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Electromagnetic Emissions Test Report and Request for Class II Permissive Change pursuant to FCC Part 15, Subpart E Specifications for an Intentional Radiator on the Wavespan Corporation Model: Stratum 100

FCC ID:	NGP7020010
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:	September 27, 1999
FINAL TEST DATE:	July 12 and August 3, 1999
AUTHORIZED SIGNATORY:	David W. Bare Principal Engineer

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SCOPE

An electromagnetic emissions test has been performed on the Wavespan Corporation UNII radio model Stratum 100 pursuant to Subpart E 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 ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

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 Corporation model Stratum 100 and therefore apply only to the tested sample. The sample was selected and prepared by Keith Brombergof Wavespan Corporation

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart E of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

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 subsequently manufactured.

STATEMENT OF COMPLIANCE

The tested sample of Wavespan Corporation model Stratum 100 complied with the requirements of Subpart E of Part 15 of the FCC Rules for low power intentional radiators.

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.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Wavespan Corporation model Stratum 100. Since only the antenna was changed, no power, bandwidth or AC power line conducted emission measurments were made. The actual test results are contained in an exhibit of this report.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.407(b)(2) and 15.407(b)(3).

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Stratum 100 ODU B, 1 - 40 GHz

Frequency MHz	Level dBuV/m	Pol v/h	FCC Limit	FCC Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
10650.000	47.9	V	54.0	-6.1	Avg	0	1.0	

LIMITS OF ANTENNA CONDUCTED SPURIOUS EMISSIONS

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.407(b)(3).

The output power level of all spurious emissions conducted from the EUT RF port were less than –27 dBm/MHz.

MEASUREMENT UNCERTAINTIES

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The WaveSpan Corporation model Stratum 100 is the Outdoor unit (ODU) for a UNII radio system. The ODU would normally mounted on a mast or wall-mounted. Testing was performed with the 6 foot diameter parabolic antenna as representative of all the parabolic antennas to be used as it is impracticable to test a larger dish on a OATS. The sample was received on July 12, 1999 and tested on July 12 and August 3, 1999. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 ODU B / UNII 5.725 – 5.825 GHz Radio	None	NGP7020010

INPUT POWER

The ODU receives 48VDC at 1 amp from the IDU unit.

PRINTED WIRING BOARDS

The EUT contained the following printed wiring boards during emissions testing:

Manufacturer/Description	Assembly #	Rev.	Serial #	Crystals (MHz)
Wavespan / ODU Radio B	500055801	X4	-	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 31 cm wide by 40 cm deep by 5 cm high.

EMI SUPPRESSION DEVICES

The EUT contained the following EMI suppression devices during emissions testing:

Description	Manufacturer	Part Number
Feedthru Filter	Corry Micronics, Inc.	FTF3-15
RF Gasket	Vanguard Products, Corp.	12125-03-075-PSA
RF Gasket	Vanguard Products, Corp.	14125-05-050-ORA-NPS

SUPPORT EQUIPMENT

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

Manufacturer/Model/Description	Serial Number	FCC ID Number
Gabriel SSP6-52A Antenna Dish P/N 664336 Feed P/N 62676	-	-
Wavespan / Stratum 100 IDU / Indoor Unit	10004	None

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
Multimode fiber	3.0	Data I/O port	IDU
Shielded multicore	3.0	Power port	IDU

TEST SOFTWARE

The EUT was set to continuously transmit at the operating frequency.

PROPOSED MODIFICATION DETAILS

GENERAL

This section details the modifications to the WaveSpan Corporation model Stratum 100 being proposed. All performance and construction deviations from the characteristics originally reported to the FCC are addressed

The Wavespan Stratum100 units transmit in the 5.25-5.35 GHz and 5.725-5.825 GHz U-NII bands and are used exclusively for fixed, point-to-point operations. The peak transmit power in either band is less than 1mW. The radio "A" units, transmitting in the former of these bands, will use only the integrated Wavespan flat panel antenna as previously certified. The radio "B" units, transmitting in the latter of these bands, will use either the integrated antenna or any external parabolic dish antenna up to 8 feet in diameter (<= 40 dBi gain), resulting in no more than 40 dBm EIRP in any case. Previously, only the integrated flat panel antenna was employed. When the parabolic dish antenna is used, professional installation is required as stated in the revision to the user's manual.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on July 12 and August 3, 1999 at the Elliott Laboratories Open Area Test Site #1 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. 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 C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal standardized RF impedance, 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 16-1 is used for emissions measurements. The receivers used 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 CISPR 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

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, 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. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the 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 LISN used also contains a 250 uH 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 direct output power measurements from transmitters as they provide a broadband indication of the power output.

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 entire 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 exhibit 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 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these are 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.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

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, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
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:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = 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 = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

Test Equipment List - SVOATS#3

July 15, 1999

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐	Elliott Laboratories	300-1000 MHz Log Periodic	EL300.1000	55	12	9/26/98	9/26/99
☐	Elliott Laboratories	Biconical Antenna, 30-300 MHz	EL30.300	773	12	11/3/98	11/3/99
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	3/24/99	3/24/2000
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	786	12	1/15/99	1/15/2000
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	868	12	9/22/98	9/22/99
☐	Filtek	High Pass Filter	HP12/1000-5B	955	12	4/17/99	4/17/2000
☐	Filtek	High Pass Filter	HP12/1000-5B	956	12	4/17/99	4/17/2000
☐	Filtek	High Pass Filter	HP12/1000-5B	957	12	4/17/99	4/17/2000
☐	Fischer	LISN	FCC-LISN-50/2	810	12	2/2/99	2/2/2000
☐	Fluke Mfg Co	Signal Generator.	6062A	852	N/A		
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐	Hewlett Packard	EMC Recever /Analyzer	8595EM	787	12	11/23/98	11/23/99
☑	Hewlett Packard	Microwave Preamplifier,	8449B	263, (F303)	12	5/24/99	5/24/2000
☐	Hewlett Packard	Microwave Preamplifier,	8449B	785	12	11/25/98	11/25/99
☐	Hewlett Packard	Microwave Preamplifier,	8449B	870	12	11/12/98	11/12/99
☐	Hewlett Packard	Power Meter	432A	259, (F304)	12	2/17/99	2/17/2000
☑	Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	12	1/18/99	1/18/2000
☐	Hewlett Packard	Spectrum Analyzer, 9 KHz-6.5 GHz	8595E-041-103-	Metric, 885	12	5/11/99	5/11/2000
☐	Hewlett Packard	Thermistor Mount	478A	652	12	2/17/99	2/17/2000
☐	Narda West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/23/99	4/23/2000
☐	Narda West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/29/99	4/29/2000
☑	Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☐	Rohde& Schwarz	Pulse Limiter	ESH3 Z2	812	12	12/8/98	12/8/99
☐	Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	215, (F197)	12	2/17/99	2/17/2000
☐	Rohde & Schwarz	Test Receiver, 20-1300MHz	ESVP	273	12	8/6/98	8/6/99

File Number: T33069

Date: 8-3-99

Engr: DW Bowe

All calibration of equipment is traceable to a national standard of measurement such as NIST.

Test Equipment List - SVOATS#1

June 25, 1999

Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐ Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	12	6/10/99	6/10/2000
☐ EMCO	Biconical Antenna, 30-300 MHz	3110B	363	12	4/19/99	4/19/2000
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	3/24/99	3/24/2000
☑ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	786	12	1/15/99	1/15/2000
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	868	12	9/22/98	9/22/99
☐ Emco	Log Periodic Antenna	3146A	A169	12	2/20/99	2/20/2000
☐ Filtek	High Pass Filter	HP12/1000-5B	955	12	4/17/99	4/17/2000
☐ Filtek	High Pass Filter	HP12/1000-5B	956	12	4/17/99	4/17/2000
☐ Filtek	High Pass Filter	HP12/1000-5B	957	12	4/17/99	4/17/2000
☐ Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐ Hewlett Packard	EMC Recever /Analyzer	8595EM	787	12	11/23/98	11/23/99
☑ Hewlett Packard	Microwave Preamplifier,	8449B	263, (F303)	12	5/24/99	5/24/2000
☐ Hewlett Packard	Microwave Preamplifier,	8449B	785	12	11/25/98	11/25/99
☐ Hewlett Packard	Microwave Preamplifier,	8449B	870	12	11/12/98	11/12/99
☐ Hewlett Packard	Power Meter	432A	259, (F304)	12	2/17/99	2/17/2000
☑ Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	12	1/18/99	1/18/2000
☐ Hewlett Packard	Spectrum Analyzer, 9 KHz-6.5 GHz	8595E-041-103-	Metric, 885	12	5/11/99	5/11/2000
☐ Hewlett Packard	Thermistor Mount	478A	652	12	2/17/99	2/17/2000
☐ Inmet Corporation	20 dB Pad, DC-18 GHz, 50Ω	18N-20	859	12	8/27/98	8/27/99
☐ Narda West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/23/99	4/23/2000
☐ Narda West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/29/99	4/29/2000
☑ Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☐ Rohde& Schwarz	Pulse Limiter	ESH3 Z2	811	12	12/8/98	12/8/99
☐ Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	274	12	5/27/99	5/27/2000
☐ Rohde &Schwarz	Test Receiver, 20-1300MHz	ESVP	213, (F196)	12	5/27/99	5/27/2000
☐ Solar Electronics	Support Equipment LISN,	8012-50-R-24-B	305, (F111)	N/A	3/26/99	3/26/2000
☑ RHODE & SCHWARTZ	POWER METER	857.8008.002	S/N DE30591	12	5-4-99	5-4-00
☑ RHODE & SCHWARTZ	POWER SENSOR	NRV-Z51	S/N 829955/002	12	4-27-99	4-27-00
☑ EMCO	HORN 18-40GHz	3116	S/N 9407-2234		6-5-98	6-5-01
☑ HP	SPECTRUM ANALYZER	8665E	S.E. LABS 855-0001		3-2-99	3-2-00

File Number: T32708

Date: 7-12-99

Engr: CHRIS

All calibration of equipment is traceable to a national standard of measurement such as NIST.

EXHIBIT 2:Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T33772 9 Pages
T33069 5 Pages

Elliott

EMC Test Log

Client:	Wavespan Corporation	Date:	7/12/99	Test Engr:	Chris Byleckie
Product:	Stratum 100 ODU B	File:	T33772	Proj. Eng:	Mark Briggs
Objective:	Class II Permissive Change	Site:	SVOATS # 1	Contact:	Roger Eline
Spec:	FCC Part 15.400 Class B	Page:	1 of 3	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	32 °C
Humidity:	42 %

Test Objective

The objective of this test session is to perform final qualification testing for a Class II Permissive Change for the EUT defined below relative to FCC Part 15E regulations for the U-NII bands defined above. The antenna that will be used with the B version of the device is being changed to a parabolic dish type with increased gain from the version that was previously certified. This change was done to increase the receive sensitivity of the system. This testing was originally performed under T32708.

Test Summary

Run # 1 - Radiated Emissions, 1000 - 40000 MHz. Stratum 100 ODU B

PASS Results: 15.407(b)(3)&(6) -6.1 dB Ave @ 10650.000 MHz Vertical

Run #2 - Out of band spurious emissions (direct measurements). Stratum 100 ODU B. Refer to attached plots.

PASS* Results: 15.407(b)(3) There were no emissions exceeding the specification outside the 5.725 to 5.825 GHz band

Equipment Under Test (EUT) General Description

The EUT is the Outdoor unit (ODU) for a UNII radio system. The ODU would normally mounted on a mast or wall-mounted. For convenience the EUT was placed on the tabletop during emissions testing to simulate the end user environment.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 ODU B / UNII 5.725 – 5.825 GHz Radio	None	NGP7020010

Power Supply and Line Filters

The ODU receives 48VDC, 1 Amp from the IDU unit.

Printed Wiring Boards in EUT (ODU B)

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Wavespan / ODU Radio A	500055701	X4	-	120.0
Wavespan / ODU Radio B	500055801	X4	-	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

Subassemblies in EUT

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

EUT Enclosure(s)

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 31 cm wide by 40 cm deep by 5 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Feedthru Filter	Corry Micronics, Inc.	FTF3-15
RF Gasket	Vanguard Products, Corp.	12125-03-075-PSA
RF Gasket	Vanguard Products, Corp.	14125-05-050-ORA-NPS

Modifications

No modifications were made to the EUT in order to comply with the requirements.

Client:	Wavespan Corporation	Date:	7/12/99	Test Engr:	Chris Byleckie
Product:	Stratum 100 ODU B	File:	T33772	Proj. Eng:	Mark Briggs
Objective:	Class II Permissive Change	Site:	SVOATS # 1	Contact:	Roger Eline
Spec:	FCC Part 15.400 Class B	Page:	3 of 3	Approved:	
Revision	1.0				

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
Gabriel SSP6-52A Antenna (6 foot) Dish P/N 664336 Feed P/N 62676	-	-
Wavespan / Stratum 100 IDU / Indoor Unit	10004	None

Remote Support Equipment

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

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Multimode fiber	3.0	Data I/O port	IDU
Shielded multicore	3.0	Power port	IDU

Test Software

The EUT was set to continuously transmit at the operating frequency. Testing was performed using a 6 foot dish antenna as representative of 2, 4, 6, and 8 foot dish antennas that may be used.

General Test Conditions

During radiated testing, the EUT was connected to the 120v / 60 Hz power input. The EUT was located on the turntable for radiated testing and conducted testing. Any remote support equipment was located approximately 30 meters from the EUT with all I/O connections running on top of the groundplane.

Test Data Tables

See attached data

Emissions Test Data

Client:	Wavespan Corporation	Date:	07/12/1999	Test Engr:	Chris Byleckie
Product:	Stratum 100 ODU	File:	T33772	Proj. Engr:	Mark Briggs
Objective	Class II Permissive Change	Site:	SVOATS #1	Contact:	Roger Eline
Spec:	FCC 15.E	Distance:	3 m	Approved:	

Ambient Conditions
Temperature: 32 °C
Humidity: 42 % RH

except in 15.205 bands, peak limit is 68.2 dBuV/m
based on -27dBm/MHz EIRP

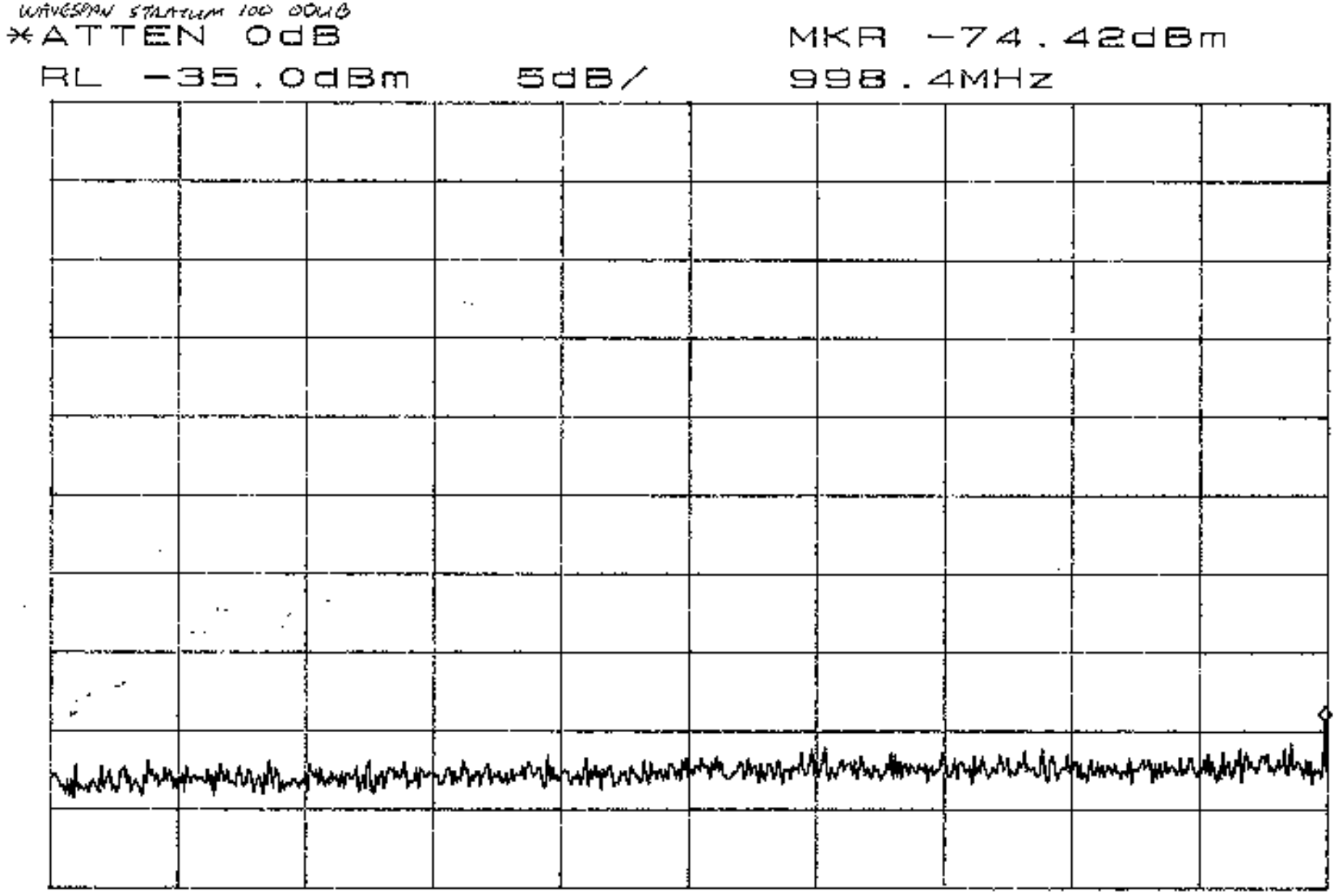
Run #1: Radiated emissions, 1 - 40 GHz
Stratum 100 ODU B

Frequency	Level	Pol	FCC	FCC	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
10650.00	47.9	v	54.0	-6.1	Avg	0	1.0	
10650.00	47.9	h	54.0	-6.1	Avg	0	1.3	
17346.00	61.8	v	68.2	-6.4	Pk	0	1.0	
1800.00	61.4	v	68.2	-6.8	Pk	0	1.0	
17346.00	60.0	h	68.2	-8.2	Pk	0	1.3	
1800.00	58.6	h	68.2	-9.6	Pk	0	1.3	
11564.00	44.2	v	54.0	-9.8	Avg	0	1.0	
11564.00	43.2	h	54.0	-10.8	Avg	0	1.3	
6244.00	55.7	h	68.2	-12.5	Pk	0	1.3	
6280.00	54.9	h	68.2	-13.3	Pk	0	1.3	
6280.00	53.8	v	68.2	-14.4	Pk	0	1.0	
10650.00	59.5	h	74.0	-14.5	Pk	0	1.3	
10650.00	59.1	v	74.0	-14.9	Pk	0	1.0	
11564.00	56.3	v	74.0	-17.7	Pk	0	1.0	
6244.00	49.2	v	68.2	-19.0	Pk	0	1.0	
11564.00	54.8	h	74.0	-19.2	Pk	0	1.3	

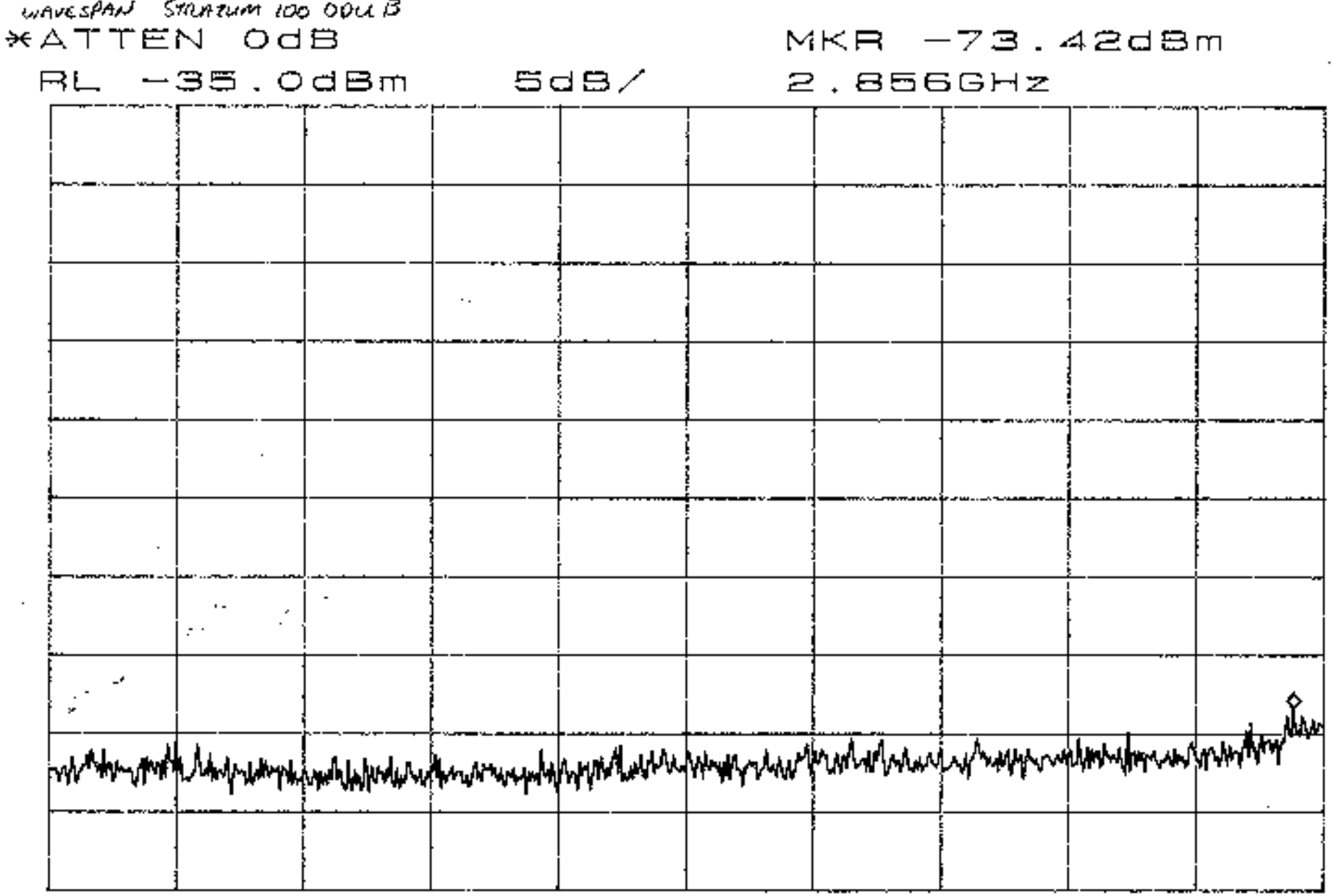
Run #2 Out-Of Band Spurious Emissions Stratum 100 ODU B
The following plots were taken for out of band emissions
Antenna Gain is 28 dBi for 2' dish, 34 dBi for 4' dish, 38 dBi for 6' dish, and 40 dBi for the 8' dish
Below 31 GHz, limit is -27-40 or -67 dbM/MHz
Cable loss above 31 GHz for the cable to be used with the dish antennas is more than 10 dB,
so the limit here is -27-40+10 or -57 dBm
Frequency Range of Plot

30 MHz - 1GHz	maximum OOB is -74.4 dBm/MHz
1GHz - 2.9 GHz	maximum OOB is -73.4 dBm/MHz
2.9GHz - 6.5 GHz	maximum OOB is -69.0 dBm/MHz
26.5 - 31 GHz	maximum OOB is -57.7 dBm/MHz
31 - 40 GHz	maximum OOB is -66.0 dBm/MHz

7-12-99
WAVESPAN STRATEGY 100 001.0



7-12-99
WAVESPAN STRATUM 100 ODU B



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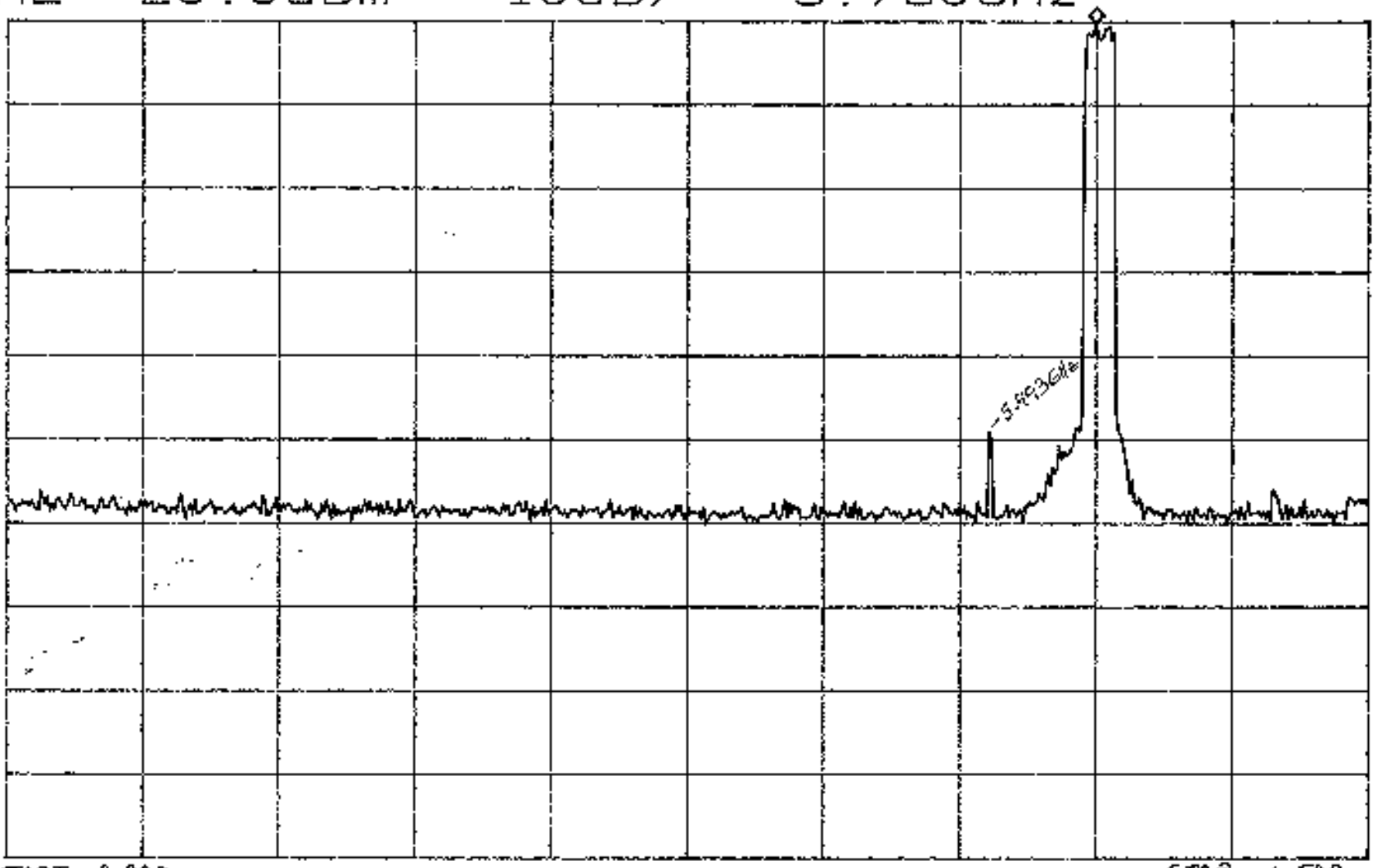
WAVESPAN STRATUM 100 ORNB

*ATTEN 0dB

MKR -20.33dBm

RL -20.0dBm 10dB/ 5.780GHz

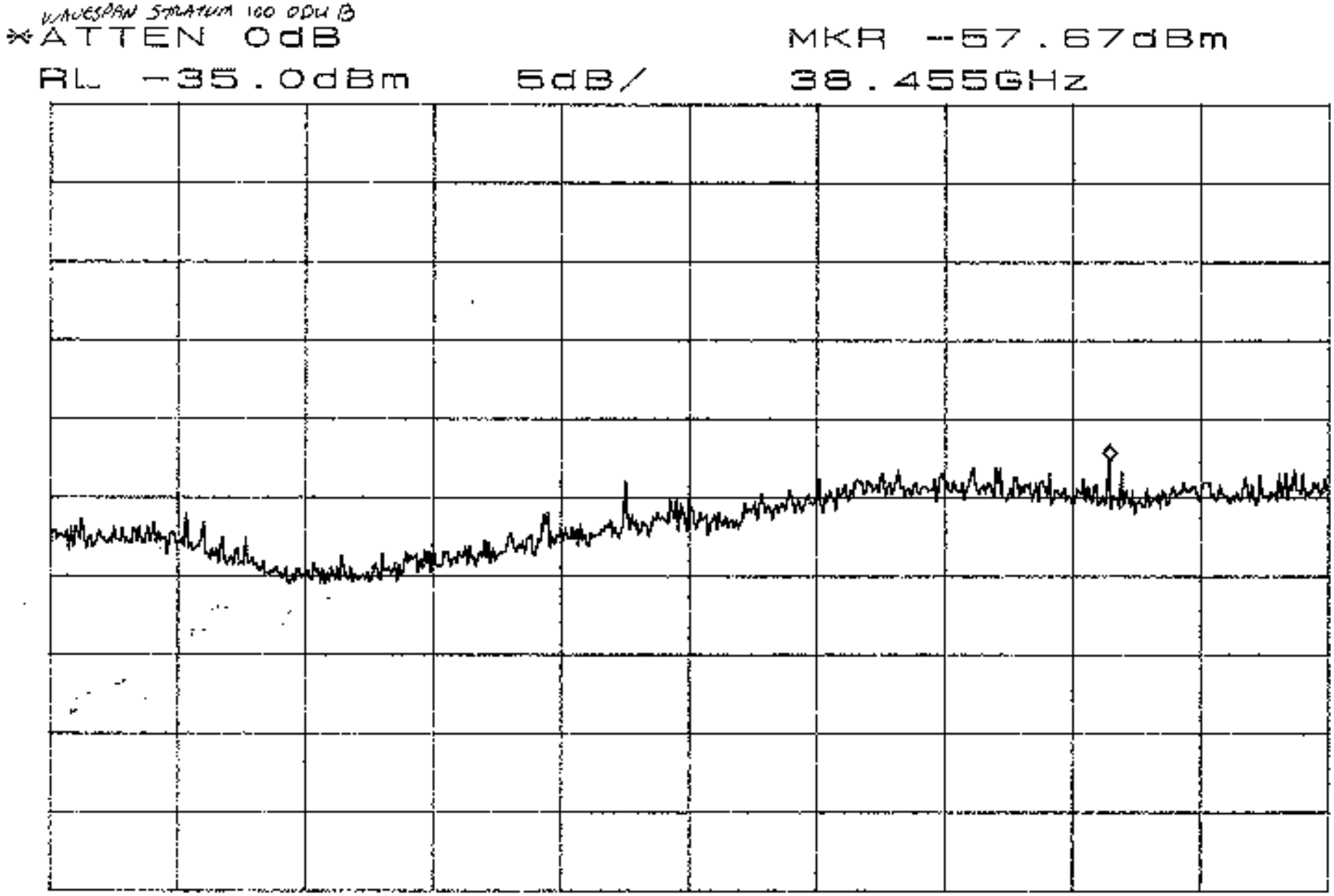


START 2.900 STOP 6.500

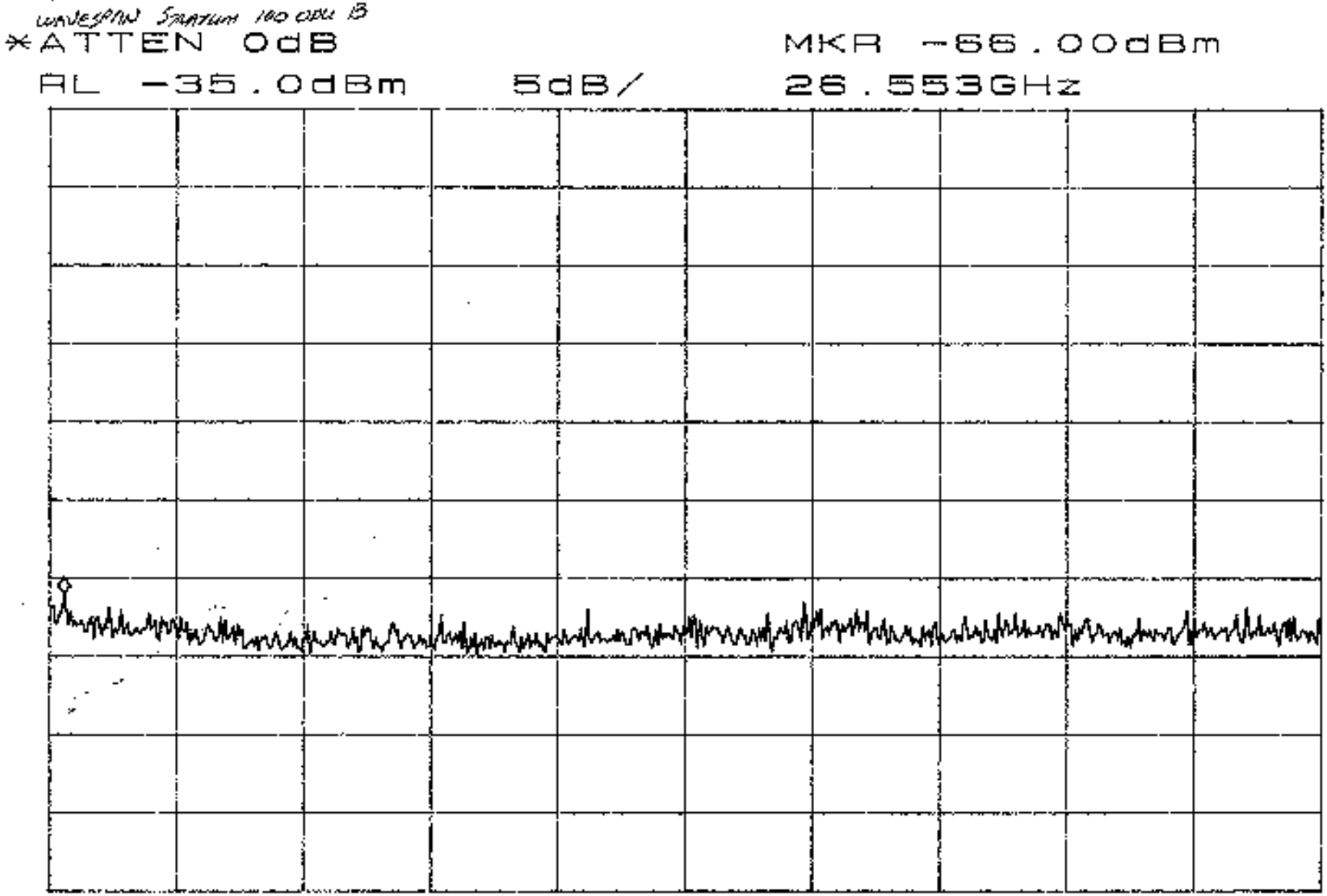
CENTER 4.700GHz SPAN 3.600GHz

*RBW 1.0MHz *VBW 1.0MHz *SWP 200ms

7-12-99
WAVESPAN STRATUM 100 ODU B



7-12-99
WAVESPAN SPECTRUM 100 ODU B



Elliott

EMC Test Log

Client:	Wavespan Corporation	Date:	8-3-99	Test Engr:	David Bare
Product:	Stratum 100 ODU B	File:	T33069	Proj. Eng:	Mark Briggs
Objective:	Final Qualification.	Site:	Chamber #2	Contact:	Mike Gustafson
Spec:	FCC 15.407	Page:	1 of 3	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	23 °C
Humidity:	48 % RH

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above.

Test Summary

Run #1 - Out of band spurious emissions (direct measurements). The antenna to be used has a maximum gain of 46 dBi, therefore the EIRP limit is –73 dBm/MHz. Refer to data plots attached.

PASS Results: 15.407(b)(3) -1.7 dB Peak @ 12.54 GHz Direct

Equipment Under Test (EUT) General Description

The EUT is the Outdoor unit (ODU) for a UNII radio system. It operates in the high band (5.725 to 5.825 GHz.) The ODU would normally mounted on the mast or wall-mounted. The EUT was, therefore, placed on the table top during emissions testing to simulate the end user environment.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 ODU B / UNII Radio	None	NGP7020010

Power Supply and Line Filters

The ODU receives 48VDC, 1 Amp from the IDU unit.

Client:	Wavespan Corporation	Date:	8-3-99	Test Engr:	David Bare
Product:	Stratum 100 ODU B	File:	T33069	Proj. Eng:	Mark Briggs
Objective:	Final Qualification.	Site:	Chamber #2	Contact:	Mike Gustafson
Spec:	FCC 15.407	Page:	2 of 3	Approved:	
Revision	1.0				

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Wavespan / ODU Radio B	500055801	X4	4002B	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

Subassemblies in EUT

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

EUT Enclosure(s)

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 31 cm wide by 40 cm deep by 5 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Feedthru Filter	Corry Micronics, Inc.	FTF3-15
RF Gasket	Vanguard Products, Corp.	12125-03-075-PSA
RF Gasket	Vanguard Products, Corp.	14125-05-050-ORA-NPS

Modifications

The following modifications were made to the EUT in order to comply with the requirements:

Metal shield covering the LED and the AIMING BNC. Shielded the DC connections to the ODU panel. Feed through filters attached.

Local Support Equipment

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

Remote Support Equipment

Client:	Wavespan Corporation	Date:	8-3-99	Test Engr:	David Bare
Product:	Stratum 100 ODU B	File:	T33069	Proj. Eng:	Mark Briggs
Objective:	Final Qualification.	Site:	Chamber #2	Contact:	Mike Gustafson
Spec:	FCC 15.407	Page:	3 of 3	Approved:	
Revision	1.0				

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 IDU / Indoor Unit	10004	None

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Duplex fiber	10	Data I/O port	IDU
Shielded multicore	3	Power port	IDU

Test Software

The EUT contained test software running during testing which continuously exercised the EUT by sending data out the antenna port.

General Test Conditions

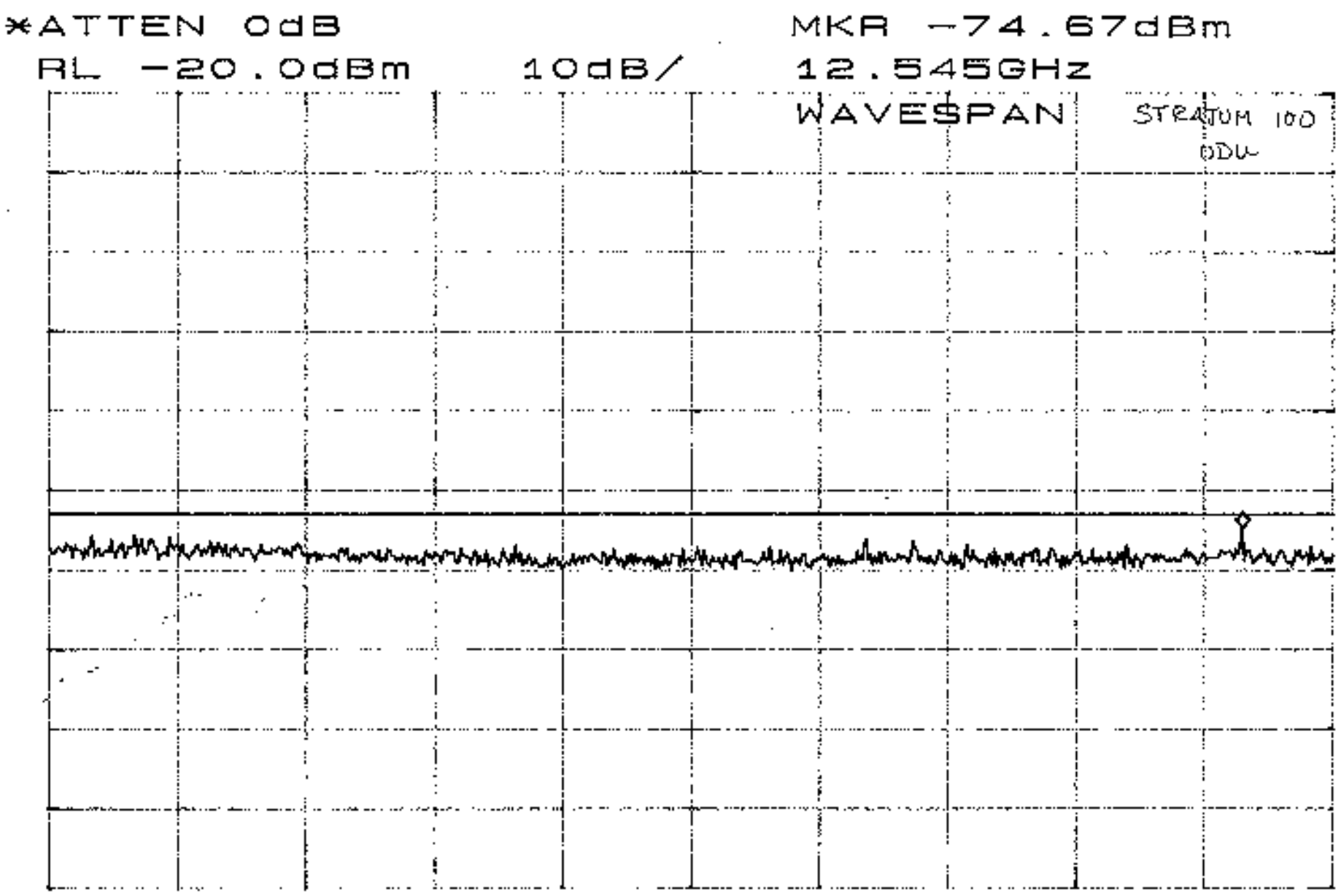
During testing, the EUT was connected to the IDU which in turn was connected to the mains. The antenna output of the EUT was connected directly to the spectrum analyzer in the 6.5 to 13 GHz band and through a filter and preamplifier in the 13 to 26.5 GHz band.

Test Data

See attached data plots

T3806 9/001

8-3-99



T33069/002 8-3-99

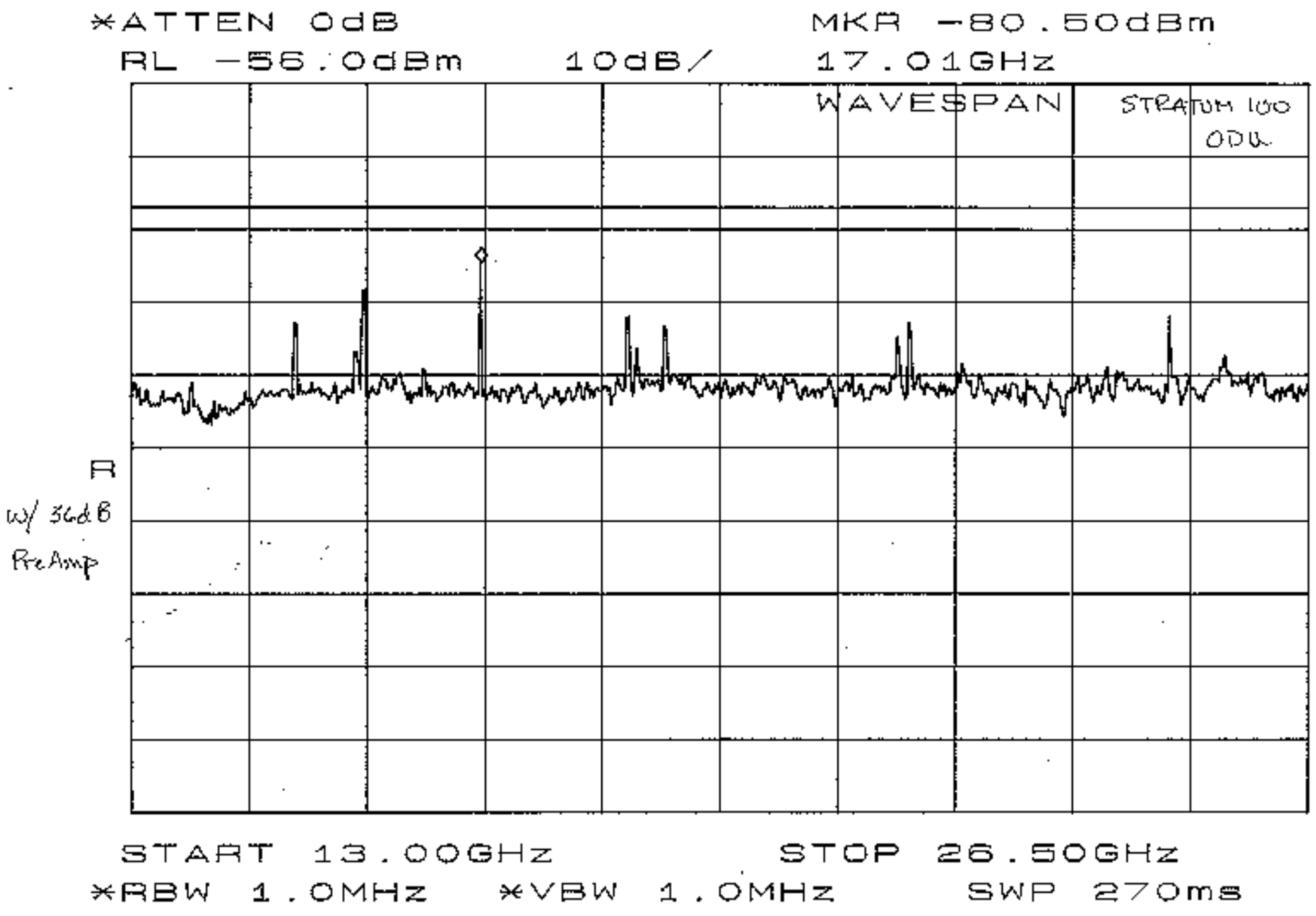


EXHIBIT 3: Radiated Emissions Test Configuration Photographs

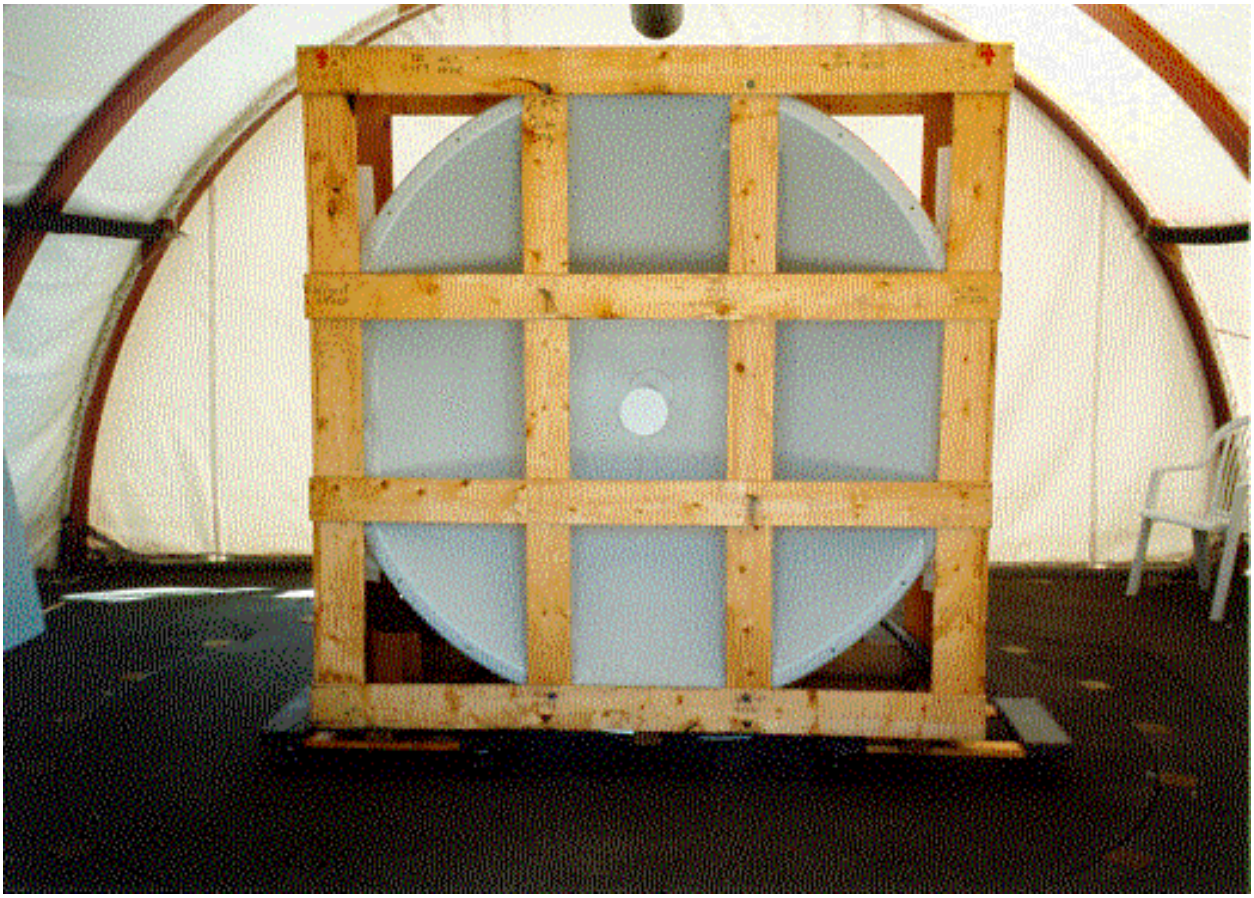


EXHIBIT 3: Radiated Emissions Test Configuration Photographs

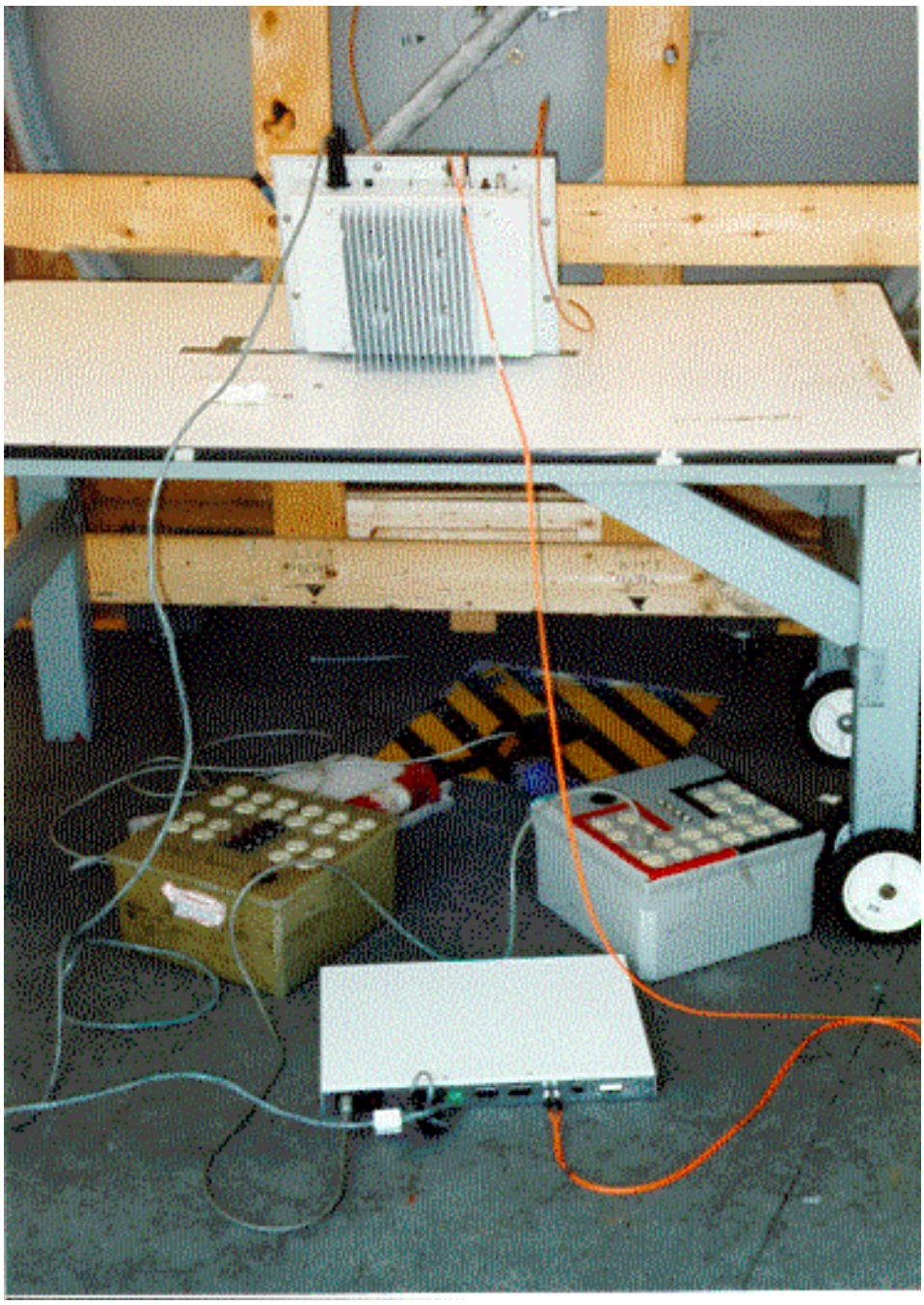


EXHIBIT 4: Operator's Manual Revisions for Wavespan Model Stratum 100

The following wording is being added to the user's manual:

"This unit is intended for point-to-point operation over an unobstructed line-of-sight path. To comply with FCC rules UNII band devices:

1. The equipment must be installed in accordance with CFR 47 Section 15.407 (a) (3) which states: "The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations."

2. The installer must ensure that the unit is properly installed in compliance with the FCC's guidelines for maximum permissable radio frequency exposure outline in CFR 47 Section 1.1307(b)(1), preventing excess exposure to all persons. The installed radiating device should be inaccessible to unauthorized personnel. The installed unit should be positioned to guarantee no direct continuous exposure to people within 5 feet of the antenna. During installation, the installer should use caution to avoid excess exposure to directed antenna radiation within 3 feet of the front of the antenna."

3. The unit is normally provided with an integral flat panel antenna for both the "A" end (5.3 GHz transmitter) and the "B" end (5.775 GHz transmitter) of the point-to-point link. For extended range applications, the unit at the "B" end may be provided with a connection for an external parabolic antenna, instead of an integral flat panel antenna. When deployed with an external antenna, the unit must be professionally installed to comply with CFR 47 Section 15.203. Only antennas with gain less than 40 dBi are authorized for use with the "B" unit. The antenna gain improvement at the "B" end of the link aids both directions of the link.