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

VLA ELECTRONICS MEMORANDUM NO. 159

THE MASTER LOCAL OSCILLATOR SUBSYSTEM

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This memorandum outlines the main design considerations in the assembly of the Master L.O. in its final form. Detailed design procurement and installation of most of the Master L.O. electronics are being taken over by W. E. Dumke.

The Master L.O. will consist basically of two type M racks very similar to the present prototype unit, one for regular operation and one as a standby unit in case of failure. A switching system for connecting the outputs of either rack to the cable feeder system to the D racks is also required. The Fluke synthesizers which provide the fine tuning signals will not be duplicated but five of them, including one spare, will be mounted in a single rack which will feed both of the M racks. There will also be a separate rack for a possible hydrogen maser frequency standard to which both M racks can be locked. The proposed configuration for the racks is shown in Figure 1.

1.0 TYPE M RACKS

Each M rack will contain the following modules.

TYPE	FUNCTION	BIN	SLOT
L1	Generates 5 and 50 MHz	T	1-2
L2	Generates 600 MHz	T	3-4
L13	Generates 1200, 1800 and 2400 MHz	T	5-6
L8	Generates 19·2 Hz timing waveforms	T	7

L12	Generates 5·0000192 MHz and controls offset L1 and L2 phaselock loop	T	8
L1 (offset)	Generate 600·0000192 MHz	T	9-10
L2 (offset)		T	11-12
L15	Phaselocks L1 to frequency standard	U	1
L17	Phaselocks synthesizers A and C, generates fine tuning L.O.	U	2-3
L17	Phaselocks synthesizers B and D, generates fine tuning L.O.	U	4-5
L18	Contains drive amplifiers for fine tuning signals from L17s	U	6-7
L19	Contains drive amplifiers for 600·0000192 MHz, 2400 MHz, 10 MHz with offset for modems[1], 5·0 MHz, 5·0000192 MHz	U	8-10
L20	Monitor and control interface with data set	U	12
P4	Power supply, +5 and -28 V	bottom	1-6
P5	Power supply, +15, -15 and 28 V	bottom	7-12

The configuration of the modules within the M racks is shown in Figure 2. Extra space in the M racks will be used for test equipment including a WWVB receiver, frequency counter and power meter.

2.0 THE SWITCHING RACK

The switching rack will be located in between the two M racks. Provision should be made for switching between the outputs of the two racks for the following signals.

SIGNAL	TO	REMARKS
5·0 MHz	Central L.O. transmitter modules (L10), Fluke Synthesizers for channels A and C, Master Clock	
5·0000192 MHz	Central L.O. control modules (L11)	May not be needed
10·0 MHz	Serial Line Controller	
10 MHz with offset[1]	Modems (T1)	

[1]Offset 10 MHz for phaselock of modem oscillators. In the interim this is generated by a spare Fluke 6160B, to be replaced by a special generator in the final system.

Channel A fine tuning	L.O. offset modules (T4)	
Channel B fine tuning	L.O. offset modules (T4)	
Channel C fine tuning	L.O. offset modules (T4)	
Channel D fine tuning	L.O. offset modules (T4)	
100·0 MHz	Delay and Multiplier system	
600·0000192 MHz	Central L.O. control modules (L11)	
1200 and 1800 MHz	L.O. transmitter modules (L10)	
2400 MHz	Modems (T1)	
19·2 Hz T/R	Modems	3 outputs from L8, one to each arm
19·2 Hz Carrier-on	L.O. transmitter modules (L10)	3 outputs from L8, one to each arm
19·2 Hz T/H, Data Invalid	Central L.O. control modules (L11) and Delay/Multiplier	3 outputs from L8, one to each arm
19·2 Hz QQ	Serial Line Controller	

To accomplish the switching a bank of coaxial relays mounted on a vertical panel located near the rear of the rack is envisaged. For all signals other than the 19·2 Hz timing signals these should be coaxial transfer switches with two input and two output terminals so that the unused signals can be terminated. The switches should be of sufficient quality that their reliability can be expected to be much greater than that of the M-rack electronics, and they should probably be a latching type to avoid switching on power dropouts. Type N connectors should be used. Transco type 300C00200 or R.L.C. SR-T-N-D-I-L are possible choices. The 19·2 Hz signals do not require terminations but coaxial relays should be used since rise times as short as 5 nanoseconds are involved. Two further coaxial switches to transfer the 5 MHz inputs of the two phaselocked

synthesizers between the L17 units in the different M racks are required, and for convenience these should be mounted on the same panel as the output-signal switches. One or two spare relays of each type should be mounted on the panel in case of a relay failure or the need to add further signals to the system.

Directional couplers will be included in the output lines after switching, with monitoring detectors that are connected to a monitor and control module.

Change over between the two M racks should be accomplished by throwing a single switch on the front of the switching rack, and should not be under computer control. It should, however, be possible to monitor the positions of the individual switches through the computer.

3.0 THE SYNTHESIZER RACK

Five Fluke Model 6160B synthesizers will be mounted in one rack. Four of these provide the variable frequency signals for channels A, B, C and D. The outputs are split in two-way power divider so that the L17 modules in both M racks can be fed in parallel. The 5 MHz inputs for the A and C channel units come from the 5 MHz output of the switching rack. The inputs for the B and D channel units come from the appropriate L17 modules by way of the switching rack. The spare synthesizer can be used to replace any unit that fails by interchange of the input, output and remote control cables at the rear panels.

4.0 MONITOR AND CONTROL

Two types of units to interface the Master L.O. to the monitor and control system will be required. These are yet to be designed and have been named the Master L.O. Control Module (L20) and the Synthesizer Control Unit (L16). Three Master L.O. Control modules will be required. One will be located in each M rack to control the L17 operating modes and to monitor critical voltages. The third is

required for the switching rack to monitor the outgoing power levels and switch conditions.

The Synthesizer Control unit will be located in the synthesizer rack and will provide control commands for the four synthesizers. Thirty-four bits of b.c.d. code are required for each synthesizer. It is proposed to build the Synthesizer Control unit in a small rack-mounting chassis instead of in a module since connections to the synthesizers can best be done directly rather than through bin connectors. The data set to which the L15 and L16 modules are connected can be located in the bin in the switching rack.

5.0 HIGH STABILITY SIGNAL SOURCE

Both of the 5 MHz crystal oscillators in the L1 modules in the M racks will eventually be phaselocked to a very high stability signal source which will initially be a rubidium standard, later probably to be replaced by a hydrogen maser. The maser will occupy a separate rack. Spaces for single width modules (L15) to contain the phaselock circuitry are included in the list of module positions in Section 1.

6.0 DESIGNATION OF NEW MODULES

Following are the names and numbers for the new modules that will be required.

L15	Master L.O. Phaselock Module
L16	Synthesizer Control Unit
L17	Synthesizer Phaselock Module
L18	Variable Frequency Driver Module
L19	Fixed Frequency Driver Module
L20	Master L.O. Control Module

L15 and L16 are being designed by P. M. Dooley.

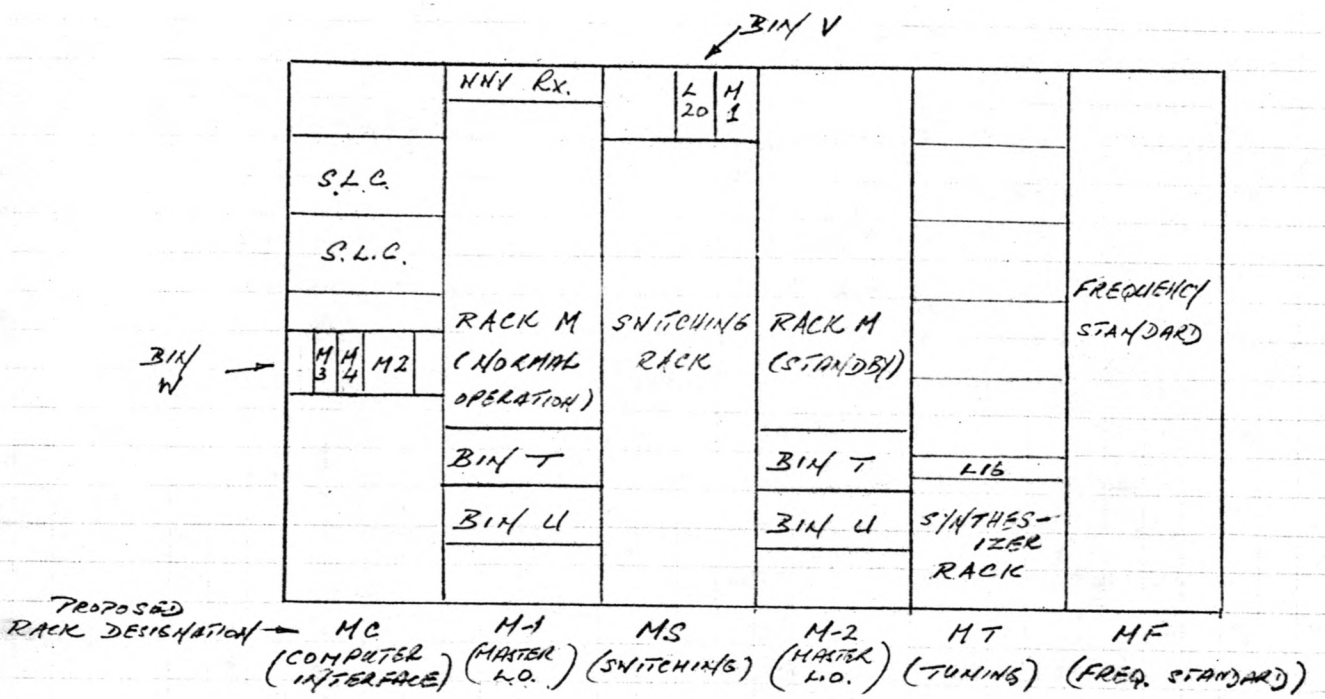

Fig 1. Proposed Configuration of Master L.O. Racks.

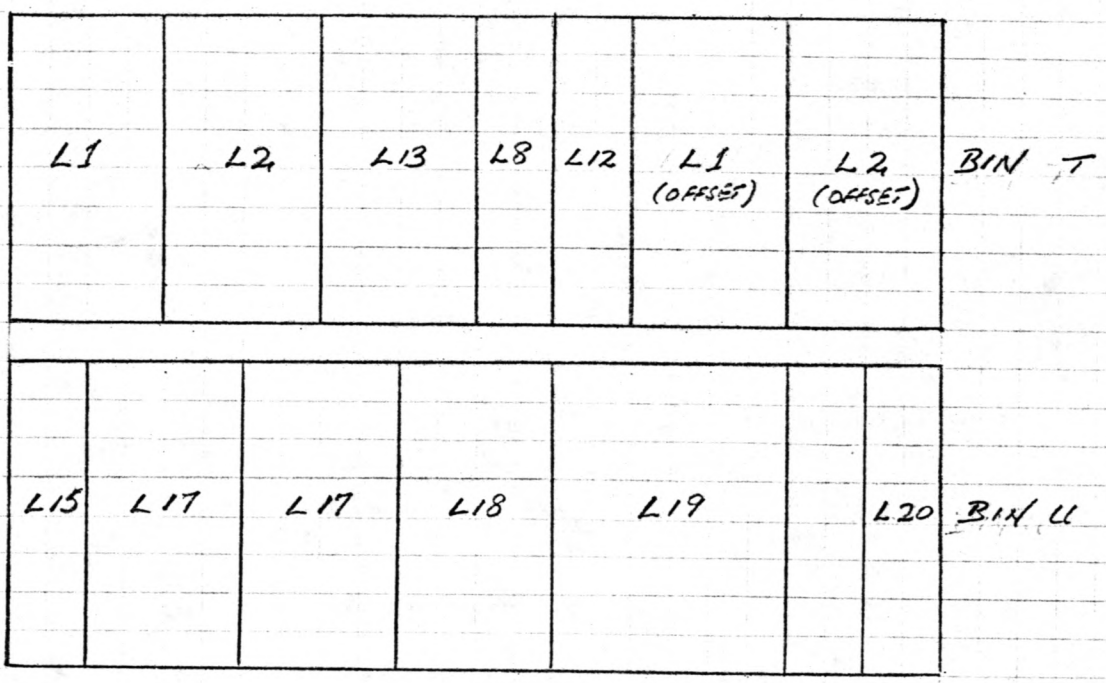

Fig 2. Proposed Configuration of Modules in Rack M.

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