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WESTFORD, MASSACHUSETTS 01886

4 March 1986

Area Code 617  
692-4765

To: VLBA Data Acquisition Group  
From: Alan E.E. Rogers  
Subject: Preliminary Tests of Prototype VLBA Baseband Converter

Some preliminary tests have been made of the baseband converter using a spectrum analyzer, scope and sweeper. More comprehensive tests will be made as soon as a digital interface is completed.

A) Bandpass Response

The bandpass response was measured using a UHF sweeper and oscilloscope. In general the active filter response is close to the theoretical 8-pole butterworth low pass (see Acquisition Memo #50) for most bandwidths. The 62 KHz bandwidth is slightly degraded by the 200K input resistance of the NE5539. From 125 KHz to 4 MHz the bandpass response is very close to ideal. At 8 MHz and 16 MHz the response is somewhat degraded owing to a combination of the limited switch isolation and the gain characteristics of the NE5539 operational amplifiers. Despite these defects the filters meet the specifications given in the project book.

B) Image rejection

The SSB mixer performance operates quite well and did not require any adjustments to meet the image rejection specification of 26 dB. See Figure 1.

C) Local Oscillator Performance

The local oscillator spectrum is shown in Figure 2. From these spectra, I estimate that the r.m.s. phase noise is about 2 degrees r.m.s. at both 500 and 704 MHz.

D) Bandpass Gain Compensation

Steps of 3dB with maximum cumulated error of less than 0.1 dB (measured on HP8566A spectrum analyzer).

E) Gain Control

Maximum cumulated error less than 0.1 dB over the range 0 to -24 dB. Attenuation with all zeroes selected (switch isolation) 55 dB. Monotonicity better than 0.1 dB.

F) Input Switch Isolation - Better than 60 dB

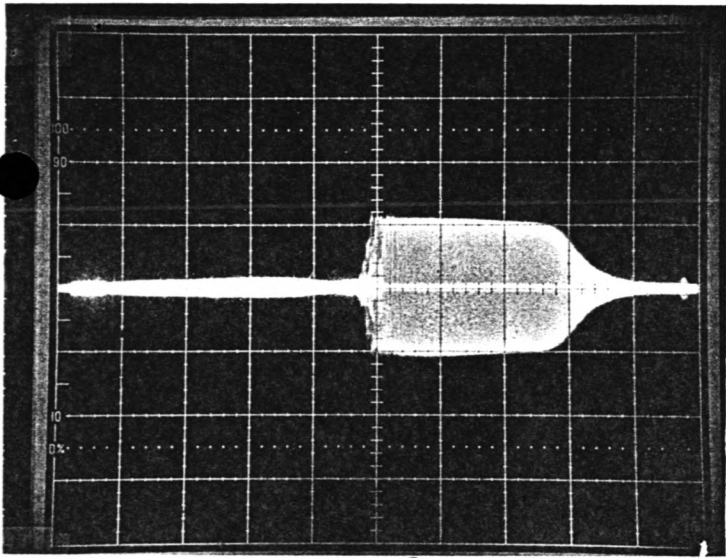
Changes in made design during prototype checkout.

- 1] Since the NE5539 operational amplifiers saturate at a much higher level than the mixers, the gain in the SSB mixer was increased from 0 to 10 dB - allowing a reduction in the gain following the active filters - see revised signal level drawing attached. The reduced gain following the filter reduces the internal noise level of the converter at narrow bandwidths.
- 2] The method of compensating the active filters for switch capacitance was changed from an adjustment of capacitance values to a method in which the feedback network is changed to give slightly greater than unity gain.
- 3] Many small changes to improve compensation of NE5539 amplifiers.

Further improvements needed.

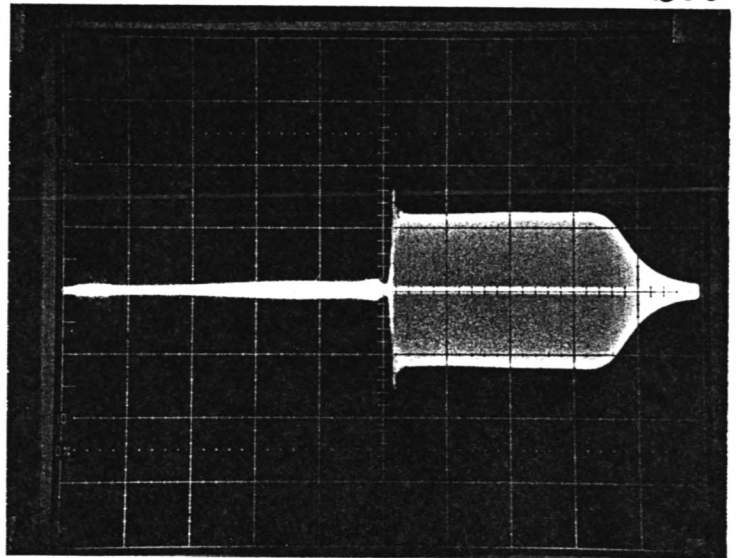
At present the local oscillator does not go beyond 960 MHz. A new printed circuit board (using low dielectric constant material) should extend its range well beyond 1000 MHz. The L.O. phase noise appears to be limited by thermal noise in the phase detector circuit. Improvements in the design are being studied.

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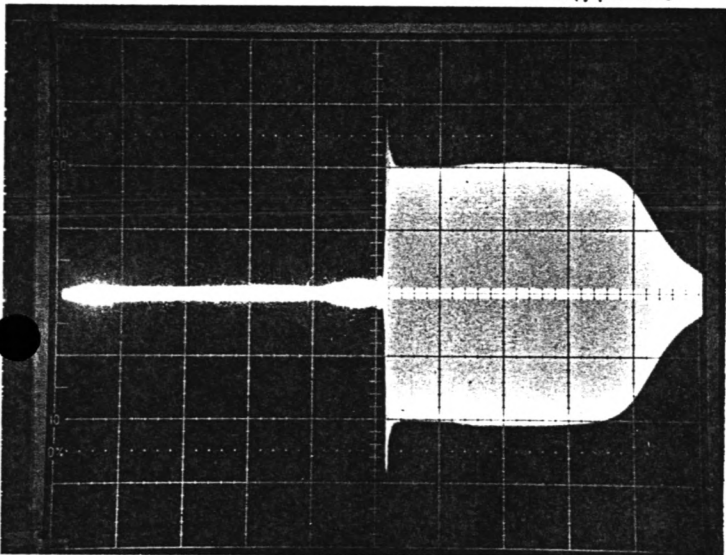
125 KHz BPF (1000000) 200 KHz

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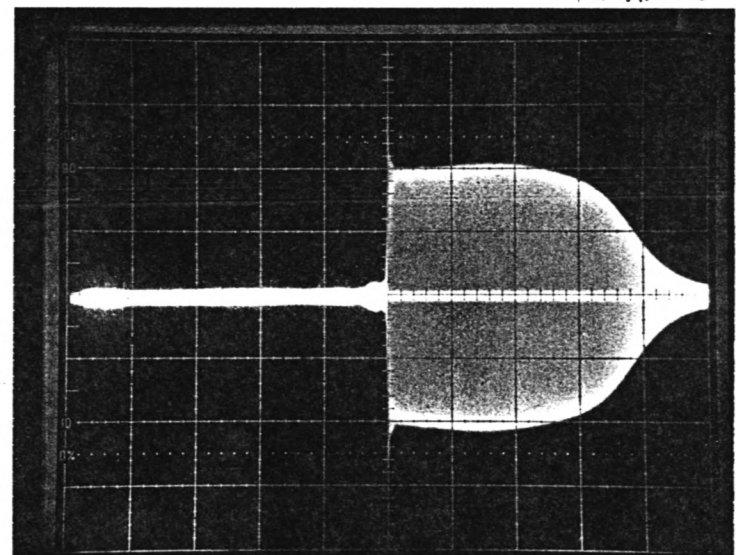
1 MHz BPF (0000100) 1.25 MHz

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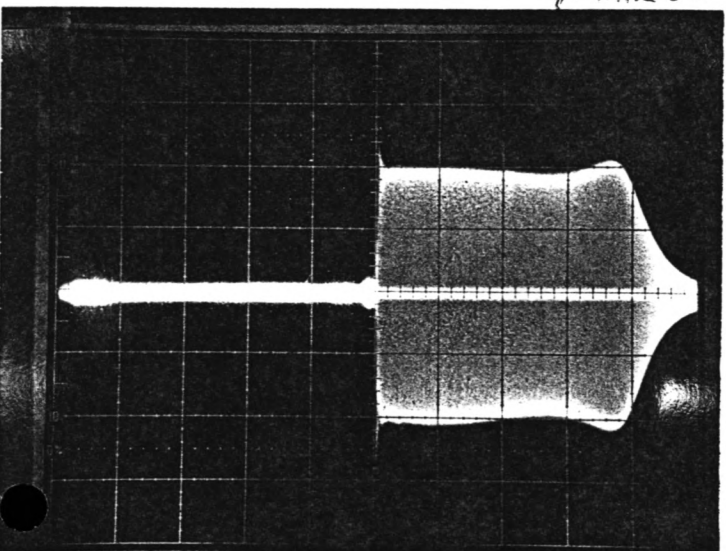
4 MHz BPF (0000010) 4 MHz

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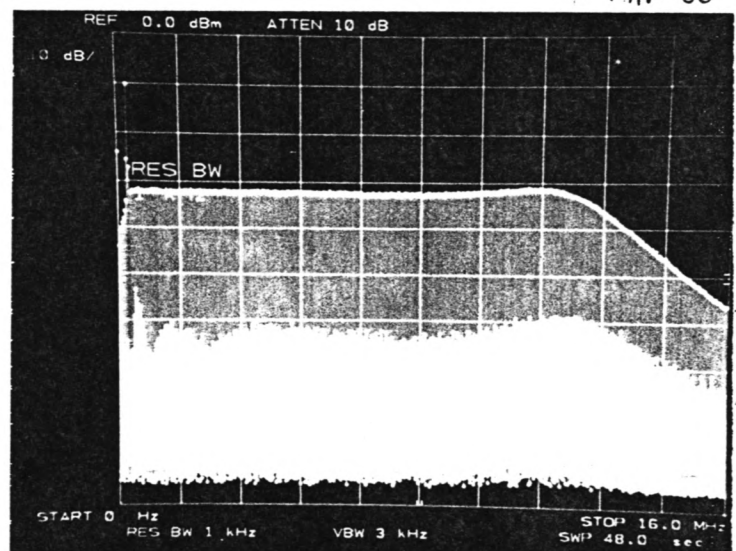
8 MHz BPF (1100001) 8 10

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16 MHz BPF (1111111) 16

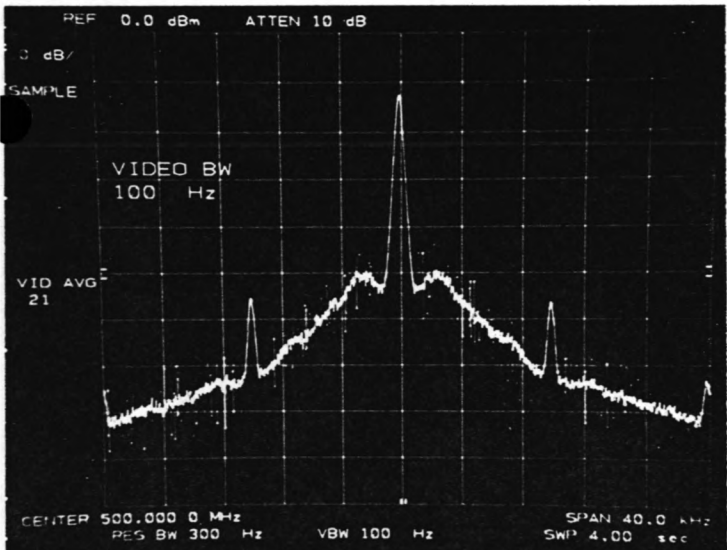
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SSB IMAGE REJ. 500 MHz C.F.

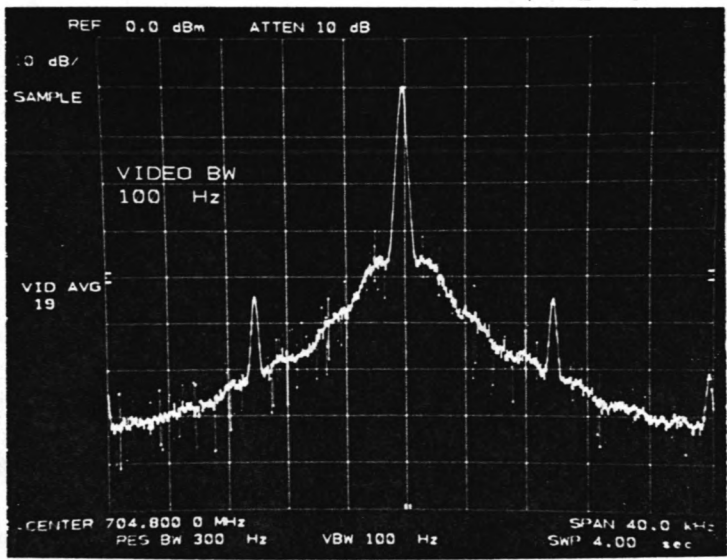
FIGURE 1. BANDPASS & IMAGE REJ.

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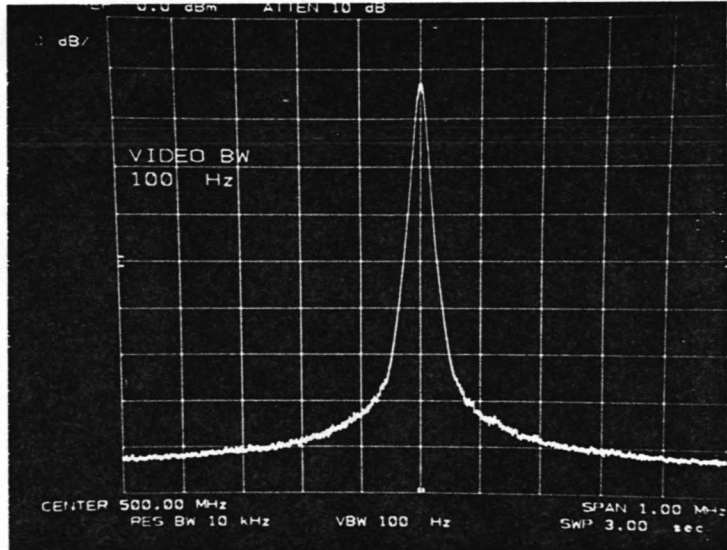
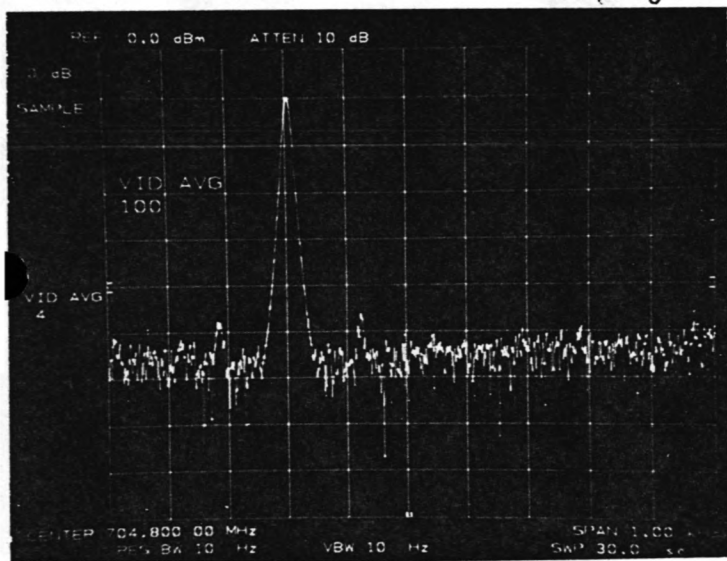
wik comp.

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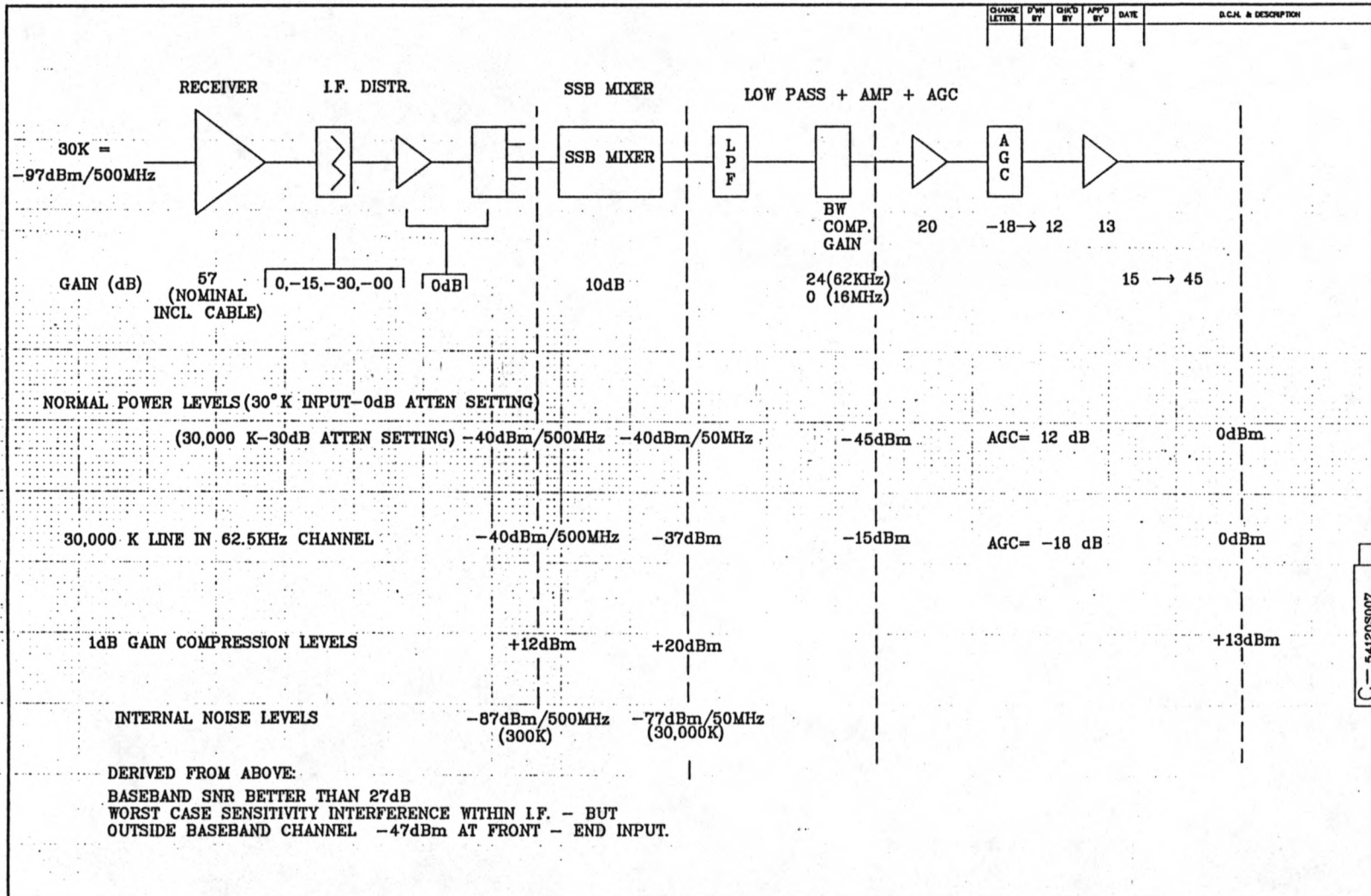
with comp.

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Noise at 100kHz from carrier  $\approx -70 - 40 = -110$  dB

FIGURE 2. L.O. Phase noise tests



CHANGE LETTER	DRN BY	CHK'D BY	APP'D BY	DATE	D.C.N. & DESCRIPTION

**NOTES**

**MATERIAL**

FRESH AND/OR HEAT TREATMENT

**SHOP NOTES UNLESS OTHERWISE SPECIFIED**

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS FRACTIONAL & 1/64 DECIMAL .001 & .01 DECIMAL .001 & .005 ANGULAR & 0.50°
- SURFACE ROUGHNESS PER MIL-STD-10
- REMOVE BURRS AND BREAK SHARP EDGES 1/64 MAX.
- SCREW THREADS PER MIL-STD-8
- ALL DIMENSIONS TO APPLY BEFORE PLATING OR CONVERSION COATING.

USED ON	DRN FOR	DATE
	A. K. ROGERS	8-85
	DRN BY	8-85
	A. PHILBROOK	
	CHECKED BY	
	PROJECT	
	ENGINEER	
	MATL. & PROBLEMS	
	STRUCTURES	
	TERRAIN	
	MED. ANALYSIS	

NORTHEAST RADIO OBSERVATORY CORPORATION  
 HAYSTACK OBSERVATORY  
 WESTFORD, MASSACHUSETTS

**SIGNAL LEVELS IN VLBA RECEIVING SYSTEM**

C 54120S007

REV.

C-54120S007