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More Notes on LO Driver Options
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These notes serve as an addendum to the LO Driver Option notes (http://www.cv.nrao.edu/~ebryerto/LO_Driver_Options.pdf) discussed last week. That document outlined 5 different options for the organization of the LO driver into a rack-mounted Phase-Locked Source (PLS) box and a cartridge-mounted Warm Multiplier Assembly (WMA) box. From these 5 options, the choice was narrowed down to options 2 and 3 based on the desire to minimize the band-specific components in the cartridge while keeping the switching electronic. Options 2 and 3 have been further revised to options 2a and 3a, with the revision being that the YTO for bands 2-10 is now at a higher frequency, 16.5-26 GHz. This reduces the total multiplication factor of the LO driver. Also, a separate YTO for band 1 is used with no multiplication. However, this eliminates the possibility of a low-cost prescaler and counter, if such a device is needed. Since only one YTO is needed for bands 2-10, we can purchase an off-the-shelf counter that works up to 26 GHz. This item is included in the budgetary estimate for both options, though it may not be required.

Table 1 below summarizes, by band, the YTO frequency, the PLS output frequency for both options, the WMA output frequency, and the final LO frequency with the corresponding multiplication factor for each assembly.

Priority	Band	Rcvr. Band (GHz)	YTO Band (GHz)	2A PLS Band (GHz)	3A PLS Band (GHz)	WMA Band (GHz)	LO Band (GHz)
2	1	31.3-45	27.3-33	27.3-33	27.3-33	27.3-33	27.3-33
2	2	67-90	22.2-26	22.2-26	x2: 44.5-52.0	x2: 89-104	89-104
1	3	84-116	24-26	24-26	x2: 48-52	x2: 96-104	96-104
2	4	125-163	17.1-18.9	17.1-18.9	x2: 34.2-37.7	x2: 68.5-75.5	x2: 137-151
3	5	163-211	21.8-24.9	21.8-24.9	x2:43.7-49.7	x2: 87.5-99.5	x2: 175-199
1	6	211-275	18.5-21.9	18.5-21.9	x2: 37.1-43.8	x2: 74.3-87.6	x3: 223-263
1	7	275-370	17.9-22.4	17.9-22.4	x2: 35.8-44.7	x2: 71.7-89.5	x4: 287-358
3	8	385-500	16.5-20.4	16.5-20.4	x2: 33-40.7	x3: 99.2-122	x4: 397-488
1	9	602-720	17.0-19.7	17.0-19.7	x2: 34.1-39.4	x3: 102.3-118	x6: 614-708
3	10	787-950	16.6-19.6	16.6-19.6	x2: 33.2-39.1	x3: 99.8-117.3	x8: 799-938

Table 1 Comparison of frequency output of the YTO, the PLS, and the WMA for each receiver band.

Table 2 below shows the budgetary estimate for options 2a and 3a. Option 3a costs slightly more based on the additional cost of the waveguide run from the PLS to the WMA. This more than compensates for adding an extra stage or two to the AMC in the WMA, which only adds a few more hours of labor per AMC. See the previous notes for preliminary drawings showing the size of the WMA for options 2 and 3. They are basically equivalent, since adding an extra stage to the AMC does not significantly increase its size with respect to the input waveguide flange needed for option 3a. The only concern then is whether the additional heat load of the extra amplifier stage in the WMA for option 2a presents a problem. The final power amplifier will dissipate up to 2W and the amplifier required for option 2a dissipates about 1.5 W. This does not include heat dissipated by bias circuitry, which could double this figure if this circuitry were inside the WMA. We are contacting the cryogenics group at RAL to see if this much heat on the flange and dewar body is a problem.

Assuming the heat dissipation factor is not important, option 2a should be the preferred alternative since it is equal in cost, if not cheaper, than option 3a and does not require waveguide connections between the PLS and WMA assemblies.

Part	Est $ per Item	Option 2A	Option 3A
YTO + Driver	2000	2	2
Counter	7000	1	1
PLL Board[1]	500	1	1
AMC 1 (x2 or x3)[1]	750	---	9
AMC 2 (x2 + amp)[1]	1000	—	1
AMC 3 (x2 + amp + x2 or x3)[1]	1250	9	---
3dB Hybrid[1]	500	10	10
RF Mixer / IF Preamp[1]	1500	10	10
Photomixer[1]	1500	10	10
Power Amp[1]	1500	9	9
Coax 1P9T PIN Switch (16.5-26 GHz)	3600	1	---
IF 1P10T Switch[2]	1000	1	1
WR-22 1P9T PIN Switch	5200	---	1
Waveguide Run[3]	1500	---	9
Semi-Rigid Coax Run	100	9	---
Total Cost per Antenna		**$76,850**	**$87,550**
Priority Cost per Antenna		**$39,500**	**$45,700**

[1]these components will be fabricated in house, the cost is based on estimated parts and labor, costs for all other components are based on vendor quotes

[2]includes digital step attenuator to maintain constant phase detector drive level for different bands

[3]includes two straights, two bends, and one flexible piece

Table 2 Listing of parts needed for each option. Note that this is a comparison of the project costs, strictly speaking some of these items may not be included in the first local oscillator budget.