Atacama
Large
Millimeter
Array

Interface Control Document

Between: AOS Technical Building
And: Baseline Correlator

ALMA-20.01.02.00-60.00.00.00-A-ICD

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1 Description

1.1 Purpose

The ALMA baseline correlator is the central signal processing element of the array. The correlator will be installed in the AOS technical building.

1.2 Scope

This ICD specifies the electrical and mechanical interface between the ALMA baseline correlator and the AOS technical building.

These interfaces include:

- the floor space required for the correlator,
- the electrical power required by the correlator,
- the cooling requirement of the correlator, and
- safety requirements.

1.3 Responsibilities

The Correlator IPT is responsible for the specification, purchase, construction, assembly, and installation of the ALMA baseline correlator, its racks, and any other associated support equipment in the AOS technical building.

The Site IPT is responsible for providing the AOS technical building with adequate space, electrical power, cooling, and mechanical support for the correlator equipment.

2 Related Documents and Drawings

1) ALMA-20.01.00.00-001-C-SPE, Oxygen Enrichment in AOS Buildings
2) ALMA-80.05.02.00-001-B-SPE, ALMA Environmental Specifications
3) Federal Standard 209D, Cleanroom and Work Station Requirements, Controlled Environments (1988) (obsolete)
4) ISO 14644-1, Cleanrooms and associated controlled environments--Part 1: Classification of air cleanliness
5) SITE-20.01.02.00-001-E-PLA, AOS Technical Building Architectural Program
6) High-altitude medical and operations problems and solutions for the Millimeter Array, Napier, P. J, & West, J. B, 1998, Proc. SPIE 3349, p. 456
7) ALMA-80.05.00.00-004-B-STD, ALMA Standard for AC Plugs, Socket-outlets and Couplers.

3 Physical System Interfaces

3.1 Mechanical Interface

3.1.1 Correlator room floor space

The complete, four quadrant ALMA correlator is housed in 42 racks:

16	0.9 m by 0.74 m station racks,
16	0.9 m by 0.74 m correlator racks,
4	0.61 m by 0.68 m power supply rectifier/breaker racks,
4	0.8 m by 1.0 m racks for the CDP computer system, and
Up to 2	0.8 m by 1.0 m rack for the CCC computer system/ Comm Switch.

Each quadrant will be assembled as a line of contiguous racks with adjacent side panels removed and racks bolted together to allow running cables from rack to rack without going under the floor. The minimum floor space required to house the correlator is 110 m^2 in a 10 m by 11 m configuration (Figure 1). All racks are 2.0 m high except for the power racks which are 2.13 m high and the ceiling height should be 3 m above the computer floor (specified below).

The correlator room shall have a raised “computer” floor at least 0.5 m above the subfloor. The space under the raised floor will serve as an air plenum for forced air cooling and will permit under-floor electrical power conduits. No other cables will be installed below the floor. The correlator racks will be bolted to frames rigidly attached to the underlying subfloor. The frames will have to allow adequate cooling airflow through them. Details for the frames and the frame attachment to the subfloor are given in drawing CORL-60.00.00.00-011-A-DWG.

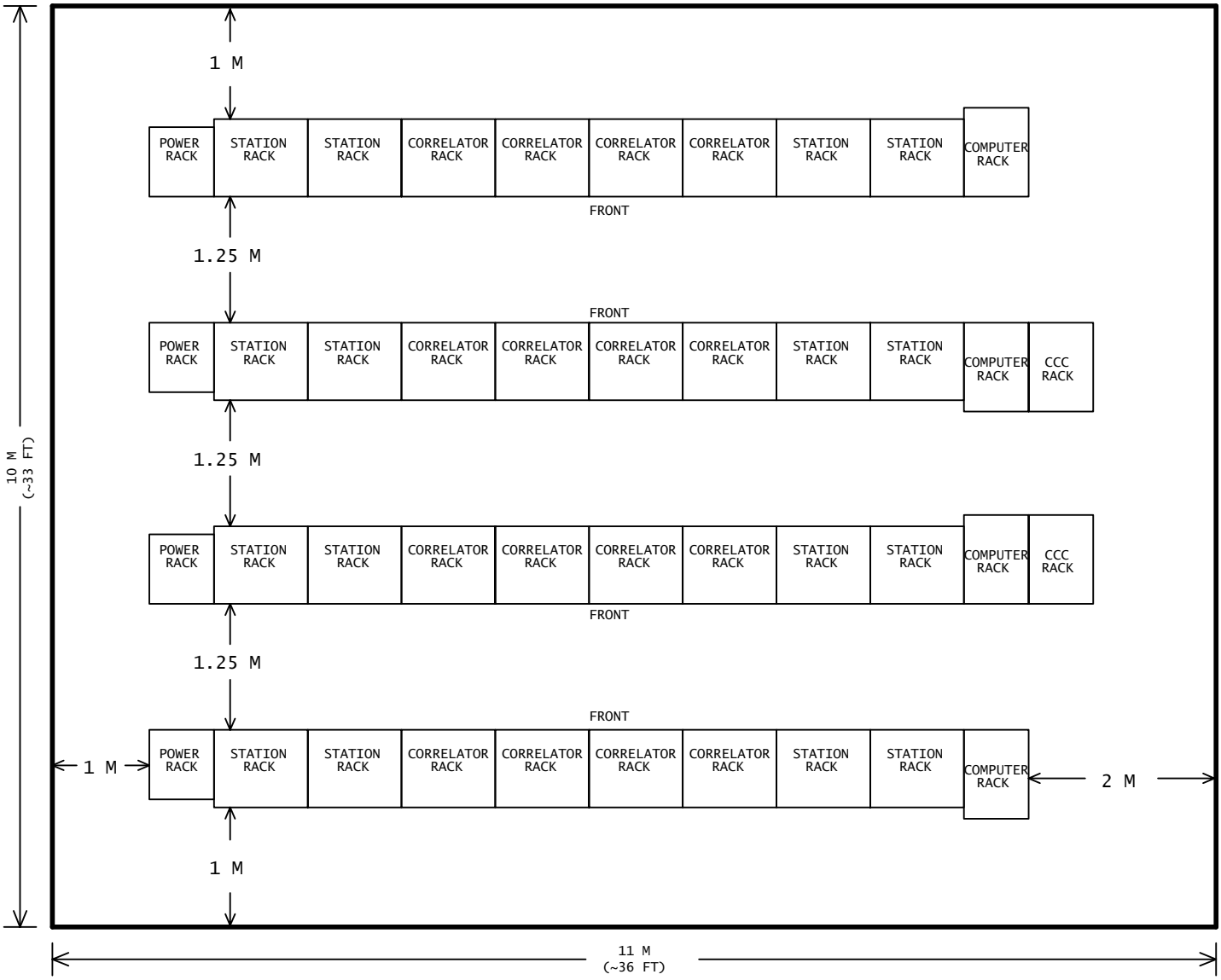

Figure 1. Correlator rack layout.

3.1.2 Weight/Loading

The total estimated weight of the correlator including the computer system is 11400 kg with a maximum floor loading of 1200 kg m^{-2}.

3.2 Air Conditioning

Correlator cooling requirement

Sufficient cooling air must be supplied to the correlator racks so there is a temperature rise of no more than 10 °C when the correlator system, including the fiber optic receiver cards and the correlator computer system, is dissipating the maximum power of 180 KW.

Air flow through the racks will be restricted to:

a 0.74 m by 0.3 m chimney for all station racks,
a 0.74 m by 0.4 m chimney for all correlator racks
a 0.40 m by 0.2 m perforated floor slot in front of all power racks, and
a 0.46 m by 0.3 m chimney for all other racks.

Electronic components with each rack will restrict the area of air flow by an average of 50% of the chimney cross section.

The inlet air temperature shall be nominally 20 °C but shall be adjustable as low as 15 °C. Once adjusted, the inlet air temperature shall be maintained within ± 2 °C. The ambient temperature in the working area around the racks in the correlator room shall be in the range 20 to 25 °C (normal working environment).

HVAC characteristics

To satisfy the correlator cooling requirement, the HVAC system shall supply an airflow of 23 m^3 s^{-1} at 15-20 °C supply. This specification shall be the basis for acceptance of the HVAC system.

3.2.1 Air Quality

To control static electricity buildup, the relative humidity shall be maintained between 30% and 50% (consistent with thermodynamics).

When personnel are working in the correlator room, the room air shall be enriched in oxygen according to Reference 1.

The air shall be filtered so airborne dust concentrations are maintained at ISO class 8 (Fed. Std. 209D class 100 000) or better (Reference 3).

3.3 Electrical Power

The correlator requires three-phase AC electrical power 230V phase-to-neutral /400V phase-to-phase. The correlator presents a balanced load with a power factor of 0.92 or greater.

Each correlator quadrant has one power rack with six rectifier units. Each of the six rectifier units requires a three phase 25 A circuit and uses all three phases equally to present a balanced load. Each of the 3 phases will have a 25 A breaker, with the 3 breakers mechanically ganged together. Hence each quadrant requires 6 three phase 25 A circuits. A total of 24 three-phase 25 A circuits are required. Each group of six socket-outlets should be located near the power supply rack for that quadrant. This may be achieved with circuit breaker panels on the walls and conduits running under the floor to a set of 6 socket-outlets below the power supply rack. Each 25 A three phase circuit will directly serve one rectifier unit, via one socket-outlet. The maximum inrush current is 20 Amps per phase.

The Correlator Computer System/ Communication Switch, while not part of the correlator, will add an additional ~20 kW power requirement for the correlator room. Each of the up to 6 computer racks shown in figure 1 requires two 230 VAC 50 Hz circuits of 10 A capacity.

Sufficient single-phase power outlets also shall be supplied to allow use of normal laboratory test and maintenance equipment (oscilloscopes, soldering irons, etc.).

None of the correlator electrical circuits require a building supplied uninterruptible power supply.

3.3.1 Electric power connectors

Twenty four 5-contact socket-outlets will be required (such as International Configurations, Inc. catalog number 888-1239, selected based on the standards of Reference 7). Each socket-outlet provides 3 phase power. These distribute the three-phase power to the power supply rectifier racks. Each of the four power

supply rectifier racks requires six socket-outlets. The socket-outlet will be placed under the computer floor, in four groups of six, near the respective power supply rectifier racks.

3.4 Electronic Interface

The AOS technical building will incorporate RFI shielding around the correlator room as specified by the Systems IPT. The racks will not be shielded.

4 Software/Control Function Interface

There is no software or control interface between the baseline correlator and the technical building.

5 Safety Interface

5.1 Illumination

Even with an enriched oxygen concentration in the room air, visual sensitivity will be approximately 30% less than at sea level (Napier & West 1998). Room lighting shall compensate for this loss both in front and rear of racks.

5.2 Earthquake protection

The subfloor shall provide adequate support for the correlator racks. The rack anchors shall be strong enough to withstand seismic accelerations. Details for the frames per section 3.1.1 and the frame attachment to the subfloor are given in drawing CORL-60.00.00.00-011-A-DWG. The requirements for anchoring the racks are currently being determined by the Backend group, based on Reference 2.

5.3 Fire protection

Fire retardant materials and components (such as cables) will be used throughout the correlator wherever possible. Most boards will be provided with temperature sensors which will provide warning of excessive temperatures.

The building fire protection system shall provide an independent set of temperature and smoke detectors for installation inside the correlator racks. In the event of an actual fire, these sensors shall trigger an inert gas fire suppression system. Separate, independent inert gas systems shall be provided for each correlator quadrant. This

fire suppression system will be provided by the Site IPT and will be independent of the correlator, although some components of the system may be installed within the correlator racks. Details for these safety components are given in drawing ALMA-80.05.00.00-008-A-SPE.

In the event of fire or other emergency, the electrical power supply will be disconnected and forced air flow within the correlator racks will be stopped.