MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313

May 23, 2005

Airo Wireless
12 Piedmont Center
Suite 310
Atlanta, GA 30305

Dear Chip Hicks,

Enclosed is the EMC test report for compliance testing of the Airo Wireless, ACM328. The Airo Wireless, ACM328 was tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 24 Subpart E for Broadband PCS Devices.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,

MET LABORATORIES, INC.

Marie Confroy
Documentation Department

Reference: (\Airo Wireless\ EMC16726-FCC)

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Electromagnetic Compatibility Criteria
Test Report

For the

Airo Wireless
ACM328

Tested under

FCC Certification Rules
Title 47 of the CFR, Part 24 Subpart E for Broadband PCS Devices

MET Report: EMC16726-FCC

May 23, 2005

Prepared For:

Airo Wireless
12 Piedmont Center
Suite 310
Atlanta, GA 30305

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave
Baltimore, MD 21230

Electromagnetic Compatibility Criteria
Test Report

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Kevin Mehaffey
Electromagnetic Compatibility Lab

Marie Confroy
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 24 Subpart E and Part 15 Subpart B of the FCC Rules under normal use and maintenance.

Liming Xu
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	May 23, 2005	Initial Issue.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci **B**els
dBμV	**D**eci-**B**els above one **micro V**olt
dBμV/m	**D**eci-**B**els above one **micro V**olt **per m**eter
DC	**D**irect **C**urrent
DCF	**D**istance **C**orrection **F**actor
E	**E**lectric Field
EUT	**E**quipment **U**nder **T**est
e.i.r.p	**e**quivalent **i**sotropically **r**adiated **p**ower
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GHz	**G**iga **H**ert**z**
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kV	**k**ilo **V**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**H**ertz
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
V/m	**V**olts **per m**eter

2.0 Requirements Summary

Reference	Description	Compliance
Part 15 Subpart B §15.109(a)	Conducted Emissions	Not Applicable
Part 15 Subpart B §15.107(a)	Radiated Emissions	Compliant
2.1046; Part 24 Subpart E §24.232 (a), (c)	RF Power Output	Compliant
2.1047 (a)	Modulation Characteristics	Compliant
2.1049	Occupied Bandwidth	Compliant
2.1051; 24.238 (a)	Spurious Emissions at Antenna Terminals	Compliant
2.1051; 24.238 (b)	Spurious Emissions at Antenna Terminals Frequency Block Edges	Compliant
2.1053; 24.238 (a)	Radiated Spurious Emissions	Compliant
2.1055 (a) (1)	Frequency Stability Over Temperature Variations	Compliant
2.1055 (d) (2)	Frequency Stability Over Battery Power	Compliant

Table 1 Requirements Summary of EMC Part 24 ComplianceTesting

2.0 Equipment Configuration

2.1 Overview

An EMC evaluation to determine compliance of the Airo Wireless ACM328 with the requirements of Part 24 Subpart E and Part 15 Subpart B, was performed. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Airo Wireless ACM328. Airo Wireless should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the ACM328 has been **permanently** discontinued.

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 24 Subpart E, and Part 15 Subpart B, in accordance with Airo Wireless, purchase order number 3000. All tests were conducted using measurement procedure *ANSI C63.4-1992*.

Type of Submission/Rule:	Part 24 Original Filing
Model(s) Tested:	ACM328
Model(s) Covered:	ACM328
EUT Specifications:	Primary Power: 3.3-4.4 Vdc
	FCC ID QDL-ACM328
	Type of Emissions: 247 KGXW
	RF Power Output: Watt Conducted 1.0 Watt
	Equipment Frequency Range: (MHz) 1850.2-1909.8
	Frequency Stability: 20 Hz
Analysis:	The results obtained relate only to the item(s) tested.
Evaluated by:	Liming Xu
Date(s):	April 25, 2005

2.2 Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed semi-anechoic chamber. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

2.3 Description of Test Sample

The ACM328, Equipment Under Test (EUT) for the remainder of this document, is powered from a 3.3-4.2 Vdc supply.

The ACM328, Equipment Under Test (EUT), is a compact GSM/GPRS module designed for a wide range of applications and industries, providing users with wireless communications access or serving as a direct link for machine-to-machine (M2M) applications. The ACM328 module provides OEM customers with a quick to market wireless solution. Features of the ACM328 include:

- Support for 850/1800/1900 MHz operation
- GPRS Class 10
- GSM voice, data, fax, SMS support
- Compact size – 48mm x 35mm x 3.3 mm
- 60-pin external function connector

2.4 Equipment Configuration

The EUT was set up as outlined in Figure 1. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Name / Description	Model Number
Airo Triband GSM/GPRS	ACM328

Table 2. Equipment Configuration

2.5 Mode of Operation

The ACM328 module has one mode of operation: a host device communications to the module via a small 60-pin connector on the module.

2.6 Method of Monitoring EUT Operation

Procedure for operating the EUT:

- Connect antenna port to GSM test set or similar base station simulator, set up for operation in 1800, 1900 or 850MHz band
- Connect power supply to EUT, nominal voltage as specified. Power up the EUT
- After a few seconds, the EUT will register with GSM test set
- Make a call from the test set to the EUT. The EUT will auto answer.
- Proceed with testing.
- If the EUT fails to register with the test set: power cycle and try again; check test set configuration; check connections; check supply voltage; check mechanical integrity of EUT. If no fault apparent, refer issue to customer.

2.7 Modifications

2.7.1 Modifications to EUT

No modifications were made to the EUT.

2.7.2 Modifications to Test Standard

No modifications were made to the test standard.

2.8 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Airo Wireless upon completion of testing.

3.0 Electromagnetic Compatibility Criteria for Unintentional Radiators

3.1 Conducted limits

Test Requirement(s):

15.107 (a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 3. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

15.107 (b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 3. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

15.207(a), Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the Table 3, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency range (MHz)	Class A Conducted Limits (dBµV)		*Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50

Note 1 — The lower limit shall apply at the transition frequencies.

Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.

* -- Limits per Subsection 15.207(a).

Table 3. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)

Results: The EUT was not applicable with the requirements of this section. The EUT is DC powered only.

Conducted Limits Test Results

3.2 Unintentional Radiated Emission Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 4.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 4.

Frequency (MHz)	Field Strength (dBμV/m)	
	§ 15.109 (b), Class A Limit (dBμV) @ 10m	§ 15.109 (a),Class B Limit (dBμV) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

Table 4. Radiated Emissions Limits calculated from FCC Part 15 Subpart B, 15.109 (a) (b)

Test Procedure:

a) The EUT was placed on a 0.8 m high wooden table (See Photograph 1).

b) Various antennas were placed near the EUT and measurements were taken of the field strengths and frequencies. For final radiated measurements, the EUT was placed in semi-anechoic chamber, and located 1 m and 3 m from an adjustable antenna mast.

c) For pre-scanning, the spectrum analyzer scanned the frequency range from 30 MHz to 1 GHz to obtain an emission profile of the EUT. For each point of measurement, the turntable was rotated, and the antenna height was varied between 1 m and 4 m, in order to find the maximum radiated emissions.

d) Measurements above 30 MHz were taken using the above procedures with the antenna in two polarizations: horizontal and vertical. Unless otherwise specified, measurements between 30 MHz and 1 GHz were made using a quasi-peak detector with a 120 kHz bandwidth.

e) For measurements above 1 GHz, a 1 MHz detector was used with either a "peak" detector or an "average" detector. In general, all radiated emissions above 1 GHz measurements were made with the peak detector unless otherwise noted.

Test Results: The EUT complies with the requirements of this section.

Test Engineer(s): Liming Xu

Test Date(s): 3/3/2005

Electromagnetic Compatibility Criteria for Unintentional Radiators

Unintentional Radiated Emission Limits Test Results

Radiated Emissions Limits Test Results, 15.109 (30 MHz to 1 GHz) Class B

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna Height (m)	Uncorrected Amplitude (dBuv)	ACF (dB) (+)	Cable Loss (dB) (+)	DCF (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
34.500	215	H	1.36	13.80	8.81	1.37	0.00	23.98	40.00	-16.02
34.500	215	V	1.00	15.60	8.33	1.37	0.00	25.30	40.00	-14.70
178.160	215	H	1.30	7.50	8.95	2.84	0.00	19.30	43.50	-24.20
178.160	215	V	1.00	15.50	8.96	2.84	0.00	27.31	43.50	-16.19
215.000	215	H	1.33	14.60	10.60	3.10	0.00	28.30	43.50	-15.20
215.000	215	V	1.00	9.55	10.70	3.10	0.00	23.35	43.50	-20.15
520.960	284	H	1.00	3.98	17.42	4.58	0.00	25.98	46.00	-20.02
520.960	284	V	1.00	3.98	17.46	4.58	0.00	26.02	46.00	-19.98
772.800	284	H	1.00	6.03	21.04	5.42	0.00	32.50	46.00	-13.50
772.800	284	V	1.00	6.03	20.60	5.42	0.00	32.05	46.00	-13.95
967.640	284	H	1.00	6.90	23.75	6.11	0.00	36.76	54.00	-17.24
967.640	284	V	1.00	7.10	23.35	6.11	0.00	36.56	54.00	-17.44

Electromagnetic Compatibility Criteria for Unintentional Radiators

Unintentional Radiated Emission Limits Test Results

High Frequency Radiated Emissions Limits Test Results, 15.109 (1GHz to 10 GHz) Class B

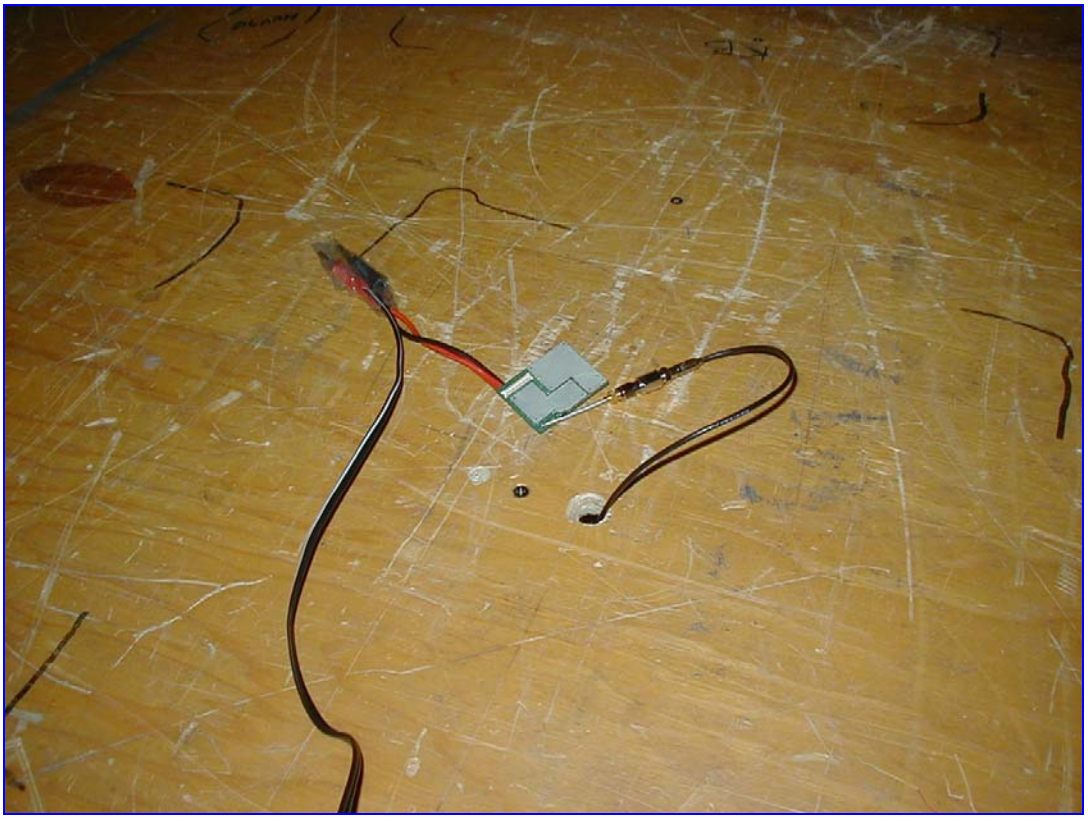
Frequency (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna Height (m)	Uncorrected Amplitude (dBuv)	ACF (dB) (+)	System Gain (dB) (-)	DCF (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
3.735	284	H	1.00	35.00	32.36	26.67	9.54	31.15	54.00	-22.85
3.735	284	V	1.00	37.50	32.26	26.67	9.54	33.55	54.00	-20.45
5.603	284	H	1.00	36.17	34.90	27.38	9.54	34.15	54.00	-19.85
5.603	284	V	1.00	37.67	34.80	27.38	9.54	35.55	54.00	-18.45
7.471	284	H	1.00	37.17	37.43	25.41	9.54	39.65	54.00	-14.35
7.471	284	V	1.00	37.17	37.33	25.41	9.54	39.55	54.00	-14.45
9.339	284	H	1.00	35.50	38.40	23.50	9.54	40.86	54.00	-13.14
9.339	284	V	1.00	35.50	38.30	23.50	9.54	40.76	54.00	-13.24
11.207	284	H	1.00	35.00	39.02	24.91	9.54	39.58	54.00	-14.42
11.207	284	V	1.00	35.00	38.92	24.91	9.54	39.48	54.00	-14.52
13.075	284	H	1.00	36.17	40.00	26.36	9.54	40.26	54.00	-13.74
13.075	284	V	1.00	36.33	39.88	26.36	9.54	40.31	54.00	-13.69
14.943	284	H	1.00	36.67	39.90	26.61	9.54	40.42	54.00	-13.58
14.943	284	V	1.00	36.67	39.63	26.61	9.54	40.14	54.00	-13.86
16.811	284	H	1.00	36.00	41.01	24.08	9.54	43.39	54.00	-10.61
16.811	284	V	1.00	36.17	40.85	24.08	9.54	43.40	54.00	-10.60

Note: The EUT was tested at 1 m. The data has been corrected for comparison with the 3 m limit using the formula: 20log (1/3) as expressed in the 'Distance Correction' column.

Unintentional Radiated Emission Limits Test Setup

Photograph 1. Unintentional Radiated Emission Limits, Test Setup

Unintentional Radiated Emission Limits Test Setup



Photograph 2. Unintentional Radiated Emission Limits, Test Setup

Unintentional Radiated Emission Limits Test Setup

Photograph 3. Unintentional Radiated Emission Limits, Test Setup

4.0 Electromagnetic Compatibility Criteria for Broadband PCS Devices

4.1 RF Power Output

Test Requirement(s): **§ 2.1046 Measurements required: RF power output:**

§ 2.1046 (a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8).The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

§ 2.1046 (b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

§ 2.1046 (c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 24.232 Power and antenna height limits.

§ 24.232 (b): Mobile/portable stations are limited to 2 watts e.i.r.p. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

HAAT in meters Maximum	e.i.r.p. (Watts)
≤300	1,640
≤500	1,070
≤1,000	490
≤1,500	270
≤2,000	160

Table 5. Table One from 24.232 (a) - Reduced Power for Base Station

§ 24.232 (c): Peak transmit-power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

Test Procedures:

a) The EUT was placed on a 0.8 m high wooden table (See Photograph 4).

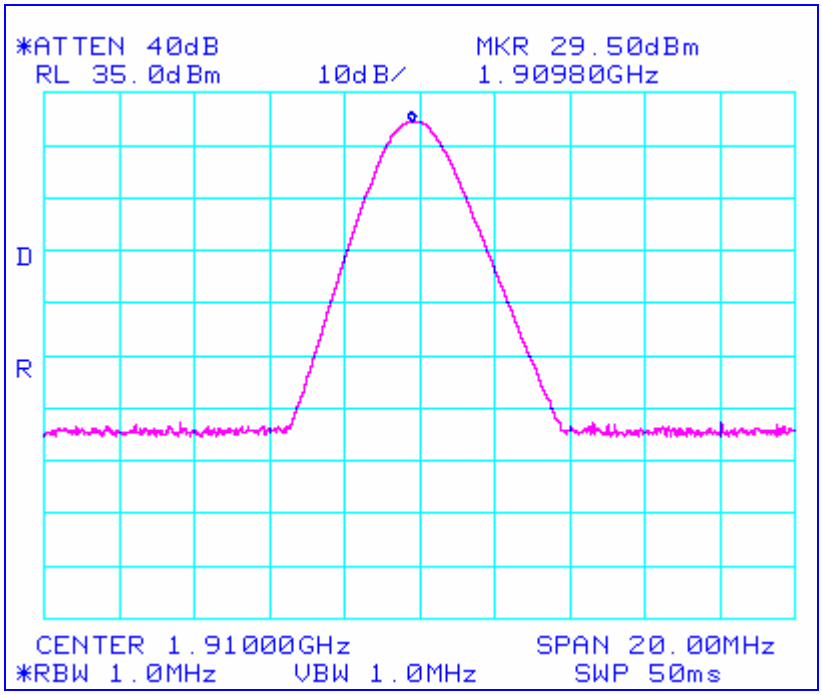
b) As required by 47 CFR 2.1046, RF power output measurements were made at the RF output terminals using an attenuator and spectrum analyzer. This test was performed with carrier modulated by a PCS GSM, modulated signal.

Test Results: The EUT complied with the requirement(s) of this section. The EUT conducted power does not exceed limit at the carrier frequency.

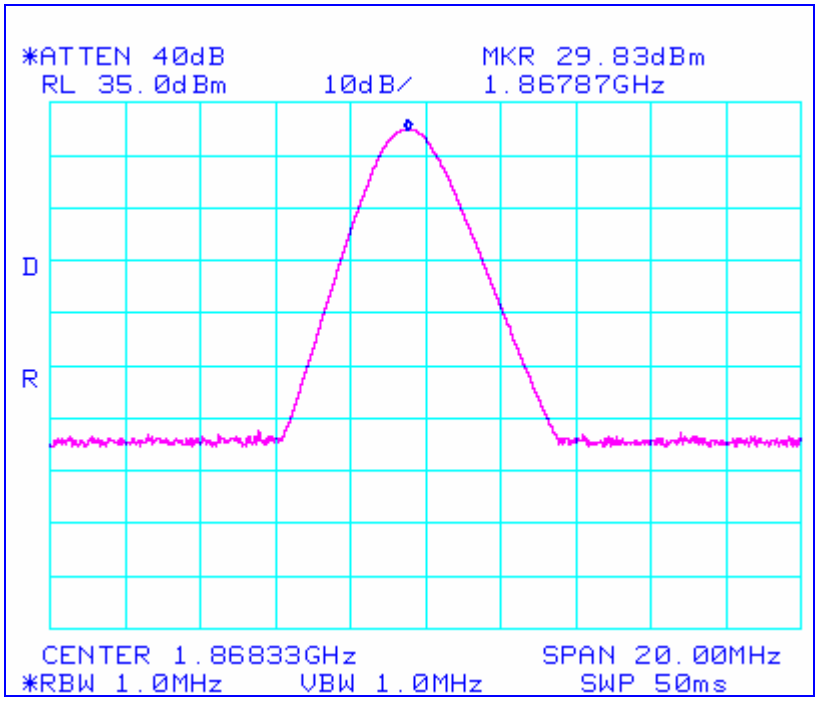
Test Engineer(s): Liming Xu

Test Date(s): 2/21/2005

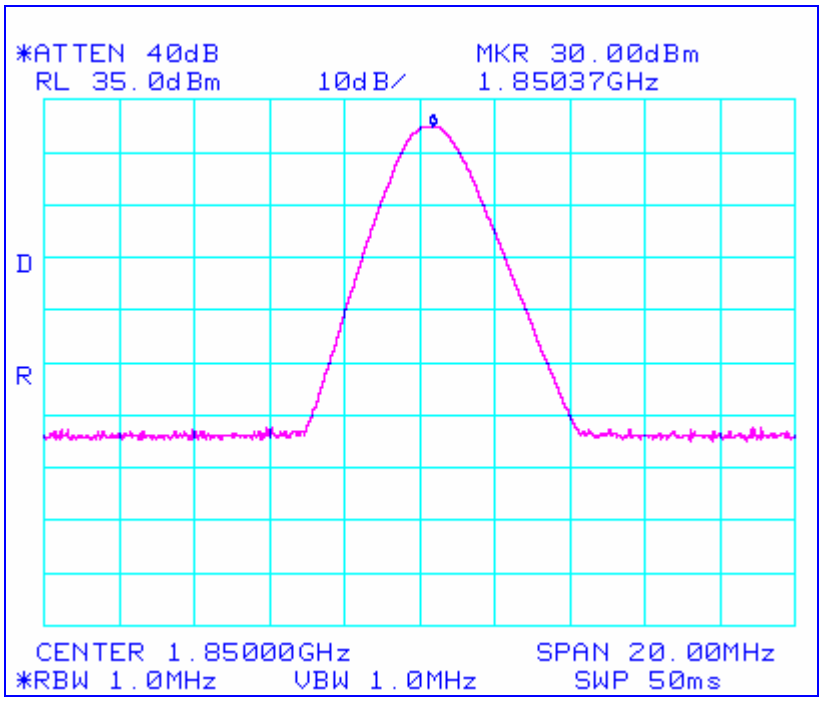
RF Power Output Test Results



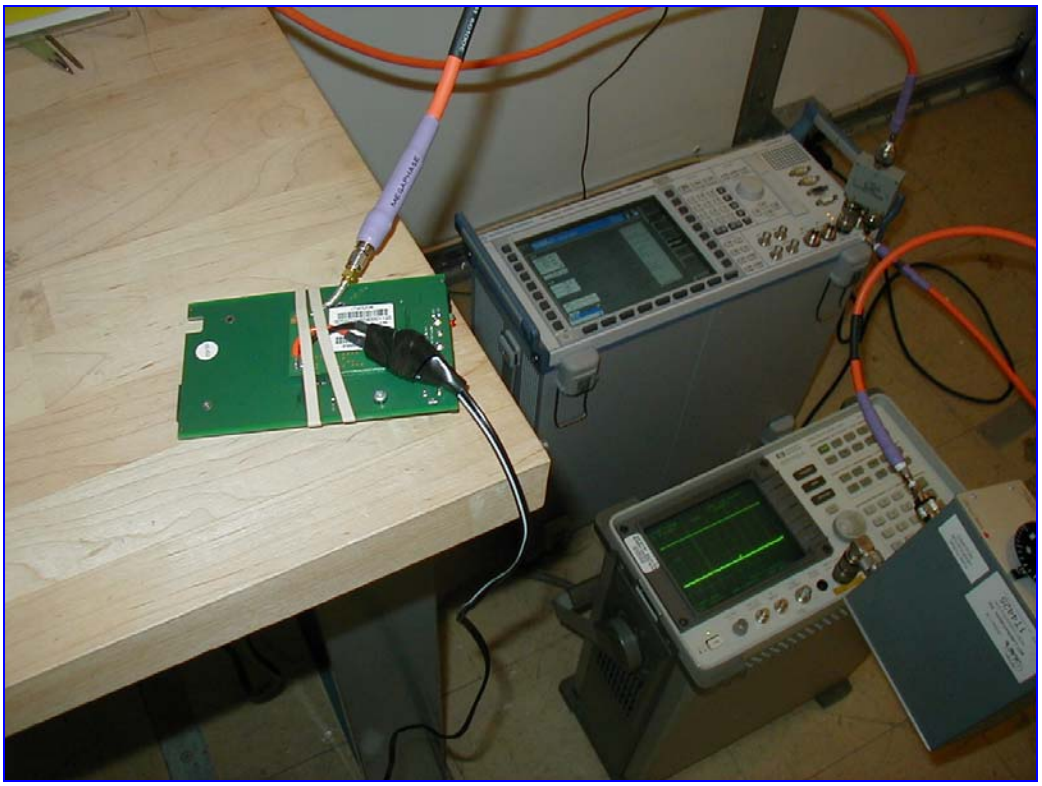
RF Power Output Test Results



RF Power Output Test Results



ACM328 Part 24 Test Setup



Photograph 4. EUT Test Setup for Part 24 - Broadband PCS Devices

4.2 Modulation Characteristics

Test Requirement(s): **§ 2.1047 Measurements required: Modulation characteristics**

§ 2.1047 (a): Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Test Procedures:

a) The EUT uses GMSK modulation. In GMSK modulation, voice or data information is digitized and coded into a bit stream.

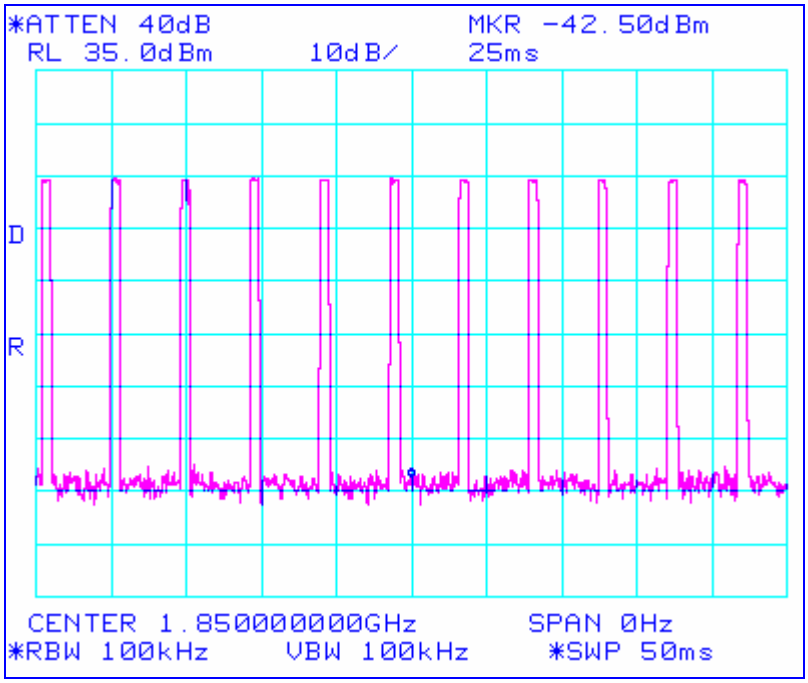
b) Modulation plots were taken in order to give a detailed explanation of the modulation scheme used in the EUT of the PCS system.

Test Results: The EUT complies with the requirements of this section. The following plot illustrates a detailed explanation of the modulation scheme used in the EUT of the PCS system.

Test Engineer(s): Liming Xu

Test Date(s): 3/1//2005

4.3 Modulation Characteristics Test Results



4.4 Occupied Bandwidth

Test Requirement(s): **§ 2.1049 Measurements required: Occupied bandwidth:** The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

a) As required by §2.1049 of CFR 47, occupied bandwidth measurements were made on the EUT.

b) The EUT was configured to transmit a PCS GMSK modulated carrier signal.

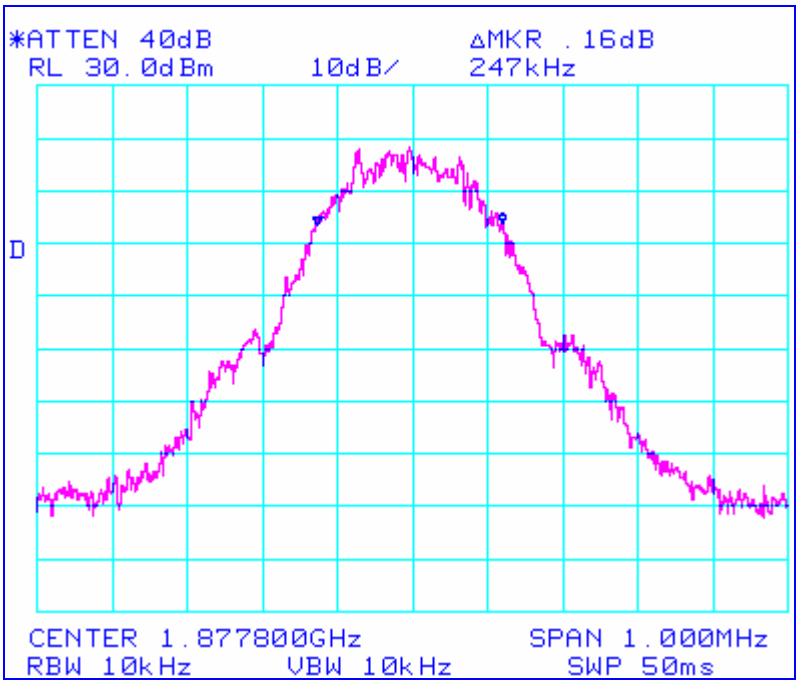
c) Using an IF bandwidth of 10 kHz, the test engineer determined the occupied bandwidth of the emission at the center of the selectable channel range and recorded the detailed measurements as plotted data.

Test Results: The EUT complies with the requirements of this section.

Test Engineer(s): Liming Xu

Test Date(s): 2/21/2005

Occupied Bandwidth Test Results



4.5 Spurious Emissions

4.5.1 Spurious Emissions at Antenna Terminals

Test Requirement(s):

§ 2.1051 Measurements required: Spurious emissions at antenna terminals: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

24.238 Emission limitations for Broadband PCS equipment: The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

§ 24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Test Procedures:

a) As required by 47 CFR 2.1051, spurious emissions at antenna terminal measurements were made at the RF output terminals using a 50 Ω attenuation and spectrum analyzer set for a 100 kHz bandwidth.

b) The RBW of 100 kHz was used to investigate and search for spurious emissions; any spurious emissions found with this technique were re-measured with the appropriate 1 MHz RBW.

c) This test was performed with digitally modulated carrier signals, and the EUT was adjusted for continuous transmission on frequencies across the operating band.

d) The frequency spectrum was investigated from 9.0 KHz to 20.0 GHz. For measuring emissions above 2 GHz, a high-pass filter was used to eliminate the fundamental transmit frequency to prevent possible saturation effects on the front end of the spectrum analyzer.

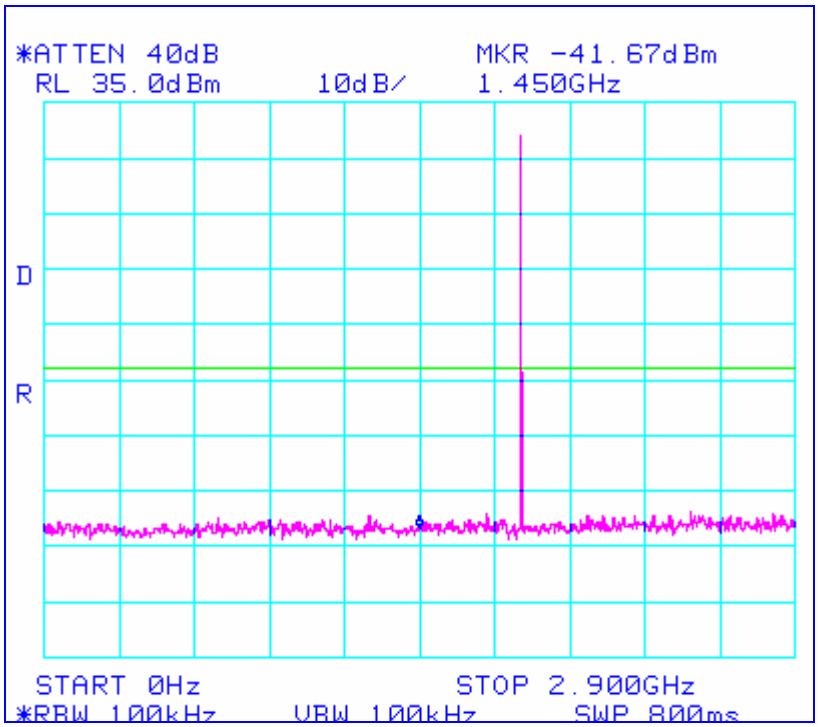
Test Results: The EUT complies with the requirements of this section. There were no detectable spurious emissions for this EUT.

Test Engineer(s): Liming Xu

Test Date(s): 2/22/2005

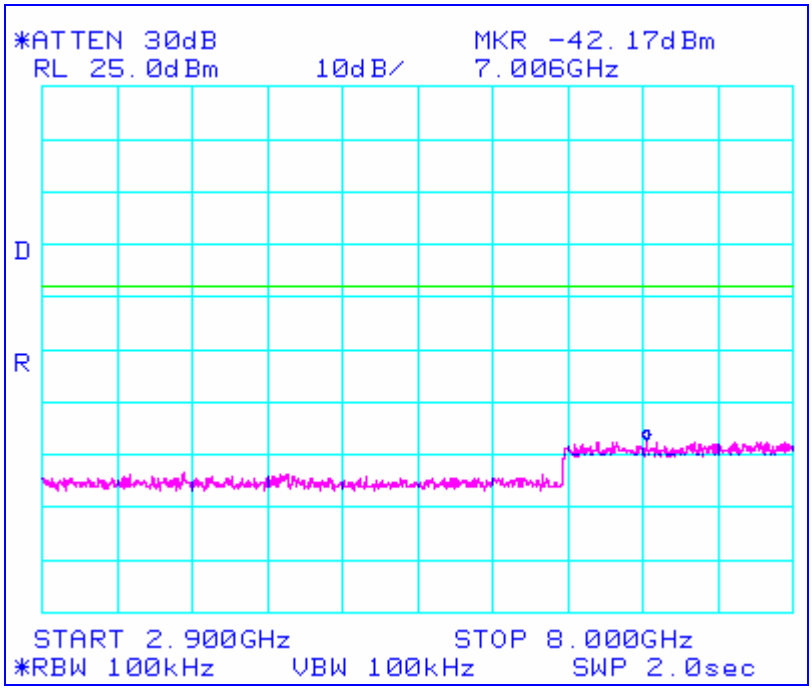
Spurious Emissions at Antenna Terminals Test Results

Conducted Spurious Emissions Measurements at Antenna Terminals, Test Data Plots



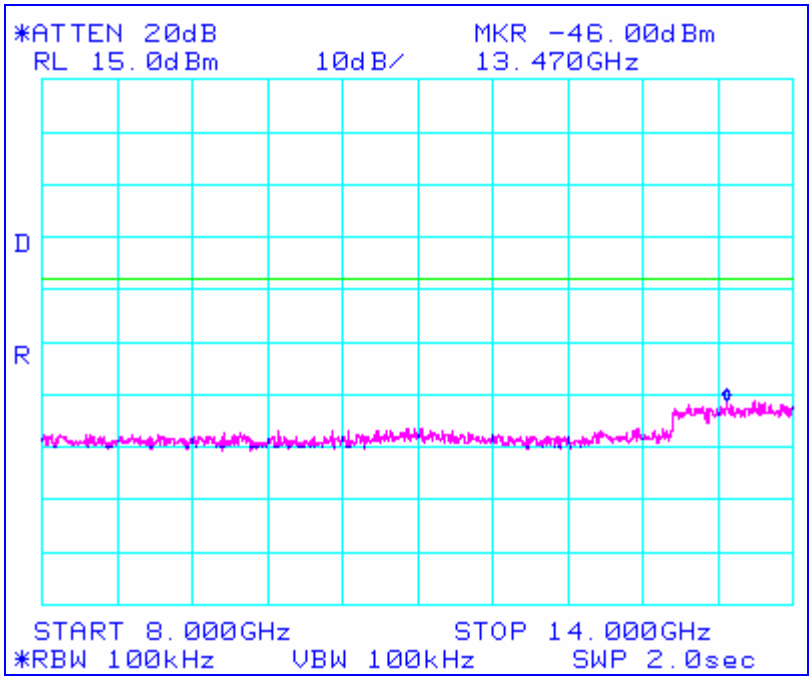
Spurious Emissions at Antenna Terminals Test Results

Conducted Spurious Emissions Measurements at Antenna Terminals, Test Data Plots



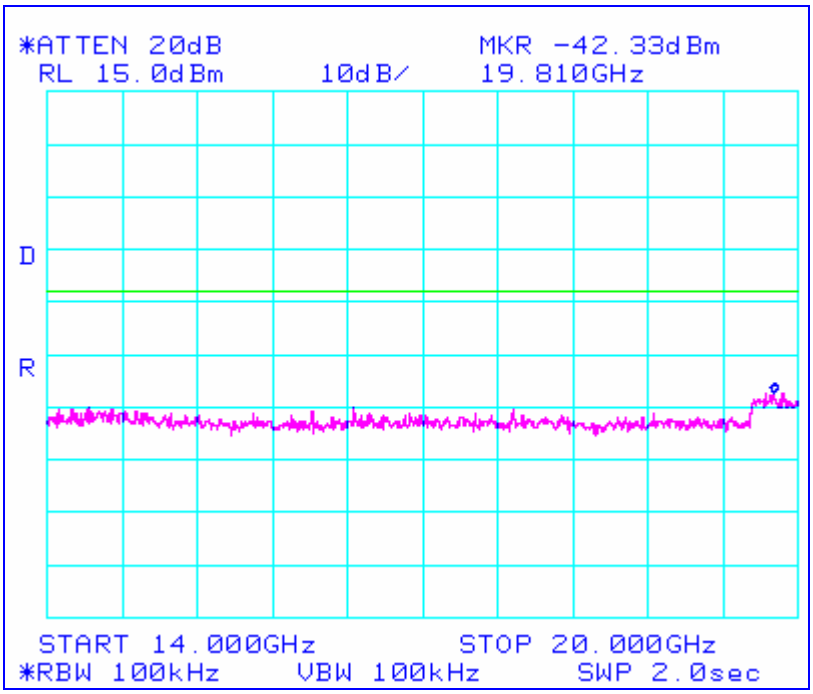
Spurious Emissions at Antenna Terminals Test Results

Conducted Spurious Emissions Measurements at Antenna Terminals, Test Data Plots



Spurious Emissions at Antenna Terminals Test Results

Conducted Spurious Emissions Measurements at Antenna Terminals, Test Data Plots



4.5.2 Spurious Emissions at Antenna Terminal Frequency Block Edges

Test Requirement(s): **§ 2.1051 Measurements required: Spurious emissions at antenna terminals:** The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

24.238 Emission limitations for Broadband PCS equipment: The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

§ 24.238 (b): Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Test Procedures:

a) As recommended in FCC Part 24, greater than or equal to 1% of emission spectrum bandwidth was chosen to measure the peak of any emission inside the 1.0 MHz frequency band adjacent to each frequency block edge. All other frequencies were measured using a 3 KHz RBW.

b) The unit was exercised using signal types required by §2.1049.

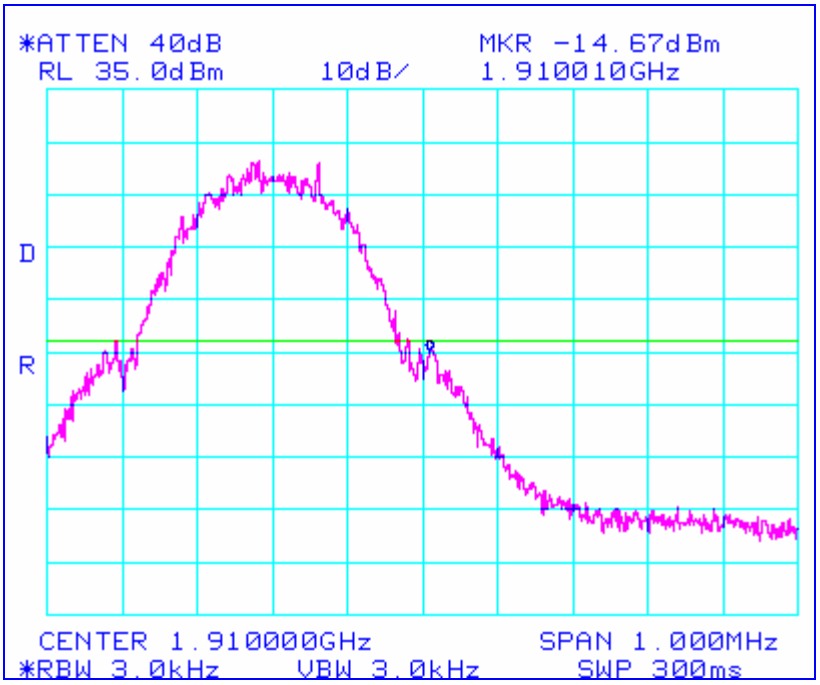
Test Results: The EUT complies with the requirements. Modulation products outside of this band are attenuated at least 43 + 10 Log (P) below the level of the modulated carrier.

Test Engineer: Liming Xu

Test Date(s): 2/22/2005

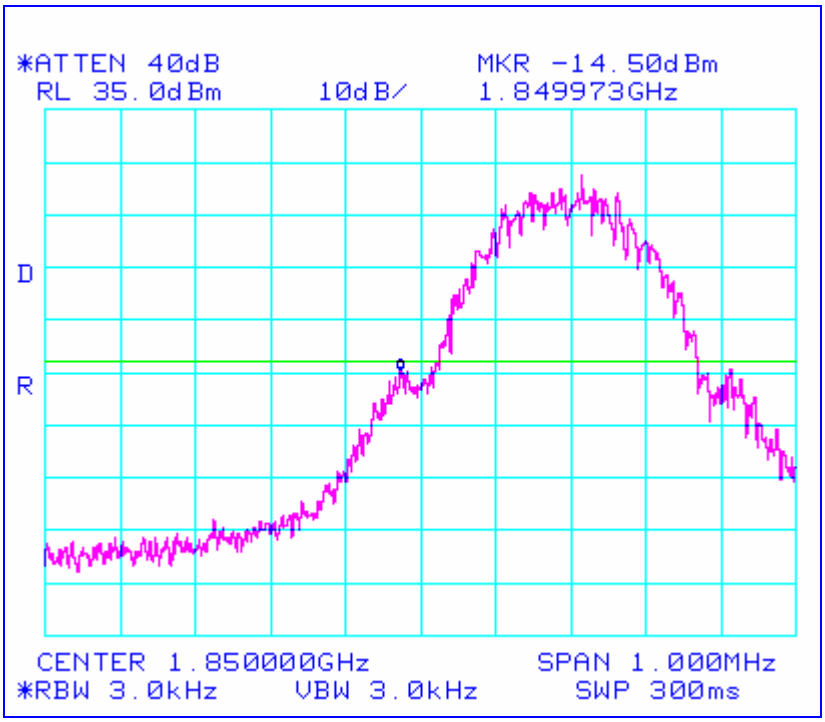
Spurious Emissions at Antenna Terminal Frequency Block Edges Test Results

Spurious Emissions (Block Edges) Test Data Plots



Spurious Emissions at Antenna Terminal Frequency Block Edges Test Results

Spurious Emissions (Block Edges) Test Data Plots



4.5.3 Radiated Spurious Emissions

Test Requirement(s): **§ 2.1053 Measurements required: Field strength of spurious radiation.**

§ 2.1053 (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

§ 2.1053 (b): The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

§ 24.238 Emission limitations for Broadband PCS equipment: The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

§ 24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Test Procedures:

a) As required by §2.1053, field strength of spurious radiation measurements were made in accordance with the general procedures of *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".*

b) Preliminary radiated emission measurements were performed inside a shielded chamber with all digital signal generators on and terminated. The frequency list from the preliminary measurements was used as a guide for making final measurements in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site).

c) The unit was scanned over the frequency range of the lowest system oscillator value to 20 GHz.

d) The Radiated Spurious Emissions Limit is obtained by the following:

e) Based on an output power (as measured at the output of the Amplifier) of 1.0 watts:

$$Po = 1.0\ W$$

-the radiated power level of all spurious emissions must be attenuated by at least 43 + 10log(Po) below Po, yielding:

$$Po-[43 + 10Log(Po) = -13dBm$$

Test Results: The EUT complies with the requirements of this section.

Test Engineer: Liming Xu

Test Date(s): 3/4/2005

4.5.4 MPE Calculation

The MPE calculation for Airo Wireless PCS module (1000mW conducted power) and @ 20cm; the maximum antenna gain 3.0 dBi (Antenna numeric gain G = 2.0)

$Pd = PG/ 4pi*R^2$

$= (1000x2)/12.566* (20)^2$
$= (2000)/12.566x\ 400$
$= (2000)/5026.4$
$= 0.398\ mW/cm^2$

*Pd = Power density in mW/cm^2

* G = Antenna numeric gain (2.0); Log G = g/10 (g = 3.0).

* P = Conducted RF power to antenna (1000 mW).

* R = Minimum allowable distance.(20 cm)

*The power density Pd =0.398 mW/cm2 is less than 1 mW/cm^2 (listed MPE limit for General Population)

*The EUT/antenna should be 20cm away from the general population with the maximum antenna gain 3.0 dBi. (Based on 2 Watts limit for Pt.24 mobile device)

** Antenna gain(g) must be equal or less then 1 dBi for compliance with band edge emissions.

4.6 Frequency Stability over Temperature Variations

Test Requirement(s): **§ 2.1055 Measurements required: Frequency stability.**

§ 2.1055 (a): The frequency stability shall be measured with variation of ambient temperature as follows:

> **(1)** From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of § 2.1055.

Test Procedures:

a) As required by §2.1055(a)(1) of CFR 47, frequency tolerance measurements were made over the temperature range of -30°C to +50°C.

b) The frequency measurements were made using direct input to a spectrum analyzer.

c) Climatic control was accomplished using an environmental simulation chamber.

d) The temperature was first lowered to -30°C and then raised hourly in 10° increments.

e) The unit remained in the chamber during temperature transitions and during the measurement process.

Test Results: The EUT complies with the requirements of this section. Frequency tolerance of carrier signal: +/- 0.005% for a temperature variation from - 30°C to + 50°C at normal supply voltage.

Test Engineer(s): Liming Xu

Test Date(s): 2/28/2005

Frequency Stability over Temperature Variations Test Results

Carrier Frequency Deviations Due to Temperature Instability

Temperature (°C)	Carrier Frequency (GHz) Channel	Frequency Deviation (Hz)	Deviation Limit (kHz)
-30	1867.80000	20 *	± 1.86
-20	1867.80000	20 *	± 1.86
-10	1867.80000	20 *	± 1.86
0	1867.80000	20 *	± 1.86
+10	1867.80000	20 *	± 1.86
+20	1867.80000	20 *	± 1.86
+30	1867.80000	20 *	± 1.86
+40	1867.80000	20 *	± 1.86
+50	1867.80000	20 *	± 1.86

* The frequency deviation is less than 20 Hz,
* There is no detectable frequency variation when the frequency counter was set to 10Hz resolution.
*The unit meets the requirements of 2.1055 (a)(1)

Frequency Stability over Battery Power

Test Requirement(s): **§ 2.1055 Measurements required: Frequency stability:**

§ 2.1055 (d): The frequency stability shall be measured with variation of primary supply voltage as follows:

> **(2)** For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

Test Procedures:

a) As required by §2.1055(d)(2) of CFR 47, frequency tolerance measurements were made over the battery power operating to the end point of battery capacity which is displayed on the phone or handset LCD indicator.

b) The frequency measurements were made using direct input to a spectrum analyzer.

c) The frequency deviation (50 Hz) can only affect the two least significant numbers of carrier frequency.

Test Results: The EUT complies with the requirements of this section.

Test Engineer(s): Liming Xu

Test Date(s): 2/22/2005

Frequency Stability over Battery Power Test Results

Carrier Frequency Deviations Due to Battery Power Drop

Percentage of Rated Supply	DC Voltage (V)	Carrier Frequency (MHz)	Frequency Deviation (Hz)	Deviation Limit (kHz)
85%	3.32	1867.80000	20 *	± 1.87
100%	3.90	1867.80000	20 *	± 1.87
115%	4.48	1867.80000	20 *	± 1.87

Note: * - The frequency deviation (50 Hz) can only affect the two least significant numbers of the carrier frequency.

5.0 Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of *ANSI/NCSL Z540-1-1994* and *ANSI/ISO/IEC 17025:2000*.

Test Equipment					
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4300	Semi-anechoic Chamber # 1	EMC Test Systems	NONE	03-May-03	03-Apr-06
1T4303	Antenna; BILOG	Schafner-Chase EMC	CBL6140A	22-Apr-04	22-Apr-05
1T2665	Antenna; Horn	EMCO	3115	28-Mar-05	28-Mar-06
1T4351	Spectrum Analyzer	AGILENT	E7405A	28-Sep-04	28-Sep-05
1T2511	Antenna; Horn	EMCO	3115	14-Jul-04	14-Jul-05
1T4302	EMI Receiver	HP	85462A	18-Oct-04	18-Oct-05
1T4320	Universal Radio Communication Tester	Rhode and Schwartz	CMU200	09-Aug-04	09-Aug-07
1T4453	Vector Signal Generator	Rhode & Schwarz	SMIQ03	23-Feb-05	23-Feb-06

Note: Functionally verified test equipment is verified using calibrated instrumentation at the time of testing.

6.0 Compliance Information

6.1 Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the

equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

6.2 Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.