

**EXHIBIT 10: Test Report for Utilicom Radio FCC ID: LFO-ISM900**

The Utilicom ISM 900 spread spectrum radio (FCC ID LFO-ISM900) is identical to the SafeTran Systems spread spectrum radio model LongRanger 2020 (FCC ID LTY53311). The test data submitted to the FCC for authorization of the SafeTran Systems radio was identical to the data submitted for the Utilicom ISM900 contained in this exhibit.

**30 Pages**

# INCHCAPE TESTING SERVICES

Dept. 206 - Belmont, CA

*Applicant: Utilicom, Inc.*  
*FCC ID: LFO-ISM900*

*Description of EUT: Spread Spectrum Transmitter*  
*ITS Belmont Folder: 90571*

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## TEST REPORT FOR SPREAD SPECTRUM INTENTIONAL RADIATOR

### RULE PART: 15.247 SPREAD SPECTRUM OPERATION

- (a) The EUT is a 590 mW spread spectrum radio using direct sequence techniques.
- 2. The minimum 6dB bandwidth is 900 kHz for 100 kHz resolution bandwidth. Please refer to the attached spectrum analyzer charts for output signal spectrum shape.
- (b) The maximum peak output of the transmitter with a spectrum analyzer at 3 MHz bandwidth is 27.7 dBm = 590 mW.
- (c) Please refer to the spectrum analyzer charts. These charts show the power in any 100 kHz or 1 MHz bandwidth to be at least 20 dB below the power in any 100 kHz within the band containing the highest level of desired power, i.e., the pass-band surrounding the 902 - 928 MHz carrier.

### RULE PART 15.205: RESTRICTED BANDS OF OPERATION

The EUT was tested for radiated emissions in the restricted bands of operation. The EUT was placed on a non-conductive turntable at 1 height of approximately 1 meter above the ground plane of a 3 meter open test site. For each frequency detected from the EUT, the turntable was rotated 360 degrees and the search antenna was raised and lowered in both horizontal and vertical polarizations, in an attempt to maximize the received emissions.

Test results, test equipment list, and test configurations are attached.

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## **RULE PART: 15.247(d) POWER DENSITY MEASUREMENTS**

The spectrum analyzer RESOLUTION BANDWIDTH was set to 3 kHz. The START and STOP frequencies were set to the band edges of the maximum output pass-band determined by the chart labelled "POWER OUTPUT". This bandwidth is approximately 900 kHz.

The specification calls for a 1 second interval at each 3 kHz bandwidth; for 900 kHz this calculates to approximately 300 seconds of total sweep. The 300 second sweep time was chosen for the analyzer of sweep. The spectrum analyzer chart labelled "POWER DENSITY" shows that the EUT emissions are approximately 1.5 dB below the 8 dBm limit line.

## **RULES PART: 15.247(e) PROCESSING GAIN MEASUREMENTS**

Processing gain data and test procedure were prepared by the radio module manufacturer and are attached.

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## RULE PART: 15.101 UNINTENTIONAL RADIATOR OPERATION

Emissions from the computer circuitry were measured to determine compliance with Class B limits. The Utilicom Inc. Model ISM 900 was found to comply with the Class B limits for digital devices.

A certificate of verification for the receiver and digital portions of the device has been submitted to the manufacturer.

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## RULE PART 15.107 CONDUCTED LIMITS

During tests for unintentional radiator emissions, line conducted measurements were made with the EUT transmitting at 915 MHz.

Data shows the EUT meets the 250 uV line conducted limit for intentional radiator.

## CONCLUSION

The Utilicom Inc. Model ISM 900, FCC ID: LFOISM900, meets all emissions requirements in Part 15 FCC Rules for a device of this type.

INCHCAPE TESTING SERVICES

AUGUST 29, 1994



Thomas N. Cokenias  
EMI Manager

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## TEST CONFIGURATION SET-UP



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## RADIATED EMISSIONS DATA SHEET

Frequency Investigated: 903 MHz  
Measurements Performed: 3 meters

| FREQ.<br>MHz | READING<br>dBuV |      | ANT.<br>CORR.<br>FACTOR<br>dB | CABLE<br>LOSS<br>dB | OTHER<br>CORR.<br>FACTOR<br>dB | TOTAL<br>CORR.<br>READING<br>dBuV/m |      | FCC<br>LIMIT<br>dBuV/m |     |
|--------------|-----------------|------|-------------------------------|---------------------|--------------------------------|-------------------------------------|------|------------------------|-----|
|              | Peak            | Ave. |                               |                     |                                | Peak                                | Ave. | Peak                   | Ave |
| 2709         | 44              | 41.0 | 31.1                          | 1.5                 | -27.7                          | 48.9                                | 45.9 | 74                     | 54  |
| 4515         | 39.9            | 36.9 | 34.8                          | 2.2                 | -26.1                          | 50.8                                | 47.8 | 74                     | 54  |
| 5418         | 44              | 40.0 | 36.0                          | 2.4                 | -26.4                          | 56                                  | 52.0 | 74                     | 54  |

### Description of Other Correction Factor

- ☒ Preamplifier gain, dB: 27.7, 26.1, 26.4  
☐ External Attenuator, dB:  
☐ Duty Cycle, dB:

### Calculation of Duty Cycle:

Total on Time in 100 msec:  
Duty Cycle =  $20 * \log (\text{ON time}/100 \text{ msec})$

☒ Filter Insertion Loss, dB = 1.0

### Analyzer Settings:

☒ Peak  
Resolution Bandwidth: 1 MHz  
Video Bandwidth: 1 MHz

☒ Average  
Resolution Bandwidth: 1 MHz  
Video Bandwidth: 30 Hz

# INCHCAPE TESTING SERVICES

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Description of EUT: Spread Spectrum Transmitter  
ITS Belmont Folder: 90571

## RADIATED EMISSIONS (CONTINUED)

Frequency Investigated: 915 MHz  
Measurements Performed: 3 meters

| FREQ.<br>MHz | READING<br>dBuV |      | ANT.<br>CORR.<br>FACTOR<br>dB | CABLE<br>LOSS<br>dB | OTHER<br>CORR.<br>FACTOR<br>dB | TOTAL<br>CORR.<br>READING<br>dBuV/m |      | FCC<br>LIMIT<br>dBuV/m |     |
|--------------|-----------------|------|-------------------------------|---------------------|--------------------------------|-------------------------------------|------|------------------------|-----|
|              | Peak            | Ave. |                               |                     |                                | Peak                                | Ave. | Peak                   | Ave |
| 2745         | 38.9            | 34.9 | 31.1                          | 1.5                 | -27.7                          | 43.8                                | 39.8 | 74                     | 54  |
| 4575         | 35.8            | 33.7 | 34.8                          | 2.2                 | -26.1                          | 46.7                                | 44.6 | 74                     | 54  |

### Description of Other Correction Factor

- ☒ Preamplifier gain, dB: 27.7, 26.1, 26.4  
☐ External Attenuator, dB:  
☐ Duty Cycle, dB:

### Calculation of Duty Cycle:

Total on Time in 100 msec:  
Duty Cycle =  $20 * \log (\text{ON time}/100 \text{ msec})$

☒ Filter Insertion Loss, dB = 1.0

### Analyzer Settings:

☒ Peak  
Resolution Bandwidth: 1 MHz  
Video Bandwidth: 1 MHz

☒ Average  
Resolution Bandwidth: 1 MHz  
Video Bandwidth: 30 Hz

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ITS Belmont Folder: 90571

## RADIATED EMISSIONS (CONTINUED)

Frequency Investigated: 927 MHz  
Measurements Performed: 3 meters

| FREQ.<br>MHz | READING<br>dBuV |      | ANT.<br>CORR.<br>FACTOR<br>dB | CABLE<br>LOSS<br>dB | OTHER<br>CORR.<br>FACTOR<br>dB | TOTAL<br>CORR.<br>READING<br>dBuV/m |      | FCC<br>LIMIT<br>dBuV/m |     |
|--------------|-----------------|------|-------------------------------|---------------------|--------------------------------|-------------------------------------|------|------------------------|-----|
|              | Peak            | Ave. |                               |                     |                                | Peak                                | Ave. | Peak                   | Ave |
| 2781         | 38.5            | 35.1 | 31.1                          | 1.5                 | -27.7                          | 43.4                                | 40.0 | 74                     | 54  |
| 4635         | 33.3            | 30.2 | 34.8                          | 2.2                 | -26.1                          | 43.2                                | 41.1 | 74                     | 54  |

### Description of Other Correction Factor

- [X] Preamplifier gain, dB: 27.7, 26.1, 26.4  
[ ] External Attenuator, dB:  
[ ] Duty Cycle, dB:

### Calculation of Duty Cycle:

Total on Time in 100 msec:  
Duty Cycle =  $20 * \log (\text{ON time}/100 \text{ msec})$

[X] Filter Insertion Loss, dB = 1.0

### Analyzer Settings:

[X] Peak  
Resolution Bandwidth: 1 MHz  
Video Bandwidth: 1 MHz

[X] Average  
Resolution Bandwidth: 1 MHz  
Video Bandwidth: 30 Hz

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## Equipment Used To Perform Tests:

### Amplifiers

- ☐ Watkins-Johnson 6882-813, 2-8 GHz
- ☐ AvanteK AFT-18855, 8-18 GHz
- ☒ Other: CDI P-1000 +

### Filter

+ 1 dB

### Analyzer

- ☐ Tektronix 2784 Spectrum Analyzer, 100 Hz - 40 GHz
- ☒ HP 8566B Spectrum Analyzer, 100 Hz - 22 GHz

### Antennas

- ☒ EMCO 3115 Waveguide Horn, 1-18 GHz
-

JTILICOM SAFETRAN 08/17/94

REF 29.2 dBm ATTN 10 dB

MKR 902.845 MHz

27.30 dBm

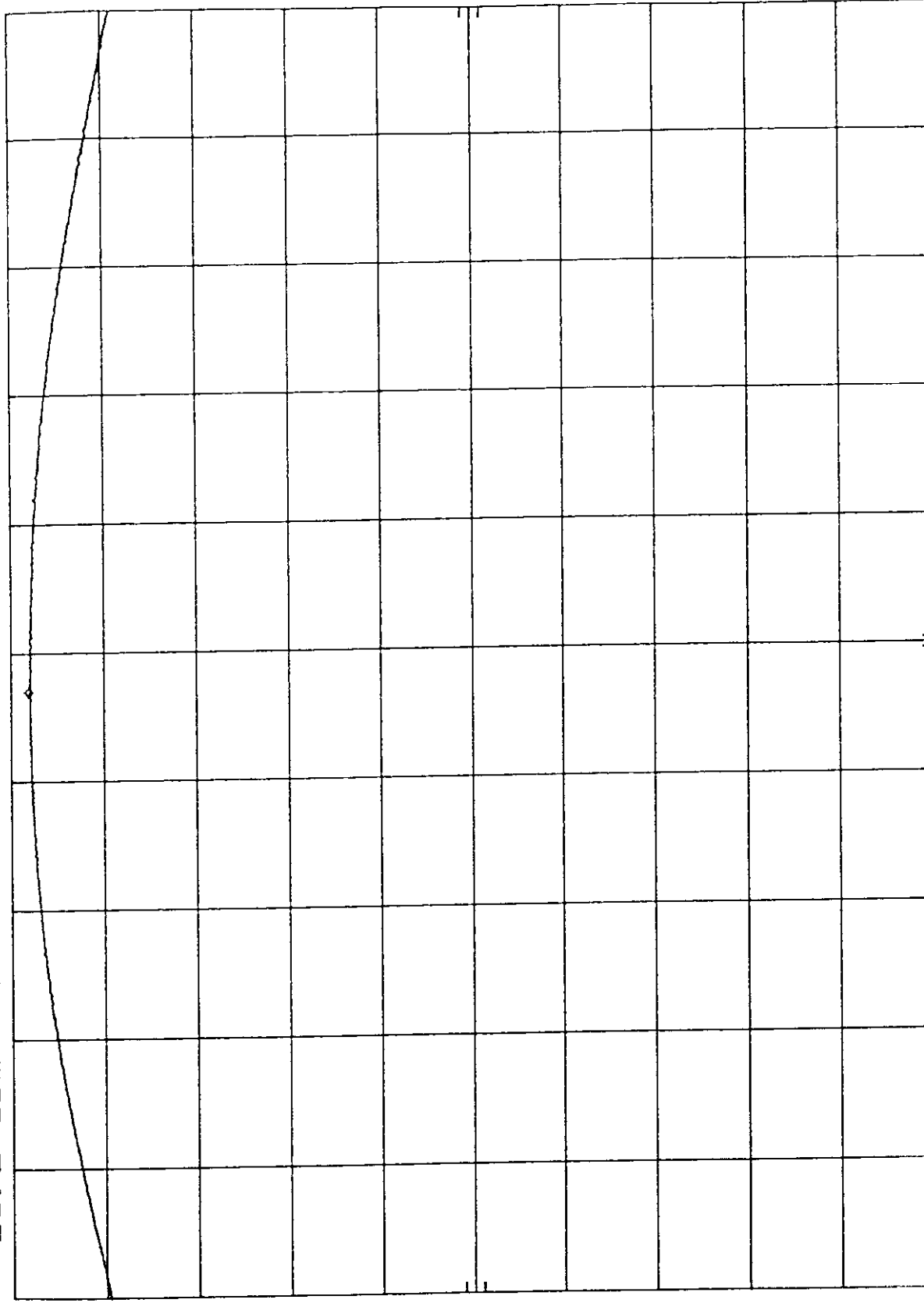
hp

10 dB/

OFFSET

29.2

dB



SPAN 5.00 MHz

SWP 1.00 sec

VBW 3 MHz

CENTER 903.00 MHz

RES BW 3 MHz

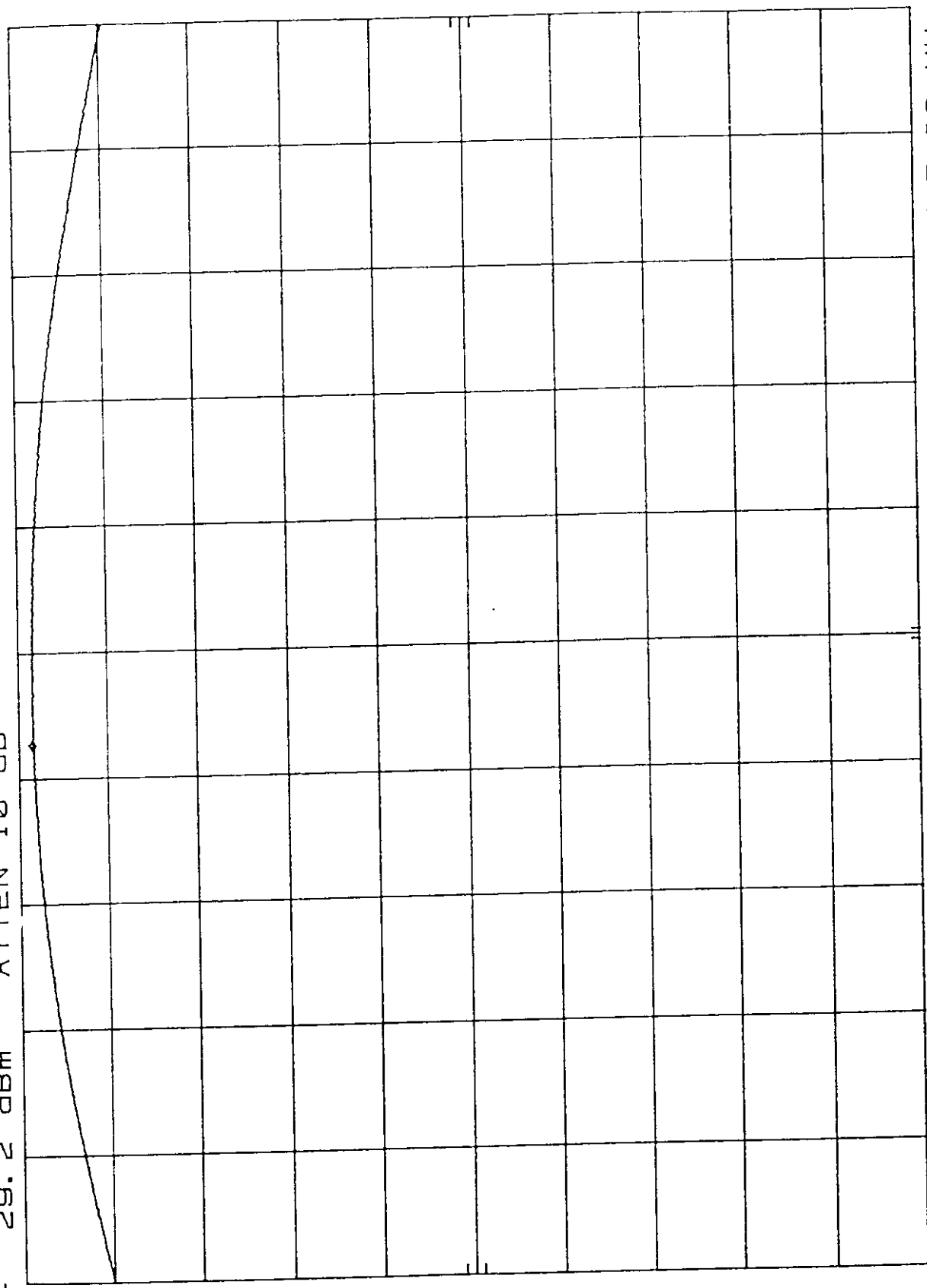
MKR 914.630 MHz  
27.70 dBm

JTILICOM SAFETRAN 08/17/94  
REF 29.2 dBm ATTEN 10 dB

hp

10 dB/

OFFSET  
29.2  
dB



SPAN 5.00 MHz  
SWP 1.00 sec

VBW 3 MHz

CENTER 915.00 MHz  
RES BW 3 MHz

UTILICOM SAFETRAN 08/17/94

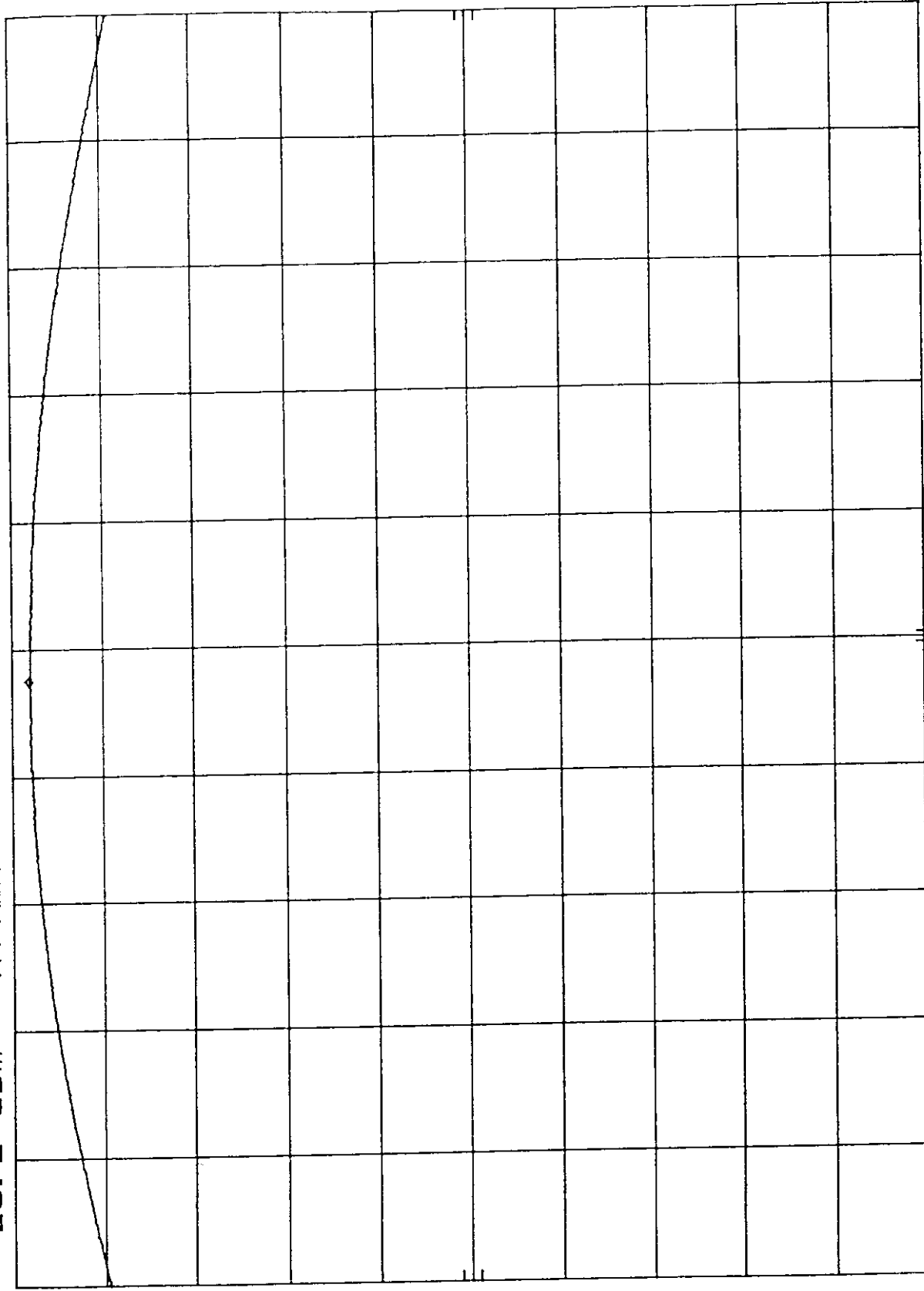
MKR 926.876 MHz  
27.40 dBm

REF 29.2 dBm ATTN 10 dB

hp

10 dB/

OFFSET  
29.2  
dB



SPAN 5.00 MHz  
SWP 1.00 sec

VBW 3 MHz

CENTER 927.00 MHz  
RES BW 3 MHz

UTILICOM SAFETRAN 08/17/94

MR 926.971 MHz  
5.90 dBm

REF 29.2 dBm ATTN 10 dB

h<sub>p</sub>

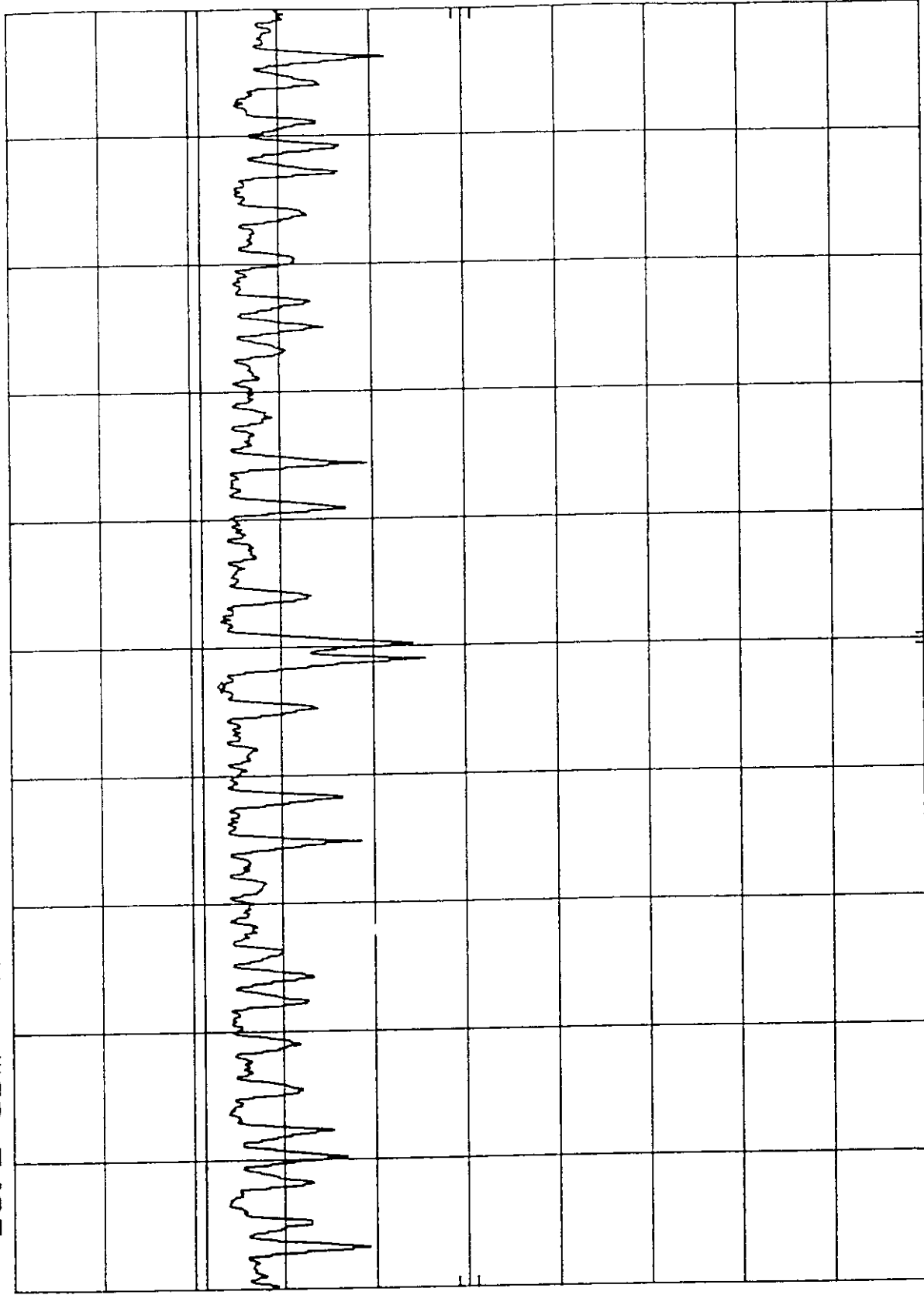
10 dB/

OFFSET

29.2  
dB

DL  
8.0  
dBm

CENTER 927.000 MHz  
RES BW 3 kHz  
SPAN 906 kHz  
SWP 302 sec  
VBW 3 kHz



MKR 914.972 1 MHz  
6.50 dBm

REF 29.2 dBm ATTEN 10 dB

59

10 dB/

TEST

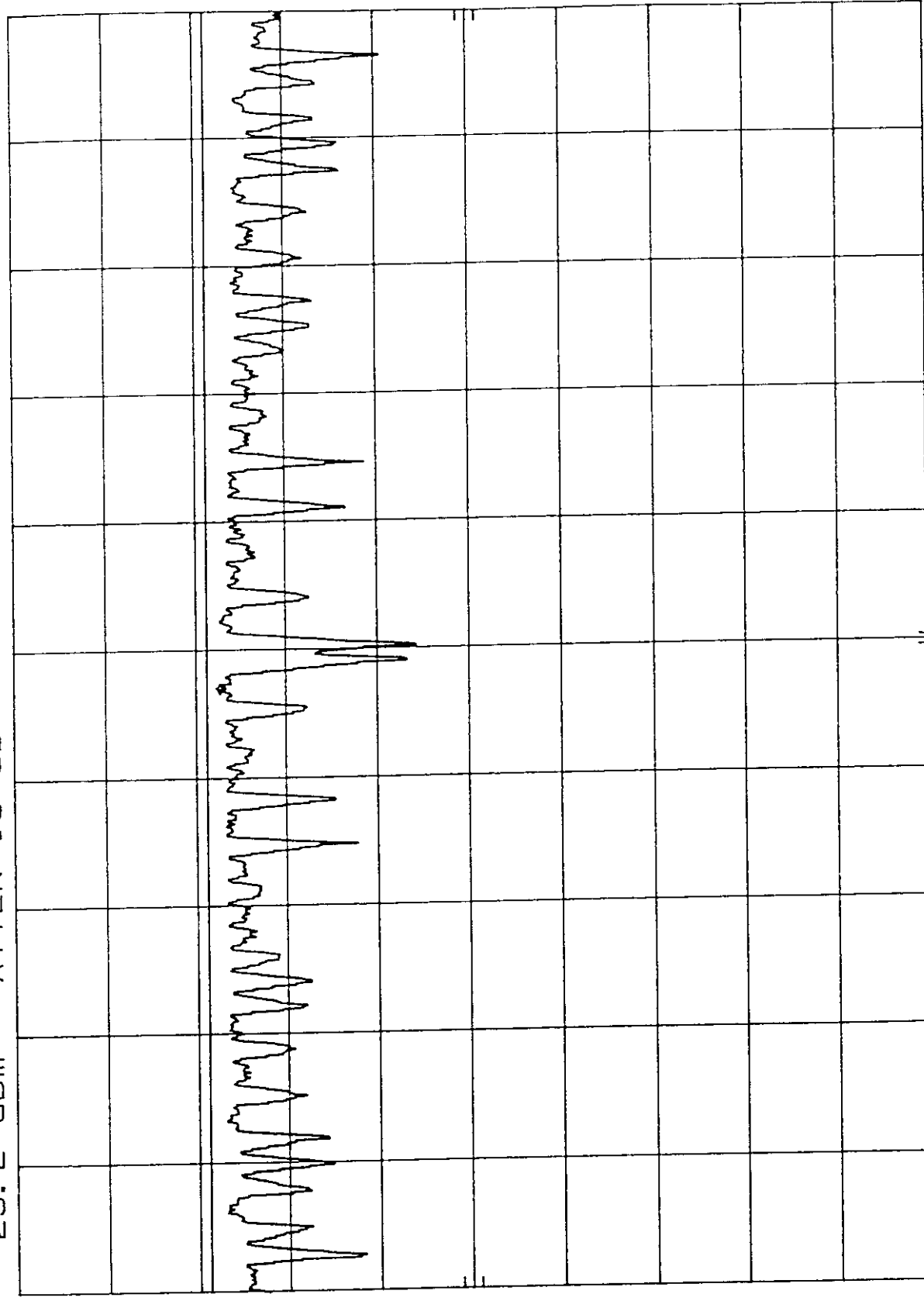
2.  
3.  
4.

BR

10

00

END



CENTER 915.000 MHZ

RES BW 3 KHZ

VBW 3 KHZ

SPAN 9000 KIN

SWP 300 sec

JTILICOM SAFETRAN 08/17/94  
REF 29.2 dBm ATTEN 10 dB

MKR 902.972 MHz  
7.50 dBm

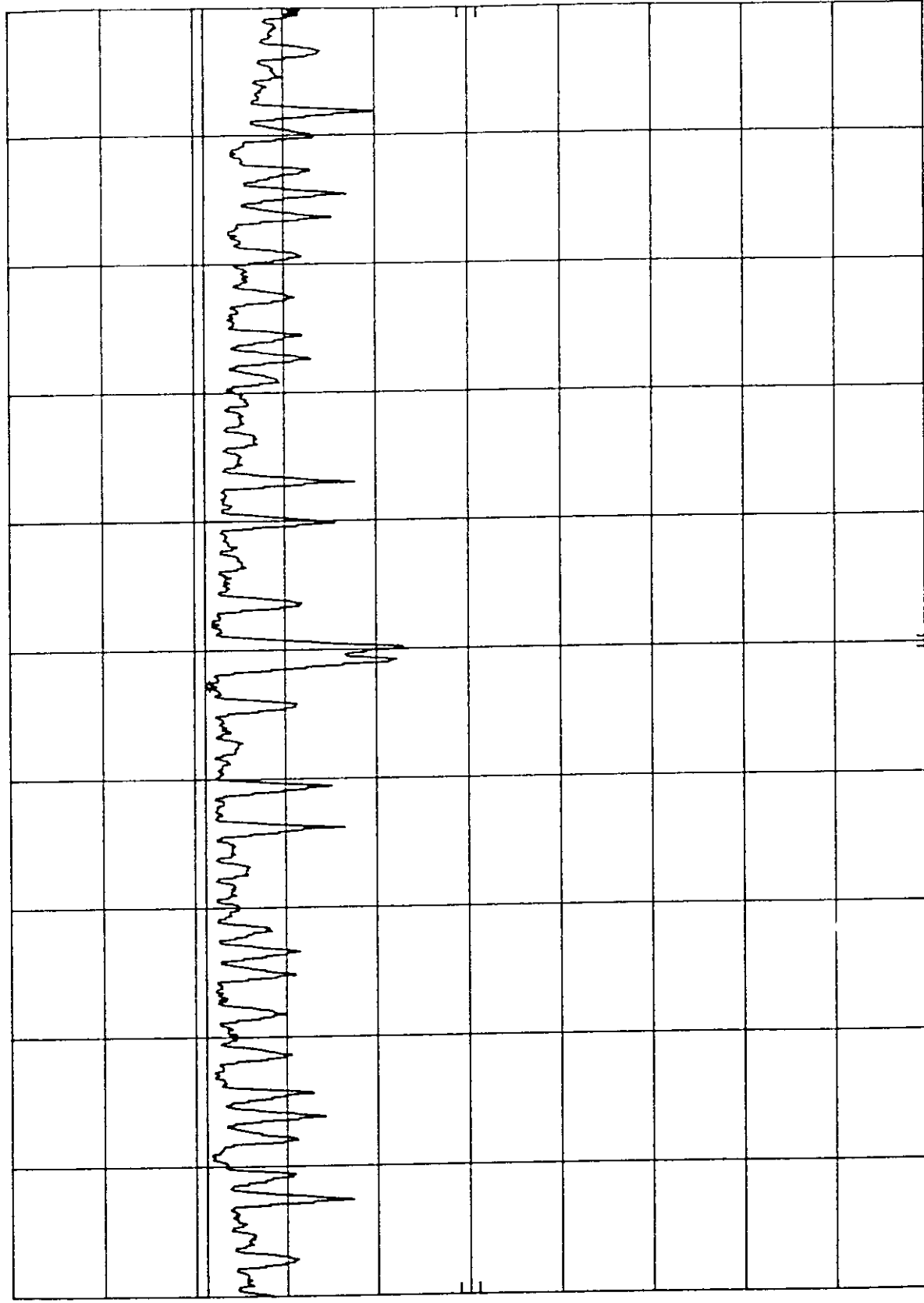
hp

10 dB/

OFFSET

29.2  
dB

DL  
8.0  
dBm



CENTER 903.00 MHz  
RES BW 3 KHz

VBW 3 KHz

SPAN 1.00 MHz  
SWP 350 sec

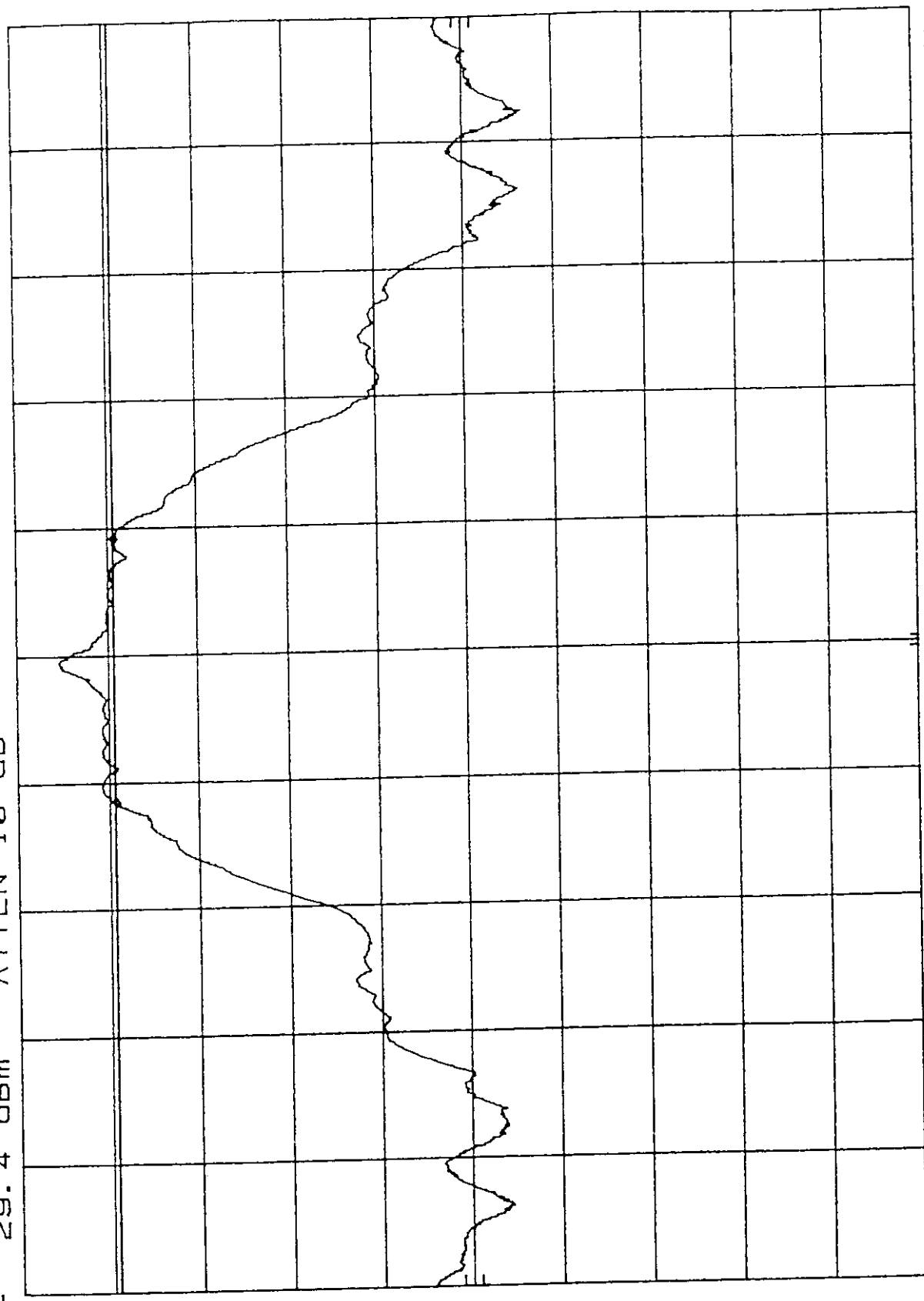
UTILICOM 07/20/94  
REF 29.4 dBm  
ATTEN 10 dB  
MKR  $\Delta$  1.03% MHz  
0.00 dB

hp

10 dB/

OFFSET  
29.4  
dB

DL  
18.8  
dBm



CENTER 903.00 MHz  
RES BW 100 kHz  
SPAN 5.00 MHz  
SWP 2.00 sec

VBW 300 kHz

h<sub>p</sub>

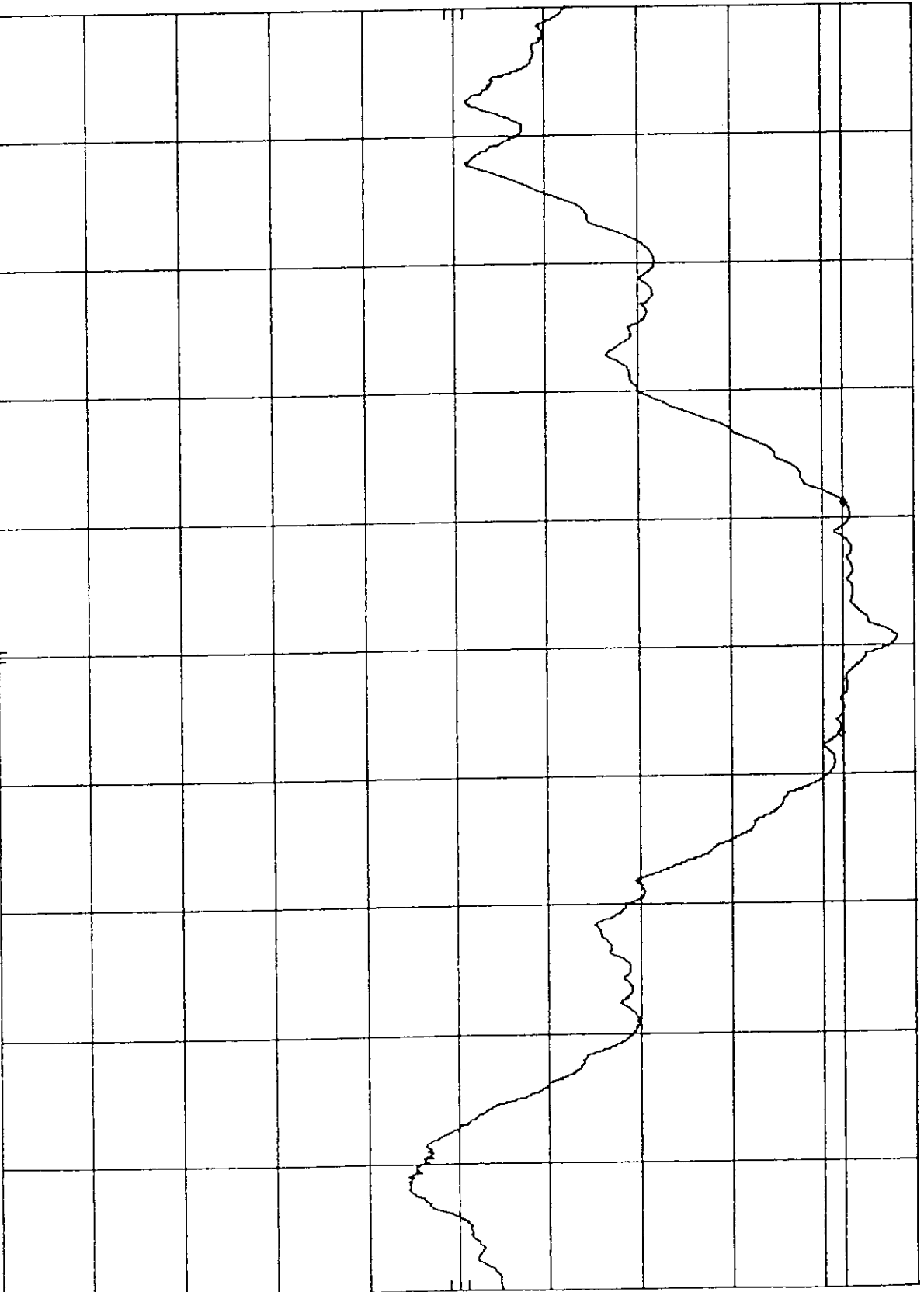
UTILICOM 07/20/94  
REF 29.4 dBm ATTEN 10 dB

MKR Δ 895 kHz  
-0.30 dB

10 dB/

OFFSET  
29.4  
dB

DL  
21.6  
dBm



CENTER 915.00 MHz  
RES BW 100 kHz

VBW 300 kHz

SPAN 5.00 MHz  
SWP 2.00 sec

MKR  $\Delta$  905 kHz  
0.00 dB

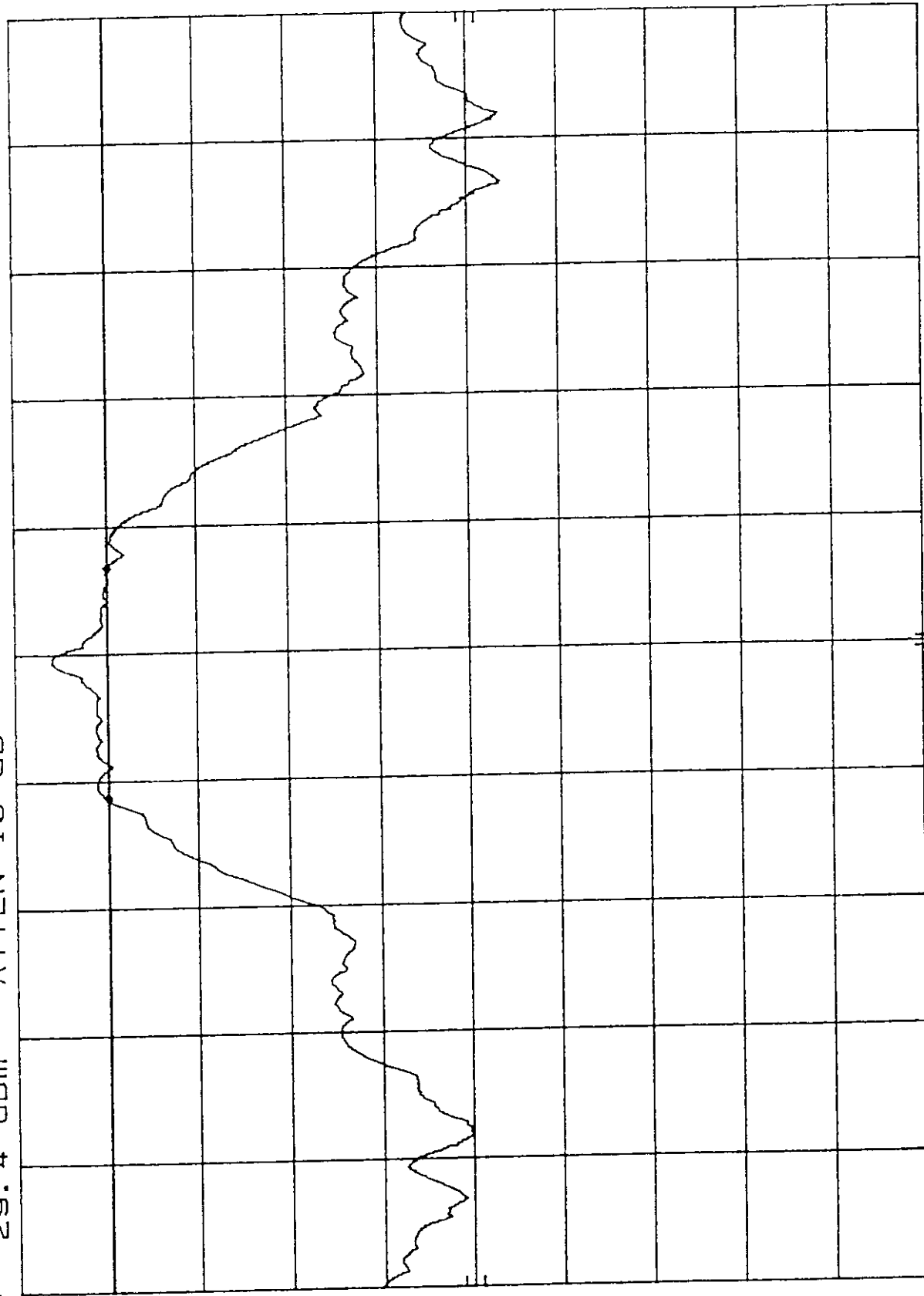
UTILICOM 07/20/94  
REF 29.4 dBm ATTN 10 dB

hp

10 dB/

OFFSET  
29.4  
dB

DL  
19.3  
dBm

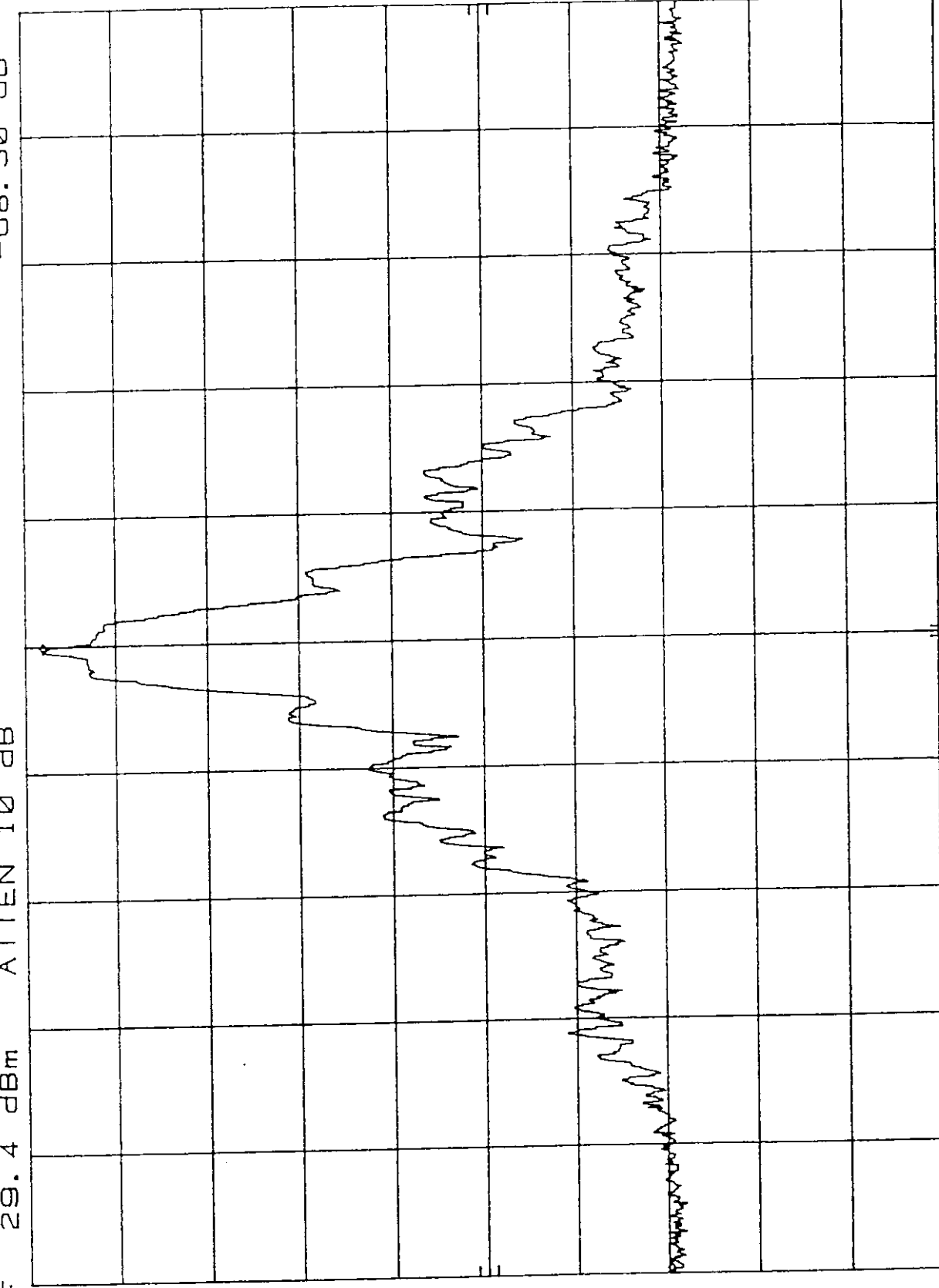


SPAN 5.00 MHz  
SWP 2.00 sec

VBW 300 kHz

CENTER 927.00 MHz  
RES BW 100 kHz

UTILICOM 07/20/94  
REF 29.4 dBm  
ATTEN 10 dB  
MKR  $\Delta$ -12.95 MHz  
-68.30 dB



hp  
10 dB/  
OFFSET  
29.4  
dB

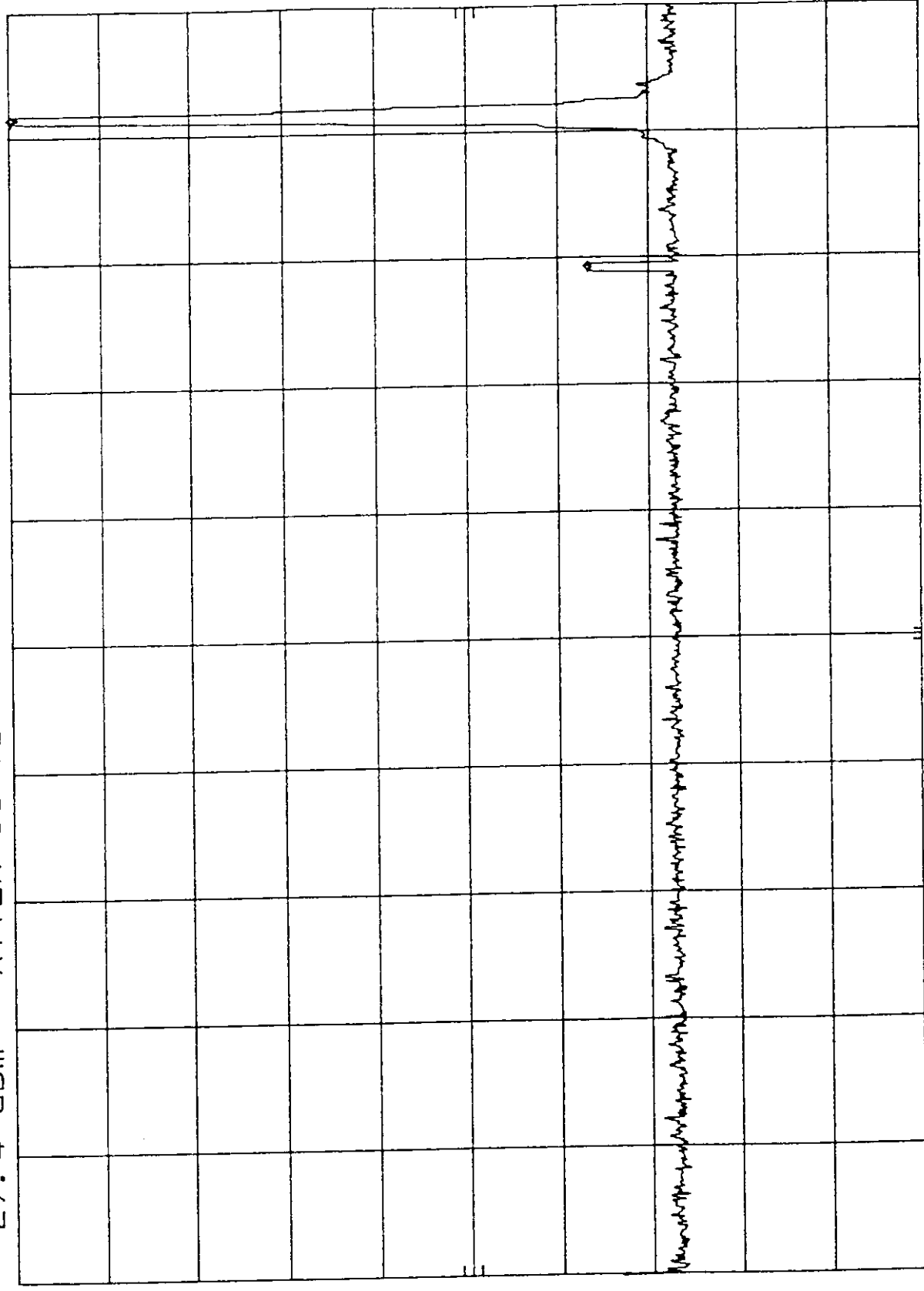
START 902.0 MHz  
RES BW 100 kHz  
STOP 928.0 MHz  
SWP 2.00 sec  
VBW 300 kHz

UTILICOM 07/20/94  
MKR Δ-121 MHz  
REF 27.4 dBm  
-63.10 dB  
ATTEN 10 dB

hp

10 dB/

OFFSET  
29.4  
dB



START 1 MHz  
RES BW 100 kHz  
VBW 300 kHz  
STOP 1.00 GHz  
SWP 2.00 sec

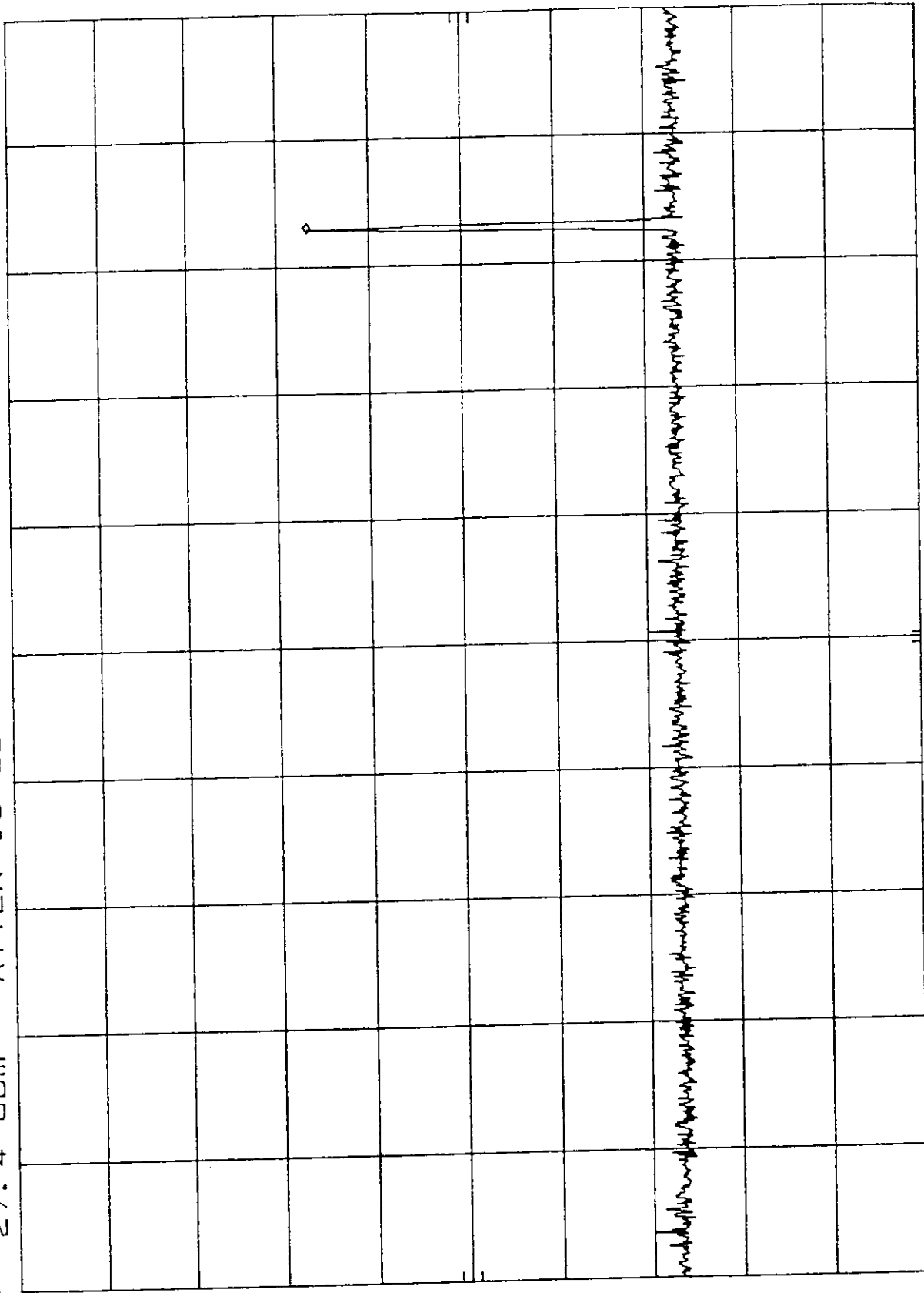
MKR 1.830 GHz  
-5.90 dBm

UTILICOM 07/20/94  
REF 27.4 dBm ATTN 10 dB

hp

10 dB/

OFFSET  
29.4  
dB



STOP 2.00 GHz  
SWP 10.0 sec

VBW 300 kHz

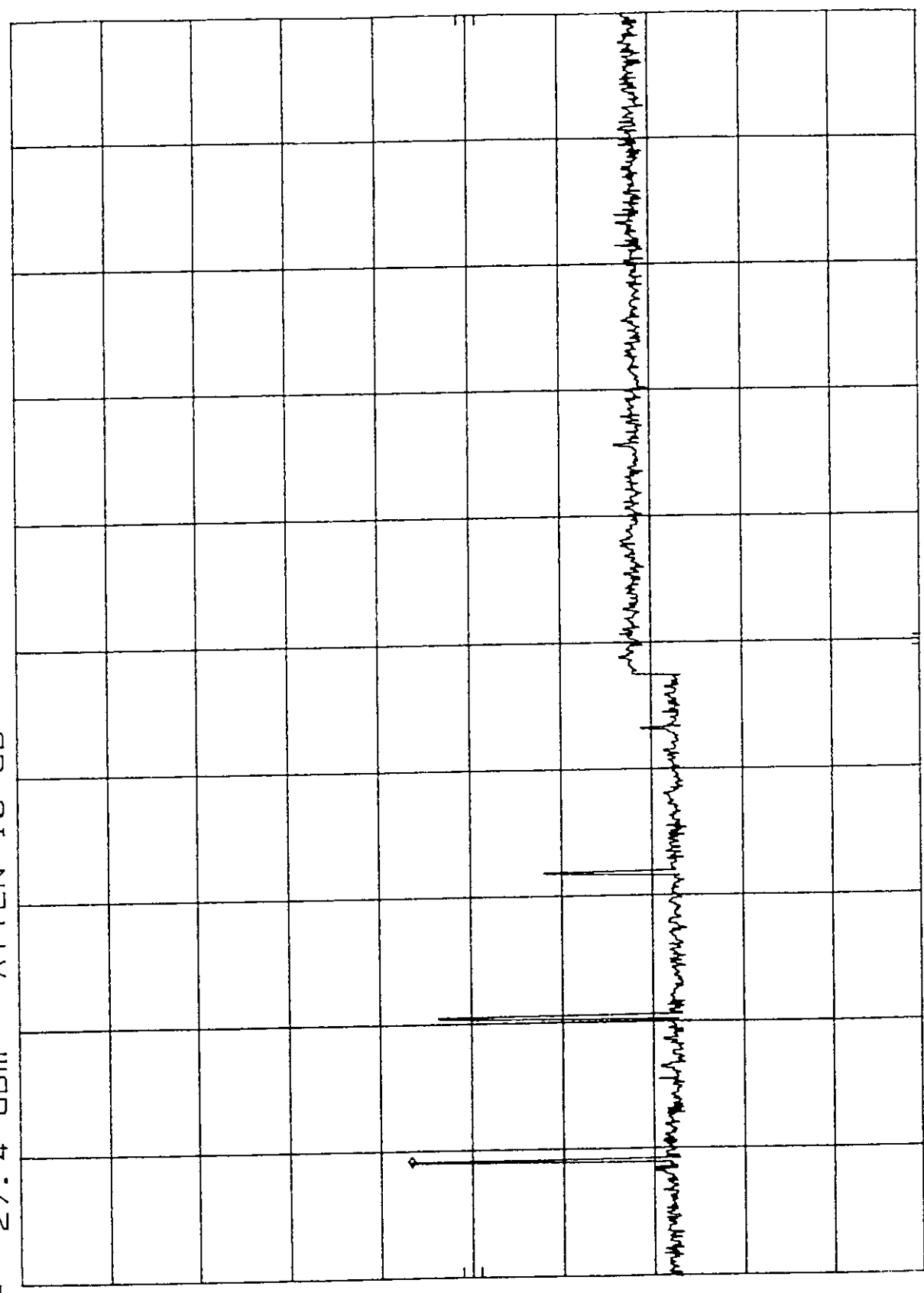
START 1.00 GHz  
RES BW 100 kHz

UTILICOM 07/20/94 MKR 2.728 GHz  
REF 27.4 dBm ATTEN 10 dB -16.00 dBm

hp

10 dB/

OFFSET  
29.4  
dB



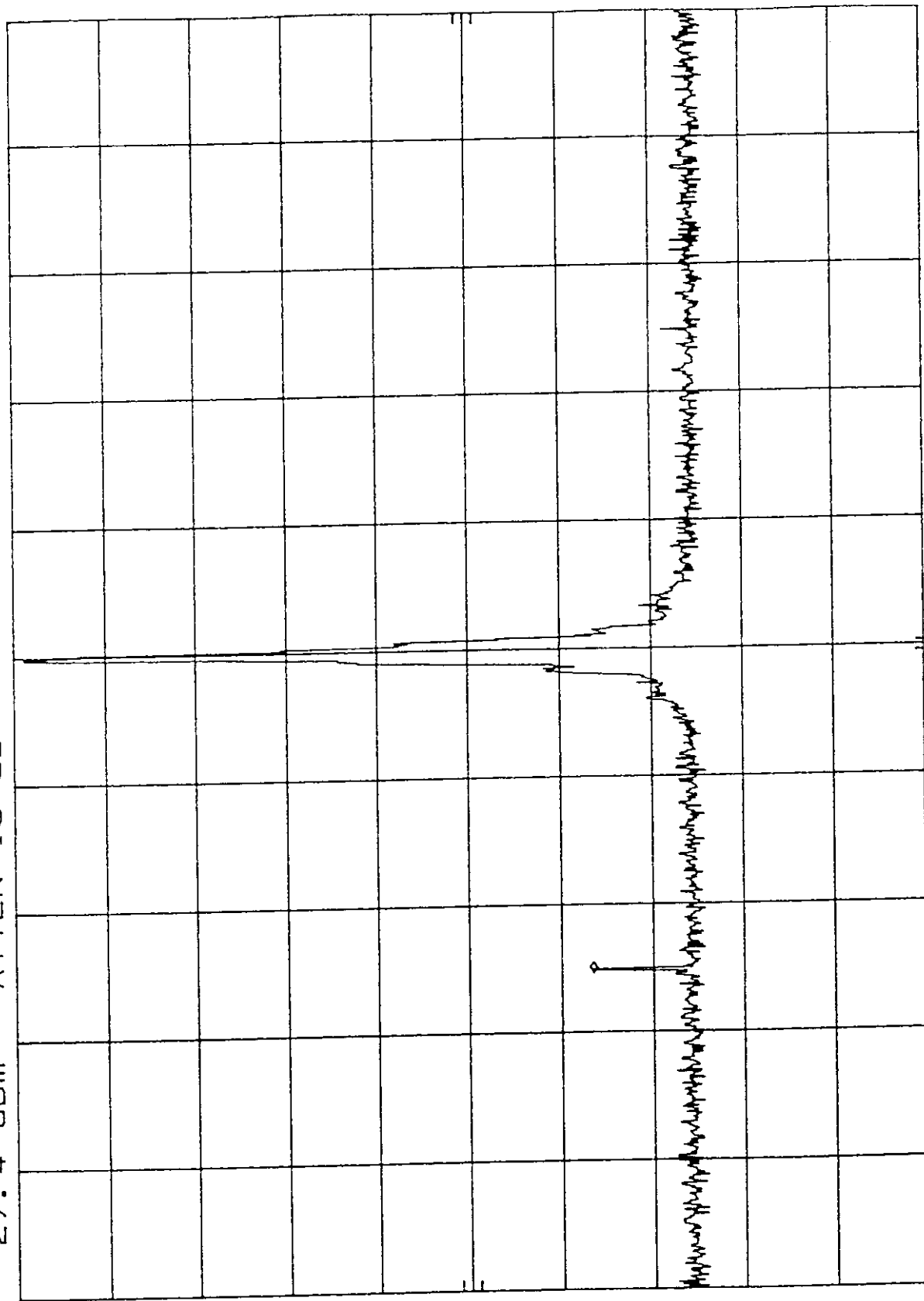
START 2.00 GHz STOP 10.00 GHz  
RES BW 100 kHz SWP 10.0 sec  
VBW 3 MHz

MKR 793.0 MHz  
-36.10 dBm

UTILICOM 07/20/94  
REF 27.4 dBm ATTN 10 dB

hp  
10 dB/

OFFSET  
29.4  
dB



CENTER 915 MHz  
RES BW 100 kHz  
SPAN 488 MHz  
SWP 1.00 sec

Company Name :UTIIACOM  
 Equipment Tested :SS DEVICE  
 Model :SAFETRAM  
 FCC ID# :N/A  
 Date Tested :07/25/94  
 Test Engineer :Eugene Payzner  
 ETL LTO Number :89536

ETL FCC Class B Radiated Data at 3 meter distance

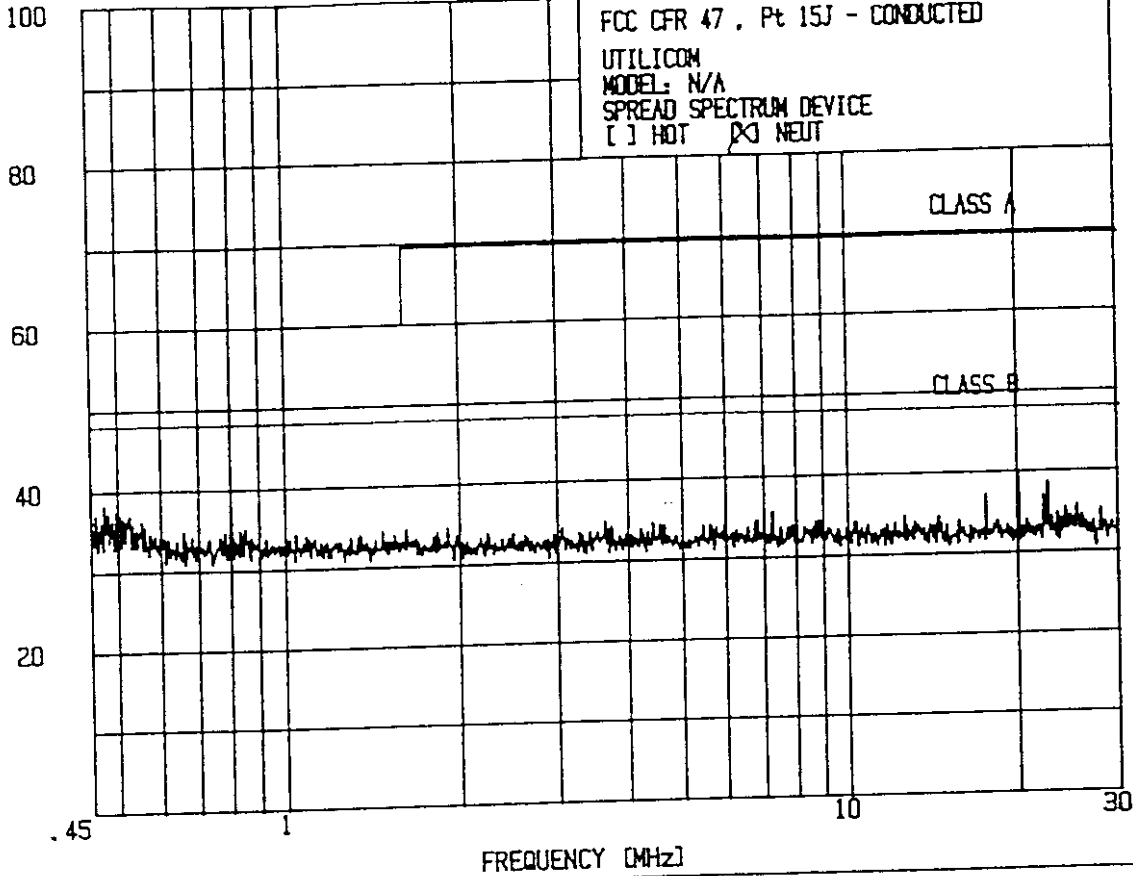
| FREQ.<br>(Mhz) | RDG.<br>(uv) | COR.<br>FACTOR | COR.<br>RDG. (uv) | FCC<br>LIMIT(uv) | DELTA<br>(dB) |
|----------------|--------------|----------------|-------------------|------------------|---------------|
| 34.9           | 6.0          | 4.02           | 24.12             | 100              | -12.35        |
| 40.2           | 6.0          | 3.51           | 21.06             | 100              | -13.53        |
| 154.3          | 5.0          | 4.95           | 24.75             | 150              | -15.65        |
| 164.8          | 6.0          | 5.03           | 30.18             | 150              | -13.93        |
| 266.1          | 9.0          | 4.98           | 44.82             | 200              | -12.99        |
| 303.1          | 6.0          | 5.34           | 32.04             | 200              | -15.91        |
| 400            | 6.0          | 6.17           | 37.02             | 200              | -14.65        |

20 JUL 1994 15:49:53

hp

EMISSION LEVEL [ dBuV]

FCC CFR 47 , Pt 15J - CONDUCTED  
UTILICOM  
MODEL: N/A  
SPREAD SPECTRUM DEVICE  
☐ HOT ☒ NEUT

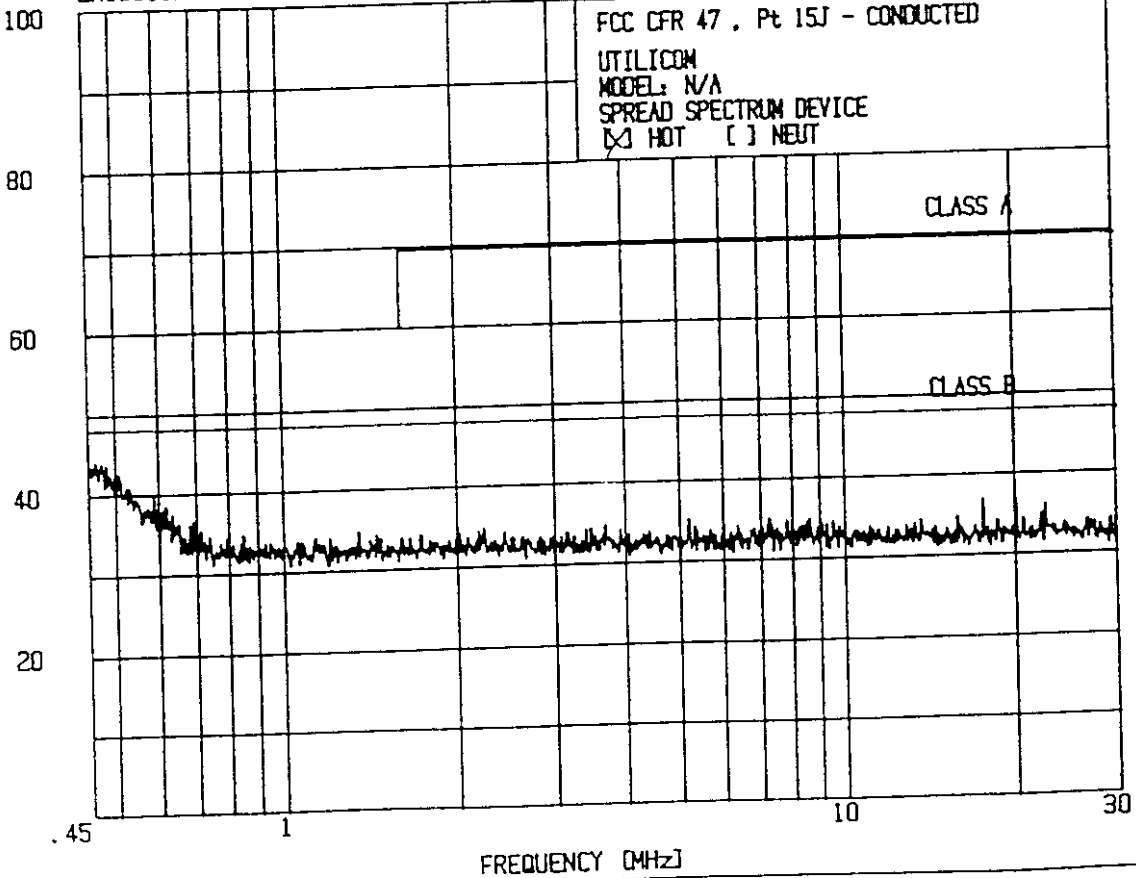


20 JUL 1994 15:54:18

hp

EMISSION LEVEL [ dBuV]

FCC CFR 47 , Pt 15J - CONDUCTED  
UTILICOM  
MODEL: N/A  
SPREAD SPECTRUM DEVICE  
☒ HOT ☐ NEUT



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ITS Belmont Folder: 90571

Frequency Investigated: 927 MHz  
Measurements Performed: 3 meters

| FREQ.<br>MHz | READING<br>dBuV | ANTENNA<br>CORR.<br>FACTOR<br>dB | CABLE<br>LOSS<br>dB | OTHER<br>CORR.<br>FACTOR<br>dB | TOTAL<br>CORR.<br>READING<br>dBuV/m | FCC<br>LIMIT<br>dBuV/m |
|--------------|-----------------|----------------------------------|---------------------|--------------------------------|-------------------------------------|------------------------|
| 2781         | 35.1            | 31.1                             | 1.5                 | -27.7                          | 40.0                                | 54                     |
| 4635         | 30.2            | 34.8                             | 2.2                 | -26.1                          | 41.1                                | 54                     |

## Equipment Used To Perform Tests:

### Amplifiers

- ☐ Watkins-Johnson 6882-813, 2-8 GHz
- ☐ Avantek AFT-18855, 8-18 GHz
- ☒ Other: CDI P-1000 +

### Filter

+ 1 dB

### Analyzer

- ☐ Tektronix 2784 Spectrum Analyzer, 100 Hz - 40 GHz
- ☒ HP 8566B Spectrum Analyzer, 100 Hz - 22 GHz

### Antennas

- ☒ EMCO 3115 Waveguide Horn, 1-18 GHz

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20 JUL 1994 15:49:53

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UTILICOM  
MODEL: N/A  
SPREAD SPECTRUM DEVICE  
☐ HOT ☒ NEUT

PEAKS FOUND ABOVE 37 dBuV

| PEAK# | FREQ (MHz) | AMPL (dBuV) |
|-------|------------|-------------|
| 1     | .4615      | 37.0        |
| 2     | .4772      | 36.3        |
| 3     | .5019      | 37.4        |
| 4     | 17.61      | 37.2        |
| 5     | 20.14      | 36.9        |
| 6     | 22.37      | 37.0        |
| 7     | 22.65      | 36.6        |

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20 JUL 1994 15:54:16

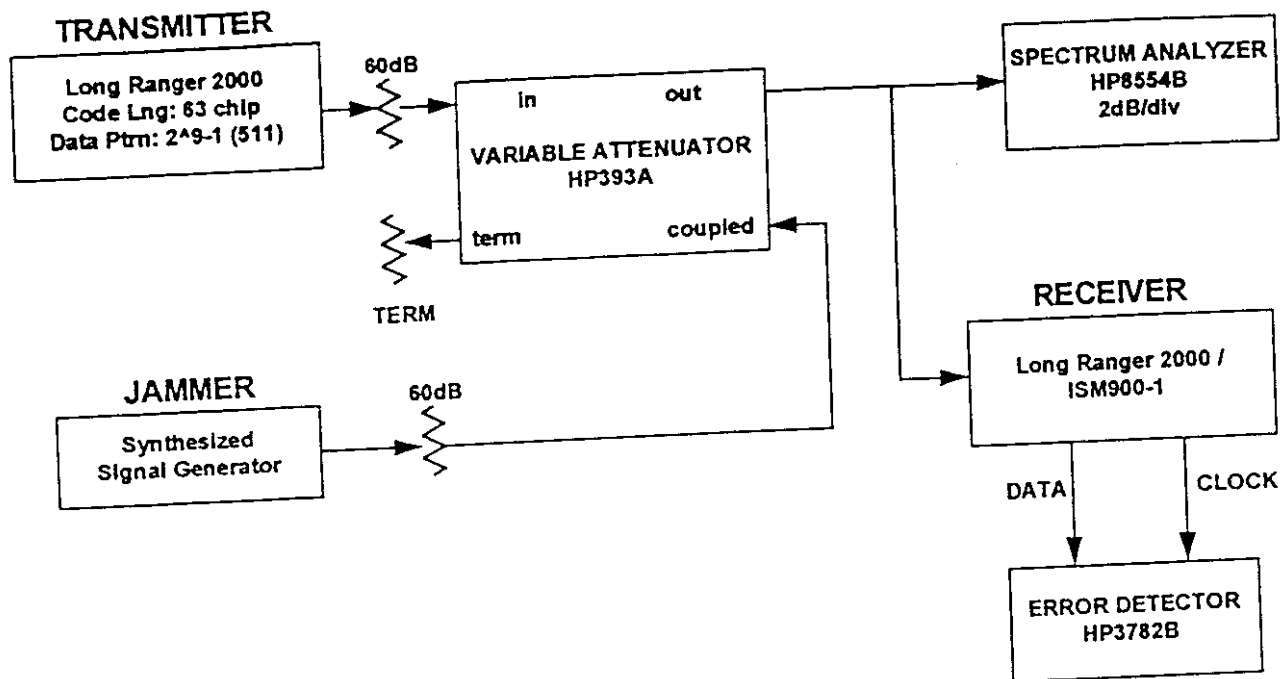
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UTILICOM  
MODEL: N/A  
SPREAD SPECTRUM DEVICE  
☒ HOT ☐ NEUT

PEAKS FOUND ABOVE 36 dBuV

| PEAK# | FREQ (MHz) | AMPL (dBuV) |
|-------|------------|-------------|
| 1     | .5311      | 36.7        |
| 2     | .5216      | 36.3        |
| 3     | .5374      | 37.3        |
| 4     | .6546      | 36.0        |
| 5     | .6560      | 36.4        |
| 6     | 17.61      | 36.6        |
| 7     | 20.14      | 36.7        |

Figure 1: Long Ranger 2000/ISM900-1 Processing Gain Setup

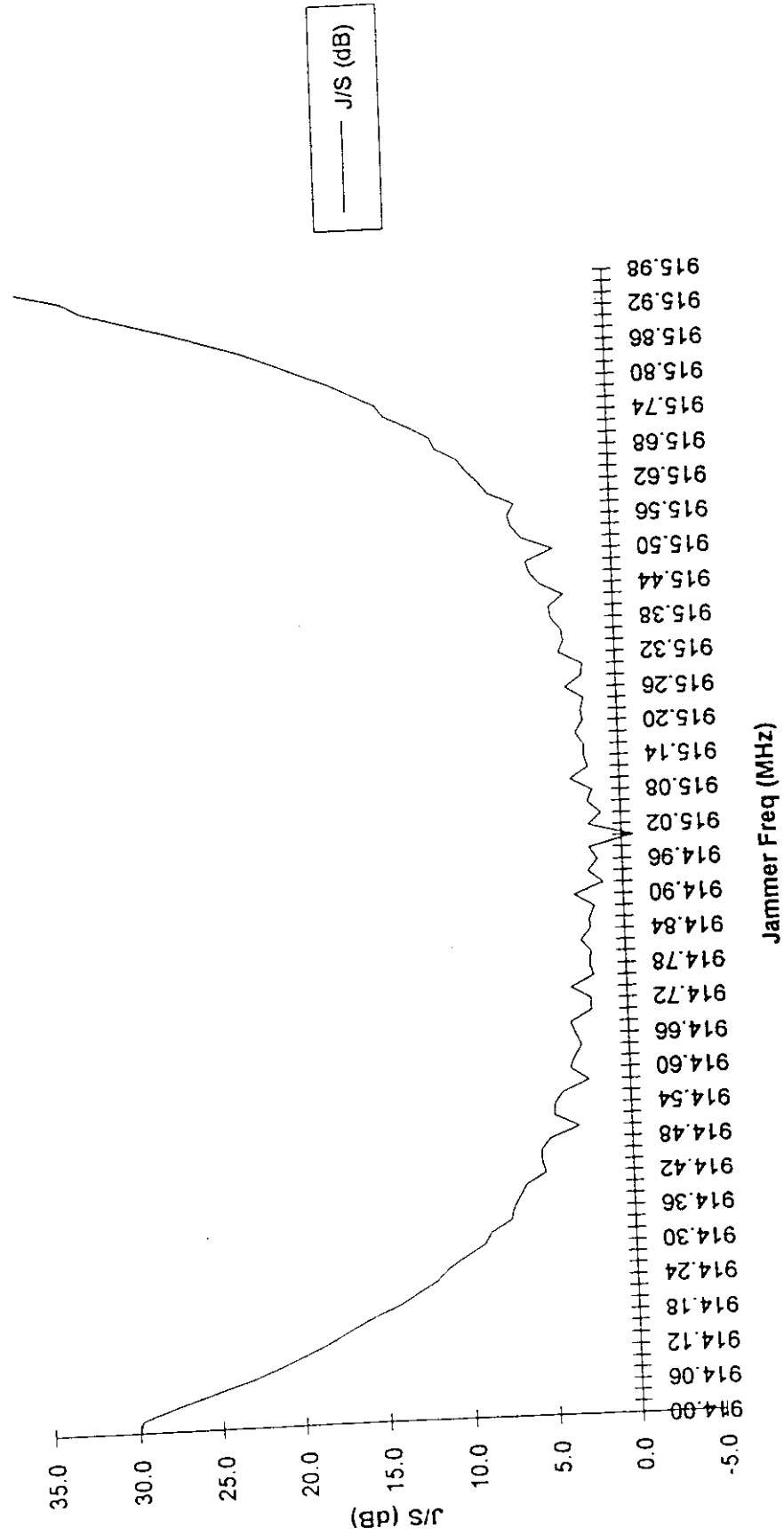


## SSMPG16B.XLS

| Jammer Freq<br>(MHz) | J/S<br>(dB) | P.G.<br>(dB) | Jammer Freq<br>(MHz) | J/S<br>(dB) | P.G.<br>(dB) |
|----------------------|-------------|--------------|----------------------|-------------|--------------|
| 914.00               | 30.0        | 41.2         | 915.00               | -0.7        | 10.50        |
| 914.02               | 29.8        | 41.0         | 915.02               | 2.0         | 13.20        |
| 914.04               | 27.9        | 39.1         | 915.04               | 1.2         | 12.40        |
| 914.06               | 25.7        | 36.9         | 915.06               | 2.0         | 13.20        |
| 914.08               | 23.5        | 34.7         | 915.08               | 1.7         | 12.90        |
| 914.10               | 21.7        | 32.9         | 915.10               | 3.0         | 14.20        |
| 914.12               | 20.1        | 31.3         | 915.12               | 1.9         | 13.10        |
| 914.14               | 18.5        | 29.7         | 915.14               | 2.1         | 13.30        |
| 914.16               | 17.1        | 28.3         | 915.16               | 2.1         | 13.30        |
| 914.18               | 15.8        | 27.0         | 915.18               | 2.6         | 13.80        |
| 914.20               | 14.2        | 25.4         | 915.20               | 2.1         | 13.30        |
| 914.22               | 13.1        | 24.3         | 915.22               | 2.2         | 13.40        |
| 914.24               | 12.0        | 23.2         | 915.24               | 2.0         | 13.20        |
| 914.26               | 11.3        | 22.5         | 915.26               | 3.1         | 14.30        |
| 914.28               | 10.2        | 21.4         | 915.28               | 2.1         | 13.30        |
| 914.30               | 9.1         | 20.3         | 915.30               | 2.0         | 13.20        |
| 914.32               | 8.7         | 19.9         | 915.32               | 3.4         | 14.60        |
| 914.34               | 7.5         | 18.7         | 915.34               | 3.1         | 14.30        |
| 914.36               | 7.3         | 18.5         | 915.36               | 3.2         | 14.40        |
| 914.38               | 6.9         | 18.1         | 915.38               | 3.8         | 15.00        |
| 914.40               | 6.5         | 17.7         | 915.40               | 3.9         | 15.10        |
| 914.42               | 5.3         | 16.5         | 915.42               | 3.0         | 14.20        |
| 914.44               | 5.5         | 16.7         | 915.44               | 4.4         | 15.60        |
| 914.46               | 5.5         | 16.7         | 915.46               | 5.0         | 16.20        |
| 914.48               | 5.0         | 16.2         | 915.48               | 5.2         | 16.40        |
| 914.50               | 3.2         | 14.4         | 915.50               | 3.5         | 14.70        |
| 914.52               | 4.7         | 15.9         | 915.52               | 5.4         | 16.60        |
| 914.54               | 4.6         | 15.8         | 915.54               | 6.0         | 17.20        |
| 914.56               | 4.1         | 15.3         | 915.56               | 6.2         | 17.40        |
| 914.58               | 2.5         | 13.7         | 915.58               | 5.8         | 17.00        |
| 914.60               | 3.6         | 14.8         | 915.60               | 7.3         | 18.50        |
| 914.62               | 3.3         | 14.5         | 915.62               | 7.9         | 19.10        |
| 914.64               | 2.9         | 14.1         | 915.64               | 8.6         | 19.80        |
| 914.66               | 3.2         | 14.4         | 915.66               | 9.1         | 20.30        |
| 914.68               | 3.5         | 14.7         | 915.68               | 10.4        | 21.60        |
| 914.70               | 2.2         | 13.4         | 915.70               | 10.7        | 21.90        |
| 914.72               | 2.2         | 13.4         | 915.72               | 11.9        | 23.10        |
| 914.74               | 3.4         | 14.6         | 915.74               | 13.3        | 24.50        |
| 914.76               | 2.0         | 13.2         | 915.76               | 13.8        | 25.00        |
| 914.78               | 2.2         | 13.4         | 915.78               | 15.2        | 26.40        |
| 914.80               | 2.1         | 13.3         | 915.80               | 16.6        | 27.80        |
| 914.82               | 2.7         | 13.9         | 915.82               | 18.3        | 29.50        |
| 914.84               | 2.1         | 13.3         | 915.84               | 20.0        | 31.20        |
| 914.86               | 2.1         | 13.3         | 915.86               | 21.7        | 32.90        |
| 914.88               | 1.8         | 13.0         | 915.88               | 23.9        | 35.10        |
| 914.90               | 3.0         | 14.2         | 915.90               | 26.1        | 37.30        |
| 914.92               | 1.2         | 12.4         | 915.92               | 28.5        | 39.70        |
| 914.94               | 2.1         | 13.3         | 915.94               | 30.9        | 42.10        |
| 914.96               | 1.5         | 12.7         | 915.96               | 32.1        | 43.30        |
| 914.98               | 2.0         | 13.2         | 915.98               | 34.8        | 46.00        |

System Center Frequency = 915.00 MHz

LONG RANGER 2000/ISM900-1



**EXHIBIT 11: Test Report for Utilicom Up/Down Converter FCC ID: LFO-ISM2400**

**33 Pages**

## EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER

### I. GENERAL INFORMATION

Requirement: Federal Communications Commission (FCC)  
Certification under FCC Rule Part 15  
(Technical Requirements: 15.205, 15.247)

Applicant: Utilicom  
323 Love Place  
Goleta, CA 93117

Product ID: FCC ID: LFO-ISM2400

### II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Utilicom 900/2400 Up/Down converter consists of a previously certificated spread spectrum transceiver (FCC ID: LFO-ISM900) connected via coaxial cable to a 2.4 GHz up/down converter. No hardware modifications were made to the LFO-ISM900. See Brief Product Description by Utilicom for further details of design and operation.

### III. TEST LOCATION

All emissions tests were performed at:

EC Labs  
Electronic Compliance Laboratories, Inc.  
1249 Birchwood Drive  
Sunnyvale, CA 94089

EC Labs has site descriptions on file with the FCC for 10m and 3m site configurations. Radiated emissions from the digital portion of the EUT were performed on the 10 m site.

AC line conducted emissions were performed in a screen room.

#### **IV. TEST PROCEDURES**

##### **Radiated Emissions**

**Test Requirement: 15.205**

1. The EUT was placed on a wooden turntable on the outdoor ground plane. The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation.
2. The turntable was slowly rotated to locate the direction of maximum emission at each harmonic and L.O. emission falling in the restricted bands of 15.205.
3. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recored in the data listed below.

**Test Results:** Refer to attached tabular data sheets

##### **Conducted Emissions**

**Test Requirement: 15.207**

1. The EUT was placed on a wooden table located near one wall of a screen room.
2. The AC-DC converter used by the LFO-ISM900 as a power supply was plugged into the LISN.
3. With EUT transmitting , line conducted data was taken.

**Test Results:** Refer to attached spectrum analyzer data charts

##### **Mimimum 6 dB Bandwidth for DSSS**

**Test Requirement: 15.247(a)(2)**

A spectrum analyzer was connected to the EUT antenna output port via a short coaxial cable. If required to protect the measurement instrument from overload, a coaxial attenuator was also used

The analyzer center frequency was set to the EUT carrier frequency. Using the analyzer DISPLAY LINE and MARKER DELTA functions, the 6 dB bandwith of the emission was determined.

**Test Results:** Refer to attached spectrum analyzer data charts

Coaxial Attenuator: ☒ Not used

☐ Attenuation Used: \_\_\_\_\_dB

**RF Power Output****Test Requirement: 15.247(b)**

The output of the EUT was connected directly to a power meter. If required to protect the measurement instrument from overload, a coaxial attenuator was also used.

Power level was read directly from the meter.

Coaxial Attenuator: ☒ Not used                      ☐ Attenuation Used:\_\_\_\_\_dB

**Test Results**

| <b>TX F, MHz</b> | <b>Power Meter Reading</b> | <b>Power Out (mW)</b> |
|------------------|----------------------------|-----------------------|
| 2452             | 16.8                       | 47.9                  |
| 2464             | 16.6                       | 45.7                  |
| 2475             | 16.4                       | 43.7                  |

Antenna Gain: 3 - 4 dBi

Power reduction:              ☐ Required              ☒ Not required

**Out of Band Measurements****Test Requirement: 15.247(c)**

A spectrum analyzer was connected to the EUT antenna output port via a short coaxial cable. If required to protect the measurement instrument from overload, a coaxial attenuator was also used.

The analyzer RES BW was set to 100 kHz. Sufficient spectrum analyzer chartes were produced to cover up to the 10th harmonic of the transmit frequency.

The maximum transmitter power was recorded on each chart using the spectrum analyzer DISPLAY LINE function.

**Test Results:** Refer to attached spectrum analyzer data charts

Coaxial Attenuator: ☒ Not used                      ☐ Attenuation Used:\_\_\_\_\_dB

**DSSS Power Density****Test Requirement: 15.247(d)**

A spectrum analyzer was connected to the EUT antenna output port via a short coaxial cable. If required to protect the measurement instrument from overload, a coaxial attenuator was also used.

The analyzer center frequency was set to the EUT carrier frequency. The frequencies between which maximum RF emissions occurred were determined using the analyzer DISPLAY LINE and MARKER DELTA functions. The START and STOP frequencies of the analyzer sweep were set to these frequencies.

Analyzer BW was set to 3 kHz. Analyzer SWEEP TIME was set according to the following formula:

$$\text{SWEEP TIME} = (\text{FSTOP,kHz} - \text{FSTART,kHz})/3 \text{ kHz.}$$

The transmitter emissions so measured were compared to the 8 dBm limit in the Rules.

**Test Results:** Refer to attached spectrum analyzer data charts

Coaxial Attenuator: ☒ Not used                      ☐ Attenuation Used: \_\_\_\_\_ dB

**Processing Gain of a DSSS****Test Requirement: 15.247(e)**

Processing gain was determined by analysis by the manufacturer. Please refer to the attached processing gain information provided by the manufacturer.

**V. CERTIFICATION OF DATA**

All radiated and conducted measurements described in this report were performed by, or were witnessed and supervised by, the undersigned. To the best of his knowledge and belief, test equipment calibrations, test procedures, and test data were accurate and as reported here.



T.N. COKENIAS

## EQUIPMENT USED TO PERFORM TESTS

| DESCRIPTION                | MFR.            | MODEL    | S/N        | TEST           |
|----------------------------|-----------------|----------|------------|----------------|
| Horn Antenna               | EMCO            | 3115     | 543        | 15.205         |
| Spectrum Analyzer          | HP              | 8563A    | 1183       | above 6.9 GHz  |
| Spectrum Analyzer          | HP              | 85462A   | 3325A0137  | .45 - 6900 MHz |
| Power Meter                | HP              | 435B     | n/a        | 15.247(b)      |
| Preamplifier               | HP              | 8449B    | 3008A00527 | 15.205         |
| LISN                       | Electro Metrics | ANS-25/2 | 2532       | 15.207         |
| High Pass AC Line Filter   | Solar           | 7801-5.0 | n/a        | 15.207         |
| High Pass Microwave Filter | Microlab        | HA-150   | n/a        | 15.205         |
| RF Cable                   | Andrews         | helix    | n/a        | all            |

## **RADIATED EMISSIONS(15.205)**

|              |                         |                         |            |
|--------------|-------------------------|-------------------------|------------|
| 34915        | FCC RADIATED DATA SHEET |                         |            |
| EUT: up/down |                         | CUSTOMER NAME: Utilicom |            |
| RULE PAI     | 15.205                  | 15.247, 15.205          |            |
| DIST dB: 0   |                         | DUTY dB: 0              | ATTN dB: 0 |
|              |                         | HP IL dB: 1             |            |
|              |                         |                         |            |

| FREQ.  | READING | Pk, QP, | A.F. | Cable loss | AMP   | O.C.F. | TOTAL,   | LIMIT    | DELTA |
|--------|---------|---------|------|------------|-------|--------|----------|----------|-------|
| MHz    | dB(uV)  | or Av   | dB   | dB         | dB    | dB     | dB(uV/m) | dB(uV/m) | dB    |
| ch 128 |         |         |      |            |       |        |          |          |       |
| 4925.8 | 44.8    | Pk      | 31.4 | 7.0        | -35.5 | 1      | 48.73    | 74.0     | -25.3 |
| 4925.8 | 35.1    | Av      | 31.4 | 7.0        | -35.5 | 1      | 39.03    | 54.0     | -15.0 |
| 1547   | 25.7    | Pk      | 24.3 | 4.5        | 0.0   | 1      | 55.52    | 74.0     | -18.5 |
| 1547   | 21.4    | Av      | 24.3 | 4.5        | 0.0   | 1      | 51.22    | 54.0     | -2.8  |
| ch240  |         |         |      |            |       | 1      |          |          |       |
| 4948   | 48.6    | Pk      | 31.4 | 7.0        | -35.9 | 1      | 52.13    | 74.0     | -21.9 |
| 4948   | 41.2    | Av      | 31.4 | 7.0        | -35.9 | 1      | 44.73    | 54.0     | -9.3  |
| 1547   | 21.5    | Av      | 24.3 | 4.5        | 0.0   | 1      | 51.32    | 54.0     | -2.7  |

NOTE:

$f_0 = 1547 \text{ MHz}$

## **CONDUCTED EMISSIONS (15.207)**

00:35:21 AUG 05, 1995  
 AC LINE CONC

(L)

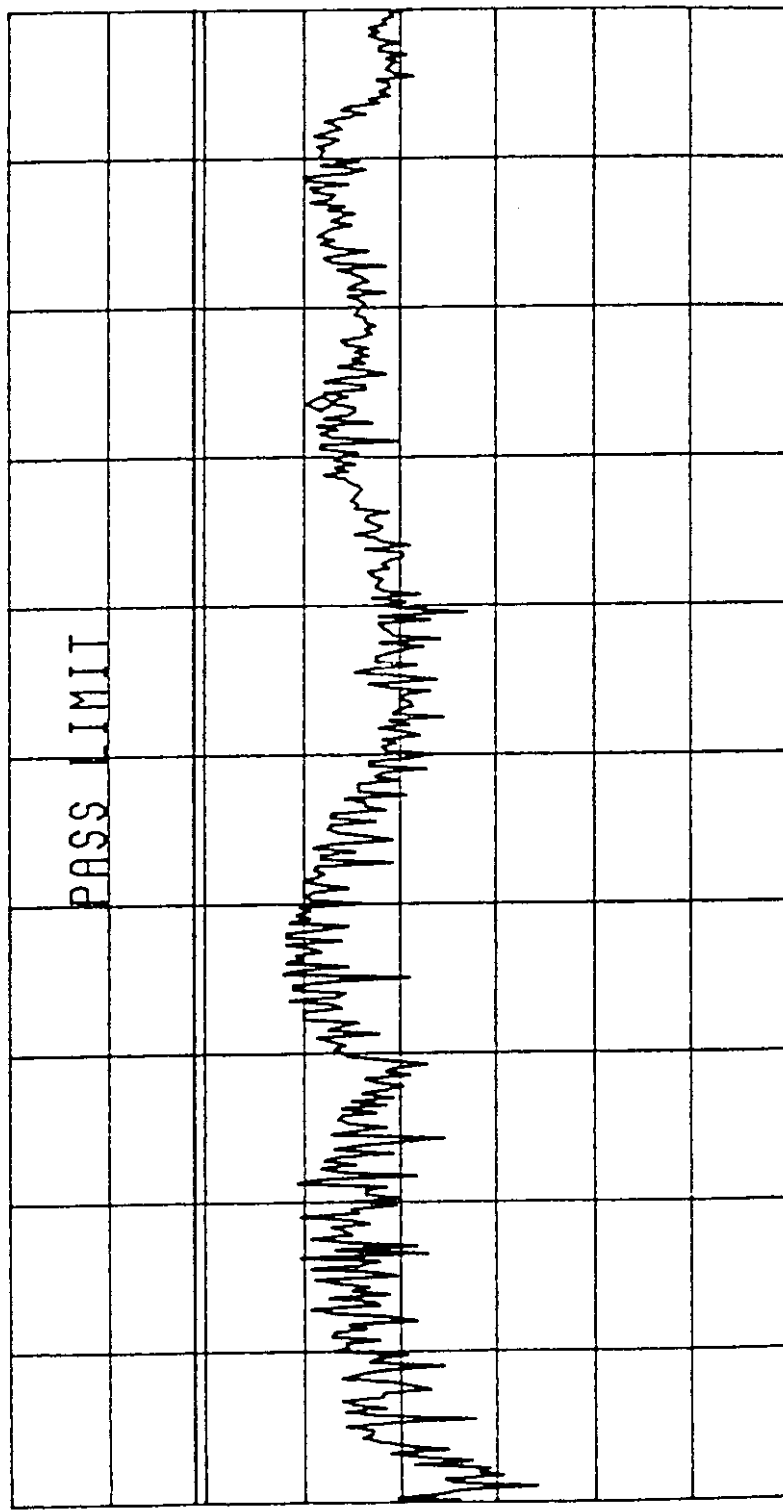
N

ACTV DET: PEAK  
 MEAS DET: PEAK QP AVG  
 MKR 22.17 MHz  
 33.62 dBμV

PREFIX= NAT0

LOG REF 67.0 dBμV

10  
 dB/  
 ATN  
 10 dB



WA SB  
 SC FS  
 CORR

START 450 kHz  
 #IF BW 9.0 kHz  
 #AVG BW 10 kHz  
 STOP 30.00 MHz  
 SWP 2.46 sec

[40]

00:39:24 AUG 05, 1995  
AC LINE CONC UP/CONV

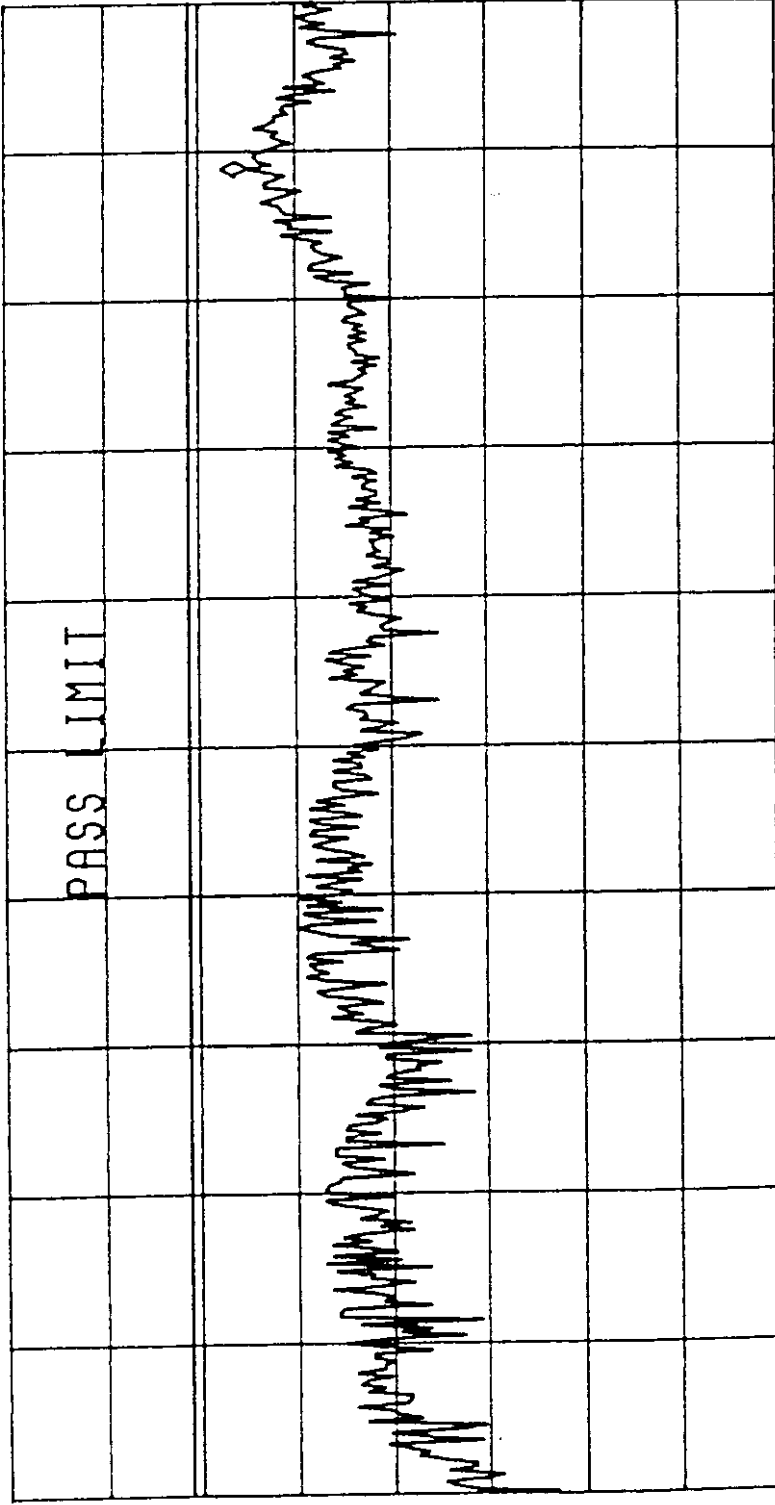
L (N)

SWEPTIME  
2.46 sec

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 26.68 MHz  
41.73 dB $\mu$ V

LOG REF 67.0 dB $\mu$ V

10  
dB/  
ATTN  
10 dB



START 450 kHz  
#IF BW 9.0 kHz  
#AUG BW 10 kHz  
STOP 30.00 MHz  
SWP 2.46 sec

**MINIMUM 6 DB BANDWIDTH (15.247(a)(2))**



21:28:34 AUG 04, 1995  
UTILICOM#/5UP/DOWN CONV 100KHZ OCC

MARKER  $\Delta$   
830 kHz  
-.07 dB

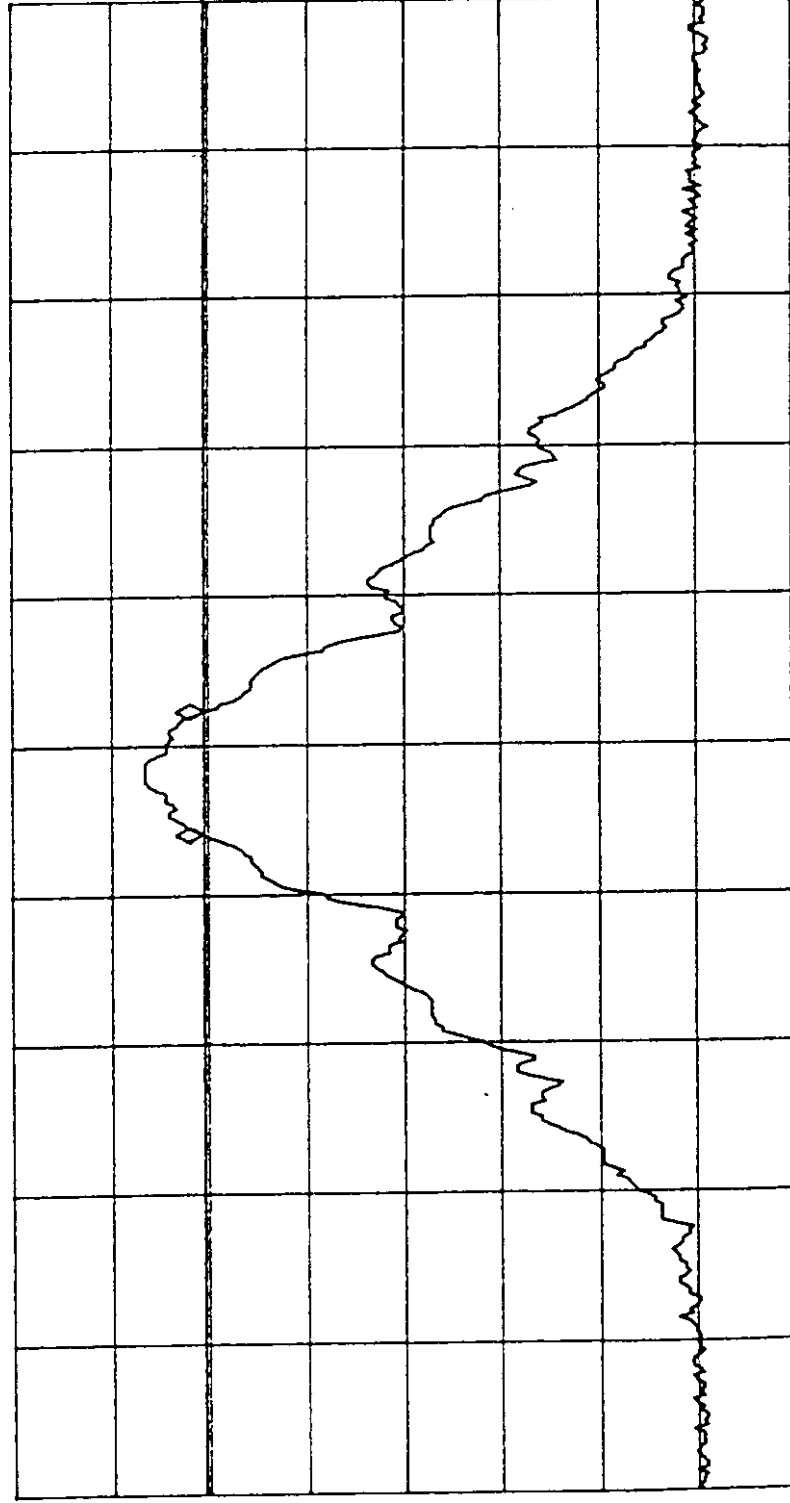
ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR $\Delta$  830 kHz  
-.07 dB

6dB BW

LOG REF 25.0 dBm

10  
dB/  
ATTN  
40 dB

DL  
5.3  
dBm  
MA SB  
SC FC  
CORR



CENTER 2.45170 GHz

#IF BW 100 kHz

AVG BW 30 kHz

SPAN 10.00 MHz

SWP 20.0 msec

22:35:38 AUG 04, 1995  
UP/DOWN 100KHZ OCC CH (128)

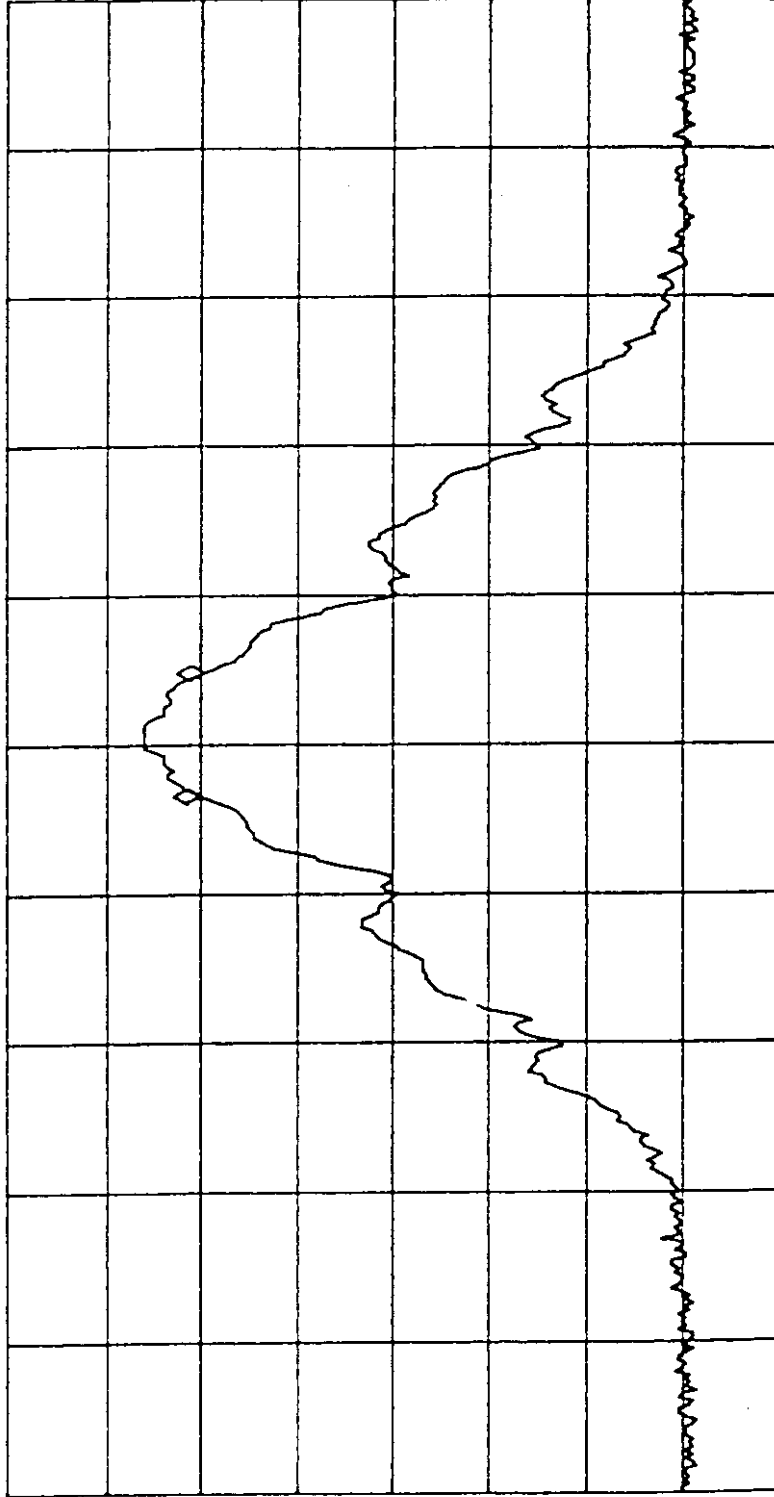
MARKER Δ  
830 kHz  
-.37 dB

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKRΔ 830 kHz  
-.37 dB

6 dB BW

LOG REF 25.0 dBm

10  
dB/  
ATN  
40 dB  
DL  
5.0  
dBm  
MA SB  
SC FC  
CORR



CENTER 2.46275 GHz  
#IF BW 100 kHz  
AUG BW 30 kHz  
SPAN 10.00 MHz  
SWP 20.0 msec



22:12:46 AUG 04, 1995  
UP/DOWN 100KHZ OCC CH 2-40

MARKER  $\Delta$   
820 kHz  
.19 dB

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR $\Delta$  820 kHz  
.19 dB

6dB BW

LOG REF 25.0 dBm

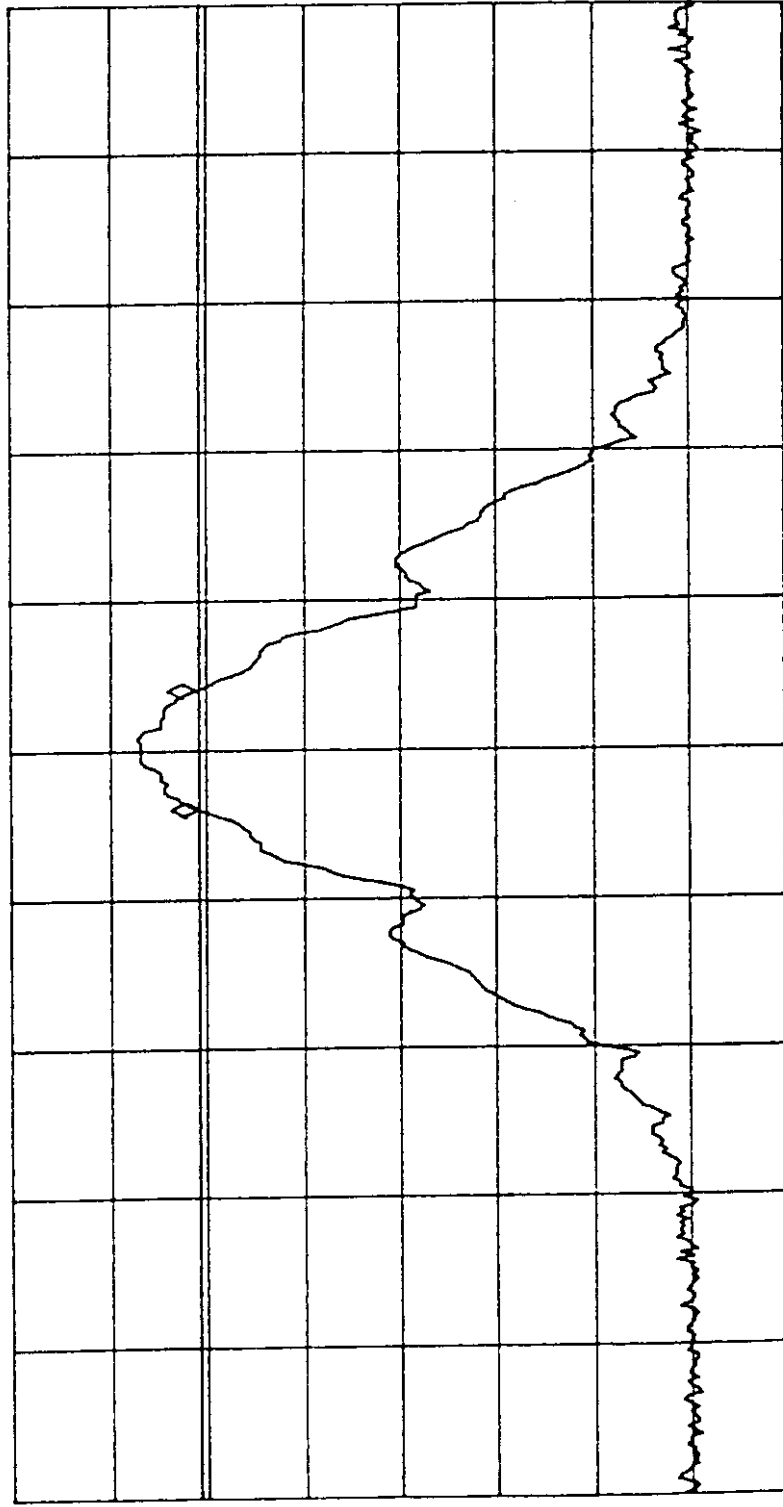
10  
dB/

ATTN

40 dB

DL  
5.8  
dBm

MA SB  
SC FC  
CORR



CENTER 2.47407 GHz

#IF BW 100 kHz

AVG BW 30 kHz

SPAN 10.30 MHz

SWP 20.0 msec

## **OUT OF BAND MEASUREMENTS (15.247(c))**



21:23:40 AUG 04, 1995

UTILICOM#15)UP/DOWN CONV 100KHZ OCC

SPAN

10.00 MHz

ACTV DET: PEAK

MEAS DET: PEAK QP AVG

MKR 2.45150 GHz

11.31 dBm

LOG REF 25.0 dBm

10

dB/

ATTN

40 dB

DL

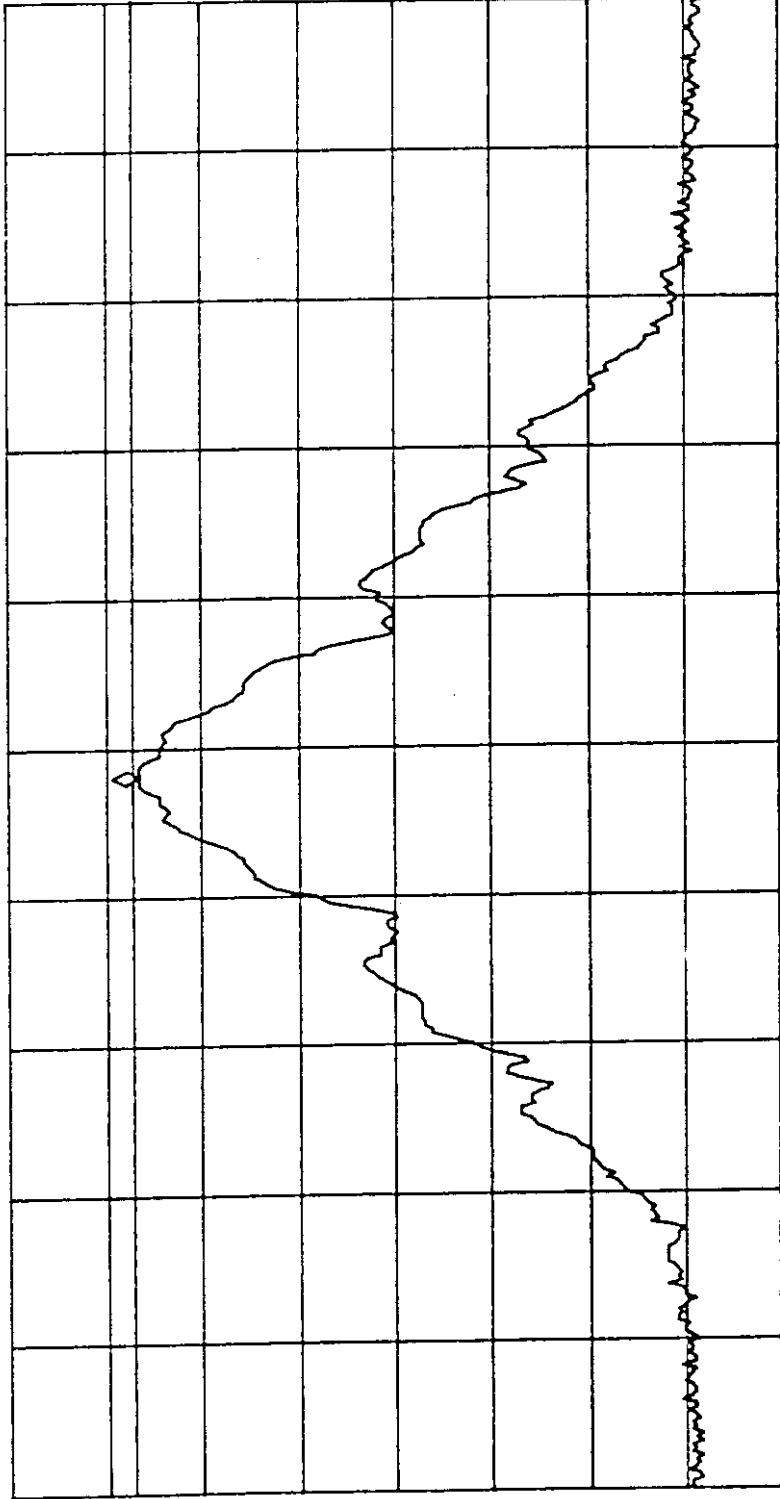
11.8

dBm

MA SB

SC FC

CORR



CENTER 2.45170 GHz

#IF BW 100 kHz

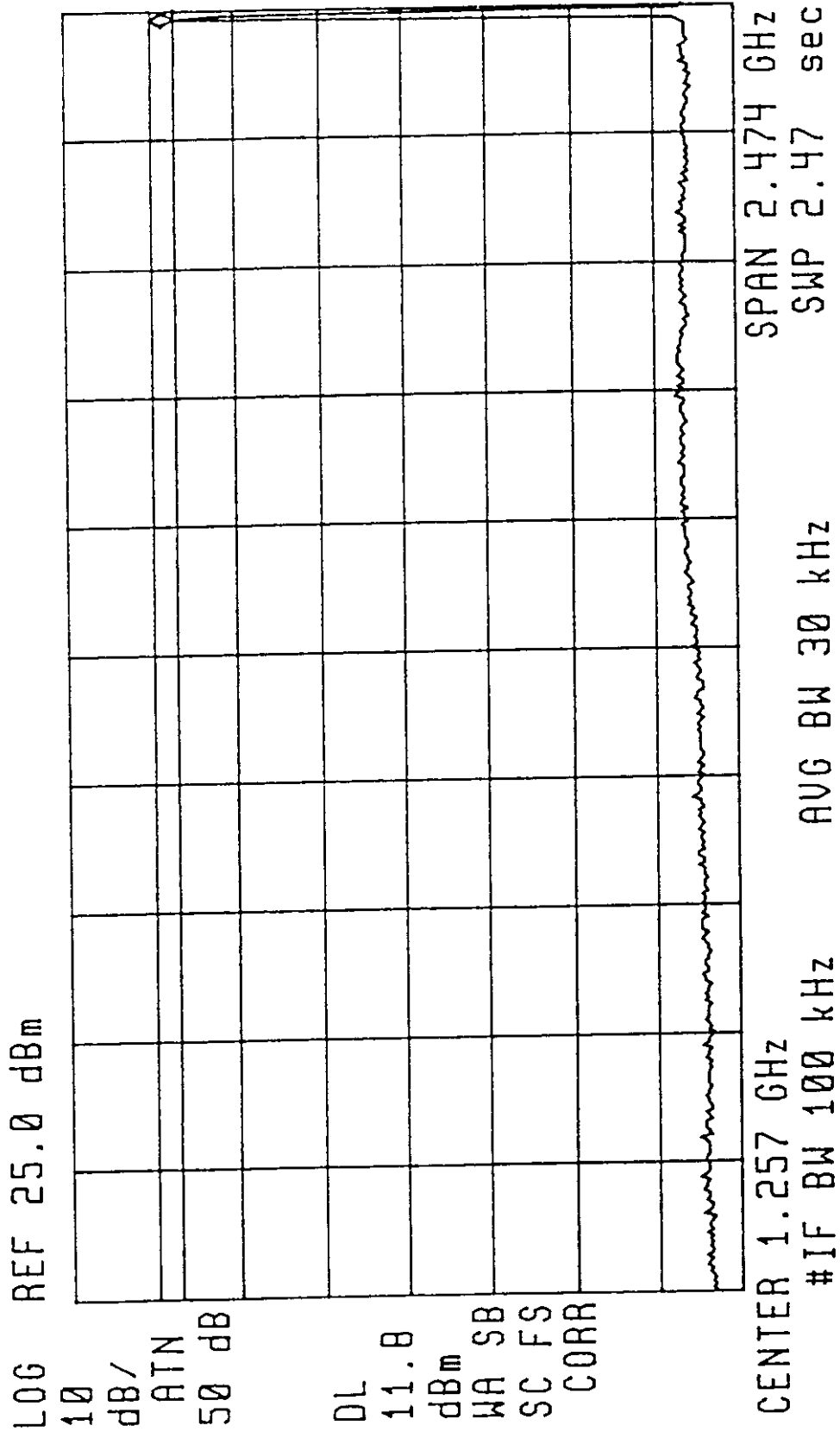
AVG BW 30 kHz

SPAN 10.00 MHz

SWP 20.0 msec

DATE: 06:51 AUG 04, 1995  
UTILICOM#15 UP/DOWN CONV 100KHZ OCC

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.475 GHz  
11.81 dBm





21:11:57 AUG 04, 1995

UTILICOM#15 UP/DOWN CONV 100KHZ OCC

SWEPTIME

4.10 sec

ACTV DET: PEAK

MEAS DET: PEAK QP AVG

MKR 2.441 GHz

11.51 dBm

LOG REF 25.0 dBm

10

dB/

ATN

40 dB

DL

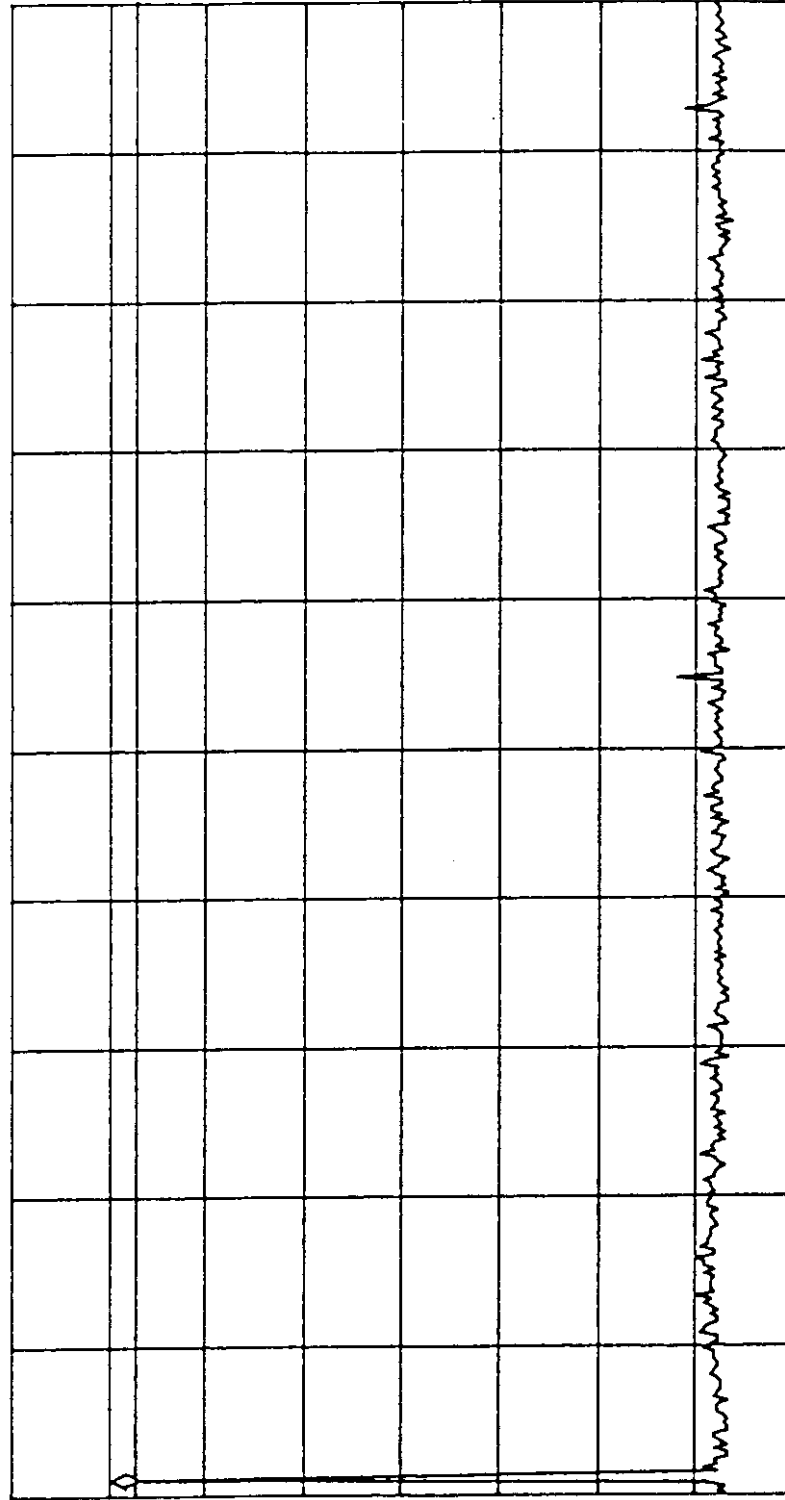
11.8

dBm

WA SB

SC FS

CORR



START 2.400 GHz

#IF BW 100 kHz

AVG BW 30 kHz

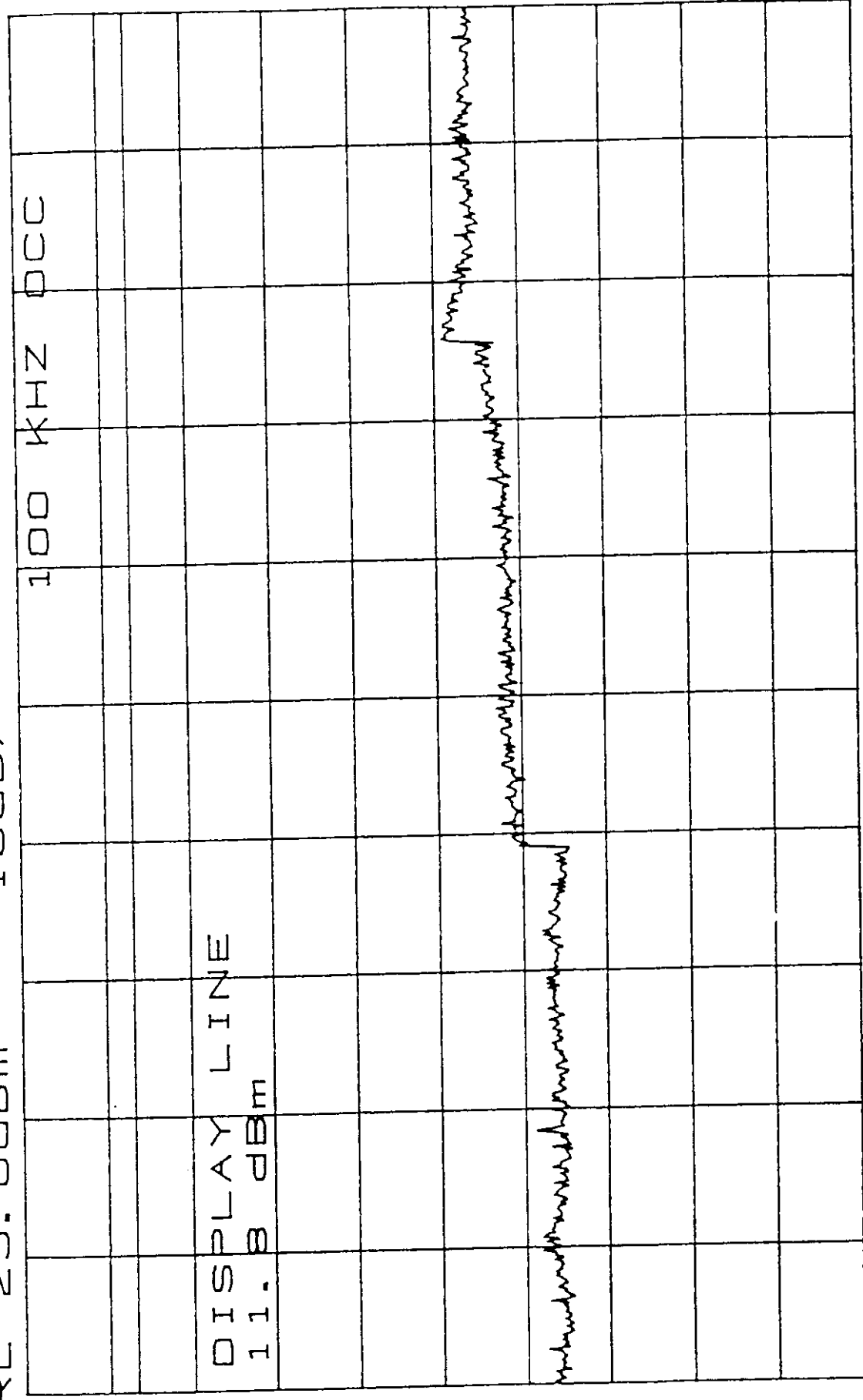
STOP 6.500 GHz

SWP 4.10 sec

UTILICE UP/DOWN CH.15 100kHz OCC

ATTEN 40dB  
RL 25.0dBm

10dB/



DS

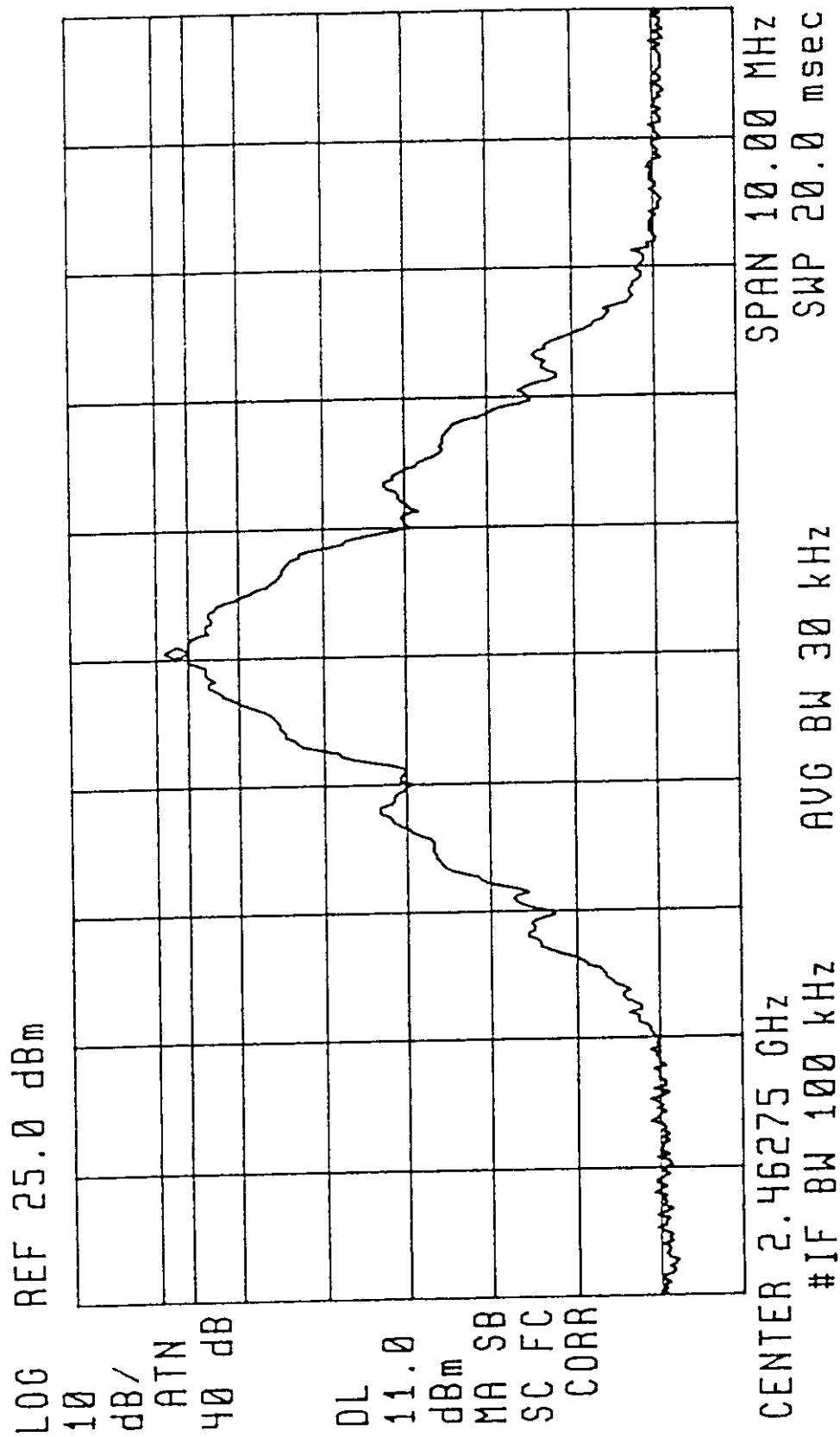
START 6.00GHZ STOP 24.00GHZ  
\*RBW 100KHZ VBW 100KHZ SWP 4.5sec



2:32:27 AUG 04, 1995  
UP/DOWN 100KHZ' OCC CH (128)

ADRS / OPERATION

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.46280 GHz  
11.01 dBm



2:39:53 AUG 04, 1995

128

SWEPTIME

2.88.285

ACTV DET: PEAK

MEAS DET: PEAK QP AVG

MKR 2.490 GHz

11.02 dBm



10

182

DATE

05 1111

00 21

2

0

11.0

DBM

WA SB

535

CORP

3  
3  
3  
3  
3

1  
2  
3  
4  
5

# LIBS

START 20 MHZ

#IF BW 100 kHz

AUG BW 30 kHz

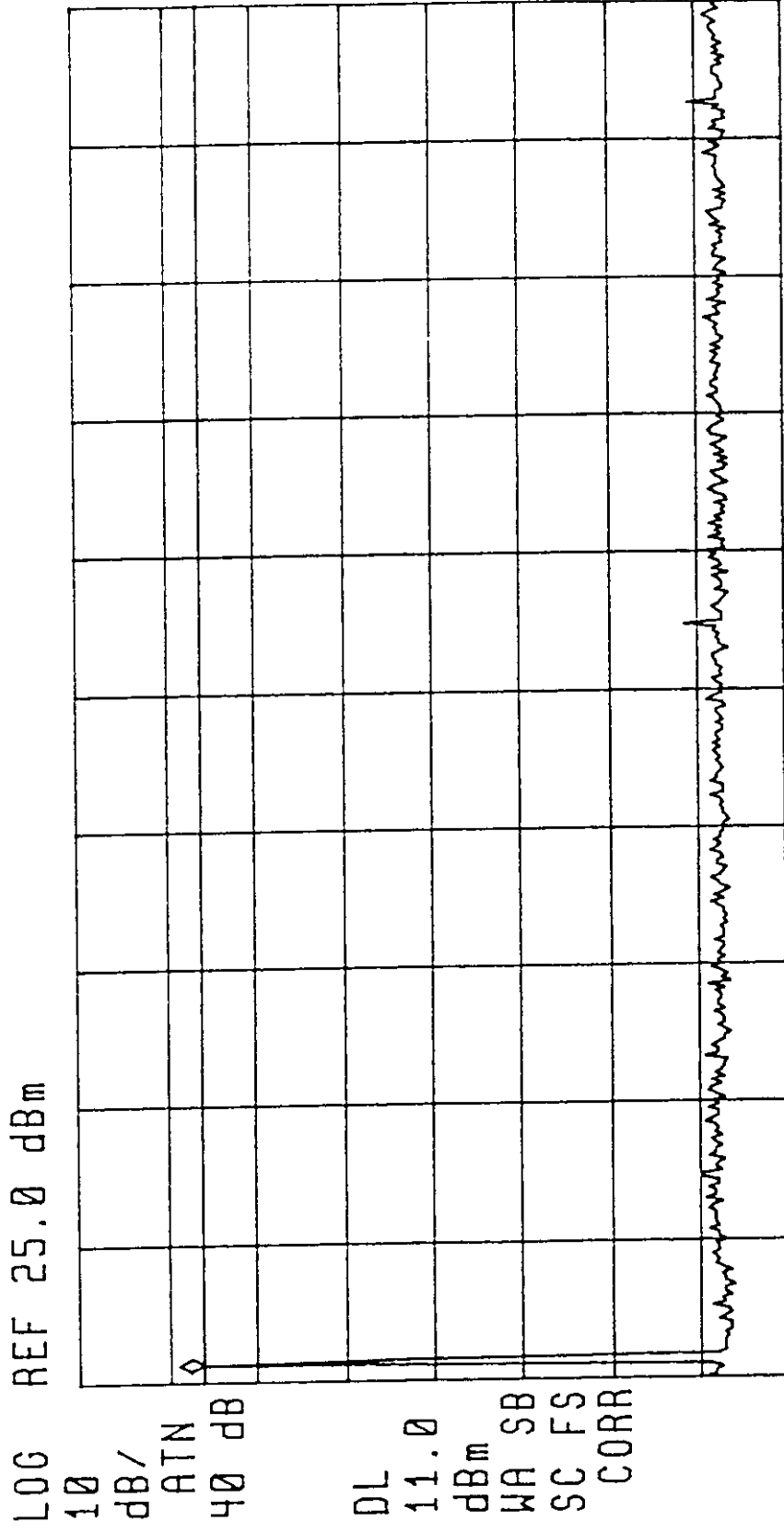
STOP 2.900 GHz

SEP 28 1966

2:42:59 AUG 04, 1995  
UP/DOWN 100KHZ OCC CH 128

SWEPTIME  
4.10 sec

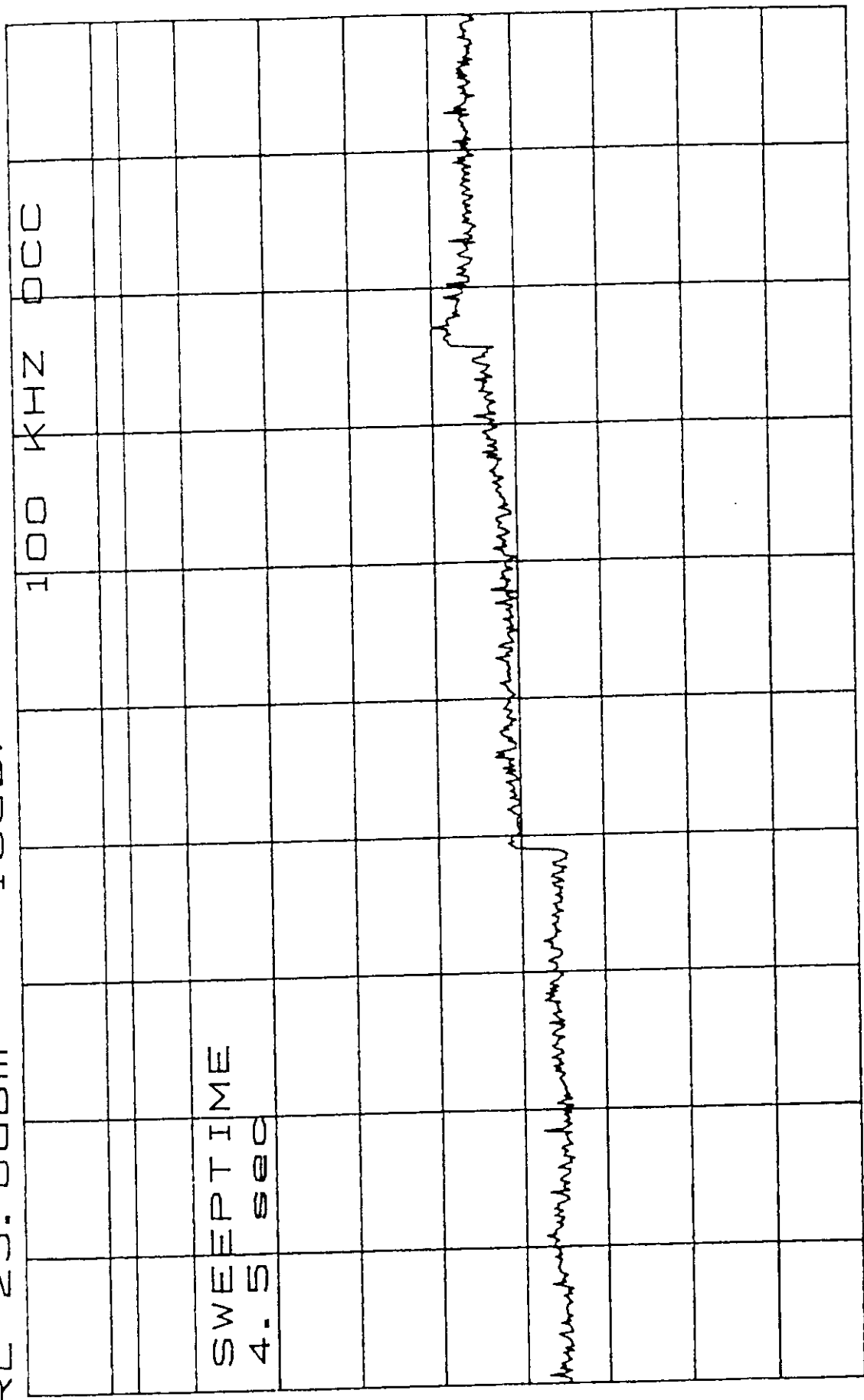
ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.451 GHz  
10.77 dBm



START 2.400 GHz  
#IF BW 100 kHz  
STOP 6.500 GHz  
SWP 4.10 sec  
AUG BW 30 kHz

Ch. 128

ATTEN 40dB  
RL 25.0dBm 10dB/



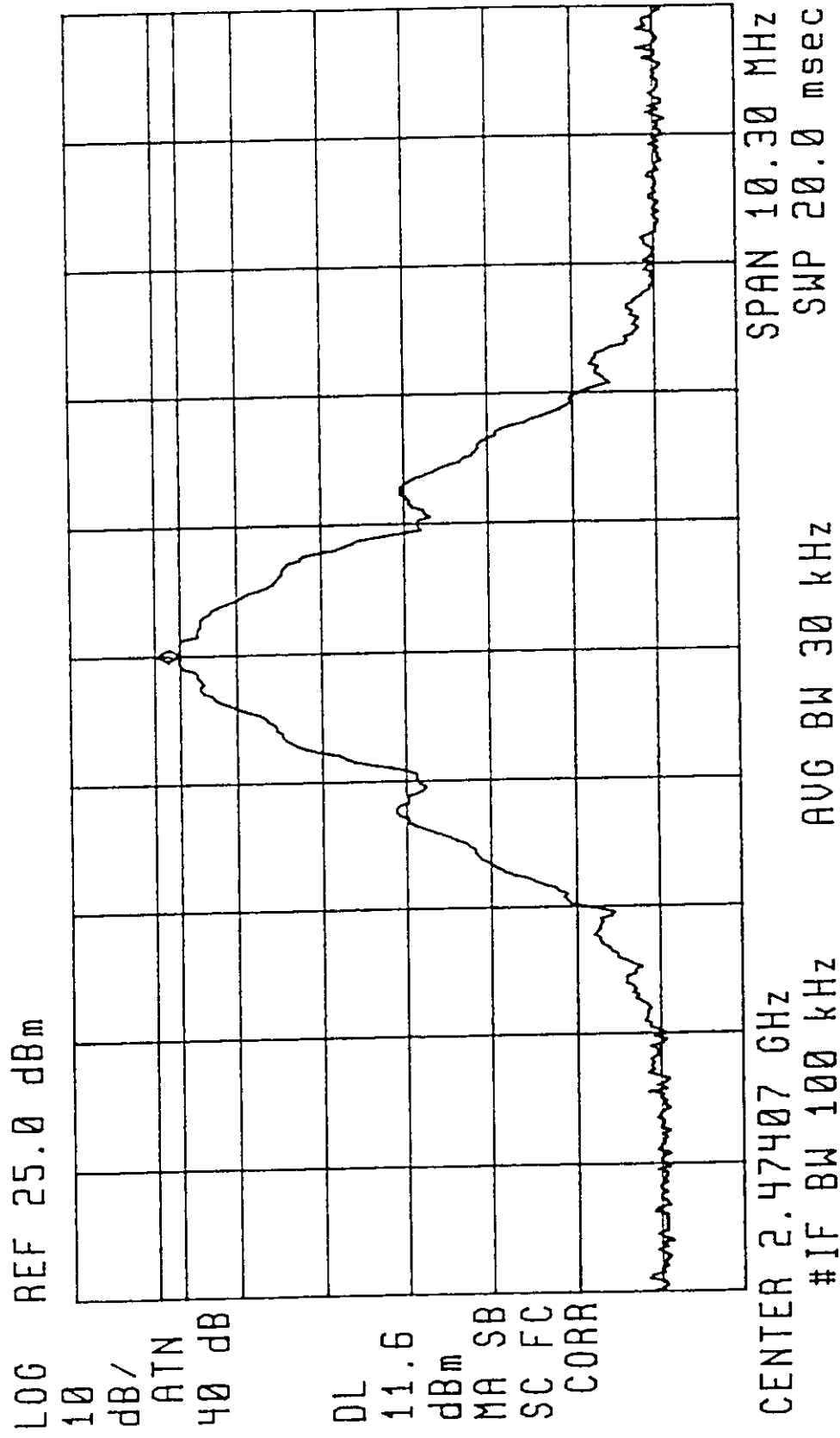
DS

START 6.00GHZ STOP 24.00GHZ  
\*RBW 100KHZ VBW 100KHZ SWP 4.5sec

2:09:41 AUG 04, 1995  
UP/DOWN 100KHZ' OCC CH 240

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.47407 GHz  
11.79 dBm

PREFIX= NATO

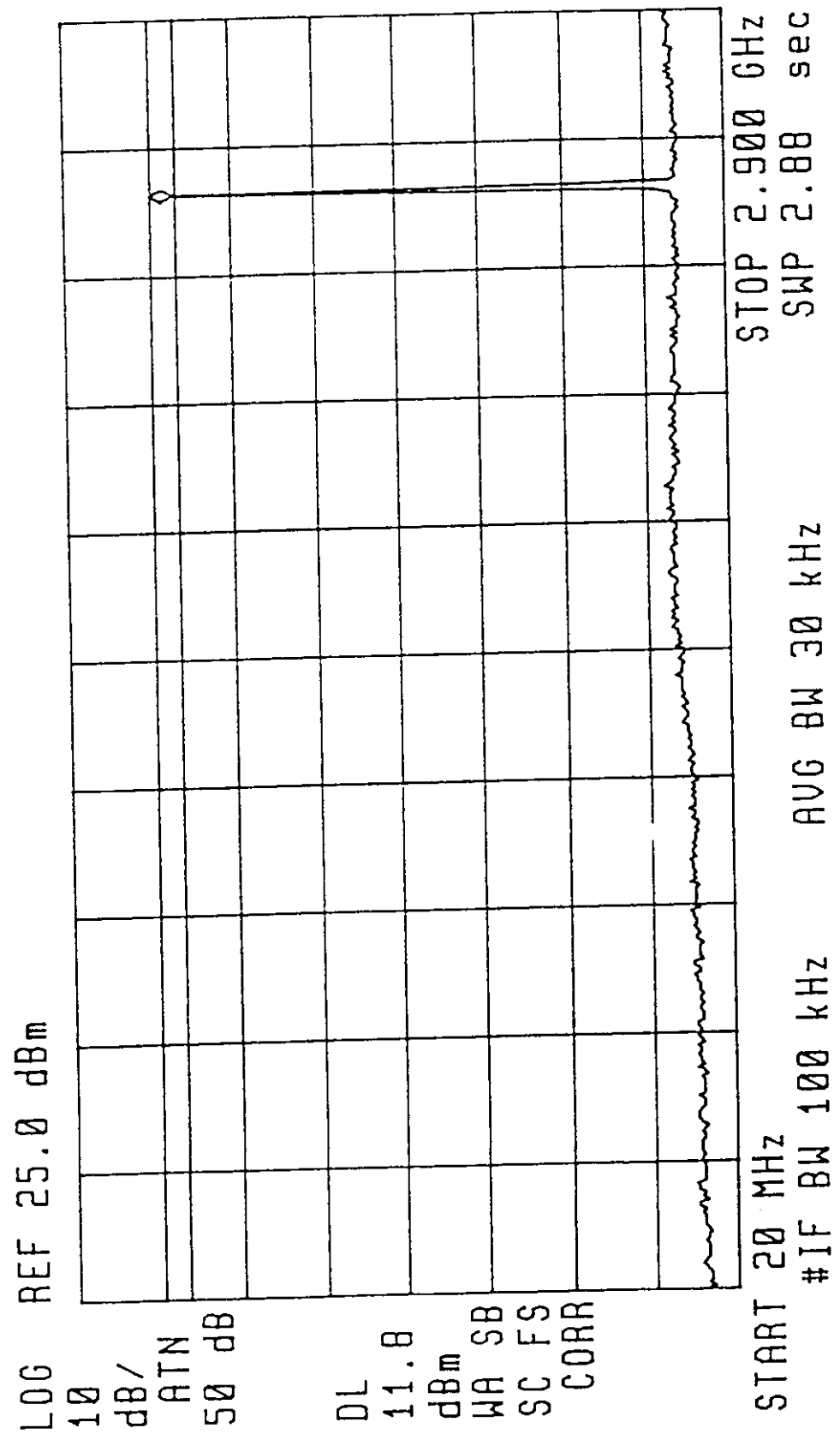




c2:17:15 AUG 04, 1995  
UP/DOWN 100KHZ, OCC CH 240

SWEPTIME  
2.88 sec

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.504 GHz  
11.88 dBm



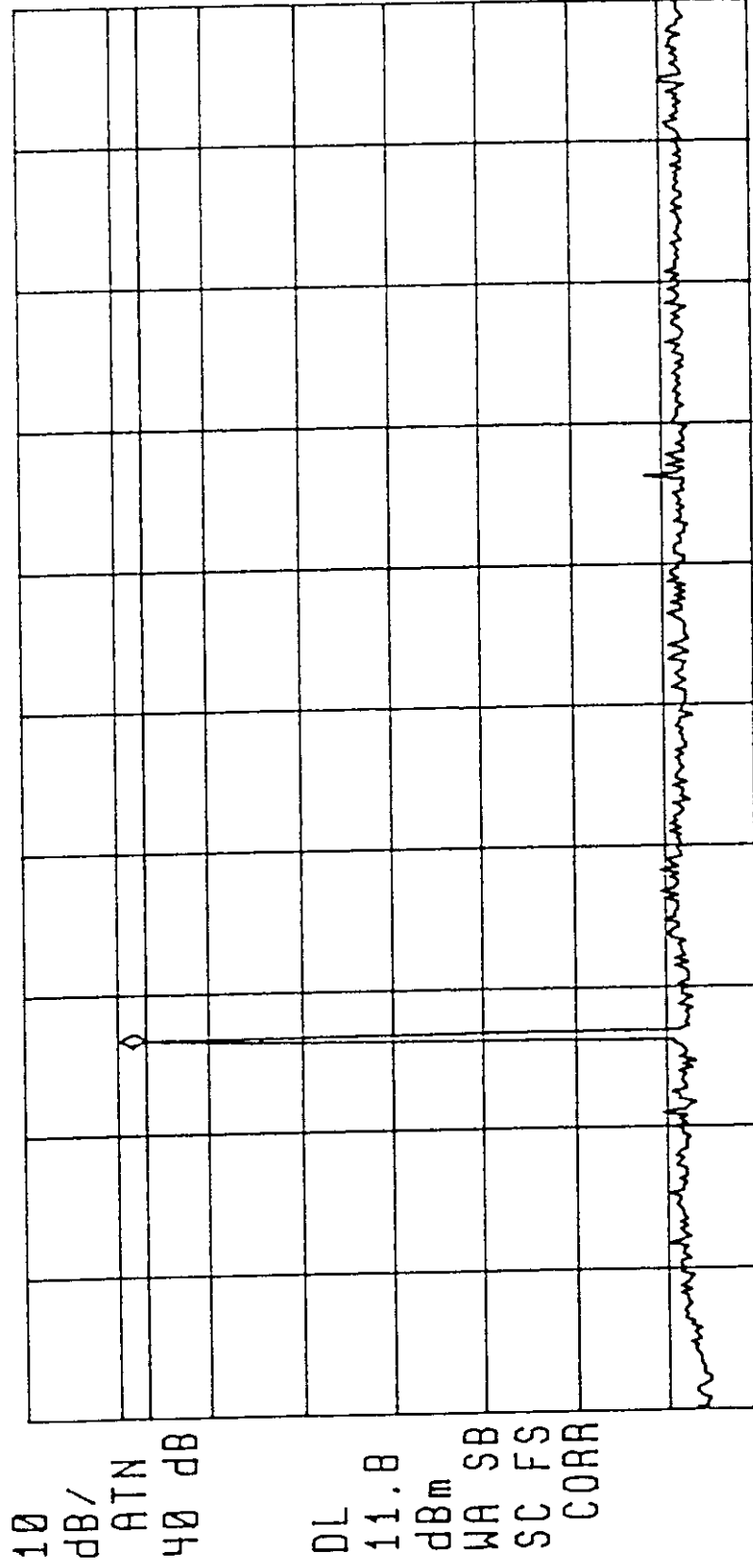


2:20:17 AUG 04, 1995  
UP/DOWN 100KHZ, OCC CH 240

SWEPTIME  
5.50 sec

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.471 GHz  
11.62 dBm

LOG REF 25.0 dBm



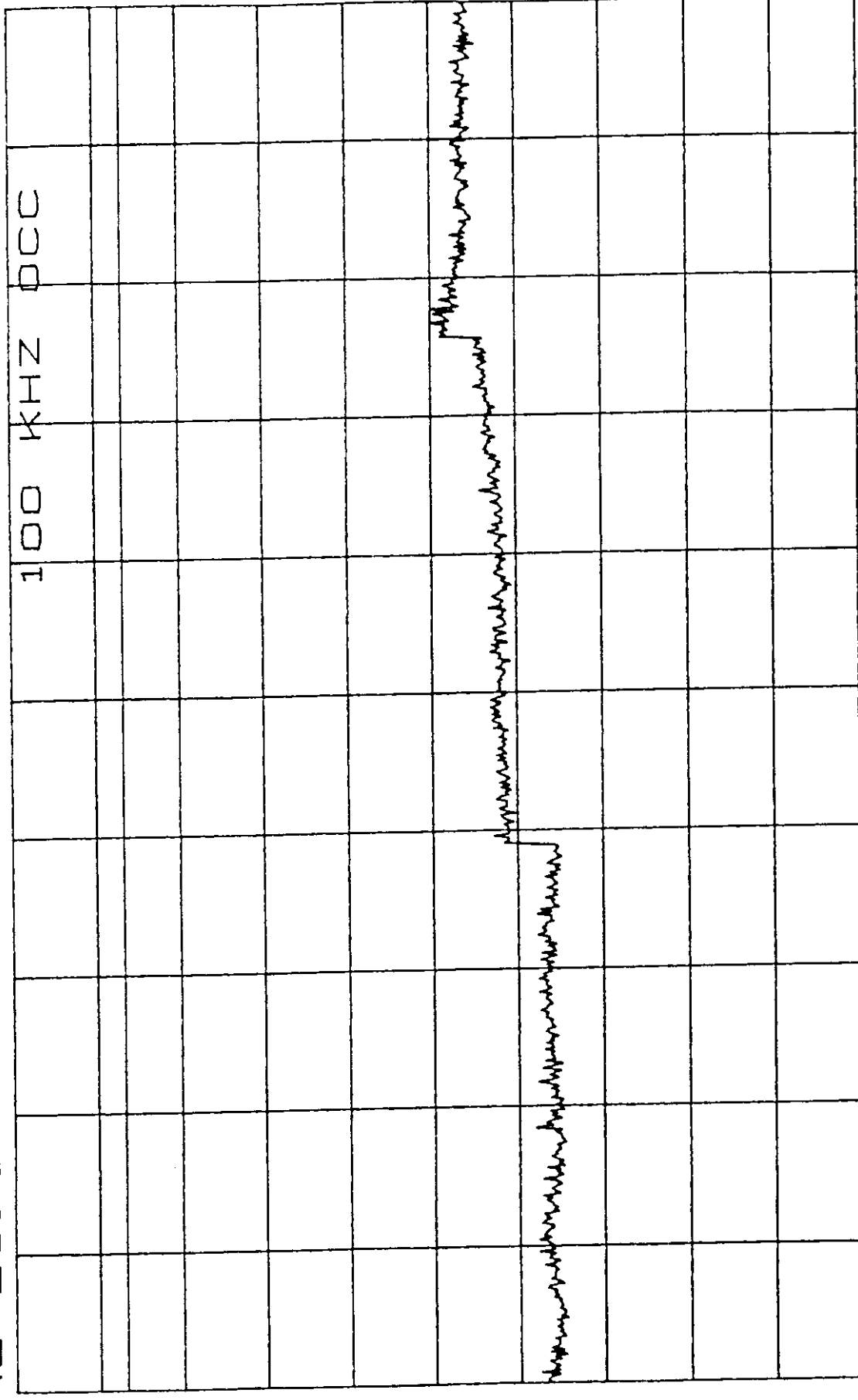
START 1.000 GHz  
#IF BW 100 kHz  
STOP 6.500 GHz  
SWP 5.50 sec  
AVG BW 30 kHz

Ch. 240

ATTEN 40dB

RL 25.0dBm

10dB/



DS

START 6.00GHz

STOP 24.00GHz

\*RBW 100kHz

VBW 100kHz

SWP 4.5sec

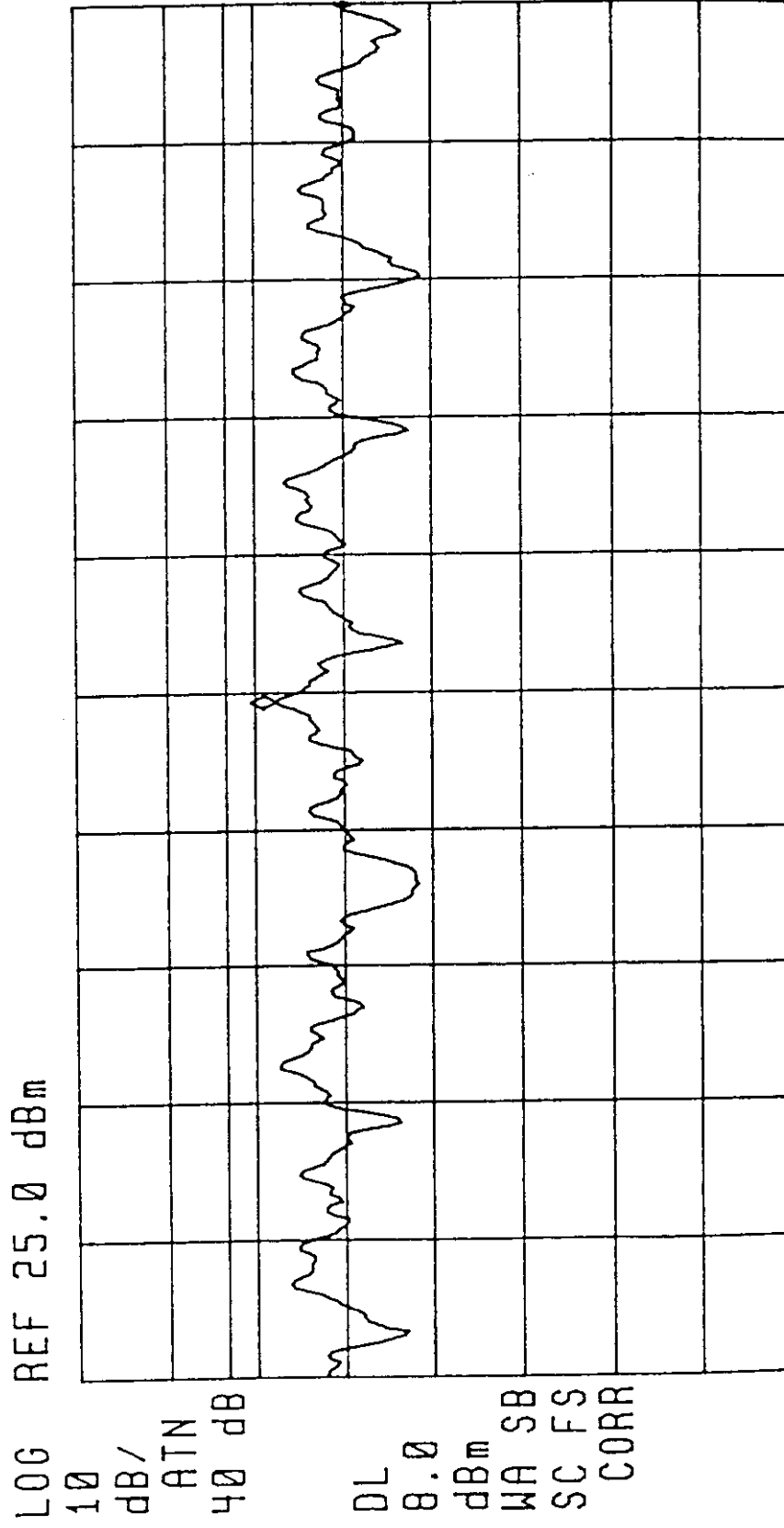
## **DSSS POWER DENSITY (15.247(d))**

Ch-15

21:56:17 AUG 04, 1995  
CH 15 UP/DOWN PWR DENSITY

SWEPTIME  
100 sec

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.4515407 GHz  
2.30 dBm

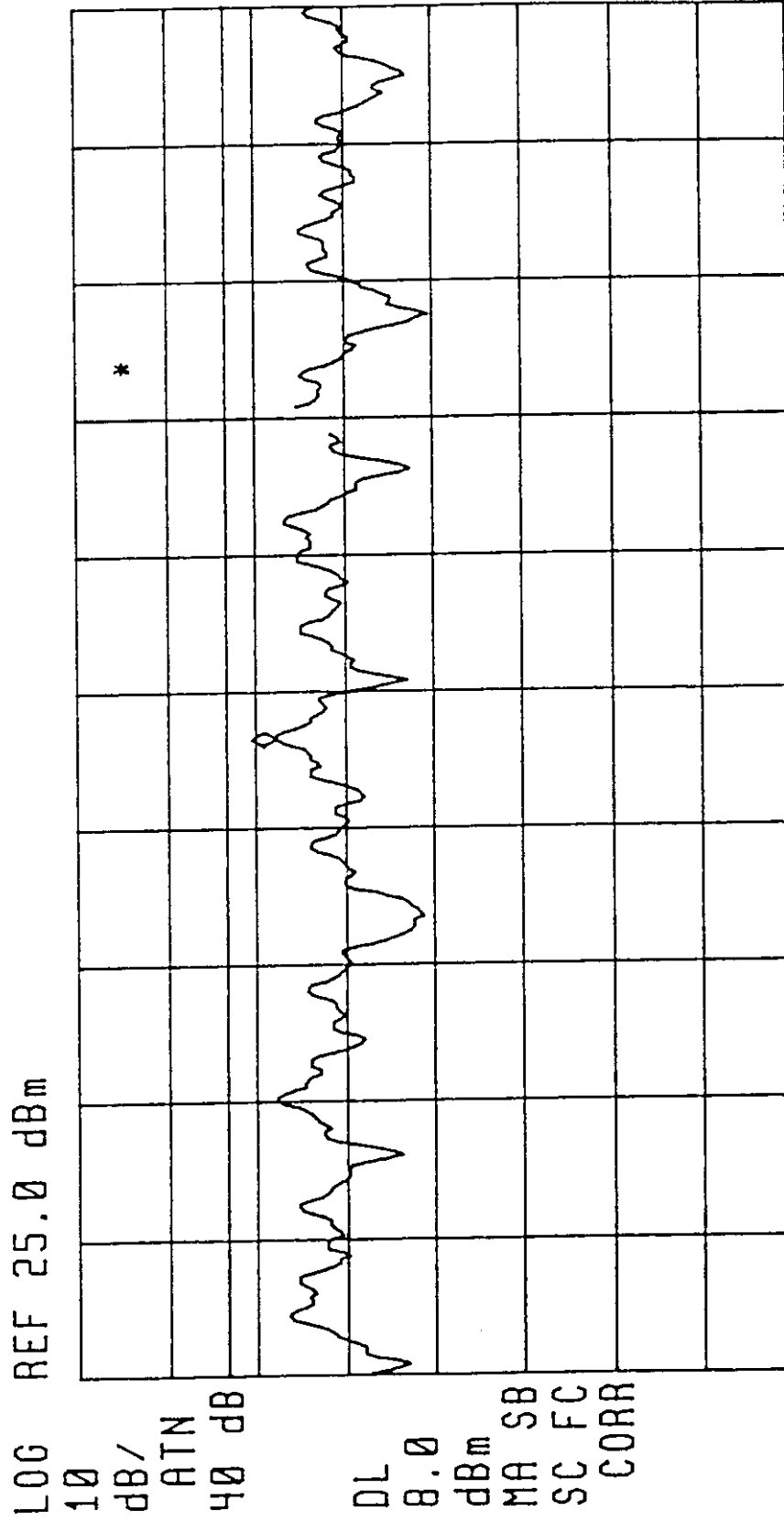


Ch 128

11:50:49 AUG 04, 1995  
CHUP/DOWN PWR DENSITY

SWEPTIME  
100 sec

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.4628405 GHz  
2.35 dBm



CENTER 2.4628510 GHz  
#IF BW 3.0 kHz  
AUG BW 3 kHz  
SPAN 300.0 kHz  
#SWP 100 sec

22:02:47 AUG 04, 1995  
CH UP/DOWN PWR DENSITY

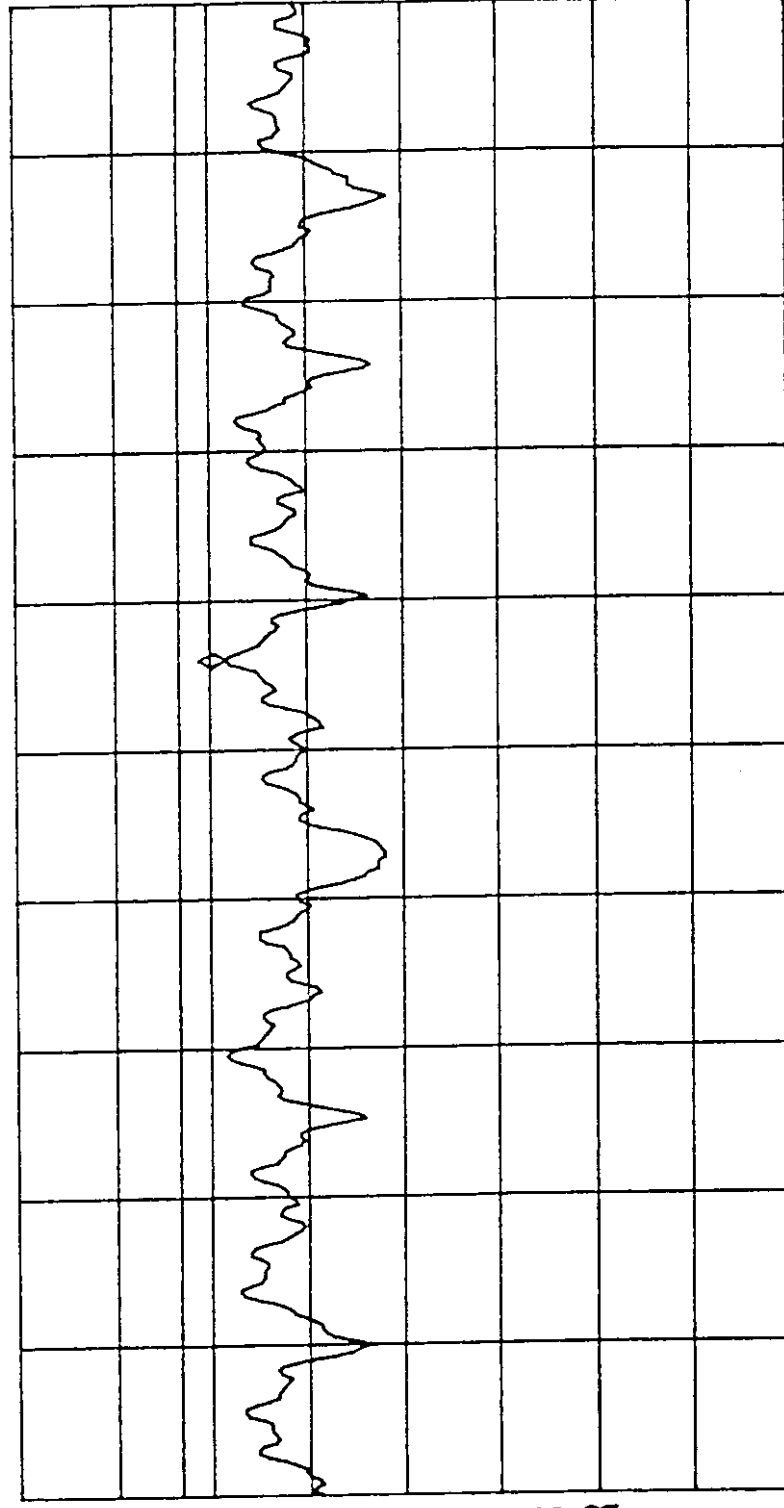
SWEPTIME  
100 sec

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.4740407 GHz  
3.07 dBm

LOG REF 25.0 dBm

10  
dB/  
ATTN  
40 dB

DL  
8.0  
dBm  
WA SB  
SC FS  
CORR



CENTER 2.4740227 GHz

#IF BW 3.0 kHz

AVG BW 3 kHz

SPAN 300.0 kHz  
#SWP 100 sec

## DSSS PROCESSING GAIN CALCULATIONS

Processing gain for the LFO-ISM2400 is identical to the processing gain of the previously certificated LFO-ISM900, since the -2400 product is a frequency translation only of of the -900 product.

Please refer to processing gain information already on file for FCC ID: LFISM900.