

Hat Creek Radio Observatory  
Component Overview  
for  
24 New Built Antonio Feeds



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## 1 General

The Allen Telescope Array as of July 2021 has half of its 42 antennas fully operational. Out of those 21 antennas 4 are equipped with the first generation feed V1.0 and 17 are equipped with fully retrofitted second generation Antonio feeds (V2.0). Three additional Antonio feeds are in the process of being installed on additional antennas, bringing the total number of build Antonio feeds to 20. In order to have the 42 ATA antennas fully operational and equipped with the second generation Antonio feeds, we will need to build 22 new feeds to install on the antennas plus an additional 2 feeds as spare parts to keep maintenance time low. Hence, we will need to build 24 new Antonio feeds.

This document provides an overview of the components required to build 24 additional Antonio feeds, as well as components required for 42 individual signal chains and spare parts for antennas.

## 2 Antonio Feeds

The construction of the Antonio Feeds is divided in three sections, the Log-Periodic Pyramid, the Vacuum Enclosure, and the Feed Base Enclosure. Each component group has an own component list and is shown in the following sub-sections.

## 2.1 The Log-Periodic Pyramid

Table 1: Log-Periodic Pyramid Component List

Quantity Required	Quantity Existing	Unit	Description
24	0	Each	Pyramid Assembly
96	0	Each	Arm Assembly, single arm (4 required per pyramid)
24	0	Each	LNA Module assembly with conditioned coaxial cables
24	0	Each	Feed assembly and tip link installation
24	0	Each	LNA Module parts
24	0	Each	Small components such as: screws, rexolite standoffs, etc.
120	0	ft	UT-034-95 Coaxial cable
48	0	Each	Cable Assembly 085 Stainless Length 19.5" Connectors: SMA Male-SMA Male
24	0	Each	Temperature Sensor diode located at LNA
50	0	Each	1-15 GHz cryogenic amplifier IAF LNA
48	0	Each	9-pin male Nano-D pigtail 18
24	0	Each	Gold-Plating

## 2.2 Vacuum Enclosure

Table 2: Vacuum Enclosure Component List

Quantity Required	Quantity Existing	Unit	Description
24	0	Each	Base Plate Assembly (new design)
96	0	Each	Titanium standoffs including vented screws
24	0	Each	Thermal flex link (cryo-cooler to pyramid)
24	0	Each	15pin D-sub hermetic feed through including wire assembly
48	0	Each	SMA hermetic feedthroughs
100	0	Each	O-rings
24	0	Each	Glass Radome 300MM OD X 610MM
24	0	Each	Clamping ring for glass dome including mounting brackets for fabric cover
24	0	Each	Fabric Cover Assembly
24	0	Each	Lens Dome Element for glass dome.

## 2.3 Feed Base Enclosure

Table 3: Feed Base Enclosure Component List

Quantity Required	Quantity Existing	Unit	Description
24	0	Each	Main enclosure
24	0	Each	Bottom EMI mesh inside
24	0	Each	Bottom filter outside
24	0	Each	24V / 48V power inlet, including filter
24	0	Each	Control board mounting plate
24	0	Each	Turbo pump mounting plate (bottom)
24	0	Each	Turbo pump spacer for mounting
24	0	Each	Cryo-cooler cover (lower and upper)
24	0	Each	Temperature sensor mount
24	0	Each	Fan mounting bracket + screws
24	0	Each	PAX box enclosure mounted
24	0	Each	Milspec connector in pax box case
24	0	Each	Front face machined for vacuum base plate
24	0	Each	Front support bracket for mounting
23	1	Each	Accelerometer case
4	20	Each	Feed Control PCB
3	21	Each	Sunpower GT Gen II Cryo Controller
3	21	Each	Sunpower CryoTel GT Cryocooler
3	21	Each	Sunpower temp. sensor RTD Assembly
3	21	Each	Sunpower Cooler Power Cable - GT
24	0	Each	Pfeiffer Diaphragm Pump MVP 010-3 DC
4	20	Each	Pfeiffer Turbo Pump Hi Pace 80/TC 110
24	0	Each	Vacuum Fittings NW-10
24	0	Each	Vacuum Fittings NW-40
24	0	Each	Vacuum Fittings NW-50
24	0	Each	Clamp NW-10
24	0	Each	Clamp NW-40
24	0	Each	Clamp NW-50
72	0	ft	1/4" Fre-Thane® 95A-152 Tubing
48	0	ft	1/8" Fre-Thane® 95A-169 Tubing
24	0	Each	Other vacuum parts: valve, connectors, etc.
0	24	Each	Wire harness retrofitted
24	0	Each	Temperature sensors A1-A6
4	20	Each	DC fan

### 3 ATA RF / IF Signal Components

In this section we cover the components that are required for 42 individual signal paths. The signal chain begins at the input of the post amplifier fiber transmitter module (PAX) and ends at the output of the RF Conversion Board (RFCB) in the signal processing room.

#### 3.1 PAX Module

The post amplifier fiber transmitter module (PAX) can be divided into four main parts, the enclosure, the control PCB, the post amplifier module (PAM), and the fiber transmitter. Initially Minex manufactured 45 PAX boxes, however only a subset of those were fully equipped with fiber transmitter and PAMs. We currently have 33 tested and fully operational PAX boxes ready for installation on antennas. Table 4, lists the components that are required to repair the remaining 12 PAX boxes and have them available for the full buildout. Note that the redesign of the control PCB / LNA bias supply board will be installed in all existing PAX boxes to eliminate different versions in the field. Hence, all of the 33 operational PAX boxes will be retrofitted with the new control PCB.

Table 4: PAX Module Component List

Quantity Required	Quantity Existing	Unit	Description
24	0	Each	Post Amplifier Module (PAM)
50	0	Each	Control PCB
6	0	Each	Fiber Transmitter
1	0	Each	Temperature stabilization (peltier cooler)
1	0	Each	D-Sub connectors and screws

### 3.2 RF Conversion Board

The RF Conversion Board (RFCB) takes the analog optical fiber signal from each antenna as input and produces four independent analog IF outputs with a bandwidth of about 700 MHz. Each of the four IF tunings (A-D) has a dedicated variable local oscillator that allows the selection of any frequency band within the primary RF band of 0.5 – 11.2 GHz and down converts it to a center frequency of 512 MHz. With the initial construction of the ATA, UCB build 46 RFCBs in total. 36 of those are currently located in the signal processing room and have been tested by Sarah Schoultz in October 2020 [1]. The remaining RFCBs are in an untested state, 7 out of the 10 remaining are complete units that just require testing. The last 3 RFCBs are not complete and will require additional testing and component replacements. Overall there are already enough RFCBs for 42 individual signal chains, the components in table 5 are required to outfit the spare modules. Note that this is a first estimate based on physically missing components. The number can increase during the testing and verification process of those RFCBs.

Table 5: RFCB Module Component List

Quantity Required	Quantity Existing	Unit	Description
4	0	Each	LO distribution module
4	0	Each	Up-converting mixer module
3	0	Each	Band-pass filter
5	0	Each	Down-converting mixer module



## 4 Antenna Components

This section includes the parts required to retrofit the ATA antennas, in order for an Antonio Feed to be mounted. The scope of the antenna retrofit consists of the installation of additional power supplies for the new feed. Table 6 provides an overview of the still required parts.

Table 6: Antenna Retrofit Component List.

Quantity Required	Quantity Existing	Unit	Description
24	0	Each	Cryo-Cooler 48 V Supply
24	0	Each	Feed 24 V Supply
14	10	Each	Circular MIL Spec Connector
0	50	Each	Standoff, Aluminum, 8-32 UNC
10	14	Each	Cable Gland, 1/2" NPT, 0.375 "
0	100	Each	Quick Disconnect Terminal
0	48	Each	Toggle Switch, On-Off, SPST
0	100	ft	LAPP ÖLFLEX® Shielded Cable

### 4.1 Spare Antenna Parts

There are enough main components, like the control box, drive box, elevation drive unit, etc. to have all 42 antennas operational. However, for some of those main components there are no spare parts available. Therefore, to reduce down time in case of equipment failure on the antennas, we require additional spare parts to be purchased / manufactured and stored at HCRO. Table 7 lists these main components, note that we want to have a minimum number of 3 spare parts for each major segment of the antenna.

## Bibliography

- [1] S. Schoultz, *Measurement of the rfc power levels* (2020).

Table 7: Spare Antenna Parts

Quantity Required	Quantity Existing	Unit	Description
1	2	Each	Antenna Control Box
2	1	Each	Antenna Drive Box
3	0	Each	Elevation Drive Unit
3	0	Each	Azimuth Drive Gear Box
6	0	Each	Servo motors for El and Az drive
8	0	Each	Raydome / Sunbrella Cover