




## TEST REPORT FROM RFI GLOBAL SERVICES LTD

Orthogon Systems Ltd.  
5.8 GHz Spectra Unit

Partial Testing To: FCC Part 15.247: 2004 (Subpart C)

**Test Report Serial No:**  
RFI/MPTE1/RP48183JD01A

<b>This Test Report Is Issued Under The Authority Of Andrew Brown, Operations Manager:</b>	
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<b>Tested By: Raul Recio</b> 	<b>Checked By: Steven Wong</b> 
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Registered in England and Wales. Company number: 2117901

**Test of:** Orthogon Systems Ltd.  
**To:** 5.8 GHz Spectra Unit  
FCC Part 15.247: 2004 (Subpart C)

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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**Table of Contents**

1. Client Information .....4

2. Equipment Under Test (EUT) .....5

3. Test Results.....8

4. Deviations from the Test Specification .....9

5. Operation of the EUT during Testing .....10

6. Summary of Test Results .....11

7. Measurements, Examinations and Derived Results .....12

8. Measurement Uncertainty .....18

9. Measurement Methods .....19

Appendix 1. Test Equipment Used .....22

Appendix 2. Test Configuration Drawings.....23

---

Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

---

## **1. Client Information**

<b>Company Name:</b>	Orthogon Systems Ltd
<b>Address:</b>	Unit 1A Linhay Business Park Eastern Road Ashburton Devon TQ13 7UP
<b>Contact Name:</b>	Mr C Fisher

Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **2. Equipment Under Test (EUT)**

The following information (with the exception of the Date of Receipt) has been supplied by the client:

### **2.1. Identification of Equipment Under Test (EUT)**

Brand Name:	Orthogon
Model Name or Number:	Spectra ODU
Unique Type Identification:	Not Applicable
Serial Number:	E23020800EDF
Hardware Version:	1SS4 Digital PCB
Software Version:	Not Applicable
FCC ID Number:	Not Applicable
Country of Manufacture:	UK
Date of Receipt:	31 March 2006

Brand Name:	Spectra Indoor Unit
Model Name or Number:	PIDU Plus 2521
Unique Type Identification:	Not Applicable
Serial Number:	0538197066
Hardware Version:	Rev.01
Software Version:	Not Applicable
FCC ID Number:	Not Applicable
Country of Manufacture:	China
Date of Receipt:	31 March 2006

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **2.2. Description of EUT**

The equipment under test is a microwave fixed link system.

## **2.3. Modifications Incorporated in EUT**

The grounding inside the EUT was increased between the circuit board and the EUT's.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

## **2.4. Additional Information Related to Testing**

Power Supply Requirement:	Nominal 155 V 60 Hz AC Mains supply		
Intended Operating Environment:	Residential, Commercial and Light Industry		
Equipment Category:	Fixed Link		
Type of Unit:	Base Station (Fixed Use)		
Transmit Frequency Range:	5742 MHz to 5832 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1	5742
	Middle	5	5792
	Top	10	5832
Receive Frequency Range:	5742 MHz to 5832 MHz		
Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1	5742
	Middle	5	5792
	Top	10	5832

## **2.5. Port Identification**

Port	Description	Type/Length	Applicable
1	LAN (Spectral Power IDU and port only)	Ethernet 6 m	Y
2	PIDU + 2521	Power over Ethernet 2m	Y

## **2.6. Support Equipment**

No support equipment was used to exercise the EUT during testing.

Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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### **3. Test Results**

Reference:	FCC Part 15.247: 2004 Subpart C
Title:	Code of Federal Regulations, Part 15.247 (47CFR22) (Intentional Radiators operating within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz)

#### **3.1. Methods and Procedures**

The methods and procedures used were as detailed in:

ANSI/TIA-603-B-2003

Land Mobile Communications Equipment, Measurements and performance Standards

ANSI C63.2 (1987)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2003)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1: (1999)

Title: Specification For Radio Disturbance and Immunity Measuring Apparatus and Methods. Part 1: Radio Disturbance and Immunity Measuring Apparatus.

#### **3.2. Definition of Measurement Equipment**

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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#### **4. Deviations from the Test Specification**

Partial testing to confirm a class and permissive change.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **5. Operation of the EUT during Testing**

### **5.1. Operating Modes**

The EUT was tested in the following operating modes, unless otherwise stated.

During testing, the EUT was set to transmit in master mode (transmits across the entire operating frequency band searching slave units).

### **5.2. Configuration and Peripherals**

The EUT was tested in the following configuration:

The EUT was powered by a PIDU through an Ethernet cable. A laptop was used to configure the EUT but then removed during the test.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **6. Summary of Test Results**

Range of Measurements	Specification Reference	Port Type	Compliance Status
Transmitter AC Conducted Emissions (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: 2004 Section 15.207	AC Mains	Complied
Transmitter Radiated Emissions	C.F.R. 47 FCC Part 15: 2004 Sections 15.247(d) & 15.209(a)	Antenna	Complied (Note 1)

### **Note(s):**

1. Testing was only performed up to 1 GHz only as requested by the customer.

### **6.1. Location of Tests**

All the measurements described in this report were performed at the premises of  
RFI Global Services Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

---

## **7. Measurements, Examinations and Derived Results**

### **7.1. General Comments**

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 8 for details of measurement uncertainties.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **7.2. Test Results**

### **7.2.1. Transmitter AC Conducted Spurious Emissions: Section 15.207**

The EUT was configured for ac conducted emission measurements as described in section 9 of this report.

Tests were performed to identify the maximum emission levels present on the ac mains line of the EUT.

#### **Results: Top Channel**

##### **Quasi-Peak Detector Measurements on Live and Neutral Lines**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.17905	Live	49.08	64.53	15.45	Complied
0.23588	Live	51.19	62.24	11.05	Complied
0.35416	Live	40.89	58.86	17.97	Complied
11.1283	Live	31.52	60.00	28.48	Complied
29.39345	Neutral	39.39	60.00	20.61	Complied

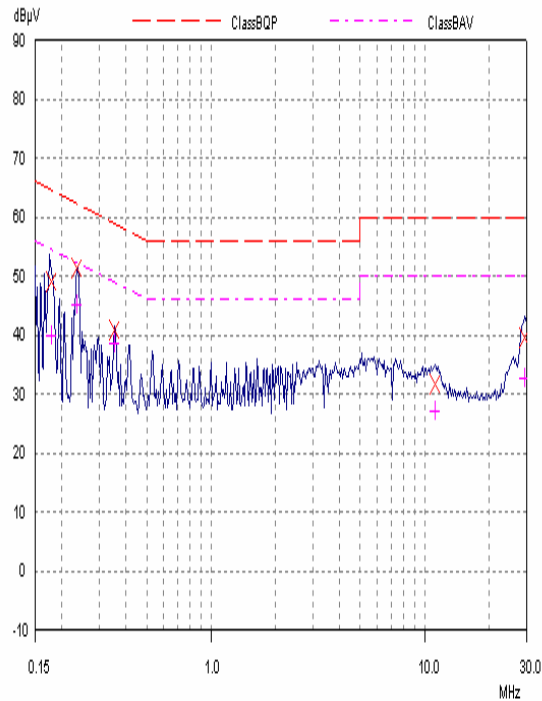
##### **Average Detector Measurements on Live and Neutral Lines**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.17905	Live	39.87	54.53	14.66	Complied
0.23588	Live	45.20	52.24	7.04	Complied
0.35416	Live	38.53	48.86	10.33	Complied
11.1283	Neutral	26.92	50.00	23.08	Complied
29.39345	Neutral	32.59	50.00	17.41	Complied

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

**Transmitter AC Conducted Spurious Emissions: Section 15.207 (Continued)**



*Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.*

Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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**7.2.2. Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) - Electric Field Strength Measurements: 30 to 1000 MHz (emissions occurring in the restricted bands)**

The EUT was configured for radiated emission testing as described in section 9 of this report.

Tests were performed to identify the maximum transmitter radiated emission levels.

**Results:**

**Top Channel**

Frequency (MHz)	Antenna Polarity	Q-P Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
399.998	Horizontal	44.3	46.0	1.7	Complied

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

---

**7.2.3. Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) - Electric Field Strength Measurements: 30 to 1000 MHz (emissions outside the restricted bands)**

The EUT was configured for radiated emission testing as described in section 9 of this report.

Tests were performed to identify the maximum transmitter radiated emission levels.

**Results:**

**Top Channel**

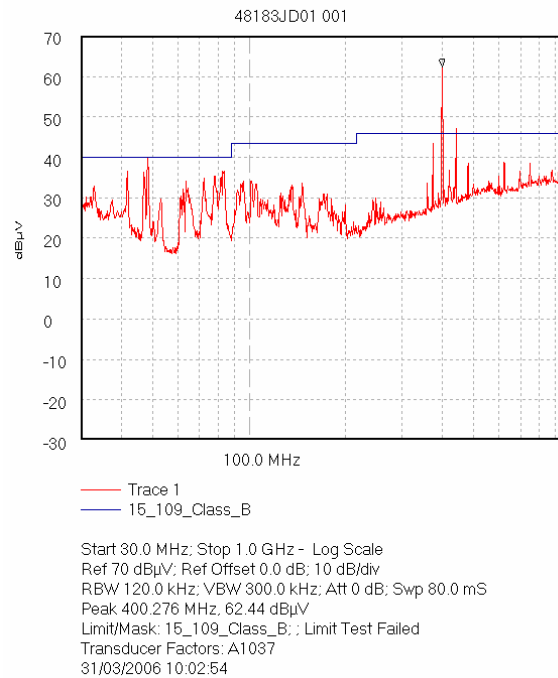
Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	-20 Limit (dB $\mu$ V/m)	Margin (dB)	Result
48.173	Vertical	33.7	105.8	75.2	Complied
82.843	Vertical	20.7	105.8	85.1	Complied
374.976	Horizontal	36.4	105.8	69.4	Complied
749.986	Horizontal	34.3	105.8	71.5	Complied

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

**Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) - Electric Field Strength Measurements: 30 to 1000 MHz (emissions outside the restricted bands) (Continued)**



*Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.*

Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **8. Measurement Uncertainty**

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.25 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	±5.26 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **9. Measurement Methods**

### **9.1. AC Mains Conducted Emissions**

AC mains conducted emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane. The EUT was powered with 110V 60 Hz ac mains supplied via a line impedance stabilisation network (LISN).

Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

Following the initial scans, a graph was produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested (at individual frequencies) using the appropriate detector function.

The test equipment settings for conducted emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)/Average
Mode:	Max Hold	Not applicable
Bandwidth:	10 kHz	9 kHz
Amplitude Range:	60 dB	20 dB
Measurement Time:	Not applicable	>1 s
Observation Time:	Not applicable	>15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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## **9.2. Radiated Emissions**

Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. Any emission within 20 dB of the limit were then measured on the open area test site, except in cases where the noise floor was within 20 dB of the limit, in these cases the highest point of the noise floor was measured.

Where an emission fell inside a restricted band, measurements were made at the appropriate test distance using a measuring receiver with a quasi peak detector for measurements below 1000 MHz and an average and peak detector for measurements above 1000 MHz. A peak detector was used for all other measurements.

For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2003 Clause 5.4.

All measurements on the open area test site were performed using broadband antennas in both vertical and horizontal polarisations.

On the open area test site, at each frequency where a signal was to be measured, the trace was maximised by rotating a turntable through 360°. The angle at which the maximum signal was observed was locked out. For frequencies below 1000 MHz the test antenna was varied in height between 1 m and 4 m in order to further maximise the target emission.

For frequencies above 1000 MHz where a horn antenna was used, height searching was performed to locate the optimal height of the horn with respect to the EUT. At this point the horn was locked off and the turntable was again rotated through 360° to maximise the target signal. It should be noted that the received signal from the EUT would diminish very quickly after it exits the beam width of the horn antenna, for this reason it may not be necessary to fully height search with the horns.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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**Radiated Emissions (Continued)**

At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

Scans were performed to the upper frequency limits as stated in section 15.33

The final field strength was determined as the indicated level in dB $\mu$ V plus cable loss and antenna factor.

The test equipment settings for radiated emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements <1 GHz	Final Measurements ≥1 GHz
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak / Average
Mode:	Max Hold	Not applicable	Max Hold
Bandwidth:	(120 kHz <1 GHz) (1 MHz ≥1 GHz)	120 kHz	1 MHz
Amplitude Range:	100 dB	100 dB	100 dB
Step Size:	Continuous sweep	Not applicable	Not applicable
Sweep Time:	Coupled	Not applicable	Not applicable

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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### **Appendix 1. Test Equipment Used**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A004	ESH3-Z5 LISN	Rohde & Schwarz	ESH3-Z5	890 604/027
A1037	Chase Bilog Antenna	Chase EMC Ltd	CBL6112B	2413
A1360	ESH3-Z2 Pulse Limiter	Rohde & Schwarz	ESH3-Z2	A1360-20112003
A259	Bilog Antenna	Chase	CBL6111	1513
C1057	Cable	RS	1	1
C363	BNC Cable	Rosenberger	RG142	None
M505	Analyser Display Unit	Rohde & Schwarz	ESAI-D	825316/010
S201	Site 1	RFI	1	
S212	Site 12	RFI	12	

**NB** In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

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Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

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**Appendix 2. Test Configuration Drawings**

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\48183JD01\EMIRAD	Test configuration for measurement of radiated emissions.

Test of: Orthogon Systems Ltd.  
5.8 GHz Spectra Unit  
To: FCC Part 15.247: 2004 (Subpart C)

DRG\48183JD01\EMICON

