Lab Code: 200167-0

FCC PART 90

TEST AND MEASUREMENT REPORT

For

Canam Technology Inc.

5318 East 2nd Street #700,

Long Beach, CA, 90803, USA

FCC ID: TCJ-M4DBDAV

Report Type:	Product Type:
Original Report	VHF Amplifier

Test Engineer:	Kevin Li
Report Number:	R1105231-90
Report Date:	2011-06-21
Reviewed By:	Victor Zhang EMC/RF Lead
Prepared By: (84)	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732 9164

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by NVLAP*, NIST, or any agency of the Federal Government.
* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "*".

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1105231-90	Original Report	2011-06-21

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Canam Technology, Inc.,* and their product, *model: M4DBDAV, FCC ID: TCJ-M4DBDAV,* which will henceforth be referred to as the EUT "Equipment under Test". The EUT is a VHF narrowband signal booster to operate within range 151-174 MHz for land mobile radio.

1.2 Mechanical Description of EUT

The EUT dimension is approximately 440mm (L) x 490 mm (W) x 260 mm (H) and weighs approximately 29 kg.

The test data gathered are from typical production sample, serial number: 913, provided by the Manufacturer.

1.3 Objective

This type approval report is prepared on behalf of *Canam Technology, Inc.*, in accordance with Part 2 Subpart J, and Part 90 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for RF output power, Inter-modulation characteristic, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation, emission mask, and conducted and radiated margin.

1.4 Related Submittal(s)/Grant(s)

No Related Submittals

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 parts:

Part 90 Private Land Mobile Radio Services

Applicable Standards: TIA-603-C, ANSI C63.4-2003.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, 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 in accordance to TIA-603-C.

2.2 EUT Exercise Software

The signal was sent through the EUT using a signal generator.

2.3 Equipment Modifications

No modification was made to the EUT

2.4 Special Equipment

No special equipment was used during testing

2.5 Local Support Equipment

Manufacturers	Descriptions	Models	Serial Numbers
Rohde & Schwarz	Signal Generator	SMIQ03	849192/0085

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Empower	Power Amplifier	1061	1105
Mini-Circuits	Pre-amplifier	2KL-2R5	-
Canam Technology Inc.	Analog Interface (AIC Module A)	M4D-AIC-155	1008
Canam Technology Inc.	Analog Interface (AIC Module B)	M4D-AIC-163	1009
Canam Technology Inc.	Analog Interface (AIC Module C)	M4D-AIC-171	1010
Canam Technology Inc.	DSP Module (Digital Signal Processor)	M4D-DSP	137
Mean Well	Power Supply (+5v,+12v,+27v)	MP450-S#-21#	RB00U50307
Canam Technology Inc.	ECM Control Board	M4D-ECM	224
Canam Technology Inc.	ECM Break-out	ECM-BO	223

2.7 External I/O Cabling List and Details

Cable Descriptions	Length (M)	From	To
-	-	-	-

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1046; §90.205	RF Output Power	Compliant
§90.209	99% and 26 dB Emission Bandwidth	Compliant
§90.210	Emission Limitation	Compliant
§90.210	Spurious Emissions at Antenna Terminals	Compliant
§90.210	Field Strength of Spurious Radiation	Compliant
§90.210;	Inter-modulation Characteristics	Compliant
§1.1310;§2.1091	RF Exposure Information (MPE)	Compliant
§2.1047	Modulation Characteristics	N/A
§2.1055; §90.539	Frequency Stability	N/A

N/A: This EUT is an amplifier and does not contain modulation circuitry or frequency generation.

4 FCC §2.1046 & §90.205 – RF Output Power

4.1 Applicable Standards

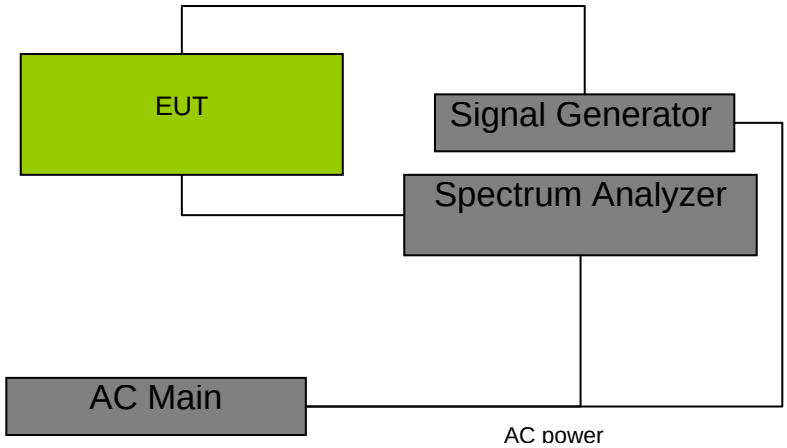
FCC §2.1046 and §90.205.

4.2 Test Procedure

Conducted:

The RF output of the transmitter was connected to the signal generator and the spectrum analyzer through sufficient attenuation.

4.3 Test Setup Block Diagram



4.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

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

4.5 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li on 2011-05-24 in RF Site.

4.6 Test Results

Input power: -60 dBm

Low Power Configuration:

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
Low	151	27.61	0.577
Middle	163	27.67	0.585
High	174	26.83	0.482

High Power Configuration:

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
Low	151	37.31	5.382
Middle	163	37.58	5.728
High	174	37.26	5.321

5 FCC §2.1047 - Modulation Characteristic

5.1 Applicable Standard

According to FCC §2.1047(d) and Part 90, the EUT is an amplifier and there is no modulating/or limiting circuit, therefore modulation characteristic is not presented.

5.2 Test Result

N/A

6 FCC §90.209 – 99% & 26 dB Emission Bandwidth

6.1 Applicable Standard

Requirements: FCC §90.209.

6.2 Test Procedure

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

According to the FCC 2-11-04/EAB/RF, Input and output signals were compared to verify that there was no any degradation to the signal due to amplification and conversion from the repeater using an RBW of 300 Hz or 1% of the emission bandwidth. Then the 26 dB & 99% bandwidth was recorded.

6.3 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li on 2011-05-24 in RF Site.

6.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

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

6.5 Test Results

Middle Channel: 163 MHz

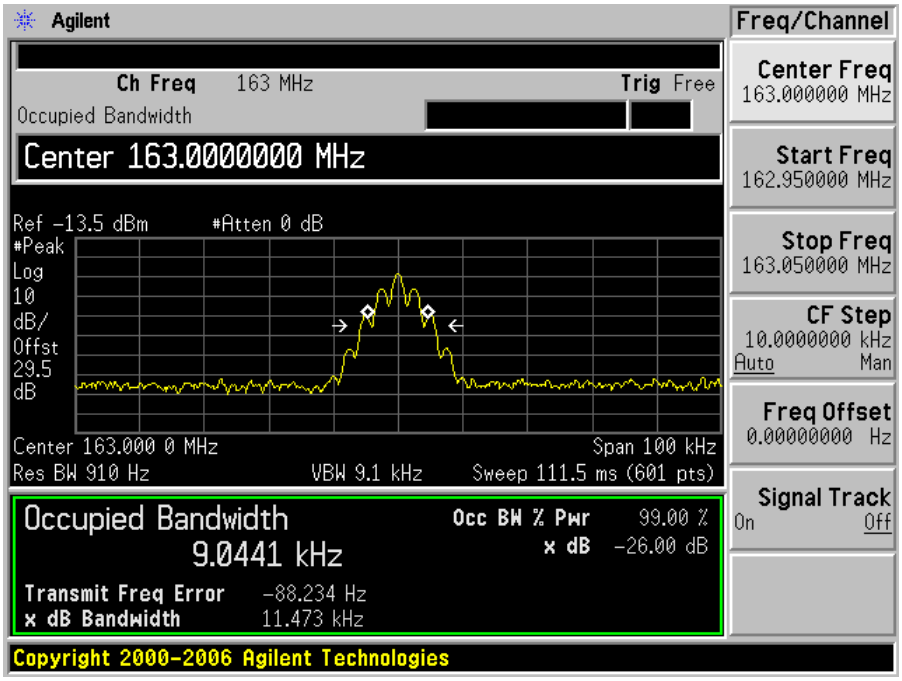
Modulation Type	Input Signal 99% Emission Bandwidth (kHz)	Output Signal 99% Emission Bandwidth (kHz)
FM Voice	9.0441	8.6997
FM Data	6.7999	6.7598
C4FM	9.3273	8.7501
CQPSK	5.9560	5.9557

Modulation Type	Input Signal 26 dB Emission Bandwidth (kHz)	Output Signal 26 dB Emission Bandwidth (kHz)
FM Voice	11.473	11.440
FM Data	9.114	9.077
C4FM	12.324	11.898
CQPSK	7.435	7.328

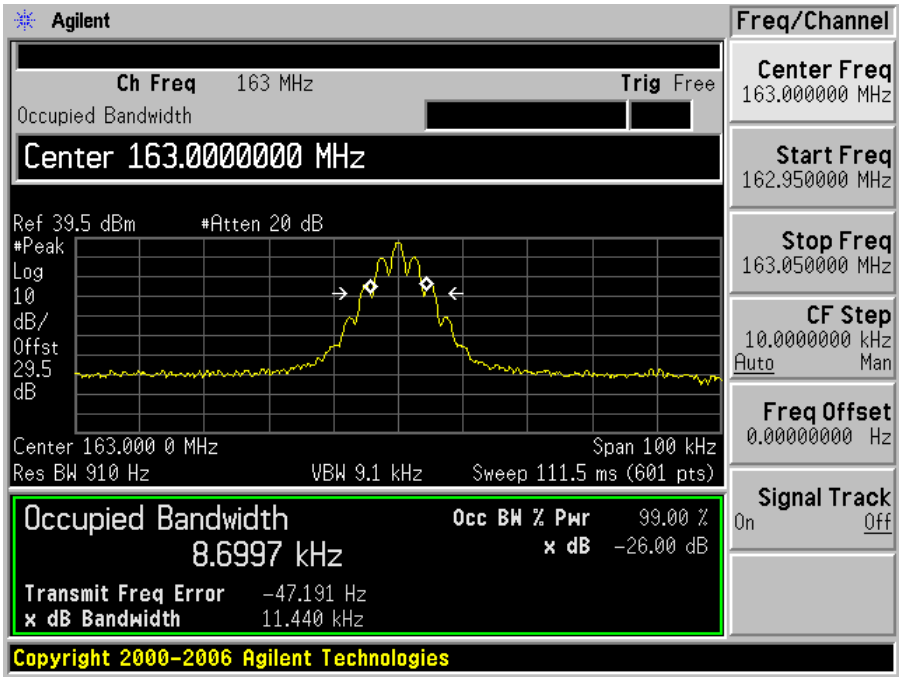
Please refer to the following plots:

12.5 kHz channel Spacing with FM Voice

Input

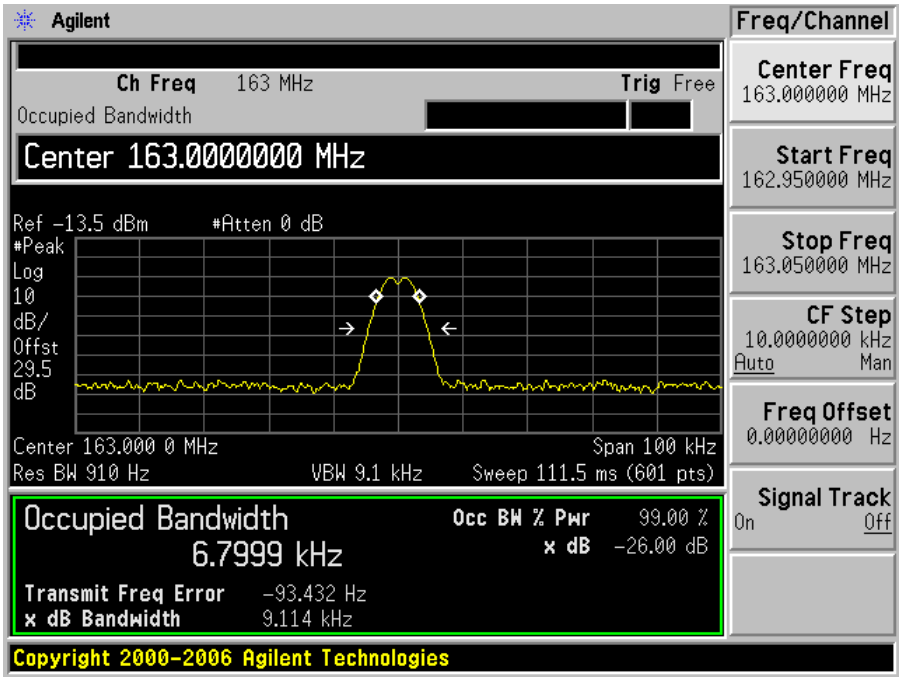


Output

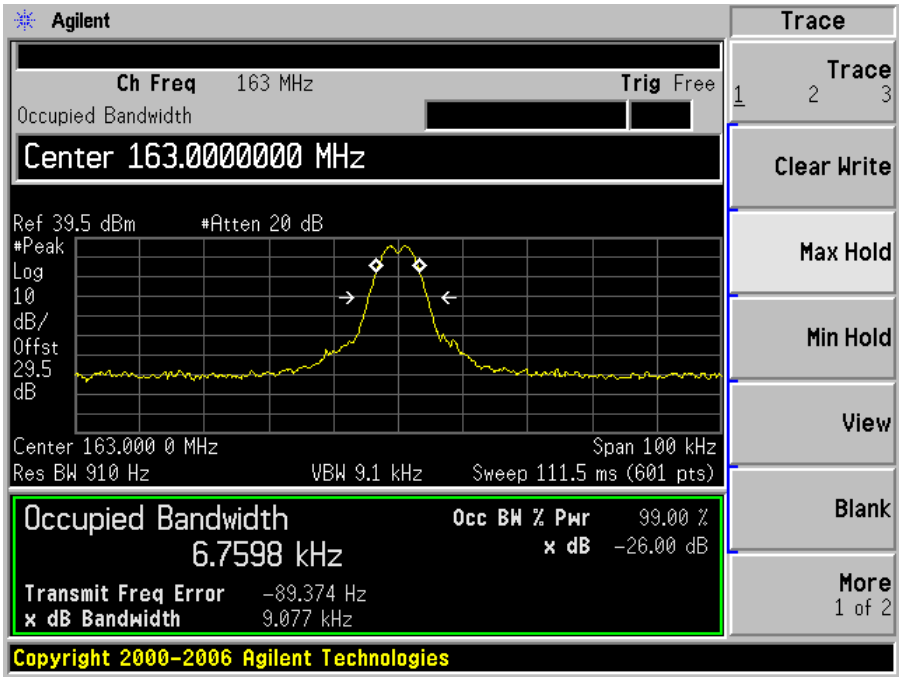


12.5 kHz channel Spacing with FM Data

Input

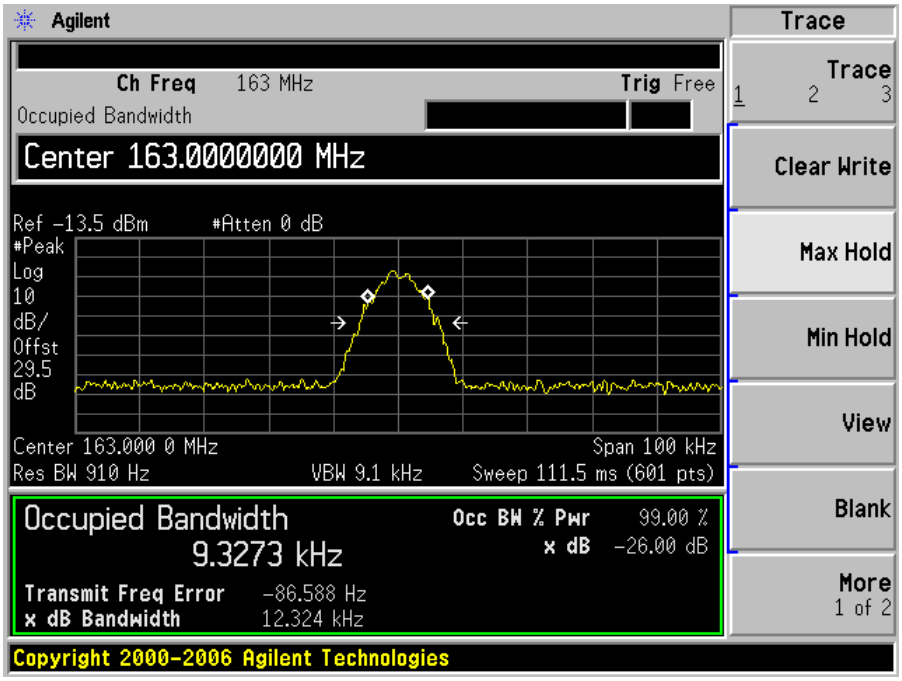


Output

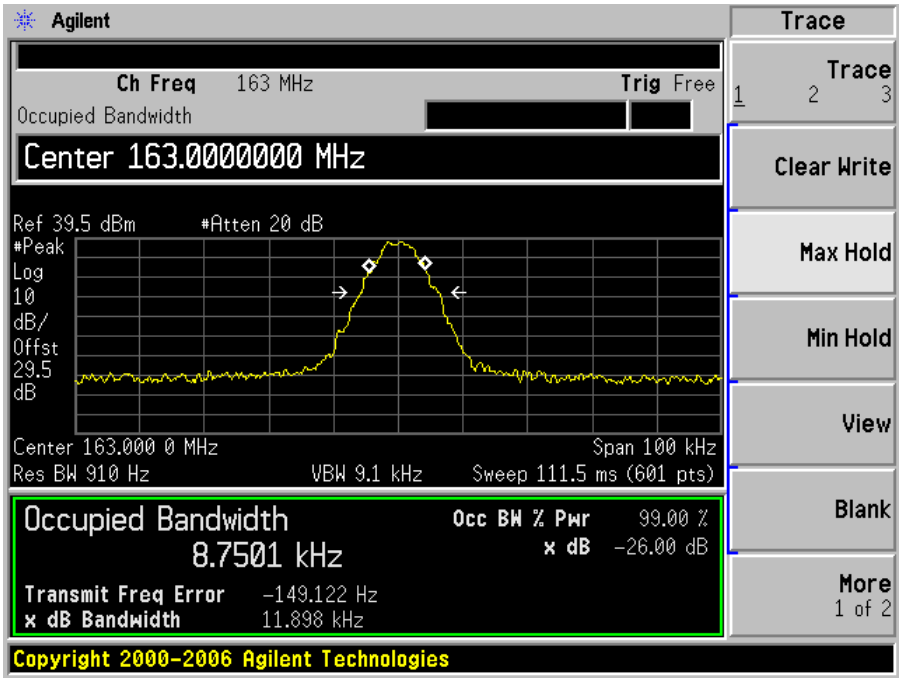


12.5 kHz channel Spacing with C4FM

Input

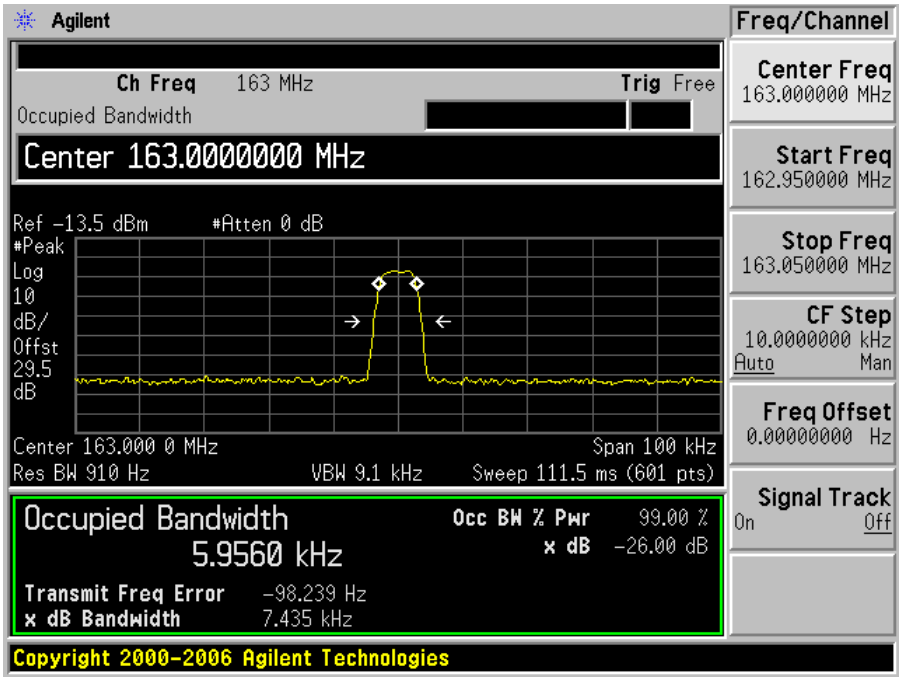


Output

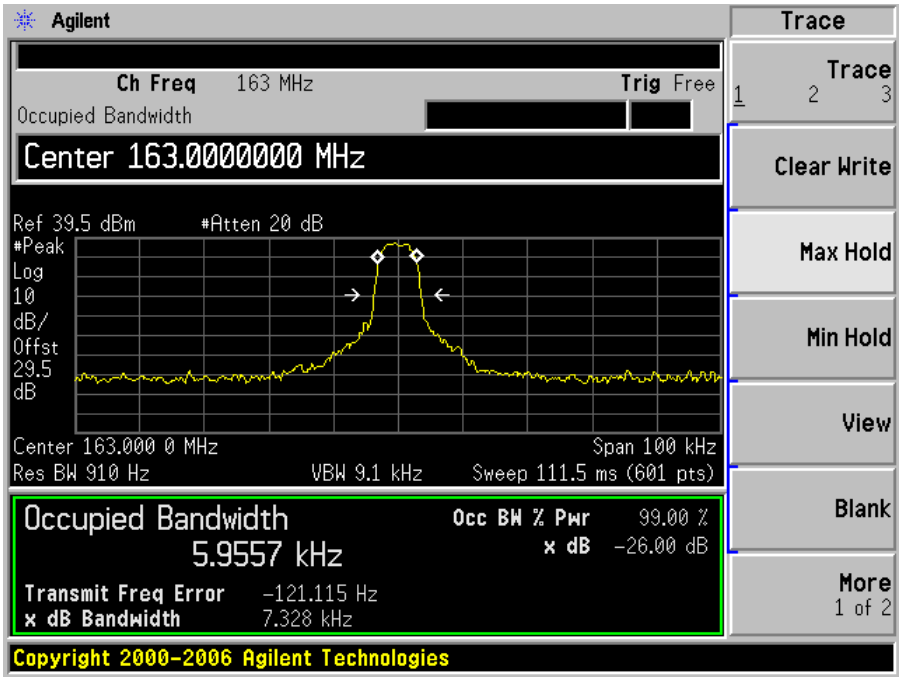


12.5 kHz channel Spacing with CQPSK

Input



Output



7 FCC §90.210 - Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

Requirements: FCC §90.543 and §90.210.

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency .

7.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator 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 10^{th} harmonic.

7.3 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li on 2011-05-24 in RF Site.

7.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

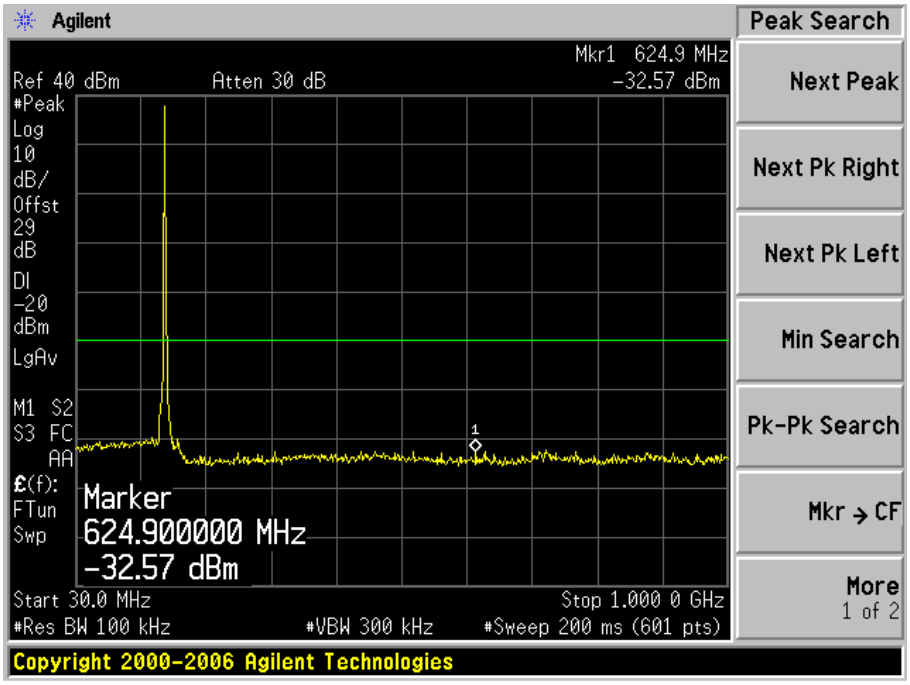
Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

7.5 Test Results

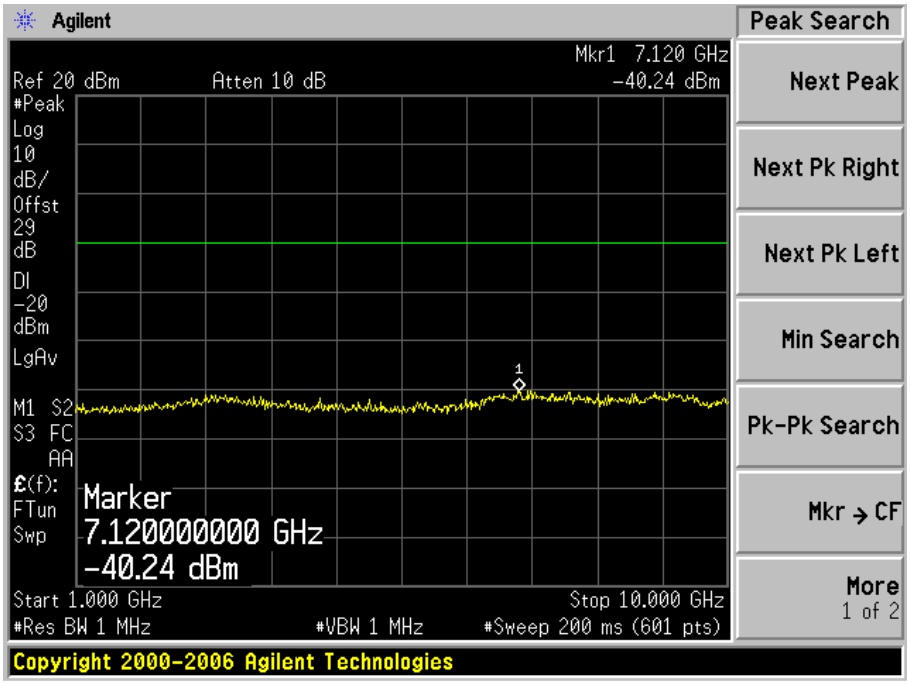
Please refer to the plot hereinafter.

Middle Channel (163 MHz)

30 MHz ~ 1 GHz



1 GHz~10 GHz



8 FCC §90.210 & §2.1047– Intermodulation Characteristics

8.1 Applicable Standard

Requirements: §2.1047 and §90.210.

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency.

8.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator 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:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li on 2011-05-25 in RF Site.

8.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

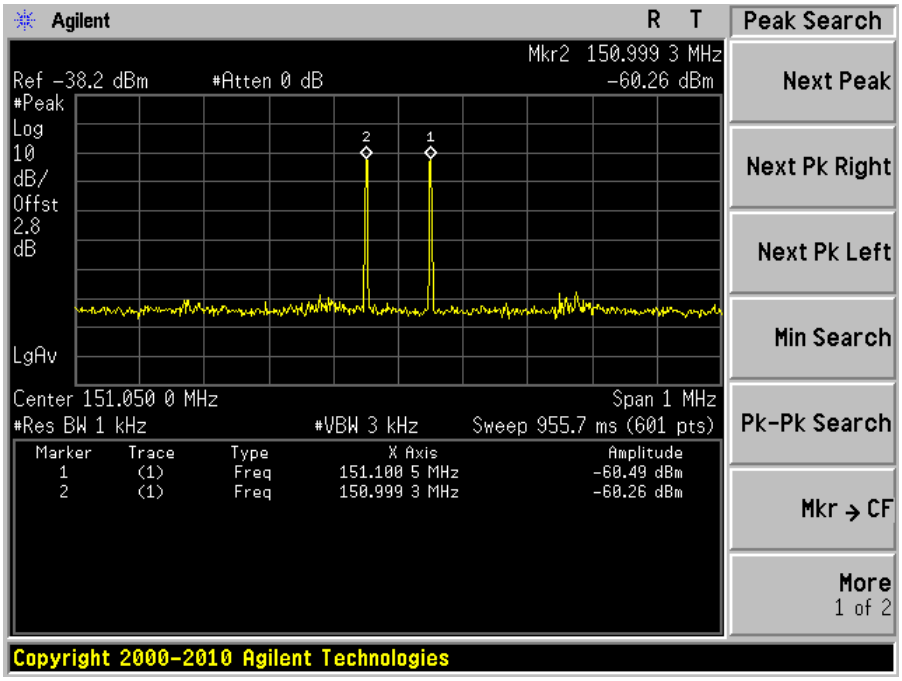
Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

8.5 Test Results

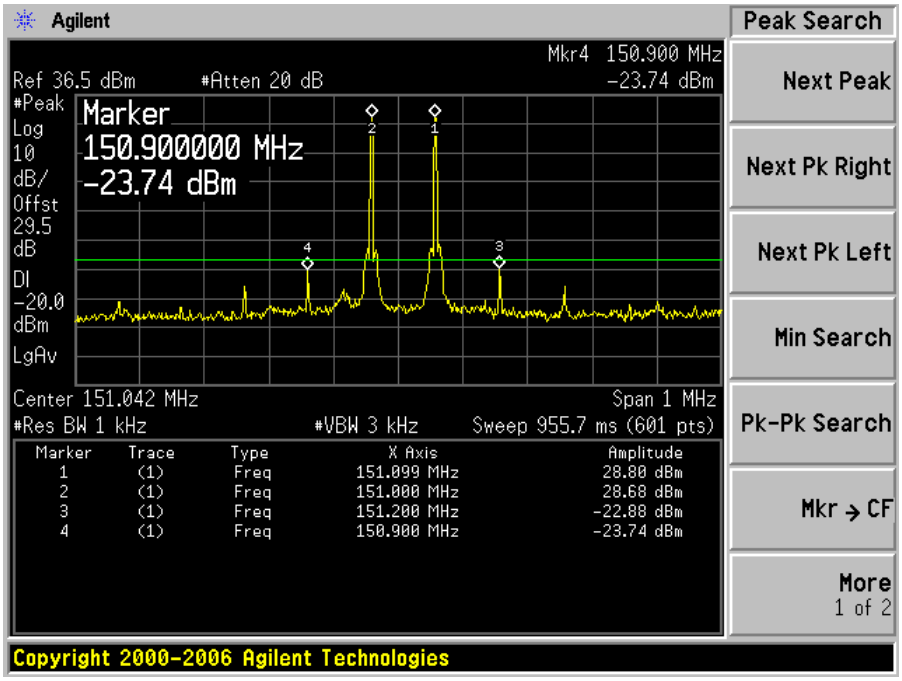
Please refer to the plots hereinafter.

Low Channel: 151 MHz

Input

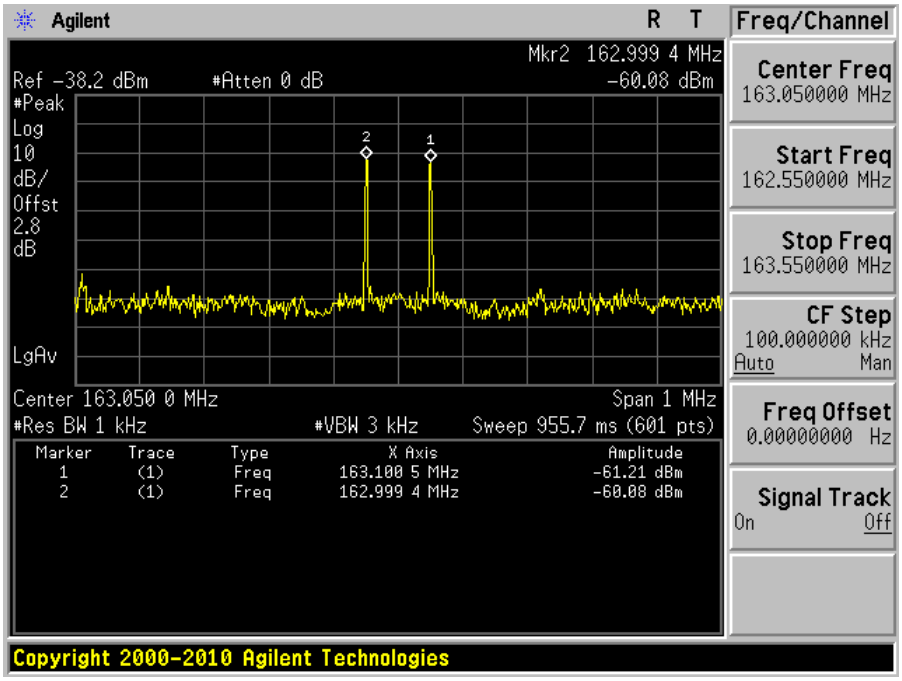


Output

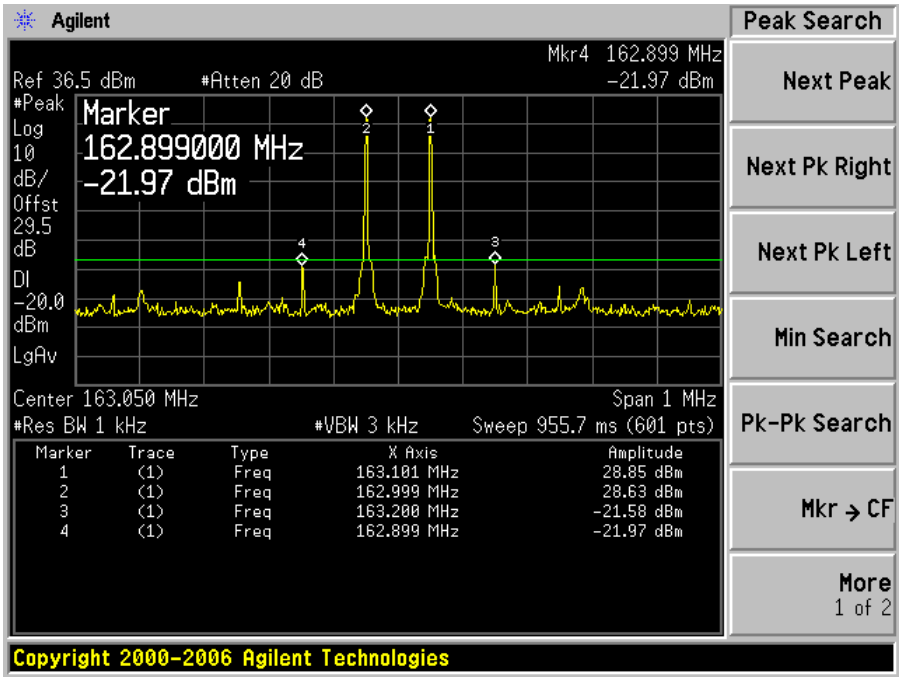


Middle Channel: 163 MHz

Input

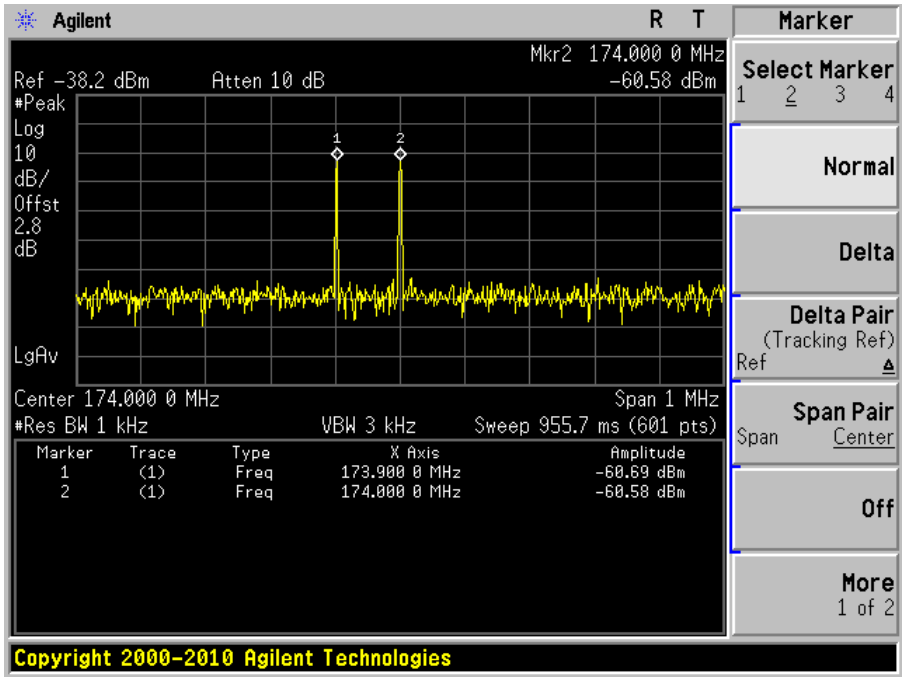


Output

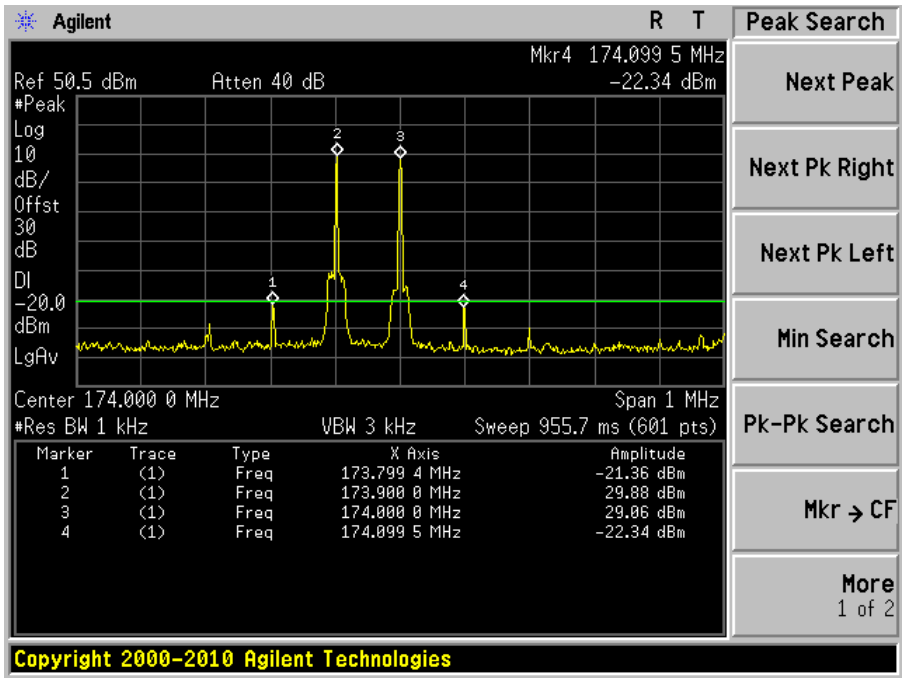


Highest Channel: 174 MHz

Input



Output



9 FCC §2.1053 & §90.210 - Spurious Radiated Emissions

9.1 Applicable Standard

Requirements: FCC §2.1053 and §90.210.

9.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load 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 log (TX Power in Watts/0.001) – the absolute level
Spurious attenuation limit in dB = 43 + 10 Log10 (power out in Watts)

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-24
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	2010-11-29
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2011-05-11

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

9.4 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li 2011-05-24 in 5 meter Chamber 3.

9.5 Test Results

Middle Channel 163 MHz

30 MHz – 2 GHz

Indicated		Turntable Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Cord. (dB)	Cable Loss (dB)	Absolute Level (dBm)		
256	42.44	189	149	V	256	-64.97	0	0.5	-65.47	-20	-45.47
256	41.16	334	236	H	256	-67.47	0	0.5	-67.97	-20	-47.97
250	39.81	163	110	V	250	-66.45	0	0.5	-66.95	-20	-46.95
250	39.65	101	183	H	250	-68.94	0	0.5	-69.44	-20	-49.44
320	33.34	52	241	V	320	-68.92	0	0.5	-69.42	-20	-49.42
320	37.85	343	156	H	320	-70.91	0	0.5	-71.41	-20	-51.41

10 FCC §90.210 – Emission Masks

10.1 Applicable Standard

Requirements: FCC §90.210.

10.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show the band edge emissions.

10.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

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

10.4 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

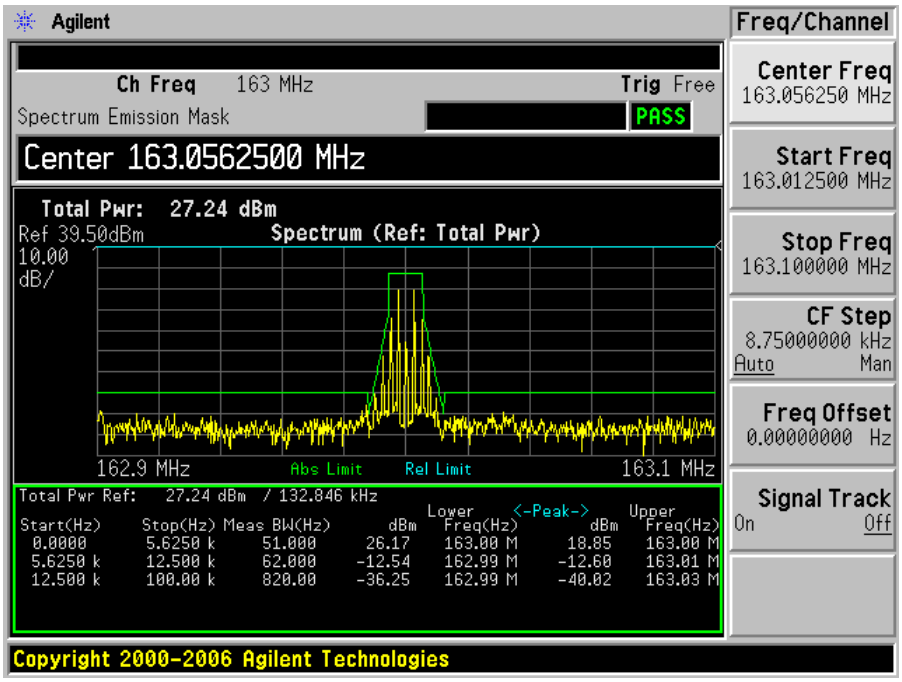
The testing was performed by Kevin Li on 2011-05-25 in RF Site.

10.5 Test Results

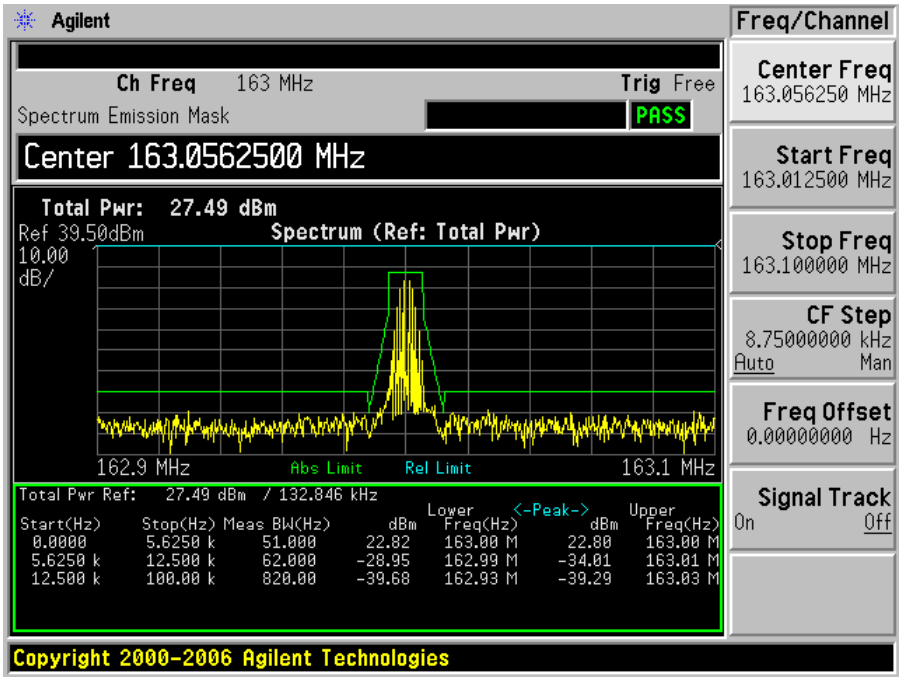
Please refer to the plots hereinafter.

Low Power Configuration:

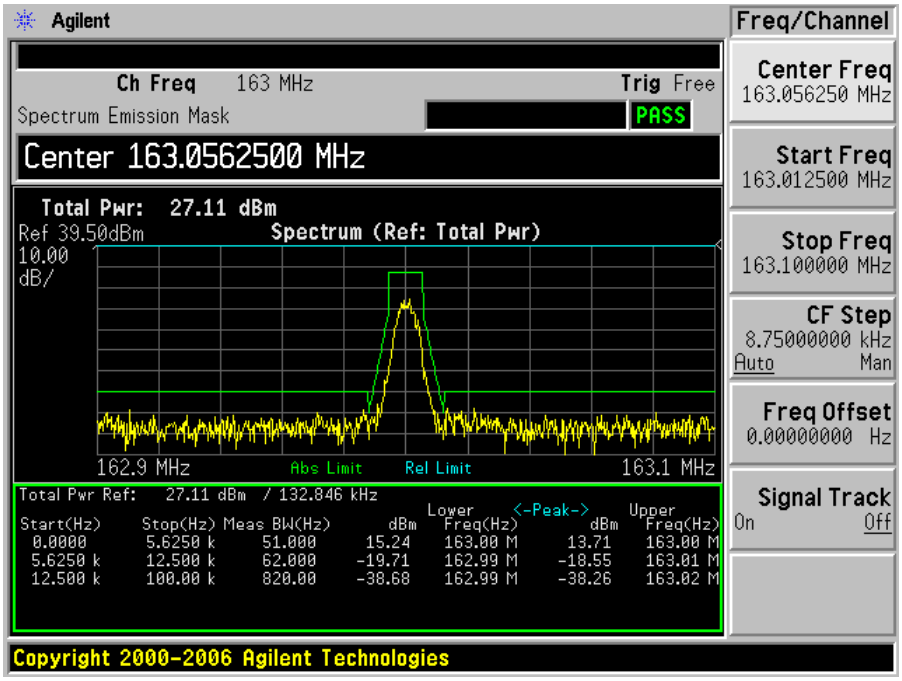
12.5 kHz channel Spacing with FM Voice



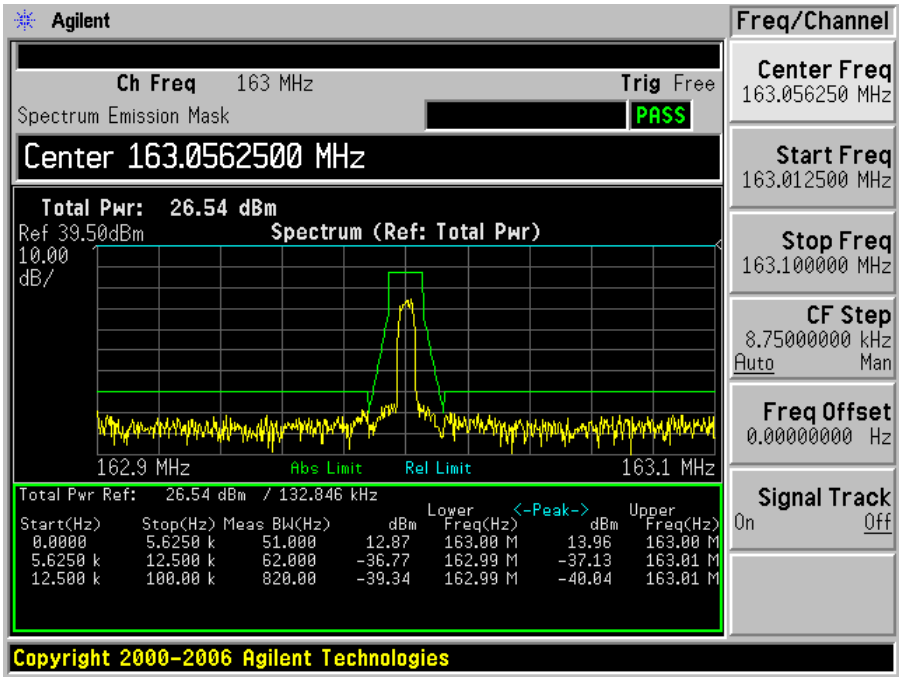
12.5 kHz channel Spacing with FM Data



12.5 kHz channel Spacing with C4FM

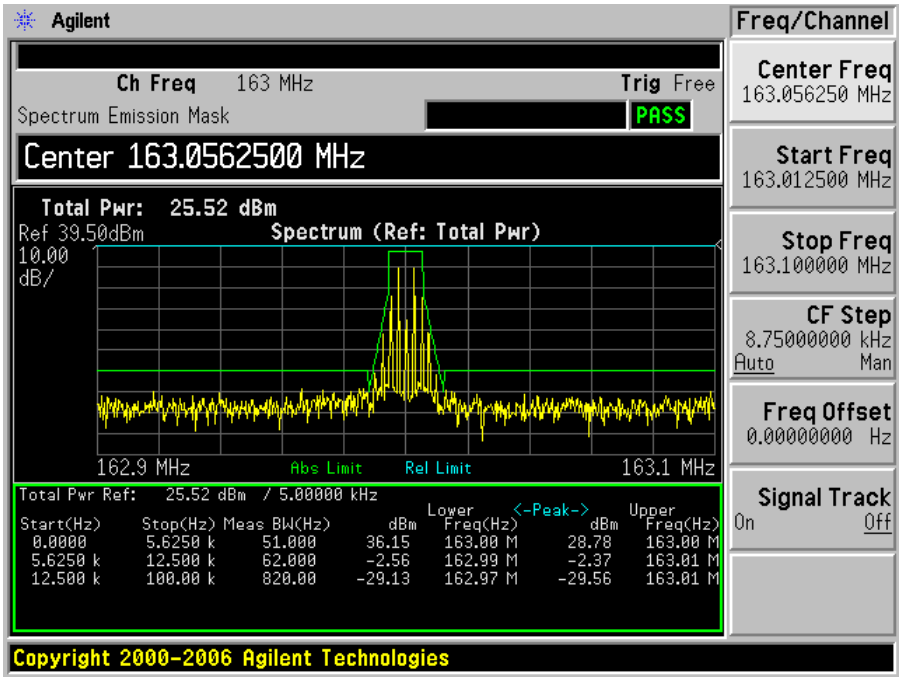


12.5 kHz channel Spacing with CQPSK

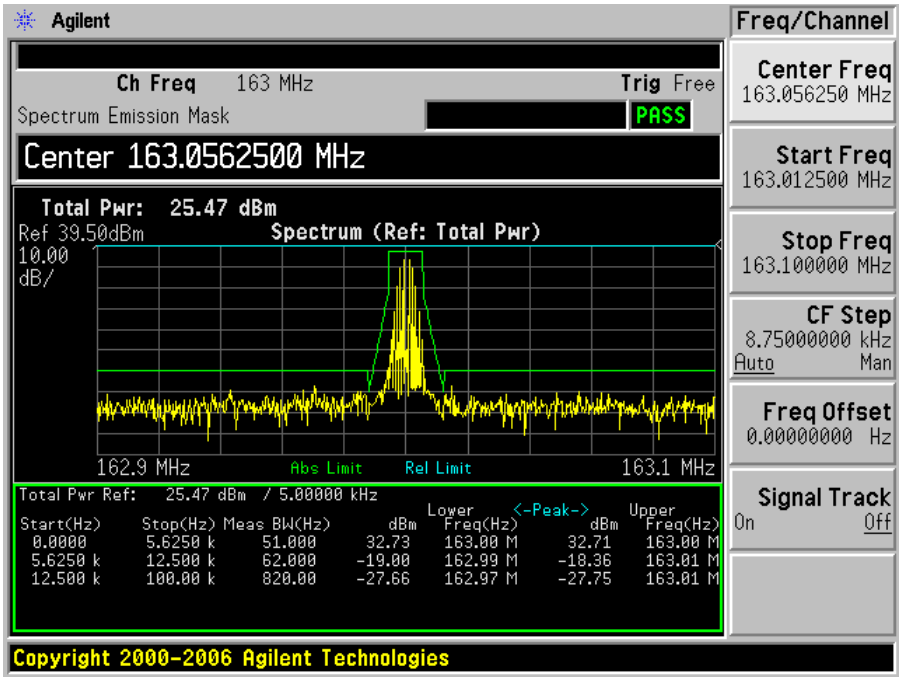


High Power Configuration:

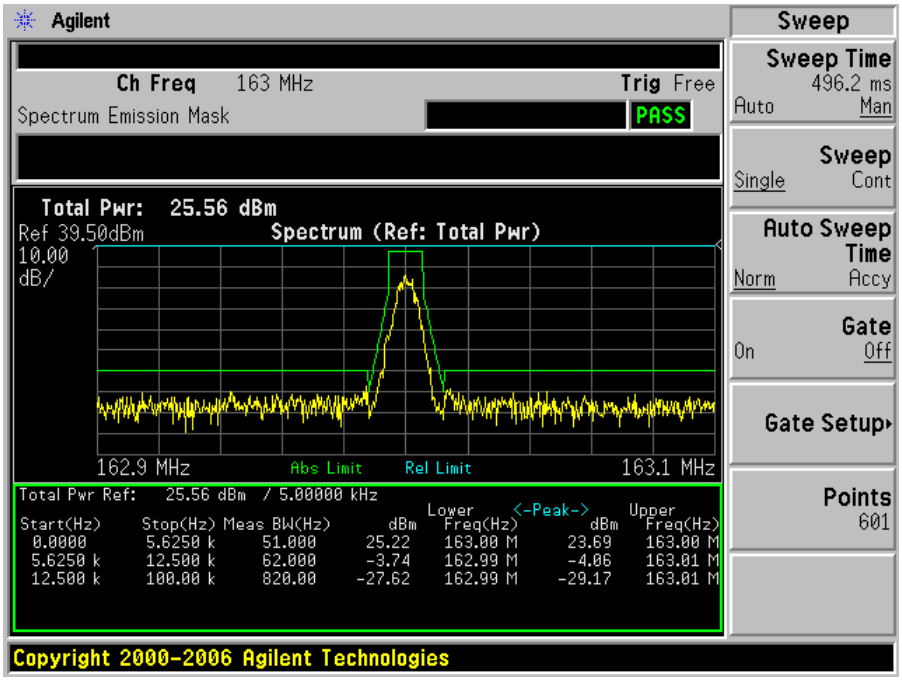
12.5 kHz channel Spacing with FM Voice



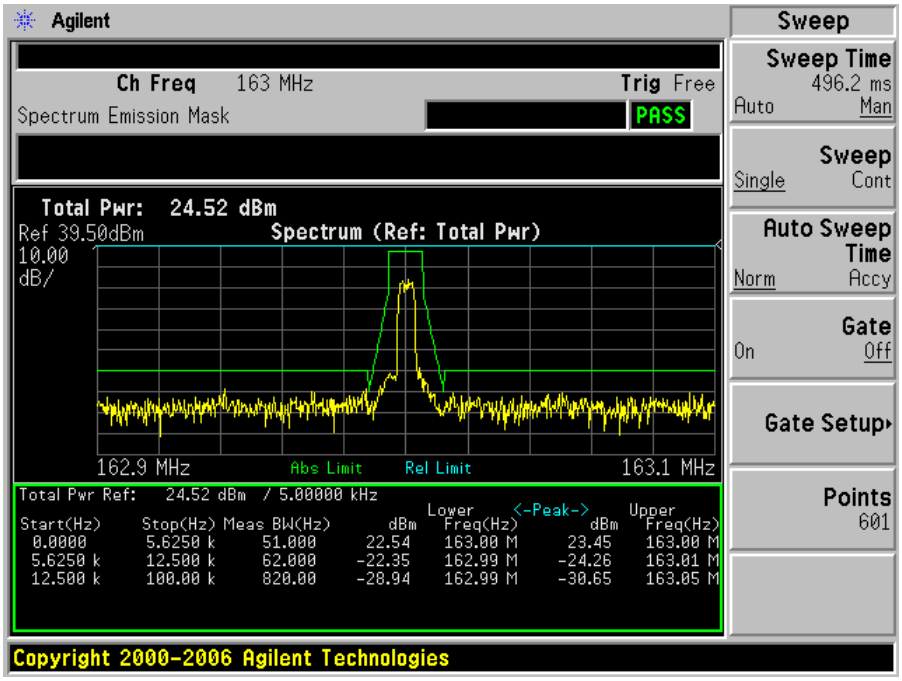
12.5 kHz channel Spacing with FM Data



12.5 kHz channel Spacing with C4FM



12.5 kHz channel Spacing with CQPSK



11 FCC §1.1307(b) (1) & §2.1091 - RF Exposure Information

11.1 Applicable Standard

According to FCC §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1824/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6
Limits for General Population/Uncontrolled Exposures				
0.3-1.34	614	1.63	*1(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

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

11.2 MPE Calculation

Predication of MPE 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

For General Population/Uncontrolled Exposure:

Maximum peak output power at antenna input terminal (dBm):	37.0
Maximum peak output power at antenna input terminal (mW):	5012
Prediction distance (cm):	100
Prediction frequency (MHz):	163
Antenna Gain (dBi):	7.01
Maximum Antenna Gain (numeric):	5.026
Power density at predication frequency and distance (mW/cm^2):	0.2
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	0.2

For Occupational/Controlled Exposure:

Maximum peak output power at antenna input terminal (dBm):	37.0
Maximum peak output power at antenna input terminal (mW):	5012
Prediction distance (cm):	100
Prediction frequency (MHz):	163
Antenna Gain (dBi):	14.0
Maximum Antenna Gain (numeric):	25.12
Power density at predication frequency and distance (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	1.0

11.3 Test Results

The antenna of the device should have at least 100 cm prediction distance with MAX antenna gain of 7.01dBi for general/uncontrolled environment and 14.0 dBi for occupation/controlled environment to meet the MPE limit.