

# **FCC CERTIFICATION REPORT**

for

**Symbol Technologies, Inc.**

**FCC ID: H9PWWC1046**

## **1.0 Introduction**

This report has been prepared on behalf of Symbol Technologies, Inc. to support the attached Application for Equipment Authorization. The test and application are submitted for an Intentional Radiator under Section 15.249 of the FCC Rules and Regulations. The Equipment Under Test was the Symbol Technologies, Inc. WWC 1046 Dual Transmitter.

All measurements herein were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and field Strength Instrumentation. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

All measurements are performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code 200066-0) as an independent test laboratory.

The results of this test report relate only to the item tested. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government.

## **1.1 Summary**

The Symbol Technologies, Inc. WWC 1046 Dual Transmitter complies with the limits for an Intentional Radiator under Section 15.249.

## **2.0 Description of Equipment Under Test (EUT)**

The Symbol Technologies, Inc. WWC 1046 Dual Transmitter controls all functions of a Symbol Technologies' Wearable Scanning System (WSS). The battery powered system is an infrared scanner used for data collection and consists of a ring scanner and wearable wrist computer (WWC). The WWC provides the user interface to the system, scanner control, and radio communication link. The WWC 1046 contains a 2.4 GHz spread spectrum transmitter PCMCIA card used to communicate with a remote PC that collects the data from the WSS. The unit also contains a second short range radio transmitter that operates at 926 MHz and is used to provide wireless printing capability for the system.

The WWC is already FCC approved, FCC ID: H9PWWC1049, with a 916.5 MHz low power transmitter and 2.4 GHz spread spectrum transmitter. This application is for the WWC 1046 which contains the 926 MHz low power transmitter and the same 2.4 GHz spread spectrum transmitter as the already FCC approved unit, FCC ID: H9PWWC1049. The two units are identical except for the transmit frequency of the low power transmitter. Data for the 2.4 GHz spread spectrum transmitter is provided from the previously approved application, FCC ID: H9PWWC1049, since the layout and placement for this transmitter is the same as the previous unit.

*Symbol Technologies, Inc.  
H9PWWC1046  
WLL Project #: 4497X*

The digital portion of the unit was FCC verified during testing of the original WWC and this portion of the unit was not changed.

## **2.1 On-board Oscillators**

The Symbol Technologies, Inc. WWC 1046 Dual Transmitter contains an FCC approved Spectrum 24 Wireless LAN PCMCIA card, FCC ID: H9PLA2400, for the 2.4 GHz spread spectrum transmitter and a RF Monolithics ASH transmitter for the 926 MHz low power transmitter. The digital section of the unit the unit contains a 16 MHz and 32.768 kHz oscillator.

## **3.0 Test Configuration**

To complete the test configuration required by the FCC, the system was powered on and tested in all three orthogonal planes.

### **3.1 Testing Algorithm**

The transmitter was turned on and continuously transmitting. Worst case emissions are recorded in the data tables.

### **3.2 Conducted Emissions Testing**

Conducted emissions testing is not required since the EUT is battery powered.

### **3.3 Radiated Emissions Testing**

The EUT was then placed on an 80 cm high 1 x 1.5 meters non-conductive motorized turntable for radiated testing on a 3 meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Biconical log periodic and horn broadband antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preselector or preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak for frequencies below 1000 MHz and peak for frequencies above 1000 MHz. For frequencies below 1000 MHz, the measurement bandwidth on the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. For frequencies above 1000 MHz, the resolution bandwidth on the spectrum analyzer system was set to 1 MHz and the video bandwidth on the spectrum analyzer system was set to 1 MHz for peak measurements.

### 3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 1. The AFc in dB/m is algebraically added to the Spectrum Analyzer Voltage in dBμV to obtain the Radiated Electric Field in dBμV/m.

Only peak measurements were taken above 1 GHz and compared to the average limit. Quasi-peak measurements were taken for emissions below 1 GHz.

Example:

|                             |                                            |
|-----------------------------|--------------------------------------------|
| Spectrum Analyzer Voltage:  | VdBμV                                      |
| Composite Antenna Factor:   | AFcdB/m                                    |
| Electric Field:             | $EdB\mu V/m = VdB\mu V + AFcdB/m$          |
| To convert to linear units: | $E\mu V/m = \text{antilog}(EdB\mu V/m/20)$ |

Data is recorded in Table 1.

**Table 1****Radiated Emissions Test Per 15.249**

CLIENT: Symbol Technologies, Inc.  
 FCC ID: H9PWWC1046  
 DATE: 4/9/98  
 BY: Steve Koster  
 JOB #: 4497X

| FREQ    | POL | Azimuth | Ant<br>Height | SA LEVEL<br>(QP) | AFc   | E-FIELD | E-FIELD | LIMIT   | MARGIN  |
|---------|-----|---------|---------------|------------------|-------|---------|---------|---------|---------|
| MHz     | H/V | Degree  | m             | dBuV             | dB/m  | dBuV/m  | uV/m    | uV/m    | dB      |
| 168.01  | V   | 135.00  | 1.0           | 7.6              | 11.2  | 18.8    | 8.7     | 150.0   | -24.7   |
| 926.00  | H   | 225.00  | 1.0           | 47.9             | 28.5  | 76.4    | 6590.2  | 50000.0 | -17.6   |
|         |     |         |               | Peak             |       |         |         |         |         |
| 1000.00 | H   | 0.00    | 1.0           | 33.5             | -16.2 | 17.3    | 7.3     | 500.0   | -36.7 * |
| 1852.13 | V   | 180.00  | 1.0           | 35.9             | -6.9  | 29.0    | 28.2    | 500.0   | -25.0   |
| 2778.00 | H   | 0.00    | 1.0           | 33.9             | -13.5 | 20.4    | 10.5    | 500.0   | -33.6 * |
| 3704.25 | H   | 225.00  | 1.0           | 34.7             | -6.0  | 28.7    | 27.2    | 500.0   | -25.3   |
| 4630.32 | H   | 225.00  | 1.0           | 34.7             | -4.5  | 30.2    | 32.4    | 500.0   | -23.8   |
| 7408.00 | H   | 0.00    | 1.0           | 32.0             | 4.0   | 36.0    | 63.2    | 500.0   | -18.0 * |
| 8334.00 | H   | 0.00    | 1.0           | 32.6             | 4.8   | 37.4    | 74.1    | 500.0   | -16.6 * |

\* No emissions from the EUT were detected at these frequencies. Ambient levels were recorded.

## **Table 2**

### **System Under Test**

FCC ID: H9PWWC1046

---

EUT: Symbol Technologies, Inc. WWC 1046 Dual Transmitter; FCC ID: H9PWWC1046; S/N: ALPH0582

---

## **Table 3**

### **Measurement Equipment Used**

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP 8568B

Hewlett-Packard Spectrum Analyzer: HP 8593A

Hewlett-Packard Quasi-Peak Adapter: HP 85650A

Hewlett-Packard Preselector: HP 85685A

Hewlett-Packard Preamplifier: HP 8449B

Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520

Antenna Research Associates Horn Antenna: DRG-118/A

Solar 50  $\Omega$ /50  $\mu$ H Line Impedance Stabilization Network

Washington Laboratories Portable Antenna Mast

AH Systems, Inc. Motorized Turntable

RG-214 semi-rigid coaxial cable

RG-223 double-shielded coaxial cable

## **EXHIBIT 1**

### **EUT PHOTOGRAPHS**

## **EXHIBIT 2**

### **MAXIMUM RADIATED EMISSIONS CONFIGURATION**

## **Technical Description**

### **2.4 GHz Spread Spectrum Transmitter**

### 2.1.3 Radio Section

The radio portion of uses a frequency hopping spread spectrum method over an extended range of 2.4 to 2.5 GHz, with actual operating frequency bands depending on various countries' regulations. The FH channels are 1 MHz wide, with nominal channel centers at the 1 MHz increments and hop dwell times up to a maximum of 400 msec. The radio transmits and receives at 1 Mbps using a binary GFSK modulation with  $BT=0.5$  and minimum deviation of 160 KHz ( $h=0.32$ ).

The radio portion is designed in two versions. The first version is a minimum cost 100 mW transmit power radio with a stuffing option for antenna diversity. The second is a higher power version scaleable from 250 mW to 500 mW, with antenna diversity included. Antenna diversity improves performance in multipath environments by constantly testing and using the best of two nearly independent propagation paths. Diversity is only used for receiving; the transmit path is hardwired to a single antenna.

The radio is designed with two synthesizers, a frequency hopped and a fixed frequency synthesizer. The radio uses a upconversion transmitter with a 371 MHz IF and a ( $f_c - 371$ ) MHz LO to produce the output signal at  $f_c$ . The output of the fixed frequency synthesizer is divided down with two different modulus values to provide different frequencies for transmit IF and receiver second LO. The receiver uses a 5.888 MHz second IF for FM demodulation.

In transmit mode, transmit data is filtered by a 3-pole Bessel low pass filter with 3 dB bandwidth of 0.5 MHz and summed with the fixed frequency synthesizer loop error at the input of the VCO. Compensation is used to reduce data bias tracking within the loop.

In receive mode, the received signal is input into an FM demodulator which has two output signals. The RSSI output of the FM demodulator is routed to an A/D with a parallel interface to Crux. DC offset at the baseband output of the demodulator is removed with a switchable time constant RC filter. The bias compensated signal is then sliced into a bi-level signal and input into Crux. Crux performs a carrier sense algorithm, recovers the symbol timing, and converts the signal into bits. Upon detection of the start frame delimiter, Crux sends a signal back to the radio to switch the RC time constant from fast to slow.

The receiver uses a SAW band-pass filter at the IF frequency. The SAW 3 dB bandwidth is 1 MHz. A low-pass filter after demodulation also limits the bandwidth to approximately 1 MHz.

### 2.1.4 Hopping Pattern

The hopping pattern for USA FCC 15.247 and Europe ETSI 300-328 is a pseudo-random sequence which selects one of 79, 1 MHz channels centered from 2402 to 2480 MHz.

Each channel is evenly utilized by selecting each channel once and only once in each cycle, and using identical dwells at each channel.

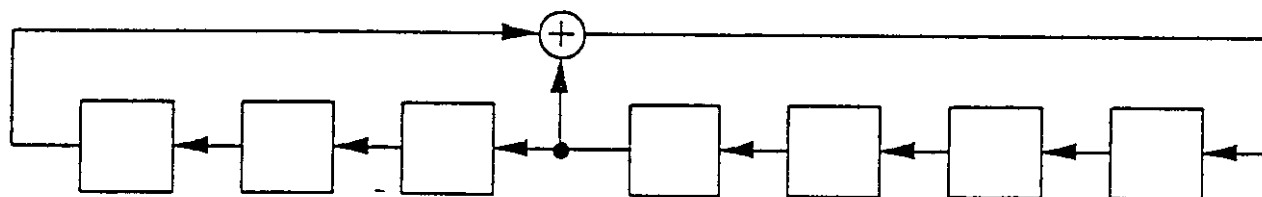
The Spectrum 24 network communicates by half duplex. A transmitter and receiver must and do follow the same hop pattern in synchronization. In this way a unit which wishes to transmit to a receiver which is part of the same association will find on any hop that the potential receivers are also on the same hop at the same time and are following the same sequence.

Each channel is evenly utilized by selecting each channel once and only once in each cycle, and using identical dwells at each channel. The hop pattern does not reset (recycle) until the hop pattern has been completed.

Each channel is equally used by the hop pattern and dwell time operation and each unit is a transceiver with receiver and transmitter following the hop pattern together. The data presented to the transceiver is random and on average evenly distributed in time. The evenly distributed data presented to the transmitter together with the equally distributed channel utilization by the hop pattern and dwell time produce on the average each frequency equally used by the transmitter.

The beacons and any other transmission (or receive) always follow the pseudorandom hopping pattern.

The hopping pattern is based on a pseudo-random sequence generated by a linear shift register with taps corresponding to the irreducible polynomial  $x^7 + x^4 + 1$  as shown in the figure below.



The contents of the registers form 7-bit words with values from 1 to 127. The irreducible polynomial produces a maximal length sequence which mean that each value from 1 to 127 occurs once and only once in each cycle. Values less than 2 and greater than 80 are eliminated, leaving 79 values from 2 through 80 which corresponds to the frequencies 2402 through 2480.

A set of 78 hopping patterns are derived by permutations of the basic pseudo-random sequence. The permutations are derived by a sequential incrementing with modulo wrap-around through the basic pseudo-random sequence with an incremental delta from 1 to

78. Because the number of channels (79) in the hopping set is a prime number, a sequential incrementing through the base pseudo-random sequence using a delta from 1 to 78 will produce a unique sequence that is equally pseudo-random and evenly utilized as the basic pseudo-random sequence.

The basic pseudo-random sequence and the first 8 permutations with deltas of 2 to 9 are shown in the tables below. A delta of 1 reproduces the basic pseudo-random sequence. The values in all columns including the index are between 2 and 80 for a total of 79 channels, and each sequence begins at the same channel as a point of reference.

| Index | Basic PRN Sequence | Delta= 2 | Delta= 3 | Delta= 4 | Delta= 5 | Delta= 6 | Delta= 7 | Delta= 8 | Delta= 9 |
|-------|--------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| 2     | 67                 | 67       | 67       | 67       | 67       | 67       | 67       | 67       | 67       |
| 3     | 7                  | 14       | 29       | 59       | 60       | 75       | 22       | 44       | 50       |
| 4     | 14                 | 59       | 75       | 44       | 73       | 36       | 16       | 64       | 4        |
| 5     | 29                 | 75       | 50       | 36       | 32       | 4        | 34       | 19       | 24       |
| 6     | 59                 | 44       | 36       | 64       | 17       | 19       | 49       | 46       | 48       |
| 7     | 60                 | 73       | 32       | 17       | 38       | 11       | 54       | 12       | 53       |
| 8     | 75                 | 36       | 4        | 19       | 11       | 48       | 51       | 78       | 52       |
| 9     | 22                 | 16       | 34       | 49       | 54       | 51       | 28       | 33       | 47       |
| 10    | 44                 | 64       | 19       | 46       | 12       | 78       | 33       | 62       | 27       |
| 11    | 50                 | 4        | 24       | 48       | 53       | 52       | 47       | 27       | 14       |
| 12    | 73                 | 17       | 11       | 12       | 57       | 21       | 70       | 7        | 18       |
| 13    | 18                 | 68       | 58       | 26       | 80       | 74       | 31       | 50       | 17       |
| 14    | 36                 | 19       | 48       | 78       | 21       | 27       | 60       | 2        | 69       |
| 15    | 72                 | 76       | 6        | 30       | 37       | 63       | 36       | 38       | 3        |
| 16    | 16                 | 49       | 51       | 33       | 70       | 60       | 8        | 58       | 39       |
| 17    | 32                 | 11       | 53       | 21       | 71       | 18       | 76       | 25       | 33       |
| 18    | 64                 | 46       | 78       | 62       | 7        | 2        | 58       | 28       | 37       |
| 19    | 2                  | 45       | 79       | 40       | 75       | 9        | 12       | 66       | 56       |
| 20    | 4                  | 48       | 52       | 27       | 18       | 69       | 39       | 37       | 59       |
| 21    | 8                  | 3        | 66       | 15       | 64       | 54       | 52       | 55       | 72       |
| 22    | 17                 | 12       | 21       | 7        | 34       | 25       | 42       | 14       | 68       |
| 23    | 34                 | 51       | 47       | 60       | 76       | 39       | 40       | 73       | 23       |
| 24    | 68                 | 26       | 74       | 50       | 23       | 61       | 71       | 4        | 12       |
| 25    | 9                  | 41       | 35       | 72       | 48       | 10       | 29       | 76       | 28       |
| 26    | 19                 | 78       | 27       | 2        | 25       | 37       | 73       | 45       | 5        |
| 27    | 38                 | 57       | 71       | 34       | 41       | 13       | 2        | 51       | 20       |
| 28    | 76                 | 30       | 63       | 38       | 79       | 31       | 19       | 57       | 15       |
| 29    | 24                 | 52       | 14       | 69       | 33       | 59       | 23       | 5        | 75       |
| 30    | 49                 | 33       | 60       | 58       | 42       | 73       | 3        | 74       | 32       |
| 31    | 69                 | 5        | 44       | 65       | 74       | 64       | 53       | 56       | 19       |
| 32    | 11                 | 21       | 18       | 25       | 13       | 68       | 30       | 29       | 58       |
| 33    | 23                 | 43       | 16       | 53       | 15       | 49       | 10       | 18       | 51       |
| 34    | 46                 | 62       | 2        | 28       | 14       | 45       | 74       | 8        | 79       |
| 35    | 58                 | 74       | 17       | 61       | 22       | 12       | 55       | 24       | 21       |
| 36    | 45                 | 40       | 9        | 66       | 36       | 41       | 7        | 54       | 35       |
| 37    | 54                 | 70       | 76       | 42       | 2        | 30       | 44       | 77       | 63       |
| 38    | 48                 | 27       | 69       | 37       | 68       | 5        | 32       | 79       | 44       |
| 39    | 65                 | 56       | 46       | 35       | 24       | 62       | 68       | 10       | 2        |
| 40    | 3                  | 15       | 54       | 55       | 46       | 70       | 69       | 20       | 76       |
| 41    | 6                  | 63       | 3        | 31       | 65       | 15       | 48       | 71       | 54       |
| 42    | 12                 | 7        | 25       | 14       | 51       | 29       | 77       | 59       | 26       |
| 43    | 25                 | 29       | 26       | 75       | 39       | 50       | 57       | 36       | 61       |
| 44    | 51                 | 60       | 39       | 73       | 30       | 32       | 66       | 17       | 43       |
| 45    | 77                 | 22       | 57       | 16       | 66       | 34       | 62       | 49       | 13       |
| 46    | 26                 | 50       | 61       | 4        | 43       | 24       | 13       | 48       | 7        |
| 47    | 53                 | 18       | 33       | 68       | 20       | 58       | 63       | 26       | 73       |
| 48    | 41                 | 72       | 10       | 76       | 27       | 6        | 75       | 30       | 8        |
| 49    | 39                 | 32       | 43       | 11       | 31       | 53       | 72       | 21       | 49       |
| 50    | 78                 | 2        | 37       | 45       | 29       | 79       | 17       | 40       | 65       |
| 51    | 28                 | 8        | 40       | 3        | 44       | 66       | 24       | 15       | 41       |

| Index | Sequence | Basic PRN | Delta= | Delta= | Delta= | Delta= | Delta= | Delta= | Delta= |
|-------|----------|-----------|--------|--------|--------|--------|--------|--------|--------|
|       |          | 2         | 3      | 4      | 5      | 6      | 7      | 8      | 9      |
| 52    | 57       | 34        | 13     | 51     | 72     | 47     | 45     | 60     | 80     |
| 53    | 79       | 9         | 56     | 41     | 4      | 35     | 25     | 72     | 62     |
| 54    | 30       | 38        | 31     | 57     | 9      | 71     | 78     | 34     | 55     |
| 55    | 61       | 24        | 7      | 52     | 49     | 14     | 80     | 69     | 29     |
| 56    | 52       | 69        | 59     | 5      | 58     | 44     | 43     | 65     | 36     |
| 57    | 80       | 23        | 22     | 43     | 3      | 16     | 35     | 53     | 34     |
| 58    | 33       | 58        | 73     | 74     | 77     | 17     | 15     | 61     | 11     |
| 59    | 66       | 54        | 72     | 70     | 78     | 76     | 59     | 42     | 6      |
| 60    | 5        | 65        | 64     | 56     | 61     | 46     | 18     | 35     | 78     |
| 61    | 10       | 6         | 8      | 63     | 5      | 3      | 4      | 31     | 66     |
| 62    | 21       | 25        | 68     | 29     | 47     | 26     | 38     | 75     | 74     |
| 63    | 42       | 77        | 38     | 22     | 40     | 57     | 46     | 16     | 71     |
| 64    | 43       | 53        | 49     | 18     | 55     | 33     | 6      | 68     | 60     |
| 65    | 47       | 39        | 23     | 32     | 63     | 43     | 41     | 11     | 16     |
| 66    | 62       | 28        | 45     | 8      | 59     | 40     | 61     | 3      | 9      |
| 67    | 37       | 79        | 65     | 9      | 50     | 56     | 21     | 41     | 46     |
| 68    | 74       | 61        | 12     | 24     | 16     | 7      | 20     | 52     | 25     |
| 69    | 20       | 80        | 77     | 23     | 8      | 22     | 56     | 43     | 57     |
| 70    | 40       | 66        | 41     | 54     | 19     | 72     | 14     | 70     | 10     |
| 71    | 35       | 10        | 28     | 6      | 69     | 8      | 50     | 63     | 40     |
| 72    | 70       | 42        | 30     | 77     | 45     | 38     | 64     | 22     | 31     |
| 73    | 13       | 47        | 80     | 39     | 6      | 23     | 9      | 32     | 22     |
| 74    | 27       | 37        | 5      | 79     | 26     | 65     | 11     | 9      | 64     |
| 75    | 55       | 20        | 42     | 80     | 28     | 77     | 65     | 23     | 38     |
| 76    | 56       | 35        | 62     | 10     | 52     | 28     | 26     | 6      | 45     |
| 77    | 71       | 13        | 20     | 47     | 10     | 80     | 79     | 39     | 77     |
| 78    | 15       | 55        | 70     | 20     | 62     | 42     | 5      | 80     | 30     |
| 79    | 31       | 71        | 55     | 13     | 35     | 20     | 37     | 47     | 42     |
| 80    | 63       | 31        | 15     | 71     | 56     | 55     | 27     | 13     | 70     |

### 2.1.5 Power Conservation

There are two methods of power conservation used in to maximize battery life. The first is at the MAC level where provisions are made for portable units to go to a "sleep" mode and periodically "awake" to check if they have any waiting messages. This requires a time synchronization with all of the terminals within a Basic Service Set. FH networks also require hop frequency synchronization, and both requirements are met by the same provision.

The second method is at the PHY level where sections of the radio are powered up separately only as needed and turned off as soon as possible.

## 3. Interface Definition

### 3.1 External Interfaces

#### 3.1.1 Physical Interface

PCMCIA type II standard interface as specified in PCMCIA Card Services Specification.

#### 3.1.2 Logical Interface

Uses I/O and memory interface

18 bit address

8 bit data

### 3.1.3 Antenna/RF Interface

#### 3.1.3.1 Antenna Connector

Connector type: Proprietary

Number of connectors: 2

Impedance: 50 ohms

#### 3.1.3.2 Channel Frequencies

Frequency range: 2400 to 2500 MHz programmable for different country regulations

Number of channels: 100 programmable in 1 MHz steps for different country regulations

#### 3.1.3.3 Modulation Format

Modulation type: Binary GFSK, Gaussian filter BT = 0.5

Peak frequency deviation: 167 kHz, +/-7 kHz

## 4. Performance Requirements and Objectives

### **4.1 General**

Frequency range: 2400 to 2500 MHz programmable for different country regulations

Number of channels: 100 programmable in 1 MHz steps for different country regulations

Minimum hopping rate: 2.5 hops/sec (per FCC part 15.247)

Hopping sequence: IEEE P802.11

Maximum data bias: +32/-32 bits over all packet lengths

Maximum data run length: 41 bits of consecutive 1's or 0's

### **4.2 Transmit Performance**

Transmit power level: Model chosen based on country regulation and cost

Low power version: 100 mW

Mid power version: 230 mW

High power version: 500 mW

|                                                                                   |                                                                                              |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Maximum radiated EIRP                                                             | FCC regulations part 15.247 in US<br>ETS 300-328 in Europe<br>RCR STD-33 in Japan            |
| Center frequency tolerance:                                                       | $\pm 25$ ppm                                                                                 |
| Modulation:                                                                       | Binary GFSK, Gaussian filter BT = 0.5                                                        |
| Modulator baseline wandering:                                                     | $\leq 20\%$ of nominal peak deviation                                                        |
| Occupied 20 dB bandwidth:                                                         | $\leq 1$ MHz                                                                                 |
| Integrated power in 1 MHz bandwidth relative to total transmit power centered at: |                                                                                              |
| $f_c \pm 2$ MHz                                                                   | $\leq -45$ dBc                                                                               |
| $f_c \pm 3$ MHz                                                                   | $\leq -60$ dBc                                                                               |
| In-band spurs                                                                     | $\leq -50$ dBc (802.11 FH & DS PHY are both -55 dBc)                                         |
| Out-of-band emissions                                                             | FCC regulations part 15.247, 15.209 in US, ETSI 300 - 328 in Europe, and RCR STD-33 in Japan |

#### 4.3 Receive Performance

|                                    |                                                                                                                  |
|------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Sensitivity:                       | $\leq 10^{-3}$ BER @ -85 dBm (min signal level)                                                                  |
| Maximum useable input level:       | $\leq 10^{-3}$ BER @ -10 dBm (1 W @ 1 meter)                                                                     |
| Center frequency acceptance range: | $\pm 25$ ppm                                                                                                     |
| Alternate channel selectivity:     | $\leq 45$ dB for desired signal at 2 dB above minimum signal level and interfering signal $\geq 2$ channels away |

#### 4.4 Timing Requirements

##### WLAN Adapter State Transition Times

|                     |                    |
|---------------------|--------------------|
| Off to Idle         | 1 ms               |
| Idle to Standby     | 8 ms               |
| Transmit to Receive | $< 20 \mu\text{s}$ |
| Receive to Transmit | $< 20 \mu\text{s}$ |

Note: transition times do not include hop frequency synchronization with the access point or ad hoc peers.

|                               |                     |
|-------------------------------|---------------------|
| Hop frequency transition time | $< 225 \mu\text{s}$ |
|-------------------------------|---------------------|

#### 4.5 Power Requirements

Estimates of the average current draw (in mA) versus power conservation state are shown in Figure 6-1.

| State Name:                                         | Sleep | Idle | Standby<br>1 | Standby<br>2 | Receive | Transmit<br>100 mW | Transmit<br>560 mW |
|-----------------------------------------------------|-------|------|--------------|--------------|---------|--------------------|--------------------|
| Sleep registers                                     | 6     | 0.05 | 0.05         | 0.05         | 0.05    | 0.05               | 0.05               |
| 20 MHz                                              | off   | 4    | 4            | 4            | 4       | 4                  | 4                  |
| CPU, arrays, memory                                 | off   | 30   | 100          | 100          | 130     | 130                | 130                |
| Fixed (slow) synth                                  | off   | off  | 62           | 62           | 62      | 62                 | 62                 |
| Hopping (fast) synth;<br>FM demod; negative<br>bias | off   | off  | off          | 48           | 48      | 48                 | 48                 |
| Receiver                                            | off   | off  | off          | off          | 36      | off                | off                |
| Transmitter (100 mW)                                | off   | off  | off          | off          | off     | 125                | 350                |
| Total Current Draw mA                               | 6     | 36   | 168          | 216          | 282     | 371                | 596                |

Figure 4.5- Power Conservation State Definition and Power Dissipation Estimates

## 2.0 General Information

**Applicant:** Symbol Technologies, Inc.  
2145 Hamilton Avenue  
San Jose, CA 95125

**Contact Person:** Ray Martino, Jr.

**Equipment Under Test:** Sirius WLAN Adapter Card

**Model Number:** LA2400

**Serial Number:** Pre Production Prototype 002

**FCC ID Number:** H9PLA24005AZL

**Report Number:** B1072495

**Date of Test:** July 24 - 28, 1995

**Manufacturer:** Symbol Technologies, Inc.

**Type of Test:** FCC part 15, Subpart B, 15.247 (Certification)

**frequency Range:** 450 kHz to 30 MHz - Line Conducted Emissions  
30 MHz to 1000 MHz - Radiated Emissions  
2400 MHz to 24.5 GHz - part 15.247

### Summary

**Pass/Fail:** Passed

#### Line Conducted Test:

The EUT was placed in a screen room and connected to a LISN of primary AC Power. All other associated peripherals and support equipment was connected to a separate power source. The highest emission observed was -35.5 dB below the applicable limit. All emissions observed were below the FCC, Class A limit.

#### Radiated Test:

The EUT was placed on a 3 meter open field test site. The highest emission observed was -10.6 dB below the applicable limit. All emissions observed were below the FCC, Class A limit.

#### 15.247 Operation within the 2400 - 2483.5 MHz band:

The EUT met all the requirements. See attached data and plots.

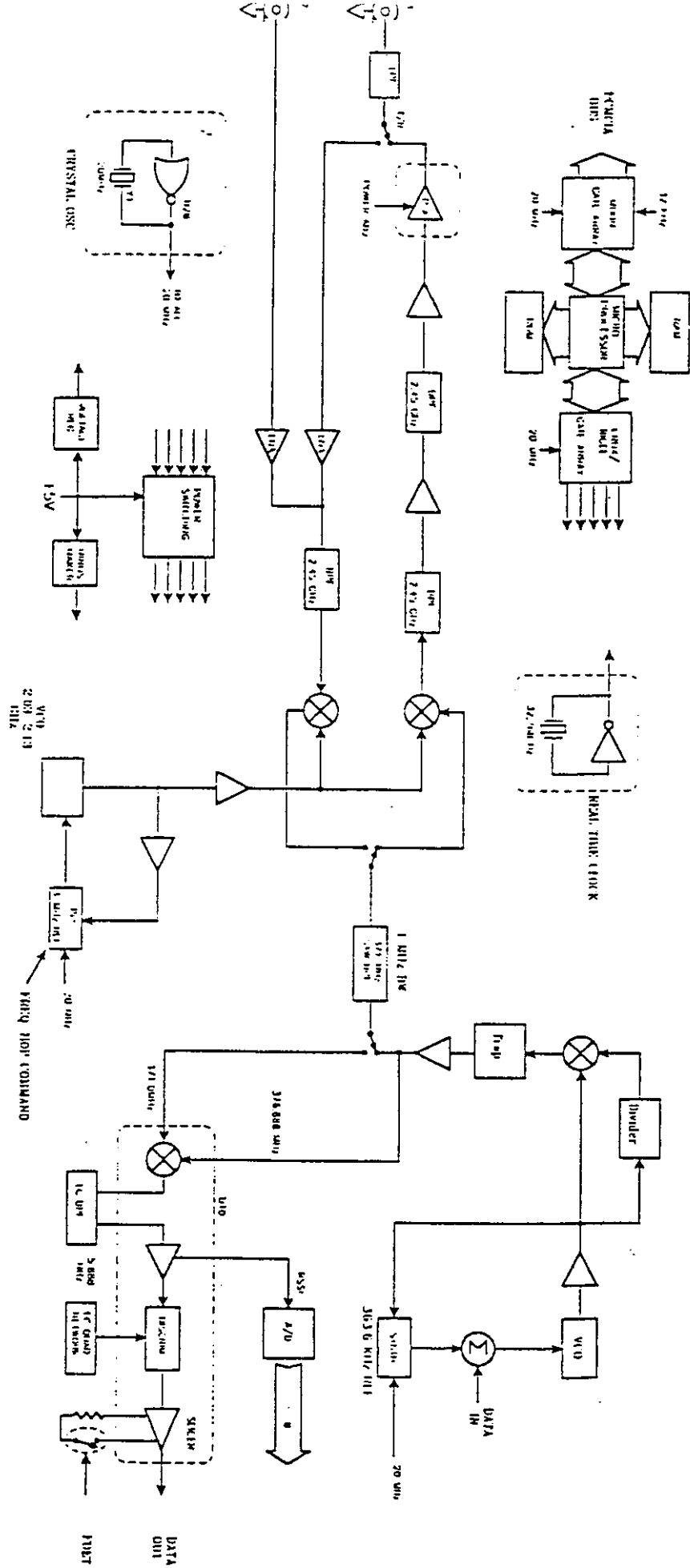


Figure 2.1.3. Radio Section Block Diagram

### 3.0 Test Facility

Name: Electronic Compliance Laboratories

Location: 1249 Birchwood Drive  
Sunnyvale, CA 94089

Site Filing: A site description is on file at the Federal Communications Commission  
P.O. Box 429  
Columbia, MD 21045

Types of Sites: Open Field Radiated and Indoor (Screen Room).  
Line Conducted: All sites are constructed and calibrated to meet  
ANSI C63.4-1994 requirements.

### 4.0 Test Equipment Settings

| <u>Parameter</u> | <u>Line Conducted Emissions</u> | <u>Radiated Emissions</u> |
|------------------|---------------------------------|---------------------------|
| Bandwidth        | 9 kHz                           | 120 kHz                   |
| *Detector Mode   | Peak                            | Peak                      |

\*(Unless otherwise specified)

#### Units of Measurement

Measurements of radiated emissions are reported in terms of micro volts per meter or in dB $\mu$ V/m, at a specified distance. The indicated readings on the spectrum analyzer are converted to micro volts per meter or to dB $\mu$ V/m by use of appropriate conversion factors. Measurements of conducted interference are reported in terms of microvolts, or dB $\mu$ V.

## 5.0 Antennas

| <u>Antenna Type</u> | <u>Frequency Range</u> |
|---------------------|------------------------|
| Biconical           | 25 to 300 MHz          |
| Log Periodic        | 300 to 1000 MHz        |
| Horn Double Ridge   | 1 to 24 GHz            |
| Horn Parabolic      | 4.9 to 10 GHz          |
| Horn Polarad        | 4.7 to 7.74 GHz        |
| Horn Polarad        | 8.3 to 10 GHz          |

**Correction Factors:** Programmed into the software.

**Antenna Height:** Varied from 1 to 4 meters above the ground plane.

**Polarization:** Vertical/Horizontal

*The antenna used at the time the data was taken is indicated on each data page. The correction factors and antenna polarization are noted on the data pages.*

### 5.1 Test Equipment

The following list contains equipment used at EC Laboratories, Inc. for compliance testing. The equipment conforms to the American National Standard Specifications for Electromagnetic Interference and Field Strength Instrumentation from 10 kHz to 1000 MHz.

| <u>Description</u> | <u>Manufacturer</u> | <u>S/N</u> | <u>Model Number</u> | <u>Cal. Due Date</u> |
|--------------------|---------------------|------------|---------------------|----------------------|
| EMI Receiver       | HP                  | 3325A00137 | Model 8546A         | 7/11/95              |
| EMI Receiver       | HP                  | 3137A01183 | Model 8563A         | 7/11/95              |
| Pre-Amp            | EM                  | 243        | BPA1000             | 7/11/95              |
| Pre-Amp            | HP                  | 3008A00527 | 8449B               | 7/11/95              |
| LISN               | EM                  | 2532       | ANS-25/2            | As needed            |
| Plotter            | HP                  | 2644V00365 | 7470A               | N/A                  |

EM = ElectroMetrics  
HP = Hewlett Packard

The calibration of the measuring instruments, including any accessories that may effect such calibration, are checked frequently to assure their accuracy. Adjustments are made and correction factors applied in accordance with instructions contained in the manual for the measuring instrument.

## **6.0 Data Reporting Format**

The measurement results are expressed in accordance with FCC Part-15, Subpart B Class B limits, where applicable, are presented in tabular or graphical form.

### **6.1 Operating Conditions**

The EUT was operated at the specified load conditions (mechanical and/or electrical) for which it was designed.

### **6.2 Conditions of the EUT**

The EUT was operated for a sufficient period of time to approximate normal operating conditions.

### **6.3 Test Configuration**

The equipment under test was configured and operated in a manner which tends to maximize its emission characteristics in a typical application. Power and signal distribution, ground, interconnecting cabling and physical placement of equipment were simulating the typical application and usage in so far as practicable. The EUT was furnished with rated voltage as specified by the manufacturer in the individual equipment's power requirements.

### **6.4 Test Platform**

The EUT was placed on a wooden table having a height of 1 meter above the test site ground plane.

### **6.5 Maximization of Emissions**

The test platform was rotated 360 degrees along with the moving of cabling and/or equipment's in order to determine the maximum level of emissions.

### **6.6 Temperature**

The ambient temperature of the testing location was within the range of 10 to 40 deg. C (50 to 104 Deg. F).

## 7.0 Detector Functions

On any frequency or frequencies below or equal to 1000 MHz, the limits shown below are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths.

On any frequency or frequencies above 1000 MHz, the radiated limits shown below are based on the use of measuring equipment employing an average detector function.

EC Laboratories uses the Peak detection mode for normal testing and initial screening of the EUT. The Peak detection mode will produce a measurement value that is always greater than, or equal to, the quasi-peak or average detection mode. Whenever the measurement value is 6 dB below the applicable limit or greater, the appropriate detector function will be employed and recorded.

### 7.1 Frequency Range of Investigation

The spectrum was investigated up to the frequency specified in the following table according to the highest clock frequency generated in the device.

| <u>Highest Frequency Used (Clock)</u> | <u>Upper Limit of Range Measured</u>           |
|---------------------------------------|------------------------------------------------|
| Below 1.705 MHz                       | 30 MHz                                         |
| 1.705 to 108 MHz                      | 1000 MHz                                       |
| 108 to 500 MHz                        | 2000 MHz                                       |
| 500 to 1000 MHz                       | 5000 MHz                                       |
| Above 1000 MHz                        | 5th Harmonic or 40 GHz<br>(Whichever is Lower) |

## 8.0 FCC Class Types

### Class A Digital Device

A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

### Class B Digital Device

A digital device that is marketed for use in a residential environment notwithstanding use in a commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

**Note:** The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a device a Class B digital device, regardless of its intended use.

Code of Federal Regulations, 47, Part 15, Subpart A, Sect. H&I)  
(CFR 47, Parts 0 TO 19, Revised as of October 1, 1990)

## 9.0 FCC Limits

### 9.1 Conducted Emission Limits

For a digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back into the AC power line on any frequency or frequencies within the band 450 kHz to 30 MHz shall not exceed the limits in the following table for the appropriate class. Compliance shall be based on the measurement of the Radio Frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

| <u>Frequency</u><br>(MHz) | <u>Class A Limit</u><br>( $\mu$ V) | <u>Class A Limit</u><br>(dB $\mu$ V) | <u>Class B Limit</u><br>( $\mu$ V) | <u>Class B Limit</u><br>(dB $\mu$ V) |
|---------------------------|------------------------------------|--------------------------------------|------------------------------------|--------------------------------------|
| 0.45 to 1.705             | 1000                               | 60.0                                 | 250                                | 48.0                                 |
| 1.705 to 30.0             | 3000                               | 69.5                                 | 250                                | 48.0                                 |

### 9.2 Radiated Emission Limits

The field strength of radiated emissions for a Class A Digital Device, when measured at a distance of 10 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

The field strength of radiated emissions for a Class B Digital Device, when measured at a distance of 3 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

| <u>Frequency</u><br>(MHz) | <u>Class A</u><br><u>(3m) Limit</u><br>( $\mu$ V/m) | <u>Class A</u><br><u>(3m) Limit</u><br>(dB $\mu$ V/m) | <u>Class A</u><br><u>(10m) Limit</u><br>( $\mu$ V/m) | <u>Class A</u><br><u>(10m) Limit</u><br>(dB $\mu$ V/m) | <u>Class B</u><br><u>(3m) Limit</u><br>( $\mu$ V/m) | <u>Class B</u><br><u>(3m) Limit</u><br>(dB $\mu$ V/m) |
|---------------------------|-----------------------------------------------------|-------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|
| 30-88                     | 300                                                 | 49.6                                                  | 90                                                   | 39.1                                                   | 100                                                 | 40.0                                                  |
| 88-216                    | 500                                                 | 54.0                                                  | 150                                                  | 43.5                                                   | 150                                                 | 43.5                                                  |
| 216-960                   | 700                                                 | 56.0                                                  | 210                                                  | 46.4                                                   | 200                                                 | 46.0                                                  |
| Above 960                 | 1000                                                | 60.0                                                  | 300                                                  | 49.5                                                   | 500                                                 | 54.0                                                  |

## 10.0 Test Methods

### 10.1 Line Conducted Emissions Test Procedure

1. EUT and any other equipment and cables were placed on a wood table one meter above a ground screen.
2. The EUT's Input Power line cord was connected to a Line Impedance Stabilization Network (LISN) under the table.
3. All other (Non-EUT) equipment received power from a separate AC Power Source. The LISN assembly has two monitoring points: Line 1 (AC-Hot) and Line 2 (AC-Neutral). Each monitoring point was scanned by the measuring equipment (the other point was terminated in 50 ohms) over the frequency range of 450 kHz to 30 MHz for conducted emissions.
4. When an emission is found, the following takes place:
  - a. The emission levels are maximized by equipment/cable placement.
  - b. Frequency and emission level data are entered into computer in dBm.
  - c. The monitoring point (Line 1 or 2) is entered into the computer.
  - d. The computer converts dBm to micro volts and uses a look-up table to find cable losses (in dB) at that frequency, calculates a corrected emission level, and compares the corrected emission level to the appropriate limit. The data is then printed out in tabular form.

An example of the printout and definitions follows below.

### 11.0 Line Conducted Emissions Test Example

| Freq  | Site  |      |        | FCC Limit |      | EUT Level (L1) |     |
|-------|-------|------|--------|-----------|------|----------------|-----|
|       | Raw   | CF   | Corr'd | A         | B    | A              | B   |
| (MHz) | (dBm) | (dB) | (dBμV) | (dBμV)    |      | (dB)           |     |
| 1.85  | -57   | 15.0 | 65.0   | 69.5      | 48.0 | -4.5           | +17 |

Freq. = Frequency of emission in MHz  
Raw dBm = Reading at Spectrum Analyzer (uncorrected)  
Site CF = Correction factor for cable loss  
Corr'd dBμV = Corrected emission level in dBμV  
FCC Limit A/B = Conducted Emission level limit in dBμV  
EUT Level A\* = Emission relative to the FCC Class A Limit  
EUT Level B\* = Emission relative to the FCC Class B Limit

Note = L1 is AC-Hot, L2 is AC-Neutral  
QP is a Quasi-Peak value

\*A negative value indicates that the emission is below (or meets) the limit and a positive value indicates that the emission is above (or exceeds) the limit.

## 12.0 Radiated Emissions Test Procedure

1. EUT and any other equipment and cables used with the EUT were placed on a wood table one meter above a ground screen.
2. The EUT receives the normal AC Power at the base of the table.
3. All equipment and cables are placed in a manner which tends to maximize their emission characteristics in a typical application.
4. The table was rotated 360 degrees to determine the maximum radial emissions.
5. The antenna was varied in height between 1 meter and 4 meters above the ground plane to determine the maximum emissions. Various antennas are used during the test in both the vertical and horizontal polarization.
6. The Spectrum Analyzer is scanned from 30 MHz to 1000 MHz for emissions. The applicable spectrum analyzer settings are:
  - a. Resolution Bandwidth = 100 kHz,
  - b. Normal Detector Mode = Peak (The Quasi-Peak is used when the emissions are near, or over the limit).
7. When an emission is found and maximized, the following actions are performed:
  - a. The emission frequency is entered into the computer.
  - b. The emission level is read from the spectrum analyzer in dBm and entered into the computer.
  - c. The antenna polarization is entered into the computer.
  - d. The computer converts the level in dBm to dB $\mu$ V and uses lookup tables to determine the coax cable loss, antenna factor, and pre-amp gain. A site correction factor is calculated for that particular frequency, and the data is printed out in tabular form.

### 13.0 Radiated Test Example

| Freq<br>(MHz) | Site  |       |        | FCC Limit |      | EUT Level (QP) |      |
|---------------|-------|-------|--------|-----------|------|----------------|------|
|               | Raw   | CF    | Cor'd  | A         | B    | A              | B    |
|               | (dBm) | (dB)  | (dBμV) | (dBμV)    |      | (dB)           |      |
| 65.4          | -58   | -14.5 | 34.5   | 39.1      | 40.0 | -4.6           | -5.5 |

- Freq. = Frequency of emission in MHz.  
 Raw dBm = Reading at Spectrum Analyzer (uncorrected)  
 Site CF = Correction Factor for coax/antenna/preamp for that frequency. Note that a negative CF is the result of the gain of the preamp.  
 Cor'd dBμV = Corrected emission level in dBμV  
 FCC Limit A/B = Limit in dBμV as stated in Part-15, Subpart B  
 EUT Level A = Emission level relative to the FCC Class A limit. A negative value indicates that the emission is below the limit and a positive value indicates the emission is above (or over) the limit.  
 EUT Level B = Emission level relative to the FCC Class B. A negative value indicates that the emission is below the limit. Whereas a positive value indicates the emission is above (or over) the limit.

Note = V/H is the antenna polarization (Vertical or Horizontal), QP indicates the Quasi-Peak value.

## 14.0 Labeling Requirements

### LABEL REQUIREMENTS, Class B Certified Digital Device

A CLASS B Digital Device subject to Certification by the FCC shall bear the following statement in a conspicuous location on the device.

(Name of Grantee)

FCC ID:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The label is to be located in a "conspicuous location". This is any location readily visible to the user of the device without the use of tools.

The label is to be permanently attached to the equipment in such a manner that the label can normally be expected to remain fastened and legible during the equipment's expected useful life.

Where the device is constructed in two or more sections connected by wires and marketed together, the statement specified in this section is required to be affixed only to the main control unit.

When the device is so small or for such use that it is not practicable to place the statement specified above on it, this required information shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier must be displayed on the device.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the user's operation manual.

**NOTE:** This equipment has been tested and found to comply with the limits for Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio and television reception, which can be determined by Turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit, different from that which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
- For systems incorporating several digital devices, the statement shown above, needs to be contained only in the instruction manual for the main control unit.
- Where special accessories, such as shielded cables, are required in order to meet FCC emission limits, appropriate instructions regarding the need to use such accessories must be contained in the operator's manual.

- The operators manual must caution the user that changes or modifications not expressly approved by the manufacturer could void their right to operate the equipment.
- The above radio interference statement is to be bound in the same manner as the operators manual. A loose-leaf insert page in a bound manual would not meet this requirement.

## 15.0 Summary of Measurements

### Summary of Measurements for a Spread-Spectrum System, 2400 - 2500 MHz

#### CFR Title 47, Part 15.247

Manufacturer: Symbol Technologies, Inc.  
2145 Hamilton Avenue  
San Jose, CA 95125  
408/369-2646  
408/446-4630 Fax

Contact: Ray Martino, Jr.

FCC ID: H9PLA24005AZL

Test Report Number: B1072495

The Symbol Technologies, Inc. Sirius WLAN Adapter card uses a frequency hopping spread-spectrum (FHSS) system transceiver operating in the 2400-2483.5 MHz band. The Sirius WLAN Adapter card transmits and receives at 1 Mbps using binary GFSK modulation with BT=0.5 and a minimum deviation of 160 kHz ( $h=0.32$ ). See Theory of Operation (Attachment A).

#### 15.247 (a) (1) Frequency Hopping Systems

The Symbol Technologies, Inc. Sirius WLAN Adapter card uses 79 programmable channels in 1 MHz wide. Frequencies of operation are 2401 to 2482 MHz inclusive. The hopping frequencies are selected from a pseudo random list of hopping frequencies generated by a shift-register. On average, each frequency is used equally. See plots titled "HOPPING CHANNEL BANDWIDTH" in Appendix B. Please refer to attached document entitled "Theory of Operation", which is in Attachment A.

#### 15.247 (a) (1) (ii) Utilization of Channels, 20 dB Channel Bandwidth, Average Time of Occupancy

The Sirius WLAN Adapter card uses 79 channels, which meets the required minimum of 75. Refer to plot entitled "Channel Utilization".

The maximum 20 dB bandwidth of the hopping channel is less than 1 MHz, as shown in the three plots labeled "Channel Bandwidth". Three separate measurements were taken for this test as shown in the table below. During this test, the EUT was placed in continuous transmit mode and set to one of the three tested frequencies.

| Portion of Band | Channel Number | Frequency, MHz | 20 dB Bandwidth, MHz |
|-----------------|----------------|----------------|----------------------|
| Low             | 01             | 2402.0         | 0.97                 |
| Middle          | 41             | 2440.0         | 0.96                 |
| High            | 82             | 2480.0         | 0.98                 |

The average time of occupancy on any given channel in a 30 second period is 0.369 seconds, which is less than the maximum permitted time of 0.4 seconds. Refer to "Theory of Operation", which is in Attachment A.

#### 15.247 (b) Maximum Peak Output Power

The spectrum analyzer plots entitled "Symbol Sirius WLAN Adapter" shows the maximum peak output power of the transmitter to be +27.0 dBm, or 500 milliwatts. Maximum permitted is 1.0 Watts, or +30 dBm. The EUT was placed in continuous transmit mode and set to a single frequency (the hopping function disabled) for each of the three measurements shown in the table below. The EUT was tested at the bottom, middle, and top of the band. The output signal was fed directly into an HP 435B Power meter with no external attenuation.

| Frequency, MHz | Reading, dBm | Cable Loss, dB | Corrected Reading, dBm / mW |
|----------------|--------------|----------------|-----------------------------|
| 2402.0         | +26.0        | N/A*           | +26.0 dBm / 398.1 mW        |
| 2440.0         | +26.5        | N/A*           | +26.5 dBm / 446.7 mW        |
| 2480.0         | +27.0        | N/A*           | +27.0 dBm / 500 mW          |

\*Note there is no cable loss, a special connector directly at the power sensor head fits directly into the antenna connector.

#### 15.247 (c) Out Of Band Emissions (Not Falling within Restricted Bands)

The EUT was placed in normal (hopping) mode and set to transmit continuously. The spectrum analyzer was placed in MAX HOLD mode. Out of band emissions are better than 20 dB (in power) below the highest in-band emission. The three plots described in the table below show the EUT's emissions remain inside the 2400 - 2483.5 MHz band during operation.

A special test program ran during this. The program was set to transmit to each of the hopping channels sequentially, the total time approximately 10 seconds. The frequencies outside the operating bands were swept at a much faster rate on MAX HOLD for 20 seconds. No emissions within the 20 dB of the transmitter's fundamentals were located.

| Plot Title                                   | Frequency Range of Plot, MHz        | Purpose of Plot                                               |
|----------------------------------------------|-------------------------------------|---------------------------------------------------------------|
| Channel Utilization<br>Out of Band Emissions | 2400.0 - 2483.5                     | Show use of 79 channels & out of band emissions down by 20 dB |
| Out Of Band Emissions - Lower Band Edge 1    | 20 - 975 MHz                        | Show emissions are better than 20 dB down                     |
| Out of Band Emissions - Lower Band Edge 2    | 975 MHz - 2.4 GHz                   | Show emissions are better than 20 dB down                     |
| Out of Band Emissions - Upper Band Edge      | 2.484 - 6.509 GHz<br>6.4 - 24.8 GHz | Show emissions are better than 20 dB down                     |

#### 15.205 Restricted Bands - Emissions Within Restricted Bands

The EUT was placed on a wooden table resting on a turntable. The wooden table was approximately 1 meter above the ground plane of the 3 meter test site.

The plot entitled "Restricted Band 2500 MHz" shows a maximum uncorrected reading and shows all emissions are greater than 20 dB below the specification requirements for the restricted band.

### 15.207 AC Line Conducted Emissions

RFD line conducted levels for emissions in the 0.450 to 30.0 MHz band must not exceed 250 $\mu$ V when measured with a line impedance stabilization network. Attached data show emissions are below the 48 V/m limit, with the worst case emission being 35.5 dB below this limit.

## 15.203 Antenna Requirement

The LA 2400 PCMCIA wireless LAN card is normally attached to its antenna via a coaxial connector. The coaxial connector is manufactured by Murata Erie Corp only. The Murata Erie part number is MM3325-2505. The mating connector with coaxial cable is part number MXYH62XXLLLL (where LLLL denotes length ex: 100 mm = 100, 500 mm = 500, 1000 = 1001.). Drawings of these connectors are attached. The other end of the coaxial cable is usually attached to a polarized BNC connector. The polarized BNC connector is similar to a regular BNC type connector but it is made unique by swapping the inner conductor sex. These connectors can be purchased by the manufacturer, M/A-COM Inc. A drawing of this connector is attached. In some cases the coax cable is directly soldered to the antenna. The following antennas are options for antennas for the LA 2400 PCMCIA wireless LAN card:

- 1) Surface Mount Box Shaped Antenna. Made by Tecom Industries part number 505042C. This antenna is 0 dBi omni-directional in azimuth plane. It is 2.5 x 2.5 x .75 inches and mounts with Velcro. The antenna is attached to coaxial cable terminated in the polarized BNC connector. A drawing of this antenna is attached.
- 2) Collinear Omni-directional Pole shaped. Made by Cushcraft Signals Corp. part number S2403BE. This antenna is 5.4 dBi, 9 inches tall, with coaxial cable terminated in the polarized BNC connector. This antenna has a dipole style pattern. A drawing is attached.
- 3) Dipole Rubber Duck. Made by Centurion corp. part number EXR-2.4-BNCP and Cushcraft Signals Corp part number RBN2400XSR. These antennas are 2.4 dBi and have dipole style pattern. The polarized BNC connector is molded into the antenna. A drawing of this antenna is attached.
- 4) An antenna can be attached directly to the PCMCIA card without a coaxial connector. This antenna Symbol calls an End Cap Antenna. When using the end cap antenna a pin connector is used. The pin connector manufactured by Samtek Corp. part number HTMS-15-01-F-S on the PCMCIA card mating to the socket SLM-15-01-F-S on the antenna. This antenna is less than 0 dBi in all planes. The antenna is manufactured by Symbol. A drawings of the end antenna and connector are attached.
- 5) IBM Dipole made by IBM part number 25H3851. The antenna is a dipole with a gain of 2 dBi. The antenna can be terminated in the Murata BFA or polarized SMA. A drawing of this antenna is attached.
- 6) The IBM Antenna is integrated inside an IBM portable computer. The antennas has a gain of 2 dBi and a dipole style pattern.

## 16.0 APPENDIX A

### ANTENNA DATA

# RADIATED DATA SHEET - SIRIUS ANTENNAS

EUT: Sirius Surface Mount Antenna  
 Rule Part: 15.209

Customer name: Symbol

Test Distance: 3 m

Restricted Frequency  
 Radiated Emissions

| FREQ.  | READING | Pk, QP, | A.F. | Cable | AMP   | O.C.F. | TOTAL,   | LIMIT    | DELTA |
|--------|---------|---------|------|-------|-------|--------|----------|----------|-------|
| MHz    | dB(uV)  | or Av   | dB   | loss  | dB    | dB     | dB(uV/m) | dB(uV/m) | dB    |
| 2851   | 57.8    | PK      | 27.8 | 5.3   | -35.5 | 0      | 55.4     | 74.0     | -18.6 |
| 2851   | 51.0    | AV      | 27.8 | 5.3   | -35.5 | 0      | 48.6     | 54.0     | -5.4  |
| 2773   | 57.2    | PK      | 27.8 | 5.3   | -35.5 | 0      | 54.8     | 74.0     | -19.2 |
| 2773   | 50.0    | AV      | 27.8 | 5.3   | -35.5 | 0      | 47.6     | 54.0     | -6.4  |
| 2357.8 | 60.0    | PK      | 27.6 | 5.3   | -35.5 | 0      | 57.41    | 74.0     | -16.6 |
| 2357.8 | 42.0    | AV      | 27.6 | 5.3   | -35.5 | 0      | 39.41    | 54.0     | -14.6 |
| 2485.9 | 53.6    | PK      | 27.6 | 5.3   | -35.5 | 0      | 51.01    | 74.0     | -23.0 |
| 2485.9 | 38.7    | AV      | 27.6 | 5.3   | -35.5 | 0      | 36.11    | 54.0     | -17.9 |

Remarks: fc + 371 MHz Local Oscillator  
 No other restricted emission location for fc +/- n \* 371 MHz  
 for n = 1, 2, 3

Rule Part: 15.247

Test Distance: 3 m

| FREQ. | READING | A.F. | Cable loss | AMP   | O.C.F. | dB(uV/m) | LIMIT    | DELTA |
|-------|---------|------|------------|-------|--------|----------|----------|-------|
| MHz   | dB(uV)  | dB   | dB         | dB    | dB     |          | dB(uV/m) | dB    |
| 4804  | 47.6    | 31.4 | 7.0        | -35.0 | 0      | 51.03    | 74.0     | -23.0 |
| 4804  | 40.5    | 31.4 | 7.0        | -35.0 | 0      | 43.93    | 54.0     | -10.1 |
| 7206  | 48.8    | 34.5 | 10.6       | -35.0 | 0      | 58.88    | 74.0     | -15.1 |
| 7206  | 36.1    | 34.5 | 10.6       | -35.0 | 0      | 46.18    | 54.0     | -7.8  |
| 4880  | 47.7    | 31.4 | 7.0        | -35.0 | 0      | 51.13    | 74.0     | -22.9 |
| 4880  | 38.3    | 31.4 | 7.0        | -35.0 | 0      | 41.73    | 54.0     | -12.3 |
| 7320  | 47.3    | 34.5 | 10.6       | -35.0 | 0      | 57.38    | 74.0     | -16.6 |
| 7320  | 36.1    | 34.5 | 10.6       | -35.0 | 0      | 46.18    | 54.0     | -7.8  |
| 4960  | 47.2    | 31.4 | 7.0        | -35.0 | 0      | 50.63    | 74.0     | -23.4 |
| 4960  | 39.6    | 31.4 | 7.0        | -35.0 | 0      | 43.03    | 54.0     | -11.0 |
| 7440  | 48.8    | 34.5 | 10.6       | -35.0 | 0      | 58.88    | 74.0     | -15.1 |
| 7440  | 36.4    | 34.5 | 10.6       | -35.0 | 0      | 46.48    | 54.0     | -7.5  |

# RADIATED DATA SHEET - SIRIUS ANTENNAS

EUT: Sirius Cushman Antenna  
Rule Part: 15.209

Customer name: Symbol

Test Distance: 3 m

Restricted Frequency  
Radiated Emissions

| FREQ. | READING | Pk, QP, | A.F. | Cable | AMP   | O.C.F. | TOTAL,   | LIMIT    | DELTA |
|-------|---------|---------|------|-------|-------|--------|----------|----------|-------|
| MHz   | dB(uV)  | or Av   | dB   | loss  | dB    | dB     | dB(uV/m) | dB(uV/m) | dB    |
| 2773  | 39.7    | PK      | 27.8 | 5.3   | -35.5 | 0      | 37.31    | 74.0     | -36.7 |
| 2773  | 34.6    | AV      | 27.8 | 5.3   | -35.5 | 0      | 32.23    | 54.0     | -21.8 |
| 2851  | 52.6    | PK      | 27.8 | 5.3   | -35.5 | 0      | 50.16    | 74.0     | -23.8 |
| 2851  | 49.6    | AV      | 27.8 | 5.3   | -35.5 | 0      | 47.2     | 54.0     | -6.8  |
| 2336  | 58.0    | PK      | 27.6 | 5.3   | -35.5 | 0      | 55.41    | 74.0     | -18.6 |
| 2336  | 40.7    | AV      | 27.6 | 5.3   | -35.5 | 0      | 38.11    | 54.0     | -15.9 |
| 2486  | 52.2    | PK      | 27.6 | 5.3   | -35.5 | 0      | 49.61    | 74.0     | -24.4 |
| 2486  | 35.2    | AV      | 27.6 | 5.3   | -35.5 | 0      | 32.61    | 54.0     | -21.4 |

Remarks:  $f_c + 371$  MHz Local Oscillator

No other restricted emission location for  $f_c \pm n * 371$  MHz

for  $n = 1, 2, 3$

Rule Part: 15.247

Test Distance: 3 m

| FREQ. | READING | A.F. | Cable loss | AMP   | O.C.F. | TOTAL,   | LIMIT    | DELTA |
|-------|---------|------|------------|-------|--------|----------|----------|-------|
| MHz   | dB(uV)  | dB   | dB         | dB    | dB     | dB(uV/m) | dB(uV/m) | dB    |
| 4804  | 48.1    | 31.4 | 7.0        | -35.0 | 0      | 51.53    | 74.0     | -22.5 |
| 4804  | 37.2    | 31.4 | 7.0        | -35.0 | 0      | 40.63    | 54.0     | -13.4 |
| 7206  | 47.9    | 34.5 | 10.6       | -35.0 | 0      | 57.98    | 74.0     | -16.0 |
| 7206  | 36.0    | 34.5 | 10.6       | -35.0 | 0      | 46.08    | 54.0     | -7.9  |
| 4880  | 46.1    | 31.4 | 7.0        | -35.0 | 0      | 49.53    | 74.0     | -24.5 |
| 4880  | 34.4    | 31.4 | 7.0        | -35.0 | 0      | 37.83    | 54.0     | -16.2 |
| 7320  | 48.6    | 34.5 | 10.6       | -35.0 | 0      | 58.68    | 74.0     | -15.3 |
| 7320  | 36.1    | 34.5 | 10.6       | -35.0 | 0      | 46.18    | 54.0     | -7.8  |
| 4960  | 44.9    | 31.4 | 7.0        | -35.0 | 0      | 48.33    | 74.0     | -25.7 |
| 4960  | 33.5    | 31.4 | 7.0        | -35.0 | 0      | 36.93    | 54.0     | -17.1 |
| 7440  | 48.9    | 34.5 | 10.6       | -35.0 | 0      | 58.98    | 74.0     | -15.0 |
| 7440  | 36.4    | 34.5 | 10.6       | -35.0 | 0      | 46.48    | 54.0     | -7.5  |

# FCC RADIATED DATA SHEET

EUT: DI-POLE

CUSTOMER NAME: SYMBOL

RULE PART: 15.247, 15.205

DIST dB: 0

DUTY dB: 0

ATTN dB: 0

HP IL dB: 0

| 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    |
| 4804  | 47.0    | PK      | 31.4 | 7.0        | -35.0 | 0      | 50.43    | 74.0     | -23.6 |
| 4804  | 38.0    | AV      | 31.4 | 7.0        | -35.0 | 0      | 41.43    | 54.0     | -12.6 |
| 7206  | 48.7    | PK      | 34.5 | 10.6       | -35.0 | 0      | 58.78    | 74.0     | -15.2 |
| 7206  | 36.0    | AV      | 34.5 | 10.6       | -35.0 | 0      | 46.08    | 54.0     | -7.9  |
| 9608  | 48.4    | PK      | 36.8 | 13.0       | -35.0 | -9.54  | 53.64    | 74.0     | -20.4 |
| 9608  | 35.7    | AV      | 36.8 | 13.0       | -35.0 | -9.54  | 40.94    | 54.0     | -13.1 |
| 12010 | 49.3    | PK      | 39.0 | 13.6       | -35.0 | -9.54  | 57.33    | 74.0     | -16.7 |
| 12010 | 36.3    | AV      | 39.0 | 13.6       | -35.0 | -9.54  | 44.33    | 54.0     | -9.7  |
| 14412 | 54.2    | PK      | 41.8 | 14.5       | -35.0 | -20    | 55.46    | 74.0     | -18.5 |
| 14412 | 41.6    | AV      | 41.8 | 14.5       | -35.0 | -20    | 42.86    | 54.0     | -11.1 |
| 4880  | 45.0    | PK      | 31.4 | 7.0        | -35.0 | 0      | 48.43    | 74.0     | -25.6 |
| 4880  | 34.0    | AV      | 31.4 | 7.0        | -35.0 | 0      | 37.43    | 54.0     | -16.6 |
| 7320  | 48.4    | PK      | 34.5 | 10.6       | -35.0 | 0      | 58.48    | 74.0     | -15.5 |
| 7320  | 36.0    | AV      | 34.5 | 10.6       | -35.0 | 0      | 46.08    | 54.0     | -7.9  |
| 9760  | 48.0    | PK      | 36.8 | 13.0       | -35.0 | -9.54  | 53.24    | 74.0     | -20.8 |
| 9760  | 35.6    | AV      | 36.8 | 13.0       | -35.0 | -9.54  | 40.84    | 54.0     | -13.2 |
| 12200 | 47.7    | PK      | 39.0 | 13.6       | -35.0 | -9.54  | 55.73    | 74.0     | -18.3 |
| 12200 | 36.3    | AV      | 39.0 | 13.6       | -35.0 | -9.54  | 44.33    | 54.0     | -9.7  |
| 14640 | 53.4    | PK      | 41.9 | 15.5       | -35.0 | -20    | 55.84    | 74.0     | -18.2 |
| 14640 | 41.6    | AV      | 41.9 | 15.5       | -35.0 | -20    | 44.04    | 54.0     | -10.0 |
| 4960  | 46.4    | PK      | 31.4 | 7.0        | -35.0 | 0      | 49.83    | 74.0     | -24.2 |
| 4960  | 37.7    | AV      | 31.4 | 7.0        | -35.0 | 0      | 41.13    | 54.0     | -12.9 |
| 7440  | 48.8    | PK      | 34.5 | 10.6       | -35.0 | 0      | 58.88    | 74.0     | -15.1 |
| 7440  | 36.3    | AV      | 34.5 | 10.6       | -35.0 | 0      | 46.38    | 54.0     | -7.6  |
| 9920  | 47.8    | PK      | 36.8 | 13.0       | -35.0 | -9.54  | 53.04    | 74.0     | -21.0 |
| 9920  | 35.5    | AV      | 36.8 | 13.0       | -35.0 | -9.54  | 40.74    | 54.0     | -13.3 |
| 12400 | 47.7    | PK      | 39.0 | 13.6       | -35.0 | -9.54  | 55.73    | 74.0     | -18.3 |
| 12400 | 35.8    | AV      | 39.0 | 13.6       | -35.0 | -9.54  | 43.83    | 54.0     | -10.2 |
| 14880 | 53.3    | PK      | 41.9 | 15.5       | -35.0 | -20    | 55.74    | 74.0     | -18.3 |
| 14880 | 41.5    | AV      | 41.9 | 15.5       | -35.0 | -20    | 43.94    | 54.0     | -10.1 |

# FCC RADIATED DATA SHEET

EUT: ENCAP ANT

CUSTOMER NAME: SYMBOL

RULE PART: 15.247, 15.205

DIST dB: 0

DUTY dB: 0

ATTN dB: 0

HP IL dB: 0

| 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    |
| 4804  | 44.8    | PK      | 31.4 | 7.0        | -35.0 | 0      | 48.23    | 74.0     | -25.8 |
| 4804  | 31.9    | AV      | 31.4 | 7.0        | -35.0 | 0      | 35.33    | 54.0     | -18.7 |
| 7206  | 49.9    | PK      | 34.5 | 10.6       | -35.0 | 0      | 59.98    | 74.0     | -14.0 |
| 7206  | 40.1    | AV      | 34.5 | 10.6       | -35.0 | 0      | 50.18    | 54.0     | -3.8  |
| 9608  | 48.5    | PK      | 36.8 | 13.0       | -35.0 | -9.54  | 53.74    | 74.0     | -20.3 |
| 9608  | 35.7    | AV      | 36.8 | 13.0       | -35.0 | -9.54  | 40.94    | 54.0     | -13.1 |
| 12010 | 47.8    | PK      | 39.0 | 13.6       | -35.0 | -9.54  | 55.83    | 74.0     | -18.2 |
| 12010 | 36.2    | AV      | 39.0 | 13.6       | -35.0 | -9.54  | 44.23    | 54.0     | -9.8  |
| 14412 | 53.6    | PK      | 41.8 | 14.5       | -35.0 | -20    | 54.86    | 74.0     | -19.1 |
| 14412 | 41.6    | AV      | 41.8 | 14.5       | -35.0 | -20    | 42.86    | 54.0     | -11.1 |
| 4880  | 48.9    | PK      | 31.4 | 7.0        | -35.0 | 0      | 52.33    | 74.0     | -21.7 |
| 4880  | 40.0    | AV      | 31.4 | 7.0        | -35.0 | 0      | 43.43    | 54.0     | -10.6 |
| 7320  | 50.8    | PK      | 34.5 | 10.6       | -35.0 | -9.54  | 51.34    | 74.0     | -22.7 |
| 7320  | 36.2    | AV      | 34.5 | 10.6       | -35.0 | -9.54  | 36.74    | 54.0     | -17.3 |
| 9760  | 48.0    | PK      | 36.8 | 13.0       | -35.0 | -9.54  | 53.24    | 74.0     | -20.8 |
| 9760  | 35.7    | AV      | 36.8 | 13.0       | -35.0 | -9.54  | 40.94    | 54.0     | -13.1 |
| 12200 | 48.7    | PK      | 39.0 | 13.6       | -35.0 | -9.54  | 56.73    | 74.0     | -17.3 |
| 12200 | 36.2    | AV      | 39.0 | 13.6       | -35.0 | -9.54  | 44.23    | 54.0     | -9.8  |
| 14640 | 54.3    | PK      | 41.9 | 15.5       | -35.0 | -20    | 56.74    | 74.0     | -17.3 |
| 14640 | 41.7    | AV      | 41.9 | 15.5       | -35.0 | -20    | 44.14    | 54.0     | -9.9  |
| 4960  | 45.6    | PK      | 31.4 | 7.0        | -35.0 | 0      | 49.03    | 74.0     | -25.0 |
| 4960  | 34.8    | AV      | 31.4 | 7.0        | -35.0 | 0      | 38.23    | 54.0     | -15.8 |
| 7440  | 54.0    | PK      | 34.5 | 10.6       | -35.0 | -9.54  | 54.54    | 74.0     | -19.5 |
| 7440  | 38.6    | AV      | 34.5 | 10.6       | -35.0 | -9.54  | 39.14    | 54.0     | -14.9 |
| 9920  | 47.6    | PK      | 36.8 | 13.0       | -35.0 | -9.54  | 52.84    | 74.0     | -21.2 |
| 9920  | 35.6    | AV      | 36.8 | 13.0       | -35.0 | -9.54  | 40.84    | 54.0     | -13.2 |
| 12400 | 48.0    | PK      | 39.0 | 13.6       | -35.0 | -9.54  | 56.03    | 74.0     | -18.0 |
| 12400 | 36.1    | AV      | 39.0 | 13.6       | -35.0 | -9.54  | 44.13    | 54.0     | -9.9  |
| 14880 | 52.1    | PK      | 41.9 | 15.5       | -35.0 | -20    | 54.54    | 74.0     | -19.5 |
| 14880 | 41.8    | AV      | 41.9 | 15.5       | -35.0 | -20    | 44.24    | 54.0     | -9.8  |

OUT OF BAND EMISSIONS (LOWER BAND EDGE 2)

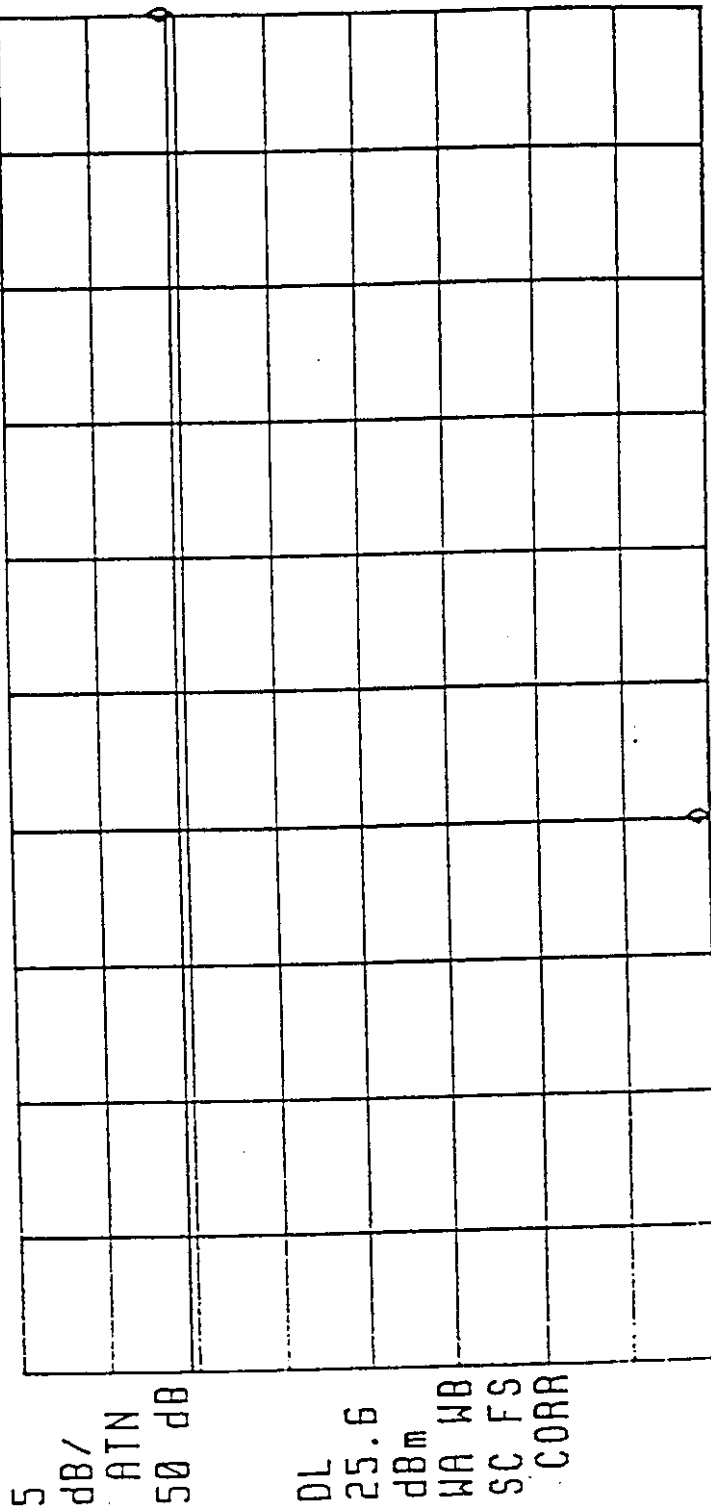
10:59:49 JUL 26, 1995

16:20:11 MAR 02, 1994SYMBOL SIRIUS BW OCC

SWEPTIME  
428 msec

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKRA -908 MHz  
-61.53 dB

LOG REF 35.0 dBm



START 975 MHz  
#IF BW 100 kHz  
#AVG BW 300 kHz  
SWP 420 msec

FCC ID NO. H9PLA24005AZL

16:20:11 MAR 02, 1994SYMBOL SIRIUS BW OCC

ACTV DET: PEAK  
MEAS DET: PEAK

MKR $\Delta$  1.640 GHz  
-58.83 dB

LOG REF 35.0 dBm

5

18/

an

8P 05

01

1. 1. 1.

2

MA 18

53  
54  
55  
56

2000

START 2.484 GHz

# IF BW 100 kHz

#AUG BW 300 KH7

FCC ID NO. H9PLA24005AZL

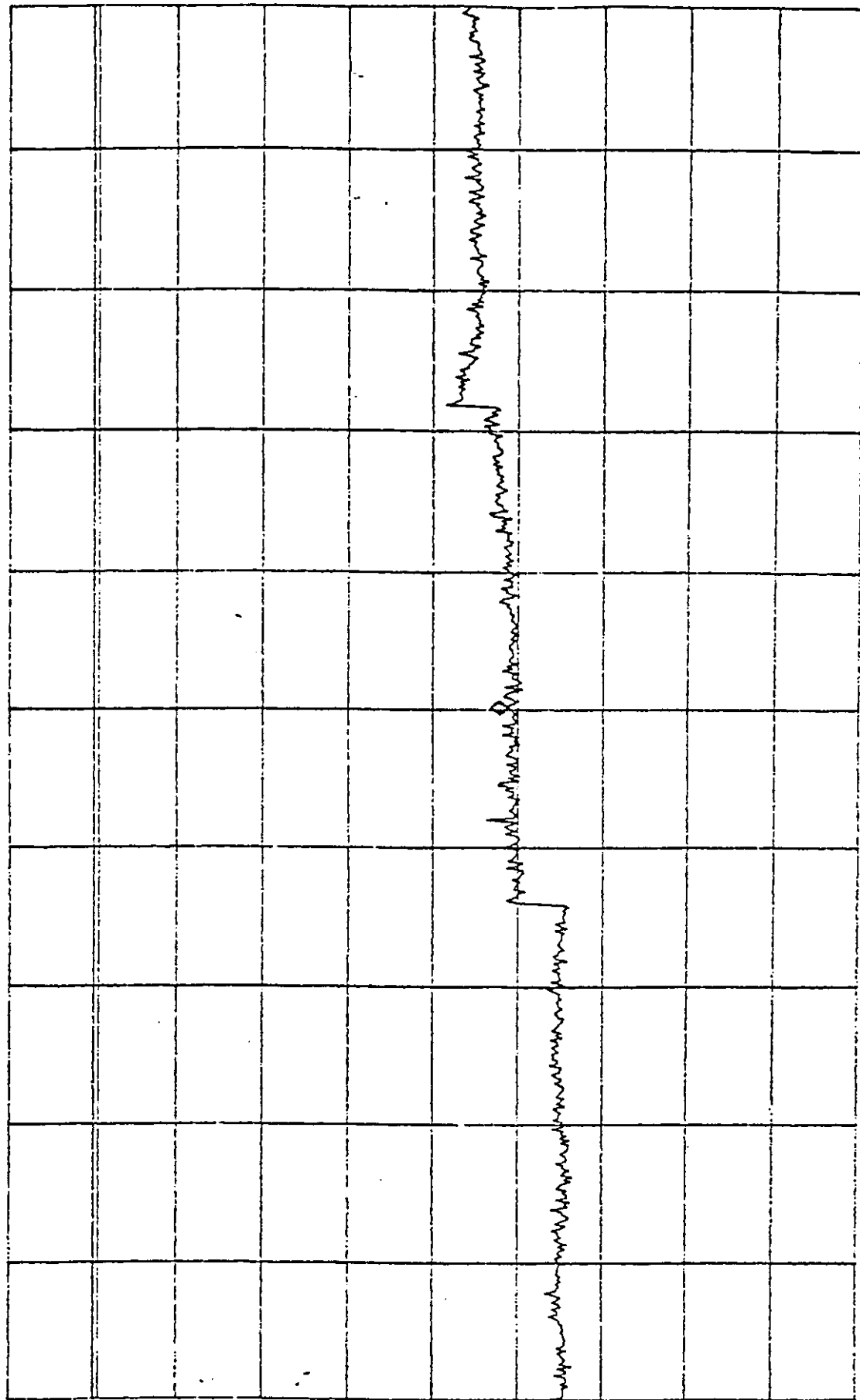
STOP 6.509 GHz

SWP 1.21 sec

0.001 of 1000 1000000

ATTEN 30dB  
RL 36.9dBm

MKR -21.93dBm  
10dB/ 15.63GHz



D  
R

START 6.40GHz

STOP 24.80GHz

\*RBW 100kHz

VBW 100kHz

SWP 4.6sec

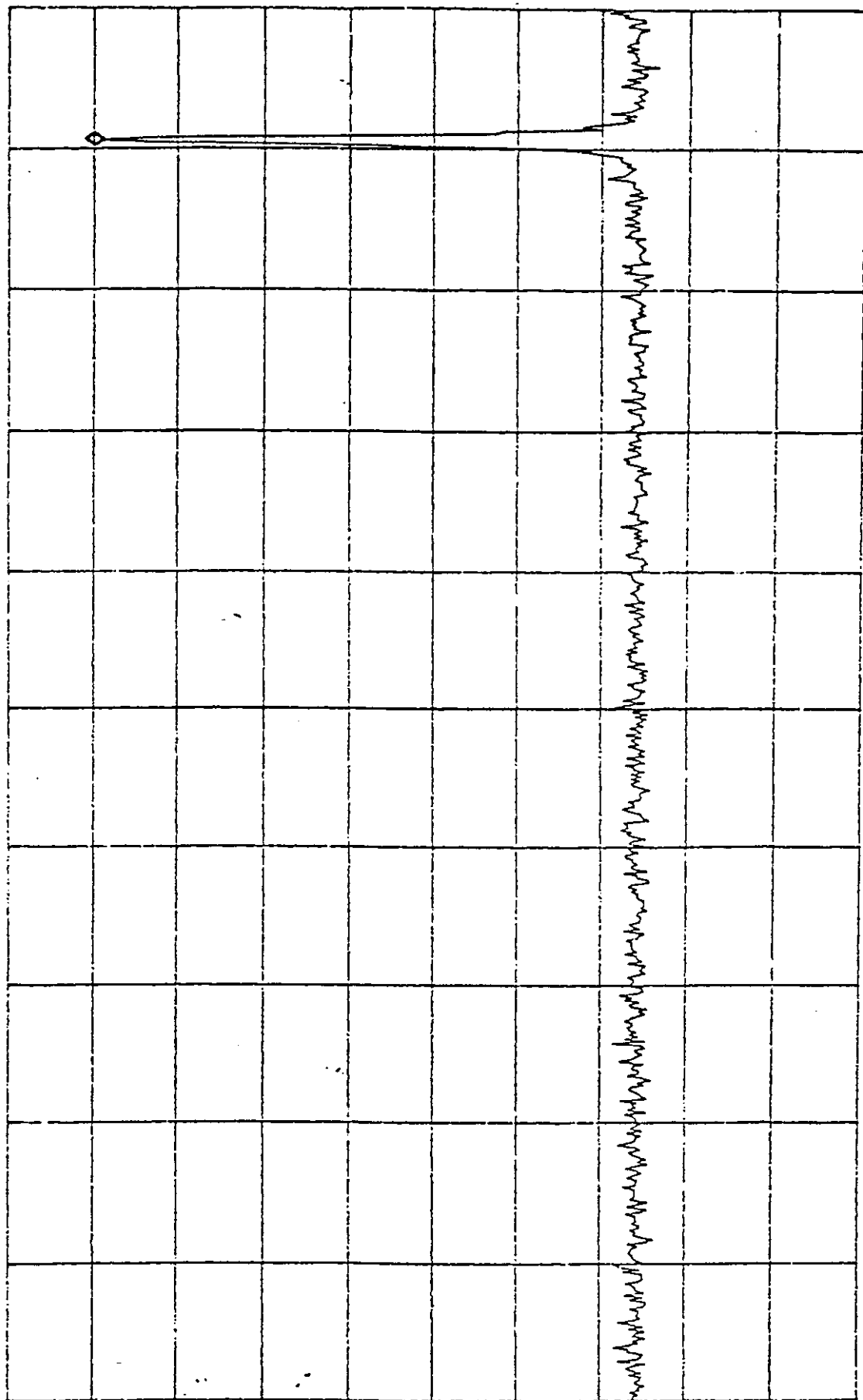
identified beam positions low level edge

ATTEN 30dB

MKR 25.90dBm

RL 36.90dBm

10dB/ 2.4027GHz



START 2.3120GHz STOP 2.4120GHz

\*RBW 100kHz

VBW 100kHz

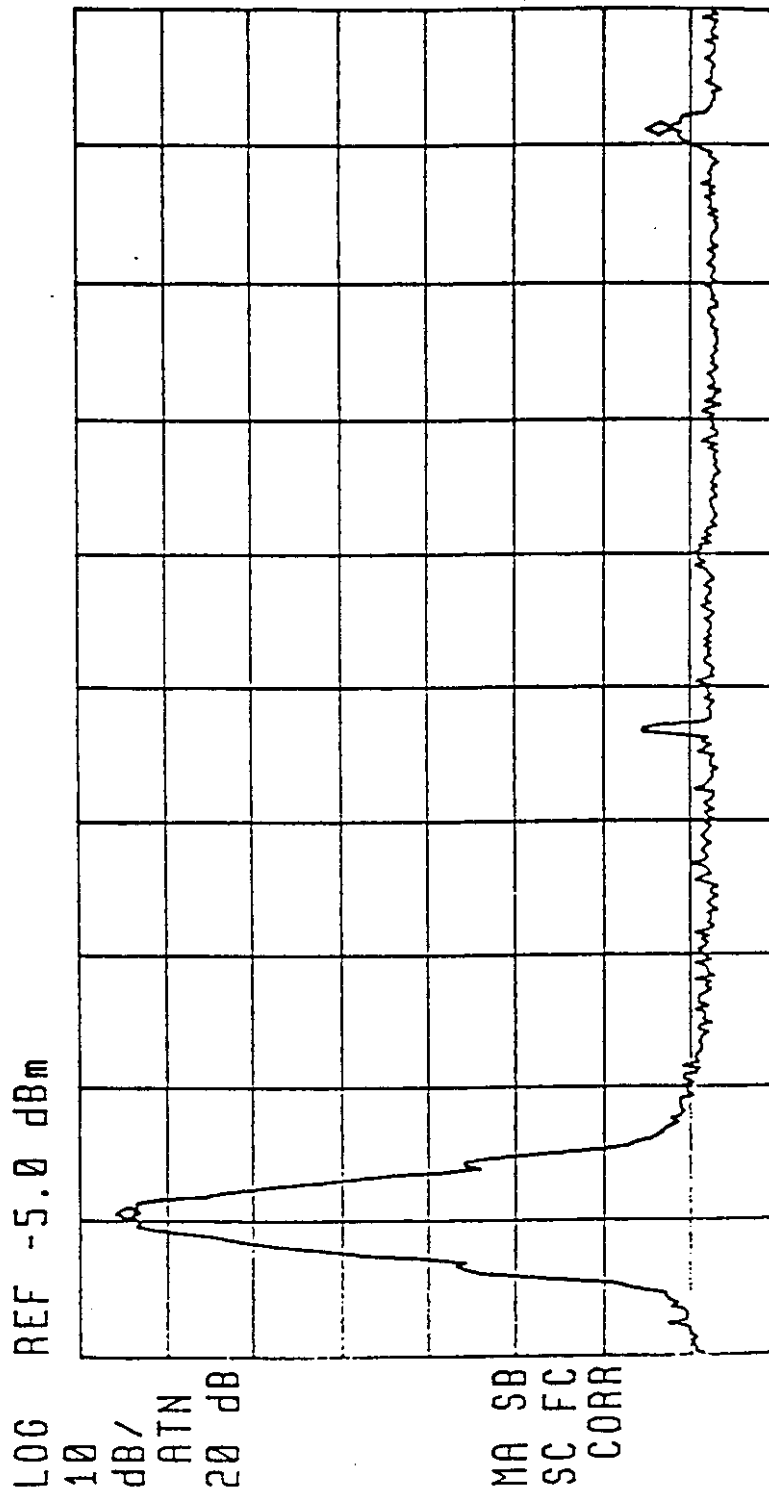
SWP 50ms

RESTRICTED BAND 2500 MHz

12:03:34 JUL 26, 1995  
SIRIUS 2480 MHz + 20 MHz

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKRA 20.13 MHz  
-61.31 dB

PREFIX= NAT0



SPAN 25.00 MHz  
SWP 23.4 msec

AVG BW 300 kHz

CENTER 2.49000 GHz  
IF BW 120 kHz

FCC ID NO. H9PLA24005AZL

**18.0 APPENDIX C**  
**RADIATED/CONDUCTED EMISSIONS**  
**DATA**

Electronic Compliance Laboratories, Inc.  
1249 Birchwood Ave.  
Sunnyvale, CA

Conducted Emissions  
Frequency range: 150KHz-30MHz

Government Agency and Limit: CISPR Class A

QP = Quasi-Peak Note: Ignore peak readings when Quasi-Peak reading exists  
PK = Peak

Customer: Symbol Operator: Rich Hedlund  
Date: 07-26-1995 Time: 14:52:38  
Temperature Range: 60-80 Deg F Percent Humidity: 50  
E.U.T.: SIRIUS  
Serial Number: 146  
Support Devices: NEC VERSA LAP TOP  
Serial Number: 53009650  
FCC ID:  
Exercise Program:  
Modifications: None  
Report File Name: C:\SCANS\5072401.C

| TEST<br>FREQ | TEST<br>dBuV | CLASS A<br>LIMIT | VERSUS<br>A LIMIT | CONDUCTOR | TYPE |
|--------------|--------------|------------------|-------------------|-----------|------|
| 0.189        | 43.5         | 79.0             | -35.5             | LINE      | PK   |
| 0.252        | 33.6         | 79.0             | -45.4             | LINE      | PK   |
| 0.377        | 31.4         | 79.0             | -47.6             | LINE      | PK   |
| 0.439        | 28.4         | 79.0             | -50.6             | LINE      | PK   |
| 0.187        | 39.7         | 79.0             | -39.3             | NEUTRAL   | PK   |
| 0.255        | 30.6         | 79.0             | -48.4             | NEUTRAL   | PK   |
| 0.371        | 26.5         | 79.0             | -52.5             | NEUTRAL   | PK   |
| 0.434        | 21.3         | 79.0             | -57.7             | NEUTRAL   | PK   |
| 0.940        | 37.1         | 74.0             | -36.9             | LINE      | PK   |
| 7.800        | 29.4         | 74.0             | -44.6             | LINE      | PK   |
| 17.400       | 32.5         | 74.0             | -41.5             | LINE      | PK   |
| 20.700       | 28.9         | 74.0             | -45.1             | LINE      | PK   |
| 0.940        | 37.3         | 74.0             | -36.7             | NEUTRAL   | PK   |
| 3.820        | 28.3         | 74.0             | -45.7             | NEUTRAL   | PK   |
| 16.900       | 31.5         | 74.0             | -42.5             | NEUTRAL   | PK   |
| 20.800       | 31.6         | 74.0             | -42.4             | NEUTRAL   | PK   |

Electronic Compliance Laboratories, Inc.  
1249 Birchwood Ave.  
Sunnyvale, CA

Radiated Emissions  
Frequency range: 30MHz-1000MHz

10 Meter Open Site  
Site Calibrated: April 1995

Government Agency and Limit: FCC Class A

QP = Quasi-Peak Note: Ignore peak readings when Quasi-Peak reading exists  
PK = Peak

Customer: SYMBOL Operator: Rich Hedlund  
Date: 07-25-1995 Time: 16:16:00  
Temperature Range: 60-80 Deg F Percent Humidity: 50  
E.U.T.: Sirius  
Serial Number:  
Support Devices: NEC VERSA LAP TOP  
Serial Number: 53009650  
FCC ID:  
Exercise Program:  
Modifications: None  
Report File Name: C:\SCANS\5072401.RF

Antenna Type: BICONICAL

TEST TEST ACTUAL CLASS A VERSUS TABLE ANTENNA POLAR- DETECTOR  
FREQ dBuV dBuV/m LIMIT A LIMIT DEGREES HEIGHT IZATION Type  
=====

NOTE: 30-300 MHz AT OR BELOW NOISE FLOOR

+-----+  
CHANGED ANTENNA TO LOG PERIODIC

|         |      |      |      |       |     |     |   |    |
|---------|------|------|------|-------|-----|-----|---|----|
| 300.000 | 36.5 | 27.9 | 46.5 | -18.6 | 90  | 1.0 | V | PK |
| 376.000 | 36.0 | 30.7 | 46.5 | -15.8 | 90  | 1.0 | V | PK |
| 400.000 | 34.5 | 29.8 | 46.5 | -16.7 | 90  | 1.0 | V | PK |
| 426.000 | 36.0 | 32.5 | 46.5 | -14.0 | 270 | 1.0 | V | PK |
| 432.000 | 36.5 | 33.3 | 46.5 | -13.2 | 90  | 1.0 | V | PK |
| 440.000 | 38.0 | 35.2 | 46.5 | -11.3 | 90  | 1.0 | V | PK |
| 456.000 | 38.0 | 35.9 | 46.5 | -10.6 | 90  | 1.0 | V | PK |

NOTE: 457-1000 MHz AT OR BELOW NOISE FLOOR

+-----+  
NOTE: ALL HORIZONTAL READINGS LOWER

+-----+

# FCC RADIATED DATA SHEET

EUT: IBM ANT

CUSTOMER NAME: SYMBOL

RULE PART: 15.247, 15.205

DIST dB: 0

DUTY dB: 0

ATTN dB: 0

CALCULATED ANT GAIN 2.2dBi

HP IL dB: 0

| FREQ.<br>MHz | READING<br>dB(uV) | Pk, QP,<br>or Av | A.F.<br>dB | Cable loss<br>dB | AMP<br>dB | O.C.F.<br>dB | TOTAL,<br>dB(uV/m) | LIMIT<br>dB(uV/m) | DELTA<br>dB |
|--------------|-------------------|------------------|------------|------------------|-----------|--------------|--------------------|-------------------|-------------|
| 4804         | 43.8              | PK               | 31.4       | 7.0              | -35.0     | 0            | 47.23              | 74.0              | -26.8       |
| 4804         | 31.7              | AV               | 31.4       | 7.0              | -35.0     | 0            | 35.13              | 54.0              | -18.9       |
| 7206         | 47.4              | PK               | 34.5       | 10.6             | -35.0     | 0            | 57.48              | 74.0              | -16.5       |
| 7206         | 36.2              | AV               | 34.5       | 10.6             | -35.0     | 0            | 46.28              | 54.0              | -7.7        |
| 9608         | 47.7              | PK               | 36.8       | 13.0             | -35.0     | -9.54        | 52.94              | 74.0              | -21.1       |
| 9608         | 35.9              | AV               | 36.8       | 13.0             | -35.0     | -9.54        | 41.14              | 54.0              | -12.9       |
| 12010        | 48.8              | PK               | 39.0       | 13.6             | -35.0     | -9.54        | 56.83              | 74.0              | -17.2       |
| 12010        | 36.4              | AV               | 39.0       | 13.6             | -35.0     | -9.54        | 44.43              | 54.0              | -9.6        |
| 14412        | 53.8              | PK               | 41.8       | 14.5             | -35.0     | -20          | 55.06              | 74.0              | -18.9       |
| 14412        | 41.7              | AV               | 41.8       | 14.5             | -35.0     | -20          | 42.96              | 54.0              | -11.0       |
| 4880         | 44.0              | PK               | 31.4       | 7.0              | -35.0     | 0            | 47.43              | 74.0              | -26.6       |
| 4880         | 31.5              | AV               | 31.4       | 7.0              | -35.0     | 0            | 34.93              | 54.0              | -19.1       |
| 7320         | 48.8              | PK               | 34.5       | 10.6             | -35.0     | 0            | 58.88              | 74.0              | -15.1       |
| 7320         | 36.2              | AV               | 34.5       | 10.6             | -35.0     | 0            | 46.28              | 54.0              | -7.7        |
| 9760         | 48.0              | PK               | 36.8       | 13.0             | -35.0     | -9.54        | 53.24              | 74.0              | -20.8       |
| 9760         | 35.7              | AV               | 36.8       | 13.0             | -35.0     | -9.54        | 40.94              | 54.0              | -13.1       |
| 12200        | 46.6              | PK               | 39.0       | 13.6             | -35.0     | -9.54        | 54.63              | 74.0              | -19.4       |
| 12200        | 36.2              | AV               | 39.0       | 13.6             | -35.0     | -9.54        | 44.23              | 54.0              | -9.8        |
| 14640        | 54.3              | PK               | 41.9       | 15.5             | -35.0     | -20          | 56.74              | 74.0              | -17.3       |
| 14640        | 41.7              | AV               | 41.9       | 15.5             | -35.0     | -20          | 44.14              | 54.0              | -9.9        |
| 4960         | 43.7              | PK               | 31.4       | 7.0              | -35.0     | 0            | 47.13              | 74.0              | -26.9       |
| 4960         | 31.8              | AV               | 31.4       | 7.0              | -35.0     | 0            | 35.23              | 54.0              | -18.8       |
| 7440         | 48.3              | PK               | 34.5       | 10.6             | -35.0     | 0            | 58.38              | 74.0              | -15.6       |
| 7440         | 36.5              | AV               | 34.5       | 10.6             | -35.0     | 0            | 46.58              | 54.0              | -7.4        |
| 9920         | 48.0              | PK               | 36.8       | 13.0             | -35.0     | -9.54        | 53.24              | 74.0              | -20.8       |
| 9920         | 35.6              | AV               | 36.8       | 13.0             | -35.0     | -9.54        | 40.84              | 54.0              | -13.2       |
| 12400        | 47.8              | PK               | 39.0       | 13.6             | -35.0     | -9.54        | 55.83              | 74.0              | -18.2       |
| 12400        | 36.0              | AV               | 39.0       | 13.6             | -35.0     | -9.54        | 44.03              | 54.0              | -10.0       |
| 14880        | 53.8              | PK               | 41.9       | 15.5             | -35.0     | -20          | 56.24              | 74.0              | -17.8       |
| 14880        | 41.7              | AV               | 41.9       | 15.5             | -35.0     | -20          | 44.14              | 54.0              | -9.9        |

Restricted band 2483.5 - 2500

FCC RADIATED DATA SHEET

EUT: Sinus LA2400 CUSTOMER NAME: Symbol  
 RULE PART: 15.205

DIST dB: 0 DUTY dB: 0 ATTN dB: 0

CUSHMAN, IBM, HP IL dB: 0  
 Big rubber duck, little rubber d antennas

| 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    |
| Little | Rubber  | Duck    |      |            |     |        |          |          |       |
| 2489   | 39.0    | Pk      | 28.6 | 1.0        | 0.0 | -20    | 48.6     | 74.0     | -25.4 |
| 2489   | 32.0    | Av      | 28.6 | 1.0        | 0.0 | -20    | 41.6     | 54.0     | -12.4 |
| 2491   | 42.0    | Pk      | 28.6 | 1.0        | 0.0 | -20    | 51.6     | 74.0     | -22.4 |
| 2491   | 35.1    | Av      | 28.6 | 1.0        | 0.0 | -20    | 44.7     | 54.0     | -9.3  |

CUSHMAN

|      |      |    |      |     |     |     |      |      |       |
|------|------|----|------|-----|-----|-----|------|------|-------|
| 2489 | 47.2 | Pk | 28.6 | 1.0 | 0.0 | -20 | 56.8 | 74.0 | -17.2 |
| 2489 | 40.4 | Av | 28.6 | 1.0 | 0.0 | -20 | 50   | 54.0 | -4.0  |
| 2491 | 43.4 | Pk | 28.6 | 1.0 | 0.0 | -20 | 53   | 74.0 | -21.0 |
| 2491 | 37.5 | Av | 28.7 | 1.0 | 0.0 | -20 | 47.2 | 54.0 | -6.8  |

IBM

|      |      |    |      |     |     |     |      |      |       |
|------|------|----|------|-----|-----|-----|------|------|-------|
| 2489 | 44.7 | Pk | 28.6 | 1.0 | 0.0 | -20 | 54.3 | 74.0 | -19.7 |
| 2489 | 37.2 | Av | 28.6 | 1.0 | 0.0 | -20 | 46.8 | 54.0 | -7.2  |
| 2491 | 47.5 | Pk | 28.6 | 1.0 | 0.0 | -20 | 57.1 | 74.0 | -16.9 |
| 2491 | 40.9 | Av | 28.6 | 1.0 | 0.0 | -20 | 50.5 | 54.0 | -3.5  |

Big Rubber Duck

|      |      |    |      |     |     |     |      |      |       |
|------|------|----|------|-----|-----|-----|------|------|-------|
| 2489 | 45.1 | Pk | 28.6 | 1.0 | 0.0 | -20 | 54.7 | 74.0 | -19.3 |
| 2489 | 36.2 | Av | 28.6 | 1.0 | 0.0 | -20 | 45.8 | 54.0 | -8.2  |
| 2491 | 44.2 | Pk | 28.6 | 1.0 | 0.0 | -20 | 53.8 | 74.0 | -20.2 |
| 2491 | 34.9 | Av | 28.6 | 1.0 | 0.0 | -20 | 44.5 | 54.0 | -9.5  |

Restricted Band 2310-2390 and 2483.5-2500

FCC RADIATED DATA SHEET

EUT: Sirius LA2400 CUSTOMER NAME: Symbol  
 RULE PART: 15.205

DIST dB: 0 DUTY dB: 0 ATTN dB: 0

TCOM & ENDCAP Antennas HP IL dB: 0

| FREQ.<br>MHz | READING<br>dB(uV) | Pk, QP,<br>or Av | A.F.<br>dB | Cable loss<br>dB | AMP<br>dB | O.C.F.<br>dB | TOTAL,<br>dB(uV/m) | LIMIT<br>dB(uV/m) | DELTA<br>dB |
|--------------|-------------------|------------------|------------|------------------|-----------|--------------|--------------------|-------------------|-------------|
|--------------|-------------------|------------------|------------|------------------|-----------|--------------|--------------------|-------------------|-------------|

TCOM 2310 - 2390 MHz:

|      |      |    |      |     |     |     |      |      |       |
|------|------|----|------|-----|-----|-----|------|------|-------|
| 2232 | 35.4 | Pk | 28.6 | 1.0 | 0.0 | -20 | 45   | 54.0 | -9.0  |
| 2232 | 29.3 | Av | 28.6 | 1.0 | 0.0 | -20 | 38.9 | 54.0 | -15.1 |
| 2362 | 37.3 | Pk | 28.6 | 1.0 | 0.0 | -20 | 46.9 | 30.0 | 16.9  |
| 2362 | 33.4 | Av | 28.6 | 1.0 | 0.0 | -20 | 43   | 30.0 | 13.0  |

ENDCAP 2310 - 2390 MHz:

|      |      |    |      |     |     |  |      |      |       |
|------|------|----|------|-----|-----|--|------|------|-------|
| 2338 | 32.8 | Pk | 28.6 | 1.0 | 0.0 |  | 62.4 | 74.0 | -11.6 |
| 2338 | 24.8 | Av | 28.6 | 1.0 | 0.0 |  | 54.4 | 74.0 | -19.6 |
| 2387 | 31.5 | Pk | 28.6 | 1.0 | 0.0 |  | 61.1 | 74.0 | -12.9 |
| 2387 | 25.8 | Av | 28.7 | 1.0 | 0.0 |  | 55.5 | 74.0 | -18.5 |

ENDCAP 2384.5 - 2500 MHz:

|        |      |    |      |     |     |   |      |      |       |
|--------|------|----|------|-----|-----|---|------|------|-------|
| 2489.2 | 24.1 | Pk | 28.6 | 1.0 | 0.0 | 0 | 53.7 | 74.0 | -20.3 |
| 2489.2 | 18.0 | Av | 28.6 | 1.0 | 0.0 | 0 | 47.6 | 74.0 | -26.4 |

TCOM 2384.5 - 2500 MHz:

|      |      |    |      |     |     |   |      |      |       |
|------|------|----|------|-----|-----|---|------|------|-------|
| 2489 | 13.2 | Pk | 28.6 | 1.0 | 0.0 | 0 | 42.8 | 54.0 | -11.2 |
|------|------|----|------|-----|-----|---|------|------|-------|

Restricted Band 2310-2390

FCC RADIATED DATA SHEET

EUT: Sinus LA2400 CUSTOMER NAME: Symbol  
 RULE PART: 15.205

DIST dB: 0 DUTY dB: 0 ATTN dB: 0

CUSHMAN, IBM, HP IL dB: 0  
 Big rubber duck, little rubber d antennas

| 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    |
| Little | Rubber  | Duck    |      |            |     |        |          |          |       |
| 2322   | 42.8    | Pk      | 28.6 | 1.0        | 0.0 | -20    | 52.4     | 74.0     | -21.6 |
| 2322   | 33.9    | Av      | 28.6 | 1.0        | 0.0 | -20    | 43.5     | 54.0     | -10.5 |
| 2362   | 44.2    | Pk      | 28.6 | 1.0        | 0.0 | -20    | 53.8     | 74.0     | -20.2 |
| 2362   | 37.4    | Av      | 28.6 | 1.0        | 0.0 | -20    | 47       | 54.0     | -7.0  |

CUSHMAN

|      |      |    |      |     |     |     |      |      |       |
|------|------|----|------|-----|-----|-----|------|------|-------|
| 2322 | 44.8 | Pk | 28.6 | 1.0 | 0.0 | -20 | 54.4 | 74.0 | -19.6 |
| 2322 | 36.4 | Av | 28.6 | 1.0 | 0.0 | -20 | 46   | 54.0 | -8.0  |
| 2362 | 44.9 | Pk | 28.6 | 1.0 | 0.0 | -20 | 54.5 | 74.0 | -19.5 |
| 2362 | 36.8 | Av | 28.7 | 1.0 | 0.0 | -20 | 46.5 | 54.0 | -7.5  |

IBM

|      |      |    |      |     |     |     |      |      |       |
|------|------|----|------|-----|-----|-----|------|------|-------|
| 2322 | 45.9 | Pk | 28.6 | 1.0 | 0.0 | -20 | 55.5 | 74.0 | -18.5 |
| 2322 | 39.2 | Av | 28.6 | 1.0 | 0.0 | -20 | 48.8 | 54.0 | -5.2  |
| 2362 | 47.8 | Pk | 28.6 | 1.0 | 0.0 | -20 | 57.4 | 74.0 | -16.6 |
| 2362 | 41.6 | Av | 28.6 | 1.0 | 0.0 | -20 | 51.2 | 54.0 | -2.8  |

Big Rubber Duck

|      |      |    |      |     |     |     |      |      |       |
|------|------|----|------|-----|-----|-----|------|------|-------|
| 2322 | 41.7 | Pk | 28.6 | 1.0 | 0.0 | -20 | 51.3 | 74.0 | -22.7 |
| 2322 | 33.6 | Av | 28.6 | 1.0 | 0.0 | -20 | 43.2 | 54.0 | -10.8 |
| 2362 | 45.0 | Pk | 28.6 | 1.0 | 0.0 | -20 | 54.6 | 74.0 | -19.4 |
| 2362 | 39.6 | Av | 28.6 | 1.0 | 0.0 | -20 | 49.2 | 54.0 | -4.8  |

# CHANNEL UTILIZATION (79 HOPPING CHANNELS)

[11:41:50 JUL 26, 1995]

SIRIUS # OF HOPPING CHANNELS = 79

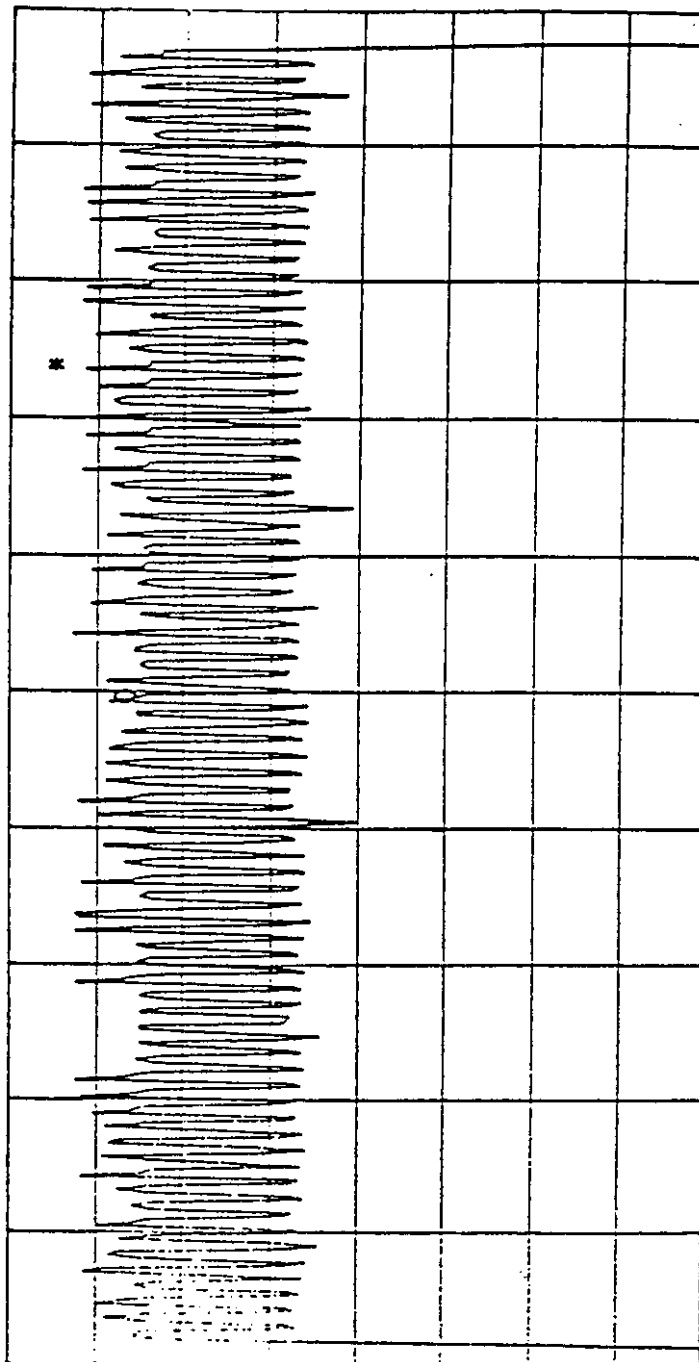
ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.44133 GHz  
20.67 dBm

PREFIX= NAT0

LOG REF 28.0 dBm

5 dB/ ATN 70 dB

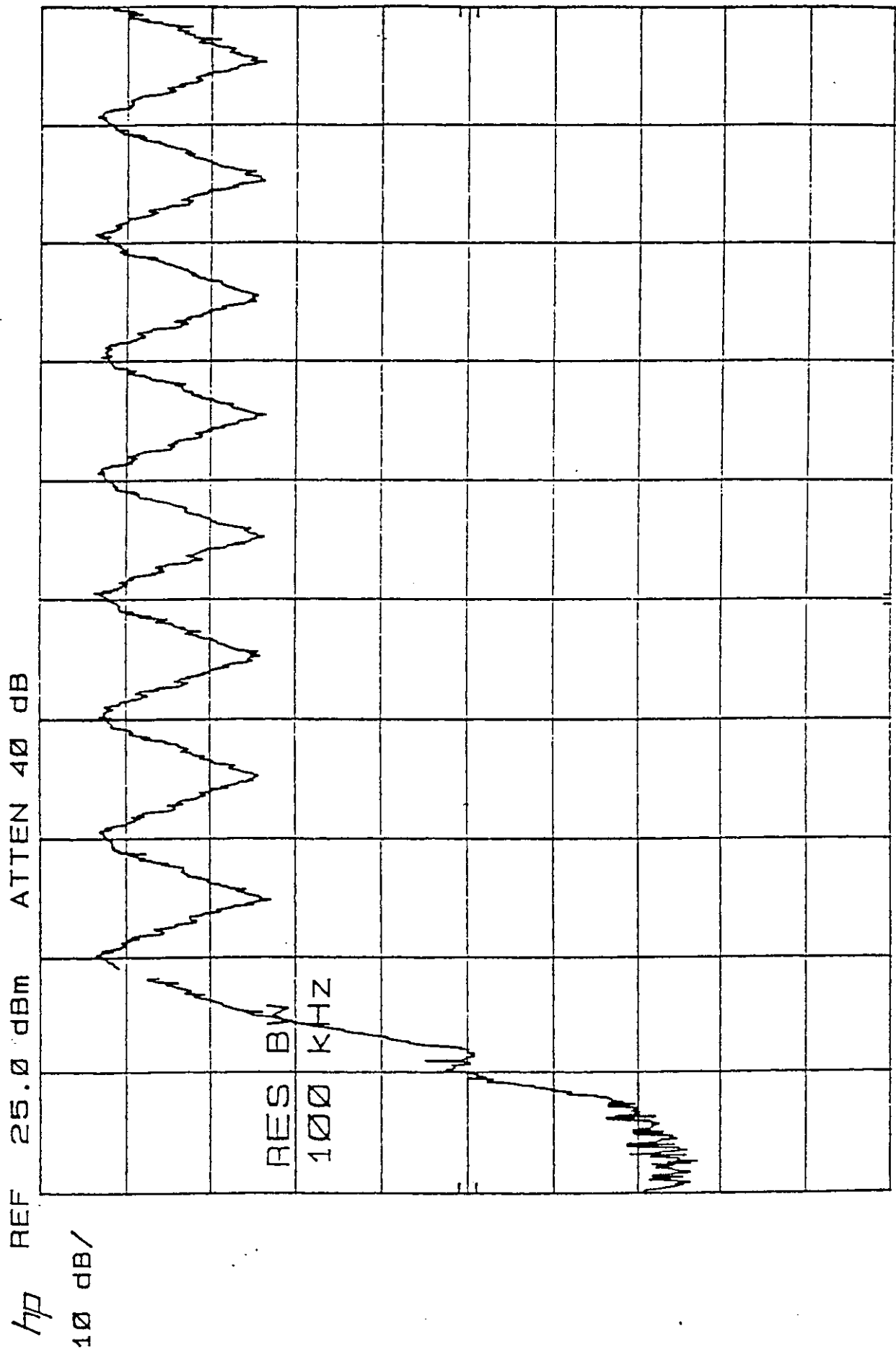
SA MB  
SC FS  
CORR



START 2.40000 GHz  
#IF BW 30 kHz  
#AUG BW 300 kHz  
STOP 2.48350 GHz  
SWP 270 msec

FCC ID NO. H9PLA24005AZL

Channel spacing



START 2.400 0 GHz RES BW 100 KHZ VBW 3 KHZ

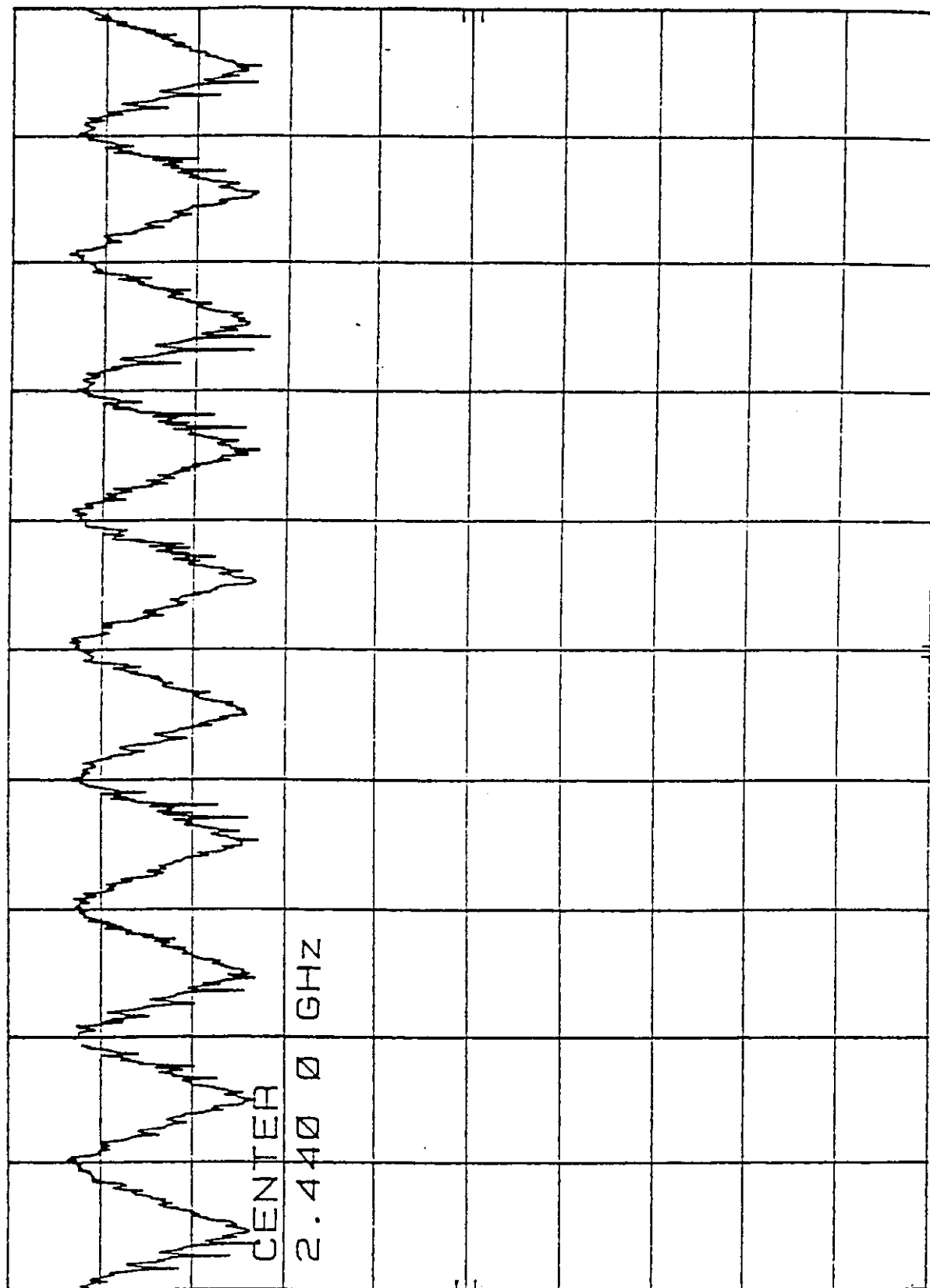
C.C. 1 Sp-000

HP REF 25.0 dBm

ATTEN 40 dB

10 dB/

10 dB/



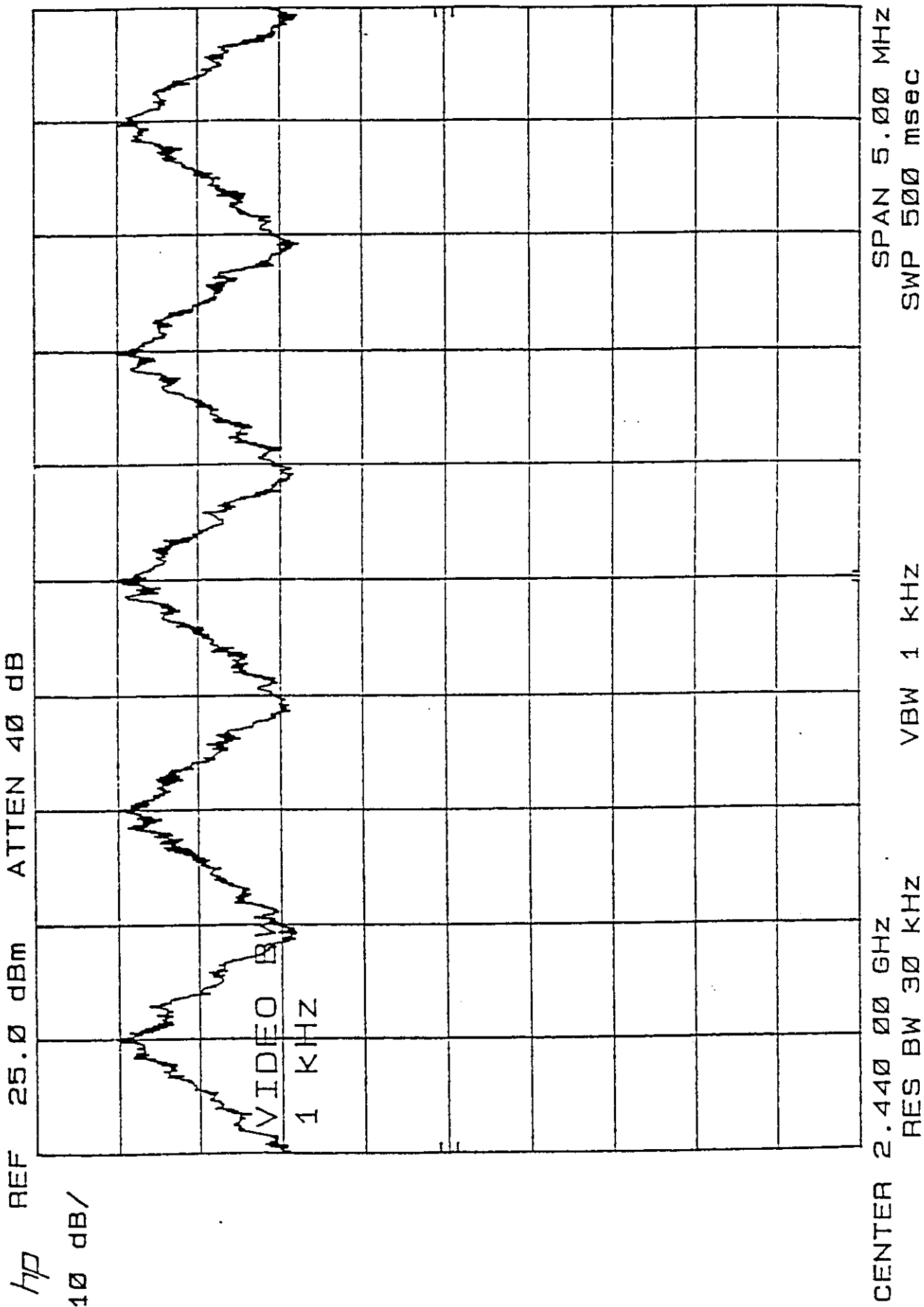
CENTER 2.440 GHz

RES BW 100 kHz

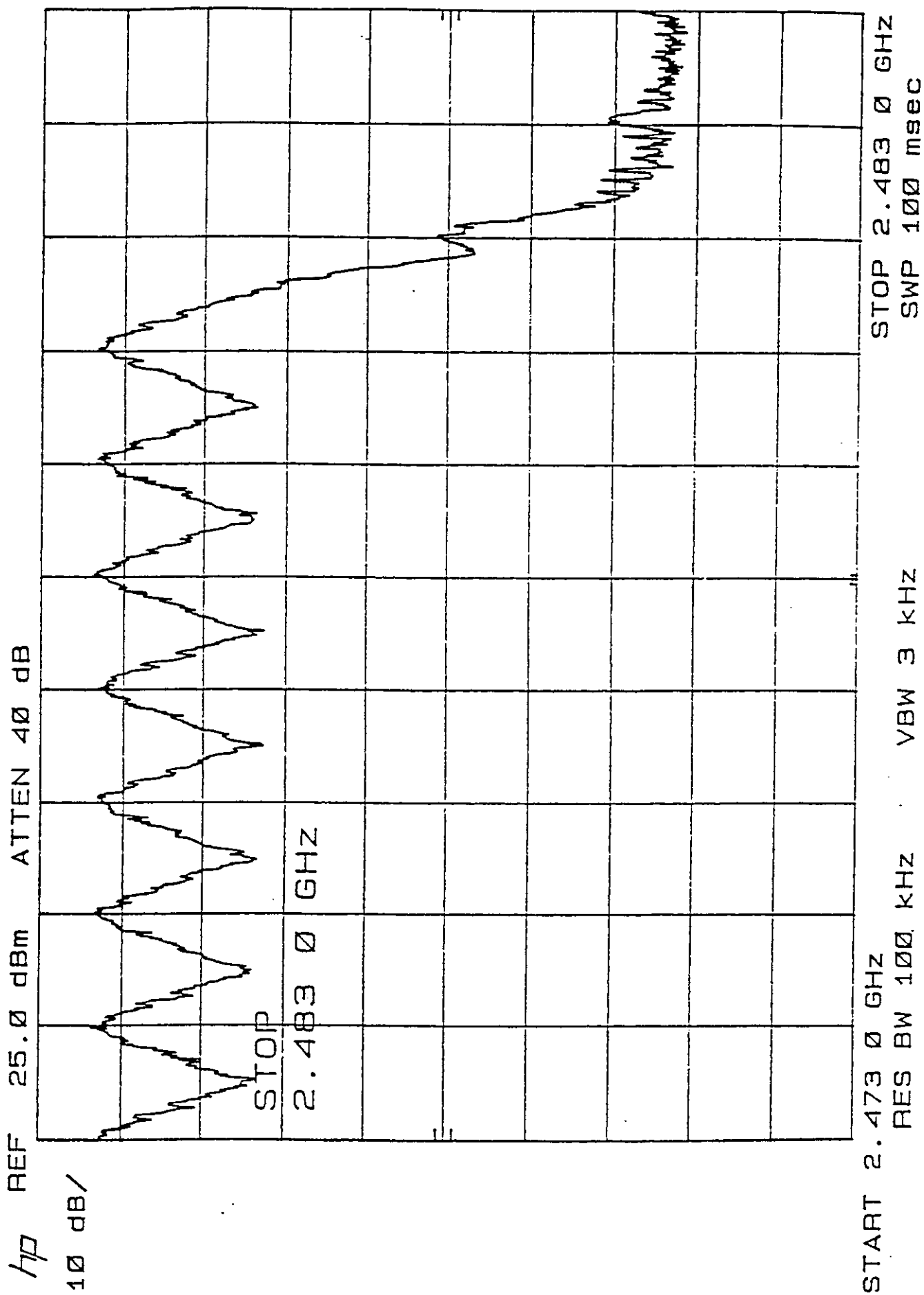
VBW 3 kHz

SPAN 10.0 MHz  
SWP 100 msec

# Channel Spacing



Cher il Speeds



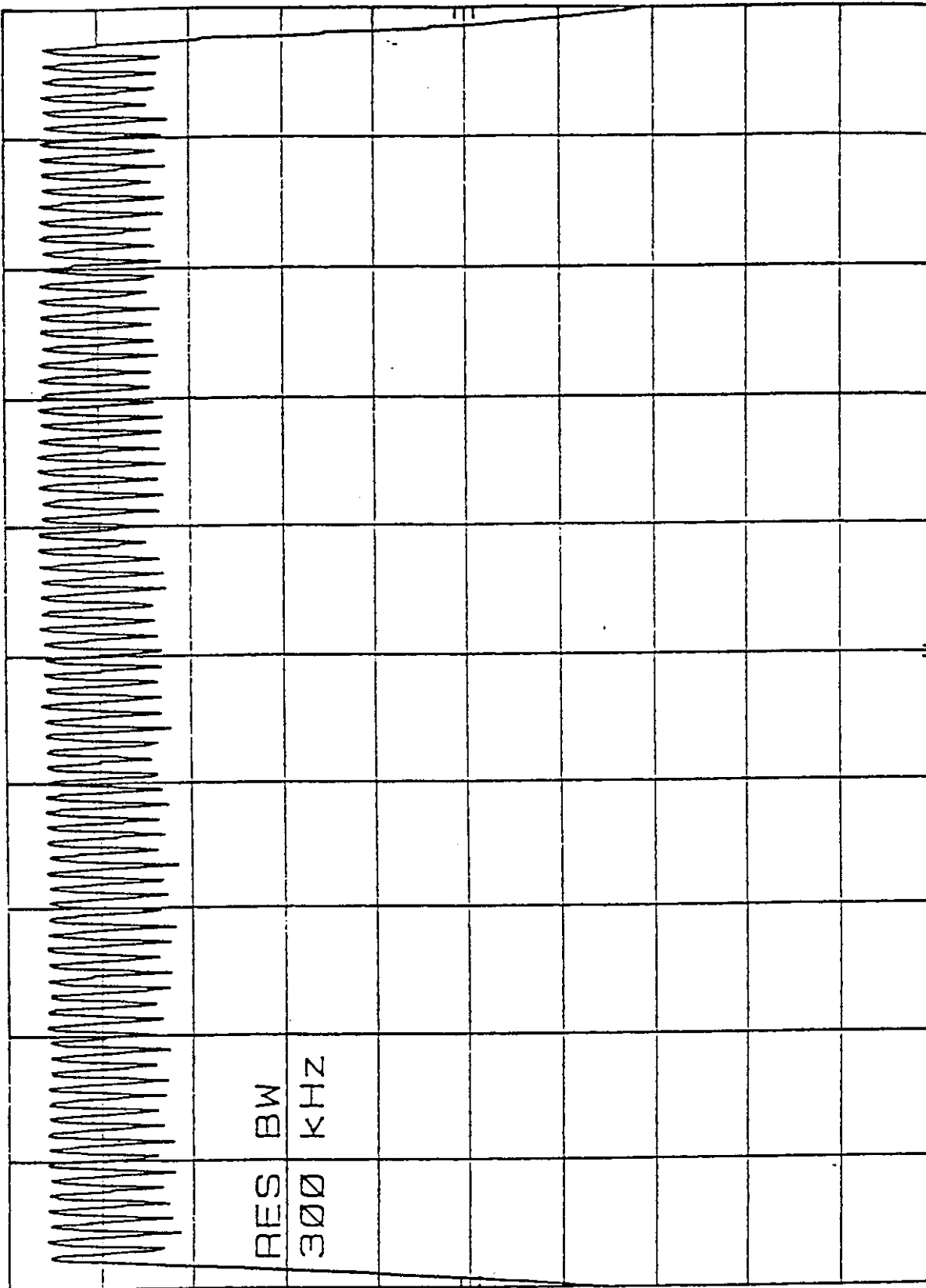
10 dB/

HP REF 25.0 dBm

ATTEN 40 dB

10 dB/

10 dB/



START 2.400 0 GHz  
RES BW 300 KHZ

VBW 3 KHZ

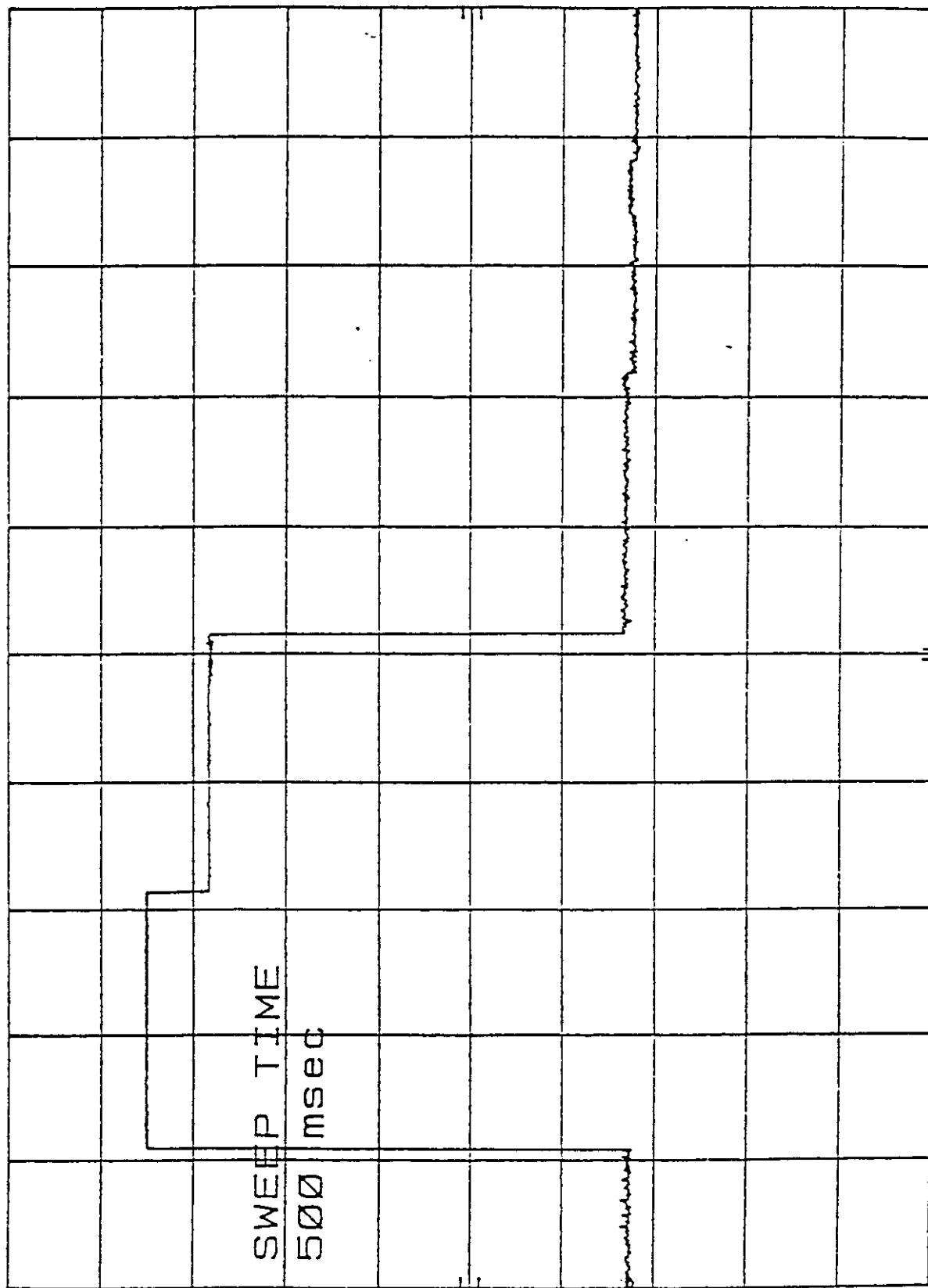
STOP 2.483 0 GHz  
SWP 249 msec

Dwell Time

MR 0.000  $\mu$ sec  
-42.50 dBm

HP REF 25.0 dBm ATTN 40 dB

10 dB/



CENTER 2.440 000 000 GHz

RES BW 3 MHz

VBW 10 kHz

SPAN 0 Hz

SWP 500 msec

Wave Time

MKR 0.000  $\mu$ s  
-42.00 dBm

ATTEN 40 dB

REF 25.0 dBm

hp

10 dB/

RES BW  
3 MHz

CENTER 2.440 000 000 GHz  
RES BW 3 MHz

VBW 10 KHz

SPAN 0 Hz  
SWP 1.00 sec

Channel Bandwidth

hp

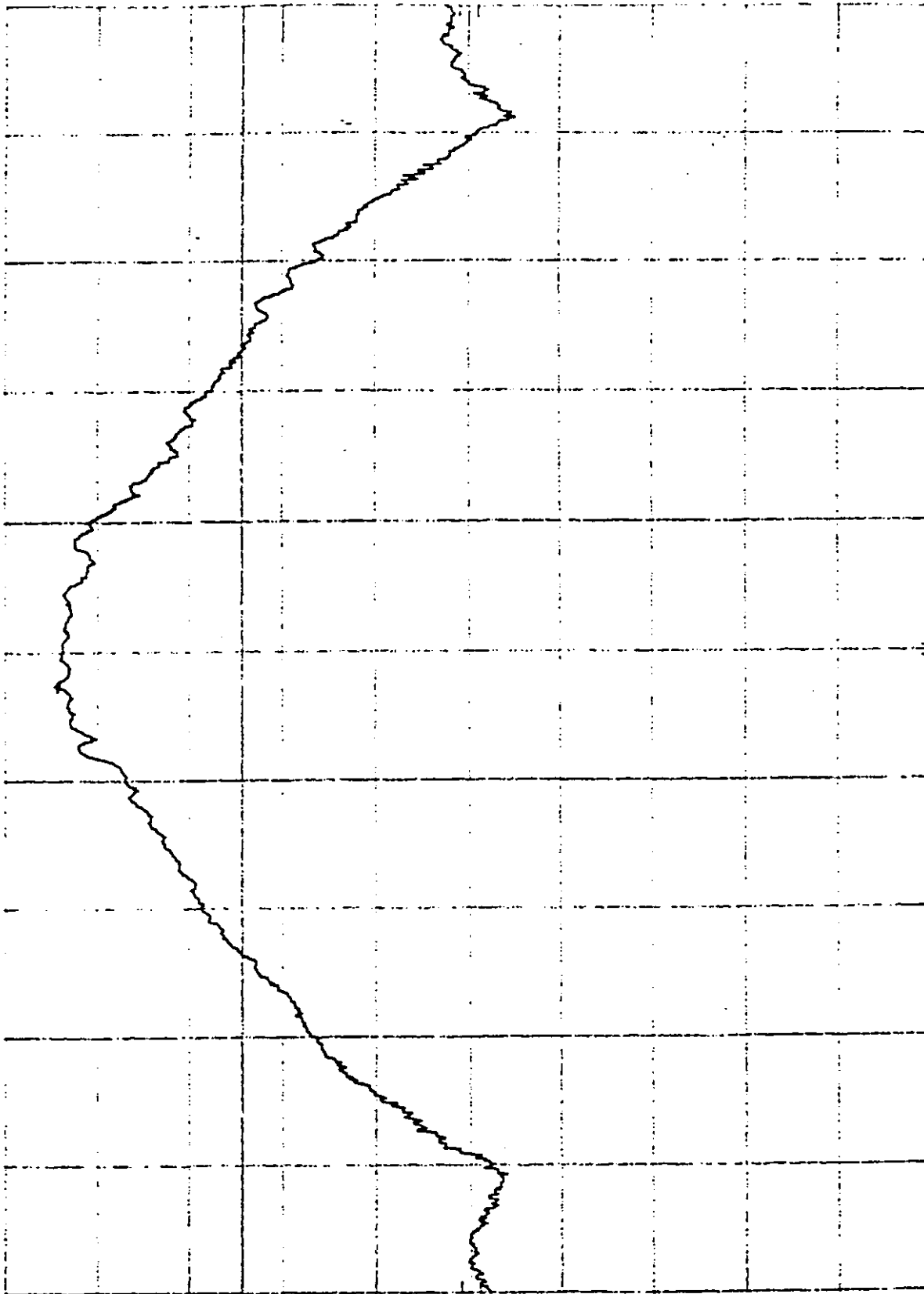
REF 30.0 dBm

ATTEN 40 dB

10 dB/

DL  
4.3  
dBm

MKR 2.401 946 GHz  
24.30 dBm



CENTER 2.402 00 GHz

RES BW 30 KHz

VBW 300 KHz

SPAN 2.00 MHz  
SWP 20.0 sec

# Channel Bandwidth

MKHZ  $\Delta$  932 KHZ  
-0.10 dB

ATTEN 40 dB

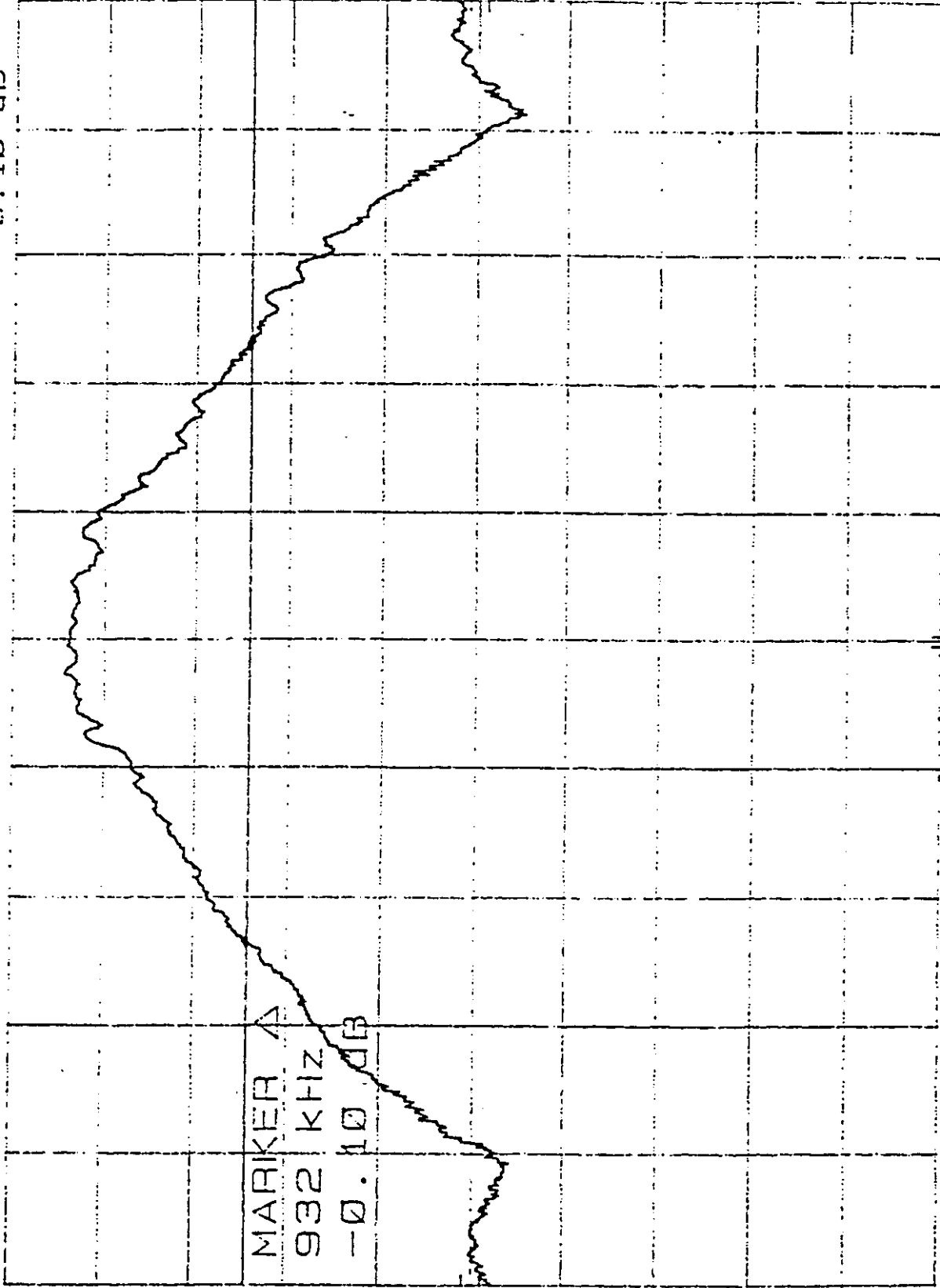
REF 30.0 dBm

HP

10 dB/

MARKER  $\Delta$   
932 KHZ  
-0.10 dB

DL  
4.3  
dBm



CENTER 2.402 00 GHZ

RES BW 30 KHZ

VBW 300 KHZ

SPAN 2.00 MHZ

SWP 20.0 sec

Channel Bandwidth

10 dB/

REF 30.0 dBm

ATTEN 40 dB

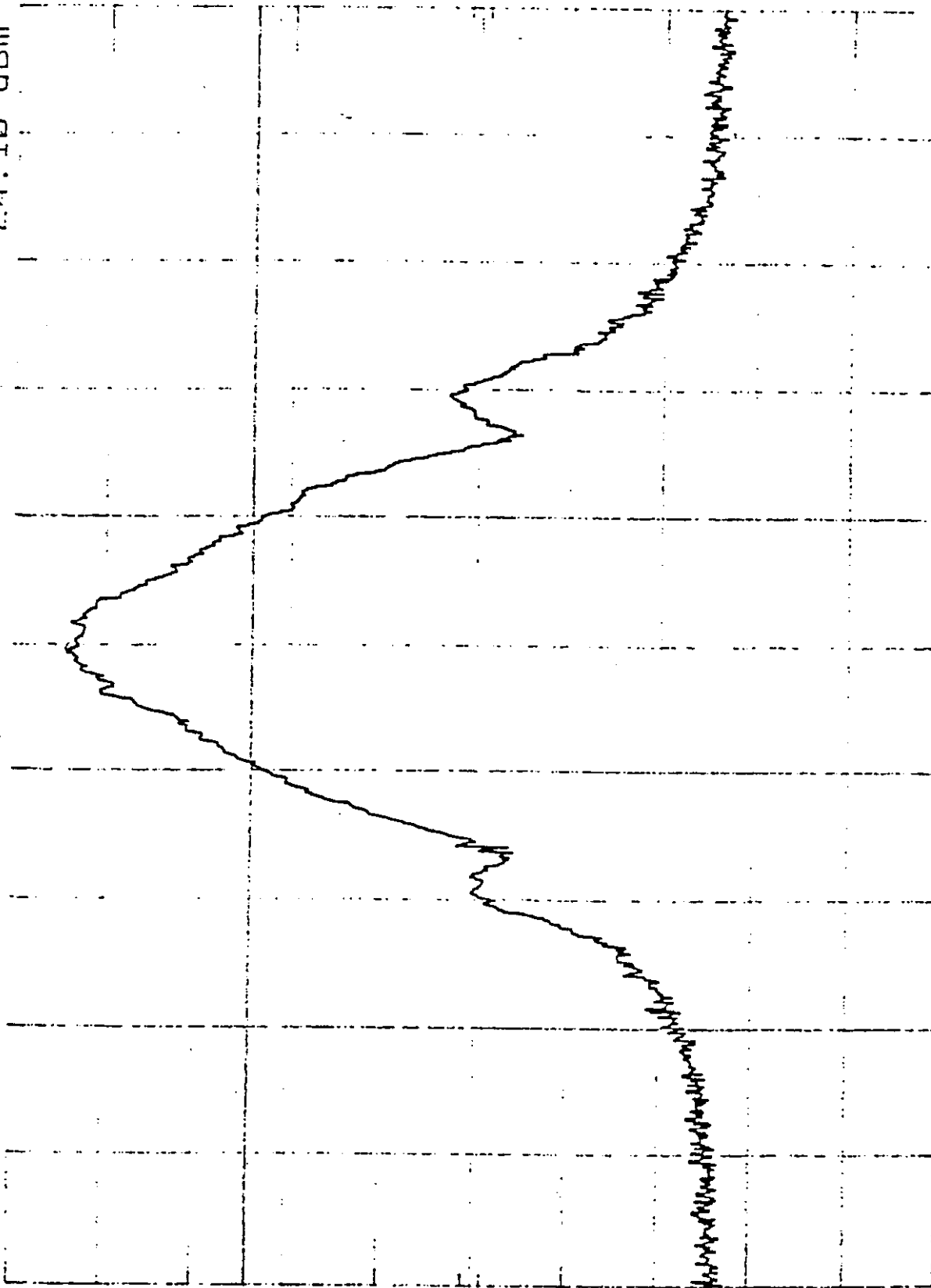
MKR 2.401 980 GHz  
24.10 dBm

DL  
4.1  
dBm

CENTER 2.402 00 GHz  
RES BW 30 KHz

VBW 300 KHz

SPAN 5.00 MHz  
SWP 20.0 sec



Channel Bandwidth

MKHZ  $\Delta$  945 KHZ  
--0.10 dB

REF 30.0 dBm

ATTEN 10 dB

10 dB/

MARKER  $\Delta$

945 KHZ

--0.10 dB

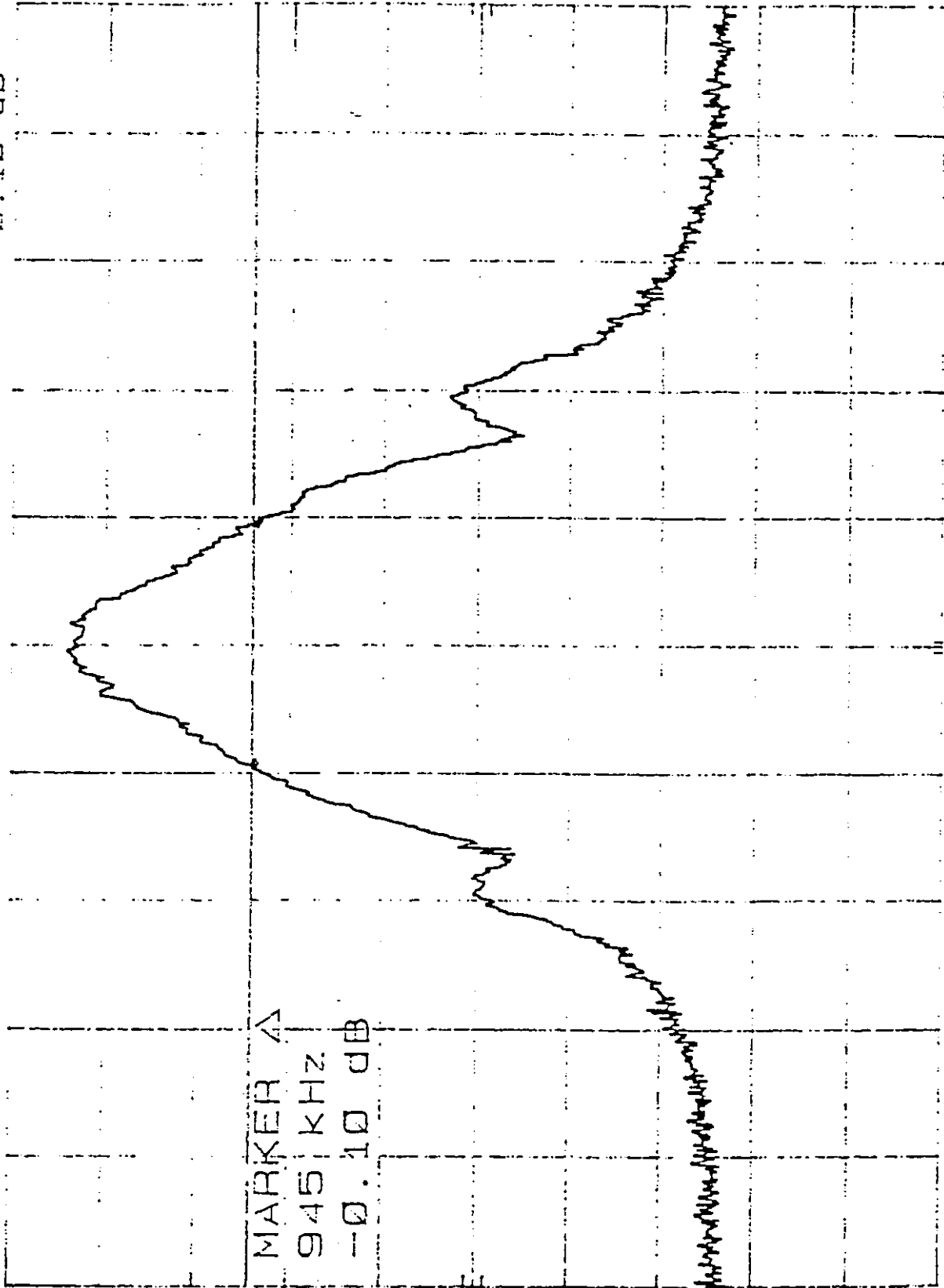
DL  
4.1  
dBm

CENTER 2.402 00 GHZ

RES BW 30 KHZ

VBW 300 KHZ

SPAN 5.00 MHZ  
SWP 20.0 sec



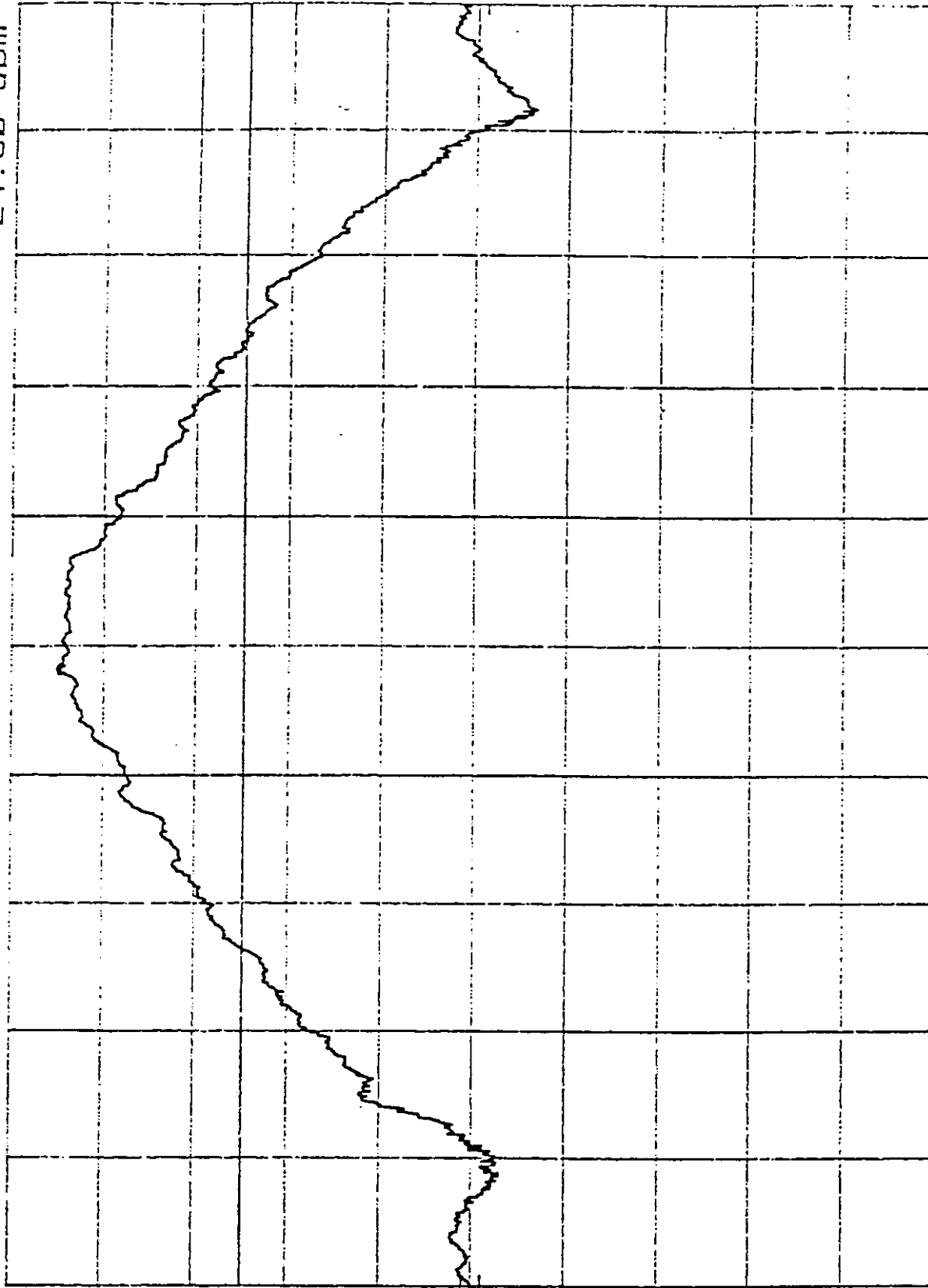
Channel Bandwidth MKR 2.439 962 GHz  
24.80 dBm

hp  
10 dB/

DL  
4.8  
dBm

REF 30.0 dBm

ATTEN 10 dB



CENTER 2.440 00 GHz

RES BW 30 KHz

VBW 300 KHz

SPAN 2.00 MHz  
SWP 20.0 sec

Channel Bandwidth

hp

10 dB/

REF

30.0 dBm

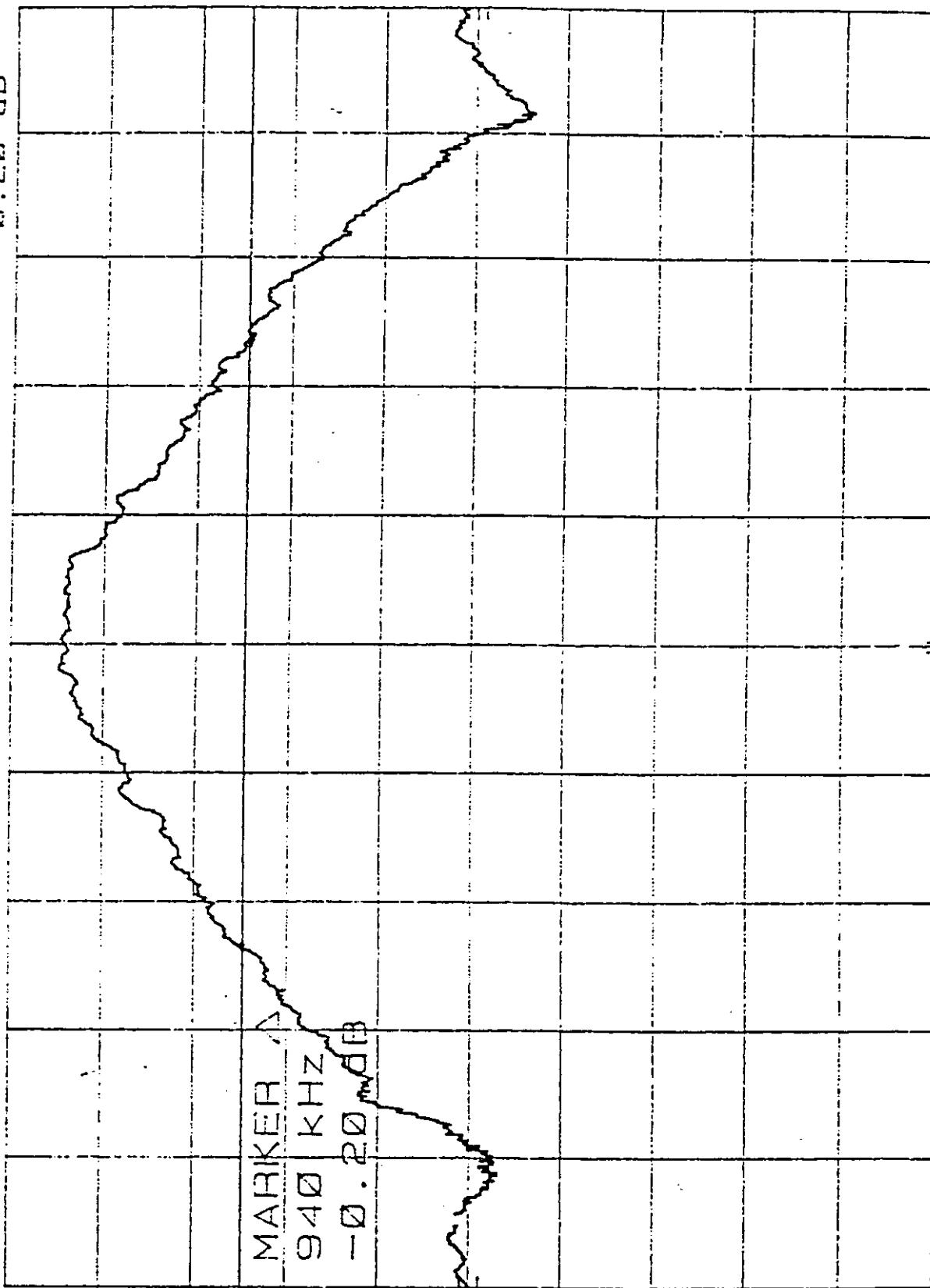
ATTEN

10 dB

MARKER  $\Delta$  940 KHz  
-0.20 dB

MARKER  $\Delta$   
940 KHz  
-0.20 dB

DL  
4.8  
dBm



CENTER 2.440 00 GHz  
RES BW 30 KHz

VBW 300 KHz

SPAN 2.00 MHz  
SWP 20.0 sec

Channel Bandwidth

ATTEN 40 dB

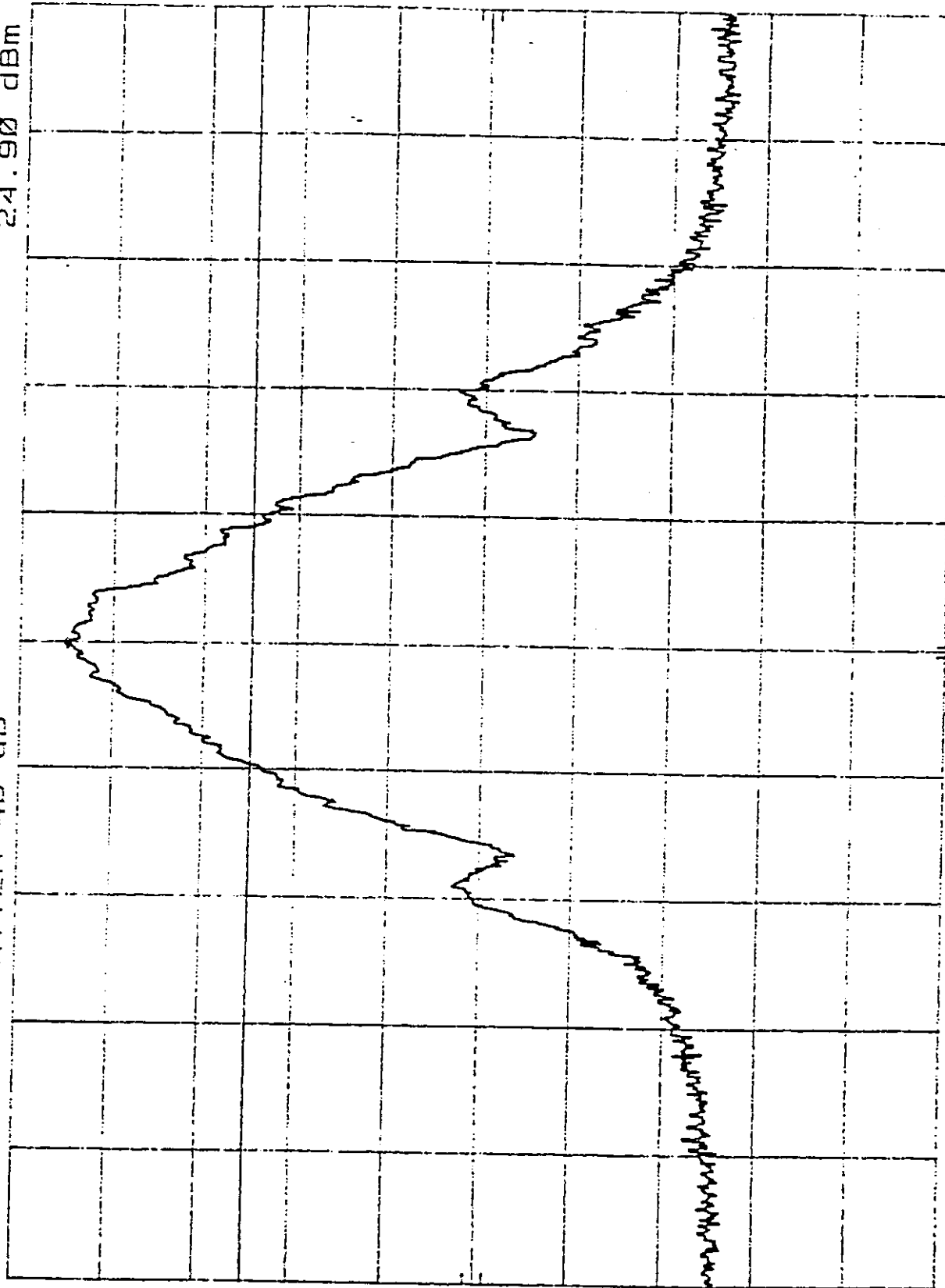
REF 30.0 dBm

HP

10 dB/

DL  
4.9  
dBm

MK1 2.439 995 GHz  
24.90 dBm



CENTER 2.440 00 GHz  
RES BW 30 KHZ

VBW 300 KHZ

SPAN 5.00 MHz  
SWP 20.0 sec

Channel Bandwidth

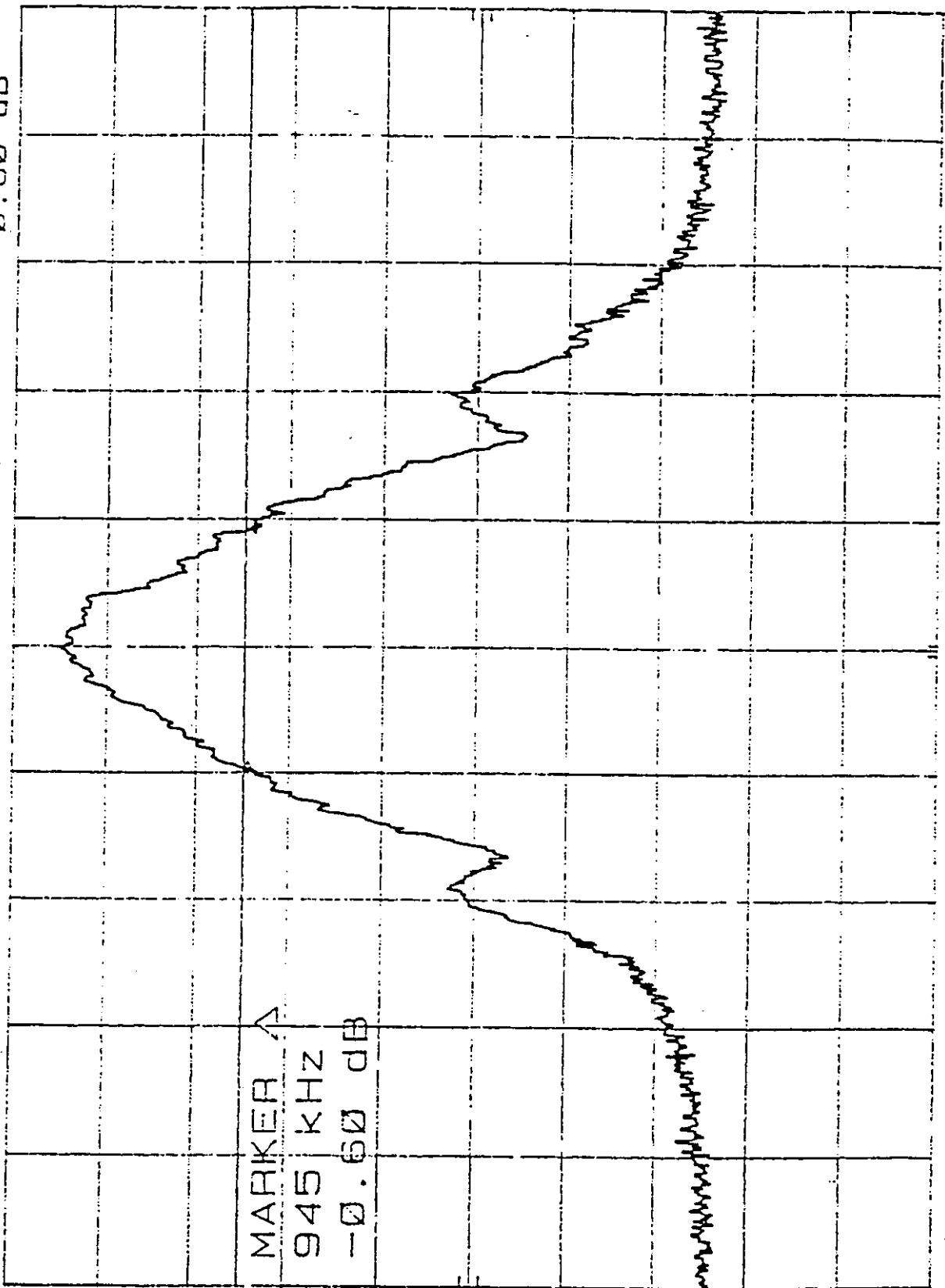
MARKER  $\Delta$  945 KHZ  
-0.60 dB

HP REF 30.0 dBm  
10 dB/

ATTEN 40 dB

MARKER  $\Delta$   
945 KHZ  
-0.60 dB

DL  
4.9  
dBm



CENTER 2.440 00 GHZ  
RES BW 30 KHZ

VBW 300 KHZ

SPAN 5.00 MHZ  
SWP 20.0 sec

Channel Bandwidth

MKR 2.479 982 GHz  
22.70 dBm

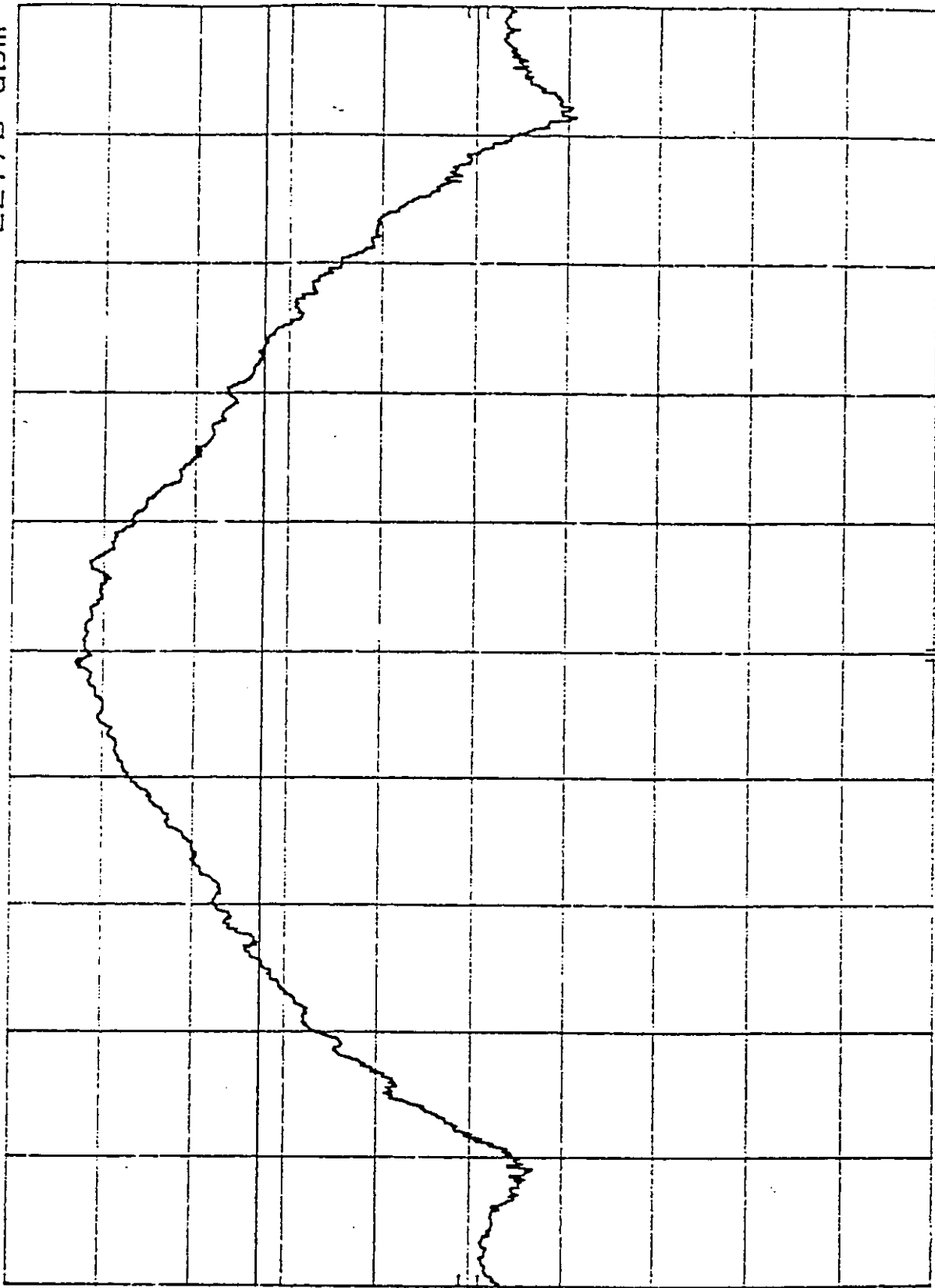
REF 30.0 dBm

h0

10 dB/

DL  
2.7  
dBm

ATTEN 40 dB



CENTER 2.480 00 GHz  
RES BW 30 KHz

VBW 300 KHz

SPAN 2.00 MHz  
SWP 20.0 sec

Channel Bandwidth

MKR  $\Delta$  962 KHz  
0.00 dB

ATTEN 40 dB

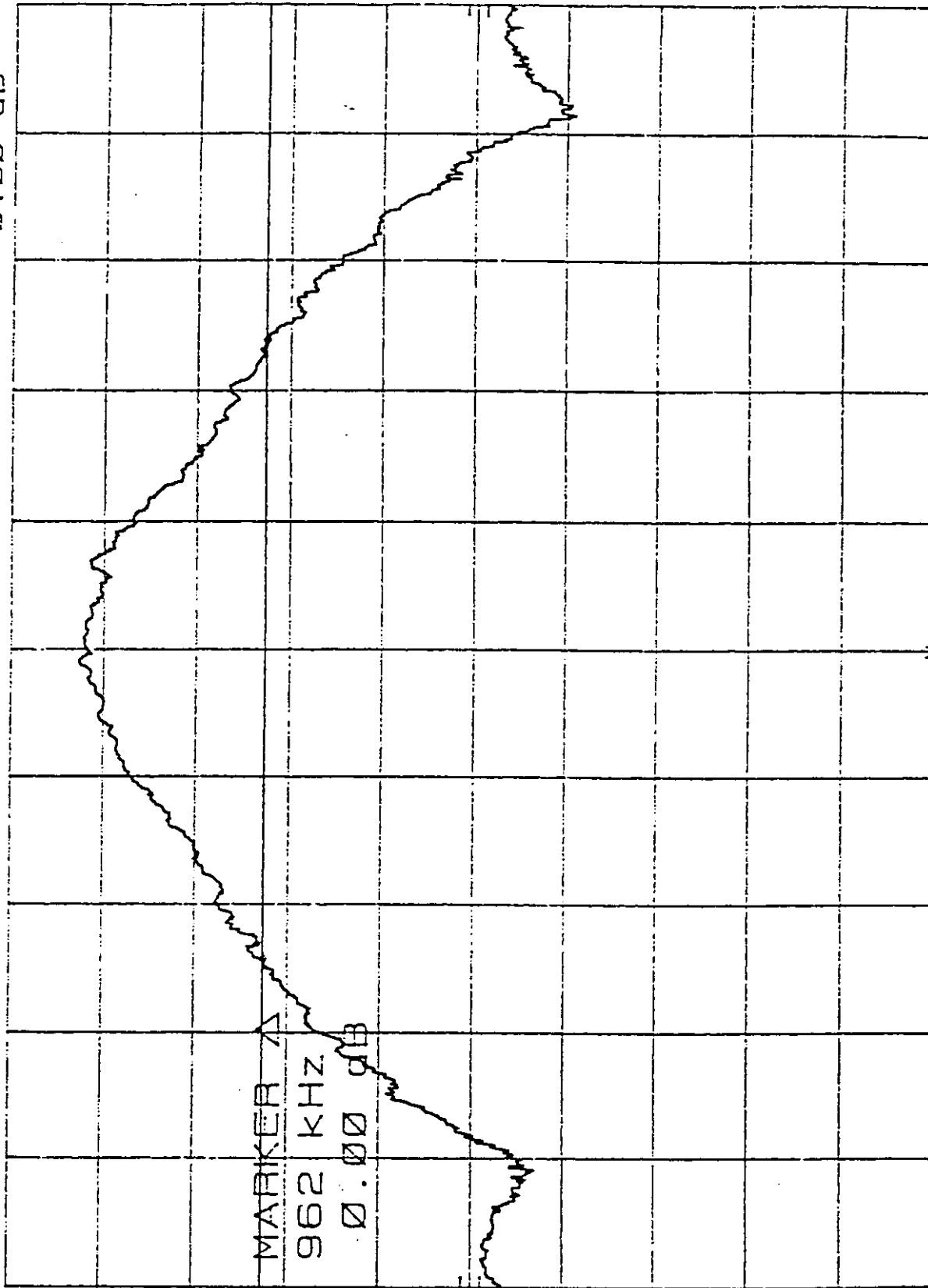
REF 30.0 dBm

hp

10 dB/

MARKER  $\Delta$   
962 KHz  
0.00 dB

DL  
2.7  
dBm



CENTER 2.480 00 GHz

RES BW 30 KHz

VBW 300 KHz

SPAN 2.00 MHz

SWP 20.0 sec

Channel Bandwidth

hp

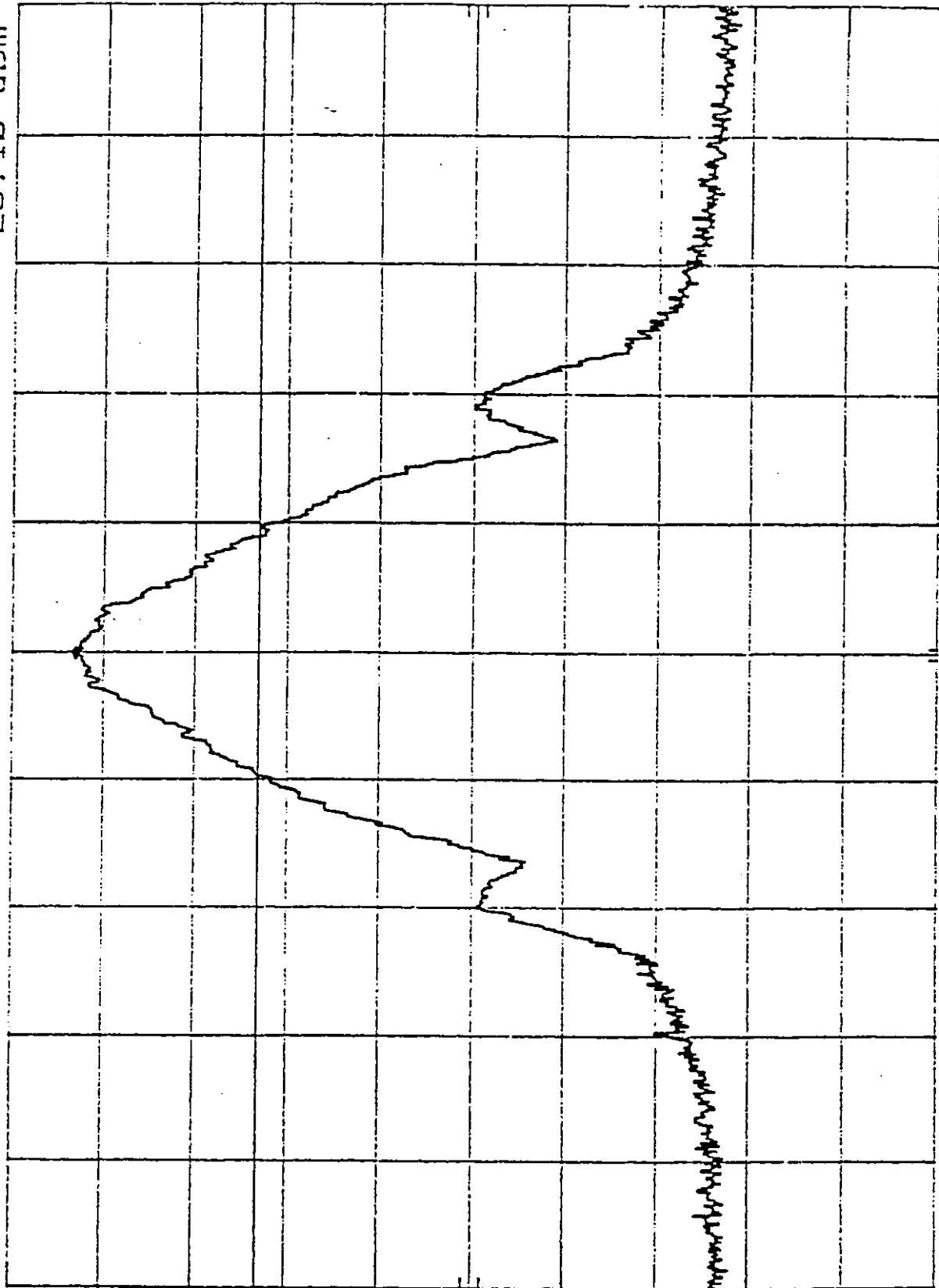
REF 30.0 dBm

ATTEN 40 dB

MKR 2.479 995 GHz  
23.10 dBm

10 dB/

DL  
3.1  
dBm



CENTER 2.480 00 GHz  
RES BW 30 KHz

VBW 300 KHz

SPAN 5.00 MHz  
SWP 20.0 sec

Channel Bandwidth

MKHZ  $\Delta$  940 KHZ  
-0.80 dB

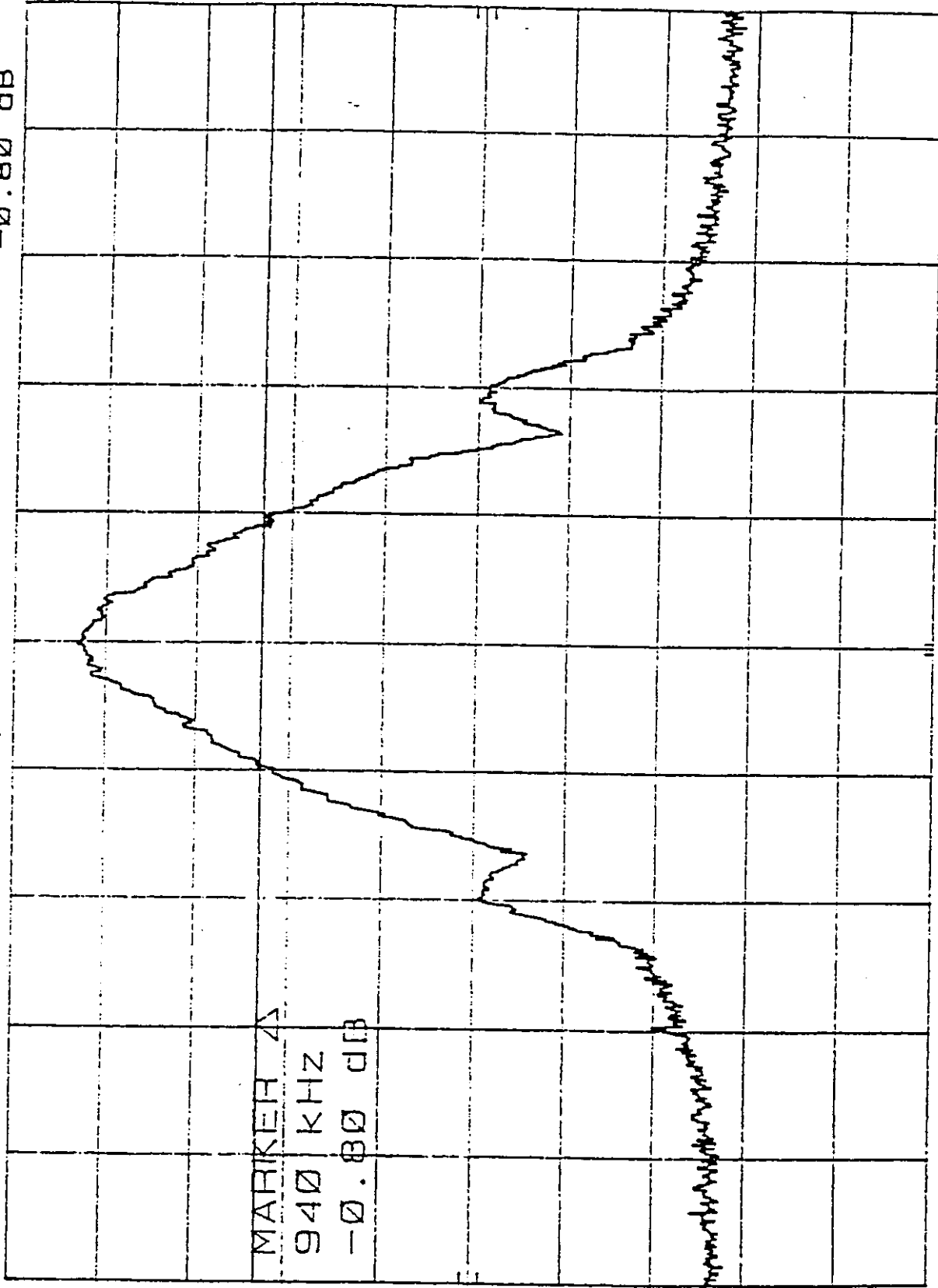
ATTEN 40 dB

REF 30.0 dBm

10 dB/

MARKER  $\Delta$   
940 KHZ  
-0.80 dB

DL  
3.1  
dBm



CENTER 2.480 00 GHZ  
RES BW 30 KHZ

VBW 300 KHZ

SPAN 5.00 MHZ  
SWP 20.0 sec

### OUT OF BAND EMISSIONS (LOWER BAND EDGE 1)

11:04:47 JUL 26, 1995

16:20:11 MAR 02, 1994SYMBOL SIRIUS BW OCC

SWEPTIME

207 msec

ACTV DET: PEAK

MEAS DET: PEAK QP AVG

MKR<sub>Δ</sub> -2.0514 GHz

-60.42 dB

LOG REF 20.0 dBm

5

dB/

ATN

508p

10

10.6

DBE

MA WB

5735

CORR

START 20.0 MHZ

#IF BW 100 kHz

#AVG BW 300 kHz

FCC ID NO. H9PLA24005AZL

STOP 975.0 MH7

SWP 287 mser



**Mobile & Wireless Systems Division**

Norman H. Nelson  
Symbol Technologies  
2145 Hamilton Ave  
San Jose, CA 95124  
Voice: (408) 369-2649  
FAX: (408) 369-2740

Richard Fabina  
Federal Communications Commission  
Authorization and Evaluation Division  
7435 Oakland Mills Road  
Columbia, MD 21046  
Voice: (301) 725 - 1585 x220  
FAX: (301) 344 -2050

*Copy*

Re: FCC ID: H9PWWC1049

Date: March 3, 1998

Dear Mr. Fabina

Thank you for your FAX of January 22 addressed to Amit Shah and your FAX of December 2 to Thomas Schneider. Regarding each of the items of concern, in order following your FAXs:

**FAX of December 2**

**1) Concerning the Radiated emissions test data:**

We tested the 2.4 GHz spread spectrum transmitter in its new housing and antenna configuration. Please see the attached test data sheets. Note that the data sheets omit a column for duty cycle correction factor. All margins on the data sheet need to be adjusted for a -9 dB duty cycle factor to increase the margins. Please see the attached duty cycle calculation.

**2) Concerning public exposure to excess radio frequency energy:**

Please see the attached Product Compliance Test Report for SAR.

**3) Concerning antenna discription:**

Please see the enclosed outline drawing, photograph, and Saturn Stub drawing.

4) Concerning intended usage statement or users manual.

See Symbol Technoloiges, Inc. letter from Amit Shah of January 8.

**FAX of January 22**

1) Concerning public exposure to excess radio frequency energy:

Please see the attached Product Compliance Test Report for SAR.

2) Concerning periodic beacon equal usage.

The beacons are generated only by the Spectrum24 Access Point not by the mobile units (like the WWC1049). The beacons occur once during each channel hop. The hop pattern as discussed is a psuedo-random sequence which selects one of 79, 1 MHz channels centered from 2402 to 2480 MHz. Each channel of the hop sequence is evenly utilized by selecting each channel once and only once in each cycle, and using identical dwells at each channel. Each channel is evenly utilized by selecting each channel once and only once in each cycle, and using identical dwells at each channel. The hop pattern does not reset (recycle) until the hop pattern has been completed.

Thank you for your attention.

Respectfully submitted,

Norman H. Nelson  
Symbol Technologies

# Intertek Testing Services

---

Company: Simbol Technologies  
Model: FCCID H9PWWC1049

Engineer: Marianna Belinkaya  
Date of test: 02/26/98

## FCC. 15.247 Radiated Emissions

| Frequency<br>MHz | Antenna<br>Polarity<br>(H/V) | Reading<br>dB(uV) | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Distance<br>Correction<br>dB | Corrected<br>Reading<br>dB(uV/m) | Limit<br>dB(uV/m) | Margin<br>dB | Detector |
|------------------|------------------------------|-------------------|------------------------------|---------------------|------------------------------|----------------------------------|-------------------|--------------|----------|
| 4804.0           | V                            | 15.8              | 32.4                         | 3.5                 | 0.0                          | 51.7                             | 74.0              | -22.3        | P        |
| 4804.0           | V                            | 11.9              | 32.4                         | 3.5                 | 0.0                          | 47.8                             | 54.0              | -6.2         | A        |
| 4804.0           | H                            | 16.7              | 32.4                         | 3.5                 | 0.0                          | 52.6                             | 74.0              | -21.4        | P        |
| 4804.0           | H                            | 14.0              | 32.4                         | 3.5                 | 0.0                          | 49.9                             | 54.0              | -4.1         | A        |
| 12010.0          | V/H                          | 6.5*              | 39.0                         | 5.5                 | -9.5                         | 41.5                             | 74.0              | -32.5        | P        |
| 12010.0          | V/H                          | -3.0*             | 39.0                         | 5.5                 | -9.5                         | 32.0                             | 54.0              | -22.0        | A        |
| 19216.0          | V/H                          | 31.0*             | 37.5                         | 6.5                 | -20.0                        | 55.0                             | 74.0              | -19.0        | P        |
| 19216.0          | V/H                          | 20.5*             | 37.5                         | 6.5                 | -20.0                        | 44.5                             | 54.0              | -9.5         | A        |

All measurement were made at 3 m.

\* Noise floor

Negative signs (-) in the margin column signify levels below the limit.

# Intertek Testing Services

Company: Simbol Technologies  
Model: FCCID H9PWWC1049

Engineer: Marianna Belinkaya  
Date of test: 02/26/98

## FCC. 15.247 Radiated Emissions

| Frequency<br>MHz | Antenna<br>Polarity<br>(H/V) | Reading<br>dB(uV) | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Distance<br>Correction<br>dB | Corrected<br>Reading<br>dB(uV/m) | Limit<br>dB(uV/m) | Margin<br>dB | Detector |
|------------------|------------------------------|-------------------|------------------------------|---------------------|------------------------------|----------------------------------|-------------------|--------------|----------|
| 4880.0           | V                            | 18.9              | 32.6                         | 3.5                 | 0.0                          | 55.0                             | 74.0              | -19.0        | P        |
| 4880.0           | V                            | 15.9              | 32.6                         | 3.5                 | 0.0                          | 52.0                             | 54.0              | -2.0         | A        |
| 4880.0           | H                            | 16.8              | 32.8                         | 3.5                 | 0.0                          | 53.1                             | 74.0              | -20.9        | P        |
| 4880.0           | H                            | 12.8              | 32.8                         | 3.5                 | 0.0                          | 49.1                             | 54.0              | -4.9         | A        |
| 7320.0           | V                            | 13.0              | 36.8                         | 4.0                 | 0.0                          | 53.8                             | 74.0              | -20.2        | P        |
| 7320.0           | V                            | 5.2               | 36.8                         | 4.0                 | 0.0                          | 46.0                             | 54.0              | -8.0         | A        |
| 7320.0           | H                            | 16.0              | 36.4                         | 4.0                 | 0.0                          | 56.4                             | 74.0              | -17.6        | P        |
| 7320.0           | H                            | 5.4               | 36.4                         | 4.0                 | 0.0                          | 45.8                             | 54.0              | -8.2         | A        |
| 12200.0          | V/H                          | 6.5*              | 39.1                         | 5.5                 | -9.5                         | 41.6                             | 74.0              | -32.4        | P        |
| 12200.0          | V/H                          | -3.0*             | 39.1                         | 5.5                 | -9.5                         | 32.1                             | 54.0              | -21.9        | A        |
| 19500.0          | V/H                          | 31.0*             | 40.5                         | 6.5                 | -20.0                        | 58.0                             | 74.0              | -16.0        | P        |
| 19500.0          | V/H                          | 20.5*             | 40.5                         | 6.5                 | -20.0                        | 47.5                             | 54.0              | -6.5         | A        |

All measurement were made at 3 m.

\* Noise floor

Negative signs (-) in the margin column signify levels below the limit.

# Intertek Testing Services

Company: Simbol Technologies  
Model: FCCID H9PWWC1049

Engineer: Marianna Belinkaya  
Date of test: 02/26/98

## FCC. 15.247 Radiated Emissions

| Frequency<br>MHz | Antenna<br>Polarity<br>(H/V) | Reading<br>dB(uV) | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Distance<br>Correction<br>dB | Corrected<br>Reading<br>dB(uV/m) | Limit<br>dB(uV/m) | Margin<br>dB | Detector |
|------------------|------------------------------|-------------------|------------------------------|---------------------|------------------------------|----------------------------------|-------------------|--------------|----------|
| 4960.0           | V                            | 16.0              | 32.6                         | 3.5                 | 0.0                          | 52.1                             | 74.0              | -21.9        | P        |
| 4960.0           | V                            | 12.9              | 32.6                         | 3.5                 | 0.0                          | 49.0                             | 54.0              | -5.0         | A        |
| 4960.0           | H                            | 16.0              | 32.8                         | 3.5                 | 0.0                          | 52.3                             | 74.0              | -21.7        | P        |
| 4960.0           | H                            | 3.1*              | 32.8                         | 3.5                 | 0.0                          | 36.3                             | 54.0              | -17.7        | A        |
| 7440.0           | V                            | 13.0              | 37.5                         | 4.0                 | 0.0                          | 54.5                             | 74.0              | -19.5        | P        |
| 7440.0           | V                            | 4.3               | 37.5                         | 4.0                 | 0.0                          | 45.8                             | 54.0              | -8.2         | A        |
| 7440.0           | H                            | 16.0              | 37.5                         | 4.0                 | 0.0                          | 57.5                             | 74.0              | -16.5        | P        |
| 7440.0           | H                            | 5.4               | 37.5                         | 4.0                 | 0.0                          | 46.9                             | 54.0              | -7.1         | A        |
| 12400.0          | V/H                          | 6.5*              | 39.1                         | 5.5                 | -9.5                         | 41.6                             | 74.0              | -32.4        | P        |
| 12400.0          | V/H                          | -3.0*             | 39.1                         | 5.5                 | -9.5                         | 32.1                             | 54.0              | -21.9        | A        |
| 19840.0          | V/H                          | 31.0*             | 40.5                         | 6.5                 | -20.0                        | 58.0                             | 74.0              | -16.0        | P        |
| 19840.0          | V/H                          | 20.5*             | 40.5                         | 6.5                 | -20.0                        | 47.5                             | 54.0              | -6.5         | A        |
| 22320.00         | V/H                          | 36.0*             | 40.5                         | 6.5                 | -20.0                        | 63.0                             | 74.0              | -11.0        | P        |
| 22320.00         | V/H                          | 25.0*             | 40.5                         | 6.5                 | -20.0                        | 52.0                             | 54.0              | -2.0         | A        |

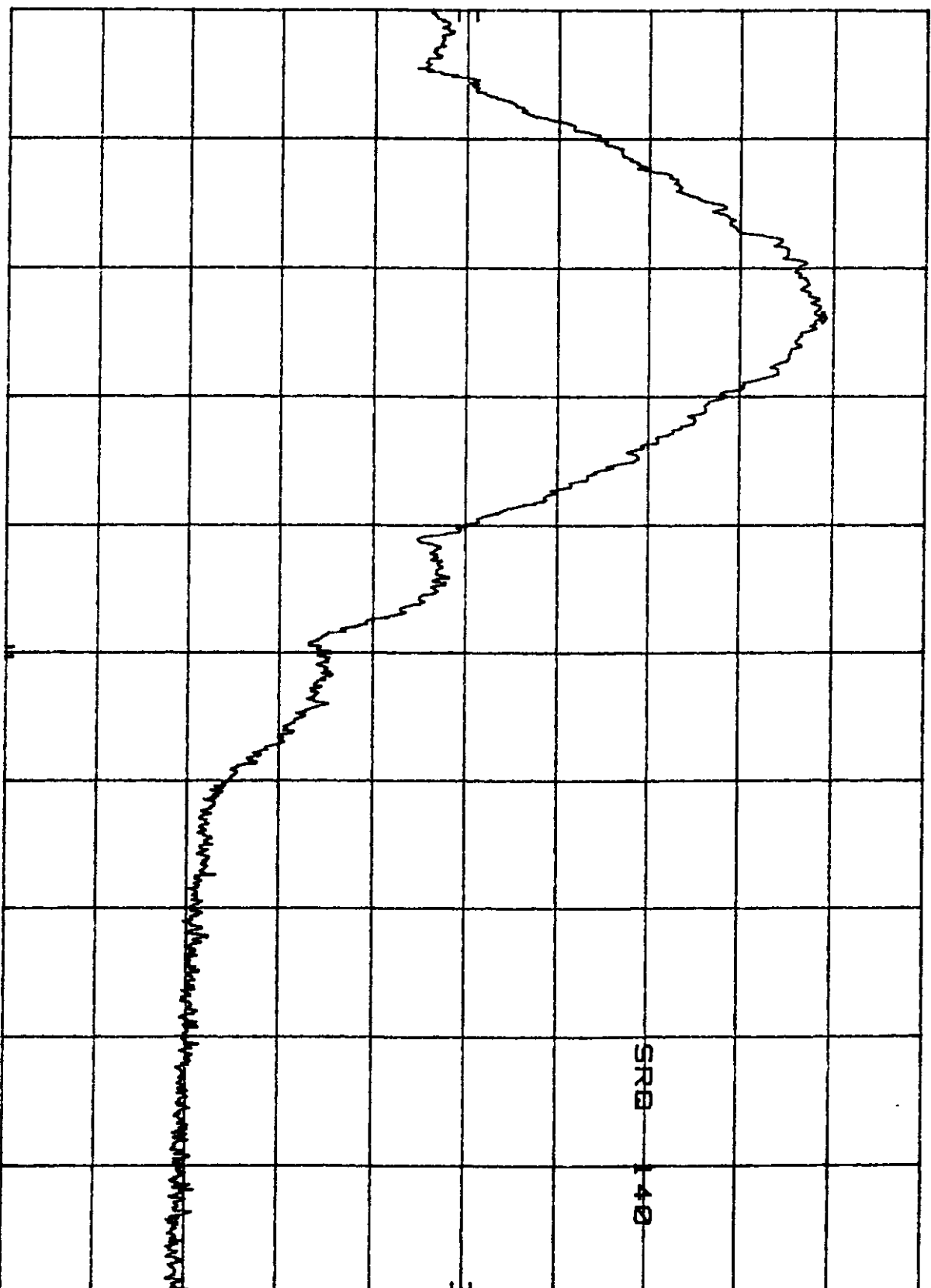
All measurement were made at 3 m.

\* Noise floor

Negative signs (-) in the margin column signify levels below the limit.

h<sub>p</sub> SYMBOL H9PWC1049 MKR Δ 3.416 MHz  
REF 97.0 dBμV ATTN 0 dB -69.90 dB

10 dB/



CENTER 2.481 25 GHz

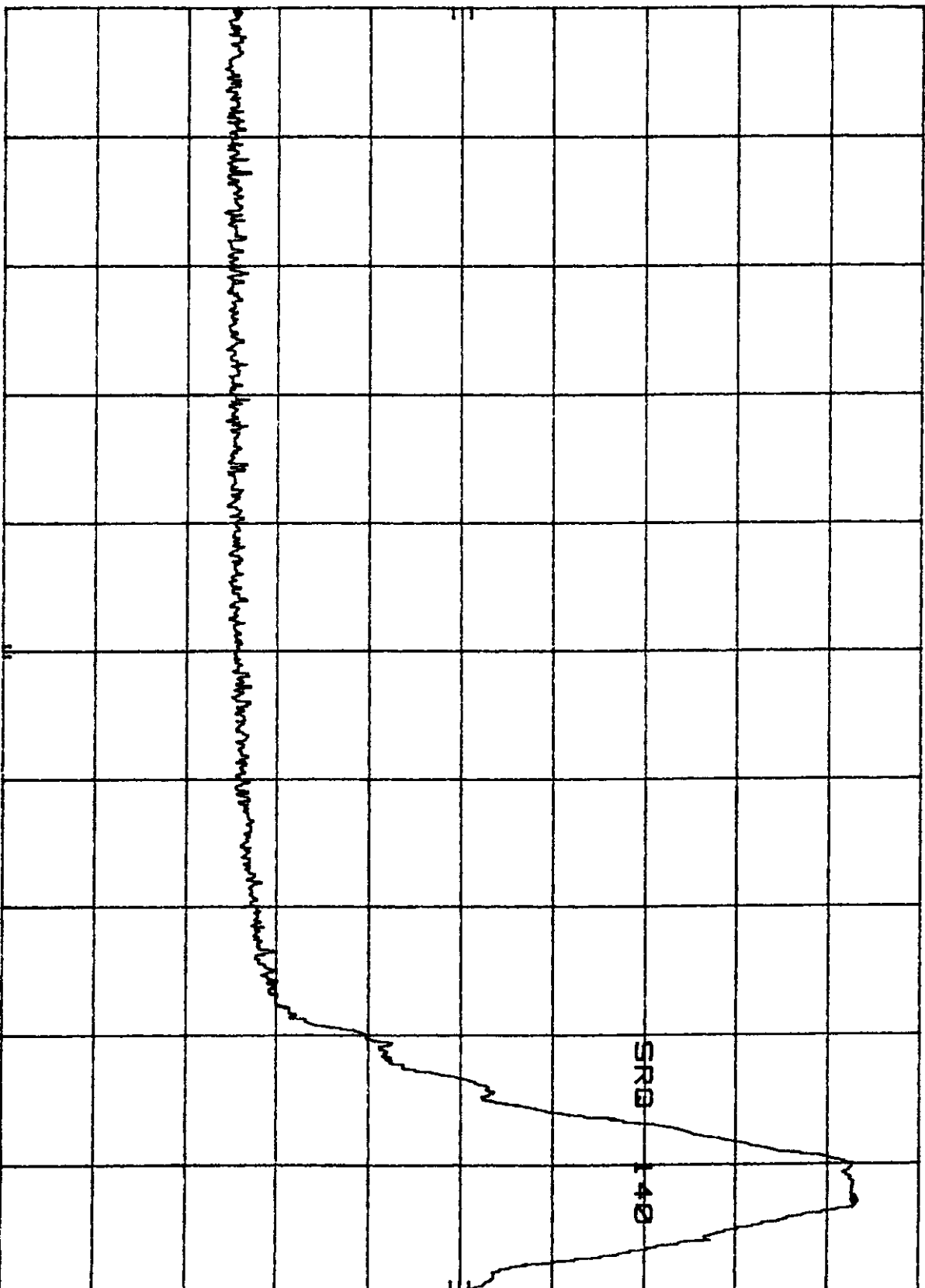
RES BW 25 kHz

VBW 30 kHz

SPAN 4.50 MHz  
SWP 20.0 msec

SYMBOL H9PWC1049 MKR  $\Delta$ -12.08 MHz  
REF 97.0 dB $\mu$ V ATTN 0 dB -67.60 dB

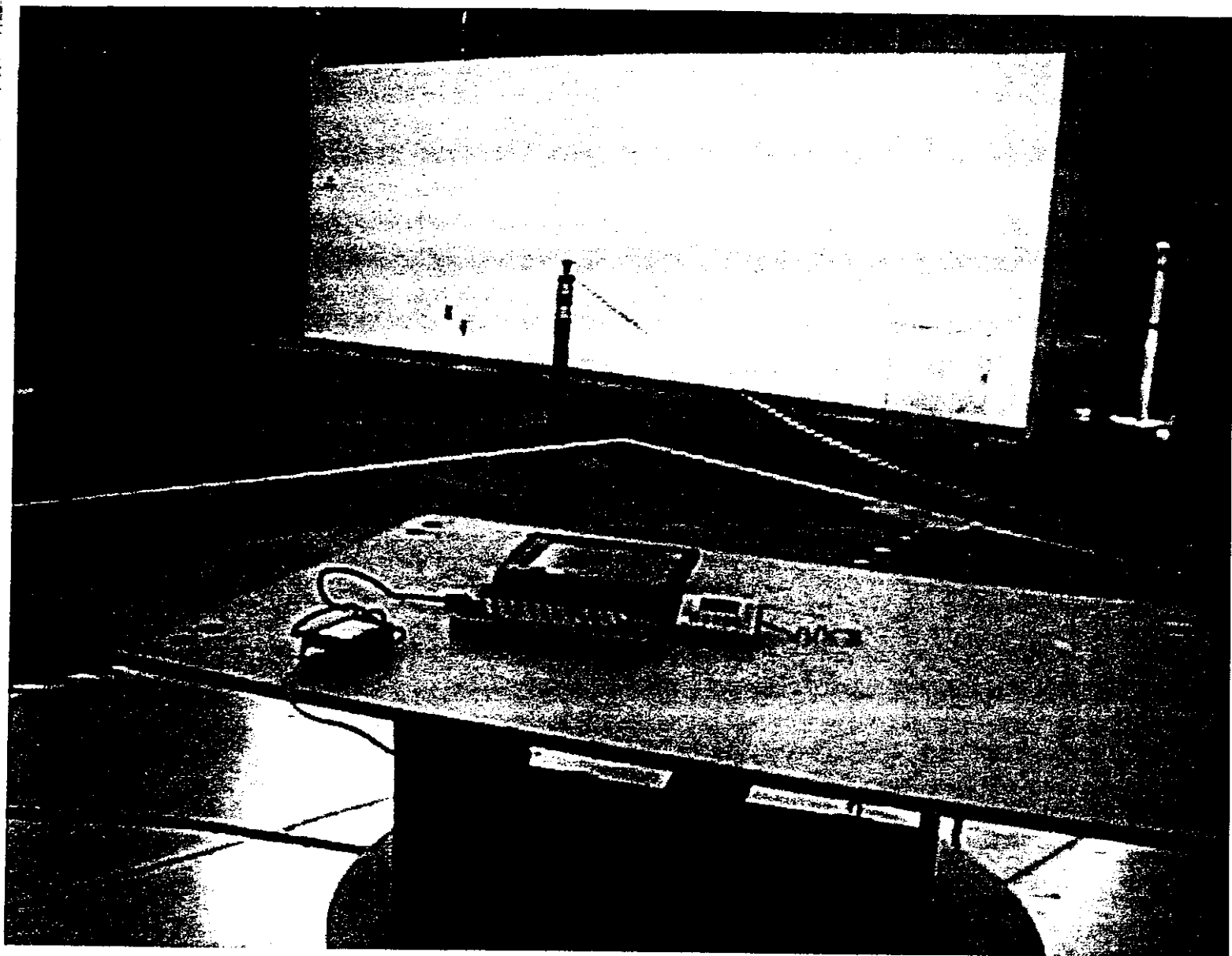
10 dB/



START 2.390 0 GHz  
RES BW 100 kHz

VBW 100 kHz

STOP 2.403 0 GHz  
SWP 20.0 msec



## Duty Cycle Calculation

The LA2400 PC Card is used in mobile hand held computers which communicate with Spectrum 24 Access Points which also contain a LA2400 PC Card. The communication is half duplex, when one unit is in transmit the other is in receive. The Access Point acts like a base station in that it talks to one or more mobiles on a time shared basis and relays the messages. The mobiles and Access Point compete for transmit time with a listen before talk protocol.

### Mobile Duty Cycle

The communications from the mobile to the Access Point begins with the mobile listening (in receive mode, transmitter off) to determine if any other transmission is under way the listening takes place for at least .1 msec. The mobile then transmits a maximum packet of 548 bytes with addressing and other packet overhead the packet size is 609 bytes at 1 Mbit per second the packet time is therefore  $(609 \text{ bytes} \times 8 \text{ bits/byte} / 1 \text{ Mbitsec} = 4.872 \text{ msec})$ . The Access Point replies with an acknowledgment in .02 msec the acknowledgment packet is .2 msec long and during the acknowledgment packet the mobile is in receive mode (transmitter is off). The mobile then prepares another packet, which takes 10 msec or more during which the mobile transmitter is off. The process then repeats itself. For the mobile the maximum transmit duty cycle is

Total transaction time  $\geq .1 \text{ msec (mobile receive)} + 4.872 \text{ msec (mobile transmit)} + .02 \text{ msec (turn from transmit to receive)} + .2 \text{ msec (mobile receive)} + 10 \text{ msec (mobile prepares next packet)}$

Total transaction time  $\geq 15.19 \text{ msec}$

Total mobile transmit time  $\leq 4.872 \text{ msec (mobile transmit)}$

Duty Cycle  $\leq \text{Total mobile transmit time} / \text{Total transaction time} = 4.872 / 15.19$

Duty Cycle  $< 0.32, 32\%, -9.9 \text{ dB}$

### Access Point Duty Cycle

The Access Point can communicate with many mobiles, but only one at a time. The Access Point sends out periodic beacons at a rate of 1 every 100 msec. The maximum length of a beacon is 100 usec. The mobiles and the Access Point compete for transmit time between beacons using a listen before talk protocol. Each mobile when clear to talk will go through the exchange as described above. The Access Point can also initiate a transmission just as the mobiles do. The worst case transmit duty cycle for the Access Point is when the Access Point is the only unit needing to transmit, so it is not competing with mobile units for transmit time. In this case the Access Point will be going through

the same cycle as the remote did above. However the wait time for preparing a new packet can be as low as 3 msec.

Total transaction time  $\geq$  .1 msec (access point receive) + 4.872 msec (access point transmit) + .02 msec (turn from transmit to receive) + .2 msec (access point receive) + 3 msec (mobile prepares next packet)

Total transaction time  $\geq$  8.19 msec

Total access point transmit time  $\leq$  4.872 msec (access point transmit)

Duty Cycle  $\leq$  Total access point transmit time / Total transaction time = 4.872 / 8.19

Duty Cycle < 0.60, 60%, -4.4 dB

### **Summary:**

| Unit         | Max Duty Cycle | Duty Cycle Offset |
|--------------|----------------|-------------------|
| Mobile       | 32%            | -9.9 dB           |
| Access Point | 60%            | -4.4 dB           |