

FCC PART 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

Actiontec Electronics, Inc.

760 North Mary Avenue
Sunnyvale, CA 94086

FCC ID: LNQ802UI3

September 7, 2001

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| This Report Concerns: <input checked="" type="checkbox"/> Original Report | Equipment Type: 802.11b Wireless LAN USB Device |
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| Test Date: August 15, 2001 | |
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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *Actiontec Electronics, Inc.*'s product, model no.: 802UI3 or the "EUT" as referred to in this report is a 802.11b Wireless LAN USB Device which measures 3.35 L" x 2.00W" x 0.4H".

The 802UI3 is a complete wireless high speed Network Interface (NIC) utilizing the Inersil Prism 2.5 Direct Sequence Spread Spectrum Wireless Transceiver chip set. It supports the IEEE 802.11b network specification for Direct Sequence Spread Spectrum DSSS signaling. The card is packaged in customized USB tangle, provides data rates of 1, 2, 5.5 and 11 Mbps and has integrated microstrip Dual Diversity Antennas.

1.2 Objective

This type approval report is prepared on behalf of *Actiontec Electronics, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for Output Power, Antenna Requirements, 6 dB Bandwidth, power density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Spurious Radiated Emission, and processing gain.

1.3 Related Submittal(s)/Grant(s)

No Related Submittal(s).

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4 –1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory Corporation. The radiated testing was performed at an antenna-to-EUT distance of 3 Meters.

1.5 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Suite 2, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI).

The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices,

IEC/CISPR 22: 1998, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

1.6 Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Cal. Due Date |
|-------------------|----------------------|------------------|---------------|---------------|
| HP | Spectrum Analyzer | 8568B | 2610A02165 | 12/6/01 |
| HP | Spectrum Analyzer | 8593B | 2919A00242 | 12/20/01 |
| HP | Amplifier | 8349B | 2644A02662 | 12/20/01 |
| HP | Quasi-Peak Adapter | 85650A | 917059 | 12/6/01 |
| HP | Amplifier | 8447E | 1937A01046 | 12/6/01 |
| A.H. System | Horn Antenna | SAS0200/571 | 261 | 12/27/01 |
| Com-Power | Log Periodic Antenna | AL-100 | 16005 | 11/2/01 |
| Com-Power | Biconical Antenna | AB-100 | 14012 | 11/2/01 |
| Solar Electronics | LISN | 8012-50-R-24-BNC | 968447 | 12/28/01 |
| Com-Power | LISN | LI-200 | 12208 | 12/20/01 |
| Com-Power | LISN | LI-200 | 12005 | 12/20/01 |
| BACL | Data Entry Software | DES1 | 0001 | 12/20/01 |

1.7 Equipment Under Test (EUT)

| Manufacturer | Description | Model | Serial Number | FCC ID |
|-----------------------------|---------------------------------|--------|---------------|-----------|
| Actiontec Electronics, Inc. | 802.11b Wireless LAN USB Device | 802UI3 | None | LNQ802UI3 |

1.8 Host System Configuration List and Details

| Manufacturer | Description | Model | Serial Number | FCC ID |
|--------------------------|--------------------|--------------|----------------------|---------------|
| HP | Motherboard | CUW-AM | A04-02961 | DOC |
| HP | Video card | Build-in | | |
| SONY | 3.5" Floppy Drive | MPF920-F | 20588872 | DOC |
| Bestec Electronics Corp. | Power Supply | ATX100-5 | 0011A064353 | DOC |
| Western Digital | Hard Drive | Caviar 33200 | None | DOC |
| SAMSUNG | CD-ROM | SC-140 | 0000226P | DOC |
| HP | Chassis | Pavillion | None | None |

1.9 Local Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number | FCC ID |
|---------------------|--------------------|----------------|----------------------|---------------|
| Microsoft | KB | Elite | E06401COMB | DOC |
| Microsoft | Mouse | X03-48591 | 6818005-00000 | C3KKMPS |
| KDS | Monitor | VS-4D | 1281150371 | EVOKD-1455 |
| Citizen | Printer | LSP-10 | 5047999-82 | DLK66TLSP-10 |
| EVEREX | Modem | EV-945 | None | E3E5UVEV-945 |
| HP | PC System | Pavillion 6830 | MX10606093 | DOC |

1.10 External I/O Cabling List and Details

| Cable Description | Length (M) | Port/From | To |
|--------------------------|-------------------|--------------------|-----------------------|
| Shielded KB Cable | 1.6 | KB Port/Host | Microsoft Keyboard |
| Shielded Mouse Cable | 1.8 | Mouse Port/Host | Microsoft Mouse |
| Shielded Serial Cable | 1.5 | Serial Port/Host | EVEREX Modem |
| Shielded Printer Cable | 2.0 | Parallel Port/Host | Citizen Printer |
| Shielded USB cable | 1.0 | USB Port/Host | Wireless LAN Card/EUT |
| Shielded Video Cable | 1.8 | VGA /EUT | KDS Monitor |

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The host system was configured for testing in a typical fashion (as a normally used by a typical user).

The EUT was tested in the normal (native) operating mode to represent *worst* case results during the final qualification test.

The power supply used in the host system is Bestec Power Supply, M/N: ATX100-5

2.2 EUT Exercise Software

The EUT exercising program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The test software, terminal.exe, provided by the customer, is started the Windows 98 terminal program under the Windows 98 operating system. Once loaded, the program sequentially exercises each system component.

The sequence used is as follows:

1. Lines of Hs scroll across the notebook monitor.
2. The modem(s) receives Hs.
3. The printer output Hs.

This process is continuous throughout all tests.

2.3 Special Accessories

As shown in section 2.5, all interface cables used for compliance testing are shielded as normally supplied by INMAC and their respective support equipment manufacturers. The printer, the modem and the VGA monitor featured shielded metal connectors.

2.4 Schematics / Block Diagram

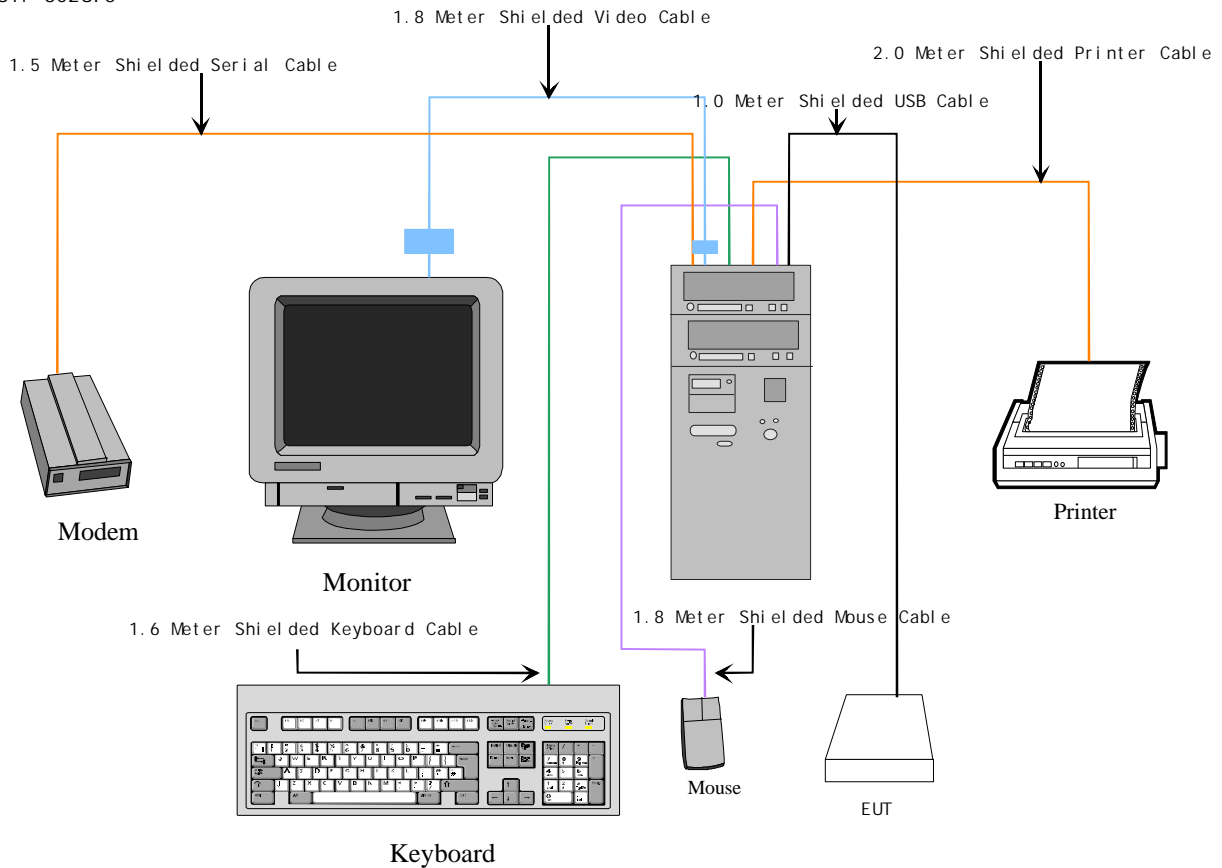
Appendix A contains a copy of the EUT's schematics diagram as reference.

2.5 Equipment Modifications

No modifications were made by BACL Corporation to ensure the EUT to comply with the applicable limits and requirements.

2.6 Configuration of Test System

EUT: 802UI 3



EUT: 802UI3



3 - SUMMARY OF TEST RESULTS

| FCC RULES | DESCRIPTION OF TEST | RESULT |
|-----------------|--|--------|
| § 15.205 | Restricted Bands | Passed |
| § 2.1091 | RF Safety Requirements | Passed |
| §15.203 | Antenna Requirement | Passed |
| §15.207 (a) | Conducted Emission | Passed |
| §15.209 (a) | Radiated Emission | Passed |
| §15.209 (f) | Spurious Emission | Passed |
| §15.247 (a) (2) | 6 dB Bandwidth | Passed |
| §15.247 (b) (2) | Output Power | Passed |
| § 15.247 (c) | 100 kHz Bandwidth of Frequency Band Edges | Passed |
| §15.247 (d) | Peak Power Spectral Density | Passed |
| §15.247 (e) | Processing Gain | Passed |

4 - Conducted Output Power Measurement

4.1 Standard Applicable

According to §15.247(b) (2), the maximum peak output power of the intentional radiator shall not exceed 1 Watt.

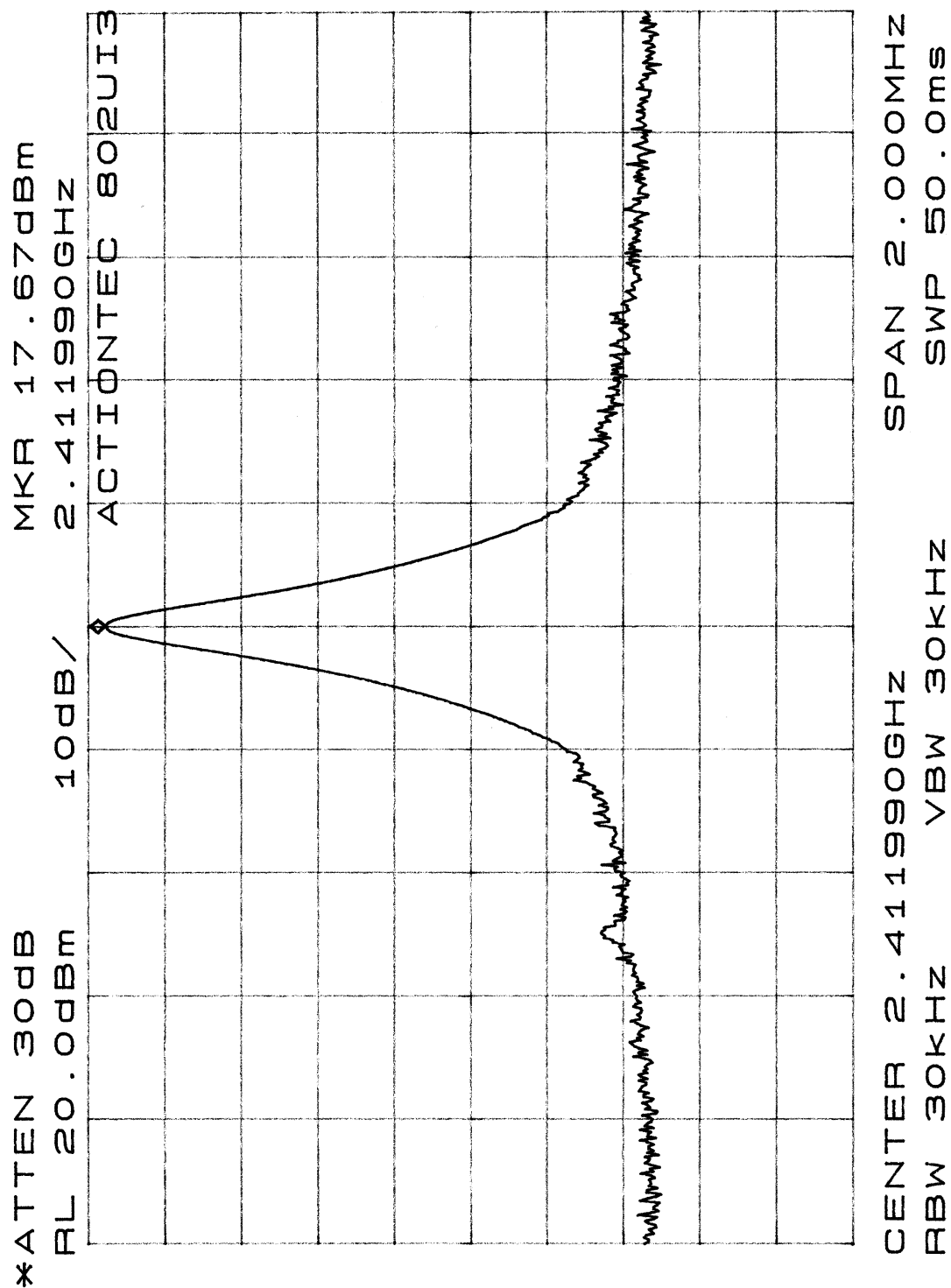
4.2 Measurement Procedure

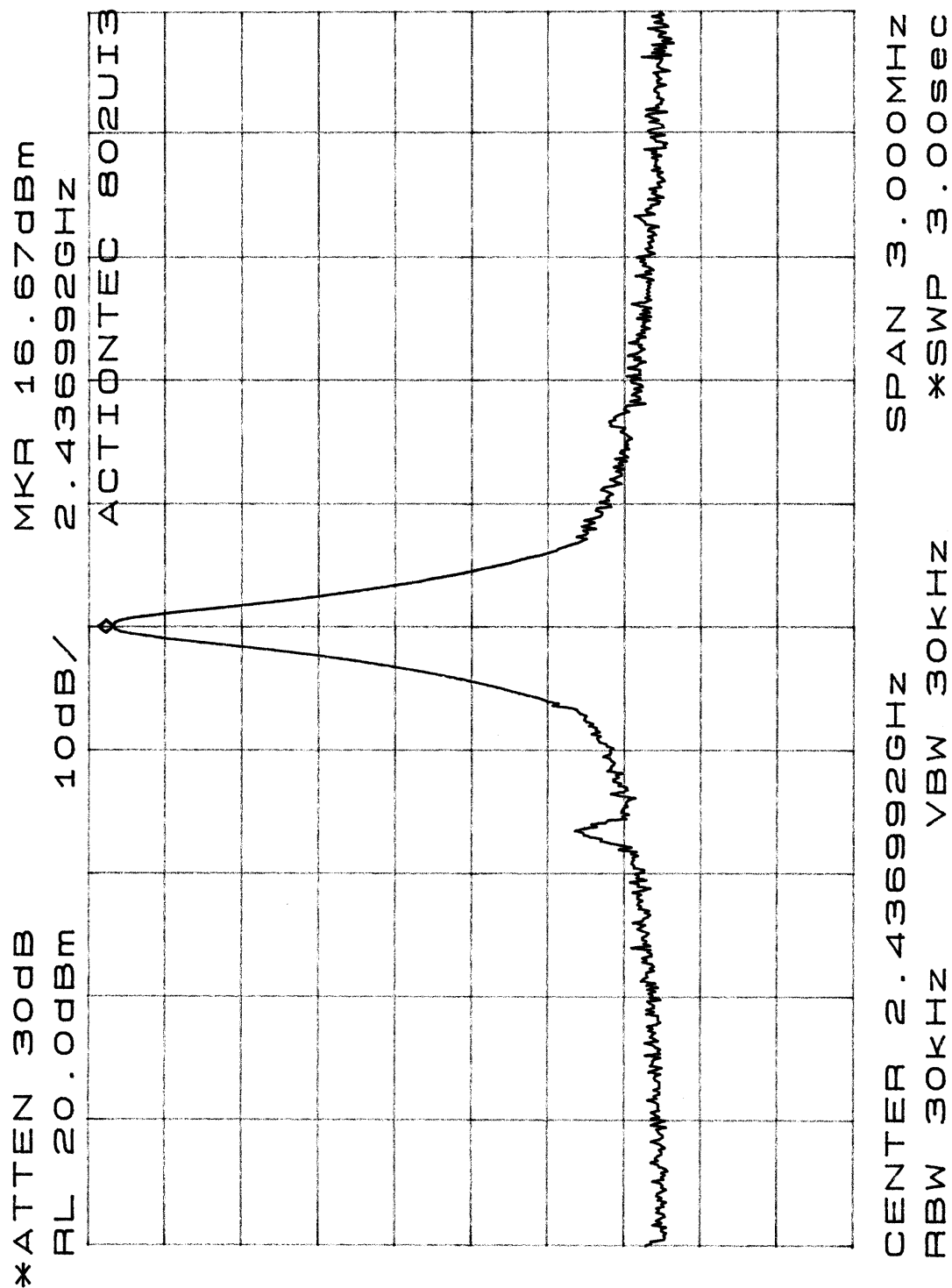
1. Place the EUT on the turntable and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

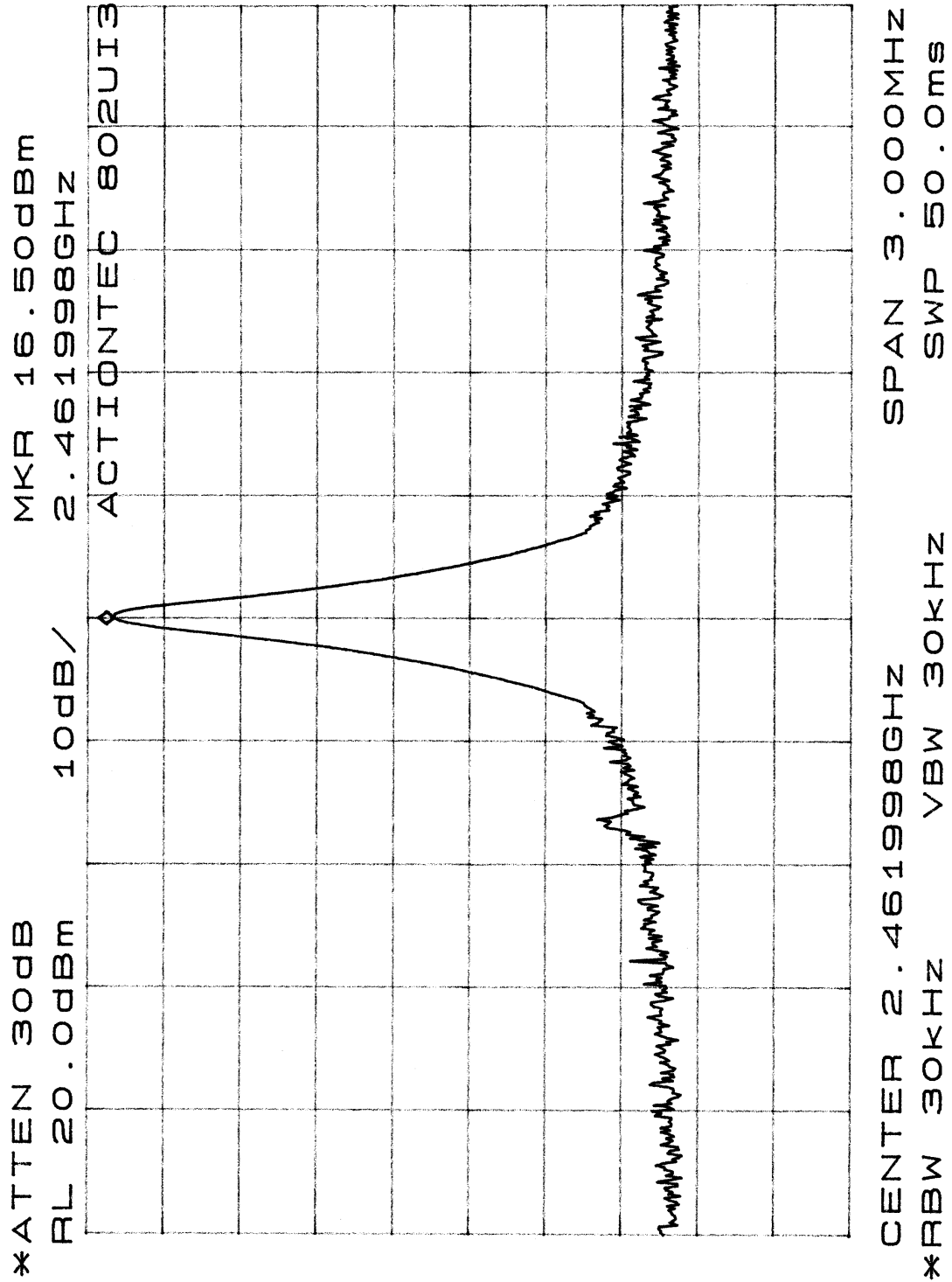
4.3 Measurement Result

Refer to the attached to the following plots:

| Peak Output Power | Page Reference | Test Result |
|-------------------|----------------|-------------|
| High Channel | 14 | Passed |
| Middle Channel | 13 | Passed |
| Low Channel | 12 | Passed |







5 – SPURIOUS EMISSION

5.1 Standard Applicable

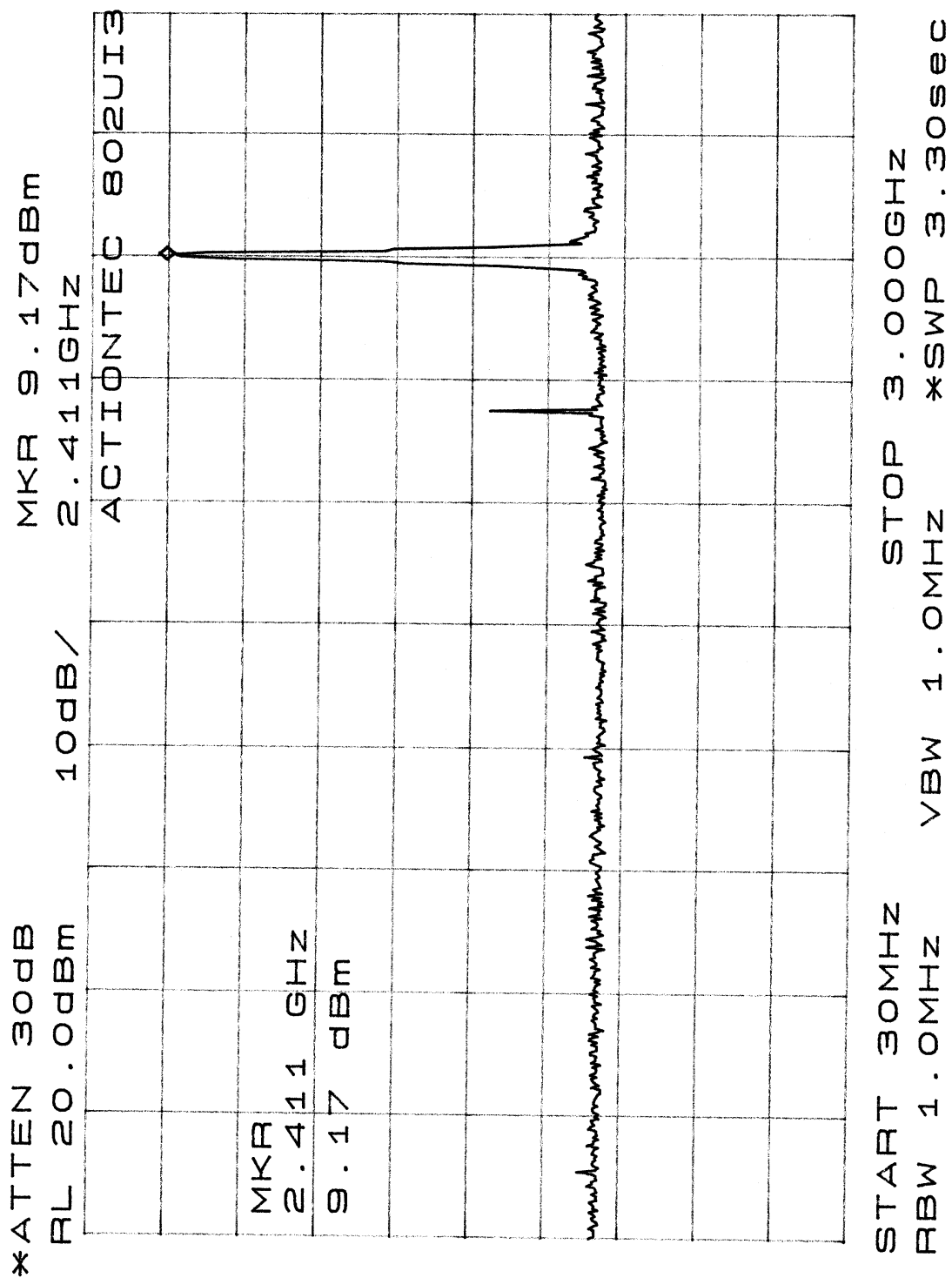
According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit.

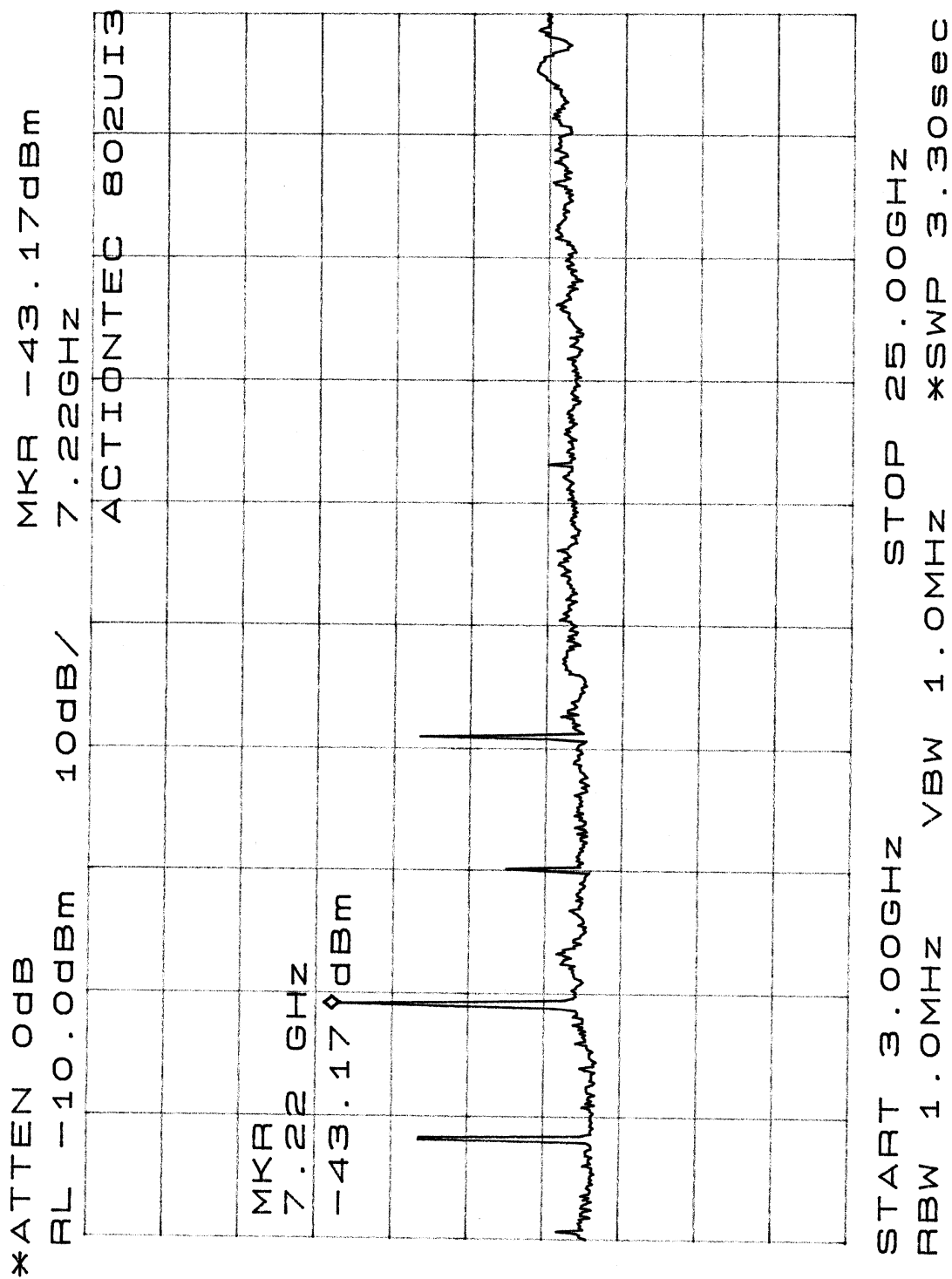
5.2 Measurement Procedure

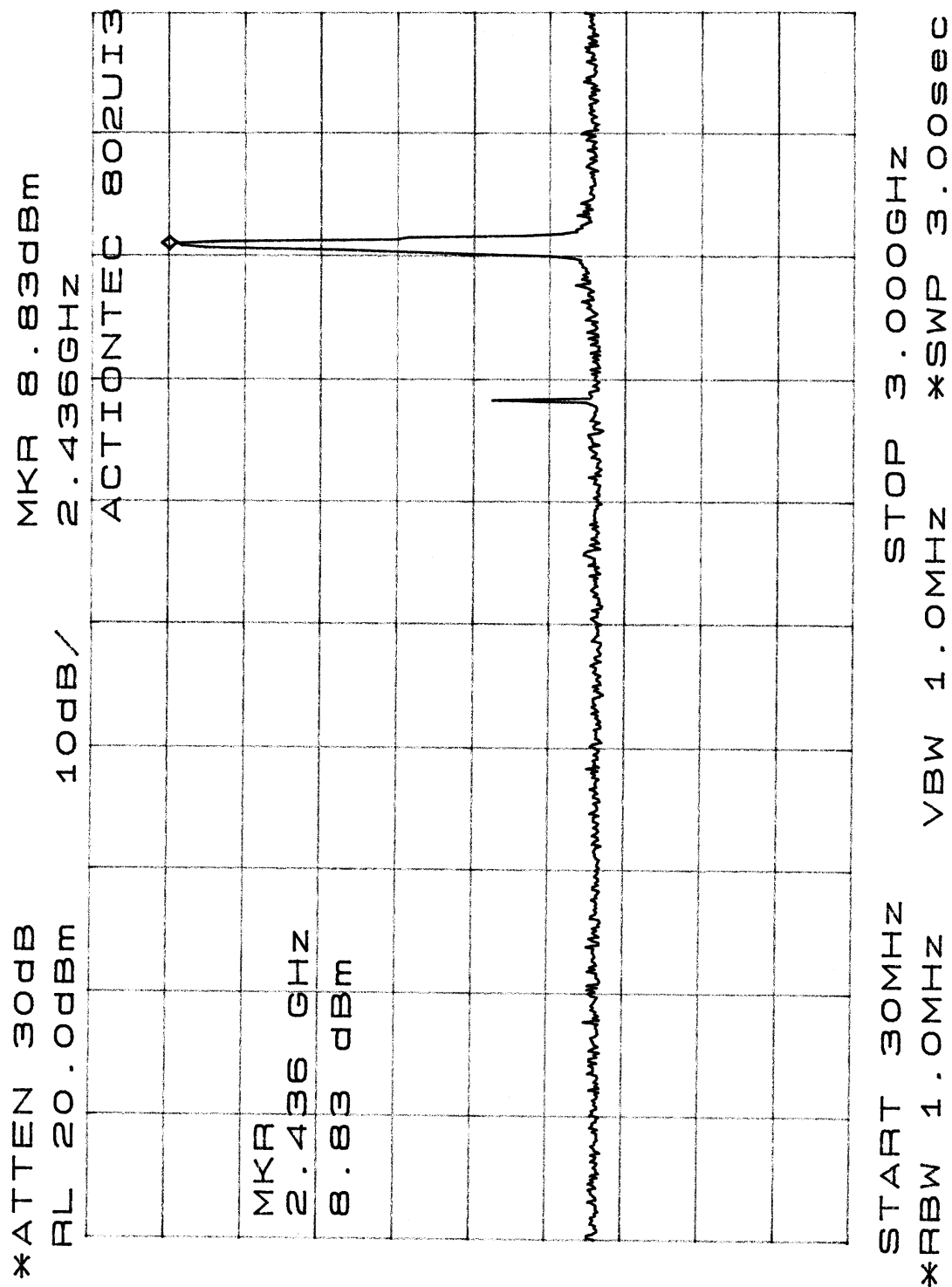
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

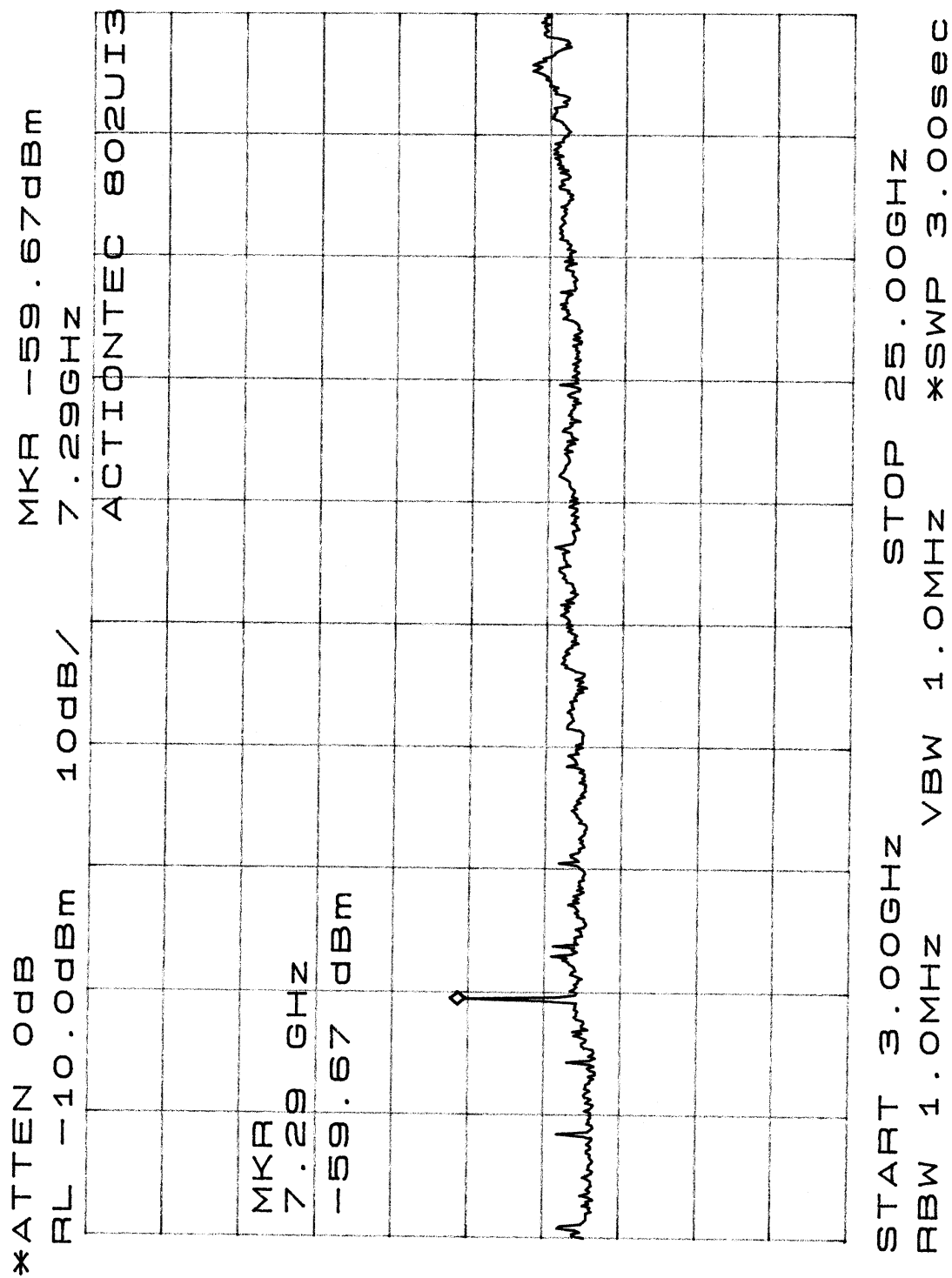
5.3 Measurement Data

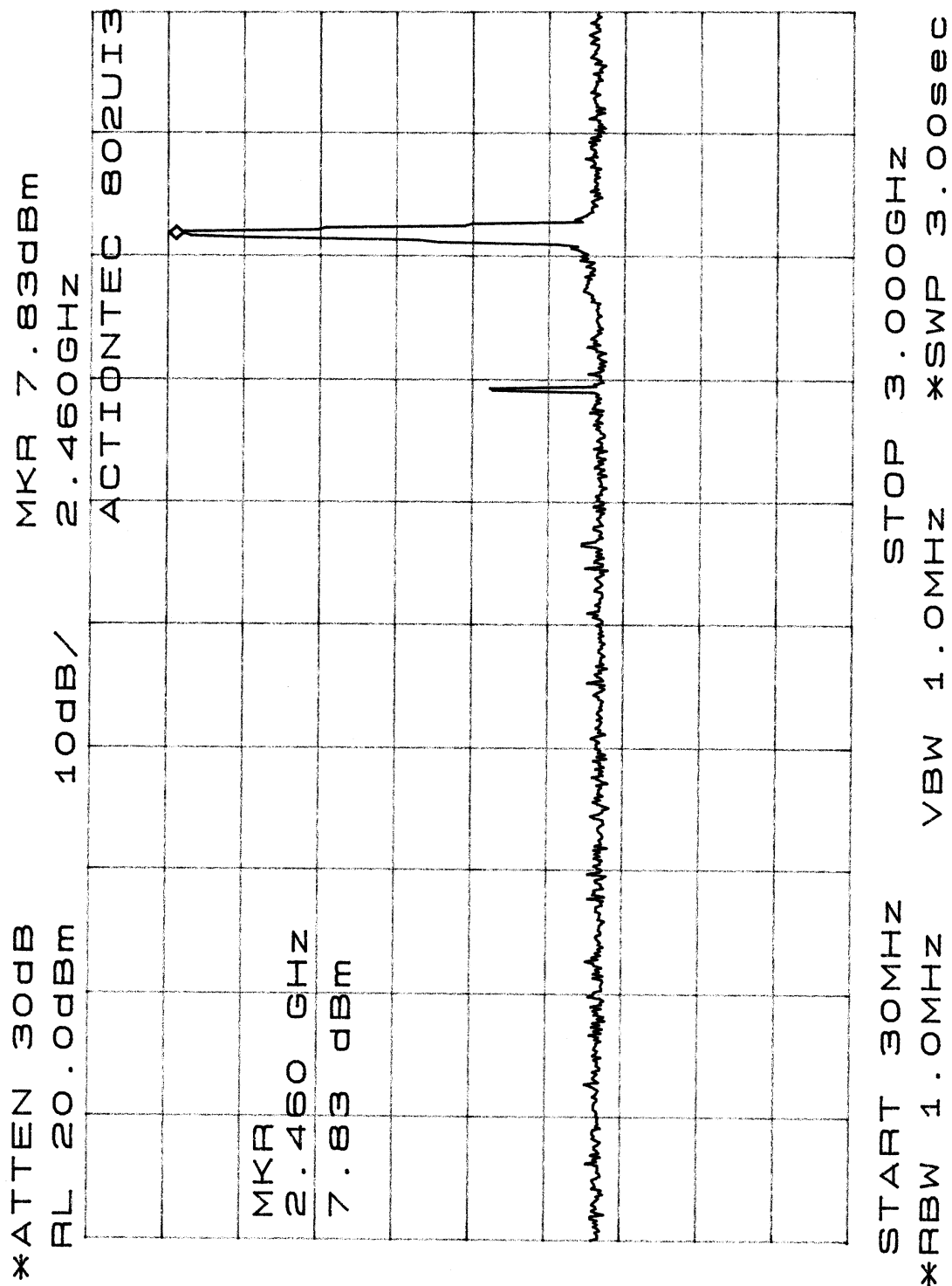
| Spurious Emission | Page Reference | Test Results |
|-------------------|----------------|--------------|
| | 16-21 | Passed |

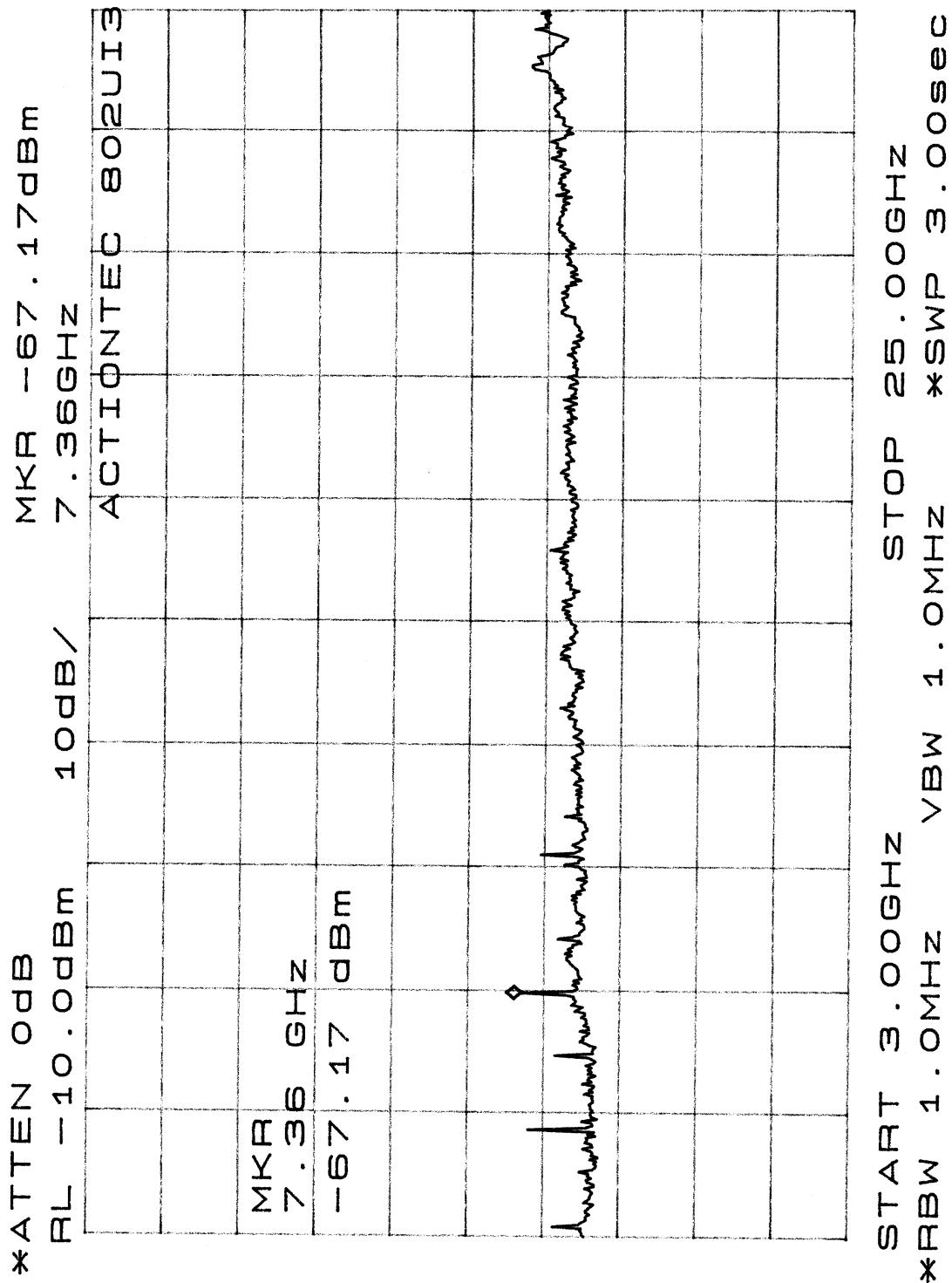












6 – POWER DENSITY

6.1 Standard Applicable

According to §15.247 (d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

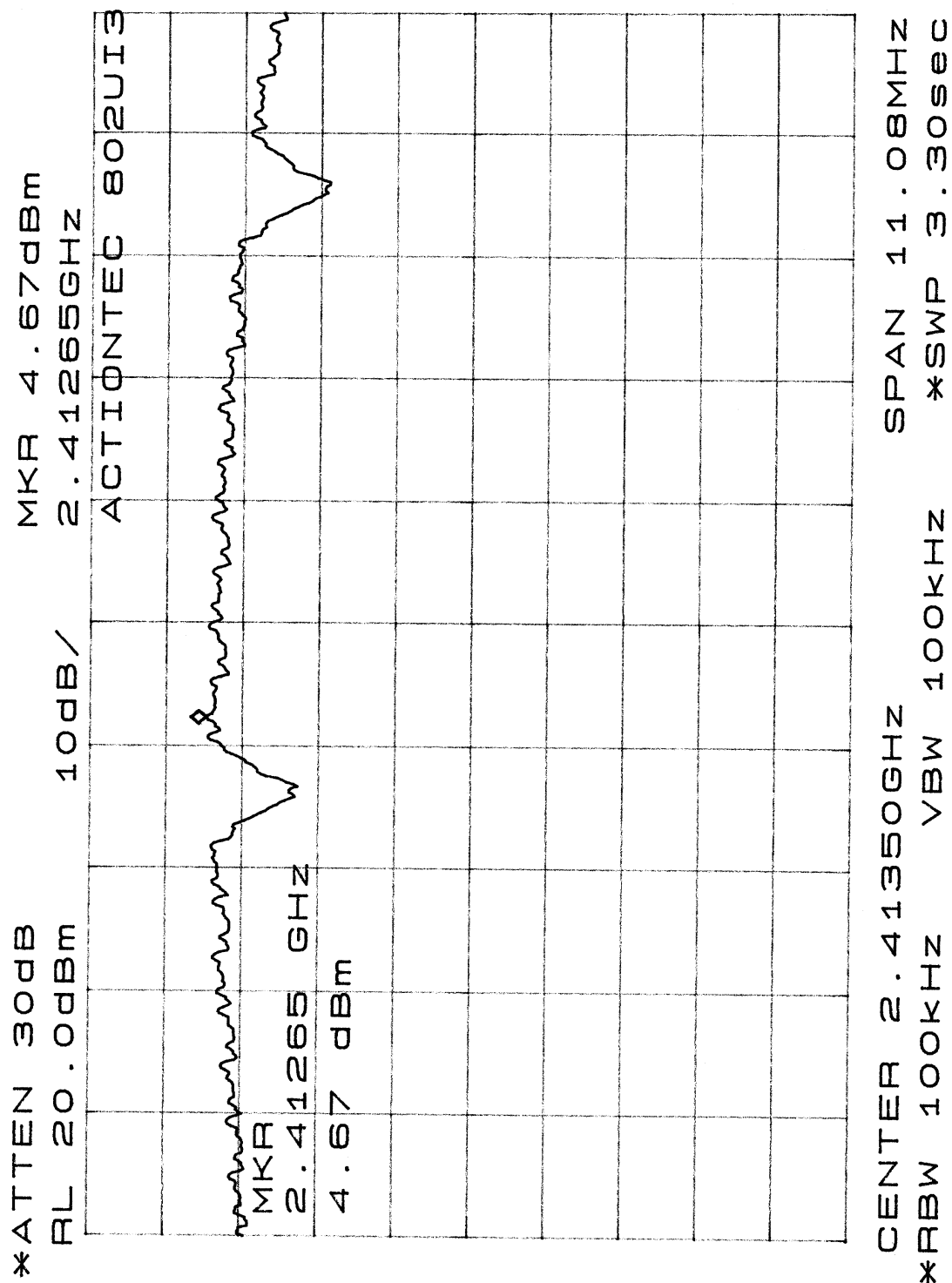
6.2 Measurement Procedure

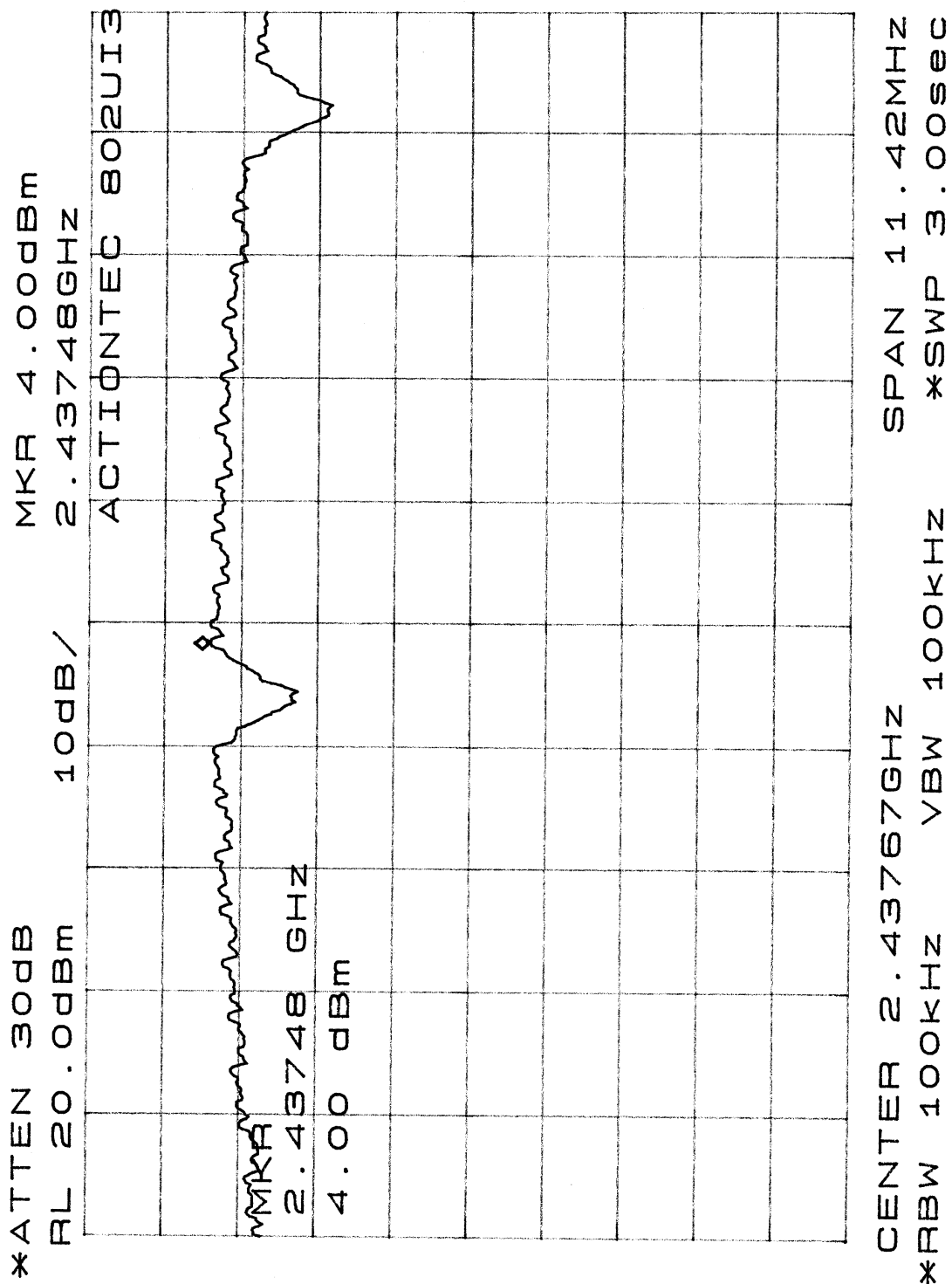
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

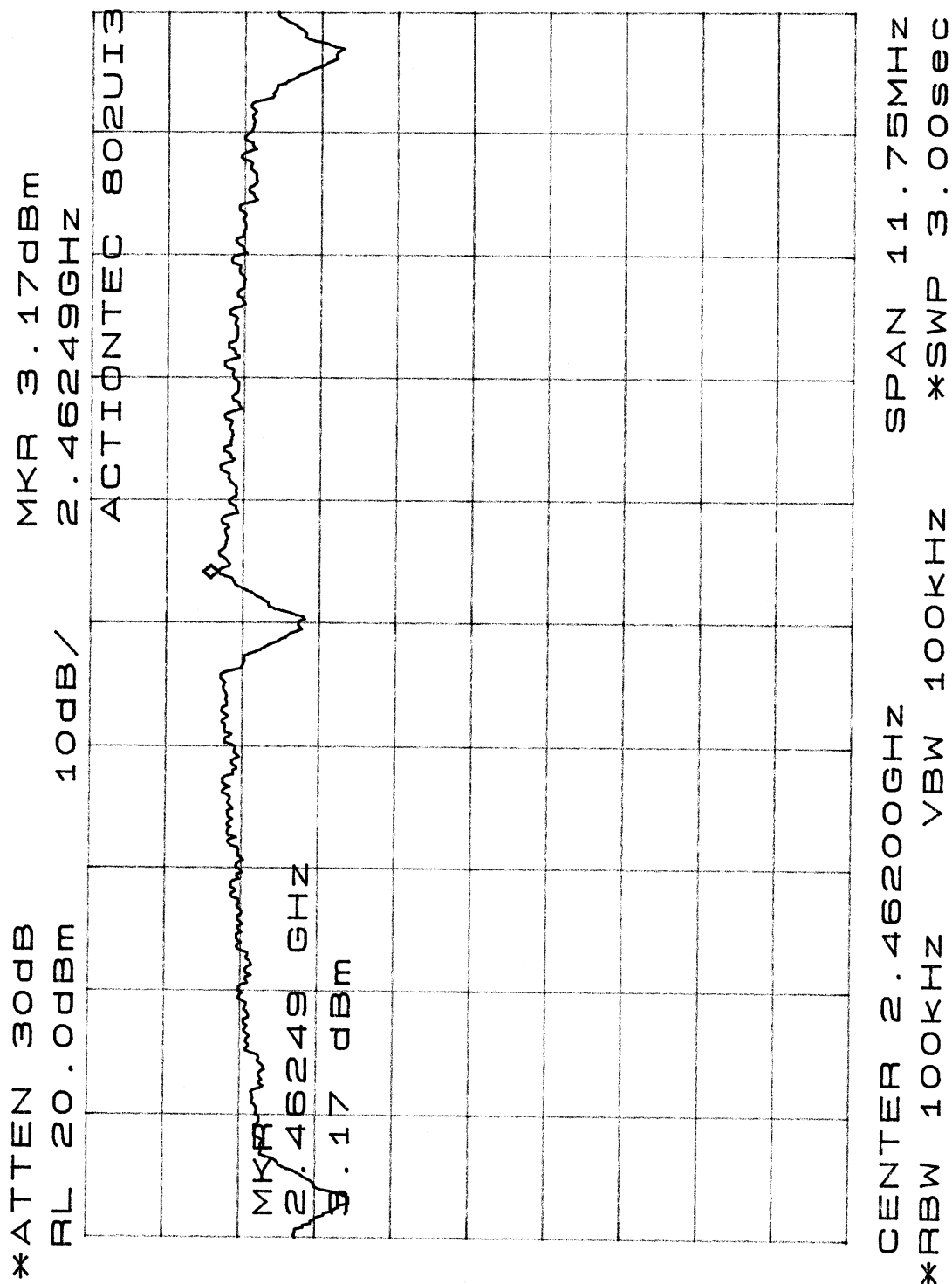
6.3 Test Results

Please refer to the following plot(s).

| Power Density | Page Reference | Test Result |
|----------------|----------------|-------------|
| High Channel | 25 | Passed |
| Middle Channel | 24 | Passed |
| Low Channel | 23 | Passed |







7 – 6 dB BANDWIDTH

7.1 Standard Applicable

According to §15.247(a)(2), for direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

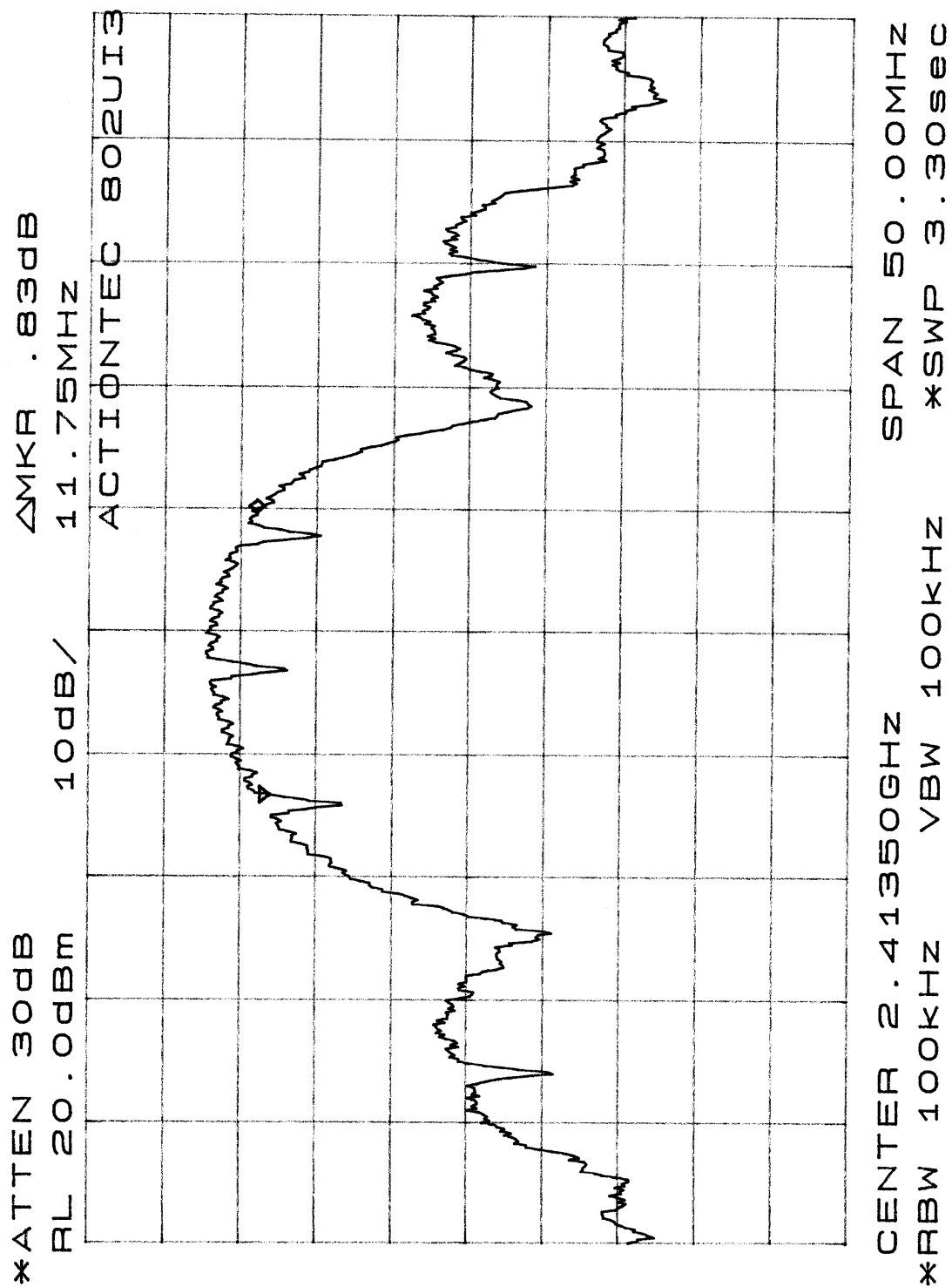
7.2 Measurement Procedure

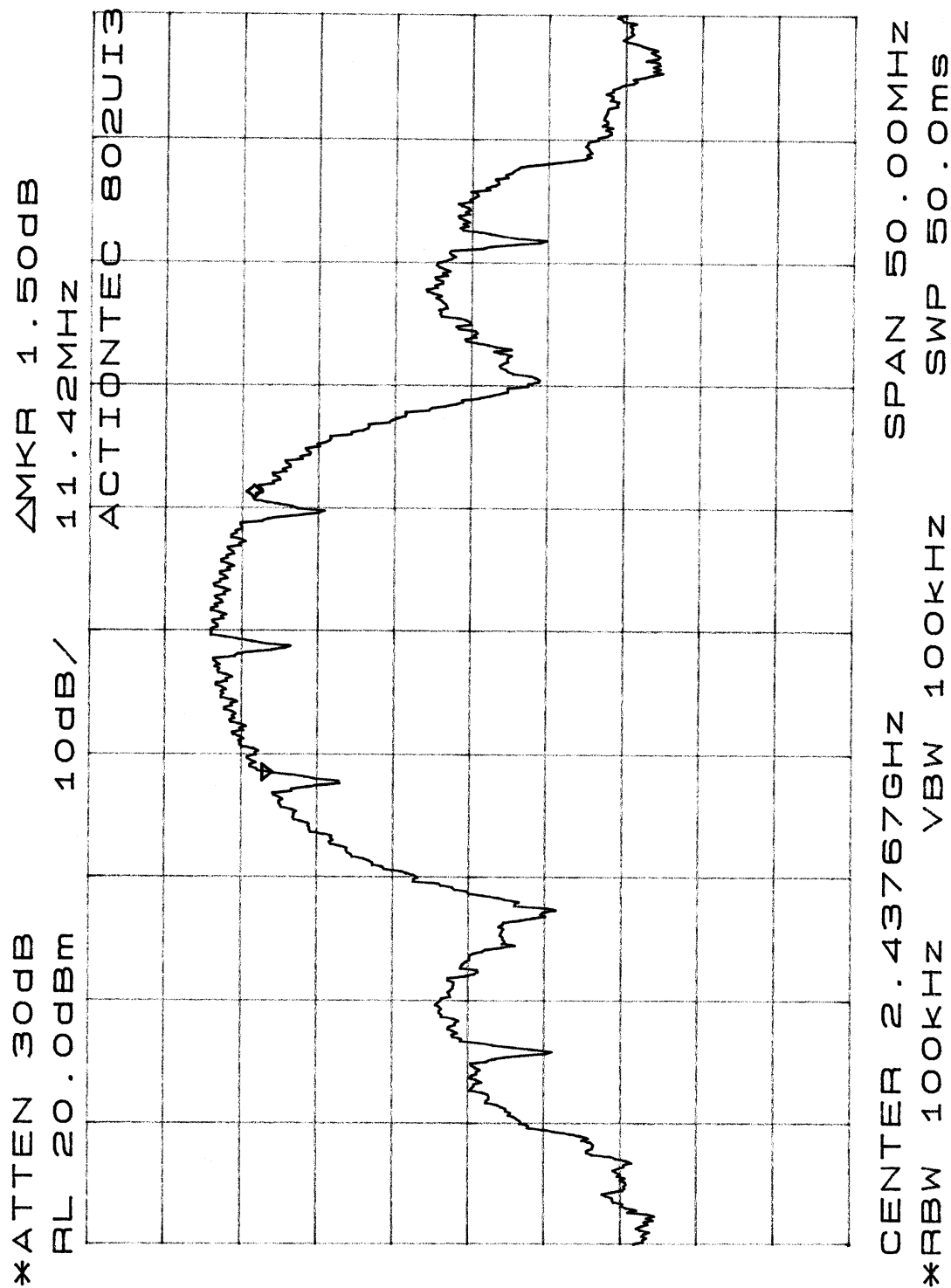
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

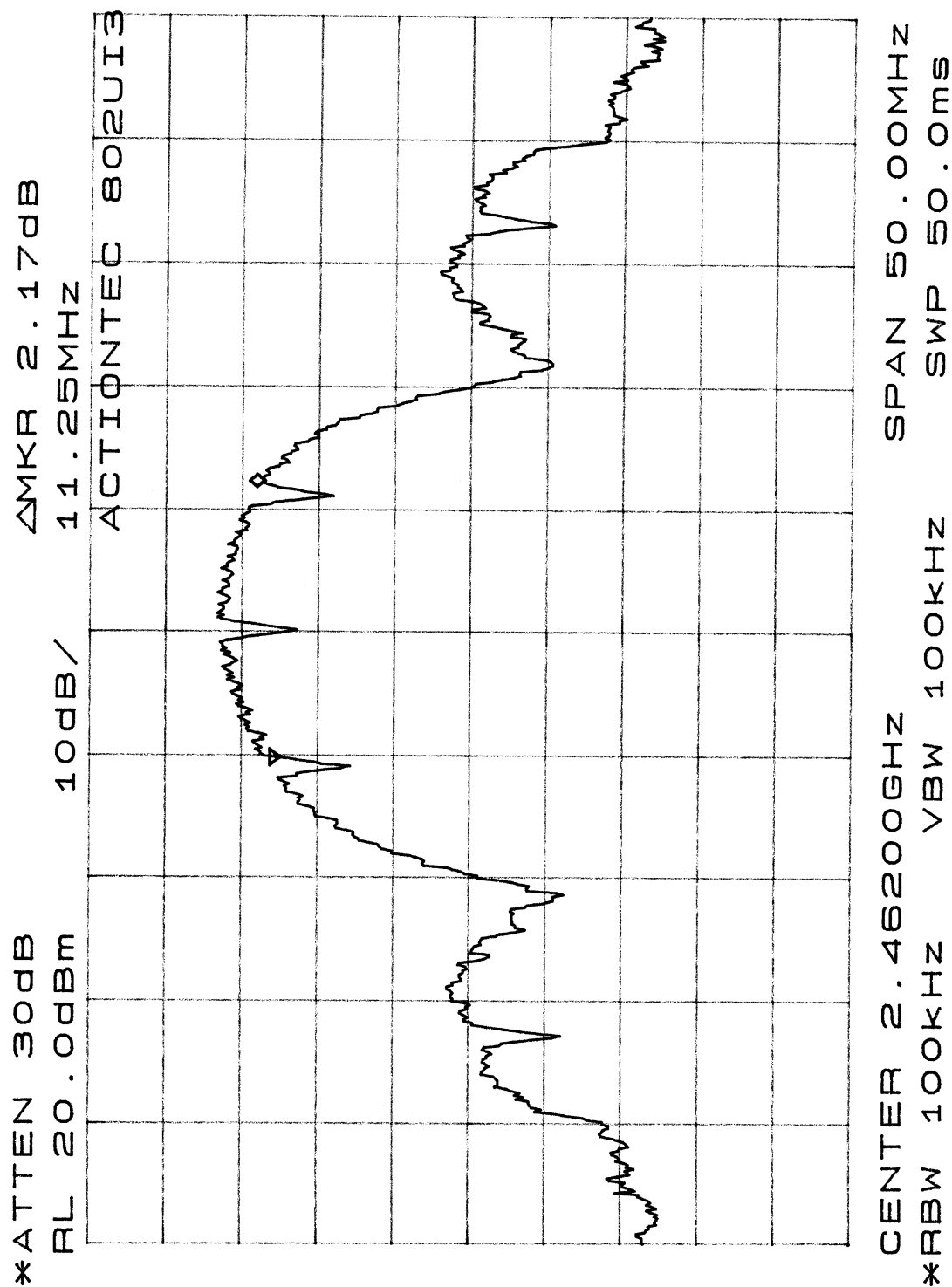
7.3 Measurement Data

The following are plots of Hopping Channel Bandwidth for low, middle and high channel.

| 6 dB Channel Bandwidth | Page Reference | Test Result |
|------------------------|----------------|-------------|
| Low Channel | 27 | Passed |
| Middle Channel | 28 | Passed |
| High Channel | 29 | Passed |







8-100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

8.1 Standard Applicable

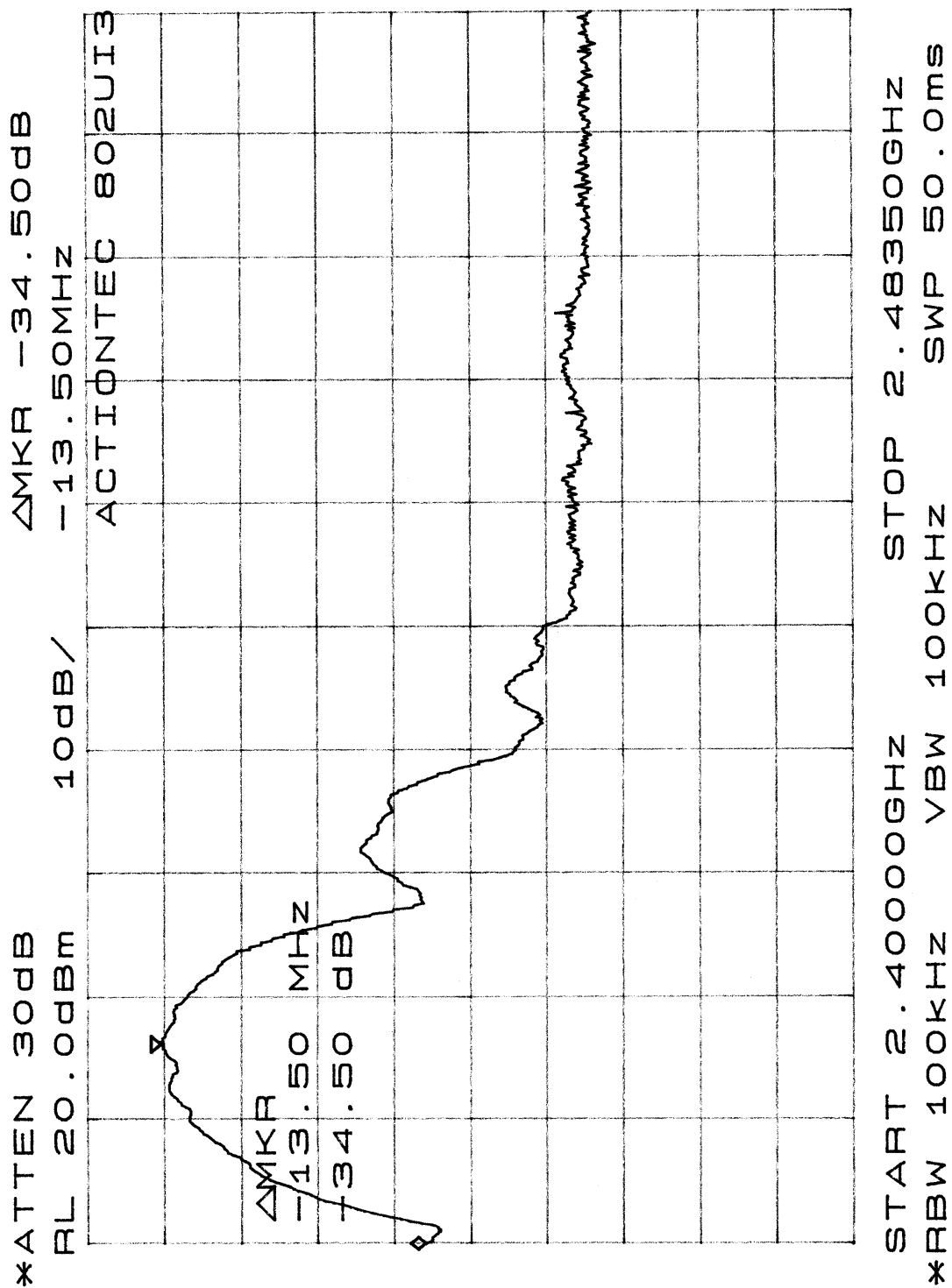
According to §15.247(c), if *any* 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in § 15.209(a), whichever results in the lesser attenuation.

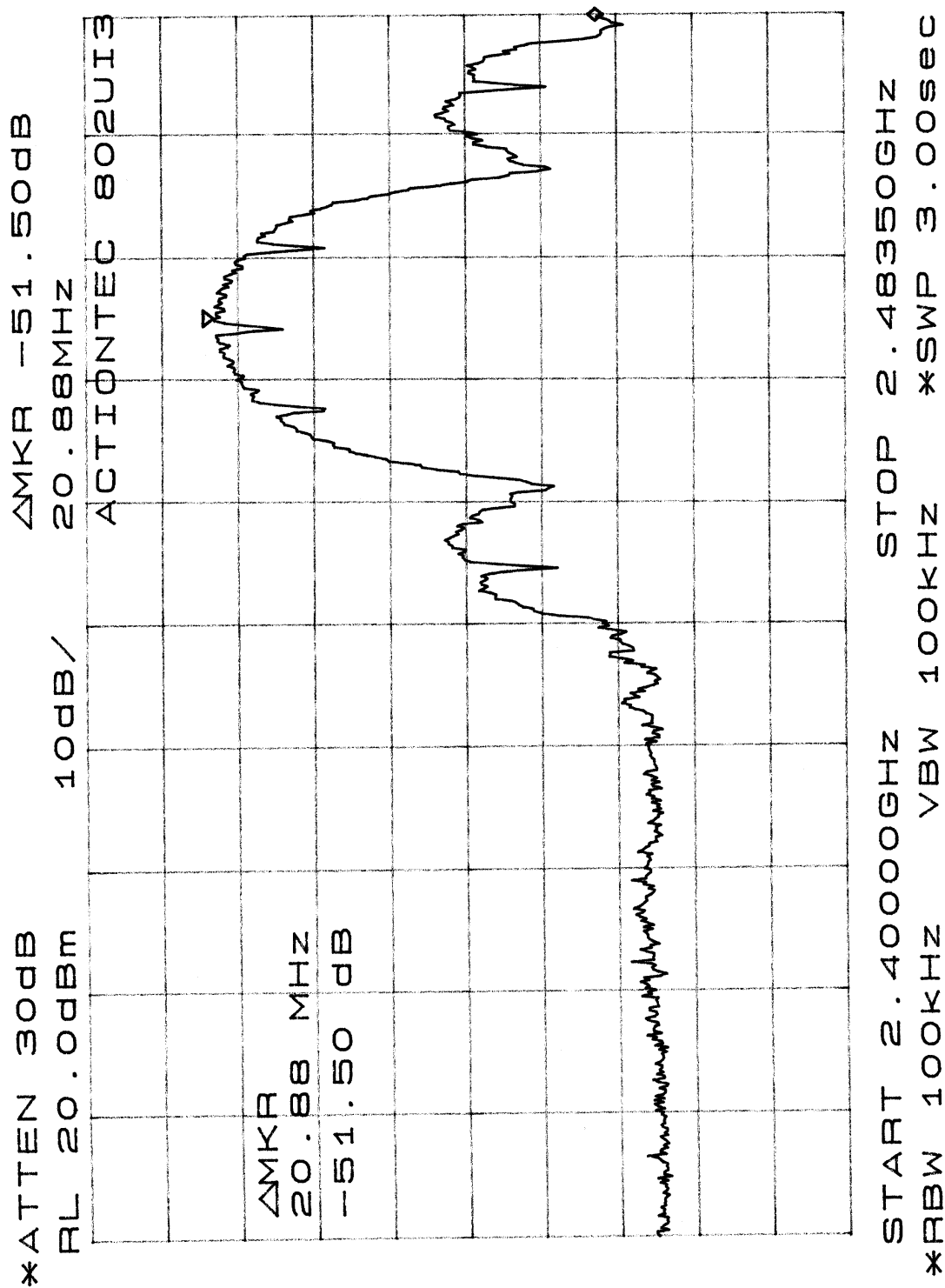
8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

8.3 Test Results

| 100KHz dB Bandwidth Band Edge | Page Reference | Test Result |
|-------------------------------|----------------|-------------|
| Low Channel | 31 | Passed |
| High Channel | 32 | Passed |





9 - ANTENNA REQUIREMENT

9.1 Standard Applicable

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

9.2 Antenna Connected Construction

The directional gain of antenna used for transmitting is 0 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

10 – RF EXPOSURE

According to 15.247(b)(4), RF exposure is calculated.

MPE Prediction

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 17.67 (dBm)

Maximum peak output power at antenna input terminal: 58.5 (mW)

Antenna Gain (typical): 2.5 (dBi)

Maximum antenna gain: 1.78 (numeric)

Prediction distance: 3 (cm)

Predication frequency: 2400(MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1.0(mW/cm^2)

Power density at predication frequency: 0.9207(mW/cm^2)

Maximum allowable antenna gain: 2.86(dBi)

Test Result

The predicted power density level at 3 cm is 0.9207W/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2400 MHz.

This radio is intended to be installed in laptop PC only and is thus classed as mobile equipment.

11 – SPURIOUS RADIATED EMISSION DATA

11.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is ± 4.0 dB.

11.2 EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with the ANSI C63.4 - 1992. The specification used was the FCC 15 Subpart C limits.

The EUT was connected with the host PC system. The host PC system was placed on the center of the back edge on the test table. The modem and the monitor were placed on the left side of the host PC system, and the printer was placed on the left side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.

The keyboard was placed directly in front of the monitor, flushed with the front of tabletop. The mouse was placed next to the keyboard, flushed with the back of keyboard.

The spacing between the peripherals was 10 centimeters.

Input / Output cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 110 Vac/60Hz power source.

11.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 24.5GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

| | |
|------------------------------------|---------|
| Start Frequency | 30 MHz |
| Stop Frequency..... | 24.5GHz |
| Sweep Speed | Auto |
| IF Bandwidth..... | 1 MHz |
| Video Bandwidth..... | 1 MHz |
| Quasi-Peak Adapter Bandwidth | 120 kHz |
| Quasi-Peak Adapter Mode | Normal |
| Resolution Bandwidth | 1MHz |

11.4 Test Procedure

For the radiated emissions test, the Host PC system and all support equipment power cords were connected to the AC floor outlet since the power supply used in the EUT did not provide an accessory power outlet.

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBμV of specification limits), and are distinguished with a "Qp" in the data table.

11.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Class B Limit}$$

11.6 Summary of Test Results

According to the data in section 11.7, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207, and 15.247, and had the worst margin of:

For Low Channel:

- 5.8 (Ave) dBmV at 4824.00 MHz in the Horizontal polarization, 30 MHz to 24.5GHz, 3 meters

For Middle Channel:

-2.2 (Ave) dBmV at 3111.80 MHz in the Horizontal polarization, 30 MHz to 24.5GHz, 3 meters

For High Channel:

-4.3 (Ave) dBmV at 4175.47 MHz in the Horizontal polarization, 30 MHz to 24.5GHz, 3 meters

11.7.a. Final Test Data, Low Channel, 30MHz to 24.5GHz, 3 meters

| INDICATED | | | TABLE | ANTENNA | | CORRECTION FACTOR | | | CORRECTED AMPLITUDE | FCC 15 Subpart C | |
|---------------|--------------|----------|--------------|--------------|------------|-------------------|----------|---------|---------------------|------------------|-----------|
| Frequency MHz | Ampl. dBmV/m | Comments | Angle Degree | Height Meter | Polar H/ V | Antenna dBmV/m | Cable DB | Amp. DB | Corr. Ampl. dBmV/m | Limit dBmV/m | Margin dB |
| 4824.00 | 40.8 | Ave | 180 | 2.0 | H | 32.5 | 4.9 | 30.0 | 48.2 | 54 | -5.8 |
| 4824.0 | 40.0 | Ave | 145 | 1.0 | V | 32.5 | 4.9 | 30.0 | 47.4 | 54 | -6.6 |
| 4075.40 | 36.0 | Ave | 120 | 1.2 | V | 31.4 | 4.7 | 30.0 | 42.1 | 54 | -11.9 |
| 4075.40 | 33.0 | Ave | 270 | 1.2 | H | 31.4 | 4.7 | 30.0 | 39.1 | 54 | -14.9 |
| 7235.70 | 27.2 | Ave | 270 | 1.0 | H | 35.1 | 5.6 | 30.0 | 37.9 | 54 | -16.1 |
| 7235.70 | 22.3 | Ave | 270 | 1.0 | V | 35.1 | 5.6 | 30.0 | 33.0 | 54 | -21.0 |

11.7.b Final Test Data, Middle Channel, 30MHz to 24.5GHz, 3 meters

| INDICATED | | | TABLE | ANTENNA | | CORRECTION FACTOR | | | CORRECTED AMPLITUDE | FCC 15 Subpart C | |
|---------------|--------------|----------|--------------|--------------|------------|-------------------|----------|---------|---------------------|------------------|-----------|
| Frequency MHz | Ampl. dBmV/m | Comments | Angle Degree | Height Meter | Polar H/ V | Antenna dBmV/m | Cable dB | Amp. dB | Corr. Ampl. dBmV/m | Limit dBmV/m | Margin dB |
| 3111.80 | 47.5 | Ave | 270 | 1.0 | H | 30.3 | 4.0 | 30.0 | 51.8 | 54 | -2.2 |
| 4873.90 | 42.8 | Ave | 90 | 1.0 | V | 32.5 | 4.9 | 30.0 | 50.2 | 54 | -3.8 |
| 4873.9 | 41.5 | Ave | 225 | 1.0 | H | 32.5 | 4.9 | 30.0 | 48.9 | 54 | -5.1 |
| 4125.46 | 40.0 | Ave | 100 | 1.0 | V | 31.4 | 4.7 | 30.0 | 46.1 | 54 | -7.9 |
| 7312.00 | 30.0 | Ave | 270 | 1.0 | V | 35.1 | 5.6 | 30.0 | 40.7 | 54 | -13.3 |
| 7312.00 | 29.7 | Ave | 270 | 1.0 | V | 35.1 | 5.6 | 30.0 | 40.4 | 54 | -13.6 |

11.7.c Final Test Data, High Channel, 30MHz to 24.5GHz, 3 meters

| INDICATED | | | TABLE | ANTENNA | | CORRECTION FACTOR | | | CORRECTED AMPLITUDE | FCC 15 Subpart C | |
|---------------|--------------|----------|--------------|--------------|------------|-------------------|----------|---------|---------------------|------------------|-----------|
| Frequency MHz | Ampl. dBmV/m | Comments | Angle Degree | Height Meter | Polar H/ V | Antenna dBmV/m | Cable dB | Amp. dB | Corr. Ampl. dBmV/m | Limit dBmV/m | Margin dB |
| 4175.47 | 43.7 | Ave | 80 | 2.0 | H | 31.4 | 4.7 | 30.0 | 49.8 | 54 | -4.3 |
| 4924.00 | 41.8 | Ave | 90 | 1.0 | H | 32.5 | 4.9 | 30.0 | 49.2 | 54 | -4.8 |
| 4175.47 | 40.0 | Ave | 270 | 2.0 | V | 31.4 | 4.7 | 30.0 | 46.1 | 54 | -7.9 |
| 4924.0 | 38.0 | Ave | 90 | 1.0 | V | 32.5 | 4.9 | 30.0 | 45.4 | 54 | -8.6 |
| 3334.42 | 25.0 | Ave | 270 | 1.2 | V | 30.3 | 4.0 | 30.0 | 29.3 | 54 | -24.7 |
| 3334.42 | 23.0 | Ave | 270 | 1.0 | H | 30.3 | 4.0 | 30.0 | 27.3 | 54 | -26.7 |

12 - CONDUCTED EMISSIONS TEST DATA

12.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is ± 2.4 dB.

12.2 EUT Setup

The measurement was performed at the **Open Area Test Site**, using the same setup per ANSI C63.4 - 1992 measurement procedure. The specification used was FCC 15 Subpart C limits.

The EUT was connected with the host PC system. The host PC system was placed on the center of the back edge on the test table. The modem and the monitor were placed on the left side of the host PC system, and the printer was placed on the left side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.

The keyboard was placed directly in front of the monitor, flushed with the front of tabletop. The mouse was placed next to the keyboard, flushed with the back of keyboard.

The spacing between the peripherals was 10 centimeters.

Input / Output cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 110 Vac/60Hz power source.

12.3 Spectrum Analyzer Setup

The spectrum analyzer was set with the following configurations during the conduction test:

| | |
|------------------------------------|---------|
| Start Frequency | 450 kHz |
| Stop Frequency | 30 MHz |
| Sweep Speed | Auto |
| IF Bandwidth | 100 kHz |
| Video Bandwidth | 100 kHz |
| Quasi-Peak Adapter Bandwidth | 9 kHz |
| Quasi-Peak Adapter Mode | Normal |

12.4 Test Procedure

During the conducted emission test, the power cord of the host system was connected to the auxiliary outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of each modes tested to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings were only performed when an emission was found to be marginal (within -4 dB μ V of specification limits). Quasi-peak readings are distinguished with a "Qp".

12.5 Summary of Test Results

According to the data in section 12.6, the EUT complied with the FCC Conducted margin for a Class B device, with the *worst* margin reading of:

--2.8 dBmV at 11.780 MHz in the Neutral mode, 450KHz – 30 MHz.

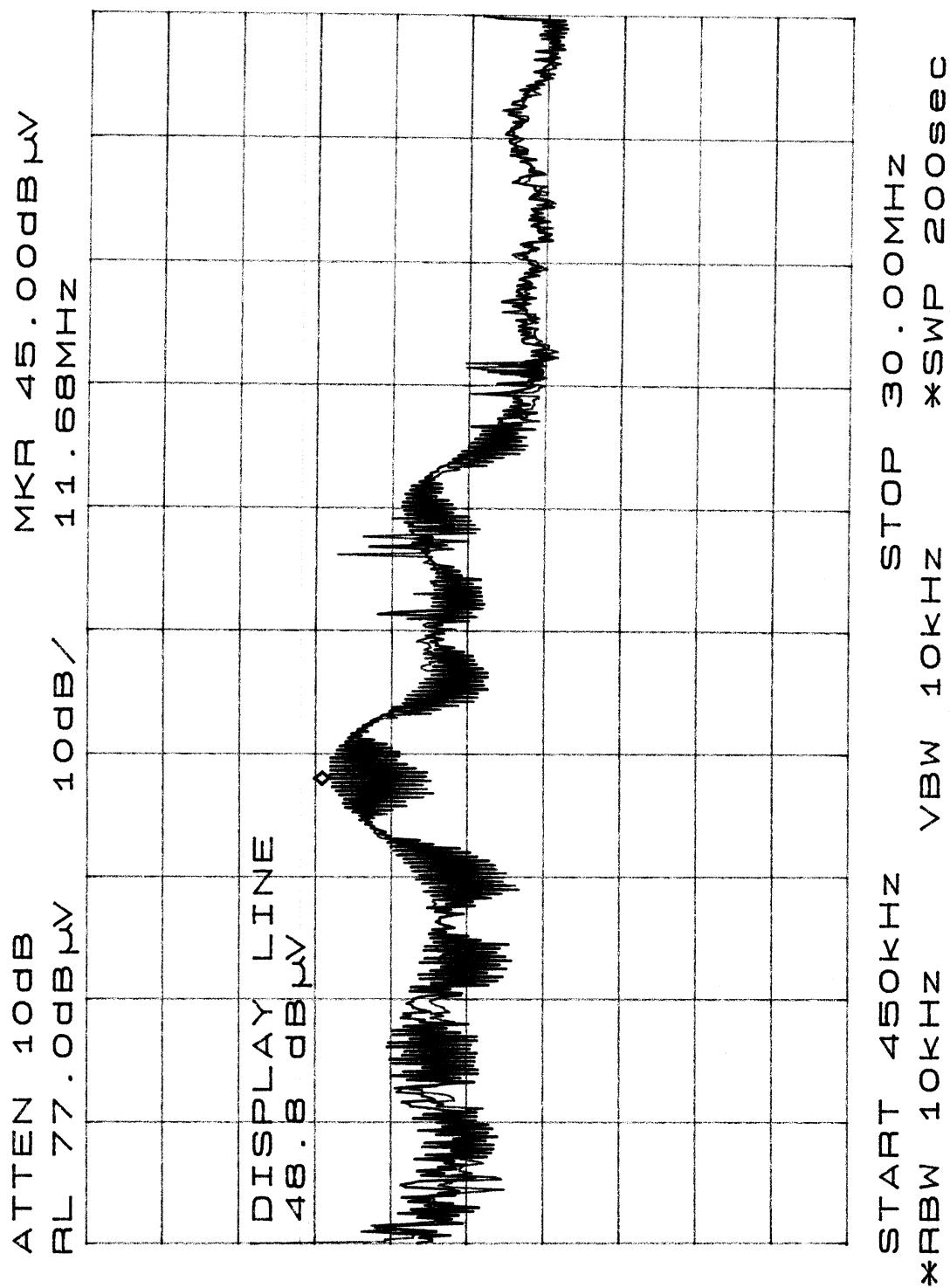
12.6 Conducted Emissions Test Data

12.6.1 Test Data, 0.45 - 30 MHz.

| LINE CONDUCTED EMISSIONS | | | | FCC CLASS B | |
|--------------------------|------------|-------------|--------------|-------------|--------|
| Frequency | Amplitude | Detector | Phase | Limit | Margin |
| MHz | dB μ V | Qp/Ave/Peak | Line/Neutral | dB μ V | dB |
| 11.780 | 45.2 | Peak | Neutral | 48 | -2.8 |
| 11.680 | 45.0 | Peak | Line | 48 | -3.0 |
| 17.050 | 44.2 | Peak | Neutral | 48 | -3.8 |
| 17.240 | 40.0 | Peak | Line | 48 | -8.0 |
| 15.620 | 38.8 | Peak | Line | 48 | -9.2 |
| 4.240 | 36.5 | Peak | Neutral | 48 | -11.5 |

12.7 Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented hereinafter as reference.



13 - PROCESSING GAIN

Brief Explanations on Processing Gain Data

1. The formula of Processing Gain is: $G_p = (S/N)_o + M_j + L_{sys}$

Where G_p : Processing Gain;

$(S/N)_o$: the ratio of signal energy vs noise power density. Based on the data provided by the chip set manufacturer, it is 16.4dB @ 11Mb/s, 13.4dB @ 5.5Mb/s, 13.3dB @ 2.0Mb/s, 10.3dB @ 1.0Mb/s;

L_{sys} : test system loss. The measurement result to our test set-up is 2.0dB;

M_j : Jamming Margin. It is the ratio of jammer vs WLAN channel signal;

2. The purpose of the measurement here is to figure out M_j at different frequencies. Processing Gain will be gotten through calculation based on the above formula at different frequencies;
3. During the tests (see the Block Diagram of Test Set-up), the input signal to RX is about -60dBm (not exactly at -60dBm) and M_j (dB) = Jammer level (dBm) - Channel signal level (dBm);
4. The criteria we define the transmission link failure is: PER = 8%;
5. FCC defines that when testing the Processing Gain for a specific channel, if the frequency is f_o , the jammer frequency has to scan from $f_o - 8.5$ MHz to $f_o + 8.5$ MHz with 50 KHz per step. In another word, 340 data will be taken just for a single channel measurement;
6. Having calculated out 340 Processing Gains for a specific channel, use the percentile average function of Microsoft Excel to figure out the final result.

Example: see the first row of 11Mb/s @ Channel 6

Frequency—Jammer frequency = $f_o - 8.5 = 2437 - 8.5 = 2428.50$ MHz;

$(S/N)_o$ —16.4 dB @ 11 Mb/s (see Item 1);

L_{sys} —2.0 dB (see Item 1);

PER—8.0%, which is the failure criteria;

Jammer— -57.2dBm, which is the Jammer level @ PER=8.0%;

M_j —Jamming Margin. 5.5 (dB) = -57.2 (dBm) - (-62.7) (dBm) (see Item 3). On here, also see the next page of spread sheet, which shows that XMIT level = -62.7 dBm);

G_p —Processing Gain = $(S/N)_o + M_j + L_{sys} = 16.4 + 5.5 + 2.0 = 23.9$ (dB).

After having calculated out 340 G_p s, use the percentile function of Microsoft Excel, the final G_p of 11Mb/s @ Ch 6 is 12.9 dB. At the same time, incorporate those 340 data into f — G_p chart, you'll get a whole picture of it.

Chip/symbol rate, the symbol/bit rate and the Chip/bit

| Bit rate | Chip/symbol rate | Bit/symbol rate | Chip/bit rate | G_p (dB) | Spec (dB) |
|--------------|------------------|-----------------|---------------|------------|-----------|
| 1 Mbit/sec | 11 | 1, DBPSK | 11 | 13.2 | 10 |
| 2 Mbit/sec | 11 | 2, DQPSK | 5.5 | 12.6 | 10 |
| 5.5 Mbit/sec | 8 | 4, CCK | 2 | 13.4 | 10 |
| 11 Mbit/sec | 8 | 8, CCK | 1 | 12.9 | 10 |

Note: 1. G_p is Processing Gain;

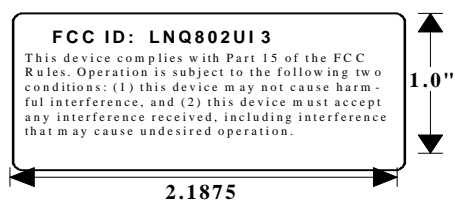
2. Spec is Processing Gain specifications defined by FCC on DSSS systems.

Attachment A: Test Data for Processing Gain

Attachment B: Test Setup – Processing Gain

14 – FCC PRODUCT LABELING AND WARNING STATEMENT

14.1 FCC ID Label

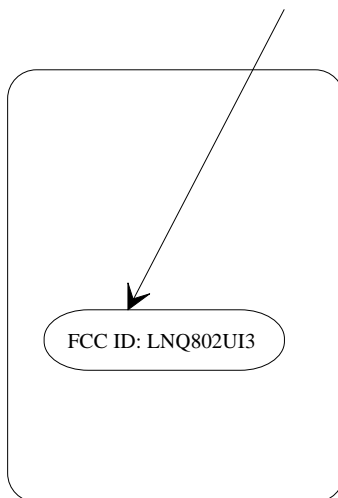


Specifications: Text is black or white in color and is left justified. Labels are silk-screened and shall be “permanently affixed” at a conspicuous location on the EUT.

14.2 Proposed Label Location on EUT

Bottom View of EUT

FCC ID Label Location



15 - Conducted and Radiated Setup Photographs

15.1 Conducted Emission – Front View



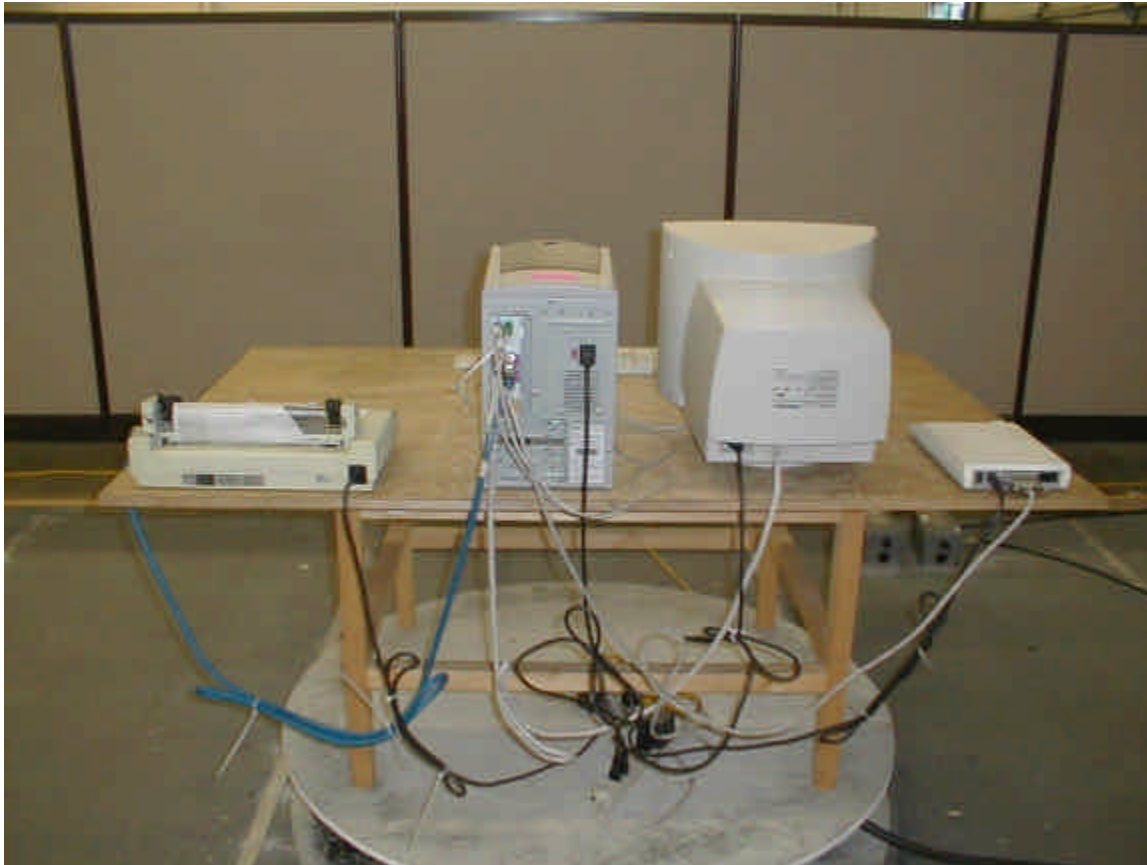
15.2 Conducted Emission – Rear View



15.3 Radiated Emission – Front View

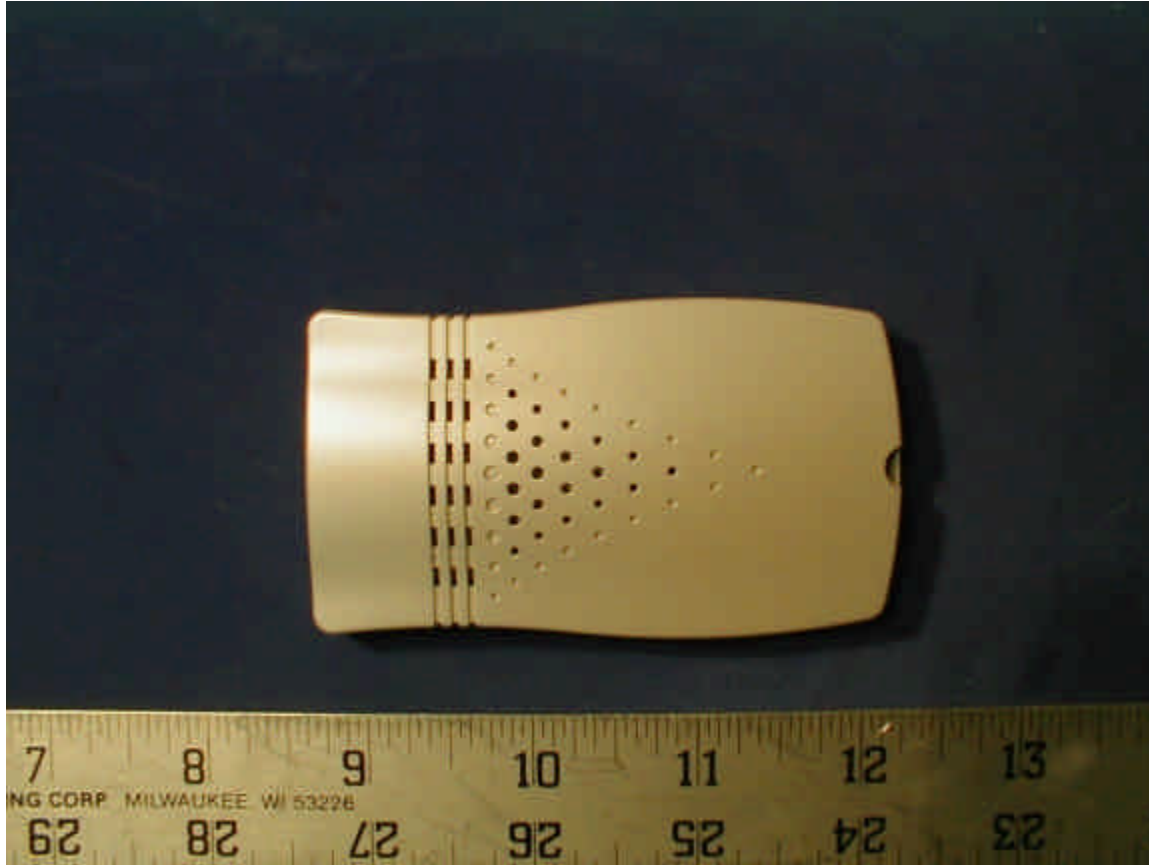


15.4 Radiated Emission – Rear View

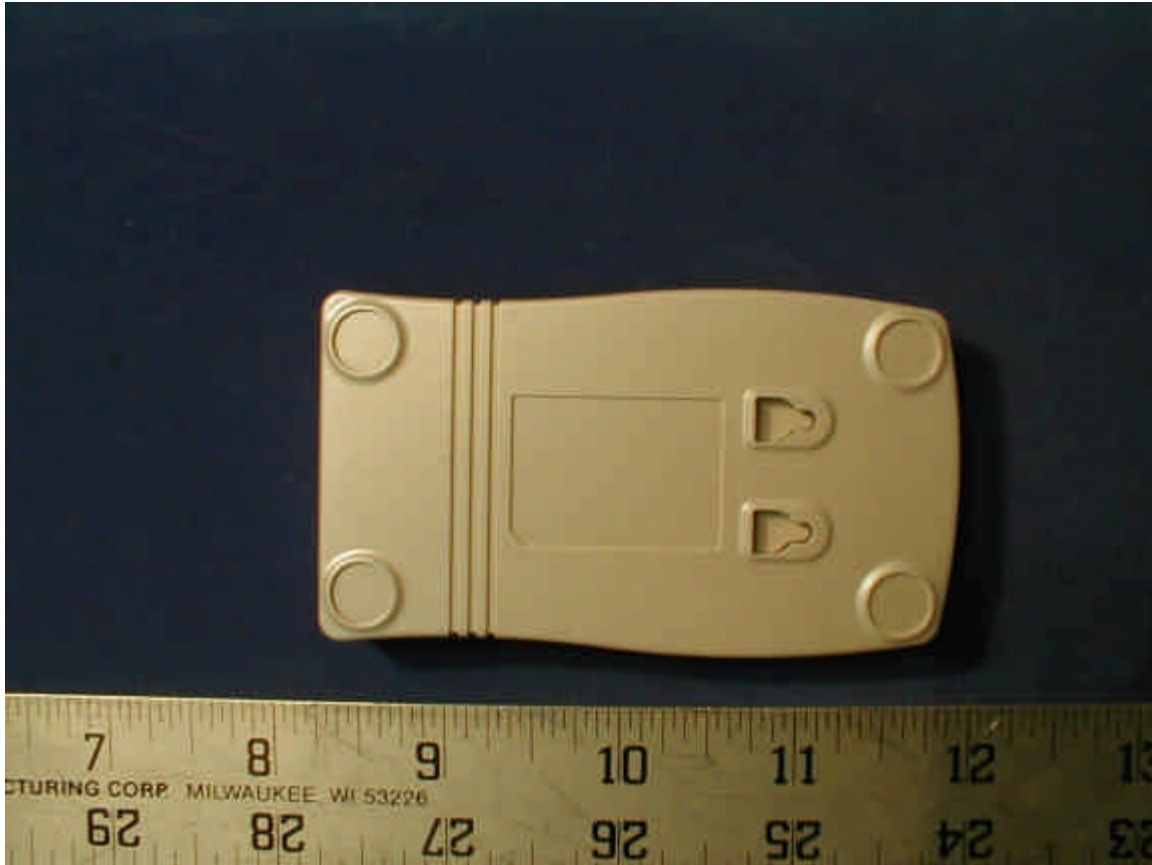


16 – EUT PHOTOGRAPHS

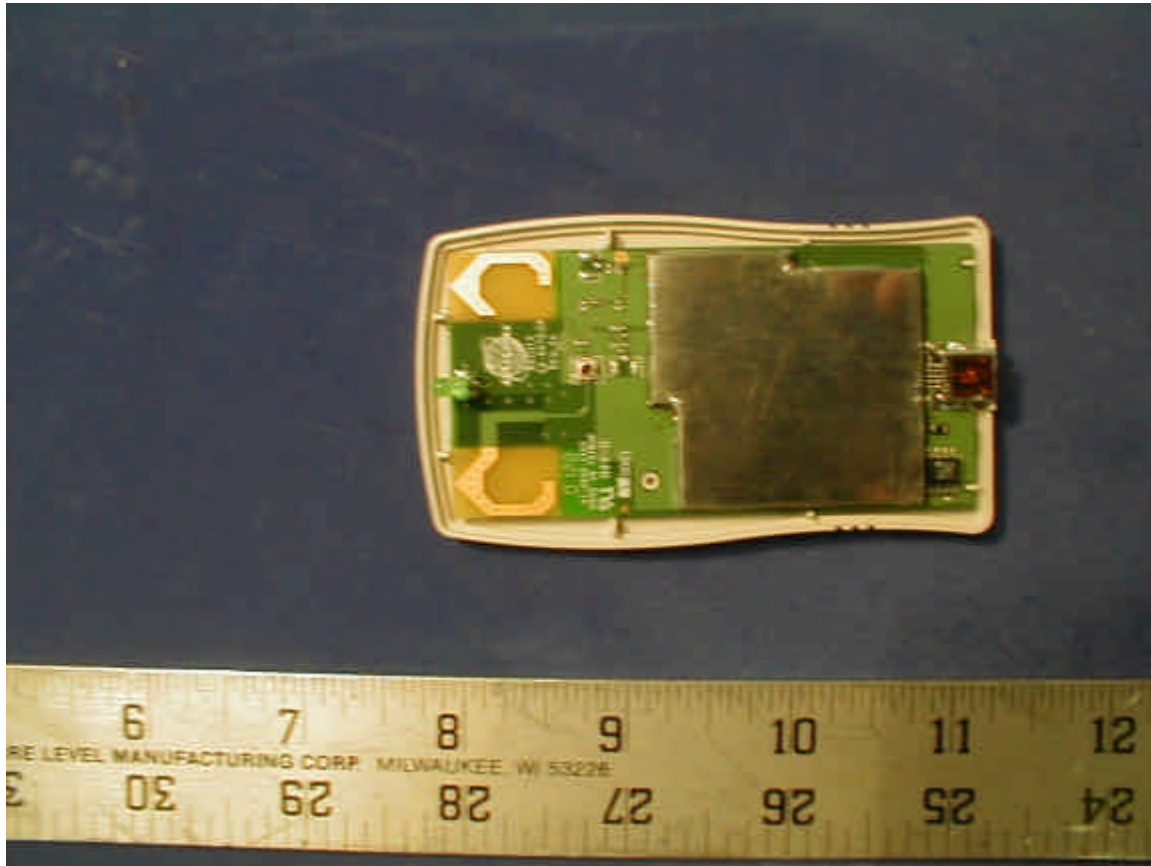
16.1 EUT-Top View



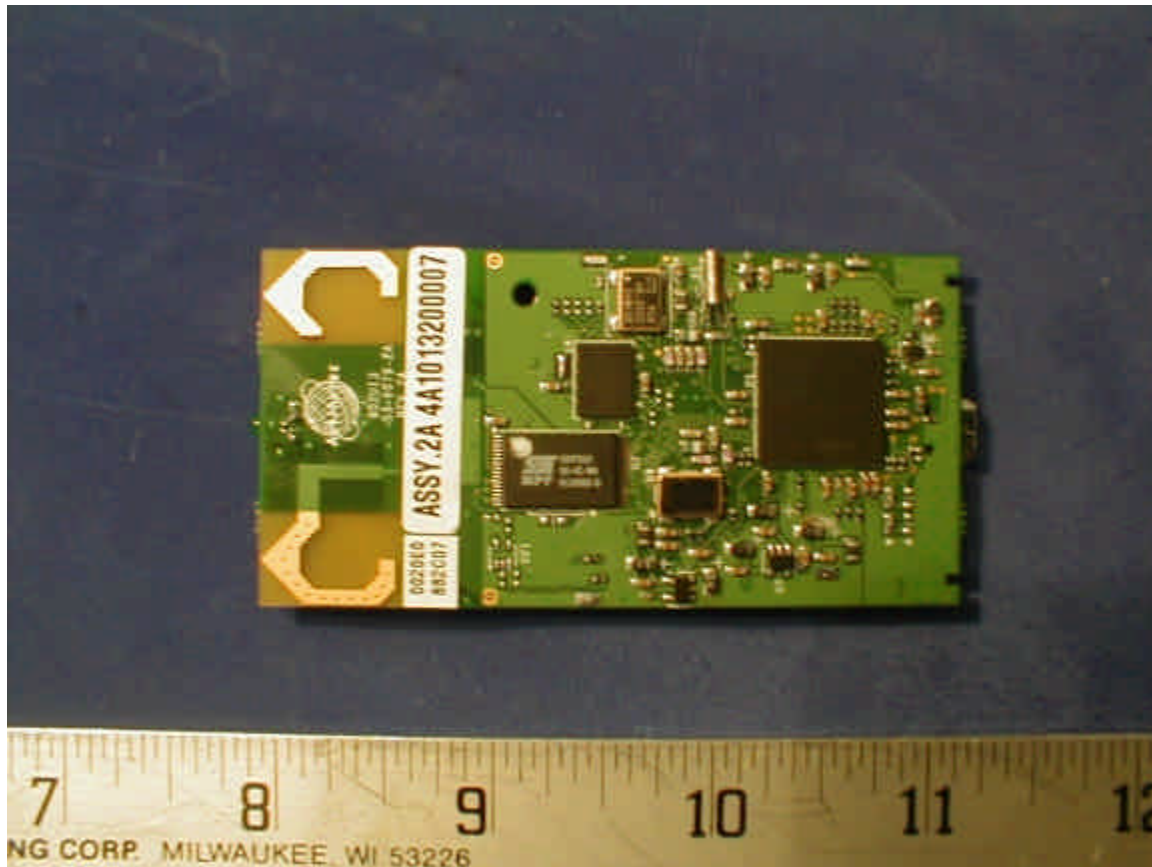
16.2 EUT- Bottom View



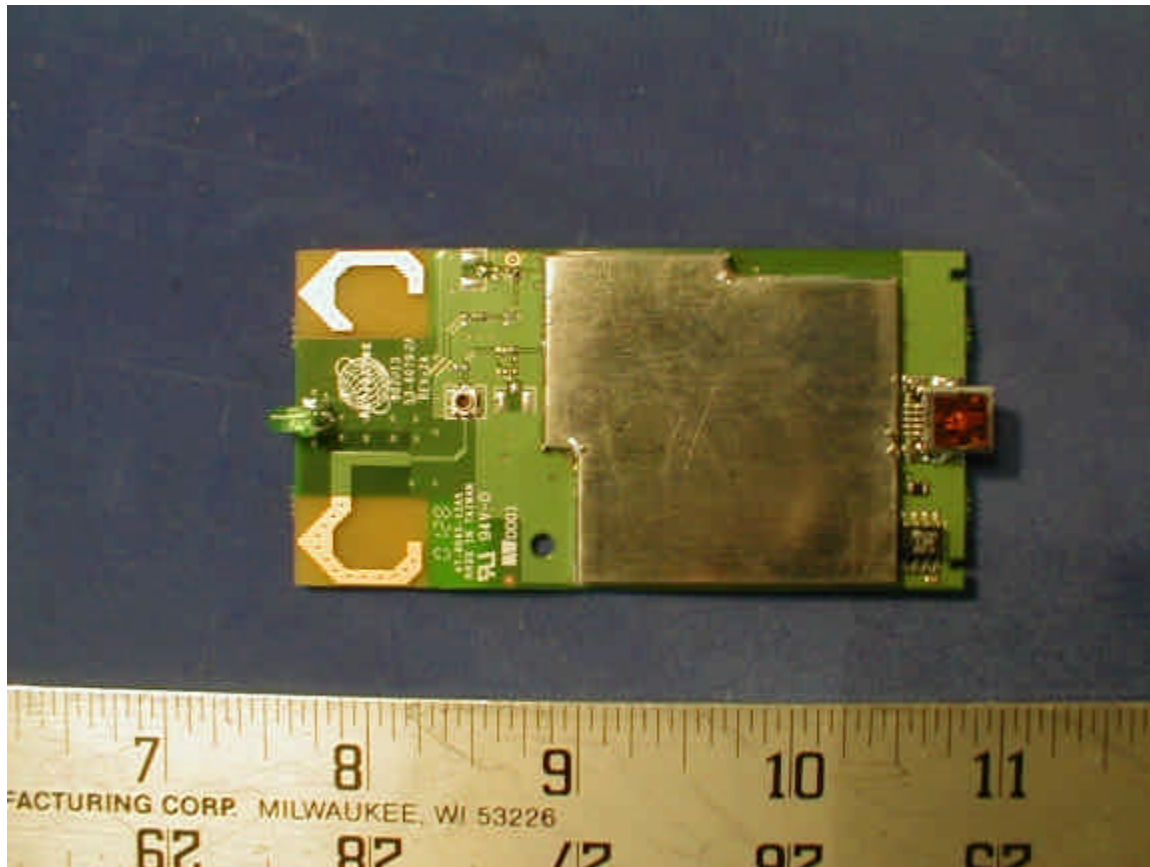
16.3 EUT- Cover Off View



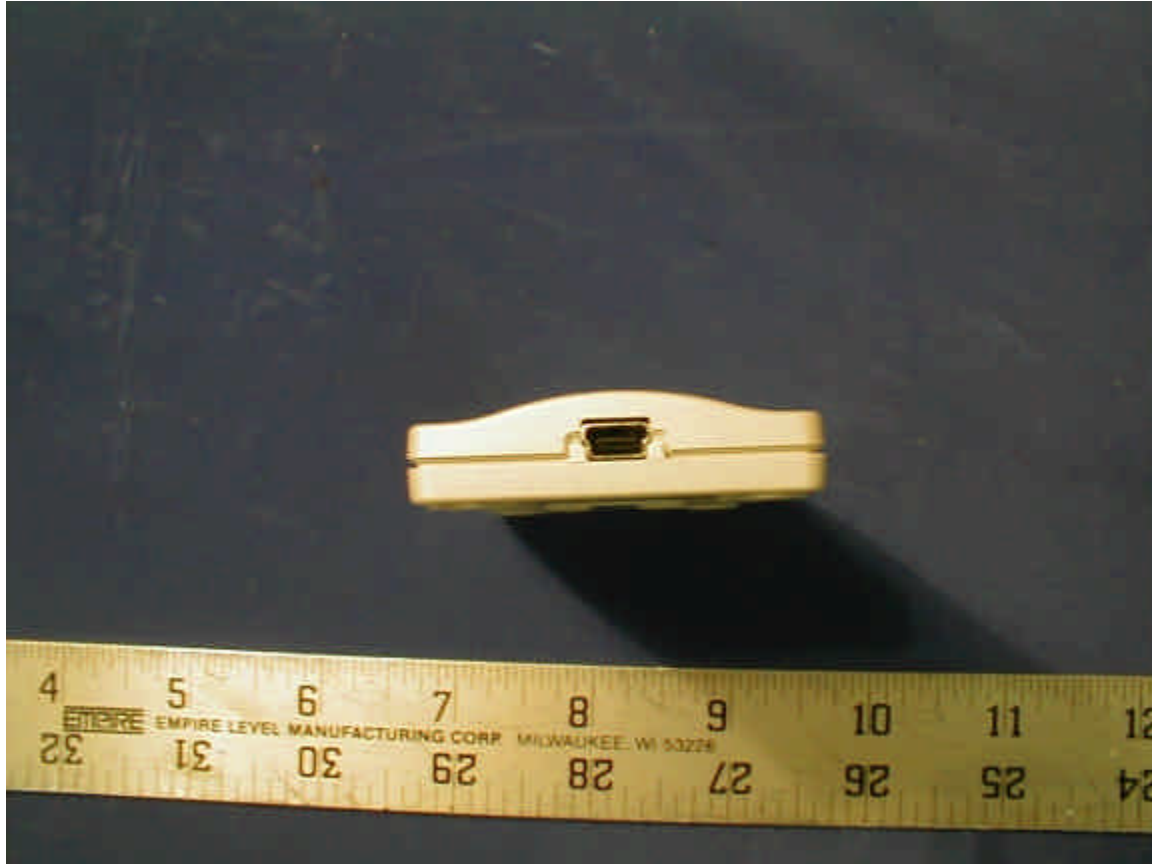
16.4 EUT – Component View



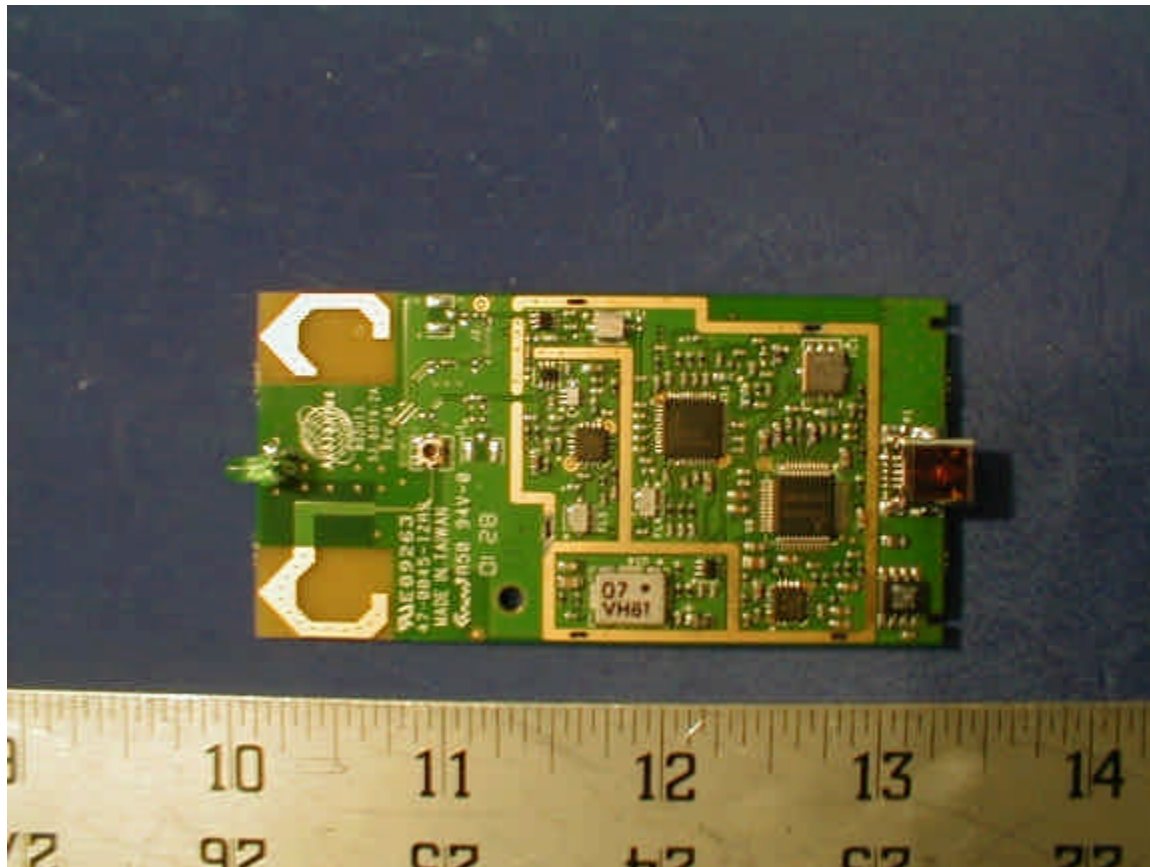
16.5 EUT – Solder View



16.6 EUT – Connector View



16.7 EUT – RF Module without Cover View



Appendix A – EUT Schematics / Block Diagram/Parts List

Appendix B – USER MANUAL
