PREPARED BY:	***Multiband Imaging Photometer for SIRTF***	NUMBER M11I60	
C. DAVIDSON		TYPE INSPECTION	
APPROVALS			
ENGINEERING	University of Arizona Steward Observatory, IR Group	DATE 04/29/98	
QUALITY	**SPECIFICATION**	SUPERSEDES SPEC. DATED 07/07/97	
PI/DEPUTY PI		REV. A	PAGE 1 of 12

TITLE

INCOMING INSPECTION OF CERAMIC MULTILAYER BOARD (MIPSD – 029), PROCEDURE FOR

1.0 SCOPE

This specification defines the equipment, materials and procedures for incoming inspection of the ceramic multi-layered board (CMLB) (P/N MIPSD-029) to be used in the assembly of the MIPS 32x32 Ge:Ga focal plane array (FPA).

Due to the multi-layered structure of the board, visual examination alone is insufficient to determine board acceptance. Therefore, the standard visual examination of an incoming inspection is supplemented with ambient room temperature electrical continuity testing and thermal cycle testing of the board.

The electrical continuity testing will be performed on traces on clock and bias layers C1 and C3 of the board. Only a limited extent of these traces is visible for inspection, while the major extent of each of these traces is obscured by insulating, grounding or other clock and bias layers comprising the board. Physical continuity and non-shorting of traces defined on the top layer of the board will be verified by visual examination.

The electrical continuity tests and visual inspection will be conducted prior to, and following thermal cycle of the board.

2.0 PURPOSE

The purpose of the testing is to screen the board for workmanship and for physical and electrical integrity of the board following exposure to cryogenic (77K) temperature.

3.0 APPLICABLE DOCUMENTS

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

Non-Government Documents

Manual
University of Arizona Safety Manual

Drawings

University of Arizona, Steward Observatory, IR Group

MIPSD-029	Board, Ceramic, Multilayer

4.0 REQUIREMENTS

4.1 Equipment

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

Item	Quantity	Description
1	1 each	Microscope, stereozoom, Bausch and Lomb
2	1 each	Microscope, measuring, 3-axes, Nikon
3	1 each	Measurement system, Nikon Digimicro System
4	1 each	Multimeter, digital (DMM), with continuity beeper
5	1 each	Manipulator, with copper tube having probe tip affixed to it
6	1 each	Probe, dissecting, with 1 mil stainless steel wire attached
7	2 each	Test leads
8	1 each	Clip, alligator
9	1 each	Plate, base, stainless steel, with stainless steel multiple-holed vacuum chuck
10	as required	Pump, vacuum, bench top
11	as required	Tubing, vacuum
12	1 each	Ultrasonic cleaner
13	1 each	Blow gun
14	1 each	Dewar, single reservoir, MIPS no. 822
15	as required	Clips, beryllium with screws to affix boards to dewar cold work surface

4.2 Materials

Item	Quantity	Description
1	lot	Board, ceramic, multi-layered P/N MIPSD-029
2	as required	Nitrogen, liquid
3	as required	Acetone, electronic grade
4	as required	Methanol, electronic grade
5	as required	Isopropanol, electronic grade
6	as required	Nitrogen, gaseous (dry) or air (dry)
7	as required	Tweezers
8	as required	Wipes, cleanroom

5.0 PROCEDURAL REQUIREMENTS

Incoming inspection/testing of the ceramic multilayered boards is to be performed and tracked on a lot basis. The lot number to be recorded on the Incoming Inspection/Test Sheet, document no. M11I60-A, is to be the lot number which is designated by the board vendor on the shipper accompanying the parts or on other vendor supplied documentation. If the vendor does not provide a lot number, then the purchase order number and the date of receipt will be used as the lot number.

Individual boards are not to be assigned a unique serial number or other distinguishing identifier once the board has been accepted for FPA build. A temporary identifier may be ascribed to a board, if necessary, to associate that board with recorded inspection, measurement or test data which are questionable and which require further review to disposition the board as acceptable or reject. The board is kept physically separate from

acceptable boards and is not to be used for next higher level assembly until it has been determine acceptable. At that time the temporary identifier will be removed and the board stored with other acceptable boards from the same lot. For FPA build, acceptable boards of the same design revision will be indistinguishable.

Boards, which fail to meet the acceptance requirements, will be stored separately from acceptable boards.

For each lot of boards, the results of incoming inspection/test are to be summarized on one inspection/test sheet.

6.0 PROCEDURE

Notes:
1. Handling, storage and disposal of chemicals, gases and cryogen materials is to be in accordance with the University of Arizona Safety Manual.
2. Cleanroom gloves or finger cots are to be worn when handling hardware and equipment.
3. Removal of outer wrappings and packaging material is to be done outside of the cleanroom.

6.1 Verify Receipt of Requested Paperwork and Quantity

6.1.1 Inspect the outer packaging for signs of damage incurred during transport. Record the results on the inspection sheet document no. M11I 60-A.

6.1.2 Carefully remove outer packaging and remove contents and paperwork. With a cleanroom wipe dampened with isopropanol, wipe down outer packaging, taking care not to obscure label information. Place the paperwork in cleanroom bags. Transport the packaged boards and paperwork to the cleanroom.

6.1.3 Verify that the quantity of boards identified on the purchase order and the shipper is agreement with the quantity received. Report any deficiencies or overages in quantity to the lead engineer for resolution.

6.2 Inspection for Contamination and Defects.

6.2.1 Using tweezers, place a board onto a clean microscope stage or a clean glass slide on the stage. Under microscope magnification, verify that the configuration of the board is to drawing MIPSD-029.

6.2.2 Inspect the board for contamination. Using dry N_2 or air from a blow gun, blow particulates from the surface of the board. If gross contamination is present, clean the board by flushing both surfaces for a minimum of 20 seconds each with acetone, methanol then isopropanol. Blow the board dry with dry N_2 or air.

Note: To prevent redistribution of contaminating materials, or possible solvent residue from remaining on the board, keep the board wet with solvents until it is blown dry.

6.2.3 Under microscope magnification, verify the board is free of contamination. Examine the board for missing, lifting, peeling, open or trace-to-trace shorting of the gold metallization.

If visual examination or probe testing indicate the traces are shorted or if there are other defects which would render the board unusable, place the board in a storage container, label the container 'reject' and store in the appropriate area of the storage desiccator.

Turn the board over and inspect the ground plane (gold) back surface for chips and cracks and for missing, lifting or peeling gold which render the board unusable Reject the part as appropriate. Note: Gold coverage should be ≥ 85% with no lifting or peeling present.

6.3 Verify the Board Dimensions

Note: If a contact measuring system (i.e., a Nikon Digimicro System or a surface profilometer) is used to measure the board thickness or the thickness of the metallization, take care not to damage the board.

6.3.1 Using a 3-axes measuring microscope, measure the length, width and thickness of the board. Measure each parameter at three different locations, making a minimum of three measurements at each location. For board acceptance, the average of the measurements for a parameter must fall within the specification range identified on the drawing and on the inspection/test sheet.

6.3.2 On each board in the lot, perform visual examination and dimensional measurements per paragraphs 6.2.1 through 6.3.2.

6.4 Setup the Probe Station.

Notes:
1. The relative position of hardware as described below provides an example of the physical positioning of hardware to conduct the CMLB continuity testing. The relative position of the hardware is not significant. Proper connection of test leads to the DMM and to the probes and contact of the probes to the board traces are important.

2. Figure 1 illustrates the typical set up for continuity testing of the CMLB.

6.4.1 Set the stainless steel base plate with the vacuum chuck on it under the microscope such that the chuck is to the operator's left. Set the manipulator with the copper probe onto the base plate.

6.4.2 Connect one end of the vacuum tubing to one of the two vacuum chuck ports. Connect the other end of the tubing to the vacuum pump.

Note: The vacuum chuck has two chambers, each independent of the other and each with multiple vacuum holes.

6.4.3 Insert the banana plug of a test lead into the common (COM) socket of the DMM. Use an alligator clip on the other end of the test lead to connect to the lead on the manual manipulator.

6.4.4 Insert the banana plug of a second test lead into the voltage/resistance socket of the DMM. Affix an alligator clip to the opposite end of the test lead and clip it directly onto the metal probe with the stainless steel wire on its tip.

6.4.5 Set the CMLB over holes in the vacuum chuck. Position the board so that the readout output lead traces are to the right of the operator; the input pads to the left.

6.4.6 Turn the DMM on and set the resistance scale to 1 Mohm. Turn on the DMM's audible continuity beeper at a range of 2K Ω.

6.4.7 Bring the stainless steel wire of the hand probe tip in contact with the end of the probe on the manual manipulator. The DMM beeper should sound to verify continuity from one probe tip to the other.

6.5 Continuity Test the CMLB.

6.5.1 Position the probe of the manipulator over the CMLB "output" traces. These output traces are the gold traces (lead lines) on the CMLB that will, in FPA form, be wire bonded to the bond pads of the flex cable assembly.

6.5.2 Slowly turn the manipulator adjustment knob to lower the tungsten probe tip onto output trace **1** (Vddd).

Notes:
1. Take care not to dig, scratch or otherwise damage the gold traces with the probes.

2. Periodically during the continuity testing monitor the DMM resistance readings. A trace that is continuous along its path between the two probes should have a resistance value in the 0 -10 ohm range. Traces, which are shorted together, should also have a resistance in the 0-10 ohm range.

The resistance value of a trace which is discontinuous (open) along its path between the probes should be in the Mohm range.

6.5.3 Bring the 1 mil diameter stainless steel wire on the second probe (hereafter referred to as the hand probe) into contact with trace metallization at position A, Det Htr (+). Listen for the audible beeper.

If the beeper sounds indicating electrical continuity between the trace(s) contacted by the probes, check the listing in Table 1 to verify continuity is expected. Record a check mark next to the appropriate trace-to-trace identification in the listing.

If the trace or trace pairing is not listed in Table 1, repeat the test. Lift the hand probe to break contact with bond pad A and then lower it to make contact again. If the first test was valid the beeper should sound again. If the beeper does not sound, check the setup and be certain both probes are making physical contact with the specified traces. Repeat the test. Record the trace identity or the identity of both traces probed.

6.5.4 Do not move the manipulator probe. Lift the hand probe and move it to the next trace, position B, Det Htr (-). Repeat step 6.5.2.

Continue in this manner until all traces along the same edge of trace position A, Det Htr (+), have been probed with the manipulator probe in contact with trace **1,** Vddd**.**

6.5.5 Lift the manipulator probe up and off trace **1,** Vddd. Move the manipulator probe and bring it into contact with trace **2** (Vpw). Bring the hand probe into contact with trace A. Repeat the probe testing as described above. Continue in this manner until all traces on the side of the board where the manipulator probe is positioned have been probed to all traces along the opposite side of the board that is, the side of the board along which the hand probe is moved.

6.5.6 If the results of the probe test identify trace to trace shorts other than those listed in Table 1, or if any given trace is shown to be open, reject the part.

If there is any ambiguity regarding the results, give the board a temporary identifier, record that identifier and the lot number on the appropriate paperwork and store the board in suspension in the storage desiccator. Review the data with the P.I., Deputy P.I. or lead engineer, as appropriate to determine an accept or a reject status for the board. Once this had been made, store the board accordingly. Include the result on the inspection/test summary sheet.

If the probe test results show that all individual traces are continuous and that no traces are shorted together, then proceed to thermal cycle the board.

6.6 Thermal Cycle the CMLB.

Note: Multiple CMLBs may be thermal cycled at one time.

6.6.1 Position the boards on the cold work surface of the test dewar, spacing the boards to accommodate the spring clips, which will be used to hold the boards in place.

6.6.2 Loosely screw the clips to the dewar work surface, providing sufficient space between the screws to accommodate the boards. One by one lift or turn a clip to one side about its screw and position a board near the screw such that the clip will secure the board in place. Carefully bring the clip in contact with the board, and tightened the screw just enough to secure the board in place. Repeat this process until all boards are secured in place on the dewar work surface.

6.6.3 Secure the dewar lid to the dewar base. Connect the dewar to a vacuum pump and evacuate the dewar to a pressure $\leq 10^{-5}$ torr.

6.6.4 **Caution:** Insulating gloves are to be worn when handling liquid nitrogen and containers of this cryogenic material in order to avoid severe frostbite. Under no circumstance is any part of the body to be submerged in or allowed extended contact with this material.

Carefully fill the dewar reservoir with liquid nitrogen. Allow the boards to remain at 77K for 15 to 20 minutes after the dewar temperature has stabilized. Carefully pour off the liquid nitrogen and allow the dewar to warm to room temperature. Warm-up time shall be a minimum of 8 hours.

6.6.5 Once the dewar has stabilized at room temperature, release the vacuum and remove the boards from the dewar.

6.6.6 Under a microscope inspect the boards for any apparent damage, and for lifting, peeling or missing metal traces. If physical damage or degradation of the traces noted on a given board would render the board unusable, record the findings on the Inspection Sheet and mark the board's storage container with the word 'reject.'

6.7 Continuity Test the Board Post-Thermal Cycle

Repeat the continuity testing per steps 6.4 through 6.5.6. Inspect the board for damage.

6.8 Store the Boards.

Place acceptable boards in a clean storage container. Cover the container and label the cover: 'MIPS CMLB PIN MIPSD-029, Lot No xxx, Acceptable." For lot number identification, reference paragraph 5.0. Store the container on the appropriate shelf of the N_2-purged desiccator.

6.9 Summarize the Inspection and Test Results on the Inspection/Test Sheet.

6.9.1 Complete an M11I60-A Incoming Inspection/Test Sheet to summarize the results of the visual and dimensional measurements, and the continuity and thermal cycle testing performed on the boards.

6.9.2 Advise the process lead engineer of the status of the lot of boards. Place all vendor-supplied paperwork and the inspection sheet in the process files.

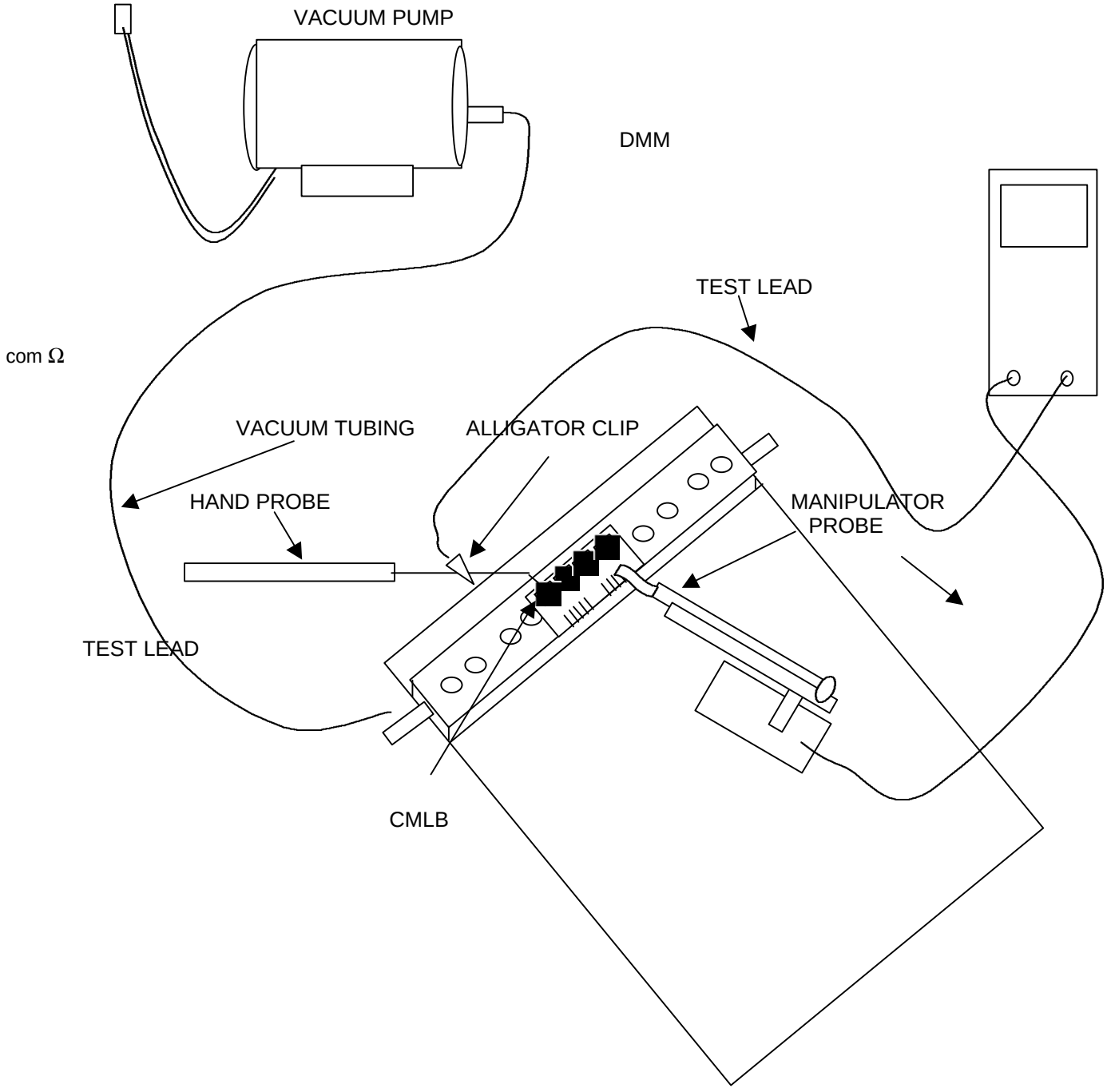


Figure 1. CMLB Electrical Continuity Test Setup

FROM: Input Trace Number	Signal Name Description	TO: Trace Location on CMLB	(✓)
1	Detector Bias(*)	Detector Bias	
2	V_{reset} (*)	V_{rst}	
8	V_{ddd}	R.O. 4 – 6	
9	V_{pw}	R.O. 4 – 5	
10	V_{ssd}	R.O. 4 – 4	
11	V_{sub}	R.O. 4 – 3	
12	V_{dduc}	R.O. 4 – 2	
13	V_{ssuc}	R.O. 4 – 1	
14	Heater (+)	Heater (+)	
15	Heater (-)	Heater (-)	
16	V_{casn}	R.O. 4 – 7	
18	Hold Off	R.O. 4 – 8	
19	Address 1	R.O. 4 – 9	
20	Address 2	R.O. 4 – 10	
21	Address 3	R.O. 4 – 11	
22	Address 4	R.O. 4 – 12	
23	Address 5	R.O. 4 – 13	
24	Q_{rst}	R.O. 4 – 14	
27	V_{casp}	R.O. 4 – 15	
28	I_{load}	R.O. 4 – 16	

(*) require the 1K resistors installed to check

Table 1. CMLB Metal Trace Identification and Probe Positions Along Trace
MIPS CMLB (PIN MIPSD-029) Incoming Inspection/Test Sheet
Document No. M11I60-A

Lot No: _____ Operator: _____ Date: _____

Supplier: _____ UA P.O. No : _____

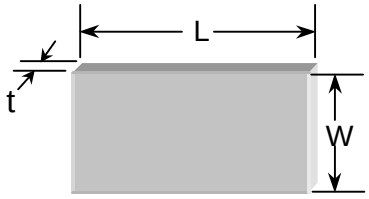
1. Outer Packaging: No damage noted ☐ Comments:
Damage noted ☐

2. Quantity of Boards Ordered: _____ Quantity Received: _____

3. Dimensional Measurement:

Length & Width: Instrument Used _____
Calibration Date _____

Board Thickness: Instrument Used _____
Calibration Date _____

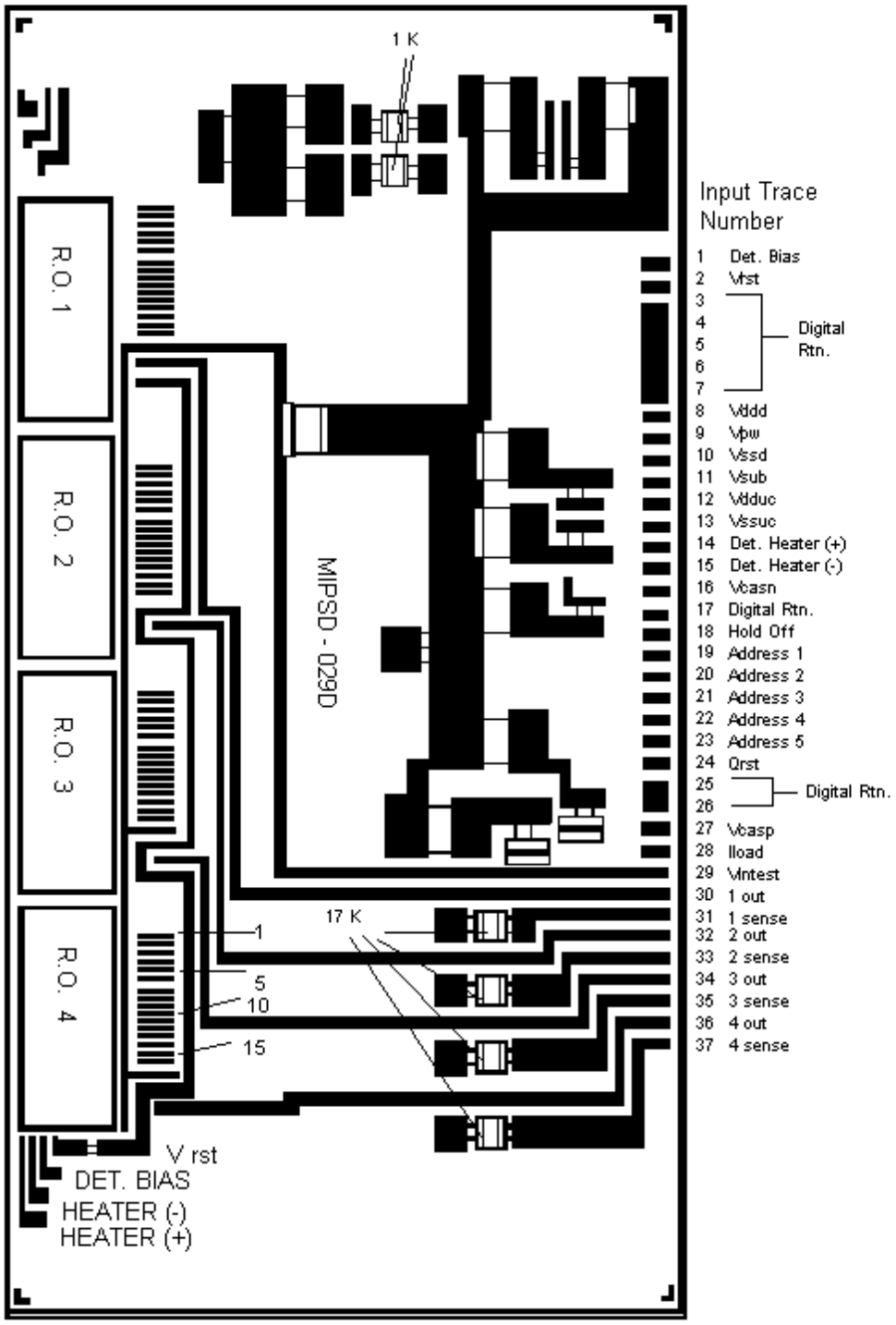


PARAMETER	SPECIFICATION
Length (L)	1.5150 – 1.5152 in
Width (W)	.7695 ± .0005 in
Thickness (t)	.027 - .023 inch

Lot Inspection/Test Summary

	Quantity Acceptable	Quantity Rejected	Prime *Cause for Rejection
Initial Inspection	_____	_____	_____
Initial Probe Test	_____	_____	_____
Inspection Post-Thermal Cycle	_____	_____	_____
Probe Test Post-Thermal Cycle	_____	_____	_____
Final Inspection	_____	_____	_____

*Cause for rejection
C - contamination
D - length or width dimension
T - board thickness
C/C - chips and/or cracks
S - trace short
O - trace open


1 K
R.O. 1
R.O. 2
R.O. 3
R.O. 4
MIPSD - 029D
17 K
1
5
10
15
V rst
DET. BIAS
HEATER (-)
HEATER (+)
Input Trace Number
1 Det. Bias
2 Vrst
3
4
5
6
7
Digital Rtn.
8 Vddd
9 Vpw
10 Vssd
11 Vsub
12 Vdduc
13 Vssuc
14 Det. Heater (+)
15 Det. Heater (-)
16 Vcasn
17 Digital Rtn.
18 Hold Off
19 Address 1
20 Address 2
21 Address 3
22 Address 4
23 Address 5
24 Qrst
25
26
Digital Rtn.
27 Vcasp
28 Iload
29 Vintest
30 1 out
31 1 sense
32 2 out
33 2 sense
34 3 out
35 3 sense
36 4 out
37 4 sense