EVLA Memo #155

Dual-band Observation on the EVLA Utilizing the New Low-band Receiver and a Single Microwave Receiver

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Abstract

The question has been raised regarding the possibility of dual-band observation on the EVLA utilizing the new low-band receiver along with any of the eight microwave receivers. To varying degrees, these capabilities do currently exist within the EVLA electronics system. This memo outlines the possible configurations that can be realized using the current EVLA system design with no changes to antenna hardware or firmware.

1. Introduction

The new low-band receiver being built for the EVLA provides frequency coverage of 68 to 436 MHz in two linear polarizations. It is connected into the system through the existing T301 4P converter module in the same manner as the legacy P-band receiver. The microwave receivers in the EVLA cover 1 to 50 GHZ in two circular polarizations via 8 separate cryogenic receivers. While the microwave receivers must be selected individually using the subreflector, the dipole feeds for the low-band receivers can be used simultaneously with any of the microwave receivers.

The subreflector prevents the low-band dipoles from being at the prime focus of the antenna. In low-band only operation, the subreflector is moved sufficiently far back that this is not a big concern. In dual-band observing, however, the subreflector moves progressively closer to the surface of the dish as the microwave observing frequency increases, moving the dipoles farther out of focus. Details on using dual-band observing capabilities with all bands are discussed here, but this defocusing must be taken into account by the user in determining if performance is suitable for their observation. It is generally believed low-band performance will be seriously degraded with microwave frequencies beyond X-band (8-12GHz).

2. System Configurations

Due to differences in switching and LO arrangements, discussion of dual-band capabilities are broken into four groups: L/S/C bands, X-band, Ku Band, and K/Ka/Q Bands. Refer to the **EVLA Antenna System Block Diagram** for technical details.

In any of these dual-band observing modes, it is possible to utilize either the 3 or 8 bit digitizers with the microwave signals as is consistent with normal observing in these bands. Due to dynamic range requirements, It is only recommended to use the 8-bit digitizers with low-band.

2.1 L/S/C-bands

For L, S & C-bands (1 to 8 GHz), there is capability to operate with a single IF each of low-band and L, S or C-band. This limitation is driven by the switching configuration of the T302 LSC Upconverter and

the availability of only two LO signals from the L301 Synthesizers. Dual-band observation is achieved by switching one input selector switch in the T302 to accept signal from the L, S or C band receiver and the other to accept signal from the T301. This allows two combinations:

1. RCP of L, S or C band, tuned by the L301-2, is routed into IF D and POL1 of low-band, tuned by the L301-1, is routed into IF-A
2. LCP of L, S or C band, tuned by the L301-1, is routed into IF-A and POL2 of low-band, tuned by the L301-2, is routed into IF-D

The T302 IF outputs (8-12 GHz) are routed to the T304 downconverters and tuned using the appropriate L302 synthesizers as usual. With both of these options, IF's B & C may or may not contain useful signal. This depends on the specific tunings of both L301's and it is left to the observer to determine the usefulness of those signals.

2.2 X-band

Dual-band observing with X-band (8-12 GHz) is the simplest to setup and use. In this mode, the user routes a polarization pair from the low-band receiver (tuned by the L301-2) through the T302 B/D outputs into the T304-B/D downconverters using S4-1/2 as is normal for low-band observing. The outputs of the X-band receiver are routed into the T304-A/C downconverters as is normal for X-band observing.

2.3 Ku-band

Dual-band observing with Ku-band (12-18 GHz) is possible but low-band performance will be degraded due to subreflector position. In this mode, the user routes a polarization pair from the low-band receiver (tuned by the L301-2) through the T302 B/D outputs into the T304-B/D downconverters using S4-1/2 as is normal for low-band observing. Ku-band is routed into the T303 UX Converter and tuned using the L301-1 in the first converted path. The T304-A/C downconverters are connected to the T303 UX converter A/C outputs using S3-1/2 as is normal for Ku-band observing.

2.4 K/Ka/Q-bands

Dual-band observing with K, Ka and Q-bands (18-50 GHz) is possible but low-band performance will be severely degraded due to subreflector position. There are also limitations in frequency access from these microwave receivers due to LO availability. In a dual-band mode with these receivers, the user routes a polarization pair from the low-band receiver (tuned by the L301-2) through the T302 B/D outputs into the T304-B/D downconverters using S4-1/2 as is normal for low-band observing. The T304-A/C downconverters are connected to the T303 UX converter A/C outputs using S3-1/2 with the desired receiver routed into the T303.

With these bands, the L301-1 synthesizer is required for the receiver's 1'st LO and the L301-2 is utilized for the low-band conversion. As a result, only the non-converted path of the T303 is useable since there is no LO available to the converted path. This limits frequency coverage for this set of

microwave receivers to frequencies that can be converted into the 8-12 GHz input range of the T304's using the receiver's 1'st LO.

3.0 CONCLUSION

It is possible to configure the EVLA electronics system for simultaneous dual-band operation using the new low-band receiver and any one of the eight microwave receivers. We have described here methods to route signals in the system to accomplish this. Performance of the low-band system with receivers above X-band will likely be compromised by the position of the subreflector and dipoles – it is left to the user to determine the suitability of that performance for their specific application.