VLBA Electronics Memo No. 134

Phase stability of the reference 500 MHz in the station building.

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Figure 1 shows a schemetic of the reference 500 MHz signal and table 1 gives a very rough estimate of temperature coefficients for various components. Depending on the operating temperature different components are likely to dominate the phase stability. Over the temperature range of 17-23 deg C standard 141 semi-rigid cable will dominate. Outside this temperature range (1) Maser (X10 multiplier and 100 MHz buffer amplifier mounted on temperature controlled hot plate inside maser enclosure), and (2) electronics inside the LO Transmitter module (which generates 500 MHz reference from 100 MHz) will both contribute.

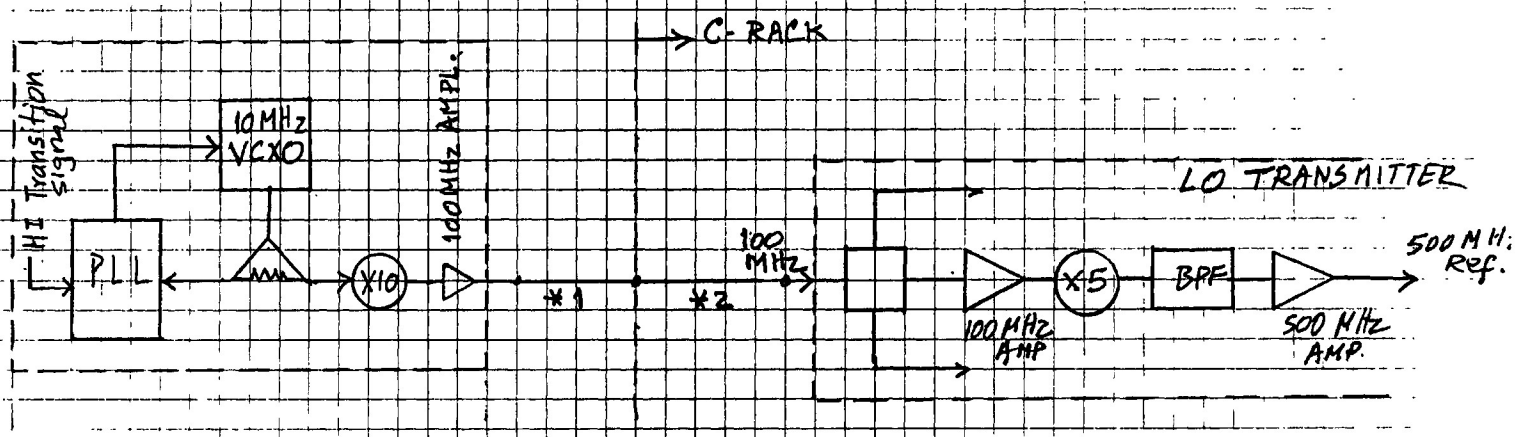
Even outside the 17-23 deg C range contribution of the standard semi-rigid cable is not negligible. To minimize its effect on the phase stability it's length should be reduced and/or it be replaced by a low temperature coefficient cable. Following optoins are possible:
(1) Replace the existing cable from C-rack input to LO Transmitter input (standard semi-rigid cable of about 6-7 ft. length) by the Precision make low temperature coefficient cable but follow the same cable run layout.
(2) Completely re-do the cabling from maser output to LO Transmitter input- (a) put Heliax 3/8" cable (temp coeff. +/-9ppm/C) from maser 100 MHz output to C-rack directly (without going below the floor) at a location near the LO Transmitter input (roughly half way up the C-rack backside), and (b) use a short length of (less than about one foot) the low temperature coefficient semi-rigid 141 cable from C-rack to LO Transmitter input. Option (1) is likely to cost about $100/station and option (2) will probably cost about $200/station and is preferable. This will minimize phase variations due to the coaxial cables and it will no longer be that important to avoid 17-23 deg C temperature near this region (though it will always be desirable to avoid this temperature range considering other teflon cables). Further to minimize phase variations of the reference signal it may be desirable to provide thermal insulation on some of the (sensitive) cables and stabilize the air temperature near the LO Transmitter/C-rack/maser.

Table 1: Temperature coefficients of different components:

component	contribution (ps/C)	Remarks
1. Maser (X10 Multiplier and 100 MHz Buffer)	+3	rough estimate by L.Beno, may be less by a factor of 2
2. Precision make low temp. coeff. cable(10ft.) (environment- part electronics room and part sub floor area)	-0.25 to -0.5	assume -20ppm/C
3. Standard 141 semi-rigid cable (~10ft) (environment C-rack back plane and LO Trans.)	-1.5(outside 17-23C) ~-6 (17-23 C range)	-100ppm/C ?? X4(?) worse in 17-23C range
4. LO Transmitter (over all)	~2.5 (see below)	

(a) 100 MHz Buffer amplifier +0.25deg/C @500MHz (estimated by P.Johnson at LA)#
(b) X5 Multiplier +0.22deg/C @500MHz (estimated by P.Johnson at LA)#
(c) 500 MHz BPF -0.17deg/C @500MHz (estimated by P.Johnson at LA)#
(d) 500 MHz Buffer amplifier +0.35deg/C @500MHz (estimated by P.Johnson at LA)#
(a)-(d) add up to about +3.5 ps/C ??; Larry thinks this may be ~+2.5ps/C
==> very rough estimate; L.Beno plans to measure it in lab.

FIG. 1: SCHEMETIC SHOWING SIGNAL PATH FOR 500 MHz REFERENCE



*1 Precision make Low Temperature coeff cable ~10 ft

*2 Standard 141 Semi-rigid Cable (6-7 ft)