Bins, Modules, and Racks Reference Design Description

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Status: **RELEASED**

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Change Record

Version	Date	Author	Affected Section(s)	Reason
01	2018-05-24	J. Allison	1-5	Initial draft
02	2018-06-25	S. Durand	All	Small edits
03	2018-07-10	S. Sturgis	All	Revised and updated
04	2018-09-24	S. Durand	All	More small edits
05	2018-10-19	J. Allison	All	Small edits and corrections
06	2018-10-23	J. Allison	All	Small edits and corrections, addressed RID numbers: IPDSR-532 & 591
07	2019-05-30	R. Selina	2, 3, 4	Minor edits for release throughout; struck interface section (duplicate to requirements doc)
A	2019-07-17	A. Lear	All	Prepared document for approvals & release

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1 Introduction

1.1 Purpose

This document provides a description for the Bins, Modules, and Racks subsystem reference design. It covers the design approach, functions, description of key components, interfaces, and risks associated with the reference design. This document will form part of the submission of the ngVLA Reference Design documentation package.

1.2 Scope

The scope of this document covers the entire design of the Bins, Modules, and Racks subsystem at the Antenna, as part of the ngVLA Reference Design. It includes the subsystem's design, how it functions, and interfaces with the necessary hardware and software systems.

It does not include specific technical requirements [see AD01] or budgetary information.

2 Related Documents and Drawings

2.1 Applicable Documents

The following documents may not be directly referenced herein, but provide necessary context or supporting material.

Reference No.	Document Title	Rev/Doc. No.
AD01	ngVLA Bins, Modules, and Racks Subsystem Preliminary Requirements	020.30.55.00.00-0001-REQ
AD02	ngVLA Preliminary System Requirements	020.10.15.10.00-0003-REQ
AD03	ngVLA EMC & RFI Mitigation Requirements	020.10.15.10.00-0002-REQ
AD04	Antenna Electronics Front End Enclosure Block Diagram	020.30.00.00.00-0002-BLK
AD05	Antenna Electronics Pedestal Enclosure Block Diagram	020.30.00.00.00-0003-BLK

2.2 Reference Documents

The following documents are referenced within this text:

Reference No.	Document Title	Rev/Doc. No.
RD01	ALMA Back End IPT Shielded Rack Specification	BEND-57.02.00.00-004-A-SPE
RD02	ARCS Module RFI Test Report	D. Mertely, 2018.

3 Subsystem Overview

The Bins, Modules, and Racks subsystem consists of individual modules (LRUs) housed in a number of bins all inside of an EIA standard electronics rack located in the antenna's pedestal room. The work package may also include a number of modules and bins in locations other than the electronics rack and other than the pedestal room. Its key function is to house the LRUs that make up the antenna electronics, and make assembly and maintenance of the antenna electronics as simple as possible while providing adequate RFI shielding for the antenna and any other sensitive equipment.

4 Subsystem Design

4.1 Modules

The proposed modules for this subsystem are the Advanced RFI Containment System (ARCS) modules that were recently developed by NRAO. There are three primary types of ARCS modules, designated as series 100, 200, and 300. The 100 series modules consist of two high-tolerance machined pieces of aluminum that fit together like a clamshell, leaving a cavity in the middle for mounting electronics. The 200 series modules consist of three pieces, and allow for dual internal cavities that are independently RFI shielded. The 300 series modules are also three-piece modules, but with individually removable side panels that allow access to the internal electronics from either side of the module. The module style to be selected is dependent on the degree of access required for the components within, and the desired mounting layout of said components.

All module types have double-gasket seams around the edge, utilizing specialized RFI gaskets. A series of compression latches compress the gasket, and ensure a high level of RFI shielding is achieved. All modules will have guide blocks that help guide the module into the bin, as well as a front panel that is used to secure the module into the bin via four captive thumbscrews.

The modules are made out of ATP5 aluminum tool plate to prevent warping during machining. This helps ensure that the modules will meet their dimensional specifications so that they may mitigate RFI effectively and fit into their bins with ease. All module pieces will be chromated per MIL-C-5541-CL.III after machining in order to maintain a conductive surface. Each piece of every module also has its own RFI gasket which is attached using electrically conductive adhesive.

All of the individual module pieces can vary in width by half-inch increments, so a large variety of sizes and styles can be achieved in order to optimize space for electrical components. Furthermore, the outer covers may be produced with heatsink fins for heat-generating components, and the interiors can be customized with pockets or ridges to better accommodate mounting of electrical components.

Input/output connections can be made on either the front or rear of the module. Blind mate connections are also possible with the addition of a panel on the rear of the bin, to hold one side of the blind mate connector.

Another benefit of these modules is that there is no designated front, rear, top or bottom of the module. Modules may be inserted into the bin from either the front or the rear, and either right side up or upside down.

The ARCS module concept can be readily adapted for applications where rack or bin mounting is not a requirement or desired. For example, the IRD enclosure is expected to be variant of a 100 series module, but with a form factor of 24" x 20" instead of the standard 8" x 20".

4.2 Bins

Bins provide a convenient and reliable method of organizing groups of modules near one another. The standard ARCS bin is six rack units (6 RU) tall by 20 inches deep, and is designed to fit into a standard EIA 19 inch wide rack. However, bins can be configured for any rack height, width or depth.

There is not a fixed number of modules per bin, because of the varying module widths. To accommodate a mix of module widths, bins are designed for module widths in increments of ½". The bins simply mount to the vertical rails of the rack using #10 machine screws.

4.3 Racks

The racks will be a variant of the ALMA Back End racks [RD01], as they are a proven solution. These racks provide a high level of RFI shielding, using a combination of a welded steel external shell, RFI gaskets, and an RFI-absorbing foam. The rack typically has multiple I/O panel location options for running power and signals in or out of the rack, and honeycomb filters on the top and bottom to allow airflow through the rack for cooling without compromising the RFI shielding. The dimensions and I/O panel locations of the racks will be dependent on the design and available space of the pedestal room in the selected antenna.

4.4 Subsystem Components

Figures 1–4 show examples of different ARCS module configurations.

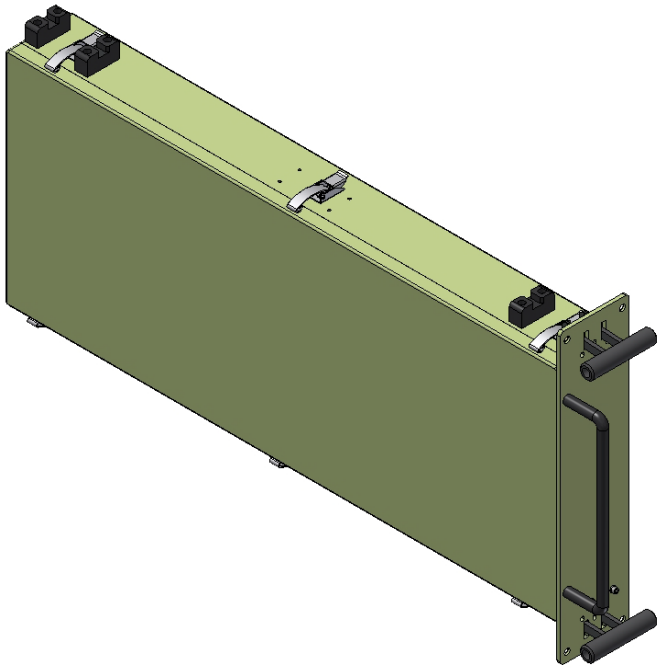

Figure 1 - Series 100 ARCS module.

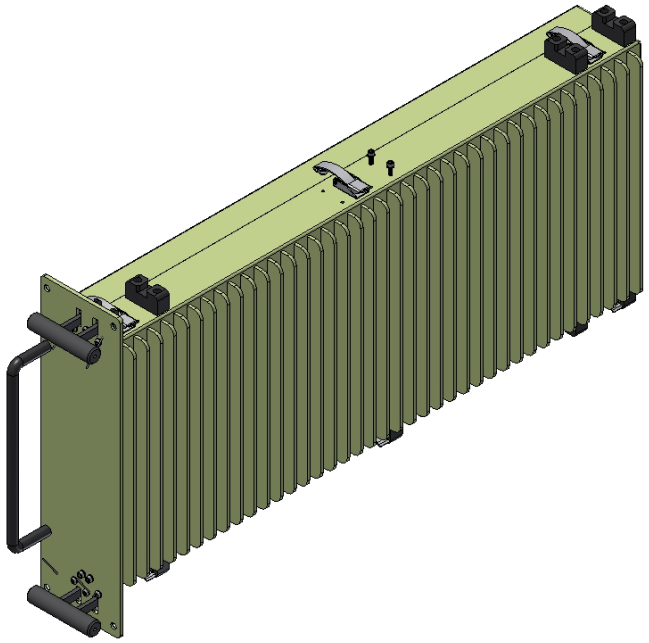

Figure 2 -100 Series ARCS module with integrated heatsink.

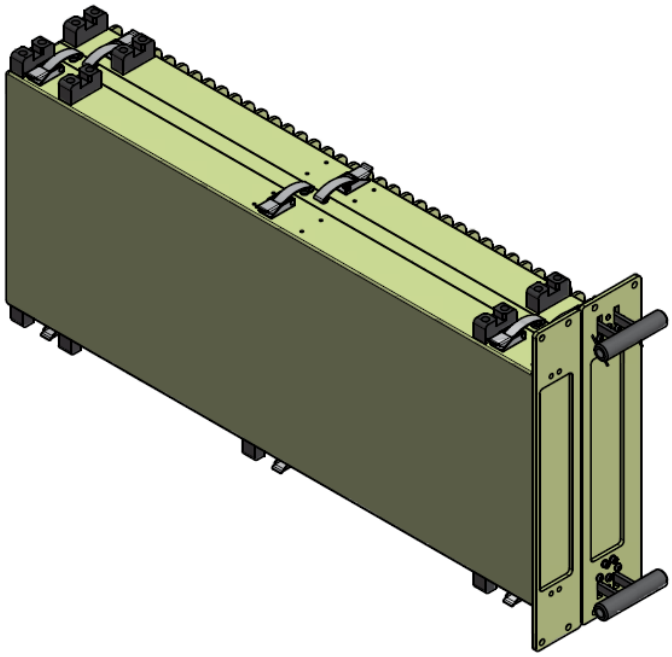

Figure 3 - 200 Series ARCS module (two cavity) with one integrated heatsink.

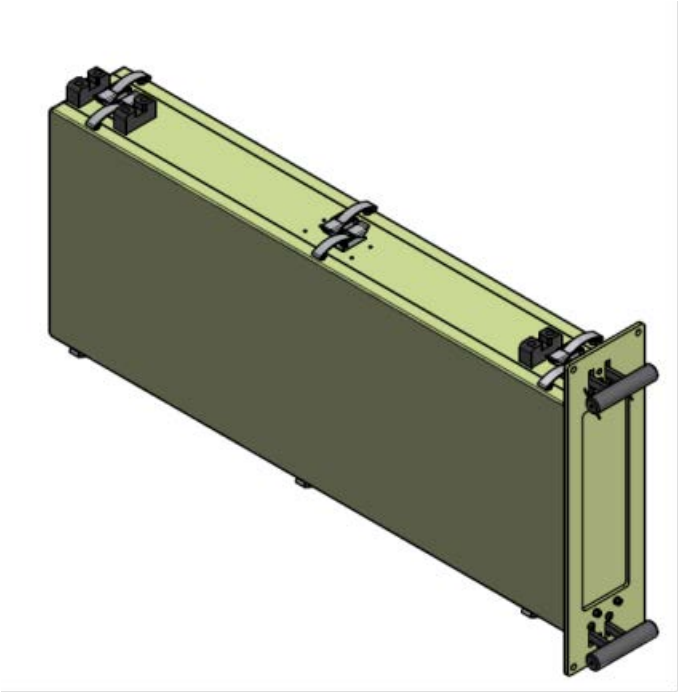

Figure 4 - 300 Series ARCS module (components accessible from either side).

Figure 5 shows an example of modules installed in a bin.

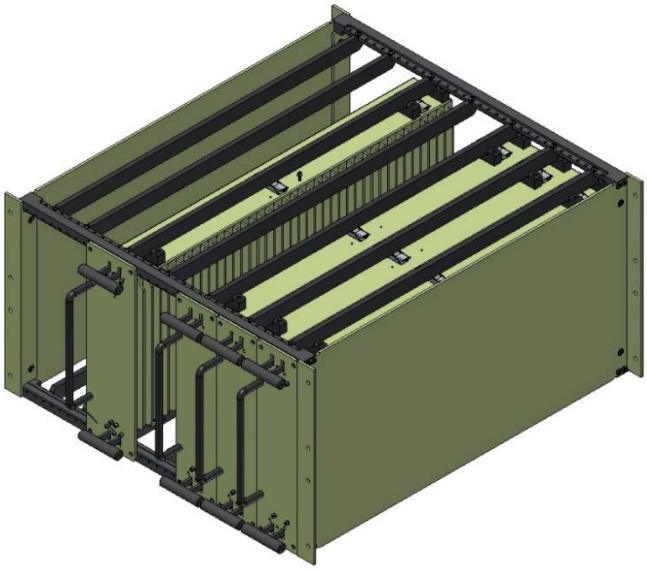

Figure 5 - ARCS modules installed in a bin.

Figure 6 shows an example of the rack used to house the ARCS bin. Note the different possible locations of the I/O panel, on top (and bottom) or the side.

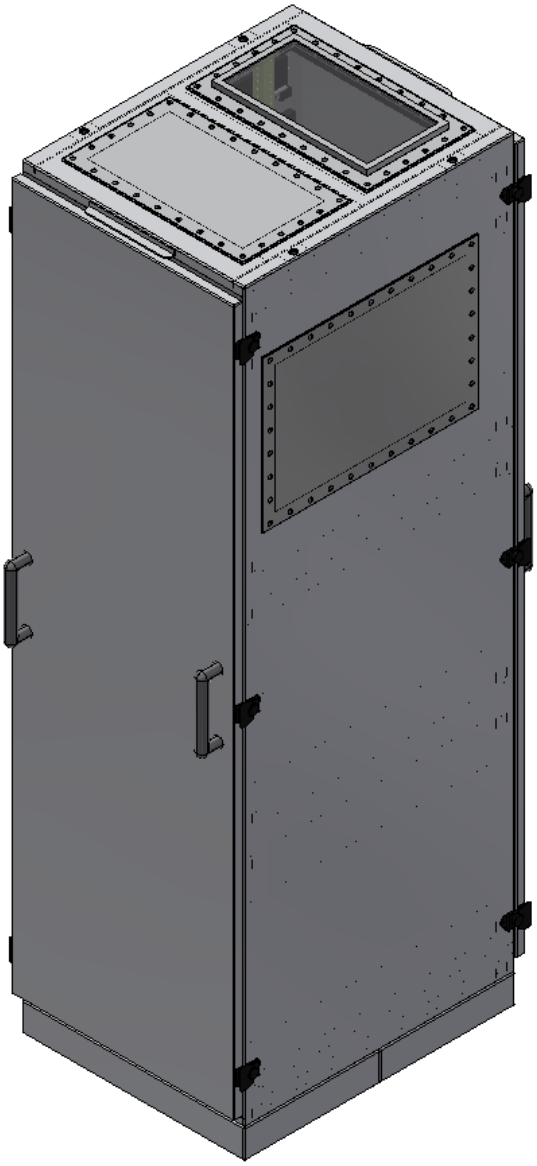

Figure 6 - Shielded rack.

5 Appendix

5.1 Abbreviations and Acronyms

Acronym	Description
ARCS	Advanced RFI Containment System
BE	Back End
EIA	Electronics Industries Alliance
FE	Front End
HVAC	Heating, Ventilation and Air Conditioning
ICD	Interface Control Document
IRD	Integrated Receiver Downconverter/Digitizer
LRU	Line Replaceable Unit
ngVLA	Next Generation VLA
RFI	Radio Frequency Interference
RU	Rack Units
UPS	Uninterruptible Power Supply
VLA	Jansky Very Large Array
WVR	Water Vapor Radiometer

5.2 ARCS Module Testing Results

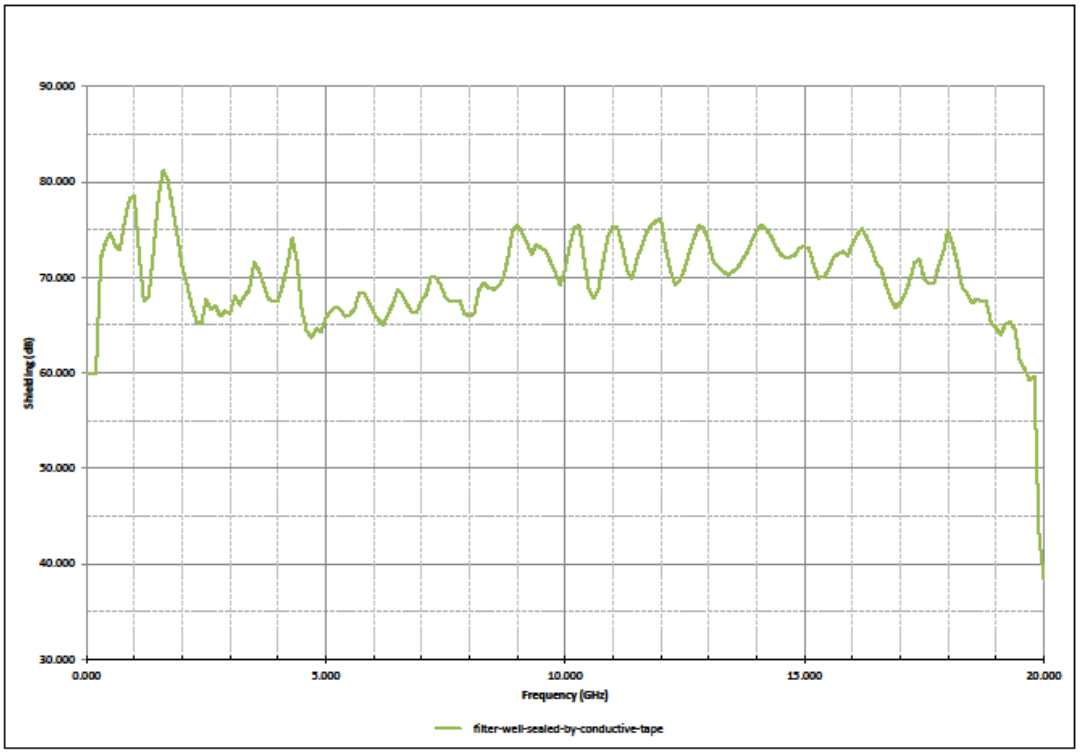

Figure 7 - Preliminary shielding effectiveness of 100 series ARCS module [RD02]. Note: tests were performed in reverb chamber, not anechoic chamber.