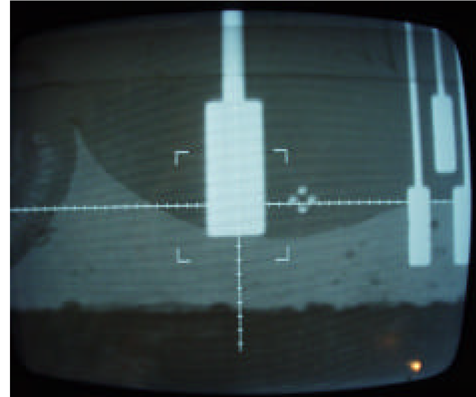
	S2	E5	S10	E13
CHIP	55 : 5	56 : 5		
FANIN	65 : 4	62 : 4		

4.4 Detector to Fanin [Top Face].

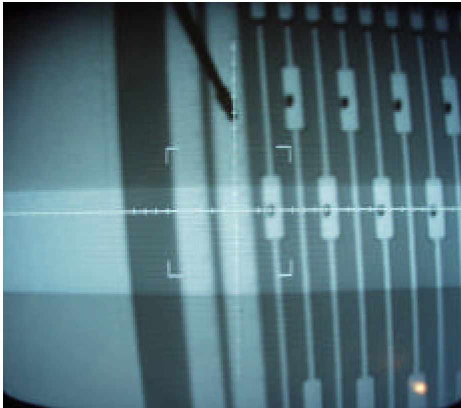
4.4.1 Bias

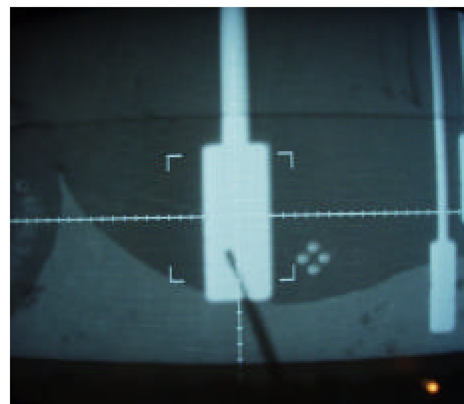
1. Move the module such that the left-hand detector to fanin is under the bond head.
2. Set 1st bond power to 2.1 and 2nd bond power to 2.3.
3. Set CVL1=CVL2=6
4. Set Loop Height to 60 in LHT mode.
5. Bond one wire from detector bias pad to fanin bias pad.


1st detector bond pad.

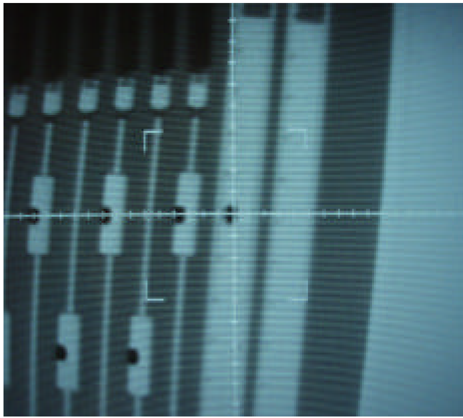

1st fanin bond pad.

6. Set Loop Height to 80 in LHT mode.
7. Bond second wire from detector bias pad to fanin bias pad.

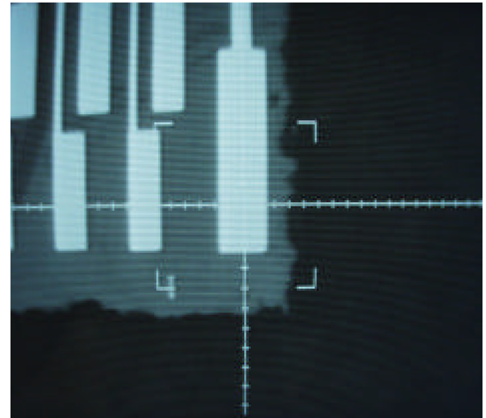

2nd detector bond pad.


2nd fanin bond pad.

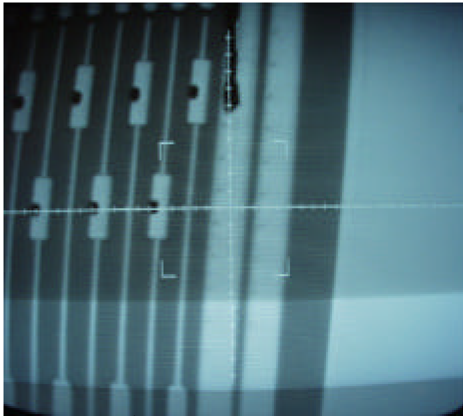
8. Move module so that the right hand side detector to fanin is under the bondhead and repeat from 4.



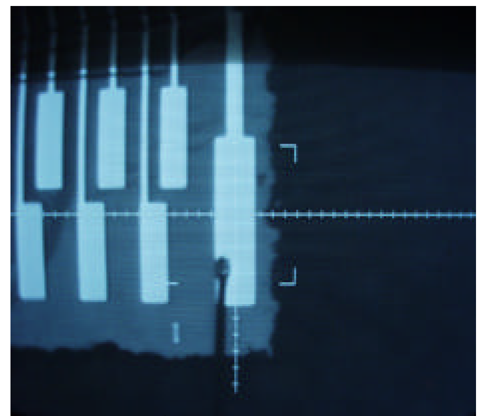
1st detector bond pad.



1st fanin bond pad.



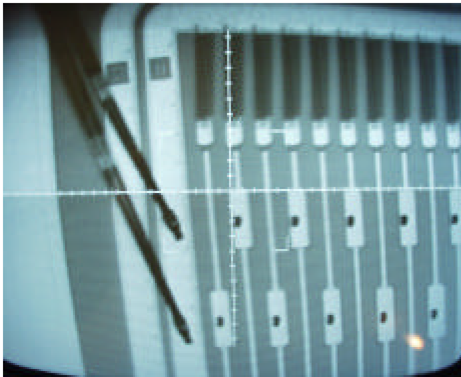
2nd detector bond pad.



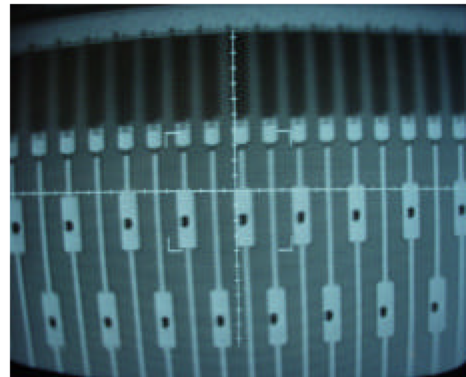
2nd fanin bond pad.

4.4.2 Detector to Fanin [LH Side 1st Row].

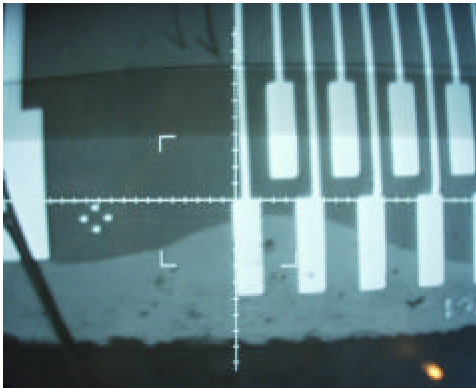
1. Load 1470 program # 21 [Atlas Forward Module Middle; Det-Fanin; 1st Row LH Side].
2. Move module under bondhead so that the left-hand side detector to fanin is positioned for bonding.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on Detector)
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.



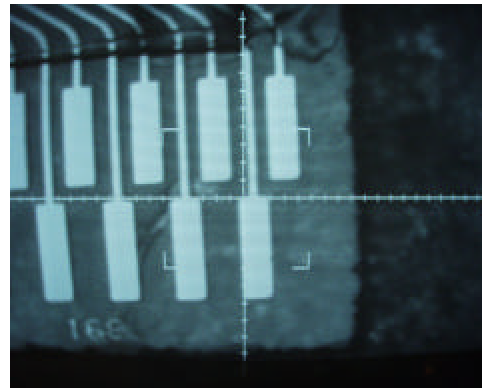
21 XY0 & Ref. 1.1



21 Ref. 1.2



21 Ref. 2.1



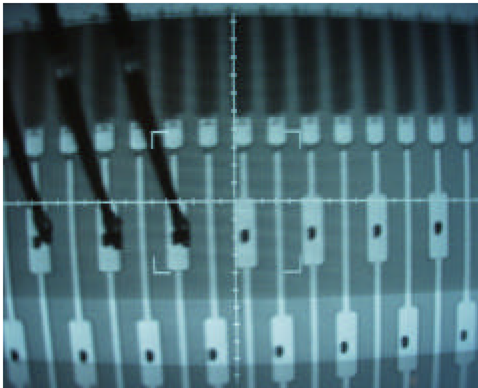
21 Ref. 2.2

6. Check CVL1=CVL2=6
7. Check Loop Height=60 and in LHT mode.
8. Set 1st bond power to 2.1 and 2nd bond power to 2.3
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from Detector to Fanin and as such the bonding operation can be observed using the stereo microscope.
12. Bond all 192 wires and record bond quality parameters, for program # 21 Top Side, on the module progress card for the last 64 wires bonded.

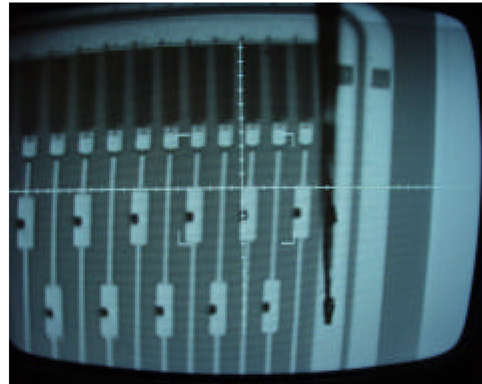
		# 21	# 22	# 23	# 24
TOP SIDE	DET	53 : 6			
	FANIN	55 : 6			

4.4.3 Detector to Fanin [RH Side 1st Row].

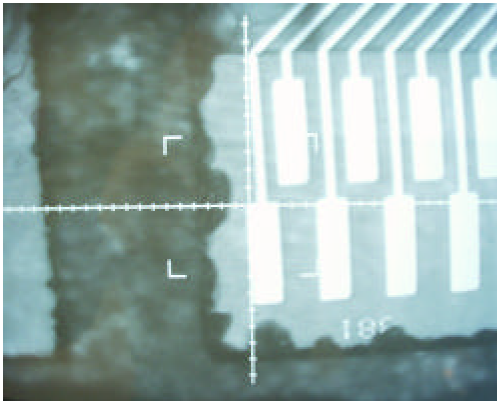
1. Load 1470 program # 22 [Atlas Forward Module Middle; Det-Fanin; 1st row RH Side].
2. Move module under bondhead so that the right-hand side detector to fanin is positioned for bonding.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on Detector)
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.



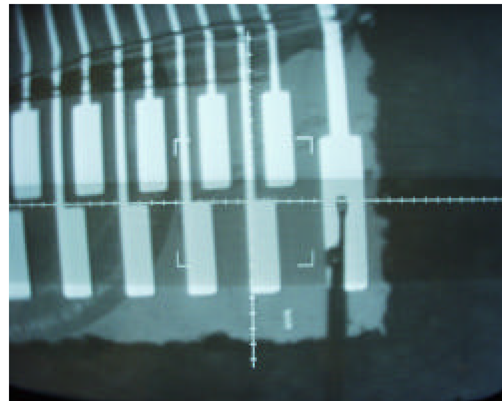
22 XY0 & Ref. 1.1



22 Ref. 1.2



22 Ref. 2.1



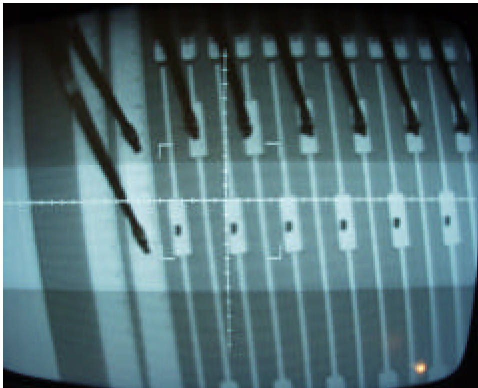
22 Ref. 2.2

6. Check CVL1=CVL2=6
7. Check Loop Height=60 and in LHT mode.
8. Set 1st bond power to 2.1 and 2nd bond power to 2.3
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from Detector to Fanin and as such the bonding operation can be observed using the stereo microscope.
12. Bond all 192 wires and record bond quality parameters, for program # 22 Top Side, on the module progress card for the last 64 wires bonded.

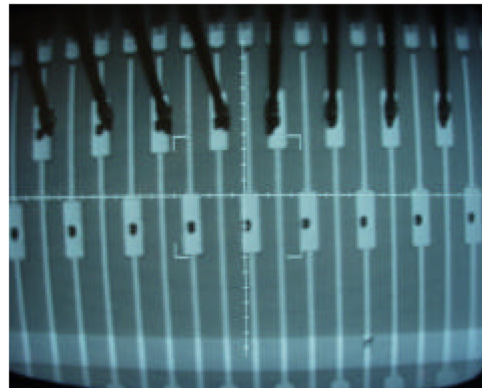
		# 21	# 22	# 23	# 24
TOP SIDE	DET	53 : 6	53 : 5		
	FANIN	55 : 6	61 : 4		

4.4.4 Detector to Fanin [LH Side 2nd Row].

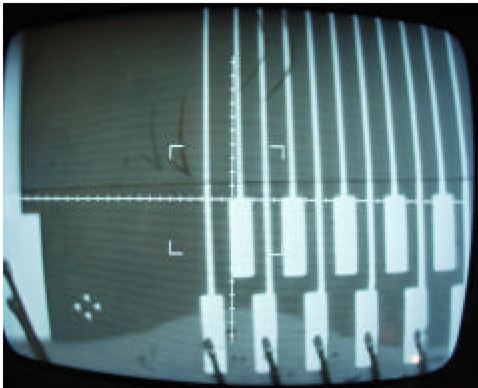
1. Load 1470 program # 23 [Atlas Forward Module Middle; Det-Fanin; 2nd row LH Side].
2. Move module under bondhead so that the left-hand side detector to fanin is positioned for bonding.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on Detector)
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.



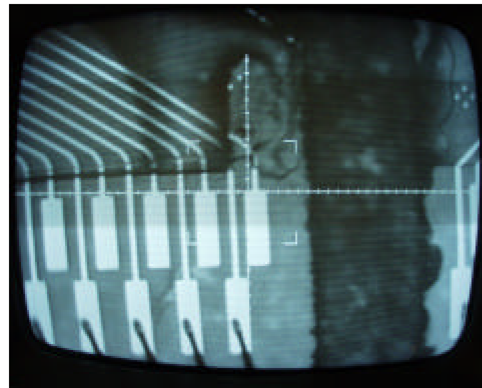
23 XY0 & Ref. 1.1



23 Ref. 1.2



23 Ref. 2.1



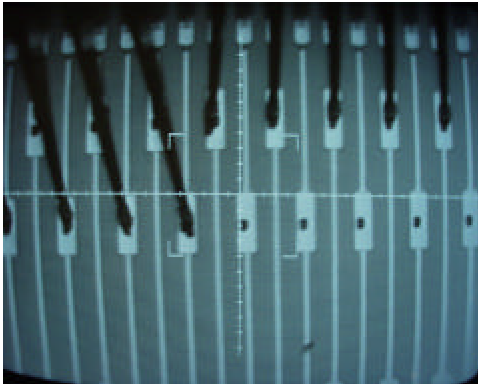
23 Ref. 2.2

6. Check CVL1=CVL2=6
7. Check Loop Height=80 and in LHT mode.
8. Set 1st bond power to 2.1 and 2nd bond power to 2.3
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from Detector to Fanin and as such the bonding operation can be observed using the stereo microscope.
12. Bond all 192 wires and record bond quality parameters, for program # 23 Top Side, on the module progress card for the last 64 wires bonded.

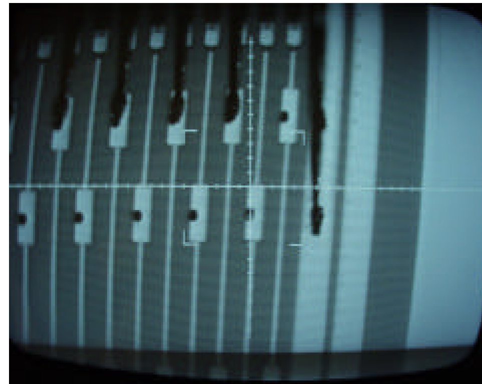
		# 21	# 22	# 23	# 24
TOP SIDE	DET	53 : 6	53 : 5	47 : 5	
	FANIN	55 : 6	61 : 4	60 : 5	

4.4.5 Detector to Fanin [RH Side 2nd Row].

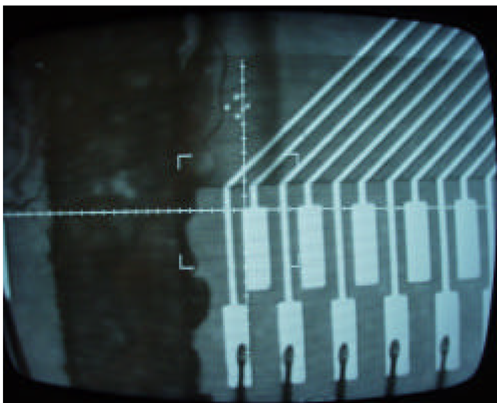
1. Load 1470 program # 24 [Atlas Forward Module Middle; Det-Fanin; 2nd row RH Side].
2. Move module under bondhead so that the left-hand side detector to fanin is positioned for bonding.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on Detector)
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.



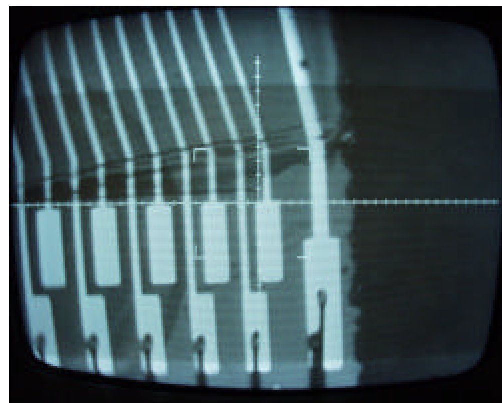
24 XY0 & Ref. 1.1



24 Ref. 1.2



24 Ref. 2.1



24 Ref. 2.2

6. Check CVL1=CVL2=6
7. Check Loop Height=80 and in LHT mode.
8. Set 1st bond power to 2.1 and 2nd bond power to 2.3
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from Detector to Fanin and as such the bonding operation can be observed using the stereo microscope.
12. Bond all 192 wires and record bond quality parameters, for program # 24 Top Side, on the module progress card for the last 64 wires bonded.

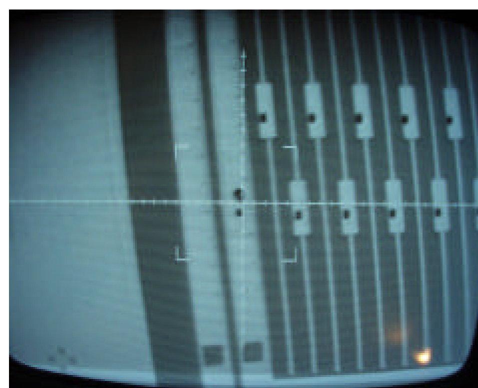
		# 21	# 22	# 23	# 24
TOP SIDE	DET	53 : 6	53 : 5	47 : 5	50 : 4
	FANIN	55 : 6	61 : 4	60 : 5	64 : 4

4.5 Detector to Detector [Top Face].

4.5.1 Bias

1. Move the module such that the left-hand detector to detector is under the bond head.
2. Set 1st bond power to 2.1 and 2nd bond power to 2.1.
3. Set CVL1=CVL2=6.
4. Set Loop Height to 60 in LHT mode.
5. Bond one wire from detector bias pad to detector bias pad.

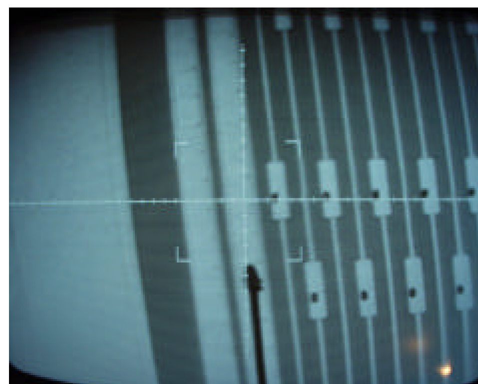
1st detector bond pad.



2nd detector bond pad.

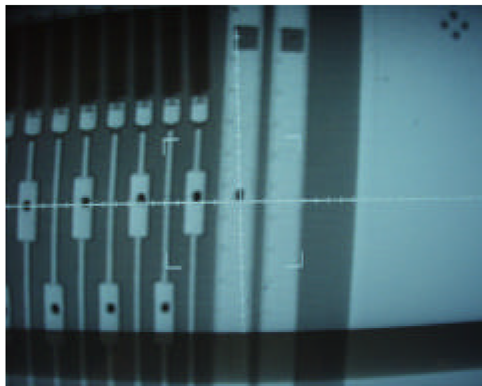
6. Set Loop Height to 80 in LHT mode.
7. Bond second wire from detector bias pad to detector bias pad.

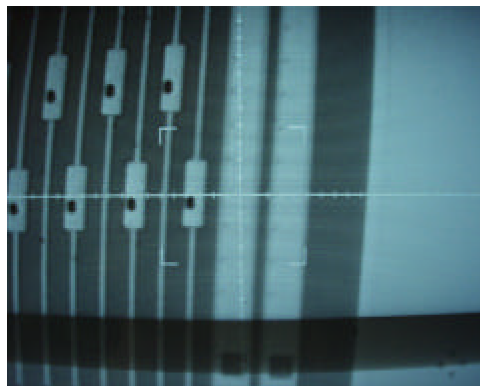
1st detector bond pad.

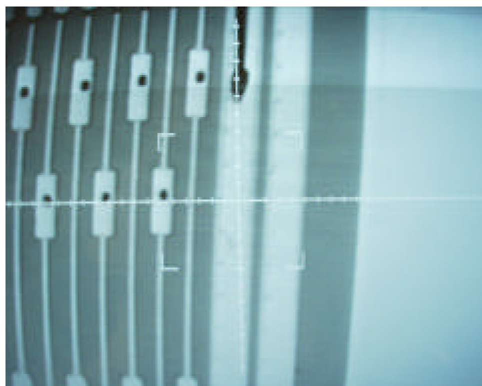


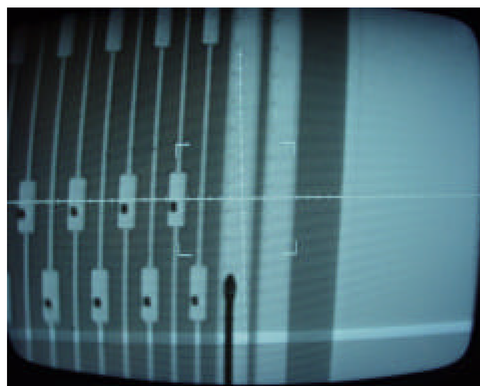
2nd detector bond pad.

8. Move module so that the right hand side detector to fanin is under the bondhead and repeat from 4.


1st detector bond pad.

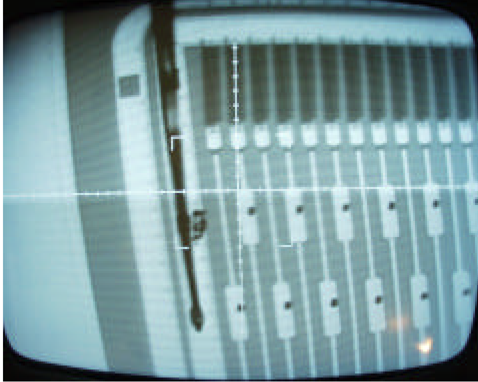

2nd detector bond pad.


1st detector bond pad.

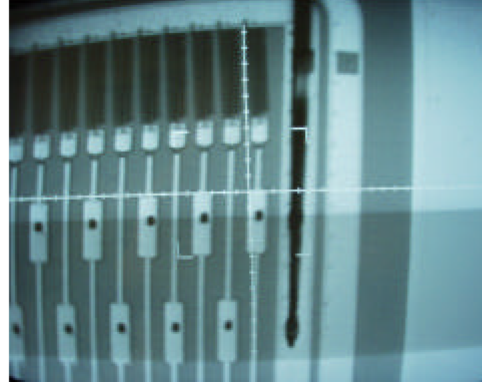

2nd detector bond pad.

4.5.2. Detector to Detector [Inner Row].

1. Load 1470 program # 25 [Atlas Forward Module Middle; Det-Det; Inner row].
2. Move module under bondhead so that the left-hand side detector to detector is positioned for bonding.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on Detector)
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.

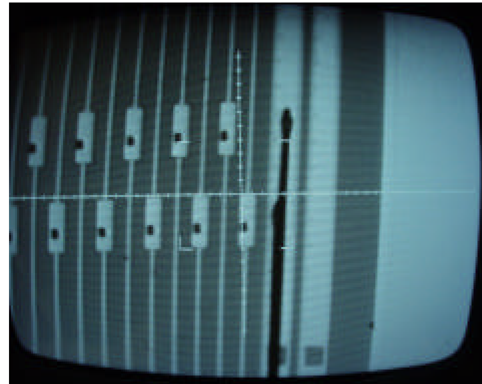


25 XY0 & Ref. 1.1



25 Ref. 1.2

25 Ref. 2.1



25 Ref. 2.2

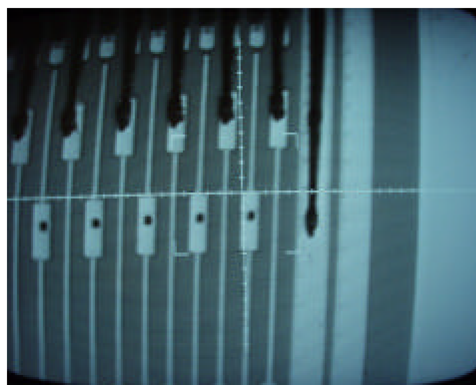
6. Check CVL1=CVL2=6
7. Check Loop Height=60 and in LHT mode.
8. Set 1st bond power to 2.1 and 2nd bond power to 2.1
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from Detector to Detector and as such the bonding operation can be observed using the stereo microscope.
12. Bond all 384 wires and record bond quality parameters, for program # 25 inner row, on the module progress card for the last 64 wires bonded.

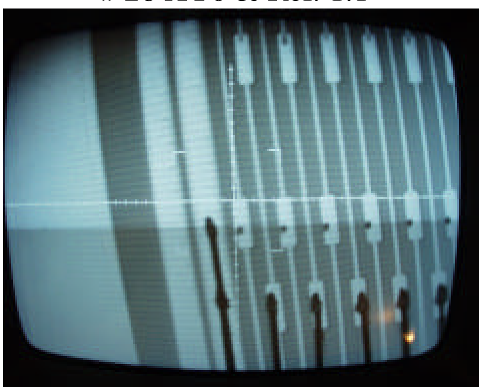
	TOP FACE		BOTTOM FACE	
	INNER ROW #25	OUTER ROW #26	INNER ROW #25	OUTER ROW #26
DET #1	57 : 4			
DET #2	57 : 3			

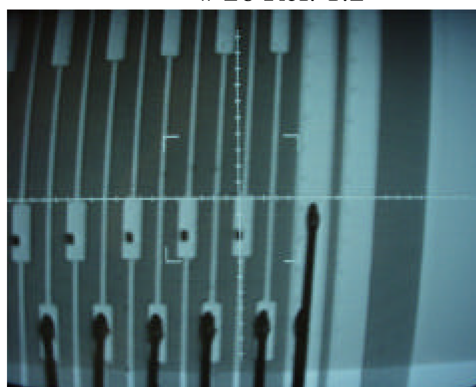
4.5.3 Detector to Detector [Outer Row].

1. Load 1470 program # 26 [Atlas Forward Module Middle; Det-Det; Outer row].
2. Move module under bondhead so that the left-hand side detector to detector is positioned for bonding.
3. Select SEMI-AUTO mode.
4. Set XY0 and Ref. 1.1 (same point on Detector).
5. Set Ref. 1.2, Ref. 2.1 and Ref. 2.2.

26 XY0 & Ref. 1.1


26 Ref. 1.2


26 Ref. 2.1


26 Ref. 2.2

6. Check CVL1=CVL2=6
7. Check Loop Height=80 and in LHT mode.
8. Set 1st bond power to 2.1 and 2nd bond power to 2.1
9. Step through bond sequence to check position of bond foot to bond pad.
10. When satisfied, select AUTO.
11. The bond direction is from Detector to Detector and as such the bonding operation can be observed using the stereo microscope.
12. Bond all 384 wires and record bond quality parameters, for program # 26 inner row, on the module progress card for the last 64 wires bonded.

	TOP FACE		BOTTOM FACE	
	INNER ROW #25	OUTER ROW #26	INNER ROW #25	OUTER ROW #26
DET #1	57 : 4	58 : 4		
DET #2	57 : 3	61 : 4		

4.6 Module Bottom Face.

1. Move module to safe area and disconnect vacuum.
2. Lift frame off module vacuum jig and turn over.
3. Reposition module over the four corner posts and lower into place on the vacuum jig.
4. Reconnect vacuum and ensure vacuum is better than 100Torr.

4.6.1 Hybrid to Fanin Bias.

1. Repeat section 4.2.

4.6.2 ABCD3T to Fanin.

1. Repeat section 4.3 completing Module Wirebonding Progress Card after wirebonding chips S10 and E13.

	S2	E5	S10	E13
CHIP	55 : 5	56 : 5	61 : 5	58 : 5
FANIN	65 : 4	62 : 4	46 : 7	63 : 8

4.6.3 Detector to Fanin.

1. Repeat section 4.4 completing Module Wirebonding Progress Card after wirebonding each of the four regions.

		# 21	# 22	# 23	# 24
BOTTOM SIDE	DET	62 : 4	56 : 4	57 : 4	56 : 4
	FANIN	62 : 5	60 : 5	64 : 6	59 : 4

4.6.3 Detector to Detector.

1. Repeat section 4.5 completing Module Wirebonding Progress Card after wirebonding both the inner and outer rows.

	TOP FACE		BOTTOM FACE	
	INNER ROW #25	OUTER ROW #26	INNER ROW #25	OUTER ROW #26
DET #1	57 : 4	58 : 4	59 : 5	58 : 4
DET #2	57 : 3	61 : 4	59 : 4	59 : 4

MODULE TIMEWALK

	0 mins	Remove module from transport covers
0 mins	2 mins	Mount module onto bonding frame
2 mins	2 mins	Mount bonding frame onto K&S 1470
4 mins	2 mins	Bond BIAS hybrid to fanin [4.2]
6 mins	45 mins	Load program # 20. Set references and bond 6 ASICS to Fanin [4.3]
51 mins	2 min	Bond BIAS Detector to Fanin [4.4.1]
53 mins	5 mins	Load program # 21. Set reference and bond 192 wires [4.4.2]
58 mins	5 mins	Load program # 22. Set reference and bond 192 wires [4.4.3]
63 mins	5 mins	Load program # 23. Set reference and bond 192 wires [4.4.4]
68 mins	5 mins	Load program # 24. Set reference and bond 192 wires [4.4.5]
73 mins	2 min	Bond BIAS Detector to Detector [4.5.1]
75 mins	10 mins	Load program # 25. Set reference and bond 384 wires [4.5.2]
85 mins	10 mins	Load program # 26. Set reference and bond 384 wires [4.5.3]
	5 mins	TURN MODULE OVER
100 mins	2 mins	Bond BIAS hybrid to fanin [4.2]
102 mins	45 mins	Load program # 20. Set references and bond 6 ASICS to Fanin [4.3]
147 mins	2 min	Bond BIAS Detector to Fanin [4.4.1]
149 mins	5 mins	Load program # 21. Set reference and bond 192 wires [4.4.2]
154 mins	5 mins	Load program # 22. Set reference and bond 192 wires [4.4.3]
159 mins	5 mins	Load program # 23. Set reference and bond 192 wires [4.4.4]
164 mins	5 mins	Load program # 24. Set reference and bond 192 wires [4.4.5]
169 mins	2 min	Bond BIAS Detector to Detector [4.5.1]
171 mins	10 mins	Load program # 25. Set reference and bond 384 wires [4.5.2]
181 mins	10 mins	Load program # 26. Set reference and bond 384 wires [4.5.3]
191 mins	5 mins	Demount module and replace transport covers onto bonding frame
TOTAL TIME 196 mins		