

Upgrade of Automatic Beam Switching (ABS) at Jicamarca Radio Observatory

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Abstract

Particular beam orientations are required for each experiment to study different atmospheric phenomena at the Jicamarca Radio Observatory (JRO). For an antenna array, this change can be done manually or remotely. JRO has had a beam steering system since 2005 for the remote operation. The remote operation is achieved using IP protocols and addresses associated with each antenna module and a web interface is used for the operation and supervision from the main building. The principle of the RF stage of the system is the phase shift due to change in the coaxial cable length between the source and the antennas in each antenna module. This poster summarizes the requirements of the system upgrade as well as the characteristics of the new electronic, mechanical, RF and interface design for each element of the automatic beam system used at JRO.

1. Introduction

The modules of the main antenna are fed from the main building by four power amplifiers configurable from kilowatt to megawatt each one. The different lengths of cable used to joint the tubes in each antenna module with the panel connector of the dipoles determine the beam forming of the array. The current technique used for implement this beam steering remotely is based on switched line phase shifters. These characteristics define the requirements resume in figure 1.

Requirement	Description
Power and frequency	Support a pulse of 5% duty cycle with 30KW at 49.92MHz
Quantity of lengths	Four integer lengths and four lengths with half meter
Environment and area	Dust, rain, change of humidity and temperature resistance
Time for change	Hundreds of milliseconds
Replicability	Quantity required for all the modules = 128

Figure 1.- Requirements.

The first version defines the following system parts resume in figure 2: RF modules, control modules, networking devices and remote user interface. From the experience of use since the installation and the need to expand the system to east and west quarters, a new version of each part was developed. The grounding connections and Faraday cages were considered for all parts.

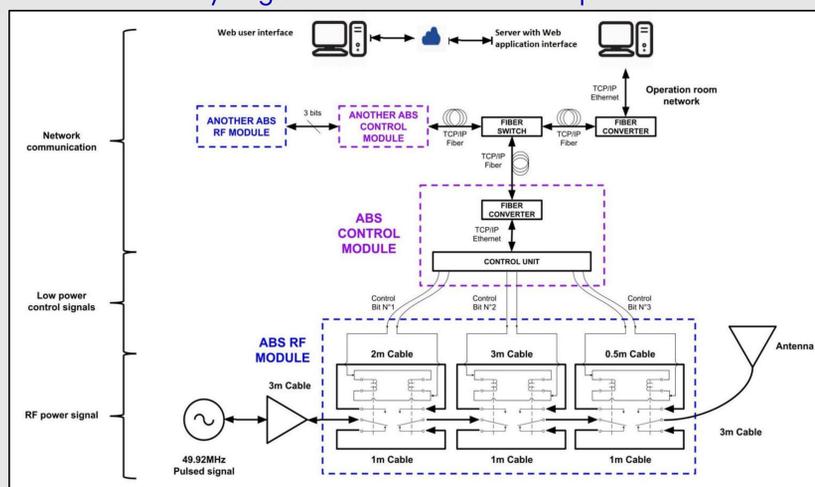


Figure 2.- ABS system parts.

2. RF modules version 2

Implemented using six RJ6B-26S Jennings Technology and the three bits for length selection are maintained. Upgrades made on this modules are the use of electric boxes, RG8 cables inside the housing, 3D printed pieces as dielectrics and mechanical holes to facilities installation of relays and cables. The soldering of some copper on the top of the relay were used to improve the VSWR measurement.



Figure 3.- RF module version 2.



Figure 4.- Control module version 2.

3. Control module version 2

The new control unit is based on a micro-controller, the digital and analog grounds were separated using optocouplers, the media converter is inside the electrical box, the housing improve the grounding and the fiber bridge connectors are supported by 3D printer pieces.

4. Networking elements and user interface version 2

Switches based on SFP transceivers and networking racks for heavy ambient were used in this upgrade. A complete new system for the radar system were developed with an specific application for the ABS length selection.



Figure 5.- Networking elements.

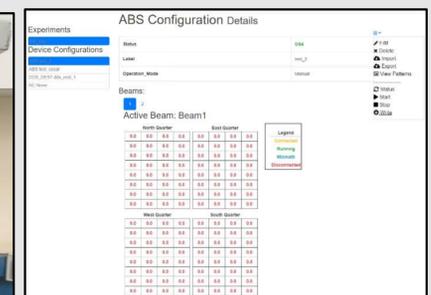


Figure 6.- Web user interface.

5. Conclusions

Two RF modules, sixteen control modules, networking devices and web user interface prototypes pass the first tests of functionality and ambient conditions for a quarter of the antenna. The next tests are the VSWR compliant with more beams and through the time.

6. Reference

[1] Beam-forming network using switch-line phase shifter. <https://ieeexplore.ieee.org/document/4603980?section=abstract>