EMC EMISSIONS - TEST REPORT (In-Part)

Test Report No.	**BC400296-1**	Issue Date:	**August 5, 2004**
Model / Serial No.	**ES1723 / proto #1**		
Product Type	**Intentional Transmitter**		
Client	**Inovonics Wireless Corp.**		
Manufacturer	**Inovonics Wireless Corp.**		
License holder	**Inovonics Wireless Corp.**		
Address	**315 CTC Blvd**		
	Louisville, CO 80027		
Test Criteria Applied	**FCC CFR47 Part 15.247**		
Test Result	**PASS**		
Test Project Number	**BC400296-1**		
References	Title 47 CFR 15: RADIO FREQUENCY DEVICES		
Total Pages Including Appendices:	30		

Todd Jeffery
Reviewed By :

Robert Cromwell
Approved By :

International Approval Laboratories and its professional staff hold government and professional organization certifications and are members of IEEE, NVLAP, and VCCI.

NVLAP
Lab Code: 200624-0

Accredited

STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty for Conducted Emissions in the frequency range of 150kHz – 30MHz is calculated to be ±2.30dB and for Radiated Emissions is calculated to be ±3.60dB in the frequency range of 30MHz – 200MHz and ±3.38dB in the frequency range of 200MHz – 1000MHz.

EUT Received Date: 19-July-2004

Testing Start Date: 19-July-2004

Testing End Date: 30-July-2004

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The tests were performed according to following regulations :

1. FCC CFR47 Part 15.205
2. FCC CFR47 Part 15.207
3. FCC CFR47 Part 15.209
4. FCC CFR47 Part 15.247
5. ICES-003

Emission Test Results:

Conducted Emissions, Powerline (15.207) - Not Applicable

Test Result

Minimum limit margin	NA	dB	at	NA MHz
Maximum limit exceeding		dB	at	MHz

Remarks:

Radiated Emissions (15.209) - PASS

Test Result

Minimum limit margin	-11.0	dB	at	9000.0 MHz
Maximum limit exceeding		dB	at	MHz

Remarks:

Radiated Emissions (15.205)/(15.247) (c) - PASS

Test Result

Minimum limit margin	-1.28	dB	at	3710.09 MHz
Maximum limit exceeding		dB	at	MHz

Remarks:

Peak Output Power 15.247 (b)(2) - PASS

Test Result

Minimum limit margin	-24.88	dB	at	914.61 MHz
Maximum limit exceeding		dB	at	MHz

Remarks:

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GENERAL REMARKS:

The following remarks are to be considered as "where applicable" and are taken into account while completing any FCC/IC/ETSI radio tests at International Approvals Laboratories, LLC.

Testing was performed in 3 different orthogonal axis to determine the worst case emissions from the device. The worst case emissions measurements are shown in this report.

FCC CFR47 Part 15.31: Measurement Standards: In any case where the device is powered off a battery, a fresh battery was used during test. In cases where the device is powered off an AC supply, voltage was varied per Part 15.31 to find worst case emissions.

FCC CFR47 Part 15.35: Measurement Detector Functions and Bandwidths: FCC Part 15.35 was utilized when performing the measurements within this report.

In any case where the device is powered off a battery, a fresh battery was used during test. In cases where the device is powered off an AC supply, voltage was verified per Part 15.31 to find worst case emissions.

The actual test distance for the FCC Part 15.209 testing was conducted at 10m for the fact that the device was being tested to EN55022 Class B from 30 MHz to 1000 MHz (meets/exceeds the FCC Part 15.209 & 109B limits) The data is automatically extrapolated back to the FCC 3m limits and measurements are corrected to better show the compliance to FCC requirements and reduce confusion. A correction factor of 10.54dB is used in cases of 30MHz and up for a difference between 10m and 3m measurement distances. All measurements that are lesser than 30MHz where applicable are accompanied with the fall of measurements and calculations to support the interpolation.

Modifications required to pass:

Test Specification Deviations: Additions to or Exclusions from

This test report is in-part, International Approvals Laboratories, LLC was asked to test only the field strength of the fundamental and harmonics as well as the unintentional radiated and conducted emissions when applicable.

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Required Information In Accordance to FCC CFR 47 Part 2.1033:

Rule Part 11, 15 & 18 Devices	*Other Rule Part Devices*	*Description*	*Comments*
2.1033(b)(1)	**2.1033(c)(1)**	*Manu. Contact*	See Page 1 of this report
2.1033(b)(2)	**2.1033(c)(2)**	*FCC Identifier*	
2.1033(b)(3)	**2.1033(c)(3)**	*Users Manual to include Operating, installation*	Attached as Exhibit
	2.1033(c)(4)	*Emissions Designator per 2.*	
	2.1033(c)(5)	*Frequency Range*	Not Applicable to Part 15 Devcies
	2.1033(c)(6)	*Power range and controls*	Not Applicable to Part 15 Devcies
	2.1033(c)(7)	*Maximum power ouput rating*	Not Applicable to Part 15 Devcies
	2.1033(c)(8)	*DC Voltage and Current suplying final RF stages*	Not Applicable to Part 15 Devcies
2.1033(b)(3)	**2.1033(c)(9)**	*Tune –up procedure*	Please refer to the users manual for applicability
2.1033(b)(4&5)	**2.1033(c)(10)**	*Complete Circuit Diagrams and circuit operation description*	Attached as Exhibit
2.1033(b)(7)	**2.1033(c)(11)**	*Photographs/drawings of the identification label & its location on the device*	Attached as Exhibit
2.1033(b)(7)	**2.1033(c)(12)**	*Photographs of the external and internal surfaces, and construction*	Attached as Exhibit
	2.1033(c)(13)	*Digital Modulation*	Not Applicable
2.1033(b)(6)	**2.1033(c)(14)**	*Report of Measurement Data Required by 2.1046 – 2.1057*	See Data Below (This report consists of the testing required under Part 15.231)
2.1033(b)(8)		*Description of publicly available support equipment used during test*	Refer to Exhibit B of this report (Client Test Plan)
2.1033(b)(9)		*Statement of Autorization to Part 15.37 of CFR47*	The equipment herein is being authorized in accordance to 15.37 of the CFR47 Rules.
2.1033(b)(10)		*Direct Sequence Spread Spectrum Devices (DSSS)*	Exhibit of compliance to 15.247(e)
2.1033(b)(10)		*Frequency Hopping Devices*	Exhibit of compliance to 15.247(a)(1)
2.1033(b)(11)		*Scanning receiver construction*	Exhibit stating compliance to construction in accordance to 15.121.
15.31	**15.31**	*Transmitter Supply Voltage*	Testing herein was completed in accordance to FCC CFR47 Part 15.31

Exhibits Including (where applicable):

1. Users Manual
2. Operation Description
3. Block Diagram
4. Report of Measurement
5. External & Internal Photographs
6. Schematic
7. Parts List
8. Tuning Procedure (if applicable)
9. Test Setup Photograph
10. Label Drawings and or Photograpghs
11. Description of Support Equipment (where Applicable)

Required Information in Accordance to Industry Canada Regulations (In addition to the above):

Information Required	*Description*	*Comments*
Modulation Type	(i.e. ASK, NON, FSK, DSSS, FHSS, etc.)	
Emissions Designator	Per TRC-49	
In Country Representative	Contact Information	
99% Bandwidth Measurement	Per RSS-210	

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Test-setup photo(s):
Conducted Emissions

Not Applicable

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Test-setup photo(s):
Radiated Intentional Emissions

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Test-setup photo(s):
Radiated Intentional Emissions

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Test-setup photo(s):
Radiated Unintentional Emissions

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Test-setup photo(s):
Radiated Unintentional Emissions

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Appendix A

Test Data Sheets

and

Test Equipment Used

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15.209 Test Data

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Radiated Electromagnetic Unintentional Emissions

Test Report #:	**BC400296 Run 04**	Test Area:	Pinewood Site 1 (3m)	Temperature:	22	°C
Test Method:	FCC pt. 15.209 below 30	Test Date:	30-Jul-2004	Relative Humidity:	48	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	81	kPa
EUT Serial #:	1					
Manufacturer:	Inovonics					
EUT Description:	Temperature Transmitter					
Notes:						

Level Key	
Pk – Peak	Pk – Peak
Qp – QuasiPeak	Qp – QuasiPeak
Av - Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV/m)	(m) (DEG)	FCC Part 15.209 Qp	FCC Part 15.209 Av
Started scan at 33kHz nothing found from the unit between 33KHz and 30MHz						
30Mhz-200MHz						
0 degrees						
No Emissions found						
90 degrees						
No Emissions found						
180 degrees						
No Emissions found						
270 degrees						
No Emissions Found						
Changing to Horizontal						
0 degrees						
No Emissions found						
90 degrees						
No Emissions found						
180 degrees						
No Emissions found						
270 degrees						
No Emissions found						
0 degrees						
No Emissions found						

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Radiated Electromagnetic Unintentional Emissions

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Test Method:	FCC pt. 15.209 below 30	Test Date:	30-Jul-2004	Relative Humidity:	48	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	81	kPa
EUT Serial #:	1					
Manufacturer:	Inovonics					
EUT Description:	Temperature Transmitter					
Notes:						

Level Key	
Pk – Peak	Pk – Peak
Qp – QuasiPeak	Qp – QuasiPeak
Av - Average	

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB\m) (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) FCC Part 15.209 Qp	DELTA2 (dB) FCC Part 15.209 Av
90 degrees						
No Emissions found						
180 degrees						
No Emissions found						
270 degrees						
No Emissions found						
Noise Floor points						
200.00	35.5 Qp	1.4 / 11.9 / 27.6	21.2	H / 1.0 / 0.0	-22.3	N/A
1000.00	18.7 Qp	2.2 / 23.9 / 27.4	17.4	H / 1.0 / 0.0	-36.6	N/A
500.00	19.2 Qp	2.4 / 18.6 / 28.6	11.7	H / 1.0 / 0.0	-34.3	N/A
0 degrees						
No Emissions found						
90 degrees						
No Emissions found						
180 degrees						
No Emissions found						
270 degrees						
No Emissions Found						
713.45 bumped the space bar						
Noise floor points						

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Radiated Electromagnetic Unintentional Emissions

Test Report #:	**BC400296 Run 04**	Test Area:	Pinewood Site 1 (3m)	Temperature:	22	°C
Test Method:	FCC pt. 15.209 below 30	Test Date:	30-Jul-2004	Relative Humidity:	48	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	81	kPa
EUT Serial #:	1					
Manufacturer:	Inovonics					
EUT Description:	Temperature Transmitter					
Notes:						

Level Key	
Pk – Peak	Pk – Peak
Qp – QuasiPeak	Qp – QuasiPeak
Av - Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV/m)	(m) (DEG)	FCC Part 15.209 Qp	FCC Part 15.209 Av
200.00	30.5 Qp	1.4 / 11.9 / 27.6	16.3	V / 1.0 / 0.0	-27.2	N/A
500.00	19.4 Qp	2.4 / 18.6 / 28.6	11.8	V / 1.0 / 0.0	-34.2	N/A
1000.00	18.7 Qp	2.2 / 23.9 / 27.4	17.5	V / 1.0 / 0.0	-36.5	N/A
No emissions found between 1 and 10 GHz These are noise floor points						
9000.00	40.9 Pk	8.5 / 40.0 / 46.8	42.6	V / 1.0 / 0.0	N/A	-11.4
9000.00	41.2 Pk	8.5 / 40.0 / 46.8	43.0	H / 2.0 / 0.0	N/A	-11.0
These are noise floor points						
6750.00	33.5 Pk	8.3 / 36.7 / 38.9	39.6	H / 2.0 / 0.0	N/A	-14.4
7500.00	33.9 Pk	8.2 / 38.0 / 39.6	40.5	H / 2.0 / 0.0	N/A	-13.5
5500.00	31.5 Pk	6.7 / 35.7 / 38.7	35.2	H / 2.0 / 0.0	N/A	-18.8
7500.00	33.0 Pk	8.2 / 38.0 / 39.6	39.6	V / 1.0 / 0.0	N/A	-14.4
6750.00	34.1 Pk	8.3 / 36.7 / 38.9	40.2	V / 1.0 / 0.0	N/A	-13.8
5500.00	32.4 Pk	6.7 / 35.7 / 38.7	36.1	V / 1.0 / 0.0	N/A	-17.9
These are noise floor points						
1500.00	13.9 Pk	2.9 / 26.9 / 37.0	6.7	V / 1.0 / 0.0	N/A	-47.3
2500.00	33.7 Pk	4.0 / 30.6 / 37.9	30.4	V / 1.0 / 0.0	N/A	-23.6
3500.00	32.6 Pk	4.8 / 32.8 / 37.8	32.4	V / 1.0 / 0.0	N/A	-21.6
1500.00	10.6 Pk	2.9 / 26.9 / 37.0	3.4	H / 2.0 / 0.0	N/A	-50.6
2500.00	32.5 Pk	4.0 / 30.6 / 37.9	29.2	H / 2.0 / 0.0	N/A	-24.8
3500.00	31.5 Pk	4.8 / 32.8 / 37.8	31.3	H / 2.0 / 0.0	N/A	-22.7

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Radiated Electromagnetic Unintentional Emissions

Test Report #:	**BC400296 Run 04**	Test Area:	Pinewood Site 1 (3m)	Temperature:	22	°C
Test Method:	FCC pt. 15.209 below 30	Test Date:	30-Jul-2004	Relative Humidity:	48	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	81	kPa
EUT Serial #:	1					
Manufacturer:	Inovonics					
EUT Description:	Temperature Transmitter					
Notes:						

Level Key	
Pk – Peak	Pk – Peak
Qp – QuasiPeak	Qp – QuasiPeak
Av - Average	

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB\m) (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) FCC Part 15.209 Qp	DELTA2 (dB) FCC Part 15.209 Av
********** Measurement Summary **********						
9000.00	41.2 Pk	8.5 / 40.0 / 46.8	43.0	H / 2.0 / 0.0	N/A	-11.0
7500.00	33.9 Pk	8.2 / 38.0 / 39.6	40.5	H / 2.0 / 0.0	N/A	-13.5
6750.00	34.1 Pk	8.3 / 36.7 / 38.9	40.2	V / 1.0 / 0.0	N/A	-13.8
5500.00	32.4 Pk	6.7 / 35.7 / 38.7	36.1	V / 1.0 / 0.0	N/A	-17.9
3500.00	32.6 Pk	4.8 / 32.8 / 37.8	32.4	V / 1.0 / 0.0	N/A	-21.6
200.00	35.5 Qp	1.4 / 11.9 / 27.6	21.2	H / 1.0 / 0.0	-22.3	N/A
2500.00	33.7 Pk	4.0 / 30.6 / 37.9	30.4	V / 1.0 / 0.0	N/A	-23.6
500.00	19.4 Qp	2.4 / 18.6 / 28.6	11.8	V / 1.0 / 0.0	-34.2	N/A
1000.00	18.7 Qp	2.2 / 23.9 / 27.4	17.5	V / 1.0 / 0.0	-36.5	N/A
1500.00	13.9 Pk	2.9 / 26.9 / 37.0	6.7	V / 1.0 / 0.0	N/A	-47.3

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15.247 (b)(2), (c)/15.205 Test Data

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Field Strength Measurements
Fundamental and Spurious of the Transmitter

Test Report #:	**BC400296**	Test Area:	Pinewood Site 1 (3m)	Temperature:	22.6	°C
Test Method:	FCC CFR47 Part 15.247/205	Test Date:	19-Jul-2004	Relative Humidity:	39	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	80	kPa
EUT Serial #:	1			Page:		
Manufacturer:	Inovonics Wireless Corp.					
EUT Description:						
Notes:						

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	Duty Cycle Correction	Final Corrected	Limit	DELTA
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV)	(m) (DEG)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
The following duty cycle was declared by the manufacturer.								
Duty Cycle = active / 100ms. = 20%								
Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.								
The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 emissions and delta limits were calculated as follows:								
Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission								
The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.209 and 15.247 and the emission/limit delta was calculated.								
the DTCF is calculated as follows $20*\log_{10}$(duty cycle in 100mS) “not to exceed 20dB”								
Part 15.247 and 15.205 Respectively								
The EUT is flat on the table								
Low channel								
902.17	77.5 Qp	2.2 / 23.3 / 0.0	103	H / 1.0 / 310.4	-13.98	89.02	119	-29.98
902.17	75.8 Pk	2.2 / 23.3 / 0.0	101.3	V / 1.0 / 23.0	-13.98	87.32	119	-31.68
Mid Channel								
914.59	80.0 Pk	2.2 / 23.1 / 0.0	105.2	V / 1.1 / 360.0	-13.98	91.22	119	-27.78
914.59	81.7 Pk	2.2 / 23.1 / 0.0	106.9	H / 1.0 / 316.0	-13.98	92.92	119	-26.08
High Channel								
927.37	79.2 Qp	2.2 / 23.3 / 0.0	104.8	H / 1.0 / 312.0	-13.98	90.82	119	-28.18
927.37	76.9 Pk	2.2 / 23.3 / 0.0	102.4	V / 1.0 / 248.5	-13.98	88.42	119	-30.58
EUT is vertical on the table								
Low Channel								
902.19	77.0 Pk	2.2 / 23.3 / 0.0	102.5	V / 1.1 / 356.0	-13.98	88.52	119	-30.48
902.19	79.0 Pk	2.2 / 23.3 / 0.0	104.5	H / 1.0 / 313.6	-13.98	90.52	119	-28.48
Mid Channel								
914.61	82.8 Pk	2.2 / 23.1 / 0.0	108.1	H / 1.0 / 307.5	-13.98	94.12	119	-24.88
914.61	77.8 Pk	2.2 / 23.1 / 0.0	103.1	V / 1.1 / 173.5	-13.98	89.12	119	-29.88
High Channel								
927.37	76.3 Pk	2.2 / 23.3 / 0.0	101.8	V / 1.0 / 183.8	-13.98	87.82	119	-31.18
927.37	79.5 Pk	2.2 / 23.3 / 0.0	105	H / 1.0 / 309.7	-13.98	91.02	119	-27.98

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Fundamental and Spurious of the Transmitter

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Test Method:	FCC CFR47 Part 15.247/205	Test Date:	19-Jul-2004	Relative Humidity:	39	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	80	kPa
EUT Serial #:	1					
Manufacturer:	Inovonics Wireless Corp.					
EUT Description:						
Notes:						

Nb – Narrow Band
Qp – QuasiPeak
Bb – Broad Band
Av – Average

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	Duty Cycle Correction	Final Corrected	Limit	DELTA
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV)	(m) (DEG)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
The following duty cycle was declared by the manufacturer.								
Duty Cycle = active / 100ms. = 20%								
Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.								
The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 emissions and delta limits were calculated as follows:								
Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission								
The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.209 and 15.247 and the emission/limit delta was calculated.								
The DTCF is calculated as follows $20*\log_{10}$(duty cycle in 100mS) “not to exceed 20dB”								
Part 15.247 and 15.205 Respectively								
EUT is still vertical, rotated 90 degrees								
Low Channel								
902.16	79.8 Pk	2.2 / 23.3 / 0.0	105.3	H / 1.0 / 314.6	-13.98	91.32	119	-27.68
902.17	74.7 Pk	2.2 / 23.3 / 0.0	100.2	V / 1.3 / 306.6	-13.98	86.22	119	-32.78
Mid Channel								
914.57	74.5 Pk	2.2 / 23.1 / 0.0	99.8	V / 1.3 / 334.0	-13.98	85.82	119	-33.18
914.57	81.5 Pk	2.2 / 23.1 / 0.0	106.8	H / 1.0 / 37.0	-13.98	92.82	119	-26.18
High Channel								
927.37	76.0 Pk	2.2 / 23.3 / 0.0	101.5	H / 1.0 / 46.0	-13.98	87.52	119	-31.48
927.35	74.5 Pk	2.2 / 23.3 / 0.0	100	V / 1.2 / 309.0	-13.98	86.02	119	-32.98
Harmonics EUT was placed in its worst case position.								
Low Channel								
1804.58	34.2 Pk	3.1 / 28.2 / 0.0	65.6	V / 1.0 / 283.3	-13.98	51.62	99	-47.38
1804.67	31.6 Pk	3.1 / 28.2 / 0.0	63	H / 1.4 / 353.7	-13.98	49.02	99	-49.98
2706.87	55.2 Pk	4.2 / 31.1 / 37.5	53	H / 2.1 / 214.1	-13.98	39.02	54	-14.98
2706.93	60.3 Pk	4.2 / 31.1 / 37.5	58.1	V / 1.5 / 25.7	-13.98	44.12	54	-9.88
3609.23	57.2 Pk	5.0 / 33.1 / 37.8	57.6	V / 1.0 / 106.0	-13.98	43.62	54	-10.38
3609.25	61.3 Pk	5.0 / 33.1 / 37.8	61.6	H / 1.5 / 125.1	-13.98	47.62	54	-6.38
4511.53	58.5 Pk	6.6 / 33.5 / 39.6	59	H / 1.2 / 131.3	-13.98	45.02	54	-8.98
4511.53	55.7 Pk	6.6 / 33.5 / 39.6	56.3	V / 1.0 / 127.9	-13.98	42.32	54	-11.68
5413.53	43.9 Pk	6.9 / 35.5 / 38.3	48	H / 1.0 / 0.0	-13.98	34.02	54	-19.98
5413.53	42.2 Pk	6.9 / 35.5 / 38.3	46.3	V / 1.0 / 0.0	-13.98	32.32	54	-21.68

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Field Strength Measurements
Fundamental and Spurious of the Transmitter

Test Report #:	**BC400296**	Test Area:	Pinewood Site 1 (3m)	Temperature:	22.6	°C
Test Method:	FCC CFR47 Part 15.247/205	Test Date:	19-Jul-2004	Relative Humidity:	39	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	80	kPa
EUT Serial #:	1					
Manufacturer:	Inovonics Wireless Corp.					
EUT Description:						
Notes:						

Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av – Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	Duty Cycle Correction	Final Corrected	Limit	DELTA
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV)	(m) (DEG)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
The following duty cycle was declared by the manufacturer.								
Duty Cycle = active / 100ms. = 20%								
Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.								
The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 emissions and delta limits were calculated as follows:								
Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission								
The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.209 and 15.247 and the emission/limit delta was calculated.								
The DTCF is calculated as follows $20*\log_{10}$(duty cycle in 100mS) “not to exceed 20dB”								
Part 15.247 and 15.205 Respectively								
6315.53	44.2 Pk	8.2 / 36.5 / 38.9	50	H / 1.0 / 0.0	-13.98	36.02	99	-62.98
6315.53	43.5 Pk	8.2 / 36.5 / 38.9	49.2	V / 1.0 / 0.0	-13.98	35.22	99	-63.78
7217.53	44.0 Pk	8.1 / 37.4 / 40.7	48.8	H / 1.0 / 0.0	-13.98	34.82	99	-64.18
7217.53	44.3 Pk	8.1 / 37.4 / 40.7	49.1	V / 1.0 / 0.0	-13.98	35.12	99	-63.88
8119.53	52.5 Pk	8.3 / 38.0 / 45.4	53.5	H / 1.0 / 0.0	-13.98	39.52	54	-14.48
8119.53	52.1 Pk	8.3 / 38.0 / 45.4	53.1	V / 1.0 / 0.0	-13.98	39.12	54	-14.88
9021.53	45.8 Pk	8.5 / 39.9 / 46.8	47.4	H / 1.0 / 0.0	-13.98	33.42	54	-20.58
9021.53	52.1 Pk	8.5 / 39.9 / 46.8	53.7	V / 1.0 / 0.0	-13.98	39.72	54	-14.28
Mid Channel								
1829.37	32.2 Pk	3.1 / 28.3 / 0.0	63.6	H / 1.2 / 353.9	-13.98	49.62	99	-49.38
1829.32	28.1 Pk	3.1 / 28.3 / 0.0	59.5	V / 1.0 / 278.3	-13.98	45.52	99	-53.48
2744.12	56.1 Pk	4.3 / 31.1 / 37.5	54.1	V / 1.1 / 118.4	-13.98	40.12	54	-13.88
2744.13	60.2 Pk	4.3 / 31.1 / 37.5	58.2	H / 1.0 / 134.2	-13.98	44.22	54	-9.78
3658.88	61.7 Pk	5.1 / 33.3 / 37.9	62.2	H / 1.5 / 121.9	-13.98	48.22	54	-5.78
3658.91	55.9 Pk	5.1 / 33.3 / 37.9	56.4	V / 1.2 / 224.9	-13.98	42.42	54	-11.58
4573.54	52.1 Pk	6.7 / 33.7 / 39.4	53.2	V / 1.0 / 125.6	-13.98	39.22	54	-14.78
4573.54	57.0 Pk	6.7 / 33.7 / 39.4	58.1	H / 1.9 / 28.8	-13.98	44.12	54	-9.88
5488.49	44.4 Pk	6.7 / 35.7 / 38.6	48.2	V / 1.0 / 138.0	-13.98	34.22	99	-64.78
5488.49	44.8 Pk	6.7 / 35.7 / 38.6	48.6	H / 1.1 / 0.0	-13.98	34.62	99	-64.38
6402.49	43.4 Pk	8.3 / 36.4 / 39.0	49.2	V / 1.0 / 0.0	-13.98	35.22	99	-63.78
6402.49	42.9 Pk	8.3 / 36.4 / 39.0	48.7	H / 1.0 / 0.0	-13.98	34.72	99	-64.28
7316.49	42.4 Pk	8.2 / 37.6 / 40.5	47.6	V / 1.0 / 0.0	-13.98	33.62	54	-20.38
7316.49	42.4 Pk	8.2 / 37.6 / 40.5	47.7	H / 1.0 / 0.0	-13.98	33.72	54	-20.28

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Field Strength Measurements
Fundamental and Spurious of the Transmitter

Test Report #:	**BC400296**	Test Area:	Pinewood Site 1 (3m)	Temperature:	22.6	°C
Test Method:	FCC CFR47 Part 15.247/205	Test Date:	19-Jul-2004	Relative Humidity:	39	%
EUT Model #:	EN1723	EUT Power:	DC	Air Pressure:	80	kPa
EUT Serial #:	1					
Manufacturer:	Inovonics Wireless Corp.					
EUT Description:						
Notes:						

Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av – Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	Duty Cycle Correction	Final Corrected	Limit	DELTA
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV)	(m) (DEG)	(dB)	(dBuV/m)	(dBuV/m)	(dB)

The following duty cycle was declared by the manufacturer.

Duty Cycle = active / 100ms. = 20%

Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 emissions and delta limits were calculated as follows:

Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission

The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.209 and 15.247 and the emission/limit delta was calculated.

The DTCF is calculated as follows $20*\log_{10}$(duty cycle in 100mS) “not to exceed 20dB”

Part 15.247 and 15.205 Respectively

8226.57	53.4 Pk	8.4 / 38.2 / 45.3	54.8	V / 1.0 / 0.0	-13.98	40.82	54	-13.18
8226.57	52.1 Pk	8.4 / 38.2 / 45.3	53.5	H / 1.0 / 0.0	-13.98	39.52	54	-14.48
9140.57	50.9 Pk	8.8 / 39.6 / 47.1	52.2	V / 1.0 / 0.0	-13.98	38.22	54	-15.78
9140.57	49.8 Pk	8.8 / 39.6 / 47.1	51.1	H / 1.0 / 0.0	-13.98	37.12	54	-16.88
High Channel								
1854.88	30.1 Pk	3.1 / 28.5 / 0.0	61.7	H / 1.2 / 184.4	-13.98	47.72	99	-51.28
1854.95	30.8 Pk	3.1 / 28.5 / 0.0	62.4	V / 1.1 / 137.8	-13.98	48.42	99	-50.58
2782.49	59.2 Pk	4.3 / 31.2 / 37.5	57.3	V / 1.4 / 23.5	-13.98	43.32	54	-10.68
2782.55	55.3 Pk	4.3 / 31.2 / 37.5	53.4	H / 1.3 / 206.7	-13.98	39.42	54	-14.58
3710.06	59.8 Pk	5.2 / 33.5 / 37.9	60.6	V / 1.0 / 205.2	-13.98	46.62	54	-7.38
3710.09	65.9 Pk	5.2 / 33.5 / 37.9	66.7	H / 1.2 / 120.5	-13.98	52.72	54	-1.28
4637.49	54.2 Pk	6.9 / 33.9 / 39.2	55.8	V / 1.0 / 129.9	-13.98	41.82	54	-12.18
4637.66	58.4 Qp	6.9 / 33.9 / 39.2	60	H / 1.8 / 360.0	-13.98	46.02	54	-7.98
5564.65	43.9 Pk	6.8 / 35.8 / 38.4	48.1	V / 1.0 / 0.0	-13.98	34.12	99	-64.88
5565.24	46.1 Pk	6.8 / 35.8 / 38.4	50.4	H / 1.6 / 0.0	-13.98	36.42	99	-62.58
6488.78	43.1 Pk	8.5 / 36.4 / 39.1	48.9	H / 1.0 / 0.0	-13.98	34.92	99	-64.08
6491.42	43.8 Pk	8.5 / 36.4 / 39.1	49.5	V / 1.0 / 0.0	-13.98	35.52	99	-63.48
7419.98	44.1 Pk	8.2 / 37.8 / 40.0	50.2	H / 1.0 / 0.0	-13.98	36.22	54	-17.78
7420.43	44.5 Pk	8.2 / 37.8 / 40.0	50.5	V / 1.0 / 0.0	-13.98	36.52	54	-17.48
8343.37	52.8 Pk	8.4 / 38.5 / 45.2	54.6	H / 1.0 / 0.0	-13.98	40.62	54	-13.38
8343.37	51.7 Pk	8.4 / 38.5 / 45.2	53.5	V / 1.0 / 0.0	-13.98	39.52	54	-14.48
9270.37	50.1 Pk	9.0 / 39.2 / 47.3	51	H / 1.0 / 0.0	-13.98	37.02	99	-61.98
9270.37	50.9 Pk	9.0 / 39.2 / 47.3	51.7	V / 1.0 / 0.0	-13.98	37.72	99	-61.28

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Project Report

End Date: 7/30/04

Technician Karen Parker **Project:** BC400296

Capital Asset ID	Manufacturer	Model #	Serial #	Description	Test Performed	Service Type	Service Date	Service Due
6	Hewlett-Packard	8594E	3223A00145	Spectrum Analyzer	R Radiated Emissions	For Cal	1/16/2004	1/16/2005
138	EMC TEST SYSTEMS	3109	3142	Biconical Antenna 30-300MHz	R Radiated Emissions	For Cal	10/3/2003	10/3/2004
171	Hewlett-Packard	85662A	1928A01169	Spectrum Analyzer - Display Section	R Radiated Emissions	For Cal	1/21/2004	1/21/2005
172	Hewlett-Packard	8566B	2430A00759	Spectrum Analyzer	R Radiated Emissions	For Cal	1/21/2004	1/21/2005
187	EMCO	3115	9205-3886	Horn Antenna 1-18GHz	R Radiated Emissions	For Cal	10/6/2003	10/6/2004
202	Avantek	AWT-18037	1002	RF Pre-Amplifier (8-18 GHz)	R Radiated Emissions	For Ver	4/7/2004	4/7/2005
203	Avantek	AFT97-8434-10F	1007	RF Pre-Amplifier (4-8 GHz)	R Radiated Emissions	For Ver	4/7/2004	4/7/2005
213	Mini-Circuits Lab	ZHL-42	N052792-2	Amplifier	R Radiated Emissions	For Ver	6/5/2004	6/5/2005
217	EMCO	3146	9203-3376	Log Periodic Antenna	R Radiated Emissions	For Cal	10/3/2003	10/3/2004
248	Hewlett-Packard	8447F	3113A05545	9 kHz- 1.3GHz Pre Amp	R Radiated Emissions	For Ver	6/22/2004	6/22/2005

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Appendix B

Test Plan

and

Constructional Data Form

To be supplied by the customer

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July 13, 2004

Todd Seeley
IA Labs
5451 Central Ave.
Boulder, CO 80301

Dear Todd,

Pursuant to section 15.247 of the FCC rules Inovonics transmitters are limited to 0.25 Watts maximum transmitted power. These devices contain integrated antennas and it is therefore impossible to measure the transmitted power in a conducted manner without significantly modifying the devices.

At the test lab the field strength is measured using an antenna located 3 meters from the device under test. The rules do not explicitly state the field strength at 3 meters corresponding to 0.25 Watts, so it must be calculated as follows:

The test facility measures the transmitted field strength, E, having units of Volts/meter, or the logarithmic equivalent. The transmitted power density as measured by the antenna is then $\frac{E^2}{\eta}$, where η is the intrinsic impedance of free space.

Assuming isotropic radiation from the product, the Effective Isotropic Radiated Power (EIRP) is found by multiplying the above power density by the area of a sphere having a radius of 3 meters,

$$P_{EIRP} = \frac{E^2}{\eta} 4\pi R^2 \qquad (1)$$

Solving for E,

$$E = \frac{1}{2R}\left(\frac{\eta P_{EIRP}}{\pi}\right)^{1/2} \qquad (2)$$

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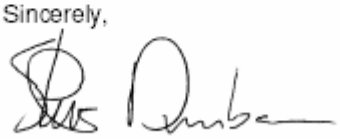
Given that P_{EIRP} = 0.25 Watts (FCC limit), R = 3 meters, and η = 377 Ohms, E = 0.913 V/m = 119.2 dB µV/m.

Remember the above assumption of isotropic radiation- all real antennas have non-isotropic radiation patterns. Using the 119.2 dB µV/m limit guarantees that the total RF power transmitted by the device is below the 0.25 Watt limit.

Also, according the part 15.35 we are allowed a relaxation of the general radiation limits found in 15.209 while using a peak detector, as applied to the harmonics of the fundamental. Inovonics EchoStream security transmitters have a transmission pulse duration of 20 ms, which corresponds to a duty cycle of 0.2 per 15.35(c). This duty cycle allows for a 14 dB relaxation of the general radiation limits from 54 dB µV/m (500 µV/m, per 15.209(a)) to 68 dB µV/m for peak measurements.

Sincerely,



Steven Dunbar
RF Engineer

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Appendix C

Measurement Protocol

And

Test Procedures

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MEASUREMENT PROTOCOL

GENERAL INFORMATION

Test Methodology

Conducted and radiated emission testing is performed according to the procedures in ANSI C63.4 & CNS13438.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into it's characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in dBμV, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the applicable limit.

To convert between dBμV and μV, the following conversions apply:

- dBμV = 20(log μV)
- μV = Inverse log(dBμV/20)

RADIATED EMISSIONS

The final level, expressed in dBμV/m, is arrived at by taking the reading from the spectrum analyzer (Level dBμV) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the applicable limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example: At a Test Frequency of 30 MHz, with a peak reading on the spectrum analyzer or measuring receiver of 14 dBμV:

Measured Level	+	Transducer & Cable Loss factor	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dBμV)		(dB)		(dBμV/m)	(dBμV/m)		(dBμV/m)		
14.0		**14.9**		**28.9**	**40.0**		**28.9**		**-11.1**

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DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 22GHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3, 10 or 30 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees.

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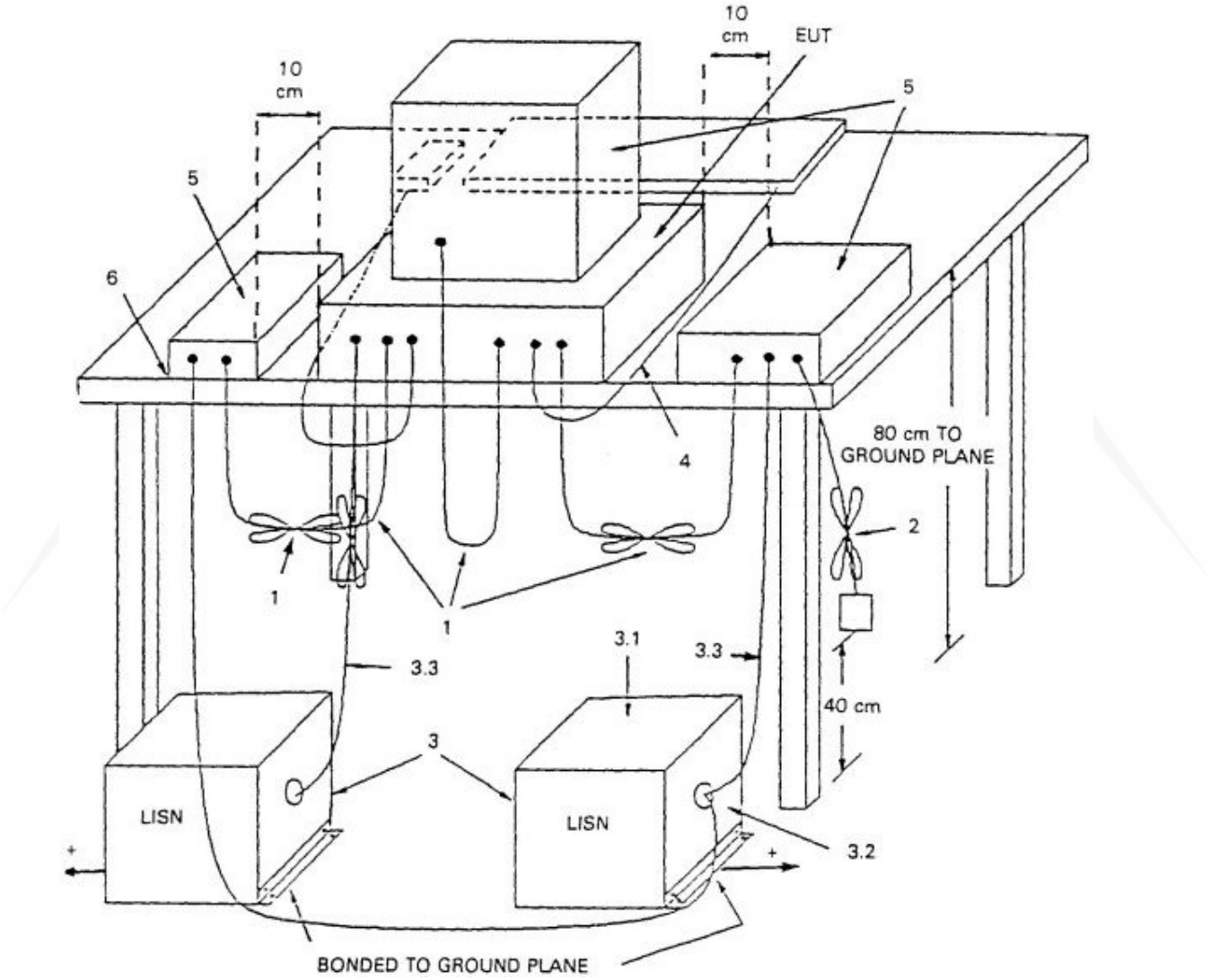
Conducted Emissions Diagram:



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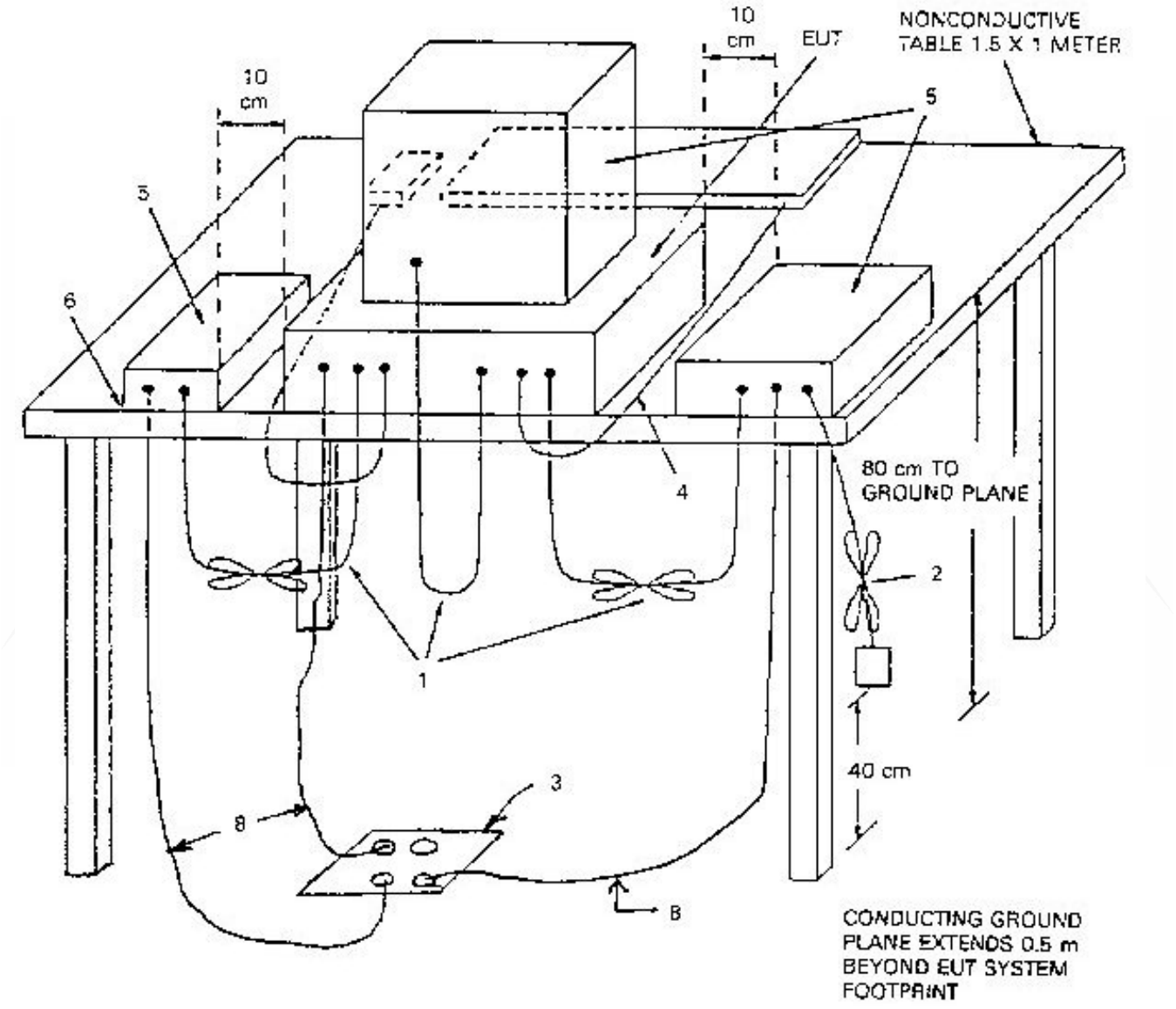
Radiated Emissions Diagram:



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