LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
Testing Cert. 1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

TEST REPORT # 310193
LSR Job #: C-943

Compliance Testing of:
Hand Hygiene Badge

Test Date(s):
July 8th to 12th 2010

Prepared For:
Ecolab
655 Lone Oak Drive F6
Eagan, MN 55121

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.249
Industry Canada (IC) RSS 210 Annex 2
Transmitters Operating in the
Frequency Band 902 MHz – 928 MHz

This Test Report is issued under the Authority of:

Signature: Thomas T. Smith Date: 08.09.10

Test Report Reviewed by:	**Tested by:**
Thomas T. Smith, Manager EMC Test Services	Khairul Aidi Zainal, Senior EMC Engineer
Signature: Thomas T. Smith Date: 08.09.10	Signature: Date: 08.09.10

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EXHIBIT 1. INTRODUCTION

1.1 SCOPE

References:	FCC Part 15, Subpart C, Section 15.249 and 15.209 FCC Part 2, Section 2.1043 paragraph (b)1. RSS GEN and RSS 210 Annex 2
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	• Commercial, Industrial or Business • Residential

1.2 NORMATIVE REFERENCES

Publication	Title
47 CFR, Parts 0-15 (FCC)	Code of Federal Regulations - Telecommunications
RSS 210	Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-1-1	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.

1.3 LS Research, LLC TEST FACILITY

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation may be accessed on our web site: www.lsr.com. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at LS Research, LLC:

- Compact Chamber
- Semi-Anechoic Chamber
- Open Area Test Site (OATS)

1.5 TEST EQUIPMENT UTILIZED

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated in accordance with A2LA standards.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	**Ecolab**
Address:	**655 Lone Oak Drive F6, Eagan MN 55121**
Contact Name:	**Cheryl Littau**

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	Hand Hygiene Badge
Model Number:	BGE1PT
Serial Number:	10240120

2.3 ASSOCIATED ANTENNA DESCRIPTION

The antennas used in this device are a Johanson 900 MHz ceramic chip antenna (P/N 0915AT43A0026) and a Toko low frequency 3-axes coil antenna (P/N 1085BAN-2047). The Toko antenna is used for low frequency receive function.

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

EUT Frequency Range (in MHz)	906.4 MHz to 921.6 MHz
RF Power in Watts	
Minimum:	0.00046 Watts
Maximum:	0.00058 Watts
Field Strength at 3 meters	92.9 dBµV/m at 906.4 MHz
Occupied Bandwidth	126.5 kHz
Type of Modulation	GFSK
Emission Designator	127KF1D
EIRP (in mW)	0.585 mW
Transmitter Spurious (worst case) at 3 meters	47.0 dBµV/m at 5529.6 MHz
Stepped (Y/N)	No
Step Value:	N/A
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor Model # (if applicable)	CC430F5137
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	Ceramic chip antenna
Gain (in dBi)	-1.0 dBi (Data Sheet)
EUT will be operated under FCC Rule Part(s)	15.249
EUT will be operated under RSS Rule Part(s)	RSS 210
Modular Filing	☐ Yes ☒ No
Portable or Mobile?	Portable

2.5 PRODUCT DESCRIPTION

The Ecolab Hand Hygiene Badge is a badge assigned to individual hospital employees to be worn along with their hospital ID in order to monitor hand hygiene performance. The Hand Hygiene Badge incorporates a 900 MHz transceiver and a low frequency (134 kHz) radio receiver for the purpose of relaying data.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	71° F
Humidity:	42 %
Pressure:	751 mmHg

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC and IC Paragraph	Test Requirements	Compliance (yes/no)
FCC : 15.207 IC : RSS GEN sect. 7.2.2	Power Line Conducted Emissions Measurements	N/A
IC : RSS GEN section 4.6.1	20 dB Bandwidth	YES
FCC : 15.249(A) & 1.1310 IC : RSS 210 A2.9 (a)	Maximum Output Power	YES
FCC : 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	YES
FCC : 15.249(a) IC : RSS 210 A2.9(a)	Transmitter harmonics	YES
FCC : 15.249(d), 15.209 & 15.205 IC : RSS 210 A2.9(b),	Transmitter Radiated Emissions	YES
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers (RSS GEN and RSS 210 of IC). The Receiver Test Report is available upon request.		

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☐ **None** ☒ **Yes (explain below)**

The power level of the transmitter was set to setting 3A

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☒ **None** ☐ **Yes (explain below)**

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.249, and Industry Canada RSS-210, Annex 2.9.

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuously transmitting modulated mode using power as provided by a battery. The unit has the capability to operate on 3 channels, controllable using shorting pins.

The applicable limits apply at a 3 meter distance. Measurements above 3 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of four (3) standard channels: **906.4 MHz, 913.8 MHz and 921.6 MHz** to comply with FCC Part 15.35.

5.2 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 10000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 10 GHz.
In the frequency range of 30 MHz to 3 GHz, the maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height while for the range of 3 GHz to 10 GHz the antenna was raised and lowered between 1 and 1.8 meters in height. In addition, the polarity of the antenna was switched between horizontal and vertical polarity.

The EUT was positioned in three orthogonal positions for the test.

Battery Voltage was periodically checked to ensure sufficient supply.

5.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBµV/m) + Antenna correction Factor +Cable factor (dB) + Miscelaneous factors when applicable (dB) – amplification factor when applicable (dB).

The EMI Receiver was operated with resolution bandwidths as prescribed in ANSI C63.4.

5.4 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.249 and Canada RSS-210, Annex 2.9. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 SAMPLE CALCULATION OF RADIATED EMISSIONS LIMITS AND REPORTED DATA

Reported data:

For both fundamental and spurious emissions measurement, the data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBμV/m) + Antenna correction Factor + Cable factor (dB) + Miscellaneous factors when applicable (dB) – amplification factor when applicable (dB).

Field Strength of Fundamental Frequencies:
The fundamental emissions for an intentional radiator in the 902-928 MHz band, operating under FCC part 15.249 and RSS 210 A2.9 limits, must have electric field strength of no greater than 50 mV/m, for the fundamental frequency, when measured at 3 meters, and harmonic field strength of no greater than 500 μV/m, when measured at 3 meters. Spurious emissions outside the 902-928 MHz band shall be attenuated by at least 50 dB below the level of the fundamental, or meet the limits expressed in FCC part 15.209 under general emission limits.
Field Strength of Fundamental Frequencies is Limited to 50,000 μV/m, or 94 dBμV/m.
Field Strength of Harmonic and Spurious Frequencies is Limited by FCC 15.249 a and d
The harmonic limit of –50 dBc with respect to the fundamental limit would be:

94 dBμV/m – 50 dB = 44 dBμV/m,

*****with the exception of where FCC 15.209***** allows for a higher limit to be used.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)
902-928	50,000	94.0
30-88 ; 88-216	159	44.0
216-902 ; 928-960	500	46.0*****
960-40,000	500	54.0*****

The following table depicts the general radiated emission limits obtained from Title 47 CFR, part 15.209a, for radiated emissions measurements, including restricted band limits as expressed in 47 CFR, part 15.205.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-40,000	500	54.0

Sample conversion from field strength μV/m to dBμV/m:

$dB\mu V/m = 20 \log_{10}$ (3m limit)

30 - 88 MHz example: $dB\mu V/m = 20 \log_{10} (100)$

$40.0\ dB\mu V/m = 20 \log_{10} (100)$

902-928 MHz example: $=20 \log_{10} (50000/1)$
$=93.98$ dBµV/m

For measurements made at 1 meter, a 9.5 dB correction may be been invoked.

960 MHz to 40,000 MHz
500 µV/m or 54.0 dBµV/m at 3 meters
54.0 + 9.5 = 63.5 dBµV/m at 1 meter

Generic example of reported data at 200 MHz:

Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor)
= 35.45 (dBµV/m).

5.6 RADIATED EMISSIONS TEST DATA CHART

Measurements of Electromagnetic Radiated Emissions
Frequency Range Inspected: 30 MHz to 10000 MHz

Manufacturer:	Ecolabs						
Date(s) of Test:	July 8th to 12th 2010						
Project Engineer:	Khairul Aidi Zainal						
Test Engineer(s):	Khairul Aidi Zainal						
Voltage:	3.0 VDC						
Operation Mode:	Continuous transmit and modulated.						
Environmental Conditions in the Lab:	Temperature: 71˚F Relative Humidity: 42 %						
EUT Power:		Single Phase 120 VAC		3 Phase ___VAC			
	X	Battery		Other:			
EUT Placement:	X	80cm non-conductive table		10cm Spacers			
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	X	Final	
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average	

The following table depicts the level of radiated fundamental:

FREQ (MHz)	ANT	EUT	HEIGHT (m)	AZIMUTH (°)	PEAK (dBµv/m)	Q.PEAK (dBµv/m)	AVERAGE (dBµv/m)	LIMIT (dBµv/m)	MARGIN (dB)
921.59	H	F	1.59	193	92.6	91.9	90.4	94.0	2.1
913.80	H	F	1.00	193	92.9	92.4	90.6	94.0	1.6
906.40	H	F	1.00	193	93.3	92.9	91.1	94.0	1.0

Note:
1. H = Horizontal, V = Vertical, F=Flat.

RADIATED EMISSIONS DATA CHART *(continued)*

The following table depicts the level of harmonic emissions seen on the low channel:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Note 3	1812.8	48.8	40.9	54.0	13.1			
Note 3	2719.2	39.2	31.1	54.0	22.9			
Horizontal	3625.6	48.4	36.6	63.5	26.9	104.1	3	V
Vertical	4532.0	47.4	35.1	63.5	28.4	106.2	12	V
Horizontal	5438.4	56.8	54.0	63.5	9.5	118.1	336	S
Horizontal	6344.8	46.1	34.3	63.5	29.2	105.4	5	V
Horizontal	7251.2	48.6	36.6	63.5	26.9	104.9	9	S
Horizontal	8157.6	48.6	36.6	63.5	26.9	111.7	5	F
Vertical	9064.0	48.2	36.6	63.5	26.9	109.8	5	S

The following table depicts the level of harmonic emissions seen on middle channel:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Note 3	1827.6	48.8	40.9	54.0	13.1			
Note 3	2741.4	38.9	31.1	54.0	22.9			
Vertical	3655.2	49.7	37.2	63.5	26.3	102.6	3	V
Vertical	4569.0	47.4	34.9	63.5	28.6	102.4	8	V
Vertical	5482.8	58.1	55.6	63.5	7.9	119.4	244	V
Vertical	6396.6	47.5	35.2	63.5	28.3	110.9	7	V
Vertical	7310.4	47.5	35.9	63.5	27.6	103.3	10	V
Horizontal	8224.2	49.1	37.5	63.5	26.0	102.9	5	V
Vertical	9138.0	48.4	36.5	63.5	27.0	106.8	8	V

The following table depicts the level of harmonic emissions seen on high channel:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Note 3	1843.2	48.7	40.9	54.0	13.1			
Note 3	2764.8	39.1	31.3	54.0	22.7			
Vertical	3686.4	48.5	37.4	63.5	26.1	103.0	6	S
Vertical	4608.0	48.3	34.9	63.5	28.6	103.0	10	S
Vertical	5529.6	58.8	56.5	63.5	7.0	103.3	352	V
Vertical	6451.2	46.9	35.0	63.5	28.5	102.2	4	F
Vertical	7372.8	47.7	36.1	63.5	27.4	115.1	8	V
Horizontal	8294.4	48.4	36.5	63.5	27.0	105.6	5	F
Vertical	9216.0	49.2	37.3	63.5	26.2	99.4	10	V

Notes:

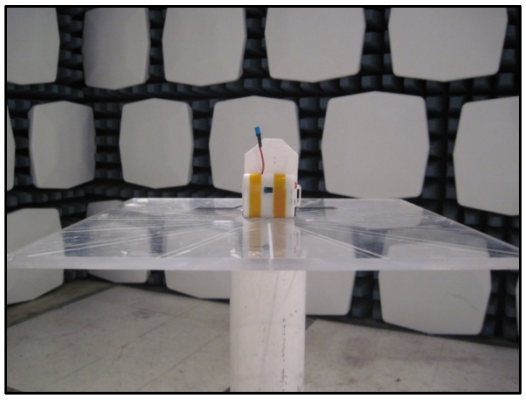
1) A Peak Detector was used in measurements above 1 GHz, for average measurement, the peak detector was used with lower VBW. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
2) Measurements above 3 GHz were made at 1 meter of separation from the EUT.
3) Measurement at receiver system noise floor.

The following table depicts the level of significant spurious radiated RF emissions (other than harmonics) found:

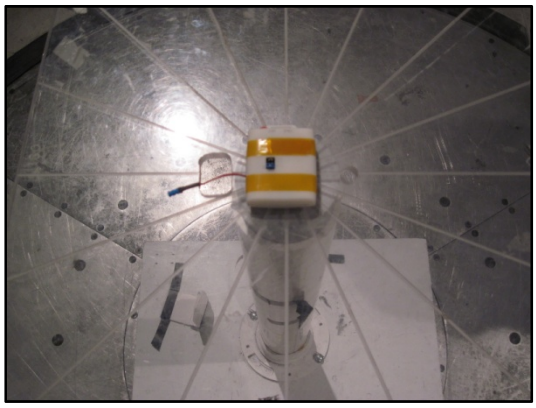
FREQ (MHz)	ANT	EUT	HEIGHT (m)	AZIMUTH (°)	PEAK (dBµv/m)	Q.PEAK (dBµv/m)	AVERAGE (dBµv/m)	LIMIT (dBµv/m)	MARGIN (dB)
997.43	H	F	1.00	0	35.0	29.8	23.2	54.0	24.2
984.31	V	F	1.00	0	34.5	28.7	22.1	54.0	25.3
791.60	H	F	1.00	0	33.0	26.9	20.3	46.0	19.1
752.80	V	F	1.00	0	32.1	26.1	19.5	46.0	19.9
293.34	H	V	1.00	0	30.7	24.7	18.2	46.0	21.3
194.99	V	V	1.00	0	22.8	17.3	11.4	43.0	25.7

Note:
1. H = Horizontal, V = Vertical, F= Flat.
2. Data listed above are measurements of the system noise floor.
3. There were no spurious emissions detected above the noise floor.

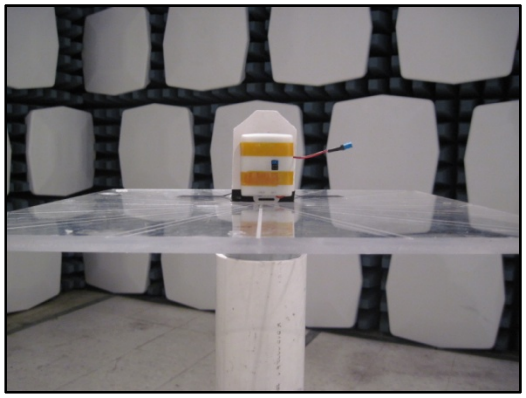
5.7 Test Setup Photo(s) – Radiated Emissions Test



Side.



Flat



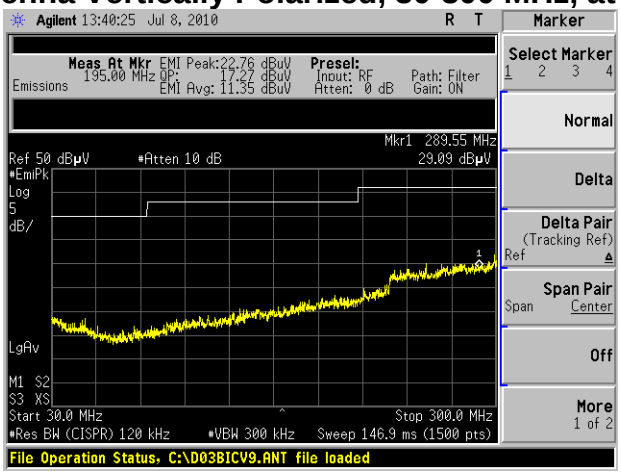
Vertical

5.8 Screen Captures - Radiated Emissions Test

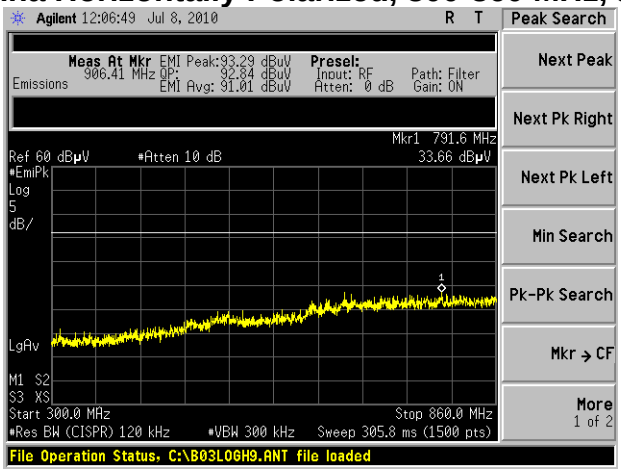
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and a peak detector with video averaging is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels low, middle and high, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Antenna Vertically Polarized, 30-300 MHz, at 3m

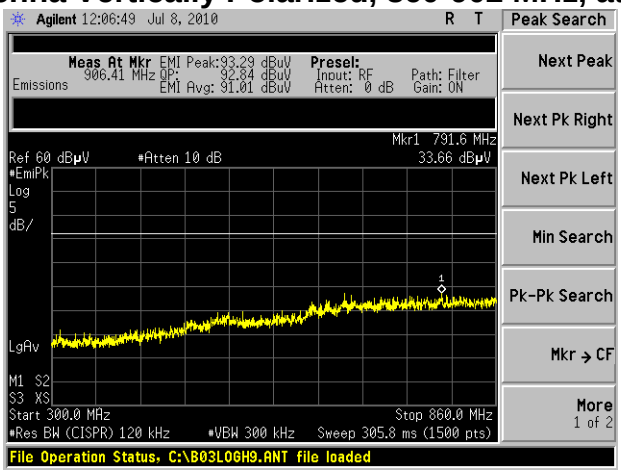


Antenna Horizontally Polarized, 300-860 MHz, at 3m

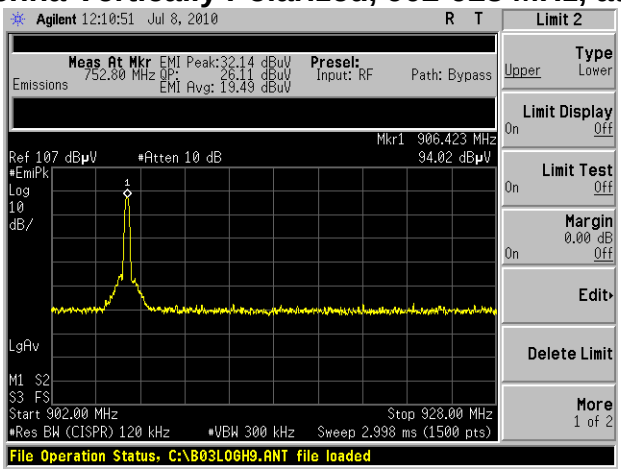


Screen Captures - Radiated Emissions Testing *(continued)*

Antenna Vertically Polarized, 860-902 MHz, at 3m

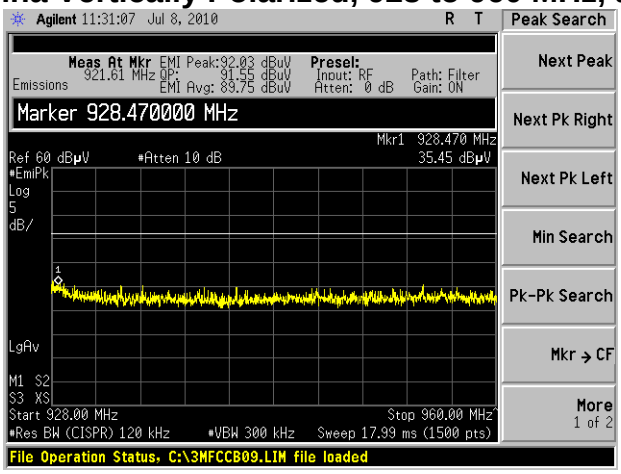


Antenna Vertically Polarized, 902-928 MHz, at 3m

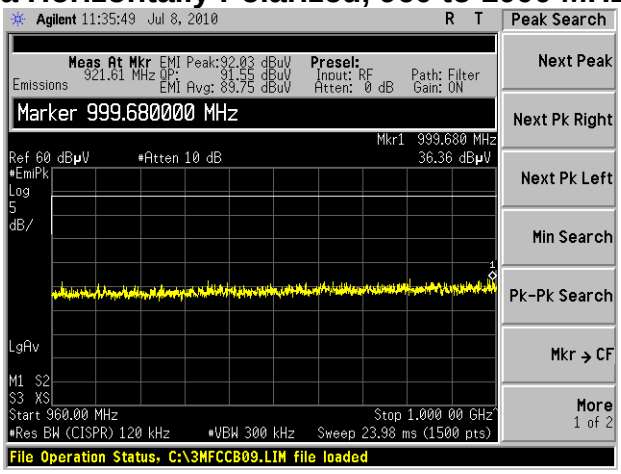


Screen Captures - Radiated Emissions Testing *(continued)*

Antenna Vertically Polarized, 928 to 960 MHz, at 3m

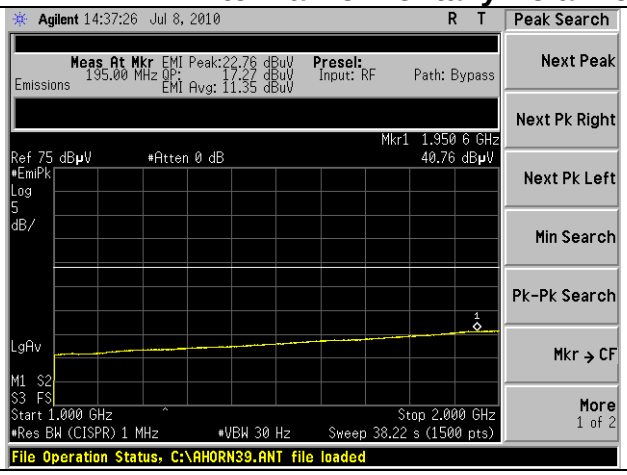


Antenna Horizontally Polarized, 960 to 1000 MHz, at 3m

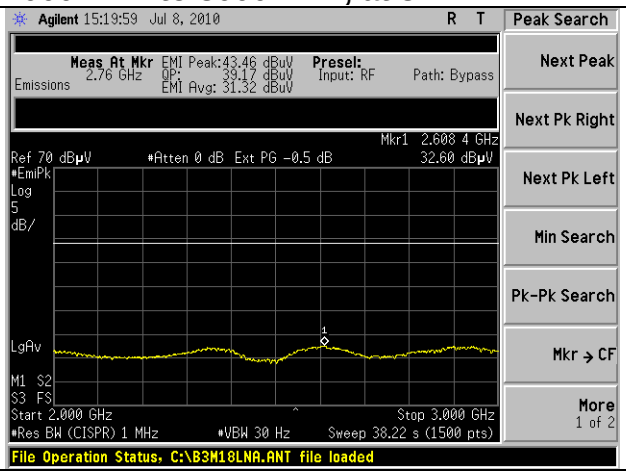


Screen Captures - Radiated Emissions Testing *(continued)*

Antenna Horizontally Polarized, 1000 MHz to 3000 MHz, at 3m



1000 to 2000 MHz



2000 to 3000 MHz

Antenna Vertically Polarized, 3000-10000 MHz, at 1m

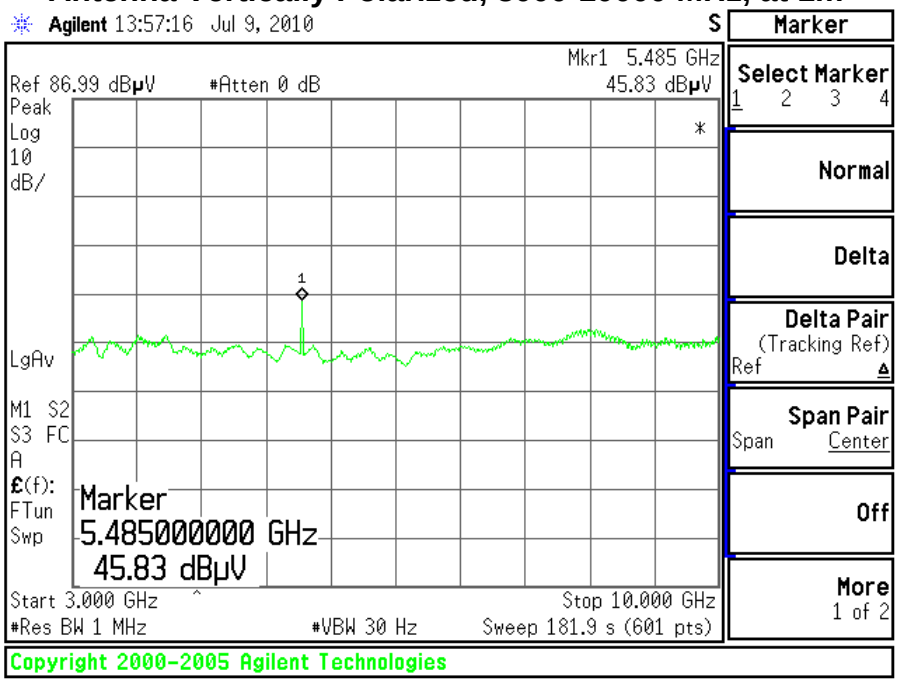


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE:

This test is not applicable since the EUT is battery powered.

EXHIBIT 7. OCCUPIED BANDWIDTH:

7.1 Limits

There are no limits specified. The occupied bandwidth need only be reported.

7.2 Method of Measurements

This test was performed radiated in a 3-meter semi-anechoic chamber. The resolution bandwidth was set such that it was greater than the occupied bandwidth. This maximum value for the fundamental was then used as reference for 20dBc.

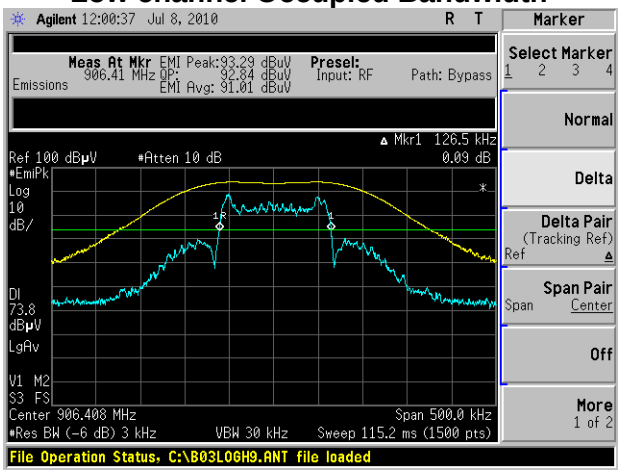
The resolution bandwidth was then set to a value that was greater than or equal to 1% of the bandwidth. Using the 20dBc, marker, the bandwidth was measured.

7.3 Test Data

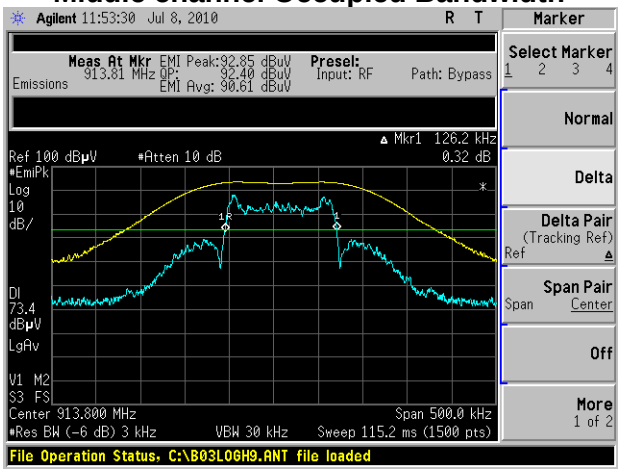
Center Frequency (MHz)	Measured -20 dBc Occ.Bw (kHz)
906.4	126.5
913.8	126.2
921.6	126.5

7.4 Screen Captures - OCCUPIED BANDWIDTH

Low channel Occupied Bandwidth



Middle channel Occupied Bandwidth



High channel Occupied Bandwidth

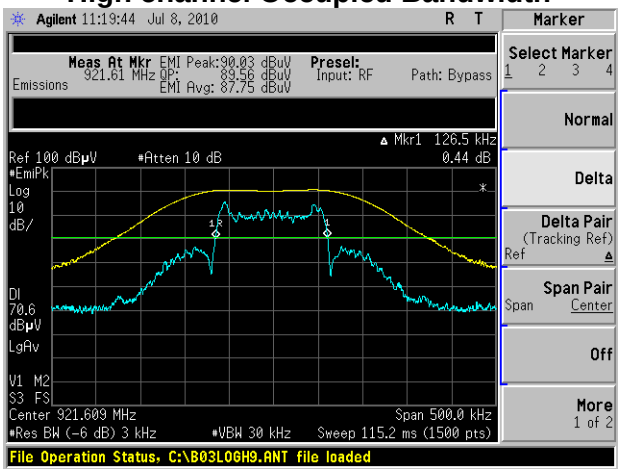
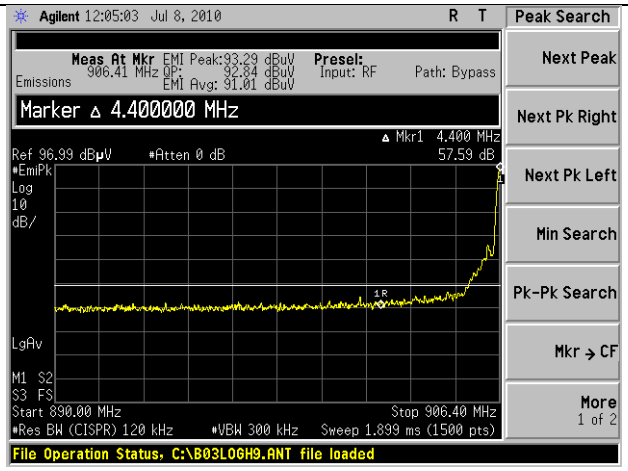


EXHIBIT 8. BAND-EDGE MEASUREMENTS

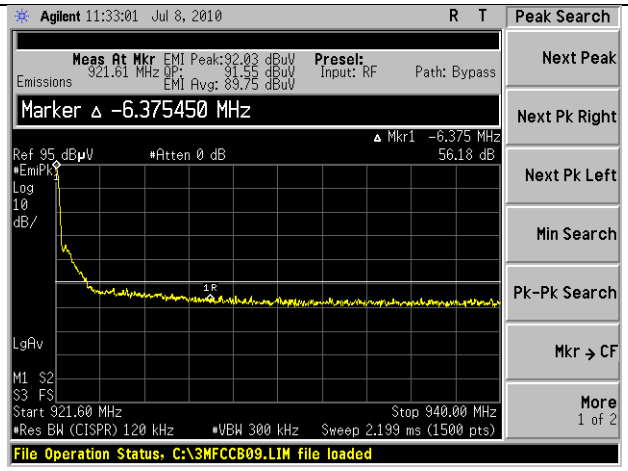
8.1 Method of Measurements

FCC 15.209(b) and 15.249(d) require a measurement of spurious emission levels to be at least 50 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in tables 2 and 3 of the same standard and also to the limits in the applicable annex. The following screen captures demonstrate compliance of the intentional radiator at the 902-928 MHz Band-Edges. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

Screen Capture Demonstrating Compliance at the **Band-Edges**



Lower band edge



Upper band edge

EXHIBIT 9. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

The stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers.

In this case, the EUT is powered via batteries. Therefore, using a variable DC power supply, the voltage was varied by - 15%.

A spectrum analyzer was used to measure the frequency at the appropriate frequency markers. For this test, the EUT was placed in continuous transmit CW mode.

	3.0 VDC		2.55 VDC			
Channel	Frequency (Hz)	Power (dBm)	Frequency (Hz)	Power (dBm)	Deviation (Hz)	Deviation (dBm)
Low	906408440	-4.6	906408210	-5.0	230	0.3
Middle	913806350	-6.2	913806320	-6.5	30	0.3
High	921604500	-4.9	921604550	-5.2	50	0.4

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.

No anomalies were noted in the measured transmit power and the frequency stability was better than 100 ppm during the voltage variation tests.

APPENDIX A

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Jul-2010 Type Test : Radiated emissions (209) Job # : C-943

Prepared By: AIDI Customer : Ecolab Quote #: 310193

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
4	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
5	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
6	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
7	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/4/2010	6/4/2011	Active Calibration

Project Engineer: AIDI Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Jul-2010 Type Test : Harmonics Job # : C-943

Prepared By: AIDI Customer : Ecolab Quote #: 310193

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
4	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
5	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
6	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
7	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/4/2010	6/4/2011	Active Calibration

Project Engineer: AIDI Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Jul-2010 Type Test : Occupied Bandwidth (6dB & 20dB) Job # : C-943

Prepared By: AIDI Customer : Ecolab Quote #: 310193

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration

Project Engineer: AIDI Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Jul-2010 Type Test : Band-Edge Job # : C-943

Prepared By: AIDI Customer : Ecolab Quote #: 310193

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration

Project Engineer: AIDI Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Jul-2010 Type Test : Fundamental Job # : C-943

Prepared By: AIDI Customer : Ecolab Quote #: 310193

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration

Project Engineer: AIDI Quality Assurance:

APPENDIX B
TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2009		
ANSI C63.10	2009		
CISPR 11	2009-05	2009-12 P	
CISPR 12	2007-05		
CISPR 14-1	2005-11	2008-11	
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2010-01		
CISPR 16-1-2 Note 1	2003	2004-04	2006-07
CISPR 22	2008-09		
CISPR 24	1997-09	2001-07	2002-10
EN 55011	2007-05		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006	2007	
EN 60601-1-2	2007-03		
EN 61000-3-2	2006-05		
EN 61000-3-3	2008-12		
EN 61000-4-2	2009-05		
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2009-05		
EN 61000-4-8	1994	2001	
EN 61000-4-11	2004-10		
EN 61000-6-1	2007-02		
EN 61000-6-2	2005-12		
EN 61000-6-3	2007-02		
EN 61000-6-4	2007-02		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2009		
FCC Public Notice DA 00-1407	2000		
FCC ET Docket # 99-231	2002		
FCC Procedures	2007		
ICES 001	2006-06		
ICES 002	2009-08		
ICES 003	2004-02		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005-11	2008-03	2009-02
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2008-12		
IEC 61000-4-3	2008-04	incl in 2008-04	2009-12 FD

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-4	2004-07	2010-10	
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-10		
IEC 61000-4-8	2009-09		
IEC 61000-4-11	2004-03		
IEC 61000-6-1	2005-03		
IEC 61326-1	2006-06		
ISO 14982	1998-07		
MIL Std. 461E	1999-08		
RSS GEN	2007-06		
RSS 119	2007-06		
RSS 123	1999-11		
RSS 125	2000-03		
RSS 131	2003-07		
RSS 136	2002-10		
RSS 137	2009-02		
RSS 210	2007-06		
RSS 213	2005-12		
RSS 243	2005-11		
RSS 310	2007-06		

Note 1: Test not on LSR Scope of Accreditation.

Updated on 02-03-10
P=Project FD= Final Draft

APPENDIX C
Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V

Appendix D

Antenna Specification(s)

"High Frequency Ceramic Solutions"

915 MHz Antenna **P/N 0915AT43A0026**

Detail Specification: 02/20/09 Page 1 of 3

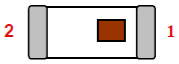
General Specifications

Part Number	0915AT43A0026
Frequency Range	902 - 928
Peak Gain	-1.0 dBi typ. (XZ-total)
Average Gain	-4.0 dBi typ. (XZ-total)
Return Loss	8.5 dB min.
Impedance	50 Ω
Input Power	2W max.

Operating Temperature	-40 to +85°C
Storage Temperature Range	+5~+35°C, Humidity 45~75%RH
Reel Quanity	1,000

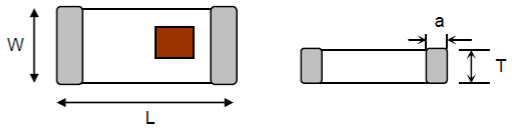
No.	Function
1	Feeding Point
2	NC

Terminal Configuration



Mechanical Dimensions

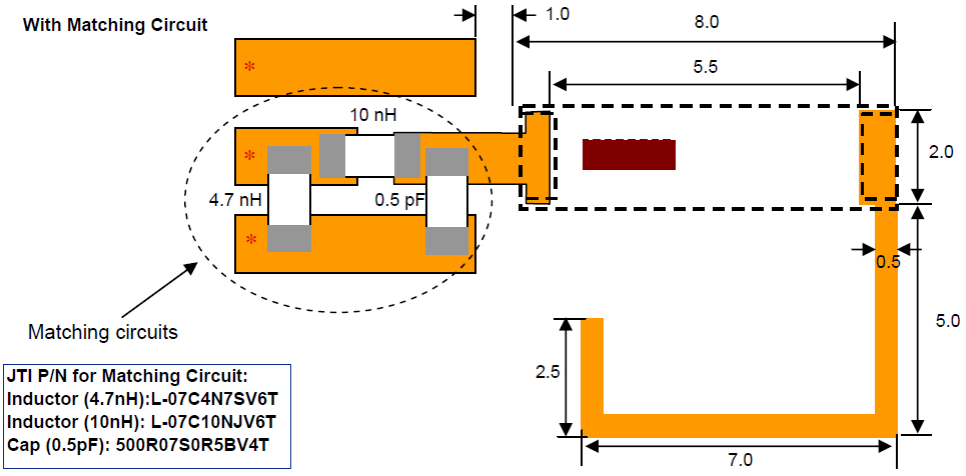
	In	mm
L	0.276 ± 0.008	7.00 ± 0.20
W	0.079 ± 0.008	2.00 ± 0.20
T	0.031 +.004/-.008	0.80 +0.1/-0.2
a	0.020 ± 0.012	0.50 ± 0.30



Mounting Considerations

Mount these devices with brown mark facing up. Units: mm

* Line width should be designed to provide 50 Ω impedance matching characteristics.



JTI P/N for Matching Circuit:
Inductor (4.7nH):L-07C4N7SV6T
Inductor (10nH): L-07C10NJV6T
Cap (0.5pF): 500R07S0R5BV4T

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JOHANSON TECHNOLOGY

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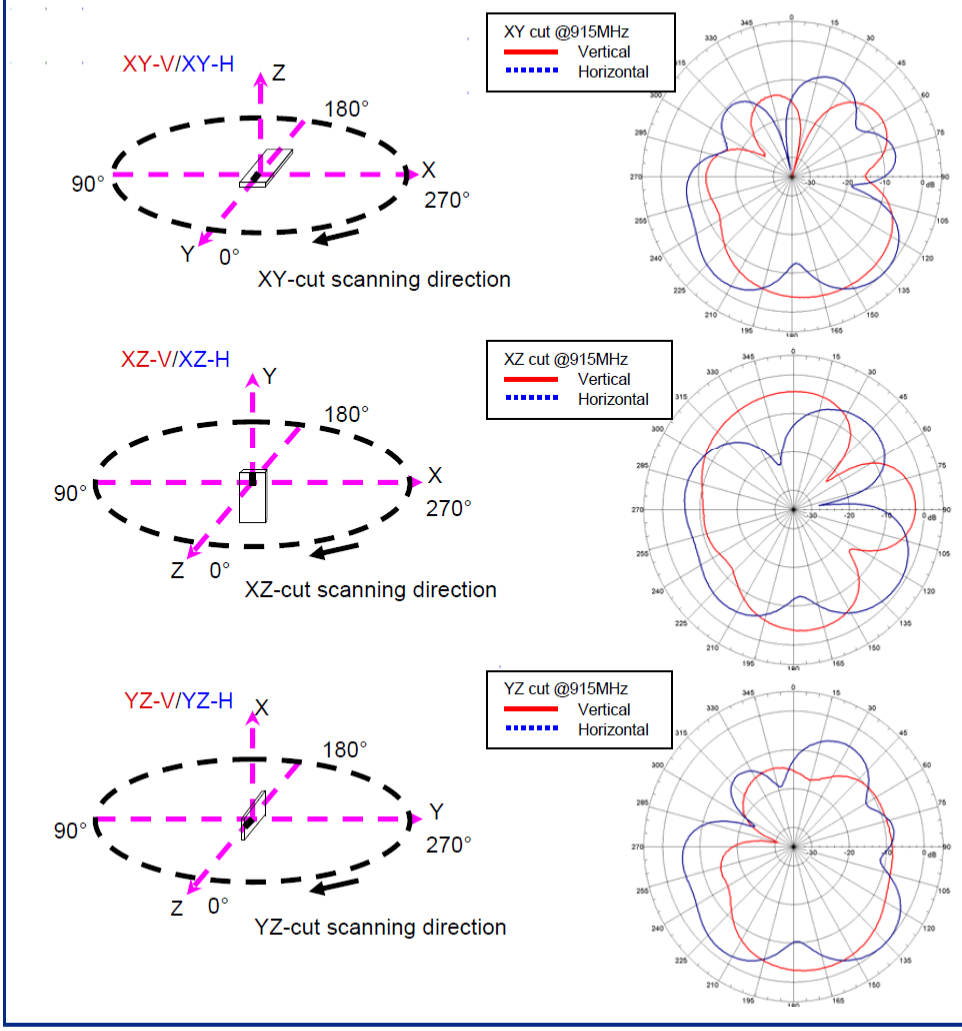
915 MHz Antenna **P/N 0915AT43A0026**

Detail Specification: 02/20/09 Page 3 or 3

Typical Radiation Patterns



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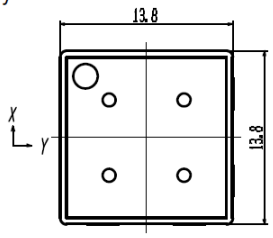
Customer

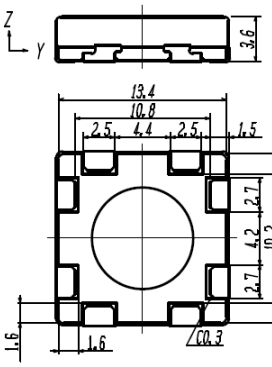
SAMPLE SPEC

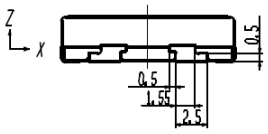
TYPE	SA3D14
Toko Part Number	1085BAN-2047

Physical Dimensions

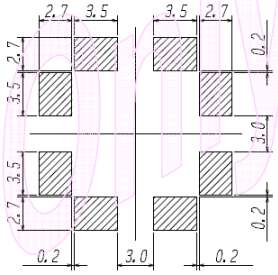
Tolerance : +/-0.2 Unit : mm



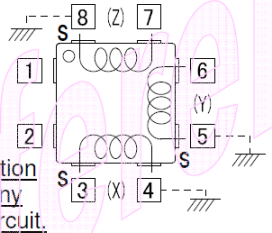




Recommendation land Pattern



Connection



(Top View)

An external connection figure is our company recommendation circuit.

Pin No.	Wire (mm)	Number of Turns
3-4(X)	ϕ 0.04	344.5 t (Those with turns correction)
5-6(Y)	ϕ 0.04	345.5 t (Those with turns correction)
8-7(Z)	ϕ 0.05	340.0 t (Those with turns correction)

a)

Inductance Tolerance Range(3-4)	4.7 mH	±	5	% Max	(at	125 or 134	kHz)
Inductance Tolerance Range(5-6)	4.7 mH	±	5	% Max	(at	125 or 134	kHz)
Inductance Tolerance Range(8-7)	7.2 mH	±	5	% Max	(at	125 or 134	kHz)

b)

Unloaded Q(3-4)	25 min	(Typ:35)	(at	125 or 134	kHz)
Unloaded Q(5-6)	25 min	(Typ:36)	(at	125 or 134	kHz)
Unloaded Q(8-7)	30 min	(Typ:42)	(at	125 or 134	kHz)

Measuring Instrument : Impedance Analyzer (HP4192A or equivalent)

Test Conditions : Unless otherwise specified, the standard range of atmospheric conditions (Temperature : 5 to 35 degree C / Humidity:45 to 85%) for making measurements.
If there is any doubt about the results, measurement shall be made within the conditions (Temperature : 20 +/-2 degree C / Humidity:65 +/-5%).

Notes	Approved by	Checked by	Made by

TOKO,INC. Coil Engineering Group Tel:049-250-2116