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***Electromagnetic Emissions Test Report  
and  
Request for Class II Permissive Change  
pursuant to  
FCC Part 15, Subpart C Specifications for a  
Intentional Radiator on the  
WaveSpan Corporation  
Model: WS5800 5.8 GHZ***

PRESENT FCC ID: NGP7058000

GRANT DATE: September 22, 1997

GRANTEE: WaveSpan Corporation  
500 N. Bernardo Avenue  
Mountain View, CA 94043

TEST SITE: Elliott Laboratories, Inc.  
684 W. Maude Avenue  
Sunnyvale, CA 94086

REPORT DATE: June 4, 1997

FINAL TEST DATE: May 22, 1998

TEST ENGINEER: Rudy Suy

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## **SCOPE**

An electromagnetic emissions test has been performed on the WaveSpan Spread Spectrum Transceiver model WS5800 5.8 GHZ pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in FCC Rules. This test has been performed to confirm continued compliance of a new version of the WS5800 5.8 GHZ in accordance with Part 2, Section 2.1043 of the FCC Rules for permissive changes to Certified devices.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the WaveSpan model WS5800 5.8 GHZ and therefore apply only to the tested sample. The sample was selected and prepared by Roger Eline of WaveSpan Corporation.

## **OBJECTIVE**

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. In this case, minor modifications to the design of the subject device require that additional testing be performed to demonstrate that the device continues to comply with the Rules. The original Grant of Equipment Authorization issued by the FCC for the Certification of the subject device will be valid for the new version once acceptance is received from the FCC.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a Grant of Equipment Authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

## **TEST SITE**

### **GENERAL INFORMATION**

Final test measurements were taken on May 22, 1998 at the Elliott Laboratories Open Area Test Site located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

### **CONDUCTED EMISSIONS CONSIDERATIONS**

Conducted emissions testing is performed in conformance with ANSI C63.4. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

### **RADIATED EMISSIONS CONSIDERATIONS**

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

## **MEASUREMENT INSTRUMENTATION**

### **RECEIVER SYSTEM**

AN EMI receiver as specified in CISPR 16 is used for emissions measurements. The ESH3 receiver can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers, allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

### **INSTRUMENT CONTROL COMPUTER**

A Rohde and Schwarz EZM Spectrum Monitor/Controller is utilized to convert the receiver measurements to the field strength at the antenna, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate.

The EZM provides a visual display of the signal being measured. In addition, the EZM Spectrum Monitor runs the automated data collection programs which control both receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors, are added automatically.

### **LINE IMPEDANCE STABILIZATION NETWORK (LISN)**

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The 50 uH LISNs used were manufactured by Fischer Custom Communications, model LISN-3 in combination with a 250 uH Fischer Custom Communications LISN-3 CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

### **POWER METER**

A power meter and thermister mount are used for all output power measurements from transmitters as they provides a broadband indication of the power output. The power meter used was the Hewlett Packard model 432A, S/N 992-05509 and the thermister mount was the Hewlett Packard model 478A, S/N 46397.

### **FILTERS/ATTENUATORS**

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

### **ANTENNAS**

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used.

The antenna calibration factors are included in site factors which are programmed into the test receivers

### **ANTENNA MAST AND EQUIPMENT TURNTABLE**

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

### **INSTRUMENT CALIBRATION**

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

**TEST PROCEDURES****EUT AND CABLE PLACEMENT**

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

**CONDUCTED EMISSIONS**

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

**RADIATED EMISSIONS**

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 to 1000 MHz. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

**SPECIFICATION LIMITS AND SAMPLE CALCULATIONS**

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

**CONDUCTED EMISSIONS SPECIFICATION LIMITS**

| Frequency<br>Range<br>(MHz) | Limit<br>(uV) | Limit<br>(dBuV) |
|-----------------------------|---------------|-----------------|
| 0.450 to 30.000             | 250           | 48              |

**RADIATED EMISSIONS SPECIFICATION LIMITS**

| Frequency<br>Range<br>(MHz) | Limit<br>(uV/m @ 3m)                | Limit<br>(dBuV/m @ 3m)                            |
|-----------------------------|-------------------------------------|---------------------------------------------------|
| 0.009-0.490                 | $2400/F_{\text{KHz}} @ 300\text{m}$ | $67.6-20*\log_{10}(F_{\text{KHz}}) @ 300\text{m}$ |
| 0.490-1.705                 | $24000/F_{\text{KHz}} @ 30\text{m}$ | $87.6-20*\log_{10}(F_{\text{KHz}}) @ 30\text{m}$  |
| 1.705 to 30                 | 30 @ 30m                            | 29.5 @ 30m                                        |
| 30 to 88                    | 100                                 | 40                                                |
| 88 to 216                   | 150                                 | 43.5                                              |
| 216 to 960                  | 200                                 | 46.0                                              |
| Above 960                   | 500                                 | 54.0                                              |

**SAMPLE CALCULATIONS - CONDUCTED EMISSIONS**

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

$R_r$  = Receiver Reading in dBuV

B = Broadband Correction Factor\*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

\* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

**SAMPLE CALCULATIONS - RADIATED EMISSIONS**

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20 \cdot \log_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

$$R_r = \text{Receiver Reading in dBuV/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_c = \text{Corrected Reading in dBuV/m}$$

$$L_s = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

**EQUIPMENT UNDER TEST (EUT) DETAILS****GENERAL**

The WaveSpan model WS5800 5.8 GHZ is a spread spectrum, frequency hopping transceiver which is designed to transmit data. The sample was received and tested on May 22, 1998. The EUT consisted of the following component(s):

| Manufacturer/Model/Description                  | Serial Number | FCC ID Number |
|-------------------------------------------------|---------------|---------------|
| Wavespan WS5800 5.8GHz Transceiver              | 00152         | NGP7058000    |
| Gabriel Inc SSP4-57 4ft. Parabolic Dish Antenna | 449954        | None          |

**ENCLOSURE**

The WaveSpan model WS5800 enclosure is primarily constructed of fabricated sheet steel. It measures approximately 47.5 cm wide by 47.5 cm deep by 7.5 cm high.

**INPUT POWER**

The EUT does not have a power supply as it takes its power from the WS5800 control unit. Conducted emissions data was taken of the power supply in the WS5800 support equipment.

**PRINTED WIRING BOARDS**

The WaveSpan model WS5800 5.8 GHZ contained the following printed wiring boards during emissions testing:

| Manufacturer/Description | Assembly # | Rev. | Serial # | Crystals (MHz) |
|--------------------------|------------|------|----------|----------------|
| Wavespan ODU Controller  | 500030503  | 3    | None     | None           |
| Wavespan RF Transceiver  | 500030303  | 3    | None     | 90.4 MHz       |
| Wavespan 18"x18" Antenna | 500050901  | -    | None     | None           |

**SUPPORT EQUIPMENT**

The following equipment was used as local support equipment for emissions testing:

| Manufacturer/Model/Description    | Serial Number | FCC ID Number |
|-----------------------------------|---------------|---------------|
| Wavespan WS5800IDU Digital Device | N/A           | -             |
| Sharp PC-9300T laptop computer    | 73120813      | -             |

**EXTERNAL I/O CABLING**

The I/O cabling configuration during emissions testing was as follows:

| Cable Description                  | Length (m) | From Unit/Port | To Unit/Port |
|------------------------------------|------------|----------------|--------------|
| Cat 5                              | 2.0        | Lap Top        | WS5800 IDU   |
| 50 $\Omega$ Alamar 200 Coaxial(x2) | 30.0       | WS5800 IDU     | WS5800 0DU   |
| Heliax                             | 7.0        | WS5800 0DU     | Dish Antenna |

**TEST SOFTWARE**

The system was configured to operate hopping continuously across all channels during testing.

**ANTENNA SYSTEM**

The antenna system used during testing was a 4' dish antenna of gain 34.4 dBi. Refer also to the section detailing proposed changes to the device.

**TEST MODES**

During emissions testing the transmitter was set to the normal operating mode (continuously hopping from channel to channel). The occupancy time on each channel was 0.4 seconds, which allowed measurements to be made on all channels. Measurements on the fundamental emission showed that all channels could be observed on the measurement instrumentation. Any spurious emissions related to a particular channel should, therefore, be measurable.

## **PROPOSED MODIFICATION DETAILS**

### **GENERAL**

This section details the modifications to the WaveSpan model WS5800 5.8 GHZ being proposed. All performance and construction deviations from the characteristics originally reported to the FCC are addressed

### **ANTENNA**

The original submittal was made for the device operating with an 18" square, flat panel antenna with a gain of 28dBi. Wavespan propose to use the following antennas with the system:

Parabolic Dish antennas between 4' and 8' in diameter with gains of between 34.4dBi and 40.8 dBi;

Smaller flat panel antennas of dimensions 9"x9" to 18" x 18".

The external antennas would have no effect on the AC powerline emissions, the antenna port conducted emissions and the power/bandwidth measurements previously reported to the Commission. These antennas would only affect the radiated spurious emissions.

Measurements of the spurious radiated emissions were performed on the device operating with a 4' dish antenna, since the larger size dish antennas would be difficult to erect on the OATS. Results of testing with the 4' dish antenna should also apply to the larger size antennas and be a worst case representation of the smaller, lower-gain flat panel antennas.

**TEST RESULTS****TEST DATA ANALYSIS - CONDUCTED**

Measurements were not performed as the proposed changes will not affect the results already reported to the Commission in the original submittal for this device.

**TEST DATA ANALYSIS - ANTENNA CONDUCTED**

Measurements were not performed as the proposed changes will not affect the results already reported to the Commission in the original submittal for this device.

**TEST DATA ANALYSIS - POWER AND BANDWIDTH**

Measurements were not performed as the proposed changes will not affect the results already reported to the Commission in the original submittal for this device.

**TEST DATA ANALYSIS - RADIATED HARMONIC AND SPURIOUS**

| Frequency<br>MHz | Level<br>dBuV/m | Pol<br>v/h | FCC<br>Limit | FCC<br>Margin | Azimuth<br>degrees | Height<br>meters | Comments                                 |
|------------------|-----------------|------------|--------------|---------------|--------------------|------------------|------------------------------------------|
| 11573.000        | 52.5            | h          | 54           | -2.5          | 180                | 1.5              | Peak Reading, Ave Limit<br>(noise floor) |
| 11755.330        | 50.9            | v          | 54           | -3.1          | 180                | 2.0              | Peak Reading, Ave Limit<br>(noise floor) |

In all of the restricted bands the noise floor of the instrumentation was 8dB below the limits outlined in §15.209. No emissions were seen above the noise floor, even when the antenna was moved to a distance of 1m from the EUT/antenna and the resolution bandwidth reduced to 10 KHz in an attempt to discriminate signals from the noise floor. The above measurement is the noise floor level with Peak Reading compared to Average Limit.

The measurements of emissions on the antenna port (antenna conducted emissions) originally reported to the Commission indicated that there were no significant spurious signals on the antenna port.

***EXHIBIT A***

Test Equipment Calibration

## Test Equipment List - SVOATS#1

| <u>Manufacturer/Description</u>                                                    | <u>Model</u>  | <u>Asset #</u> | <u>Interval</u> | <u>Last Cal</u> | <u>Cal Due</u> |
|------------------------------------------------------------------------------------|---------------|----------------|-----------------|-----------------|----------------|
| <input type="checkbox"/> Elliott Laboratories FCC / CISPR LISN                     | LISN-3, OATS  | 304            | 12              | 6/5/97          | 6/5/98         |
| <input checked="" type="checkbox"/> EMCO Double Ridge Horn Antenna, 1-18           | 3115          | 487            | 12              | 6/3/97          | 6/3/98         |
| <input type="checkbox"/> EMCO Biconical Antenna, 30-300 MHz                        | 3110B         | 363            | 12              | 4/8/98          | 4/8/99         |
| <input type="checkbox"/> EMCO Log Periodic Antenna, 0.3-1 GHz                      | 3146A         | 364            | 12              | 4/8/98          | 4/8/99         |
| <input type="checkbox"/> EMCO Double Ridge Horn Antenna, 1-18                      | 3115          | 786            | 12              | 11/13/97        | 5/13/99        |
| <input type="checkbox"/> Hewlett Packard Power Meter                               | 432A          | 259, (F304)    | 12              | 3/10/98         | 3/10/99        |
| <input checked="" type="checkbox"/> Hewlett Packard Spectrum Analyzer              | 8563E         | 284, (F194)    | 24              | 1/14/98         | 1/14/2000      |
| <input checked="" type="checkbox"/> Hewlett Packard Microwave Preamplifier, 1-26.5 | 8449B         | 263, (F303)    | 12              | 6/6/97          | 6/6/98         |
| <input type="checkbox"/> Hewlett Packard Thermistor Mount                          | 478A          | 652            | 12              | 3/10/98         | 3/10/99        |
| <input type="checkbox"/> Hewlett Packard EMC Receiver /Analyzer                    | 8595EM        | 780            | 24              | 10/24/97        | 10/24/99       |
| <input type="checkbox"/> Hewlett Packard Microwave Preamplifier, 1-26.5GHz         | 8449B         | 785            | 12              | 11/10/97        | 11/10/98       |
| <input type="checkbox"/> Hewlett Packard EMC Receiver /Analyzer                    | 8595EM        | 787            | 12              | 10/27/97        | 10/27/98       |
| <input checked="" type="checkbox"/> Narda-West EMI Filter 5.6 GHz, High Pass       | 60583 HXF370  | 247            | 12              | 4/22/97         | 4/22/98        |
| <input type="checkbox"/> Narda-West EMI Filter 2.4 GHz, High Pass                  | 60583 HPF-161 | 248            | 12              | 4/22/97         | 4/22/98        |
| <input type="checkbox"/> Rohde & Schwarz 10 dB Pad / Pulse Limiter, 50W            | ESH3 Z2       | 371            | 12              | 7/24/96         | 7/24/97        |
| <input type="checkbox"/> Rohde & Schwarz 10 dB Pad / Pulse Limiter                 | ESH3 Z2       | 372            | 12              | 6/17/97         | 6/17/98        |
| <input type="checkbox"/> Rohde & Schwarz Test Receiver                             | ESN           | 775            | 12              | 6/30/97         | 6/30/98        |
| <input type="checkbox"/> Solar Electronics High Pass Filter, fc = 8 kHz            | 7930-8.0      | 277            | 12              | 7/18/97         | 7/18/98        |

File Number: T26747

Date: 5/22/98  
 Engr: [Signature]

## ***EXHIBIT B***

### Test Measurement Data

The following data includes conducted emission measurements of the WaveSpan model WS5800 5.8 GHZ and maximized radiated emissions measurements of the complete system.



## EMC Test Log

|            |                     |       |           |            |             |
|------------|---------------------|-------|-----------|------------|-------------|
| Client:    | WaveSpan Corp.      | Date: | 5/22/98   | Test Engr: | Rudy Suy    |
| Product:   | WS5800              | File: | T26747    | Proj. Eng: | Mark Briggs |
| Objective: | Final Qualification | Site: | SVOATS #1 | Contact:   | Roger Eline |
| Spec:      | FCC pt. 15          | Page: | 1 of 3    | Approved:  | <i>MB</i>   |

### Test Objective

The objective of this test session is to perform class 2 permissive change of the EUT defined below relative to the specification(s) defined above. This EUT was tested and submitted to the FCC before; the only change is the antenna (from Flat panel array to 4ft. parabolic disk).

### Test Summary

Run #1 Spurious Emissions Falling In Restricted Bands, 1-40 GHz.

**PASS** Results: FCC -2.5 dB Peak @11573.000 MHz Horizontal

### Equipment Under Test (EUT) General Description

The EUT is a spread spectrum, frequency hopping transceiver which is designed to transmit data. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, placed in this position during emissions testing to simulate the end user environment.

### Equipment Under Test (EUT)

| Manufacturer/Model/Description                  | Serial Number | FCC ID Number |
|-------------------------------------------------|---------------|---------------|
| Wavespan WS5800 5.8GHz Transceiver              | 00152         | NGP7058000    |
| Gabriel Inc SSP4-57 4ft. Parabolic Dish Antenna | 449954        | None          |

### Power Supply and Line Filters

The EUT does not have a power supply as it takes its power from the WS5800 control unit. Conducted emissions data was taken of the power supply in the WS5800 support equipment.

### Printed Wiring Boards in EUT

| Manufacturer/Description | Assembly # | Rev. | Serial Number | Crystals (MHz) |
|--------------------------|------------|------|---------------|----------------|
| Wavespan ODU Controller  | 500030503  | 3    | None          | None           |
| Wavespan RF Transceiver  | 500030303  | 3    | None          | 90.4 MHz       |
| Wavespan 18"x18" Antenna | 500050901  | -    | None          | None           |



## EMC Test Log

|            |                     |       |           |            |             |
|------------|---------------------|-------|-----------|------------|-------------|
| Client:    | WaveSpan Corp.      | Date: | 5/22/98   | Test Engr: | Rudy Suy    |
| Product:   | WS5800              | File: | T26747    | Proj. Eng: | Mark Briggs |
| Objective: | Final Qualification | Site: | SVOATS #1 | Contact:   | Roger Eline |
| Spec:      | FCC pt. 15          | Page: | 2 of 3    | Approved:  | <i>MB</i>   |

### Subassemblies in EUT

| Manufacturer/Description | Assembly Number | Rev. | Serial Number |
|--------------------------|-----------------|------|---------------|
| None                     | -               | -    | -             |

### EUT Enclosure(s)

The WaveSpan model WS5800 enclosure is primarily constructed of fabricated sheet steel. It measures approximately 47.5 cm wide by 47.5 cm deep by 7.5 cm high.

### EMI Suppression Devices (filters, gaskets, etc.)

| Description | Manufacturer | Part Number |
|-------------|--------------|-------------|
| None        | -            | -           |

### Local Support Equipment

| Manufacturer/Model/Description    | Serial Number | FCC ID Number |
|-----------------------------------|---------------|---------------|
| Wavespan WS5800IDU Digital Device | N/A           | -             |
| Sharp PC-9300T laptop computer    | 73120813      | -             |

### Remote Support Equipment

| Manufacturer/Model/Description | Serial Number | FCC ID Number |
|--------------------------------|---------------|---------------|
| None                           | -             | -             |

### Interface Cabling

| Cable Description           | Length (m) | From Unit/Port | To Unit/Port |
|-----------------------------|------------|----------------|--------------|
| Cat 5                       | 2.0        | Lap Top        | WS5800 IDU   |
| 50Ω Alamar 200 Coaxial (x2) | 30.0       | WS5800 IDU     | WS5800 ODU   |
| Heliax                      | 7.0        | WS5800 ODU     | Dish Antenna |

### Test Software

The system was configured to operate hopping continuously across all channels during testing.



## EMC Test Log

|            |                     |       |           |            |             |
|------------|---------------------|-------|-----------|------------|-------------|
| Client:    | WaveSpan Corp.      | Date: | 5/22/98   | Test Engr: | Rudy Suy    |
| Product:   | WS5800              | File: | T26747    | Proj. Eng: | Mark Briggs |
| Objective: | Final Qualification | Site: | SVOATS #1 | Contact:   | Roger Eline |
| Spec:      | FCC pt. 15          | Page: | 3 of 3    | Approved:  | <i>MB</i>   |

### General Test Conditions

During testing, the WS5800 control unit was connected to 120V/60Hz power input. The WS5800 IDU & WS5800 ODU was located on a non-conducting bench which is 0.8 meter of the ground plane and the Antenna was standing on the turntable. Refer to set-up photo for more details.

### Test Data Tables

Run #1 - Maximized Radiated Spurious Emissions, 1-40 GHz, Restricted Band.

| Frequency MHz | Level dBuV/m | Pol v/h | FCC Limit | FCC Margin | Azimuth degrees | Height meters | Comments                              |
|---------------|--------------|---------|-----------|------------|-----------------|---------------|---------------------------------------|
| 11573.000     | 52.5         | h       | 54        | -2.5       | 180             | 1.5           | Peak Reading, Ave Limit (noise floor) |
| 11755.330     | 50.9         | v       | 54        | -3.1       | 180             | 2.0           | Peak Reading, Ave Limit (noise floor) |

In all of the restricted bands the noise floor of the instrumentation was 8dB below the limits outlined in §15.209. No emissions were seen above the noise floor, even when the antenna was moved to a distance of 1m from the EUT and the resolution bandwidth reduced to 10 KHz in an attempt to discriminate signals from the noise floor. The above measurement is the noise floor level with Peak Reading compared to Average Limit.

***EXHIBIT C***

Photographs of Test Configurations