FCC PART 15, SUBPART C
IC RSS-210, ISSUE 8, DECEMBER 2010

TEST AND MEASUREMENT REPORT

For

The Q-Track Corporation

515 Sparkman Drive,

Huntsville, Alabama 35816, USA

FCC ID: VJ3-Q-DOSE
IC: 10503A-QDOSE

Report Type: Original Report	**Product Type:** ZigBee Transceiver
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Report Number:	R1306145-247 Rev A
Report Date:	2014-07-17
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*"

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1306145-247	Original Report	2014-07-02
1	R1306145-247 Rev A	Revised Report	2014-07-17

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *The Q-Track Corporation*, and their product *FCC ID: VJ3-Q-DOSE; IC: 10503A-QDOSE;* model: *Q-Dose* or the "EUT" as referred on this report. The EUT is a ZigBee transceiver which operates on 2405-2480 MHz.

Radio Mode	Frequency (MHz)		
	Low CH	Mid CH	High CH
ZigBee	2405	2445	2480

1.2 Mechanical Description of EUT

The "EUT" measures approximately 6.9 *cm (L) x 5.2 cm (W) x 3.7 cm (H),* and weighs approximately 61.5 g.

The test data gathered are from typical production sample, serial number: 471D5P, which assigned by BACL.

1.3 Objective

This report is prepared on behalf of *The Q-Track Corporation.* In accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions rules and IC RSS-210, Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-210 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Radiated Spurious Emissions. All of the measurements were collected in radiated method.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

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1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2009 and FCC KDB 558074 D01 DTS Meas Guidance v03r01.

2.2 EUT Exercise Software

N/A

2.3 Special Equipment

There were no special accessories required, included, or intended for use with EUT during these tests.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

N/A

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Q-Track	Main PCB Board	ATZB-A34-U0	020000004645
Q-Track	Display Screen	CFAL12832EWB1	-
Tenergy	Li-ion Cell Battery	PL303048	-

2.7 Interface Ports and Cables

N/A

2.8 External I/O Cabling List and AC Cord

N/A

2.9 Power Supply List and Details

Manufacturer	Description	Model	Serial Number
Emerson Network Power	AC/DC Adapter	DCH3-050US-0002	-

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.247(i), §2.1093 IC RSS-102	RF Exposure	Compliant
FCC §15.203 IC RSS-Gen §7.1.2	Antenna Requirement	Compliant
FCC §15.207(a) IC RSS-Gen §7.2.4	AC Line Conducted Emissions	N/A[1]
FCC §15.247 (d) IC RSS-210 §A8.5	Spurious Emissions at Antenna Port	N/A[2]
FCC §15.209, §15.205, §15.247(d) IC RSS-210 §2.2, §A8.5	Restricted Bands, Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) IC RSS-210 §A8.2	6 dB Emission Bandwidth	Compliant
FCC §15.247(b)(3) IC RSS-210 §A8.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) IC RSS-210 §A8.2(b)	Power Spectral Density	Compliant
IC RSS-210 §2.3 & RSS-Gen §6.1	Receiver Spurious Emission	Compliant

Note[1]: EUT can't transmit while being charged.
Note[2]: Radiated Emission was collected due to the EUT configuration didn't support conducted testing method.

4 FCC §15.247 (i), §2.1093 & IC RSS-102 – RF Exposure

4.1 Applicable Standards

FCC §2.1093, §15.247(i) and IC RSS-102

4.2 SAR Exemption Guild lines

According to FCC KDB 447498 D01, Appendix A:

SAR Test Exclusion Thresholds for 100 MHz-6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distance are illustrated in the following Table:

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

According to IC RSS-102 §2.5.1: Exemption from Routine Evaluation Limits-SAR evaluation

SAR evaluation is required if the separation distance between the user and the radiated element of the device is less than or equal to 20 cm, except when the device operates as follows.

- Above 2.2 GHz and up to 3GHz inclusively, and with output power (i.e. the higher of the conducted or radiated(e.i.r.p.) source-based, time-average output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled used;

4.3 Evaluation Result

The maximum conducted output power of this device is 0.707 dBm, the antenna gain is 5.3 dBi, the maximum e.i.r.p. is 0.707+ 5.3 = 6.007 dBm, i.e. 3.987 mW which is less than the SAR threshold of 10 mw (FCC KDB 447498 D01 Appendix A), and 20 mw (IC RSS-102 §2.5.1). SAR evaluation is not required.

5 FCC §15.203 & IC RSS-Gen §7.1.2 – Antenna Requirements

5.1 Applicable Standards

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to IC RSS-Gen §7.1.2: Transmitter Antenna

A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 mW or less. For devices of output powers greater than 10 mW, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

5.2 Antenna List

Manufacturers	Models/Name	Antenna Gain (dBi) @ 2.4 GHz
Texas Instruments	CC2511/PCB Antenna	5.3

5.3 Result

The EUT's antenna has the maximum gain of 5.3 dBi and permanently attached to the PCB; which complies with sections FCC Part 15.203 and IC RSS-Gen §7.1.2.

6 FCC §15.205, §15.209, §15.247(d) & IC RSS-210 §2.2, §A8.5 – Spurious Radiated Emissions

6.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a) and RSS-210: Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

As per IC RSS-210 §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

6.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15 Subpart C and IC RSS-210 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

6.3 Test Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 11: Emissions in non-restricted frequency bands and section 12: Emissions in restricted frequency bands. As well as ANSI C63.4: 2009 as described below:

For the radiated emissions test, the EUT host, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

6.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

6.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2013-08-22	1 Years
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 Year
A.H. Systems	Horn Antenna	SAS-200/571	261	2013-01-29	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2013-05-09	1 Year
Rohde & Schwarz	Test Receiver	ESCI 1166.5950K03	100338	2013-01-08	1 Year
Sunol Sciences	Biconi-Log Antenna	JB3	A020106-3	2013-07-11	1 Year
Agilent	Pre-amplifier	8447D	2944A10187	2013-03-08	1 Year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

6.6 Test Environmental Conditions

Temperature:	22-23 °C
Relative Humidity:	43-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Jeffrey Wu from 2013-10-16 to 2013-10-28at the 5m chamber 3.

6.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-210 standard's radiated emissions limits, and had the worst margin of:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-10.63	82.629	Vertical	High, 30 MHz to 1 GHz

1-25 GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
1.019	7440	Vertical	High, 1GHz to 25 GHz

Please refer to the following table and plots for specific test result details

6.8 Radiated Emissions Test Data

1) 30 MHz – 1 GHz, Measured at 3 meters

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (QP/Ave.)
41.98275	10.22	287	V	187	40	-29.78	QP
54.0035	21.52	126	V	256	40	-18.48	QP
82.629	29.37	147	V	119	40	-10.63	QP
88.47225	26.24	100	V	184	43.5	-17.26	QP
106.0573	14.18	344	H	262	43.5	-29.32	QP

2) 1–25 GHz, Measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
2405	69.08	84	100	V	28.96	3.12	-	101.160	Fund.	-	Peak
2405	61.93	167	100	H	28.96	3.12	-	94.010	Fund.	-	Peak
2405	58.28	84	100	V	28.96	3.12	-	90.360	Fund.	-	Ave
2405	51.13	167	100	H	28.96	3.12	-	83.210	Fund.	-	Ave
4810	40.79	243	128	V	33.464	4.56	28.1	50.714	74	-14.531	Peak
4810	39.71	307	100	H	33.464	4.56	28.1	49.634	74	-15.021	Peak
4810	29.99	243	128	V	33.464	4.56	28.1	39.914	54	-22.991	Ave
4810	28.91	307	100	H	33.464	4.56	28.1	38.834	54	-23.061	Ave
7215	38.5	297	128	V	37.806	5.49	27.65	54.146	74	-8.219	Peak
7215	38.72	304	131	H	37.806	5.49	27.65	54.366	74	-10.899	Peak
7215	27.7	297	128	V	37.806	5.49	27.65	43.346	54	-17.929	Ave
7215	27.92	304	131	H	37.806	5.49	27.65	43.566	54	-18.119	Ave
9620*	31.57	0	100	V	38.459	6.54	27.27	49.299	74	-12.614	Peak
9620*	32.24	0	100	H	38.459	6.54	27.27	49.969	74	-17.714	Peak
9620*	20.77	0	100	V	38.459	6.54	27.27	38.499	54	-17.814	Ave
9620*	21.44	0	100	H	38.459	6.54	27.27	39.169	54	-18.244	Ave
Middle Channel 2445 MHz, measured at 3 meters											
2445	68.32	83	100	V	28.96	3.25	0	100.530	Fund.	-	Peak
2445	64.25	164	108	H	28.96	3.25	0	96.460	Fund.	-	Peak
2445	57.52	83	100	V	28.96	3.25	0	89.730	Fund.	-	Ave
2445	53.45	164	108	H	28.96	3.25	0	85.660	Fund.	-	Ave
4890	46.84	235	117	V	33.772	4.54	27.76	57.392	74	-16.608	Peak
4890	45.06	306	100	H	33.772	4.54	27.76	55.612	74	-18.388	Peak
4890	36.04	235	117	V	33.772	4.54	27.76	46.592	54	-7.408	Ave
4890	34.26	306	100	H	33.772	4.54	27.76	44.812	54	-9.188	Ave
7335	43.58	204	100	V	37.535	5.57	27.8	58.885	74	-15.115	Peak
7335	43.93	321	100	H	37.535	5.57	27.8	59.235	74	-14.765	Peak
7335	32.78	204	100	V	37.535	5.57	27.8	48.085	54	-5.915	Ave
7335	33.13	321	100	H	37.535	5.57	27.8	48.435	54	-5.565	Ave
9780	35.68	198	100	V	38.186	6.58	27.16	53.286	74	-20.714	Peak
9780	35.15	181	100	H	38.186	6.58	27.16	52.756	74	-21.244	Peak
9780	24.88	198	100	V	38.186	6.58	27.16	42.486	54	-11.514	Ave
9780	24.35	181	100	H	38.186	6.58	27.16	41.956	54	-12.044	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2480 MHz, measured at 3 meters											
2480	68.58	83	100	V	29.16	3.25	0	100.990	Fund.	-	Peak
2480	64.76	164	108	H	29.16	3.25	0	97.170	Fund.	-	Peak
2480	57.78	83	100	V	29.16	3.25	0	90.190	Fund.	-	Ave
2480	53.96	164	108	H	29.16	3.25	0	86.370	Fund.	-	Ave
4958	48.83	198	100	V	34.069	4.52	27.95	59.469	74	-14.531	Peak
4958	48.34	70	100	H	34.069	4.52	27.95	58.979	74	-15.021	Peak
4958	38.03	198	100	V	34.069	4.52	27.95	48.669	54	-5.331	Ave
4958	37.54	70	100	H	34.069	4.52	27.95	48.179	54	-5.821	Ave
7440	50.66	299	100	V	37.121	5.66	27.66	65.781	74	-8.219	Peak
7440	47.98	320	100	H	37.121	5.66	27.66	63.101	74	-10.899	Peak
7440	37.86	299	100	V	37.121	5.66	27.66	52.981	54	-1.019	Ave
7440	37.18	320	100	H	37.121	5.66	27.66	52.301	54	-1.699	Ave
9920	43.83	320	100	V	38.056	6.67	27.17	61.386	74	-12.614	Peak
9920	38.73	336	100	H	38.056	6.67	27.17	56.286	74	-17.714	Peak
9920	33.03	320	100	V	38.056	6.67	27.17	50.586	54	-3.414	Ave
9920	27.93	336	100	H	38.056	6.67	27.17	45.486	54	-8.514	Ave

3) Restricted Band Edge

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
2390	25.63	84	100	V	28.96	3.12	0.00	57.706	74	-16.294	Peak
2390	23.93	167	100	H	28.96	3.12	0.00	56.006	74	-17.994	Peak
2390	12.73	84	100	V	28.96	3.12	0.00	44.806	54	-9.194	Ave
2390	12.66	167	100	H	28.96	3.12	0.00	44.736	54	-9.264	Ave
High Channel 2480 MHz, measured at 3 meters											
2483.5	38.12	83	100	V	29.16	3.25	0.00	70.525	74	-3.475	Peak
2483.5	35.16	164	108	H	29.16	3.25	0.00	67.565	74	-6.435	Peak
2483.5	14.29	83	100	V	29.16	3.25	0.00	46.695	54	-7.305	Ave
2483.5	13.36	164	108	H	29.16	3.25	0.00	45.765	54	-8.235	Ave

7 FCC§15.247(a)(2) & IC RSS-210 §A8.2 – 6 dB & 99% Emission Bandwidth

7.1 Applicable Standards

According to FCC §15.247(a)(2) and IC RSS-210 A8.2 (a), systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

7.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth; as well as the procedures lists under ANSI C63.10-2009.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2013-08-22	1 year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	45 %
ATM Pressure:	101.4 kPa

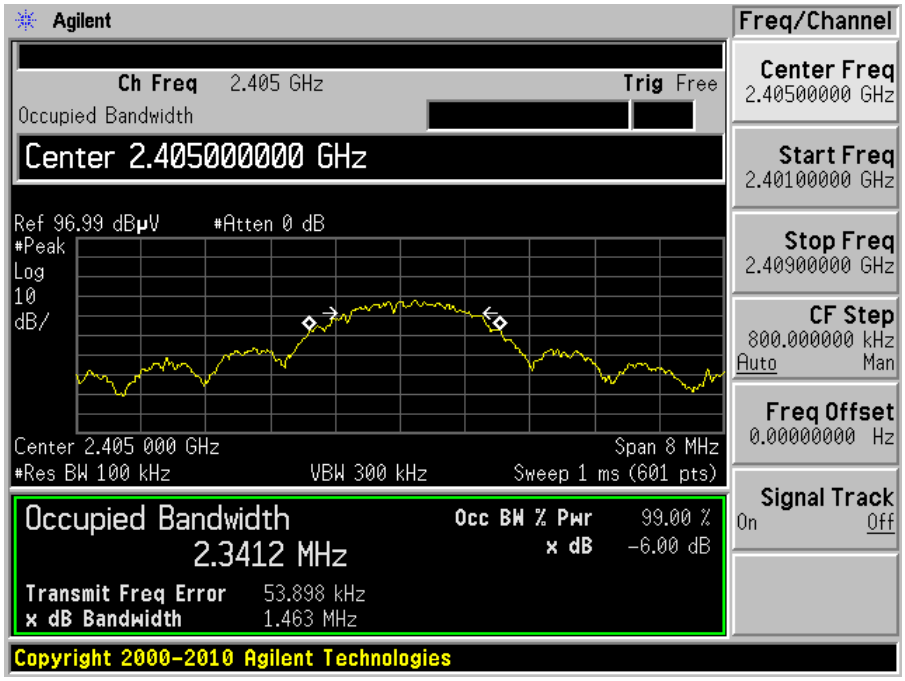
The testing was performed by Jeffrey Wu on 2013-10-16 at 5m3.

7.5 Test Results

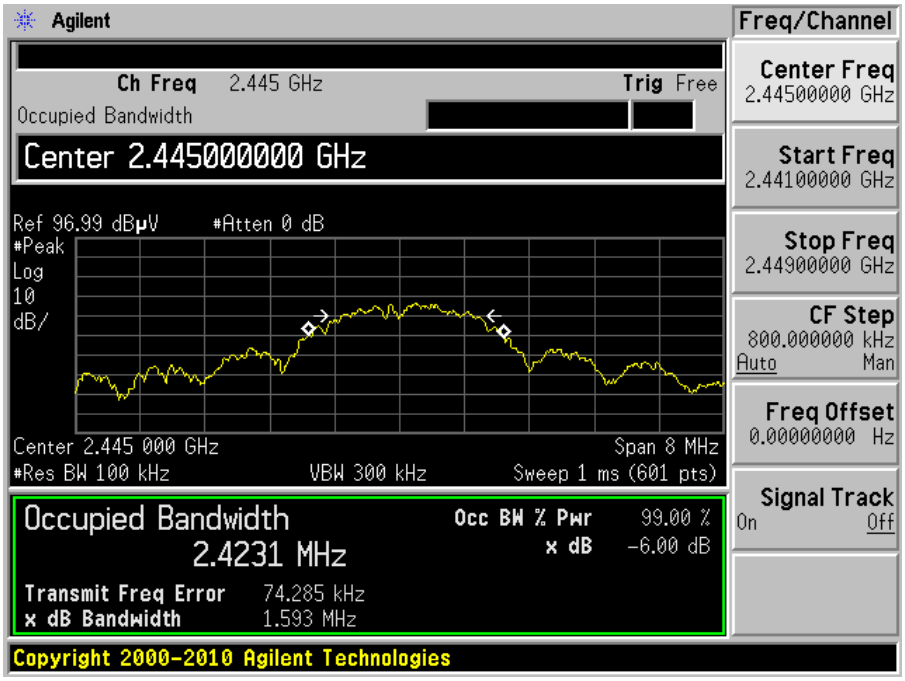
Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	99% Emission Bandwidth (kHz)	6 dB OBW Limit (kHz)	Results
Low	2405	1463	2341.2	> 500	Pass
Middle	2445	1593	2423.1	> 500	Pass
High	2480	1514	2416.2	> 500	Pass

Please refer to the following plots for detailed test results

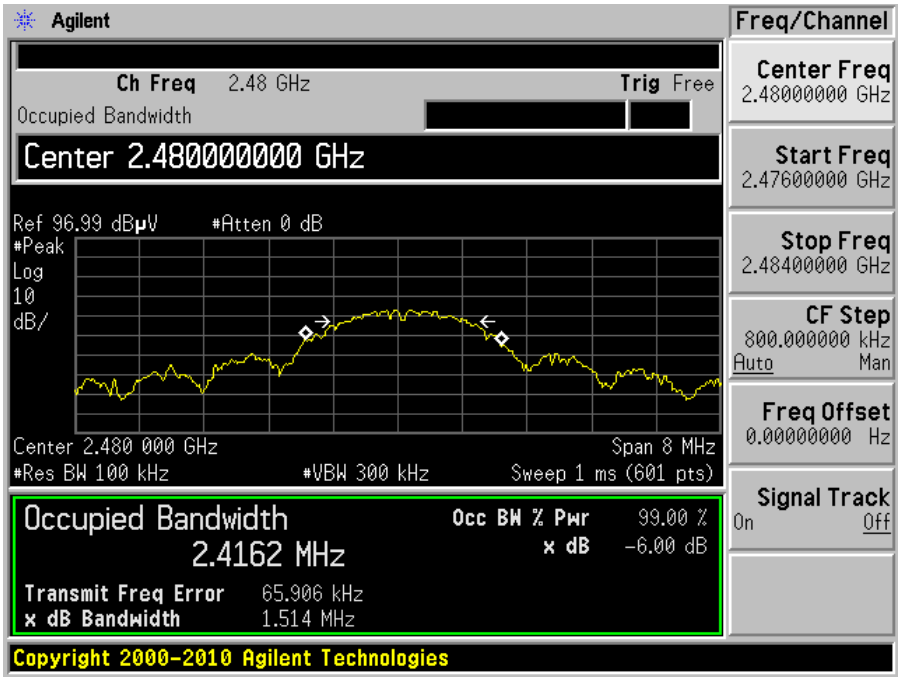
Low channel: 2405 MHz



Middle channel: 2445 MHz



High channel: 2480 MHz



8 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement

8.1 Applicable Standards

According to FCC §15.247(b) and IC RSS-210 §A8.4 (4) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

8.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power, and ANSI C63.10 -2009.

8.3 Corrected Amplitude

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + Atten – Ga$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

8.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2013-08-22	1 year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

8.5 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	45 %
ATM Pressure:	101.4 kPa

The testing was performed by Jeffrey Wu on 2013-10-16 at 5m3.

8.6 Test Results

Frequency (MHz)	SA Reading (dBµV/m) @ 3m	Antenna Polarity (H/V)	Antenna Factor (dB/m)	Cable Loss (dB)	Cord. Reading (dBµV/m) @ 3m	Antenna Gain (dBi)	Cord. Peak Output Power		FCC/IC Limit (dBm)	Margin (dB)
							EIRP (dBm)	Conducted (dBm)		
2405	69.16	V	28.956	3.12	101.236	5.3	6.007	0.707	30	-29.293
2405	62.11	H	28.956	3.12	94.186	5.3	-1.043	-6.343	30	-36.343
2445	68.45	V	28.956	3.25	100.656	5.3	5.427	0.127	30	-29.873
2445	64.3	H	28.956	3.25	96.506	5.3	1.277	-4.023	30	-34.023
2480	68.63	V	29.155	3.25	101.035	5.3	5.806	0.506	30	-29.494
2480	64.8	H	29.155	3.25	97.205	5.3	1.977	-3.323	30	-33.323

Note 1: The Corrected Peak Output Power (EIRP) was calculated from the formula:

$$P_{EIRP} = (E*d)^2/(30*G)$$

P_{EIRP} =Watts
E=Measured Field Strength in V/m
D=distance in meters from which the field strength was measured
G=Numeric gain of the EUT's antenna

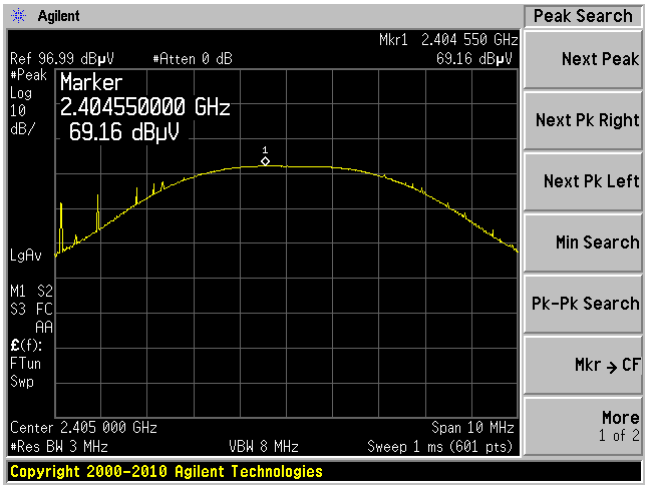
Note 2: The conducted peak output power was calculated based on the EIRP and the antenna gain.

$$P_{cond.} = P_{EIRP} + Gain_{Antenna,}$$ Antenna Gain=5.3 dBi

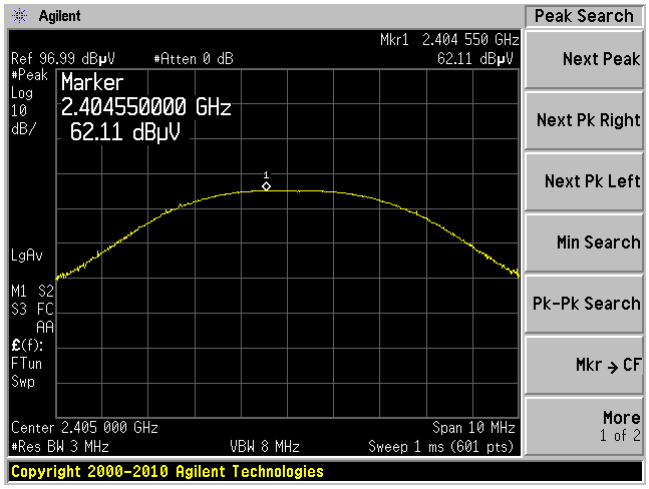
Please refer to the following plots.

Low channel: 2405 MHz

Vertical Polarity

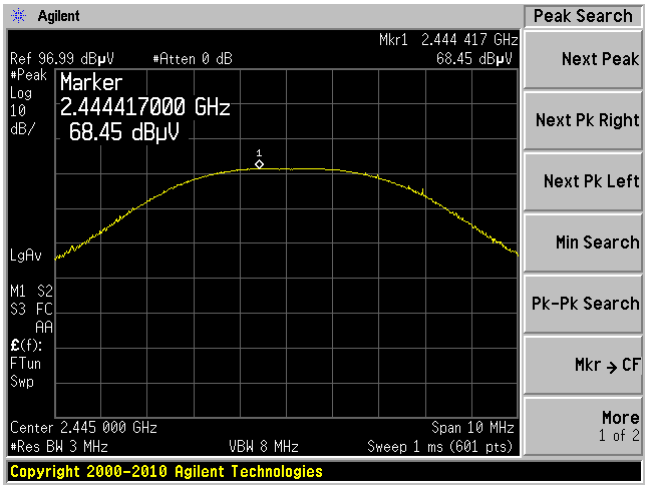


Horizontal Polarity

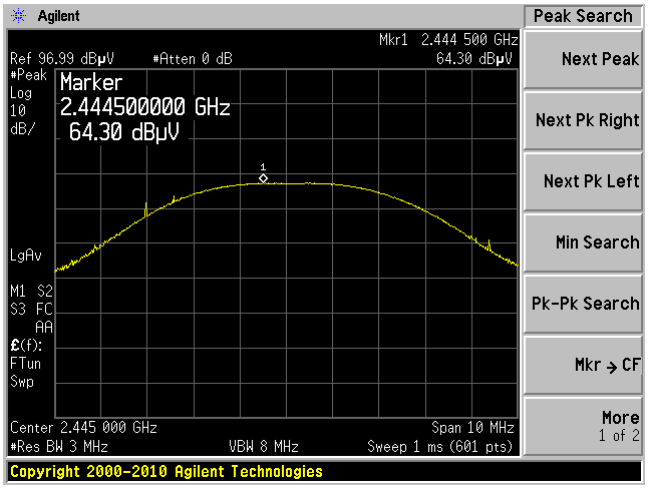


Middle channel: 2445 MHz

Vertical Polarity

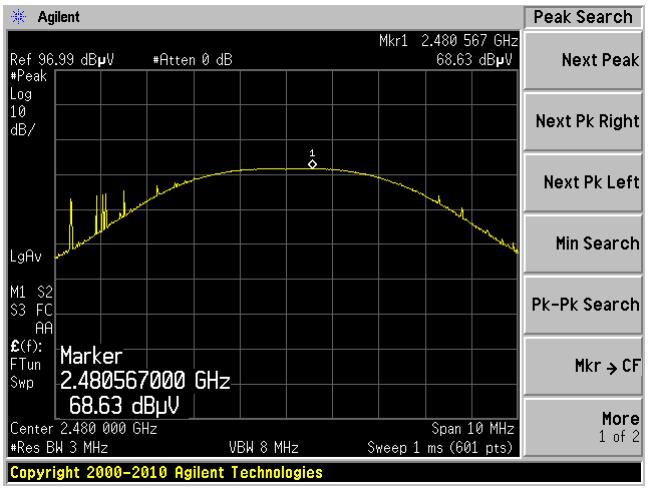


Horizontal Polarity

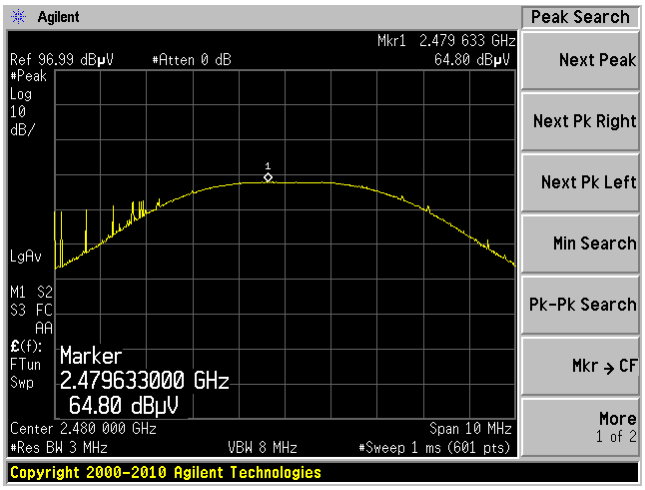


High channel: 2480 MHz

Vertical Polarity



Horizontal Polarity



9 FCC §15.247(d) & IC RSS-210 §A8.5 – 100 kHz Bandwidth of Band Edges

9.1 Applicable Standards

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

According to IC Rss-210 §A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

9.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements, and ANSI C63.10 -2009..

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2013-08-22	1 Years
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 Year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	45 %
ATM Pressure:	101.4 kPa

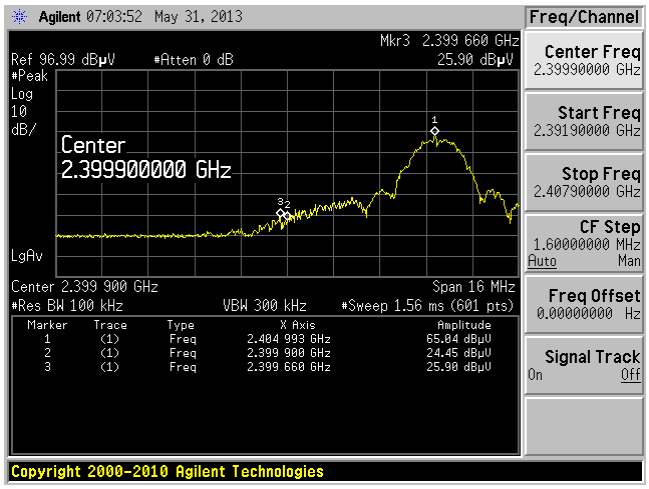
The testing was performed by Jeffrey Wu on 2013-10-16 at 5m3.

9.5 Test Results

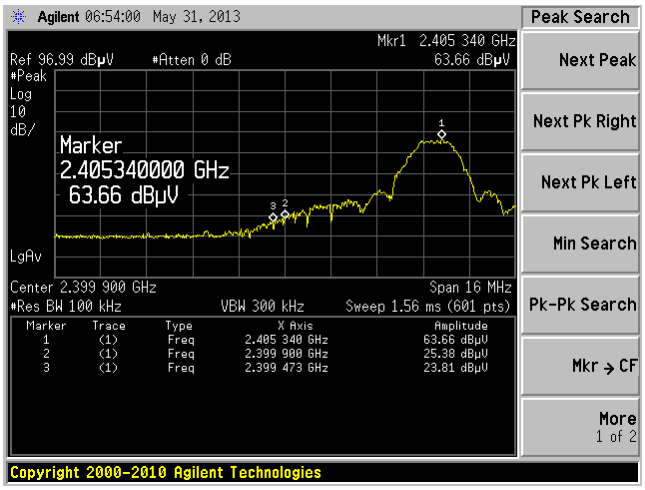
Please refer to following pages for plots of band edge.

Low Band Edge

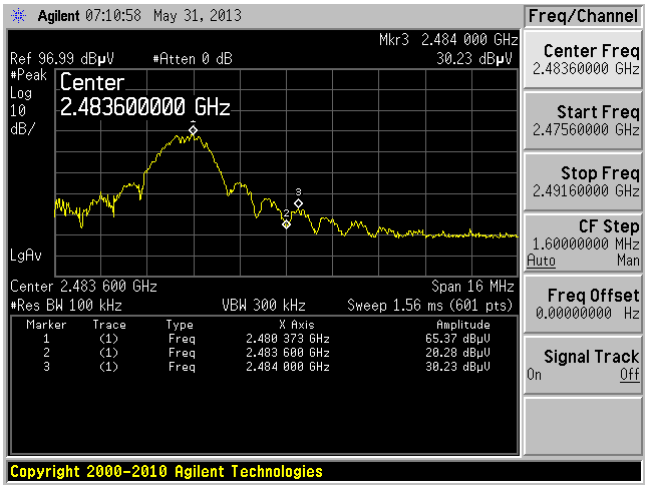
Vertical Polarity

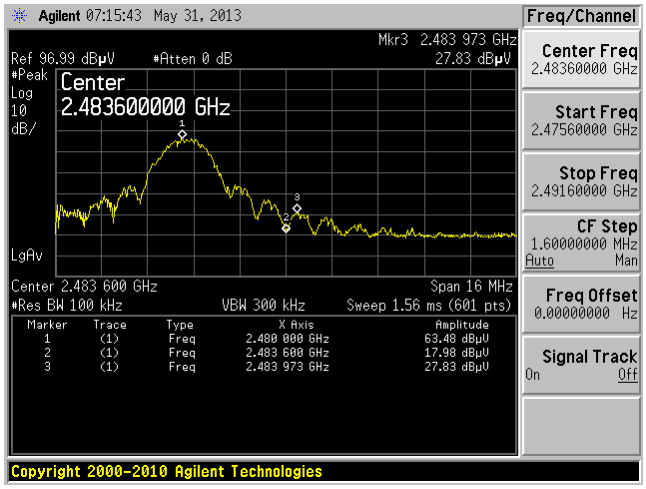


Horizontal Polarity



High Band Edge





Note: The difference between Marker 1 and Marker2/3 is greater than 30 dBc

10 FCC §15.247(e) & IC RSS-210 §A8.2 (b) – Power Spectral Density

10.1 Applicable Standards

According to FCC §15.247(e) and RSS-210 §A8.2 (b) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10: Maximum power spectral density level in the fundamental emission, and ANSI C63.10 -2009.

10.3 Corrected Amplitude

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

10.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2013-08-22	1 year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

10.5 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	45 %
ATM Pressure:	101.4 kPa

The testing was performed by Jeffrey Wu on 2013-10-16 at 5m3.

10.6 Test Results

Frequency (MHz)	SA Reading (dBµV/m) @ 3m	Antenna Polarity (H/V)	Antenna Factor (dB/m)	Cable Loss (dB)	Cord. Reading (dBµV/m) @ 3m	Antenna Gain (dBi)	Cord. PSD		FCC/IC Limit (dBm)	Margin (dB)
							EIRP (dBm)	Conducted (dBm)		
2405	62.28	V	28.956	3.12	94.356	5.3	-0.873	-6.173	8	-14.173
2405	58.14	H	28.956	3.12	90.216	5.3	-5.013	-10.313	8	-18.313
2445	62.89	V	28.956	3.25	95.096	5.3	-0.133	-5.433	8	-13.433
2445	58.05	H	28.956	3.25	90.256	5.3	-4.973	-10.273	8	-18.273
2480	62.36	V	29.155	3.25	94.765	5.3	-0.464	-5.764	8	-13.764
2480	59.79	H	29.155	3.25	92.195	5.3	-3.034	-8.334	8	-16.334

Note 1: The Corrected PSD (EIRP) was calculated from the formula:

$$P_{EIRP} = (E*d)^2/(30*G)$$

P_{EIRP} =Watts
E=Measured Field Strength in V/m
D=distance in meters from which the field strength was measured
G=Numeric gain of the EUT's antenna

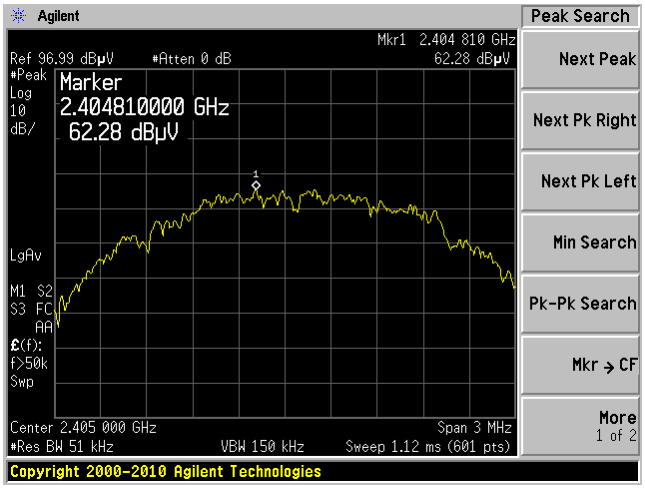
Note 2: The conducted PSD was calculated based on the EIRP and the antenna gain.

$$PDS_{cond.} = PSD_{EIRP} + Gain_{Antenna,}$$ Antenna Gain=5.3 dBi

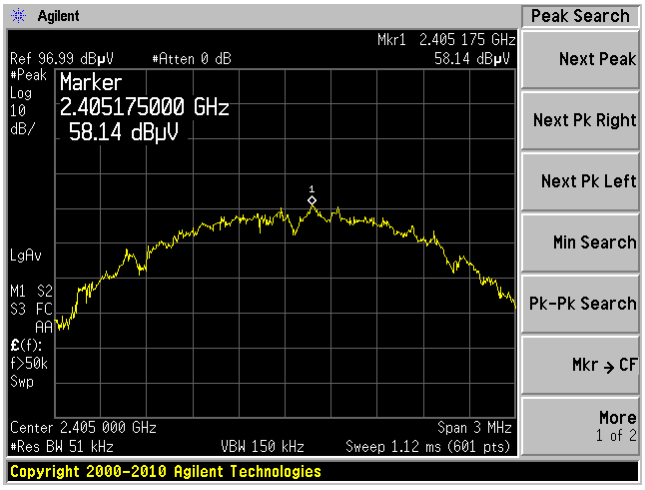
Please refer to the following plots.

Low channel: 2405 MHz

Vertical Polarity

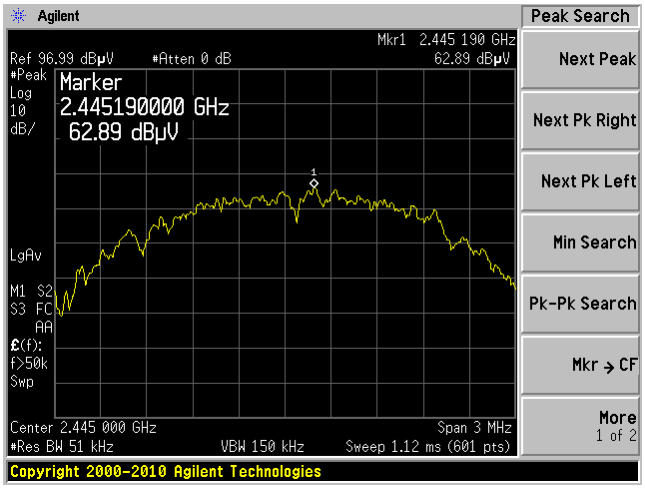


Horizontal Polarity

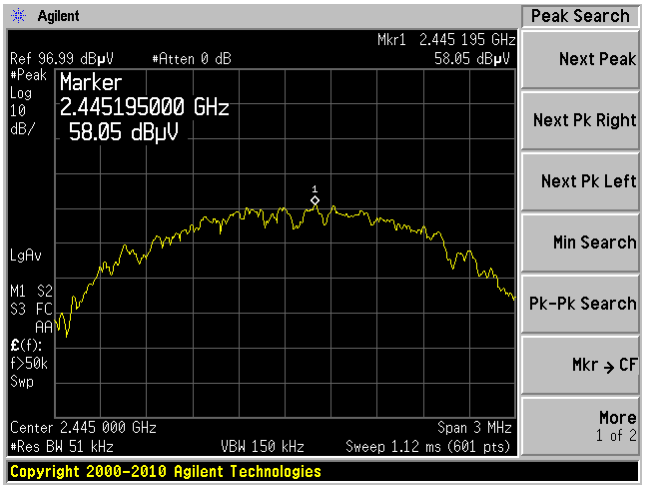


Middle channel: 2445 MHz

Vertical Polarity

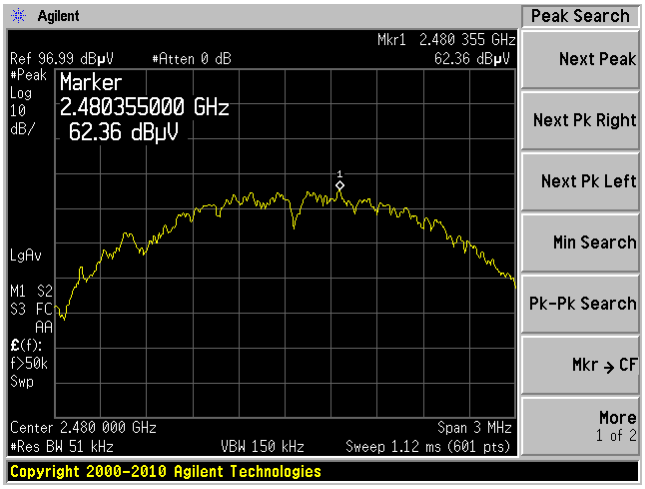


Horizontal Polarity

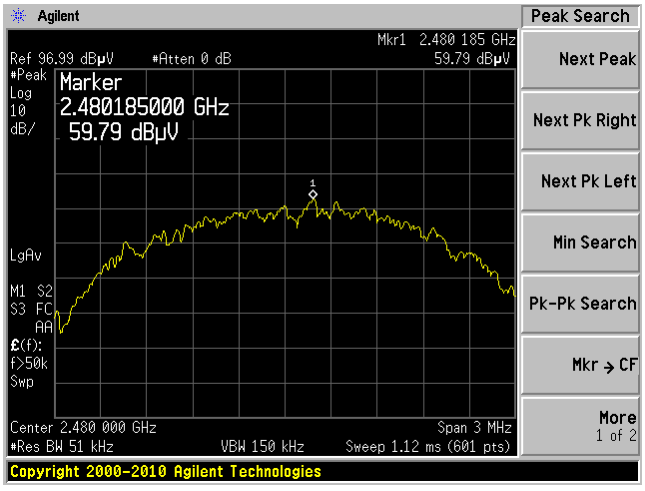


High channel: 2480 MHz

Vertical Polarity



Horizontal Polarity



11 IC RSS-210 §2.3 & RSS-Gen §6.1 – Receiver Spurious Radiated Emissions

11.1 Applicable Standards

According to IC RSS-Gen §6.1, spurious emissions from receivers shall not exceed the radiated limits shown in the table below.

Table 2: General Field Strength Limits for Transmitters and Receivers at Frequencies above 30 MHz

Frequency (MHz)	Field Strength Microvolts/m at 3 meters
30-88	100
88-216	150
216-960	200
Above 960	500

11.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.

11.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

11.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit The equation for margin calculation is as follows:

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

11.5 Test Equipment Lists and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-10-22	1 year
A.H. System	Horn Antenna	SAS-200/571	261	2013-01-29	1 year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2013-05-09	1 year
Rohde & Schwarz	Test Receiver	ESCI 1166.5950K03	100338	2013-01-08	1 year
Sunol Sciences	Biconi-Log Antenna	JB3	A020106-3	2013-07-11	1 year
Agilent	Pre-amplifier	8447D	2944A10187	2013-03-08	1 year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

11.6 Test Environmental Conditions

Temperature:	19° C
Relative Humidity:	29 %
ATM Pressure:	101.2 kPa

The testing was performed by Jeffrey Wu on 2013-12-02 at the 5m chamber 2.

11.7 Summary of Test Results

According to the test data, the EUT complied with the RSS-210/RSS-Gen, with the closest margins from the limit listed below:

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-24.84	-31.452	Horizontal	30 to 25000

11.8 Test Results

1) 30-1000 MHz, Measured at 3 meters

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (QP/Ave.)
31.452	15.16	405	H	27	40	-24.84	QP
38.31375	9.6	309	H	360	40	-30.4	QP

2) Above 1 GHz, Measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	IC		Detector (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
2740*	36.88	0	100	V	29.258	3.270	27.930	41.478	74	-32.522	PK
2740*	37.43	0	100	H	29.258	3.270	27.930	42.028	74	-31.972	PK
2740*	22.76	0	100	V	29.258	3.270	27.930	27.358	54	-26.642	Ave.
2740*	22.79	0	100	H	29.258	3.270	27.930	27.388	54	-26.612	Ave.

Note: Data collected as noise floor.