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Electromagnetic Emissions Test Report and Application for Class II Permissive Change pursuant to FCC Part 15, Subpart C (15.247) DTS Specifications, FCC Part 15, Subpart E (UNII Devices) on the Meru Networks Model: AP208 Dual Board 802.11abg Access Point

FCC ID:	RE7-AP200
GRANTEE:	Meru Networks 1309 S. Mary Ave Sunnyvale, CA 94087
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	April 26, 2005
FINAL TEST DATE:	April 5, 2005
AUTHORIZED SIGNATORY:	Mark Briggs Principal Engineer

ACCREDITED
2016-01

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SCOPE

An electromagnetic emissions test has been performed on the Meru Networks model AP208 Dual Board 802.11abg Access Point pursuant to Subparts C and E of Part 15 of FCC Rules for Unlicensed National Information Infrastructure (UNII) devices. Radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4:2003 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 Meru Networks model AP208 Dual Board 802.11abg Access Point and therefore apply only to the tested sample. The sample was selected and prepared by Paul Chapman of Meru Networks

OBJECTIVE

The primary objective of the manufacturer is compliance with Subparts C and E of Part 15 of FCC Rules 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	Description	Measured Value	Comments	Result
15.247(a)	Digital Modulation	The proposed modifications do not affect the measured values for these parameters as reported in the original filing.		
15.247 (a) (2); 15.407(a) (1) 15.407(a) (2)	Bandwidths			
15.247 (b) (3)	Output Power, 2400 - 2483.5 MHz	21.6 dBm (0.144 Watts)	Aggregate power based on both transceivers operating in the same band at the same time. These values are double the values reported in the original application.	Complies
15.407(a) (1)	Output Power, 5150 - 5250 MHz	9.8 dBm (0.0096 Watts)		Complies
15.407(a) (2)	Output Power, 5250 - 5350 MHz	19.3 dBm (0.0858 Watts)		Complies
15.247 (b) (3)	Output Power, 5725 - 5850 MHz	15.8 dBm (0.038 Watts)		Complies
15.247(d) 15.407(a) (1) 15.407(a) (2)	Power Spectral Density	The proposed modifications do not affect the measured values for these parameters as reported in the original filing.		
15.247(c)	Antenna Port Spurious Emissions –30MHz – 40 GHz			
15.407(a)(6)	Peak Excursion Ratio			
15.407 (c)	Automatic Discontinuation of Operation in the absence of information to transmit			
15.407 (g)	Frequency Stability			
15.247(c) / 15.209	Radiated Spurious Emissions –30MHz – 40 GHz	49.1dBµV/m (285.1µV/m) @ 4775.0MHz (-4.9dB)	Testing limited to measuring inter-modulation products.	Complies
15.207	AC Conducted Emissions	The proposed modifications do not affect the measured values for these parameters as reported in the original filing.		
15.247 (b) (5)	RF Exposure Requirements	MPE distance of 20cm is still valid	MPE distance recalculated for eirp with both transceivers operational	Complies
15.203	RF Connector	The proposed modifications do not affect the measured values for these parameters as reported in the original filing.		

Note – the output power during testing was verified to be within 0.5dB of the powers reported in the original application on all channels used.

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 UKAS document LAB 34.

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 Meru Networks model AP208 Dual Board 802.11abg Access Point is a combination DTS and UNII Radio which is designed to operate in the DTS and UNII bands. Normally, the EUT would be wall mounted during operation. The EUT was treated as tabletop equipment during testing to simulate the end user environment.

The sample was received on April 5, 2005 and tested on April 5, 2005. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Meru Networks	AP200	802.11abg Access Point	4604AP000CE60 017CF	RE7-AP200
MY-Chance electronics	200SRP-T-W007	Triband antenna (2dBi in 2GHz band, 5dBi in 5GHz bands)	-	N/A
Maxrad	MCO24005PT Elevation	5.5dBi Ceiling mount omni antenna (2.4 GHz band)	-	N/A

ENCLOSURE

It measures approximately 15 cm wide x 19 cm deep x 3.8 cm high (w/o antennas or wall/ceiling mounting bracket)

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

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

Manufacturer	Model	Description	Serial Number	FCC ID
PowerDsine	6001	POE Hub	IO4136040005949B03	-
IBM	ThinkPad G40	Laptop	KM-5693H	-

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)
Power/Ethernet	POE Hub	Cat 5	Unshielded	1.8
Console	Laptop	Serial	Unshielded	2

Note: The console port would not normally be connected as the manufacturer stated that these are for configuration purpose. It was only connected to allow changing of the modes of the two radios for test purposes.

EUT OPERATION DURING TESTING

The two transceivers were transmitting at the rated power on the specified channels with a duty cycle of 100 % (maximum allowed) and at a data rate of 6 or 11 Mb/s depending on the mode. The following combinations of channels were used during testing to cover the different possible combinations of transmitter operation:

- Both radios in the 2412 – 2462 MHz band (one at 2412 MHz and one at 2462 MHz).
- One radio in the 2412 – 2462 MHz band (2412 MHz), one in the 5GHz band (5785 MHz)
- One radio in the lower 5GHz band (5180 MHz), one in the upper 5GHz band (5825 MHz)
- One radio in the center 5GHz band (5300 MHz), one in the upper 5GHz band (5825 MHz)
- One radio in the lower 5GHz band (5180 MHz), one in the middle 5GHz band (5260 MHz)

The device operating in the 2412-2462 MHz band was configured to operate in 802.11b mode as this produced the highest spurious signal level.

Note – the output power during testing was verified to be within 0.5dB of the powers reported in the original application for each operating band.

PROPOSED MODIFICATION DETAILS

This section details the modifications to the Meru Networks model AP208 Dual Board 802.11abg Access Point being proposed. All performance and construction deviations from the characteristics originally reported to the FCC are addressed

The only change to the device is the ability for both transceivers to operate simultaneously. The original application allowed only one device to operate at a time.

For this reason the only tests repeated were the radiated spurious emissions test with both transceivers operational in the same and in different bands. Measurements were limited to any inter-modulation products generated. The original test measurement data submitted to the FCC for radiated spurious emissions at the band edges and harmonics of the fundamental signals remain valid.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on April 5, 2005at the Elliott Laboratories Open Area Test Site #1 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 C63.4:2003. 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 C63.4:2003 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 C63.4:2003 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 C63.4:2003 , 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) 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.

FCC 15.407 (a) 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
5150 - 5250	50mW (17 dBm)	4 dBm/MHz
5250 - 5350	250 mW (24 dBm)	11 dBm/MHz
5725 – 5825	1 Watts (30 dBm)	17 dBm/MHz

For system using antennas with gains exceeding 6dBi, the output power and power spectral density limits are reduced by 1dB for every dB the antenna gain exceeds 6dBi.
Fixed point-to-point applications using the 5725 – 5825 MHz band may use antennas with gains of up to 23dBi without this limitation. If the gain exceeds 23dBi then the output power limit of 1 Watt is reduced by 1dB for every dB the gain exceeds 23dBi.

FCC 15.247 TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS

The 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 (30dB if the power is measured using the sample detector/power averaging method).

FCC 15E TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS

The table below shows the limits for unwanted (spurious) emissions falling in the restricted bands detailed in Part 15.205 and Industry Canada RSS-210 Table 2.

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

The table below shows the limits for unwanted (spurious) emissions outside of the restricted bands above 1GHz.

Operating Frequency (MHz)	EIRP Limit (dBm)	Equivalent Field Strength At 3m (dBuV/m)
5150 - 5250	-27 dBm	68.3 dBuV/m
5250 - 5350	-27 dBm (note 1)	68.3 dBuV/m
5725 – 5825	-27 dBm (note 2)	68.3 dBuV/m
	-17 dBm (note 3)	78.3 dBuV/m

Note 1: If operation is restricted to indoor use only then emissions in the band 5.15 – 5.25 GHz must meet the power spectral density limits for the intentional signals detailed in RSS 210 and FCC Subpart E for devices operating in the 5.15 – 5.25 GHz band.
Note 2: Applies to spurious signals separated by more than 10 MHz from the allocated band.
Note 3: Applies to spurious signals within 10 MHz of the allocated band.

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

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

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

$$R_r = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

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

Radiated Emissions, 1,000 - 40,000 MHz, 05-Apr-05
Engineer: David Bare

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	786	08-Nov-05
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	787	17-Dec-05
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	13-Jan-06
Filtek	High Pass Filter, 1GHz	HP12/1000-5BA	957	26-Mar-06
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz), Sunnyvale	84125C	1149	11-Jun-05
EMCO	Horn antenna, 18-26.5 GHz (SA40 30Hz)	3160-09 (84125C)	1150	11-Jun-05
EMCO	Horn antenna, 26.5-40 GHz (SA40 30 Hz)	3160-10 (84125C)	1151	11-Jun-05
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1534	01-Mar-06
Rohde & Schwarz	Peak Power Sensor 100uW - 2 Watts	NRV-Z32	1536	22-Apr-05

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 59188 6 Pages

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EMC Test Data

Client:	Meru Networks	Job Number:	J59119
Model:	AP200	T-Log Number:	T59188
		Project Manager:	Susan Pelzl
Contact:	Paul Chapman		
Emissions Spec:	FCC Part 15 C and E, RSS-210	Class:	-
Immunity Spec:	N/A	Environment:	-

EMC Test Data

For The

Meru Networks

Model

AP200

Client:	Meru Networks	Job Number:	J59119
Model:	AP200	T-Log Number:	T59188
		Proj Eng:	Susan Pelzl
Contact:	Paul Chapman		
Emissions Spec:	FCC Part 15 C and E, RSS-210	Class:	-
Immunity Spec:	N/A	Environment:	-

EUT INFORMATION

General Description

The EUT is a combination DTS and UNII Radio which is designed to operate in the DTS and UNII bands. Normally, the EUT would be wall mounted during operation. The EUT was treated as tabletop equipment during testing to simulate the end user environment.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Meru Networks	AP200	802.11abg Access Point	4604AP000CE60017CF	RE7-AP200

Antenna

The EUT uses the following external antennas:

Manufacturer	Model	Description	Serial Number	Antenna Gain (dBi)
MY-Chance electronics	200SRP-T-W007	Triband antenna (2dBi in 2 GHz band, 5dBi in 5GHz bands)	-	N/A
Maxrad	MCO24005PT Elevation	5.5dBi Ceiling mount omni antenna (2.4 GHz band)	-	N/A

The antenna connector used is non-standard antenna (reverse SMA) to meet the requirements of FCC Part 15.203.

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 15 cm wide x 19 cm deep x 3.8 cm high (w/o antennas or wall/ceiling mounting bracket)

Modification History

Mod. #	Test	Date	Modification
1			

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EMC Test Data

Client:	Meru Networks	Job Number:	J59119
Model:	AP200	T-Log Number:	T59188
		Proj Eng:	Susan Pelzl
Contact:	Paul Chapman		
Emissions Spec:	FCC Part 15 C and E, RSS-210	Class:	-
Immunity Spec:	N/A	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
PowerDsine	6001	POE Hub	IO4136040005949B03	-
IBM	ThinkPad G40	Laptop	KM-5693H	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Power/Ethernet	POE Hub	Cat 5	Unshielded	1.8
Console	Laptop	Serial	Unshielded	2

Note: The console port would not normally be connected as the manufacturer stated that these are for configuration purpose. It was only connected to allow changing of the modes of the two radios for test purposes.

EUT Operation During Emissions Testing (Radio)

The radio was transmitting at the specified power on the specified channels with a duty cycle of 100 % (maximum allowed) and at a data rate of 6 or 11 Mb/s depending on the mode. The channels were selected since they are at the top, center and bottom of the allocated bands.

Client:	Meru Networks	Job Number:	J59119
Model:	AP200	T-Log Number:	T59188
		Account Manager:	Susan Pelzl
Contact:	Paul Chapman		
Spec:	FCC Part 15 C and E, RSS-210	Class:	-

Radiated Emissions - 2 Transmitters operating simultaneously

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: 4/5/2005
Test Engineer: David Bare
Test Location: SVOATS #1
Config. Used: 1
Config Change: None
EUT Voltage: 48 V POE

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.

The test distance and extrapolation factor (if used) are detailed under each run description.

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 FCC specifies the limit as an average measurement. In addition, the FCC 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: 17 °C
Rel. Humidity: 48 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 1 -40000 MHz, Preliminary Scan, Intermodulation Products	15.209	Pass	49.1dBµV/m (285.1µV/m) @ 4775.0MHz (-4.9dB)
2	Output Power	15.247 & 15.407	Pass	Refer to individual runs

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:	Meru Networks	Job Number:	J59119
Model:	AP200	T-Log Number:	T59188
		Account Manager:	Susan Pelzl
Contact:	Paul Chapman		
Spec:	FCC Part 15 C and E, RSS-210	Class:	-

Run #1a: Maximized Radiated Emissions due to intermodulation products, 1-40000 MHz
Radio 0 set to channel 1 (2412 MHz) in 802.11b mode, Radio 1 on channel 157 (5785 MHz)
Radio 0 set to power level 12, Radio 1 set to power level 13

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1320.000	49.1	v	54.0	-4.9	AVG	233	1.0	Unrelated to the transmitter
31586.400	45.1	h	54.0	-8.9	Avg	0	1.0	Measurement at 20 cm, no correction
21058.000	59.3	h	74.0	-14.7	Pk	45	1.0	Measured @ 1 m, 10.5dB correction
31586.400	58.2	h	74.0	-15.8	Pk	0	1.0	Measurement at 20 cm, no correction
1320.000	52.9	v	74.0	-21.1	PK	233	1.0	Unrelated to the transmitter
21058.000	29.9	h	54.0	-24.1	Avg	45	1.0	Measured @ 1 m, 10.5dB correction

Note 1:	No intermod frequencies observed. The signals observed at 21 and 31.5 GHz turned out to be local ambients.

Run #1b: Maximized Radiated Emissions due to intermodulation products, 1-25000 MHz
Radio 0 set to channel 1 (2412 MHz) in 802.11b mode, Radio 1 on channel 11 (2462 MHz) in 802.11b mode
Radio 0 set to power level 12, Radio 1 set to power level 13

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1320.000	48.7	v	54.0	-5.3	AVG	233	1.0	Unrelated to the transmitter
1320.000	52.6	v	74.0	-21.4	PK	233	1.0	Unrelated to the transmitter

Note 1:	No intermod frequencies observed. The 1320 MHz emission was unchanged from run 1a and will not be remeasured with the additional channel intermod tests.

Run #1c: Maximized Radiated Emissions due to intermodulation products, 1-40000 MHz
Radio 0 set to channel 36 (5180 MHz), Radio 1 on channel 165 (5825 MHz)
Radio 0 set to power level 13, Radio 1 set to power level 13

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4535.000	46.3	v	54.0	-7.7	Avg	180	1.0	Measured @ 1 m, corr'd by 10.5 dB
4535.000	44.4	v	54.0	-9.6	AVG	281	1.0	Measured @ 3m
4535.000	59.9	v	74.0	-14.1	Pk	180	1.0	Measured @ 1 m, corr'd by 10.5 dB
4535.000	55.4	v	74.0	-18.6	PK	281	1.0	Measured @ 3m

Note 1:	Only the $2f_1$ - f2 intermod observed

Client:	Meru Networks	Job Number:	J59119
Model:	AP200	T-Log Number:	T59188
		Account Manager:	Susan Pelzl
Contact:	Paul Chapman		
Spec:	FCC Part 15 C and E, RSS-210	Class:	-

Run #1d: Maximized Radiated Emissions due to intermodulation products, 1-40000 MHz
Radio 0 set to channel 60 (5300 MHz), Radio 1 on channel 165 (5825 MHz)
Radio 0 set to power level 13, Radio 1 set to power level 13

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4775.000	49.1	v	54.0	-4.9	AVG	223	1.2	Measured @ 3m
4775.000	45.5	v	54.0	-8.5	Avg	180	1.0	Measured @ 1 m, corr'd by 10.5 dB
4775.000	62.0	v	74.0	-12.0	PK	223	1.2	Measured @ 3m
4775.000	59.3	v	74.0	-14.7	Pk	180	1.0	Measured @ 1 m, corr'd by 10.5 dB

Note 1:	Only the $2f_1$ - f2 intermod observed

Run #1e: Maximized Radiated Emissions due to intermodulation products, 1-40000 MHz
Radio 0 set to channel 36 (5180 MHz), Radio 1 on channel 52 (5260 MHz)
Radio 0 set to power level 13, Radio 1 set to power level 13

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5100.000	45.6	v	54.0	-8.4	AVG	0	1.0	Measured @ 3m
5100.000	40.2	v	54.0	-13.8	Avg	0	1.0	Measured @ 1m, corr'd by 10.5 dB
5100.000	58.1	v	74.0	-15.9	PK	0	1.0	Measured @ 3m
5100.000	53.6	v	74.0	-20.4	Pk	0	1.0	Measured @ 1m, corr'd by 10.5 dB

Note 1:	All of the measurements at 5100 are of the noise floor which is different using the test setup for measurements at 1 and 3m.

Run #2: Output Power

Measurements of the output power were performed using a peak power meter on the above channels. All power measurements were within 0.5 dB of those in the origianl FCC application. Also, the output power of radio 0 was checked both with and without radio 1 transmitting. There was no difference in the power level from radio 0 with or without radio 1 transmitting.

The following items are not required as the documents submitted with the original application are still valid:

- FCC ID Label & Label Location
- Detailed Photographs
- Operator's Manual
- Block Diagram
- Schematic Diagrams