FCC PART 80

TEST AND MEASUREMENT REPORT

For

Full Spectrum Inc.

687 N. Pastoria Ave.,

Sunnyvale, CA 94085, USA

FCC ID: X27-FS-218

Report Type: Original Report	**Product Type:** Base Station and Remote Station Radios
Prepared By	Chen Ge Test Engineer
Report Number	R1410272-80
Report Date	2014-12-23
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1410272-80	Original Report	2014-12-23

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of Full Spectrum, Inc., and their product models: BS1010, FS4500; FCC ID: X27-FS-218 or the "EUT" as referred to in this report. The EUT's are a Base Station and Remote Station Radios.

1.2 Mechanical Description of EUT

BS1010: The EUT measures 43cm (L), 39cm (W), 4.5cm (H), and weighs 4.54kg.

The data gathered are from a production sample provided by the manufacturer, serial number: R1410272-01, assigned by BACL.

FS4500: The EUT measures 58cm (L), 28cm (W), 12cm (H), and weighs 17.24kg.

The data gathered are from a production sample provided by the manufacturer, serial number: R1410272-02, assigned by BACL.

1.3 Objective

This report is prepared on behalf of *Full Spectrum, Inc*., in accordance with Part 2, Part 80, ANSI C63.4-2009 and ANSI TIA 603-D

The objective is to determine compliance with FCC Part 80.

1.4 Related Submittal(s)/Grant(s)

N/A.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009 and ANSI TIA 603-D

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.

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.

1.7 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 TIA-603-D.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2 EUT Exercise Software

The test utility used was Full Spectrum embedded v2.4, which was provided by Full Spectrum Inc., and was verified by Chen Ge to comply with the standard requirements being tested against.

2.3 Special Equipment

There were no special accessories were 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

Manufacturer	Description	Model	Part Number
ACER	Laptop	KAWG0	LXPGX0200500119D1C1601

2.6 EUT Internal Configuration Details

BS1010:

Manufacturer	Description	Model	Serial Number
Full Spectrum	Baseband Processor (BBP) Board	3.0	FSB-3-A-01740
Full Spectrum	Radio Frequency Small Signal (RFSS) Board	7.1	FSC-7.1-A-01807
Full Spectrum	Radio Frequency Front End (RFFE) board	4.1	FSD-4.1-A-01709
Full Spectrum	Low Voltage Power Supply	5.1	LVPS-5.1–A-01685

FS4500:

Manufacturer	Description	Model	Serial Number
Full Spectrum	Baseband Processor (BBP) Board	3.0	FSB-3-A-01770
Full Spectrum	Radio Frequency Small Signal (RFSS) Board	7.1	FSC-7.1-A-01762
Full Spectrum	Radio Frequency Front End (RFFE) board	4.1	FSD-4.1-A-01699
Full Spectrum	Low Voltage Power Supply	5.1	FSA-5.1-A-01755

2.7 Power Supply List and Details

Manufacturer	Description	Model	Part Number
FSP Group Inc.	24 VDC Power Supply	FSP150-ABB	9NA1500900

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
FCC §2.1091	RF Exposure	Compliant
FCC §80.215 FCC §2.1046	Output Power	Compliant
FCC §80.211 FCC §2.1047	Emission Limit	Compliant
FCC §80.205 FCC §2.1049	Bandwidth	Compliant
FCC §80.209 FCC §2.1055	Frequency Stability	Compliant
FCC §2.1051 FCC §80.211	Transmit Spurious Emission-Conducted	Compliant
FCC §2.1053 FCC §80.211	Transmit Spurious Emission-Radiated	Compliant

4 FCC §2.1091 - RF Exposure

4.1 Applicable Standard

According to FCC §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

BS1010:

Maximum peak output power at antenna input terminal (dBm):	43.68
Maximum peak output power at antenna input terminal (W):	23.334
Prediction distance (cm):	150
Prediction frequency (MHz):	217.25
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0825
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.2

FS4500:

Maximum peak output power at antenna input terminal (dBm):	43.60
Maximum peak output power at antenna input terminal (W):	22.908
Prediction distance (cm):	150
Prediction frequency (MHz):	217.75
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.081
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.2

The EUT complies with FCC MPE limit at 150 cm distance.

5 FCC §2.1046 & §80.215(h) – Output Power

5.1 Applicable Standard

According to FCC §80.215(h):

(5) The transmitter power, as measured at the input terminals to the station antenna, must be 50 watts or less.

5.2 Test Procedure

Connect the EUT to spectrum analyzer and set the spectrum analyzer as following:

- Center frequency: channel frequency under test
- RBW: 1 MHz
- VBW: 3 MHz
- Detector mode: Peak
- Span: 2 MHz

Max hold the trace and record the peak value once the trace stabilized.

5.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2014-09-29	1 year

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

5.4 Test Environmental Conditions

Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge from 2014-10-13 and 2014-10-17 at RF site.

5.5 Test Results

BS1010:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
1	217.25	43.68	47	-3.32
2	217.75	43.63	47	-3.37
3	219.25	43.54	47	-3.46
4	219.75	43.48	47	-3.52

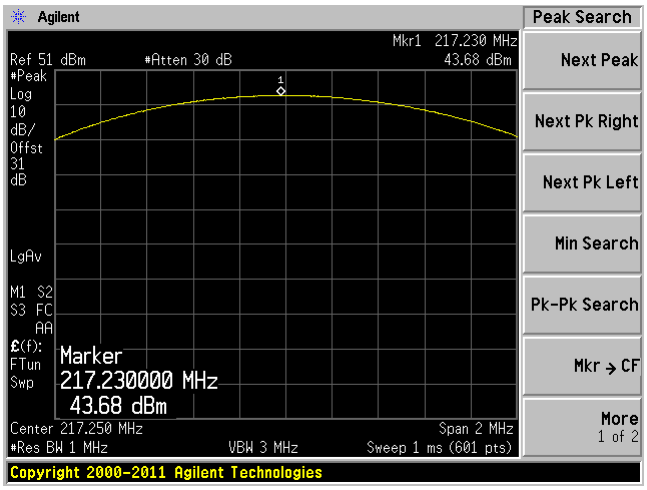
FS4500:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
1	217.25	43.32	47	-3.68
2	217.75	43.60	47	-3.40
3	219.25	42.60	47	-4.40
4	219.75	42.63	47	-4.37

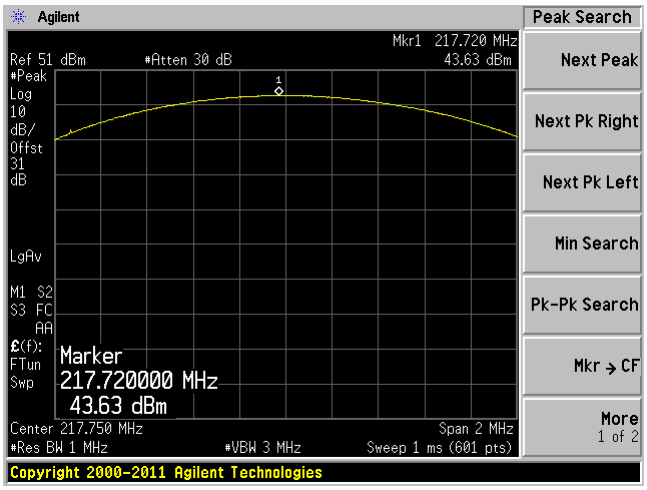
Please refer to the following plots for the test results:

BS1010:

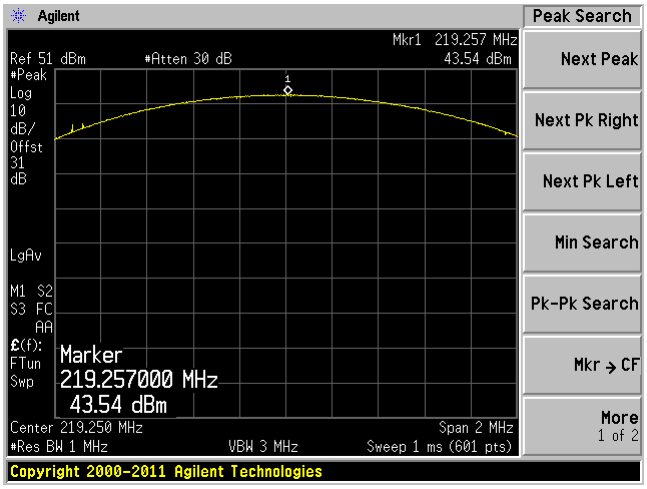
Channel 1, 217.25MHz



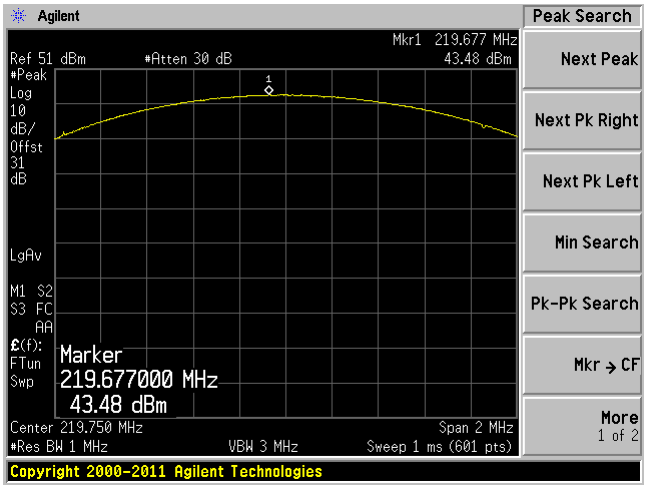
Channel 2, 217.75MHz



Channel 3, 219.25MHz

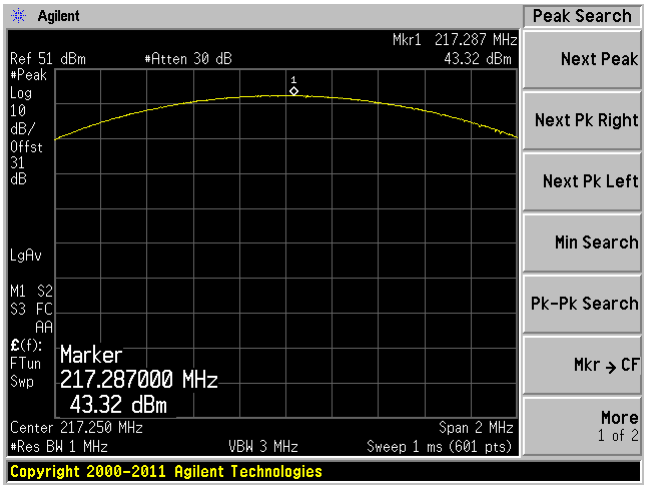


Channel 4, 219.75MHz

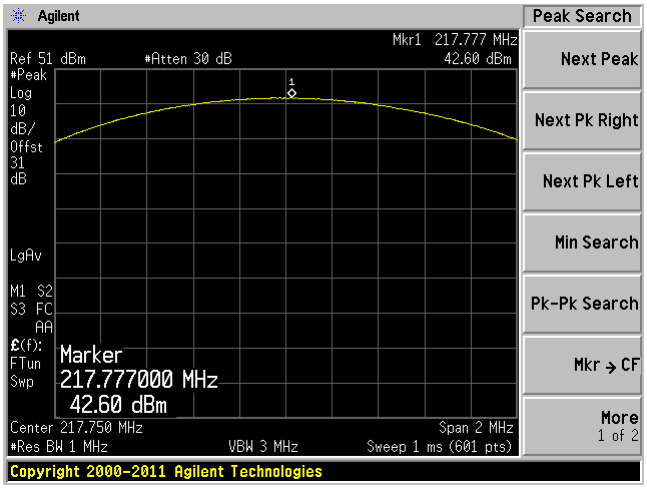


FS4500:

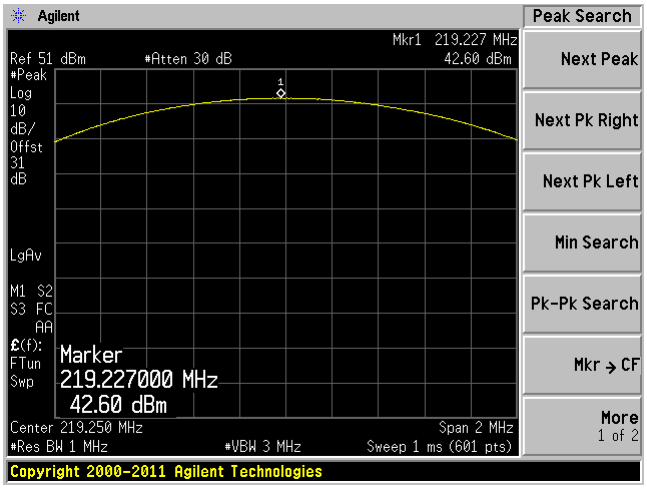
Channel 1, 217.25MHz



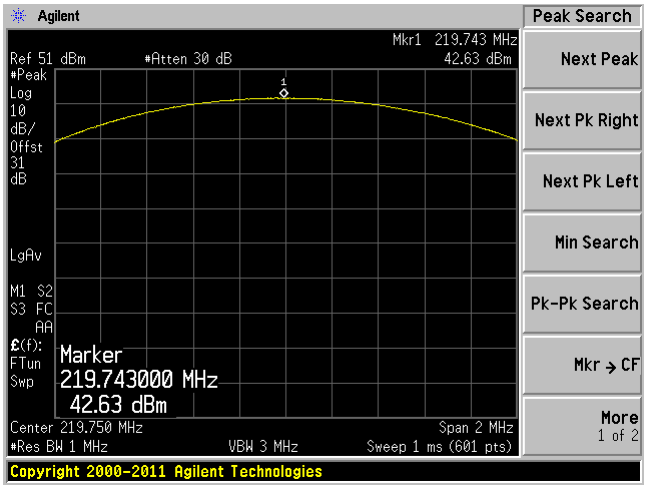
Channel 2, 217.75MHz



Channel 3, 219.25MHz



Channel 4, 219.75MHz



6 FCC §2.1047 & §80.211 – Emission Limit

6.1 Applicable Standard

According to FCC §80.211.
(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

6.2 Test Procedure

According to ANSI/TIA-D 2010 section 2.2.13, conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired. The method of measurement is as following:

- Set the center frequency of the spectrum analyzer to the assigned transmitter frequency, key the transmitter, and set the level of the carrier to the full scale reference line.

- Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

- Adjust the spectrum analyzer for the following setting:

    1) Resolution bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
    2) Video bandwidth ≥ 3 times the resolution bandwidth.
    3) Sweep speed ≤ 2000 Hz per second.
    4) Detector mode = mean or average power.

- Record the frequencies and levels of spurious emissions.

According to RSS-Gen issue 3 Section 4.6.1, when the applicable unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, used for the transmitter output power measurement, shall be used for unwanted emission measurement.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given in (a) and (b):

(a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiple of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth for emissions below 1000 MHz. as an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable XISPR quasi-peak bandwidth.

Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

6.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2014-09-29	1 year

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

6.4 Test Environmental Conditions

Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

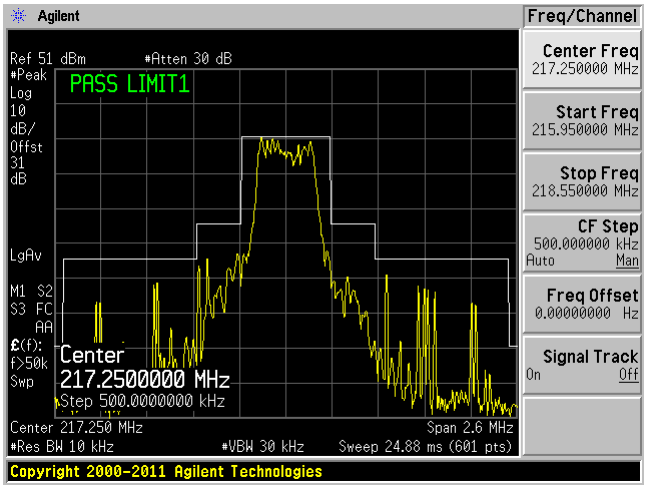
The testing was performed by Chen Ge from 2014-10-13 and 2014-10-17 at RF site.

6.5 Test Results

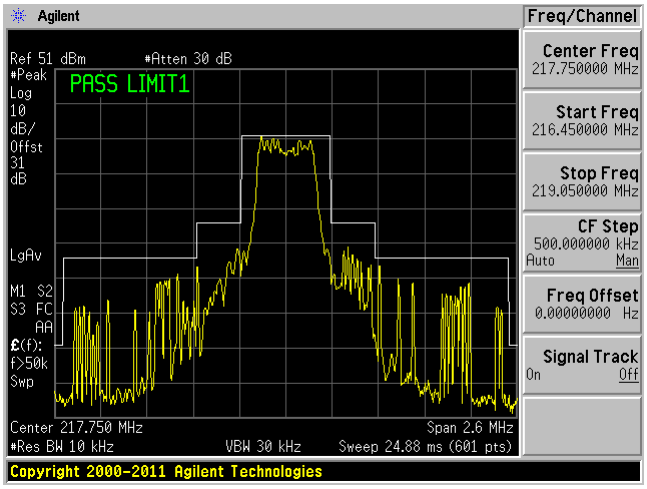
Please refer to the following plots for the test results:

BS1010:

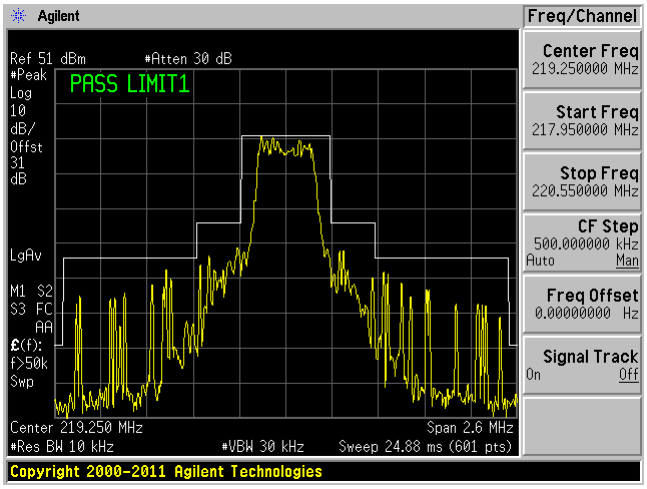
Channel 1, 217.25MHz



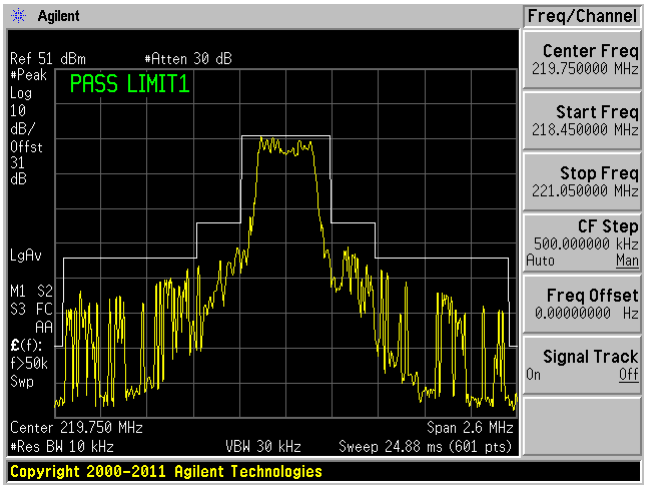
Channel 2, 217.75MHz



Channel 3, 219.25MHz

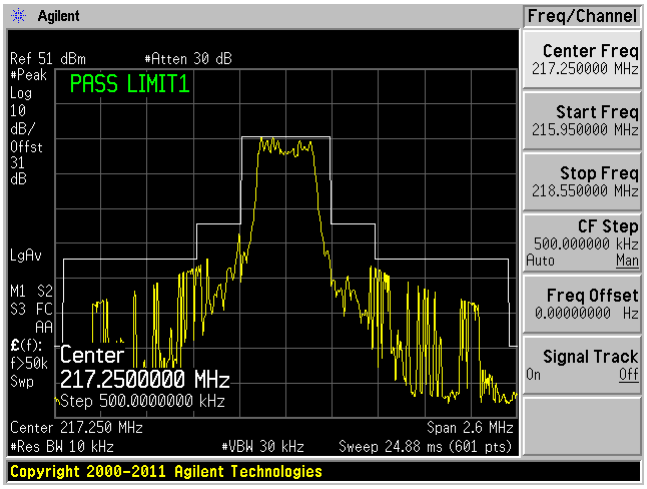


Channel 4, 219.75MHz

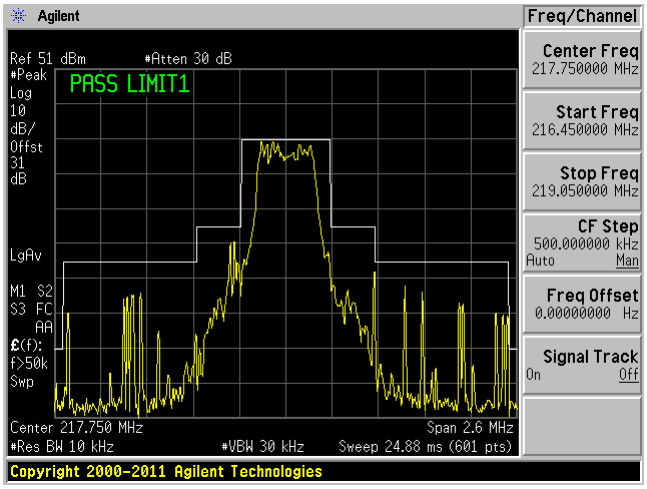


FS4500:

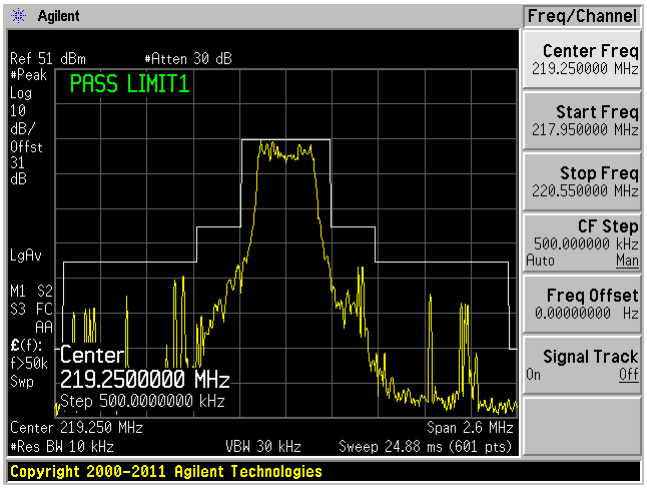
Channel 1, 217.25MHz



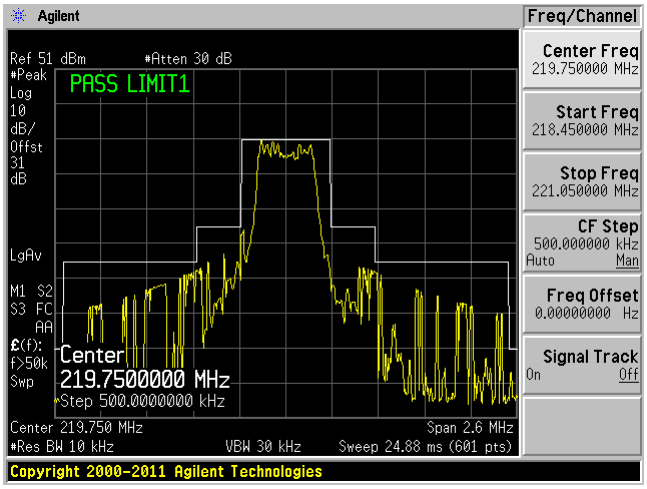
Channel 2, 217.75MHz



Channel 3, 219.25MHz



Channel 4, 219.75MHz



7 FCC §2.1049 & §80.205 - Emission Bandwidths

7.1 Applicable Standard

According to FCC §80.205 and WT Docket No. 98-169, the bandwidth can go up to 1MHz.

7.2 Test Procedure

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shal be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold my produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between two recorded frequencies is the occupied bandwidth.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2014-09-29	1 year

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:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge from 2014-10-13 and 2014-10-17 at RF site.

7.5 Test Results

BS1010:

Channel	Frequency (MHz)	99% Bandwidth (kHz)
1	217.25	325.8534
2	217.75	324.4161
3	219.25	326.3502
4	219.75	324.8205

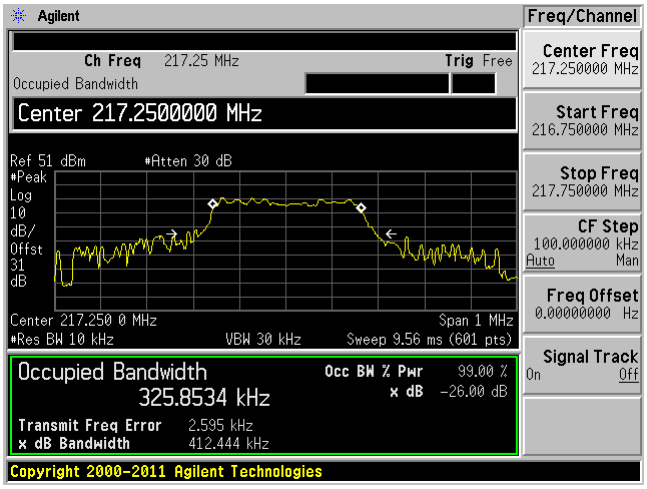
FS4500:

Channel	Frequency (MHz)	99% Bandwidth (kHz)
1	217.25	326.4653
2	217.75	325.5391
3	219.25	324.9716
4	219.75	325.0583

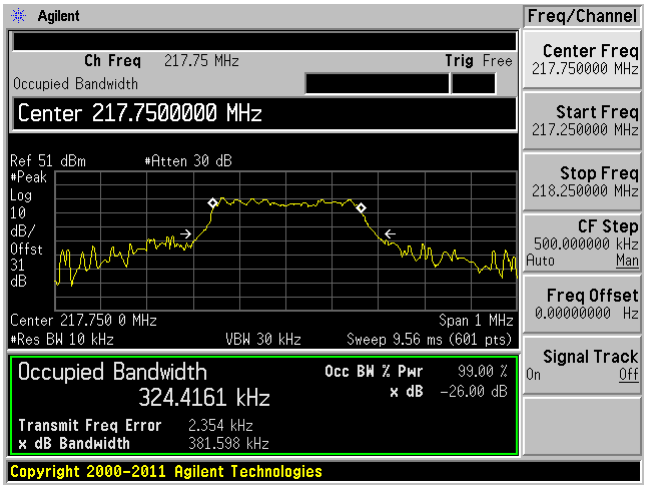
Please refer to the following plots for the test result

BS1010:

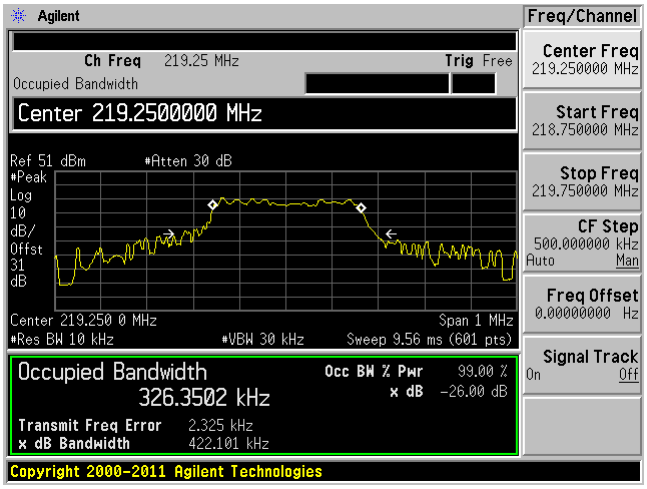
Channel 1, 217.25MHz



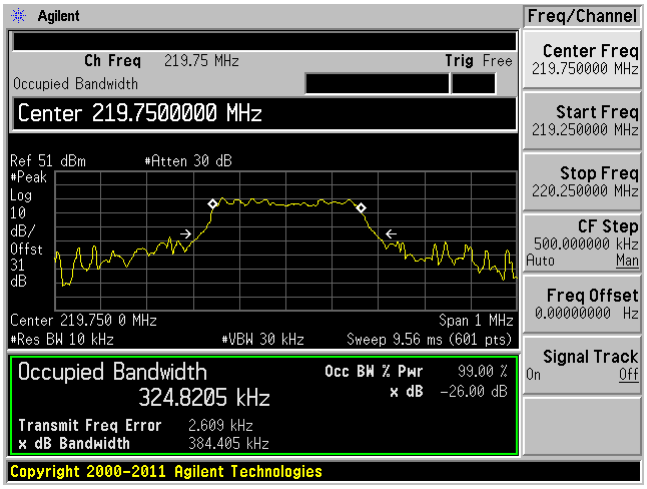
Channel 2, 217.75MHz



Channel 3, 219.25MHz

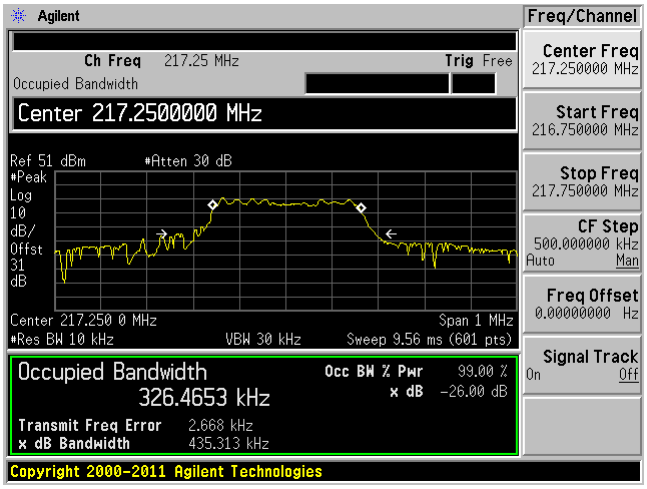


Channel 4, 219.75MHz

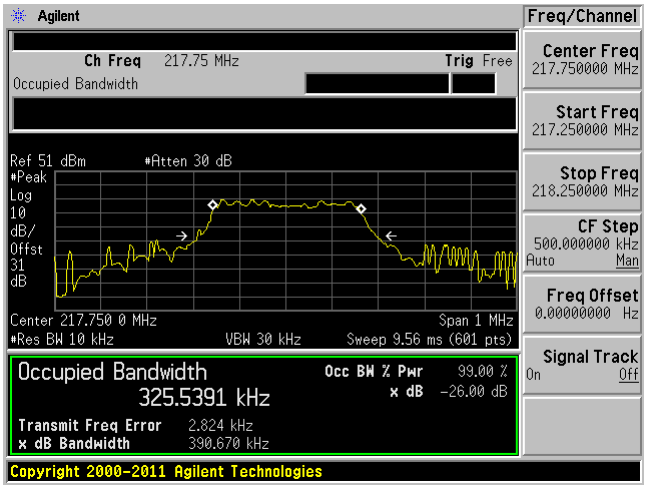


FS4500:

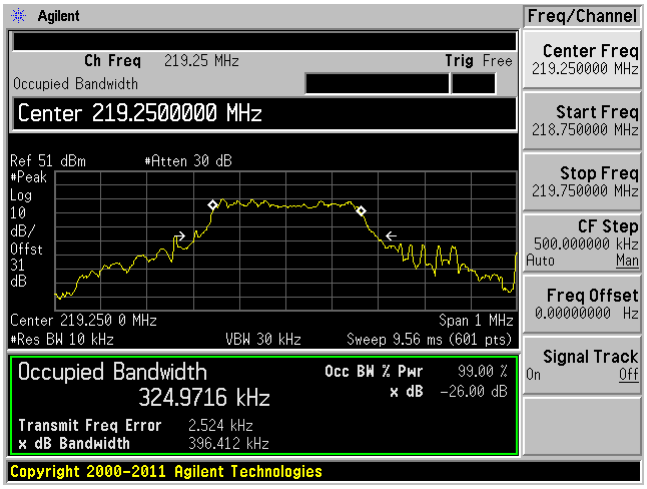
Channel 1, 217.25MHz



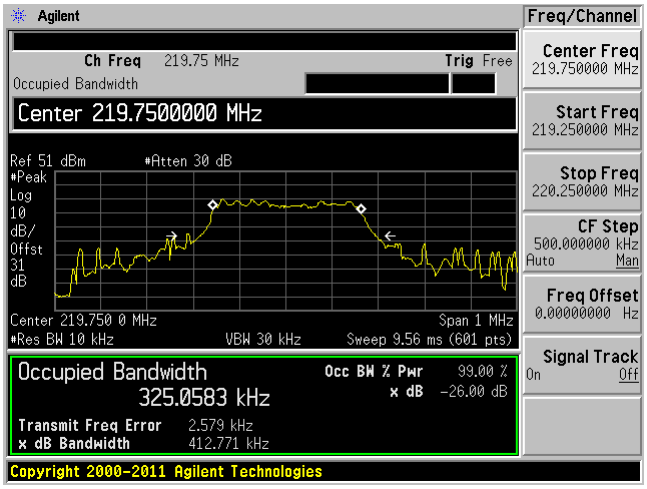
Channel 2, 217.75MHz



Channel 3, 219.25MHz



Channel 4, 219.75MHz



8 FCC §2.1055 & §80.209 & - Frequency Tolerance

8.1 Applicable Standard

Refer to FCC §80.209.

8.2 Measurement Procedure

According to ANSI/TIA-D 2010 section 2.2.2, the carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The measurement method is as following:

- Operate the equipment in standby conditions for 15 minutes before proceeding.
- Record the carrier frequency of the transmitter as MCF MHz.
- Calculate the ppm frequency error by the following:

  Ppm error = ((MCF/ACF) - 1) * 10^6

  Where

  MCF is the Measured Carrier Frequency in MHz
  ACF is the Assigned Carrier Frequency in MHz

- The value recorded above is the carrier frequency stability.

According to RSS-Gen issue 3 Section 4.7, frequency stability is a measure of frequency drift due to temperature and supply voltage variations with reference to the frequency measurement at an appropriate reference temperature and the rated supply voltage.

Unless specified otherwise in the RSS that is applicable to the device, the reference temperature for transmitters is +20℃.

A hand-held device that is only capable of operating using internal batteries shall be tested using a new battery without any further requirement to vary the supply voltage. Alternatively, an external supply voltage can be used and set at the battery nominal voltage, and again at the battery operating end point voltage which must be specified by the equipment manufacturer.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency-determining circuit element shall be made subsequent to this initial set-up.

With the transmitter installed in an environment test chamber, the unmodulated carrier frequency shall be measured under the conditions specified below. A sufficient stabilization period at each temperature shall be used prior to each frequency measurement. The following temperatures and supply voltage ranges apply, unless specified otherwise in the applicable RSS.

(a) At temperature of -30℃, +20℃ and +50℃, and at the manufacturer's rated supply voltage; and
(b) At a temperature of +20℃ and at ±15 percent of the manufacturer's rated supply voltage.

If the frequency stability limits are only met at a different temperature range than specified in (a), the frequency stability requirement will be deemed met if the transmitter is automatically inhibited from operating outside this different temperature range and the published equipment operating characteristics are revised to reflect this different temperature range. If an unmodulated carrier is not available, the measurement method shall be described in the test report.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2014-09-29	1 year
Tenney	Temperature Chamber	TUJR	27445-06	2014-07-09	1 year
BK PRECISION	DC Power Supply	E3	N/A	N/A	N/A
Fluke	Digital Voltmeter	189	N/A	2014-02-05	1 Year

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

8.4 Test Environmental Conditions

Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge from 2014-10-13 and 2014-10-17 at RF site.

8.5 Test Results

BS1010:

Frequency: 219.75 MHz

Temperature (°C)	Voltage (V)	Frequency (MHz)	ppm	Limit (ppm)
0	24	219.7502	0.91	+/-5
10	24	219.7510	4.55	+/-5
20	21.6	219.7508	3.64	+/-5
20	24	219.7506	2.73	+/-5
20	26.4	219.7504	1.82	+/-5
30	24	219.7502	0.91	+/-5
40	24	219.7507	3.19	+/-5
50	24	219.7504	1.82	+/-5
60	24	219.7506	2.73	+/-5
70	24	219.7509	4.10	+/-5

FS4500:

Frequency: 219.75 MHz

Temperature (°C)	Voltage (V)	Frequency (MHz)	ppm	Limit (ppm)
-30	24	219.7503	1.36	+/-5
-20	24	219.7505	2.27	+/-5
-10	24	219.7506	2.73	+/-5
0	24	219.7506	2.73	+/-5
10	24	219.7508	3.55	+/-5
20	21.6	219.7506	2.64	+/-5
20	24	219.7504	1.73	+/-5
20	26.4	219.7502	0.82	+/-5
30	24	219.7500	-0.09	+/-5
40	24	219.7505	2.19	+/-5

9 FCC §2.1051 & §80.211 - Transmit Conducted Spurious Emission

9.1 Applicable Standard

According to FCC §80.211 and §2.1051
(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

9.2 Measurement Procedure

According to ANSI/TIA-D 2010 section 2.2.13, conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired. The method of measurement is as following:

- Set the center frequency of the spectrum analyzer to the assigned transmitter frequency, key the transmitter, and set the level of the carrier to the full scale reference line.

- Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

- Adjust the spectrum analyzer for the following setting:

    5) Resolution bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
    6) Video bandwidth ≥ 3 times the resolution bandwidth.
    7) Sweep speed ≤ 2000 Hz per second.
    8) Detector mode = mean or average power.

- Record the frequencies and levels of spurious emissions.

According to RSS-Gen issue 3 Section 4.6.1, when the applicable unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, used for the transmitter output power measurement, shall be used for unwanted emission measurement.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given in (a) and (b):

(c) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(d) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiple of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth for emissions below 1000 MHz. as an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable XISPR quasi-peak bandwidth.

Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2014-09-29	1 year

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

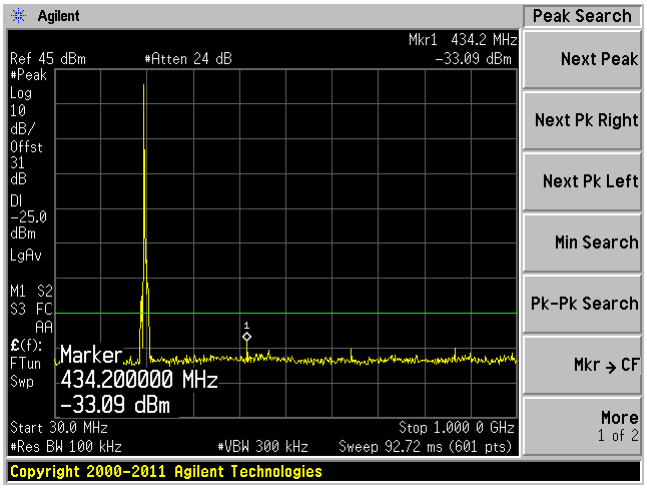
Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge from 2014-10-13 and 2014-10-17 at RF site.

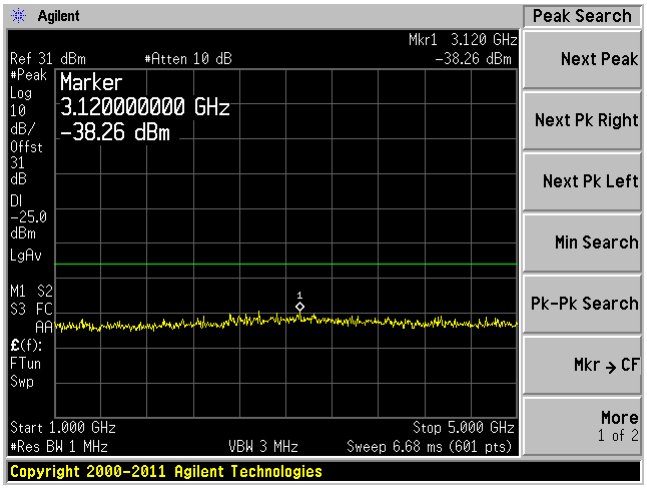
9.5 Test Results

BS1010:

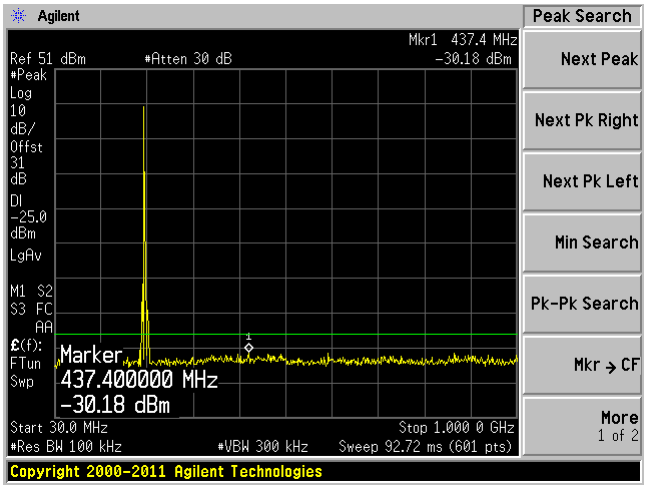
Channel 1, 30MHz – 1GHz



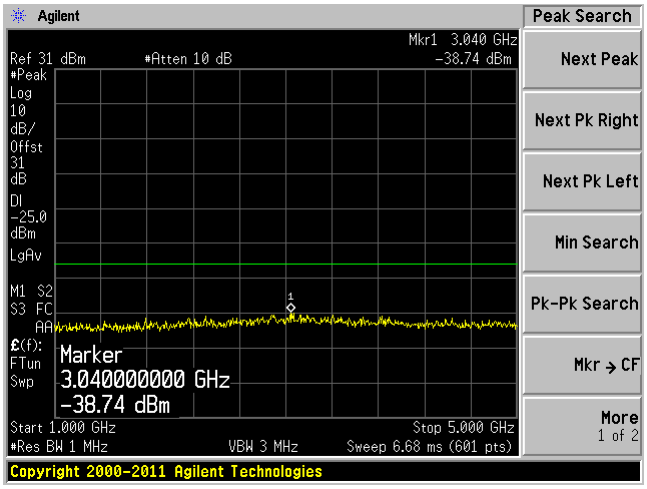
Channel 1, 1GHz – 5GHz



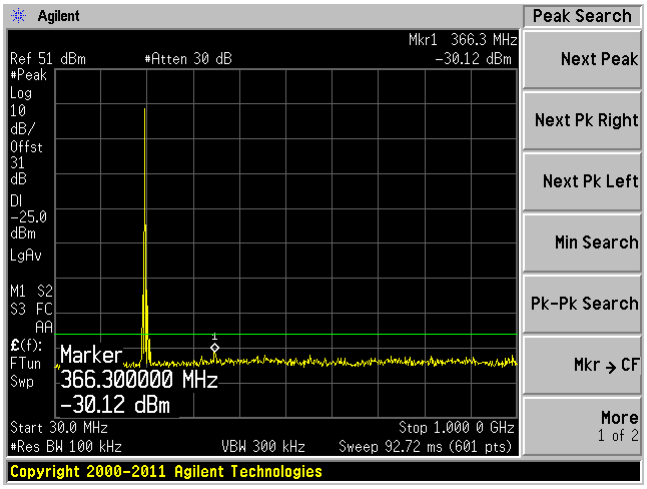
Channel 2, 30MHz – 1GHz



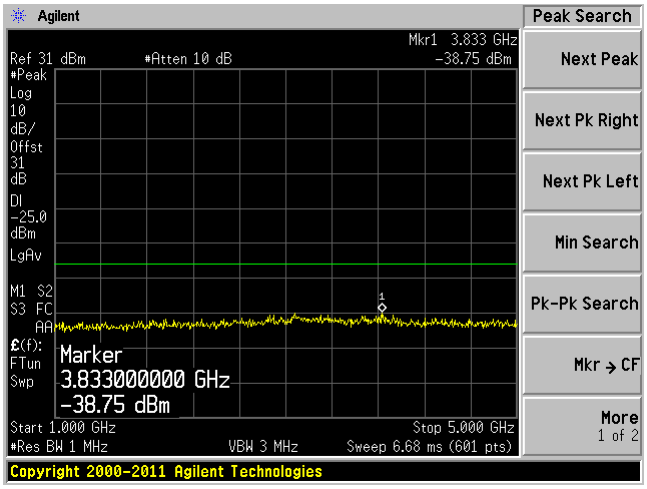
Channel 2, 1GHz – 5GHz



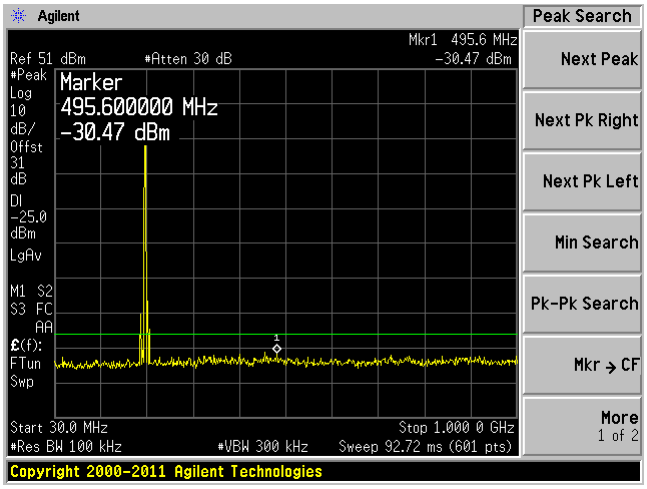
Channel 3, 30MHz – 1GHz



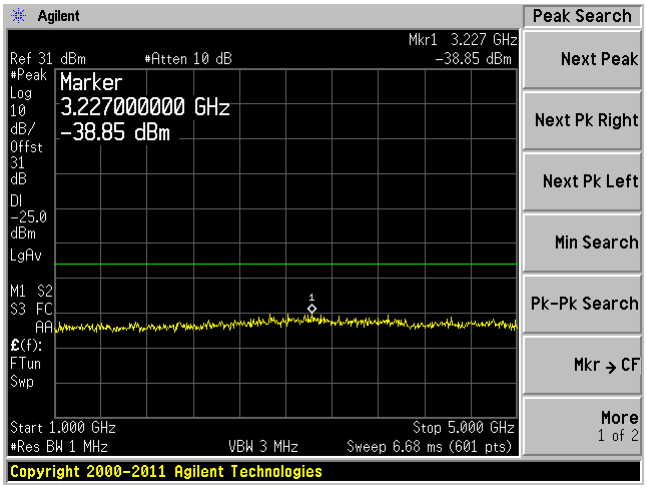
Channel 3, 1GHz – 5GHz



Channel 4, 30MHz – 1GHz

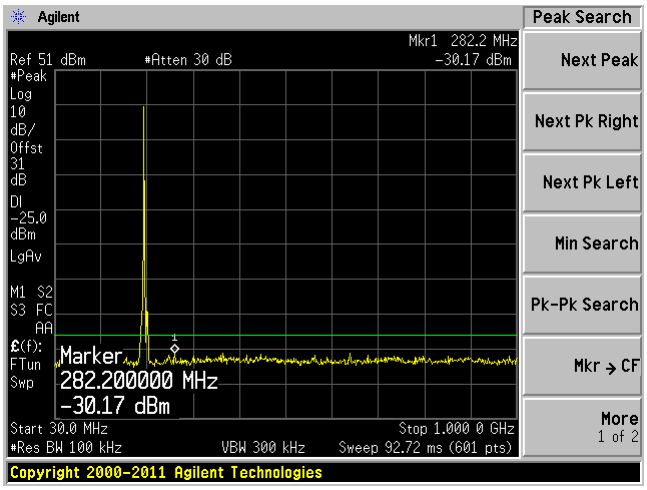


Channel 4, 1GHz – 5GHz

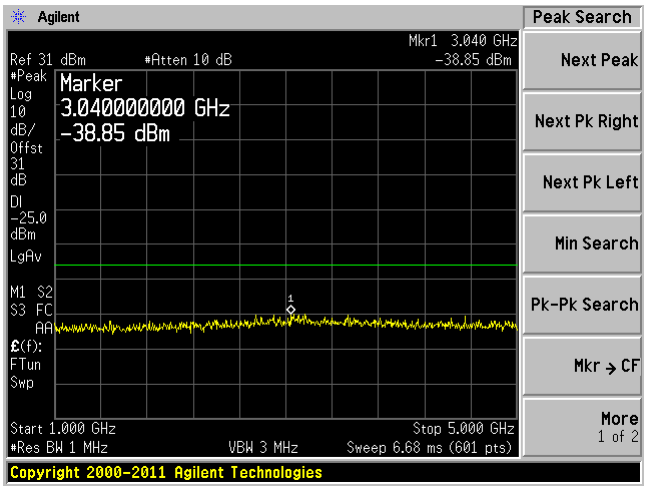


FS4500:

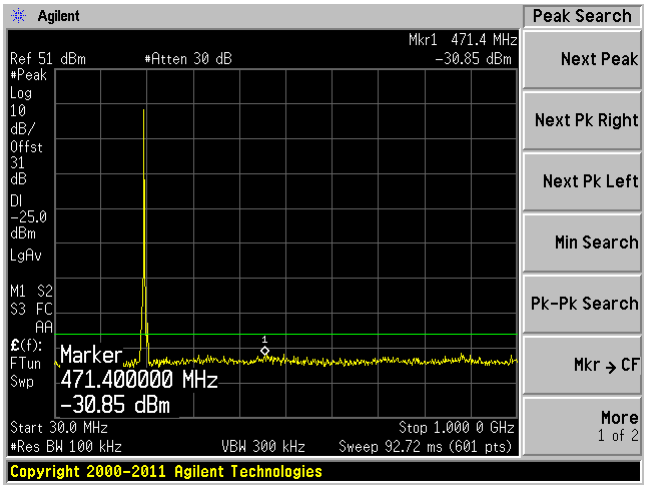
Channel 1, 30MHz – 1GHz



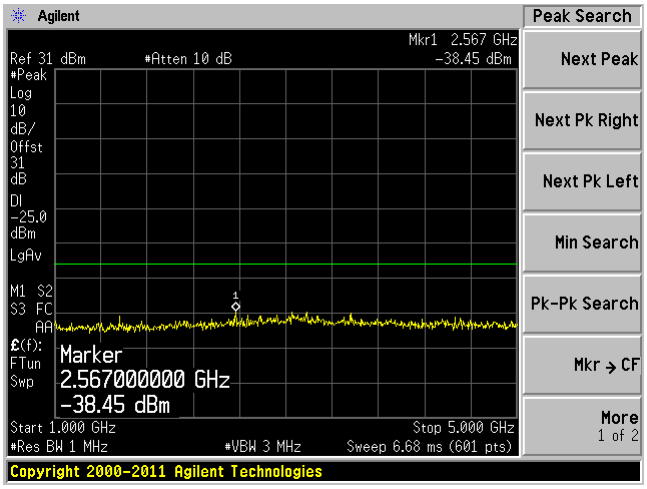
Channel 1, 1GHz – 5GHz



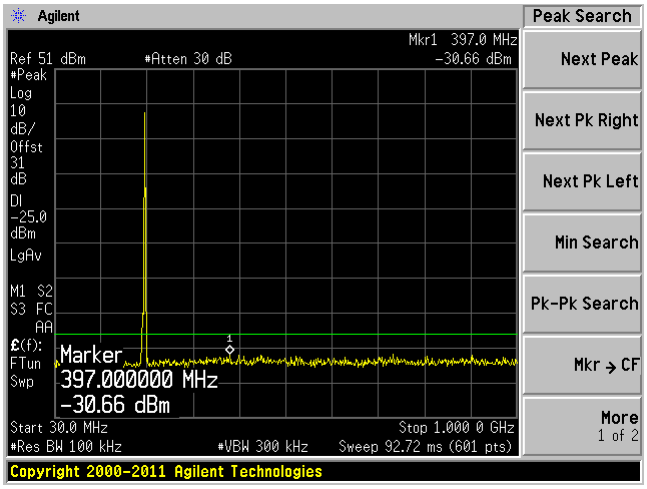
Channel 2, 30MHz – 1GHz



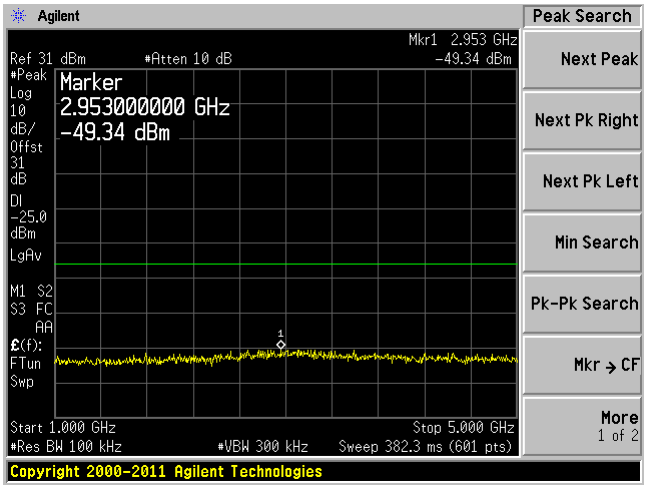
Channel 2, 1GHz – 5GHz



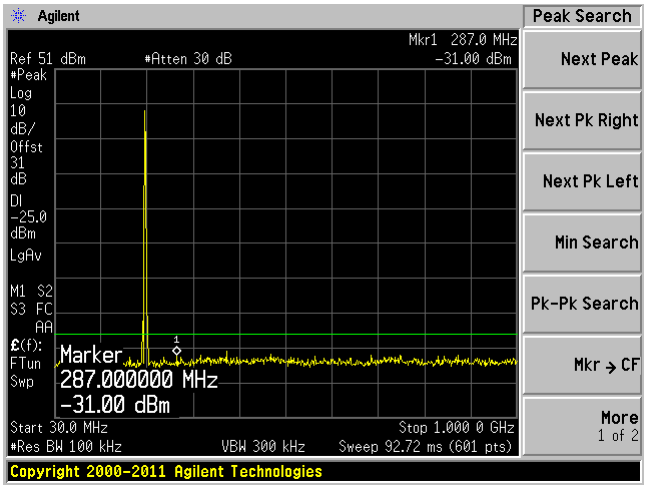
Channel 3, 30MHz – 1GHz



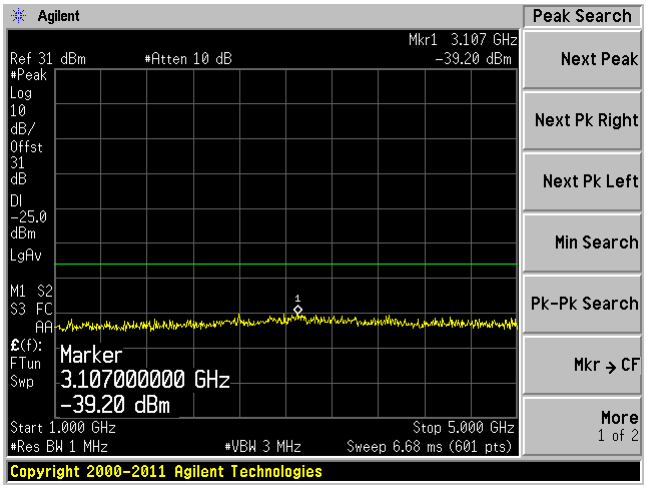
Channel 3, 1GHz – 5GHz



Channel 4, 30MHz – 1GHz



Channel 4, 1GHz – 5GHz



10 FCC §2.1053 & §80.211 – Field Strength of Spurious Emission

10.1 Applicable Standard

According to FCC §80.211 and §2.1053

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(4) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(5) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(6) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

10.2 Measurement Procedure

According to ANSI/TIA-D 2010 section 2.2.13, conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired. The method of measurement is as following:

- Set the center frequency of the spectrum analyzer to the assigned transmitter frequency, key the transmitter, and set the level of the carrier to the full scale reference line.

- Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation. The input level shall be established at the frequency of maximum reponse of the audio modulating circuit.

- Adjust the spectrum analyzer for the following setting:

  9) Resolution bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
  10) Video bandwidth ≥ 3 times the resolution bandwidth.
  11) Sweep speed ≤ 2000 Hz per second.
  12) Detector mode = mean or average power.

- Record the frequencies and levels of spurious emissions.

According to RSS-Gen issue 3 Section 4.6.1, when the applicable unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, used for the transmitter output power measurement, shall be used for unwanted emission measurement.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given in (a) and (b):

(e) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(f) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiple of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth for emissions below 1000 MHz. as an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable XISPR quasi-peak bandwidth.

Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2014-06-18	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2014-06-09	1 year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2014-05-09	1 year
Agilent	Spectrum Analyzer	E4446A	US44300386	2014-09-29	1 year
EMCO	Horn Antenna	3315	9511-4627	2014-10-17	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2014-03-28	1 year

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

10.4 Test Environmental Conditions

Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge from 2014-10-13 and 2014-10-17 at 5 meter chamber 3.

10.5 Test Results

BS1010:

Frequency: 217.25 MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
434.5	62.79	72	100	H	434.5	-42.21	0	0.22	-42.43	-13	-29.43
434.5	61.65	60	100	V	434.5	-43.35	0	0.22	-43.57	-13	-30.57
651.75	58.23	0	100	H	651.75	-43.77	0	0.41	-44.18	-13	-31.18
651.75	58.74	0	100	V	651.75	-43.26	0	0.41	-43.67	-13	-30.67
869	52.39	63	100	H	869	-45.61	0	0.75	-46.36	-13	-33.36
869	51.92	99	105	V	869	-46.08	0	0.75	-46.83	-13	-33.83
1220	58.33	47	100	H	1220	-44.67	6.249	1.02	-39.441	-13	-26.441
1220	65.12	125	111	V	1220	-37.88	6.249	1.02	-32.651	-13	-19.651

Frequency: 217.75 MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
435.5	62.46	72	100	H	435.5	-42.54	0	0.22	-42.76	-13	-29.76
435.5	61.74	60	100	V	435.5	-43.26	0	0.22	-43.48	-13	-30.48
653.25	53.78	0	100	H	653.25	-48.22	0	0.41	-48.63	-13	-35.63
653.25	58.02	0	100	V	653.25	-43.98	0	0.41	-44.39	-13	-31.39
871	52.67	63	100	H	871	-45.33	0	0.75	-46.08	-13	-33.08
871	52.21	99	100	V	871	-45.79	0	0.75	-46.54	-13	-33.54
1220	58.86	47	100	H	1220	-44.14	6.249	1.02	-38.911	-13	-25.911
1220	64.31	125	100	V	1220	-38.69	6.249	1.02	-33.461	-13	-20.461

Frequency: 219.25 MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
438.5	62.29	72	100	H	438.5	-42.71	0	0.22	-42.93	-13	-29.93
438.5	63.08	60	100	V	438.5	-41.92	0	0.22	-42.14	-13	-29.14
657.75	53.67	0	100	H	657.75	-48.33	0	0.41	-48.74	-13	-35.74
657.75	53.47	0	100	V	657.75	-48.53	0	0.41	-48.94	-13	-35.94
877	53.06	63	100	H	877	-44.94	0	0.75	-45.69	-13	-32.69
877	56.41	99	105	V	877	-41.59	0	0.75	-42.34	-13	-29.34
1220	57.69	47	100	H	1220	-45.31	6.249	1.02	-40.081	-13	-27.081
1220	65.49	125	111	V	1220	-37.51	6.249	1.02	-32.281	-13	-19.281

Frequency: 219.75 MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
439.5	62.87	72	100	H	439.5	-42.13	0	0.22	-42.35	-13	-29.35
439.5	60.78	60	100	V	439.5	-44.22	0	0.22	-44.44	-13	-31.44
659.25	54.22	0	100	H	659.25	-47.78	0	0.41	-48.19	-13	-35.19
659.25	54.62	0	100	V	659.25	-47.38	0	0.41	-47.79	-13	-34.79
879	53.92	63	100	H	879	-44.08	0	0.75	-44.83	-13	-31.83
879	58.56	99	100	V	879	-39.44	0	0.75	-40.19	-13	-27.19
1220	58.31	47	100	H	1220	-44.69	6.249	1.02	-39.461	-13	-26.461
1220	65.48	125	100	V	1220	-37.52	6.249	1.02	-32.291	-13	-19.291

FS4500:

Channel 217.25 MHz

Freq. (MHz)	S.A. Amp. (dBμV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
434.5	58.32	94	100	H	434.5	-46.68	0	0.22	-46.9	-13	-33.9
434.5	57.39	78	100	V	434.5	-47.61	0	0.22	-47.83	-13	-34.83
651.75	51.93	121	100	H	651.75	-50.07	0	0.41	-50.48	-13	-37.48
651.75	51.96	236	100	V	651.75	-50.04	0	0.41	-50.45	-13	-37.45
869	51.25	82	100	H	869	-46.75	0	0.75	-47.5	-13	-34.5
869	51.36	129	105	V	869	-46.64	0	0.75	-47.39	-13	-34.39
1220	52.44	61	100	H	1220	-50.56	6.249	1.02	-45.331	-13	-32.331
1220	52.12	163	111	V	1220	-50.88	6.249	1.02	-45.651	-13	-32.651

Channel 217.75 MHz

Freq. (MHz)	S.A. Amp. (dBμV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
435.5	58.77	94	100	H	435.5	-46.23	0	0.22	-46.45	-13	-33.45
435.5	56.57	78	100	V	435.5	-48.43	0	0.22	-48.65	-13	-35.65
653.25	56.64	121	100	H	653.25	-45.36	0	0.41	-45.77	-13	-32.77
653.25	56.58	236	100	V	653.25	-45.42	0	0.41	-45.83	-13	-32.83
871	51.92	82	100	H	871	-46.08	0	0.75	-46.83	-13	-33.83
871	51.57	129	100	V	871	-46.43	0	0.75	-47.18	-13	-34.18
1220	51.84	61	100	H	1220	-51.16	6.249	1.02	-45.931	-13	-32.931
1220	52.66	163	100	V	1220	-50.34	6.249	1.02	-45.111	-13	-32.111

Frequency: 219.25 MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
438.5	59.17	94	100	H	438.5	-45.83	0	0.22	-46.05	-13	-33.05
438.5	59.53	78	100	V	438.5	-45.47	0	0.22	-45.69	-13	-32.69
657.75	55.76	121	100	H	657.75	-46.24	0	0.41	-46.65	-13	-33.65
657.75	54.03	236	100	V	657.75	-47.97	0	0.41	-48.38	-13	-35.38
877	52.21	82	100	H	877	-45.79	0	0.75	-46.54	-13	-33.54
877	52.8	129	105	V	877	-45.2	0	0.75	-45.95	-13	-32.95
1220	52.31	61	100	H	1220	-50.69	6.249	1.02	-45.461	-13	-32.461
1220	51.58	163	111	V	1220	-51.42	6.249	1.02	-46.191	-13	-33.191

Frequency: 219.75 MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (cm)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
439.5	59.82	94	100	H	439.5	-45.18	0	0.22	-45.4	-13	-32.4
439.5	58.99	78	100	V	439.5	-46.01	0	0.22	-46.23	-13	-33.23
659.25	53.96	121	100	H	659.25	-48.04	0	0.41	-48.45	-13	-35.45
659.25	55.63	236	100	V	659.25	-46.37	0	0.41	-46.78	-13	-33.78
879	53.24	82	100	H	879	-44.76	0	0.75	-45.51	-13	-32.51
879	54.17	129	100	V	879	-43.83	0	0.75	-44.58	-13	-31.58
1220	52.44	61	100	H	1220	-50.56	6.249	1.02	-45.331	-13	-32.331
1220	52.31	163	100	V	1220	-50.69	6.249	1.02	-45.461	-13	-32.461