FCC Part 24
Transmitter Certification

Test Report

FCC ID: DNY0A1EKLNK1900

FCC Rule Part: CFR 47 Part 24 Subpart E

ACS Report Number: 05-0458-24H

Manufacturer: EMS Wireless
Equipment Type: PCS Fiber-optic RF Distribution Remote Unit
Model: EkoLink II 1900

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FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612

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System Block Diagram
Schematics
External Photographs
Product Labeling
Installation/Users Guide
Parts List
Tune-up Procedure

1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J and Part 24 Subpart E of the FCC's Code of Federal Regulations.

1.2 Product Description

The EkoLink II System is designed to distribute Cellular and PCS radio signals within a building or campus of buildings where coverage/capacity would be otherwise impeded. Using fiber optics to distribute the signals, and a network of local antennas, the coverage area can be greatly enhanced. In an alternative system that covers a building by distributing radio base stations, one must add a base station in that area when faced with the problem of poor coverage in one section. Thus, capacity is added to a section which might not need it. Similarly, when faced with a capacity problem in a portion of the building, one would need an additional base station regardless of whether additional coverage is required.

Detailed photographs of the EUT are filed separately with this filing.

The EkoLink II 1900 is part of a product line that consist of a 800 PCS version as well as more compact lower power versions known as the EkoLite II 800 and 1900. Some documents contained in this filing may reference other models, configurations, or system components but the purpose of this report is to show compliance for the EkoLink II 1900 MHz remote unit only.

Detailed photographs of the EUT are filed separately with this filing.

1.3 Technical Specifications

Table 1.3-1: Specifications

PARAMETER	SPECIFICATIONS
Passband: PCS	1930 to 1990 MHz
Optical Connectors	SC/APC
Wavelength Uplink Downlink	 1550 nm ± 30 nm 1310 nm ± 30 nm
Optical Output Power (at I-Ith = 40 mA)	0 dBm ± 2 dB typical
Optical Return Loss	> 40 dB
LED Indicators	Green: Normal Operation Other than Green: Alarm

PARAMETER	SPECIFICATIONS
External DC Power Supply Requirement	20 - 48 V ± 1 V at 0.4 A (Max Ripple: <170 mV pp
Dimensions	19"L X 12.84"W X 3.47"D (48.3 cm x 32.6 cm x 8.8 cm) (EkoLink Standard) 22.76"L X 15.70"W X 7.98"D (57.8 cm x 39.9 cm x 20.3 cm) (EkoLink NEMA) 18.00"L X 18.00"W X 4.07"D (45.7 cm x 45.7 cm x 10.3 cm) (EkoLink Junction Box)
Weight (approximate)	8 lbs. (3.6 kg) (Standard Enclosure) 18 lbs. (8.2 kg) (NEMA Enclosure) 8 lbs. (3.6 kg) (Junction Box Enclosure)
Max Uplink RF Input Power	-10 dBm Max (no damage)
Downlink RF Output Power	+20 dBm (normal operation)
Temperature Range Performance to Full Spec Operating Storage Relative Humidity Operating Short Term	 5oC to 40oC 0oC to 50oC -20oC to 65oC 20 to 55% 10 to 80% (not exceeding 0.024 lbs water/dry air)

1.4 EUT Operating Configuration and Test Conditions

The EUT was configured and tested utilizing the maximum input drive level resulting in maximum gain conditions for all tests. If the maximum input drive level is exceeded, internal attenuators are activated to produce a level RF output and eliminate the device from operating beyond the maximum RF output power that is below the saturated RF output power.

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

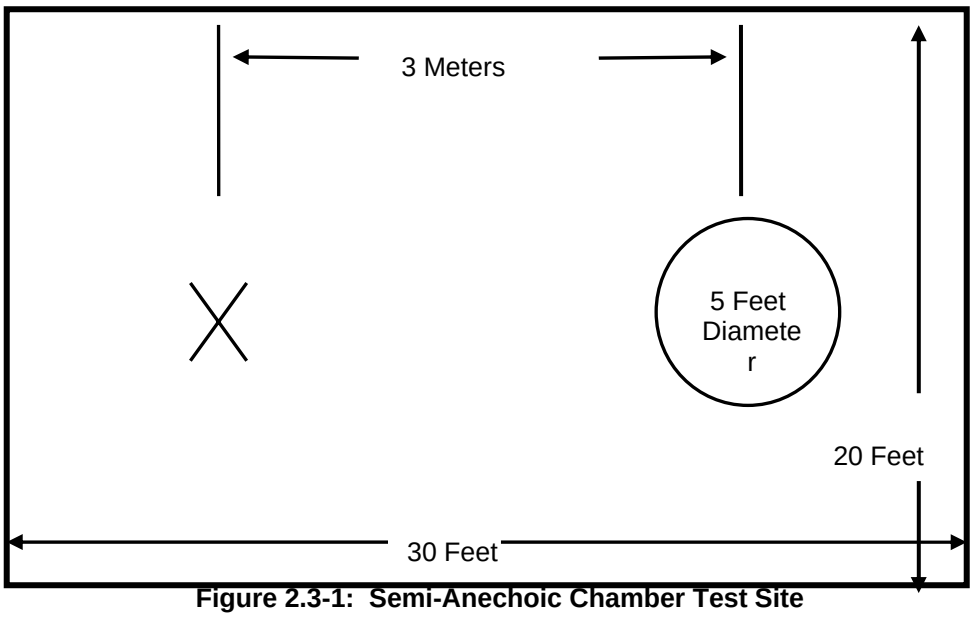

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

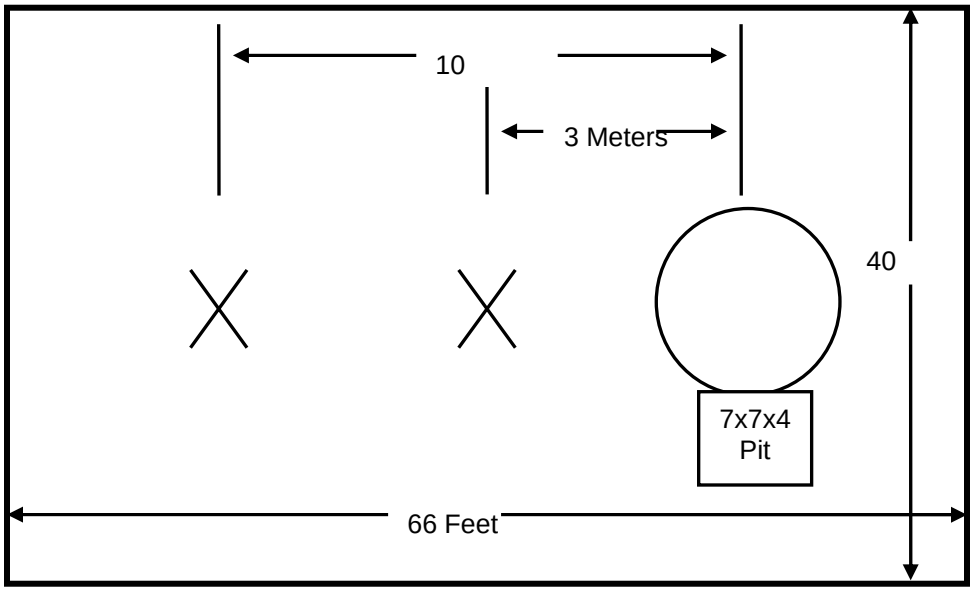

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description
The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 2.4-1:

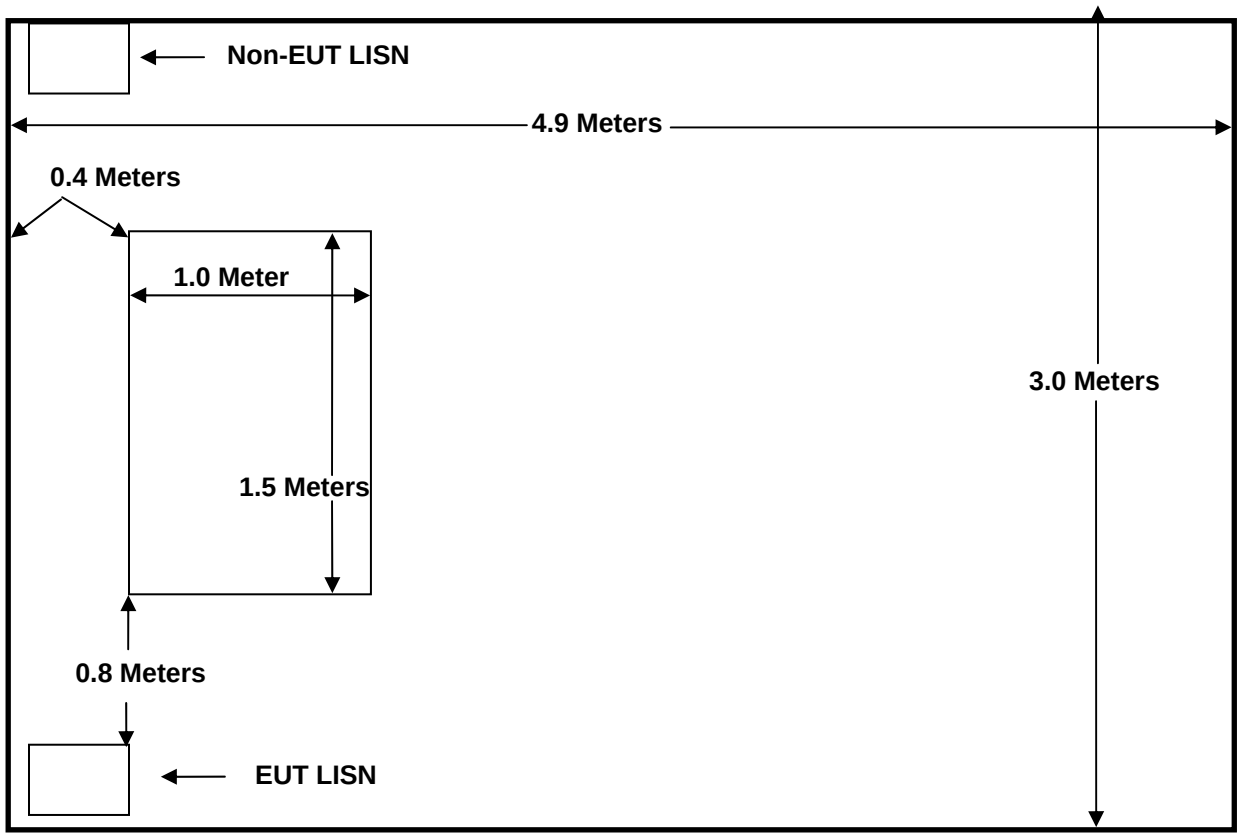

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

1 - ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
2 - US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures
3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart E: Broadband PCS

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
☐ 25	Chase	Bi-Log Antenna	CBL6111	1043	5/23/06
☐ 268	Agilent	Sensor	N1921A	MY45240184	10/10/06
☐ 041	ElectroMetrics	Bi-Con Antenna	BIA-25	2925	5/25/06
☐ 090	ElectroMetrics	LPA Antenna	LPA-25	1476	5/27/06
☐ 152	EMCO	LISN	3825/2	9111-1905	1/18/06
☐ 153	EMCO	LISN	3825/2	9411-2268	12/5/06
☐ 225	Andrew	OATS RF cable	Heliax	225	1/07/07
☐ 165	ACS	Conducted EMI Cable Set	RG8	165	1/06/06
☐ 22	Agilent	Pre-Amplifier	8449B	3008A00526	5/06/06
☐ 73	Agilent	Pre-Amplifier	8447D	272A05624	5/18/06
☐ 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	5/09/06
☐ 105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	9/13/06
☐ 209	Microwave Circuits	High Pass Filter	H3G020G2	4382-01 DC0421	9/20/06
☐ 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	3/07/06
☐ 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	3/07/06
☐ 3	Rohde & Schwarz	Receiver Display	804.8932.52	839379/011	11/02/06
☐ 4	Rohde & Schwarz	ESMI Receiver	1032.5640.53	833827/003	11/02/06
☐ ---	Agilent	Spectrum Analyzer	E7405A	US39110103	6/6/06
☐ 213	Test Equipment Corp.	Pre-Amplifier	PA-102	44927	12/5/06
☐ 211	Eagle	Band Reject Filter	C7RFM3NFNM	n/a	1/07/07
☐ 168	Hewlett Packard	Pulse Limiter	11947A	3107A02268	3/2/06
☐ 93	Chase	EM Clamp	CIC 8101	65	1/09/07
☐ 204	ACS	Cable	RG8	204	3/16/06
☐ 6	Harbour Industries	HF RF Cable	LL-335	00006	3/16/06
☐ 7	Harbour Industries	HF RF Cable	LL-335	00007	3/16/06
☐ 208	Harbour Industries	HF RF Cable	LL142	00208	6/24/06
☐ 5	Chase RF Current Probe	Current Probe	CSP-8441	19	1/06/06
☐ 167	ACS	Chamber EMI Cable Set	RG6	167	1/7/07
☐ 204	ACS	Chamber EMI RF cable	RG8	204	3/16/06
☐ 237	Gigatronics	Signal Generator	900	282706	1/10/07
☐ 267	Agilent	Power Meter	N1911A	MY45100129	10/30/06
☐ ---	Schaffner	ESD Generator	NSG 438	409	5/5/06

5.0 SUPPORT EQUIPMENT AND ACCESSORIES

Table 5-1: Support Equipment and Accessories

Diagram	Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
Amplifier	Hughes	Amplifier	1177H09F00	185	NA
Sig. Gen.	Agilent	Signal Generator	E4437B	US39260478	NA

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6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM

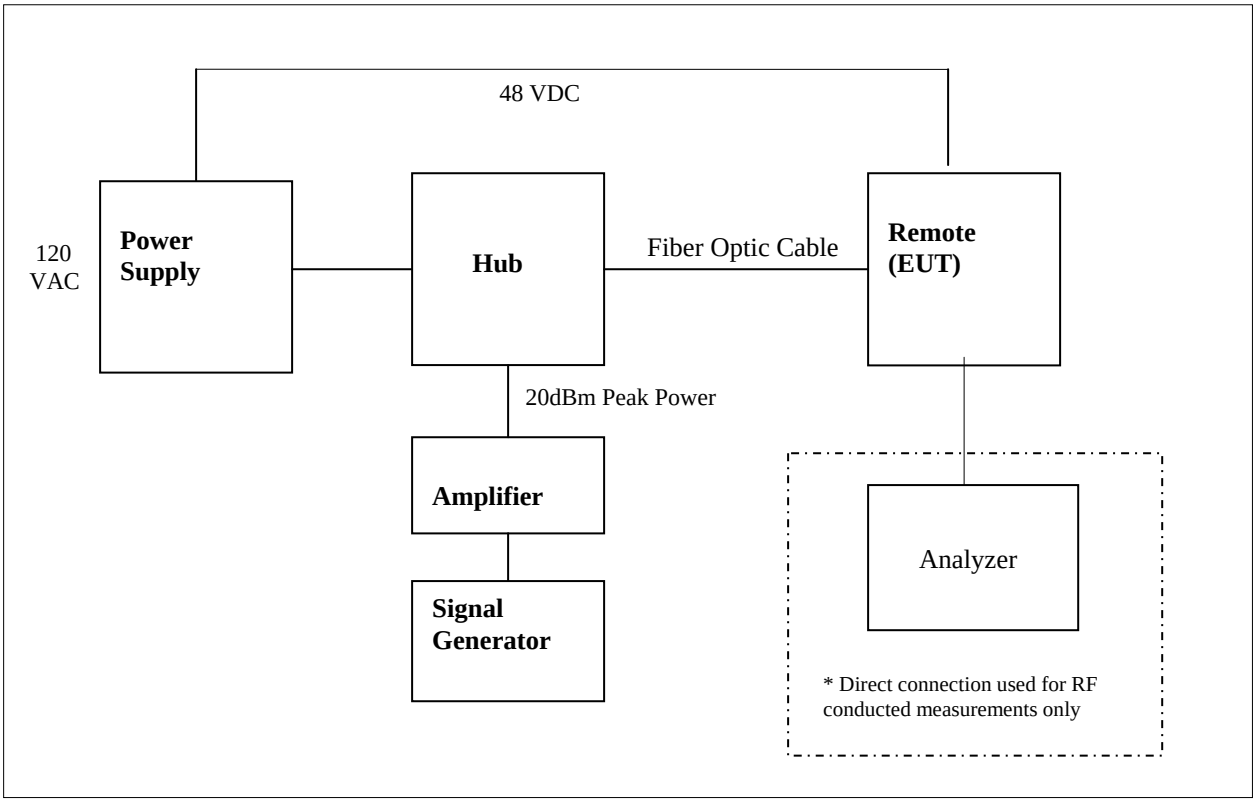

Figure 6-1: EUT Test Setup

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document. Data plots can be found in the test report appendix 05-0458-24E-A.

7.1 RF Power Output

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The resolution and video bandwidths of the spectrum analyzer were set at sufficient levels, >> emission bandwidth, to produce accurate results. The analyzer was set for Max Hold using a peak detector. Results are shown below in Table 7.1-1.

7.1.2 Measurement Results

Table 7.1-1: Peak Output Power

Modulation	Channel	Frequency (MHz)	RF Power Output (dBm)
CDMA	Low	1960.10	20.94
CDMA	Middle	1931.35	20.82
CDMA	High	1988.59	20.65
TDMA	Low	1959.07	20.23
TDMA	Middle	1930.07	20.32
TDMA	High	1990.01	20.07
GSM	Low	1930.20	20.42
GSM	Middle	1960.00	19.79
GSM	High	1989.80	19.84

7.2 Occupied Bandwidth (Emission Limits)

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The spectrum analyzer resolution and video bandwidths were set to 1% the emission bandwidth. The analyzer was set for Max Hold using a peak detector. Both the input and output bandwidths were evaluated to show similar characteristics of the emissions. Results for are shown below in Table 7.2-1.

7.2.2 Measurement Results

Occupied bandwidth plots are listed below and are supplied in the test report appendix 05-0458-24E-A.

Table 7.2-1: Occupied Bandwidth

Modulation	Channel	Frequency (MHz)	Plot Reference
CDMA	Middle	1960.0	Figure 1.
TDMA	Middle	1958.9	Figure 2.
GSM	Middle	1959.0	Figure 3.

7.3 Spurious Emissions at Antenna Terminals and Inter-modulation Products

7.3.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. For inter-modulation products the three tone method was used with the device operating at maximum drive levels. Three tones were placed at the lower band-edge and adjusted such that the third order harmonics were maximized and within the operating frequency band. Inter-modulation products were tested using TDMA, CDMA, and CW signals. CW covers FM (GSM and F1D) for inter-modulation products. The spectrum analyzer resolution and video bandwidths were set to 1% the emission bandwidth

For out of band spurious emissions the spectrum analyzer resolution and video bandwidths were set to 1 MHz according to Section 24.238 (b). The spectrum was investigated for the 30 MHz to 20 GHz in accordance to CFR 47 Part 2.1057. The analyzer was set for Max Hold using a peak detector. Spurious emissions were evaluated for all modulation modes.

7.3.2 Measurement Results

Emission plots are listed below in Table 7.3-1 and plots are supplied in the test report appendix 05-0458-24E-A.

Table 7.3-1: Spurious Emissions

Modulation	Channel	Frequency Range (MHz)	Plot Reference
CDMA	Low	In Band	Figure 4.
CDMA	Low	30 – 2500	Figure 5.
CDMA	Low	2500 - 20000	Figure 6.
CDMA	Middle	30 – 2500	Figure 7.
CDMA	Middle	2500 - 20000	Figure 8.
CDMA	High	30 – 2500	Figure 9.
CDMA	High	2500 - 20000	Figure 10.
TDMA	Low	In Band	Figure 11.
TDMA	Low	30 – 2500	Figure 12.
TDMA	Low	2500 - 20000	Figure 13.
TDMA	Middle	30 – 2500	Figure 14.
TDMA	Middle	2500 - 20000	Figure 15.
TDMA	High	30 – 2500	Figure 16.
TDMA	High	2500 - 20000	Figure 17.
CW	Low	In Band	Figure 18.
CW	Low	30 – 2500	Figure 19.
CW	Low	2500 - 20000	Figure 20.
GSM	Low	30 – 2500	Figure 21.
GSM	Low	2500 - 20000	Figure 22.
GSM	Middle	30 – 2500	Figure 23.
GSM	Middle	2500 - 20000	Figure 24.
GSM	High	30 – 2500	Figure 25.
GSM	High	2500 - 20000	Figure 26.

7.4 Band-edge Compliance

7.4.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The spectrum analyzer resolution and video bandwidths were set to 1% the emission bandwidth. The analyzer was set for Max Hold using a peak detector. The center frequency was set to both the upper and lower cellular frequency block edges.

7.4.2 Measurement Results

Band-edge plots in are listed in Table 7.4-1below and are supplied in the test report appendix 05-0458-24E-A.

Table 7.4-1: Band-edge

Modulation	Channel	Frequency (MHz)	Plot Reference
CDMA	Low	1931.3	Figure 27.
CDMA	High	1988.6	Figure 28.
TDMA	Low	1930.1	Figure 29.
TDMA	High	1990.0	Figure 30.
GSM	Low	1930.2	Figure 31.
GSM	High	1989.8	Figure 32.

7.5 Field Strength of Spurious Emissions

7.5.1 Measurement Procedure

The equipment under test is placed on the Semi-Anechoic Chamber (described in section 2.3.1) on a wooden table at the turntable center. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º and the maximum reading on the spectrum analyzer is recorded. This repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded.

The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057. A CW was used for low, middle and high channels. The worst case emissions are reported. All emissions not reported were below the noise floor of the measurement equipment.

Results of the test are shown below in Table 7.5-1.

7.5.2 Measurement Results

Table 7.5.-1: Field Strength of Spurious Emissions

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
3860	-62.00	-63.00	H	5.77	-57.23	-13.00	44.23
3860	-58.75	-56	V	5.77	-50.23	-13.00	37.23
3920	-60.60	-60.00	H	5.72	-54.28	-13.00	41.28
3920	-60	-58	V	5.72	-52.28	-13.00	39.28
3980	-61.9	-58	H	5.67	-52.33	-13.00	39.33
3980	-58.85	-56	V	5.67	-50.33	-13.00	37.33

7.6 Frequency Stability - FCC Section 2.1055

The device performs no frequency translation therefore frequency stability requirements are not applicable.

7.7 Radiated Emissions (Unintentional Radiators) - FCC Section 15.109

7.7.1 Measurement Procedure

The equipment under test is placed on the Open Area Test Site (described in section 2.1) on a wooden table at the turntable center. For each radiated emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º to obtain a maximum peak reading on the spectrum analyzer. The radiated emissions are then measured using an EMI receiver employing a CISPR quasi-peak detector for frequencies below 1000 MHz and an Average detector function for frequencies above 1000 MHz. This repeated for both horizontal and vertical polarizations of the receive antenna.

The field strength of each radiated emission is calculated by correcting the EMI receiver level for cable loss, amplifier gain, and antenna correction factors.

Field Strength (dBuV/m) = EMI Receiver Level (dBuV) + Cable Loss (dB) – Amplifier Gain (dB) + Antenna Correction Factor (1/m)

Results of the test are shown below in Table 7.7.-1.

7.7.2 Measurement Results

Table 7.7-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Uncorrected Reading (dBµV/m)	Antenna Polarity (H/V)	Total Correction Factor (dB)	Corrected Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
31.14	47.24	V	-14.45	32.79	39	6.2
35.09	50.83	V	-15.97	34.86	39	4.1
39.22	54.69	V	-16.34	38.35	39	0.6
43.75	50.54	V	-15.89	34.65	39	4.4
170.3	23.99	V	-7.93	16.06	43.5	27.4
173.3	31.3	V	-7.90	23.40	43.5	20.1
58.82	34.61	H	-14.99	19.62	39	19.4
61.23	42.45	H	-15.51	26.94	39	12.1
124.8	26.29	H	-13.70	12.59	43.5	30.9
92.22	23.09	H	14.95	38.04	43.5	5.5
109.7	8.26	H	15.94	24.20	43.5	19.3

7.8 Power Line Conducted Emissions - FCC Section 15.107

The EkoLink II 1900 is DC powered from a separate external power supply therefore Power Line Conducted Emissions is not required.

END Report