FCC PART 74 SUBPART H
IC RSS-210 ISSUE 8, AMENDMENT 1
TEST AND MEASUREMENT REPORT

For

Lectrosonics, Inc.

581 Laser Road, Rio Rancho, NM 87124, USA

FCC ID: DBZHHAC1
IC: 8024A-HHAC1

Report Type:	**Product Type:**
Original Report	Wireless Microphone Transmitter

Prepared By: Leonard Gray

Report Number: R1508185-74

Report Date: 2015-10-23

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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1508185-74	Original Report	2015-10-23

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report has been compiled on behalf of Lectrosonics, Inc. and their product model: *HHA-C1, FCC ID: DBZHHAC1, IC: 8024A-HHAC1*, which henceforth is referred to as the EUT (Equipment Under Test). The EUT is a Wireless microphone transmitter with fixed antenna, battery powered, compatible with Lectrosonics wireless microphone receivers. The EUT operates in the frequency range: 614.4-691.175 MHz.

1.2 Mechanical Description of EUT

The EUT measures approximately 4.8 cm (L) x 4.8 cm (W) x 24 cm (H) and weighs approximately 0.211 kg.

The data gathered are from a typical production sample provided by the manufacturer with serial number: 3 provided by customer.

1.3 Objective

The following type approved report is prepared on behalf of *Lectrosonics, Inc.* in accordance with Part 74, Subparts H of the Federal Communications Commission rules, Issue 4 of the Industry Canada RSS-Gen General Requirements and Information for the Certification of Radio Apparatus and Issue 8 of Industry Canada RSS-210, Amendment 1, License-Exempt, Low-Power Radio Apparatus Operating in the Television Bands.

The objective is to determine compliance with Part 74 of the FCC Rules, Industry Canada RSS-Gen and Industry Canada RSS-210 Standard, limits for RF output power, Modulation characteristics, Emission bandwidth, Feld strength of spurious radiation and Frequency stability for license-exempt, low-power radio apparatus operating in the television bands.

1.4 Related Submittal(s)/Grant(s)

NA

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with TIA 603-D Land Mobile FM or PM Communications Equipment Measurement and Performance Standards. ANSI C63.10-2013, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9kHz to 40GHz.

All tests were performed at Bay Area Compliance Laboratories 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.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from ±2.0 dB for Conducted Emissions tests and ±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 EUT Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA 603-D and ANSI C63.10-2013 Standards.

2.2 EUT Exercise Software

N/A

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 No.	Serial No.
Lenovo	Laptop	0679	CB08585694

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model/ Rev.	Serial No.
Lectrosonics, Inc.	Radio Board	17489A	-
Lectrosonics, Inc.	Audio Board	17490A	-

2.7 Power Supply List and Details

N/A

2.8 Interface Ports and Cables

Cable Description	Length(m)	To	From
RF Cable	<1.0	PSA	EUT
Dynamic mic level adapter	<1.0	EUT	Communication Test Set

3 Summary of Test Results

FCC & IC Rules	Descriptions of Test	Result (s)
FCC §2.1093, IC RSS-102	RF Exposure	Compliant
FCC §74.861(e)(1), IC RSS-210 Amend 1 § 6.1	RF output power	Compliant
FCC §74.861(e)(3), IC RSS-210 Amend 1 §6.6.2	Modulation characteristics	Compliant
FCC §74.861(e)(5)(6), IC RSS-210 Amend 1 §6.2	Emission bandwidth & Emission Mask	Compliant
FCC §74.861(e)(6), IC RSS-210 Amend 1 §6.4.1	Spurious radiation at the antenna port	Compliant
FCC §74.861(e)(6), IC RSS-210 Amend 1 §6.4.1	Field strength of spurious radiation	Compliant
FCC §74.861(e)(4), IC RSS-210 Amend 1 §6.3	Frequency stability	Compliant

4 FCC §2.1093 & IC RSS-102 - RF Exposure

4.1 Applicable Standards

According to FCC KDB 447498 D01 General RF Exposure Guidance v05r02 Section 4.3.1,Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
   [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

   • f(GHz) is the RF channel transmit frequency in GHz
   • Power and distance are rounded to the nearest mW and mm before calculation
   • The result is rounded to one decimal place for comparison
   • 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

   The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:

   a) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
   b) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz

3) At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:

   a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by [1 + log(100/f(MHz))] for test separation distances > 50 mm and < 200 mm

b) The power threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by ½ for test separation distances ≤ 50 mm

c) SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

According to IC RSS-102 Issue 5 §2.5.1,

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤ 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71	101	132	162	193
450	52	70	88	106	123
835	17	30	42	55	67
1900	7	10	18	34	60
2450	4	7	15	30	52
3500	2	6	16	32	55
5800	1	6	15	27	41

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥ 50 mm
≤ 300	223	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431
2450	83	123	173	235	309
3500	86	124	170	225	290
5800	56	71	85	97	106

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required. For medical implants devices, the exemption limit for routine evaluation is set at 1 mW.

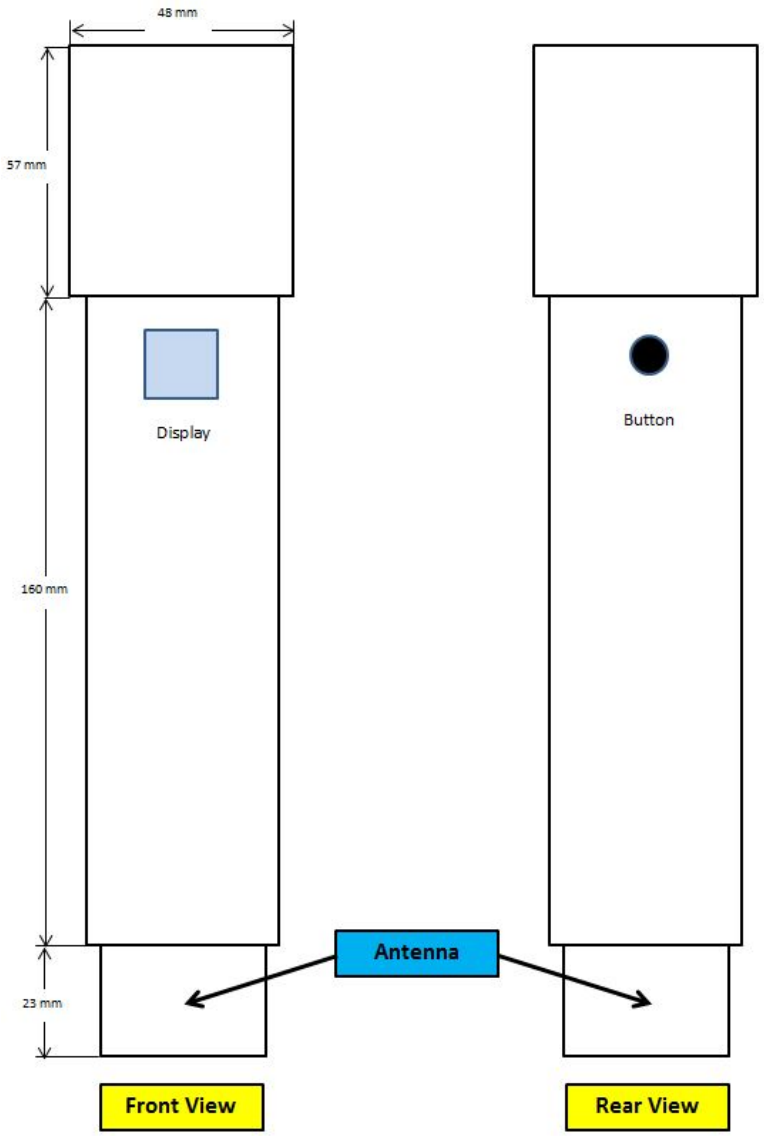
The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

4.2 EUT Dimension and Antenna Location

The EUT is a hand held wireless microphone, the physical dimension and the antenna location is shown in the diagram below.

There will be no accessories sold together with this product and the normal usage will be hand held only.

The distance between antenna and human hand should be 20 mm or more.



4.3 FCC and IC SAR Exclusion Consideration

Channel	Frequency (MHz)	Target Conducted Output Power Including Tune-up Tolerance		Max. Antenna Gain (dBi)	Max. e.i.r.p (mW)	Distance (mm)	Calculated Value	FCC 10-g Extreme SAR Threshold	SAR Exclusion (Yes/No)
		dBm	mW						
Low	614.4	20	100	2.15	164.059	20	6.43	7.5	Yes
Middle	652	20	100	2.15	164.059	20	6.62	7.5	Yes
High	691.175	20	100	2.15	164.059	20	6.82	7.5	Yes

Channel	Frequency (MHz)	Target Conducted Output Power Including Tune-up Tolerance		Max. Antenna Gain (dBi)	Max. e.i.r.p (mW)	Distance (mm)	IC 10-g SAR Exemption Limit * (mW)	SAR Exclusion (Yes/No)
		dBm	mW					
Low	614.4	20	100	2.15	164.059	20	210.56	Yes
Middle	652	20	100	2.15	164.059	20	198.10	Yes
High	691.175	20	100	2.15	164.059	20	185.13	Yes

* Linear interpolation was applied for finding the exemption limit for the channel frequencies list above. The following equation was used to determine the exemption power level p_c at channel frequency f_c.

$(f_1-f_2)/(f_c-f_2) = (p_1-p_2)/(p_c-p_2)$

5 FCC §74.861 & IC RSS-210 Amend 1 §6.1 - RF Output Power

5.1 Applicable Standards

According to FCC §74.861 (e) (1): the power of the measured unmodulated carrier power at the output of the transmitter power amplifier (antenna input power) may not exceed the following:

(i) 54-72, 76-88, and 174-216 MHz bands—50 mW
(ii) 470-608 and 614-698 MHz bands—250 mW

As per IC RSS-210 Issue 8, Amendment 1 §6.1:

470-608 MHz and 614-698 MHz bands -250 mW

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: 1 MHz

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

5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2015-06-23	1 year
Mini Circuits	Precision Fixed Attenuator, 20 dB	BW-S20W5+	-	-	N/A
UTiFLEX	SMA Cable	64639	218625006	2015-06-04	1 year

Cable and attenuator included in the test set-up were checked each time before testing.

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

5.4 Test Environmental Conditions

Temperature:	23 ºC
Relative Humidity:	45 %
ATM Pressure:	101.68 kPa

The testing was performed by Leonard Gray on 2015-8-26 at RF site.

5.5 Test Results

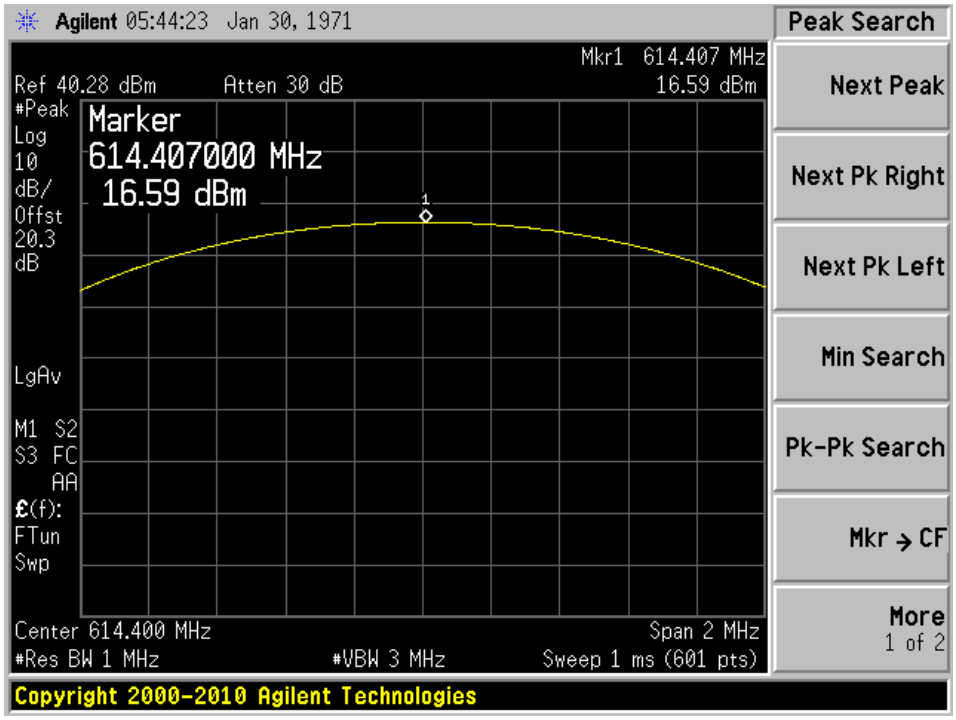
Conducted output power:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limits (dBm)	Margin (dB)	Rated Power (mW/dBm)
Low	614.4	16.59	24	-7.41	50/17
		19.23	24	-4.77	100/20
Middle	652	15.94	24	-8.06	50/17
		19.21	24	-4.79	100/20
High	691.175	16.42	24	-7.58	50/17
		19.51	24	-4.49	100/20

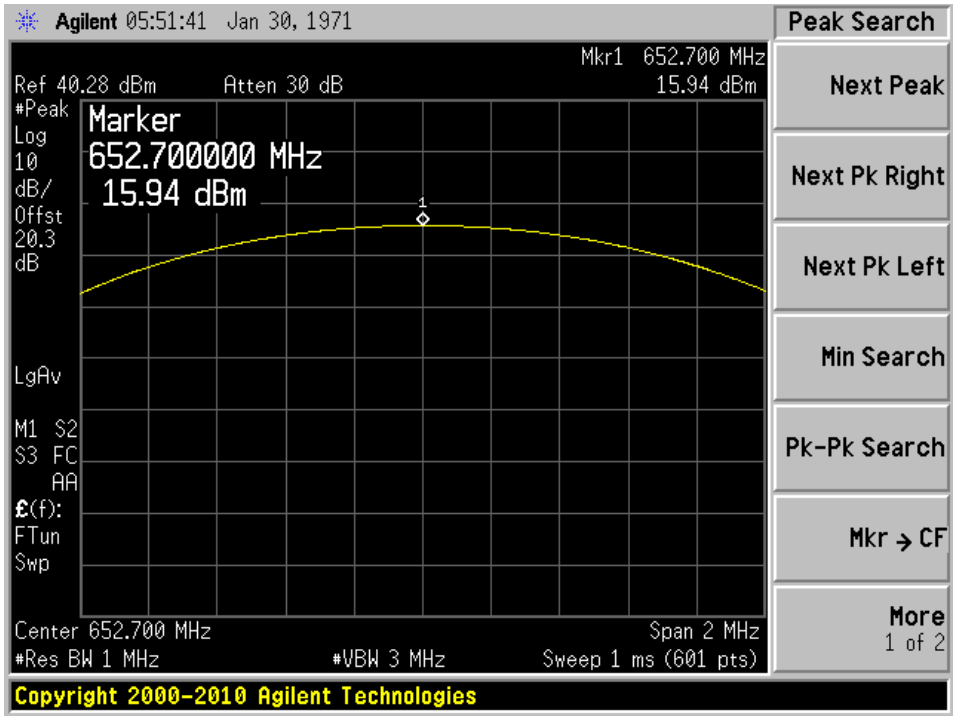
Please refer to the following plots for detailed test results

50 mW Power Setting:

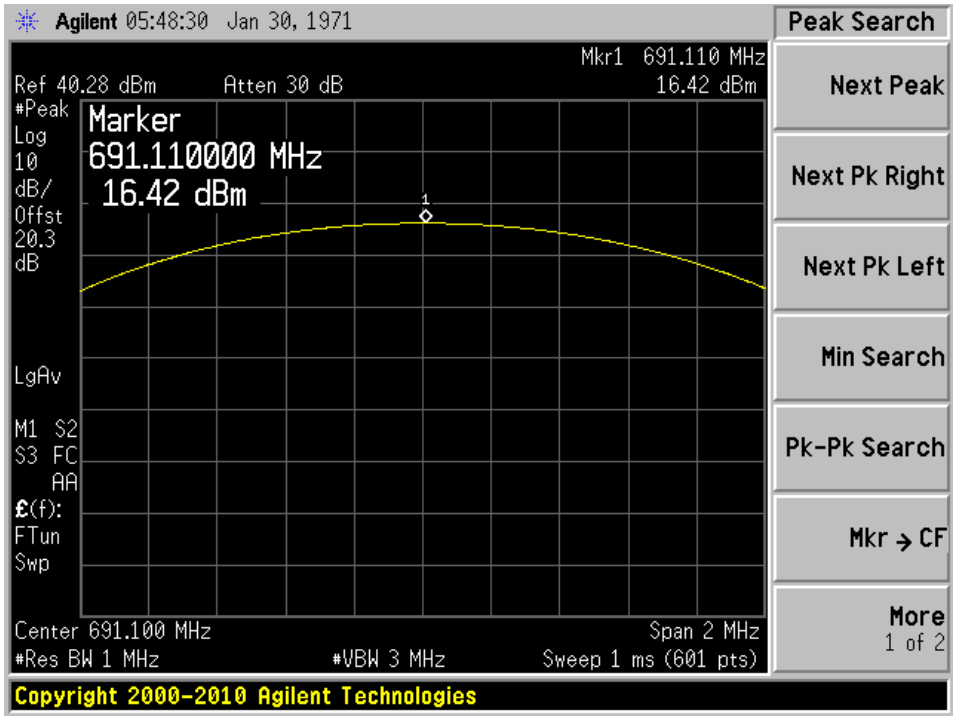
Low Channel



Middle Channel

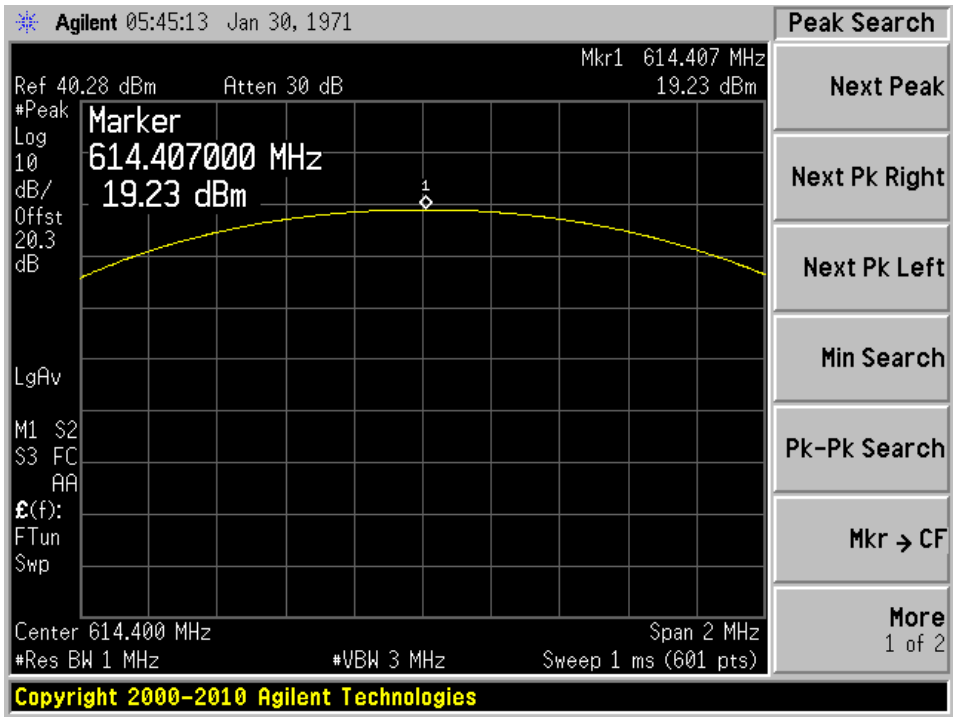


High Channel

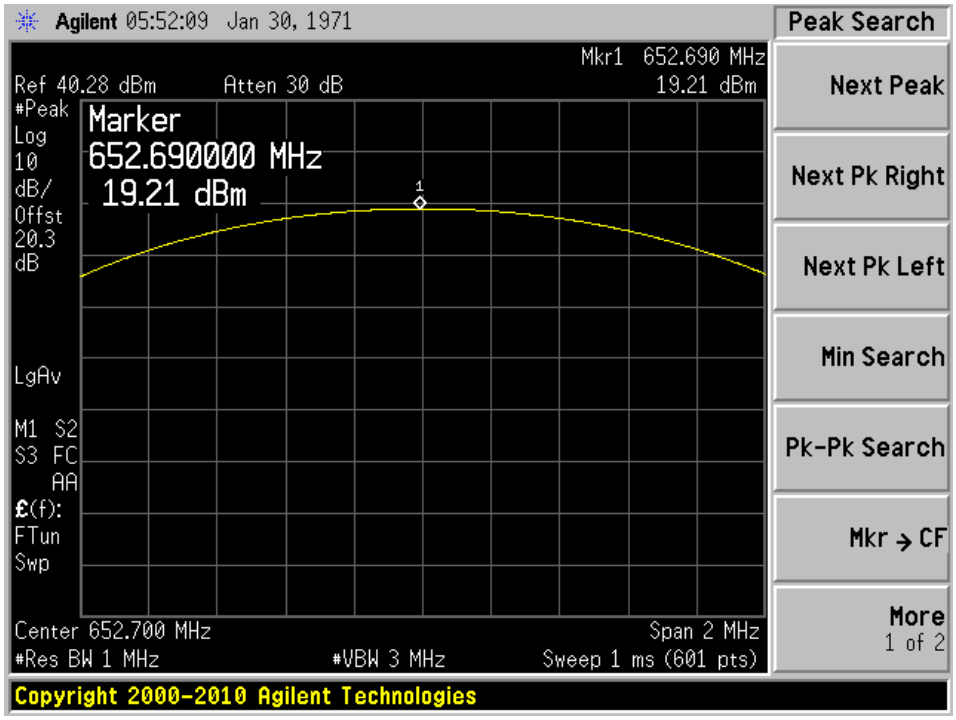


100 mW Power Setting:

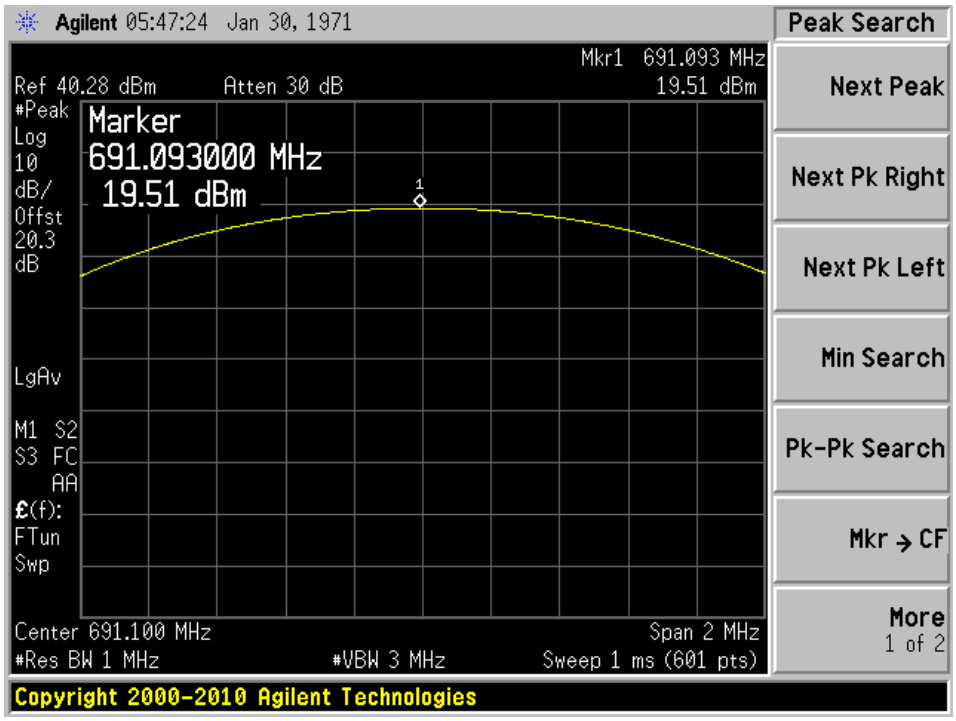
Low Channel



Middle Channel



High Channel



6 FCC §74.861(e)(3) & IC RSS-210 Amend 1 §6.6.2 - Modulation Characteristics

6.1 Applicable Standards

According to FCC §74.861 (e) (3):

Any form of modulation may be used. A maximum deviation of ±75 kHz is permitted when frequency modulation is employed.

As per IC RSS-210 Issue 8, Amendment 1 §6.6.2:

The devices may employ any type of modulation. The type of modulation used shall be reported in the test report.

Low-power auxiliary equipment using FM may employ a frequency deviation up to a maximum of ±75 kHz.

6.2 Test Procedure

According to ANSI/TIA-603-D 2010 section 2.2.3, modulation limiting is the transmitter circuit's ability to limit the transmitter from producing deviation in excess of a rated system deviation.
Connect the modulation analyzer to EUT and EUT to test receiver. Apply a 1000 Hz modulating signal to the transmitter from the modulation analyzer, and adjust the level to obtain 60% of full rated system deviation.
Increase the level from the modulation analyzer by 5dB in one step, record the deviation obtained from the receiver.
Decrease the level from the modulation analyzer by 5dB in one step, record the deviation obtained from the receiver.
With the level from the modulation analyzer held constant at each level, vary frequency from 300 Hz to 15000 Hz. Record the deviation.

6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
HP	Analyzer, RF Communications Test Set	8920A	3438A05338	2015-07-23	1 year
HP	Analyzer, Modulation	8901A	2026A00847	2014-08-25	1 year
Mini Circuits	Precision Fixed Attenuator, 20 dB	BW-S20W5+	-	-	N/A
UTiFLEX	SMA Cable	64639	218625006	2015-06-04	1 year

Cable and attenuator included in the test set-up were checked each time before testing.

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

6.4 Test Environmental Conditions

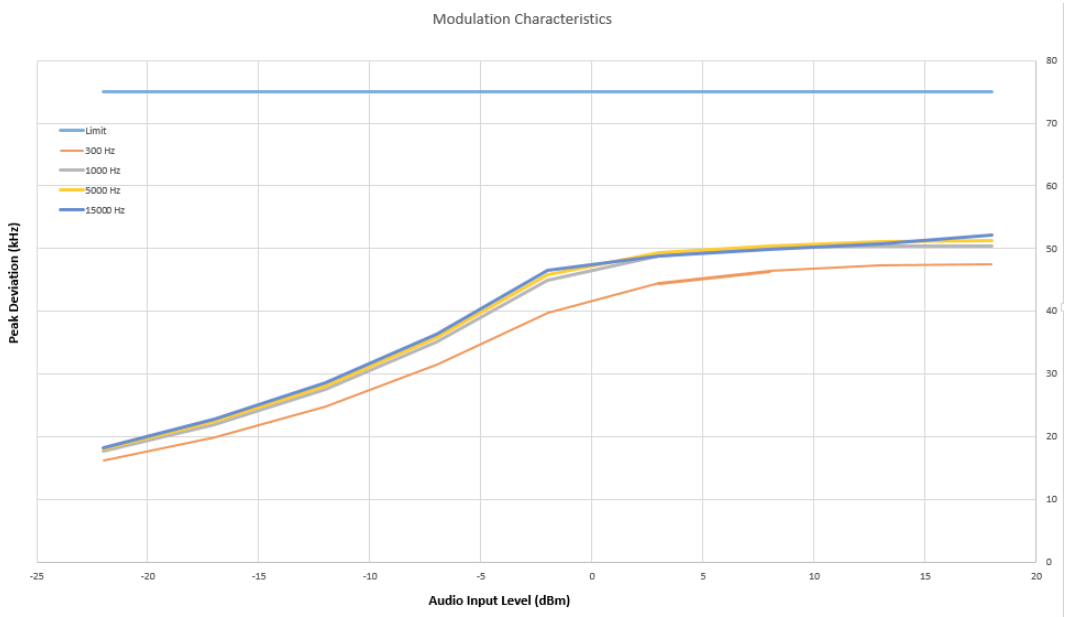
Temperature:	23 ºC
Relative Humidity:	45 %
ATM Pressure:	101.68 kPa

The testing was performed by Leonard Gray on 2015-8-26 at RF site.

6.5 Test Results

Deviation versus Audio input level and Audio Frequency, Middle Channel

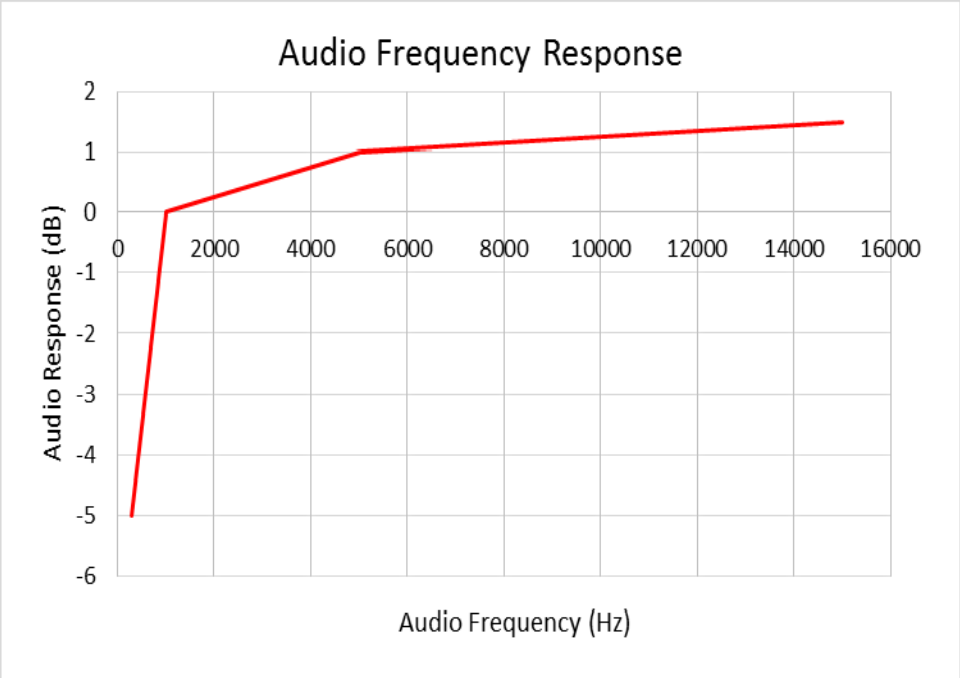
AF Level (dBm)	AF Frequency (Hz)/Peak Deviation (kHz)				Limit (kHz)
	300 Hz	1000 Hz	5000 Hz	15000 Hz	
-42	16.27	17.8	18.11	18.33	±75
-37	19.98	22.0	22.44	22.77	±75
-30	24.93	27.5	28.12	28.56	±75
-27	31.5	35.1	35.9	36.42	±75
-22	39.87	45.0	45.9	46.5	±75
-18	44.5	48.9	49.4	48.8	±75
-12	46.4	50.2	50.4	49.9	±75
-7	47.3	50.5	51.1	50.8	±75
-2	47.6	50.5	51.3	52.2	±75



Audio Frequency Response, Middle Channel

AF Frequency (Hz)	AF Level (uW)	AF Response (dB)
300	1995.26	-5
1000	630.96	0
5000	501.19	1.0
15000	446.68	1.5

Note: AF Response = 20*log (AF Level of 1 kHz/AF Level)



7 FCC §74.861(e) (5) (6) & IC RSS-210 Amend 1 §6.2 - Occupied Bandwidth & Emission Mask

7.1 Applicable Standards

According to FCC §74.861 (e) (5) (6):

The operating bandwidth shall not exceed 200 kHz.

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

- On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB;
- On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB;
- On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least 43+10log10 (mean output power in watts) dB.

As per IC RSS-210 Issue 8, Amendment 1 §6.2:

The occupied bandwidth as defined in RSS-Gen shall not exceed the authorized bandwidth of 200 kHz when the frequency band is 470 MHz-608MHz.

7.2 Test Procedure

According to RSS-Gen Issue 4 Section 6.6, When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- 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 (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Us of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level 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 (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
HP	Analyzer, RF Communications Test Set	8920A	3438A05338	2015-07-23	1 year
Agilent	Spectrum Analyzer	E4440A	US42221851	2015-06-23	1 year
Mini Circuits	Precision Fixed Attenuator, 20dB	BW-S20W5+	-	-	N/A
UTiFLEX	SMA Cable	64639	218625006	2015-06-04	1 year

Cable and attenuator included in the test set-up were checked each time before testing.

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

7.4 Test Environmental Conditions

Temperature:	23 ºC
Relative Humidity:	45 %
ATM Pressure:	101.68 kPa

The testing was performed by Leonard Gray on 2015-8-26 at RF site.

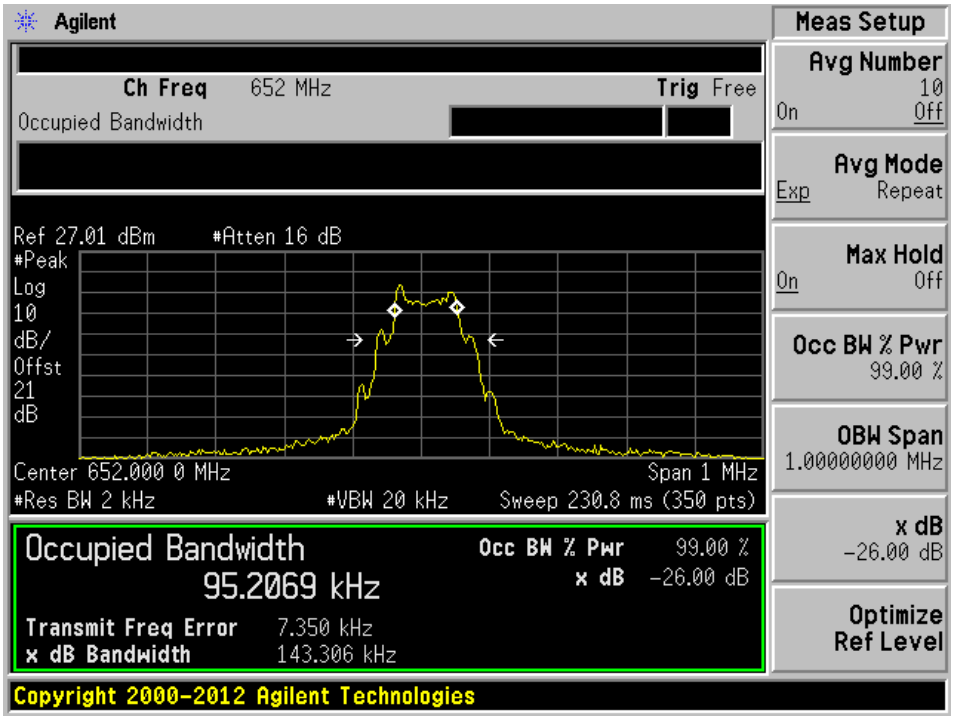
7.5 Test Results

Center Frequency (MHz)	99% Bandwidth (kHz)	Limit (kHz)	Result	Power Setting
652	95.21	200	Pass	Low (50 mW)
652	94.80	200	Pass	High (100 mW)

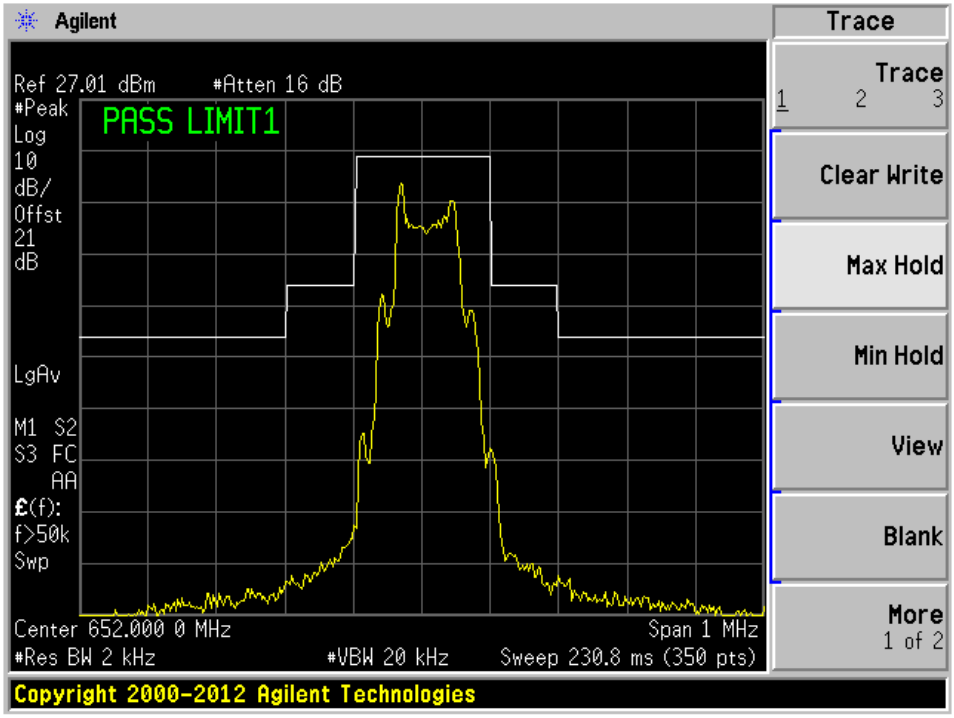
Please refer to the following table plots for detailed test results

50mW power setting

Occupied Bandwidth

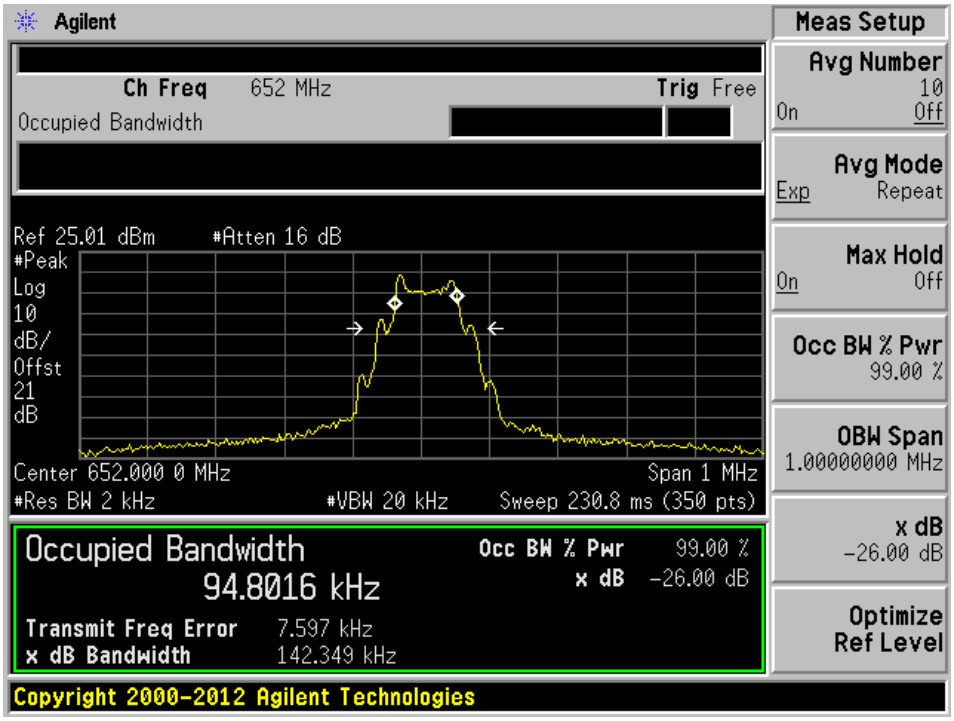


Emission Mask

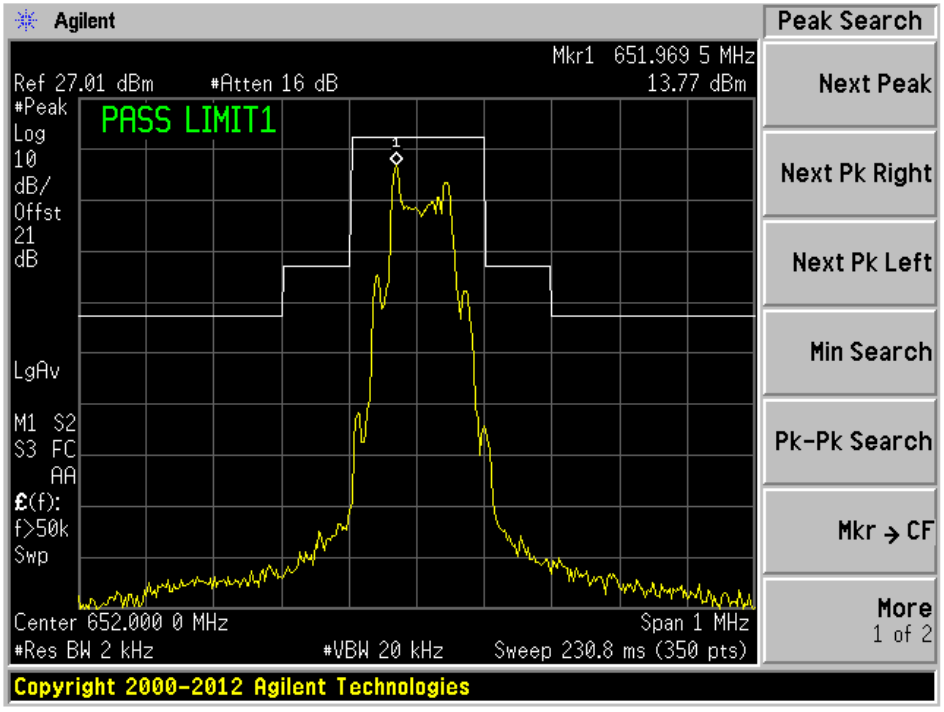


100mW power setting

Occupied Bandwidth



Emission Mask



8 FCC §74.861(e) (6) (iii) & IC RSS-210 Amend 1 §6.4.1 - Conducted Spurious Emissions at Antenna Port

8.1 Applicable Standards

According to FCC §74.861 (e) (6) (iii):

On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least 43 + 10log (mean output power in watts) dB.

As per IC RSS-210 Issue 8, Amendment 1 §6.4.1:

The power of unwanted emissions (measured with a resolution bandwidth of 30 kHz) shall be attenuated below the mean output power, p-mean in dBW, of the transmitter as follows:

At least 55 + 10log (P-mean in watts) dB: on any frequency removed from the operating frequency by more than 250% of the authorized bandwidth.

8.2 Test Procedure

According to ANSI/TIA-603-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 = 10 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 level of spurious emissions.

According to RSS-Gen issue 4 Section 6.13, when the applicable unwanted emission 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 operated 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 CISPR 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.

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2015-03-09	1 year
Mini Circuits	Precision Fixed Attenuator, 20dB	BW-S20W5+	-	-	N/A
UTiFLEX	SMA Cable	64639	218625006	2015-06-04	1 year

Cable and attenuator included in the test set-up were checked each time before testing.

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

8.4 Test Environmental Conditions

Temperature:	23 ºC
Relative Humidity:	45 %
ATM Pressure:	101.68 kPa

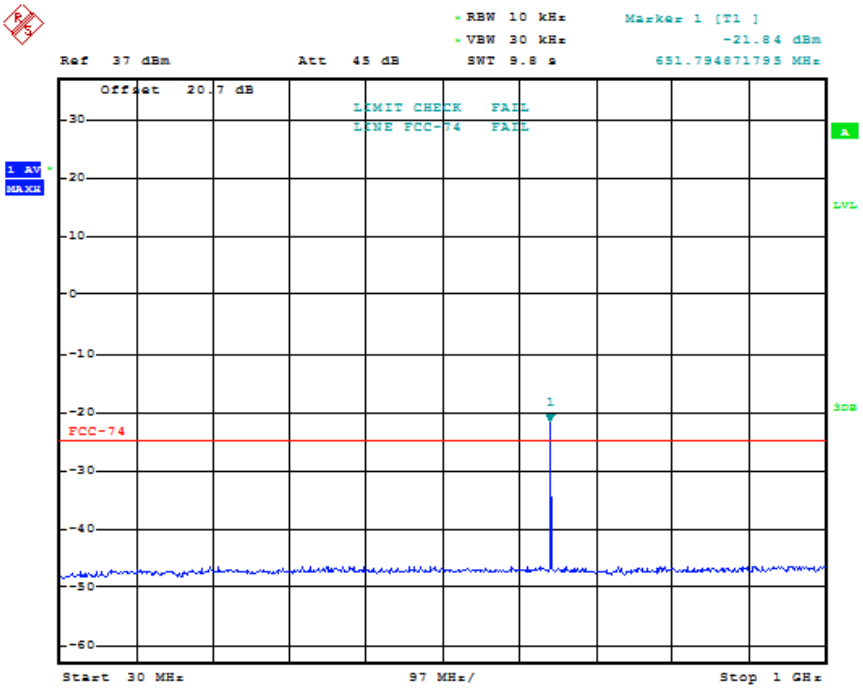
The testing was performed by Leonard Gray on 2015-8-26 at RF site.

8.5 Test Results

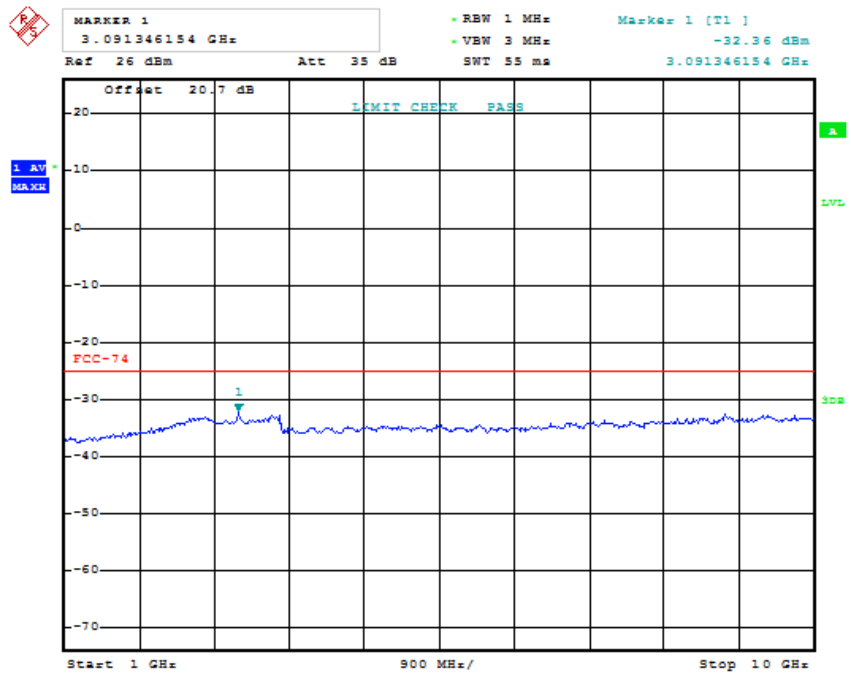
Note: The peak emission found in the 30MHz to 1GHz plots is the fundamental signal.

50 mW Power Setting:

30 MHz to 1 GHz

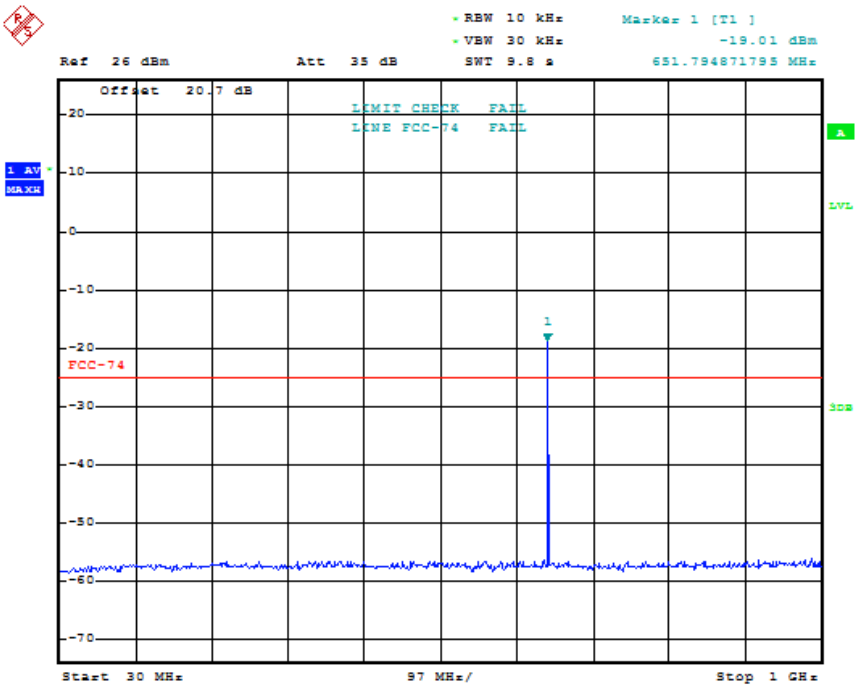


1 GHz to 10 GHz

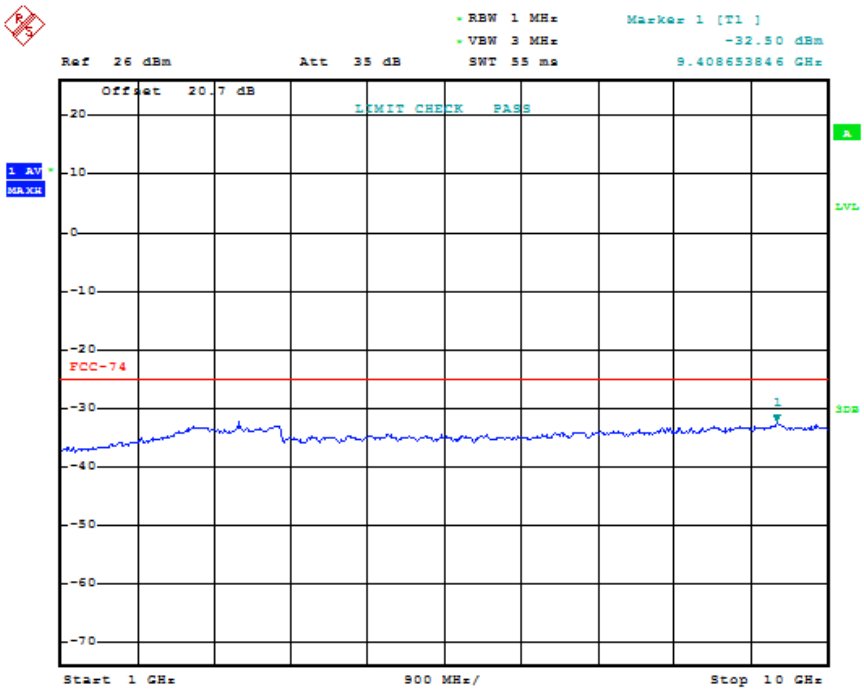


100 mW Power Setting:

30 MHz to 1 GHz



1 GHz to 10 GHz



Note: The limit line in above plots is based on IC limit; however, FCC limit line is -13 dBm. Plots comply with both FCC and IC requirements

9 FCC §74.861(e) (6) (iii) & IC RSS-210 Amend 1 §6.4.1 - Field Strength of Spurious Radiation

9.1 Applicable Standards

According to FCC §74.861 (e) (6) (iii):

On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least 43 + 10log (mean output power in watts) dB.

As per IC RSS-210 Issue 8, Amendment 1 §6.4.1:

The power of unwanted emissions (measured with a resolution bandwidth of 30 kHz) shall be attenuated below the mean output power, p-mean in dBW, of the transmitter as follows:

At least 55 + 10log (P-mean in watts) dB: on any frequency removed from the operating frequency by more than 250% of the authorized bandwidth.

9.2 Test Procedure

According to ANSI/TIA-603-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 = 10 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 level of spurious emissions.

According to RSS-Gen issue 4 Section 6.13, when the applicable unwanted emission 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 operated 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 CISPR 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	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2015-06-23	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
HP/Agilant	Pre-Amplifier	8449BOPTHO2	3008A0113	2015-05-19	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2015-03-09	2 year
HP	Pre-Amplifier	8447D	2944A06639	2015-06-08	1 year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
COM-POWER	Antenna, Dipole	AD-100	721033DB1, 2, 3, 4	2014-11-03	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	1 year
-	SMA Cable	-	C0003	-	N/A
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2015-07-11	2 year
IW Microwave	High Frequency Cable	DC-1438	SPS-2303-3840-SPS	2014-09-23	1 year

Cable and attenuator included in the test set-up were checked each time before testing.

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

9.4 Test Environmental Conditions

Temperature:	22 ºC
Relative Humidity:	46 %
ATM Pressure:	101.68 kPa

The testing was performed by Leonard Gray on 2015-8-28 at RF site.

9.5 Test Results

EUT was configured to high power setting,

Freq. (MHz)	S.A. Amp. (dBmV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)			
447.2	40.41	0	150	H	447.2	-56.8	0	0.27	-57.07	-25	-32.07
447.2	40.02	0	150	V	447.2	-56.54	0	0.27	-56.81	-25	-31.81
756.9	40.65	0	150	H	756.9	-49.99	0	0.3	-50.29	-25	-25.29
756.9	39.72	0	150	V	756.9	-50.87	0	0.3	-51.17	-25	-26.17
1307	40.12	0	150	H	1307	-74.04	7.54	0.6	-67.1	-25	-42.1
1307	47.17	0	150	V	1307	-68.52	7.525	0.6	-61.595	-25	-36.595

Note: FCC limit is -13 dBm, which is higher than the RSS limit.

10 FCC §74.861(e) (4) & IC RSS-210 Amend 1 §6.3 - Frequency Stability

10.1 Applicable Standards

According to FCC §74.861 (e) (4):

The frequency tolerance of the transmitter shall be 0.005 percent

As per IC RSS-210 Issue 8, Amendment 1 §6.3:

The frequency stability of low-power licensed radio apparatus shall comply with the limits of ±50 ppm when the frequency band is 470 MHz – 608 MHz.

10.2 Test Procedure

According to ANSI/TIA-603-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 4 Section 6.11, 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°C.

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 batter 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°C, +20°C and +50°C, and at the manufacturer's rated supply voltage; and
b) At a temperature of +20°C 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.

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2015-03-09	1 year
Tenney	Chamber, Environmental	TUJR	27445-06	2014-08-06	2 Years
KEPCO	Source, DC	25-10M	H1334526	Cal. Not Required	N/A
Mini Circuits	Precision Fixed Attenuator, 20dB	BW-S20W5+	-	-	N/A
-	SMA Cable	-	C0003	-	N/A

Cable and attenuator included in the test set-up were checked each time before testing.

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

10.4 Test Environmental Conditions

Temperature:	23 ºC
Relative Humidity:	45 %
ATM Pressure:	101.68 kPa

The testing was performed by Leonard Gray on 2015-8-26 at RF site.

10.5 Test Results

Varying temperature:

Temperature (℃)	Measured Frequency (MHz)	Channel Frequency (MHz)	Frequency Tolerance (ppm)	Limits (+/-ppm)
-20	652.0041875	652	6.42	50
-10	652.0056875	652	8.72	50
0	652.005375	652	8.24	50
10	652.0053125	652	8.15	50
20	652.006375	652	9.78	50
30	652.0059375	652	9.11	50
40	652.00525	652	8.05	50
50	652.00025	652	0.38	50

Varying supply voltage:

Temperature (℃)	Measured Frequency (MHz)	Channel Frequency (MHz)	Frequency Tolerance (ppm)	Limits (+/-ppm)
2.7 V at 20°C	652.001875	652	2.88	50
3.0 V at 20°C	652.002375	652	3.64	50
3.3 V 20°C	652.0019375	652	2.97	50