

VLA Test Memoranda
No. 150

GLONASS Observations
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TO: Distribution
FROM: J. C. Carter
SUBJECT: More GLONASS Observations

On July 1 and 2, 1986, Haystack again observed the Soviet GLONASS satellites for transmissions which could cause interference in the 1610.6-1613.8 MHz radio astronomy band. Similar measurements, made on Dec. 4, 1984, found eight active satellites out of the fifteen observed. The new observations found only four of these to now be active. However, six more GLONASS satellites are now in orbit, of which three were found to be active.

A combination of Haystack's satellite radar and radio astronomy capabilities were used. The antenna was pointed by the Long Range Imaging Radar computer, according to initial state vectors from the Millstone Hill satellite catalog, and the radio astronomy L-band cooled FET receiver was used to receive the satellite signals. A Hewlett-Packard 8566A spectrum analyzer was used to process the signals and produce the photographs in this report. For some satellites, computer generated spectral plots were produced by using the radio astronomy spectral line processing computer to read the spectrum analyzer output.

In Table 1, which is a summary of the observations, each satellite is identified by its COSMOS number. The frequency shown is the observed frequency and is not corrected for doppler shift. Signal amplitude is the strength of the signal, at its center frequency, compared with the measured strength (antenna temp. = 81 K) of the radio source CASS A. For example, COSMOS 1711 transmitted at 1612.5 MHz and produced a signal 37 db stronger than did CASS A.

For each transmitting satellite, two spectra are shown in Fig. 1 through Fig. 7. The top spectrum, labeled "A", is a double exposure which shows the received signal when the antenna was pointed at the satellite (upper trace) and what was received when the antenna was pointed five degrees off of the satellite (lower trace). The off-source trace best shows the 70 MHz wide receiver bandpass, which is determined by an image rejection filter located between the r.f. amplifier and the first mixer. Note that most of these off-source spectra still show some of the satellite's signal as well other weak lines. Occasionally, other nearby GLONASS satellites are seen. Some of the lines between 1566 MHz and 1600 MHz are the second harmonics of the video and sound carriers of television Ch. 66 and Ch. 68 in Boston, MA.

The lower spectrum, labeled "B", is a higher resolution look at the received signal. It spans 100 MHz with a 100 KHz resolution. Each satellite signal has a narrow center feature less than 1 MHz wide. (The marker dot marks the peak of this feature). About 10 db below the center feature is a much broader almost 10 MHz wide at its 10 db points.

For several of the satellites, the spectrum shown in the "B" photograph was transferred from the spectrum analyzer to the radio astronomy computer and then printed. Each printed spectrum is labeled "C" and displays a frequency span of 80 MHz instead of the 100 MHz span of the "B" photograph.

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TABLE NO: 1

SUMMARY OF JULY, 1986 GLONASS SATELLITE OBSERVATIONS						
COSMOS NUMBER	FREQUENCY (MHz)	AMPLITUDE (db. Above CASS A)	OBSERVATION TIME AND POSITION			
			DATE	TIME (UT)	AZIMUTH	ELEVATION
1490	1603.3	32	7/1/86	1711	354	4
1520	1615.3	33	7/1/86	1340	41	25
1593	1607.4	38	7/1/86	1605	331	10
1595	1611.4	29	7/1/86	1703	354	38
1650	1605.7	37	7/1/86	1520	307	22
1710	1604.1	37	7/1/86	1444	28	18
1711	1612.5	37	7/2/86	2032	258	7

No signals were observed for the following satellites:

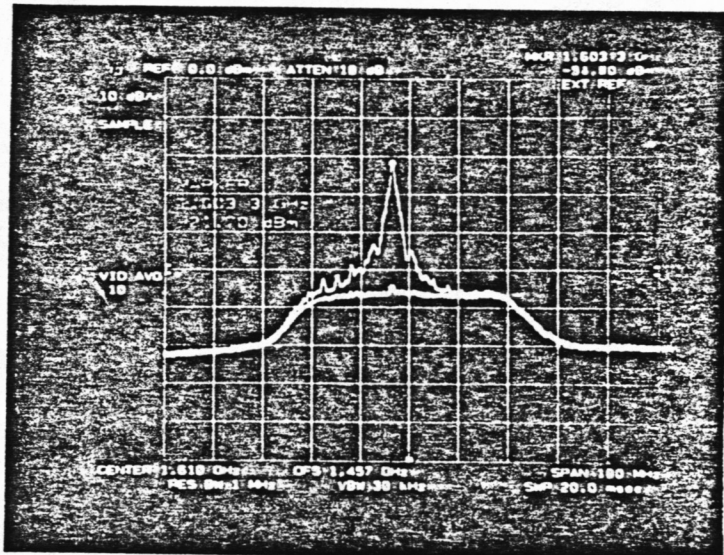
COSMOS 1413, 1414, 1415, 1491, 1492, 1519, 1521, 1554, 1555, 1556
1594, 1595, 1651, 1652, 1712

FIG. 1

COSMOS 1490

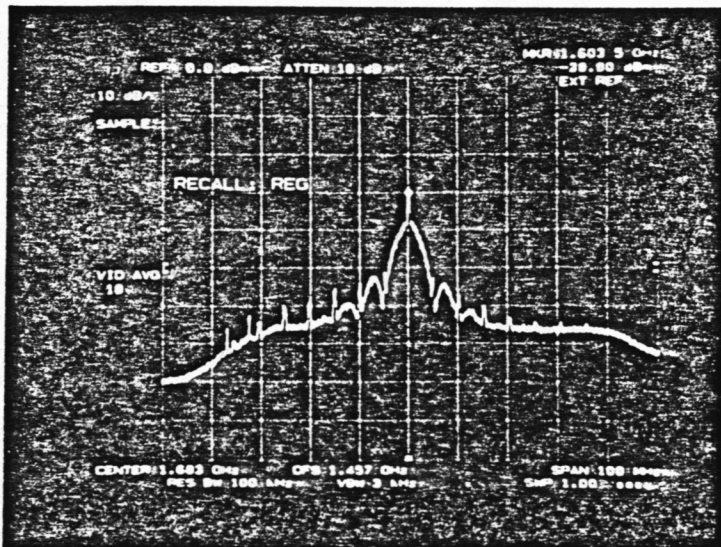
FREQUENCY = 1603.3 MHz.

AMPLITUDE = 32 db. (Above CASS A)



A. Center Freq. = 1610 MHz.
Freq. Span = 180 MHz.

16



B. Center Freq. = 1603 MHz.
Freq. Span = 100 MHz.

17

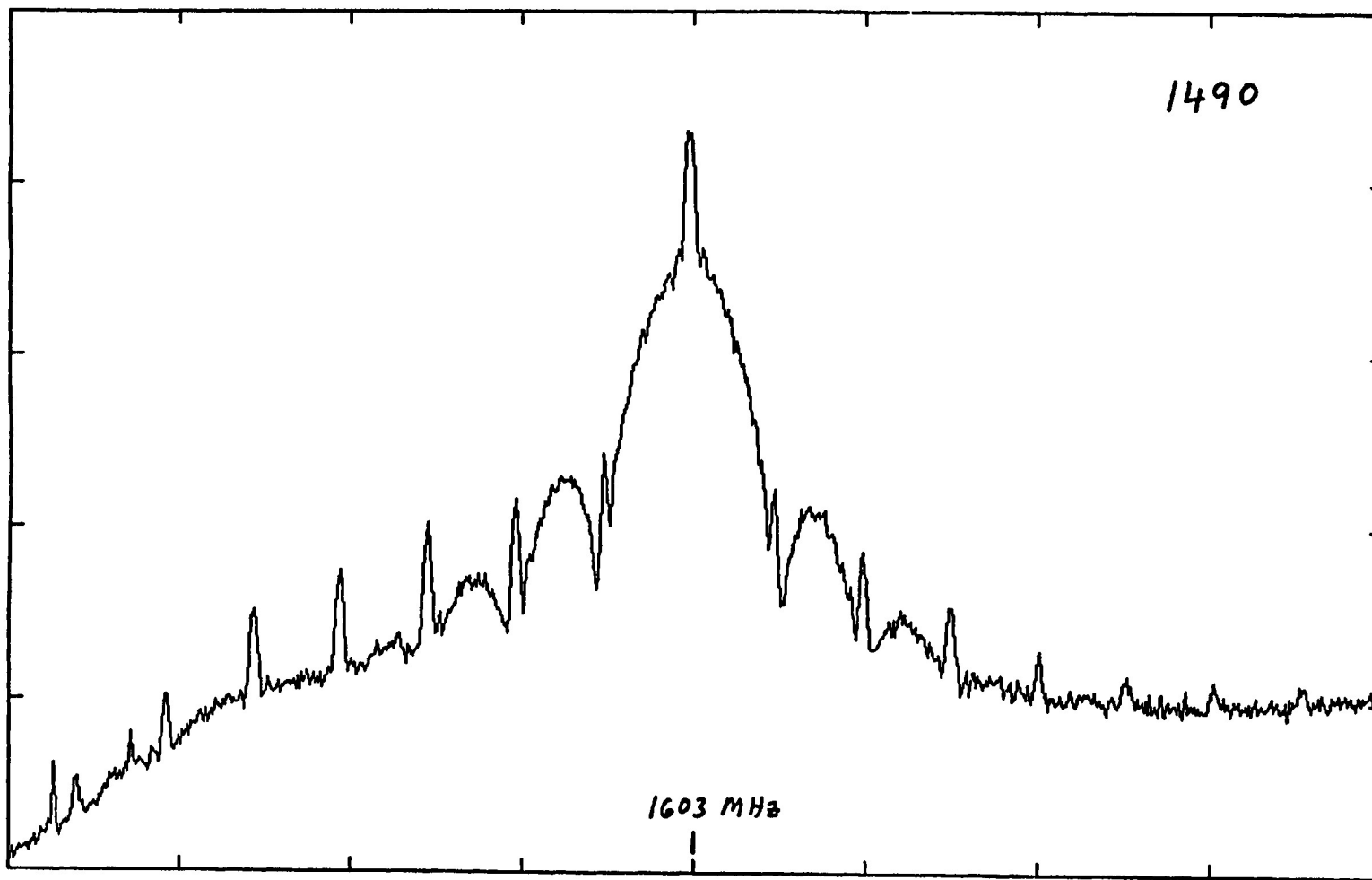


FIG. 1 C

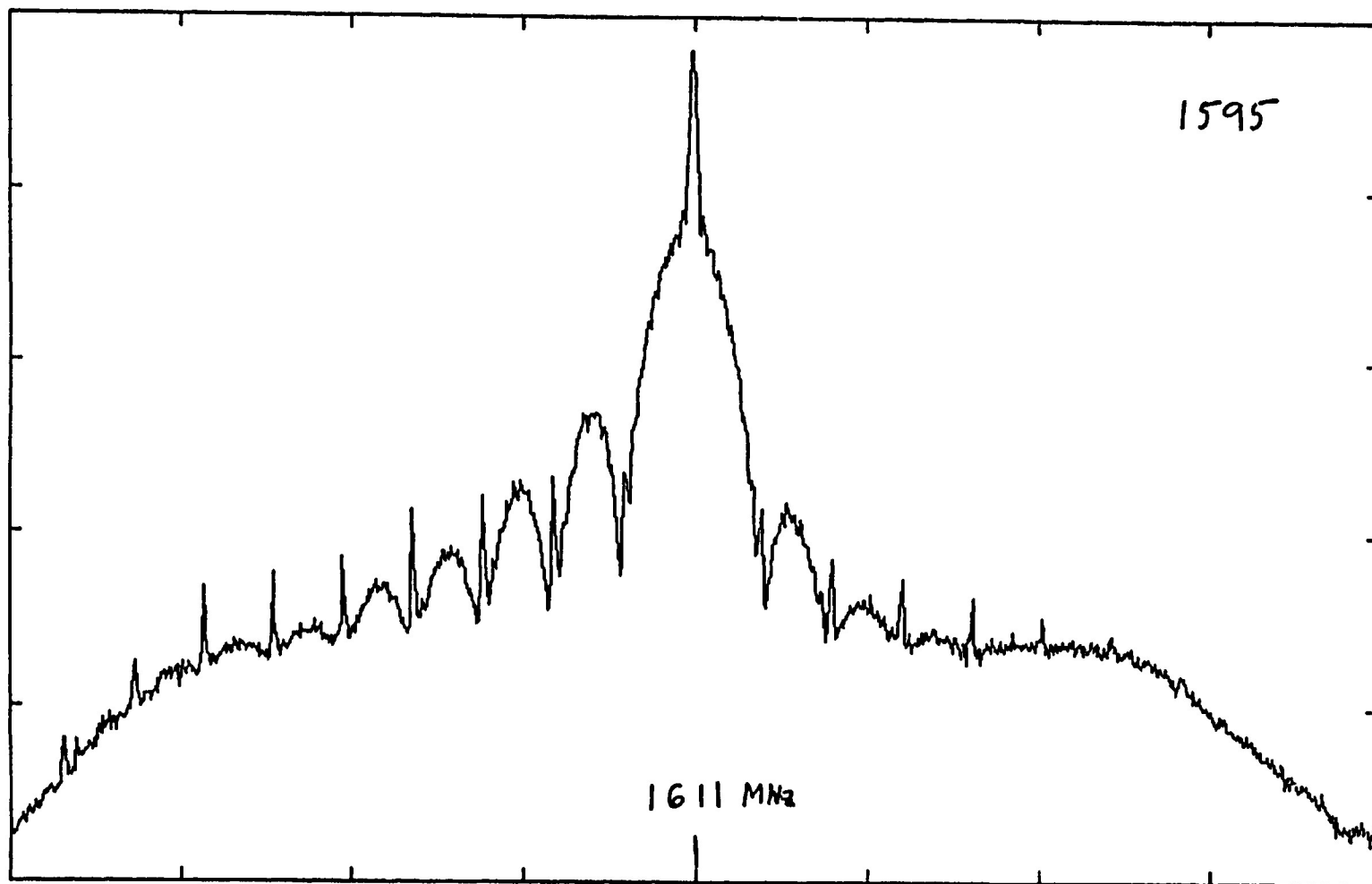
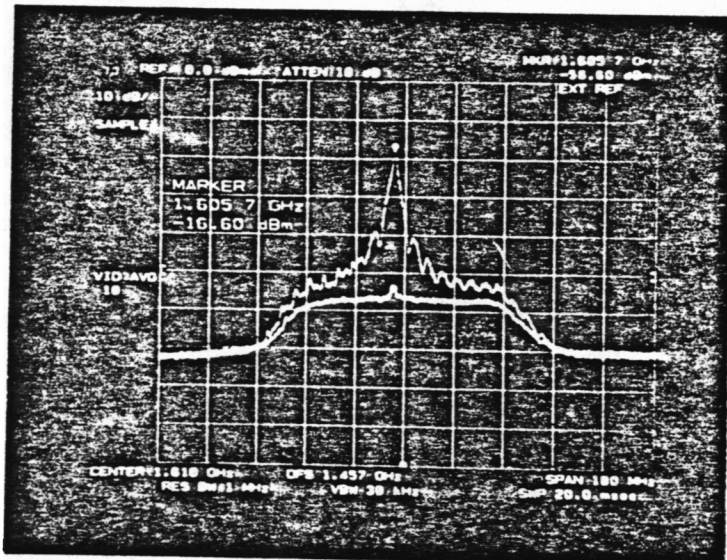


FIG. 4C

FIG. 5

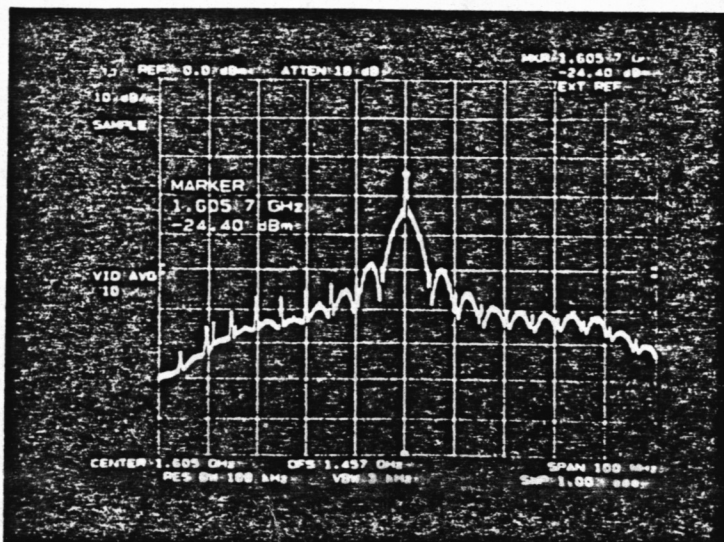
COSMOS 1650

FREQUENCY = 1605.7 MHz.
AMPLITUDE = 37 db. (Above CASS A)



A. Center Freq. = 1610 MHz.
Freq. Span = 180 MHz.

10



B. Center Freq. = 1605 MHz.
Freq. Span = 100 MHz.

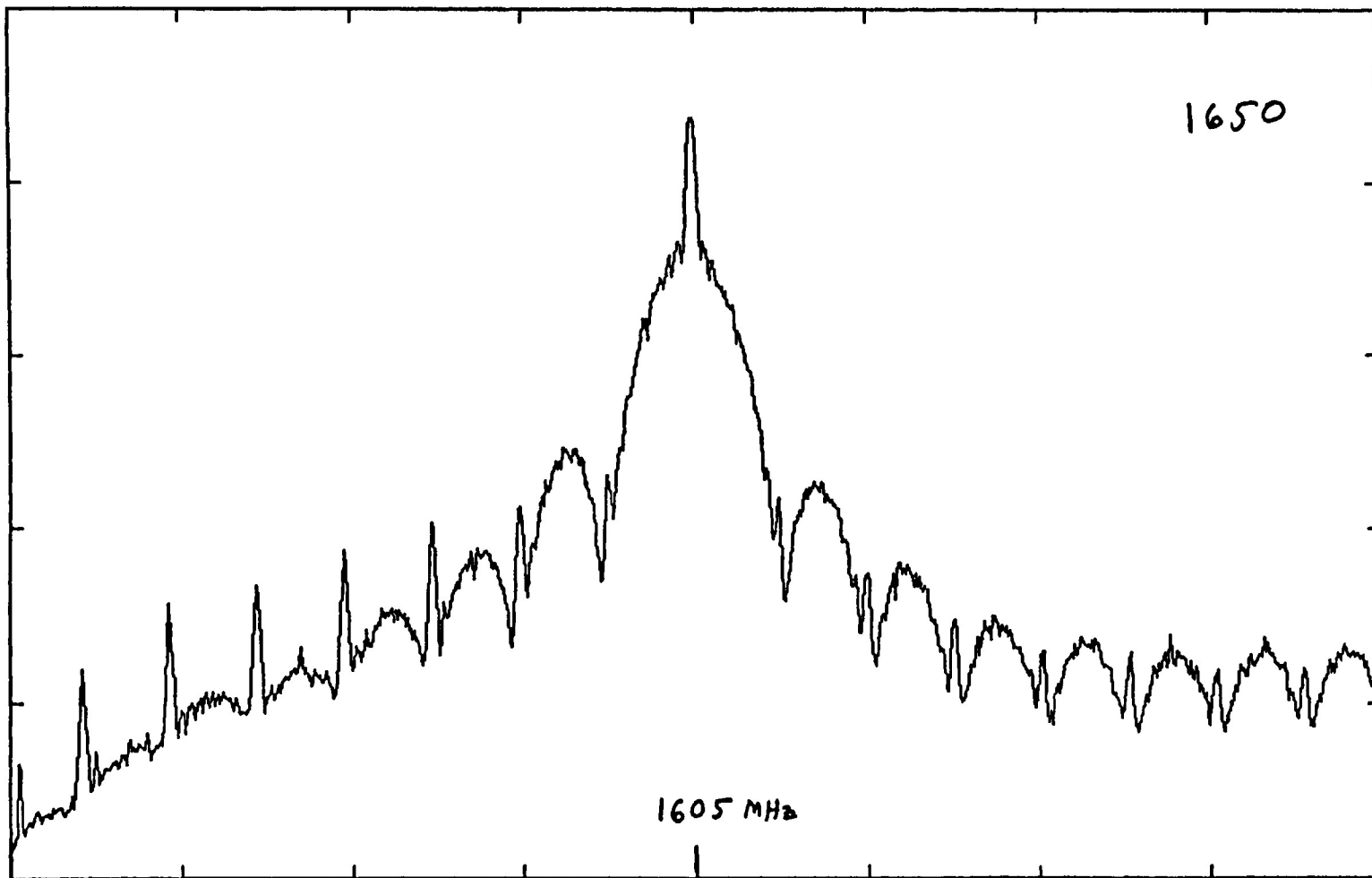


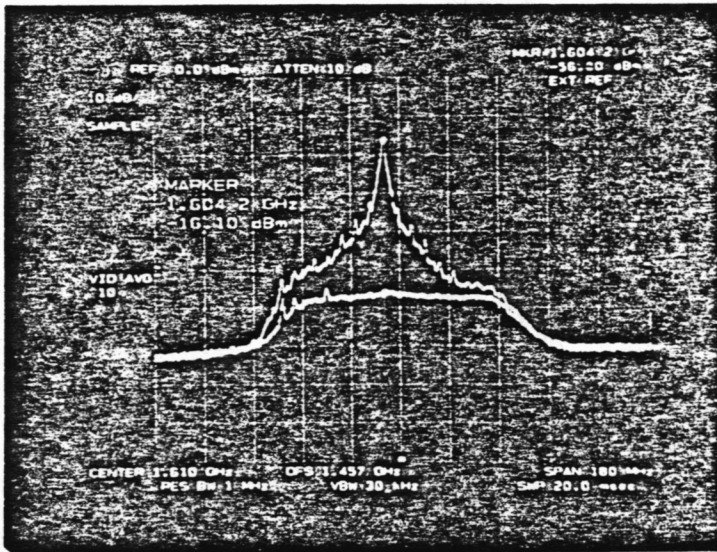
FIG. 5 C

FIG. 6

COSMOS 1710

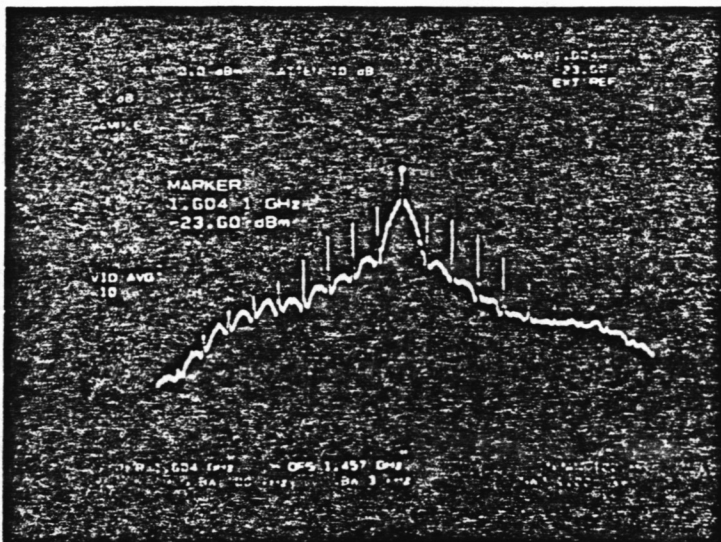
FREQUENCY = 1604.1 MHz.

AMPLITUDE = 37 db. (Above CASS A)



A. Center Freq. = 1610 MHz.
Freq. Span = 180 MHz.

818



B. Center Freq. = 1604 MHz.
Freq. Span = 100 MHz.

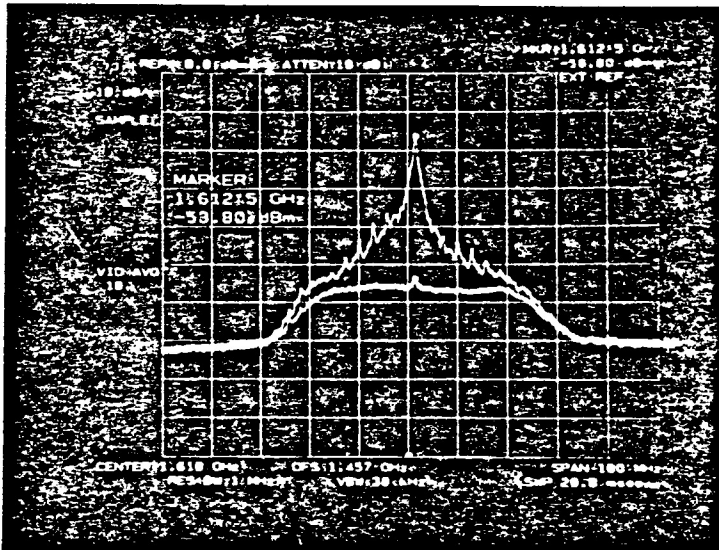
9

FIG. 7

COSMOS 1711

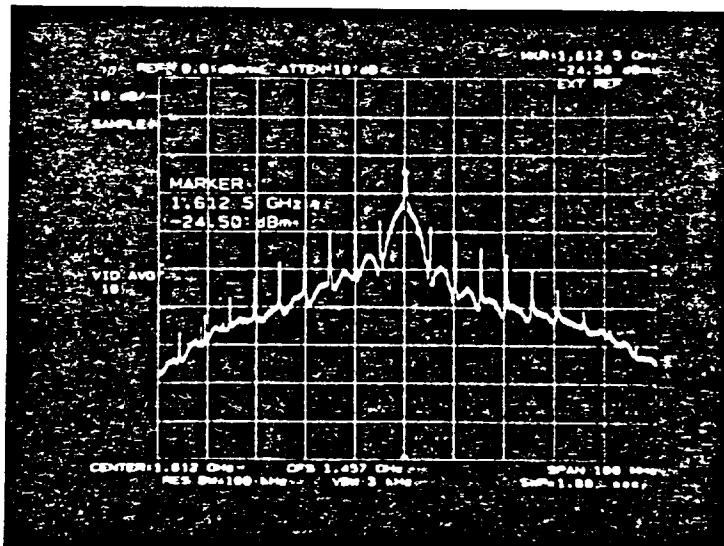
FREQUENCY = 1612.5 MHz.

AMPLITUDE = 37 db. (Above CASS A)



A. Center Freq. = 1610 MHz.
Freq. Span = 180 MHz.

21



B. Center Freq. = 1612 MHz.
Freq. Span = 100 MHz.

22

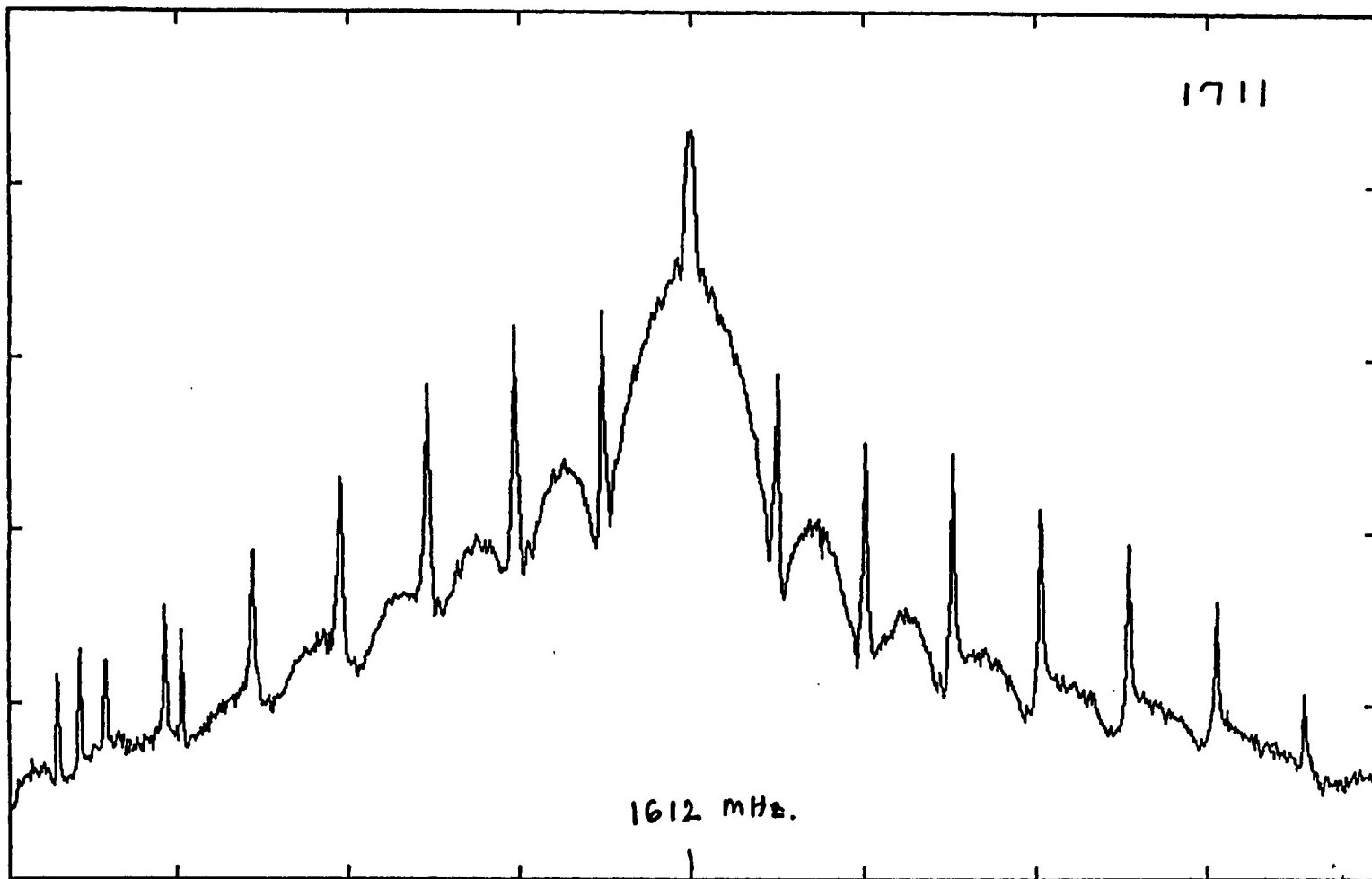


FIG. 7 C