MEMORANDUM November 17, 1987

To: Vanden Bout, Napier, Kellermann
From: George Seielstad

Subject: **Green Bank rfi Environment**

1) Wes Sizemore has surveyed the rfi as requested. Plots are the **worst** cases.

2) All measurements were made during working day. Times are EST.

3) Formulas for converting from dbm (Sizemore's calibration on his spectrum analyzer) to W m^{-2} were provided by Fisher.

4) Bands chosen for direct comparison with NE results.

5) No instrumentation for measurements at frequencies > 1500 MHz. Reason is we have essentially no requests for tracking down interference at those frequencies; it simply isn't noticeable.

6) Note Sizemore's comments about 300-350 MHz. He has established excellent contacts with the military.

NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, WV

MEMORANDUM

November 16, 1987

To: G. Seielstad

From: W. Sizemore

Subj: **0-1500 MHz Green Bank RFI Survey**

Per your request, the frequency bands

50- 100 MHz
73- 75 MHz
300- 350 MHz
500-1000 MHz
550- 650 MHz
and 1000-1500 MHz

were surveyed during the week of 9 November 1987. The monitoring procedure, results, and my comments are attached.

WAS/cjd

Enclosure
RFI Survey

GREEN BANK RFI SURVEY OF 50-100, 73-75, 300-350, 500-1000, 550-650 AND 1000-1500 MHz

November 9-13, 1987

Monitoring Procedure

In order to conduct this survey, the monitoring station at the 40-ft telescope was used The schematic diagram of this station is attached as Figure 1. The spectrum analyzer was calibrated at 280 MHz using its internal calibration signal a -30 dBm. The following information and formulas were used to convert from the calibrated signal strength shown on the spectrum analyzer to flux density at the antenna.

Conversion to Flux Density

$$S_{(W/m^2)} = \frac{P_a \, 4\pi}{G_a \, \lambda_{(m)}^2}$$

where

$$P_a = P_{sa}{}_{(watts)} \left(\text{ALOG} \left[\frac{L_s \text{ (dB)} - G_s \text{ (dB)}}{10} \right] \right)$$

$$P_{sa}{}_{(watts)} = \frac{\text{ALOG} \left(\frac{dBm}{10} \right)}{1000}$$

$$\lambda_{(m)} = \frac{300}{f_{(MHz)}}$$

$$G_a = \text{ALOG} \frac{G_{AD}}{10}$$

where

$S_{(W/m^2)}$ = Flux density (W/m^2)

P_a = Power at antenna terminals.

G_a = Antenna gain.

G_{AD} = Antenna gain in dB.

L_S = Loss ahead of spectrum analyzer in dB.

G_S = Gain ahead of spectrum analyzer in dB.

f = Frequency in MHz.

P_{sa} = Power at spectrum analyzer input.

dBm = Spectrum analyzer reference level.

Results

Plots were taken at azimuths of 0°, 90°, 180°, and 270° for each frequency band. However, I have included only one plot for each frequency band which shows the worst case for that band. These data are presented as Figures 2, 3, and 4.

Comments

50-100 MHz: This band contains TV channels 2 to 6, part of FM band, and other fixed mobile transmitters. However, radio astronomy band (73.0 to 74.6 MHz) is fairly quiet.

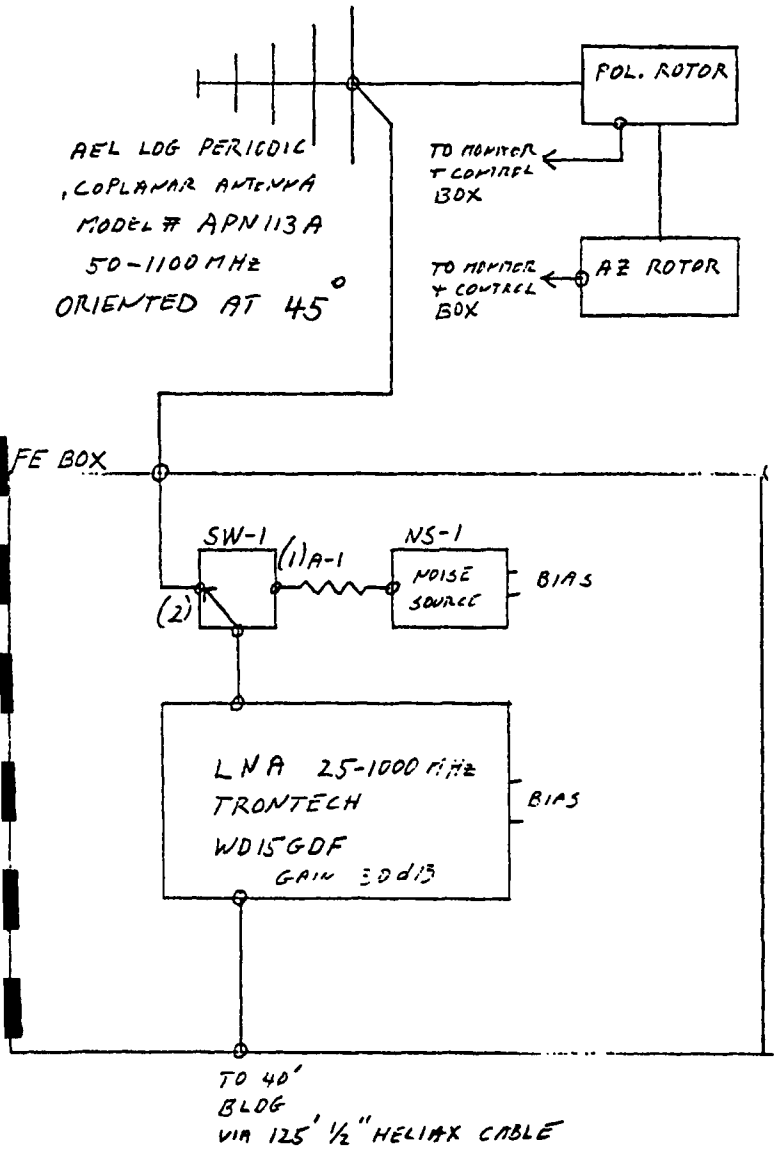
73-75 MHz: The plot of the band contains 3 or 4 "birdies" which may have been due to the close proximity of the monitoring station to the 140-ft and 85-1.

300-350 MHz: The predominant user of this band is military aircraft. I have had **excellent** results in clearing this band for observation by reporting our observing frequencies to the appropriate military command.

500-1000 MHz: The majority of this band is allocated to broadcasting which the quiet zone controls very well thank you.

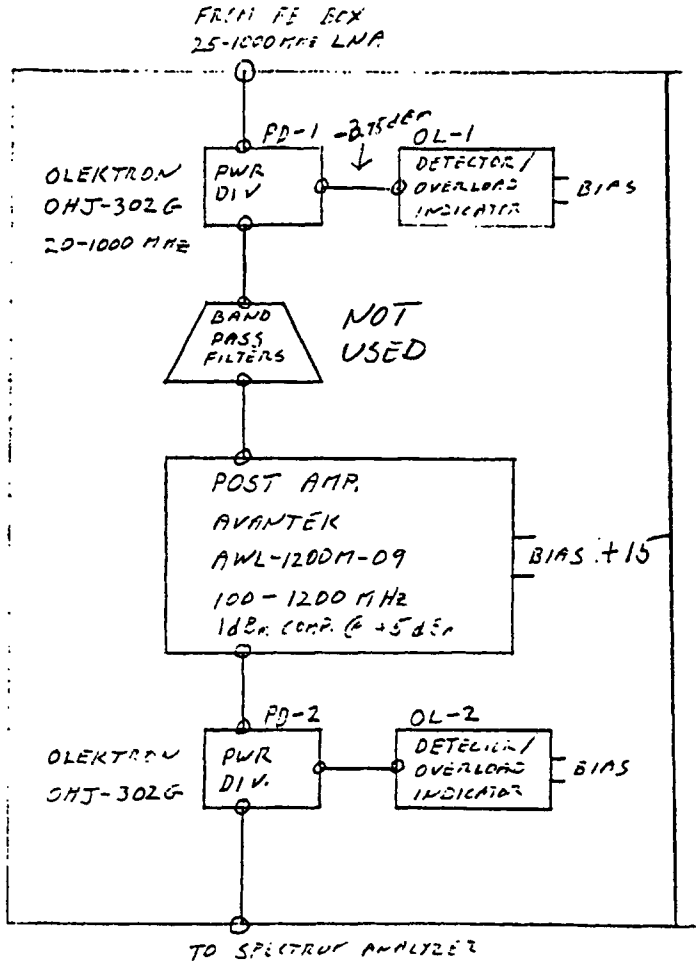
550-650 MHz: Allocated to broadcasting except for radio astronomy band. Again, the quiet zone controls this band very well.

1000-1500 MHz: The signals centered around 1100 MHz are FAA radars.



SW1 = TRANSCO 11300

NS1 = NOISE COM NS 3201-G



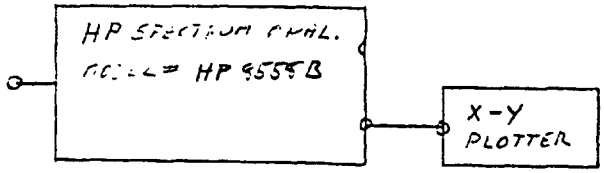
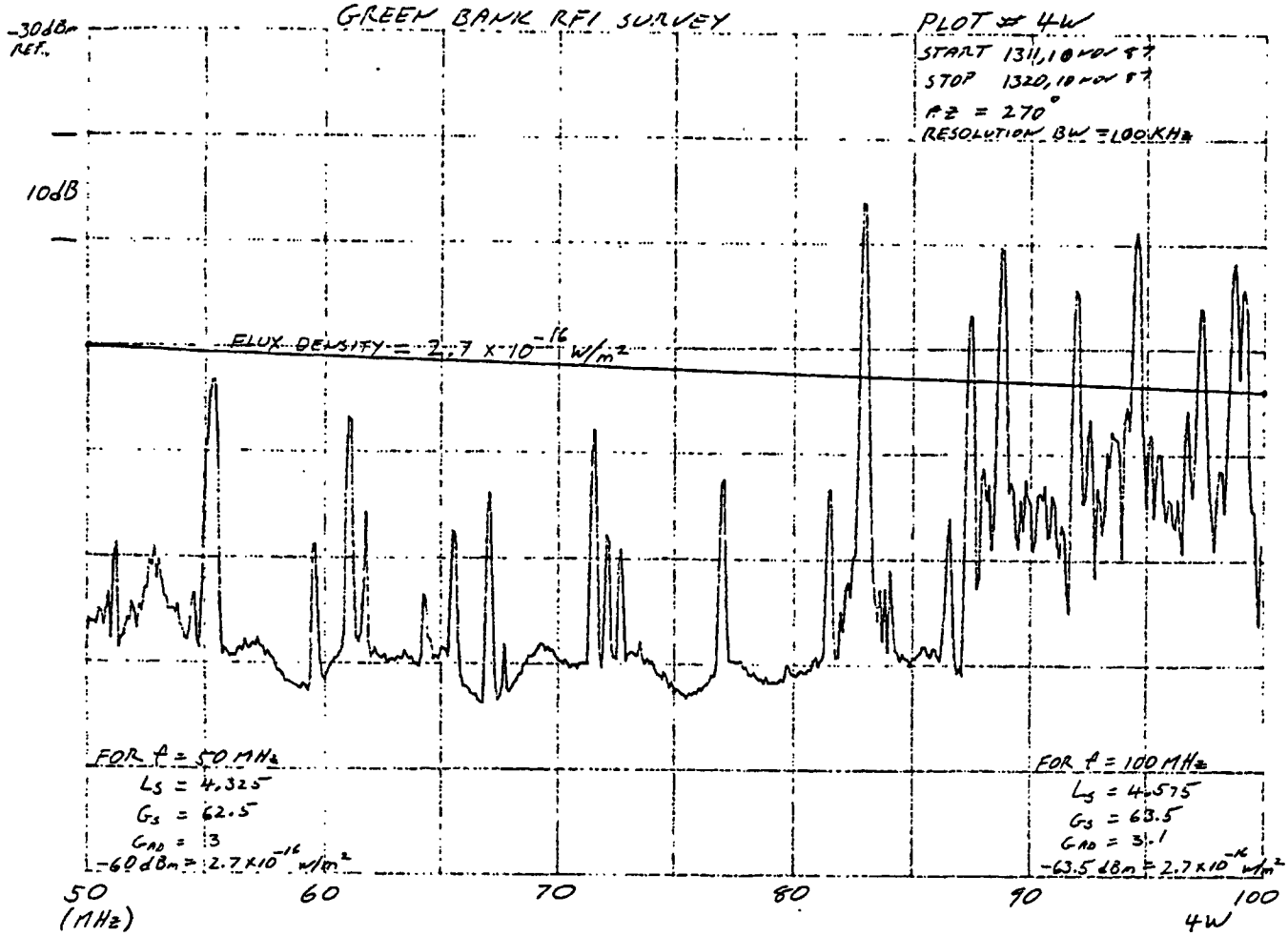


FIGURE 1


GREEN BANK RFI SURVEY
PLOT # 4W
START 1311, 10 NOV 87
STOP 1320, 10 NOV 87
AZ = 270°
RESOLUTION BW = 100 KHz
-30dBm REF.
10dB
FLUX DENSITY = 2.7 x 10⁻¹⁶ W/m²
FOR f = 50 MHz
Ls = 4.325
Gs = 62.5
GAD = 3
-60 dBm = 2.7 x 10⁻¹⁶ W/m²
FOR f = 100 MHz
Ls = 4.575
Gs = 63.5
GAD = 3.1
-63.5 dBm = 2.7 x 10⁻¹⁶ W/m²
50
60
70
80
90
100
(MHz)
4W

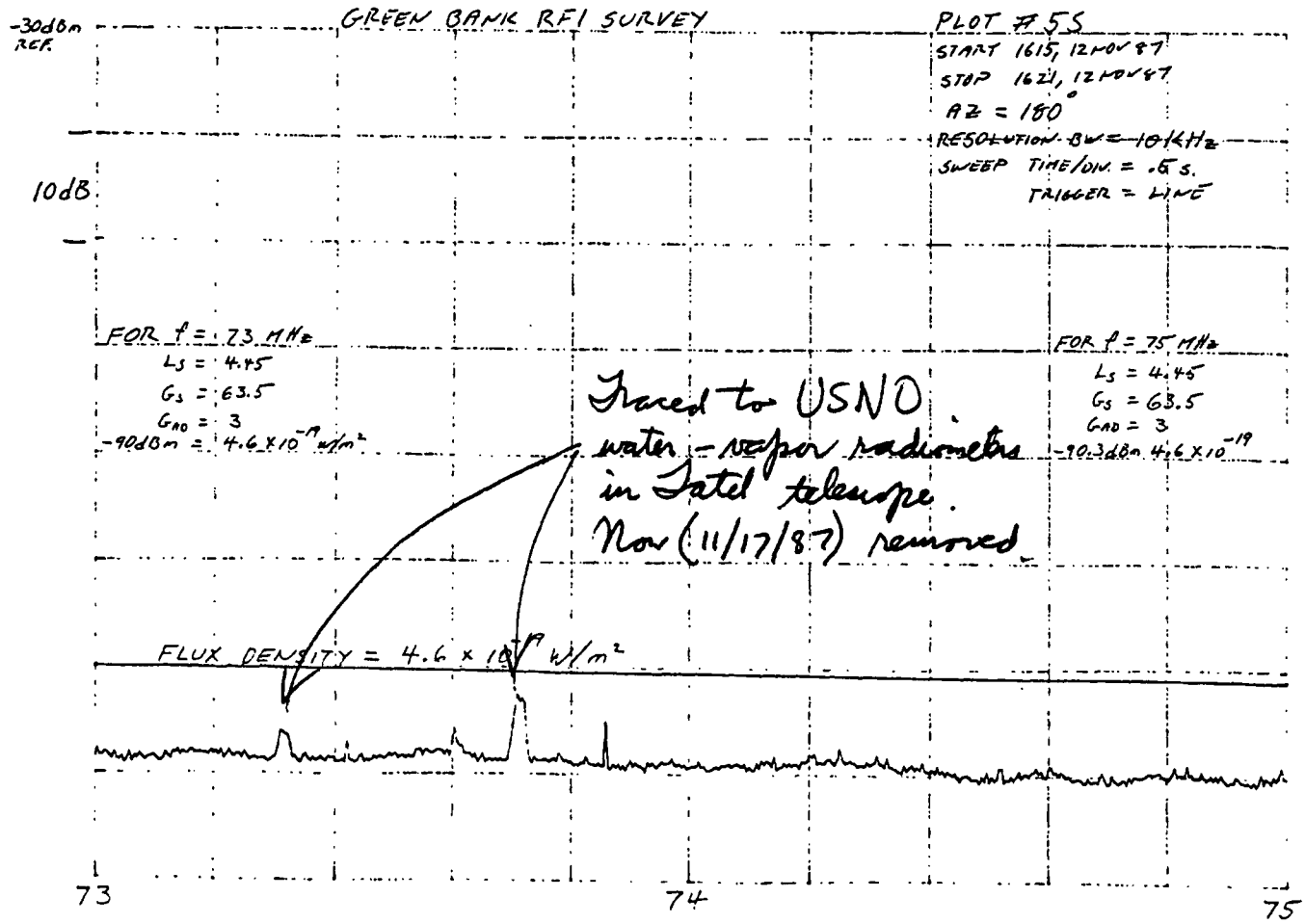
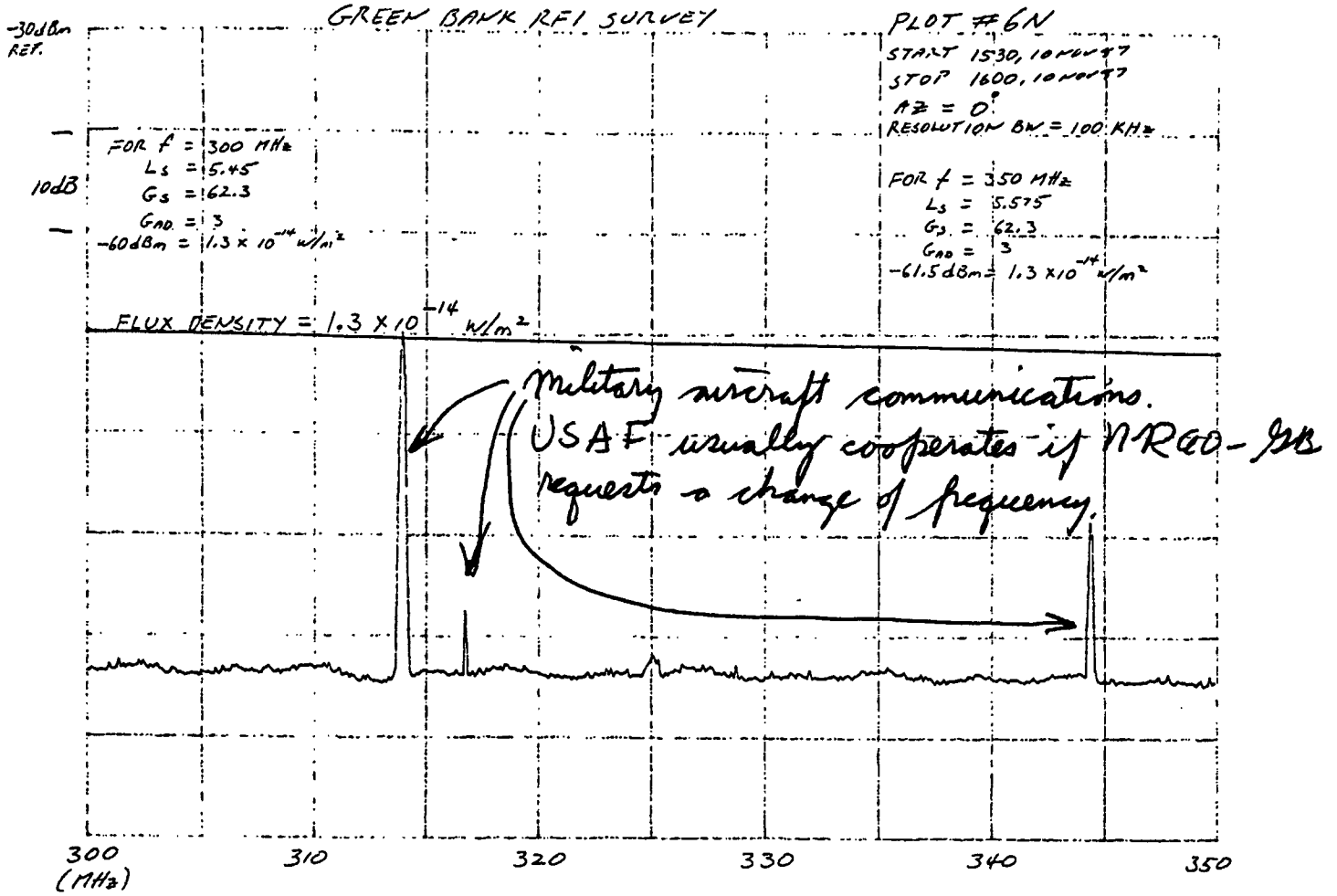

GREEN BANK RFI SURVEY
PLOT # 5S
START 1615, 12 NOV 87
STOP 1621, 12 NOV 87
AZ = 180°
RESOLUTION BW = 10 KHz
SWEEP TIME/DIV. = .6 s.
TRIGGER = LINE
-30dBm REF.
10dB
FOR f = 73 MHz
Ls = 4.45
Gs = 63.5
GAD = 3
-90dBm = 4.6 x 10⁻¹⁹ W/m²
FOR f = 75 MHz
Ls = 4.45
Gs = 63.5
GAD = 3
-90.3dBm 4.6 x 10⁻¹⁹
Traced to USNO water-vapor radiometer in Satel telescope. Now (11/17/87) removed.
FLUX DENSITY = 4.6 x 10⁻¹⁹ W/m²
73
74
75

FIGURE 2


GREEN BANK RFI SURVEY
PLOT #6N
START 1530, 10 NOV 77
STOP 1600, 10 NOV 77
AZ = 0°
RESOLUTION BW = 100 KHz
-30dBm REF.
10dB
FOR f = 300 MHz
Ls = 5.45
Gs = 62.3
GAD = 3
-60dBm = 1.3 x 10^-14 w/m²
FOR f = 350 MHz
Ls = 5.575
Gs = 62.3
GAD = 3
-61.5dBm = 1.3 x 10^-14 w/m²
FLUX DENSITY = 1.3 X 10^-14 w/m²
Military aircraft communications. USAF usually cooperates if NRAO-GBB requests a change of frequency.
300
310
320
330
340
350
(MHz)

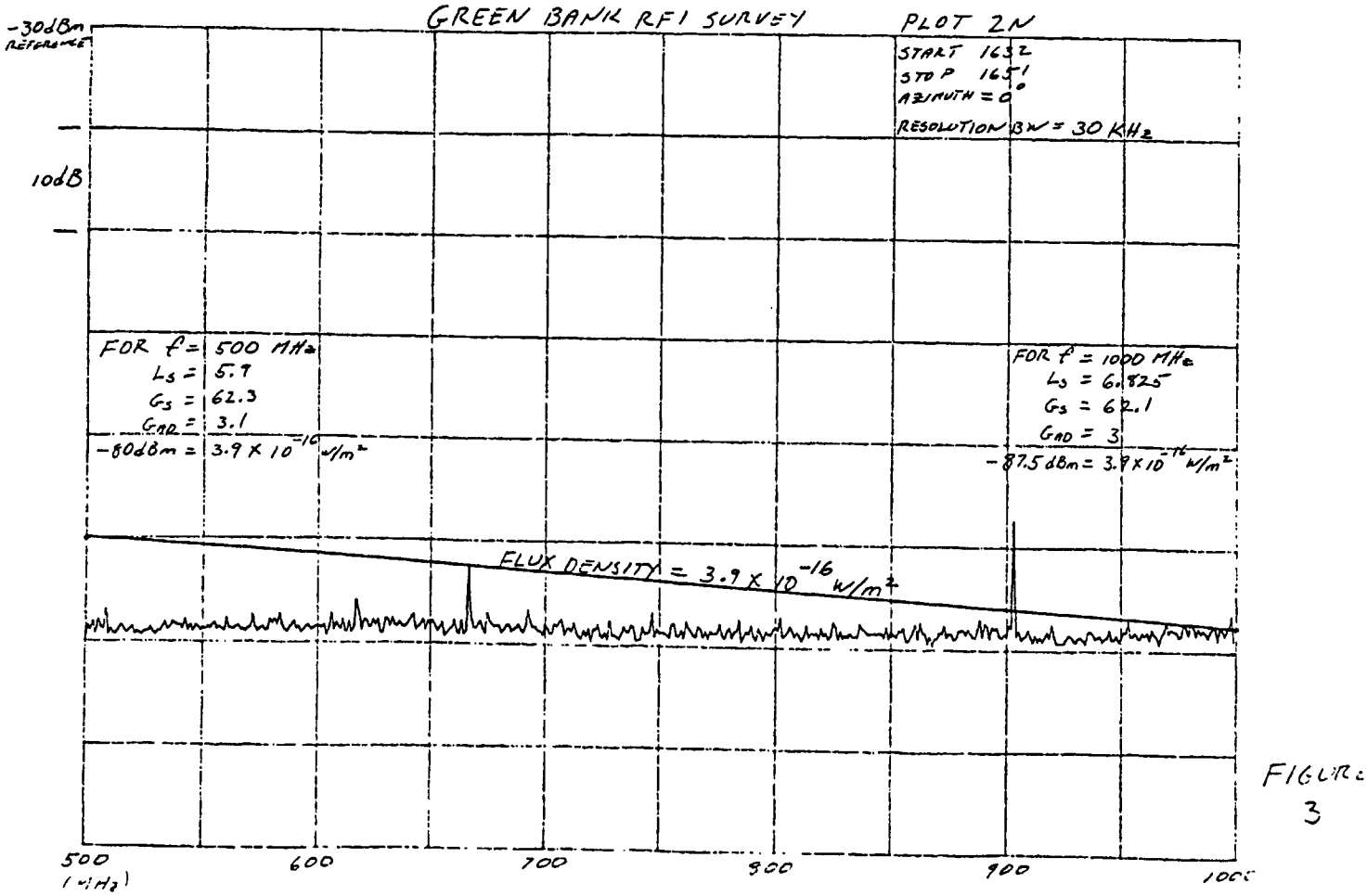
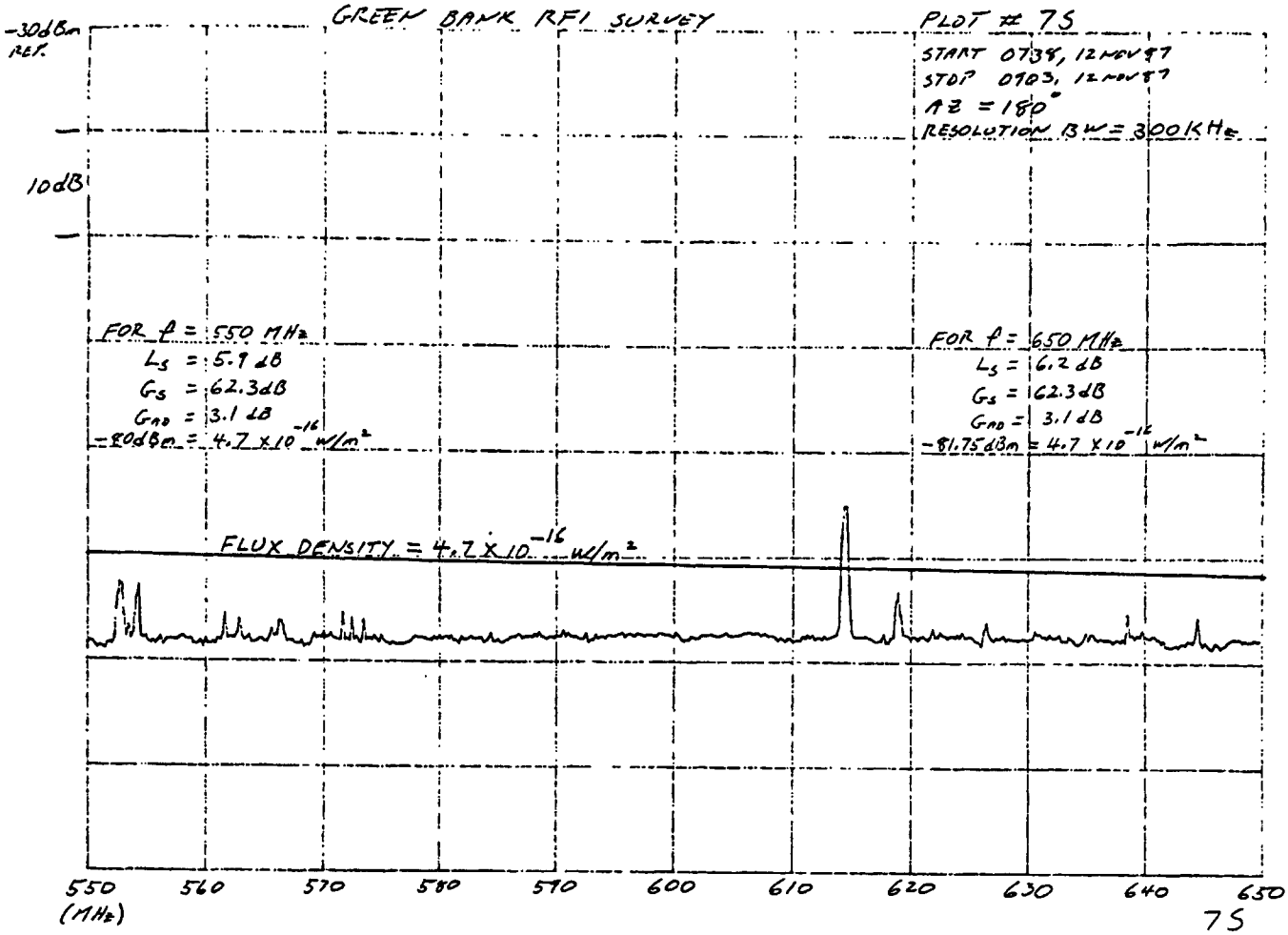

GREEN BANK RFI SURVEY
PLOT 2N
START 1632
STOP 1651
AZIMUTH = 0°
RESOLUTION BW = 30 KHz
-30dBm REFERENCE
10dB
FOR f = 500 MHz
Ls = 5.9
Gs = 62.3
GAD = 3.1
-80dBm = 3.9 X 10^-16 w/m²
FOR f = 1000 MHz
Ls = 6.825
Gs = 62.1
GAD = 3
-87.5 dBm = 3.9 X 10^-16 w/m²
FLUX DENSITY = 3.9 X 10^-16 w/m²
500
600
700
800
900
1000
(MHz)

FIGURE 3


GREEN BANK RFI SURVEY
PLOT # 7S
START 0738, 12 NOV 87
STOP 0903, 12 NOV 87
AZ = 180°
RESOLUTION BW = 300 KHz
-30dBm REF.
10dB
FOR f = 550 MHz
Ls = 5.9 dB
Gs = 62.3dB
GAD = 3.1 dB
-80dBm = 4.7 X 10^-16 w/m²
FOR f = 650 MHz
Ls = 6.2 dB
Gs = 62.3dB
GAD = 3.1 dB
-81.75dBm = 4.7 X 10^-16 w/m²
FLUX DENSITY = 4.7 X 10^-16 w/m²
550 560 570 580 590 600 610 620 630 640 650
(MHz)
7S

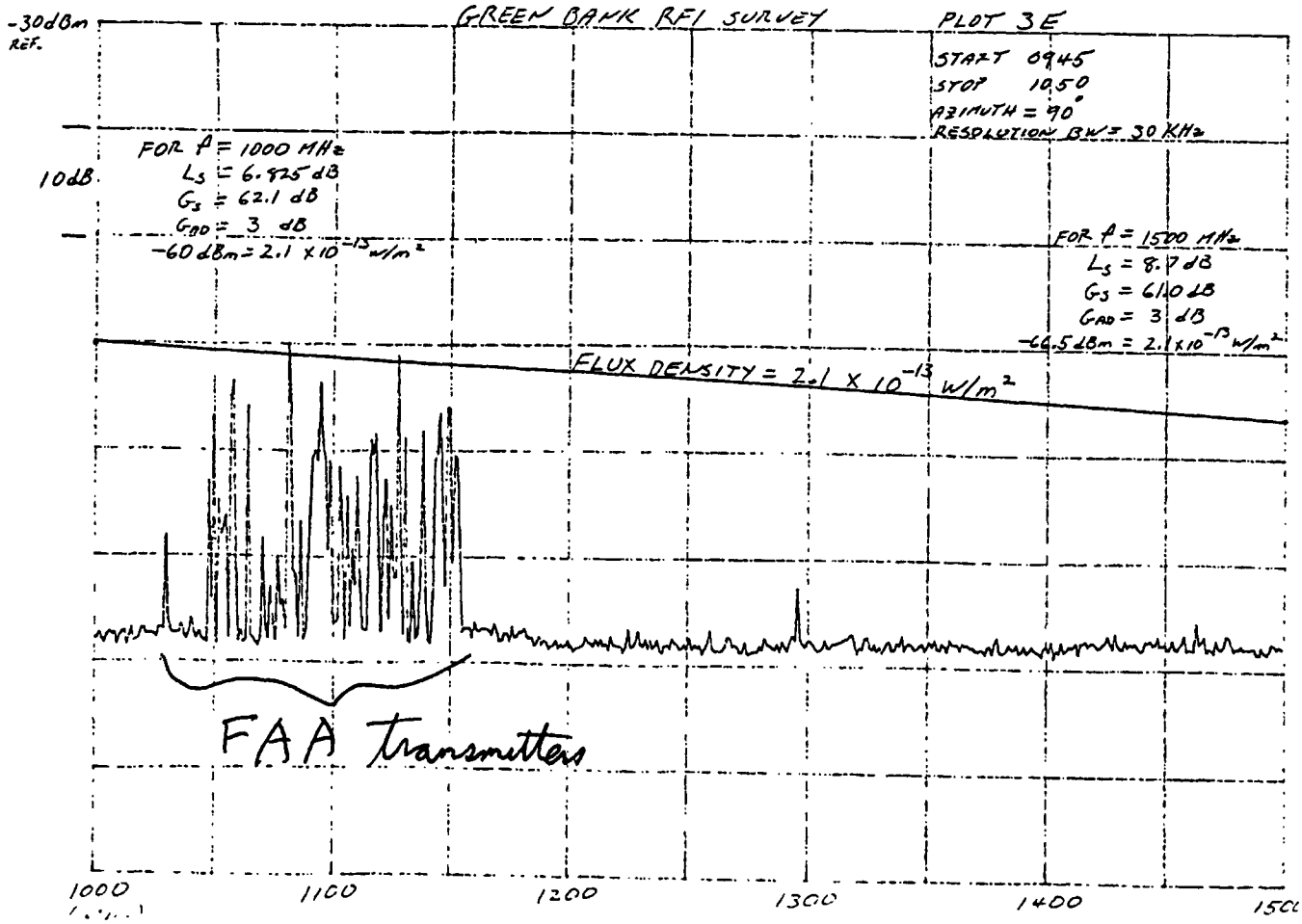

GREEN BANK RFI SURVEY
PLOT 3E
START 0945
STOP 1050
AZIMUTH = 90°
RESOLUTION BW = 30 KHz
-30dBm REF.
10dB
FOR f = 1000 MHz
Ls = 6.825 dB
Gs = 62.1 dB
GAD = 3 dB
-60 dBm = 2.1 X 10^-13 w/m²
FOR f = 1500 MHz
Ls = 8.7 dB
Gs = 61.0 dB
GAD = 3 dB
-66.5 dBm = 2.1 X 10^-13 w/m²
FLUX DENSITY = 2.1 X 10^-13 w/m²
FAA transmitters
1000 1100 1200 1300 1400 1500

FIGURE 4