NATIONAL RADIO ASTRONOMY OBSERVATORY
SOCORRO, NEW MEXICO
VERY LARGE ARRAY PROGRAM

VLA ELECTRONICS MEMORANDUM NO. 203

ANTENNA L.O. INDUCED VISIBILITY PHASE JUMPS

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Figure 1 shows a simplified view of the usual antenna operation when the L.O. is phase-locked to the master L.O. in a 600 MHz sampled (1 millisecond) loop at the 19.2 Hz T/R rate. The reference phase is the received difference phase of the 1200 and 1800 MHz carriers. An additional phase locked loop at 5 MHz is provided to initially lock the antenna and to automatically switch to the 5 MHz loop if the error exceeds a $\pm$ 2° limit. The 5 MHz reference is amplitude modulated on the 1200 MHz carrier and envelope detected at the antenna. The $\pm$ 2° limit is an open loop measurement at 5 MHz. When the limit is reached the automatic re-lock process causes the 600 MHz phase to either slip or advance one cycle. The 5MHz phase variations are caused by a non-proportional mechanism between the 600 MHz and 5MHz phases, such as VSWR ripple in the waveguide when the guide is subjected to temperature and pressure changes. Also component aging, component problems, or temperature sensitivity in the L.O. electronics can cause the phase variations.

The following chart at the VLA default frequencies and the equations can be used to predict the visibility phase jump magnitude due to the L. O. re-locking process.

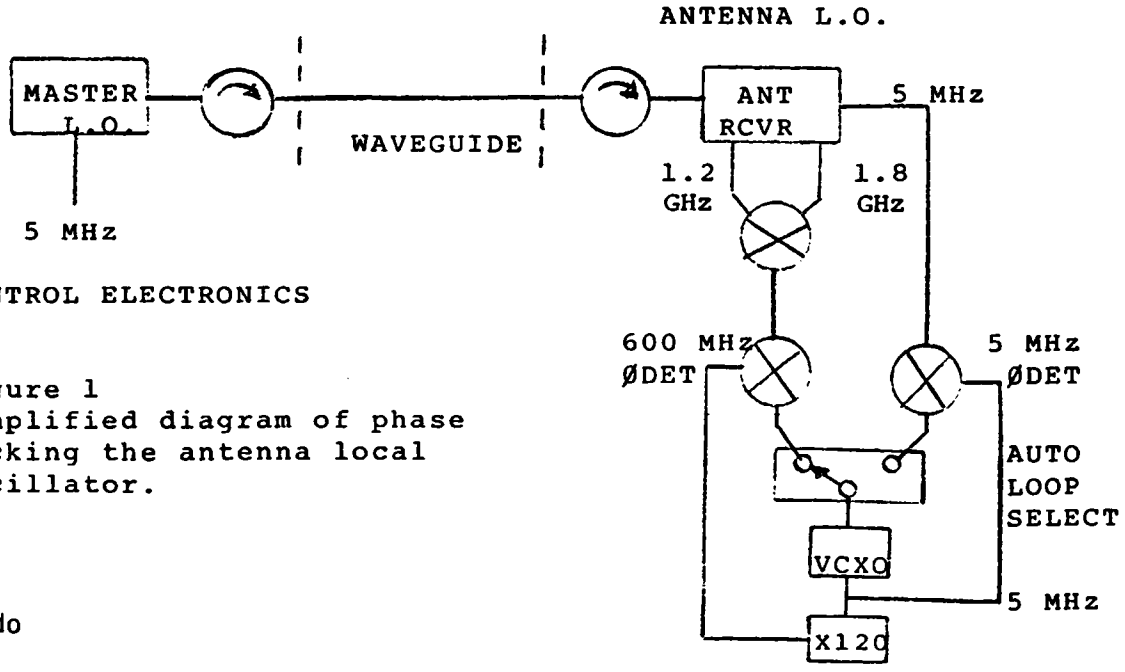

Figure 1
Simplified diagram of phase locking the antenna local oscillator.

LB/do

Effect of Antenna 600 MHz Slipping 1 Cycle at VLA Default Frequencies

Band	f_{L6A}	f_{L6C}	f_{sky} 50MHz BW	f_{F3}	f_{F2}	$\Delta\phi_A$	$\Delta\phi_C$
C	3860	3860	4.885 GHz	0	0	-24	-174
L	3640	3640	1.465 GHz	0	3.2	+84	-66
Ku	3610	3610	14.965 GHz	19.6	0	-54	+156
K	3860	3860	22.485 GHz	17.6	0	+96	-54

($\Delta\phi$ = change in visibility phase for 600 MHz slipping one cycle. Change sign of $\Delta\phi$ if 600 MHz advances one cycle.)

$$\Delta\phi_A = \frac{\left[\begin{matrix}+(k)\\-(ku)\end{matrix}\right]_{F3} + f_{L6} - .300 - f_{F2}\ \text{GHz}}{0.6\ \text{GHz}} \times 360°$$

$$\Delta\phi_C = \frac{\left[\begin{matrix}+(k)\\-(ku)\end{matrix}\right]_{F3} + f_{L6} - .550 - f_{F2}\ \text{GHz}}{0.6\ \text{GHz}} \times 360°$$