FCC PART 90

TEST AND MEASUREMENT REPORT

For

TPL Communications Inc.

3370 San Fernando Road, Unit 206,

Los Angeles, CA 90065, USA

FCC ID: BBD3-125

Report Type:	Product Type:
Original Report	VHF RF Power Amplifier

Prepared By	Wei Sun
Report Number	R1208013-90
Report Date	2012-09-26
Reviewed By	Victor Zhang EMC/RF Lead

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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1208013-90	Original Report	2012-09-26

1 GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *TPL Communications, Inc*., and their product, FCC ID:BBD3-125, model: PA3-1XE, which will henceforth be referred to as the EUT "Equipment Under Test". The EUT is a VHF RF Power Amplifier. Two 50 Ω UHF connectors are used to connect the input and output of the amplifier. The frequency band is: 136~174 MHz.

Specifications	
Frequency Bands	136-174 MHz
Modulation	FM
Emission Designator	F1E, F3E, F1D, F2D, F1W, F7W, FXW, FXE
RF Output Power	40-130 Watt
Channel Spacing	12.5 kHz
Power Supply	13.8 Vdc

1.2 Mechanical Description of EUT

The EUT Approximate measurement is: 29.5 cm (L) x 14 cm (W) x 7.6 cm (H). Weight: 2.3kg.

The test data gathered are from typical production sample, serial number: 12008013-1 assigned by BACL.

1.3 Objective

This type approval report is prepared on behalf of *TPL Communications, Inc.,* accordance with Part 90.

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, as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA603-C

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 CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: R-3729, C-4176, G-469, and T-1206. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was configured for testing according to TIA/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 EUT Exercise Software

Signal was sent through 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

Manufacturer	Description	Model	Serial Number
Electronic Measurements Inc.	TCR power supply	TCR 80S34-2-0V	92D-6839
IFI	Wideband Amplifier	CMX5001	2194-1296

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
TPL Communications, Inc	PCB Board	PA3-1XE	1029520

2.7 External I/O Cabling List and Details

Cable Descriptions	Length (m)	From	To
RF cable	<1	Signal Generator	Amplifier
RF cable	<1	Output/ EUT	Attenuator
RF cable	<1	Amplifier	Input/ EUT
RF cable	<1	Attenuator	Spectral Analyzer

3 SUMMARY OF TEST RESULTS

FCC Rules	Description of Tests	Results
§1.1310, §2.1091	RF Exposure	Compliant
§2.1046, §90.205	RF Output Power	Compliant
§2.1047, §90.207	Modulation Characteristics, Audio Frequency Response and Audio Filter Response	N/A [1]
§2.1049, §90.209/90.210	Occupied Bandwidth and Emission Mask	Compliant
§2.1051, §90.210	Spurious Emissions at Antenna Terminals	Compliant
§2.1055, §90.213	Frequency Stability	N/A[2]
§2.1051, §90.210	Field Strength of Spurious Radiation	Compliant
§ 90.214	Transient Frequency Behavior	N/A [1]

Note:

N/A[1] - Not applicable due to the EUT is a power amplifier and has no mix circuitry to modulate the RF signal.
N/A[2] - The EUT is the amplifier and does not contain modulation circuitry or frequency generation.

4 FCC §2.1091 - RF Exposure Information

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
1500-100,000	/	/	5	6

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

4.2 MPE Prediction

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

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

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

Maximum peak output power at antenna input terminal (dBm):	51.04
Maximum peak output power at antenna input terminal (W):	127.06
Prediction distance (cm):	60
Prediction frequency (MHz):	156
Antenna Gain (dBi)	0
Cable, typical (dB):	-4.47
Maximum Antenna Net (numeric):	0.357
Power density of prediction frequency at 60 cm (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Conclusion:

The device complies with the MPE requirements by providing a safe separation distance of at least 60 cm between the antenna and human body, including any radiating structure, and any persons when normally operated.

5 FCC §2.1046 & §90.205 – RF OUTPUT POWER

5.1 Applicable Standards

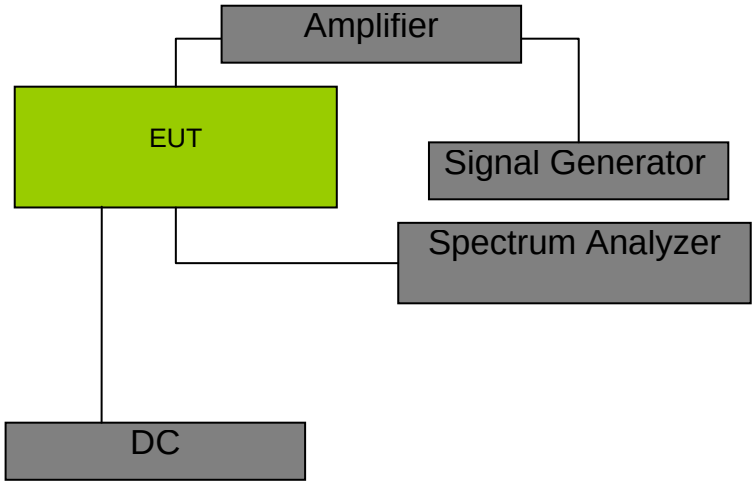
According to FCC §2.1046, and §90.205, maximum ERP is dependent upon the station's antenna HAAT and required service area.

5.2 Test Procedure

Conducted:

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

5.3 Test Setup Block Diagram



5.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10
HP	Signal Generator	8648C	3426A00417	2012-08-18
Agilent	Signal Generator	E4438C	MY45091309	2012-05-03
IFI	Wideband Amplifier	CMX5001	2194-1296	N/R

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

5.5 Test Environmental Conditions

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

The testing was performed by Wei Sun on 2012-08-22 on RF Site.

5.6 Test Results

Input power: 36.10 dBm (High power)

FM Voice Modulation

Frequency (MHz)	Conducted Output Power (dBm)	Conducted Output Power (Watt)
138.1	50.93	123.88
156	51.04	127.06
173.9	50.96	124.74

FM Data Modulation

Frequency (MHz)	Conducted Output Power (dBm)	Conducted Output Power (Watt)
138.1	50.92	123.59
156	51.05	127.35
173.9	51.01	126.18

Input power: 30.77 dBm (Low power)

FM Voice Modulation

Frequency (MHz)	Conducted Output Power (dBm)	Conducted Output Power (Watt)
138.1	46.01	39.90
156	46.21	41.78
173.9	46.03	40.09

FM Data Modulation

Frequency (MHz)	Conducted Output Power (dBm)	Conducted Output Power (Watt)
138.1	46.01	39.90
156	46.17	41.40
173.9	46.02	39.99

6 FCC §2.1049 & §90.209/210 – EMISSION BANDWIDTH & MASK

6.1 Applicable Standard

§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.

§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.

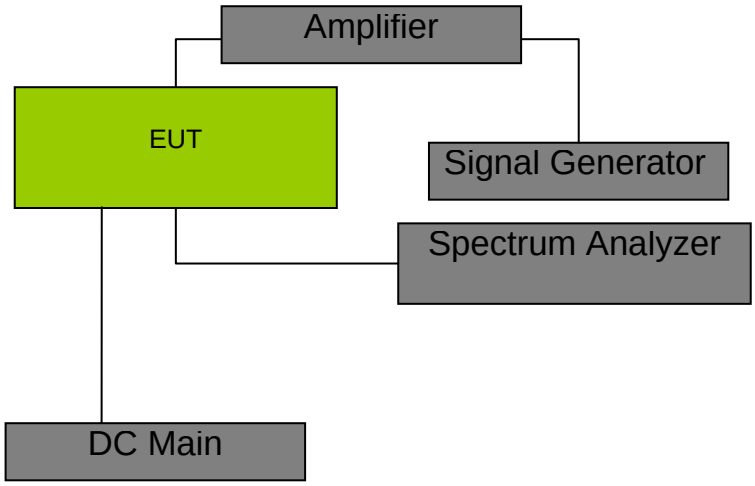
The resolution bandwidth was 100Hz or greater for measuring up to 250kHz from the edge of the authorized frequency segment, and 30kHz or greater for measuring more than 250kHz from the authorized frequency segment.

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 20 dB & 99% bandwidth was recorded.

6.3 Test Setup Block Diagram



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IFI	Wideband Amplifier	CMX5001	2194-1296	N/R

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

6.5 Test Environmental Conditions

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

The testing was performed by Wei Sun on 2012-08-22 on RF Site.

6.6 Test Results

For 12.5 kHz Channel Spacing, FM Voice Modulation

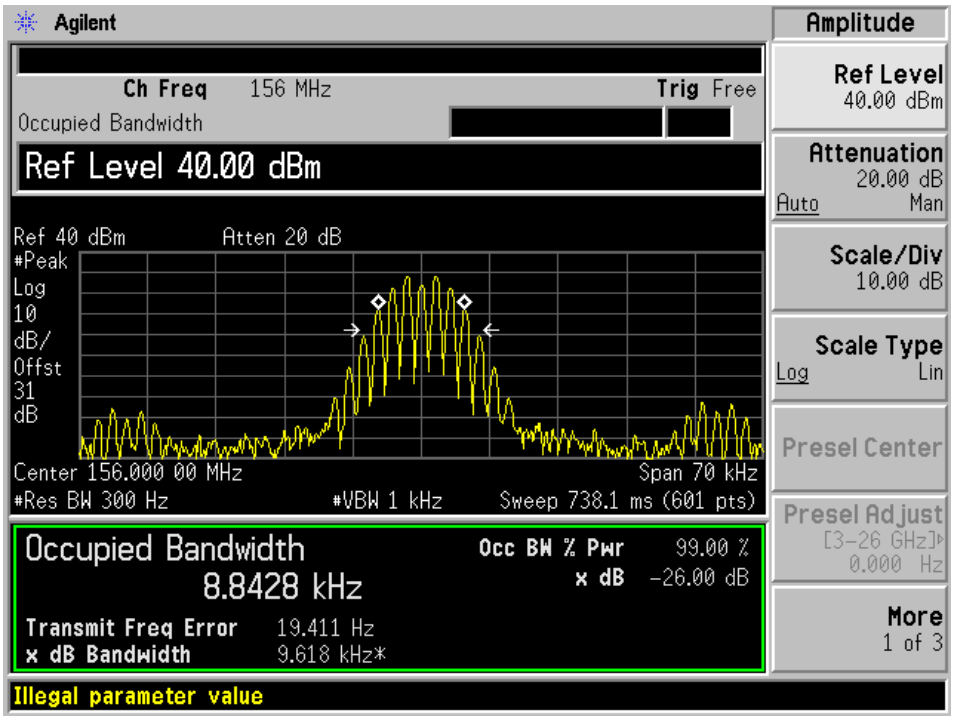
Frequency (MHz)	Input Occupied Bandwidth (kHz)	Output Occupied Bandwidth (kHz)
156	8.8428	8.8464

For 12.5 kHz Channel Spacing, FM Data Modulation

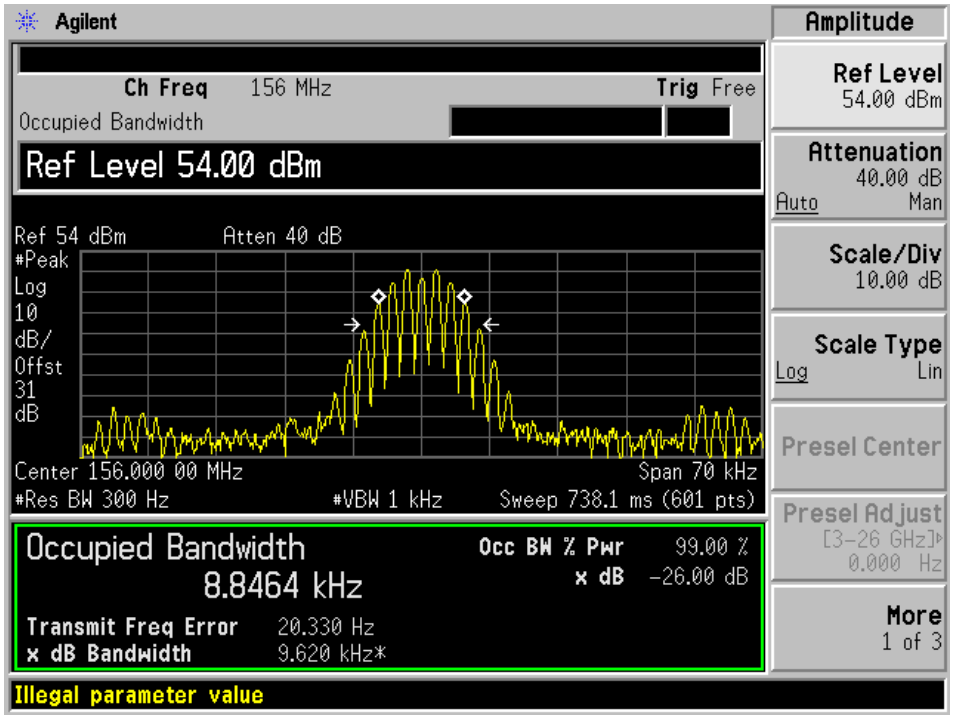
Frequency (MHz)	Input Occupied Bandwidth (kHz)	Output Occupied Bandwidth (kHz)
156	8.4367	8.4392

Please refer to the following plots:

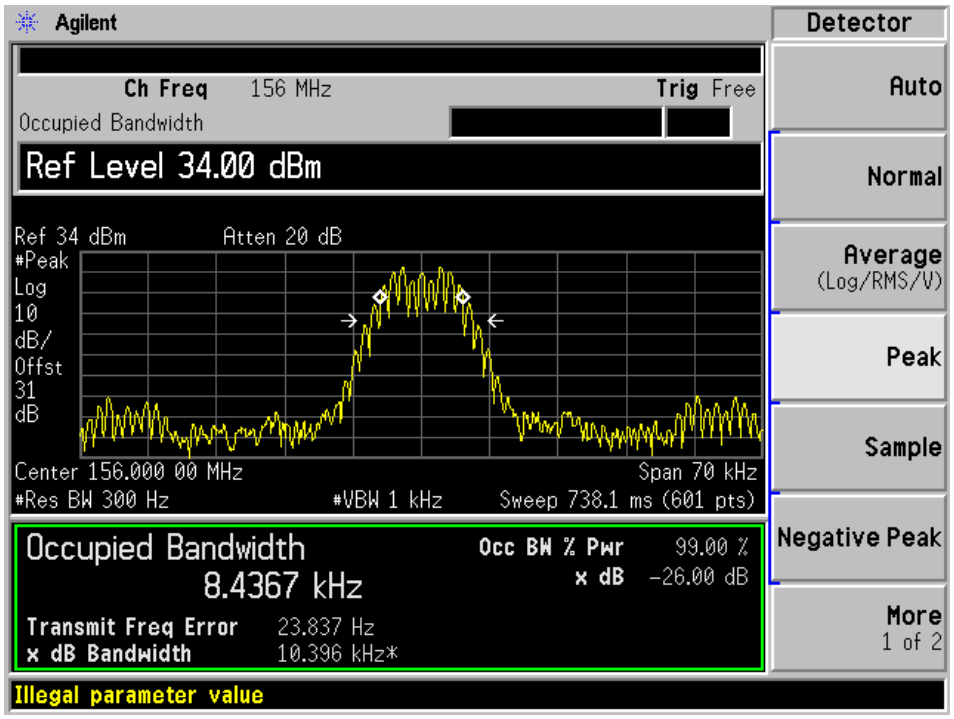
12.5 kHz channel Spacing with FM Voice Modulation Input



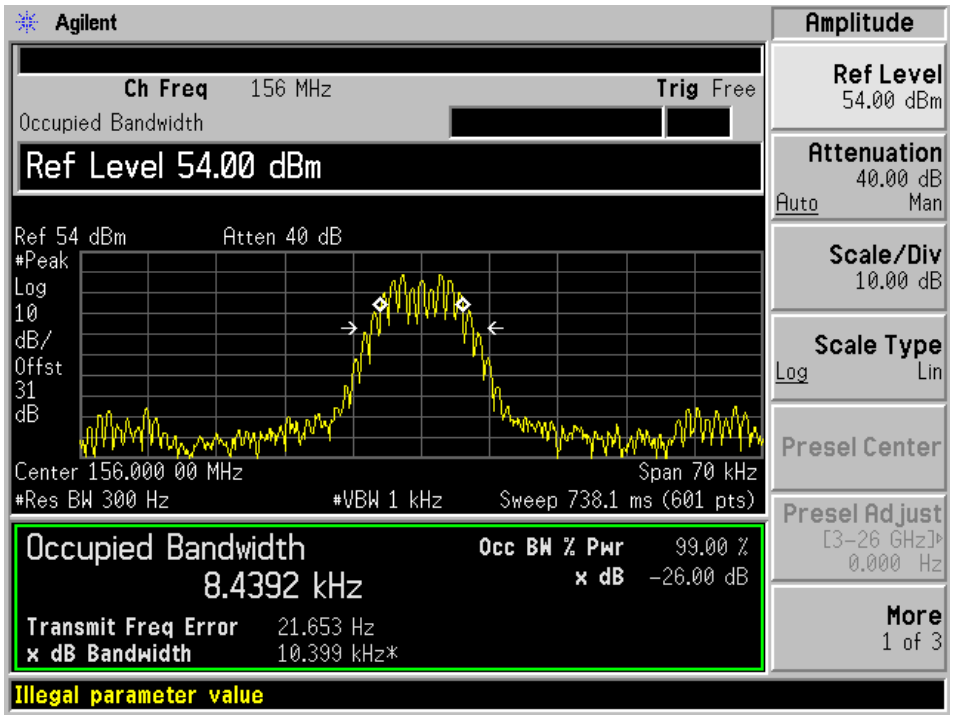
12.5 kHz channel Spacing with FM Voice Modulation Output



12.5 kHz channel Spacing with FM Data Modulation Input



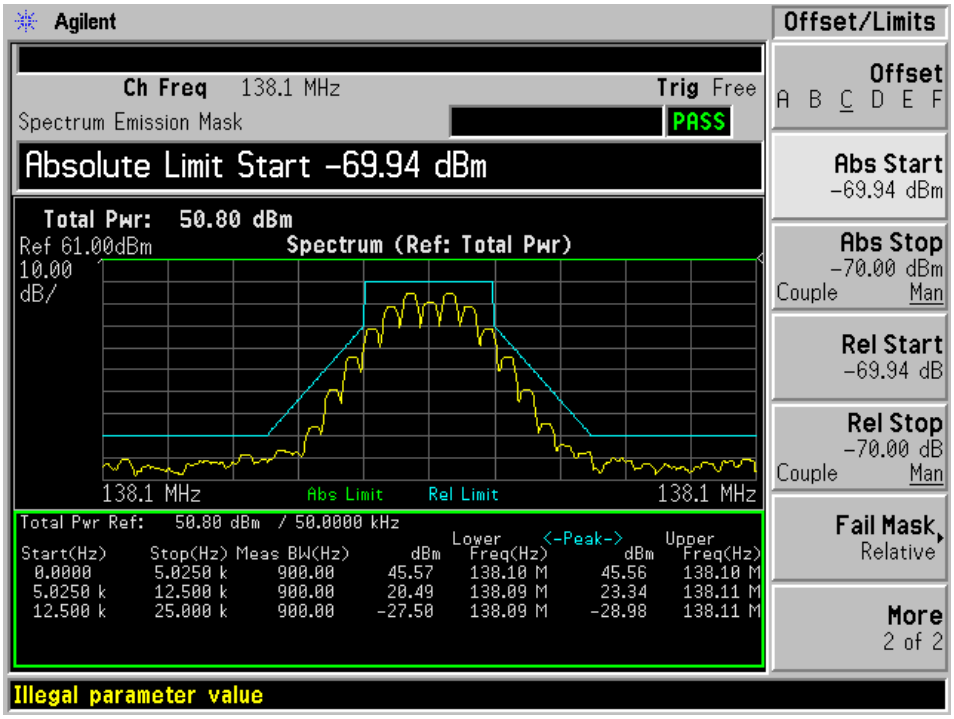
12.5 kHz channel Spacing with FM Data Modulation Output



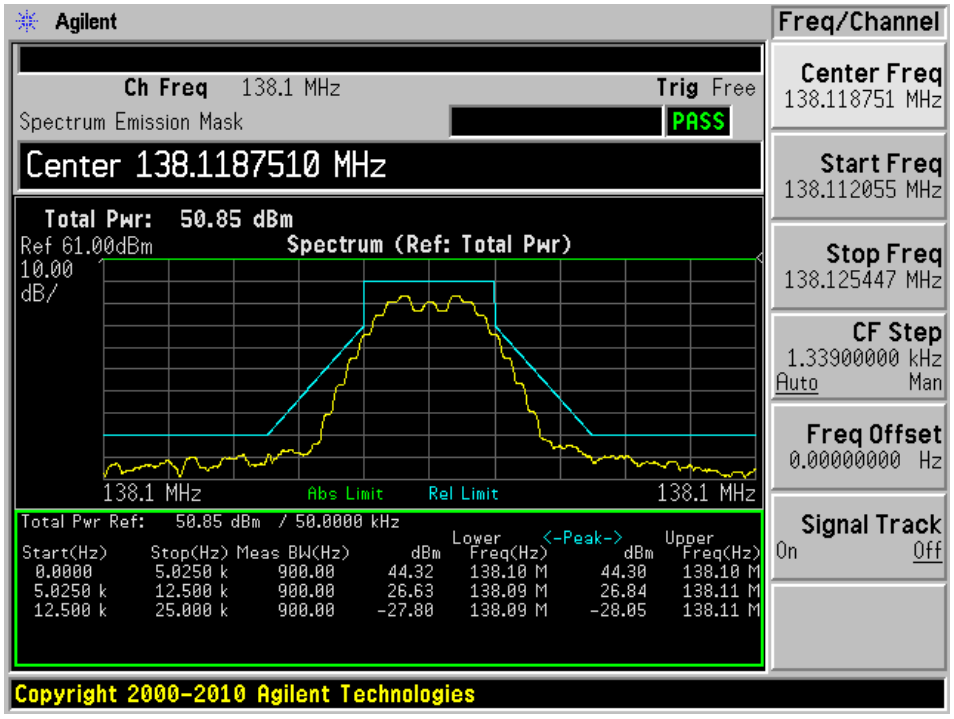
Emission Mask D

Low Channel: 138.1 MHz

12.5 kHz channel Spacing with FM Voice Modulation

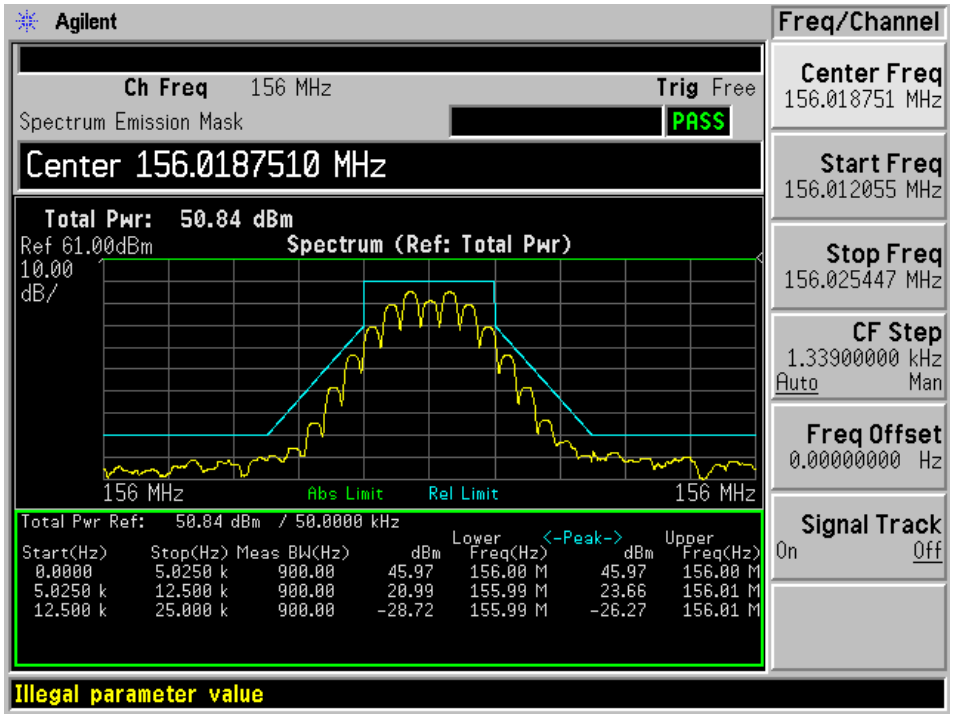


12.5 kHz channel Spacing with FM Data Modulation

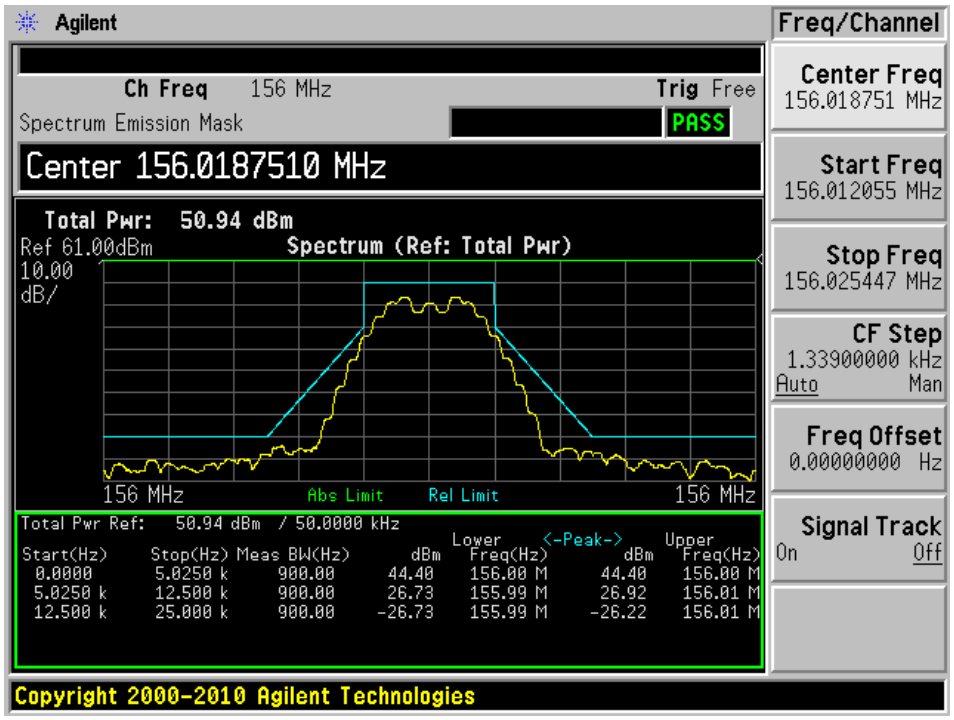


Middle Channel: 156 MHz

12.5 kHz channel Spacing with FM Voice Modulation

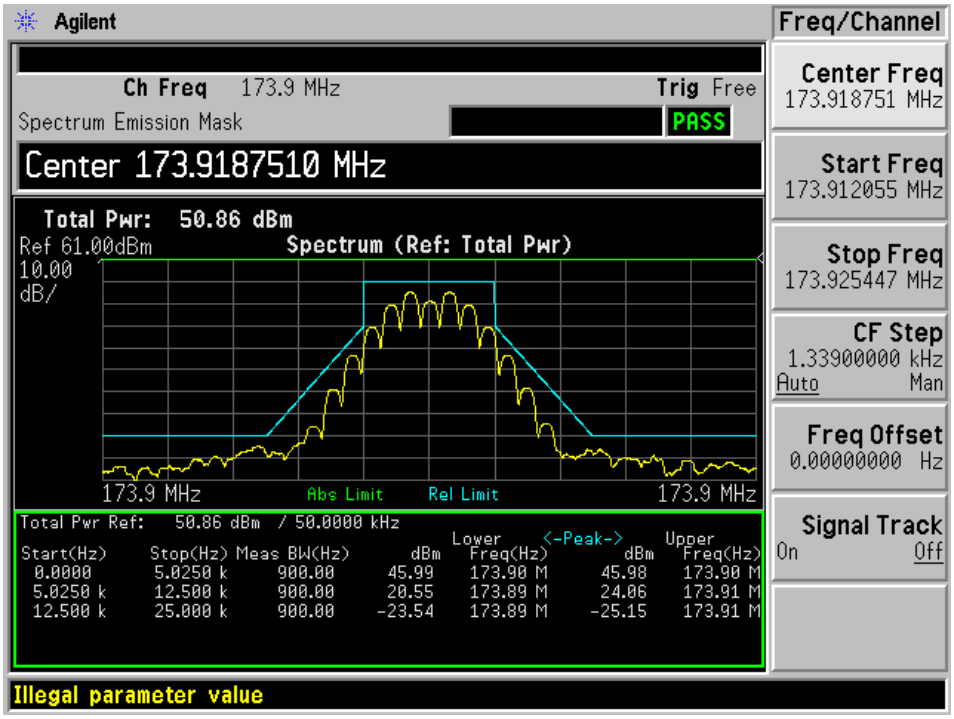


12.5 kHz channel Spacing with FM Data Modulation

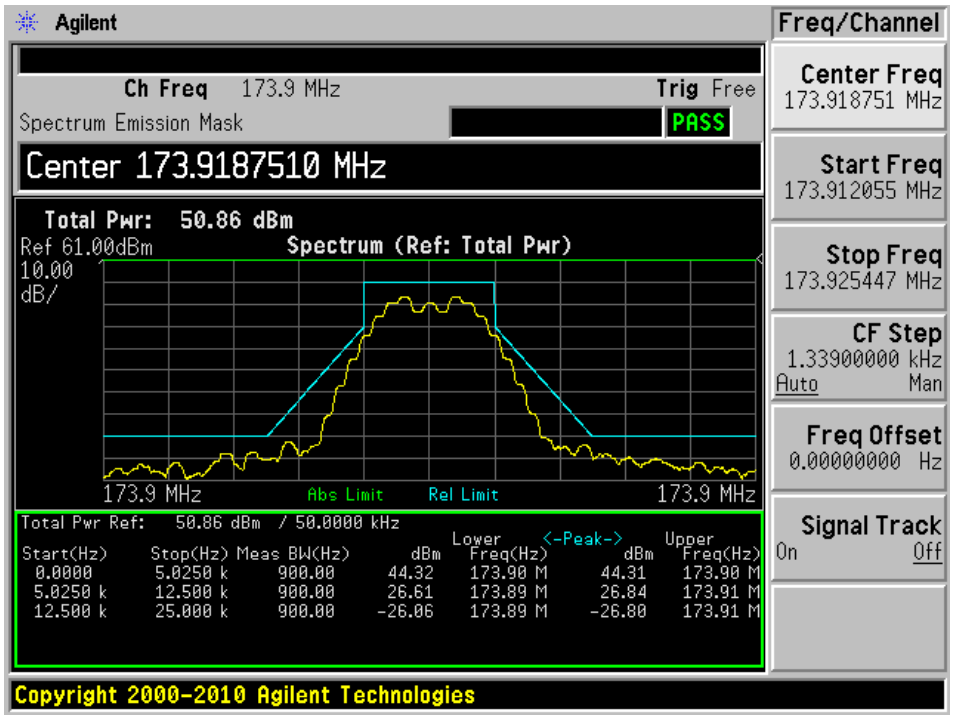


High Channel: 173.9 MHz

12.5 kHz channel Spacing with FM Voice Modulation



12.5 kHz channel Spacing with FM Data Modulation



7 FCC §2.1051 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

7.1 Applicable Standard

§90.210 (12.5 kHz bandwidth only)

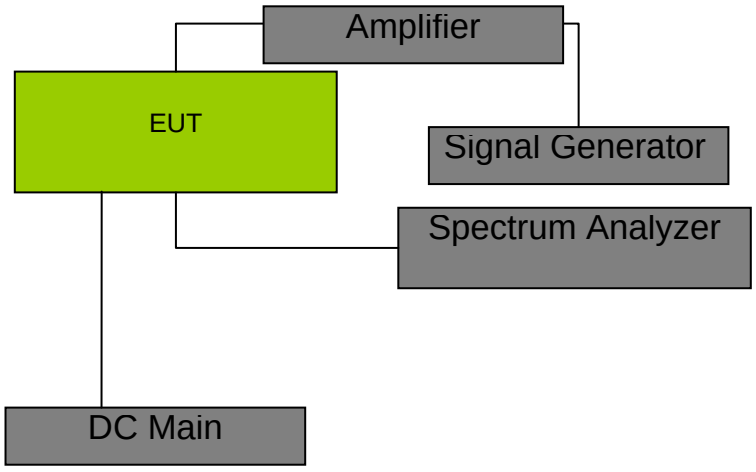
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5kHz at least:

50+10logP or 70 dB

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 10th harmonic.

7.3 Test Setup Block Diagram



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IFI	Wideband Amplifier	CMX5001	2194-1296	N/R

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

7.5 Test Environmental Conditions

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

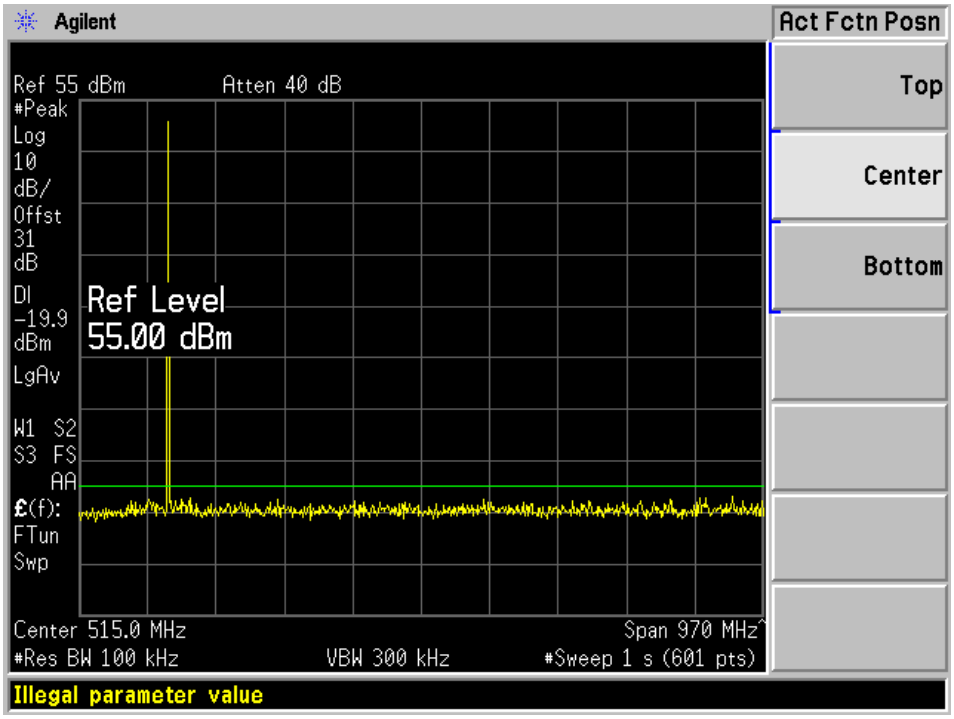
The testing was performed by Wei Sun on 2012-08-22 on RF Site.

7.6 Test Results

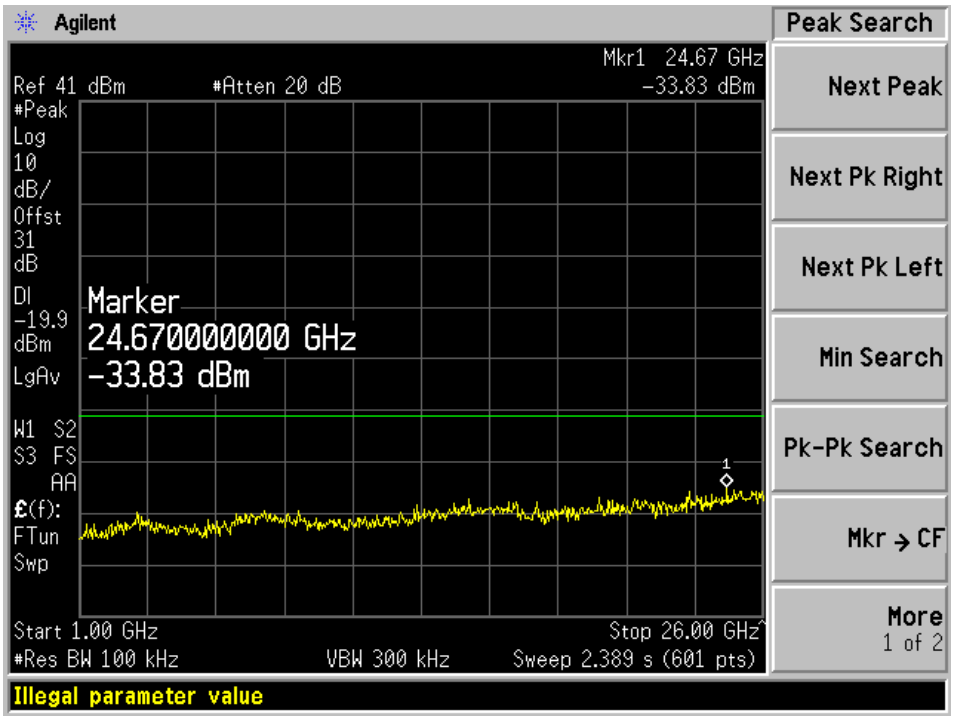
Please refer to the plot hereinafter.

Middle Channel: 156 MHz (Worst Case: CW Signal)

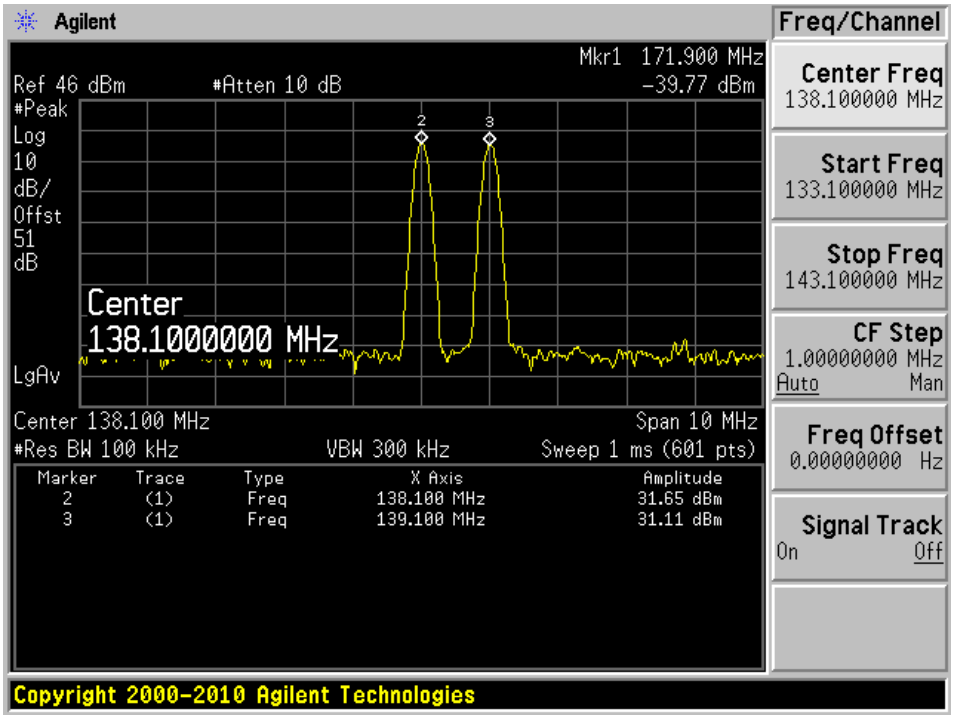
Plot 1: 30 MHz to 1 GHz



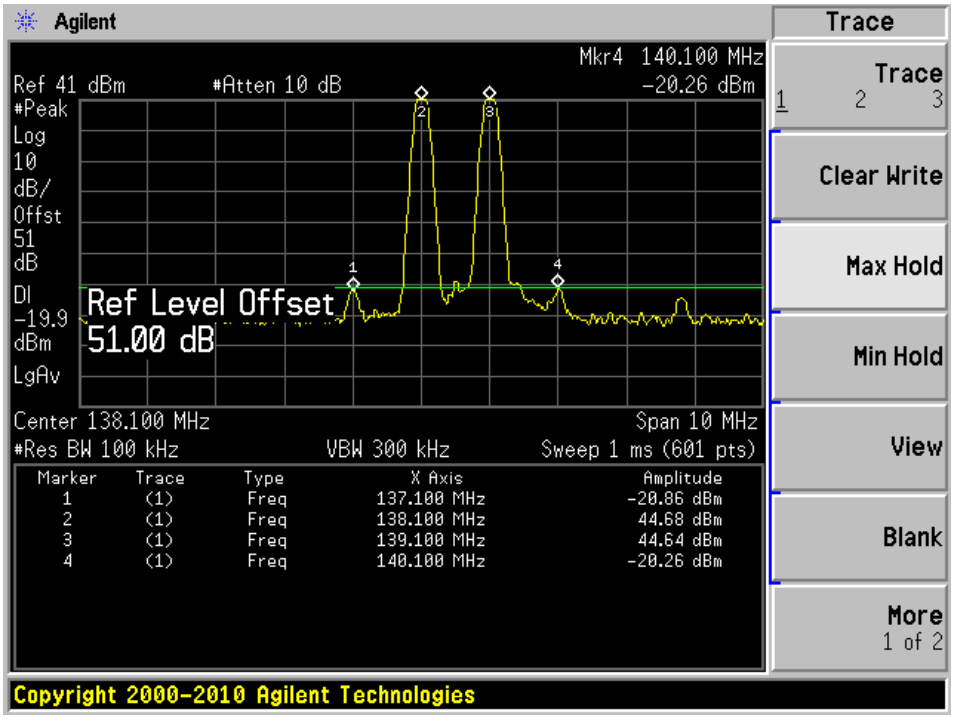
Plot 2: Above 1 GHz



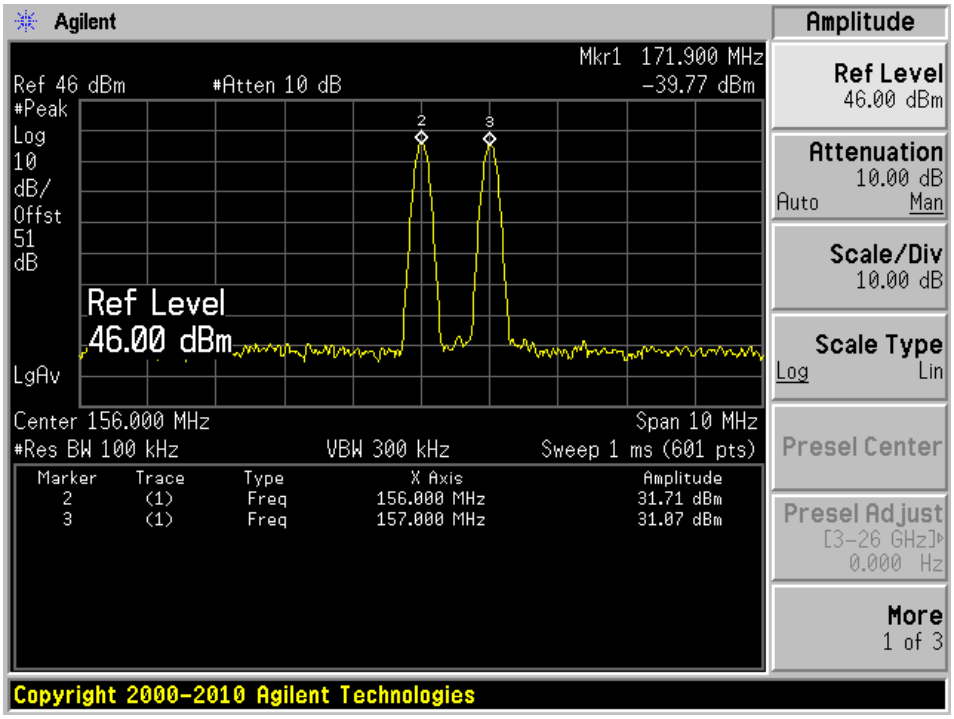
Inter-modulation, Two Tones, Low Channel, Input



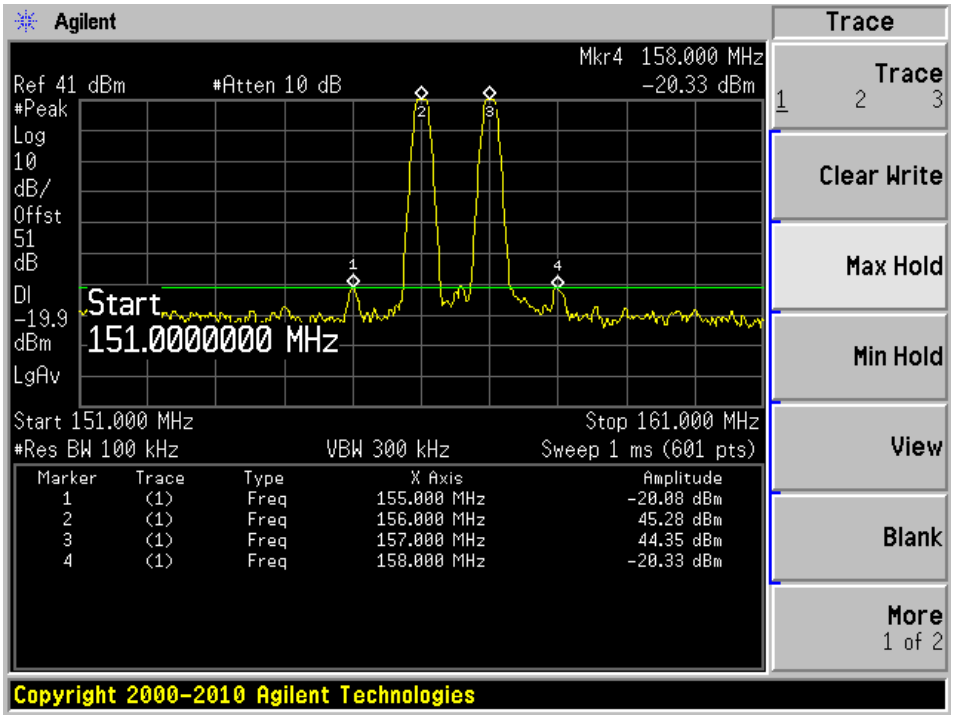
Inter-modulation, Two Tones, Low Channel, Output



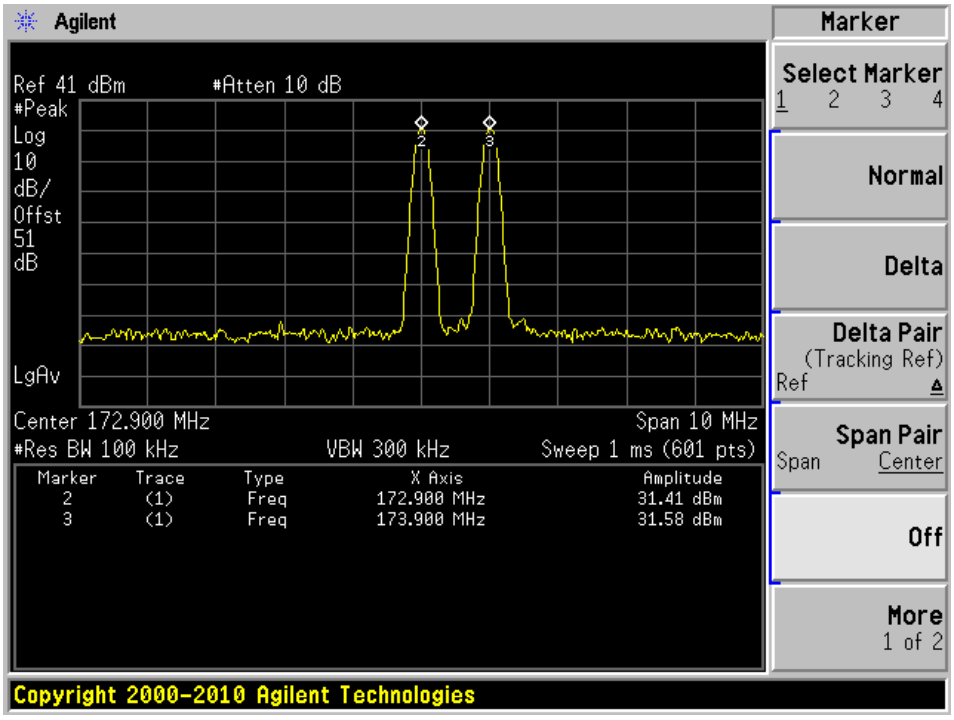
Inter-modulation, Two Tones, Middle Channel, Input



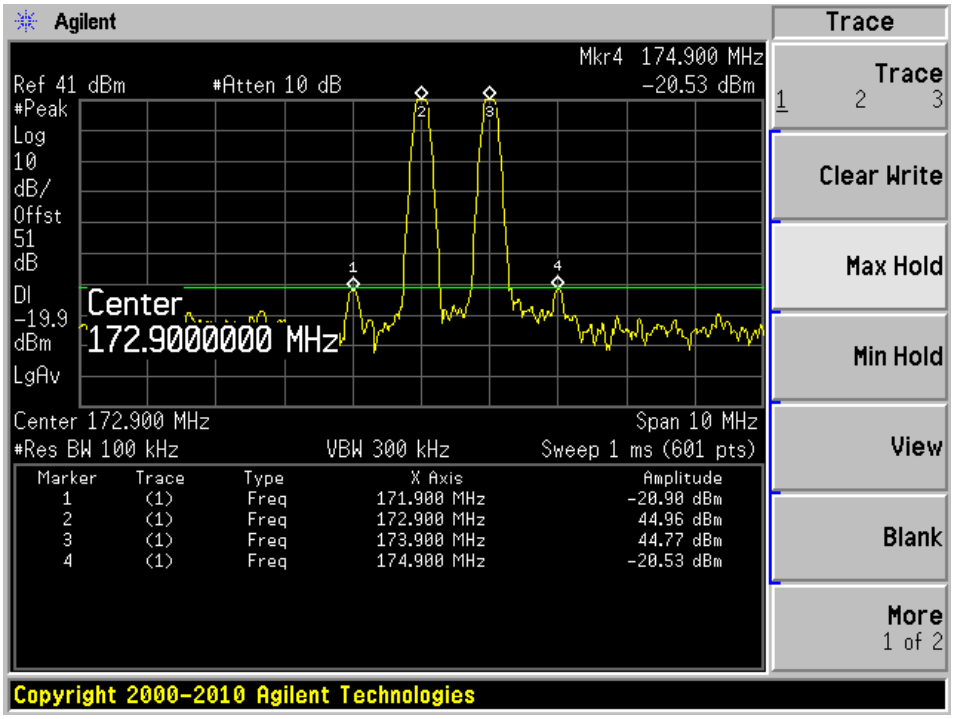
Inter-modulation, Two Tones, Middle Channel, Output



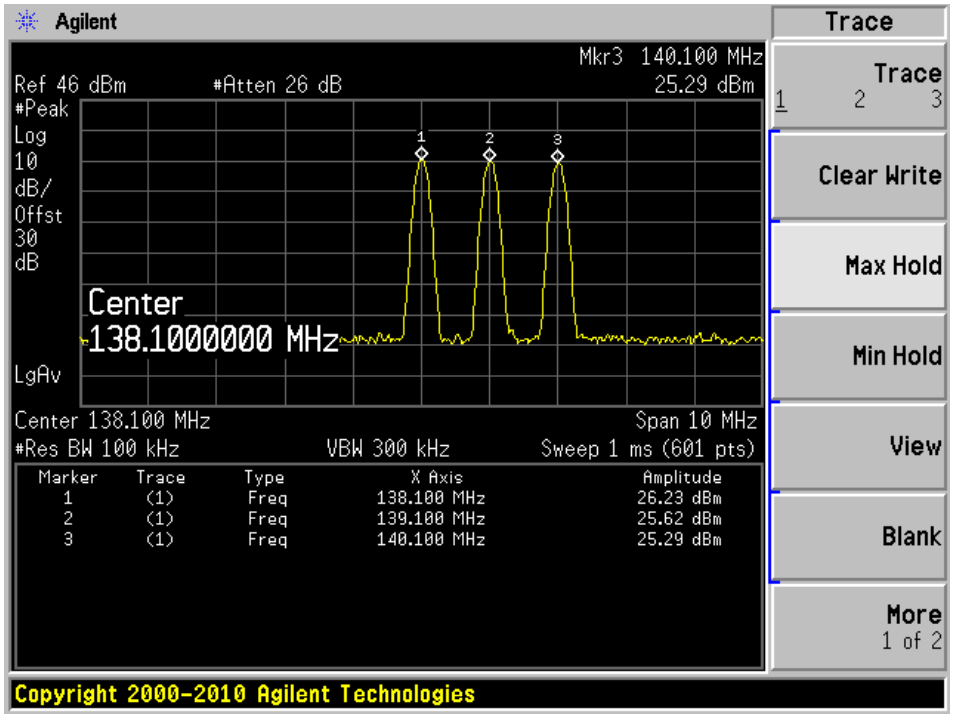
Inter-modulation, Two Tones, High Channel, Input



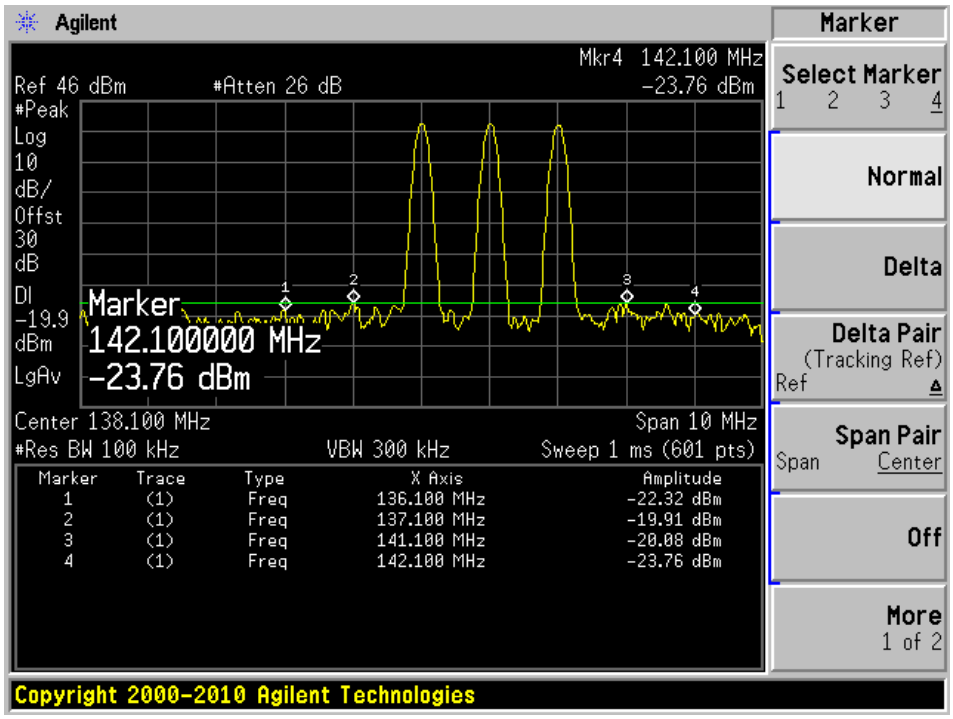
Inter-modulation, Two Tones, High Channel, Output



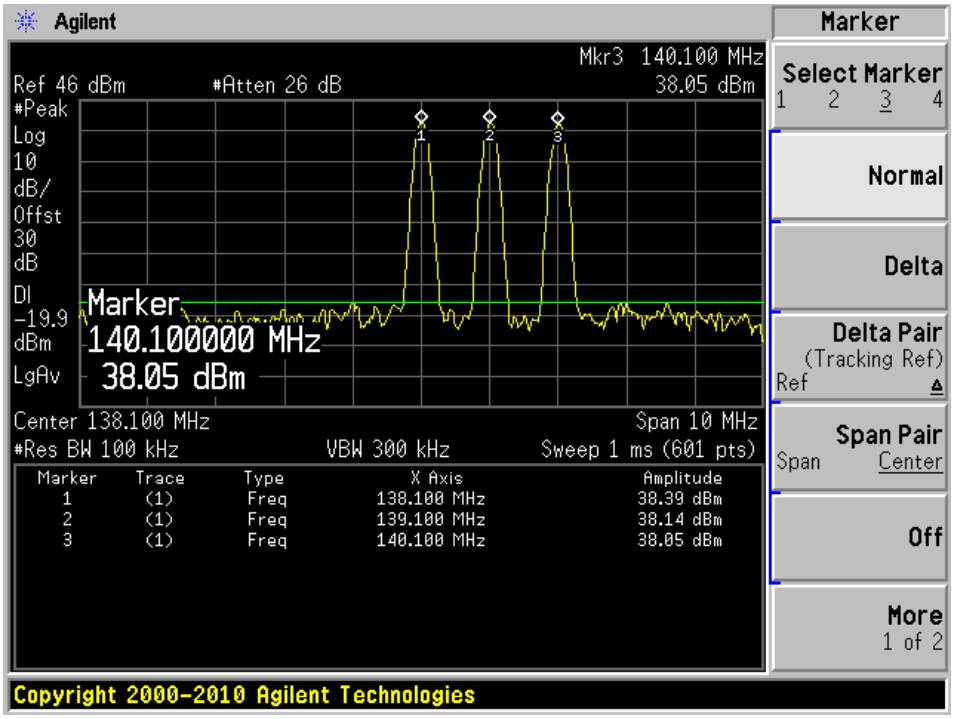
Inter-modulation, Three Tones, Low Channel, Input



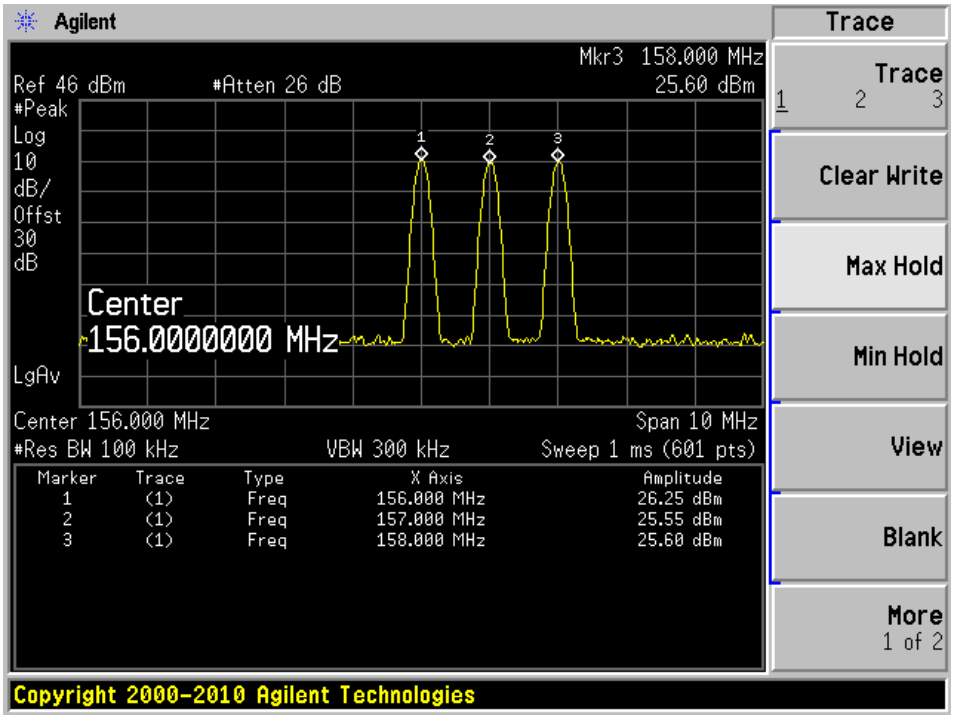
Inter-modulation, Three Tones, Low Channel, Output (1)



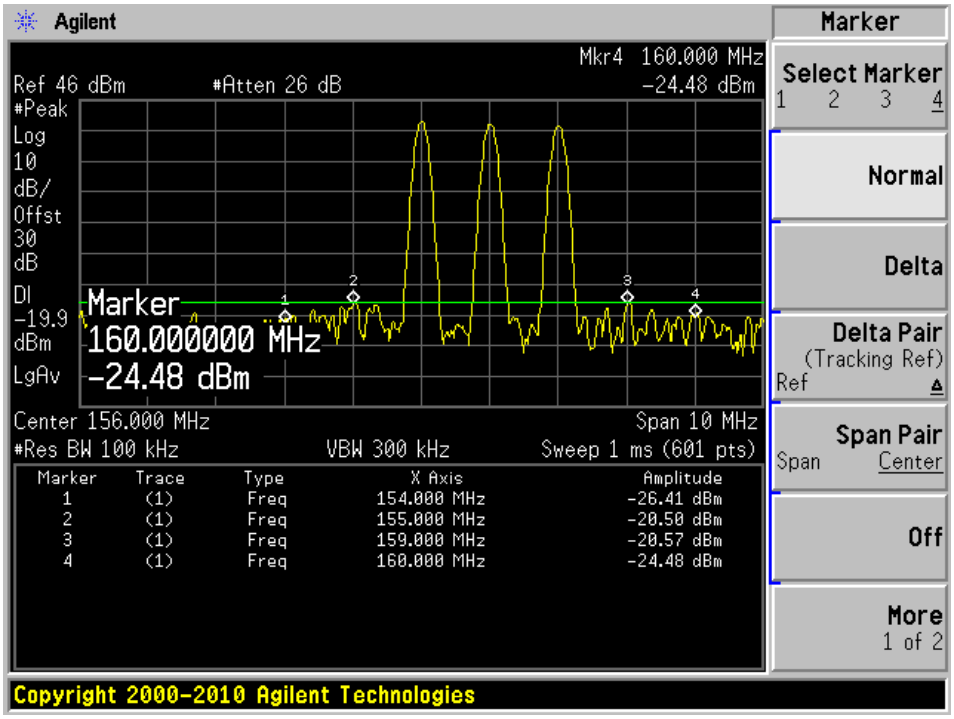
Inter-modulation, Three Tones, Low Channel, Output (2)



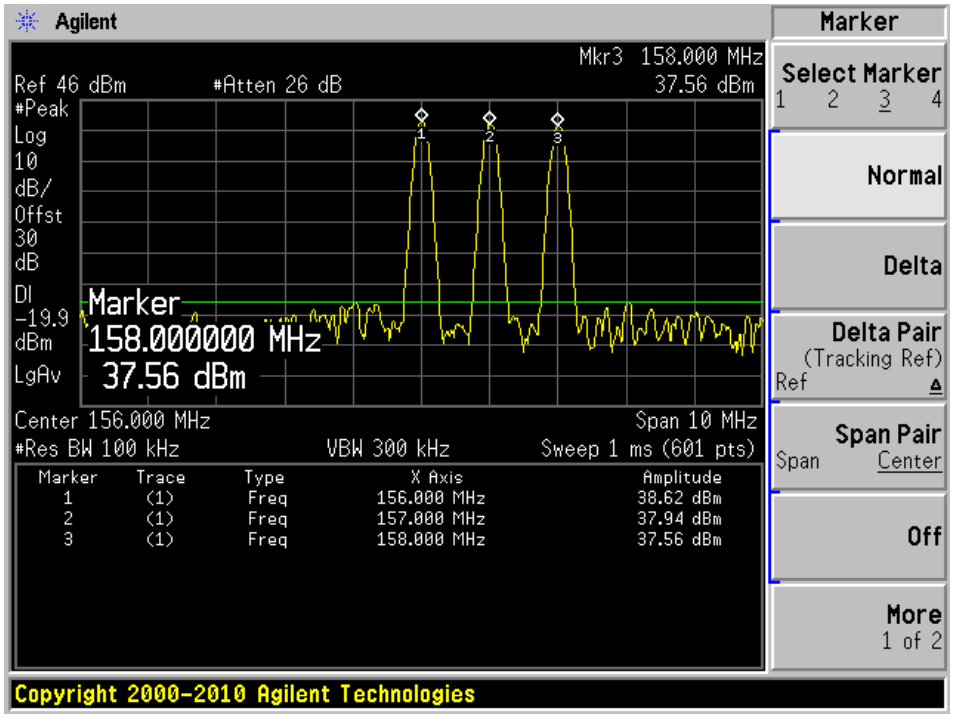
Inter-modulation, Three Tones, Middle Channel, Input



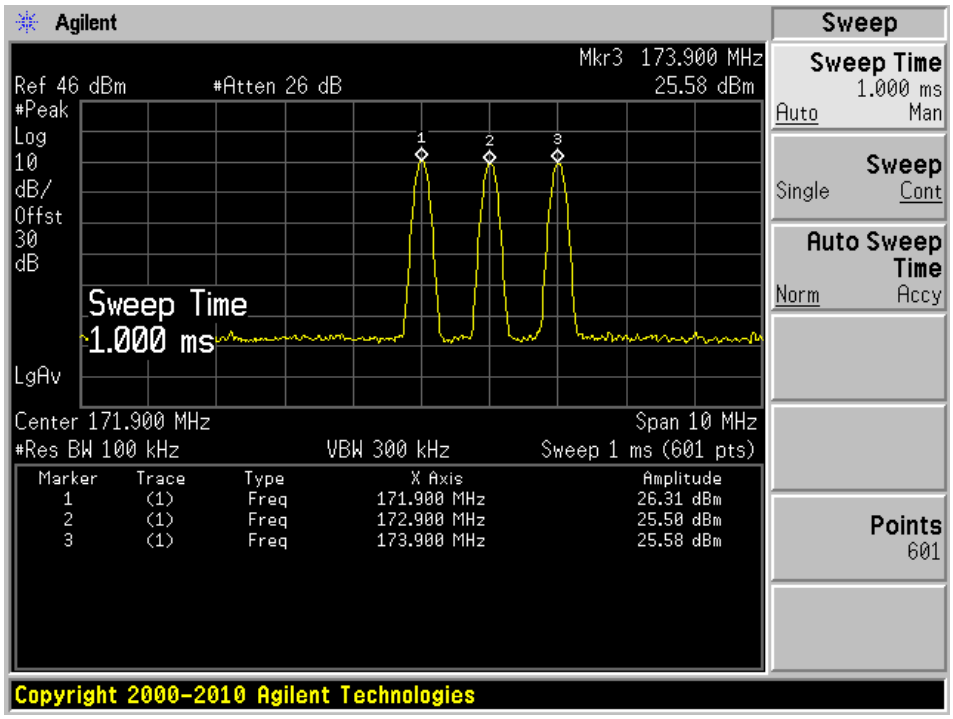
Inter-modulation, Three Tones, Middle Channel, Output (1)



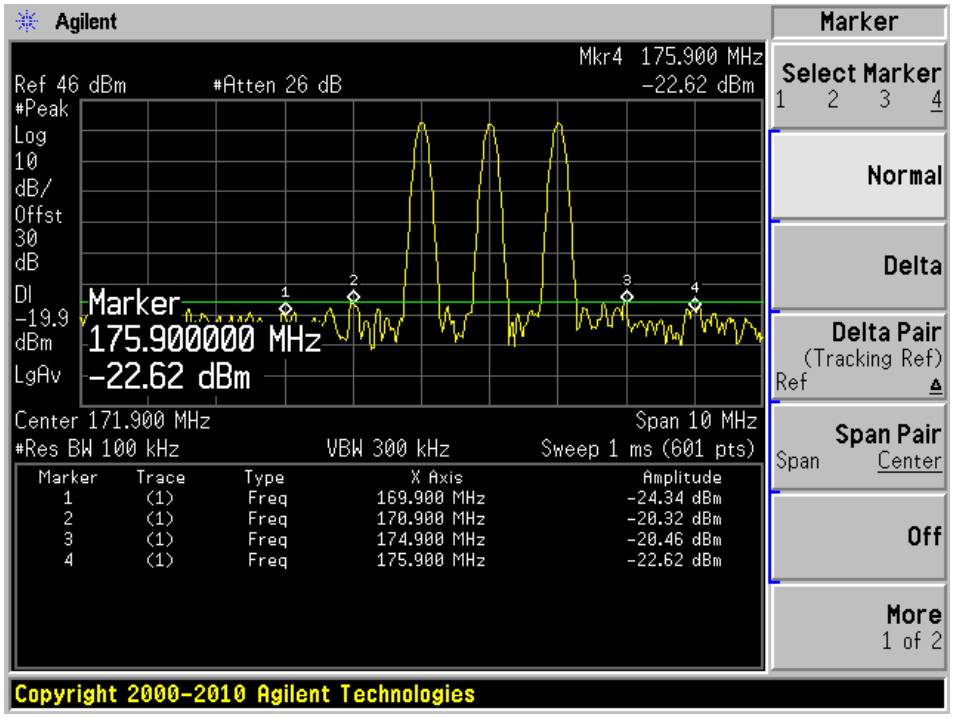
Inter-modulation, Three Tones, Middle Channel, Output (2)



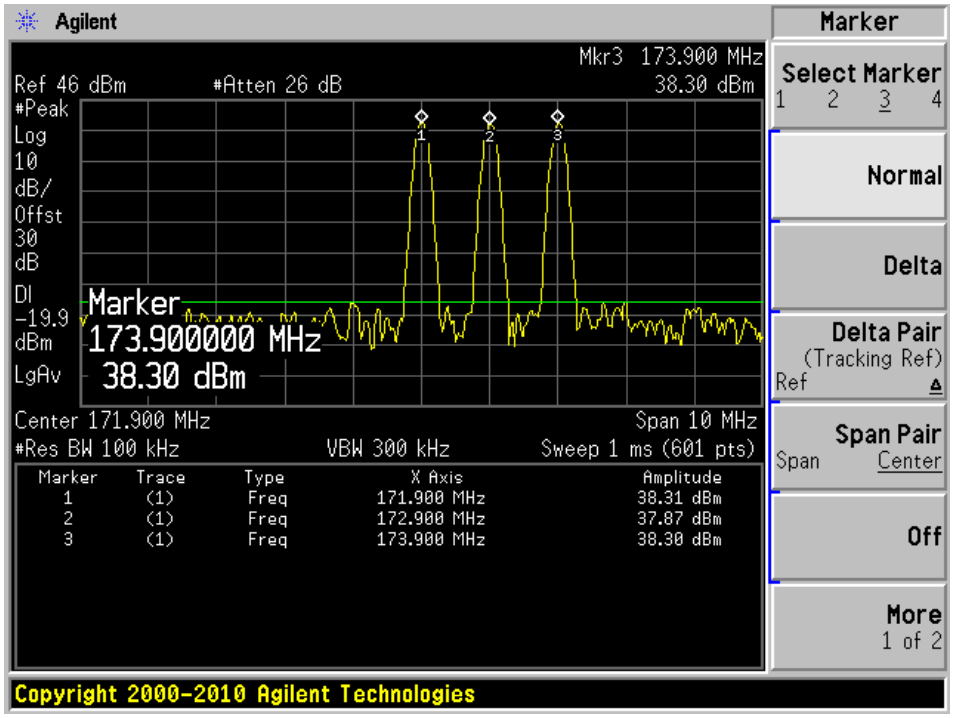
Inter-modulation, Three Tones, High Channel, Input



Inter-modulation, Three Tones, High Channel, Output (1)



Inter-modulation, Three Tones, High Channel, Output (2)



8 FCC §2.1053 & §90.210 – FIELD STRENGTH OF SPURIOUS RADIATIONS

8.1 Applicable Standard

§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.

8.2 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.

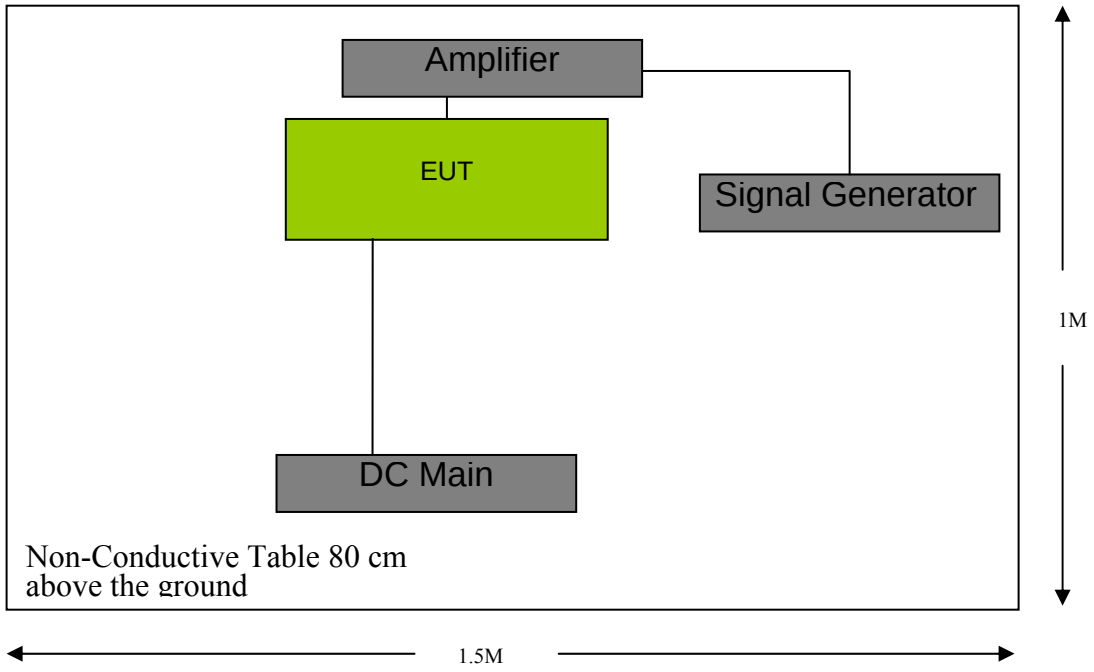
The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

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)

8.3 Test Setup Block Diagram



8.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2012-06-18
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2012-03-08
Eaton	Horn antenna	96001	Mar-07	2011-10-03
Com-Power	Dipole Antenna	AD-100	2228	2012-07-23
A.H. Systems	Horn antenna	SAS-200/571	261	2012-01-18
Mini-Circuits	Pre Amplifier	ZVA-183-S	667400960	2012-05-08
Agilent	Signal Generator	E4438C	MY45091309	2012-05-03

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

8.5 Test Environmental Conditions

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

The testing was performed by Wei Sun on 2012-08-21 in 5 Meters Chamber #3.

8.6 Test Results

Middle Channel, Input frequency = 156 MHz (Worst mode: CW signal)

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)		
311	76.94	28	155	V	311	-48.38	0	0.67	-49.05	-20	-29.05
311	68.31	197	155	H	311	-55.89	0	0.67	-56.56	-20	-36.56