

VLBA ACQUISITION MEMO #213

VLBA Data Acquisition Memo No. 213

NATIONAL RADIO ASTRONOMY OBSERVATORY

Edgemont Road

Charlottesville, VA 22903

To: VLBA Data Acquisition Group

August 10, 1990.

From: A. R. Thompson

Subject: Performance Specifications of the Baseband Converter Module.

During the past year a total of something like 40 baseband converter modules have been constructed and adjusted for operation by NRAO groups at Green Bank and Charlottesville and by Interferometrics Inc. Experience has shown that a great deal of care is required in the final adjustment of the units to obtain performance close to that specified in the VLBA Project Book (Version 7, Oct. 1 1988). In particular it now appears that small changes of the specifications are required in two areas in order to conform with realistically achievable performance. These are described as follows.

(1) Rejection of Unwanted Sideband Responses (Image Rejection).

Earlier in the year it became evident that the specification of 26 dB rejection of the unwanted sideband in the IF-to-baseband conversion could not be met for all ranges of both the local oscillator and the baseband output frequencies. It was therefore proposed that the required rejection should be reduced to 23 dB for LO frequencies in the ranges 500-550 MHz and 850-1000 MHz, and for baseband frequencies below 100 kHz. This revised specification was given in a letter by Alan Rogers dated April 12, 1990, a copy of which is attached herewith. The usual practice in adjustment of the baseband mixers is to set the LO to a fixed value and then to sweep an input signal to provide coverage of the baseband range. Experience showed that there is generally little difficulty in obtaining the required rejection at any one LO frequency, but that as the adjustment is repeated for a number of LO frequencies it is generally not possible to retain the required performance at more than two or three of them. With some care it is usually possible to adjust the mixer to obtain the rejection specified in Alan Roger's letter at 550, 750, and 950 MHz, and this has been considered to be a satisfactory performance for NRAO-built units. However, for other LO frequencies the performance may fall short by typically 3 dB over parts of the baseband range. This situation was discussed at a teleconference meeting on Aug 8, 1990, by representatives of Interferometrics Inc., NRAO (Green Bank and Charlottesville), and Alan Rogers. It was agreed that to provide a specification that can be met at this time, the performance given in Alan Roger's letter of April 12 would be used with the modification that the figure of 26 dB is to be regarded as a goal (the figure of 23 dB remains a firm specification). This modification is necessary because it is likely that the 26 dB specification in the letter will not be fully met at all frequencies by all units. It was further noted that measurement and adjustment of the performance would be made only at a limited

number of frequencies across the LO range; typically 550, 650, 750, 850, 950 MHz, or a subset of at least three of these frequencies. Note that the effect of unwanted responses arising through image responses of the mixers is likely to be important only when fringe frequencies are very low. If the change described above has any significant impact on the scientific capabilities of the VLBA it will be necessary to redesign the mixer at some future time. Retrofitting the mixer with an improved design would be feasible since this unit is assembled in a small box within the Baseband Converter and could be replaced without altering the rest of the module.

(2) Isolation of the Input Switches.

The specification on the isolation of the four-way input switch that selects between the four IF channels is 60 dB, as given in the project book. The typical measured value is 55-57 dB, with careful grounding of the switch cases and use of ferrite beads on the control lines. Low level coupling of the IF channels is likely to cause problems mainly for polarization measurements, where cross coupling of oppositely polarized signals at a level of -55 dB could result in instrumental polarization at a level of a few tenths of one percent, which would probably be calibrated out. It could also cause errors in pulse calibration signals that may occur at the same frequency in different IF channels. An isolation of 55 dB would result in a maximum phase error of 0.1 deg. in a pulse calibration signal. It is therefore decided that the switch isolation specification should be reduced to 55 dB.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

12 April 1990

Area Code 508

692-4764

Dr. A. Richard Thompson
National Radio Astronomy Observatory
Edgemont Road
Charlottesville, VA 22903-2475

Dear Dick,

I suggest we formally modify the VLBA BBC image rejection specification to the following:

<u>L.O. Range</u>	<u>Baseband Range</u>	<u>Rejection</u>
550 - 850 MHz	100 KHz - 16 MHz	26 dB

and all other L.O. and baseband frequencies

<u>L.O. Range</u>	<u>Baseband Range</u>	<u>Rejection</u>
500 - 1000 MHz	10 KHz - 16 MHz	23 dB

to conform more closely with what can be achieved in a reasonable amount of time to "trim" the mixers. Since most observing will be in the I.F. range of 550 - 850 MHz, I don't think this revised specification will significantly compromise the performance of the VLBA.

Best regards,

Alan E.E. Rogers

xc: D. Baghri
E. Childers
P. Napier
E. Schlecht
C. Walker