Installation of Interrack Cables and Switchover Procedure for Hydrogen Maser Frequency Standard for the CLOA – ALMA Phasing Project

ALMA-05.11.21.02-0002-A-PLA

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Change Record

Version	Date	Affected section(s)	Author	Reason/Initiation/Remarks
A.1	2010-07-22	All	C. Jacques A. Saez	Initial draft
A.2	2014-10-28	All	A. Caceres	Document number and format corrections
A	2014-10-30	Section 5.1	C. Jacques	Document reference correction

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1. Description

1.1. Purpose

As part of the ALMA Phasing Project (APP), an upgrade of the Master Frequency Standard (MFS) is required, as the current Rubidium based source is inadequate.

This document describes the steps required to test and install the RF cables connecting the HMaser rack to the Central Variable Reference Racks 1 and 2 (CVRR1 and CVRR2), change the CRG and CVRs (1 through 4) to the HMaser output, and verify that all modules are locked to the new standard

1.2. Scope

This plan only covers the CLOA cabling between the racks located in the AOS technical building.

It does not address the software and Monitor and Control upgrades that are required.

NOTE: although intended to ultimately replace the current, Rubidium cell based MFS, this work will allow ALMA to switch back to the current Rubidium MFS at any time should the need arise.

2. Related Documents and Drawings

2.1. Applicable Documents

Ref	Document Title	Document ID
[AD01]	Backend IPT Product Assurance Requirements	BEND-50.00.00.00-079-B-PRO
[AD02]	ALMA Environmental Specification	ALMA-80.05.02.00-001-B-SPE
[AD03]	ALMA System General Safety Design Specification	ALMA-10.08.00.00-003-B-SPE
[AD04]	ALMA Safety Manual	ALMA-10.08.00.00-011-D-MAN
[AD05]	RF Reference Cables between CLOA racks Ver B	BEND-57.04.07.00-004-B-DWG

2.2. Interface Control Documents

Ref	Document Title	Document ID
[ICD01]	ICD between APP and ALMA Back End	ALMA-05.11.10.00-50.00.00.00-A-ICD

2.3. Test Report Documents

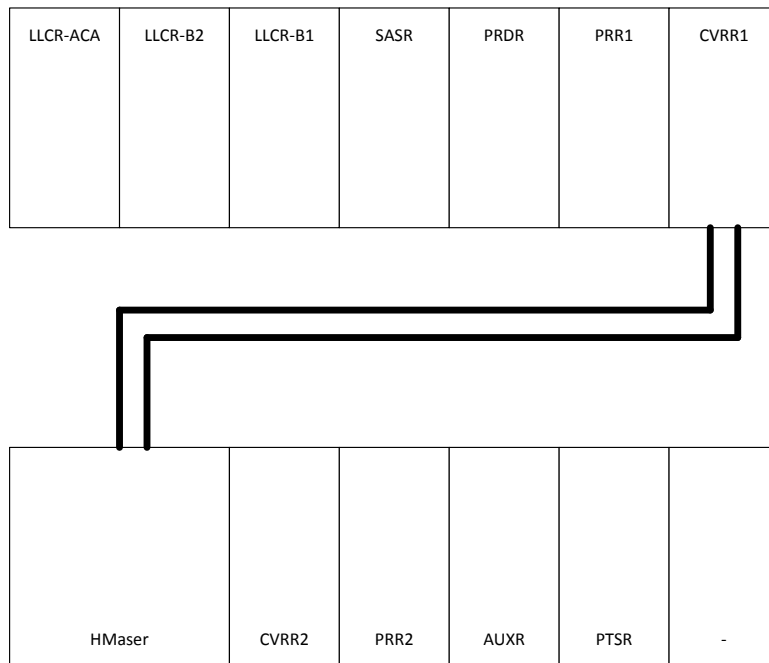| Ref	Document Title	Document ID
PAI	PAI for APP Hydrogen Maser Master Frequency Standard	ALMA-05.11.21.50-001-A-TDR
PAS	PAS for APP Hydrogen Maser Master Frequency Standard	ALMA-05.11.21.50-001-A-TDR

2.4. Abbreviations and Acronyms

AD	Applicable Document
ADE	ALMA Department of Engineering

AIV	Assembly, Integration and Verification
ALMA	Atacama Large Millimeter Array
AOS	ALMA Operation Site
APP	ALMA Phasing Project
BE	Back End
CLOA	Central LO Article
COTS	Commercial Off the Shelf
CRD	Central Reference Distributor
CRG	Central Reference Generator
ICD	Interface Control Document
LO	Local Oscillator
Maser	T4Science Hydrogen Maser
MFS	Master Frequency Standard
MIT	Massachusetts Institute of Technology Haystack Obs.
NRAO	National Radio Astronomy Observatory
OSF	Operations Support Facility
PAI	Preliminary Acceptance In-House
PAS	Product Acceptance On-Site
RD	Reference Document
TBD	To Be Determined
UC	Universidad de Concepcion

3. Installation Drawing

Below is a drawing representing the rack layout in the LO room at the AOS, and the connections to be made. Cables are to be installed in the racketracks located above the two rows of racks.

4. Equipment required

- Calibrated RF power meter capable of measuring up to +13 dBm @ 5 MHz and 10 MHz. Ex: Agilent E4418B mainframe with E4412A head

- SMA torque wrench

- one BNC (female) to SMA (male) adapter

- one N-type to N-type RG214 coax cable, labeled "10M_CVRR1_CVRR2"

- one N-type to N-type RG214 coax cable, labeled "5M_CVRR1_LLCR-ACA"

5. New Cabling Configuration

NOTE: although the results of this work will result in mislabeled/misidentified cables and connectors, these will be relabeled after the Acceptance Review.

5.1. External cabling to be installed

As per the ICD listed in [ICD01], we need to install:

1 x 5 MHz cable from HMaser rack to CVRR1 rack
1 x 10 MHz cable from HMaser rack to CVRR1 rack

The cables to be installed are N-type to N-type RG213 coax, as defined in [AD05]. These cable types have already been installed as part of CLOA2, and have met all of the ALMA requirements.

We will use cables already built as spares for CLOA2, namely part numbers:10M_CVRR1_CVRR2 and 5M_CVRR1_LLCR-ACA, as they have the required length to go from the HMaser rack to the CVRR1 rack.

5.2. Internal cabling

Also as per the ICD, the internal cabling of CVRR1 needs to be modified. The 5 Mhz reference signal to the CRG needs to be disconnected from the Rb MFS and connected to HMaser 5 MHz ouptut, and the 10 MHz RF splitter that feeds the CVRs needs to be connected to the HMaser, instead of the CRD. These cables are already installed in the CVRR1 and simply need to be redirected.

6. Task list

NOTE: all requested measurements of RF power levels must be recorded for inclusion in the PAS reports

a. Lay both cables in the overhead trays, routing them from the HMaser rack to the CVRR1 rack, taking care to minimize the distance required. The cables must come down directly, with little slack, as shown in the picture below:
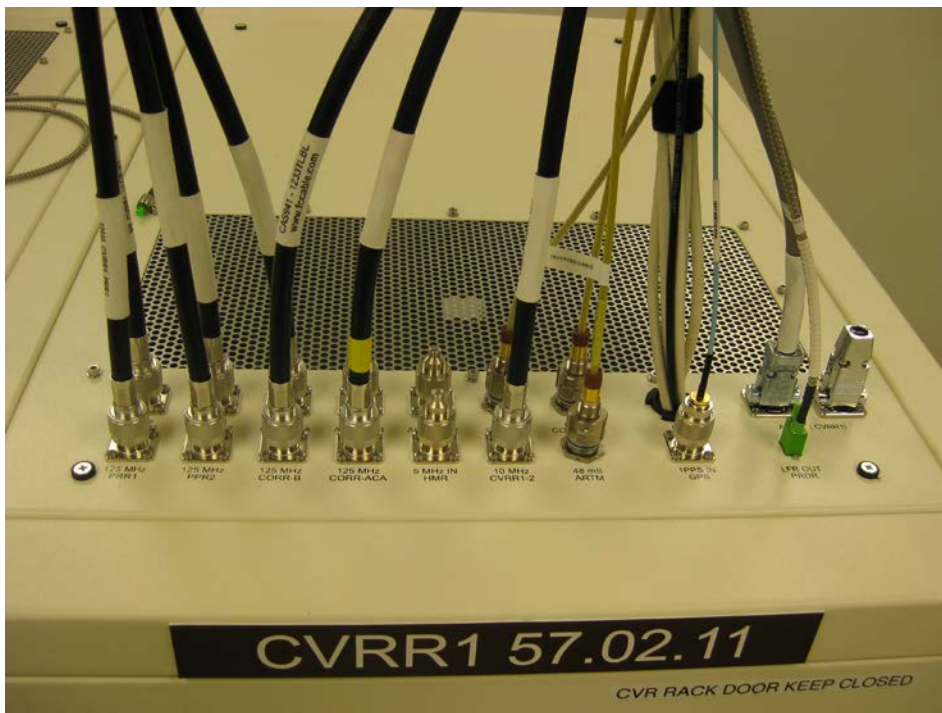

Loop excess length of cable, if any, in the race track above, similar to what has been done for other cables.

b. Measure the power of the 10 MHz and the 5 MHz signals coming out of the HMaser (at the rack top panel connector for example).

c. Connect the cables on the HMaser rack end, 5 MHz using the cable labeled "5M_CVRR1_LLCR-ACA" and the 10 MHz with the cable labeled "10M_CVRR1_CVRR2"

d. Measure the power of the 10 MHz and the 5 MHz signals coming out of the cable ends, on the CVRR1 end.

e. If power levels are within range (min 12.5 dBm @ 10 MHz, min 10.5 dBm @ 5 MHz), connect the 5 MHz to the top panel connector labeled "5 MHz IN HMR" and the 10 MHz to the unused connector immediately behind it, labeled "5 MHz AUXOUT2", also shown in picture above.

f. Disconnect the 5 MHz output from the Symmetricom Rb MFS (IDENTIFY WHICH CONNECTOR IT WAS), install the BNC-to-SMA adapter and connect it (inside the rack) to the "5 MHz IN HMR".

g. Verify that the power level going into the CRG via the SMA connector labeled "(7) 5 MHz IN +10 dBm to +15 dBm" (light green "In from Master Laser") is indeed in that range. See picture below.
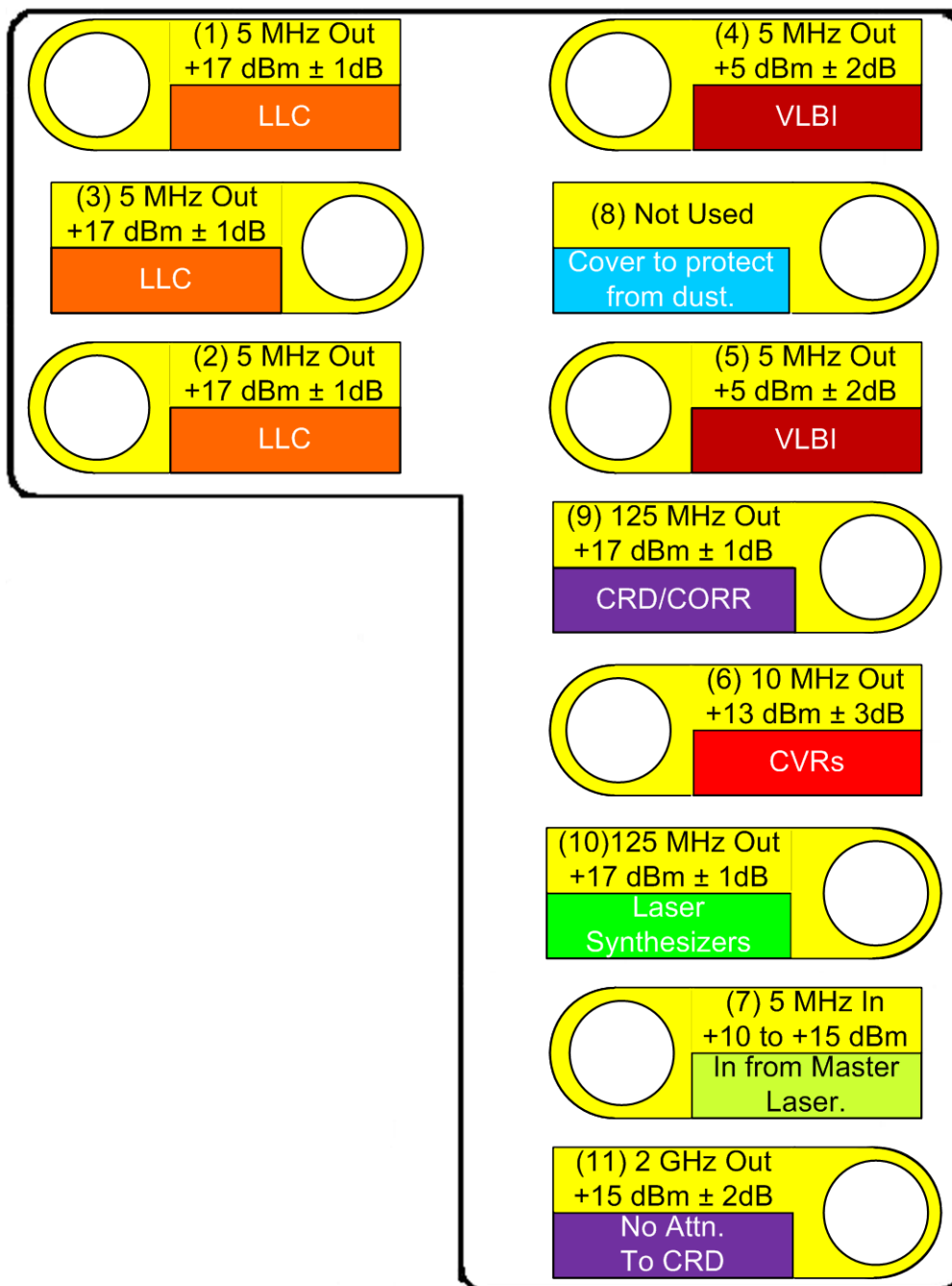
Note: the "In from Master Laser" is a typo, as it should read "In from MFS" this will be corrected later.

h. Disconnect the cable connected to CRG port labeled "(6) 10 MHz Out" (red "CVR") and connect it to the inside of the connector labeled "5 MHz AUXOUT".

i. Verify that RF power delivered to the splitter is at least 12 dBm @ 10 MHz.

j. Torque all SMA connections.

DO NOT TURN THE Rb MFS OFF

7. Verification

1. Verify that all the CVRs (Agilent E8257D) have relocked to the external reference, first on the unit front panel display, then using the CLOA GUI running on the test stand computer.
2. Verify that the CRG is locked to the 5 MHz using the CLOA GUI.
3. Verify that the Analog rack LORR has not lost lock.

8. Switching back to the original (Rb MFS) configuration

If, for any reason, it is necessary to revert back to using the Symmetricom MFS, simply undo steps "f" and "h", namely:

a. Disconnect the 5 MHz signal coming from the "5 MHz IN HMR" connector and reconnect it to the Rb MFS back panel.
b. Disconnect the 10 MHz signal coming from the "5 MHz AUXOUT" connector and reconnect it to the CRG "(6) 10 MHz Out" (red "CVR") on the back panel.
c. Verify all items listed in section 8