Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT)

Interface Control Document between the CAL Analog Front End Electronics (AFEE) and the Pre Electronics Module (PEM)

DOCUMENT APPROVAL

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	15 Feb 2002	Original version

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1 PURPOSE

This document describes the electrical, mechanical and thermal interfaces between the AFEE, Close-Out Plates, Side Panels and the PEM. It is intended to convey the interfaces so that the AFEE, PEM, Close-Out Plates and Side Panels are designed and built with a clear understanding of the electrical, mechanical and thermal interface requirements needed to successfully integrate the AFEE, Close-Out Plates and Side Panels with the PEM. This ICD will also serve as the requirements document from which interface test plans and procedures will be developed.

2 SCOPE

This ICD includes all electrical, mechanical and thermal interfaces between the AFEE, Close-Out Plates, Side Panels and the PEM.

3 DEFINITIONS

3.1 Acronyms

AFEE	Analog Front End Electronics
CAL	LAT calorimeter subsystem
CDE	CsI Crystal Detector Element
DPD	Dual PIN Diode
EGSE	Electrical Ground Support Equipment
ICD	Interface Control Document
I&T	Integration and Test
LAT	Large Area Telescope
MGSE	Mechanical Ground Support Equipment
PEM	Pre Electronics Module
TBD	To Be Determined
TBR	To Be Resolved
TEM	Tower Electronics Module

3.2 Definitions

Testing	A measurement to prove or show, usually with precision measurements or instrumentation, that the project/product complies with requirements.
Validation	Process used to assure the requirement set is complete and consistent and that each requirement is achievable.
Verification	Process used to ensure that the selected solutions meet specified requirements and properly integrate with interfacing products.

4 INTRODUCTION

4.1 Component Descriptions

4.1.1 PEM

The PEM consists of the Cal Structure with mechanically integrated CDEs. The PEM interfaces with the Close-Out Plates, AFEE and the Side Panels. The electrical and thermal interfaces consist of a flex cable between the CDE and AFEE and thermisters mounted on the structure and the AFEE. The mechanical interfaces consist of mounting hardware for attaching the Close-Out Plates, AFEE and Side Panels to the core structure of the PEM. Figure 1 below shows the PEM with the external components displayed around the perimeter.

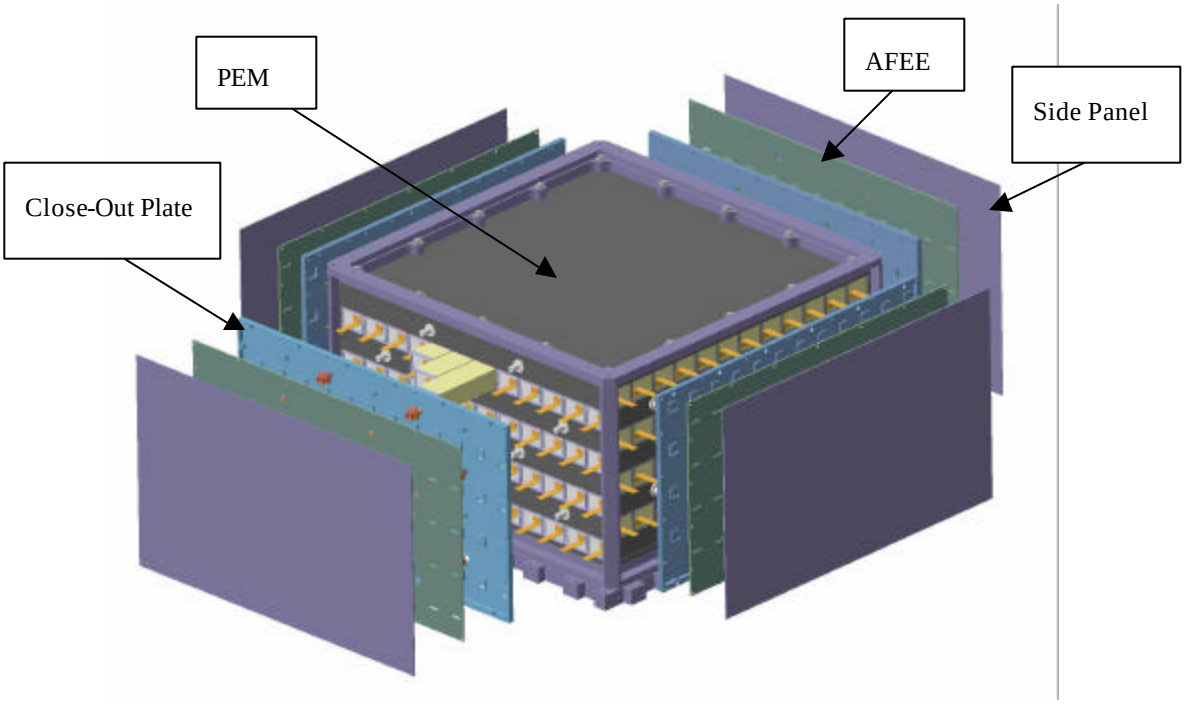


Figure 1 - PEM

4.1.2 AFEE

The AFEE consists of four electronics boards mounted on the sides of the PEM between the aluminum cell Close-Out Plate and the outer EMI shield (Side Panel). The electronics interface with the CDE consists of a connection to the PIN photodiodes. This connection is made via a Kapton polyimide flexible cable. Figure 2 shows the AFEE boards around the PEM. A Close-Out Plate contains the CDEs within the core structure of the PEM. The AFEE boards mount to the Close-Out Plates.Side Panels close out the AFEE boards, providing EMI protection.

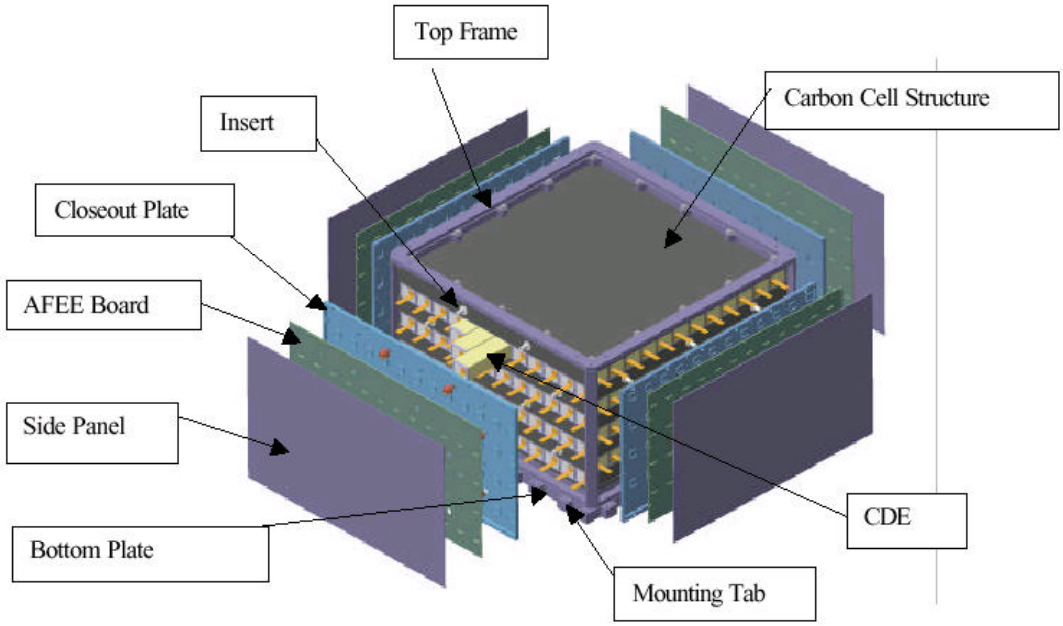


Figure 2. AFEE Boards

4.1.3 Close out Plate

The Close-Out Plates mount between the PEM and the AFEE boards. The details of these components are shown in drawing (TTT). **(need drawing and number**) (Paul has requested from Oscar F.)

4.1.4 Side Panels

The Side Panels mount on the outside of the AFEE boards and are bolted to the core structure of the PEM. These panels provide protection to the AFEE and PEM components from external EMI environments. The Side Panels are shown in drawing (RRR). **(need drawing and number)** (Paul has requested from Oscar F.)

4.2 Applicable Documents

Documents that are relevant to the definition and functionality of the CDE - AFEE interfaces include the following:

LAT-MD-00228-D2, "Calorimeter, Tracker and Data Acquisition Contamination Control Plan."

LAT-SS-00089, "GLAST LAT Calorimeter Front End Electronics ASIC Specification."

LAT-SS-00211, "Specification for the Calorimeter Photodiode Flexible Cable."LAT-SS-00238, "GLAST LAT Interface Control Document between the Calorimeter Subsystem and LAT Instrument."

LAT-SS-00239, “GLAST LAT Calorimeter CsI Detector Element Specification.”

LAT-SS-00241, “GLAST LAT Calorimeter Mechanical Structure Specification.”

LAT-SS-00278, “Calorimeter Front-end Electronics Board Specification.”

4.3 Interface Description

4.3.1 General Description

The AFEE provides a current limited 50-100V reverse bias to the dual PIN photodiodes on the CDE. This bias is used to amplify the analog signals measured from the CDE dual PIN photodiodes. The AFEE then processes and provides these signals to the TEM. The electrical interface consists of a Kapton polyimide flexible cable between the crystal mounted PIN photodiodes and the AFEE. Each end of a CDE has a dual PIN photodiode that requires a connection to the AFEE.

4.3.2 Electrical Systems Responsibilities

Fabrication and test of the AFEE boards and electrical I&T GSE is the responsibility of NRL.

Fabrication, test and integration of the flexible cables to the CDE PIN Photodiodes is the responsibility of CEA.

4.3.3 .Mechanical Systems Responsibilities

Fabrication and test of the Close-Out Plates, Side Panels, fasteners and mechanical I&T GSE is the responsibility of IN2P3.

5 ELECTRICAL INTERFACES

5.1 Interface Connections

5.1.1 Cables

A Kapton polyimide flexible cable provides the electrical interface between the CDE PIN photodiodes and the AFEE boards. The detail design of the flex cable is specified in LAT-SS-00211, (See Addendum A) and is shown in Figure 3.

5.1.1.1 Mechanical Properties

The dimensions of the Kapton flexible cable are described in the specification document LAT-SS-00211. The cable is 2.5 cm ± TBD cm long. The maximum width and height of the cable are TBD.

5.1.1.2 Pin Assignment

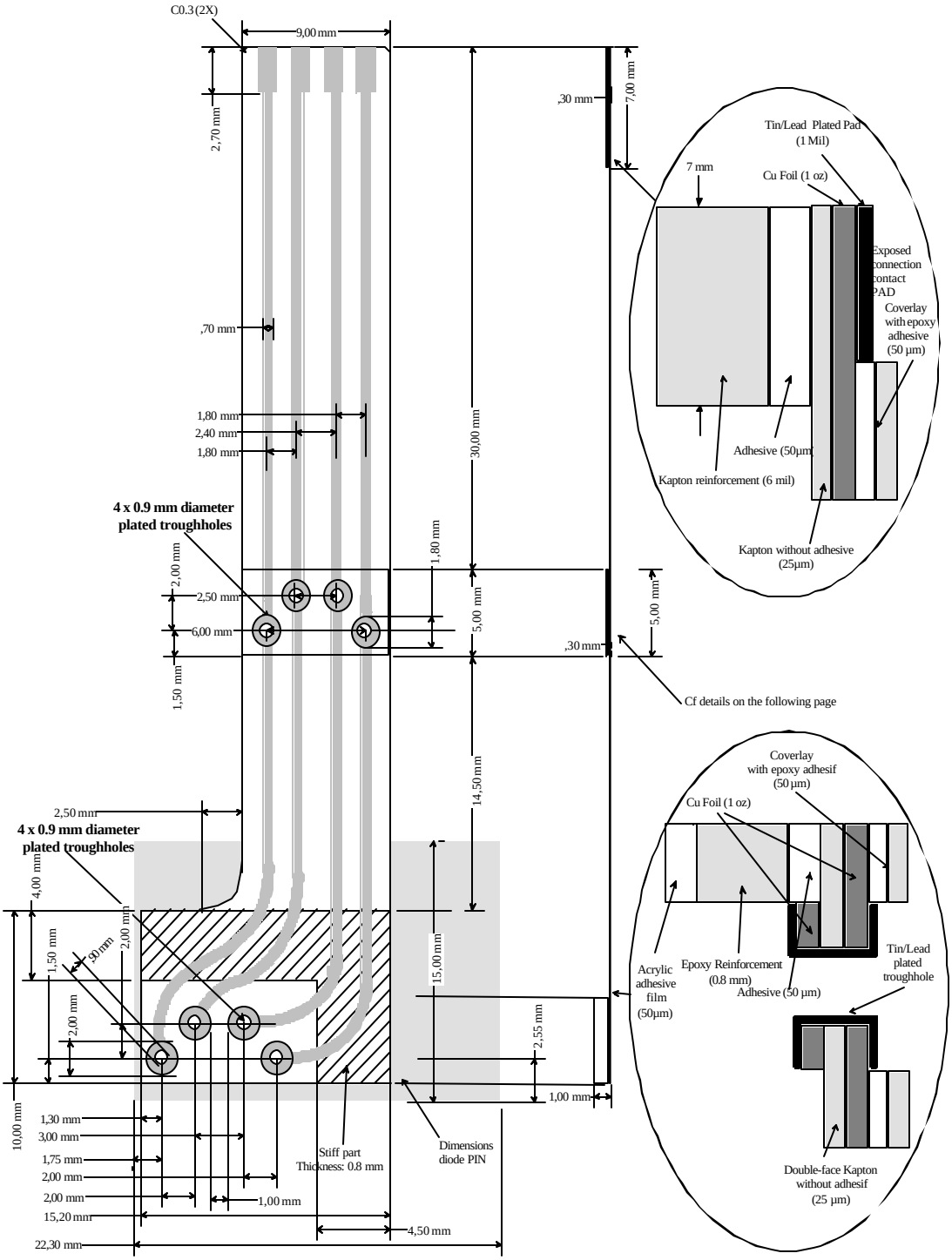
The flexible cable contains four plated through-hole solder pads on each end to interface with the large diode cathode and anode and the small diode cathode and anode on one end and with the AFEE board on the other end. Two conductors carry thenegative 50-100V bias to the high energy and low energy diode anodes respectively. The two remaining conductors carry the amplified analog output of the diode cathodes to the AFEE. This pin assignment is controlled by the layout on the PIN photodiode ceramic carrier and is shown in Figure 4.(LAT-DS-0209)

5.1.2 Cable Routing

The flexible cables cannot come into electrical contact with the Close-Out Plates. Each flex cable will route through a hole in the Close-Out Plate and AFEE and meet with the buss wire on the AFEE board. At each end of the interface, strain relief, will be provided by a bonding agent such as a staking compound. The details of the routing

and mechanical bonding are shown in drawing ZZZ **(need drawing and number**). Figure 5 shows the routing of the flex cable from the diode pins through the Close-Out Plate and AFEE board.

Figure 3 - Flexible Cable Design



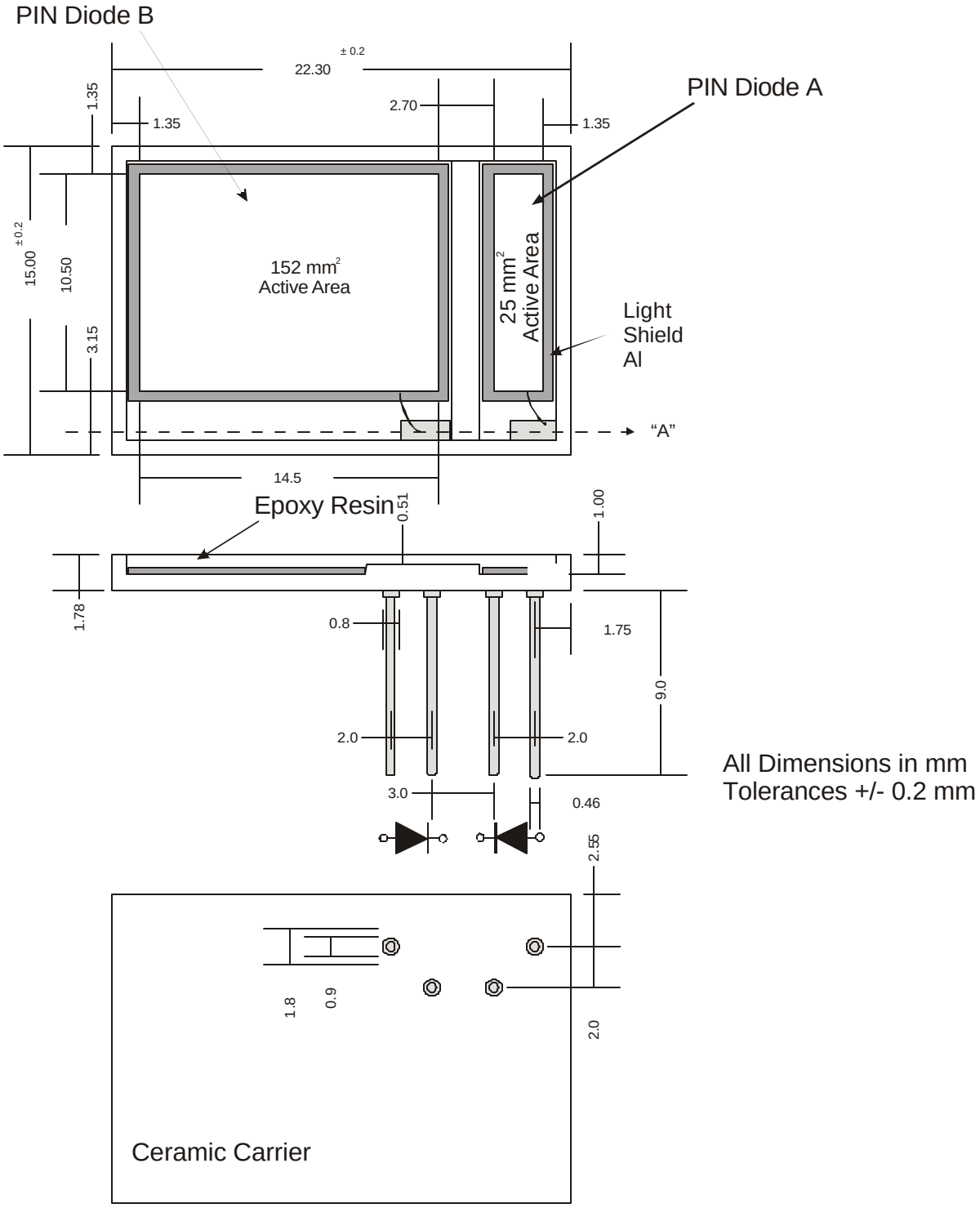


Figure 4 - Pin Layout for the PIN Photodiode Assembly

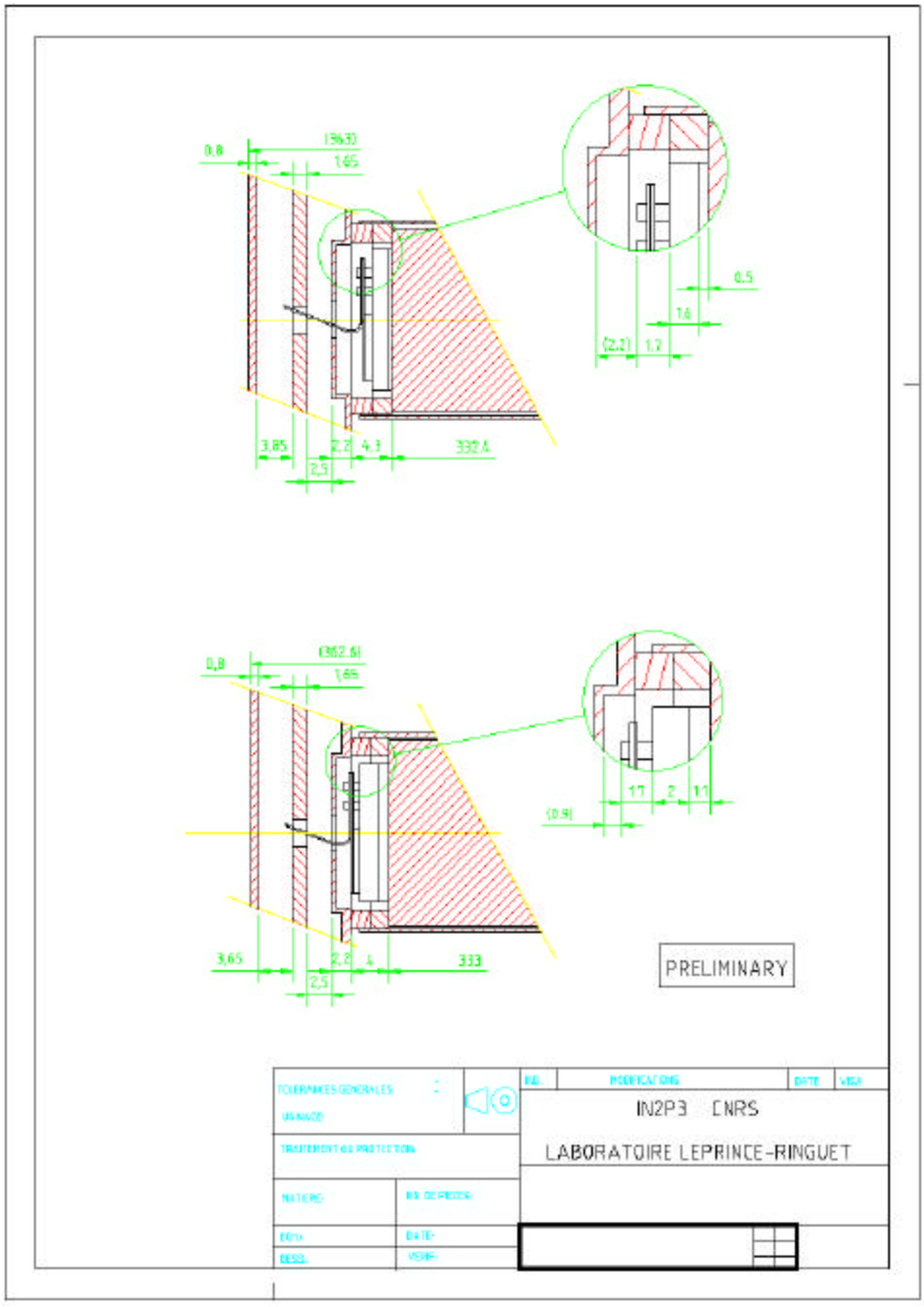


Figure 5 - Flexible Cable Routing

5.1.3 Connections

No connectors are used in the interface between the dual PIN photodiodes and the AFEE boards. On the PIN photodiode, the flex cable is bonded and soldered to the four diode pins. The details of this connection are shown in drawing XXX. **(Need a drawing and number)** On the AFEE end, solder connections are made with four buss

wires on the AFEE board. A duplicate set of contacts is available on the AFEE end of the flex cable for ground testing purposes. After completion of ground testing, this interface will be cut off. Figure 6 shows the mechanical mounting of the flex cable onto the ceramic carrier pins of the PIN photodiode.

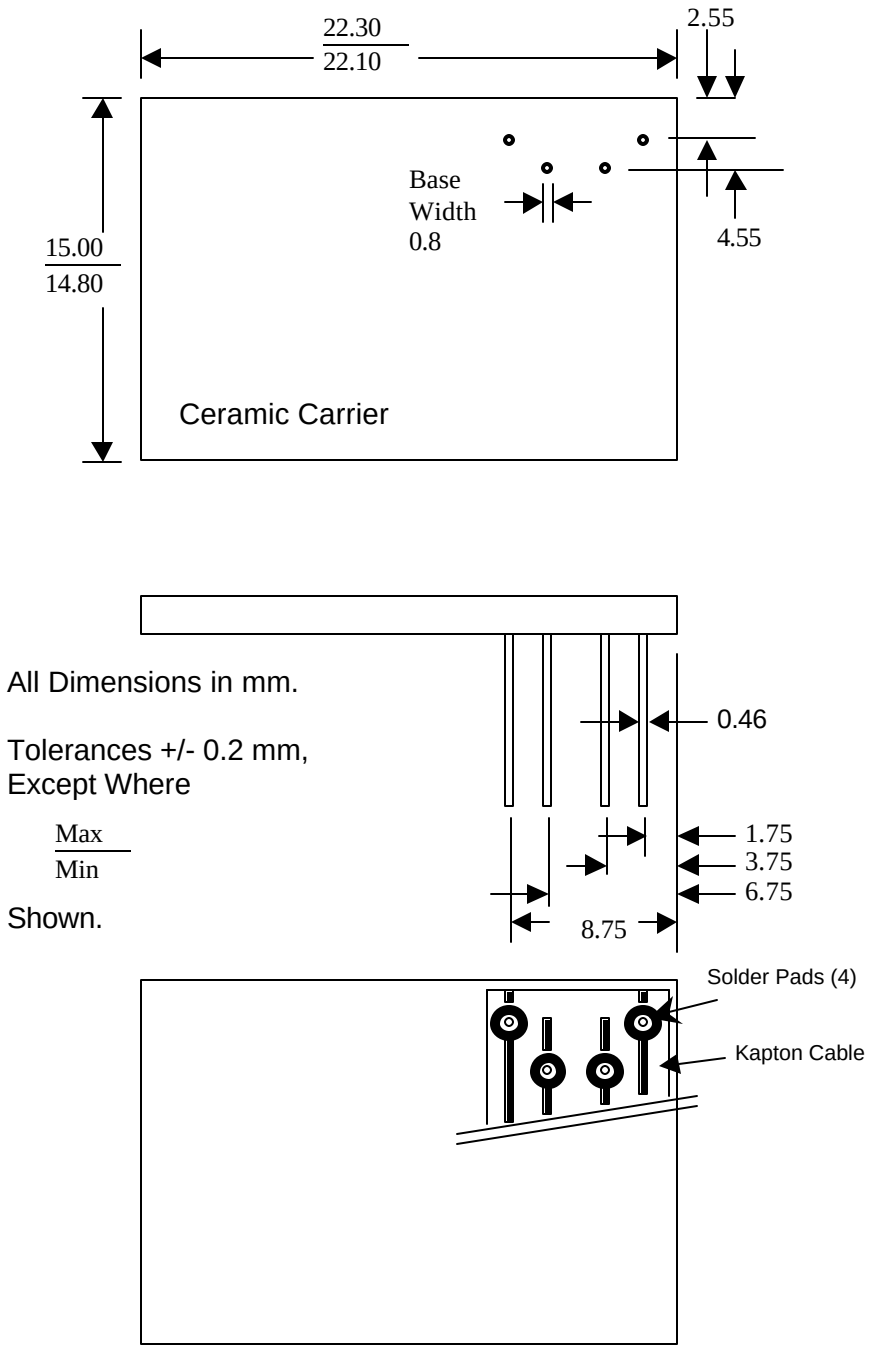


Figure 6 - Mechanical Configuration of the GLAST CAL PIN Photodiode to Flex Cable Connection

5.1.3.1 Cable to dual PIN photodiode bonding

The bonding of the flex cable to the DPD will be done in accordance with document LAT-SS-00211.

5.1.3.2 Cable to AFEE bonding

The bonding of the flex cable to the AFEE will be done in accordance with document LAT-SS-00211.

5.2 Signal Characteristics

The signal characteristics of the PIN photodiodes are documented in the GCFE specification, LAT-SS-00089.

5.3 Grounding/Bonding/Isolation

5.3.1 Structure Bonding

The resistance between any two metallic surfaces on the integrated module will be less than .1 ohms (TBR).

5.3.2 Leakage Current

The leakage current between any two conductors in the flex cable will be < 2nA at 100 Volts. The diode leakage current is defined to be < 10nA for the large diode and < 3nA for the small diode (LAT-DS-00209).

5.4 EMI Protection

The PIN photodiodes must be protected from AFEE electrical noise by the Close-Out Plates.

The flexible cable does not contain any shielding material.

6 MECHANICAL INTERFACES

6.1 Close-Out Plate to PEM Interface

(Drawings needed here for details) (Paul has requested from Oscar F.)

Holes are provided on the Close-Out Plate to pass through bosses for bolting the Side Panel to the core structure. The details of this interface are defined in the PEM structure description document (TBD). Figure 5 shows the clearance between the Close-Out Plate and the end of the CDE. The Close-Out Plate mounts to the top plate and base plate of the core structure via bolt holes around the perimeter of the structure interface.

6.2 AFEE to Close-Out Plate Interface

(Drawings needed here for details)(Paul has requested from Oscar F.)

The Close-Out Plate provides attachment points at the 4 corners and along the 4 edges for the mounting of the AFEE PCBs. The Close-Out Plate also provides 10 posts for attachment of the AFEE PCBs.. The planarity of the surface to which the boards are attached shall be lower than 0.2mm (all fixation points shall remain inside two 0.2 mm apart planes). The boards are mechanically attached to the Close-Out plates with bolts. The detials of this interface are defined in the PEM structure description document (TBD).

6.3 Side Panel to PEM Interface

(Drawings needed here for details)(Paul has requested from Oscar F.)

The Side Panels bolt to posts on the core structure of the PEM. The details of this interface are defined in the PEM structure description document (TBD).

7 INTEGRATION AND TEST INTERFACES

7.1 Mechanical GSE

Installation of the AFEE into the PEM structure requires the following

MGSE as specified in the Calorimeter Assembly Procedure:

1) PEM Alignment Plate - the Base Plate of the PEM Structure is attached to the PEM Alignment Plate. This plate has rails that accommodate sliding brackets, which properly align the AFEE and structure for integration. This plate also accomodates additional tooling used for the CDE integration.

2) Flex Cable Alignment Bracket - this bracket properly supports and positions the Flex Cable so that it can pass through the openings of the Close-Out Plate and AFEE Board for integration. This bracket is adjustable so that the row height of the Flex Cable ends can be positioned to simulaneously pass through these openings.

3) Close-Out Plate Bracket - this sliding bracket supports the Close-Out Plate so that it can be slid into position so while the Flex Cables are threaded through the openings in the plate.

4) AFEE Board Alignment Bracket - this sliding bracket supports the AFEE Board so that it can be slid into position so while the Flex Cables are threaded through the openings in the board.

The Flex Cable Alignment Bracket is removed once the Flex Cable is threaded through the openings of both the Close-Out Plate and the AFEE Board. After the Close-Out Plate is slid into place and securely fastened to the core structure, its bracket can be removed. Likewise, the AFEE Board Bracket is removed after it is securely fastened to the Close-Out Plate.

7.2 Electrical GSE

The following electrical ground support equipment is required during interface testing of the CAL module: TEM interface card, TEM host computer, interface cables, power supply and multimeter.

8 ENVIRONMENTS

8.1 ESD Control

The integration area will provide ESD protected benches and mats. Personnel must be trained in ESD and cleanliness practices prior to being given access to the integration area.

8.2 Environmental Control

The temperature environment of the integration area in which the CAL PEM and AFEE boardsare integrated must be in the range of 20 to 25^{o}C (TBR). The humidity of the room will be maintained between 35% RH (TBR) and 50% RH (TBR). These requirements are defined in the Calorimeter, Tracker and Data Acquisition Contamination Control Plan, LAT-MD-00228-D2.

8.3 Contamination Control

The integration environment will be free of dust at the level defined by ISO 7 norm. All personnel will wear dust free gloves when handling the components of the CAL module. The detailed requirements are defined in the Calorimeter, Tracker and Data Acquisition Contamination Control Plan, LAT-MD-00228-D2.

9 Addendum A

Specification for the Calorimeter Photodiode Flexible Cable, LAT-SS-00211.