VLBA Acquisition Memo # 77

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To: VLBA Data Acquisition Group

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Subject: Checks and Diagnostics of I.F. Processing Electronics

I.F. Distributor

A] Passive Tests

1) Total power - should read 2000H to 8000H (0.5 to 2 volts) for broadband receivers looking at cold sky. Narrow band receivers (330 and 610 MHz) will read less. For solar observations the 20 dB attenuation setting may be required.

2) Switched power - should read 334H (820) for a 5% Tcal and a total power of 4000H (16384). The output should be proportional to the total power and noise source fraction.

B] Active Tests - Switch to external input (BB#1 L.O. output connected to IFD#2 Ch 2 external input via Front Panel BNC cable)

1) Total power - should read 800H to 4000H for test signal.

2) Switched power - should read less than 10 in magnitude for 1 second averaging.

Baseband Converter

A] Passive Tests

1) L.O. Lock - should read 1 (locked) for L.O. in range 500 MHz to 1000 MHz.

2) Total power checks in fixed gain mode.

a) With gain set at 51H (81) and I.F. total power in range, total power should read 1000H to F000H. The total power should not change by more than 20% with bandwidth setting provided bandwidth gain compensation is set to the value which matches the bandwidth and a strong spectral line is not in the bandpass.

b) With bandwidth set at 8 MHz change the bandwidth gain compensation by 3 dB in both directions and check that gain changes (brought about by the 8751 uP) follow the 3 dB changes to within 0.4 dB (or within 2 counts).

c) Vary the fixed gain from 20H to FFH and check that total power is proportional to the square of the gain setting with 5%.

3) Total Power Checks in Autolevel Mode

a) In autolevel the total power should read 4000H (provided the reference levels have not been altered by MCB communications) and the gain should read 51H (-10 dB from maximum gain) within 6 dB (28H to A2H).

b) With bandwidth set at 2 MHz change the bandwidth gain compensation by 3 steps in either direction and check that gain changes (brought about by the 8751 uP) follow the 3 dB changes to within 0.4 dB (or within 2 counts).

4) Sampler Quantization Level

With the baseband converter in autolevel mode, sample some data using the data buffer. 32 $\pm$5% of the data should have codes 00 and 11 (i.e. above 220 mV threshold).

5) Cross Correlation Check

Set 2 baseband converters to the same frequency and cross correlate some data for upper vs upper sideband to check bandpass match and L.O. phase noise and upper vs. lower sideband to check image rejection.

B] Active Tests

1) Bandpass and Image Rejection Test

Use one baseband converter (BB#1 L.O. connected to IFD#2 Ch 2) as a test generator to measure the bandpass. The baseband converter under test should be run in fixed gain mode with the bandwidth compensation gain set to zero (16 MHz) for all bandwidths. When the test signal scans the lower sideband the bandwidth compensation gain can be increased to extend the dynamic range of the total power detector.

The results of this test should be as follows:

Bandpass 3 dB frequency should be 90 $\pm$5% of bandedge.

Bandpass ripple should be less than 1 dB peak to peak.

Bandpass response more than 10 dB down at 108% of bandedge.

Image rejection should be better than 26 dB.

2) L.O. Phase Noise and Coherence Test

The differential baseband L.O. phase noise can be measured either by cross-correlation of the outputs of 2 converters set to the same frequency and I.F. input or by Fourier analysis of test signal data acquired from the data buffer. For example, the 10 KHz signal obtained by using the L.O. of one converter as a test signal for another converter can be analysed for phase noise and drift.