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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C (15.247) DTS Specifications and Industry Canada RSS 210 Issue 5 for an Intentional Radiator on the Airflow Networks Model: Airhub

FCC ID:	RC9-AH100
GRANTEE:	Airflow Networks 455 West Maude Ave. Sunnyvale, CA. 94085-3517
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	August 20, 2003
FINAL TEST DATE:	July 30, 2003
AUTHORIZED SIGNATORY:	Mark Briggs Director of Engineering

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SCOPE

An electromagnetic emissions test has been performed on the Airflow Networks model Airhub pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators and RSS-210 Issue 5 for licence-exempt low power devices. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Airflow Networks model Airhub and therefore apply only to the tested sample. The sample was selected and prepared by Paul Richards of Airflow Networks

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules and RSS-210 Issue 5 for license-exempt low power devices for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

SUMMARY OF RESULTS

FCC Part 15 Section	RSS 210 Section	Description	Measured Value	Comments	Result
15.247(a)	6.2.2(o)(b)	Digital Modulation	Systems uses DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	6.2.2(o)(b)	6dB Bandwidth	10.3 MHz	Minimum allowed is 500kHz	Complies
	RSP 100	99% Bandwidth	15.7 MHz	For information only	Complies
15.247 (b) (3)	6.2.2(o)(b)	Output Power, 2400 - 2483.5 MHz	19.4 dBm (0.087 Watts) EIRP = 0.138 W	Multi-point applications: Maximum permitted is 1Watt, with EIRP limited to 4 Watts.	Complies
15.247(d)	6.2.2(o)(b)	Power Spectral Density	-10.08 dBm / MHz	Maximum permitted is 8dBm/3kHz	Complies
15.247(c)	6.2.2(o)(e1)	Antenna Port Spurious Emissions – 30MHz–26 GHz	All spurious emissions < -20dBc	All spurious emissions < -20dBc.	Complies
15.247(c) / 15.209		Transmitter Radiated Spurious Emissions – 30MHz–26 GHz	50.0 dBuV/m @ 2244MHz (-4.0 dB)	Emissions in restricted bands must meet the radiated emissions limits detailed in 15.207. All others must be < -20dBc	Complies
	Table 3	Receiver Spurious Emissions – 30MHz–6 GHz	31.1dBuV/m @ 1124.95MHz (-22.9dB)		Complies
15.207		AC Conducted Emissions	46.1dBuV @ 0.249 MHz (-5.7 dB)		Complies
	6.6	AC Conducted Emissions	41.3dBuV @ 2.843 MHz (-6.7dB)		Complies
15.247 (b) (5)		RF Exposure Requirements	Meets requirements for mobile devices	Refer to rf exposure exhibit and user manual	
15.203		RF Connector	Antenna is integarl to the device with no user access to the connectot	Unique antenna connection required for user-installed applications.	Complies

EIRP calculated using antenna gain of 2dBi.

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.6

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Airflow Networks model Airhub is an 802.11b Access Point which is designed to provide a wireless LAN service in the 2400-2483.5 MHz band. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end-user environment. The EUT can be powered from an external AC-DC adapter rated at 120V/60Hz, 0.5 Amps or via the Ethernet port using power-over-Ethernet.

The sample was received on July 30, 2003 and tested on July 30, 2003. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number	Proposed FCC ID #

OTHER EUT DETAILS

The EUT can operate on channels with center frequencies from 2412 MHz to 2462 MHz.
The EUT has two 10/100 Base-T ethernet interface ports plus the dc power input. One ethernet port is for connection to a switch, the other is intended for connection to a PC.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 15 cm wide by 11 cm deep by 2.5 cm high.

MODIFICATIONS

The EUT was modified with the placement of a ferrite core on the dc cable form the AC-DC adapter to the EUT. The ferrite was located at the EUT end of the cable and will be integrated into the cable assembly for production units.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for emissions testing:

Manufacturer/Model/Description	Serial Number	FCC ID Number
3Com POE Injector	-	-

The following equipment was used as remote support equipment for emissions testing:

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	Latitude PP01L	Laptop	CN-06P823-48155-260-6918	-
CIDEX	P4 - 1.8 GHz	PC	200212014	-
Logitech	-	Mouse	LNA15156164	DZL211029
Dell	AT101W	Keyboard	38841-9B6-1647	GYUM90SK
ViewSonic	A70F	Monitor	23X022500607	-
Airflow	-	Controller Unit	-	-

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Desktop	Laptop	CAT 5	Unshielded	10
Airswitch	POE Unit ethernet out	CAT 5	Unshielded	10
POE Unit ethernet in	Control Unit	CAT 5	Unshielded	30
Control Unit	PC	Multi Wire	Shielded	1

EUT OPERATION DURING TESTING

The transmitter was configured to transmit continuously on the selected channel.

ANTENNA REQUIREMENTS

The antenna is integrated into the device with no user-access to the rf connector between antenna and circuit board.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on July 30, 2003at the Elliott Laboratories Open Area Test Site #2 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Federal Communications Commission. In accordance with Industry Canada rules detailed in RSS 210 Issue 5 and RSS-212, construction, calibration, and equipment data for the test sites have been filed with the Federal Communications Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and peak power sensor are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

Measurement bandwidths (video and resolution) are set in accordance with FCC procedures for the type of radio being tested.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions from the AC power port are given in units of microvolts, the limits for radiated electric field emissions are given in units of microvolts per meter at a specified test distance and the output power limits are given in temrs of Watts, milliwatts or dBm. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp) the following formula is used to determine the field strength limit in terms of microvolts per meter at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \text{ v } 30\ P}{3} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For reference, converting the voltage and electric field strength specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. Conversion of power specification limits from linear units (in milliwatts) to decibel form (in dBm) is accomplished by taking the base ten logarithm, then multiplying by 10.

FCC 15.407 (a)and RSS 210 (o) OUTPUT POWER LIMITS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watts (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watts (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watts (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

RSS 210 (o) AND FCC 15.247 SPURIOUS RADIATED EMISSIONS LIMITS

T limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands detailed in Part 15.205 and for all spurious emissions from the receiver are:

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level.

FCC 15.205 AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in FCC Part 15.205.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

RSS-210 SECTION 6.6 AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in Industry Canada RSS-210 section 6.6.

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Spurious Emissions, 1 - 26.5 GHz, 30-Jul-03
Engineer: Mark

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	487	12	4/24/2003	4/24/2004
Hewlett Packard	Microwave EMI test system (SA40, 9kHz - 40GHz)	84125C	1149	12	3/12/2003	3/12/2004
Hewlett Packard	Spectrum Analyzer 30Hz - 40 GHz	8564E (84125C)	1148	12	4/2/2003	4/2/2004

Conducted Emissions, 0.15 - 30MHz, 120V/60Hz, 13-Aug-03
Engineer: Rafael

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Elliott Laboratories	LISN 2 x (Solar 8028 LISN + 6512 Caps)	LISN-5,Support	379	12	8/20/2002	8/20/2003
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	372	12	7/17/2003	7/17/2004
Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	274	12	1/24/2003	1/24/2004

Radiated Emissions, 30 - 2000 MHz, 18-Aug-03
Engineer: yho

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Biconical Antenna, 30-300 MHz	3110B	363	24	5/28/2002	5/28/2004
Hewlett Packard	EMC Spectrum Analyzer, Opt. 026 9 KHz -26.5GHz	8593EM	1141	12	3/19/2003	3/19/2004
Filtek	High Pass Filter, 1GHz	HP12/1000-5BA	956	12	3/11/2003	3/11/2004
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	786	12	2/28/2003	2/28/2004
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1347	12	10/30/2002	10/30/2003
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12	1/10/2003	1/10/2004
Rohde & Schwarz	Test Receiver, 20-1300MHz	ESVP	273	12	2/13/2003	2/13/2004

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T52096 18 Pages

Elliott

EMC Test Data

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Emissions Spec:	FCC, RSS210, VCCI	Class:	B
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Airflow Networks

Model

802.11b Access Point

Date of Last Test: 7/30/2003

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Emissions Spec:	FCC, RSS210, VCCI	Class:	B
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is an 802.11b Access Point which is designed to provide a wireless LAN service in the 2400-2483.5 MHz band. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end-user environment. The EUT can be powered from an external AC-DC adapter rated at 120V/60Hz, 0.5 Amps or via the Ethernet port using power-over-Ethernet.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Airflow Networks	Airhub	Wireless Hub	-	-

Other EUT Details

The EUT can operate on channels with center frequencies from 2412 MHz to 2462 MHz.
The EUT has two 10/100 Base-T ethernet interface ports plus the dc power input. One ethernet port is for connection to a switch, the other is intended for connection to a PC.
The EUT antenna has a gain of 2dBi. It is integral to the device with no user access to the rf connector between antenna and circuit board. The device has two antennas, one is for transmit and either may be used for receive to provide spatial diversity.

EUT Enclosure

The EUT enclosure is primarily constructed of plastic. It measures approximately 15 cm wide by 11 cm deep by 2.5 cm high.

Modification History

Mod. #	Test	Date	Modification
1	Radiated and conducted emissions	8/13/203	Integrated ferrite onto dc cable from AC-DC adpater, located by dc input of main device.

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

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EMC Test Data

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Emissions Spec:	FCC, RSS210, VCCI	Class:	B
Immunity Spec:	-	Environment:	-

Test Configuration #1 - Radio

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
3 Com	None given	POE Injector	-	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	Latitude PP01L	Laptop	CN-06P823-48155-260-6918	-
CIDEX	P4 - 1.8 GHz	PC	200212014	-
Logitech	-	Mouse	LNA15156164	DZL211029
Dell	AT101W	Keyboard	38841-9B6-1647	GYUM90SK
ViewSonic	A70F	Monitor	23X022500607	-
Airflow	-	Controller Unit	-	-

EUT Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Desktop	Laptop	CAT 5	Unshielded	10
Airswitch	POE Unit ethernet out	CAT 5	Unshielded	10
POE Unit ethernet in	Control Unit	CAT 5	Unshielded	30
Control Unit	PC	Multi Wire	Shielded	1

EUT Operation During Emissions Testing

The transmitter was configured to transmit continuously on the selected channel.

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	B

Conducted Emissions - Power Ports

Test Specifics

Objective: The objective of this test session is to perform engineering evaluation testing of the EUT with respect to the specification listed above.

Date of Test: 8/13/2003
Test Engineer: Rafael
Test Location: SVOATS #3

Config. Used: 1
Config Change: Added ferrite to Power cable
EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN.

Ambient Conditions:

Temperature: 28 °C
Rel. Humidity: 40 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	FCC 15.209	Pass	-5.7dB @ 0.249MHz
1	CE, AC Power,120V/60Hz	RSS 210	Pass	-6.7dB @ 2.843MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz

Modified EUT with AC power source plus ferrite bead

Note - graphs show the Class A limit from 15.109, all emissions are below the 15.209 limit.

Frequency	Level	AC	FCC 15.209		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.249	46.1	Neutral	51.8	-5.7	Average	
0.249	51.0	Neutral	61.8	-10.8	QP	
0.246	38.9	Line 1	51.9	-13.0	Average	
0.625	31.4	Neutral	46.0	-14.6	Average	
2.843	41.3	Neutral	56.0	-14.7	QP	
2.849	39.4	Line 1	56.0	-16.6	QP	
0.246	45.2	Line 1	61.9	-16.7	QP	
0.888	29.3	Line 1	46.0	-16.7	Average	
0.625	38.9	Neutral	56.0	-17.1	QP	
0.888	36.3	Line 1	56.0	-19.7	QP	
2.843	24.5	Neutral	46.0	-21.5	Average	
2.849	21.4	Line 1	46.0	-24.6	Average	

Frequency	Level	AC	RSS 210		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
2.843	41.3	Neutral	48.0	-6.7	QP	
2.849	39.4	Line 1	48.0	-8.6	QP	
0.625	38.9	Neutral	48.0	-9.1	QP	
0.888	36.3	Line 1	48.0	-11.7	QP	
0.249	51.0	Neutral	N/A	N/A	QP	
0.246	45.2	Line 1	N/A	N/A	QP	

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	B

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 8/18/2003
Test Engineer: Yu-Chien Ho
Test Location: SVOATS #3
Config. Used: #1
Config Change: EUT in receive mode on specified channel
EUT Voltage: 230V/50Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing. Remote support equipment was located approximately 30 meters from the test area with all I/O connections running on top of the groundplane routed overhead.

On the OATS, the measurement antenna was located 10 meters from the EUT for the measurement range 30 - 1000 MHz and 3m from the EUT for the frequency range 1 - 10 GHz.

Note, **preliminary** testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. **Maximized** testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Note, for testing above 1 GHz, the RSS210 specifies the limit as an average measurement. In addition, RSS210 states that the peak reading of any emission above 1 GHz, can not exceed the average limit by more than 20 dB.

Ambient Conditions:

Temperature: 18.3 °C
Rel. Humidity: 75 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 1000 - 6000 MHz, Maximized Emissions	RSS 210 Receiver	Pass	-22.9dB @ 1125.0MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Run #1: Maximized readings, 1000 - 2000 MHz
Measurements made at 3m per RSS 210 requirements.
RSS 210 LO: 374 MHz

Frequency	Level	Pol	RSS 210		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1124.950	31.1	h	54.0	-22.9	Avg	98	1.0	
1124.950	30.4	v	54.0	-23.6	Avg	280	1.0	
1124.950	42.9	h	74.0	-31.1	Pk	98	1.0	
1124.950	42.5	v	74.0	-31.5	Pk	280	1.0	

No emissions below 1GHz could be attributed to the reciver, all were from the digital device.
All other LO signals were measured in transmit mode.
Signals noted above did not change with channel frequency.

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

Antenna Conducted and Radiated Spurious Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to FCC 15.247 and RSS 210 6.2.2(o) specifications.

Date of Test: 7/30/2003
Test Engineer: Mark Briggs
Test Location: SVOATS #2

Config. Used: #1
Config Change: N/A
EUT Voltage: 120V/60Hz to external AC-DC adapter

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing. All remote support equipment was located approximately 10 meters from the EUT with all I/O connections routed in overhead.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via the same length and type of cable that connects the antenna to the circuit board. No corrections were made for this cable.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 52 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 30 - 26000 MHz - Spurious Emissions In	FCC Part 15.209 / 15.247(c)	Pass	-4.0dB @ 2244.02MHz
2	6dB Bandwidth	15.247(a)	Pass	Min Bandwidth = 9.7 MHz
2	99% Bandwidth	RSP 100	Pass	15.7MHz
3	Output Power	15.247(b)	Pass	Max Power = 19 dBm
4	Power Spectral Density (PSD)	15.247(d)	Pass	Max PSD = -10.1dBm
5	Antenna Port Spurious Emissions, 30MHz - 26 GHz	15.247(d)	Pass	All emissions < -20dBc

EMC Test Data

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Run #1a: Radiated Spurious Emissions, 30 - 26000 MHz. Low Channel @ 2412 MHz

	H	V
Fundamental emission level @ 3m in 100kHz RBW:		99.95
Limit for emissions outside of restricted bands:	79.95 dBµV/m	

Band-Edge Marker Deltas
Peak: 48.7 dB
Average: 56.2 dB

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2412.000	112.4	V	-	-	Pk	140	1.0	Fundamental signal
2412.000	99.8	V	-	-	Avg	140	1.0	Fundamental signal
2412.000	100.8	H	-	-	Pk	60	1.0	Fundamental signal
2412.000	88.1	H	-	-	Avg	60	1.0	Fundamental signal
2038.000	-	-	-	-	-	-	-	Not in restricted band - note 2
2244.000	50.0	V	54.0	-4.0	Avg	54	1.4	Signal is at the noise floor
2244.000	66.0	V	74.0	-8.0	Pk	54	1.4	Signal is at the noise floor
4824.000	44.0	V	54.0	-10.0	Avg	203	2.0	
2386.900	63.7	V	74.0	-10.3	Pk	140	1.0	
2386.900	43.6	V	54.0	-10.4	Avg	140	1.0	
7236.000	39.7	V	54.0	-14.3	Avg	222	1.5	
7236.000	37.0	H	54.0	-17.0	Avg	262	1.2	
4824.000	36.8	H	54.0	-17.2	Avg	48	1.6	
7236.000	54.5	V	74.0	-19.5	Pk	222	1.5	
4824.000	53.2	V	74.0	-20.8	Pk	203	2.0	
7236.000	48.9	H	74.0	-25.1	Pk	262	1.2	
4824.000	47.3	H	74.0	-26.7	Pk	48	1.6	

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20 dB below the level of the fundamental.
Note 2:	LO is 374 Mhz below the fundamentla frequency. It does not lie in a restricted band. No signifcant signal observed.
Note 3:	Band-edge measurement made using delta marker method

Elliott

EMC Test Data

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

Run #1b: Radiated Spurious Emissions, 30 - 26000 MHz. Center Channel @ 2437 MHz

	H	V
Fundamental emission level @ 3m in 100kHz RBW:		100.95
Limit for emissions outside of restricted bands:	80.95 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2370.900	65.5	V	74.0	-8.5	Pk	342	1.4	Signal is at the noise floor
7311.000	44.8	V	54.0	-9.2	Avg	52	2.0	
2370.900	44.7	V	54.0	-9.3	Avg	342	1.4	Measured using RB=10kHz, Note 1
4874.000	42.0	H	54.0	-12.1	Avg	40	1.9	
7311.000	41.0	V	54.0	-13.0	Avg	60	1.3	
4874.000	37.2	H	54.0	-16.8	Avg	0	1.6	
7311.000	55.2	V	74.0	-18.8	Pk	60	1.3	
7311.000	53.5	V	74.0	-20.5	Pk	52	2.0	
4874.000	51.5	H	74.0	-22.5	Pk	40	1.9	
4874.000	50.9	H	74.0	-23.1	Pk	0	1.6	

Note 1:	Signal at 2680 is artifact of LO and a narrowband signal. Average measurement made using a resolution bandwidth of 10kHz as noise floor at this frequency is at the limit when using RB=1MHz. As signal is narrowband actula signal level in 10kHz would be the same as that in 1MHz.

Elliott

EMC Test Data

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

Run #1c: Radiated Spurious Emissions, 30 - 26000 MHz. High Channel @ 2462 MHz

	H	V
Fundamental emission level @ 3m in 100kHz RBW:		98.96
Limit for emissions outside of restricted bands:	78.96 dBµV/m	

Band-Edge Marker Deltas
Peak: 47.7 dB
Average: 58.2 dB

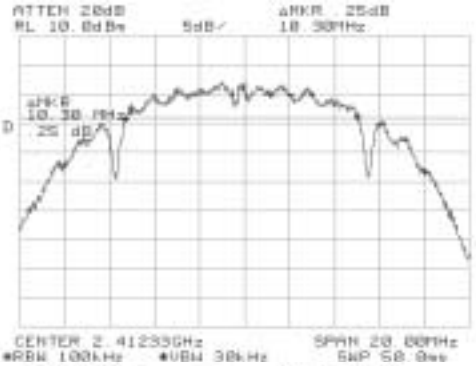
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2462.000	111.4	V	-	-	Pk	140	1.0	Fundamental signal
2462.000	99.5	V	-	-	Avg	140	1.0	Fundamental signal
2462.000	97.7	H	-	-	Pk	60	1.0	Fundamental signal
2462.000	85.5	H	-	-	Avg	60	1.0	Fundamental signal
2088.000	-	-	-	-	-	-	-	Not in restricted band, note 3
2680.000	66.9	V	74.0	-7.1	Pk	84	1.2	Signal is at the noise floor
2680.000	46.0	V	54.0	-8.0	Avg	84	1.2	Measured using RB=10kHz, Note 4
2483.790	63.7	V	74.0	-10.3	Pk	140	1.0	
4924.000	43.0	V	54.0	-11.0	Avg	160	2.0	
7386.000	43.0	V	54.0	-11.0	Avg	115	1.4	
2483.790	41.3	V	54.0	-12.7	Avg	140	1.0	
4924.000	39.5	H	54.0	-14.5	Avg	24	1.9	
7386.000	58.6	V	74.0	-15.4	Pk	115	1.4	
7386.000	38.1	H	54.0	-15.9	Avg	300	1.4	
4924.000	51.9	V	74.0	-22.1	Pk	160	2.0	
7386.000	50.9	H	74.0	-23.1	Pk	300	1.4	
4924.000	48.8	H	74.0	-25.2	Pk	24	1.9	

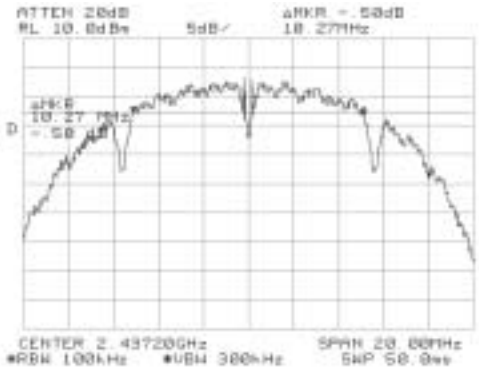
Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20 dB below the level of the fundamental.
Note 2:	Band-edge measurement made using delta marker method
Note 3:	LO is 374 Mhz below the fundamentla frequency. It does not lie in a restricted band. No signifcant signal observed.
Note 4:	Signal at 2680 is artifact of LO and a narrowband signal. Average measurement made using a resolution bandwidth of 10kHz as noise floor at this frequency is at the limit when using RB=1MHz. As signal is narrowband actula signal level in 10kHz would be the same as that in 1MHz.

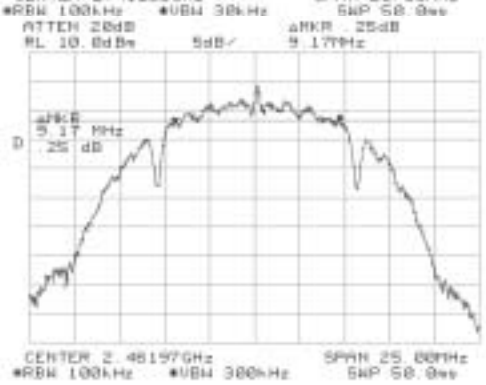
Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

Run #2: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	6dB Signal Bandwidth	99% Bandwidth
Low	2412	100kHz	10.30 MHz	15.70 MHz
Mid	2437	100kHz	10.27 MHz	15.73 MHz
High	2462	100kHz	9.17 MHz	15.58 MHz







Run #3: Output Power

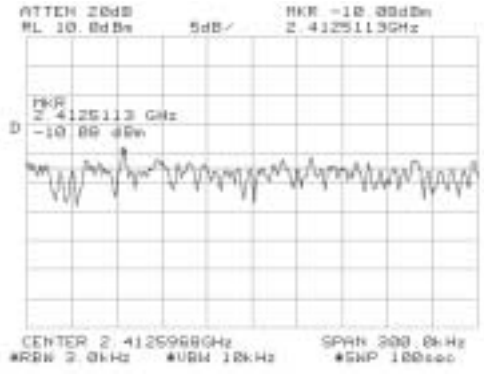
Channel	Frequency (MHz)	Output Power		Output Power	
Low	2412	19.40	dBm	0.087	Watts
Mid	2437	18.70	dBm	0.074	Watts
High	2462	17.10	dBm	0.051	Watts

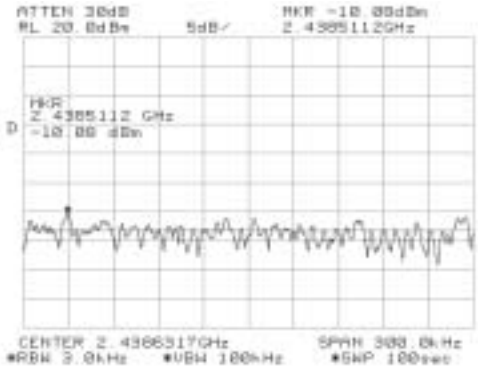
Note 1:	Measured using peak power sensor

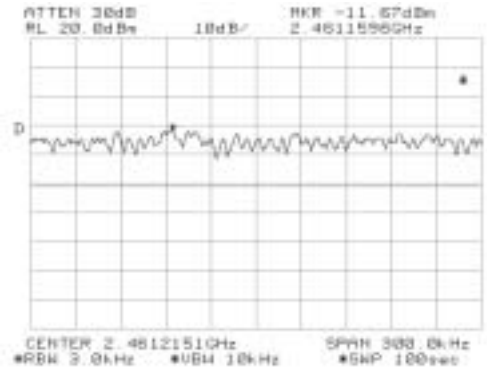
Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

Run #4: Power Spectral Density

Channel	Frequency (MHz)	Res BW	P.S.D. (averaged over 1 second in a 3kHz bandwidth)
Low	2412	3kHz	-10.08 dBm
Mid	2437	3kHz	-10.08 dBm
High	2462	3kHz	-11.67 dBm



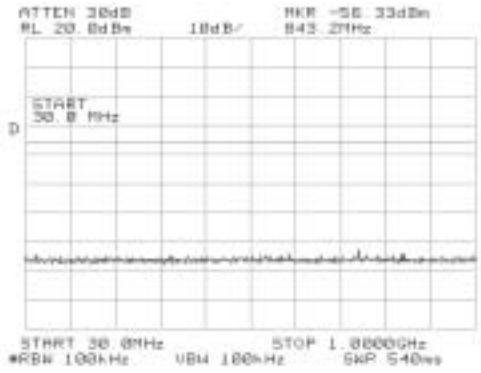


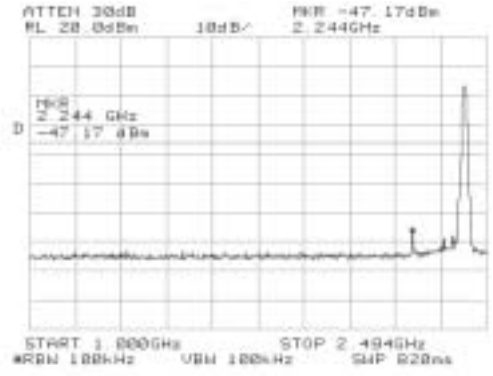


Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

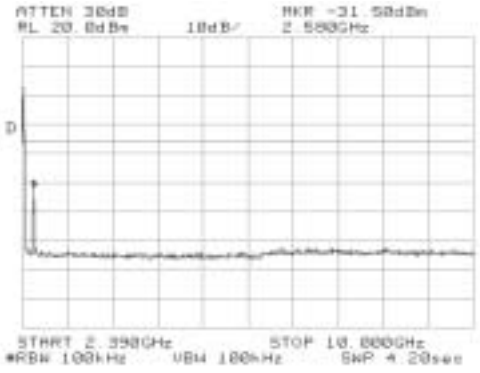
Run #5: Out of Band Spurious Emissions - Antenna Port

Low Channel (2412 MHz)

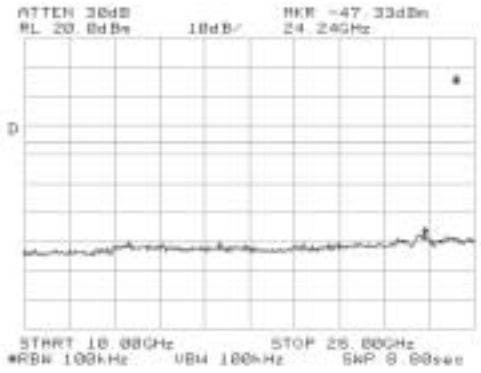


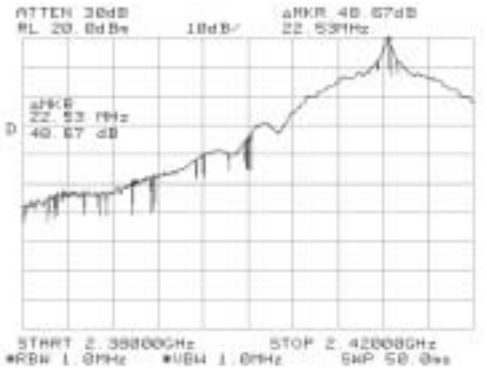


2244MHz is in a restricted band.

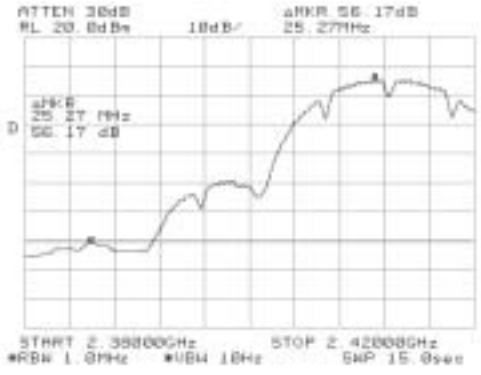


2580MHz is not in a restricted band





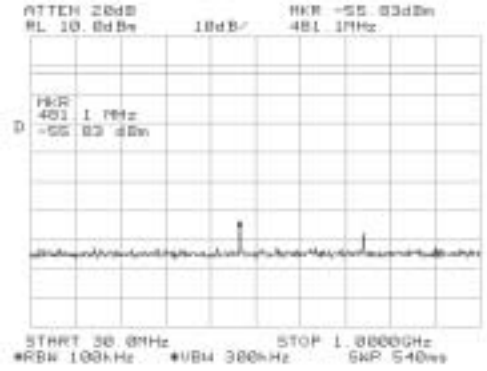
Band Edge Delta (Peak)



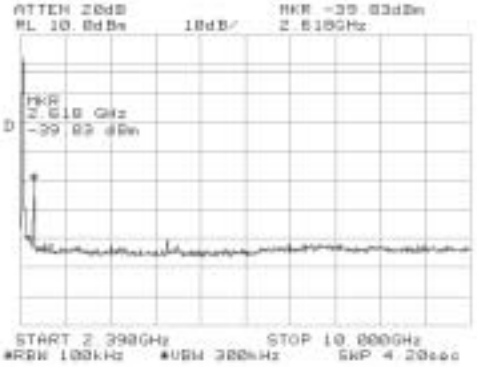
Band-edge delta (Average)

Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

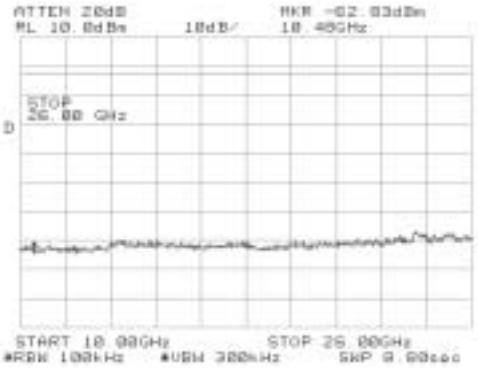
Center Channel (2437 MHz)



2372 MHz is in a restricted band.

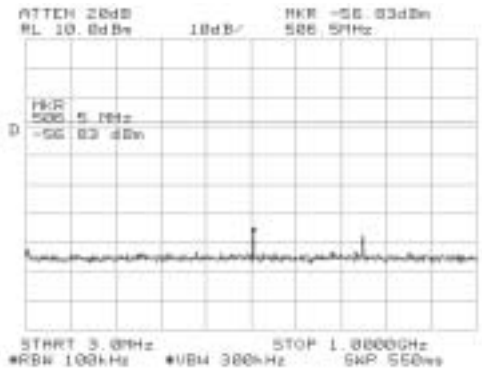


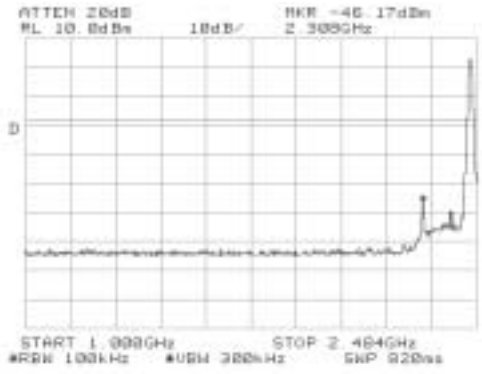
2618MHz is not in a restricted band



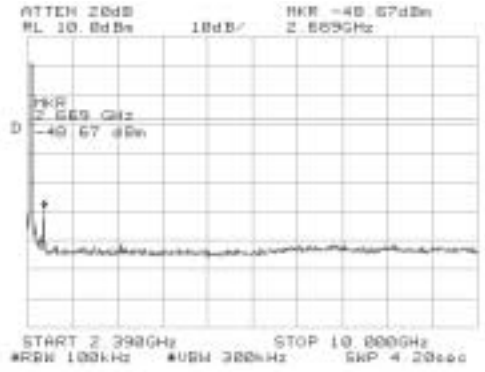
Client:	Airflow Networks	Job Number:	J52054
Model:	802.11b Access Point	T-Log Number:	T52096
		Account Manager:	S.Pelzl, M. Briggs
Contact:	Paul Richards		
Spec:	FCC, RSS210, VCCI	Class:	N/A

High Channel (2462 MHz)

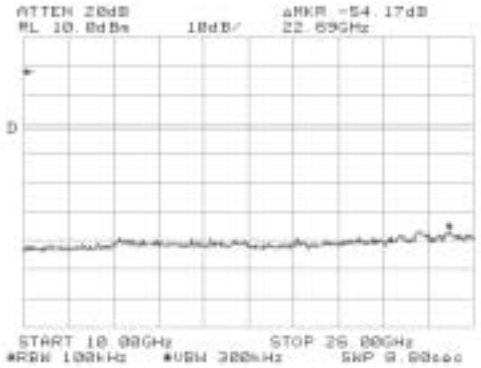


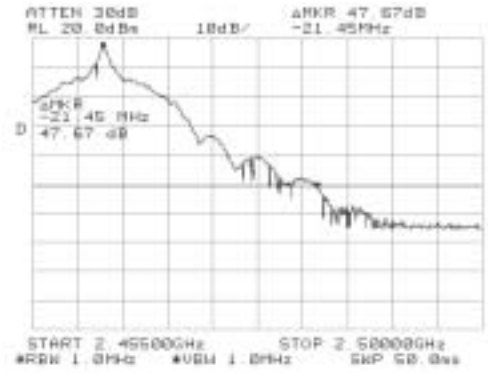


2308 MHz is not in a restricted band.

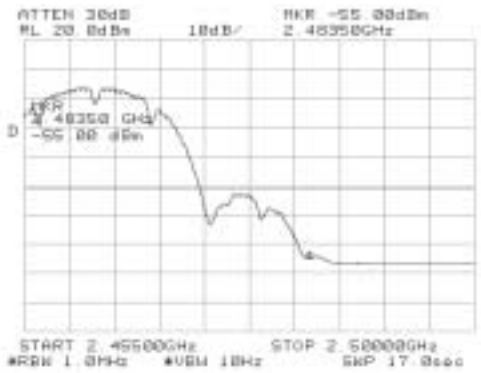


2680MHz is in a restricted band





Band Edge Delta (Peak)



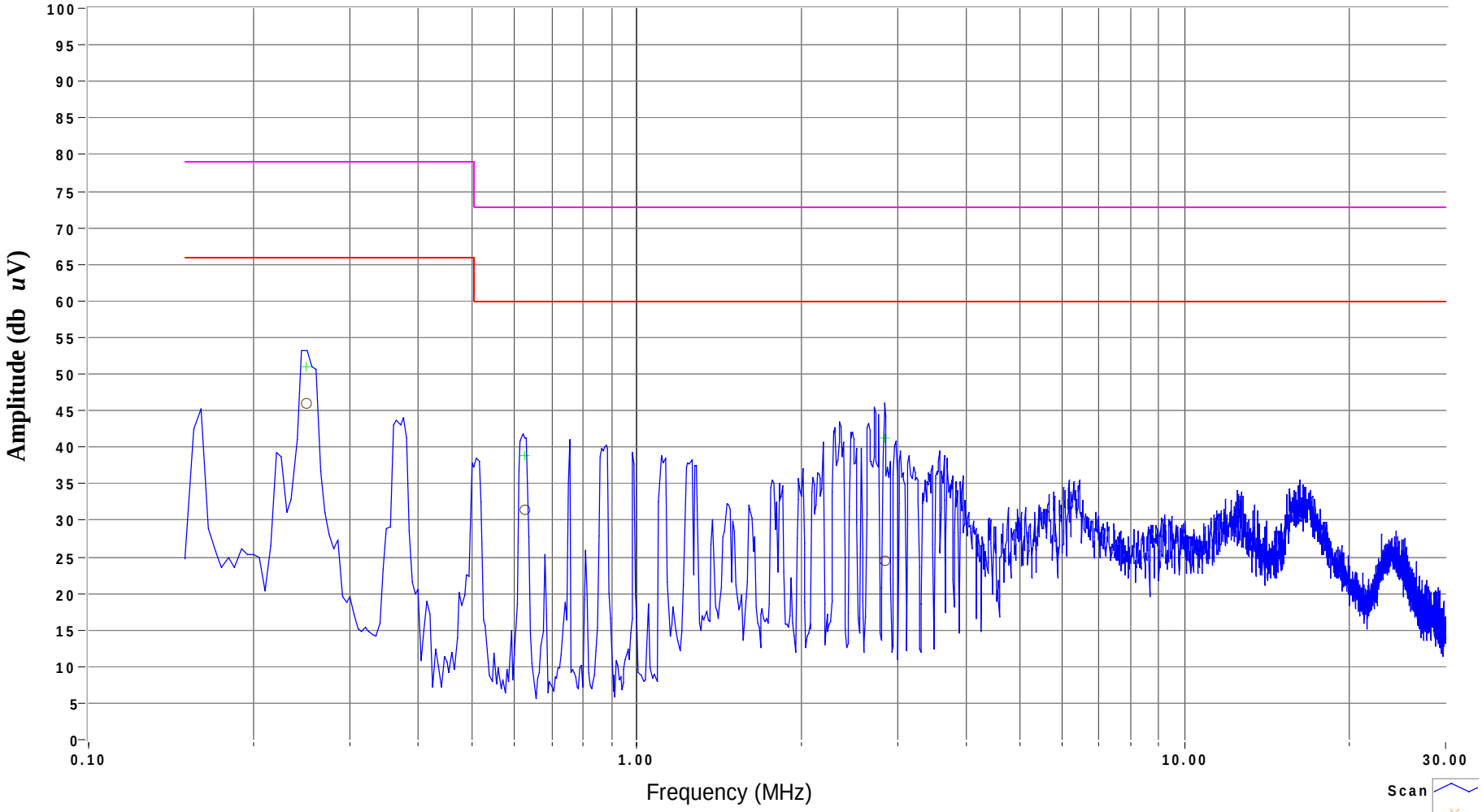
Band-edge delta (Average)

SVOATS #3: Airflow Networks Airhub Run 1

Spec: EN55022A

Mains Lead Neutral

T52091



120V/60Hz, AC/DC switcher with ferrite

8/13/03

Rafael Varelas

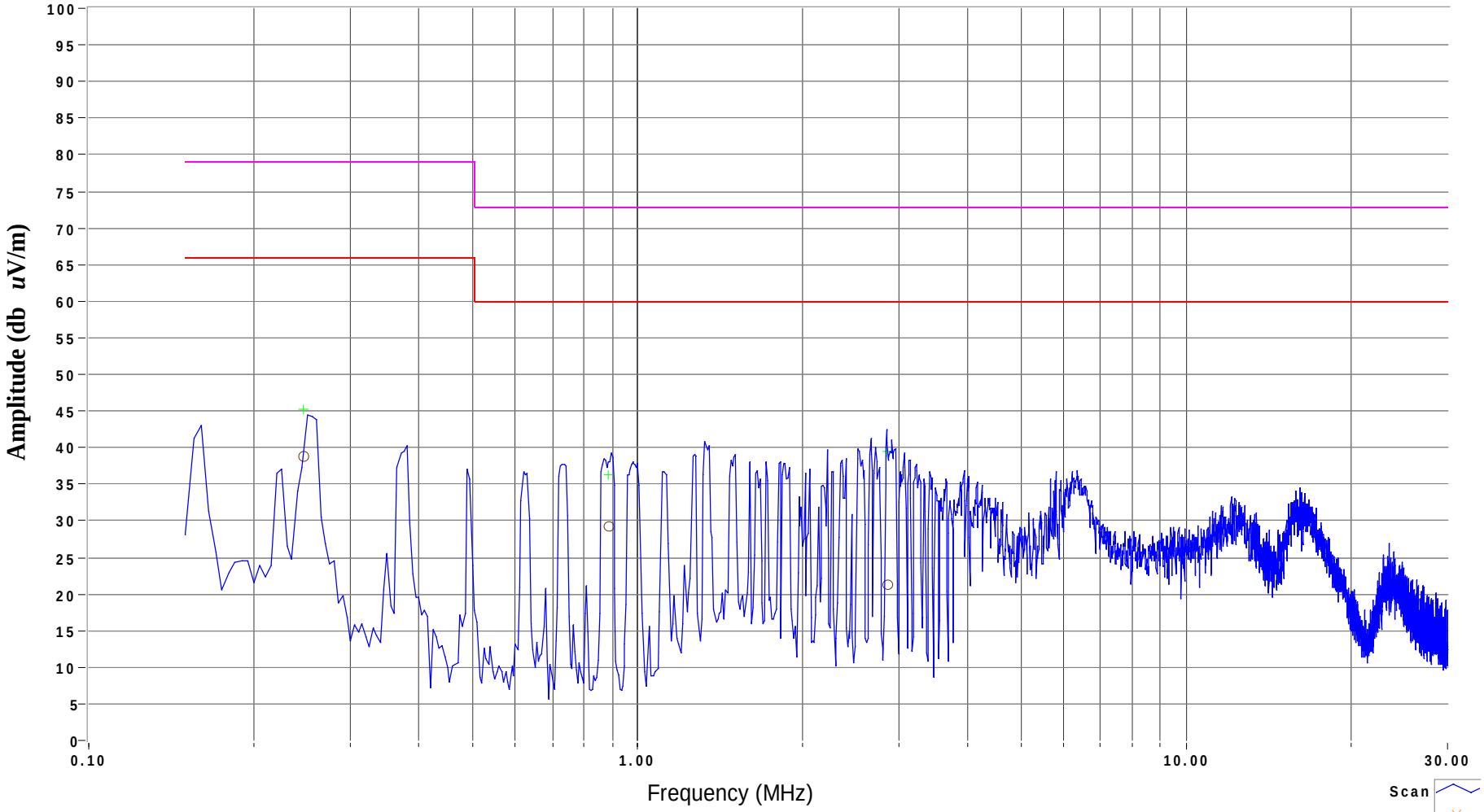
Elliott

SVOATS #3: Airflow Networks Airhub Run 1

Spec: EN55022A

Mains Lead Line 1

T52091



120V/60Hz, AC/DC switcher with ferrite

8/13/03

Rafael Varelas

EXHIBIT 3: Test Configuration Photographs

4 Pages

EXHIBIT 4: Proposed FCC ID Label & Label Location

EXHIBIT 5: Detailed Photographs of Airflow Networks Model Airhub Construction

External Photographs 2 Pages
Internal Photographs 11 Pages

EXHIBIT 6: Operator's Manual for Airflow Networks Model Airhub

Pages

EXHIBIT 7: Block Diagram of Airflow Networks Model Airhub

1 Page

EXHIBIT 8: Schematic Diagrams for Airflow Networks Model Airhub

Digital Schematics 7 Pages
RF Schematics 3 Pages

EXHIBIT 9: Theory of Operation for Airflow Networks Model Airhub

1 Page

EXHIBIT 10: Advertising Literature

None available at this time

EXHIBIT 11: RF Exposure Information

MPE Calculations 1 Page