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9 February 1987

To: VLBA Data Acquisition Group  
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Subject: I.F. Distributor and Baseband Converter Evaluation and Modifications

### Introduction

While initial tests of the prototype baseband converter appeared to indicate that the unit would meet all the specifications, tests at the VLA have shown up several problem areas as follows:

- 1] Excessive variation of detector sensitivity between units.
- 2] The image rejection is poor, especially with L.O. frequencies above 800 MHz.
- 3] The SSB mixer section saturates at too low a level.
- 4] The input switch isolation is poor in some cases.
- 5] The L.O. fails to cover the specified 500 MHz to 1 GHz range in some cases.

These problems require some circuit modifications and the calibration/adjustment of some submodules.

### Submodules Which Require Bench Calibration and/or Adjustment

#### 1] Square Law Detectors

Owing to the variation in the sensitivity of back diode detectors it is necessary to adjust each detector on the bench so that -22 dBm produces a mid-scale output of 1 volt or 50.4 KHz (a total power count of 4000H from the 8751 uP). This adjustment/calibration is made to 5% or 0.2 dB. The calibration adjustment is made by adjusting R04.

#### 2] SSB Mixer

Owing to the variation in the mixers and hybrid it may be necessary to adjust the L.O. phase quadrature in the SSB mixer submodule in order to meet the 26 dB image rejection specification for the entire L.O. range of 500 MHz to 1000 MHz. The phase quadrature adjustment can be made by adding a resistor across ports C and D of the hybrid or by adjustment of the path length (moving position of wire) to mixer inputs.

## Circuit Modifications

### 1) SSB Mixer

The operational amplifiers were somewhat undercompensated and as a result tended to saturate with signals around 40-60 MHz. The compensation has been adjusted and an approximately 20 dB improvement made in the 1 dB saturation point which is now close to +4 dBm for the worst case baseband frequency range. The Mini-circuits LMX-113 mixers are marginal in the L.O. range above 800 MHz where their loss increases rapidly and the mixers do not track well enough. The Olektron CDB-235 mixers perform much better and probably should replace the Mini-circuit's units, however, Mini-circuit and Olektron are sending me information on the repeatability of conversion loss for several of their mixers to allow further evaluation of which mixers we should use.

### 2) Input Selector Switch

At some frequencies and combinations of input selection the isolation is only 40 dB. Changing the control to the input switches so as to leave the unselected inputs open (rather than terminated) improves the isolation (by reducing R.F. return currents through the p.c. board) so that 60 dB is now the worst case. The fact that unselected inputs are not terminated doesn't appear to have any detrimental effect on system operation since the outputs from the I.F. distributor are derived from an isolation power splitter (expansion slots are unterminated anyway).

### 3) 500-1000 MHz Oscillator

The oscillator frequency coverage can be improved by adding some inductance and low pass filtering (via a ferrite bead) to the gate of the FET. Prior to since change the power output at the low end of the frequency range was drooping enough so that the ECL divider was failing to count all the input pulses.