

VLA/VLBA Interference Memo #9

Presentation of VLA Interference Information on the Web

N. Lui, Polytechnic University and D. Jenkins, NMIMT

September 1995

Summary:

Radio frequency interference (RFI) has been measured for some time in L band at the VLA. Recently, plots showing the L band interference were made accessible via the World Wide Web (WWW); and starting August 1995, RFI in P band was measured, plotted, and put on the Web as well. This memo explains the VLA interference testing procedure and how to access the various programs and files. Plans for improvements are listed.

The RFI Test:

There are three steps to testing RFI in a VLA receiver band, 1) write an Observe File to control the VLA and the correlator during the observations, 2) reduce the data with the AIPS (Advanced Image Processing System) software, and 3) produce a plot file with a FORTRAN program. The graphics routine xvgr can be used to merge a text overlay with the plot file, if desired. Current plans call for running the P and L band interference tests on double maintenance days, which occur about 11 times per year. The three steps are explained below:

1. The VLA Observational Status Summary (Reference 1) explains the use of OBSERVE to write a file of observing commands for the VLA. The conversion schemes for the various VLA receiver bands is shown in Appendix A. For the band 300 - 350 MHz (P band), two L6 settings are required, 3710 MHz for the low end of the band and 3690 MHz for the high end. The band 1155 - 1750 MHz (L band) requires L6 settings from 3410 to 3940 MHz. The array is held at a fixed position for the test, looking at the North Pole, which increases the susceptibility to terrestrial interference by reducing the fringe rotation to zero. The remainder of the settings in the Observe File are a trade-off between the narrowest possible frequency separation or resolution bandwidth (RBW) and time available for the test. Tables 12 and 13 of the VLA Observational Status Report, available on the Web, show the available bandwidth and number of spectral line channels for normal and smoothing modes.

For P band, the test is relatively short, so that the RBW can be quite narrow. An RBW of 12.5 KHz is provided by a channel bandwidth of 3.125 MHz and single IF mode. An integration time of 2 minutes per channel leads to an overall test time of about 40 minutes. Fluke filter settings bracket the channel bandwidth over the frequency range 304 to 348 MHz. A channel overlap of 125 kHz was selected

empirically to reduce the effect of the Fluke filter roll-off on the data plots. The Observe File for the P band interference test can be found on banshee.

L band is much wider than P band, so that to keep the test under an hour, RBW has to be much coarser than the P band test. Two IF mode and a channel bandwidth of 12.5 MHz provide an RBW of 390.625 kHz. With an integration time of 1 minute, the test takes 45 minutes. The tested frequency range is 1213 to 1771 MHz, and the channel overlap is 2.5 MHz. The Observe File for the L band interference test can be found on banshee.

2. The test results are saved on Exabyte tape. The AIPS reduction procedure, described in Appendix B, can be performed on any workstation. Linear and in AIPS format, the data when reduced can be found in the /AIPS/RUN directory on the workstation; but the data files are removed after step 3 below.
3. Separate FORTRAN data reduction routines are available for the P band and L band tests, PLOTPQ for P band and PLOTLQ for L band. The routines produce two files, yymmdd.list and yymmdd.plot, where yy, mm, and dd are numerical representations for the year, month, and day. Each datum point in the *.list file represents the power flux density for the observed frequency bin in units of log Jansky. The *.plot file is in postscript format. The postscript file can be converted to .gif format for quicker plotting on the Web. A listing for the FORTRAN routine can be found in the /usr/local/doc/vla/interference directory on zia and the *.list and *.plot files are in a subdirectory.

The overlays:

The data plot files include very little text identification. In response, an overlay prepared by Brundage and Dhawan was included in the data directory for merging with the data plot files. The overlays provide identification of interfering signals, bracketing of various frequency bands, and other information. However, the amplitude scale had to be compressed on the plot to provide space for the text information. The overlays are now available as separate files in the plot directories and the expanded scales restored.

A procedure for merging the overlay file with a plot file is shown in Appendix C in the event the need arises.

Accessing the WWW:

To access the World Wide Web, operate the programs Netscape or Mosaic. A beginner's guide on the html language can be found at the URL browser <http://www.ncsa.uiuc.edu/demowed/html-primer.html>. The NRAO home page can be accessed at <http://info.aoc.nrao.edu>. Click on VLA and L or P band interference to access the plots. Ghostview can be used to show *.ps (postscript) files. The current plan is to drop older plots off

the directory after two years.

Future plans:

The following are improvements planned to the interference plots:

1. The varying baseline of the Fluke filter can be corrected in AIPS.
2. Hanning smoothing may identify the wide interference at about 305 MHz in the P band interference plot as a Gibbs artifact.
3. Including RBW, channel width, and integration time information on the plot overlays would facilitate interpretation of power flux density levels.
4. The negative spike on the P band plots is probably just channel 0 and can be flagged out.
5. Reduce the number of plots on the Web by averaging the linear data for all the plots taken at a given configuration when moving to the next configuration. This way, there will be only 4 - 5 plots per year per band. The AIPS procedure must be repeated to access the linear data.
6. The roll-off at the bandedge of the P band receiver could be shown correctly, but then the calibration of the interfering signals just past the bandedge would be lost.
7. The .gif plot format could be included along with the postscript plot format on the Web. .gif permits faster access to plots, but .ps provides accurate hardcopy.
8. Other VLA bands may be added to the interference testing.

Acknowledgments:

The authors thank Vivek Dhawan and Stephane Beland for their considerable help in developing the P band interference test Observe File and for getting the results on the Web.

Appendix A

VLA Band Conversions

Band	Frequency Range (MHz)	Conversion to 1000 - 1050 MHz in IF3, L6 = 50N +/- 10.1 MHz where N is an integer
4	72.9 - 74.7	Sky + L6 - 3000 MHz, L6 = 3940 or 3960
P	300 - 345	Sky + L6 - 3000 MHz, L6 = 3690 or 3710
L	1155 - 1734	Sky + 3200 - L6, L6 = 3310 to 3910
C	4300 - 5100	Sky - L6, L6 = 3260 to 4060
X	7600 - 9000	Sky - 13 GHz + L6, L6 = 2990 to 4390
Ku	14,200 - 15,700	Sky - F3 - L6, F3 = 19 GHz to 20 GHz, 0.1 GHz steps
K	21,700 - 24,500	Sky - F3 - L6, F3 = 17 GHz to 20 GHz, 0.1 GHz steps
Q	40,000 - 50,000	Sky - (3 x F3) + F12 - L6, F3 = 17 GHz to 19.4 GHz, 0.1 GHz steps (assume F12 = 13,000 MHz)

Appendix B AIPS Procedures

The following is a list of general steps to reduce the data:

- 1) Get the tape and find out what file no. the data is on the tape.
- 2) Get into AIPS and put the tape into the tape drive.
- 3) Mount the tape. (Make sure inputs are correct)
- 4) Perform the task "film". Set qual to -1 (for all qualifiers), set calcode to '' (any calibrator code), and enter the date and time. This retrieves the data from the tape.
- 5) Use uc to see which file no. you want. (You want .line file)
- 6) Use getn to get the file. (ex: getn 2 gets file number 2)
- 7) Perform the task "tacop". This makes a copy of the CL table.
For AIPS to reduce the data, it needs the copy.
- 8) Then run poss*q where the * is replaced by the band letter (ex. >run posspq for pband). This will exit from AIPS when it is finished.

Appendix C Producing an Overlay

The overlay is the overlay.* file in the same directory with the plot files. Run the *.list data file and the *.prm overlay file in xvgr to produce the final plot.

To get into xvgr for a pband plot, for example, type:

```
xvgr -p overlay_for_pband.prm _____.list  
---where _____.list is the actual plot file gotten from data reduction, and  
overlay_for_pband.prm should be the overlay created separated just for p-band.  
Once inside the xvgr program,
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- 1>. Click at VIEW-->string & things-->title under the menu bar.
- 2>. Click at the place where the title should go on the graph.
- 3>. Enter an appropriate title.
- 4>. Click at FILE-->Printer Setup, change "print to printer" to "print to file".
- 5>. Change the file name to be yymmdd.ps, where yymmdd should be the date of observation.
- 6>. Click at print.

The resulting file is in postscript format.