EMC EMISSIONS - TEST REPORT (In Part)

Test Report No.	**3153191DEN-003** Issue Date: **Thursday 22/May/2008**
Model / Serial No.	**MN: EN1249 /SN: 3566058**
Product Type	**Bill trap**
Client	**Inovonics Wireless Corporation**
Manufacturer	**Inovonics Wireless Corporation**
License holder	**Inovonics Wireless Corporation**
Address	**315 CTC Blvd.**
	LOUISVILLE, CO 80027
Test Criteria Applied	**FCC 47 CFR Part 15.247**
Test Result	**PASS**
Test Project Number	**3153191**
References	Title 47 CFR 15: RADIO FREQUENCY DEVICES
Total Pages Including Appendices:	**19**

Tested By : Ty Orosco

Reviewed By : Michael Spataro

REVISION SUMMARY - The following changes have been made to this Report:

Rev.	Revision Statement	Author	Revision Date
	Initial Release of Document	See above	See above

DIRECTORY

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: 16-May-2008

Testing Start Date: 16-May-2008

Testing End Date: 16-May-2008

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The tests were performed according to following regulations:

1. FCC CFR47 Part 15 subpart C

Emission Test Results:

Peak Output Power 15.247 (b)(2) - PASS					
Test Result					
Minimum limit margin	-2.4	dB	at	902.43	MHz
Remarks: Low Channel					

Radiated Emissions 15.205/15.247(d) - PASS					
Test Result					
Minimum limit margin	-0.4	dB	at	2785.8	MHz
Remarks: High Channel					

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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 Intertek.

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.

Whenever possible the approved test procedures specified in FCC KDB 558074 for DTS devices was used for testing.

Limit Calculation:
At the time of testing, Intertek ETL Semko was unable to obtain the gain of the antenna for the EUT from the manufacture of the EUT or from the manufacture of the antenna. Therefore, the following calculation was used to determine the field strength limit for a test distance of 3m. This calculation assumes ideal isotropic radiation from the source.

P = 20*log(E)-95.2289

P is power in dBm
E is uV/m

EUT is battery powered.

Only the fundamental and harmonics of the fundamental are covered in this report, as requested by the customer.

Sample:
☒Production ☐Prototype ☐See RFQ

Modifications required to pass: None

Test Specification Deviations: Additions to or Exclusions from: None

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Test-setup photo(s):
Radiated Emissions:

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Test-setup photo(s):
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Test-setup photo(s):
Radiated Emissions:

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Appendix A

Test Data Sheets

and

Test Equipment Used

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Fundamental field strength
And
Harmonics of the Fundamental

15.247 (b)(2), (d)/15.205

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Field Strength Measurements
Fundamental and Spurious of the Transmitter

Test Report #:	**3153191**	Test Area:	PW 1 (3M)	Temperature:	22.2	°C
Test Method:	FCC 47 CFR part 15 subpart C	Test Date:	16-May-2008	Relative Humidity:	27	%
EUT Model #:	EN1249	EUT Power:	3VDC	Air Pressure:	101	kPa
EUT Serial #:	3566058					
Manufacturer:	Inovonics					
EUT Description:	Bill trap					
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.								
14mS								
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								
Low Channel								
Axis 1 EUT is flat on the table.								
902.38	78.7 Pk	3.6 / 22.7 / 0.0	104.9	V / 1.7 / 8.1	0.0	104.9	119.0	-14.1
902.42	88.1 Pk	3.6 / 22.7 / 0.0	114.4	H / 1.0 / 93.5	0.0	114.4	119.0	-4.6
Axis 2 EUT is vertical on the table.								
902.43	90.3 Pk	3.6 / 22.7 / 0.0	116.6	V / 1.0 / 238.3	0.0	116.6	119.0	-2.4
902.38	80.9 Pk	3.6 / 22.7 / 0.0	107.2	H / 1.0 / 299.3	0.0	107.2	119.0	-11.8
Axis 3 EUT is laying on its side.								
902.39	85.3 Pk	3.6 / 22.7 / 0.0	111.6	V / 1.8 / 222.0	0.0	111.6	119.0	-7.4
902.42	87.0 Pk	3.6 / 22.7 / 0.0	113.3	H / 1.0 / 332.3	0.0	113.3	119.0	-5.7
Mid Channel								
Axis 1								
914.83	88.0 Pk	3.6 / 22.7 / 0.0	114.4	H / 1.0 / 103.1	0.0	114.4	119.0	-4.6
914.79	80.8 Pk	3.6 / 22.7 / 0.0	107.2	V / 1.7 / 118.1	0.0	107.2	119.0	-11.8
Axis 2								
914.79	80.2 Pk	3.6 / 22.7 / 0.0	106.5	H / 1.0 / 300.8	0.0	106.5	119.0	-12.5
914.83	89.1 Pk	3.6 / 22.7 / 0.0	115.5	V / 1.0 / 236.3	0.0	115.5	119.0	-3.5
Axis 3								
914.79	85.2 Pk	3.6 / 22.7 / 0.0	111.5	H / 1.0 / 328.4	0.0	111.5	119.0	-7.5
914.79	85.5 Pk	3.6 / 22.7 / 0.0	111.9	V / 1.0 / 181.4	0.0	111.9	119.0	-7.1
High Channel								
Axis 1								
927.59	79.2 Pk	3.6 / 22.8 / 0.0	105.6	V / 1.6 / 114.9	0.0	105.6	119.0	-13.4
927.63	87.2 Pk	3.6 / 22.8 / 0.0	113.7	H / 1.0 / 108.2	0.0	113.7	119.0	-5.3
Axis 2								
927.59	87.7 Pk	3.6 / 22.8 / 0.0	114.2	V / 1.0 / 266.1	0.0	114.2	119.0	-4.8
927.59	78.7 Pk	3.6 / 22.8 / 0.0	105.2	H / 1.0 / 302.6	0.0	105.2	119.0	-13.8
Axis 3								
927.59	86.7 Pk	3.6 / 22.8 / 0.0	113.2	V / 1.1 / 187.4	0.0	113.2	119.0	-5.8

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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)
927.59	86.5 Pk	3.6 / 22.8 / 0.0	112.9	H / 1.0 / 152.3	0.0	112.9	119.0	-6.1
Axis 2 was measured to be worst case.								
All harmonics will be measured with the EUT in axis 2.								
Low Channel								
1804.79	97.2 Pk	2.8 / 26.3 / 37.1	89.2	V / 1.8 / 7.9	-14	75.2	96.6	-21.4
1804.83	88.0 Pk	2.8 / 26.3 / 37.1	80	H / 1.0 / 124.1	-14	66	96.6	-30.6
2707.19	64.4 Pk	3.5 / 29.7 / 37.6	60	V / 1.0 / 172.5	-14	46	54	-8.0
2707.2	70.0 Pk	3.5 / 29.7 / 37.6	65.5	H / 1.7 / 0.0	-14	51.5	54	-2.5
3609.6	60.1 Pk	4.5 / 31.7 / 38.4	57.9	V / 1.4 / 118.9	-14	43.9	54	-10.1
3609.61	60.1 Pk	4.5 / 31.7 / 38.4	57.9	H / 1.3 / 326.3	-14	43.9	54	-10.1
4512	66.9 Pk	5.3 / 32.3 / 40.7	63.8	H / 1.3 / 30.1	-14	49.8	54	-4.2
4512	60.5 Pk	5.3 / 32.3 / 40.7	57.4	V / 1.0 / 355.3	-14	43.4	54	-10.6
5414.4	66.0 Pk	6.0 / 34.3 / 39.9	66.5	V / 1.1 / 17.4	-14	52.5	54	-1.5
5414.41	64.0 Pk	6.0 / 34.3 / 39.9	64.5	H / 1.0 / 329.9	-14	50.5	54	-3.5
6316.85	65.4 Pk	6.6 / 35.2 / 40.4	66.8	V / 1.1 / 29.4	-14	52.8	96.6	-43.8
6316.86	61.3 Pk	6.6 / 35.2 / 40.4	62.7	H / 1.1 / 291.8	-14	48.7	96.6	-47.9
7219.23	49.1 Pk	7.3 / 36.2 / 39.9	52.7	V / 1.1 / 6.2	-14	38.7	96.6	-57.9
7219.27	54.8 Pk	7.3 / 36.2 / 39.9	58.4	H / 1.1 / 319.9	-14	44.4	96.6	-52.2
Harmonics not listed were not seen above the noise floor.								
Mid Channel								
1829.67	89.2 Pk	2.8 / 26.4 / 37.1	81.4	H / 1.0 / 110.4	-14	67.4	94.4	-27.0
1829.68	100.1 Pk	2.8 / 26.4 / 37.1	92.3	V / 1.4 / 8.1	-14	78.3	94.4	-16.1
2744.45	68.6 Pk	3.5 / 29.8 / 37.6	64.3	H / 1.2 / 0.0	-14	50.3	54	-3.7
2744.46	64.2 Pk	3.5 / 29.8 / 37.6	60	V / 1.1 / 172.9	-14	46	54	-8.0
3659.29	62.1 Pk	4.5 / 31.8 / 38.4	60	H / 1.0 / 350.5	-14	46	54	-8.0
3659.29	60.2 Pk	4.5 / 31.8 / 38.4	58.2	V / 1.3 / 113.3	-14	44.2	54	-9.8
4574.11	56.6 Pk	5.3 / 32.4 / 40.7	53.6	V / 2.5 / 23.1	-14	39.6	54	-14.4
4574.11	63.8 Pk	5.3 / 32.4 / 40.7	60.8	H / 1.4 / 32.9	-14	46.8	54	-7.2
5488.94	57.9 Pk	6.1 / 34.5 / 40.1	58.4	V / 1.2 / 14.9	-14	44.4	94.4	-50.0
5488.94	56.3 Pk	6.1 / 34.5 / 40.1	56.8	H / 1.0 / 29.4	-14	42.8	94.4	-51.6
6403.81	60.2 Pk	6.7 / 35.2 / 40.5	61.7	V / 1.2 / 354.3	-14	47.7	94.4	-46.7
6403.82	60.3 Pk	6.7 / 35.2 / 40.5	61.8	H / 1.1 / 326.9	-14	47.8	94.4	-46.6
7318.63	49.5 Pk	7.4 / 36.4 / 40.3	52.9	H / 1.3 / 14.5	-14	38.9	54	-15.1
7318.64	51.6 Pk	7.4 / 36.4 / 40.3	55	V / 1.0 / 27.5	-14	41	54	-13.0
8233.26	53.8 Pk	7.9 / 37.1 / 47.7	51.1	V / 1.4 / 0.0	-14	37.1	54	-16.9
8233.27	53.2 Pk	7.9 / 37.1 / 47.7	50.6	H / 1.0 / 39.5	-14	36.6	54	-17.4
9148.08	52.9 Pk	8.5 / 38.1 / 48.6	50.8	H / 1.0 / 320.6	-14	36.8	54	-17.2
9148.09	53.3 Pk	8.5 / 38.1 / 48.6	51.3	V / 1.7 / 47.6	-14	37.3	54	-16.7
High Channel								
1855.24	90.8 Pk	2.9 / 26.5 / 37.1	83.1	H / 1.0 / 227.3	-14	69.1	94.2	-25.1
1855.29	100.3 Pk	2.9 / 26.5 / 37.1	92.6	V / 1.0 / 354.6	-14	78.6	94.2	-15.6
2782.8	71.7 Pk	3.5 / 30.0 / 37.6	67.6	H / 1.8 / 177.4	-14	53.6	54	-0.4
2782.86	66.8 Pk	3.5 / 30.0 / 37.6	62.8	V / 1.0 / 174.8	-14	48.8	54	-5.2
3710.41	65.0 Pk	4.5 / 31.9 / 38.2	63.3	H / 1.0 / 343.3	-14	49.3	54	-4.7
3710.49	64.2 Pk	4.5 / 31.9 / 38.2	62.4	V / 1.2 / 133.5	-14	48.4	54	-5.6
4638.02	63.2 Pk	5.4 / 32.6 / 40.5	60.7	H / 1.5 / 32.7	-14	46.7	54	-7.3
4638.02	55.1 Pk	5.4 / 32.6 / 40.5	52.5	V / 1.1 / 269.0	-14	38.5	54	-15.5
5565.63	57.1 Pk	6.1 / 34.6 / 39.8	58	H / 1.0 / 36.4	-14	44	94.2	-50.2
5565.63	58.8 Pk	6.1 / 34.6 / 39.8	59.7	V / 1.3 / 0.0	-14	45.7	94.2	-48.5
6493.29	59.1 Pk	6.8 / 35.3 / 40.2	61	H / 1.1 / 322.5	-14	47	94.2	-47.2
6493.3	59.6 Pk	6.8 / 35.3 / 40.2	61.4	V / 1.2 / 11.2	-14	47.4	94.2	-46.8
7420.84	53.8 Pk	7.4 / 36.5 / 39.8	57.8	V / 1.0 / 350.0	-14	43.8	54	-10.2
7420.9	53.1 Pk	7.4 / 36.5 / 39.8	57.2	H / 1.1 / 303.9	-14	43.2	54	-10.8
8348.48	52.9 Pk	8.0 / 37.1 / 47.9	50.1	H / 1.0 / 41.0	-14	36.1	54	-17.9
8348.49	54.6 Pk	8.0 / 37.1 / 47.9	51.8	V / 1.0 / 353.1	-14	37.8	54	-16.2
Harmonics not listed were not seen above the noise floor.								

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List of Equipment Utilized for Final Test

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Project Report

Begin Date: 5/16/2008 **End Date:** 5/16/2008

Technician Ty Orosco **Project** 3153191

Capital Asset ID	Manufacturer	Model #	Serial #	Description	Test Performed	Service Type	Service Date	Service Due
18808	EMCO	3146	9203-3376	Log Periodic Antenna	R Radiated Emissions	For Cal	10/12/2007	10/12/2008
18880	Hewlett-Packard	85650A	2811A01300	Q.P Adapter	R Radiated Emissions	For Cal	11/15/2007	11/15/2008
18882	Hewlett-Packard	8566B	2410A00154	Spectrum Analyzer (dc-22 GHz)	R Radiated Emissions	For Cal	11/13/2007	11/13/2008
18887	EMCO	3115	9205-3886	Horn Antenna 1-18GHz	R Radiated Emissions	For Cal	3/6/2008	3/6/2009
18900	Avantek	AFT97-8434-10F	1007	RF Pre-Amplifier (4-8 GHz)	R Radiated Emissions	For Ver	5/2/2008	5/2/2009
18901	Avantek	AWT-18037	1002	RF Pre-Amplifier (8-18 GHz)	R Radiated Emissions	For Ver	5/2/2008	5/2/2009
18906	Mini-Circuits Lab	ZHL-42	N052792-2	Amplifier	R Radiated Emissions	For Ver	5/2/2008	5/2/2009

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Appendix B

Test Plan

and

Constructional Data Form

To be supplied by the customer

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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 C63.4-2003 - "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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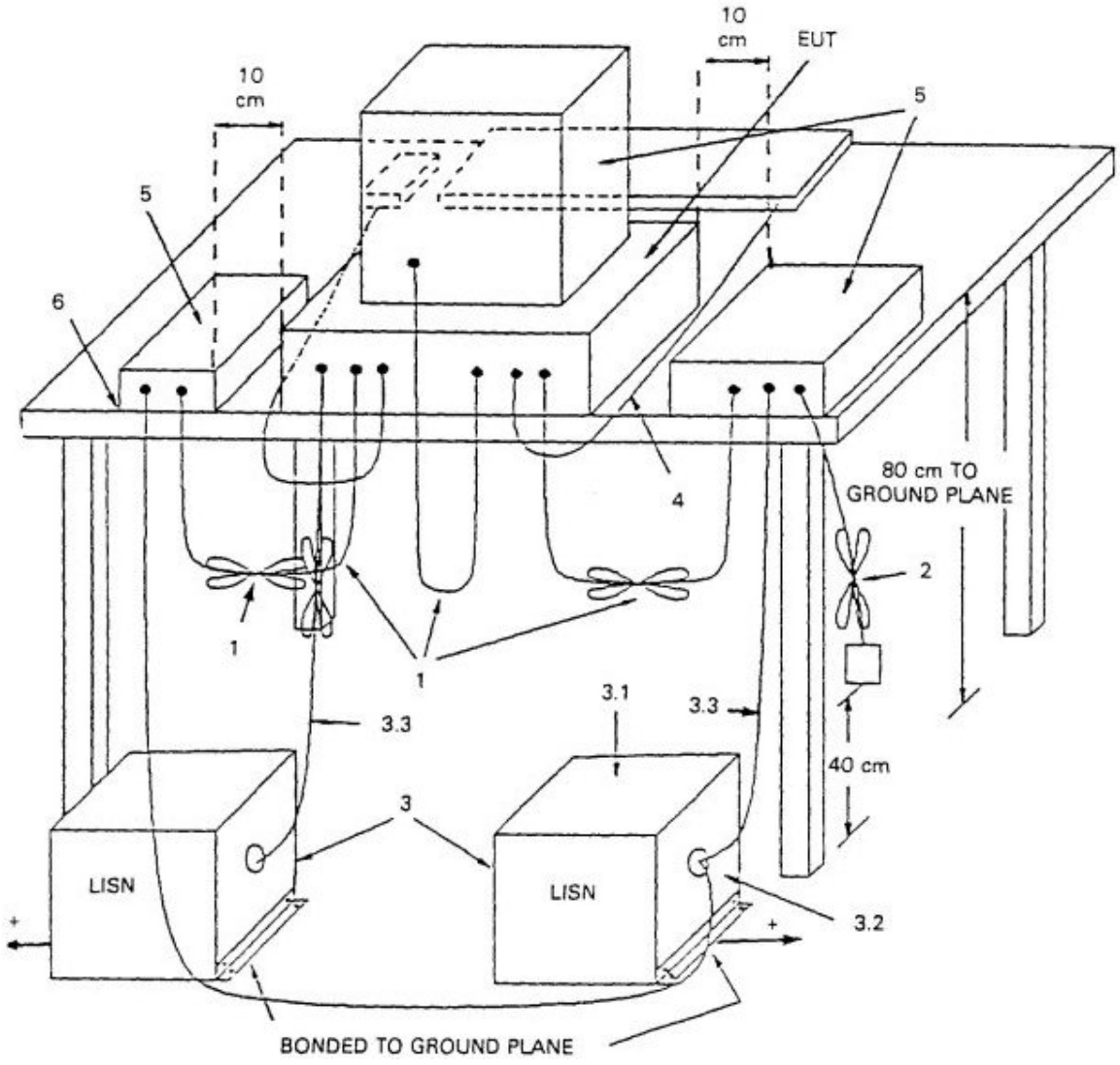
Conducted Emissions Diagram:



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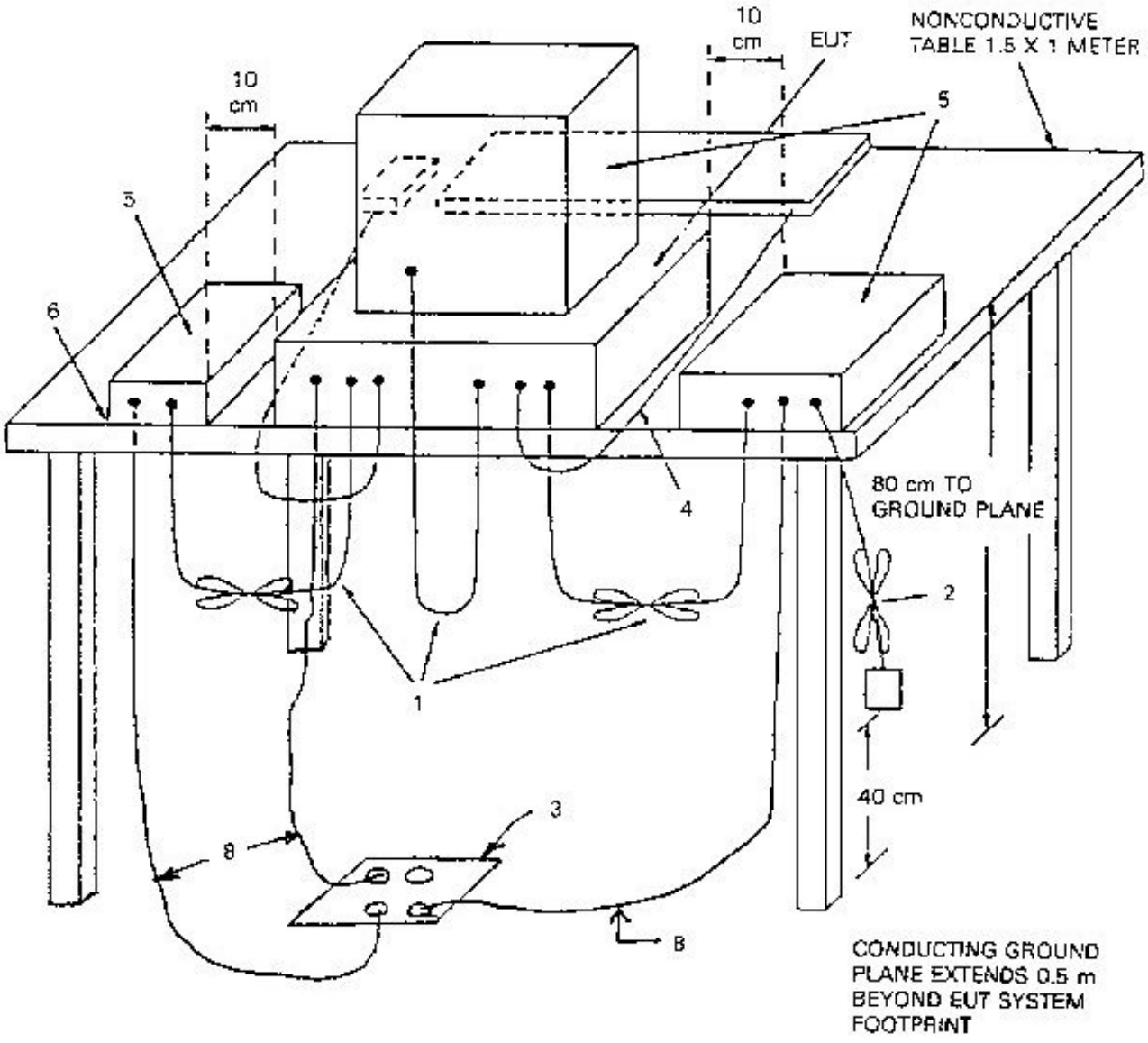
Radiated Emissions Diagram:



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