



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	Title 47 CFR 15: RADIO FREQUENCY DEVICES	
References			
Total Pages			
Including			
Appendices:	30		
<i>Todd J. Kelley</i>	<i>Robert Crosswell</i>		
Reviewed By :	Approved By :		

INTERNATIONAL APPROVALS LABORATORIES (IAL) reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. IAL have no liability for any deductions, inferences or generalizations drawn by the client or others from IAL issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval of IAL. This report shall not be used by the client to claim product endorsement by NVLAP (No. 200624-0) or any agency of the US government.

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



Lab Code: 200624-0



Accredited

DIRECTORY

Documentation	Page(s)
Test report	<u>1-30</u>
Directory	<u>2</u>
Test Regulations	<u>3</u>
General Remarks	<u>4-5</u>
Test-setup Photographs	<u>6-10</u>
Appendix A	
Test Data Sheets and Test Equipment Used	<u>11-22</u>
Appendix B	
Test Plan/Constructional Data Form	<u>23-25</u>
Appendix C	
Measurement Protocol/Test Procedures	<u>26-30</u>

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 $\pm 2.30\text{dB}$ and for Radiated Emissions is calculated to be $\pm 3.60\text{dB}$ in the frequency range of 30MHz – 200MHz and $\pm 3.38\text{dB}$ 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

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.

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

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	

Test-setup photo(s):
Conducted Emissions

Not Applicable



Test-setup photo(s):
Radiated Intentional Emissions



Test-setup photo(s):
Radiated Intentional Emissions



Test-setup photo(s):
Radiated Unintentional Emissions



Test-setup photo(s):
Radiated Unintentional Emissions



Appendix A

Test Data Sheets
and
Test Equipment Used

15.209 Test Data

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						

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
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						

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) (dBm) (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

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
***** 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

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

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.		<table border="1" style="width: 100%;"> <thead> <tr> <th colspan="2">Level Key</th> </tr> </thead> <tbody> <tr> <td>Pk – Peak</td> <td>Nb – Narrow Band</td> </tr> <tr> <td>Qp – QuasiPeak</td> <td>Bb – Broad Band</td> </tr> <tr> <td>Av - Average</td> <td></td> </tr> </tbody> </table>	Level Key		Pk – Peak	Nb – Narrow Band	Qp – QuasiPeak	Bb – Broad Band	Av - Average	
Level Key										
Pk – Peak	Nb – Narrow Band									
Qp – QuasiPeak	Bb – Broad Band									
Av - Average										
EUT Description:										
Notes:										

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	Duty Cycle Correction	Final Corrected	Limit	DELTA
(MHz)	(dBuV)	(dB) (dBm) (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 $20 \cdot \log_{10}(\text{duty cycle in 100ms})$ "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

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:		

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) (dBm) (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 $20 \cdot \log_{10}(\text{duty cycle in 100mS})$ "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

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) (dBm) (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 $20 \cdot \log_{10}(\text{duty cycle in 100mS})$ "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

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) (dBm) (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 $20 \cdot \log_{10}(\text{duty cycle in 100ms})$ "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

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

Appendix B

Test Plan
and
Constructional Data Form

To be supplied by the customer



315 CTC Boulevard, Louisville, CO 80027 | ph. 303.939.9336 | fx. 303.939.8977 | www.inovonicswireless.com

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,

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

Solving for E,

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

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

Remember the above assumption of isotropic radiation- all real antennas have non-isotropic radiation patterns. Using the 119.2 dB μ V/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 μ V/m (500 μ V/m, per 15.209(a)) to 68 dB μ V/m for peak measurements.

Sincerely,



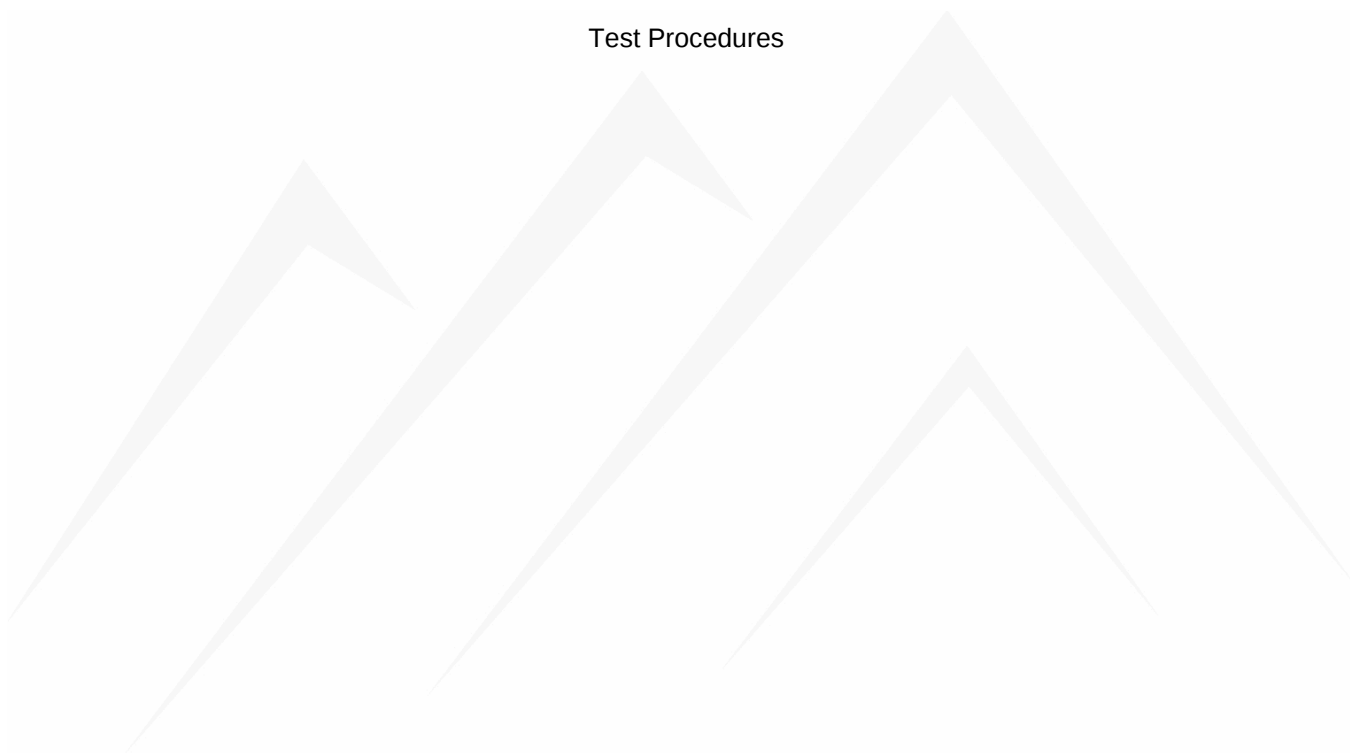
Steven Dunbar
RF Engineer

Appendix C

Measurement Protocol

And

Test Procedures



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 its 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 dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the applicable limit.

To convert between dB μ V and μ V, the following conversions apply:

- $\text{dB}\mu\text{V} = 20(\log \mu\text{V})$
- $\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$

RADIATED EMISSIONS

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB μ V) 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 dB μ V:

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

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."

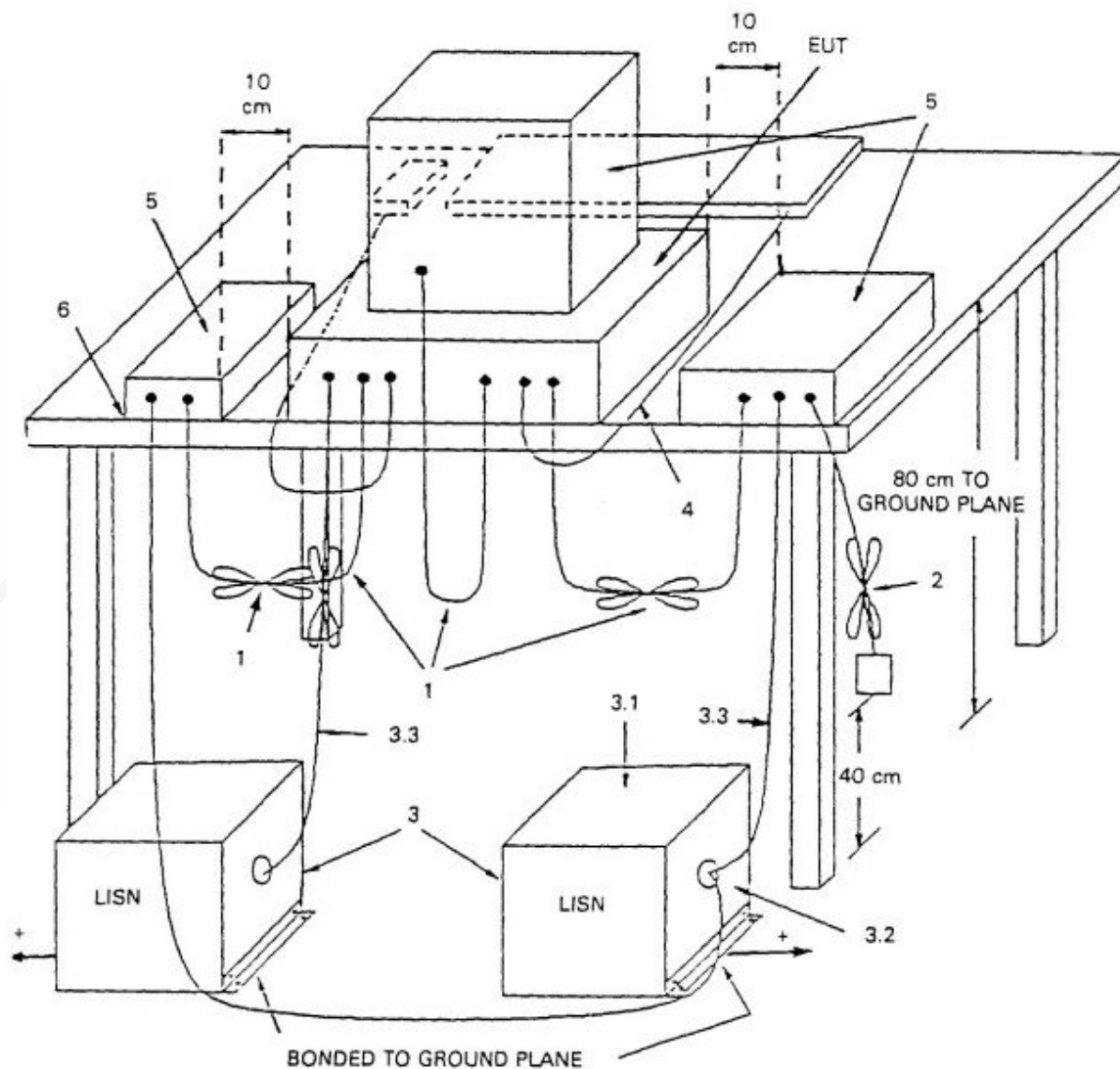
Conducted Emissions

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 μ H (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.

Conducted Emissions Diagram:



Radiated Emissions Diagram:

