



# Atacama Large Millimeter Array

## ALMA Control Software Test 1 Report

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**ALMA Project**  
**ALMA Control Software**  
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## Change Record

Version	Date	Affected Section(s)	Author	Reason/Initiation/Remarks
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## ALMA Project

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## 1 Goals

The goal of this exercise was to test the basic functionality of the following components of the telescope monitor and control subsystem on the ALMA Test Facility (ATF):

- Optical Pointing
- Holography
- Radiometry

## 2 Scope

The ATF was built to evaluate the prototype antennas and evaluation software was written specifically for this purpose. However, while writing the ATF software, some of the software infrastructure for the ALMA Control Subsystem was prototyped. Thus, some parts of the ATF software is a prototype for the Control Subsystem, while other parts were written specifically for ATF tests. The major infrastructure change between the ATF software and the ALMA Control Software is that VxWorks will be replaced with real-time Linux.

The ATF software will be used, whenever practical, as the basis for the software that will be developed for ALMA. Thus, this test focuses on testing the ATF control software to ensure that the prototype components are working properly. Real-time control was done with VxWorks; data analysis was performed using the Gildas software package for holography and radiometry data while Tpoint software was used to process OPT measurements. This test did NOT use monitor and control prototype software, thus these tests should be re-executed with prototype software when it becomes available. None the less, this test has been useful to identify and solve problems hardware/software interfaces and define the algorithms for the prototype software.

Note: The control software is inexorably linked to the hardware of the ATF antennas and components. As such, hardware problems that prevent the software tests from being completed on schedule should not be considered a problem with software development.

## 3 Testing Summary

The tests were performed by Jeff Mangum and Robert Lucas.

Details of the ATF software tests are given below. A quick summary is:

- The Optical Pointing Telescope (OPT) was installed and integrated into the system. Software development to control the OPT took longer than expected due to hardware problems (see details below). Optical pointing was not completed.
- Holography software is composed of two systems: 1) Receiver M&C and 2) Observing/Data Acquisition. Both systems were integrated, tested and performed



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adequately. Successful measurement of the surface accuracy for the VertexRSI and AEC prototype antennas has been completed.

- The radiometry system required integration of the frontend, backend, and nutator hardware. Numerous hardware failures have hindered progress. The actual taking of radiometric data and analyzing it has been partially completed (see details below).

Future software tests must ensure that Optical Pointing and Radiometry work successfully with the ATF software. All tests should be re-run using the full monitor and control prototype software.

## 4 Details of the ATF Monitor and Control Software Tests

Written by Jeff Mangum:

Integration of the prototype Optical Pointing Telescope (OPT), holography, and radiometry systems at the ATF have afforded the opportunity to gain experience with hardware/software integration of radio telescope systems. Following is a brief summary of these integration tasks: OPT: The OPT system is an invaluable tool for commissioning and characterizing antennas. The software integration of this system spanned about 9 months due to:

- (1) Personnel conflicts with other tasks associated with antenna acceptance.
- (2) An incomplete description of the various uses of this device.
- (3) The need to work-around a number of hardware shortcomings.

Holography: The holography system was used to measure the surface accuracy of the VertexRSI and AEC prototype antennas. These measurements were used to set the surface panels and determine the surface accuracy performance of both antennas.

Laboratory integration of this system was done poorly, which lead to the installation of this receiver system without the ability to tune it. The failure of this laboratory integration was reviewed by the AEG and Computing IPT. Unfortunately, most recommendations were Ignored by other IPTs, and subsequent laboratory integration tasks for ATF equipment suffered similar fates to that of the holography receiver.

The monitor and control software for the holography system is composed of two main parts: observing/data acquisition and receiver monitor and control (the holography transmitter was controlled by a separate LabView program delivered by the Frontend IPT). The following summarizes the integration of both software systems:

Receiver Monitor and Control: Other than the important fact that receiver tuning was not possible when the receiver was installed, laboratory integration of this system was sufficient such that integration on the antenna took a relatively short amount of time.



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Observing/Data Acquisition: This integration was only possible once the receiver and transmitter systems were installed and functional. As this was the first radiometric data acquisition system installed on either prototype antenna, integration of this system took several weeks. This integration is by nature a tedious process, involving checks of tracking, data synchronization, and timing.

Radiometry: The radiometry system integration, composed of the evaluation frontend, backend, and nutator, took approximately 3 months. Most of these three months were spent working around poorly-performing hardware, such as:

- (1) Incomplete characterization of the tuning needs for the frontend. The engineers in the Frontend IPT did not provide sufficient information to the programmers in the Computing IPT who were assigned the task of writing the monitor and control software.
- (2) Backend firmware failures.
- (3) Numerous nutator hardware failures. These nutator problems were exacerbated by numerous shortcomings with the ICD describing the interface between the hardware and control software. Most of the 3 months spent on integration of this system was consumed by the nutator integration.