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TO: VLBA Acquisition Group

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SUBJECT: Improving the Dynamic Range of the I.F. to Video Converters

The MK III I.F. to video converters have 36 dB gain at 2 MHz bandwidth* and operate with a nominal input of -99 dBm/Hz or -14 dBm in a 340 MHz bandwidth. The SNR of the MK III video converters is limited to 33 dB by the very noisy video amplifiers (≈ 26 dB NF) which follow the SSB mixer. The converters reach the 1 dB compression point with ≈0 dBm input and will produce a 0 dBm output from intermodulation products if there are two signals at -3 dBm with difference frequency within the low pass filter bandpass.

The performance of the I.F. converters could be greatly improved by using low noise video amplifiers along with an increase in the gain following the low pass filters. Less gain should be provided ahead of the SSB mixer to maintain an overall gain of about 46 dB. The increased gain after the low pass filter will allow the mixers to operate at the lower level and hence reduce the level of undesired intermodulation products. The relatively high input level required by the I.F. to video converters is advantageous in reducing the level of spurious signals picked up in the I.F. transmission from the receiver to the acquisition rack. However the high input level puts fairly stringent requirements on the I.F. output amplifiers in the receiver to ensure that gain compression and intermodulation distortion do not occur in these amplifiers.

If the I.F. distributor provides approximately unit gain (with attenuators to provide a reasonable range in either direction) the level at which intermodulation products are generated will be about the same in the receiver and video converters assuming about 12 dB loss in the cables. I would suggest the following nominal gains to bring a 30°K 500 MHz bandwidth front-end to 0 dBm video:

Front-end gain	87 dB
Front-end output	-10 dBm in 500 MHz bandwidth
I.F. Cable loss	12 dB
I.F. distributor gain (including cable compensation network)	0 dB
I.F. to video converter gain	46 dB (at 2 MHz bandwidth)
Video output	0 dBm

*with 10 dB video attenuation

To make the VLBA receivers as immune as possible to interference it would be nice to make the VLBA receivers of high "communication" quality. Unfortunately it is very hard to achieve a large amount of rejection for signals in the unwanted sideband of the video converters or signals within the front-end bandpass and outside the video bandpass. A case which illustrates the problem is Channel 38 TV interference which may generate a -51 dBm signal into the receiver at the Haystack site. The signal will saturate the receiver I.F. output unless the front-end gain is reduced or additional filters are added to the front-end. Decreasing the front-end gain will make the system more susceptable to picking up Channel 38 (= 616 MHz) directly in the I.F. cable while placing bandstop filters in the front-end will add to the receiver complexity.