Lab Code: 200167-0

FCC PART 90
IC RSS-119, ISSUE 10, APRIL 2010

TEST AND MEASUREMENT REPORT

For

Spectra Engineering Pty Ltd.

9 Trade Road,

Malaga, WA 6090, Australia

FCC ID: OKRMX800D3V
IC: 5605A-MX800VHFV

Report Type:	**Product type:**
Original Report	VHF Radio Base Station

Test Engineer:	Dennis Huang
Report Number:	R1009097A-90
Report Date:	2010-10-06
Reviewed By:	Victor Zhang RF Lead
Prepared By: (84)	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94085, U.S.A. Tel: (408) 732-9162 Fax: (408) 732 9164

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1009097A-90	Original Report	2010-10-06

1. General Information

1.1 Product Description for Equipment under Test (EUT)

The report has been prepared on behalf of *Spectra Engineering Pty Ltd*. and their product FCC ID: OKRMX800D3V, IC: 5605A-MX800VHFV, model: MX800D3D3V or the EUT as referred to in the rest of this report. The EUT is a conventional 2-way voice VHF base station.

The EUT is a VHF Radio Transceivers that operates under FCC Part 90.

Specifications	
Frequency Bands	148-174 MHz
Modulation Type	FM
Emission Designator	F3E, F1D, F7D, F9W
RF Output Power	110 Watts
Channel Spacing	25 kHz/12.5 kHz
Power Supply	13.8 VDC Nominal
Frequency Deviation	Peak ±5 kHz (25 kHz Channel Spacing) Peak ±2.5 kHz (12.5 kHz Channel Spacing)

1.2 Mechanical Description

The EUT measures approximately 485mm (L) x 330 mm (W) x 80 mm (H) and weighs 7.48kg.

The test data gathered are from production sample, serial number: 10082541 provided by the manufacture.

1.3 Objective

This Type approval report is prepared on behalf of *Spectra Engineering Pty Ltd* in accordance with Part 90 of the Federal Communication Commissions rules and Industry Canada RSS-119 Issue 10, April 2010.

1.4 Related Submittal(s)/Grant(s)

None.

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards:TIA603-C and ANSI 63.4-2003, American National Standard for Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All emissions measurement was performed by Bay Area Compliance Laboratories Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

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 NIS 81, 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.

Detailed instrumentation measurement uncertainties can be found in BACL Corp. report QAP-018.

1.7 Test Facility

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 sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has 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 facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-C.

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

2.2 Equipment Modifications

No modifications were made to the EUT.

2.3 Internal Configuration

Manufacturer	Description	Model No.	Serial No.
Spectral Engineering Pty Ltd	Band 148-174 MHz PCB Board 1	L518 Rev A	00688W0011 OPT. T82
Spectral Engineering Pty Ltd	Band 148-174 MHz PCB Board 2	T13/T3 L538 Rev E	M13Z00753400720W 1007
Spectral Engineering Pty Ltd	Band 148-174 MHz PCB Board 3	Rev E14	XP1001000-03R
Spectral Engineering Pty Ltd	Band 148-174 MHz PCB Board 4	L053 Rev. E	00717W0022 Tx-10-08
Spectral Engineering Pty Ltd	Band 148-174 MHz PCB Board 5	L040 1005 Rev F	00710W0116 Rx-C-D3

2.4 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
-	-	-	-

2.5 Local Support Equipment Power Supply and Line Filters

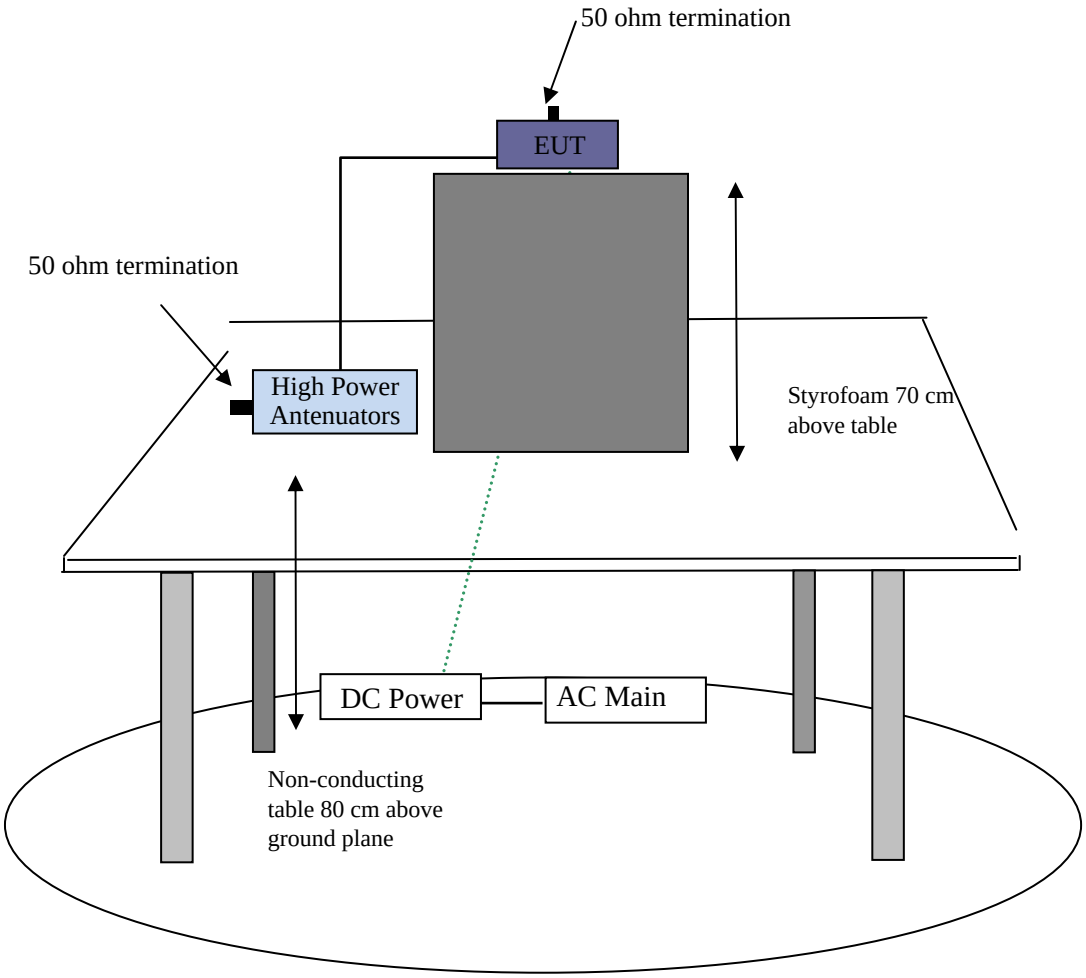
Manufacturer	Description	Model	Serial Number
Electronic Measurements Inc.	DC power supply	TCR 20S30-20V	84A-6267

2.6 Interface Ports and Cabling

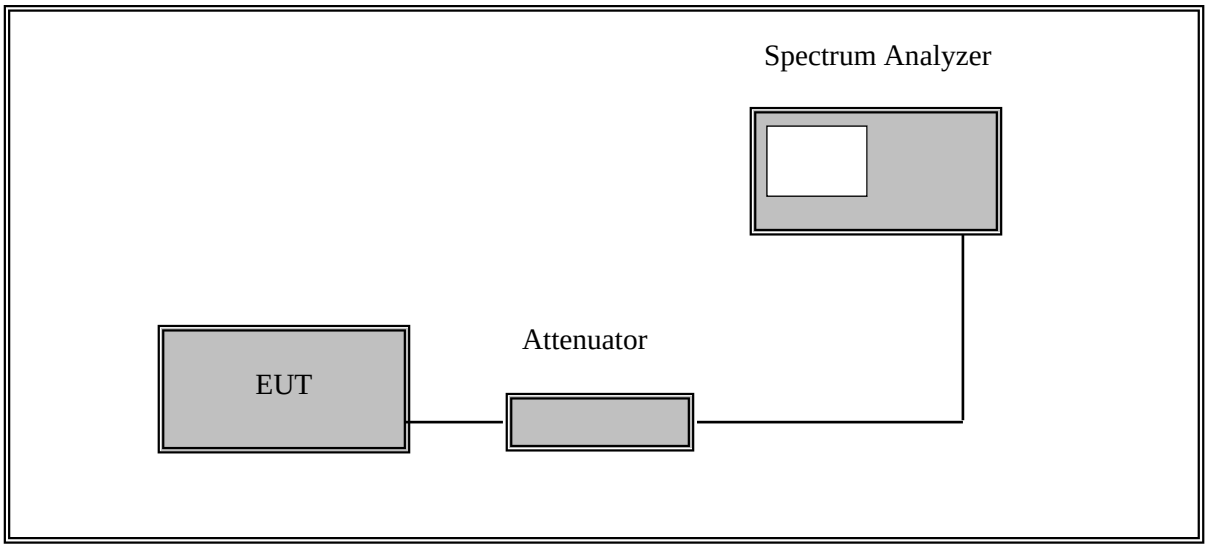
Cable Description	Length (m)	From	To
BNC Cable	< 1.0	High Power Attenuator	EUT
RF Cable	< 1.0	High Power Attenuator	PSA

2.7 Test Setup Block Diagram

Radiated Test



Conducted Test



3 Summary of Test Results

FCC and IC Rules	Description of Test	Result
FCC §1.1310, §2.1091 IC RSS-102	RF Exposure	Compliant
FCC §2.1046, §90.205 IC RSS-119 §5.4	RF Output Power	Compliant
FCC §2.1047, §90.207 IC RSS-119 §5.2	Modulation Characteristics, Audio Frequency Response and Audio Filter Response	Compliant
FCC §2.1049,§90.209/90.210 IC RSS-119 §5.5	Occupied Bandwidth and Emission Mask	Compliant
FCC §2.1051, §90.210 IC RSS-119 §5.8	Spurious Emissions at Antenna Terminals	Compliant
FCC §2.1055, § 90.213 IC RSS-119 §5.3	Frequency Stability	Compliant
FCC §2.1053, §90.210 IC RSS-119 §5.8	Field Strength of Spurious Radiation	Compliant
FCC § 90.214 IC RSS-119 §5.9	Transient Frequency Behavior	Compliant
IC RSS-119 §5.11	Receiver Spurious Emission	Compliant

4 FCC §2.1091 & IC RSS-102 - RF Exposure

4.1 Applicable Standards

FCC §2.1091

(a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,00	/	/	1	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	842/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/150	30
1500-100,000	/	/	1	30

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

Note 1 to Table 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2 to Table 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

According to IC RSS-102 Issue 2 section 4.4, RF Field Strength Limits for Controlled Use Devices (Controlled Environment).

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Time Averaging (min)
0.003 - 1	600	2.19	-	6
1 - 10	600 / f	4.9 / f	-	6
10 - 30	60	4.9 / f	-	6
30 – 300	60	0.163	10*	6
300 – 1 500	$3.54\ f^{0.5}$	$0.0094f^{0.5}$	f/30	6
1 500 – 15 000	137	0.364	50	6
15 000 – 150 000	137	0.364	50	$616000 / f^{1.2}$
150 000- 300 000	$0.354f^{0.5}$	$9.4 \times 10^{-4}\ f^{0.5}$	$3.33 \times 10^{-4}\ f$	$616000 / f^{1.2}$

Note: *f* is frequency in MHz
* = Power density limit is applicable at frequencies greater than 100 MHz

4.2 Result

Conclusion

No MPE calculation needed:

The antenna(s) used for this transmitter must be fixed-mounted on outdoor permanent structures. RF exposure compliance is addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co-location requirements of Para. 1.1307(b)(3).

5 FCC §2.1046, §90.205 & IC RSS-119 §5.4 – Conducted Output Power

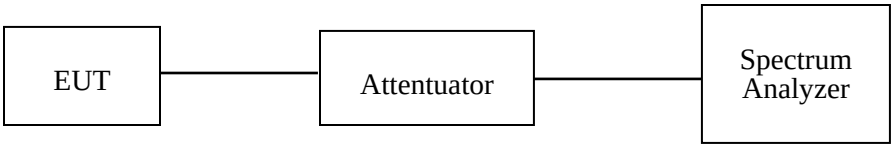
5.1 Applicable Standard

According to FCC §2.1046, and §90.205, maximum ERP is dependent upon the station's antenna HAAT and required service area.

According to IC RSS-119 §5.4, the output power should be within ± 1.0 dB of the manufacture's rated power. The power limited is specified in SRSP-501 Issue 5 2004, technical requirements for land mobile and fixed radio service operating in the bands 406.1-430MHz and 450-470MHz and SRSP-500 Issues 1 March 2004 for bands 138-144MHz and 148-174MHz.

5.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.



5.3 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Dennis Huang on 2010-09-27 ~ 2010-10-01.

5.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09

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

5.5 Test Result

Test Mode: Transmitting

148 – 174 MHz Band:

Frequency Spacing (kHz)	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
25 kHz	161	50.41	110.01
12.5 kHz	161	50.43	110.43

6 FCC §2.1047, §90.207 & IC RSS-119 §5.2 – Modulation Characteristic

6.1 Applicable Standard

FCC §2.1047 & §90.207:

(a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
(b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

IC RSS-119 §5.2

Equipment that operates in frequency bands other than 746-770 MHz and 794-800 MHz may employ any type of modulation. The type of modulation used shall be reported.

6.2 Test Procedure

Test Method: TIA/EIA-603-C 2.2.3

6.3 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Dennis Huang on 2010-09-27 ~ 2010-10-01.

6.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Agilent	Function Arbitrary Waveform Generator	33220A	MY43004878	2010-07-29
HP	RF Communication test set	8920A	3438A05338	2010-05-18

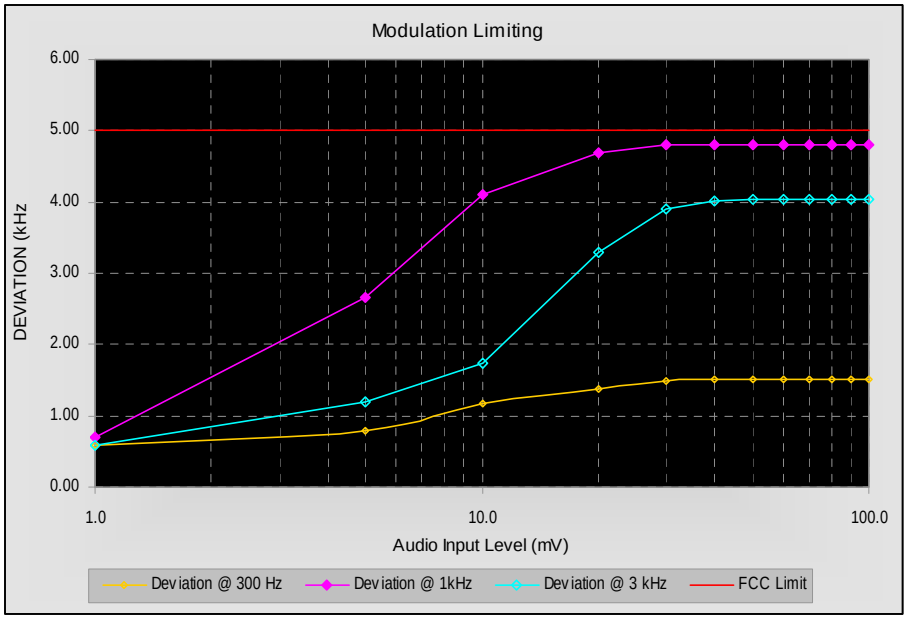
Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

6.5 Test Result

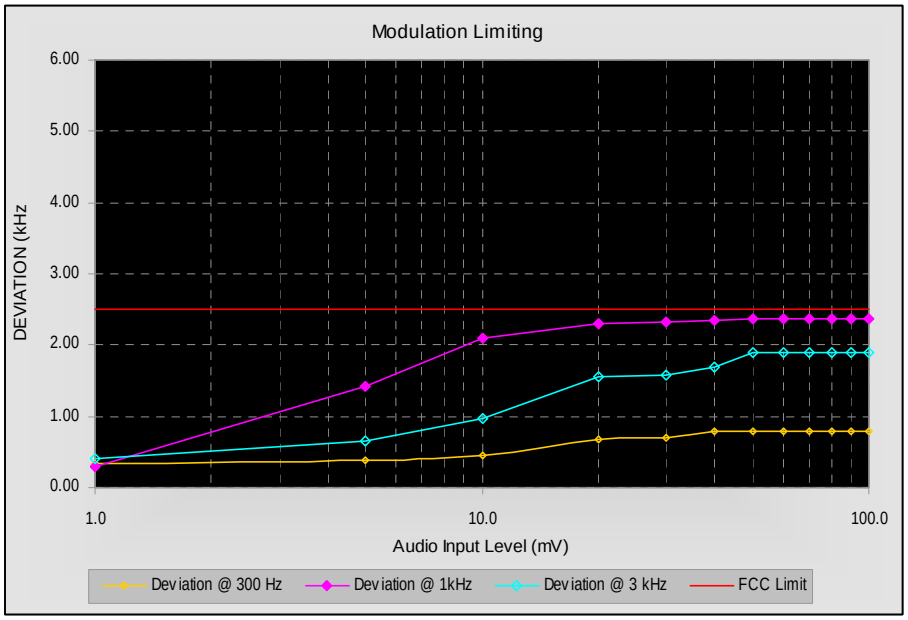
Please refer to the hereinafter plots.

Modulation Limit

Channel Spacing 25 kHz

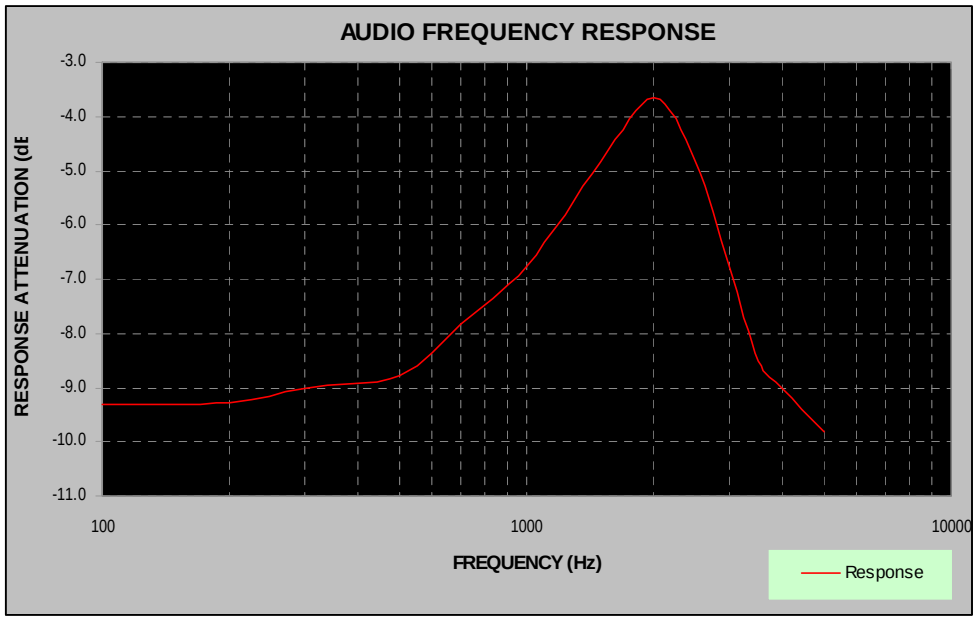


Channel Spacing 12.5 kHz

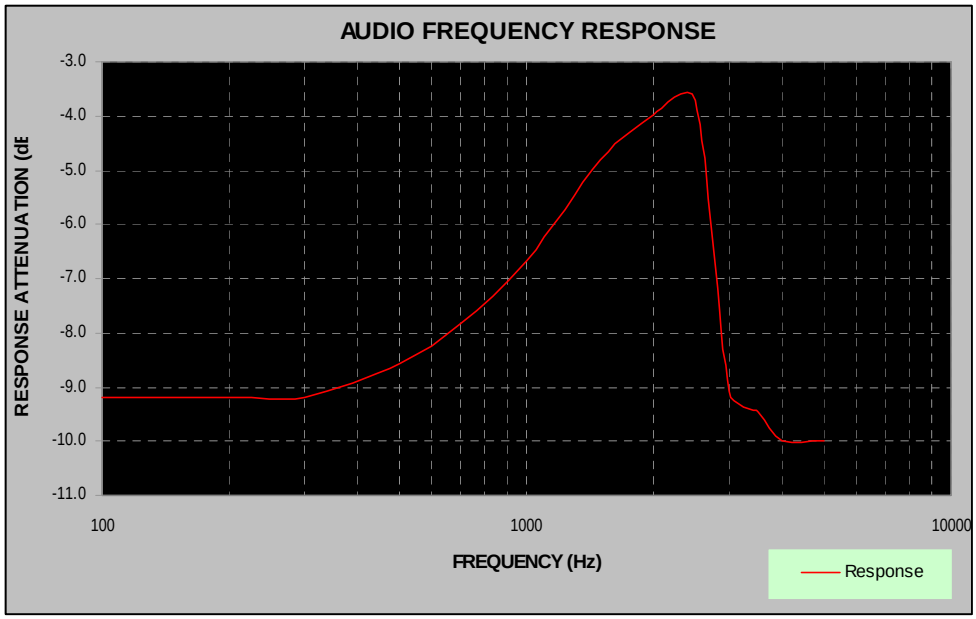


Audio Frequency Response

Channel Spacing 25 kHz

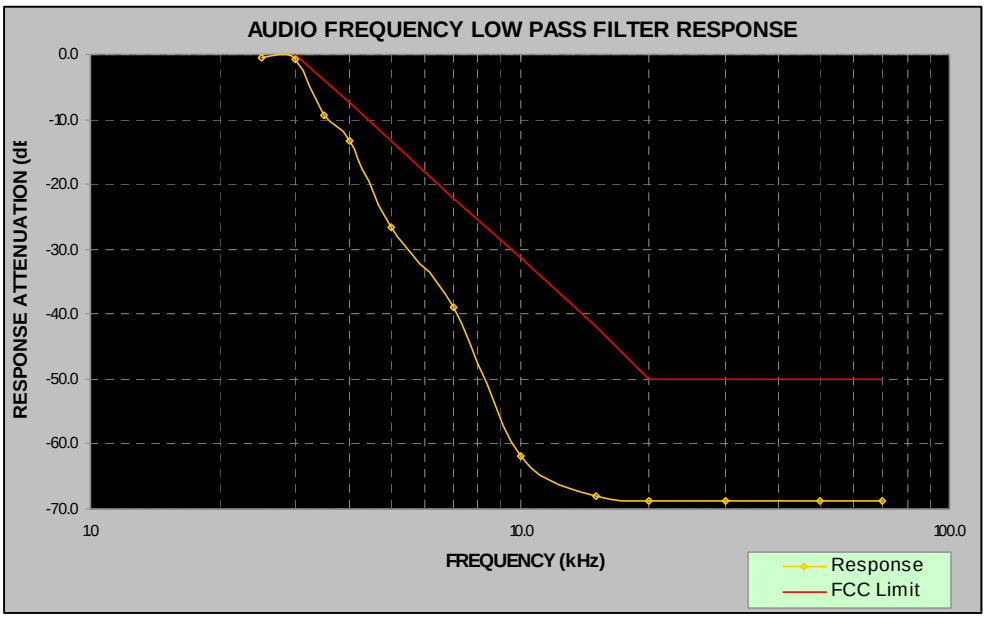


Channel Spacing 12.5 kHz

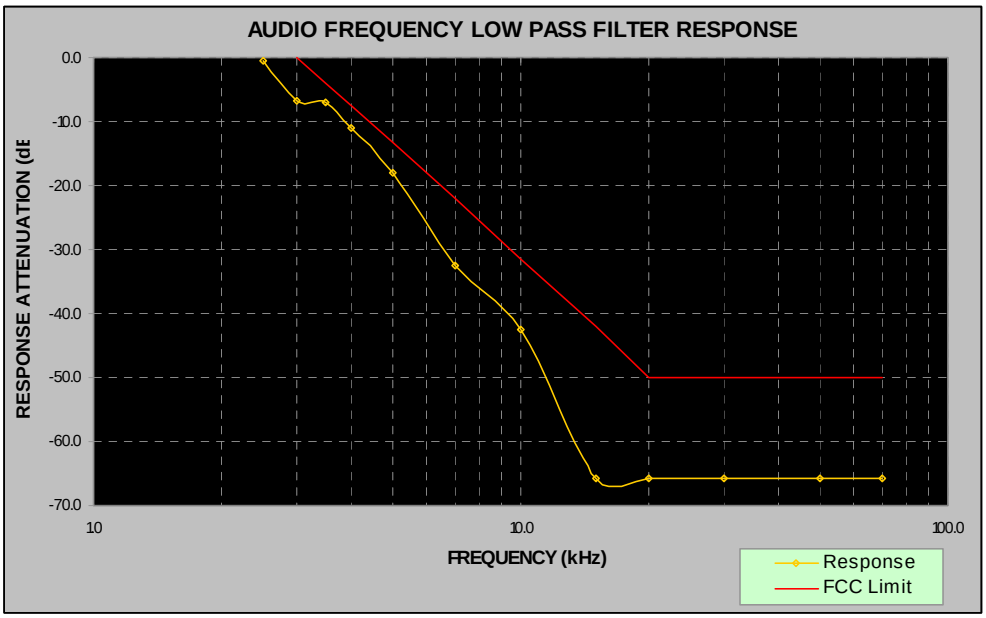


Audio Filter Response

Channel Spacing 25 kHz



Channel Spacing 12.5 kHz



7 FCC §2.1049, §90.210 & IC RSS-119 §5.5– Occupied Bandwidth & Emission Mask

7.1 Applicable Standard

FCC §90.209

Operations using equipment using a 25 kHz bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized an 11.25 kHz bandwidth.

FCC §2.1049, §90.210

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1) For any frequency removed from the center of the authorized bandwidth f_0 to 5.625kHz removed from f_0, 0dB.

2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.626kHz but no more than 12.5kHz, at least 7.27 (f_d –2.88kHz) dB.

3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5kHz at least:

50+10logP=50+10log (P) or 70 dB, whichever is the lesser attenuation.

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + log (P) dB.

The resolution bandwidth was 100Hz or greater for measuring up to 250kHz from the edge of the authorized frequency segment, and 30kHz or greater for measuring more than 250kHz from the authorized frequency segment.

IC RSS-119 §5.5

1) Within the frequency ranges 138-470 MHz, transmitters which have channel bandwidths of more than 12.5 kHz can only be authorized if the minimum spectrum efficiency of one voice channel per 12.5 kHz of channel bandwith (e.g. two voice channels per 25 kHz) is achieved.

2) When an actual or physical 25 kHz channel of a transmitter carries two voice channels, the equipment's spectrum efficiency is equivalent to one voice channel per 12.5 kHz. However, the physical channel is still 25 kHz and therefore the requirements concerning authorized bandwidth, spectrum mask, frequency stability, etc. are those for transmitter using a 25 kHz channel and not those for the equivalent 12.5 kHz.

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + log (P) dB.

The resolution bandwidth was 100Hz or greater for measuring up to 250kHz from the edge of the authorized frequency segment, and 30kHz or greater for measuring more than 250kHz from the authorized frequency segment.

7.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band ±50 kHz from the carrier frequency.

7.3 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Dennis Huang on 2010-09-27 ~ 2010-10-01.

7.4 Test Equipment List and Details

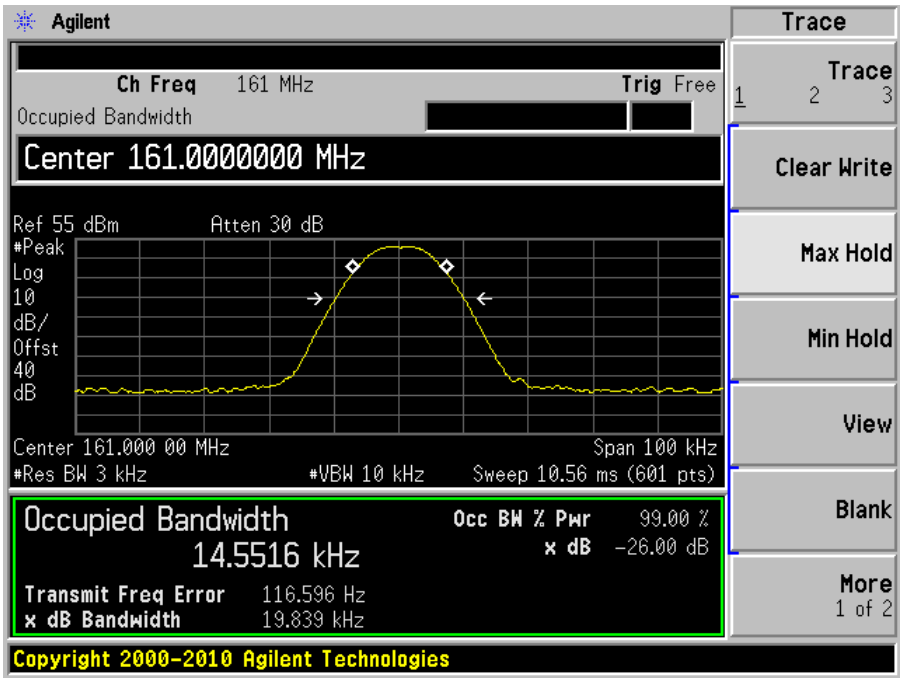
Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Agilent	Function Arbitrary Waveform Generator	33220A	MY43004878	2010-07-29
HP	RF Communication test set	8920A	3438A05338	2010-05-18

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

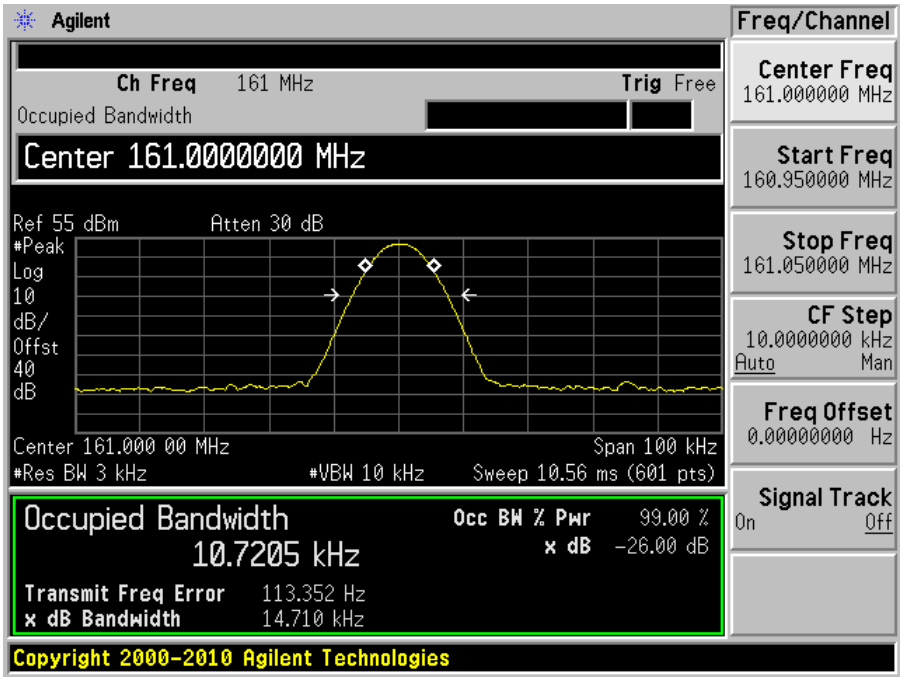
7.5 Test Result

Occupied Bandwidth

25 kHz Channel Space, Middle Channel – 161 MHz

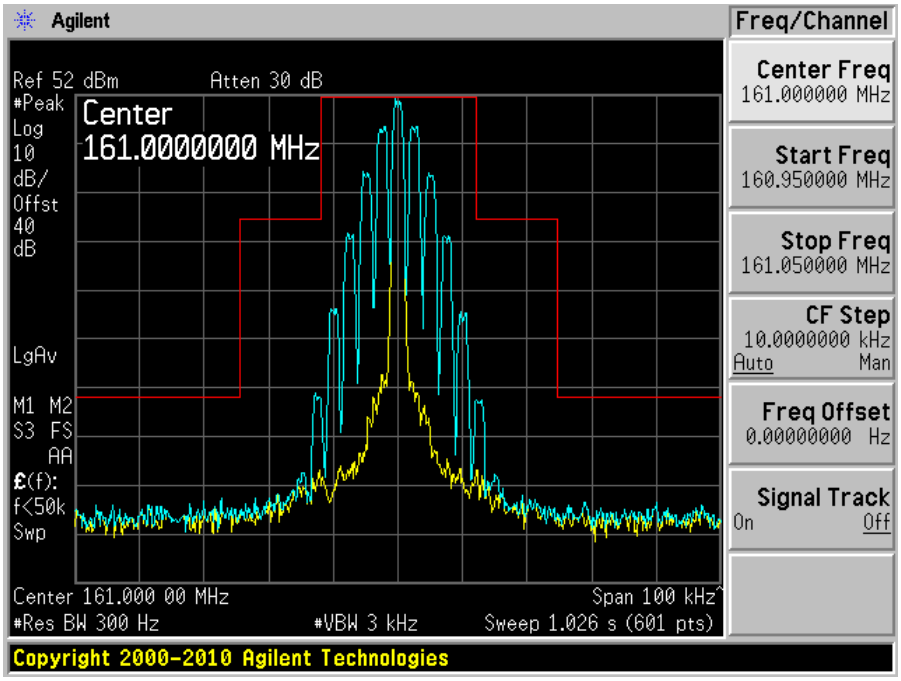


12.5 kHz Channel Space, Middle Channel – 161 MHz

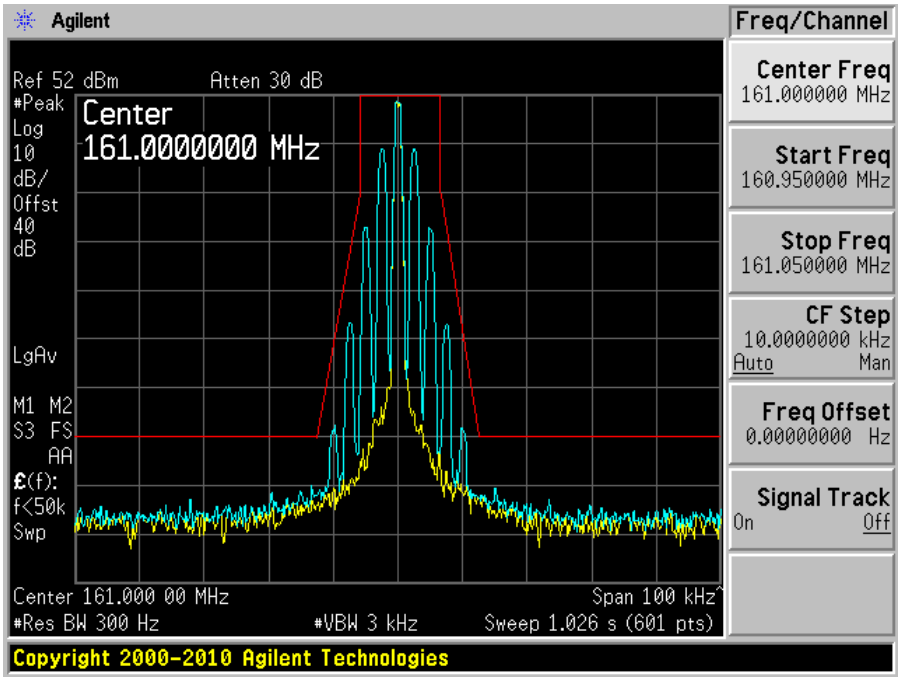


Emission Mask

25 kHz Channel Space, Middle Channel – 161 MHz



12.5 kHz Channel Space, Middle Channel – 161 MHz



8 FCC §2.1051, §90.210 & IC RSS-119 §5.8 - Spurious Emissions at Antenna Terminals

8.1 Applicable Standard

FCC §90.210 (12.5 kHz bandwidth only)

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5kHz at least:

50+10logP or 70 dB

FCC §2.1051and §90.210 (25 kHz bandwidth and 20 kHz bandwith)

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

43+10log (P)

IC RSS-119 §5.8

8.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

8.3 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Dennis Huang on 2010-09-27 ~ 2010-10-01.

8.4 Test Equipment List and Details

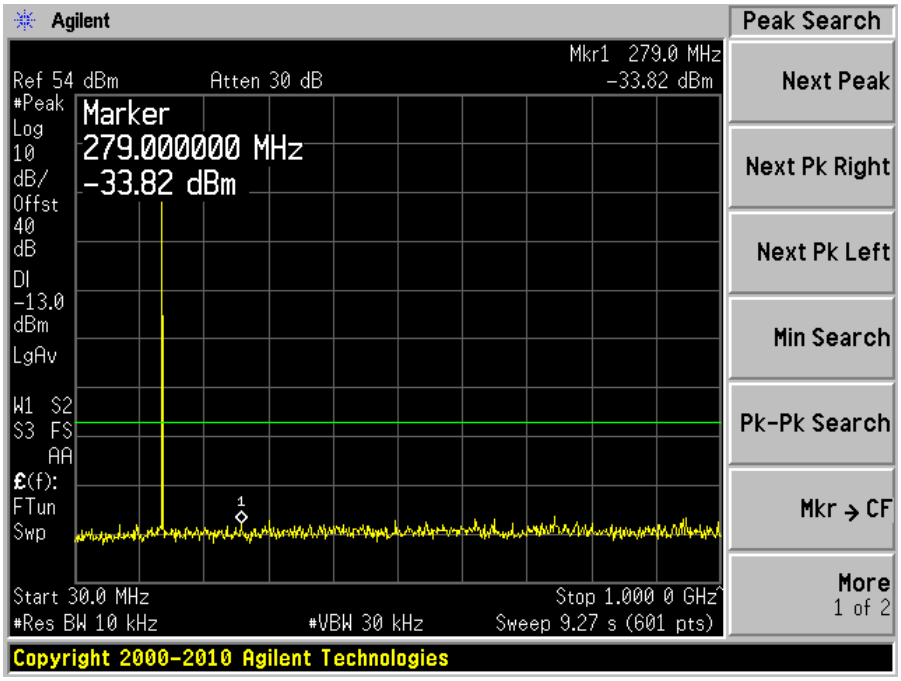
Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09

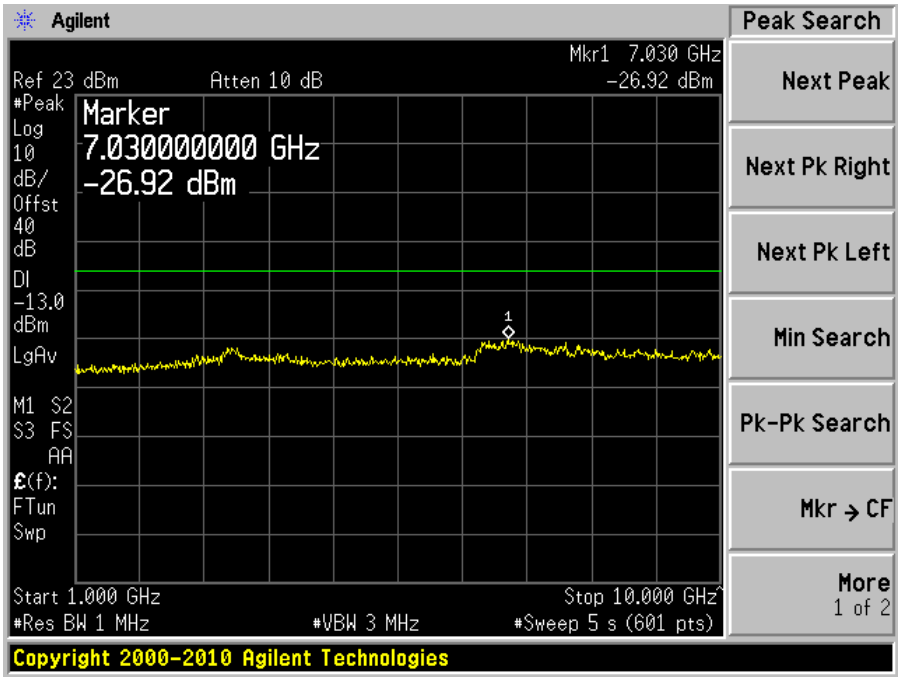
Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

8.5 Test Results

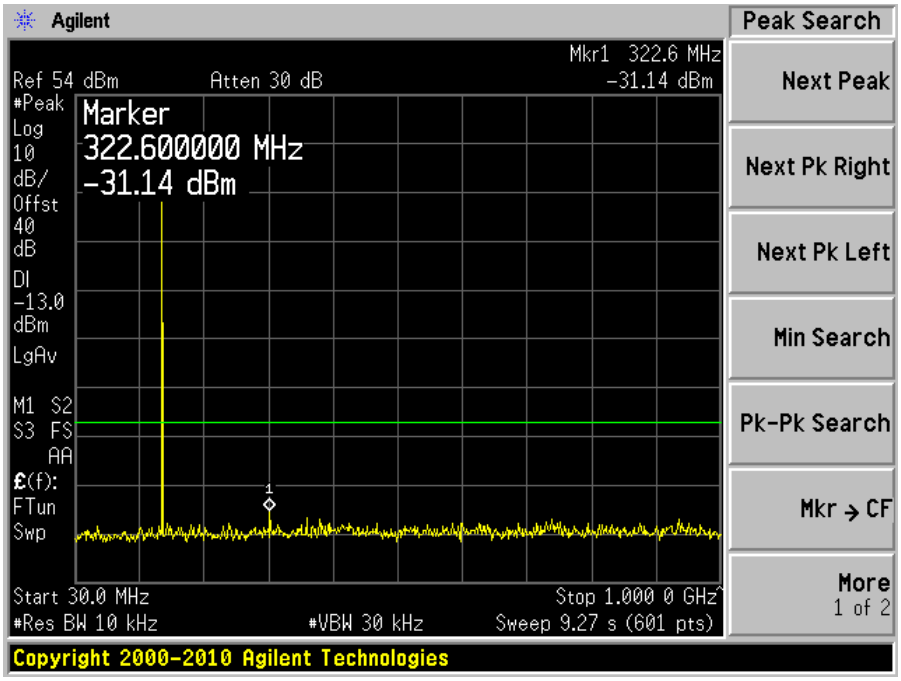
Please refer to the hereinafter plots.

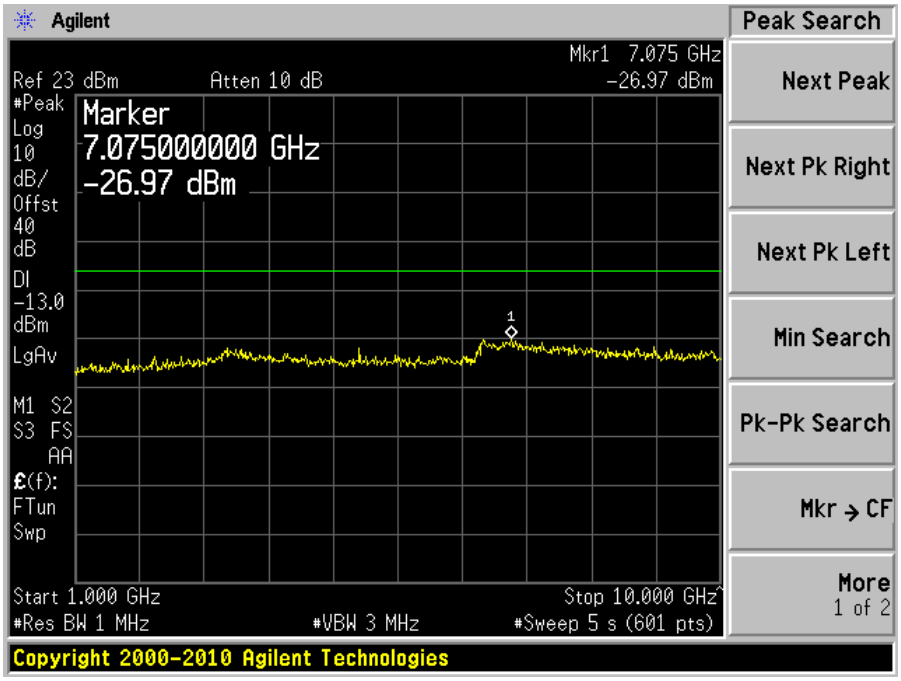
25 kHz Channel Space, Middle Channel – 161 MHz





12.5 kHz Channel Space, Middle Channel – 161 MHz





9 FCC §2.1055 (d), §90.213 & IC RSS-119 §5.3- Frequency Stability

9.1 Applicable Standard

FCC §2.1055 (d), §90.213

For output power > 2 watts, the limit is ±5.0 ppm.

In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

IC RSS-119 §5.3
Band 138MHz-174MHz: the limit is ±2.5 PPM (11.25 KHz BW) and ±5.0 PPM (20 KHz BW).
Band 406.1MHz-430MHz and 450MHz-470MHz: the limit is ±1.5 PPM (11.25 KHz BW) and ±2.5 PPM (20 KHz BW).

9.2 Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to the Spectrum Analyzer via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable DC power supply Source. The voltage was set to 110% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the end point. The output frequency was recorded for each voltage.

9.3 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Dennis Huang on 2010-09-27 ~ 2010-10-01.

9.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Electronic Measurements Inc.	DC power supply	TCR 20S30-20V	84A-6267	N/A
ESPEC	Oven, Temperature	ESL-4CA	18010	N/A

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

9.5 Test Result

25 kHz Channel Space

Frequency vs. Temperature

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (°C)				
13.8	60	161	160.99989	-0.701863354	±5
13.8	50	161	160.99987	-0.826086957	±5
13.8	40	161	160.99978	-1.347826087	±5
13.8	30	161	160.99973	-1.658385093	±5
13.8	20	161	160.99943	-3.571428571	±5
13.8	10	161	160.99936	-3.98757764	±5
13.8	0	161	160.99978	-1.347826087	±5
13.8	-10	161	160.99988	-0.732919255	±5
13.8	-20	161	160.99991	-0.559006211	±5
13.8	-30	161	160.99979	-1.329192547	±5

Frequency vs. Voltage

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (°C)				
15.18	20	161	160.99934	-4.086956522	±5
12.42	20	161	160.99925	-4.677018634	±5

12.5 kHz Channel Space

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (°C)				
13.8	60	161	160.99984	-0.98757764	± 2.5
13.8	50	161	160.99985	-0.952173913	± 2.5
13.8	40	161	160.99984	-1.004347826	± 2.5
13.8	30	161	160.99987	-0.826086957	± 2.5
13.8	20	161	160.99988	-0.776397516	± 2.5
13.8	10	161	160.99983	-1.086956522	± 2.5
13.8	0	161	161.00008	0.51552795	± 2.5
13.8	-10	161	160.99996	-0.248447205	± 2.5
13.8	-20	161	160.99991	-0.559006211	± 2.5
13.8	-30	161	160.99985	-0.931677019	± 2.5

Frequency vs. Voltage

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (°C)				
15.18	20	161	160.9995	-3.105590062	± 2.5
12.42	20	161	160.9997	-1.863354037	± 2.5

10 FCC §2.1053, §90.210 & IC RSS-119 §5.8 – Field Strength of Spurious Radiation

10.1 Applicable Standard

FCC §2.1053 (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. and §90.210(b),(d): Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

IC RSS-119 §5.8

10.2 Test Procedure

The transmitter was placed on a Styrofoam with wooden turntable, and it was normal transmitting with 50ohm termination which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

10.3 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Kevin Li 2010-09-27 ~ 2010-09-29 in 5 meter chamber #3.

10.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2010-03-24
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2010-06-16
Hewlett Packard	Pre amplifier	8447D	2944A06639	2010-06-18
A.R.A Inc	Horn antenna	DRG-1181A	1132	2009-10-27
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2010-05-0

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

10.5 Test Result

Worst Margin: -25.79 dB at 1200 MHz in the Horizontal polarization.

25 kHz Channel Space, Middle Channel – 161 MHz

		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
1200	57.8	207	1.51	V	1200	-47.93	7.53	0.5	-40.9	-13	-27.9
1200	55.14	95	1.72	H	1200	-51.65	7.53	0.5	-44.62	-13	-31.62

12.5 kHz Channel Space, Middle Channel – 161 MHz

		Azimuth degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
1200	55.8	225	1.00	V	1200	-49.93	7.53	0.5	-42.9	-13	-29.9
1200	60.97	42	1.57	H	1200	-45.82	7.53	0.5	-38.79	-13	-25.79

11 FCC §90.214 & IC RSS-119 §5.9 - Transient Frequency Behavior

11.1 Applicable Standard

FCC §90.214: Transmitters designed to operate in the 150–174 MHz and 421–512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals[1,2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	± 25.0 kHz	5.0 ms	10.0 ms
t_2	± 12.5 kHz	20.0 ms	25.0 ms
t_3[4]	± 25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	± 12.5 kHz	5.0 ms	10.0 ms
t_2	± 6.25 kHz	20.0 ms	25.0 ms
t_3[4]	± 12.5 kHz	5.0 ms	10.0 ms

As per IC RSS-119 §5.9, When a transmitter is turned on, the radio frequency may take some time to stabilize. During this initial period, the frequency error or frequency difference (i.e. between the instantaneous and the steady state frequencies) must not exceed the limits specified in Table 16.

Table 16 - Transient Frequency Behaviour

Channel Spacing (kHz)	Time Intervals1, 2	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138-174 MHz	406.1-512 MHz
25	t_1	± 25.0	5	10
	t_2	± 12.5	20	25
	t_3	± 25.0	5	10
12.5	t_1	± 12.5	5	10
	t_2	± 6.25	20	25
	t_3	± 12.5	5	10
6.25	t_1	± 6.25	5	10
	t_2	± 3.125	20	25
	t_3	± 6.25	5	10

1 t_{on}: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t1: the time period immediately following ton.
t2: the time period immediately following t1.
t3: the time period from the instant when the transmitter is turned off until toff.
toff: the instant when the 1 kHz test signal starts to rise.

2 If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t1 and t3 shall be recorded in the test report.

11.2 Test Procedure

TIA/EIA-603-C 2.2.19

11.3 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Dennis Huang on 2010-09-27 ~ 2010-10-01.

11.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
HP	Modulation Analyzer	8901A	2026A00847	2010-08-17
Tektronix	Digital Phosphor Oscilloscope	TDS7104	B020557	2010-06-11
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rohde & Schwarz	Signal Generator	SMIQ03	849192.0085.DE23746	2010-03-31

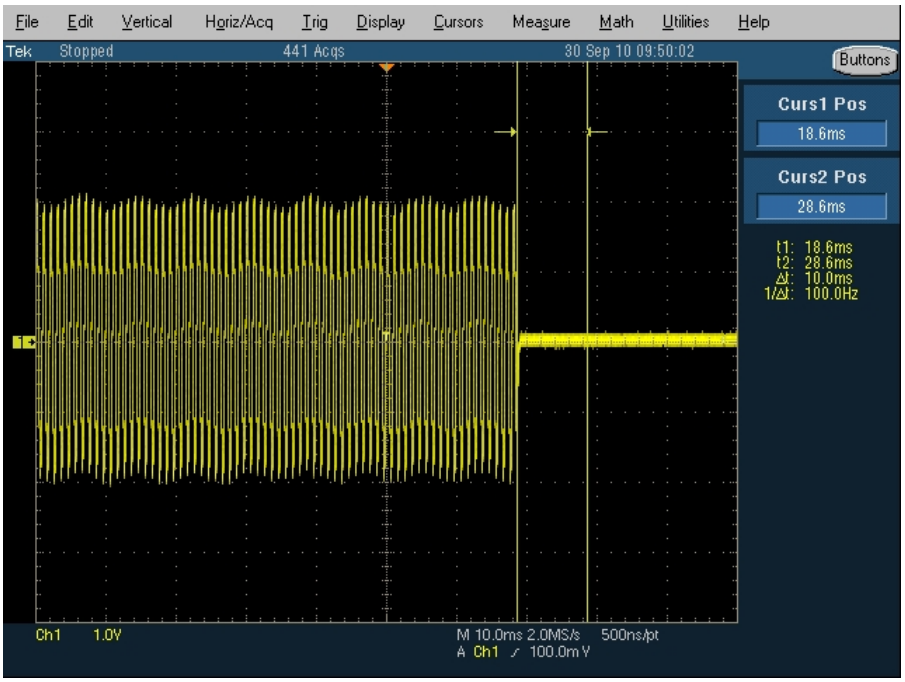
Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST

11.5 Test Results

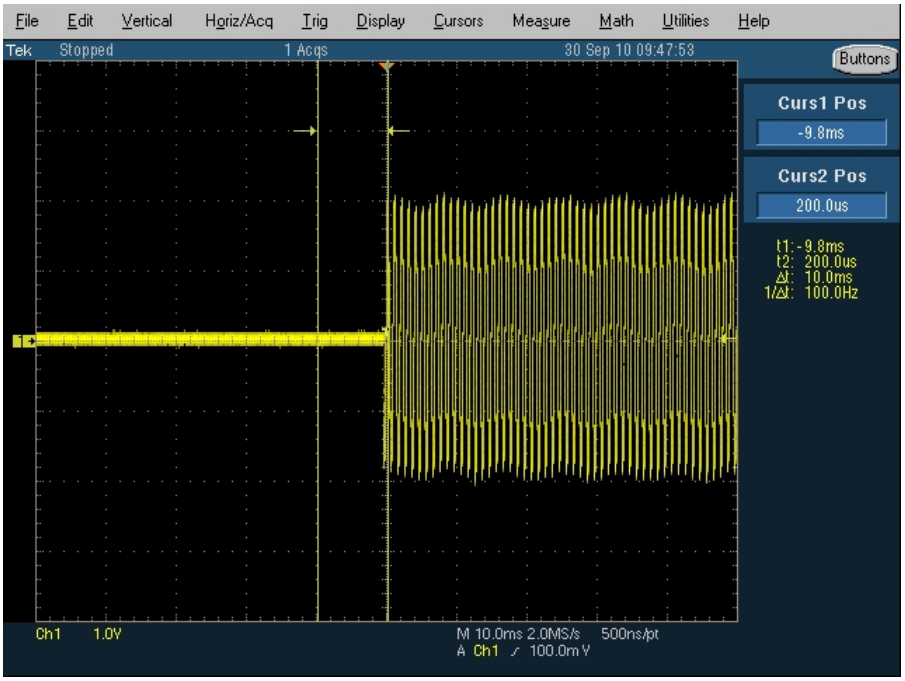
Please refer to the following plots.

25 kHz Channel Spacing

Powering Up

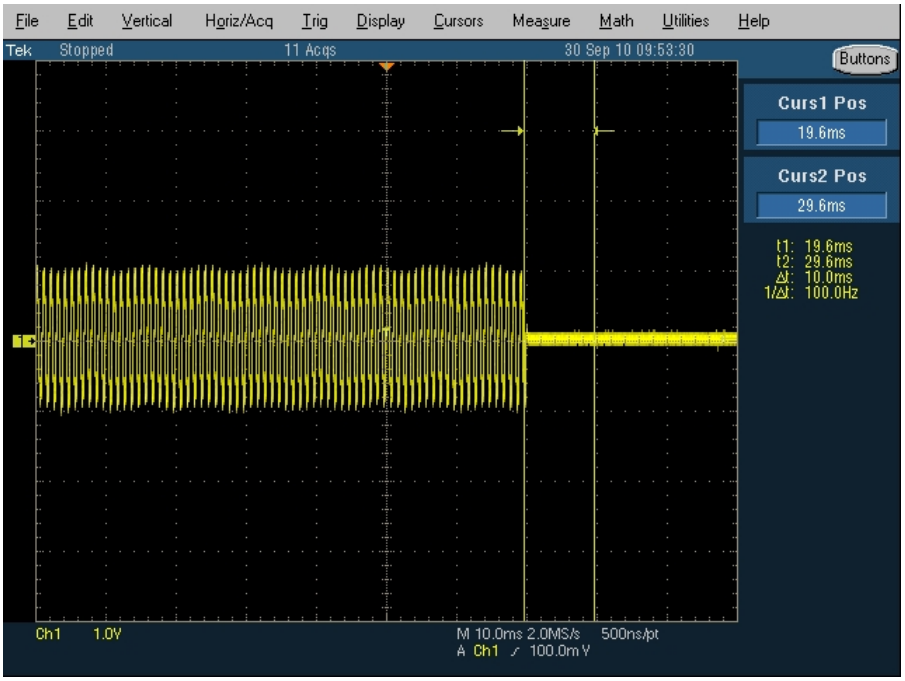


Powering Down

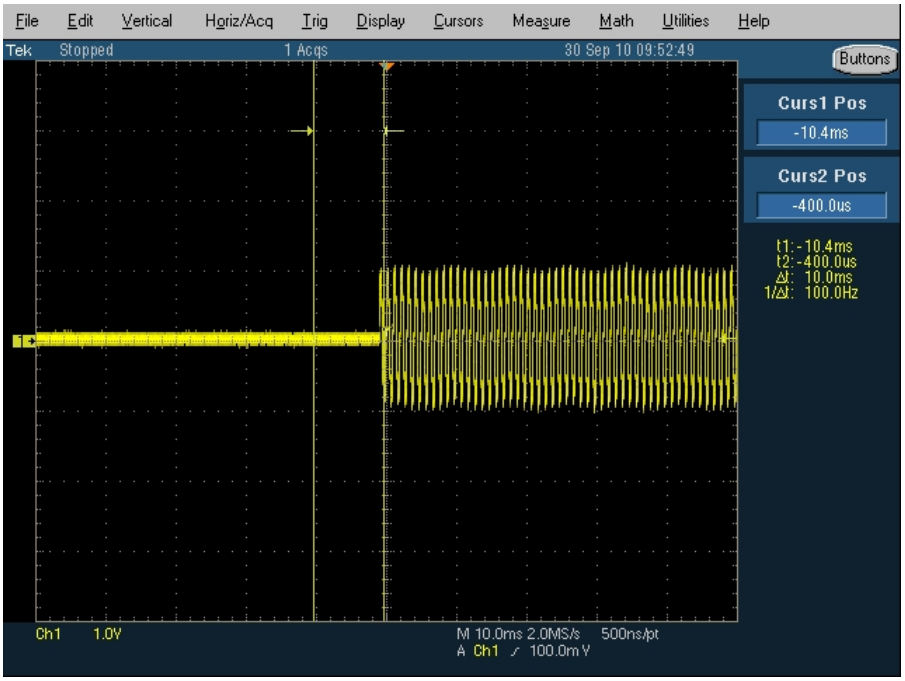


12.5 kHz Channel Spacing

Powering Up



Powering Down



12 IC RSS-119 §5.11 & RSS-Gen §6 - Receiver Spurious Radiated Emissions

12.1 Applicable Standard

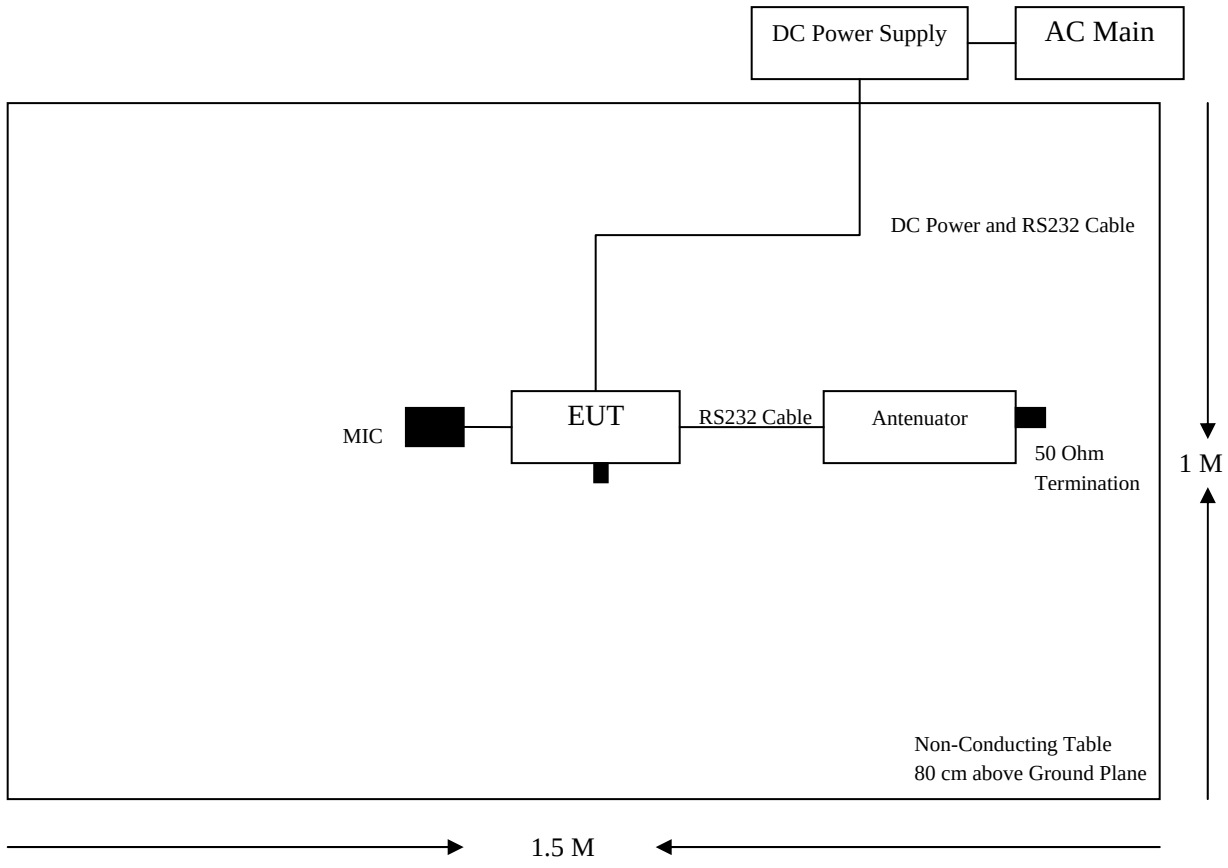
IC RSS-119 §5.11 and RSS-Gen §6

The following receiver spurious emission limits shall be complied with:
(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1.

Table 1 - Spurious Emission Limits for Receivers

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

12.2 Test Block Diagram



12.3 Test Equipment Lists and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2010-03-24
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2010-06-16
Hewlett Packard	Pre amplifier	8447D	2944A06639	2010-06-18
A.R.A Inc	Horn antenna	DRG-1181A	1132	2009-10-27
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2010-05-0

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

12.4 Test Environmental Conditions

Temperature:	24~30 °C
Relative Humidity:	30~42 %
ATM Pressure:	100.9~101.6 kPa

The testing was performed by Kevin Li 2010-09-27 ~ 2010-09-29 in 5 meter chamber #3.

12.5 Test Procedure

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

12.6 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

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

Margin = Corrected Amplitude - Limit

12.7 Summary of Test Results

According to the test data, the EUT complied RSS Gen, with the worst margins from the limit listed below:

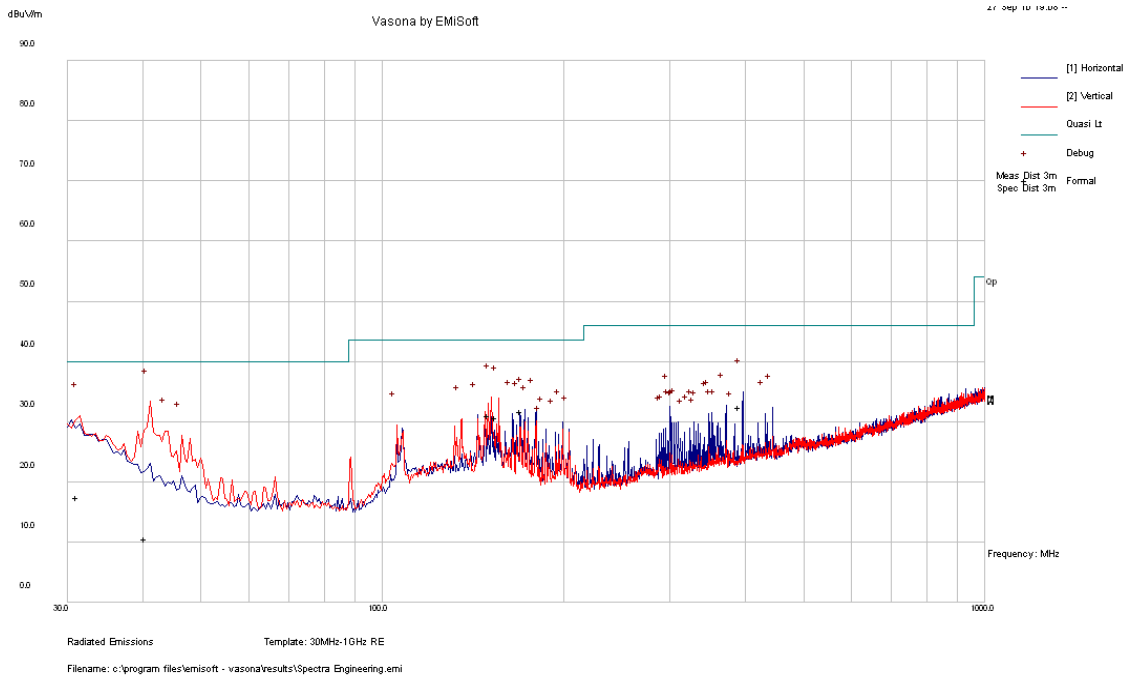
Measure at 3 Meters (30 MHz – 1 GHz)

Model: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Test Range**
-11.8	172.032	Horizontal	30 MHz-1 GHz
-	-	-	1 GHz – 6 GHz *

*Note: *All Emissions above 1GHz were on the noise floor level and/or 20 dB under the limit.*

12.8 Radiated Spurious Emissions Plot & Data

1) 30~1000 MHz, Measured at 3 Meter:



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
40.98436	10.55	116	V	142	40.0	-29.45
31.50060	17.51	331	V	188	40.0	-22.49
151.97450	31.00	109	V	173	43.5	-12.50
156.0023	30.71	97	V	193	43.5	-12.79
395.97320	32.45	95	H	85	46.0	-13.55
172.03200	31.70	180	H	219	43.5	-11.8

2) 1 – 6 GHz, Measured at 3 Meter:

Frequency (MHz)	Averge (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
-	-	-	-	-	-	Note[1]

Note[1]: All emissions were on the noise floor level and/or 20 dB below the limit.