

**VLBA ACQUISITION MEMO #223**  
**MASSACHUSETTS INSTITUTE OF TECHNOLOGY**

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To: VLBA Data Acquisition Group  
 From: Alan E.E. Rogers  
 Subject: Spurious signal levels in DAR and proposed changes

Introduction Spurious signal levels have now been measured (see VLBA Acquisition Memo #219 for measurements on BBC done) in the DAR at Greenbank. The table below gives the results:

Signal	BBC BW	BBC Gain dB	Level dBm at Front Panel	Comments
10 KHz	2M	64	<-85	after proposed mods
10 KHz	2M	64	-75	before proposed mods
10 KHz	2M	64	-75	2 BBCs set at same frequency and connected to the same I.F.
beat between BBC L.O.s	2M	64	-28 - -38	leakage of the L.O. of one BBC into the I.F. of another before mods
beat between BBC L.O.s	2M	65	-48 - -58	estimate of worst case - after mods BBCs connected to the same I.F.
5 MHz	16M	49	-85	worst case - BBCs connected to different I.F.s
$\mu$ P clock (11.05 MHz)	16M	59	-70	pick-up within BBC
32 MHz	16M	49	-75	fed back from sampler
96 MHz	16M	49	-66	fed back from sampler
60, 120, etc. Hz sideband on L.O.	-	-	-45 dBc	no line noise on baseband - only observed as sidebands on L.O.

Mechanism for spurious 10 KHz

The mechanism for the generation of 10 KHz in the baseband was found to be due to the modulation of the 5 volt power supply current at the 10 KHz rate. This modulation produces 0.8 mV p-p signal on the 5 volts and a corresponding 0.4 mV p-p signal on the power supply ground. The presence of the signal on the common ground transfers the 0.4 mV p-p signal to the + and -15 volt power at the BBC. Inadequate filtering of the +15 volt to the oscillator buffer and -15 volt to the oscillator produce amplitude modulation sidebands on the L.O. which are detected in the mixer and amplified at baseband.

Proposed changes

Change	Module	Reason
Add 33 $\mu$ F from pin 10 of MC1648 to ground	32 MHz synthesizer	Improves rejection of line frequency noise on 32 MHz.
Add 33 $\mu$ F from +15 volt to ground and 220 $\mu$ H in series with supply	BBC oscillator buffer	Adds 30 dB rejection of 10 KHz to +15 volt power.
Add 100 ohm in series with -15 volt supply to oscillator	BBC oscillator	Improves filtering of 10 KHz and line frequency harmonics.
Replace GPD-1003 with GPM-1052 and MAT-3 with MAT-12	BBC 4-way switch	Reduce L.O. leakage out of BBC (See Acquisition Memo #217).

The last proposed change will only improve the pick-up of the L.O. of one BBC by another when the L.O. is in the BBC passband and both BBCs have selected the same I.F. In addition, consideration should be given to adding some ground strapping between bins from the top to bottom of the rack. In the 14 BBC DAR at Greenbank there is about 80 mV developed between the +5 volt ground at the power supply and the BBC grounds. Much of this is due to high resistance contacts between the yellow chromated rear bin panels on the power supplies. On these panels better contact can be obtained if the chromate is removed (or "star" washers used) at the places where the 4 mounting screws attach the panel to the bin.

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