EMC Test Report
Application for Grant of Equipment Authorization
pursuant to
Industry Canada RSS-Gen Issue 2 / RSS 210 Issue 7
FCC Part 15 Subpart C

RFID Tag System model SP3000

UPN:	8398A-SP3000
FCC ID:	XGR-SP3000
APPLICANT:	Ambient Systems, B.V. Colosseum 15d 7521PV Enschede, The Netherlands
TEST SITE(S):	Elliott Laboratories 684 W. Maude Avenue Sunnyvale, CA 94085
and	41039 Boyce Road. Fremont, CA. 94538-2435
IC Site Registration #:	IC 2845A-2 and IC 2845B-5
REPORT DATE:	July 2, 2009
FINAL TEST DATES:	June 22, June 23 and June 25, 2009

AUTHORIZED SIGNATORY:

Mark E. Hill
Staff Engineer
Elliott Laboratories.

ACCREDITED

Testing Cert #2016-01

REVISION HISTORY

Rev#	Date	Comments	Modified By
1	July 30, 2009	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Ambient Systems, B.V. RFID Tag System model SP3000, pursuant to the following rules:

Industry Canada RSS-Gen Issue 2
RSS 210 Issue 7 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003
FCC DTS Measurement Procedure KDB558074, March 2005

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada 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.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's 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.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Ambient Systems, B.V. RFID Tag System model SP3000 complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 2
RSS 210 Issue 7 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Ambient Systems, B.V. RFID Tag System model SP3000 and therefore apply only to the tested sample. The sample was selected and prepared by Bob Ashlock of Ambient Systems, B.V..

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 210 A8.2	Digital Modulation	Systems uses DSSS techniques	-	Complies
15.247 (a) (2)	RSS 210 A8.2 (1)	6dB Bandwidth	1.6 MHz	>500kHz	Complies
	RSP100	99% Bandwidth	3.3 MHz	Information only	Complies
15.247 (b) (3)	RSS 210 A8.2 (4)	Output Power (multipoint systems)	10.3 dBm (0.011 Watts)	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)	RSS 210 A8.2 (2)	Power Spectral Density	-8.7 dBm / 3kHz	8dBm/3kHz	Complies
15.247(c) / 15.209	RSS 210 A8.5	Radiated Spurious Emissions 30MHz – 25 GHz	45.9dBµV/m @ 2483.5MHz (-8.1dB)	15.207 in restricted bands, all others < -20dBc	Complies

Note 1: Power value is calculated from a radiated field strength.

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Antenna is internal and integral to the device	-	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	32.9dBµV/m @ 92.341MHz (-10.6dB)	Refer to standard	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions		Refer to standard	N/A – EUT is Battery Powered
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in Exhibit 11, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual		Statement required regarding non-interference	Complies

MEASUREMENT UNCERTAINTIES

ISO/IEC 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	0.015 to 30	± 3.0
Radiated Emissions	30 to 1000	± 3.6
Radiated Emissions	1000 to 40000	± 6.0

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Ambient Systems, B.V. RFID Tag System model SP3000 is a 2.4GHz ZigBee RFID tag device. It is designed to communicate with the RFID Gateway and Routers. The EUT is typically mounted on objects (such as containers) that are to be tracked and reported for inventory control. Because they can be placed in various orientations and positions which include table-top heights, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The EUT is battery powered, 3.6 VDC, ~25 mA worst case.

The sample was received on June 22, 2009 and tested on June 22, June 23 and June 25, 2009. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Ambient Systems	SP3000	2.4GHz ZigBee RFID tag	601	XGR-SP3000

ANTENNA SYSTEM

The EUT uses an integral pcb trace antenna.

OTHER EUT INFORMATION

The SP3000 can be provided with optional tilt sensor and/or reed switch. These are options that are stuffing options in the digital circuitry on the main pcb. Preliminary testing was performed and showed no changes in the emissions with or without these stuffing options.
The Ambient SP3000 will also be marketed under the DeltaTrak brand, using model number 20172 for US and 20172C for Canada.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 6 cm wide by 6 cm deep by 1.5 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

No support equipment was used during testing.

EUT INTERFACE PORTS

The EUT has no interface ports.

EUT OPERATION

During testing, the EUT was configured to transit continuously on the desired channel at full power.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on June 22, June 23 and June 25, 2009 at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
SVOATS #2	90593	IC 2845A-2	684 West Maude Ave, Sunnyvale CA 94085-3518
Chamber 5	211948	IC 2845A-5	41039 Boyce Road Fremont, CA 94538-2435

ANSI C63.4:2003 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, on OATS sites, of predictable local TV, radio, and mobile communications traffic. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

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 or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

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. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak 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, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & 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.

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 loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

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. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

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 regulations require 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.

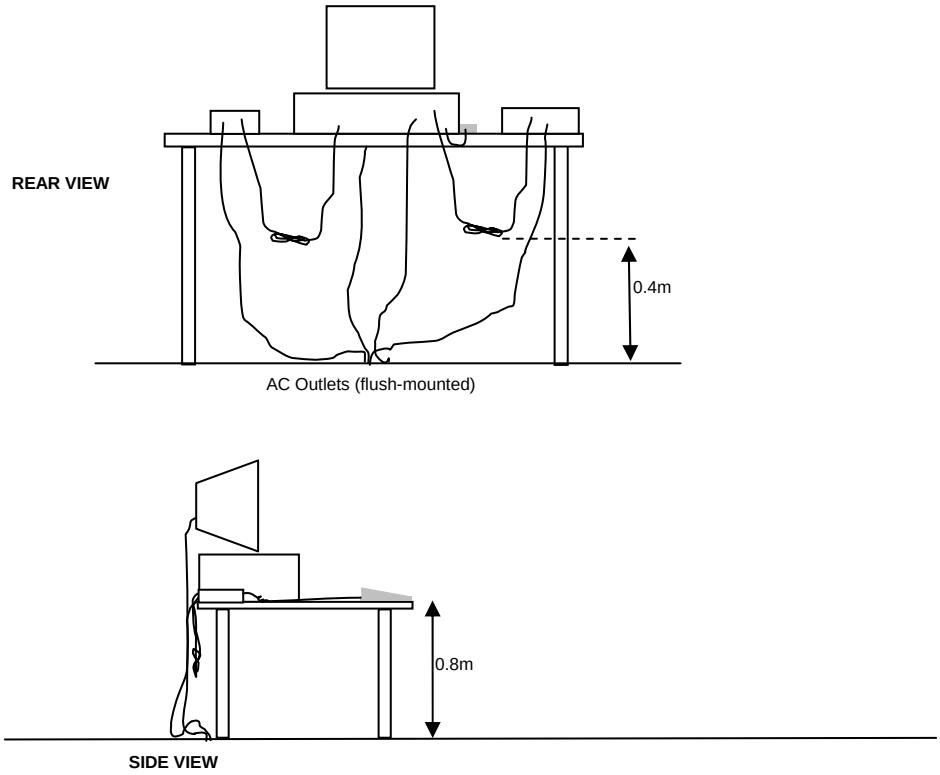
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

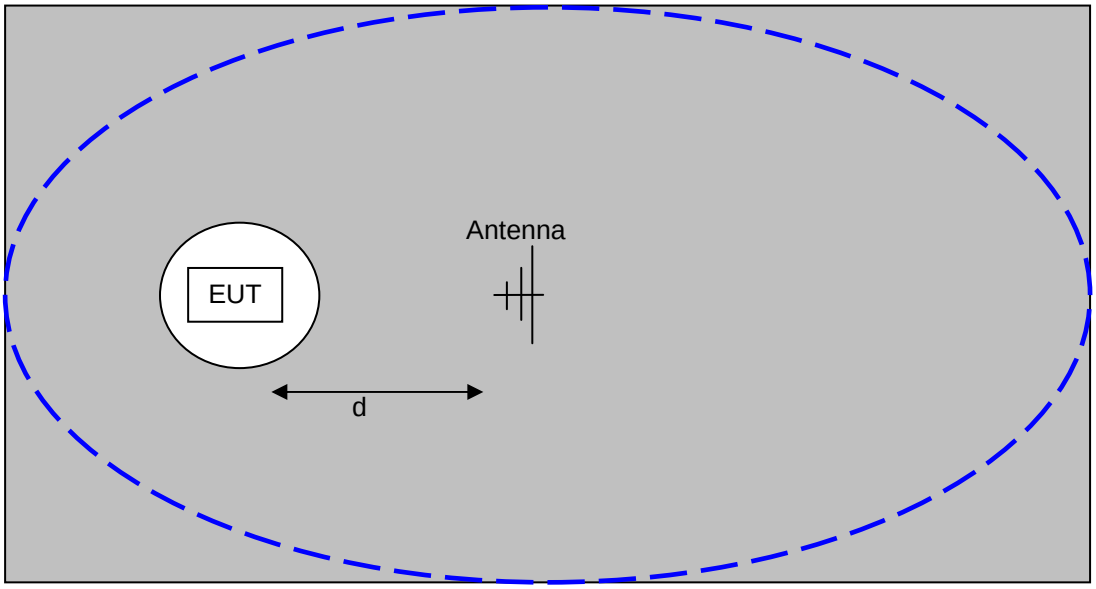
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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 (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). 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.

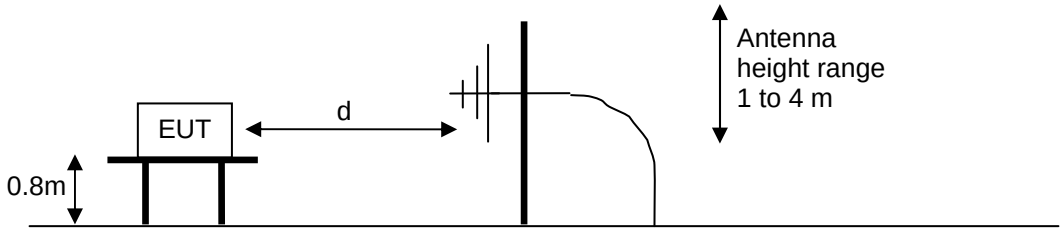
When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.



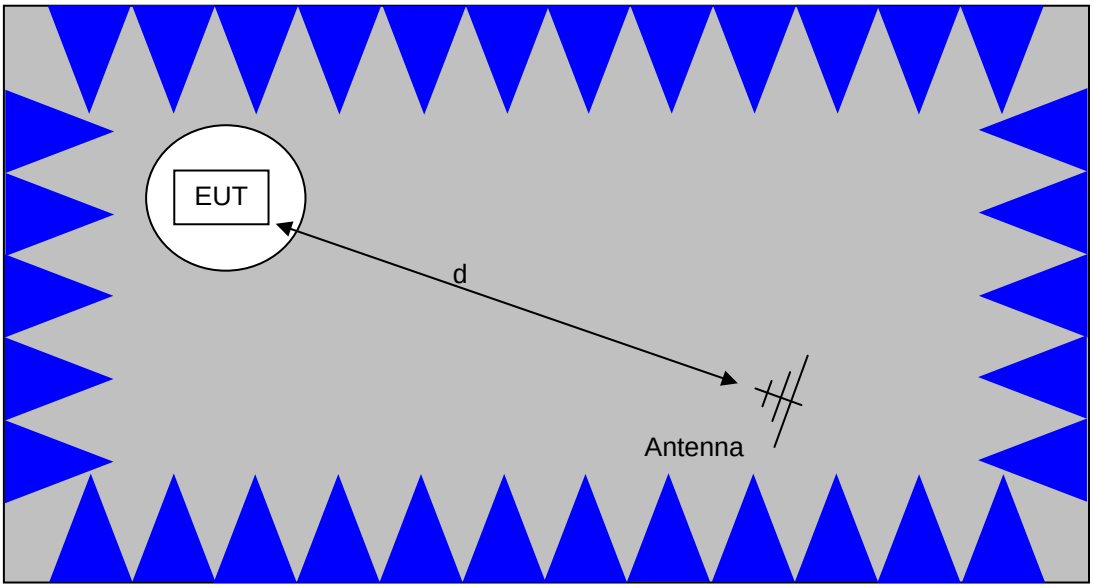
Typical Test Configuration for Radiated Field Strength Measurements



The ground plane extends beyond the ellipse defined in CISPR 16 / CISPR 22 / ANSI C63.4 and is large enough to accommodate test distances (d) of 3m and 10m. Refer to the test data tables for the actual measurement distance.

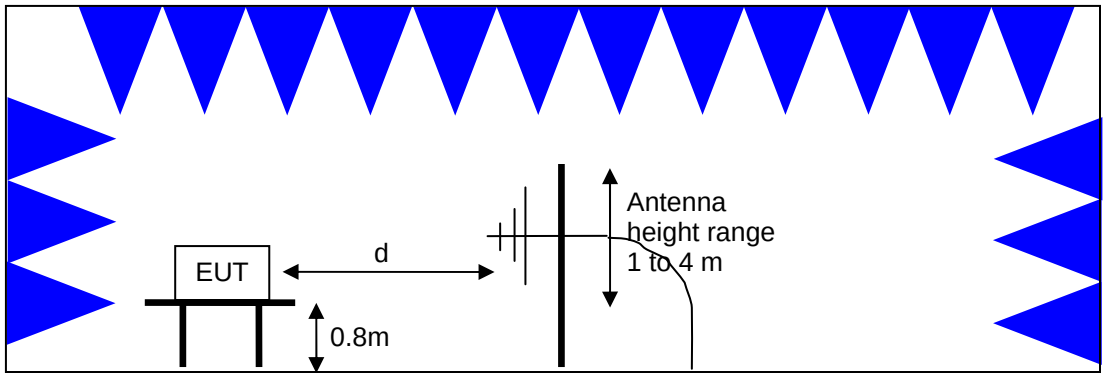


Test Configuration for Radiated Field Strength Measurements
OATS- Plan and Side Views



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. 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.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

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

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

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 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (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.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. 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).

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 above 30MHz, 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

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

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

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of 3m from the equipment under test:

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

where P is the eirp (Watts)

Appendix A Test Equipment Calibration Data

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Radiated Emissions, 30 - 10,000 MHz, 22-Jun-09
Engineer: Suhaila Khushzad

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	23-Dec-09
Hewlett Packard	EMC Spectrum Analyzer, 9 kHz - 6.5 GHz	8595EM	787	18-May-10
EMCO	Biconical Antenna, 30-300 MHz	3110B	801	19-Sep-09
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	09-Oct-09
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	15-Jul-10
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	12-Mar-10
Hewlett Packard	Preamplifier, 100 kHz - 1.3 GHz	8447D OPT 010	1826	26-May-10

Radiated Emissions, 30 - 1,000 MHz, 23-Jun-09
Engineer: JOhn Caizzi

Manufacturer	Description	Model #	Asset #	Cal Due
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	19-Sep-09
Com-Power Corp.	Preamplifier, 30-1000 MHz	PA-103	1632	13-Apr-10
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	23-May-10

Radiated Emissions, 30 - 26500 MHz, 26-Jun-09
Engineer: Rafael Varelas

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	09-Oct-09
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	15-Jul-10
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	12-Mar-10
Hewlett Packard	High Pass filter, 3.5 GHz (Red System)	P/N 84300-80038 (84125C)	1403	28-Aug-09

Radiated Emissions, 30 - 10,000 MHz, 16-Jul-09
Engineer: John Caizzi

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	23-Dec-09
EMCO	Biconical Antenna, 30-300 MHz	3110B	801	19-Sep-09
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	09-Oct-09
Hewlett Packard	EMC Spectrum Analyzer, 9 KHz-26.5 GHz	8593EM	1141	29-Dec-09
EMCO	Antenna, Horn, 1-18 GHz	3117	1662	11-Apr-10
Hewlett Packard	Preamplifier, 100 kHz - 1.3 GHz	8447D OPT 010	1826	26-May-10

Appendix B Test Data

T75761 15 Pages

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Emissions Standard(s):	FCC 15.247/RSS-210	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Ambient Systems

Model

SmartPoint (TAG)

Date of Last Test: 7/27/2009

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manger:	Christine Krebill
Contact:	Bob Ashlock		
Emissions Standard(s):	FCC 15.247/RSS-210	Class:	B
Immunity Standard(s):	-	Environment:	-

EUT INFORMATION

The following information was collected during the test session(s).

General Description

The EUT is a 2.4GHz ZigBee RFID tag device. It is designed to communicate with the RFID Gateway and Routers. The EUT is typically mounted on objects (such as containers) that are to be tracked and reported for inventory control. Because they can be placed in various orientations and positions which include table-top heights, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The EUT is battery powered, 3.6 VDC, ~25 mA worst case.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Ambient Systems	SP3000	2.4GHz ZigBee RFID tag	601	XGR-SP3000

EUT Antenna (Intentional Radiators Only)

The antenna is integral to the device.

EUT Enclosure

The EUT enclosure is primarily constructed of plastic. It measures approximately 6 cm wide by 6 cm deep by 1.5 cm high.

Modification History

Mod. #	Test	Date	Modification
1			No modifications were made to the EUT during testing.
2			
3			

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

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manger:	Christine Krebill
Contact:	Bob Ashlock		
Emissions Standard(s):	FCC 15.247/RSS-210	Class:	B
Immunity Standard(s):	-	Environment:	-

Test Configuration #1

The following information was collected during the test session(s).

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None	-	-	-	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None	-	-	-	-

Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
None	-	-	-	-

EUT Operation During Emissions Tests

During emissions testing the EUT was configured to transmit continuously on the desired channel.

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Standard:	FCC 15.247/RSS-210	Class:	B

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

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: 6/22/2009 & 6/25/09
Test Engineer: Suhaila Khushzad/Rafael Varelas
Test Location: Chamber # 2/OATS #2

Config. Used: 1
Config Change: None
EUT Voltage: 3.6 V DC

General Test Configuration

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

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

Ambient Conditions:

Temperature: 28 °C
Rel. Humidity: 35 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1b	-	Low 2405MHz	0.6	-	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	45.6dBµV/m @ 2387.9MHz (-8.4dB)
			0.6	-	Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	41.0dBµV/m @ 7216.5MHz (-13.0dB)
1d	-	Center 2440MHz	0.6	-	Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	39.0dBµV/m @ 7318.6MHz (-15.0dB)
1e	-	High 2475MHz	0.6	-	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	45.9dBµV/m @ 2483.5MHz (-8.1dB)
			0.6	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	40.3dBµV/m @ 7423.5MHz (-13.7dB)
2	RX/Digital Device	Center 2440MHz	0.6	-	Radiated Emissions, 30-1000 MHz, 1-10GHz	15.109/RSS-GEN	32.9dBµV/m @ 92.341MHz (-10.6dB)

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:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Standard:	FCC 15.247/RSS-210	Class:	B

Note: Preliminary testing showed that fundamental levels were maximized with the EUT in a vertical orientation. Harmonics outside of the band were measured with the EUT flat, based on preliminary measurements.

Run #1: Radiated Spurious Emissions, 30 - 25000 MHz (Power Setting: +0.6dBm)

Run #1b: Low Channel @ 2405 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

Vertical Orientation

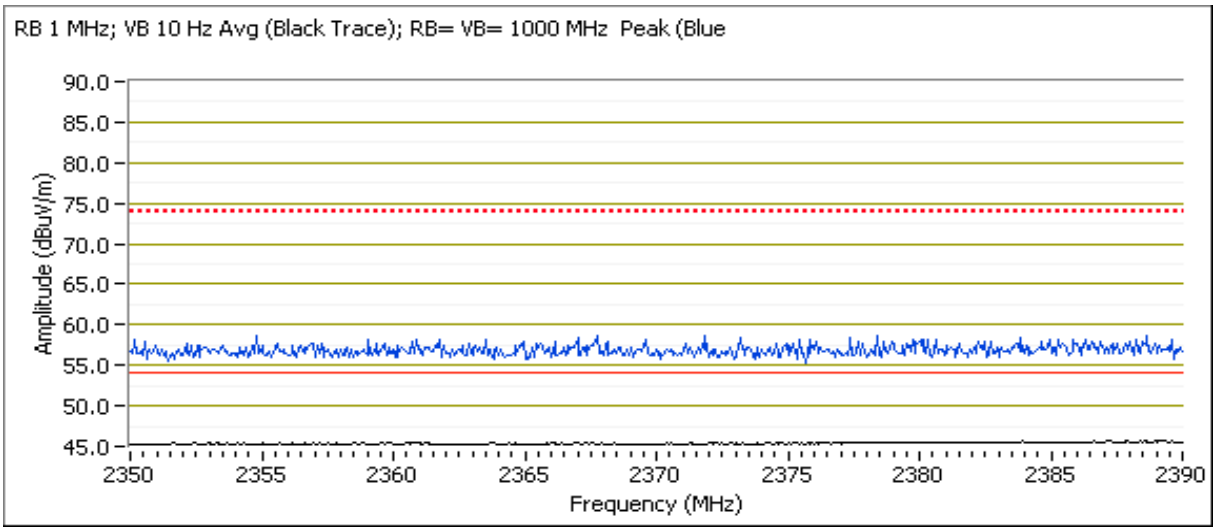
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2405.080	97.7	H	-	-	AVG	184	2.0	RB 1 MHz; VB: 10 Hz
2404.480	100.1	H	-	-	PK	184	2.0	RB 1 MHz; VB: 1 MHz
2405.040	95.2	V	-	-	AVG	260	1.4	RB 1 MHz; VB: 10 Hz
2404.610	97.6	V	-	-	PK	260	1.4	RB 1 MHz; VB: 1 MHz
2405.480	95.9	H	-	-	PK	184	2.0	RB 100 kHz; VB: 100 kHz
2405.150	92.8	V	-	-	PK	260	1.4	RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	95.9 dBµV/m	
Limit for emissions outside of restricted bands:	75.9 dBµV/m	Limit is -20dBc (Peak power measurement)

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2387.930	45.6	H	54.0	-8.4	Avg	184	2.0	RB 1 MHz; VB: 10 Hz
2389.220	58.0	H	74.0	-16.0	PK	184	2.0	RB 1 MHz; VB: 1 MHz
2388.220	45.4	V	54.0	-8.6	Avg	260	1.4	RB 1 MHz; VB: 10 Hz
2387.470	57.7	V	74.0	-16.3	PK	260	1.4	RB 1 MHz; VB: 1 MHz

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Standard:	FCC 15.247/RSS-210	Class:	B



Other Spurious Emissions
Flat Orientation

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
7216.460	41.0	H	54.0	-13.0	AVG	360	1.7	RB 1 MHz; VB: 10 Hz
7216.480	38.8	V	54.0	-15.2	AVG	121	1.6	RB 1 MHz; VB: 10 Hz
4809.160	36.0	V	54.0	-18.0	AVG	68	1.0	RB 1 MHz; VB: 10 Hz
4809.080	32.6	H	54.0	-21.4	AVG	87	1.0	RB 1 MHz; VB: 10 Hz
7216.280	51.2	H	74.0	-22.8	PK	360	1.7	RB 1 MHz; VB: 1 MHz
7216.080	49.3	V	74.0	-24.7	PK	121	1.6	RB 1 MHz; VB: 1 MHz
4809.270	45.5	V	74.0	-28.5	PK	68	1.0	RB 1 MHz; VB: 1 MHz
4811.050	43.1	H	74.0	-30.9	PK	87	1.0	RB 1 MHz; VB: 1 MHz

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental and measured in 100kHz.

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Standard:	FCC 15.247/RSS-210	Class:	B

Run #1d: Center Channel @ 2440 MHz. Software setting = +0.6dBm

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz
Vertical Orientation

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2440.000	98.1	H	-	-	AVG	188	2.0	RB 1 MHz; VB: 10 Hz
2440.640	100.5	H	-	-	PK	188	2.0	RB 1 MHz; VB: 1 MHz
2440.050	95.6	V	-	-	AVG	236	1.4	RB 1 MHz; VB: 10 Hz
2439.630	98.0	V	-	-	PK	236	1.4	RB 1 MHz; VB: 1 MHz
2439.820	96.7	H	-	-	PK	188	2.0	RB 100 kHz; VB: 100 kHz
2439.820	94.7	V	-	-	PK	266	1.4	RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	96.7	dBµV/m	
Limit for emissions outside of restricted bands:	76.7	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	66.7	dBµV/m	Limit is -30dBc (UNII power measurement)

Spurious Emissions
Flat Orientation

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7318.580	39.0	H	54.0	-15.0	AVG	305	1.7	MHz; VB: 10 Hz
7318.540	37.1	V	54.0	-16.9	AVG	277	1.0	MHz; VB: 10 Hz
4879.090	36.5	V	54.0	-17.5	AVG	64	1.0	MHz; VB: 10 Hz
4879.150	33.6	H	54.0	-20.4	AVG	8	1.0	MHz; VB: 10 Hz
7319.480	49.5	H	74.0	-24.5	PK	305	1.7	MHz; VB: 1 MHz
7321.080	48.6	V	74.0	-25.4	PK	277	1.0	MHz; VB: 1 MHz
4878.980	46.3	V	74.0	-27.7	PK	64	1.0	MHz; VB: 1 MHz
4879.370	44.6	H	74.0	-29.4	PK	8	1.0	MHz; VB: 1 MHz

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental and measured in 100kHz.

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Standard:	FCC 15.247/RSS-210	Class:	B

Run #1e: High Channel @ 2475 MHz = +0.6dBm

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

Vertical Orientation

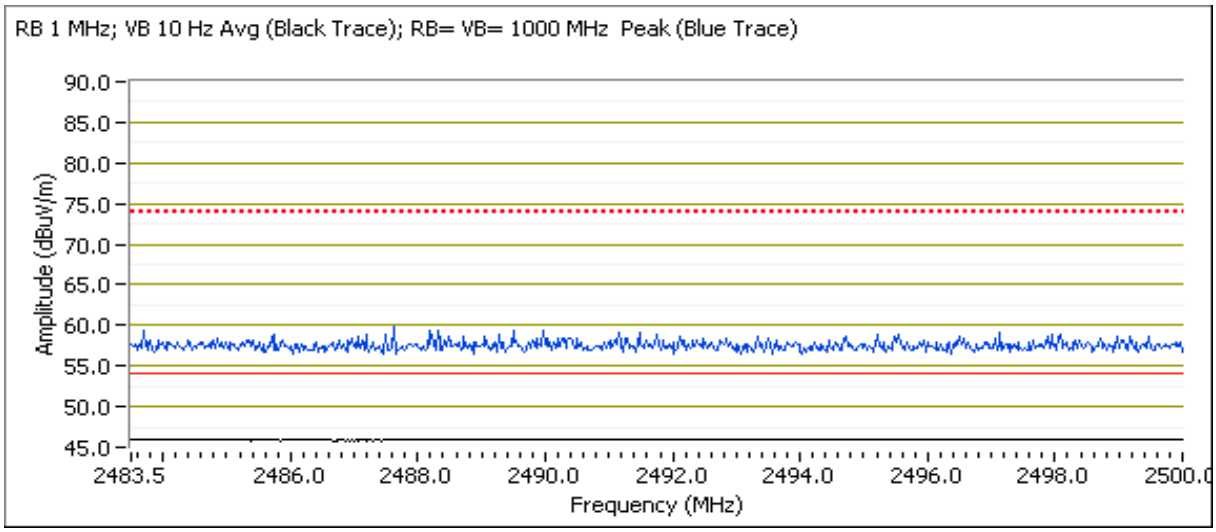
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2475.100	96.1	H	-	-	AVG	207	2.0	RB 1 MHz; VB: 10 Hz
2474.650	98.6	H	-	-	PK	207	2.0	RB 1 MHz; VB: 1 MHz
2475.060	94.0	V	-	-	AVG	297	1.5	RB 1 MHz; VB: 10 Hz
2474.570	96.4	V	-	-	PK	297	1.5	RB 1 MHz; VB: 1 MHz
2475.290	94.8	H	-	-	-	207	2.0	RB 100 kHz; VB: 100 kHz
2475.280	91.0	V	-	-	-	298	1.5	RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	94.8	dBµV/m	
Limit for emissions outside of restricted bands:	74.8	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	64.8	dBµV/m	Limit is -30dBc (UNII power measurement)

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	45.9	H	54.0	-8.1	Avg	207	2.0	RB 1 MHz; VB: 10 Hz
2484.190	58.3	H	74.0	-15.7	PK	207	2.0	RB 1 MHz; VB: 1 MHz
2483.550	45.9	V	54.0	-8.1	Avg	297	1.5	RB 1 MHz; VB: 10 Hz
2486.150	58.0	V	74.0	-16.0	PK	297	1.5	RB 1 MHz; VB: 1 MHz

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Standard:	FCC 15.247/RSS-210	Class:	B



Other Spurious Emissions
Flat Orientation

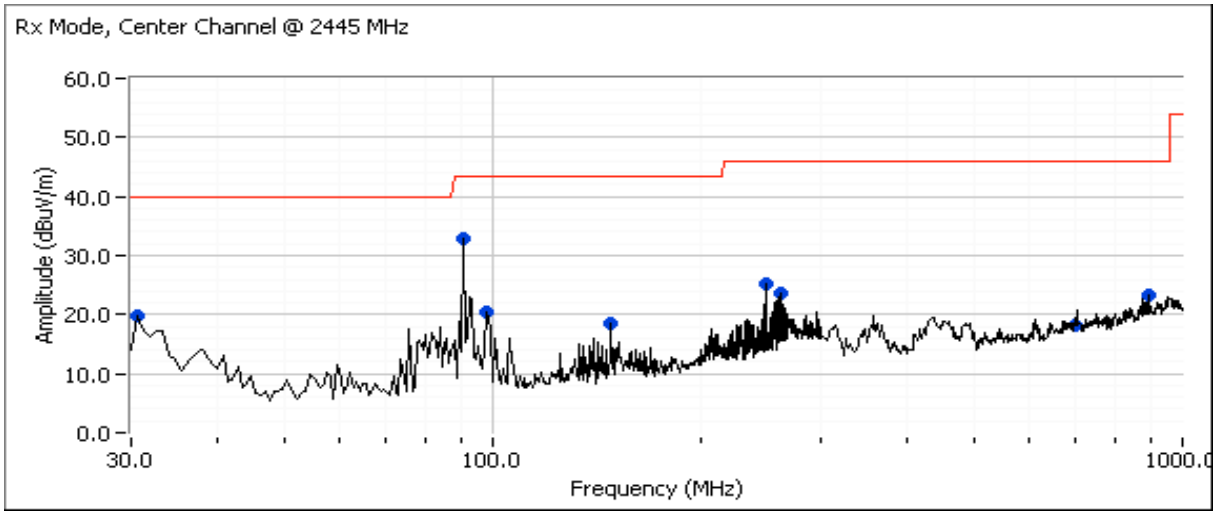
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7423.500	40.3	V	54.0	-13.7	AVG	209	1.6	MHz; VB: 10 Hz
7423.660	39.2	H	54.0	-14.8	AVG	257	1.8	MHz; VB: 10 Hz
4949.280	36.2	V	54.0	-17.8	AVG	86	1.0	MHz; VB: 10 Hz
4949.210	33.8	H	54.0	-20.2	AVG	349	1.0	MHz; VB: 10 Hz
7423.990	51.1	V	74.0	-22.9	PK	209	1.6	MHz; VB: 1 MHz
7424.040	49.7	H	74.0	-24.3	PK	257	1.8	MHz; VB: 1 MHz
4949.310	46.1	V	74.0	-27.9	PK	86	1.0	MHz; VB: 1 MHz
4951.400	44.9	H	74.0	-29.1	PK	349	1.0	MHz; VB: 1 MHz

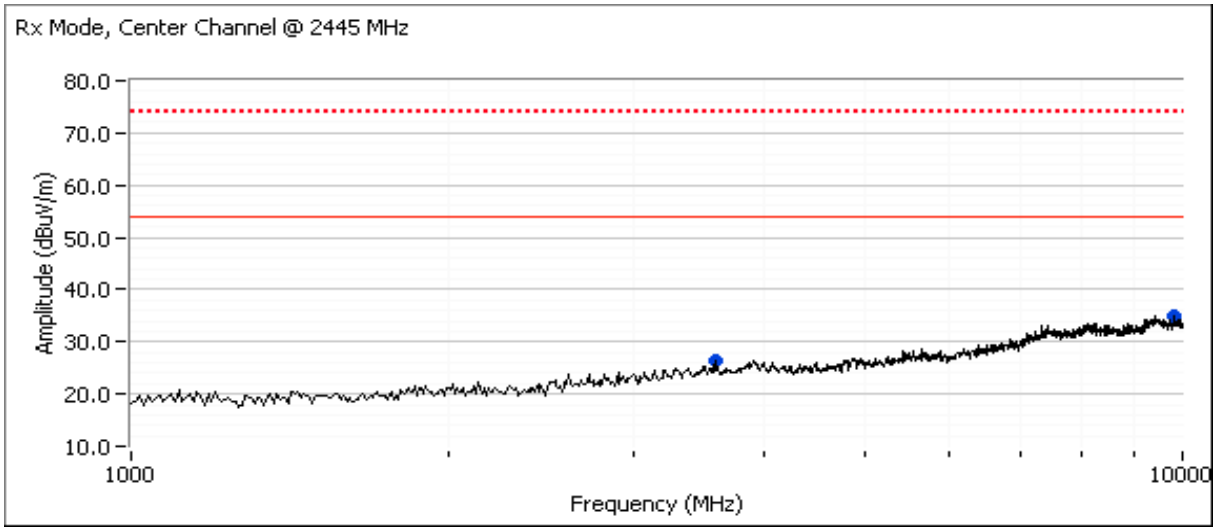
Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental and measured in 100kHz.

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock	Project Manager:	Mark Hill
Standard:	FCC 15.247/RSS-210	Class:	B

Run #2: Radiated Spurious Emissions, 30 - 10000 MHz, RX Mode (center channel @ 2440 MHz)

Frequency	Level	Pol	RSS-GEN		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
92.341	32.9	V	43.5	-10.6	Peak	211	1.7	
9827.530	34.8	H	54.0	-19.2	Peak	246	1.7	
30.573	19.8	V	40.0	-20.2	Peak	61	1.7	
251.018	25.3	V	46.0	-20.7	Peak	211	1.7	
261.003	23.5	H	46.0	-22.5	Peak	29	1.7	
885.373	23.2	V	46.0	-22.8	Peak	271	1.7	
97.675	20.5	H	43.5	-23.0	Peak	360	1.7	
147.027	18.4	V	43.5	-25.1	Peak	211	1.7	
3598.150	26.3	H	54.0	-27.7	Peak	283	1.7	
700.239	18.1	V	46.0	-27.9	Peak	211	1.7	





Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock		
Standard:	FCC 15.247/RSS-210	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements

Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

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: 6/25/2009
Test Engineer: Rafael Varelas
Test Location: SVOATS #2

Config. Used: 1
Config Change: None
EUT Voltage: 3.6 V DC

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 12 °C
Rel. Humidity: 81 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	0.6	-	Output Power	15.247(b)	Pass	10.3 dBm (0.011 W)
2	0.6	-	Power spectral Density (PSD)	15.247(d)	Pass	-8.7 dBm/3kHz
3	0.6	-	Minimum 6dB Bandwidth	15.247(a)	Pass	1.6 MHz
3	0.6	-	99% Bandwidth	RSS GEN	-	3.3 MHz

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.
The following deviations were made from the standard:
Describe deviation here

Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock		
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #1: Output Power

Channel	Frequency (MHz)	Field Strength at 3m (dBuV/m)	Antenna Pol. (H/V)	Res BW	Signal Banwidth	Bandwidth Correction	Power - EIRP (dBm)	Power (Watts)
Low	2405	100.1	H	1	3.1	4.9136169	9.7136169	0.0093619
Mid	2440	100.5	H	1	3.2	5.0514998	10.2515	0.0105962
High	2475	98.6	H	1	3.3	5.1851394	8.4851394	0.0070553

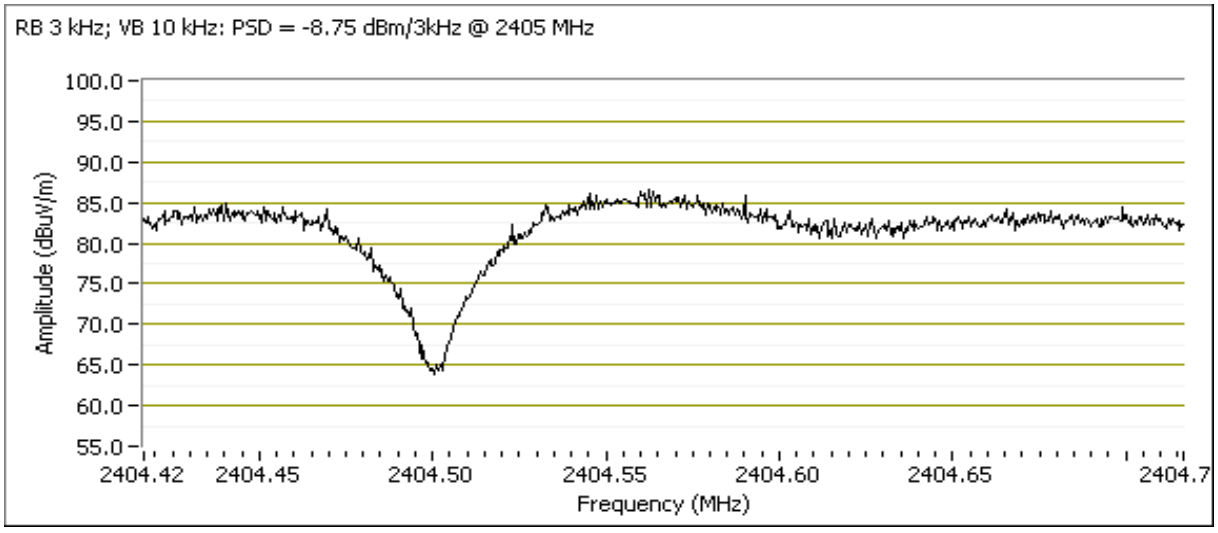
Note 1:	Output power calculated from field strength at 3m based on free space path loss formula E = √(30PG) / d, where E is the field strength (V/m), PG is the effective isotropic radiated power (W) and d is the distance (3m). Additional correction to the calculated power is made to account for the difference between the measurement bandwidth and signal bandwidth.

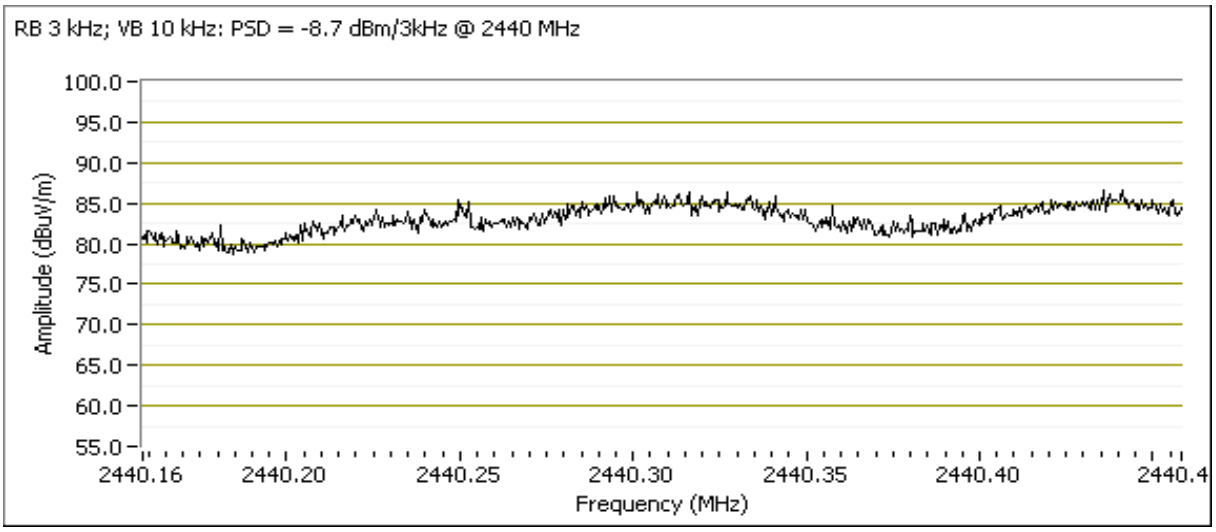
Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock		
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #2: Power spectral Density

Power Setting	Frequency (MHz)	PSD (dBm/3kHz) Note 1	Limit dBm/3kHz	Result
0.6	2405	-8.8	8.0	Pass
0.6	2440	-8.7	8.0	Pass
0.6	2475	-10.0	8.0	Pass

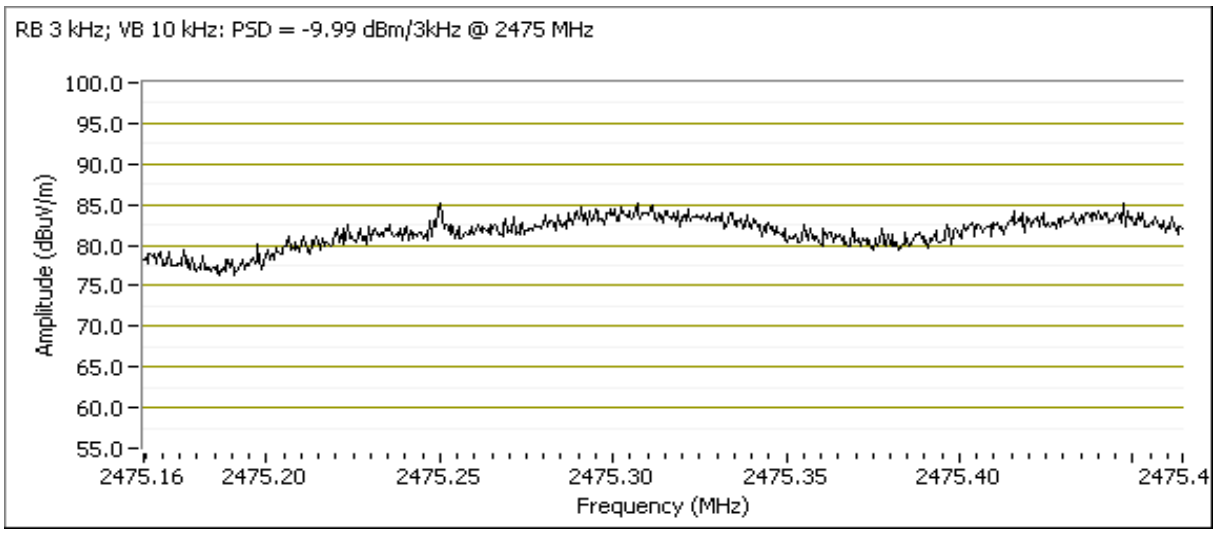
Note 1:	Power spectral density measured using RB=3 kHz, VB=10kHz, analyzer with peak detector and with a sweep time set to ensure a dwell time of at least 1 second per 3kHz. The measurement is made at the frequency of PPSD determined from preliminary scans using RB=3kHz using multiple sweeps at a faster rate over the 6dB bandwidth of the signal. Final PSD values were calculated by measuring field strength and correcting the reading by 95.3dB.





Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock		
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #2: Continued

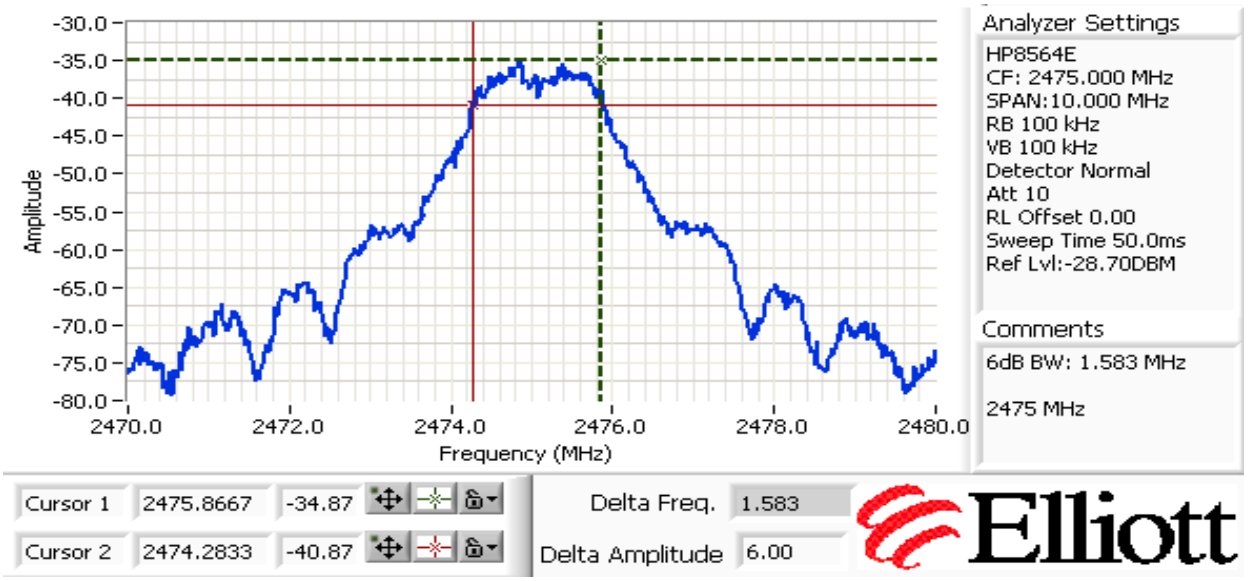


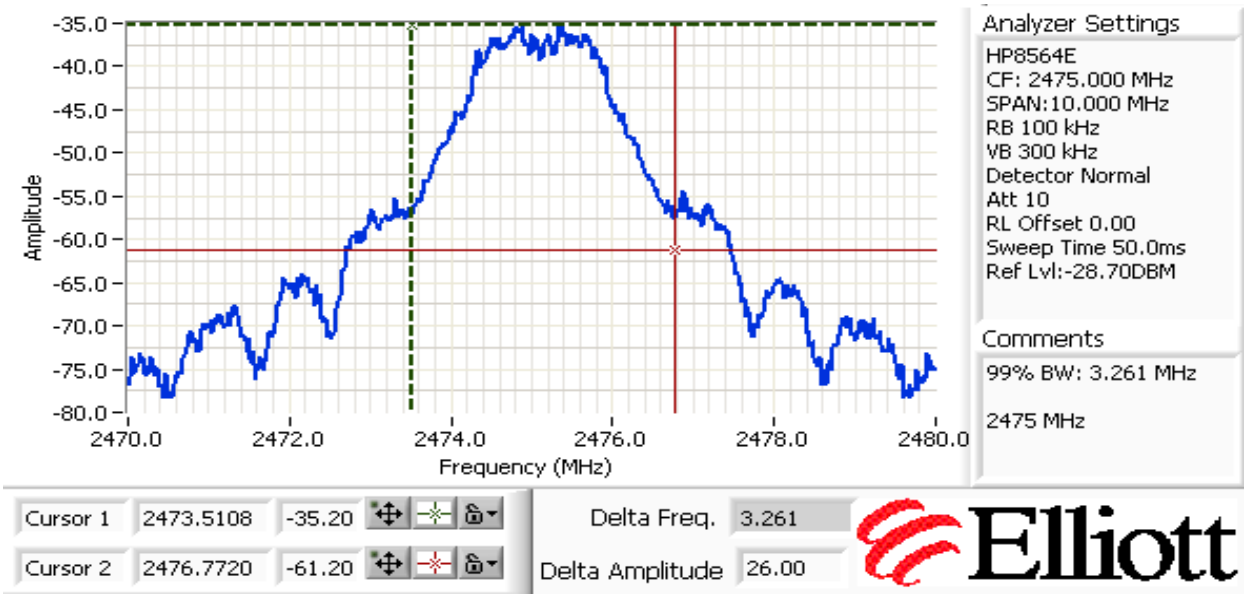
Client:	Ambient Systems	Job Number:	J75672
Model:	SmartPoint (TAG)	T-Log Number:	T75761
		Account Manager:	Christine Krebill
Contact:	Bob Ashlock		
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #3: Signal Bandwidth

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (MHz) 6dB	99%
0.6	2405	100kHz	1.6	3.1
0.6	2440	100kHz	1.6	3.2
0.6	2475	100kHz	1.6	3.3

Note 1:	99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB





Appendix C Photographs of Test Configurations

Uploaded as a separate Exhibit

Appendix D Proposed FCC ID Label & Label Location

Uploaded as a separate Exhibit

Appendix E Detailed Photographs

Uploaded as a separate Exhibit

Appendix F Operator's Manual

Uploaded as a separate Exhibit

Appendix G Block Diagram

Uploaded as a separate Exhibit

Appendix H Schematic Diagrams

Uploaded as a separate Exhibit

Appendix I Theory of Operation

Uploaded as a separate Exhibit

Appendix J Advertising Literature

Uploaded as a separate Exhibit

Appendix K RF Exposure Information

Uploaded as a separate Exhibit