STAR Note 128
WBS 4.2.4

September 22, 1993

Pad plane printed circuit board specifications

Introduction

The Lawrence Berkeley Laboratory (LBL) has been chosen as the fabricator of a large particle detector called a time projection chamber (TPC). This chamber will be used at the Brookhaven National Laboratory as part of the Relativistic Heavy Ion Collider project. A critical component in the TPC is a double-sided NEMA G-10, non FR-4, circuit (PC) board with an array of small rectangular pads on one side and leads for 44-pin surface-mount connectors on the other. Plated via holes join the pads to the leads. There are two sizes of boards; 28 of each size are required for a total of 56. Figure 1 shows an overall view, with major dimensions; of the two PC boards. An insulating layer of NEMA G-10, non FR-4, may be attached to the connector side of the PC board. This insulator layer will have cutouts that match the connector pattern. This configuration is shown in Figure 2. During assembly of the TPC at LBL, an aluminum strong back will glued to this insulator. It is extremely important that the completed configuration not allow gas to flow from the pad plane side to the connector side.

The contract with the vendor shall be in two phases. The first phase will be for fabrication of the larger PC boards and the second will be for fabrication of the smaller boards. Fabrication of an insulating layer and the bonding of this layer to the connector side of the PC board may also be required. In addition, the price for bonding of a prepreg layer only to the connector side should be included. The price for each phase, the insulator board fabrication and bonding and the prepreg bonding only will be part of the vendor proposal.

Specifications

The latest version of the following specifications shall be considered part of this document:

ANSI/IPC-A-600D, Acceptability of Printed Boards
IPC-RB-276, Qualification and Performance Specification for
Rigid Printed Boards. (Supersedes IPC-SD-320B)
ANSI/IPC-D-325, Documentation Requirements for Printed
Boards.

The PC boards shall be considered to have a Class 3 classification as defined by ANSI/IPC-A-600D. The acceptance criteria within this classification shall be "acceptable" or better as defined by the same specification.

The vendor shall specify in the proposal the documentation to be provided to ensure that the guidelines of ANSI/IPC-D-325 are met. These documents shall include the vendor's QA plan for fabrication and inspection.

Pre-award conference

There shall be a pre-award conference at a time and location that is acceptable to both LBL and the vendor. A suggested time and place shall be specified in the proposal.

Vendor and LBL technical contacts

The vendor shall identify a contact representative in the proposal and LBL will do the same prior to contract award. Weekly communications will be expected between these two people. The LBL contact shall have the power to authorize changes. All changes will be documented and this document will include the date, description of the change made, reason for change, and signature of the LBL contact and a vendor representative.

Material and tolerances

The base material for the PC board will be copper-clad NEMA G-10 without bromine, No FR-4 material will be used. The copper shall be 0.5 oz on the pad plane side and 2.0 oz on the connector side. The PC board thickness shall be 0.062 in ± 0.003. This material shall be provided either by the vendor or LBL. A material certification shall be provided by the vendor if the material is supplied by them. The insulator board thickness shall also be 0.062 in ± 0.003 in thick. The insulator shall be bonded to the PC board using no-flow, < 0.005 in thick, prepreg if required. The thickness of the PC board, with insulator, shall be < 0.135 in with a thickness variation of < 0.002 in over the finished board.

Artwork and Masks

The following drawings will be supplied by LBL:

Phase 1

24A1021 U-1	Printed circuit - Outer board 1 of 2 - connector side 2 of 2 - pad plane side
24A1024 E-1	Hole schedule - Outer board

Phase 2

24A1041 U-1	Printed circuit - Inner board 1 of 2 - connector side 2 of 2 - pad plane side
24A1044 E-1	Hole schedule - Inner board

Other

24A0916	Outer sector insulator board
24A1024 E-2	Routing schedule - outer insulator board
24A1024 M-1	Board outline/insulator and outer board assembly
Layout	Inner sector insulator board layout
24A1044 E-2	Routing schedule - inner insulator board
24A1044 M-1	Board outline/insulator and inner board assembly

The artwork and any changes to the artwork shall be provided by LBL to the vendor as a Gerber or DFX file. If these formats are not satisfactory, the vendor must specify on the proposal their preferred format. All masks used for fabrication shall be of glass. Mylar masks will not be allowed. The completed parts shall have etched lines with variations less than 1/20 of the nominal width or height. LBL reserves the right to approve the vendor's final artwork before the start of etching.

The connector side pattern shall not be visible on the pad plane side or cause more than 0.0005 in height variation on the pad plane side. This requirement should only be applicable if the vendor glues the insulator to the connector side of the PC board. There shall be no surface variations on the pad plane side > 0.001 in due to the plated-through via copper. The artwork shall be placed on each copper clad NEMA G-10, non FR-4, board with the same orientation in the long dimension for each part. This will help ensure that any residual bowing will be the same for all the parts.

The connector pads shall have a plating such as tin-lead to facilitate soldering the surface-mount connectors to the PC board. The minimum plating thickness shall be as specified by ANSI/IPC-A600D for the specific material used.

First-off items

The vendor shall notify LBL 3 days before the first article in each phase is completed. LBL reserves the right to send a representative to the vendor's facility to inspect the first article of each phase for opens and shorts. LBL shall approve or disapprove the procedures and materials within 5 business days after the inspection. The vendor shall not begin the production run until the first article has been inspected by LBL and approved.

Board tests and identification

The vendor shall perform such tests as they see fit prior to shipping the completed boards. The vendor shall include as part of the proposal a price for a 100% board testing option for opens and shorts. These tests and their price shall be described in the proposal. LBL shall reserve the right to approve the method of testing. No testing method or equipment may be used that indents or deforms the pad plane surface. LBL shall test all boards, after receipt, for opens and shorts. Boards with more than 3 opens or shorts shall be returned to the vendor for rework. The resistance from the pad to its connector lead shall be less than 0.01 ohms. The resistance from a pad to an adjacent pad shall be greater than 20 megohms. Any vendor repairs to a board shall be noted and LBL shall be informed of such rework.

When the completed PC boards are placed unrestrained upon a smooth flat surface the back surface at any point shall not be more than 0.375 in above the flat surface.

Each finished board shall have an individual and unique manufacturing identification number. This number can be etched into the copper at an approved location or attached to the board in such a way that the number will remain with the board during shipping. No vibrating pencil may be used for this marking. If a stick-on label is used, the adhesive must be easily removed with simple non toxic solutions. The vendor shall specify the method of identification in the proposal.

Prior to shipping, the boards shall be cleaned and free of fingerprints. After this cleaning, the boards shall be packaged or handled in such a manner to preserve the cleanliness.

Shipping

The vendor shall specify the method of shipping and what precautions will be taken to prevent damage to either side of the boards. The boards must arrive at LBL without any residue on the surface attributable to the protective material used.

Schedule and milestones

The successful vendor shall provide an informal schedule with milestones indicated. As a minimum, following milestone dates shall be indicated:

All materials ready for start of fabrication
First etching of Phase 1 board
First Phase 1 board ready for inspection and testing
Delivery schedule for phase 1 boards
Start of production run for second size board (Phase 2)
First Phase 2 board ready for inspection and testing
Delivery schedule for phase 2 boards
Start of insulation board routing, if applicable
Completion of contract

The order of delivery shall be Phase 1 boards, with or without the insulators, then Phase 2 boards, with or without the insulators.

Informal progress reports shall be made once per month. The due date shall be on or before the 5th working day of the month. The form of the report shall be determined by the technical contacts.

Quotation summary

As a minimum, the vendor shall include in their quotation the following:

1. Suggested time and location for pre-award conference
2. Name of vendor contact person
3. Schedule and milestones
4. Documentation to be provided (QA plan)
5. If NEMA G-10, non FR-4 material is to be provided, price and delivery time
6. Statement that glass will be used as mask substrate
7. Description of PC board tests and their price
8. Method of board identification
9. Method of cleaning and shipping
10. Price for Phase 1, Phase 2, fabrication of insulator board and bonding it to the PC board and prepreg bonding only to connector side of PC board
11. Total price, including all materials and labor, for providing 56 PC boards with an insulator board bonded to the connector side.

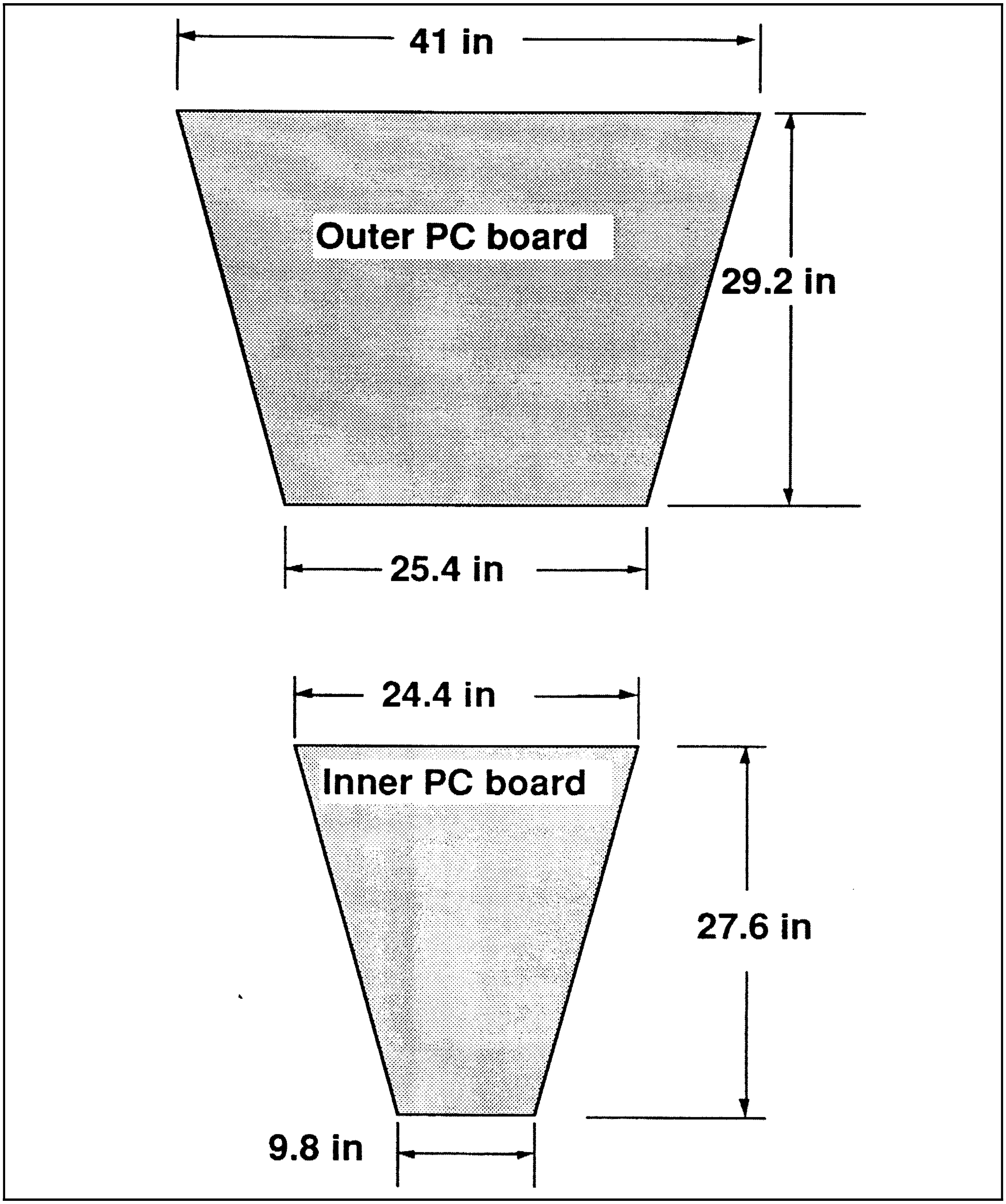

Figure 1. Overall dimensions of PC boards.

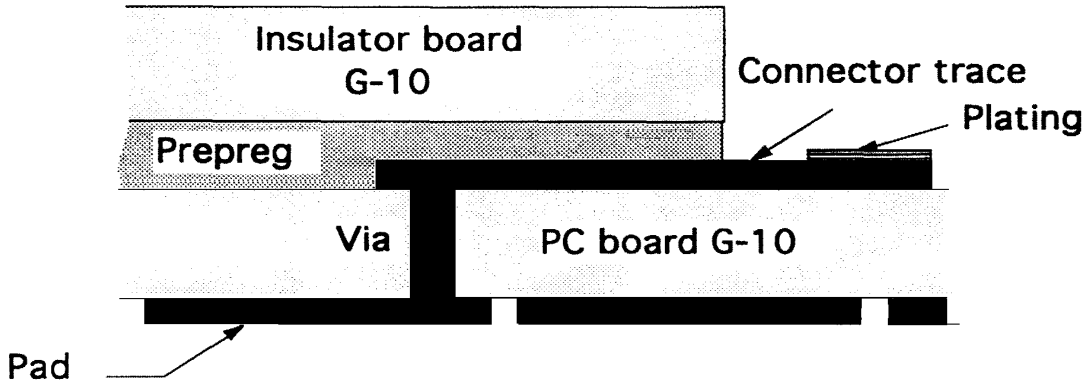

Figure 2. Sketch of insulator board bonded to the PC board.