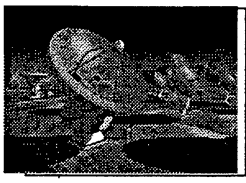
Draft only



ALMA Project ICD Interface *From: Band 4 cartridge* *To: Dewar*	Doc # : FEND-40.02.04.00-40.03.01.00-A-ICD Date: 2004-09-24 Status: *Draft* Page: 1 of 11

Interface Control Document

Between:
Band 4 Cartridge
and:
Dewar

FEND- 40.02.04.00-40.03.01.00-A-ICD

Version: Draft
Status: (*Draft, ~~Pending, Approved, Released, or obsolete~~*)

2004-09-24

Prepared By:		
Name(s) and Signature(s)	**Organization**	**Date**
S. Asayama K. Kimura	NAOJ OPU	2004-09-24
Approved By:		
Name and Signature	**Organization**	**Date**
	NAOJ	yyyy-mm-dd
Released By:		
Name and Signature	**Organization**	**Date**

Change Record

Version	Date	Affected Section(s)	Change Request #	Reason/Initiation/Remarks
A	2004-11-17	N/A	N/A	Initial draft

Table of Contents

1 Description

1.1 Purpose

This document describes the interface between the Band 4 front-end cartridge components include the cartridge body supplied by NAOJ, and the cryostat assembly supplied by RAL. For the purpose of this document, the cryostat assembly will supply to NAOJ.

1.2 Scope

The interaction between the Band 4 components and the cryostat is limited to mechanical and thermal interfaces. There are no electrical, electronic or software interfaces to discuss. This document was drafted with reference to [RD3]

2 Related Documents and Drawings

2.1 References

did not obtain these document

RD1	**Cryostat Technical Specifications**	FEND-40.03.00.00-002-B-SPE	Version: B 2003-09-20
RD2	**ALMA Coordinate System Definition?**	ALMA-80.05.00.00-009-B-SPE	Version: B 2003-12-15
RD3	**ICD between Band 9 Cartridge and Dewar**	FEND- 40.02.09.00-40.03.01.00-A4-ICD	Version: A4 2004-04-22

2.2 Abbreviations and Acronyms

NAOJ – National Astronomical Observatory of Japan
OPU – Osaka Prefecture University
SRON – Space Research Organization Netherlands
RAL – Rutherford Appleton Laboratory
IR – Infrared

2.3 Glossary

(none)

2.4 Related Interface Control Drawings

Drawing #	Date	Origin	Description
KG0772-001	2002-03-25	RAL	ALMA Cryostat Assembly
FEND-40.00.00.00-016.dwg	2003-09-25	RAL	ALMA Cryostat Window and Filter Interface Details
?	TBD	RAL	Cartridge Assembly Bands 4
40.02.04.07.03	TBD	NAOJ	80K-plate band 4
40.02.04.07.02	TBD	NAOJ	12K-plate band 4
40.02.04.07.01	TBD	NAOJ	4 K-plate band 4
40.02.04.07.04	TBD	NAOJ	Cartridge base plate band 4

Note that these interface drawings need to be updated and given FEND document numbers.

3 Physical System Interfaces

3.1 Definition of Cartridge Coordinate System

For the purpose of discussions within this ICD, the RAL cryostat coordinate system will be used (see also RD2). The location of the origin and positive X and Y directions are shown in RAL drawing FEND-40.00.00.00-016.dwg (see Section 2.4 above). The Z = 0 plane is assumed to be located at the mounting interface between the cartridge body and cryostat.

3.2 Mechanical Interface Between the Cartridge Body and Cryostat

The mechanical interface between the cartridge body and cryostat is controlled by NAOJ. Applicable drawings will be: KG0772-001 and Cartridge Assembly Bands 4 (see Section 2.4 above). Figure 1 shows the Band 4 Cartridge location from the ambient side.

3.3 Mechanical Interface Between the Cartridge Body and the Band 4 Components

The cartridge body of the Band 4 front-end cartridge components will be supplied by NAOJ.The first cartridge stage (T~110 K) details are shown in drawing (40.02.04.07.03, TBD) to provide mounting interfaces for Band 4 components and routing of wires and waveguides.

The second cartridge stage (T~15 K) details are shown in drawing (40.02.04.07.02, TBD) to provide mounting interfaces for Band 4 components and routing of wires and waveguides.

The third cartridge stage (T~4 K) details are shown in drawing (40.02.04.07.01, TBD) to provide mounting interfaces for Band 4 components and routing of wires and waveguides.

3.3.1 Stability of the Cartridge Plate Separation During Operation

In order to meet the total output power stability and signal path phase stability requirements for the integrated cartridge, the following mechanical stability of the cartridge plate separation during operation would be needed:

Distance	Stability up to 1 sec.	Stability up to 5 min.
300 K to 110 K	TBD	TBD
110 K to 4 K	TBD	TBD

3.4 Clearance Between the Band 4 Components/Beam and the Cryostat

The cryostat radiation shields will include a clear aperture and interface bolt hole pattern for mounting IR filters. The locations of the shields and interface details are shown in RAL drawing FEND-40.00.00.00-016.dwg. Figure 2 shows the layout and dimensions for Bands 4 optics.
To prevent vignetting of the beam or contact between the Band 4 components and the shields, the locations and maximum deflections of these shields and apertures are (with respect to coordinate system described in section 3.1):

	Location (mm)[1]	Max. Deflection (mm)[2]
Dewar window aperture	X = 53.873(TBC) Y = 305.283 (TBC) TBC	ΔX :TBD ΔY :TBD ΔZ :TBD
90 K shield aperture	X = 53.873(TBC) Y = 305.283 (TBC) TBC	ΔX :TBD ΔY :TBD ΔZ :TBD
12 K shield aperture	X = 53.873(TBC) Y = 305.283 (TBC) TBC	ΔX :TBD ΔY :TBD ΔZ :TBD

Note 1: The Y location stated here is the nominal location of the optical beam at the given vertical position. The actual aperture location may be offset to a nominal value of X=54=mm, and Y =306 mm, but this will affect the allowable deflection (by making the ΔY tolerance asymmetrical).
Note 2: The ΔZ tolerance may be traded against the ΔX and ΔY tolerances.

3.5 Mass/Balance

A breakdown of the total cartridge mass by temperature level is indicated in the following table. Note that the second column is the mass of the Band 4 components mounted on each temperature level and the mass of the cartridge plate.

Temperature Level	Component Mass	Total Mass	Comments
4 K	3.5+0.5(plate)	3.5+0.5	Partially Detailed
15 K to 4 K	0.1 + 0.5(pillar)		Estimate
15 K	0.1 + 0. 5(plate)	0.1+0.6	Estimate
110 K to 15 K	0.05 + 0. 5(pillar)		Estimate
110 K	0.1 + 0.5(plate)	0.1+0.6	Estimate
300 K to 110 K	0.2 + 0.5(pillar)		Estimate
300 K	0.3 + 0.5(plate)		Estimate

The centre of mass of this assembly will be located at (with respect to the coordinate system described in section 3.1):

X =	TBC
Y =	TBC
Z =	TBC

3.6 Thermal Interface

Details of the thermal environment are given in RD1. The radiation load between the stages of the cartridge must be minimized by shielding any holes in the 110K and 15 K cartridge plates and by including an MLI blanket between the cartridge base plate and the 110K plate (**TBC**).

Note that the bulky components located on the 300 K level will make the insertion of a MLI blanket on the 300 K level difficult – if it is not necessary, then this line should be removed.

3.6.1 110K stage

The temperature of the "110K" cartridge plate will be between 80 K and 130 K.

"On" Load - The total maximum instantaneous heat load due to dissipation of electronic components mounted on the '110 K' stage of the band 9 cartridge shall be less than or equal to 0.83W.
"Off" load.- The heat load on the '110 K' stage due to conduction by wiring is assumed to be less than or equal to 400 mW, and is additional to the stated value of 0.83 W.

3.6.2 15 K stage

The temperature of the "15K" cartridge plate will be between 10.0K and 18.0 K

"On" Load - The total maximum instantaneous heat load due to dissipation of electronic components mounted on the '15 K' stage of the Band 9 cartridge shall be 66 mW.

"Off" load.- The heat load on the '15 K' stage due to conduction by wiring is to be less than or equal to 95 mW, and is additional to the stated value of 66mW.

3.6.3 4K stage

The temperature of the "4K" cartridge plate will be less than or equal to 4.0K.

"On" Load - The total maximum instantaneous heat load due to dissipation of electronic components mounted on the '4 K' stage of the Band 9 cartridge shall be 36 mW.

"Off" load.- The heat load on the '4 K' stage due to conduction by wiring is to be less than or equal to 5 mW (TBC), and is additional to the stated value of 36mW.

3.7 Thermal Stability

In order to meet the total power and signal path phase stability requirements for the integrated cartridge, the following (Allan variance) thermal stability of the 110, 15, and 4 K levels would be needed:

Level	Within 0.1-1 sec.	Within 5 min.
110 K	± TBD	± TBD
15 K	± TBD	± TBD
4 K	± 0.11 mK (TBC)	± TBD

4 Vacuum Interface (TBC)

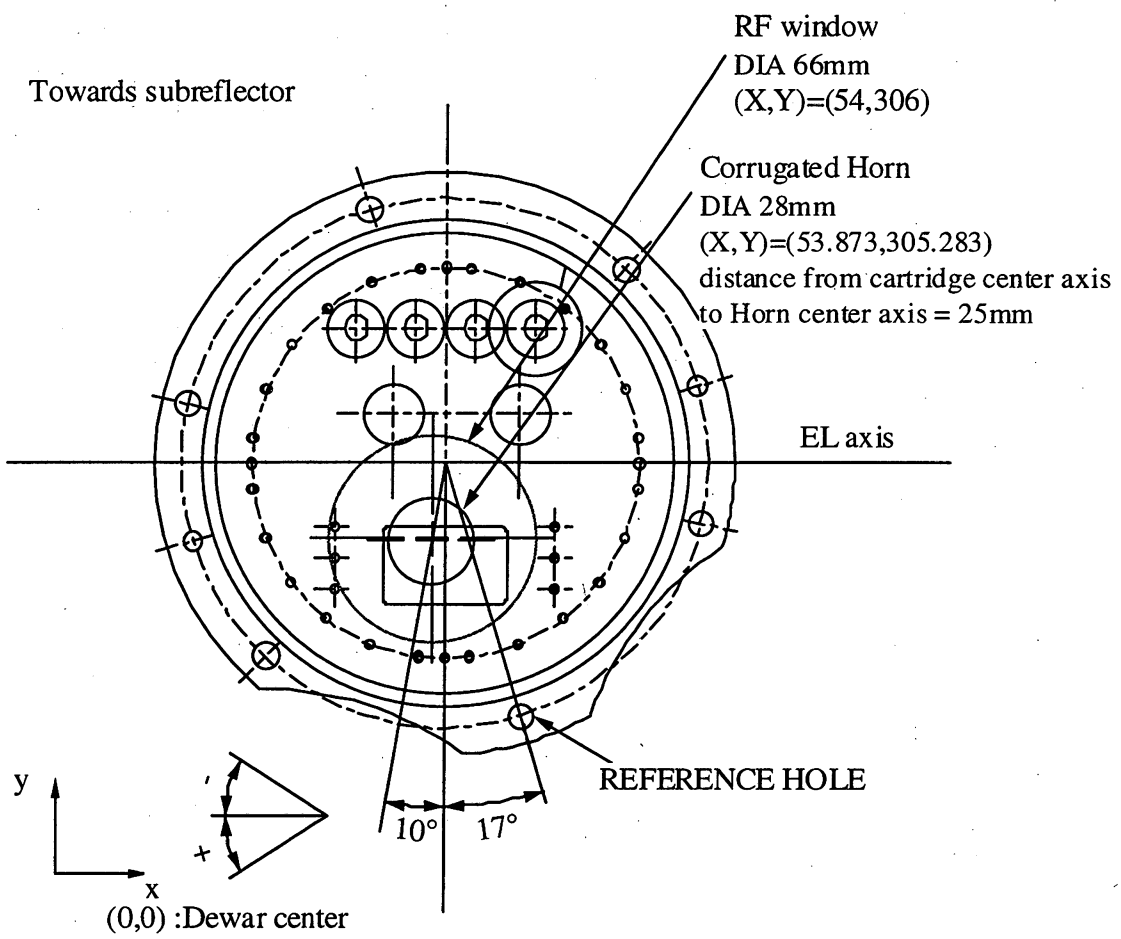
Note that the text in this section could be replaced by a reference to a separate document that is applicable to all components inside the cartridge. In order to not harm the vacuum and thermal properties of the cryostat, and to avoid contamination of the critical RF and optical components inside the cartridges (including the Band 9 cartridge), the materials and constructions used in all components mounted inside the cryostat shall be designed for long-term use in high vacuum conditions.

Materials with low outgassing characteristics shall be selected. In particular, the use of materials (including metals and water-retaining dielectrics) that could contaminate sensitive optical and electronic components shall be avoided wherever possible. Provision shall be made to vent closed volumes of air and to avoid liquid inclusions. The use of blind attachment holes shall be avoided wherever reasonably possible.

All vacuum feedthroughs should be leak-tested to at least 10^{-8} mbar·L/s (TBC).

5 Safety Interface

(none)



Band4 cartridge center	
Cartridge Radial Location	335mm
Caritridge Azimuth	-100deg
(X,Y)=(58.17,329.91)	

Band4 RF Window coordinate position
(X,Y)=(54,306)

Horn location
(X,Y)=(53.873,305.283)

Figure 1: Band 4 Cartridge location

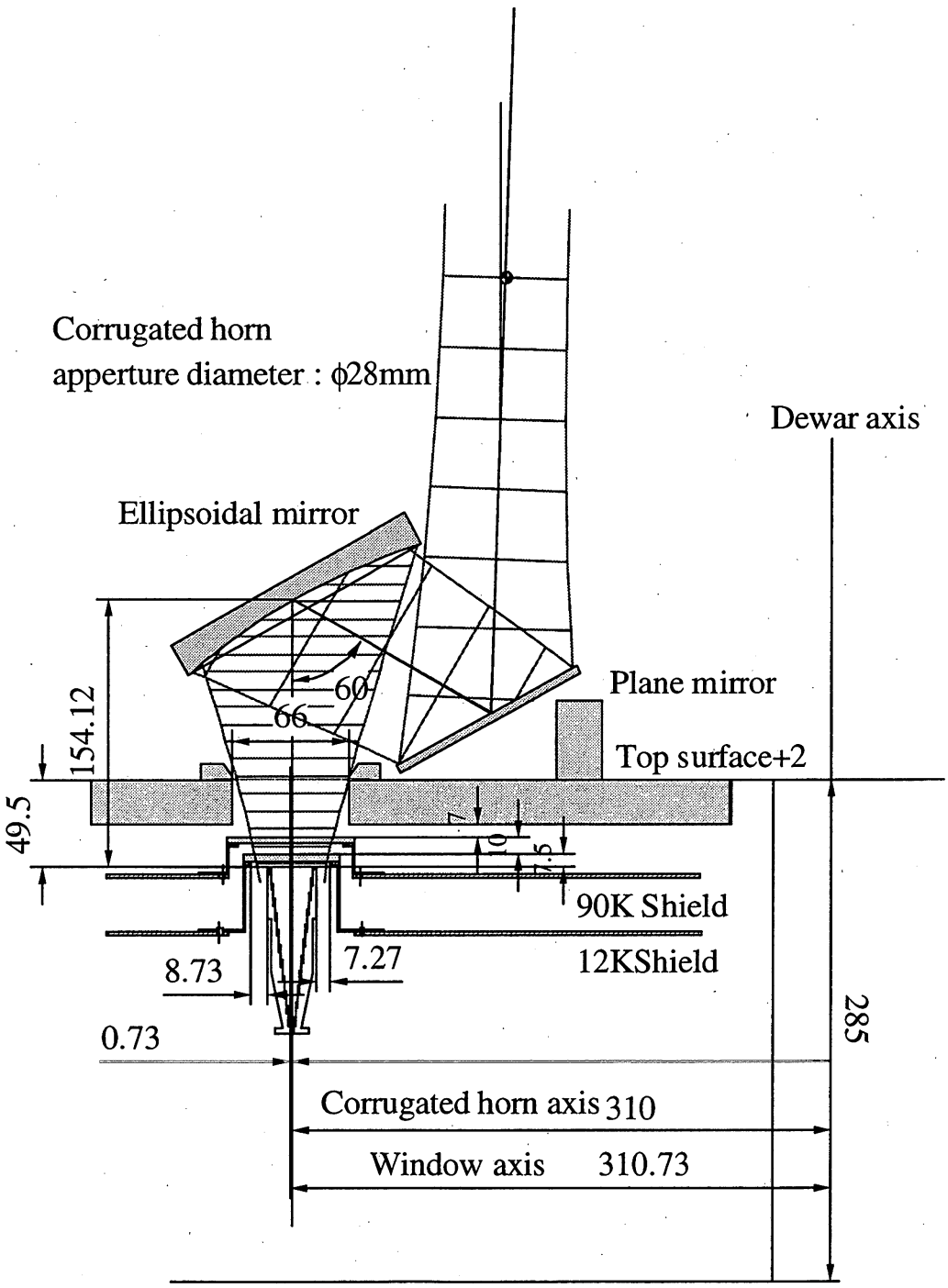


Figure 2: Layout and dimensions for Bands 4 optics.