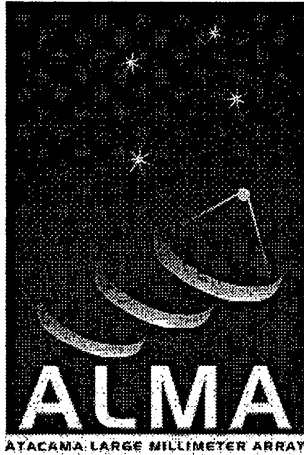


Draft only



Atacama Large Millimeter Array

Interface Control Document

Between:

Band 4 Cartridge

And:

Band 4 First Local Oscillator

FEND-40.02.04.00-40.02.04.13-A-ICD

Version: A

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Change Record

Version	Date	Affected Section(s)	Change Request #	Reason/Initiation/Remarks
A	2004-09-24	all		First Issue

	ALMA Interface Control Document <i>Between: Band 4 Cartridge</i> <i>And: Band 4 First Local</i> Oscillator	Doc # : FEND-40.02.04.00-40.02.04.13-A-ICD Date: 2004-09-24 Status: Draft Page: 3 of 9
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1 Purpose and scope

The electrical and physical interfaces between the Band 4 cartridge and the band 4 first local oscillator are described. The interfaces include the mounting of the doubler blocks, the input and the output waveguides to the doublers, and the mounting of the band 4 warm cartridge assembly (which includes the waveguide interfaces between the warm part of the first LO and the waveguide vacuum window/feedthrough assembly. The doubler blocks generate local oscillator signals for operating the SIS mixers by using the second harmonic of input drive signal. Two doublers– one for each polarization shall be provided. Each doubler has an identical interface to Band 4 cartridge. There is no need for any biasing, monitoring or control signals to the doublers. This document was drafted with reference to [RD1].

2 Related Documents and Drawings

2.1 Applicable documents and drawings

The following documents are part of this document to the extent specified herein. If not explicitly stated differently, the latest issue of the document is valid.

<i>Reference</i>	<i>Document title</i>	<i>Document ID</i>
[AD1]	ALMA System: Electromagnetic Compatibility (EMC) Requirements	ALMA-80.05.01.00-001-A-SPE
[AD2]	ALMA Band 4 Cartridge Technical Specifications and Requirements	FEND-40.02.04.00-001-A-SPE
[AD3]	ALMA Front End First Local Oscillator Technical Specifications and Requirements	(in preparation)
[AD4]	ALMA band 4 frequency multipliers specifications and requirements	(in preparation)
[AD5]	Vacuum Guidelines for receiver components inside the ALMA Front End cryostat	FEND-40.03.00.00-015-A-SPE

In the event of a conflict between one of the before mentioned applicable documents and the contents of this document, the contents of the applicable document shall be considered as a superseding requirement.

2.2 Reference documents

The following documents contain additional information and are referenced in this document.

<i>Reference</i>	<i>Document title</i>	<i>Document ID</i>
[RD1]	ICD between Band 9 cartridge and IF switch sub-system	FEND-40.02.09.00-40.02.09.13-A-ICD

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2.3 Abbreviations and Acronyms

A limited set of basic acronyms used in this document is given below. A complete set of acronyms used in the ALMA project can be found in the ALMA Project Book.

ALMA	<u>A</u> tacama <u>L</u> arge <u>M</u> illimetre <u>A</u> rray
DSB	<u>D</u> ouble- <u>S</u> ide <u>B</u> and
ICD	<u>I</u> nterface <u>C</u> ontrol <u>D</u> ocument
IF	<u>I</u> ntermediate <u>F</u> requency
IO	<u>I</u> nput / <u>O</u> utput
LO	<u>L</u> ocal <u>O</u> scillator
NAOJ	National Astronomical Observatory of Japan
SIS	<u>S</u> uperconductor- <u>I</u> nsulator- <u>S</u> uperconductor
SSB	<u>S</u> ingle- <u>S</u> ide <u>B</u> and
VSWR	<u>V</u> oltage <u>S</u> tanding <u>W</u> ave <u>R</u> atio
2SB	<u>S</u> ide <u>B</u> and separating

2.4 Related Interface Control Drawings

[AD6] ALMA Band 4 LMA Band 4 Coolable Frequency doubler - Mechanical Details (in preparation)

[AD7] Front End Cartridge DIA140 Baseplate Feed Thru Cutout Pattern, ALMAEDM Front End IPT Workspace/Documentation/Cartridges.

[AD8] WR-8 Photonic Grid Array, FEND-40.10.05.00-002-A-DWG, ALMAEDM Front End IPT Workspace/Documentation/Local oscillator system/LO Frame Assembly

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3 Interface Design (TBD)

3.1 Mechanical Interface

3.1.1 Mechanical interface of the warm cartridge assembly

The warm cartridge assembly, which contains all the ambient temperature portions of the first LO, connects to the cartridge baseplate with three M6 screws and three 2.99mm guide pins as shown in drawing [AD7].

The two LO waveguide connections at the baseplate shall be blind mate. The waveguide flanges shall be pinned but not screwed together, instead there shall be a pre-loaded pressure fit between the flanges. This approach allows making this assembly removable when all the cartridges and LOs are in place on the back of the dewar. Since it is likely that this waveguide physical interface would not be perfect, a "waffle-iron" filter shall be designed and machined into the output flange of the warm LO assembly to make this interface much less sensitive to waveguide misalignment, cocking, etc. The input flange of the waveguide feedthrough in the cartridge plate will thus be a standard waveguide flange (to allow it to interface with standard measurement equipment).

The input flange of the waveguide feedthrough will be TBD +/- 0.2 mm above the ambient side of the warm cartridge baseplate (e.g., this TBD=14.1 for band 6). The centre of the feed through flanges will be located to true position to within 0.02 mm (TBC).

The warm cartridge assembly shall be removable from the cartridge baseplate without breaking the vacuum seal.

3.1.2 Mechanical interface of the doubler block (TBD)

The doubler outline drawings and detailed drawings of the interface will be found in ref. [AD6].

The output waveguide flange can act as the mounting interface. The mounting bracket and waveguide that are provided by the cartridge manufacturer shall be designed as to not put undo mechanical stress on the doubler for any expected thermal cycling.

The input flange of the doubler is a standard WR-12 UG-387/U flat waveguide (TBD). The waveguide will be oriented with its E-plane oriented perpendicular to the mounting faces of the block. The output flange of each doubler is a WR-6 UG-387/U flat waveguide. The waveguide will be oriented with its E-plane oriented perpendicular to the mounting faces of the block.

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3.2 Electronic Interface (TBD)

3.2.1 Electronic Interface at the warm cartridge assembly

- **Waveguide type and flange:** WR-12 UG-387/U flat waveguide on cartridge side and WR-12 UG-387/U “waffle-iron” waveguide on LO side (detailed drawing of “waffle-iron” flange is shown in [AD8]).
- **Frequency Range:** 66.5-77.5 GHz
- **Maximum Foreseeable Power at Interface:** 0.1 mW at any frequency (this value will be used in defining an allowable RF leakage of the waffle-iron thermal break, if one is used)
- **Return loss:** the input return loss of the connection between the warm LO assembly and the doubler shall have, as a goal, a return loss of -10 dB, or better.

3.2.2 Electronic Interface at the input of the doubler

- **Waveguide type and flange:** WR-6 UG-387/U flat flange on the doubler block and WR-12 UG-387/U flat or anti-cocking flange on the input waveguide.
- **Power loss** (with respect to the interface defined in 3.2.1): less than 2 dB (note that this should include both resistive and reflective losses)
- **Return loss:** the output return loss of the connection between the warm LO assembly and the doubler shall have, as a goal, a return loss of -10 dB, or better.

3.2.3 Electronic Interface at the output of the doubler (TBD)

- **Waveguide type and flange:** WR-6 UG-387/U flat waveguide
- **Frequency Range:** 133-155 GHz
- **Power:** from 0 to P_{max} , with steps of no more than 0.25 dB between $0.25P_{max}$ and P_{max}
- **Minimum Achievable Output Power:** 50 μ W at any LO frequency (with a goal of 75 μ W at any LO frequency). (Note that this minimum power includes the effect of the standing wave between the output of the warm local oscillator assembly and the input of the doubler, with < 2 dB attenuation between the two units.)
- **Excess Sideband Noise:** When used with the band 4 warm cartridge assembly and an ALMA band 4 receiver, will add no more than 20 K measured SSB receiver noise above the same receiver with a Gunn oscillator LO integrated over the full IF bandwidth at any LO frequency. This includes the contribution of frequency spurs within the signal and image bands (average over TBD MHz of bandwidth).
- **Phase Noise:** The LO phase noise should be specified in AD3 and AD4.

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- **Phase Drift:** the phase drift contributions of the warm LO assembly and the doublers shall be $< 0.6^\circ$ on time scales up to 5 min. (measured in 16 ms intervals).
- **Frequency Spurs:** less than -20 dBc outside the signal and image bands ($\pm 4-8$ GHz offset from the LO frequency). The allowable level of narrow-band frequency spurs within the signal and image bands should be defined in AD3 and AD4. If present, these spurs shall not be included as part of the cartridge output power ripple.
- **Amplitude Stability:** 0.05% over 0.1 to 1 sec (TBC).

3.2.4 List of connectors

List of Electronic Connectors			
Issue:			
Date:			

Connectors #	Connector Reference	Function	Comment – Responsibility for delivery
WG1A-LO4	WR-12 UG-387/U “waffle-iron”	Band 4 first LO output, polarisation 0	
WG1B-LO4	WR-12 UG-387/U flat	band 4 cartridge input, polarisation 0	
WG2A-LO4	WR-12 UG-387/U “waffle-iron”	Band 4 first LO output, polarisation 1	
WG2B-LO4	WR-12 UG-387/U flat	band 4 cartridge input, polarisation 1	
WG3A-LO4	WR-12 UG-387/U flat	Doubler block input, polarisation 0	
WG3B-LO4	WR-12 UG-387/U flat	Input waveguide to doubler, polarisation 0	
WG4A-LO4	WR-12 UG-387/U flat	Doubler block input, polarisation 1	
WG4B-LO4	WR-12 UG-387/U flat	Input waveguide to doubler, polarisation 1	
WG5-LO4	WR-6 UG-387/U/U-M	Doubler Output, polarisation 0	
WG6-LO4	WR-6 UG-387/U/U-M	Doubler Output, polarisation 1	

3.3 Thermal and Vacuum Interface

The doubler shall dissipate not more than 100 mW into the connected cartridge structure. The cooling is done passively through the mounting structure.

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The doubler shall operate in temperature range 80...130 K. Operation at 300 K shall be possible, although the output power will be reduced (by approximately 2 dB).

The temperature stability of the temperature level of the doubler at operation conditions is 100 mK (peak-to-peak) in a 1 minute period (from AD2). No active thermal feedback is foreseen.

Provisions shall be made that the doubler is made compatible with high vacuum systems [AD5]:

Materials with low vapour pressure shall be used in the doubler, or a surface treatment to avoid outgassing shall be chosen. There shall be no inclusions of liquid and closed volumes of air. Blind attachment holes must be provided with venting holes or indicated in AD6.

4 Interface handling

The interface is sensitive to electrostatic discharge (ESD). Only ESD trained personnel should handle the unit and then only when wearing a wrist or heel strap. The interface is sensitive to dust/particles. A protective cover shall be used on waveguide flanges during transport.