Lab Code: 200167-0

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

TEST AND MEASUREMENT REPORT

For

Midland Radio Corporation

5900 Parretta Drive,
Kansas City, MO 64120, USA

FCC ID: MMASD250U2
IC: 3690A-SD250U2
Model: SD250U2

Report Type:	**Product type:**
Original Report	UHF Data Radio

Test Engineer:	Jack Liu
Report Number:	R1008023-90
Report Date:	2010-09-03
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 www.baclcorp.com

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1008023-90	Original Report	2010-09-03
1	R1008023-90	Update typo	2010-09-14

1. General Information

1.1 Product Description for Equipment under Test (EUT)

The report has been prepared on behalf of Midland Radio Corporation and their product FCC ID: MMASD250U2, IC: 3690A-SD250U2, model: SD250U2 or the EUT as referred to in the rest of this report. The EUT is a network free, point to point RF data module that offers great flexibility in varied applications where wireless data or voice communication is needed. It can be used as a transparent radio, with no internal modem fitted, to allow users to facilitate the use of their own modem and protocol. The correct signal levels need to be used with the use of separate control lines, see the pin out table below.

The EUT can also be fitted with below a few different modems
• Bell 202/V23 modem (1200 baud rate)
• FFSK modem (4800 baud rate)
• GMSK modem (9600 baud rate)

The internal modem allows communication with a pc using RS 232 for the data and control lines. For further details, please refer to the modem manual. EUT has standard radio features available which are associated with a private radio. This includes CTCSS and DCS, software controlled squelch, time out timer options and busy channel lockout as listed below (not all available with option modem fitted). There is a microphone input and speaker output to allow speech to be transmitted and received.

The EUT is a UHF Radio Transceiver that operates under FCC Part 90.

Specifications	
Frequency Band	440–480 MHz
Modulation Type	F1D, F2D, F3E
RF Output Power	1.0 -6.0 Watts
Channel Spacing	25 kHz/12.5 kHz
Number of Channels	16
Power Supply	12 VDC Nominal (9 – 18 volt supply input)
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 117mm (L) x 62 mm (W) x 30 mm (H) and weighs 253 g.

** The test data gathered are from production sample, serial number: R1008023-1 provided by the BACL.*

1.3 Objective

This Type approval report is prepared on behalf of *Midland Radio Corporation* 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 $\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.

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 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
IBM	Laptop	T41	00416
Dell	Laptop	PP18L	17899297525
Midland Radio	SD250 Test JIG	ACC-2160	-

2.4 Internal Configuration

Manufacturer	Description	Model No.	Serial No.
Midland Radio	RF Board	SD250 UHF RF B'D Ver 1.0	-
Midland Radio	Digital Board	SD250 Digital B'D Ver 1.0.0A	-

2.5 Local Support Equipment Power Supply and Line Filters

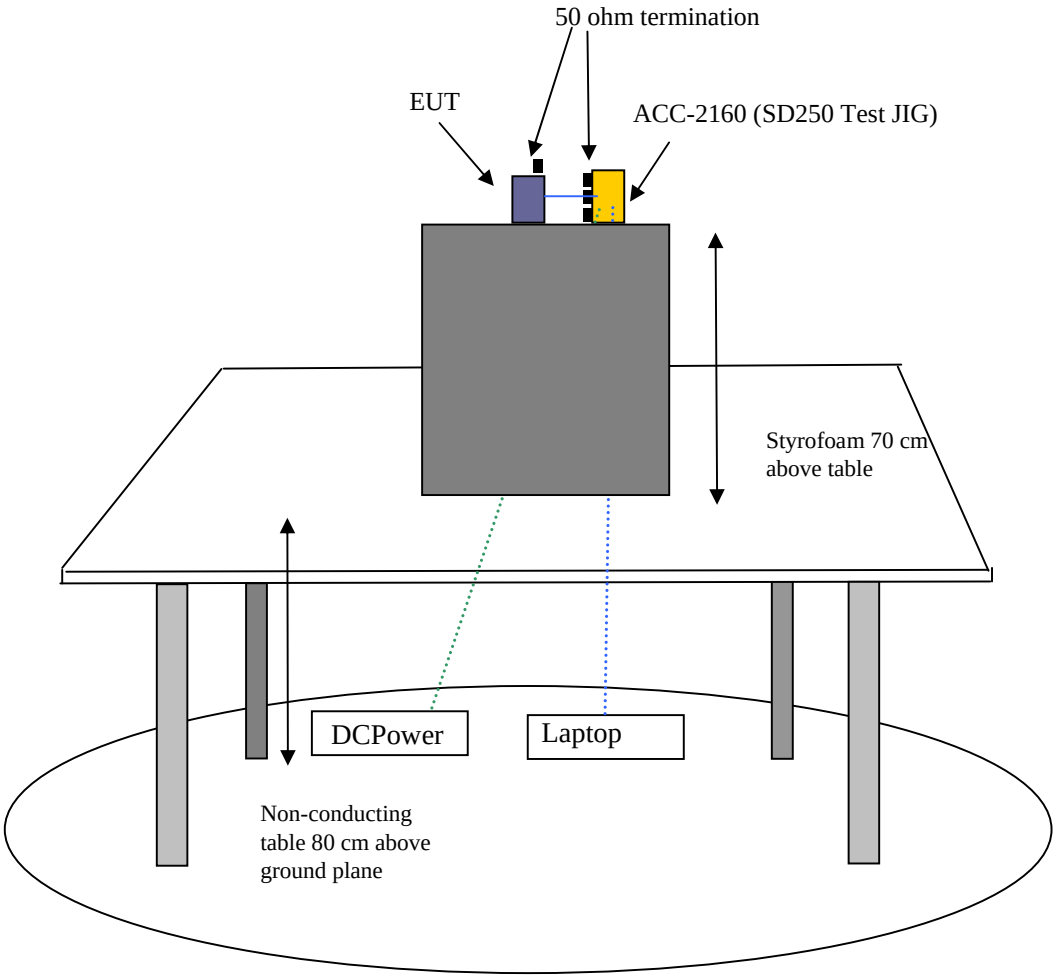
Manufacturer	Description	Model	Serial Number
BK PRECISION	DC power supply	1612A	D185052265

2.6 Interface Ports and Cabling

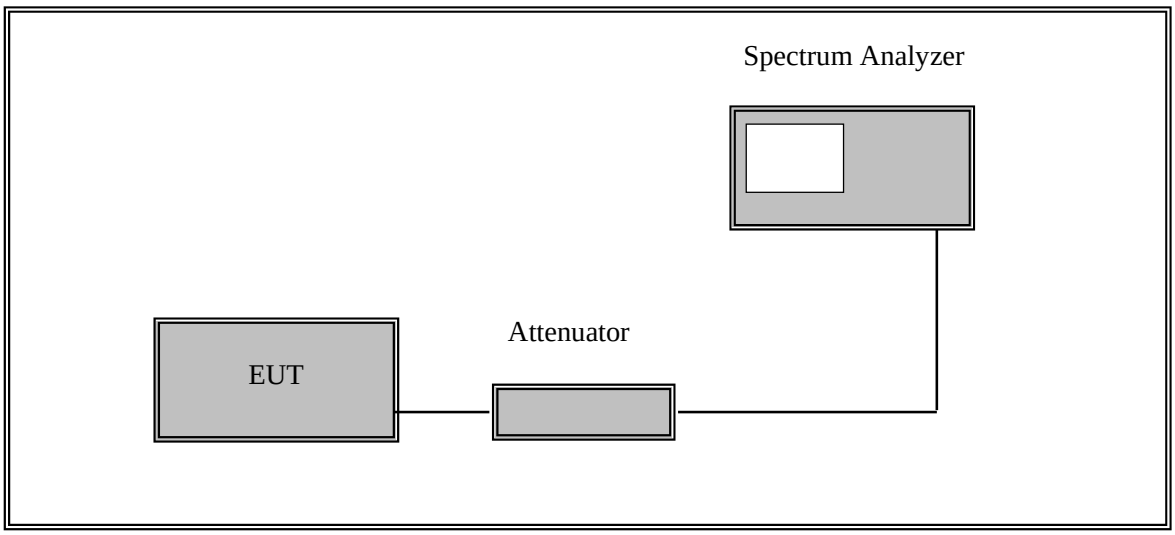
Cable Description	Length (m)	From	To
Serial cable	>1.0	ACC-2160 (SD250 Test JIG)	EUT Serial Port
Serial cable	>1.0	PC Serial Port	EUT Serial Port

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, §22.355, § 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

Antenna:

The manufacturer does not specify an antenna. A typical vehicle antenna has a gain of 6 dBi was used with this device.This device has provisions for operation in a vehicle, or a fixed location.

Operating Cionfiguration and exposure conditions:

Device category: Mobile per Part 2.1091

Environment: Controlled Exposure

Typical use qualifies for a maximum duty cycle factor of 50%. The manufacturer also markets this device only for occupation use.

- Vehicle Operation: A typical vehicle installation consists of an antenna system with a coaxial cable of the type RG 58 which has a loss of 1 dB for a length of 15 feet.

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

Maximum peak output power at antenna input terminal (dBm):	37.75
Maximum peak output power at antenna input terminal (mW):	5956.6
Prediction distance (cm):	25
Prediction frequency (MHz):	460.075
Maximum Antenna Gain, typical (dBi):	6.0
Maximum Antenna Gain (numeric):	3.98
Cable Loss (dB):	1.0
Power density of prediction frequency at 25 cm (W/m^2):	11.998
Power density of prediction frequency at 25 cm (mW/cm^2):	1.1998
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	15.34
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.534

Note: The conducted power output is 5.956 watt, the coax loss was taken as 1 dB, and Antenna gain was taken as 6 dBi, 50% talk time in 6 minutes

Conclusion

The device complies with the MPE requirements by providing a safe separation distance of 25 cm between the antenna, including any radiating structure, and any persons when normally operated.

Proposed RF exposure safety information to include in User's Manual:

"FCC RF Exposure Requirements":

CAUTION:

The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This device is approved with emissions having a source-based timeaveraging duty factor not exceeding 50%.

Vehicle – Antenna Installation:

- Antennas used for this transmitter must not exceed an antenna gain of 6 dBi
- For rear deck trunk and roof top installations, the antenna must be located at least 25 cm away from rear-seat passengers and bystanders in order to comply with the FCC RF exposure requirements.

The following label will be mounted in conspicuous view on the radio.

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. And 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.

5.2 Test Procedure

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

Spectrum Analyzer Setting:

RBW	Video BW
100 kHz	300 kHz

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 Jack Liu on 2010-08-20 ~ 2010-08-25.

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

High Power

Frequency Spacing (kHz)	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
25 kHz	440.075	36.81	4.79
25 kHz	460.075	37.62	5.78
25 kHz	479.975	37.57	5.71
12.5 kHz	440.075	36.98	4.99
12.5 kHz	460.075	37.75	5.96
12.5 kHz	479.975	37.48	5.60

Low Power

Frequency Spacing (kHz)	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
25 kHz	440.075	29.20	0.83
25 kHz	460.075	30.69	1.17
25 kHz	479.975	31.24	1.33
12.5 kHz	440.075	29.22	0.83
12.5 kHz	460.075	30.70	1.17
12.5 kHz	479.975	31.22	1.32

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 Jack Liu on 2010-08-20 ~ 2010-08-25.

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.

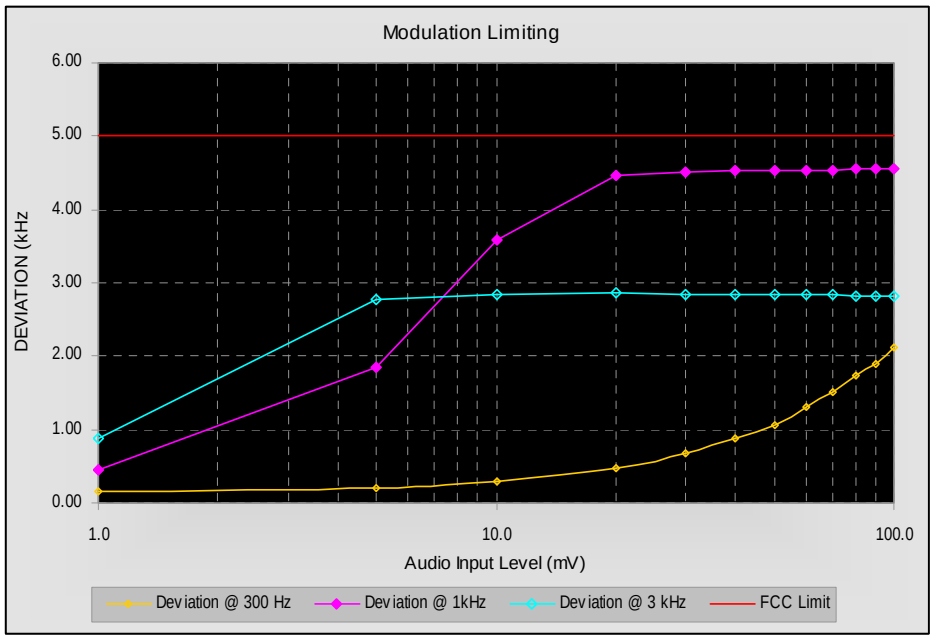
6.5 Test Result

Please refer to the hereinafter plots.

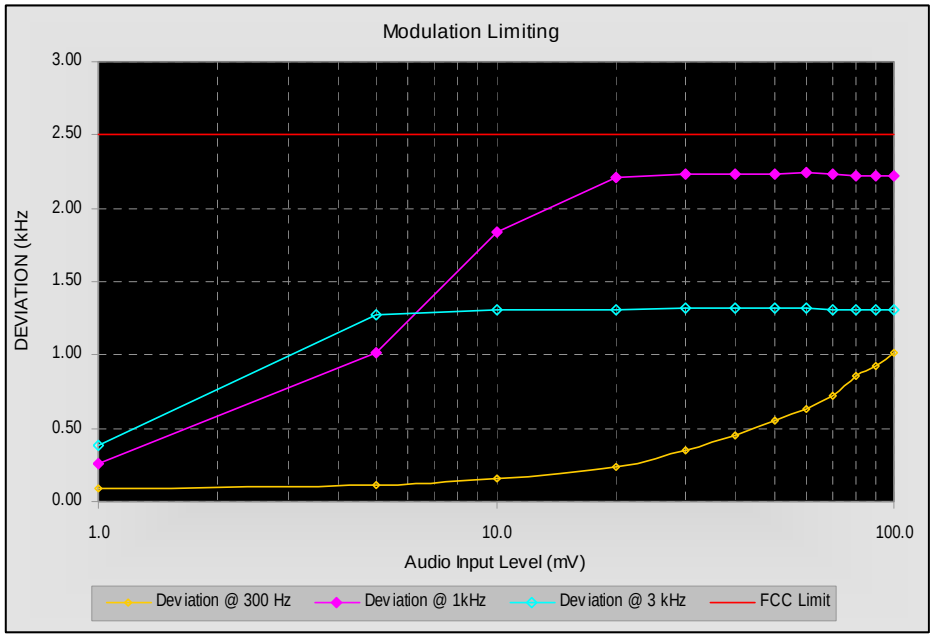
Modulation Limit for SD-250U2

High Power

Channel Spacing 25 kHz

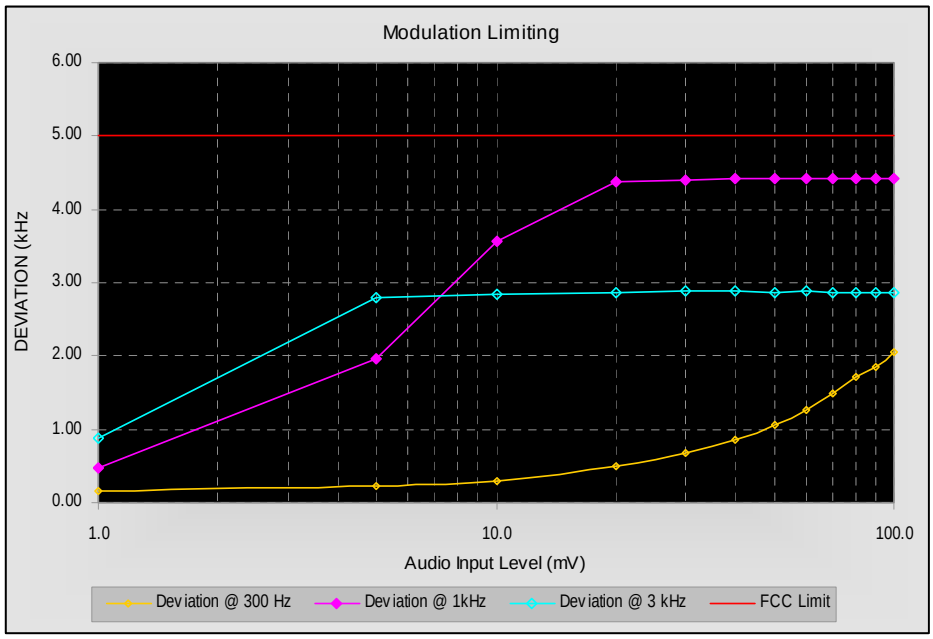


Channel Spacing 12.5 kHz

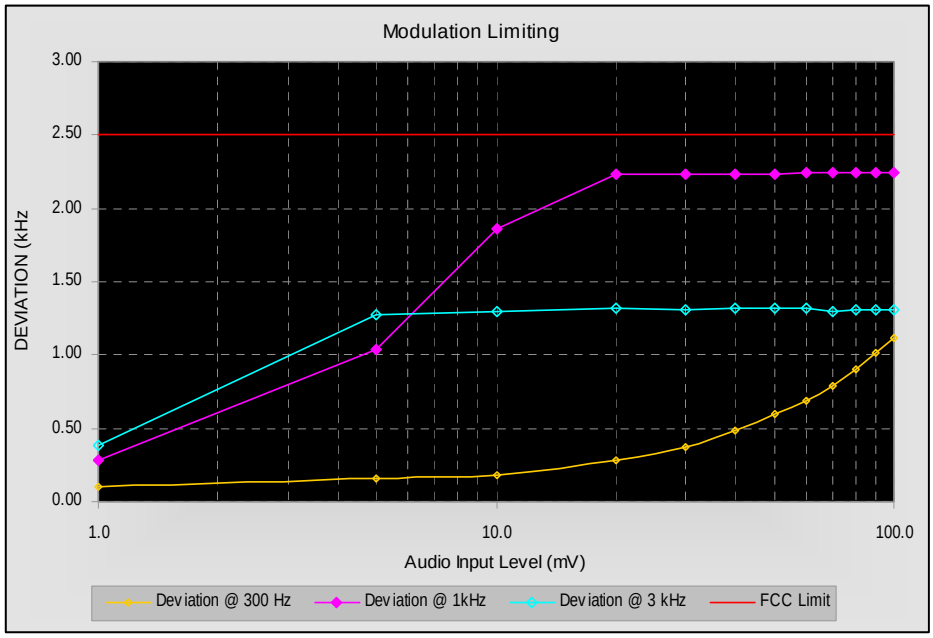


Low Power

Channel Spacing 25 kHz

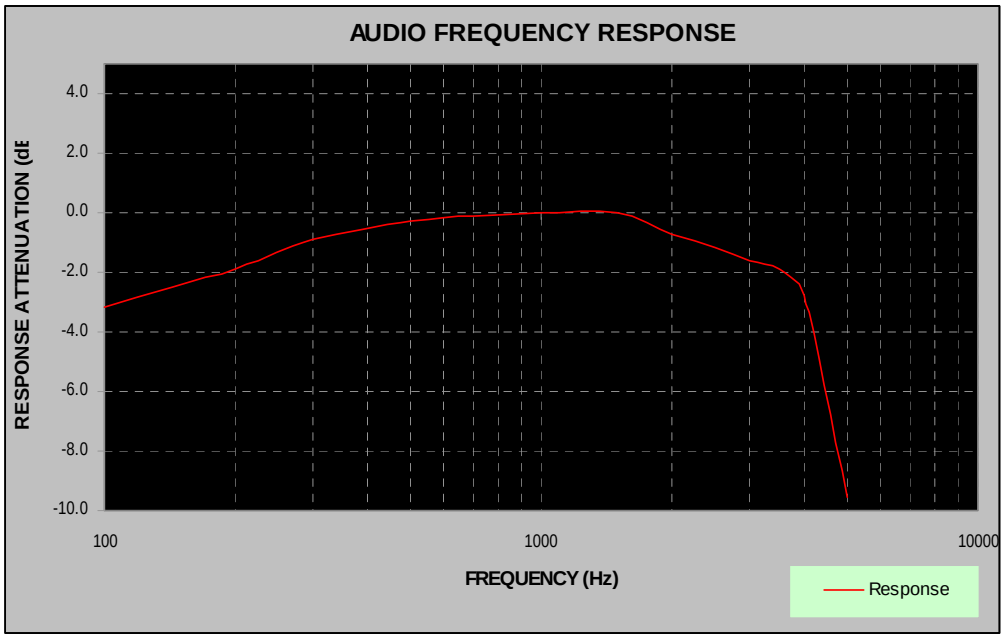


Channel Spacing 12.5 kHz

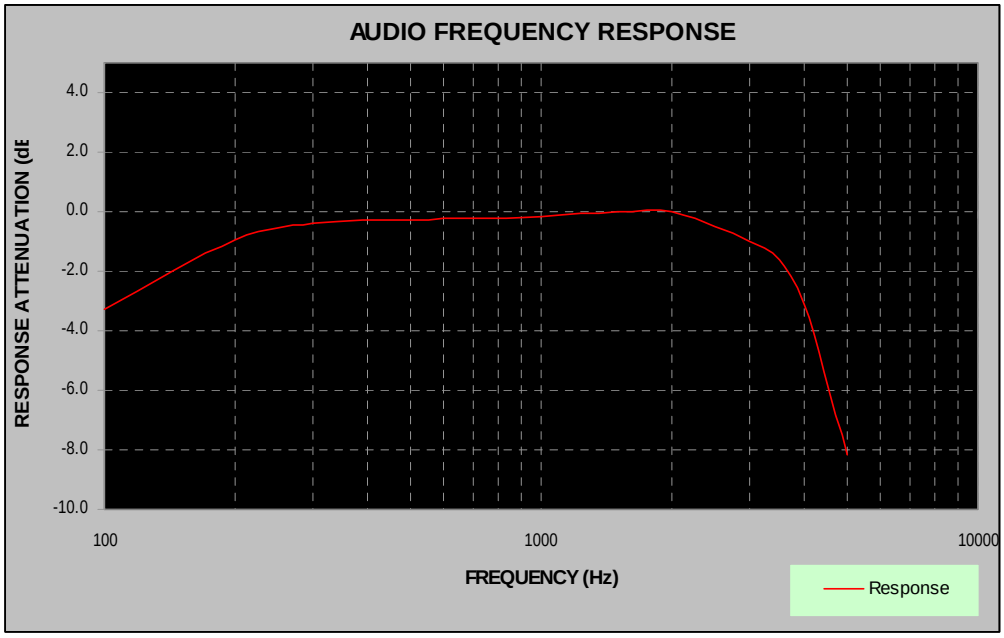


Audio Frequency Response

Channel Spacing 25 kHz

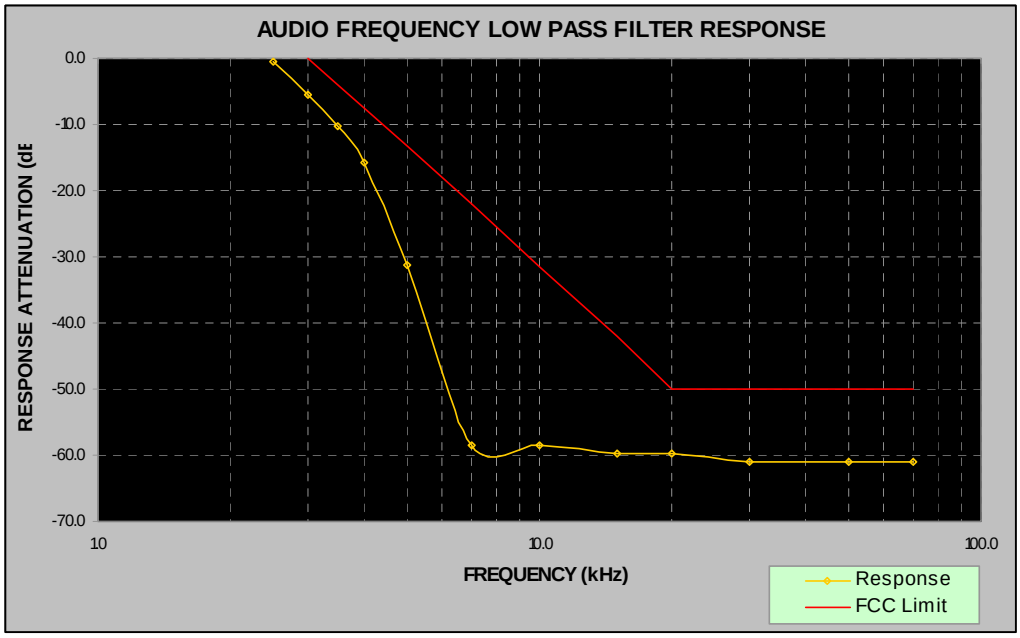


Channel Spacing 12.5 kHz

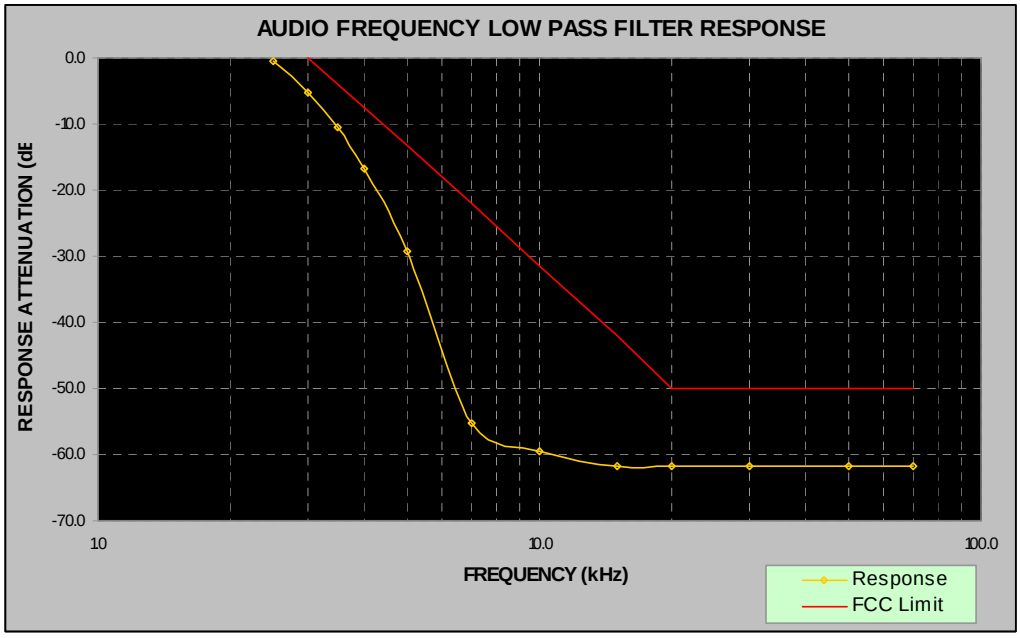


Audio Filter Response

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 100 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 Jack Liu on 2010-08-20 ~ 2010-08-25.

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

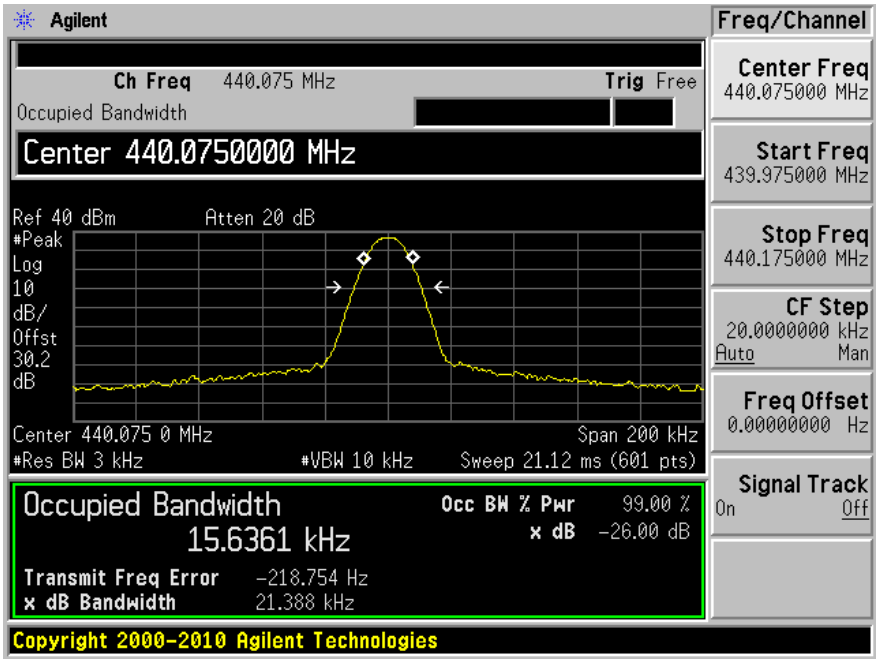
Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

7.5 Test Result

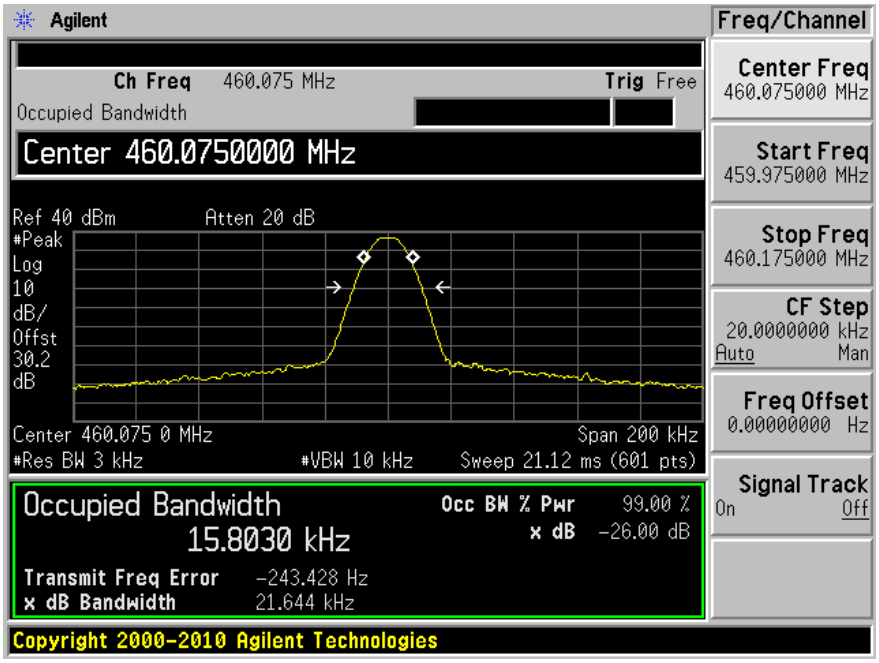
Occupied Bandwidth

High Power Audio (25 kHz)

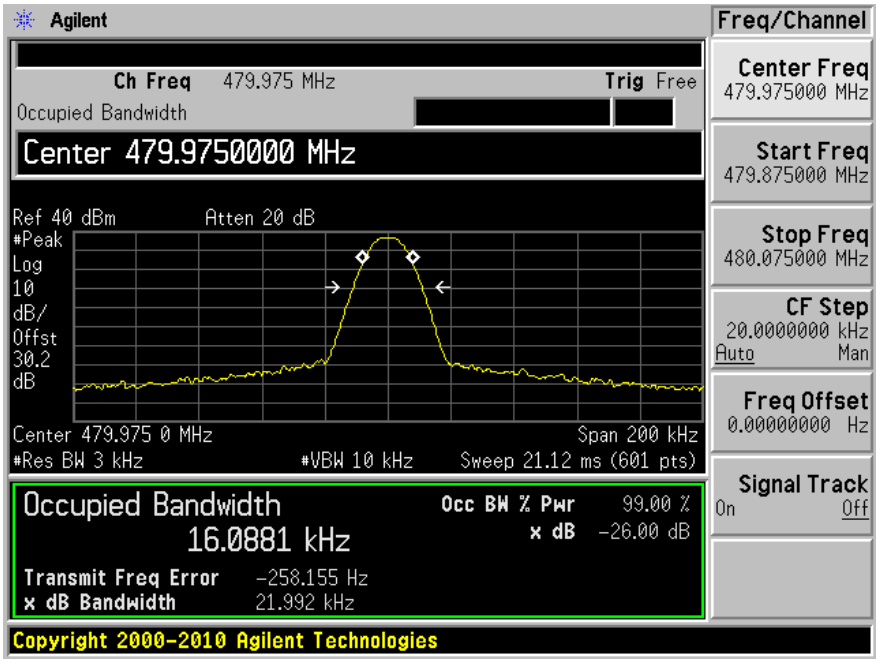
Low Channel – 440.075 MHz



Middle Channel – 460.75 MHz

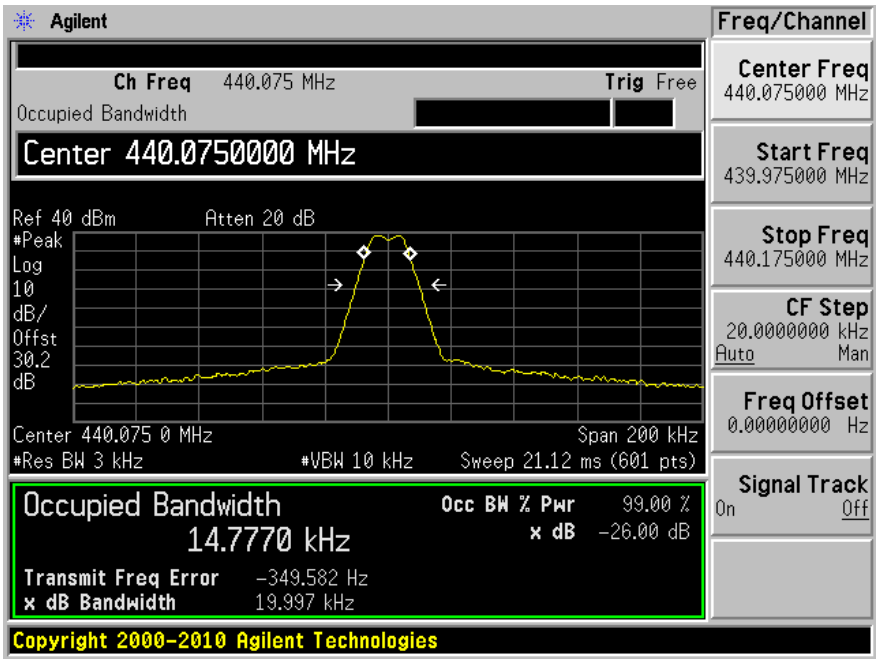


High Channel – 479.975 MHz

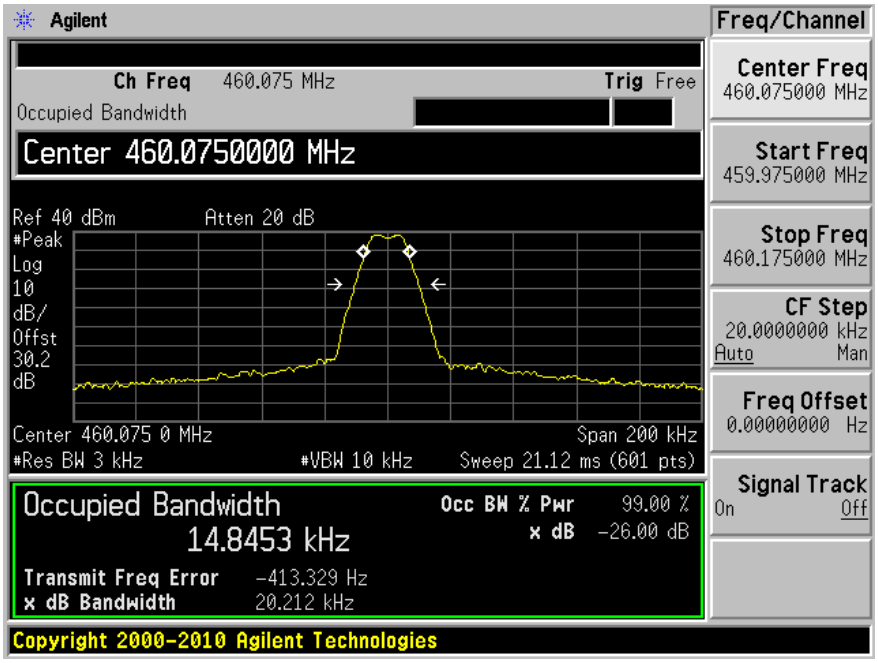


High Power Data (25 kHz)

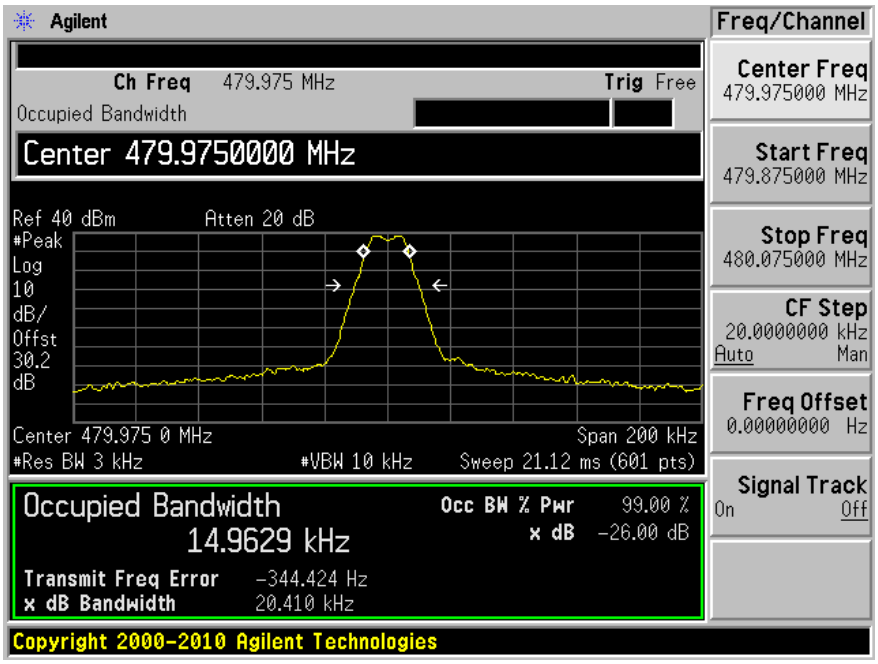
Low Channel - 440.75 MHz



Middle Channel - 460.075 MHz

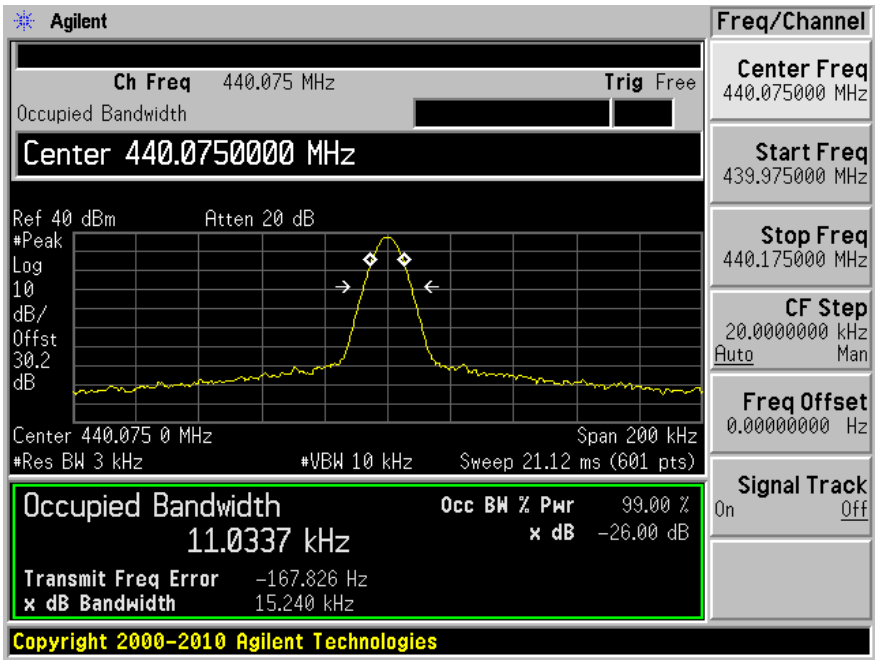


High Channel – 479.975 MHz

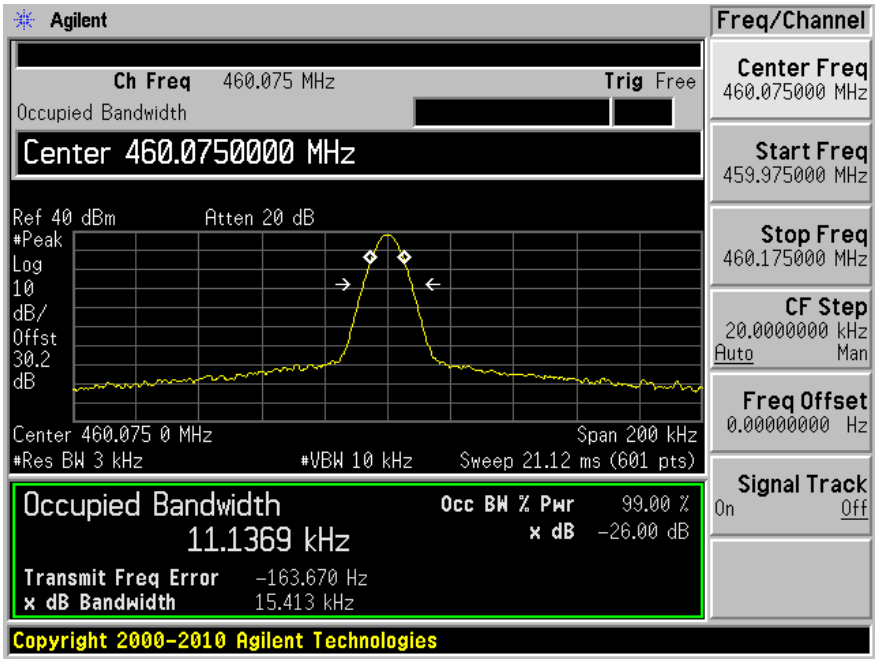


High Power Audio (12.5 kHz)

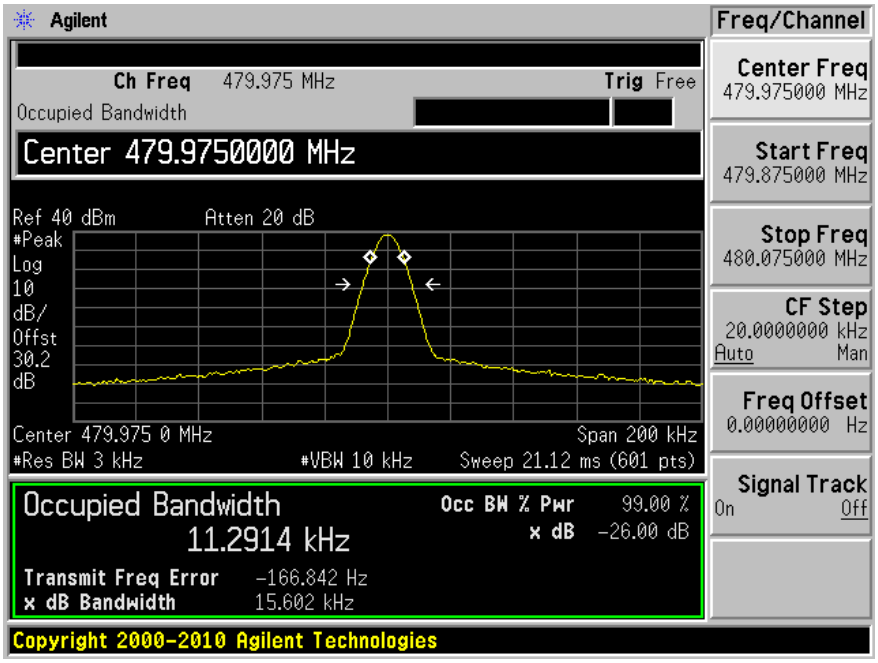
Low Channel – 440.075 MHz



Middle Channel – 460.075 MHz

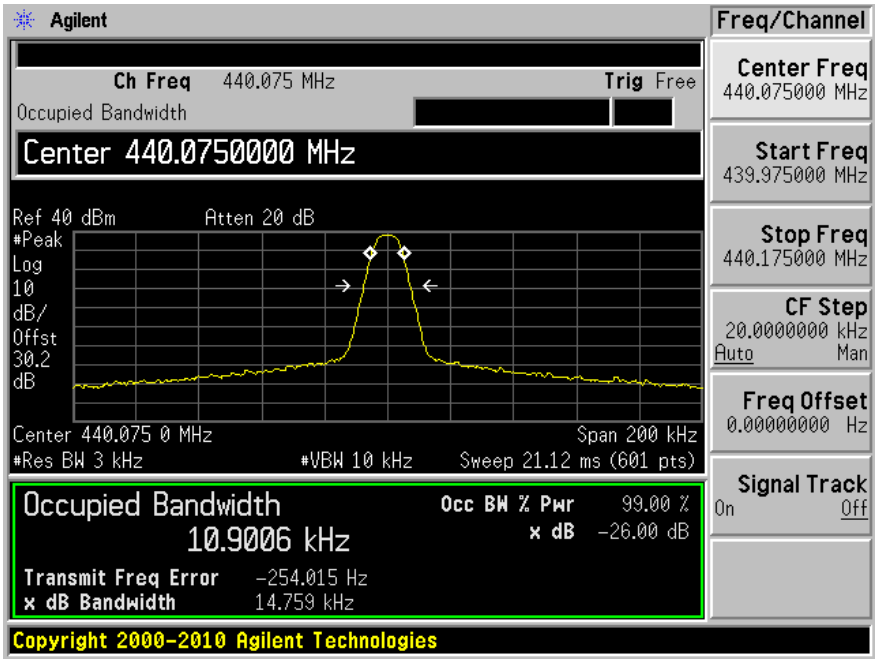


High Channel – 479.975 MHz

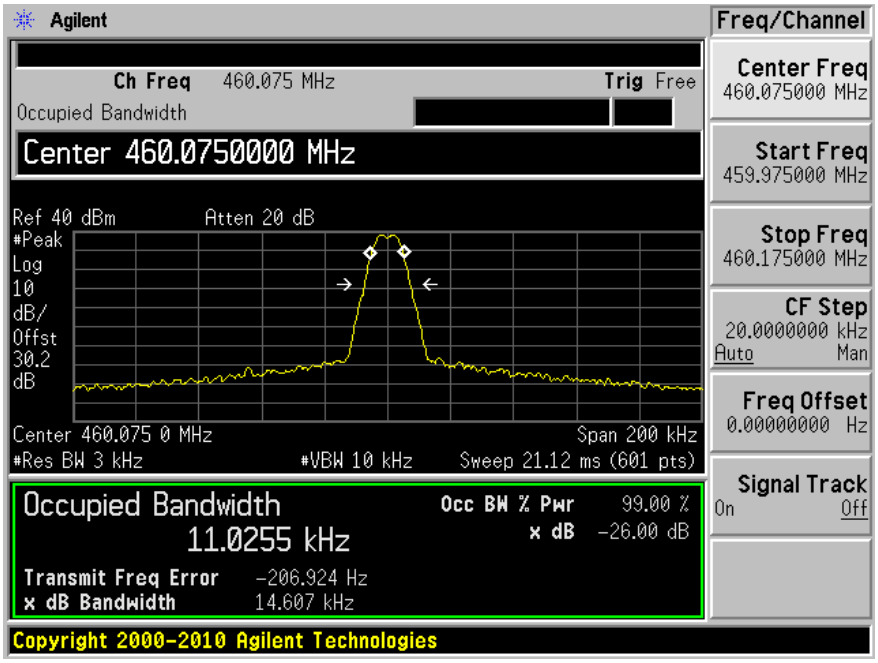


High Power Data (12.5 kHz)

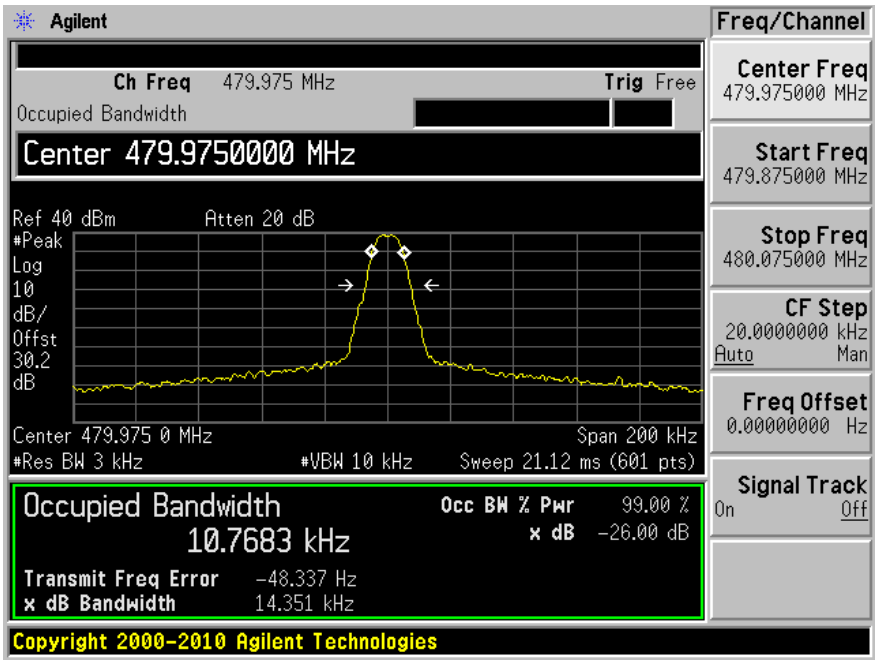
Low Channel – 440.075 MHz



Middle Channel – 460.075 MHz

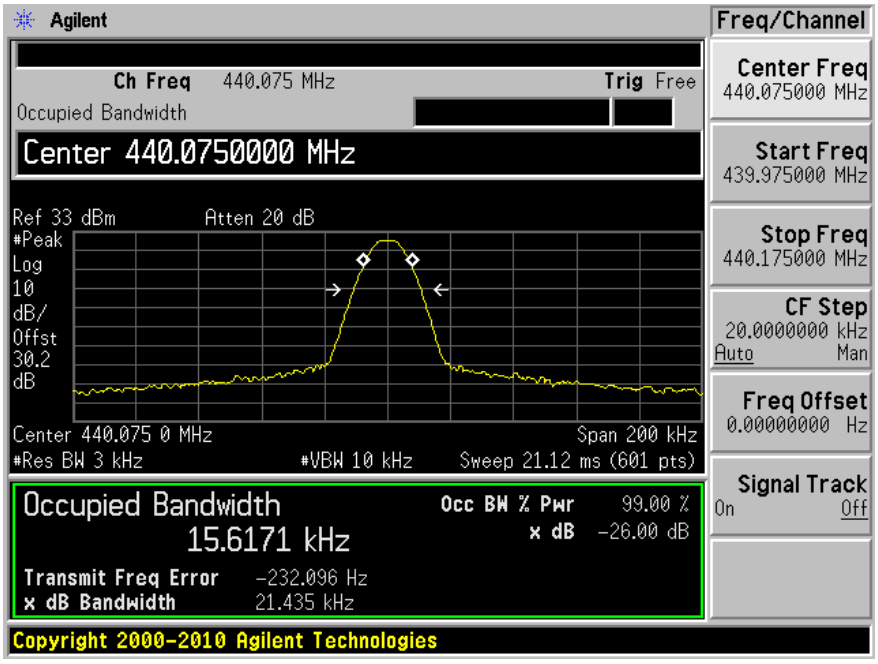


High Channel – 479.975 MHz

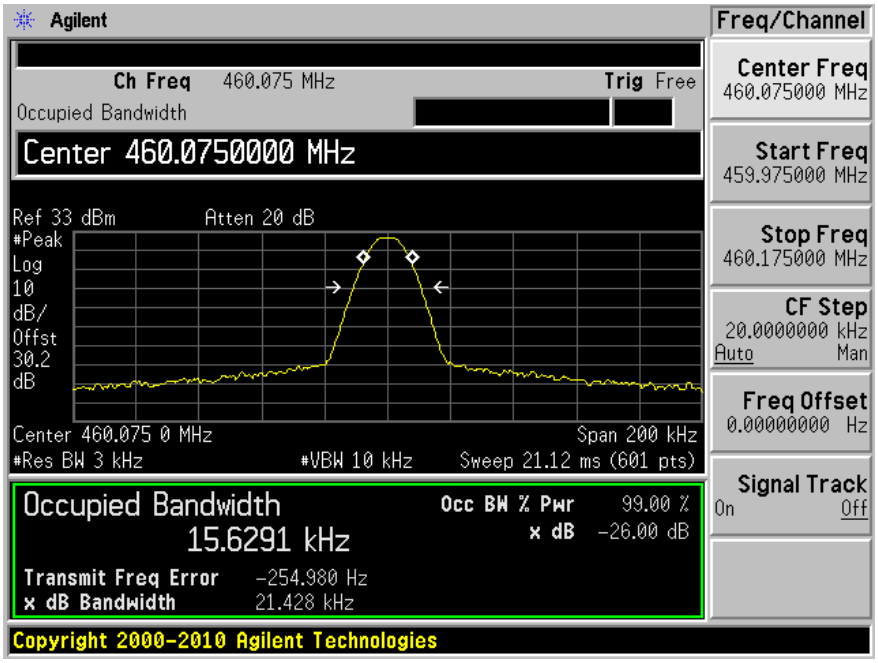


Low Power Audio (25 kHz)

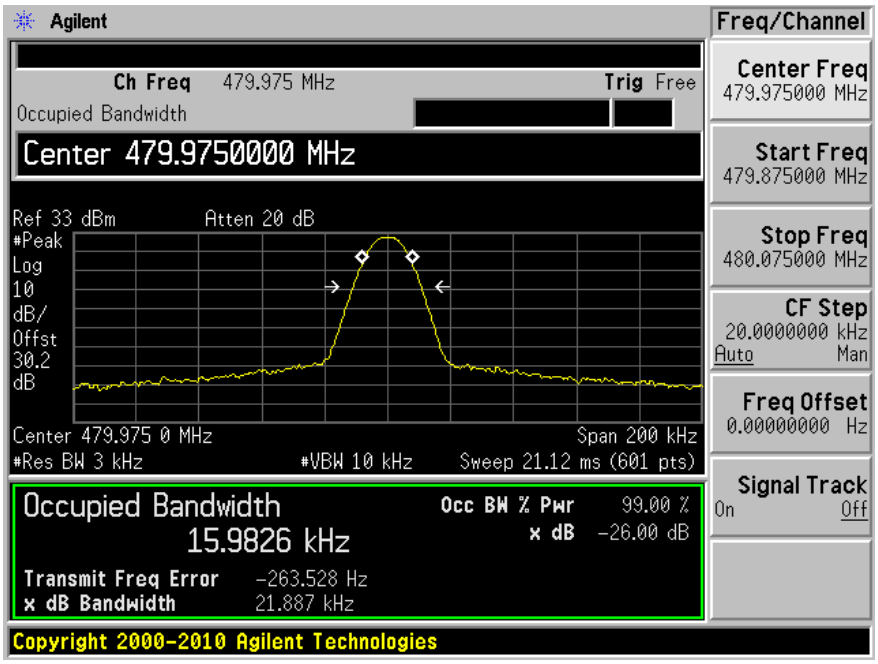
Low Channel – 440.075 MHz



Middle Channel – 460.075 MHz

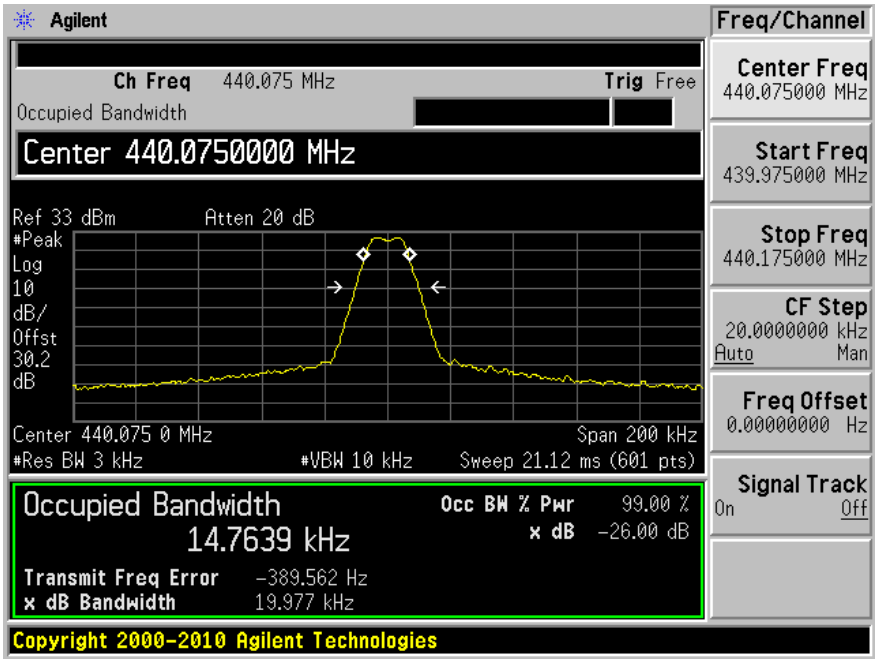


High Channel – 479.975 MHz

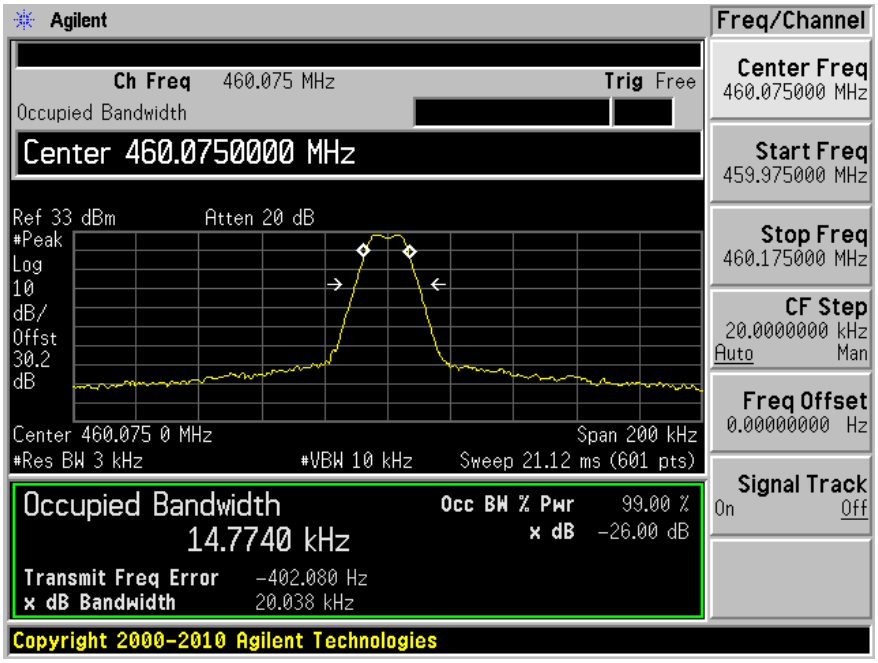


Low Power Data (25 kHz)

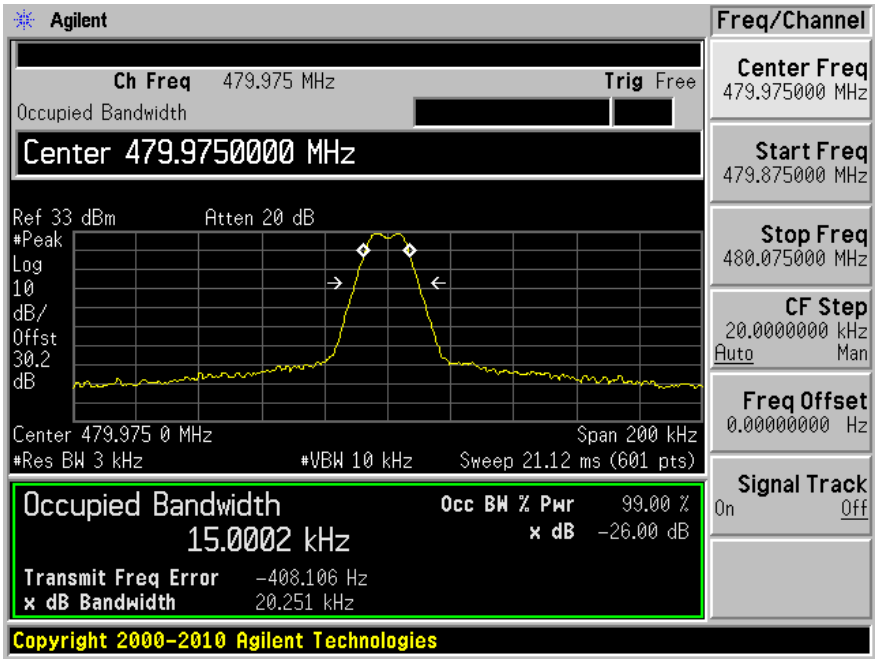
Low Channel – 440.075 MHz



Middle Channel – 460.075 MHz

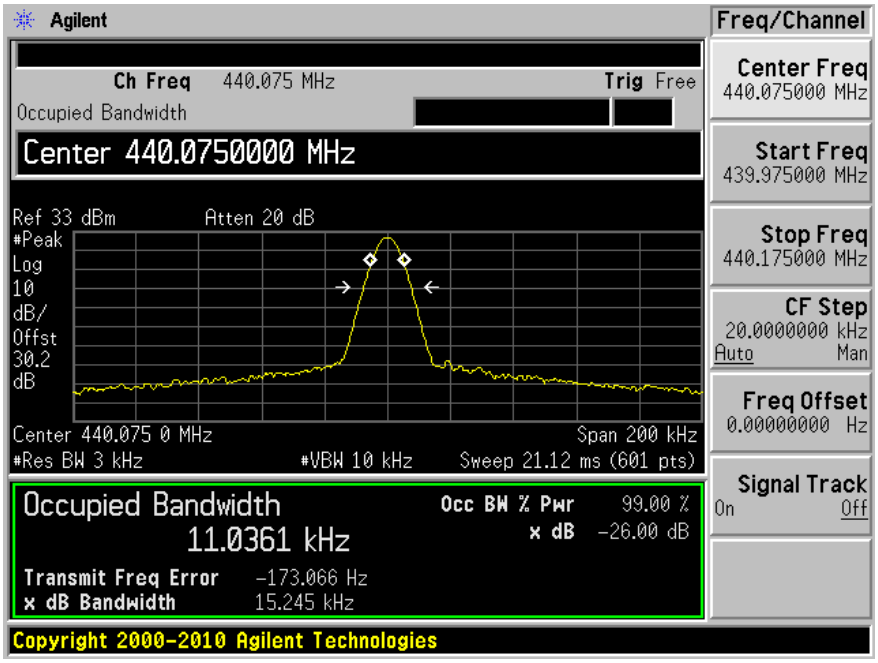


High Channel – 479.975 MHz

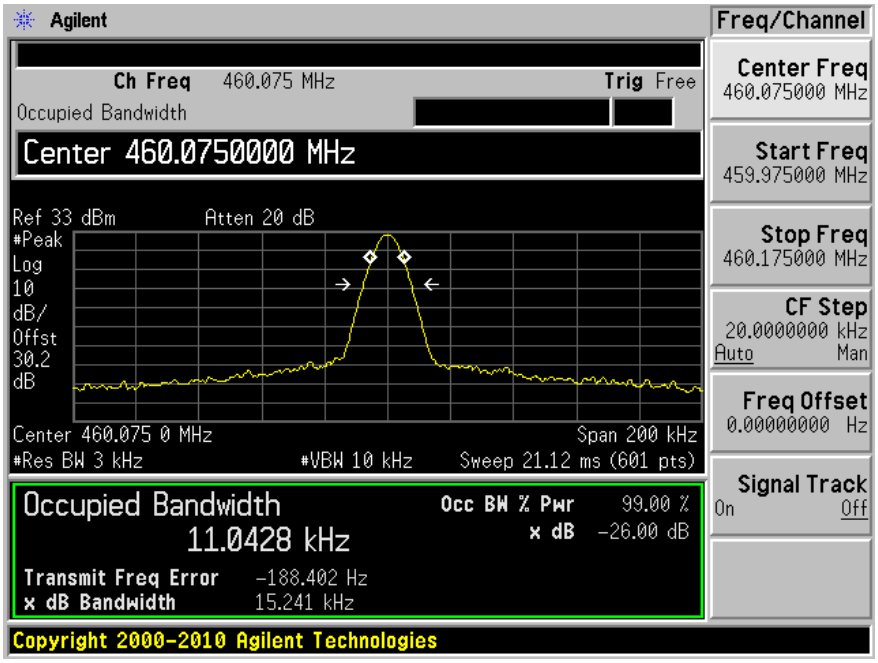


Low Power Audio (12.5 kHz)

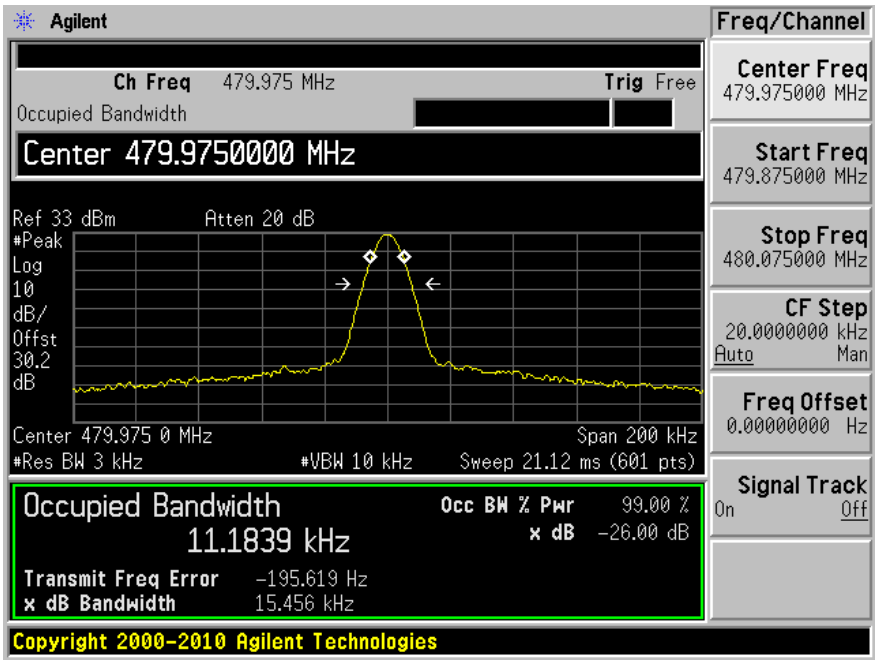
Low Channel – 440.075 MHz



Middle Channel – 460.075 MHz

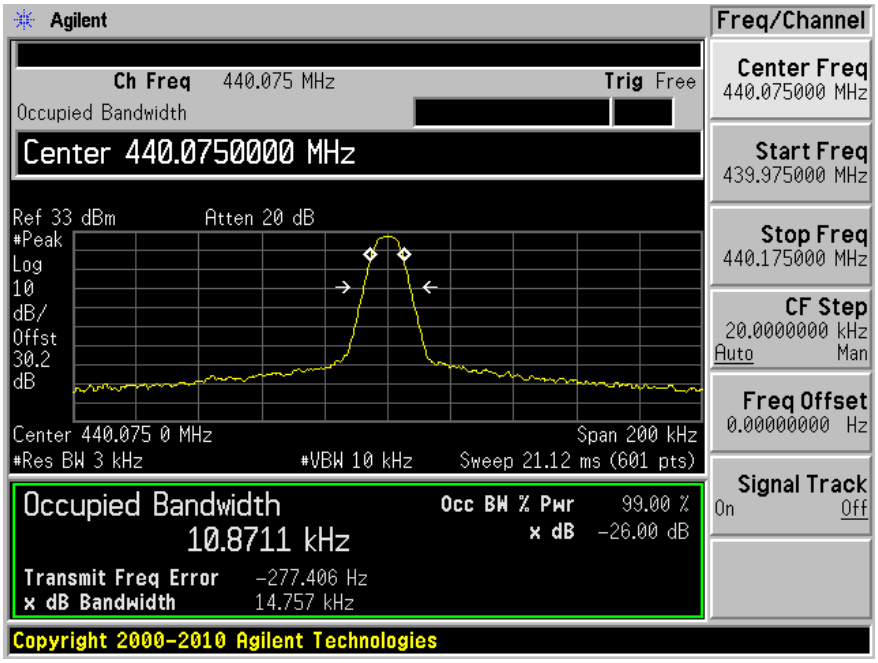


High Channel – 479.975 MHz

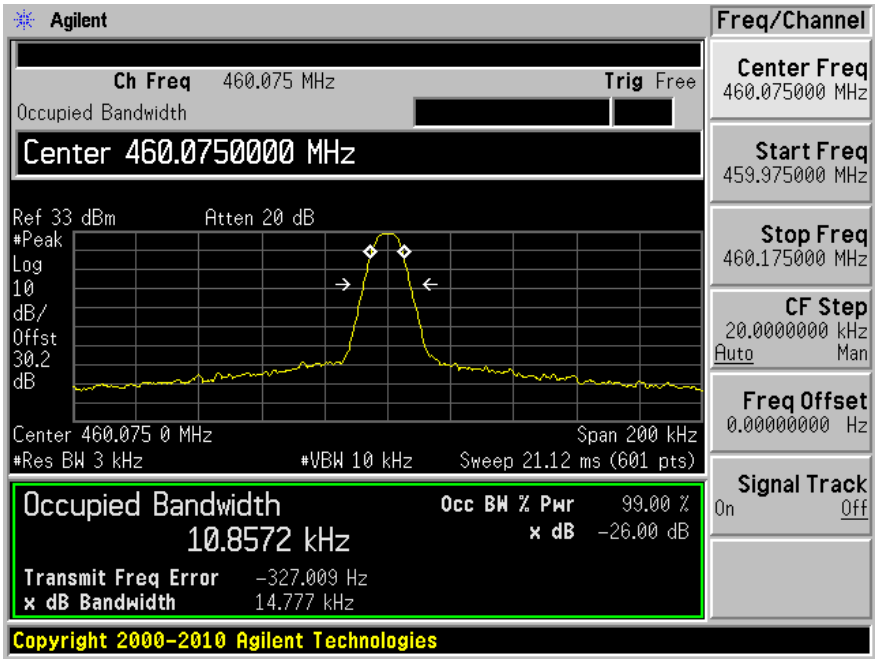


Low Power Data (12.5 kHz)

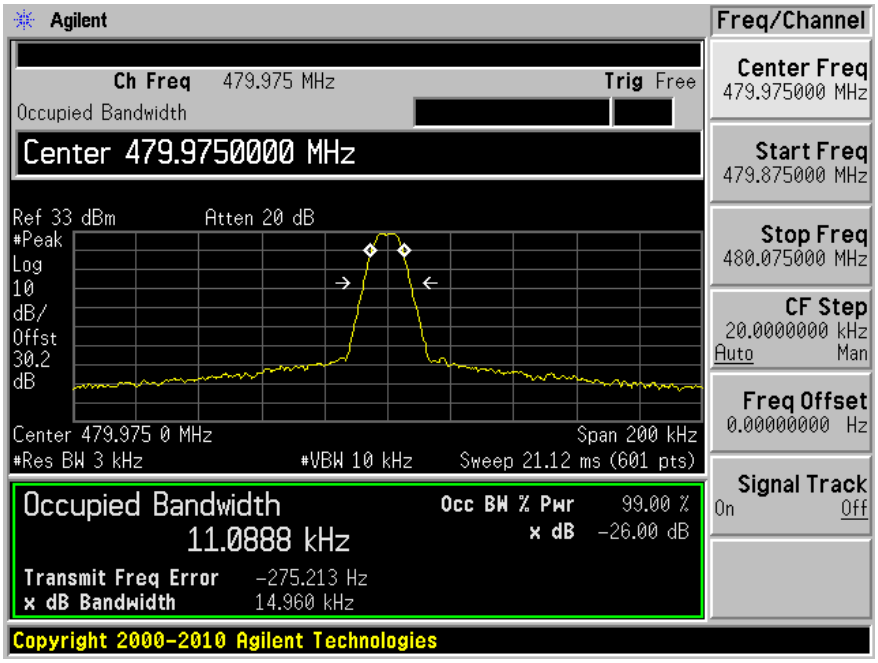
Low Channel – 440.075 MHz



Middle Channel – 460.075 MHz

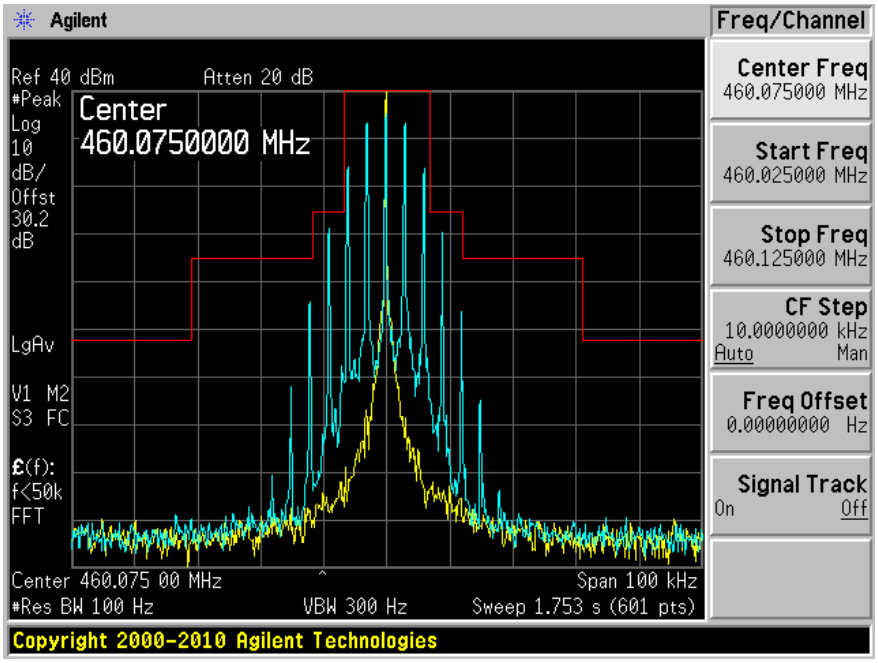


High Channel – 479.975 MHz

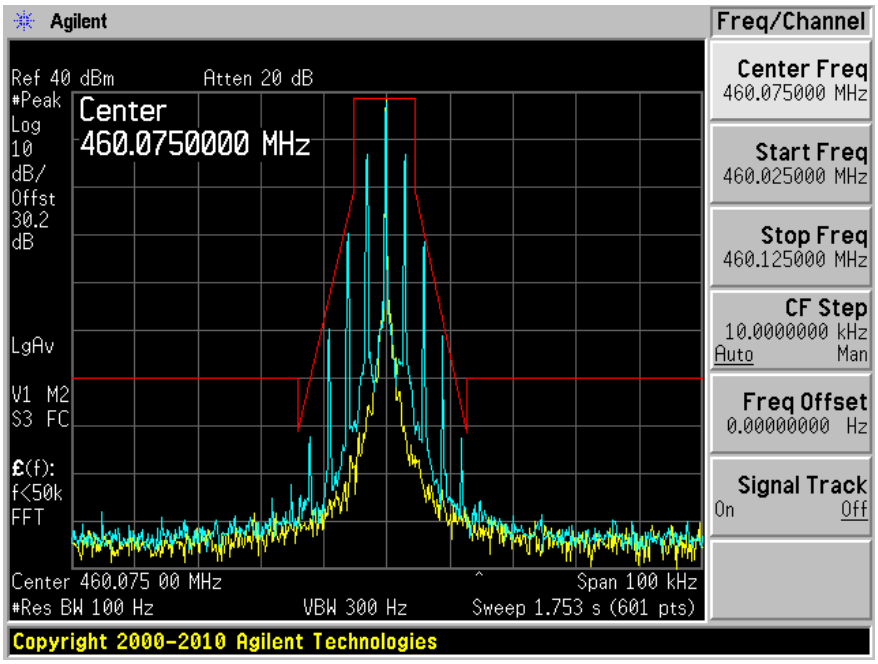


Emission Mask

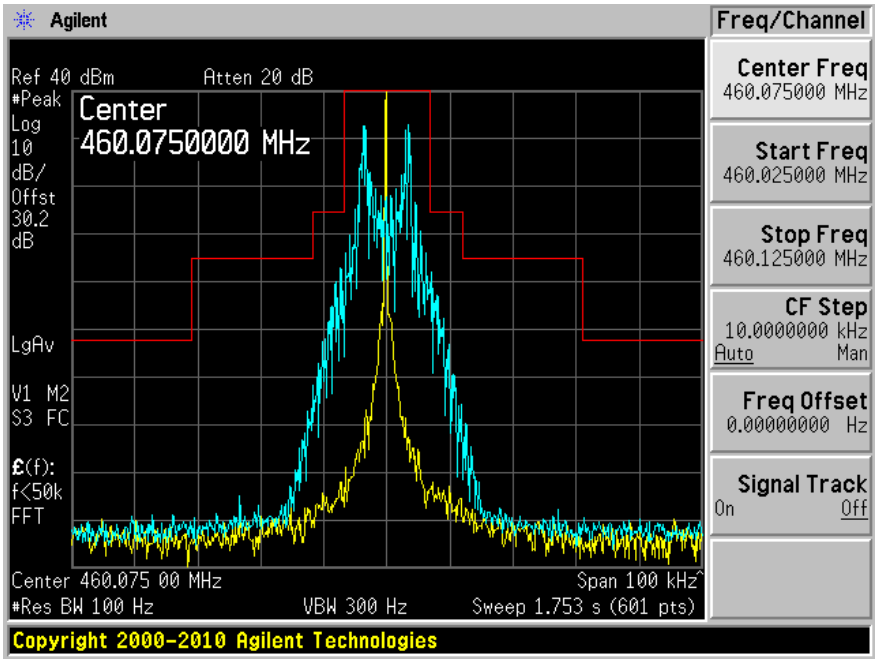
High Power: Audio; 25 kHz Channel Spacing



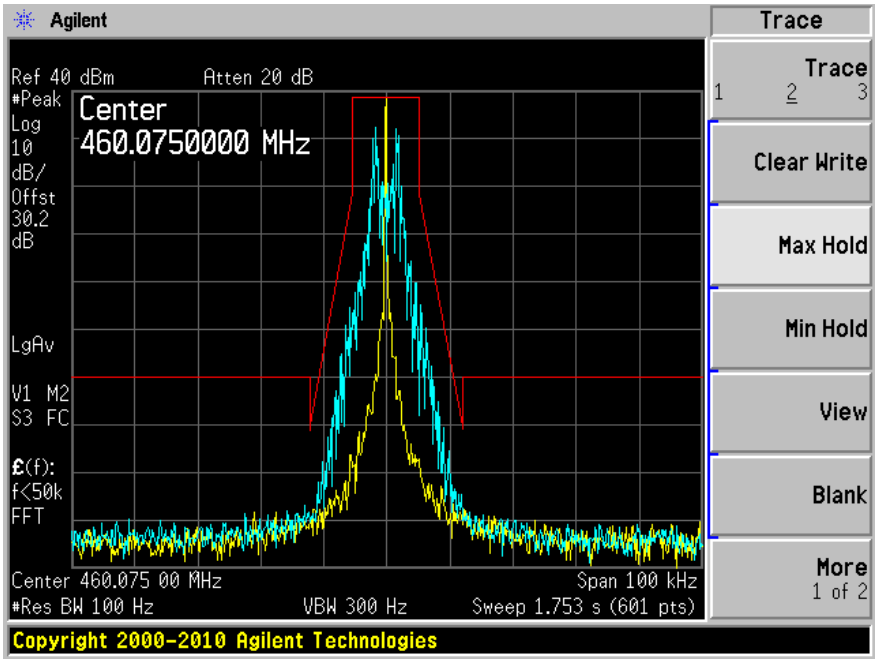
High Power: Audio; 12.5 kHz Channel Spacing



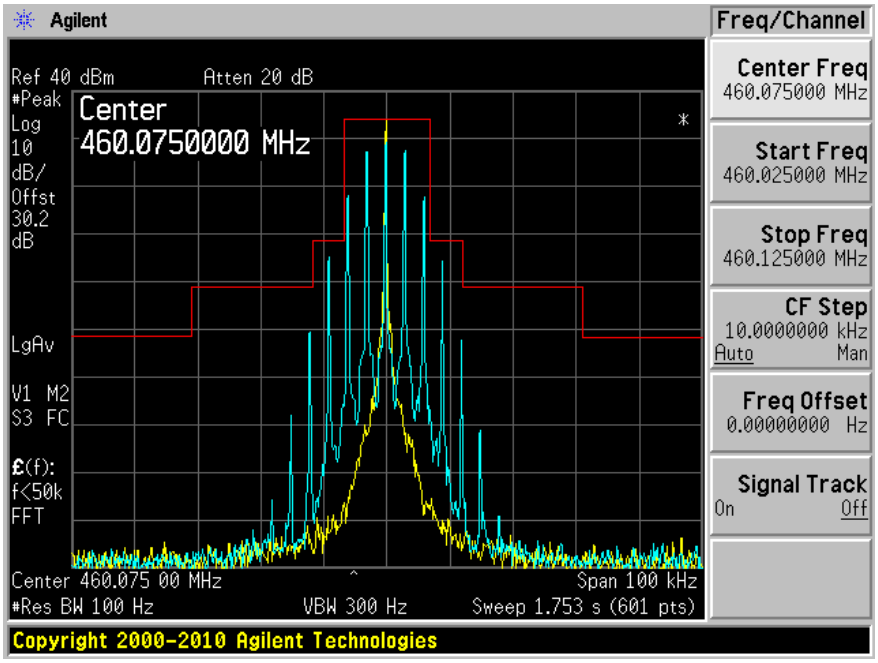
High Power: Data; 25 kHz Channel Spacing



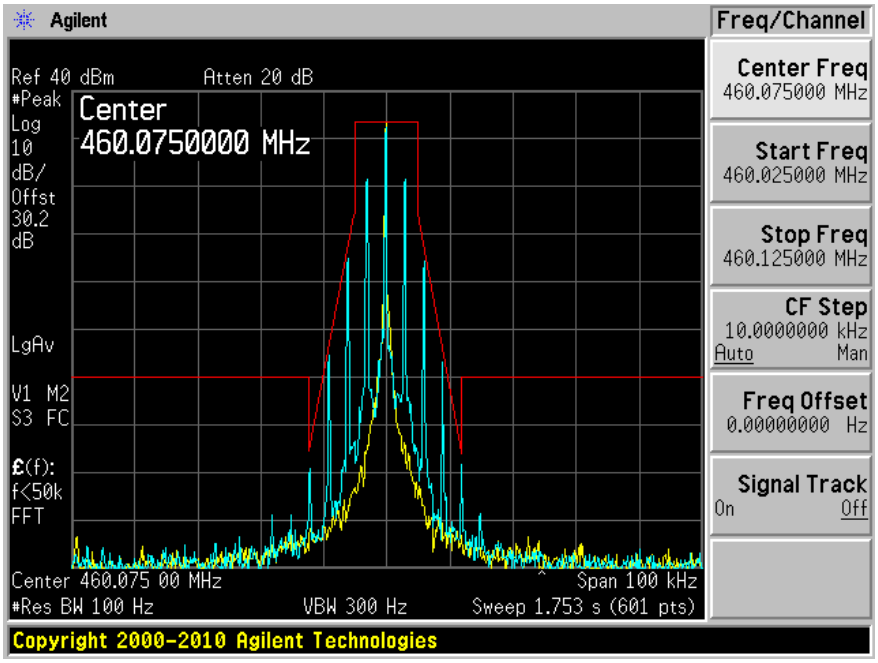
High Power: Data; 12.5 kHz Channel Spacing



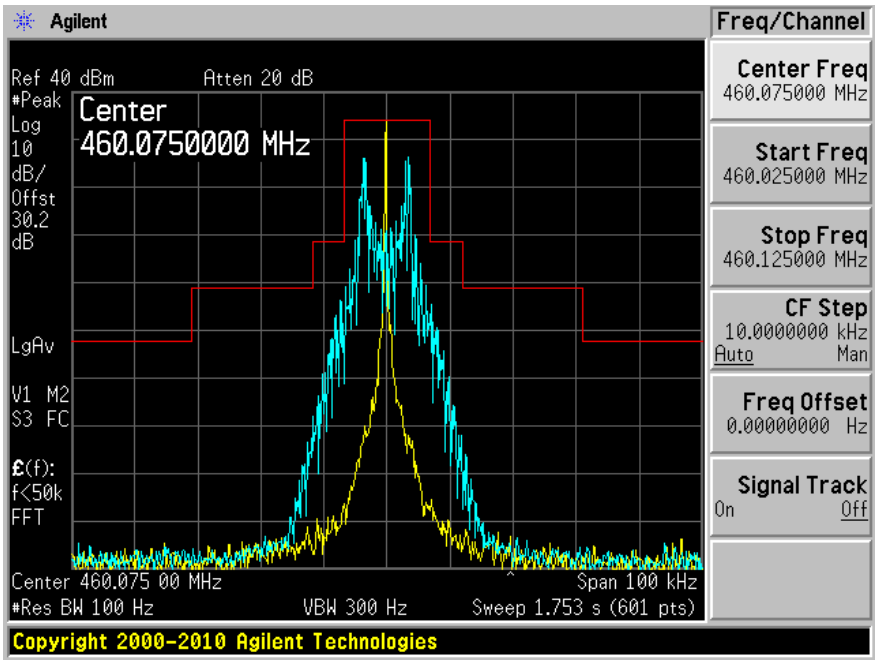
Low Power: Audio; 25 kHz Channel Spacing



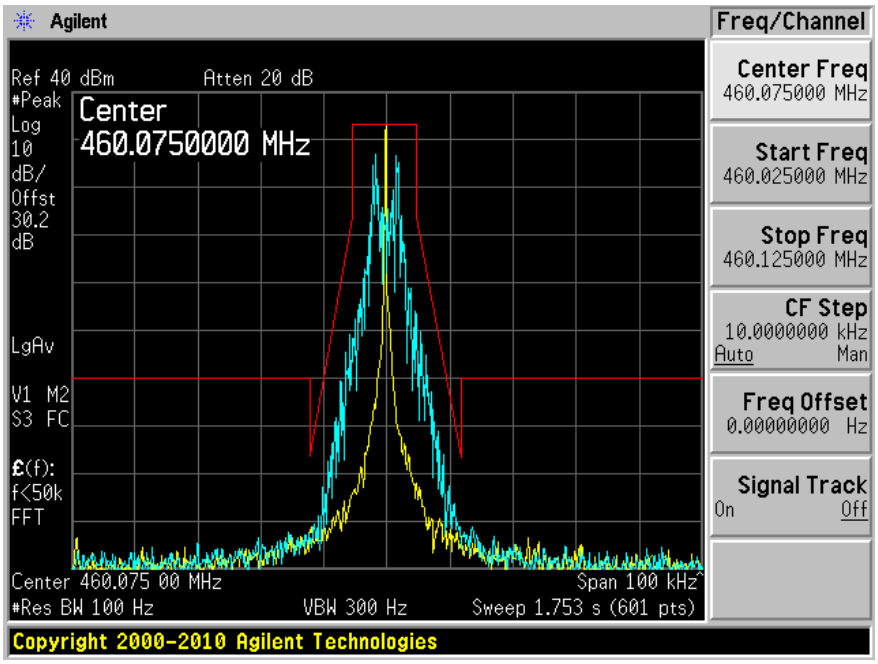
Low Power: Audio; 12.5 kHz Channel Spacing



Low Power: Data; 25 kHz Channel Spacing



Low Power: Data; 12.5 kHz Channel Spacing



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 Jack Liu on 2010-08-20 ~ 2010-08-25.

8.4 Test Equipment List and Details

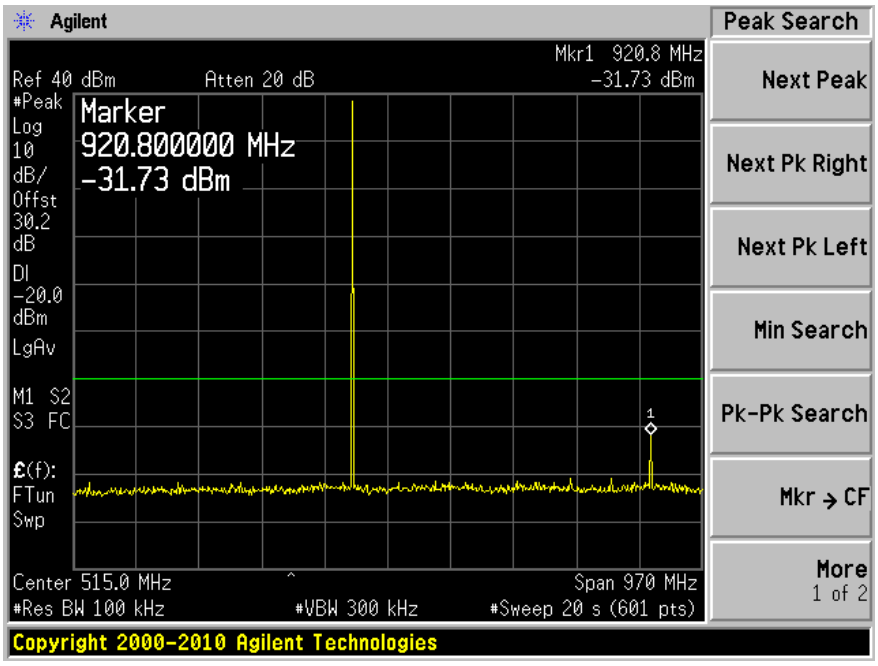
Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09

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

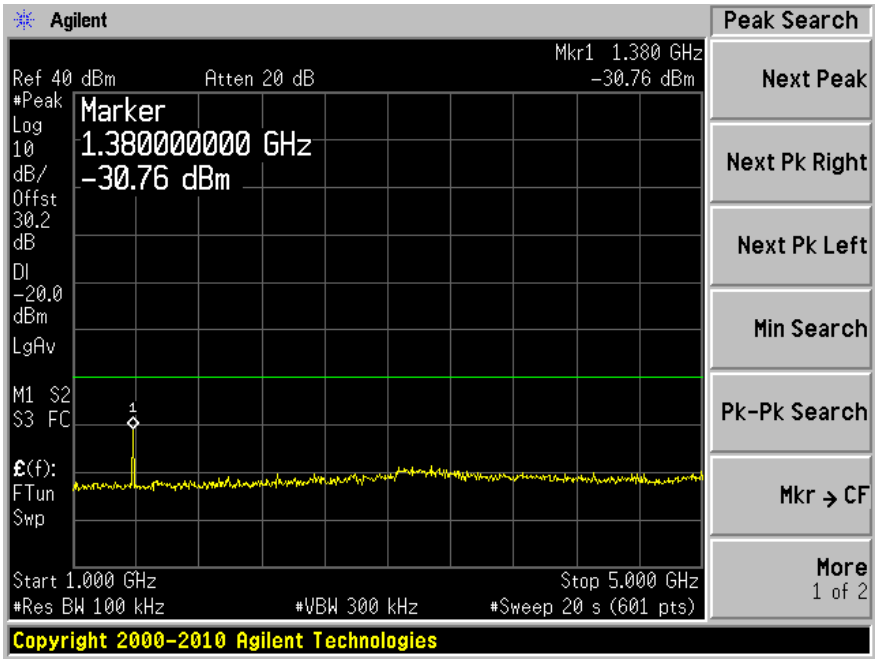
8.5 Test Results

Please refer to the hereinafter plots.

Worst case: Middle channel High Power (12.5 kHz)



30 MHz to 1 GHz



1 GHz to 5 GHz

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
For output power > 2 watts; the limit is 2.5 PPM (11.25 KHz BW) and 5.0 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 Jack Liu on 2010-08-20 ~ 2010-08-25.

9.4 Test Equipment List and Details

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

High Power Band 12.5 kHz

Frequency vs. Temperature

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (^{o}C)				
12	50	460.075	460.07445	-1.195457262	± 2.5
12	40	460.075	460.074783	-0.471662229	± 2.5
12	30	460.075	460.075158	0.343422268	± 2.5
12	20	460.075	460.074825	-0.380372765	± 2.5
12	10	460.075	460.074833	-0.362984296	± 2.5
12	0	460.075	460.074842	-0.343422268	± 2.5
12	-10	460.075	460.074758	-0.526001195	± 2.5
12	-20	460.075	460.074725	-0.597728631	± 2.5

Frequency vs. Voltage

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (^{o}C)				
18	20	460.075	460.074817	-0.397761235	± 2.5
9	20	460.075	460.074825	-0.380372765	± 2.5

High Power Band 25 kHz

Frequency vs. Temperature

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (^{o}C)				
12	50	460.075	460.074608	-0.852034994	± 5
12	40	460.075	460.074817	-0.397761235	± 5
12	30	460.075	460.074817	-0.397761235	±5
12	20	460.075	460.074783	-0.471662229	± 5
12	10	460.075	460.074817	-0.397761235	± 5
12	0	460.075	460.074775	-0.489050698	± 5
12	-10	460.075	460.074767	-0.506439167	± 5
12	-20	460.075	460.074692	-0.669456067	± 5

Frequency vs. Voltage

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (°C)				
18	20	460.075	460.074775	-0.489050698	± 5
9	20	460.075	460.074767	-0.506439167	± 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 Jack Liu on 2010-08-20 ~ 2010-08-25.

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

-13.65 dB at **920.15 MHz** in the **Horizontal** polarization

Test Mode: Transmission Using substitution method

Indicated		Azimuth degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Correction (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
920.15	34.64	247	200	V	920.15	-38.52	0	0.6	-39.12	-13	-26.12
920.15	51.23	182	112	H	920.15	-26.05	0	0.6	-26.65	-13	-13.65
1380.225	55.61	79	272	V	1380.225	-47.99	8.1	1	-48.99	-13	-35.99
1380.225	62.84	92	137	H	1380.225	-40.76	8.1	1	-41.76	-13	-28.76
1840.3	47.99	237	86	V	1840.3	-53.84	9.4	1.17	-55.01	-13	-42.01
1840.3	53.86	74	164	H	1840.3	-47.97	9.4	1.17	-49.14	-13	-36.14

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
		421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels		
t_1[4]	±25.0 kHz	10.0 ms
t_2	±12.5 kHz	25.0 ms
t_3[4]	±25.0 kHz	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels		
t_1[4]	±12.5 kHz	10.0 ms
t_2	±6.25 kHz	25.0 ms
t_3[4]	±12.5 kHz	10.0 ms

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 Intervals[1, 2]	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138-174 MHz	406.1-512 MHz
25	t_1	±25	5	10
	t_2	±12.5	20	25
	t_3	±25	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.
t_1: the time period immediately following t_{on}.
t_2: the time period immediately following t_1.
t_3: the time period from the instant when the transmitter is turned off until t_{off}.
t_{off}: 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 t_1 and t_3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t_1 and t_3 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 Jack Liu on 2010-08-20 ~ 2010-08-25.

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

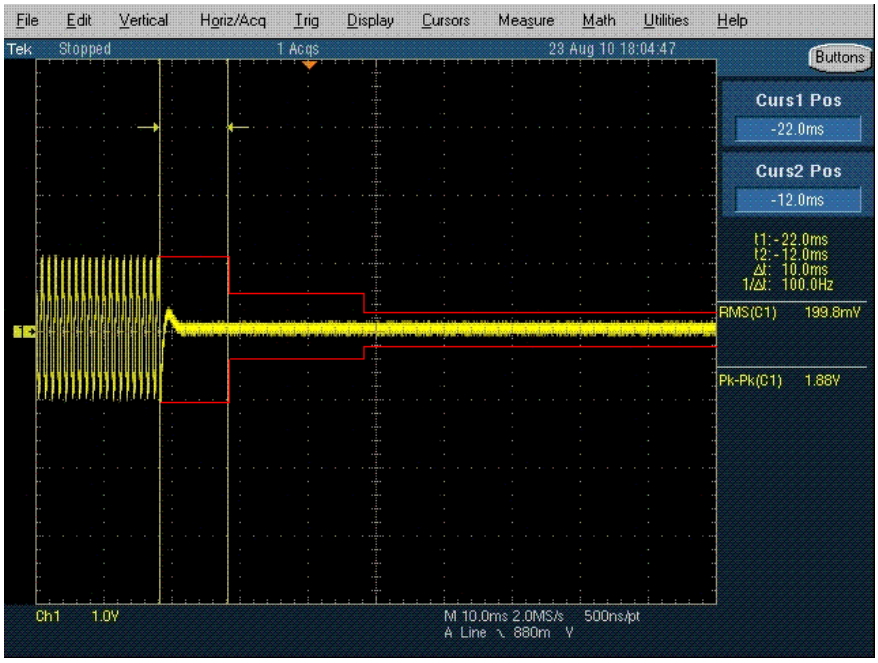
Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST

11.5 Test Results

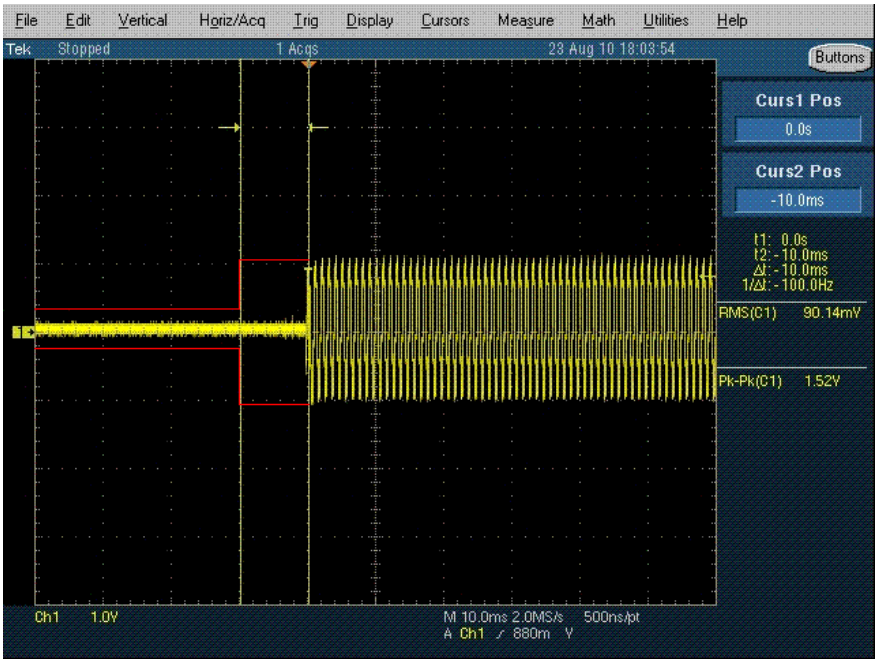
Please refer to the following plots.

12.5 kHz Channel Spacing

Powering Up

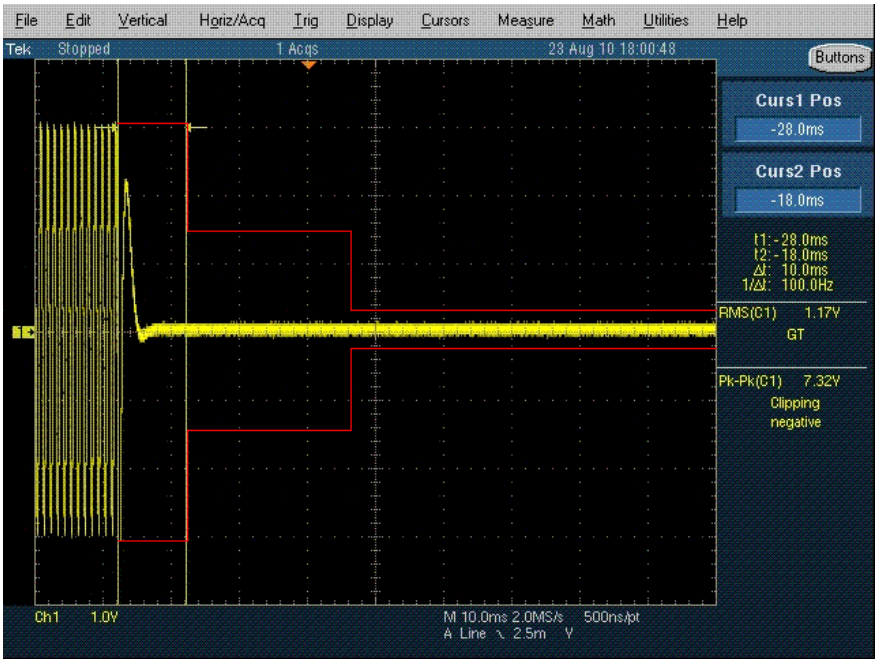


Powering Down

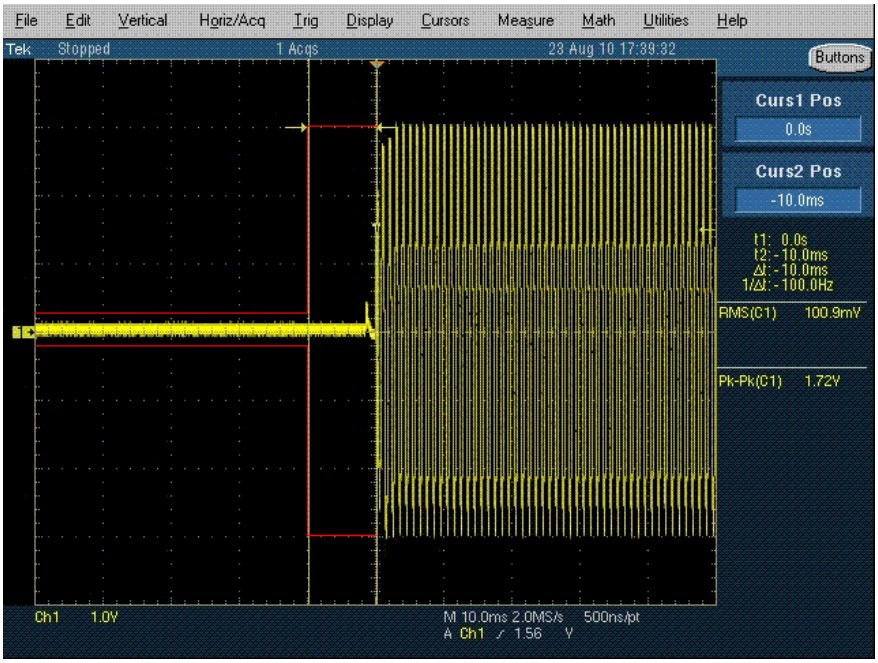


25 kHz Channel Spacing

Powering Up



Powering Down



12 IC RSS-119 §5.11 Receiver Spurious Radiated Emissions

12.1 Applicable Standard

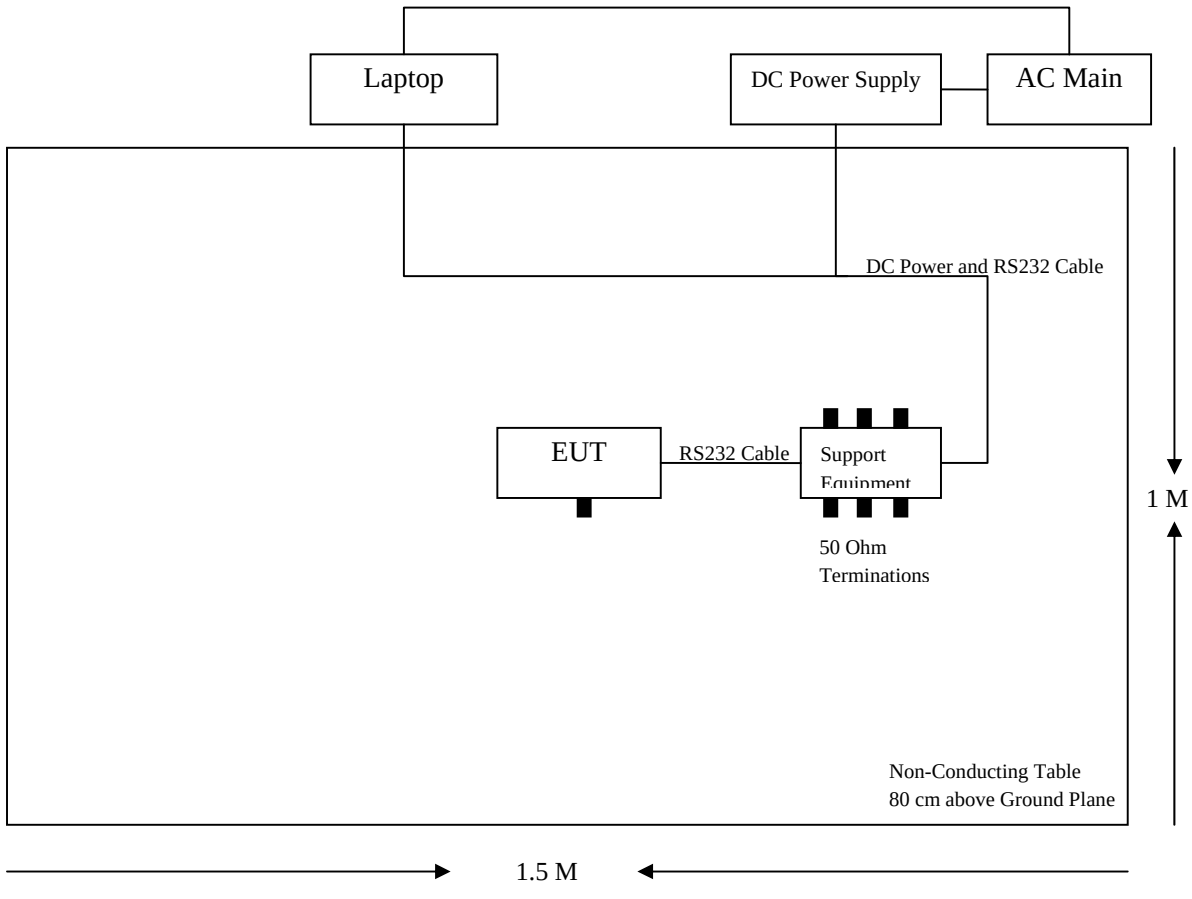
IC RSS-119 §5.11 and RSS-Gen §6

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 Jack Liu on 2010-08-20 ~ 2010-08-25.

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)

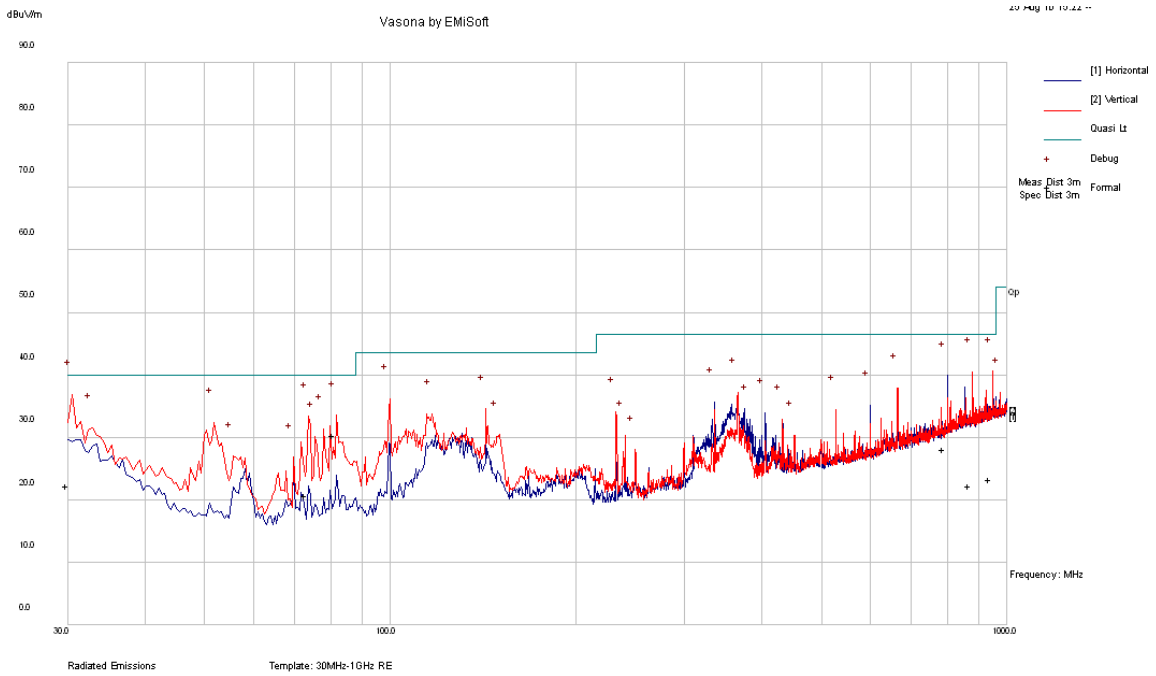
Model: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Test Range**
-9.56	82.00612	Vertical	30 MHz-1 GHz

Measure at 3 Meters (Above 1 GHz)

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Test Range**
-19.52	5828.892	Vertical	1 GHz – 6 GHz

12.8 Radiated Spurious Emissions Plot & Data

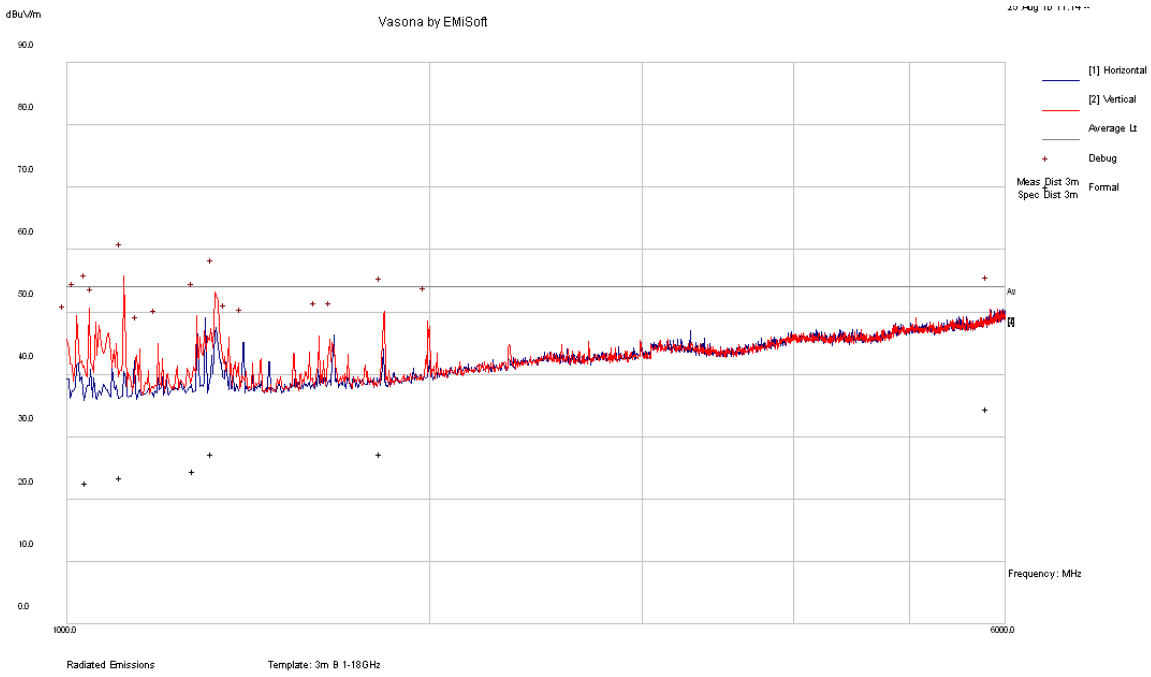
Measured at 3 Meter Distance (30 MHz – 1 GHz)



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
82.00612	30.44	153	V	85	40	-9.56
30.26828	22.21	286	V	165	40	-17.79
799.9554	28.16	119	H	157	46.5	-18.34
73.73904	20.65	179	V	113	40	-19.35
948.9668	23.23	236	V	223	46.5	-23.27
878.1109	22.3	241	V	314	46.5	-24.20

Measured at 3 Meter Distance (1 GHz – 6 GHz)



Average Measurements

Frequency (MHz)	Averge (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
5828.892	34.48	246	V	130	54	-19.52
1328.792	27.31	99	V	346	54	-26.69
1832.029	27.27	122	V	350	54	-26.73
1281.773	24.53	99	V	262	54	-29.47
1114.821	23.56	168	V	130	54	-30.44
1044.308	22.55	141	V	70	54	-31.45