

Electronics Memo 247

Importance of LO/IF Remote Level Setting

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Abstract

Since the first move of the first antenna, LO/IF engineers and technicians have had to visit antennas to set power levels. For 38 straight years, qualified workers have visited each antenna after a move from one pad to the next. We would like to institute Remote Level Setting (RLS) capability in the system. RLS will be accomplished by modifying and calibrating the L304 LO Receiver module in the LO Rack located in the vertex room. Eventually, there will be a computer script that will automatically set up *all* aspects of the antenna.

Introduction

In mid-1976 Antenna-1 construction was completed in the Antenna Assembly Barn. Shortly after this the very first wave guide connection was terminated. This waveguide connection required LO/IF level setting manually performed by a qualified person physically present in the antenna Vertex room. This procedure was followed until VLA was fully functional. At that time a new procedure for setting levels was generated, which also required a qualified person physically present in the Vertex room. An estimated 4000 antenna moves have been performed at the VLA site. Figure 1 shows an aerial view of Antenna 1 on the Master pad and Antenna 2 under construction inside the Antenna assembly barn.

Purpose

In completing this RLS upgrade, including antenna set-up software, we will have an enormous savings of: time, vehicle wear and tear, employee travel, and gas for transport, etc. In addition to this, going to, and ascending an antenna to set levels requires: previous safety training, hard hats, locks, steel-toed boots, tool kits, test equipment, two-way radios, operator approval, etc. Most importantly, down time for antenna moves will be greatly reduced.



Figure 1: Aerial view of Antenna 1 on the Master pad and Antenna 2 under construction inside the Antenna assembly barn in 1976. Credit: NRAO Website.

Methodology

A Local Oscillator, or LO, optical signal is transmitted from the master rack to each antenna. In the antenna this optical signal goes directly to the L304 LO Receiver module. A qualified person must take an Optical Power measurement in the Vertex room, and assist Fiber Optics Technicians with calibration to -5dBm input to L304. The calibrations are performed by replacing optical attenuators in the fiber patch panel in the Control Building. Time is also taken to properly clean fiber connections before final termination.

Each Optical receiver in the L304 has an uncalibrated monitor which is currently available; all we have to do is calibrate it. This is accomplished using a LabVIEW/MATLAB program which fits a curve to the optical power response function, and produces a set of 4 coefficients which can be unique for each receiver. A real optical power measurement will be represented in the Device Browser remotely, with an accuracy of $\pm 0.5\text{dBm}$.

We will then add a Mini-Circuits 31dB Digital Step Attenuator (PN ZX76-31-SP-S+) immediately after the first RF amplifier (Minicircuits PN ZFL-1000) and before the 10dB

coupler (Minicircuits PN ZFDC-10-2). Serial Control for the Step Attenuator will be added to the MIB software, and will be interfaced through a ribbon cable plugged directly into the MIB.

After these steps are completed the module will require a recalibration of the coupled power to the RF total power detector on the Analog board. At that point, the real RF output of the L304 module will be represented in the Device Browser remotely.

This RF signal goes directly from the RF output of the L304 to the input of the L305. L305 desired input is $-25.5\text{dB} \pm 1\text{dB}$, which we can use the step attenuator to achieve. The step attenuator will add a small delay in the antenna timing line, which will be calibrated out when delays are calibrated by operator scripts after a move.



Figure 2: Proposed Mini-Circuits ZX76-31 SMA Digital Step Attenuator.

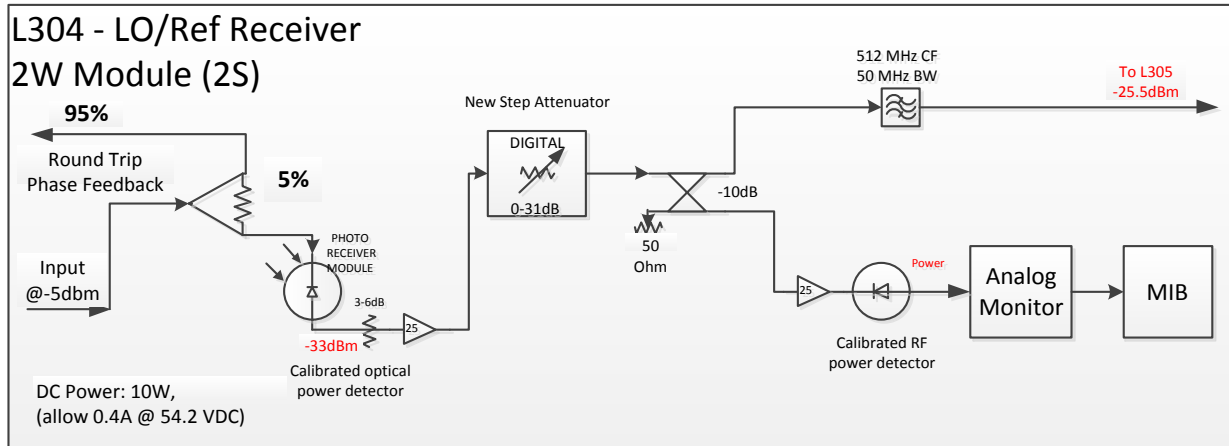


Figure 3: New modified L304 block diagram

Conclusion

This L304 retrofit will greatly streamline operational functionality of antenna moves. Total cost in parts is about \$3500 for the project. This retrofit will take about one year to fully outfit all antennas (hardware modification, calibration and installation). Some time and effort will be involved in developing software to fully set-up other portions of the antenna, but this will also streamline the process of returning the antenna to operations in a more timely fashion after a move. LO/IF qualified personal will have the capabilities of Remote Level Setting (RLS), and total remote antenna set-up. These new procedures will no longer require qualified persons in the vertex room; instead it will be done with the click of a mouse at a desk or work bench. All immediate costs and work will result in future savings of NRAO time, resources, and money.