FCC PART 90Y

TEST AND MEASUREMENT REPORT

For

Tropos Networks, Inc.

555 Del Rey Avenue,

Sunnyvale, CA 94085, USA

FCC ID: P9J-4902
Model: Spear

Report Type:	**Product Type:**
Original Report	4.9 GHz 802.11a PCI Card

Prepared By: Wei Sun

Report Number: R1303065-90

Report Date: 2013-03-21

Reviewed By: Quinn Jiang, Test Engineer

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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1303065-90	Original Report	2013-03-21

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Tropos Networks, Inc*., and their product, FCC ID: P9J-4902, model: Spear, which will henceforth be referred to as the EUT "Equipment Under Test". The EUT is a low power 802.11a PCI card with 9 dBi and 12 dBi gain antenna that operates in 4940-4990 MHz.

1.2 Mechanical Description of EUT

The EUT Approximate measurement is: 6.5cm (L) x 6.3cm (W) x 0.3cm (H). Weight: 22.5g.

The test data gathered are from typical production sample, serial number: CTS712TP6080 provided by client.

1.3 Objective

This type approval report is prepared on behalf of *Tropos Networks, 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 90Y – Regulations Governing Licensing and Use of Frequencies in the 4940-4990 MHz Band.

Applicable Standards: TIA-603-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

The software used during the test is Atheros Radio transmissions and was verified by Wei Sun from BACL.

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

N/A

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Tropos Networks	PCI Card	Spear 4.9	CTS712TP6080

2.7 External I/O Cabling List and Details

Cable Descriptions	Length (m)	From	To
RF cable	<1	Output/ EUT	Spectral Analyzer

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§90.1217, §2.1091	RF Exposure	Compliant
§2.1046, §90.1215	RF Output Power	Compliant
§2.1046, §90.1215	Power Spectral Density	Compliant
§2.1049, §90.210	Occupied Bandwidth and Emission Mask	Compliant
§2.1051, §90.210	Spurious Emissions at Antenna Terminals	Compliant
§90.1215	Peak Excursion Ratio	Compliant
§2.1055, §90.213	Frequency Stability	Compliant
§2.1053, §90.210	Field Strength of Spurious Radiation	Compliant
§2.1053, §90.210	Modulation Characteristics	N/A [1]
§ 90.214	Transient Frequency Behavior	N/A [1]

Note: N/A[1] – Not Applicable to EUT.

4 FCC §2.1046 & §90.1215 – RF Output Power

4.1 Applicable Standards

According to FCC §90.1215(a)(1), the maximum conducted power for Low power devices with 20 MHz channel bandwidth is 20 dBm.

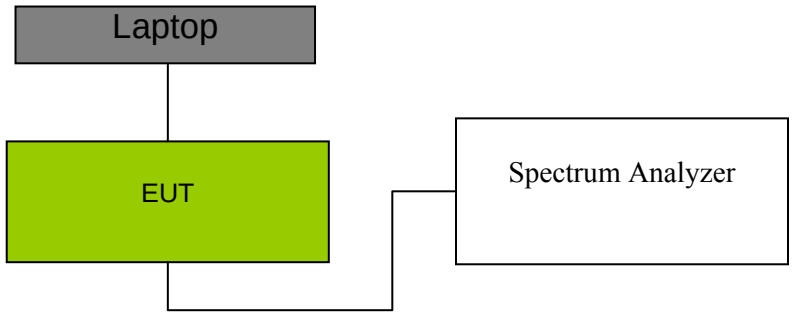
According to FCC §90.1215 (b), for low power devices, if transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

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	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed per the A2LA 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 Wei Sun on 2013-03-06 on RF Site.

4.6 Test Results

Lower power setting for 12 dBi Antenna

Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dBm)
4950	15.45	17	-1.55
4970	15.84	17	-1.16

Higher power setting for 9 dBi Antenna

Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dBm)
4950	19.43	20	-0.57
4970	19.87	20	-0.17

5 FCC §2.1049 & §90.210 – Occupied Bandwidth & Emission Mask

5.1 Applicable Standard

§90.210

(l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

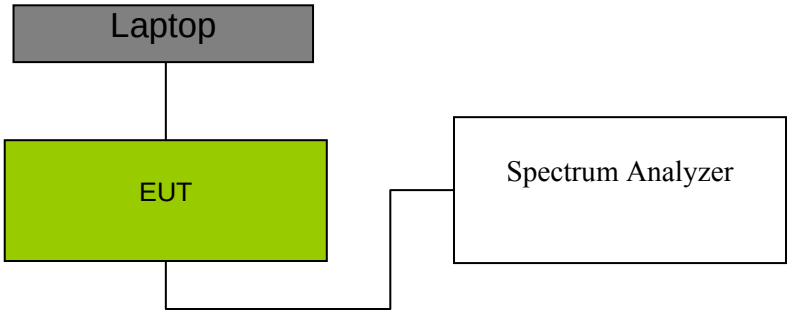
(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

5.2 Test Procedure

The RF output of the transmitter was connected to the simulator 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	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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 2013-03-07 on RF Site.

5.6 Test Results

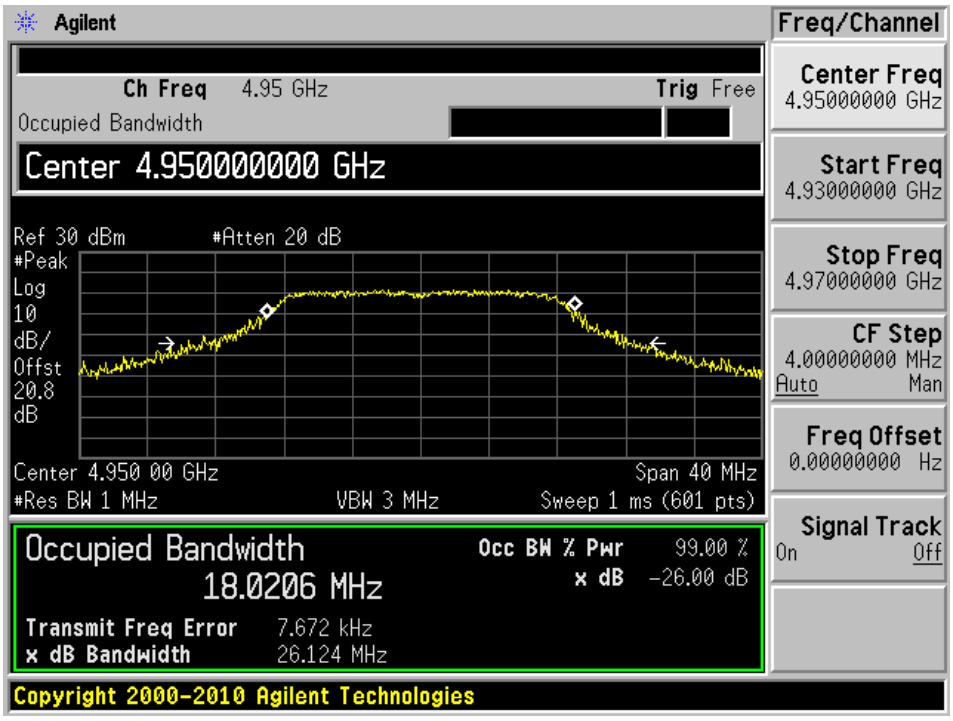
Lower power setting for 12 dBi Antenna

Frequency (MHz)	Output Occupied Bandwidth (MHz)
4950	18.0206
4970	18.0814

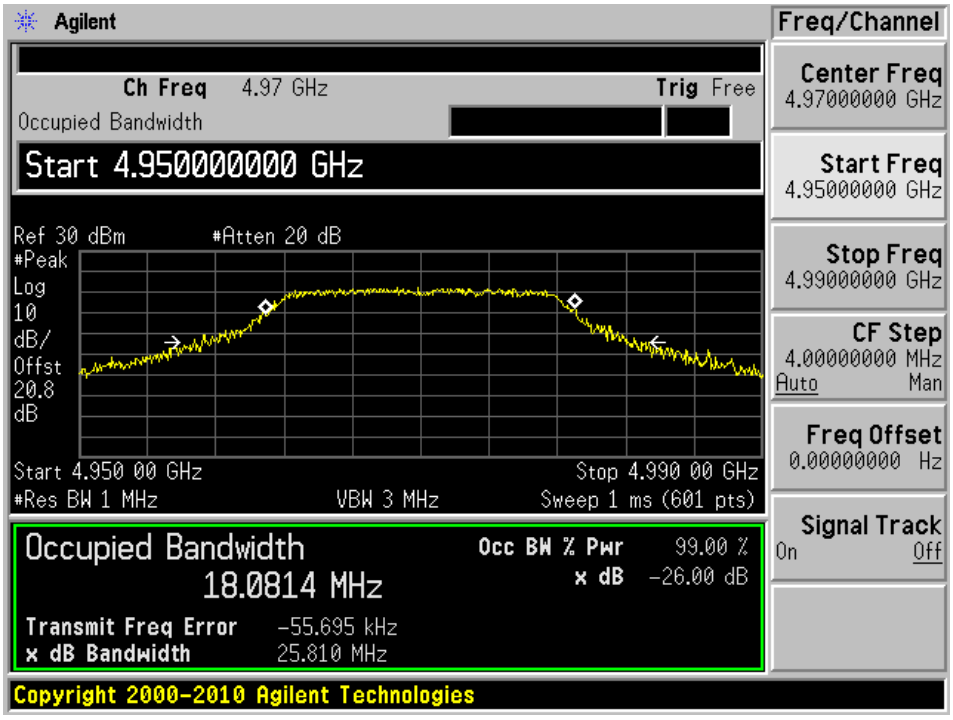
Higher power setting for 9 dBi Antenna

Frequency (MHz)	Output Occupied Bandwidth (MHz)
4950	18.0178
4970	18.0028

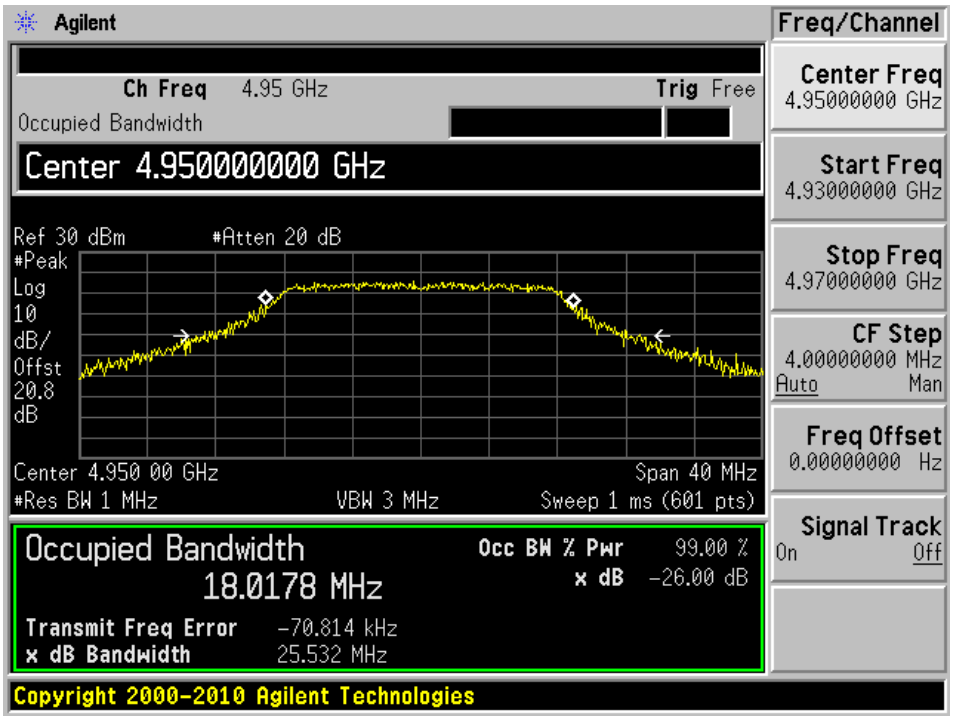
Lower power setting for 12 dBi Antenna Low channel 4950 MHz



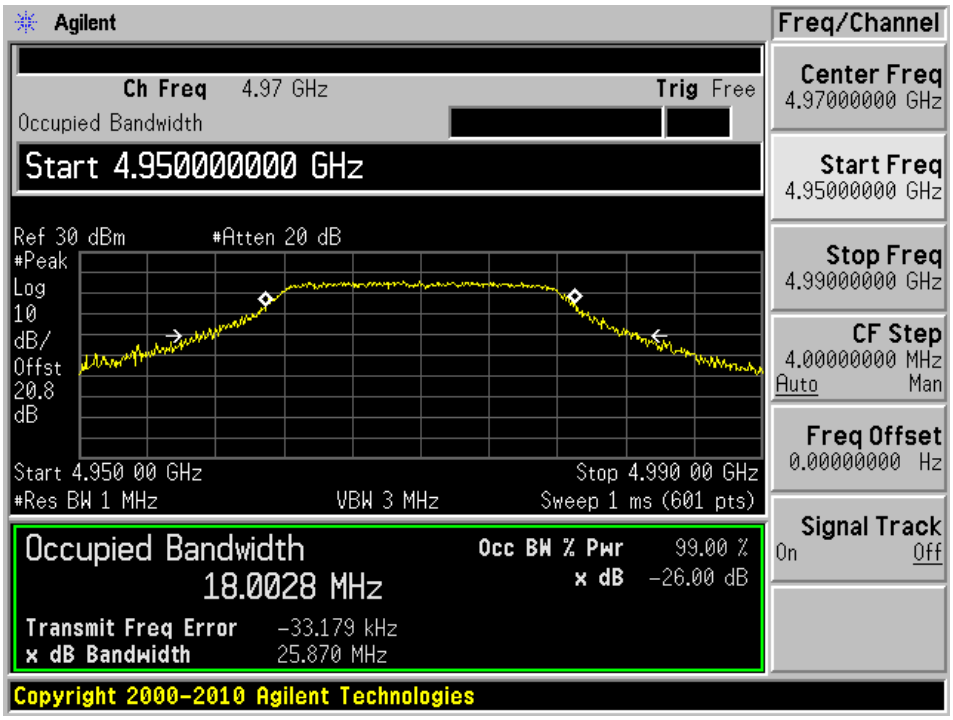
Lower power setting for 12 dBi Antenna High channel 4970 MHz



Higher power setting for 9 dBi Antenna Low channel 4950 MHz

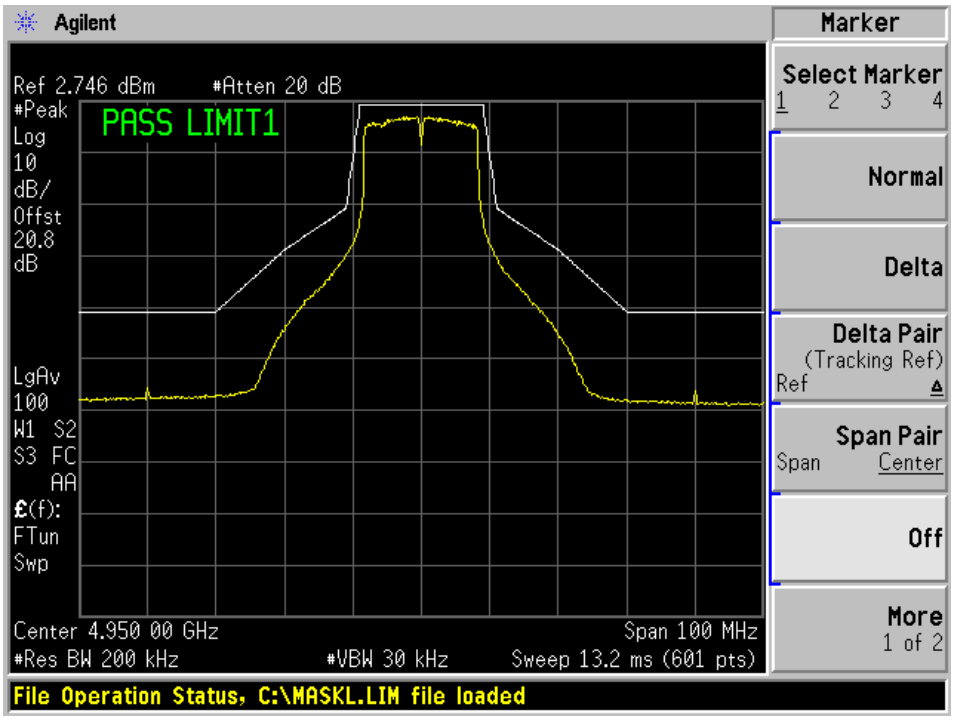


Higher power setting for 9 dBi Antenna High channel 4970 MHz

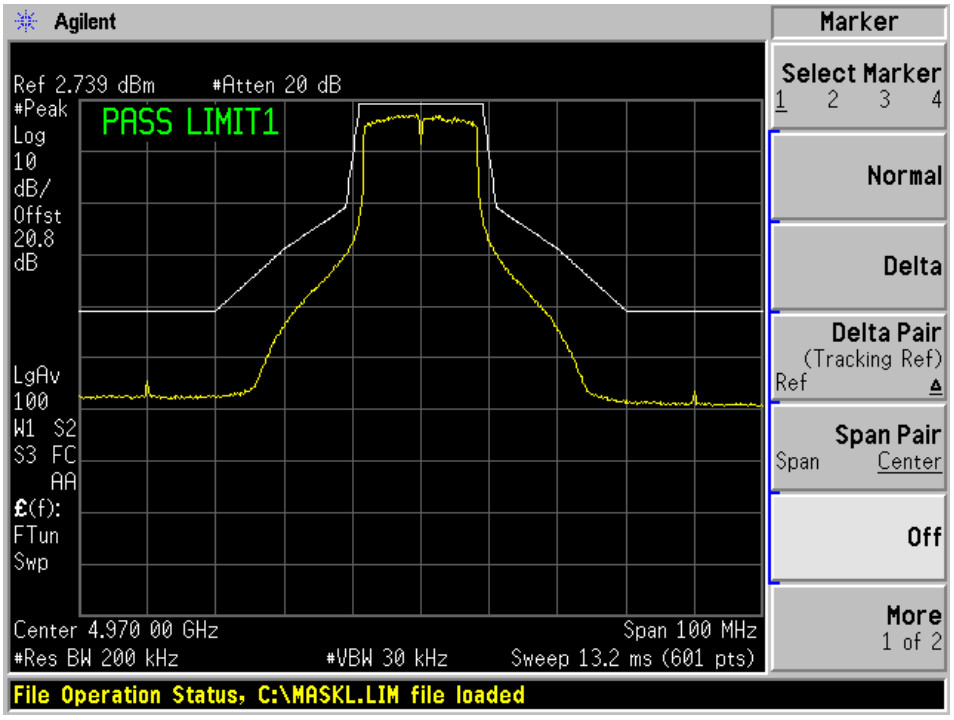


Emission Mask L:

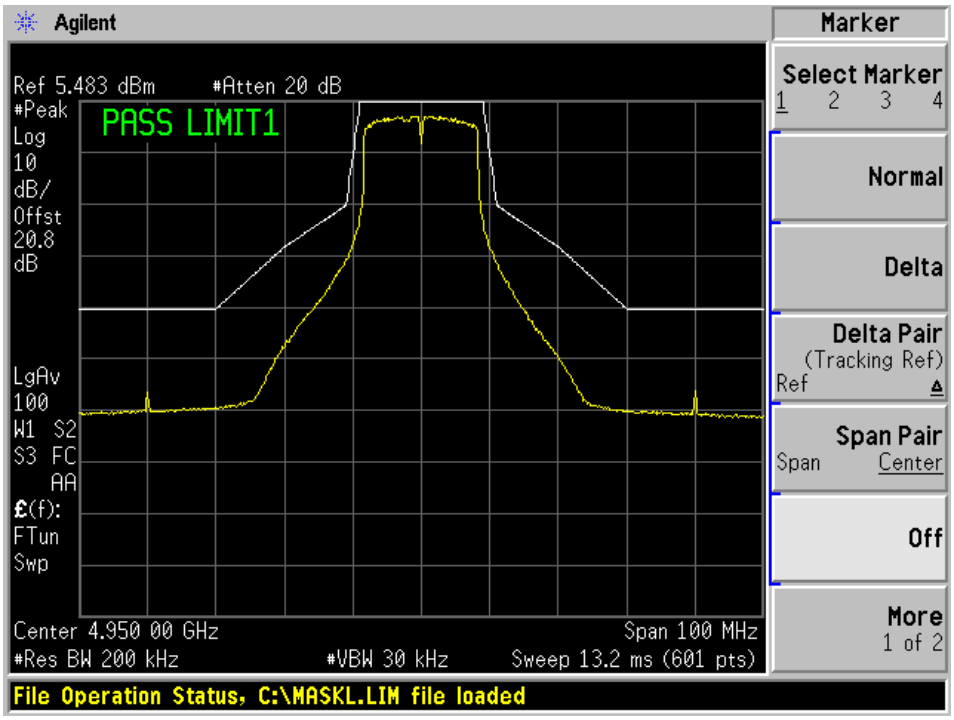
Lower power setting for 12 dBi Antenna Low channel 4950 MHz



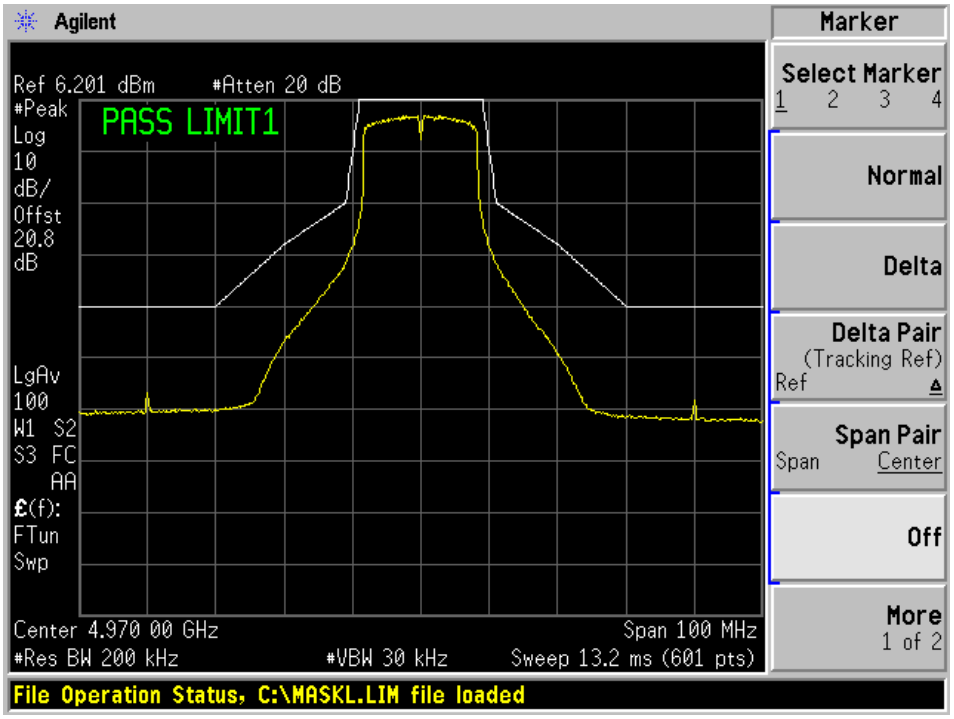
Lower power setting for 12 dBi Antenna High channel 4970 MHz



Higher power setting for 9 dBi Antenna Low channel 4950 MHz



Higher power setting for 9 dBi Antenna High channel 4970 MHz



6 FCC §2.1051 & §90.210 – Spurious Emissions at Antenna Terminals

6.1 Applicable Standard

§90.210

(l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

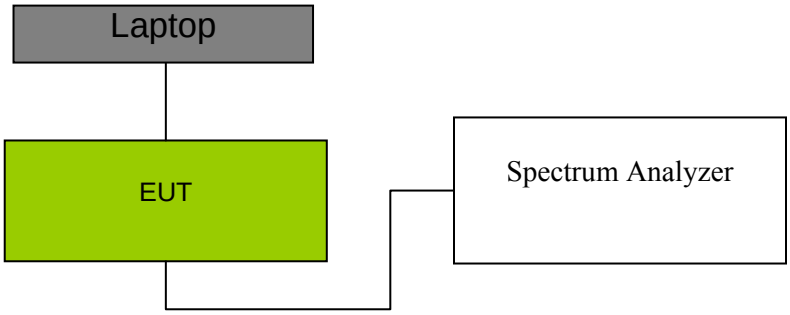
(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

6.2 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 and 1MHz. Sufficient scans were taken to show any out of band emissions up to 10^{th} harmonic.

6.3 Test Setup Block Diagram



6.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

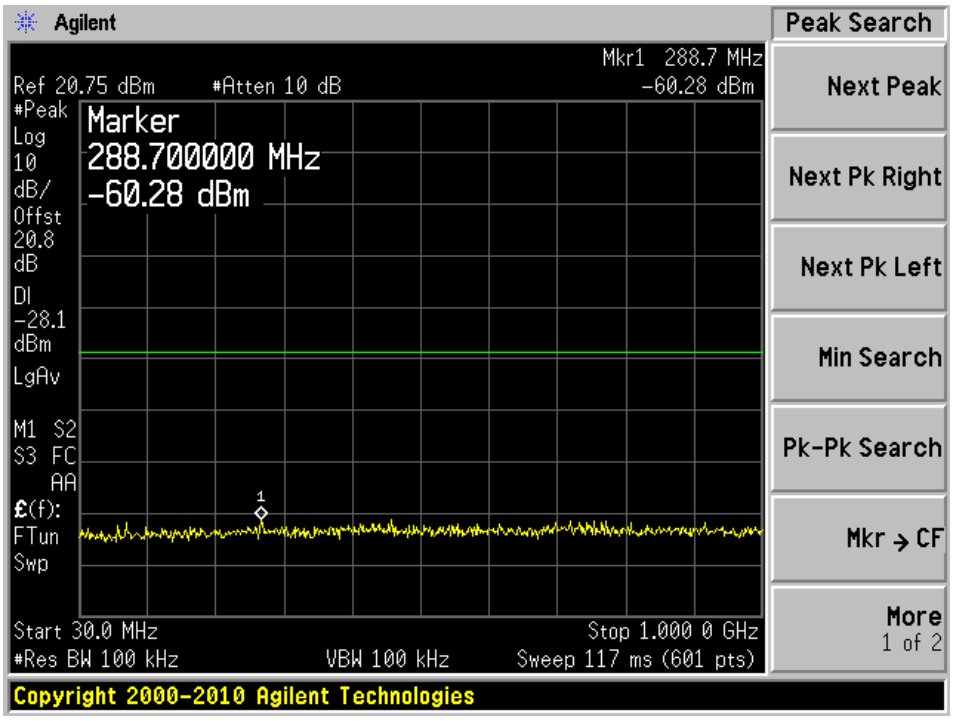
The testing was performed by Wei Sun on 2013-03-06 on RF Site.

6.6 Test Results

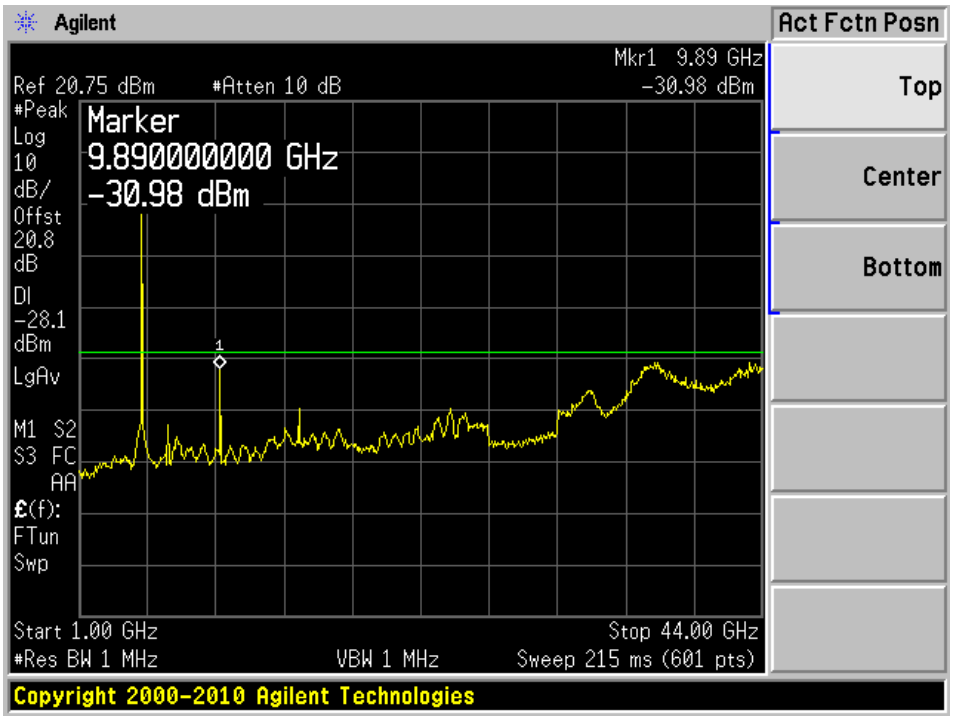
Please refer to the plot hereinafter.

Lower power setting for 12 dBi Antenna Low channel 4950 MHz

Below 1 GHz

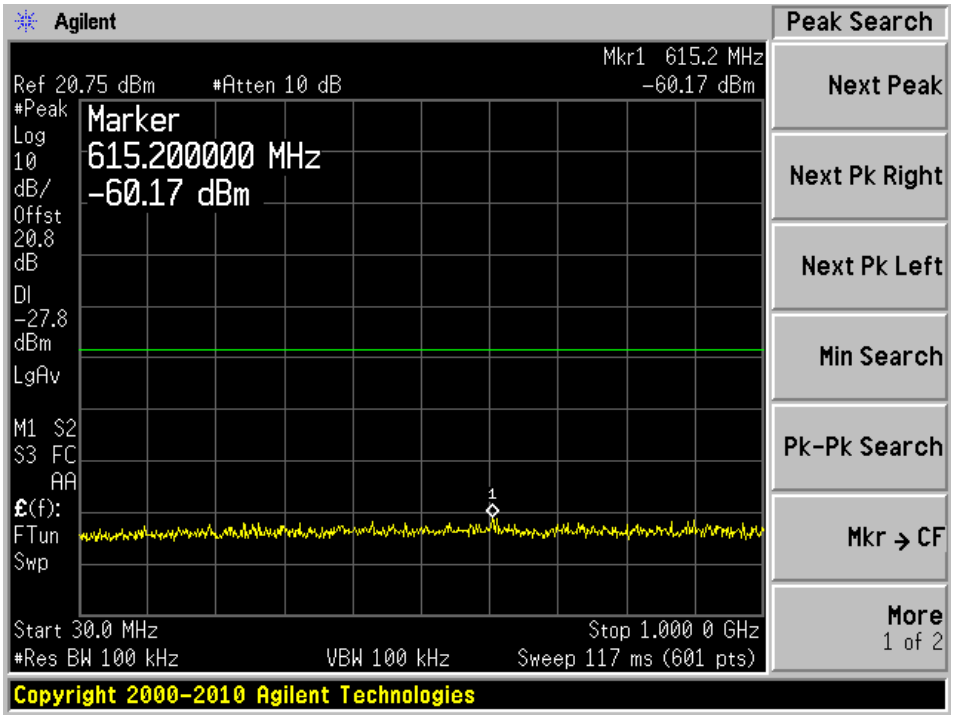


Above 1 GHz

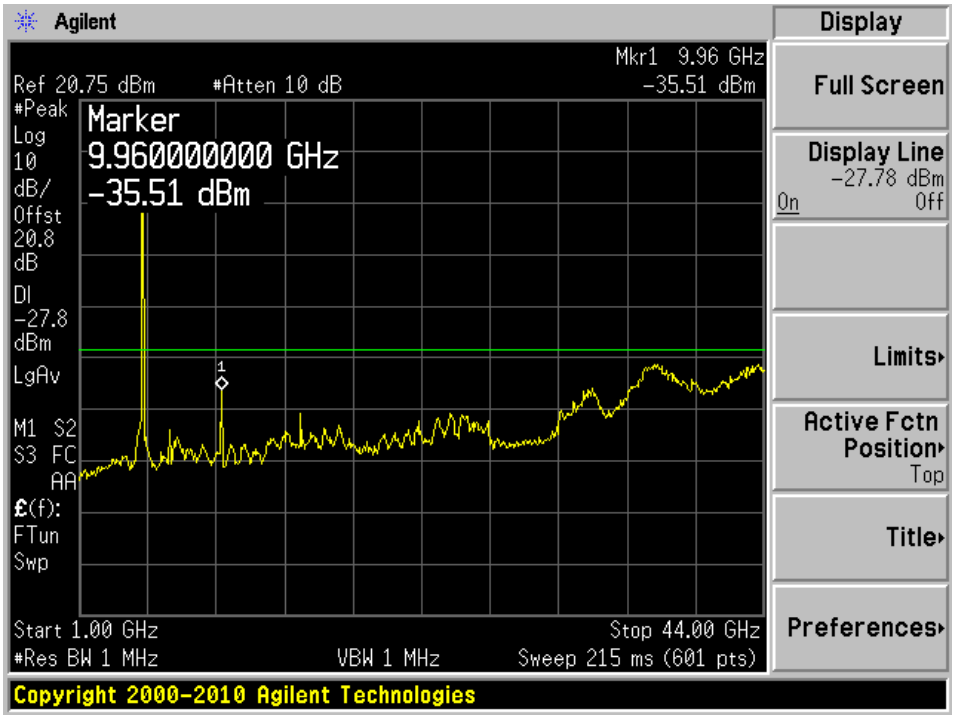


Lower power setting for 12 dBi Antenna High channel 4970 MHz

Below 1 GHz

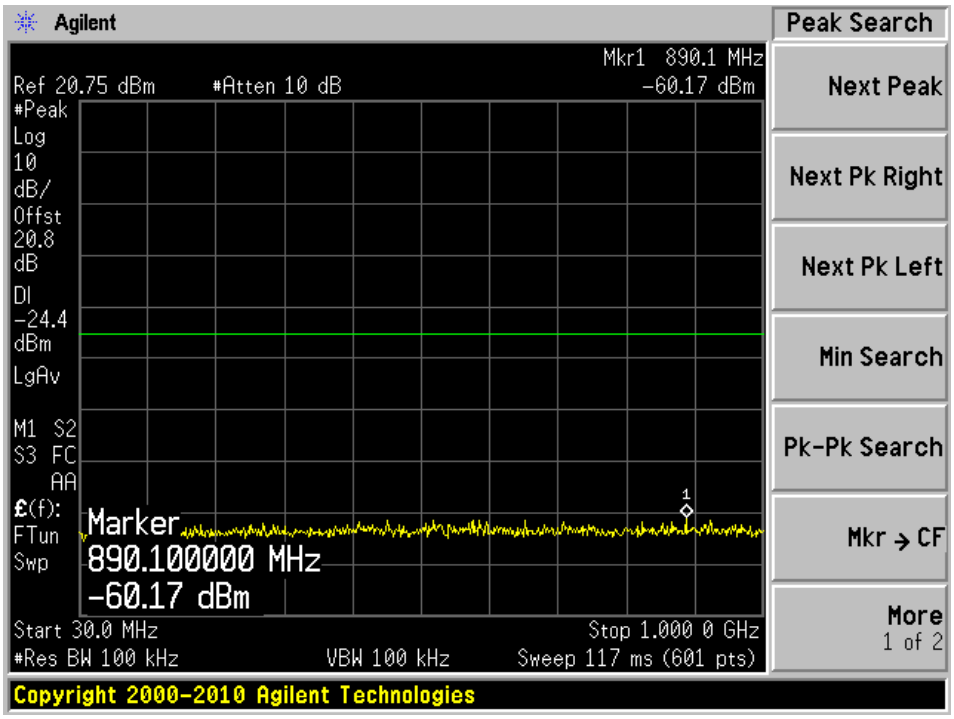


Above 1 GHz

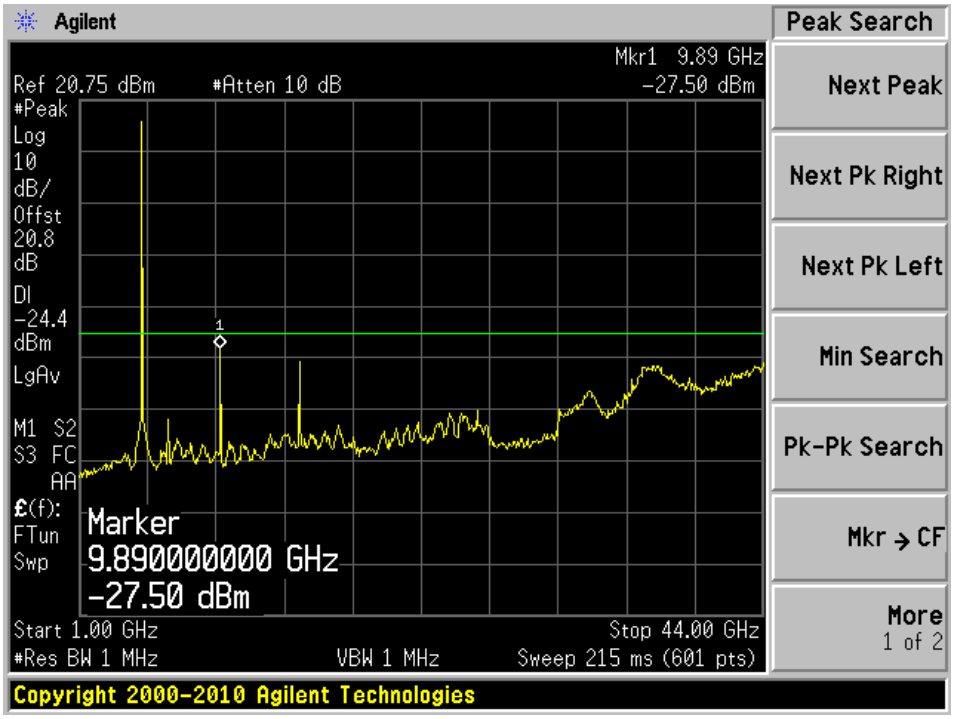


Higher power setting for 9 dBi Antenna Low channel 4950 MHz

Below 1 GHz

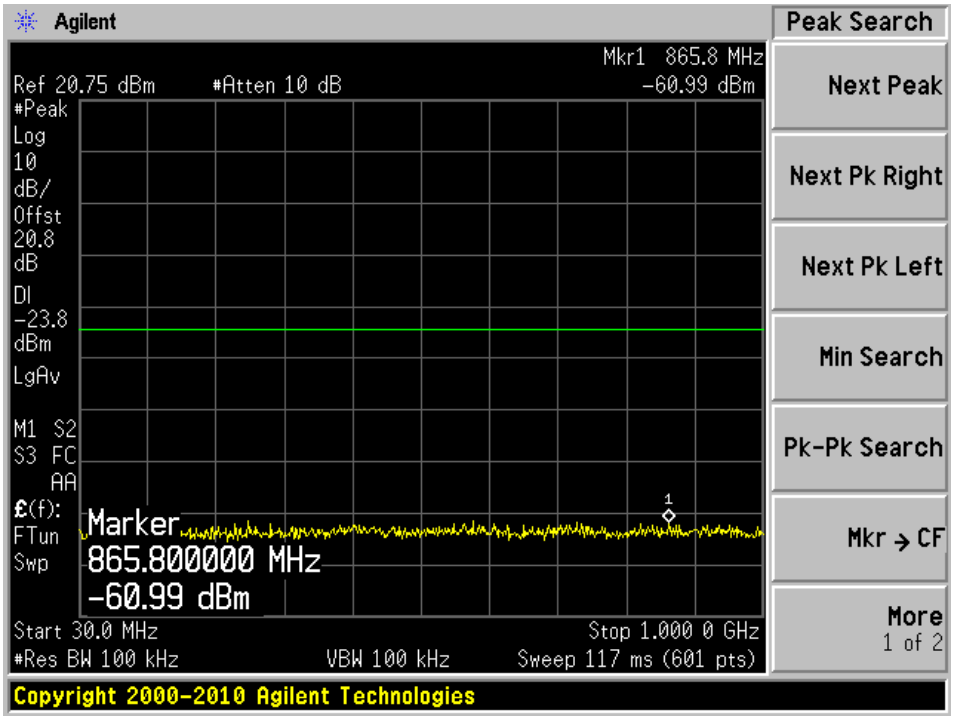


Above 1 GHz

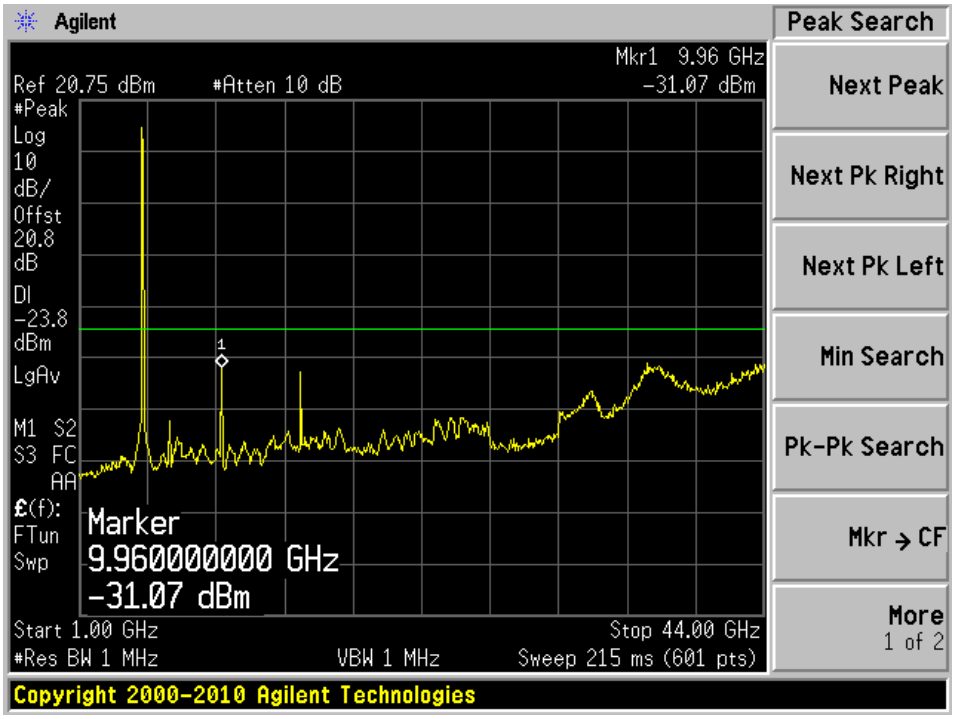


Higher power setting for 9 dBi Antenna High channel 4970 MHz

Below 1 GHz



Above 1 GHz



7 FCC §2.1053 & §90.210 – Field Strength of Spurious Radiations

7.1 Applicable Standard

As per 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.

As per FCC §90.210

(l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

7.2 Test Procedure

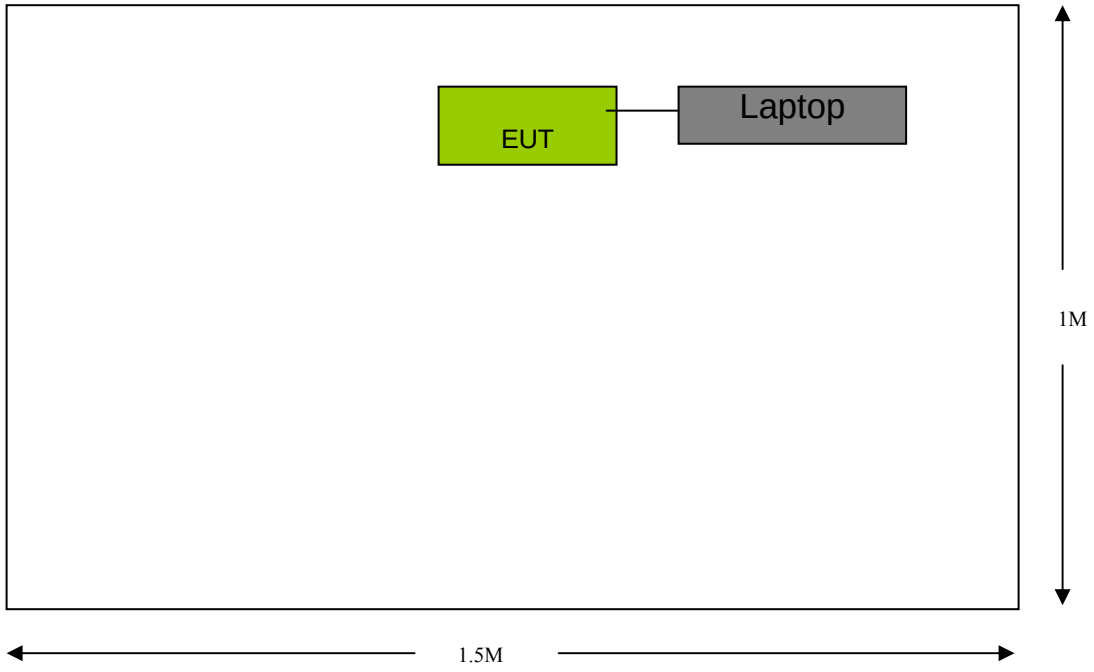
The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

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.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2012-06-18	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2012-06-09	1 Year
EMCO	Horn antenna	3115	9511-4627	2012-10-17	1 Year
Eaton	Horn antenna	96001	3/1/1907	2012-10-17	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	667400960	2012-05-08	1 Year
Com-Power	Dipole Antenna	AD-100	2226	2012-06-18	1 Year

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 2013-03-08 in 5 Meter Chamber #2.

7.6 Test Results

Low channel: 4950 MHz (High power setting, worst case)

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)		
14850	51.01	0	215	V	14850	-28.5	11.64	4.07	-20.93	-20.57	-0.36
14850	49.05	63	217	H	14850	-30.46	11.64	4.07	-22.89	-20.57	-2.32
220.78	55.66	262	155	V	220.78	-60.54	0	0.71	-61.25	-20.57	-40.68
220.78	50.79	138	155	H	220.78	-65.41	0	0.71	-66.12	-20.57	-45.55

High channel: 4970 MHz (High Power setting, worst case)

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)		
14910	49.59	1	155	V	14910	-29.78	11.64	4.07	-22.21	-20.13	-2.08
14910	45.59	332	179	H	14910	-33.78	11.64	4.07	-26.21	-20.13	-6.08
220.78	58.09	292	155	V	220.78	-58.11	0	0.71	-58.82	-20.13	-38.69
220.78	53.48	328	155	H	220.78	-62.72	0	0.71	-63.43	-20.13	-43.3

Note: On any frequency removed from the assigned frequency above 150% of the authorized bandwidth must attenuate 40 dB from the output power.

8 FCC §90.1215 – Peak Excursion Ratio

8.1 Applicable Standards

As per FCC §90.1215 (e), The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

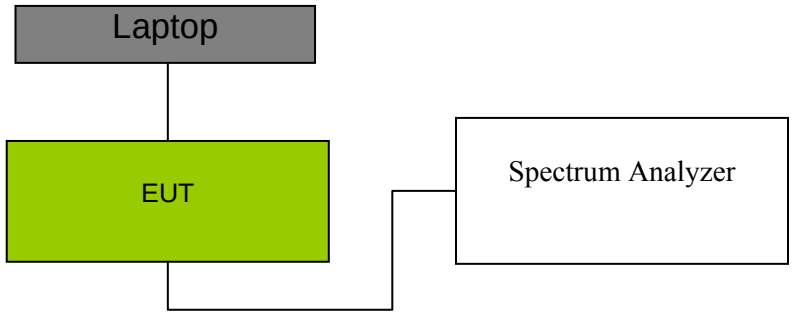
8.2 Test Procedure

Set the spectrum analyzer span to view the entire emission bandwidth.
The largest difference between the following two traces must be ≤ 13 dB for all frequencies across the emission bandwidth. Submit a plot.

1st Trace:
• Set RBW = 1 MHz, VBW ≥ 3 MHz with peak detector and maxhold settings.

2nd Trace:
• Set RBW = 1 MHz, VBW ≥ 3 MHz with Average detector, 100 average traces and maxhold settings.

8.3 Test Setup Block Diagram



8.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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 2013-03-06 on RF Site.

8.6 Test Results

Lower power setting for 12 dBi Antenna

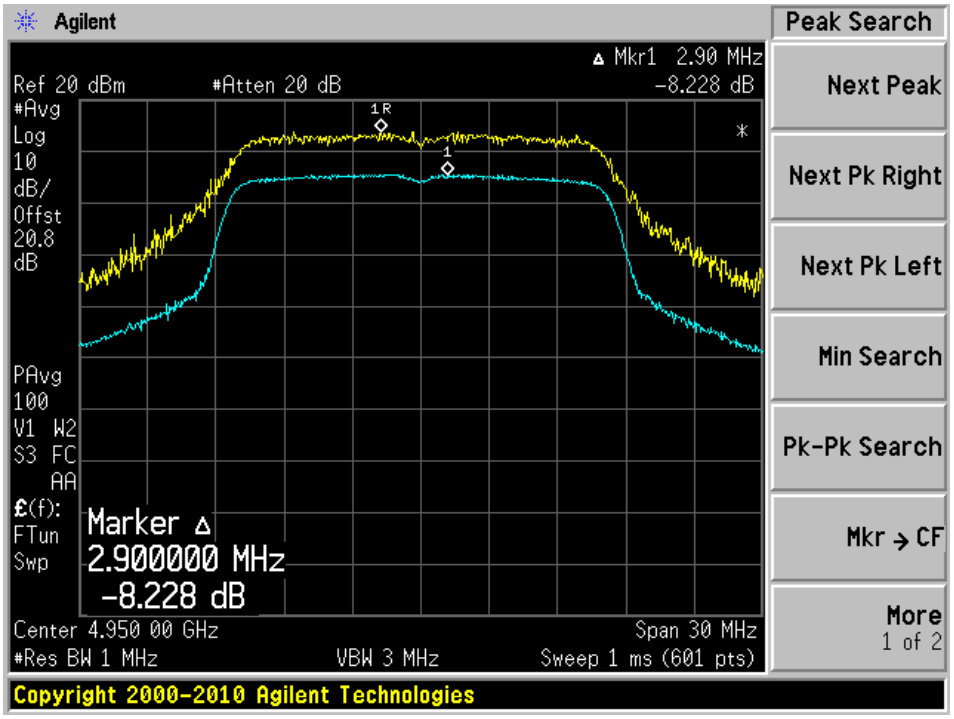
Frequency (MHz)	Excursion (dB)	Limit (dB)	Margin (dB)
4950	8.228	13	4.772
4970	8.378	13	4.622

Higher power setting for 9 dBi Antenna

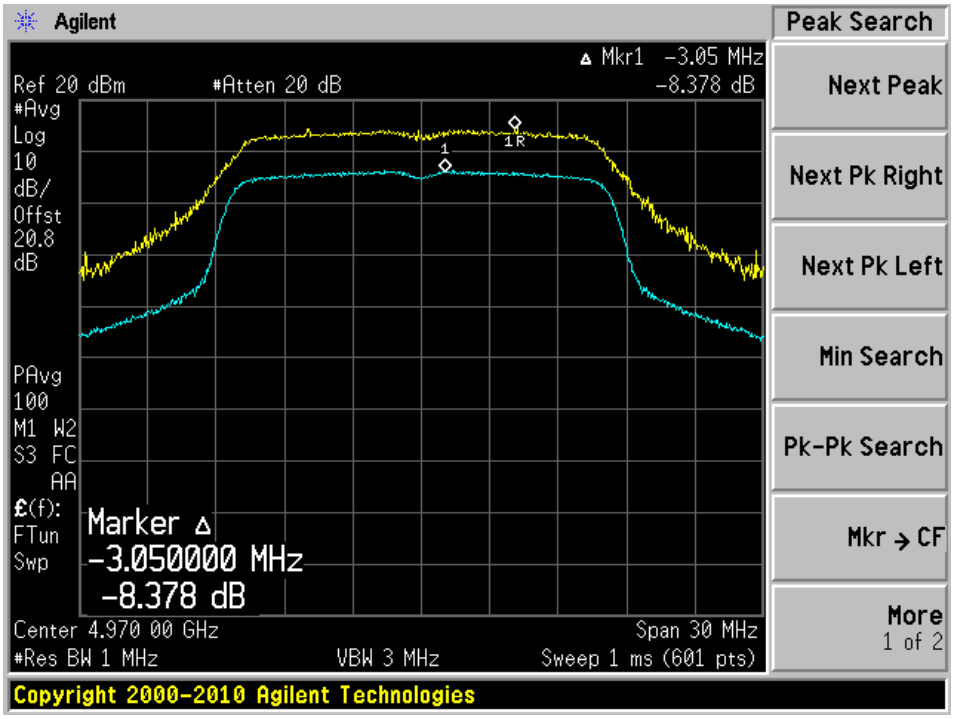
Frequency (MHz)	Output Power (dBm)	Limit (dB)	Margin (dB)
4950	8.650	13	4.35
4970	7.865	13	5.135

Please refer to the following plots.

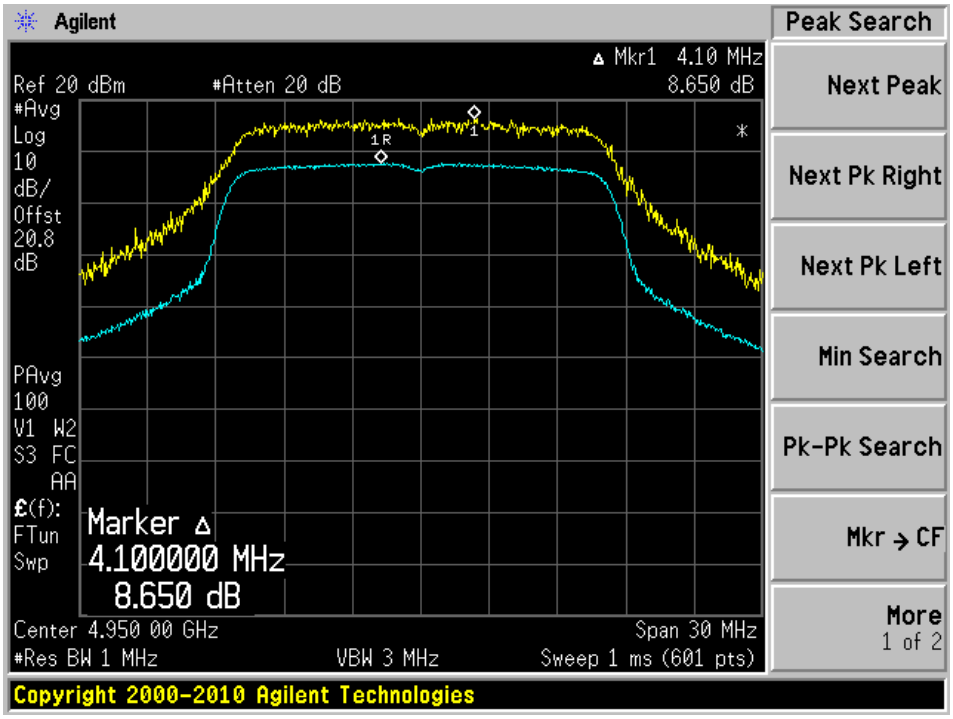
Lower power setting for 12 dBi Antenna Low channel 4950 MHz



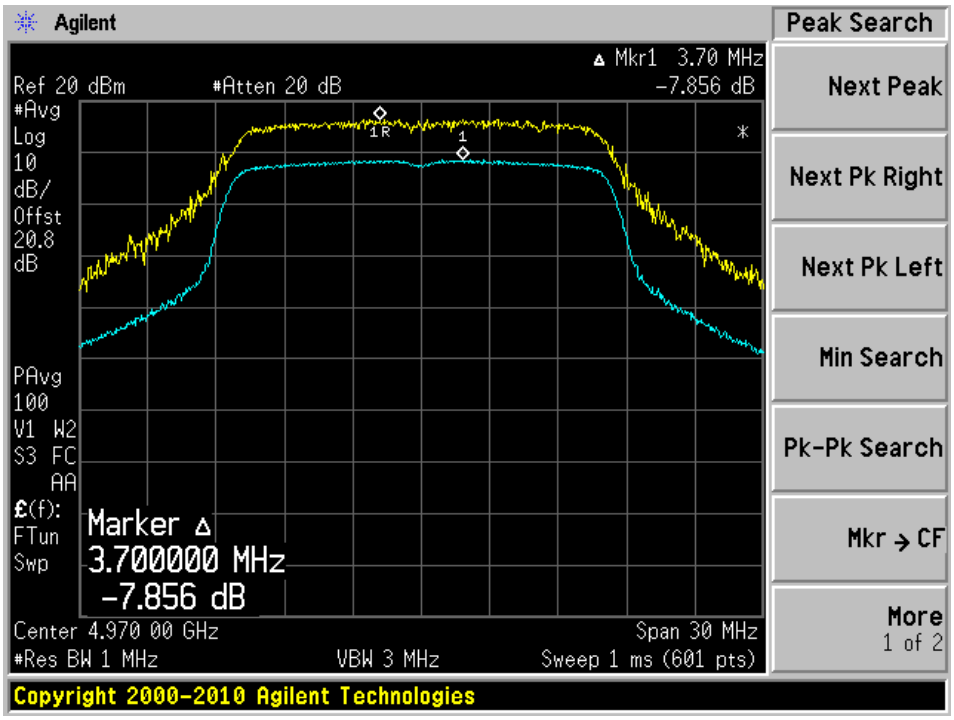
Lower power setting for 12 dBi Antenna High channel 4970 MHz



Higher power setting for 9 dBi Antenna Low channel 4950 MHz



Higher power setting for 9 dBi Antenna High channel 4970 MHz



9 FCC §2.1055 & §90.213 – Frequency Stability

9.1 Applicable Standards

§2.1055(a)(1)

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From −30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(2) From −20° to +50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

(3) From 0° to +50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and +30° centigrade with no primary power applied.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10° centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

(4) When it is impracticable to subject the complete transmitter to this test because of its physical dimensions or power rating, only its frequency determining and stabilizing portions need be tested.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

§90.213

For frequency range above 2450 MHz, Note 10

10 Except for DSRCS equipment in the 5850-5925 MHz band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5850-5925 MHz band is specified in subpart M of this part

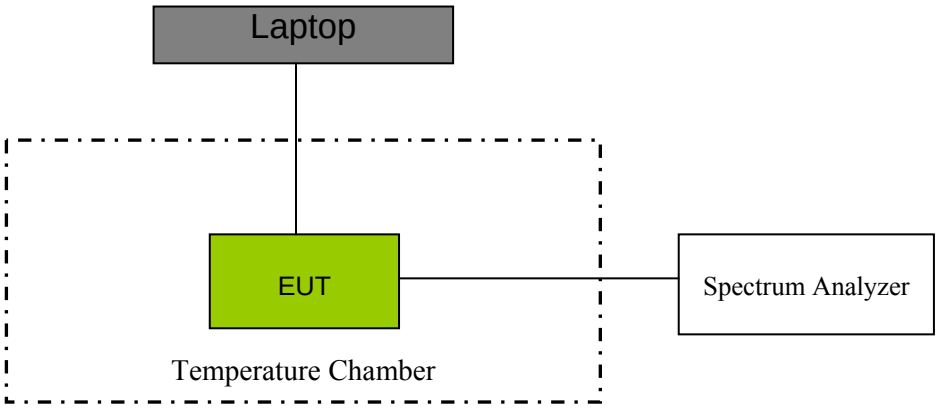
9.2 Test Procedure

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 115% and 85% of the nominal value. The output frequency was recorded for each voltage

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year
Espec	Temperature Chamber	ESL-4CA	18010	2012-02-10	1 Year

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

9.5 Test Environmental Conditions

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

The testing was performed by Wei Sun on 2013-03-07 on RF Site.

9.6 Test Results

Low Channel 4950 MHz

Environment Condition	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)
5 Vdc. -30 °C	4950	4949.97	-6.1
5 Vdc. -20 °C	4950	4949.9767	-4.7
5 Vdc. -10 °C	4950	4949.9683	-6.4
5 Vdc. 0 °C	4950	4949.9733	-5.4
5 Vdc. 10 °C	4950	4949.9742	-5.2
5 Vdc. 20 °C	4950	4949.9842	-3.2
5 Vdc. 30 °C	4950	4950.0008	0.16
5 Vdc. 40 °C	4950	4950.0067	1.35
5 Vdc. 50 °C	4950	4950.0133	2.69
4.5 Vdc*. 25 °C	4950	4949.9985	-0.3
5.5 Vdc*. 25 °C	4950	4949.998	-0.4

High Channel 4970 MHz

Environment Condition	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)
5 Vdc. -30 °C	4970	4970.0033	0.664
5 Vdc. -20 °C	4970	4969.9867	-2.7
5 Vdc. -10 °C	4970	4969.9833	-3.4
5 Vdc. 0 °C	4970	4969.9717	-5.7
5 Vdc. 10 °C	4970	4969.9767	-4.7
5 Vdc. 20 °C	4970	4969.97	-6
5 Vdc. 30 °C	4970	4969.9933	-1.3
5 Vdc. 40 °C	4970	4970.0139	2.8
5 Vdc. 50 °C	4970	4970.0183	3.68
4.5 Vdc*. 25 °C	4970	4969.9867	-2.7
5.5 Vdc*. 25 °C	4970	4969.98	-4

* Note: the nominal functional voltage range for EUT is 4.5 Vdc to 5.5 Vdc.

10 FCC §2.1046 & §90.1215 – Power Spectral Density

10.1 Applicable Standard

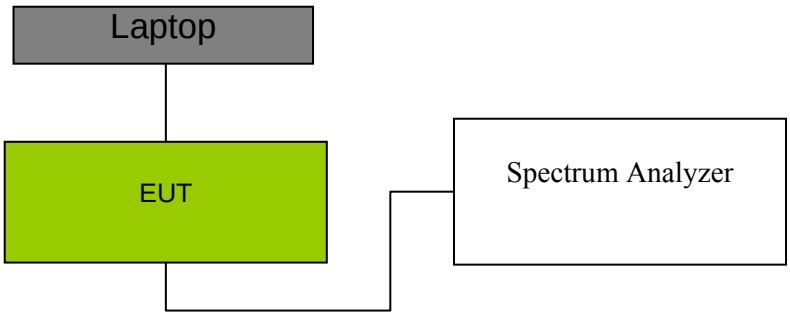
§90.1215

(b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

10.2 Test Procedure

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

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

10.5 Test Environmental Conditions

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

The testing was performed by Wei Sun on 2013-03-07 on RF Site.

10.6 Test Results

Lower power setting for 12 dBi Antenna

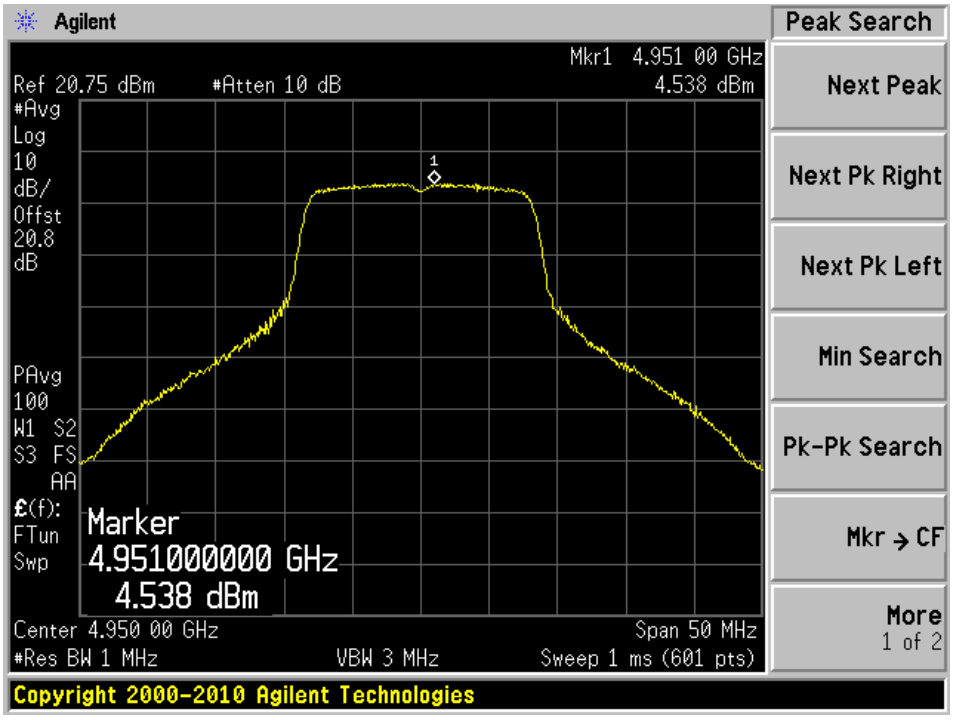
Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)
4950	4.538	5
4970	4.939	5

Higher power setting for 9 dBi Antenna

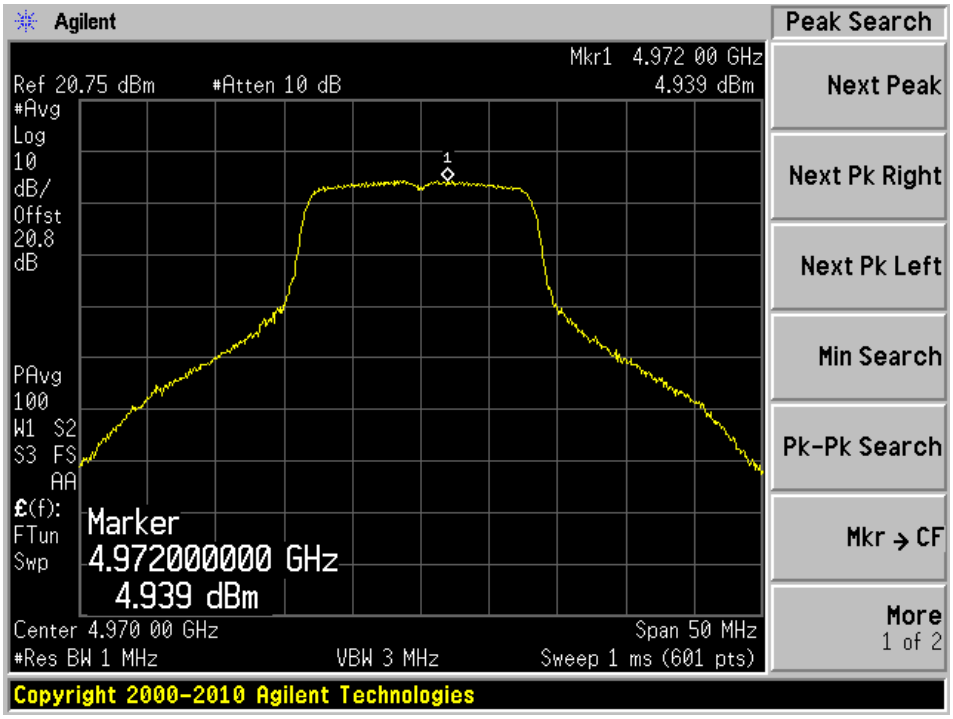
Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)
4950	7.486	8
4970	7.859	8

Please refer to the following plots.

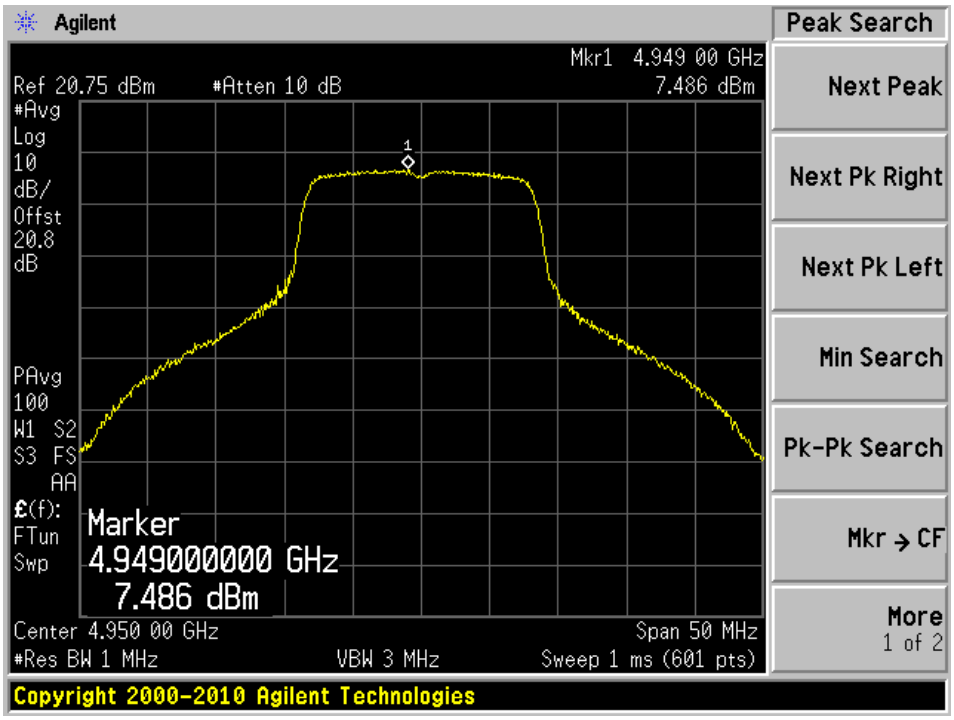
Lower power setting for 12 dBi Antenna Low channel 4950 MHz



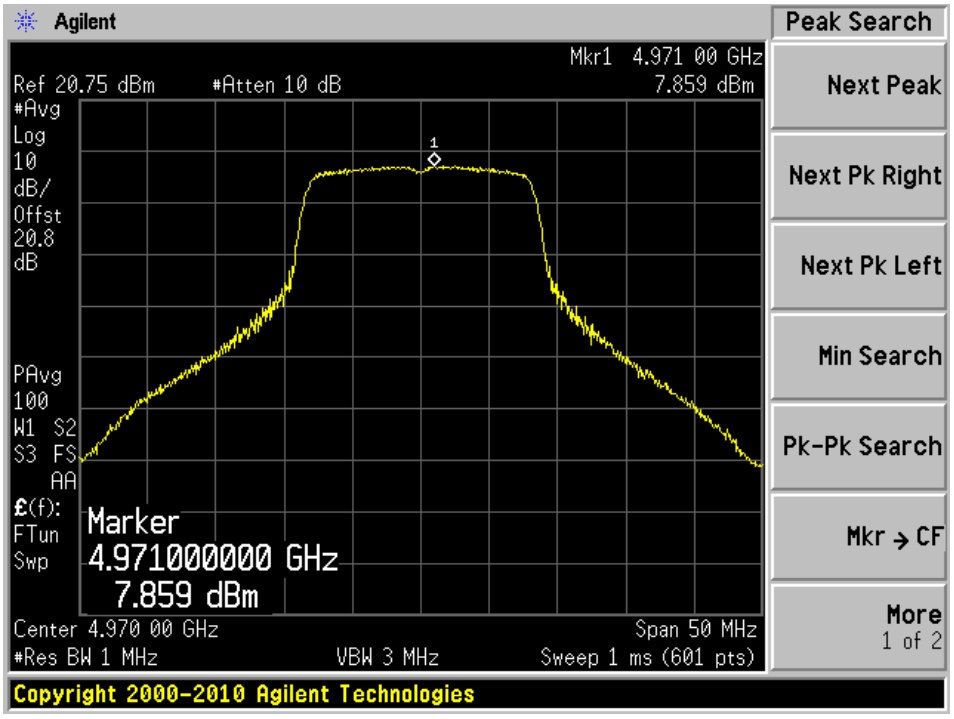
Lower power setting for 12 dBi Antenna High channel 4970 MHz



Higher power setting for 9 dBi Antenna Low channel 4950 MHz



Higher power setting for 9 dBi Antenna High channel 4970 MHz



11 FCC §90.1217 & §2.1091 - RF Exposure Information

11.1 Applicable Standards

According to FCC §90.1217 and §1.1307(b), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (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 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

For 12 dBi gain antenna

Maximum peak output power at antenna input terminal (dBm):	15.84
Maximum peak output power at antenna input terminal (mW):	38.37
Prediction distance (cm):	20
Prediction frequency (MHz):	4950
Maximum Antenna Gain (dB):	12
Maximum Antenna Gain (numeric):	15.85
Power density of prediction frequency at 20 cm (mW/cm^2):	0.12
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

For 9 dBi gain antenna

Maximum peak output power at antenna input terminal (dBm):	19.87
Maximum peak output power at antenna input terminal (mW):	97.05
Prediction distance (cm):	20
Prediction frequency (MHz):	4970
Maximum Antenna Gain (dB):	9
Maximum Antenna Gain (numeric):	7.94
Power density of prediction frequency at 20 cm (mW/cm^2):	0.153
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 20 cm between the antenna with 12 and 9 dBi gains, including any radiating structure, and any persons when normally operated.