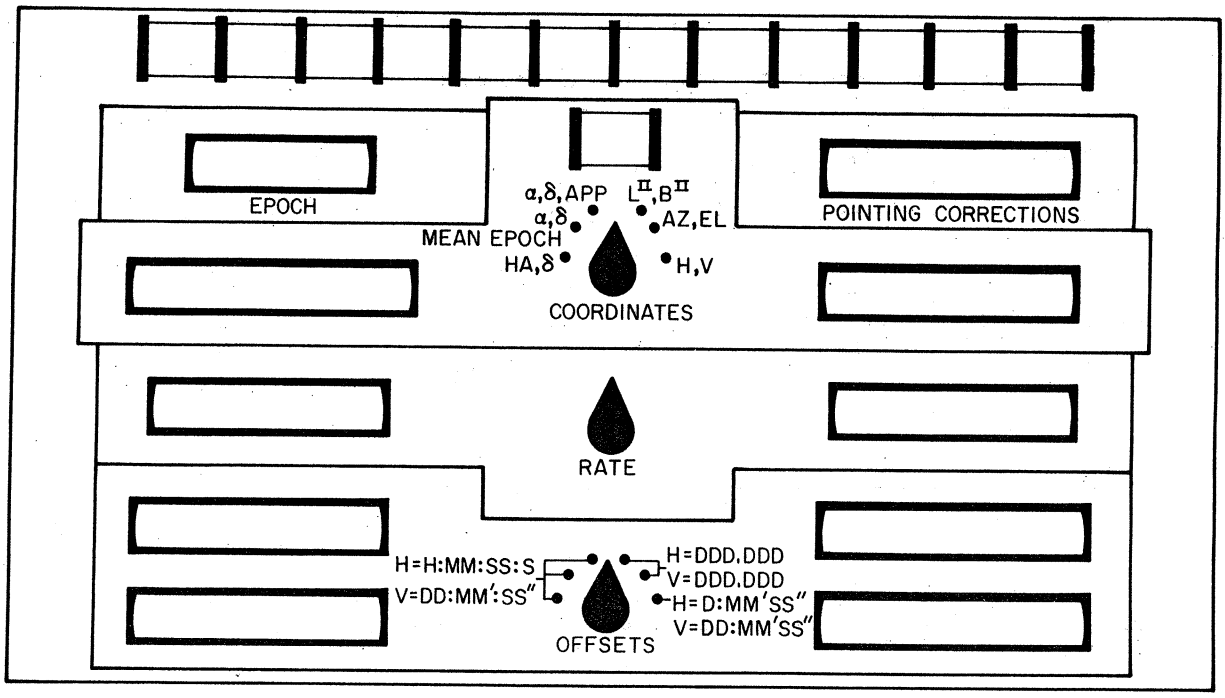

Figure 8. - Layout of Position Panel

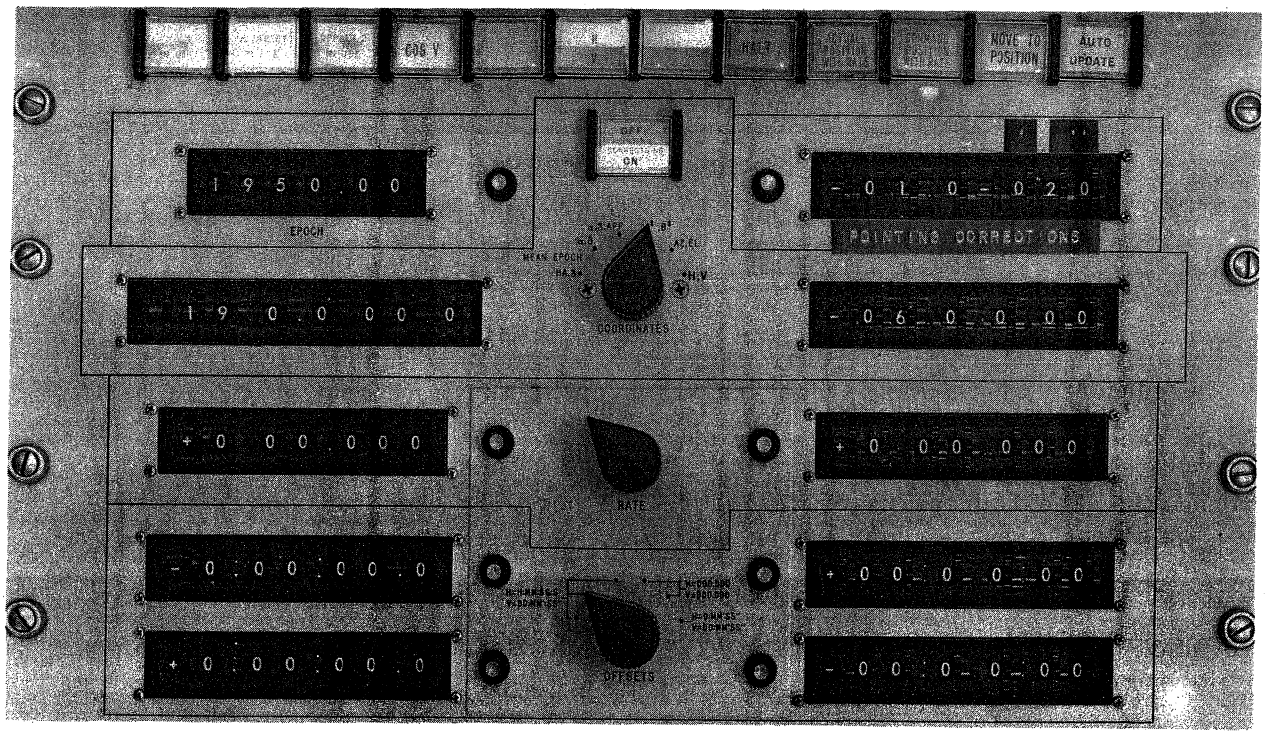

Figure 9. - Position Panel

TABLE 5

Coordinate Systems and Formats

System	Coordinates		Coordinate Formats	
	Hor.	Vert.	Horizontal	Vertical
Equatorial	HA	DEC	±HH:MM:SS.S	±DD:MM:SS
	RA	DEC	±HH:MM:SS.S	±DD:MM:SS
Galactic	II	II	±DDD.DDDD	±DDD.DDD
	AZ	EL	±DDD.DDDD	±DDD.DDD
Descriptive	H	V	+DD:MM:SS.S	+DD:MM:SS

Table 6 lists the formats for the offset registers.

TABLE 6

Offset Register Formats

Offset Formats	
Horizontal	Vertical
±H:MM:SS.S	±DD:MM:SS
±DDD.DDD	±DDD.DDD
±D:MM:SS.S	±DD:MM:SS

The contents of the registers are transferred to the computer when a position panel button is depressed or when the verb PPV is activated in a procedure. The four pairs of registers are normally used for source coordinates, rates and offsets, but may be redefined in observing procedures. For example, they may be used to store pattern or step sizes. The observing procedure documentation in Section VI includes a description of the use of each register in each procedure.

C. Sequence Panel

The sequence panel is used to enter observing parameters, to select observing procedures, and to start or stop observing. Figure 10 shows the layout of the panel. The registers on the left are for the observing parameters: integration period, duration, number of repeats, etc. Two of the three buttons at the top left are for manual operation of the noise tube; the third is a light that indicates when observing is in progress. The fifteen buttons on the lower right are fixed observing commands, such as "read setup cards", "terminate observing", and "disk-to-tape-copy", etc. The two buttons on the upper right execute observing procedures that have been liked to them by the computer command ATTACH. The attached procedure names are displayed in the associated LED labels.

The control system uses the sequence panel when operating in panel input mode. The contents of the registers are transferred to the computer when a sequence panel button is depressed.

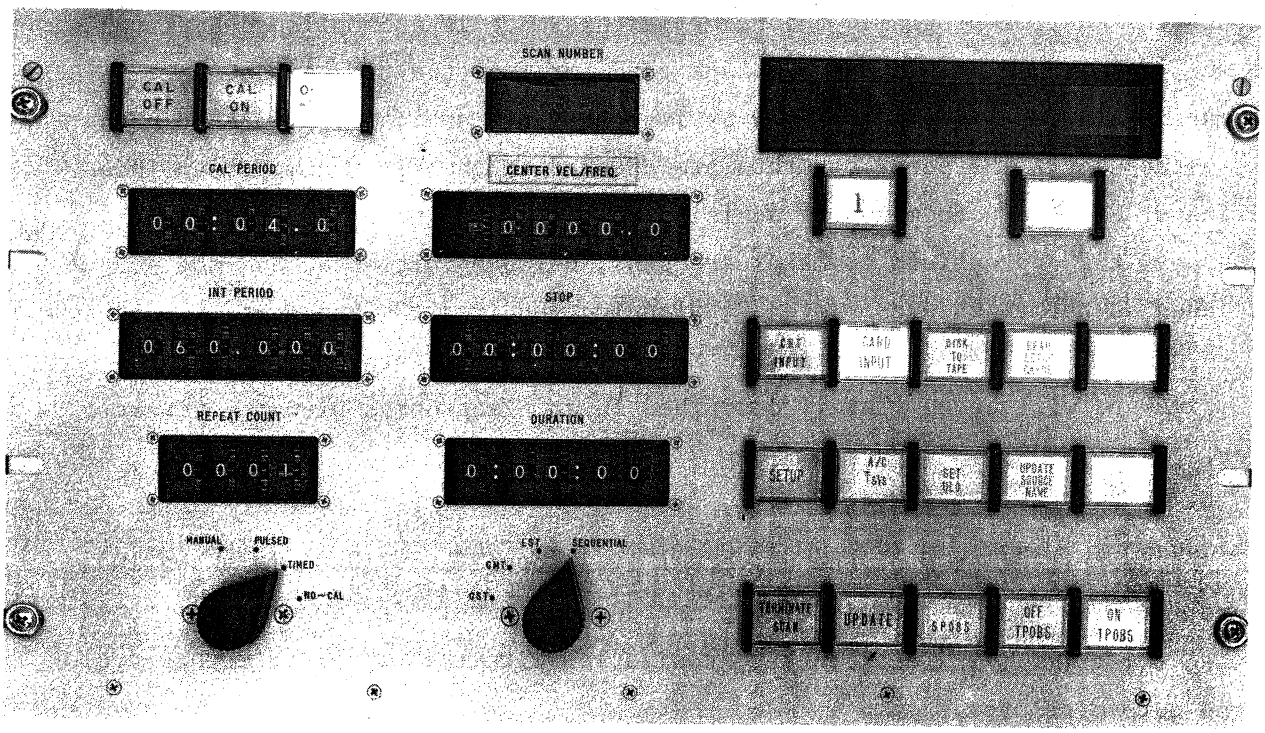

Figure 10. - The Sequence Panel

D. Model IV Autocorrelator

The Model IV autocorrelator is controlled by a Univac (Varian) V77-400 computer. Observations are initiated by a 22 word Modcomp to Varian computer link transfer. These 22 words contain data pertinent to an observation such as bandwidth, signal and reference period, blanking time, configuration, IF's, and sideband selection.

Signal and reference data are collected for the dump period (normal 20 seconds), fast Fourier transformed, and transmitted to the Modcomp computer by the Varian to Modcomp link. Dump periods are integrated in the Modcomp computer for the integration period desired, written on disk and displayed. Individual records are dumped to magnetic tape when the disk file is full by the operator. One averaged record per scan is transferred to the analysis computer for the observer's reduction programs.

Balancing the autocorrelator is accomplished by feedback loops within the Varian computer when commanded. Two models are available for balancing the receiver: manual and automatic. Manual Balancing (MANUALBAL) is the default mode of the control program. Balancing in this mode is accomplished by invoking the web, BALANCE, in a procedure, blank card, or from the CRT keyboard. Automatic balancing is accomplished by inserting a blank card, AUTOBAL, in the card setup deck. The power counters are checked in the first dump of an integration of each scan to make the decision to balance or not. If balance is necessary, the appropriate commands are sent, balance initiated, and the scan continues as normal when completed. Balancing requires 20 seconds to complete.

A preliminary description of the Model IV autocorrelator is available at this time and will be completely described in an Electronics Division report later.

E. Universal Local Oscillator

A schematic diagram of the universal local oscillator (ULO) is shown in Figure 11. The synthesizer is either locked to a single frequency or switched between f_0, f_1, f_0, f_2, etc. in synchronization with the signal-reference cycle of the autocorrelator.

The control system can set the three synthesizer frequencies and read the frequency counter. The counter is used to check the output of the synthesizer. The system warns of any difference between the commanded and read counter

frequencies greater than 300 Hz. The control system cannot select, but does check, the frequency-modulate switch and the computer/manual switch. These must be set by the operator prior to observing. The Control System can control one or two ULO's.

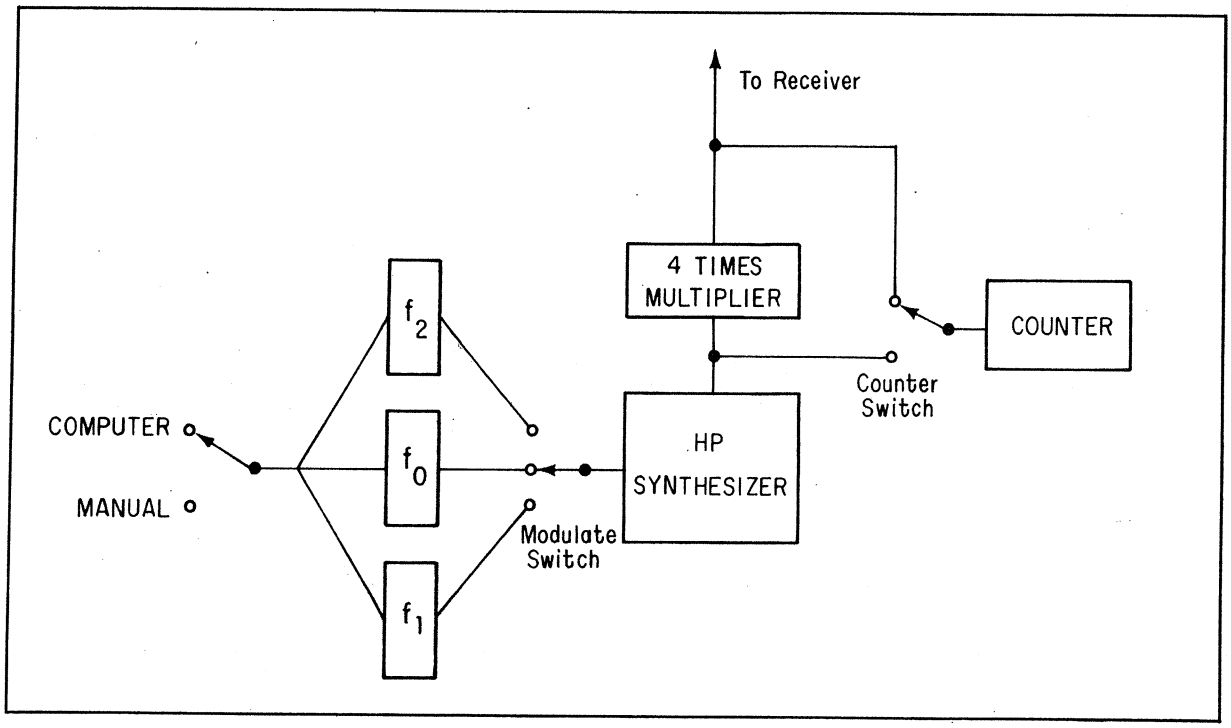

Figure 11. - Universal Local Oscillator Schematic

F. VLBI Local Oscillator

The phase stability of the HP synthesizer is inadequate for VLBI work. Instead, VLBI observers use the "Mauzy Box", which is set manually and produces a phase-stable frequency every 10 MHz between 1 and 3 GHz from a combgenerator. If the 10 MHz comb does not provide the desired local oscillator frequency, the HP synthesizer may be used as an interpolation oscillator with the Mauzy Box. The preferred technique, however, is to use the HP synthesizer as a second LO at low frequencies (100-500 MHz) as part of the VLBI IF system.

G. Analog to Digital Converter

The Analog-to-digital converter (A/D) has 64 channels. It is fed by a multiplexer with 8 conditioning cards. The conditioning cards have a time constant of 0.1 second, but other time constants are available upon request. There is no standard cabling of the multiplexer to the A/D. The observer must inform the system of the starting A/D channel and the number of channels used.

IV. Observing Programs

A. Spectral Line Observing Program

The spectral line observing program takes data records from the Model IV autocorrelation receiver. Each record contains 1024 channels of signals and reference fourier transformed data plus header data that describes the equipment status and switch settings. The computer accumulates the spectral values for one integration period (TINTG). This sum is then written to a disk file. An identical record is sent to the Analysis computer. A logical grouping of records that forms a complete observation is assigned a five digit identification number. This group of records is called a "scan" and the identification number is called a "scan number". The disk file fills up in about sixteen normal observing hours, and must then be copied to tape. Observing may continue during the disk-to-tape transfer. The computer also generates a log; a sample copy is given in Appendix K.

The spectral line program controls the ULO synthesizer setting. The observer can elect to specify the sky frequency in velocity, frequency, or synthesizer units. Sky frequencies in velocity or frequency units are with respect to the telescope, Earth, Sun or LSR. The synthesizer setting is either updated once prior to the scan, or before each integration period.

The sky frequency is calculated from a formula, called "center frequency formula". It has the form:

$$CF = XXXXXX \pm L1 * SM * BM \pm LA.$$

The variables L1, SM, BM, and LA refer respectively to the synthesizer frequency, the synthesizer multiplier, the receiver box multiplier, and the IF processor frequency for the receiver. The XXXXXX variable is a fixed frequency oscillator associated with upconverter receivers and K-band maser. These values are coded on the 'R' card.

Three types of line observing are supported. Switched power or S-Power is our generic term for frequency switched observations. In S-Power the signal and reference spectra have different center frequencies. The

ULO must be physically set in the switching (MOD) configuration, otherwise an error message appears and the observing is stopped. The signal and reference spectra are written separately on the disk file.

Total power or T-Power is our generic term for observation in which an off-source spectrum is subtracted from the on-source spectrum. The on-source and off-source data are taken as separate scans. The ULO is locked on a frequency so that both the signal and reference spectral bands have the same center frequency. If the ULO is on MOD, the Control System gives an error message and stops observing. The signal and reference values are summed, and only these summed values are written on the disk.

Position switched observing uses S-Power to switch the Cassegrain subreflector so that signal and reference spectra are taken on and off source respectively. Both spectra have the same center frequency.

Following is a list of line observing options showing how they are entered into the computer:

TABLE

LINE OBSERVING OPTIONS

Option	Choices	Entered By		
		Card	Terminal	
1) LO				
a) ULO Switch	Computer Control Manual Control Offline	'L' card	LOMODE	= 1 = 2 = 3
b) Rest Frame	None (Telescope) Local Standard of Rest (LSR) Sun Earth	'L' card	VREF	= 1 = 2 = 3 = 4
c) Velocity Definition	Radio $\frac{\nu-\nu_o}{\nu_o} c$ Optical $\frac{\nu-\nu_o}{\nu} c$	'L' card	VDEF	= 1 = 2
d) Set Sky Frequency	Velocity Frequency Synthesizer	'S'	VFS	= 1 = 2 = 3
e) Set Center Frequency	Beginning of each integration period Beginning of scan only	N.A.	LOTRACK	= 1 = 2
f) Center Value	Value of either velocity, frequency, or synthesizer (controlled by set sky frequency)	'S'	CV	= ####
g) Signal Frequency Offset	Offset value added to center frequency to get center of the signal bandpass	'L'	SFO	= #### MHz
h) Reference Frequency Offset	Offset value added to center frequency to get center of the reference bandpass	'L'	RFO1 RFO2	= #### MHz = #### MHz
i) IF Frequency	IF frequency value. Used to calculate center frequency.	'R'	N.A.	

-Continued-