VLA TECHNICAL REPORT #4

MODULES T4A and T4B

LO OFFSET

A. R. Thompson

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FIGURES

I (a). L.O. OFFSET MODULE (T4A & T4B), DRAWINGS AND PARTS LISTS

Schematic Diagram

L.O. Offset Schematic	C13450S2

Parts List

L.O. Offset Module	A13450Z4

Module, Mechanical

Front Panel	B13450M21 (Parts 1&2)
Rear Panel	B13450M20
Top and Bottom Support Bar	B13050M3
Left Side Plate	C13450M22
Perforated Cover	C13050M7
Fastener for Perforated Cover	C13050M17
Guide	B13050M4
Mixer Mounting Blocks	A13050M33
Assembly Drawing for L.O. Offset Module	D13450P5

I (b). RELATED PUBLICATIONS AND MEMORANDA

VLA Electronics Memo #116

Some Tolerances Relating to Spurious Responses

A. R. Thompson August 29, 1973

Addendum to VLA Electronics Memo #116

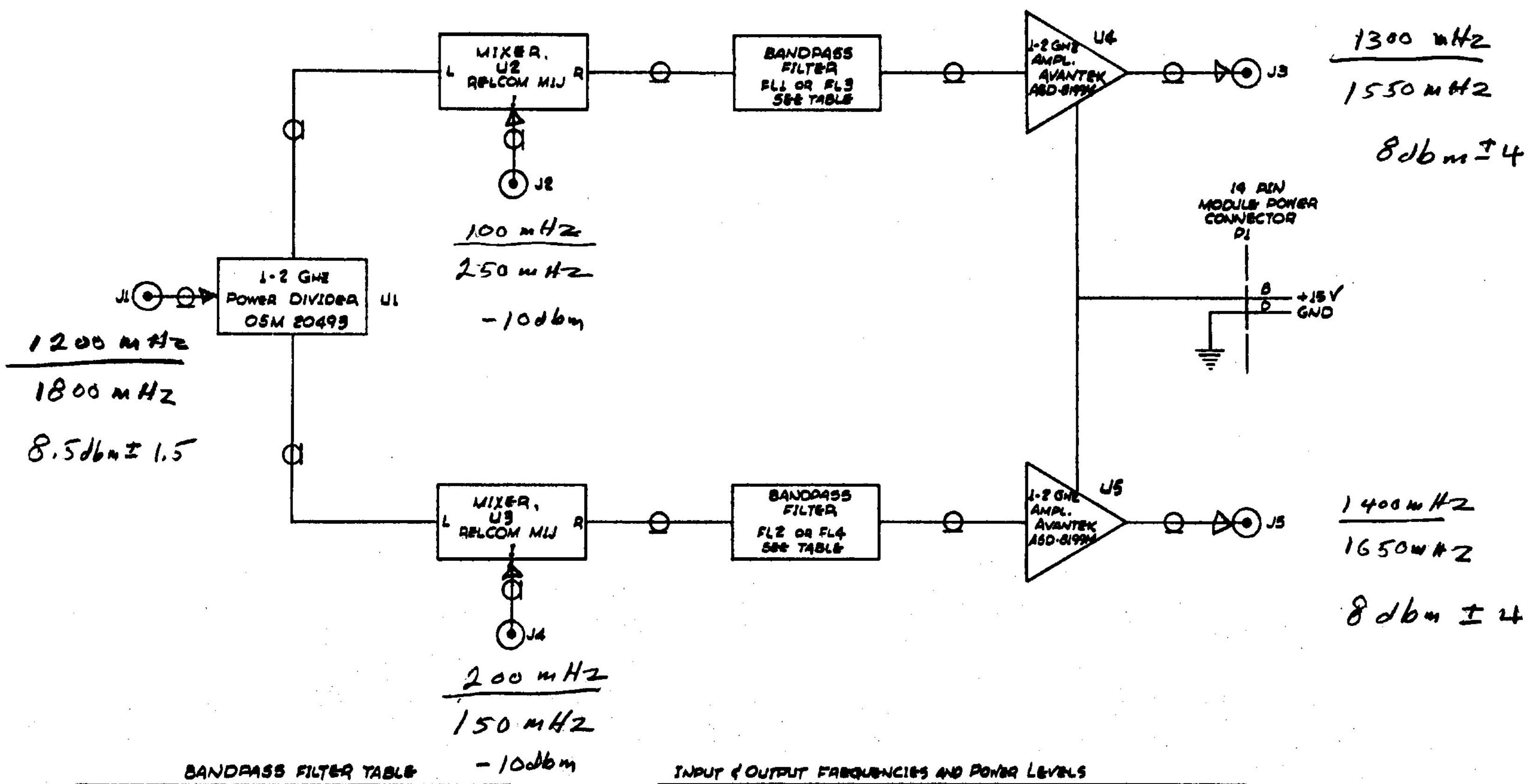
A. R. Thompson September 6, 1973

II. Operation and Circuit Description

The LO Offset module provides the oscillator signals for converting the IF signals from the modem down to base-band. This conversion is performed in the IF Receiver modules. The IF bands are 1300-1350, 1400-1450, 1550-1600, and 1650-1700 MHz, and when using the full bandwidths of the IF Receiver modules the required LO frequencies are 1300, 1400, 1550, and 1650 MHz. When using the narrower IF Receiver bandwidths it is necessary to be able to select the signal from any part of the 50 MHz wide band, and this requires that the four LO frequencies also be variable over ±25 MHz.

In transmission along the waveguide the 1300-1350 and 1400-1450 MHz signals effectively become sidebands to a 1200 MHz subcarrier, and hence share with that signal some of the instrumental phase shifts that may occur in the transmission. To remove these unwanted phase shifts the received 1200 MHz signal is subtracted from the two IF bands by deriving the local oscillator for the IF Receivers from the same 1200 MHz. This is done in an LO Offset module, the circuit of which is shown in Figure 1. The 1200 MHz input at J1 is divided in a power splitter and fed into two mixers. The mixers also receive signals at 100 ±25 MHz from J2 and 200 ±25 MHz from J4. The sum frequencies are selected by appropriate filters F1 and F2 and the outputs at 1300 ±25 MHz and 1200 ±25 MHz are amplified and appear at J3 and J5. These outputs go to the LO inputs of two IF Receiver modules. The amplifiers, Avantek ASD 8199M, were supplied in accordance with specification no. A13450N1 and contain one each UT02011, UT02002 and UT02003 module (see Section V.)

In an exactly similar way, the IF bands at 1550-1600 and 1650-1700 MHz act as sidebands on an 1800 MHz subcarrier in the waveguide transmission. The LO signals for these channels are derived by subtracting 250 ±25 MHz and 150 ±25 MHz from 1800 MHz in another LO Offset module. The LO Offset module



BANDPASS FILTER TABLE

T4A MODULE (1.2 GHz INPUT)		T4B MODULE (1.8 GHz INPUT)	
FILTER	DESCRIPTION	FILTER	DESCRIPTION
FL1	G8120-1300/100-0 KEL	FL3	G8120-1550/100-0 KEL
FL2	G8120-1400/100-0 KEL	FL4	G8120-1650/100-0 KEL

INPUT & OUTPUT FREQUENCIES AND POWER LEVELS

TERM.	T4A MODULE	T4B MODULE	COMMON POWER LEVELS
J1	1200 MHz	1800 MHz	8.5 ± 1.5 dbm
J2	100 ± 25 MHz	250 ± 25 MHz	-10 dbm
J3	1300 ± 25 MHz	1550 ± 25 MHz	8 ± 4 dbm
J4	200 ± 25 MHz	150 ± 25 MHz	-10 dbm
J5	1400 ± 25 MHz	1650 ± 25 MHz	8±4 dbm

REV	DATE	DRAWN BY	APPR'VD BY	DESCRIPTION
A	11/14/76	J. GRAY	CKP	"J4" WAS -10 dbm "J5" WAS 8±4 dbm

VLA
SUBJECT: L.O. OFFSET T4A & T4B

TITLE: SCHEMATIC DIAGRAM

NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA. 22904

DRAWN BY: J. GRAY — DATE: 9-3-76
DESIGNED BY: A.R. THOMPSON — DATE: 8-25-76
APPROVED BY: — DATE:

SHEET NUMBER 1 OF 1 — DRAWING NUMBER C13460S2 — REV A — SCALE

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which produces the two lower LO signals is designated T4A and the one which produces the two higher frequency signals T4B. The T4A and T4B modules differ only in the center frequencies of the filters F1 and F2 as shown in Figure 1.

In the central control building the equipment that receives the signals from each antenna is called the IF Receiver sybsystem. It contains one T4A and one T4B module which together produce the LO signals for 4 IF Receiver modules. The T4A and T4B modules are located in slots 1 and 2 respectively of bin S, rack N.

The LO Offset module is so simple that test procedures are rather obvious. A signal at 1200 or 1800 MHz is injected at J1 and a signal variable over the appropriate frequency range at J2 or J4. The output at J3 or J5 is best displayed on a spectrum analyzer, so that as well as checking that the wanted frequencies are present at the correct level, the presence of any unwanted signals can also be detected. For a correctly operating module, avoidance of unwanted responses is the main constraint on the input power levels, as discussed in the following section.

Power requirements for each T4A and T4B module are 140 ma at +15V.

III. Spurious Responses

Let f_1 indicate the frequency 1200 or 1800 MHz entering J1 and f_2 denote the frequency entering J3 or J4. The spurious responses with which we are concerned are of two kinds. The first occurs when $2f_1 - mf_2$ falls within the passband of the appropriate filter F1 or F2. The second occurs when nf_2 falls within the filter passband. Here m and n are integers, and both responses depend upon the production of harmonics of f_2 within the mixer. The strengths of these harmonics fall off as the harmonic number m or n increases, and thus the most serious unwanted signals are expected when m or n have the lowest value. Note that the two kinds of responses can be identified on the spectrum analyzer