MRO Delay Line ICD

Delay Line to Metrology System

ICD INT-406-VEN-0010

The Cambridge Delay Line Team

rev 0.3

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Cavendish Laboratory
JJ Thomson Avenue
Cambridge CB3 0HE
UK

1 ICD Description

ICD Number	Sub-systems		Org	Owner	Brief description and preliminary contents
INT-406-VEN-0010	Delay line	Metrology system	MRAO	RCB	Defines the opto-mechanical and electronic interfaces between the delay lines and the metrology system. • Geometric requirements for metrology beams – positions, sizes • Control signals and communications

2 Change Record

Revision	Date	Authors	Changes
0.1	2007-08-10	MF	First draft version
0.2	2009-05-20	MF	Removed TBDs and TBCs. Revised text and drawings. Appended MROI BCF drawings. Incorporated electrical interface connection details.
0.3	2009-06-16	MF	Changed low latency cable to plenum type: p7 Changed pin allocations for datum cable: p7

3 Notification List

The following people should be notified by email that a new version of this document has been issued:

MROI: **Fernando Santoro**

MRAO: **Chris Haniff**
David Buscher
Martin Fisher

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4 Scope

This ICD details the positioning of the metrology beams with respect to each delay line pipe and electrical connections specifically between the metrology system and the delay lines. It does not define the height or positioning of the metrology table(s) nor electrical connections between the delay lines and other BCF subsystems.

5 Acronyms and Abbreviations

BCA Beam Combining Area
BCF Beam Combining Facility
BRS Beam Relay System
DL Delay Line
DLA Delay Line Area
ICD Interface Control Document
ICS Interferometer Control System
MROI Magdelena Ridge Observatory Interferometer
MRAO Mullard Radio Astronomy Observatory
NMT New Mexico Tech
OPD Optical Path Delay
TBC To be confirmed
TBD To be determined

6 Applicable Documents

AD1 Derived Requirements

DRAWINGS

AD2 MROI Beam Combining Facility (Delay Line Metrology System)

AD3 MROI Infrastructure (Delay Line System)

Specific interface dimension: – a diagram is included in this document.

AD2 and AD3 are included in the appendices

REFERENCE DOCUMENTS

RD1 Delay line to Beam Relay system (INT-406-VEN-0008)

RD2 Delay line to BCF infrastructure (building) (INT-406-VEN-0009)

RD3 Metrology System to BCF (INT-406-VEN-0012)

RD4 Metrology System to Beam Relay System (INT-406-VEN-0013)

RD5 Metrology System design drawings

7 Introduction

This ICD describes the interface between the delay line pipes and the metrology system. There are two aspects:

1. Mechanical: the positioning of the expanded metrology beams with respect to the delay lines.
2. Electrical: the direct electrical connections between the metrology system and the delay lines.

7.1 Mechanical interfaces

The incoming science beams are the reference positions for the delay line pipes whose centre positions at the end-plates become the reference positions for the expanded beam lines of the metrology system. The horizontal separation of the delay lines is a compromise between accessibility of the pipe support structure, the pipe joints etc. and minimising the size and hence cost of the DLA.

For each delay line the design constraints of the trolley cat's eye and the windows of the delay line end-plate determine the position and separation of the outgoing and returning metrology beams. The diameter of the metrology beams is a derived requirement (AD1), determined by error budget considerations and detailed in the risk reduction experiments (RD5).

Considerations of accessibility to the delay line end-plates and to components of the metrology system for alignment or removal place a minimum requirement on the distance between the end-plate and the metrology system and also on the metrology bench. The latter is dealt with specifically in RD3.

7.2 Electrical interfaces

The electrical interfaces between the delay lines and the metrology system are defined at the VME system which is housed in the outer BCA area. The signals that pass between the VME system and the delay line are:

1. The datum signal and associated power for each delay line.
2. The low latency analogue signals for each delay line.

The datum signal and power connect to the sensor on each delay line whereas the low latency signals connect to individual transmitter modules which in turn are connected to the antennae input at the far end of each delay line. The transmitter modules are housed in an enclosure mounted on the end plate at the far end of each delay line.

8 Requirements

8.1 Mechanical

The requirements of the interface are:

The horizontal separation of the geometric centre of each pair of expanded metrology beams (outgoing and return) is 2 feet.

The horizontal separation of the outgoing and returning expanded metrology beams for each delay line is [165mm].

The vertical separation between the horizontal line joining the centres of the expanded metrology beams and the incoming science beam is [82.5 mm].

The diameter of the outgoing expanded metrology beam should be no greater than [25mm] and no less than [18mm].

The aperture of the beam compressor for the return beam should be sufficiently large to accept a deviated beam which still passes through the window on the delay line pipe end-plate. That is it should accommodate a [24]mm diameter beam whose centre is displaced by up to [10]mm from the nominal beam axis.

The distance between the end-plate of the delay line and the nearest metrology component to it should not be less than 1m. (This allows sufficient space for the metrology table to project into this space by 150mm and for the protection mechanism for the science window to project a further 250mm in front of the end-plate, the surface of which is 100mm from the inside wall of the BCA, thus allowing at least 500mm clear for personnel access).

8.2 Electrical

The connection requirements of the interfaces are detailed here:

The datum signal and associated power for each delay line occupy one cable and connect to the VME system using an individual connector for each delay line.

The low latency analogue signal is carried on a shielded pair of wires and connects to the VME system using a single connector for each delay line.

9 Design

9.1 Mechanical

The dimensions of the positions of the metrology beams are shown in the diagram provided in the appendix. Tolerances are specified to allow for some small deviation between the beam centres and the apertures of the associated windows of the delay line pipe end-plate because the metrology beams are to be adjusted such that satisfactory performance is obtained. The design of the metrology system which satisfies the requirements is available as a set of drawings (RD5)

The distance between the end-plate of the delay line and the nearest component mounted on the metrology bench is not to be less than 1 metre. This is shown on an extract of the metrology layout drawing in Figure 1 below.

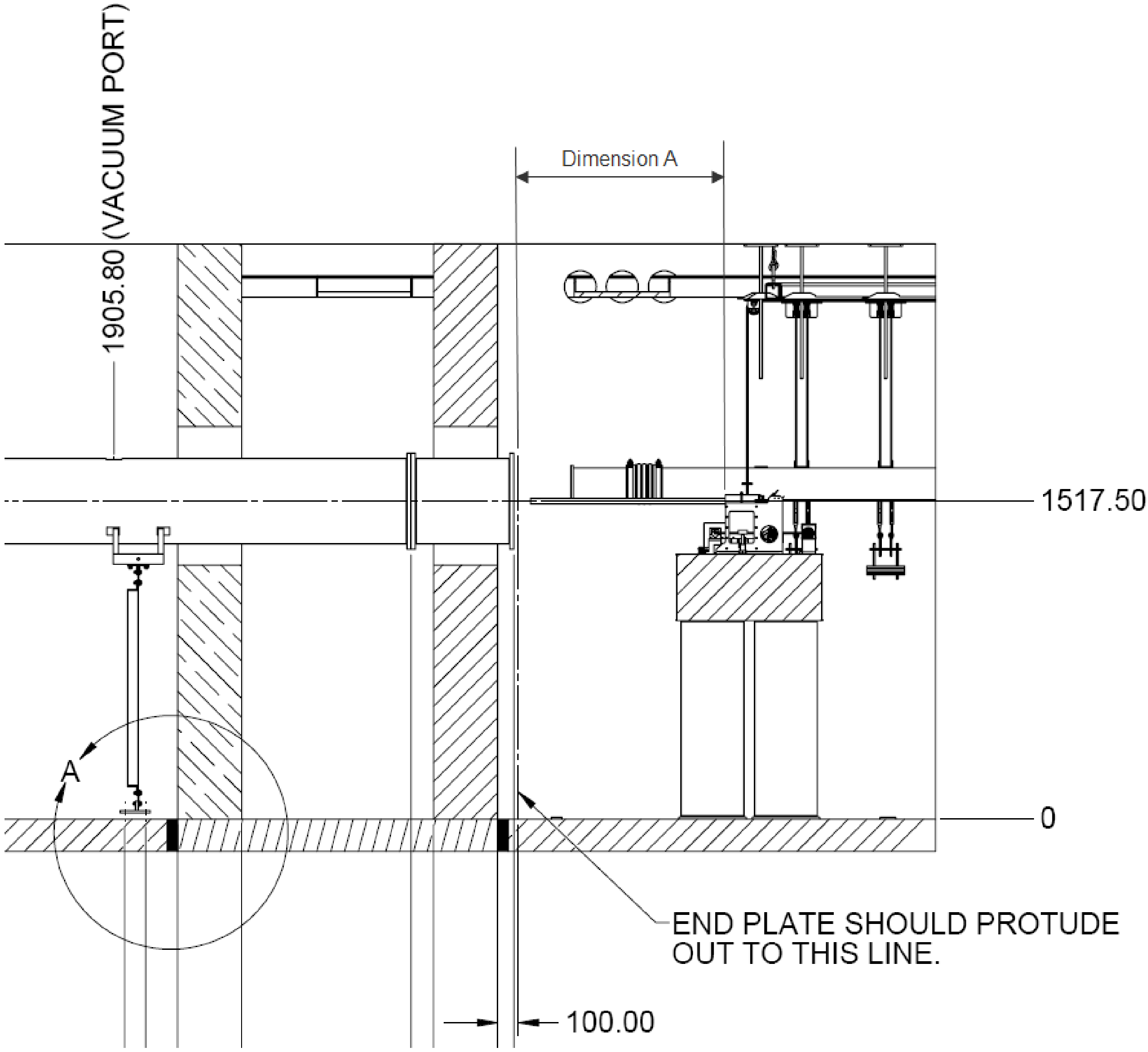

Figure 1 Extract of metrology layout showing the dimension A between the end-plate of the delay line and the beam expander blocks mounted on the metrology bench. Dimension A is not to be less than 1m.

9.2 Electrical

The OPD error signal is converted to an analogue signal in the VME system. This analogue signal is buffered by a differential driver and is carried by an individual screened twisted pair cable to the RF module mounted at the far end of the delay line. The cable for each delay line is fitted with a connector which connects directly to the VME output module.

The details of cables and connectors and the routing for cables are given in RD2.

These details are repeated here together with pin allocations that correspond with the as-built designs for the modules. Pin allocations are given in the tables provided below.

9.2.1 Low latency cable

Table 1 Interface connectors and cable types for the low latency cable

Cable	**From [Cable connector]**	**To [Cable connector]**	**Cable type**
Low latency analogue signal	VME System (BCF) [3-way Lemo 0B plug FGG.0B.303.CLAD42Z]	DL RF module * [3-way Lemo 0B plug FGG.0B.303.CLAD42Z]	2-conductor stranded, foil shielded with drain wire Belden 9451P

* Note: shield of cable is not to be connected at the DL end of the cable.

Table 2 Pin allocations for low latency link cable

Signal	**From** VME System (BCF) [3-way Lemo 0B plug FGG.0B.303.CLAD42Z]	**To** DL RF module [3-way Lemo 0B plug FGG.0B.303.CLAD42Z]	**Wire**
A	Pin 1	Pin 1	Red
B	Pin 2	Pin 2	Black
GND	Pin 3	Pin 3	Drain

9.2.2 Datum switch cable

Table 3 Interface connectors and cable types for the datum cable

Cable	**From [Cable connector]**	**To [Cable connector]**	**Cable type**
Datum signal and power	VME System (BCF) [5-way Lemo 0B plug FGG.0B.305.CLAD42Z]	DL datum switch [Harting Harax M12 female plug part 21 03 221 2405]	4-conductor stranded, shielded diameter 3.1mm to 3.4mm Alpha Wire 57004

Table 4 Pin allocations for the datum cable

Signal	**From** VME System (BCF) [5-way Lemo 0B plug FGG.0B.305.CLAD42Z]	**To** DL datum switch [Harting Harax M12 female plug: part 21 03 221 2405]	**Wire**
+V	Pin 1	Pin 1	Red
A2	Pin 2	Pin 2	White
0V	Pin 4	Pin 3	Black
A1	Pin 3	Pin 4	Green
	Pin 5		Drain

10 Appendix

AD2 MROI Beam Combining Facility (Delay Line Metrology System)

AD3 MROI Infrastructure (Delay Line System)