ELVA 1

FCC Certification Test Report

for

Elva

Gigabit Ethernet MM-wave Link

ELVA 1 PPC-1000 –E

FCC ID: T3S-PPC-1000-E

June 12, 2006

FCC Certification Test Report
for the
Elva Corporation
ELVA 1 PPC-1000-E
Gigabit Ethernet MM-wave Link
FCC ID: T3S-PPC-1000-E

Prepared by: Sergey Petrov, ELVA Ltd

Reviewed by: Michael Violette, Washington Laboratories

Abstract

This report has been prepared to support the attached Application for Equipment Authorization. The test report and application are submitted for a Licensed Non-Broadcast Station Transmitter under Part 101 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for an ELVA ELVA 1 PPC-1000-E.

The ELVA 1 PPC-1000-E is a point-to-point radio system operating under Part 101 of the FCC Rules.

Conducted emissions, power and emissions mask measurements were performed at Elva company offices at 2 Voroshilova, OHTA Business Centre, St Petersburg, Russia 193318.

Supplemental testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The ELVA ELVA 1 PPC-1000-E complies with the limits for a licensed transmitter under Part 101 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Elva 1 ELVA 1 PPC-1000-E Transmitter complies with the limits of Part 101 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4 and EIA/TIA 603. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Test Dates

Testing of case radiated spurious emissions was performed from February 28 to March 1 2006.

1.4 Test and Support Personnel

Washington Laboratories, LTD (Radiated Spurious Emissions)	James Ritter
Client Representative (Antenna Port Conducted Tests)	Sergey Petrov

1.5 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
Cm	Centimeter
CW	Continuous Wave
dB	Decibel
Dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
Rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The Elva Wireless Bridge PPC-1000 is intended for full duplex 1 Gigabit communication between two remote points. It is composed of two subscriber transceivers which are operated within line-of-sight conditions at working frequencies within mm-wave range.

Two different central frequencies are used for the duplex operation. One Radio (High) transmits data at a frequency of upper part of the frequency range and the second one (Low) uses a frequency from the lower part. The label on the radio indicates whether it is a Highband (HI index in the end of serial #) or Low-band (LO index in the end of serial #).

Thus, PPC-1000 provides 1.25Gbps capacity in each direction.

This report documents the measurements collected for the HUB unit.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Elva 1
FCC ID Number	T3S-PPC-1000-E
EUT Name:	Gigabit Ethernet MM-wave Link
Model:	ELVA 1 PPC-1000-E
FCC Rule Parts:	101
Frequency Range:	E-band
Modulation:	DQPSK
Necessary Bandwidth:	1000MHz + 1000MHz and channel separation 10 GHz
Keying:	Automatic
Type of Information:	Gigabit Ethernet full duplex
Number of Channels:	One per band
Power Output Level	10 dBm
Antenna Type	Cassegrain type
Frequency Tolerance:	N/A
Emission Type(s):	Digital
Interface Cables:	1000Base-SX(for multimode fiber)
Power Source & Voltage:	From 36 to 60 Volt DC
Emissions Designator	1400M3X1D

Table 2 provides a list of the channel frequencies, synthesizer frequencies and IF frequencies.

Table 2. Channel Specifications

Channel No.	TX Center Freq (MHz)	RX Center Freq (MHz)	TX IF Center freq (MHz)	RX IF Center Freq (MHz)
1	73000	83800	3000	3000
2	83800	73000	3000	3000

2.2 Test Configuration

The equipment was configured with the required cables, power supply, and coupling waveguides to measure the RF energy from the device.

Both center frequencies were measured.

Figure 1. EUT Testing Configuration

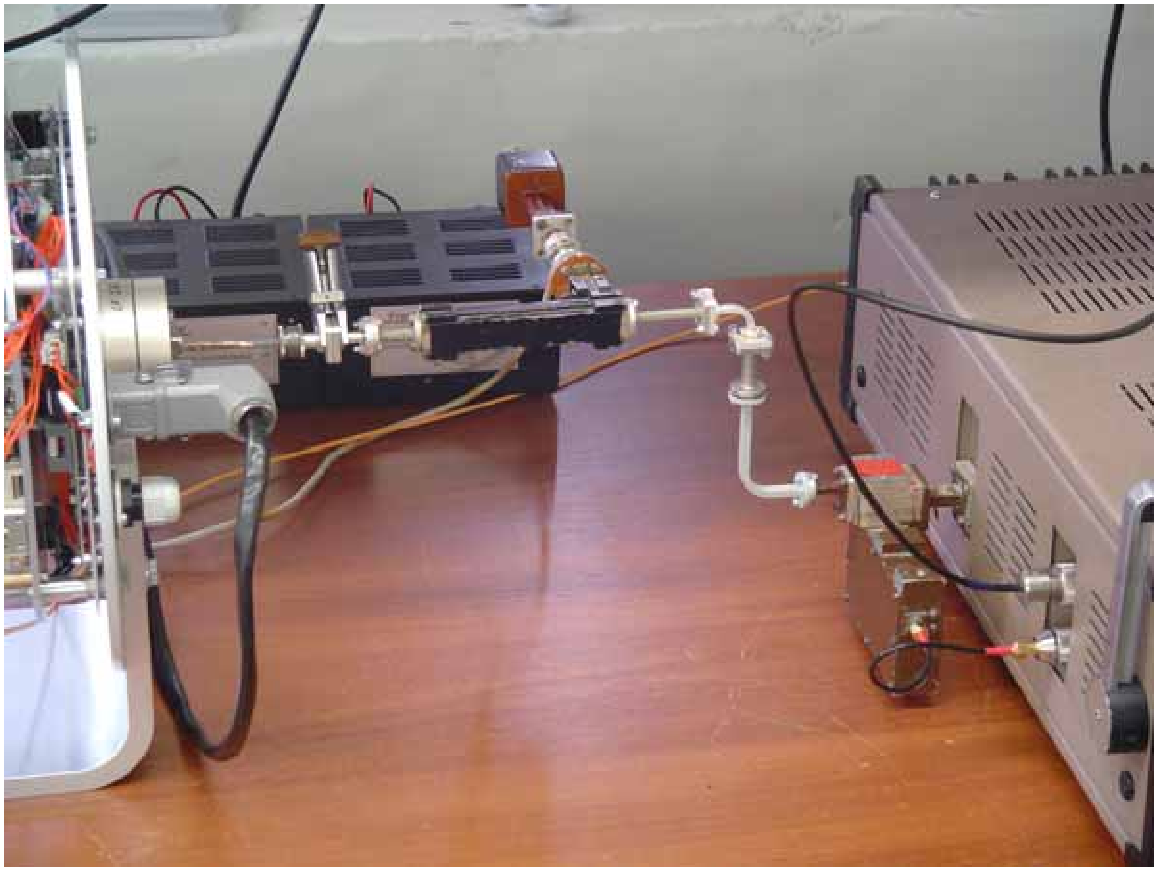


Figure 2. EUT Testing Configuration

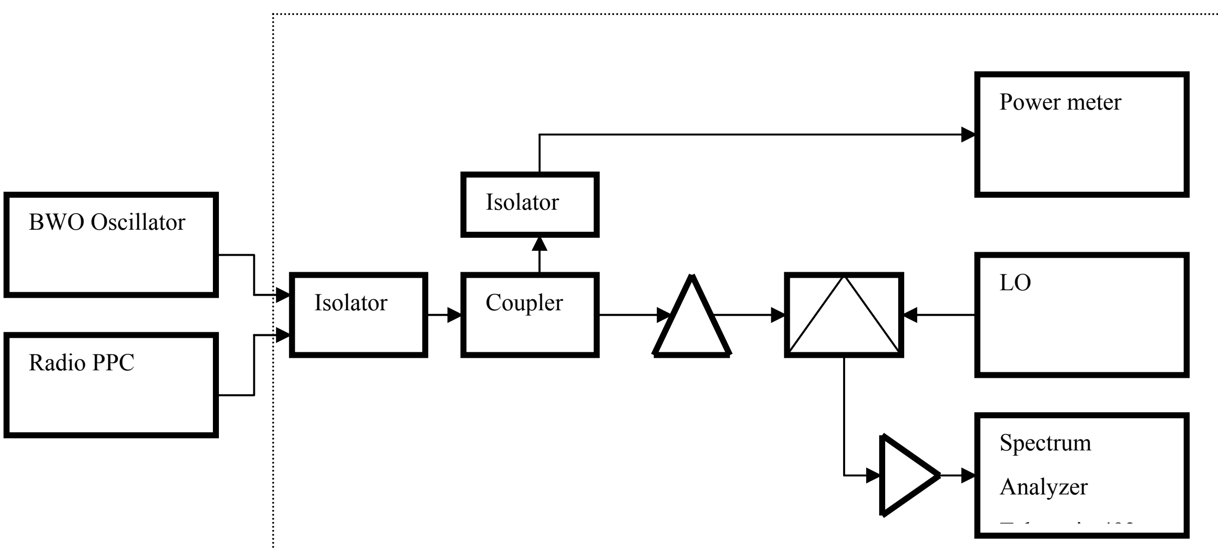


Figure 3. EUT Testing Configuration

3 Measurement Summary

3.1 Testing Algorithm

Worst-case emission levels are provided in the test results data.

3.2 Test Location

Conducted measurements were taken by Elva personnel at the Elva facility in St. Petersburg, Russia.

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

3.3 Measurements

3.3.1 References

- ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation
- ANSI C63.4 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
- WT Docket No. 02-146; FCC 05-45 Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands

4 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information and Table 4 shows the support equipment. All power measurements were made relative to the Rimeda R2M-66 power meter.

Table 3. Test Equipment List

Equipment	Serial/Asset Number	Calibration Due
ELVA Equipment		
Tektronix 494P Spectrum Analyzer	8011081	N/A
Power Meter Rimeda	R2M-66	7/29/2006
Agilent 54845A Oscilloscope	US40380153	N/A
USSR G4-186 Local Oscillator; 53-76 GHz	N/A	N/A
USSR GR4-14 Local Oscillator; 78-118 GHz	N/A	N/A
USSR CH5-30 Local Oscillator; 37-200 GHz	N/A	N/A
Washington Laboratories Equipment		
HP 8564 E Spectrum Analyzer (Radiated and conducted emissions)	67	7/16/2006
Narda 638 Standard Gain Horn Antenna 18-26.5 GHz	210	CNR
Narda 637 Standard Gain Horn Antenna 26.5-40 GHz	209	CNR
HP11970V Harmonic Mixer	54	6/9/2010
HP 11970W Harmonic Mixer	55	6/1/2010
Oleson Microwave Labs., M06HW	103	9/17/2008
Oleson Microwave Labs., M05HW	104	9/17/2008
MilliTek, SGH-19-RP000 Standard Gain Horn	32	CNR
Millitech, H05R and SGH-05-RP000 Standard Gain Horn	16	CNR
MilliTech, H06R and SGH-06-RP000 Standard Gain Horn	21	CNR
MilliTech, SGH-10-RP000 Standard Gain Horn	117	CNR
MilliTek, SGH-15-RP000 Standard Gain Horn	85	CNR

Table 4. Support Equipment List

Description	Manufacturer	Model And/or P/N	S/N
Media converter	Planet	GT-702	AA40015300215(000)
Power supply AC/DC	Mean Well	ESP-240-54	CA57159324
Desktop computer	Marwell; WinXP;	P4_2000	N/A

4.1 Calibration of Measurement Path

To determine correction factors used to account for losses in the measurement system, measurements were made of the Directional Couplers, Attenuators and cables. These calibration factors were subsequently used to offset the raw data to a corrected form.

The Tektronix spectrum analyzer uses an external harmonic mixer, driven by the LO to create a 4GHz wide frequency display. The mixer is adjusted over the frequency range of 4 GHz to 200 GHz. This results in (200-4)/4 = 49 plots of the out-of-band emissions over the range. The technology available does not allow for computerized collection of the data, so photographs of the display were taken and a correction curve, using the data collected about the frequency response of the system (described below) were drawn on the chart at the -13dBm level. Figure **4** shows the setup used to derive the calibration factors to be applied to the power measurements, mask and the out-of-band emissions requirements.

The measurements were done in ELVA-1 lab, St. Petersburg Russia.

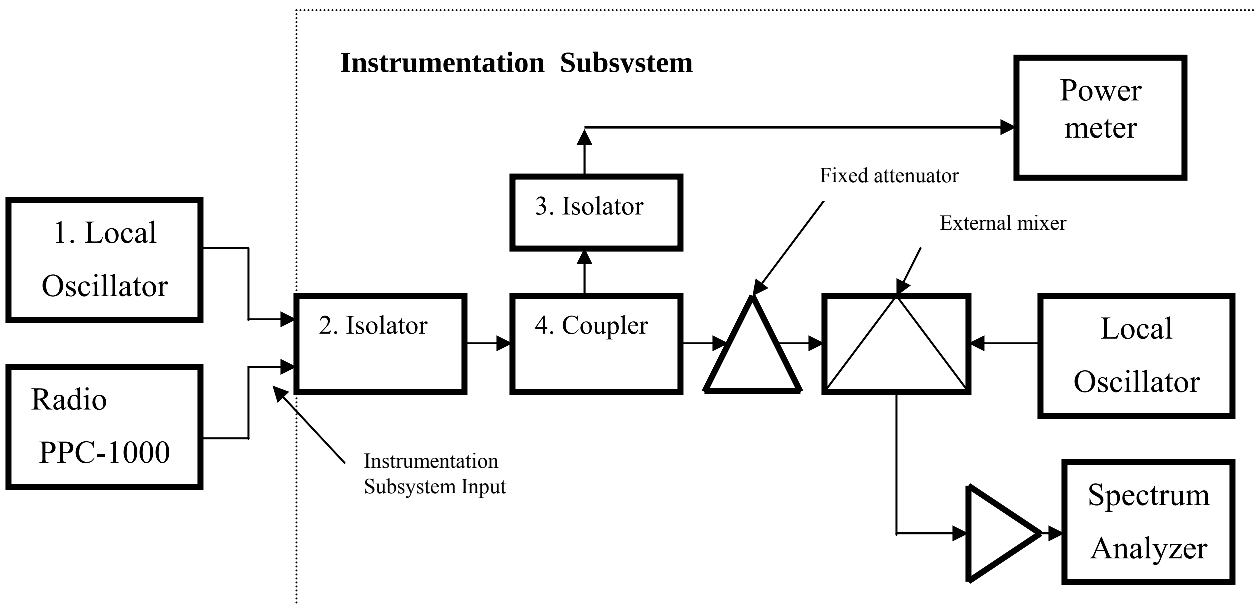


Figure 4. Instrumentation Subsystem Block Diagram

4.1.1 Procedure

To determine power and spurious emissions levels, it is necessary to calibrate the waveguide, isolator and coupler. This method provides a correspondence between the input power level and the carrier level at the Spectrum Analyzer input in absolute values.

The calibration procedure establishes a reference between a calibrated power meter and the indication on the spectrum analyzer. By tuning a local oscillator ("1" in the above figure) across the frequency range, in 100 MHz steps, it was possible to determine the losses in the measurement system. These losses are applied to the spectrum analyzer display to convert the -13dBm power limit to a display line on the analyzer screen.

Specifically, the local oscillator was connected to the Instrumentation Subsystem input at the Isolator (to the Isolator "2"). The Local Oscillator output power was set to a level to measure the 100 uW (-10dBm) at power meter input. Then the oscillator was re-tuned with a 100 MHz sweep step.

A 100 uW (-10dBm) at Power Meter input ensured 1.0 mW or 0.0 dBm at the Instrumentation Subsystem input (on the Isolator). After re-tuning with an each 100 MHz Local Oscillator sweep step, the carrier level was measured at the Spectrum Analyzer. Thus the Instrumentation Subsystem was calibrated at 0.0 dBm level.

Then the PPC-1000 transceiver was connected to the Instrumentation Subsystem input instead of the Local Oscillator. Because the Instrumentation Subsystem was already calibrated at 0.0 dBm level, the -13 dBm level was calculated and drawn by a red curve on the photos of the spectrum analyzer display.

4.2 Calibration of Power Meter

The power meter used to perform the measurements is traceable to the Russian Federal Standards Laboratory. A copy of the certificate is shown below.

ГОССТАНДАРТ РОССИИ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ УЧРЕЖДЕНИЕ
«НИЖЕГОРОДСКИЙ ЦЕНТР СТАНДАРТИЗАЦИИ,
МЕТРОЛОГИИ И СЕРТИФИКАЦИИ»

СВИДЕТЕЛЬСТВО О ПОВЕРКЕ

№ 541 / 2400

Действительно до
«29» июля 2006 г.

Эталон (средство измерений) Ваттметр поглощаемой мощности
наименование, тип (если в состав средства измерений
М3-75/1
входят несколько автономных блоков, то приводят их перечень)

Серия и номер клейма (знака) предыдущей поверки (если такие серия и номер имеются)

Заводской номер (номера) 00198789, ПП-13 № 042, ПП-14 № 014
принадлежащее ФГУП ННИПИ „Кварц"
наименование юридического (физического) лица
ИНН 5261003453
Поверено в соответствии с ГОСТ 8.569-2000
наименование и номер документа на методику поверки
с применением эталонов: ПП-09 № 02486, ПП-10 № 000788
наименование, заводской номер, разряд
δКх ±2,5%, Гэфф < 0,03
класс точности или погрешность
При следующих значениях влияющих факторов: t = 21°C, относит. влажность 65%
приводят перечень влияющих факторов,

нормированных в документе на методику поверки с указанием их значений

и на основании результатов первичной (периодической) поверки признано
пригодным к применению.

004225795

Поверительное клеймо

Начальник отдела (лаборатории) _________ НВ Кузякин
(подпись) *(инициалы, фамилия)*

Поверитель _________ И.М. Трушаненко
(подпись) *(инициалы, фамилия)*

«29» июля 2005 г.

Figure 5. Certificate of Calibration. Russian Federal Standard Laboratory

5 Test Results

5.1 RF Power Output: (FCC Part §2.1046); §101.113 Transmitter power limitations

The output power of a transmitter on any authorized frequency in this service may not exceed the following:

Table 5. Maximum Allowable Power

Frequency (MHz)	Fixed Allowable EIRP dBW (dBm)	Mobile Allowable EIRP dBW (dBm)
71,000-76,000	+55 (85)	+55 (85)
81,000-86,000	+55 (85)	+55 (85)
92,000-95,000	+55 (85)	+55 (85)

Reported power is as follows:

Table 6. Maximum Measured Power

Frequency (MHz)	Measured Power dBW (dBm)	Max Gain (dB)*	EIRP dBW (dBm)
71,000-76,000	-20 (+10)	50	30 (60)
81,000-86,000	-21 (+9)	50	29 (59)

- See Table 14 through Table 16 in this report for antenna gain data.

Table 7. RF Channel Power Output

Channel	Channel Power (dBm/MHz)
ELVA 1 PPC-1000-E (LO)	-10
ELVA 1 PPC-1000-E (HI)	-12

Table 8. DC Power Consumption, Final Stage

Frequency Range	DC Voltage V	DC Current mA
71,000-76,000	18	130
81,000-86,000	16	130

5.2 Occupied Bandwidth to §101.109 (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the directional coupler to the input of a spectrum analyzer.

Table 9 provides a summary of the Occupied Bandwidth Results. Maximum authorized bandwidth is 5000 MHz.

Table 9. Occupied Bandwidth Results

Channel	QPSK Bandwidth MHz Level -13 dBm	QPSK Bandwidth MHz Level – 20 dBc
ELVA 1 PPC-1000-E (LO) @ 73 GHz	280	1360
ELVA 1 PPC-1000-E (HI) @83.8 GHz	250	1300

At full modulation, the occupied bandwidth was measured as shown Figure 6 and Figure 7.

The occupied bandwidth is the frequency range covered by the -20dBC points on the spectrum.

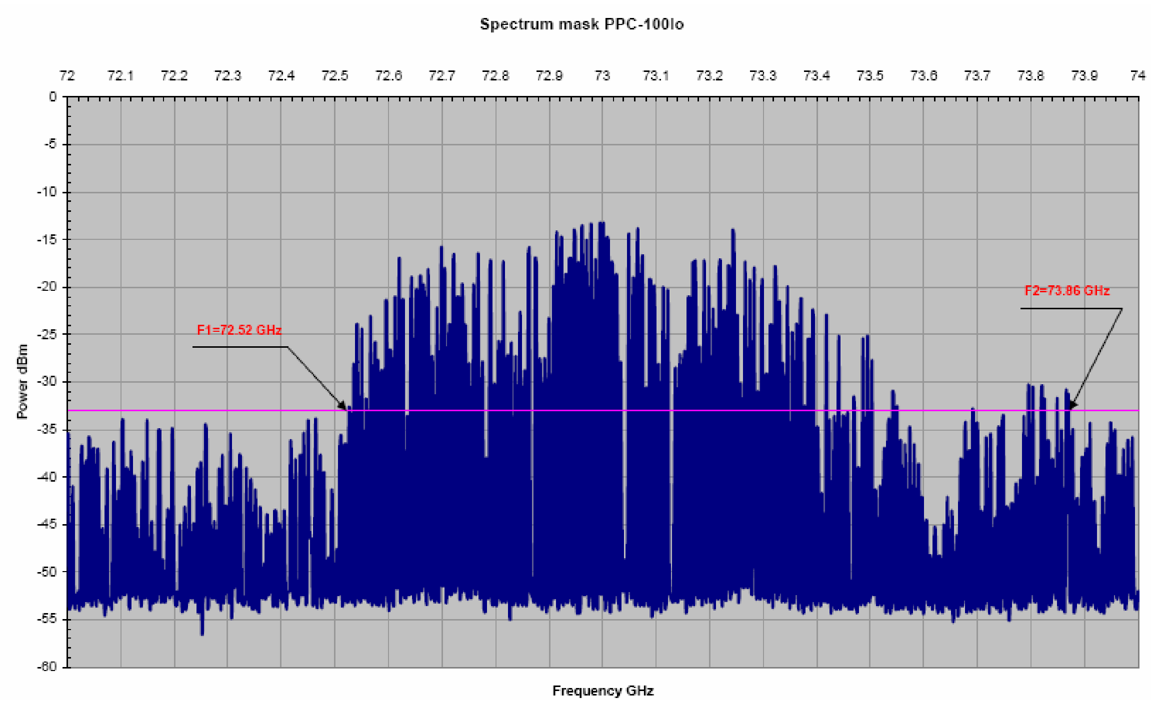


Figure 6. Spectrum Mask. 73 MHz

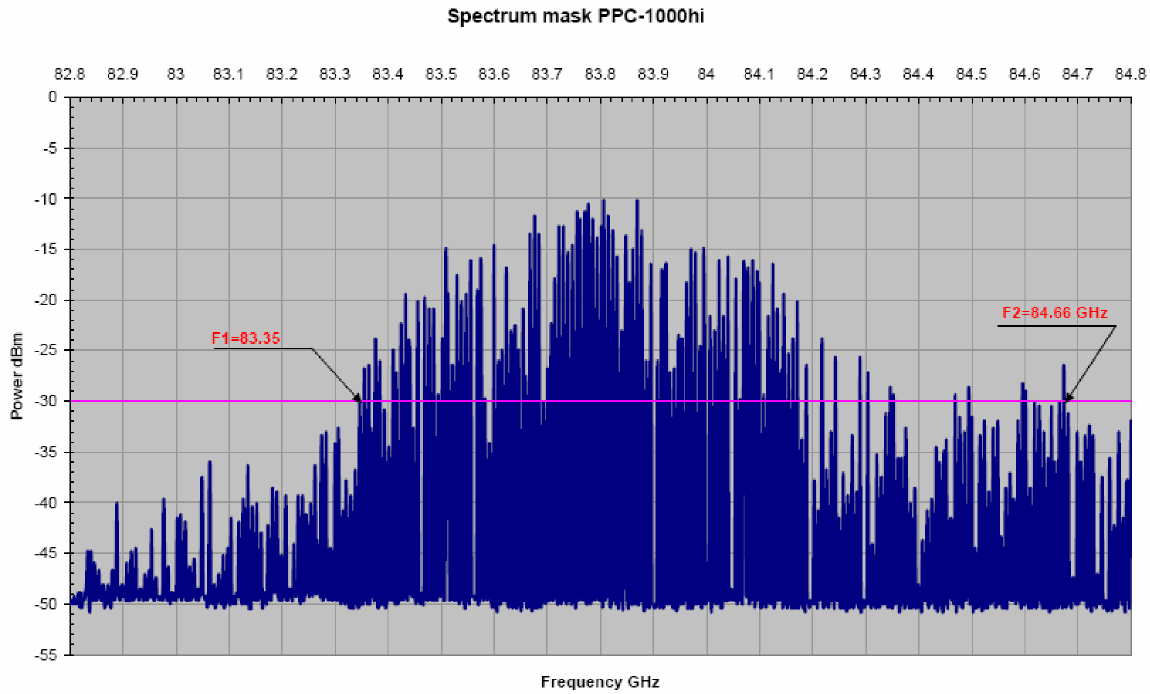


Figure 7. Spectrum Mask. 83.8 MHz

5.3 Emissions and emission limitations to §101.111

Emissions limitations are specified in §101.111. The output of the transmitter was connected to the input of the spectrum analyzer and the transmitter modulated. Conducted emissions from 30 MHz to 40 GHz were measured. Radiated emissions were measured from 1 GHz to 200 GHz.

Below is a plot of spurious emissions at the second harmonic of transmitter.

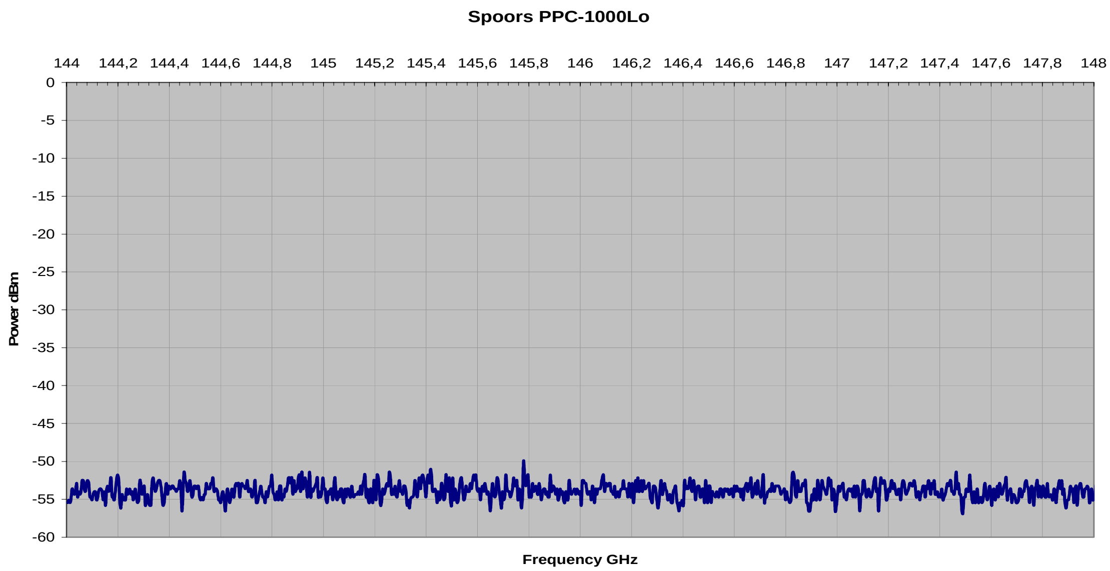


Figure 8. Spurious Emissions @ 2 X 73 GHz

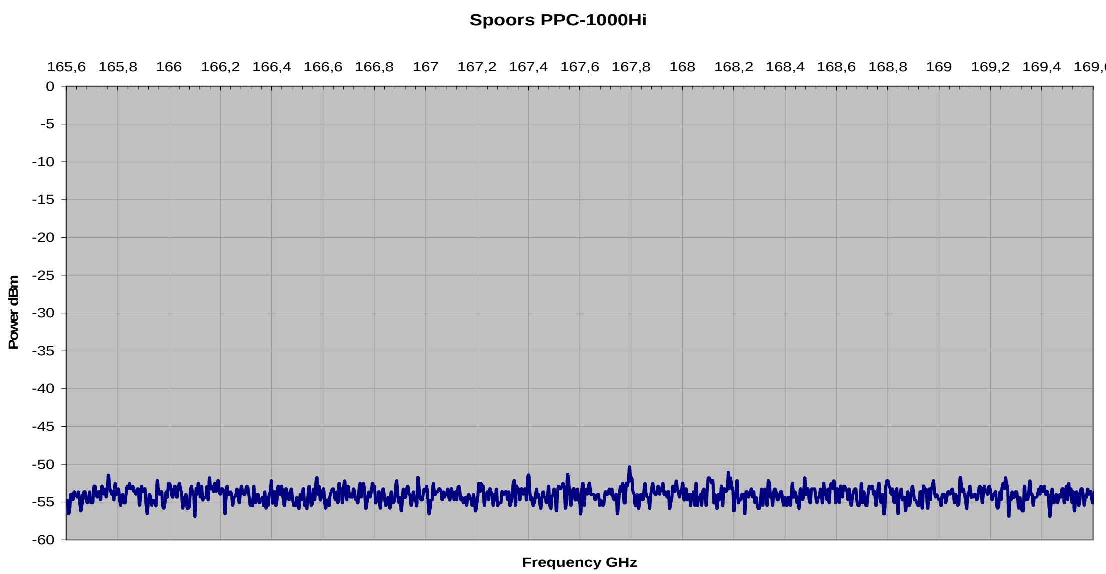


Figure 9. Spurious Emissions @ 2 X 83.8 GHz

All conducted emissions measurements, with the exception of the fundamental, were greater than 10 dB below the limit. Spurious emissions measurements were made up to 200 GHz. The conducted spurious emissions were measured using an external down-converter connected to a Tektronix 494P spectrum analyzer. The down-converter, operating with a local oscillator sweeping a 4 GHz frequency range, provides measurements of 4GHz increments of spectrum from 40 GHz to 200GHz. The large range of frequencies (up to 200 GHz) in 4 GHz increments necessitated the collection of 50 plots.

A sample plot is shown in the following figure. The figure is a photograph of the spectrum analyzer display over the frequency range of 88 to 92 GHz. The red line is the adjusted limit of -13dBm, which accounts for the correction factors and attenuation in the measurement setup. Hence, instead of adjusting the amplitude of the measured values, the limit has been adjusted.

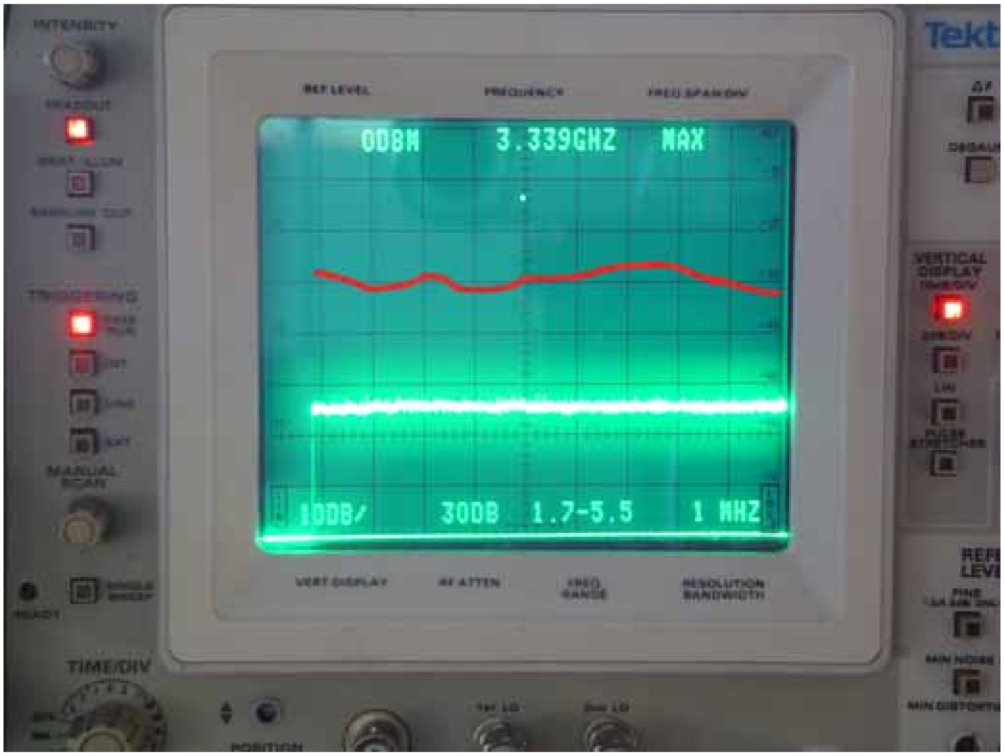


Figure 10. Spurious Emissions: 88-92GHz.

5.4 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions.

5.4.1 Test Procedure

Below 1 GHz, the EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Above 1 GHz, measurements were collected inside a shielded anechoic room. The EUT was placed on a turntable and, at a 1 meter distance, emissions data collected over the frequency range of 1GHz to 220GHz.

The resolution bandwidth was set to 1 MHz and the radio scanned over the frequency range. The emissions were low and no spurious emissions were detected; the measurement antenna was moved to a 0m distance and only ambient/system noise floor measurements were recorded.

The following table provides radiated spurious emissions data above 1 GHz. The data were collected at a distance of 1meter; the theoretical field strength at an EIRP limit of minus 13dBm is adjusted for one meter distance.

The salient feature of the data is that the emissions are many orders of magnitude below the theoretical EIRP spurious emissions limit.

Table 10. Radiated Emissions 1- 40 GHz

Date: 1 March 2006 By: James Ritter

Freq (GHz)	POL	E-Field dBuV/m	1 m Limit dBuV/m	Margin	Distance in cm
1.2533	H	25.8	97.7	71.9	100
1.627	H	18.8	97.7	78.9	100
1.767	H	22.3	97.7	75.4	100
1.882	H	23.7	97.7	74	100
2.061	H	40.1	97.7	57.6	100
2.338	H	20.5	97.7	77.2	100
2.42	H	25.3	97.7	72.4	100
2.504	H	22.8	97.7	74.9	100
2.562	H	22.6	97.7	75.1	100
3.028	H	25.5	97.7	72.2	100
3.185	H	35.1	97.7	62.6	100
3.914	H	26	97.7	71.7	100
5.878	H	20.3	97.7	77.4	100
6.05	H	29.6	97.7	68.1	100
1.0643	V	19.5	97.7	78.2	100
1.2021	V	18.3	97.7	79.4	100
1.2533	V	22.4	97.7	75.3	100
1.4239	V	17.7	97.7	80	100
2.5401	V	18.3	97.7	79.4	100
2.5606	V	19.9	97.7	77.8	100
3.028	V	20.9	97.7	76.8	100
3.185	V	26.9	97.7	70.8	100
3.573	V	23.8	97.7	73.9	100
3.701	V	24.6	97.7	73.1	100
4.243	V	22.8	97.7	74.9	100
4.724	V	26.6	97.7	71.1	100
6.05	V	26.7	97.7	71	100

Table 11. Radiated Emissions; Transmit Frequency 73 GHz

Freq (GHz)	POL	SA Level dBuV	Conv Loss	AF	E-Field dBuV/m	Limit dBuV/m	Margin	Distance in cm
72.67	V	78.67	35.7	43.77	119.64	NA	NA	10
145.34	V	54.5 **(NF)**	35	50.84	96.84	117	20.16	0
218.01	V	69.3 **(NF)**	35	53.31	114.11	117	2.89	0
72.67	H	77.6	35.7	43.77	118.57	NA	NA	10
145.34	H	54 **(NF)**	35	50.84	96.34	117	20.66	0
218.01	H	69 **(NF)**	35	53.3	113.8	117	3.2	0

NF: Noise Floor

Table 12. Radiated Emissions; Transmit Frequency 83.8 GHz

Freq (GHz)	POL	SA Level dBuV	Conv Loss	AF	E-Field dBuV/m	Limit dBuV/m	Margin	Distance in cm
83.627	V	85.17	38.6	45.54	127.81	NA	NA	10
167.254	V	56.17 **(NF)**	35	51.01	112.18	117	4.82	0
83.627	H	82.1	38.6	45.54	127.74	NA	NA	10
167.254	H	56 **(NF)**	35	51.01	112.01	117	4.99	0

NF: Noise Floor

5.5 Emission Designator

The emission designator is determined from the necessary bandwidth, the type of modulation and the information conveyed in the signal.

For the subject unit, the following Emission Designator has been determined according to Section 2.201 of the FCC Rules.

- First Symbol, type of modulation of the main carrier: X
- Second Symbol, nature of signal(s) modulating the main carrier:
- Third Symbol, type of information to be transmitted: D

The necessary bandwidth, Bn, is taken to be the occupied bandwidth of the signal: 1360 MHz.

Hence, the emission designator is: **1400M3X1D**

5.6 §101.107 Frequency Tolerance: (FCC Part §2.1055)

Devices operating in these frequency bands are exempt from the requirements. However data are provided herein.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter.

The EUT is powered by an external AC power supply.

Table 13. Frequency Deviation

CLIENT:	ELVA
MODEL NO:	PPC – 1000 – E
JOB #:	9069
Limit:	None

Temperature Deviation

HUB Unit

Temperature Degrees C	Frequency MHz	Difference Hz	Deviation (%)
-30	73000.2	200000	0.0002740
-20	73000.33	70000	0.0000958900
-10	73000.35	50000	0.0000684900
0	73000.38	20000	0.0000274
10	73000.39	10000	0.0000137
20	73000.4	0	0.0000000
30	73000.46	60000	0.0000821900
40	73000.62	220000	0.0003014
50	73000.7	300000	0.0004110

Voltage Deviation

Voltage Volts	Frequency MHz	Difference Hz	Deviation (%)	Voltage Volts
At rated	73000.4	0	0	54
At 85%	73000.4	0	0	45.9
At 115%	73000.4	0	0	62.1

5.7 §101.101 Frequency availability

These requirements are left to the licensee.

5.8 §101.103 Frequency coordination procedures

These requirements are left to the licensee.

5.9 §101.105 Interference protection criteria

These requirements are left to the licensee.

5.10 §101.115 Directional antennas

(a) Unless otherwise authorized upon specific request by the applicant, each station authorized under the rules of this part must employ a directional antenna adjusted with the center of the major lobe of radiation in the horizontal plane directed toward the receiving station with which it communicates.

The following parameters describe the antenna, which is in compliance with §101.115.

Table 14. Parameters of 300 mm antenna with compare FCC standard

Frequency (MHz)		Maximum beam-width to 3 dB points 1 (included angle in degrees)	Minimum antenna gain (dbi)	Minimum radiation suppression to angle in degrees from center-line of main beam in decibels						
				5° to10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000 (copolar) 15.	FCC standard	1.2	43	35	40	45	50	50	55	55
	Measured	1.2	44	35	41	45.5	52	51	60	60
71,000 to 76,000 (crosspolar) 15.	FCC standard	1.2	43	45	50	50	55	55	55	55
	Measured	1.2	12	50	55	58	60	60	60	60
81,000 to 86,000 (copolar) 15.	FCC standard	1.2	43	35	40	45	50	50	55	55
	Measured	1.2	44	35	41	45.5	52	51	60	60
81,000 to 86,000 (crosspolar) 15.	FCC standard	1.2	43	45	50	50	55	55	55	55
	Measured	1.2	12	50	55	58	60	60	60	60

Table 15. Parameters of 450 mm antenna with compare FCC standard

Frequency (MHz)		Maximum beam-width to 3 dB points 1 (in-cluded angle in de-grees)	Min-imum an-tenna gain (dbi)	Minimum radiation suppression to angle in degrees from center-line of main beam in decibels						
				5° to10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000 (copolar) 15.	FCC standard	1.2	43	35	40	45	50	50	55	55
	Measured	1.2	47.5	35.5	41	45	52	53	59	60
71,000 to 76,000 (crosspolar) 15.	FCC standard	1.2	43	45	50	50	55	55	55	55
	Measured	1.2	15.5	50	61	63	64	70	70	70
81,000 to 86,000 (copolar) 15.	FCC standard	1.2	43	35	40	45	50	50	55	55
	Measured	1.2	47.5	35.5	41	45	52	53	59	60
81,000 to 86,000 (crosspolar) 15.	FCC standard	1.2	43	45	50	50	55	55	55	55
	Measured	1.2	15.5	50	61	63	64	70	70	70

Table 16. Parameters of 600 mm antenna with compare FCC standard

Frequency (MHz)		Maximum beam-width to 3 dB points 1 (in-cluded angle in de-grees)	Min-imum an-tenna gain (dbi)	Minimum radiation suppression to angle in degrees from center-line of main beam in decibels						
				5° to10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000 (copolar) 15.	FCC standard	1.2	43	35	40	45	50	50	55	55
	Measured	1.2	50	35.5	42.5	46	50	51	58	58
71,000 to 76,000 (crosspolar) 15.	FCC standard	1.2	43	45	50	50	55	55	55	55
	Measured	1.2	18	55	60	67	64	65	70	70
81,000 to 86,000 (copolar) 15.	FCC standard	1.2	43	35	40	45	50	50	55	55
	Measured	1.2	50	35.5	42.5	46	50	51	58	58
81,000 to 86,000 (crosspolar) 15.	FCC standard	1.2	43	45	50	50	55	55	55	55
	Measured	1.2	18	55	60	67	64	65	70	70

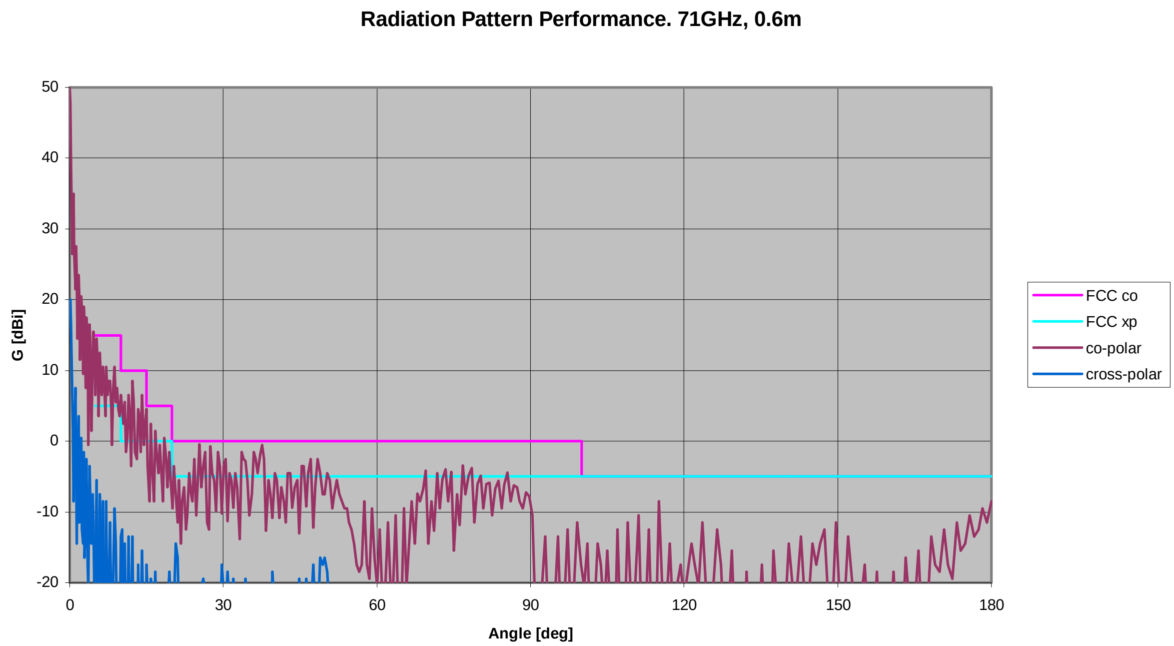


Figure 11. Antenna Measurements

5.11 §101.117 Antenna polarization

The type used are linearly-polarized.

5.12 §101.139 Authorization of Transmitters

For equipment employing digital modulation techniques, the minimum bit rate requirement is 0.125 bit per second per Hz. The data rate is 1250 Mbps over 1360 MHz bandwidth, which corresponds to a bit rate per second of of 0.92 bits per second per Hz.

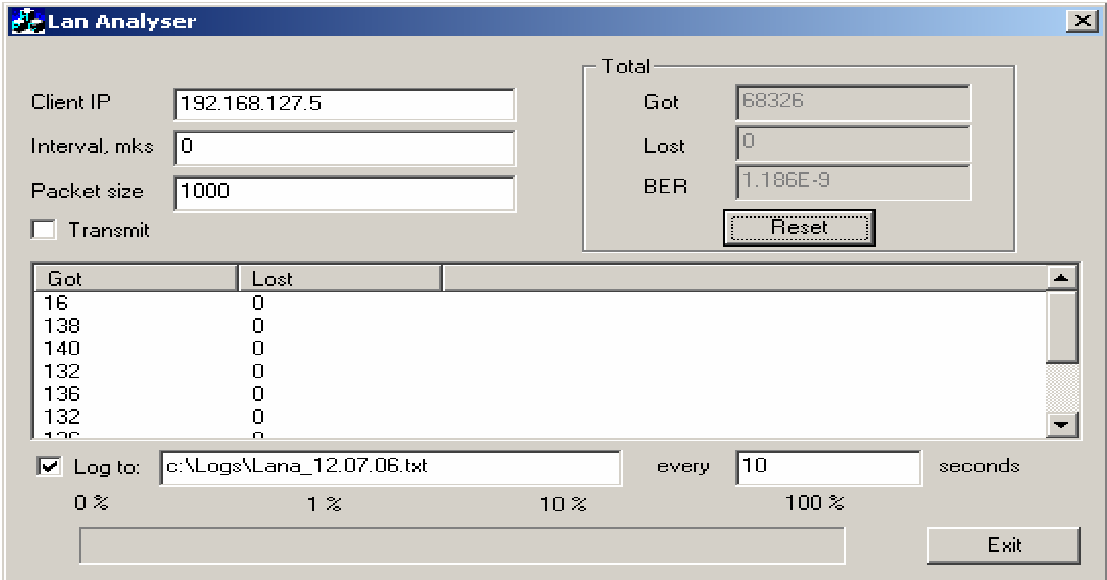
5.13 §2.1033(c)(9) Tune Up Procedure

During equipment tune up, the following equipment is used: Power Meter, Spectrum Analyzer with external mixer and mm-wave source. Output power and spectrum width are measured for each radio.

For additional information we compare theoretical sensitivity of receiver and measured sensitivity at BER 10^-9. If the spectrum or output power are not correct, then BER will be affected.

The radio is connected over a waveguide path and Gigabit Ethernet traffic is sent from PC to another one over the radio link. We increase attenuation and check Voltage of AGC output of the radio and BER on PC.

The following is a typical display from BER tester.


Lan Analyser
Client IP
192.168.127.5
Interval, mks
0
Packet size
1000
Transmit
Total
Got
68326
Lost
0
BER
1.186E-9
Reset
Got
Lost
16 0
138 0
140 0
132 0
136 0
132 0
Log to:
c:\Logs\Lana_12.07.06.txt
every
10
seconds
0 %
1 %
10 %
100 %
Exit