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VLA ELECTRONICS MEMO. 223

Spurious signals at L-band due to image problems

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ABSTRACT

This memo describes cause of spurious signals due to image frequency signals about 1600 MHz and suggest a possible sheme to eliminate it.

INTRODUCTION

L-band (1.3 to 1.75 GHz) signals in the VLA are first upconverted to C-band (4.5-5 GHz) by mixing with 3.2 GHz LO. The (frequency conversion) mixer also produces product of the second harmonic of 3200 MHz beating with the input signal to give spurious signals in 4.5 to 5 GHz range. For example a strong signal at 1710 MHz will mix with 2×3200 MHz to give output at 4690 MHz, as if there was a signal in the input at 1490 MHz. This problem can be eliminated by using different frequency like 6200 MHz instead of 3200 MHz. This solution was suggested when we were considering forest service transmissions causing RFI problems, but finally decided to add BPFs of 1200 to 1730 MHz to solve it. The reason for adding filters was that using 6200 MHz LO would have changed the frequency conversion scheme (such that the existing and new system would not have remained compatible) disrupting observations during transition, unless during transition we maintain the old system till new system is completed on all antennas.

TYPES OF SOLUTIONS AND SUGGESTED SCHEME

Recently there have been serious concerns due to other RFI signals causing spurious responses because of the image problem. Efforts to reduce the image problem by reducing the product of second harmonic of 3200 MHz beating with input signal by using different types of mixers haven't been much successful. There is no clean solution without affecting conversion scheme to solve the image problem completely. However, if we agree to go for a scheme where we accept a solution which affects conversion scheme, we can go for 6200 MHz LO instead of 3200 MHz, or go for anything else which provides a clean solution.

Block diagram in figure 1 shows a scheme based on going directly from L-band to IF of 1025 MHz using 2-4 GHz Synthesizer signals. This scheme has advantage over using 6200 MHz LO (instead of 3200 MHz LO at present) that it reduces number of frequency conversions used at present, eliminates almost 40 dB gain in the path of L-band signals, and allows using high level mixers before the signals are band limited by 1025 MHz filters in F7 modules. This will increase the dynamic range of the L-band system by several tens of dBs.

CONCLUSION

While making any changes we need to keep in mind that we are hoping to not make any further changes in the L-band system when the upgrade is done. Also if the components of the new module are chosen properly we should be able to use the same module for frequency conversion for S-band and 1000-1250 MHz signals (below 1000 MHz is covered by existing F11), assuming rest of the LO/IF system is kept when these bands are added. Keeping these points in mind I feel that even if this scheme costs a little bit more than the frequency conversion scheme using 6200 MHz LO, we should take this opportunity to change to the frequency conversion scheme suggested here.

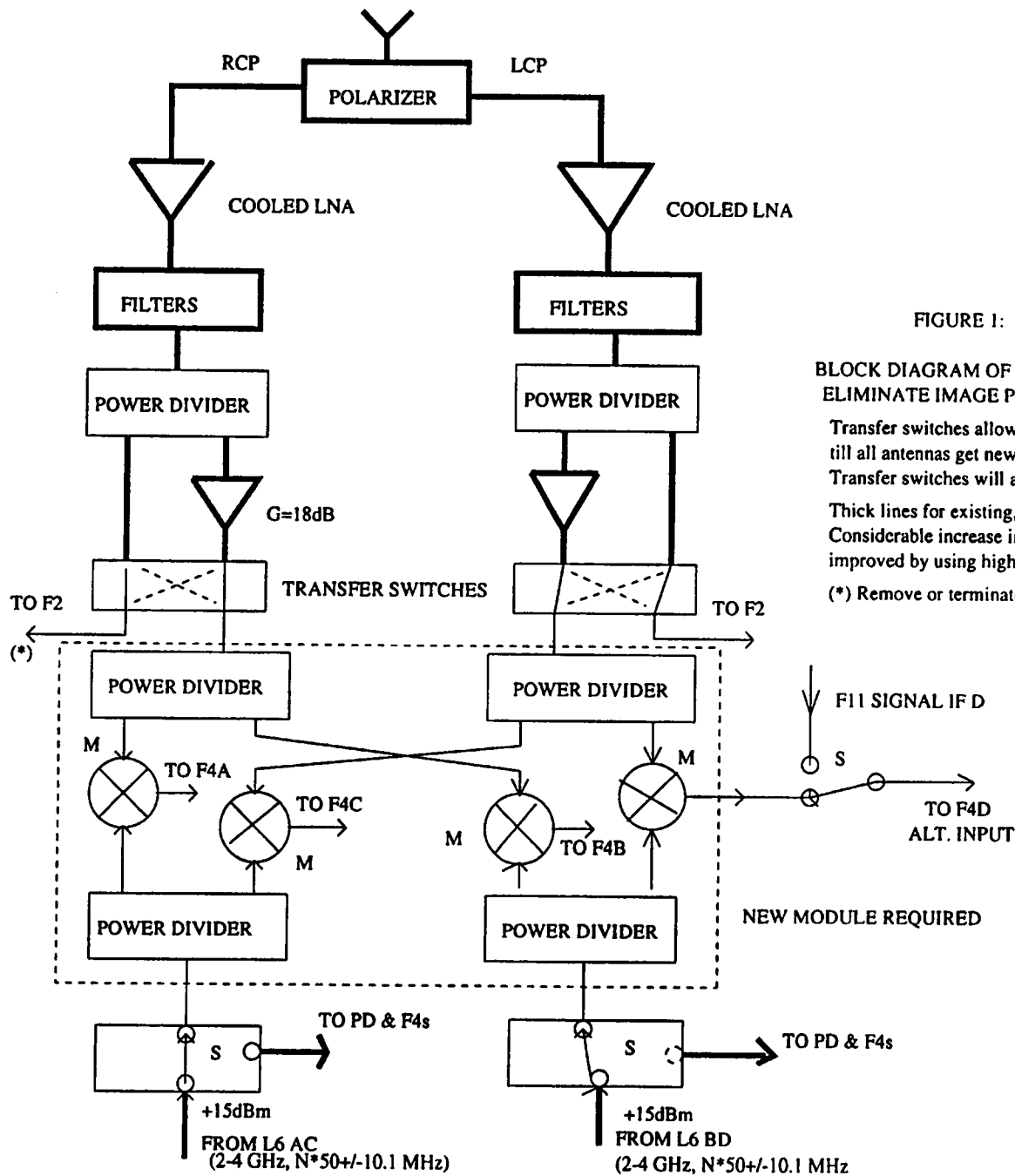


FIGURE 1:

BLOCK DIAGRAM OF SUGGESTED SCHEME TO ELIMINATE IMAGE PROBLEM AT L-BAND

Transfer switches allow observations with existing system till all antennas get new system.
 Transfer switches will also allow solar observations.

Thick lines for existing, Thin lines for to be added
 Considerable increase in dynamic range, which can be further improved by using high level mixers (4*M)

(*) Remove or terminate after all antennas converted