



FCC PART 90

TEST AND MEASUREMENT REPORT

For

SpotterRF, LLC

709 E Technology Way, Bldg. E Ste. 3100,
Orem, UT 84097, USA

FCC ID: CO6-C950-LIC

Report Type: Original Report	Product Type: Ground Surveillance Radar
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Report Number: <u>R1503305-90</u>	
Report Date: <u>2015-06-02</u>	
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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 A2LA*, NIST, or any agency of the Federal Government.

* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*” (Rev.2)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1503305-90	Original Report	2015-06-02

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *SpotterRF, LLC* and their product model: *C950-LIC, FCC ID: CO6-C950-LIC* or the “EUT” as referred to in this report. The EUT is surveillance radar that locates and tracks moving objects in front of it. The device operates in 10-10.5 GHz frequency range.

1.2 Mechanical Description of EUT

The EUT measures approximately 38.0 cm (L) x 24.9 cm (W) x 6.8 cm (H) and weighs 2.15 kg.

The test data gathered are from typical production sample, serial number: SP10905 assigned by Client.

1.3 Objective

This report is prepared on behalf of *SpotterRF, LLC* in accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 90 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 90 rules for Output Power, Antenna Requirements, Occupied Bandwidth, Frequency Stability, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

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, Part 90.

Applicable Standards: TIA/EIA603-D.

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 CISPR16-4-2:2011, 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.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:

- 1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.
- 2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminaires and Computers.
- 3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.
- 4- A Product Certification Body accredited to **ISO Guide 65:1996** by **A2LA** to certify:
 - 1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
 2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
 3. Radio Communication Equipment for Singapore.
 4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
 5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
 6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

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 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.: A-0027. 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-603-D.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the occupied bandwidth, output power, frequency stability and radiated spurious emission across all channels.

2.2 EUT Exercise Software

The exercise software used was *Spotter RF v3.2.0-00731b_2013-08-08*, provided by SpotterRF, LLC. and was verified by BACL Jerry Tong to comply with the standard requirements being tested against.

2.3 Special Equipment

There were no special accessories required, included, or intended for use with EUT during these tests.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
HP	Laptop	HP ProBook 4525s	2CE041168V
Spotter RF	P.O.E.	POE-IN-J-01	-

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
SpotterRF	Motherboard	ADC 4.2	50052408
SpotterRF	RF Board	JQAdams 2.0	50054461-004
SpotterRF	Receive Antenna	R2220000-03	0001
SpotterRF	Transmit Antenna	T1220000-01	0001
SpotterRF	Surge Protection Board	Ethguard	W37770-005

2.7 Interface Ports and Cables

Cable Description	Length (m)	To	From
Ethernet Cable	<1.0	EUT	POE
Ethernet Cable	>1.0	POE	Laptop

2.8 Power Supply List and Details

Manufacturer	Description	Model	Part Number
Phihong	Single Port Power Over Ethernet	POE31U-240	P142000542A1

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§2.1091	RF Exposure	Compliant
§2.1046, §90.205(s), §90.103(c)(13)	RF Output Power	Compliant
§2.1049	Occupied Bandwidth	Compliant
§2.1051, §90.210	Spurious Emissions at Antenna Port	Compliant
§2.1053, §90.210	Radiated Spurious Emissions	Compliant
§2.1055, §90.213(b)	Frequency Stability	Compliant

4 FCC §2.1091 – RF Exposure

4.1 Applicable Standard

According to FCC §1.1307(b)(1), 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

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

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	<u>21.53</u>
Maximum peak output power at antenna input terminal (mW):	<u>142.23</u>
Prediction distance (cm):	<u>20</u>
Prediction frequency (MHz):	<u>10268</u>
Maximum Antenna Gain, typical (dBi):	<u>15</u>
Maximum Antenna Gain (numeric):	<u>31.623</u>
Power density of prediction frequency at 20.0 cm (mW/cm ²):	<u>0.895</u>
MPE limit for uncontrolled exposure at prediction frequency (mW/cm ²):	<u>1.0</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.895 mW/cm². Limit is 1.0 mW/cm².

5 FCC §2.1046, §90.205 & §90.103 (c) – Output Power

5.1 Applicable Standard

FCC §2.1046

FCC §90.205 (s) The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with §90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

FCC §90.103 (c) (13) Operations in this band are limited to survey operations using transmitters with a peak power not to exceed 5 watts into the antenna.

5.2 Measurement Procedure

The test set-up was following TIA 603-D Radiated testing set-up procedure. The output power was measured with the wideband power meter at the low, middle and high channel in each band.

5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 Year
HP	Generator, Signal	83650B	3614A00276	2014-08-06	1 year
Eaton	Antenna, Horn	96001	2617	2014-11-18	1 year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year

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

5.4 Test Environmental Conditions

Temperature:	22-24° C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Jerry Tong on 2015-05-08.

5.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	10029.5	21.17	37	-15.83
Middle	10268	21.53	37	-15.47
High	10467	21.12	37	-15.88

Note: 37 dBm = 5 Watts

6 FCC§2.1049 – Occupied Bandwidth

6.1 Applicable Standard

FCC §2.1049

6.2 Measurement Procedure

The test set-up was following TIA 603-D Radiated testing set-up procedure. The spectrum analyzer internal 99% and 26dB bandwidth function is utilized.

KDB 971168 Occupied bandwidth measurement method is used.

6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
HP	Generator, Signal	83650B	3614A00276	2014-08-06	1 year
Eaton	Antenna, Horn	96001	2617	2014-11-18	1 year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 Year

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

6.4 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Jerry Tong on 2015-05-08.

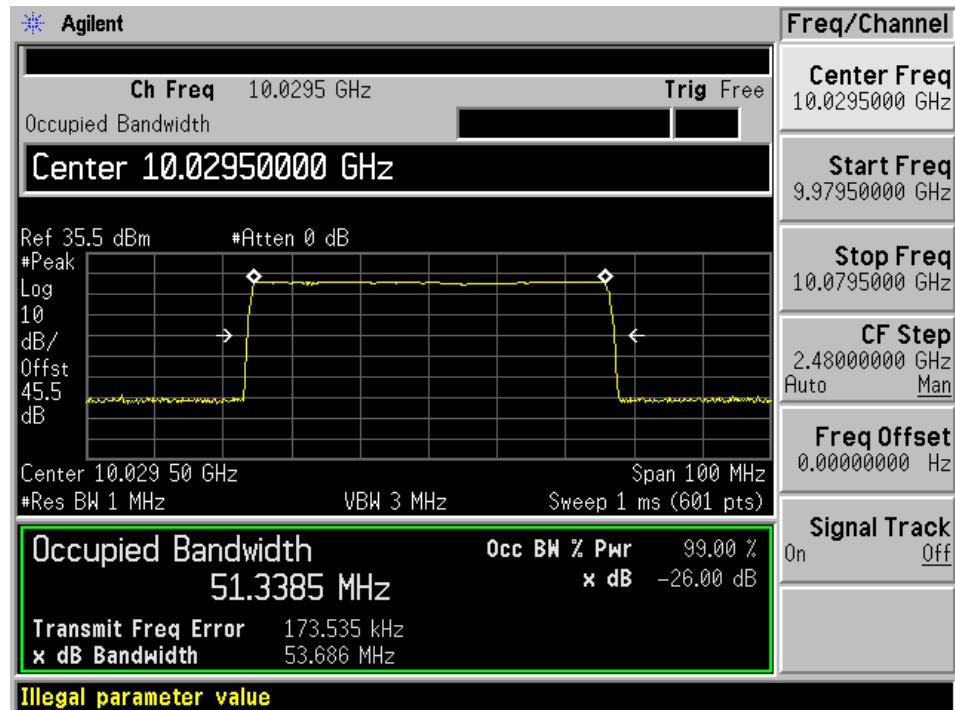
6.5 Test Results

Channel	Frequency (GHz)	26 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Note
Low	10.0295	53.686	51.3385	Sweeping Mode
Middle	10.268	55.883	53.4497	
High	10.467	57.789	55.5231	

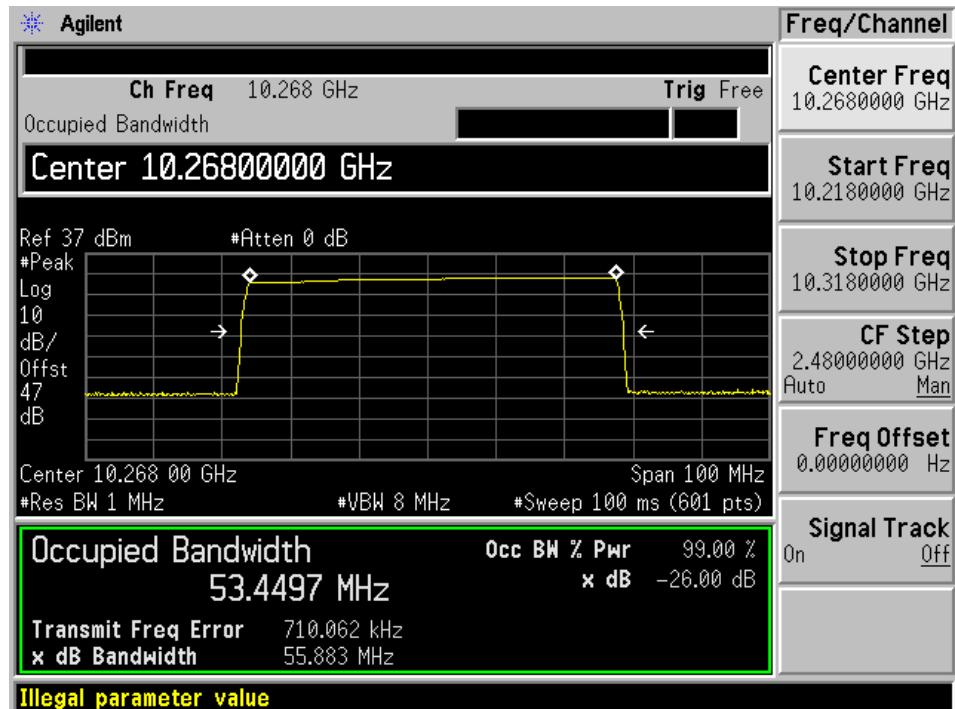
Please refer to the following plots for detailed test results

Emission Bandwidth in Sweeping Mode

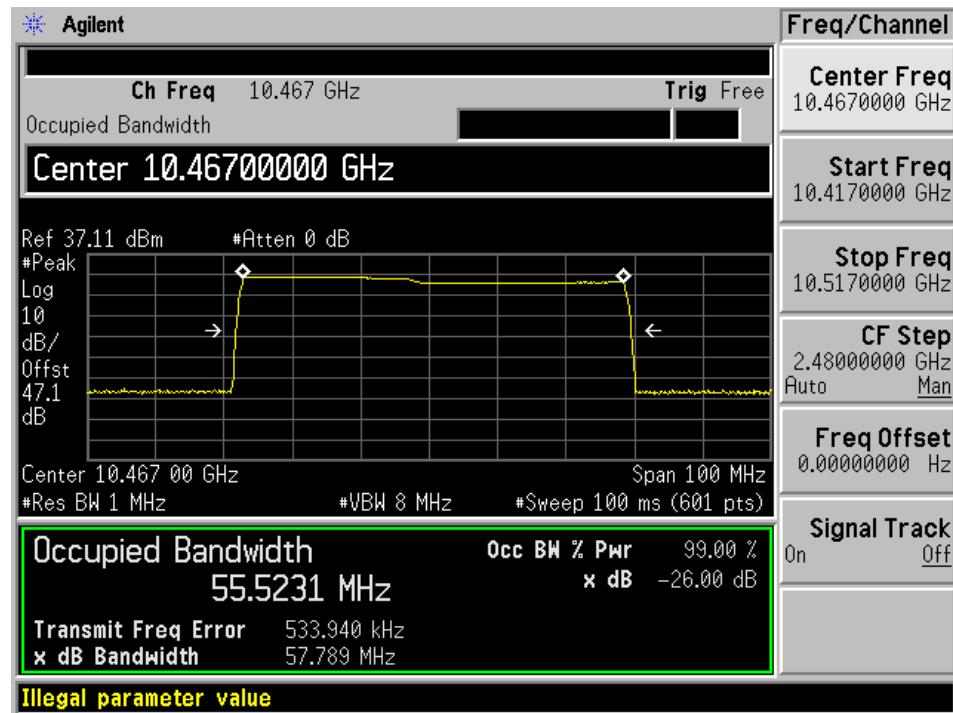
Low channel: 10029.5 MHz



Middle channel: 10268 MHz



High channel: 10467 MHz



7 FCC §2.1051 & §90.210 – Spurious Emissions at Antenna Port

7.1 Applicable Standard

For FCC §2.1051 and FCC §90.210

Attenuation below carrier of $43 + 10 \log (P)$ dB or -13 dBm.

7.2 Test Procedure

TIA-603-D section 2.2.13

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 Year
OML	Mixer, Harmonic	M19HWD	U60313-1	2015-01-09	1 year
OML	Harmonic, Mixer	M12HWD	E60120-1	2015-01-09	1 year
OML	Harmonic, Mixer	M08HWD	F60313-1	2015-01-09	1 year

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

7.4 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

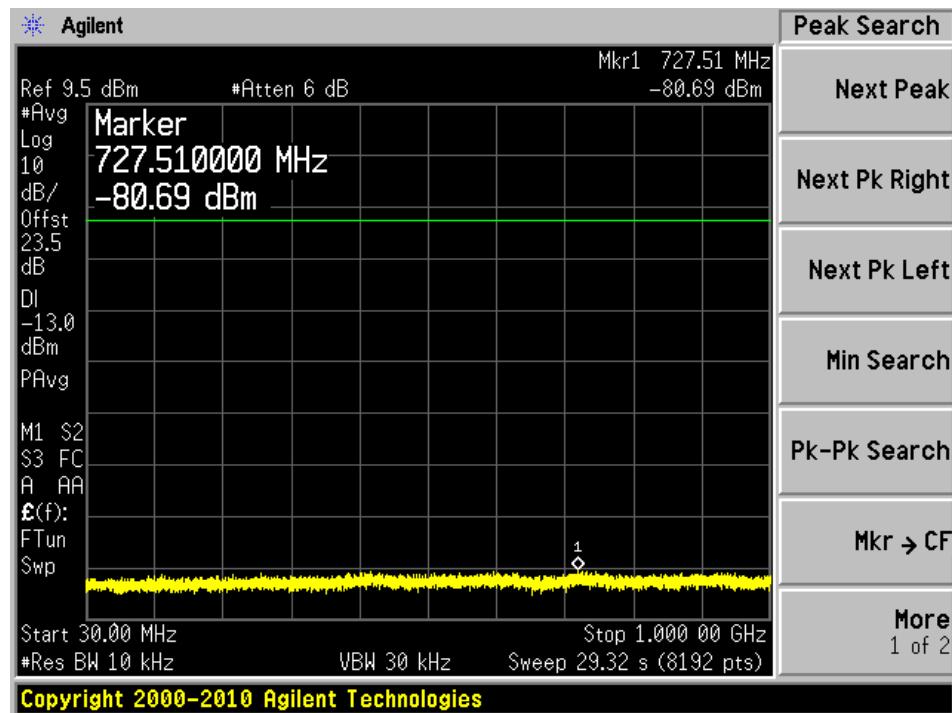
The testing was performed by Jerry Tong on 2015-05-08 at RF site.

7.5 Test Results

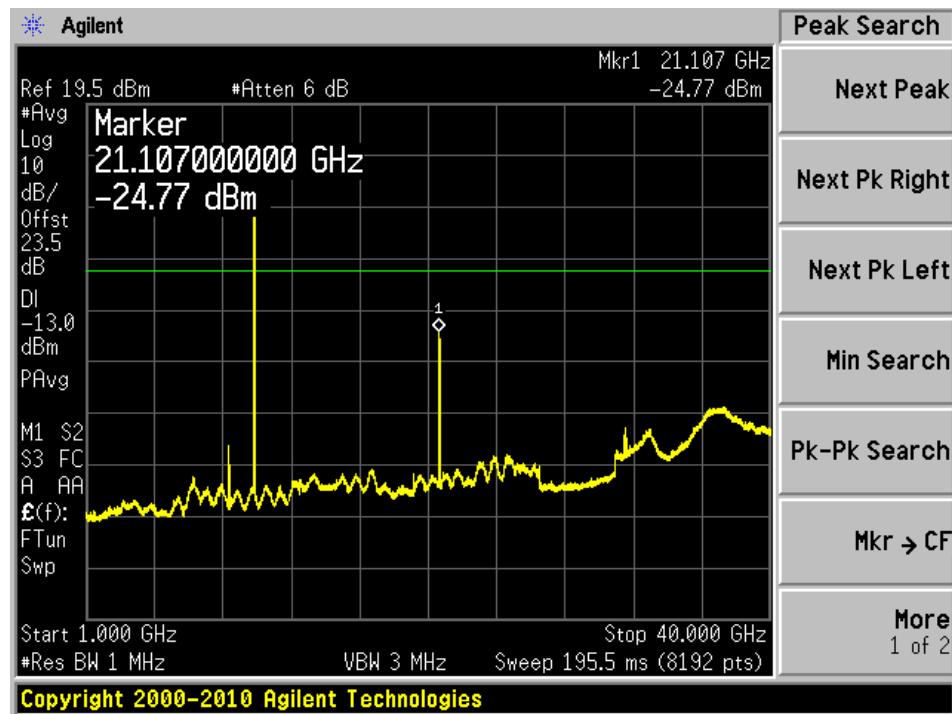
Please refer to following plots of spurious emissions.

Low Channel

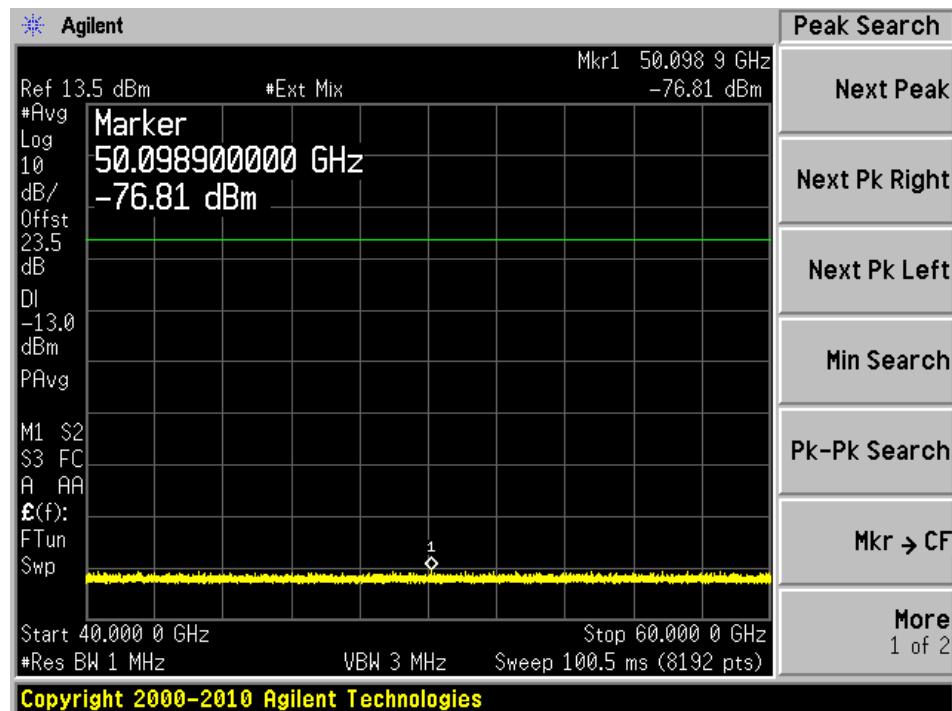
30 MHz – 1 GHz



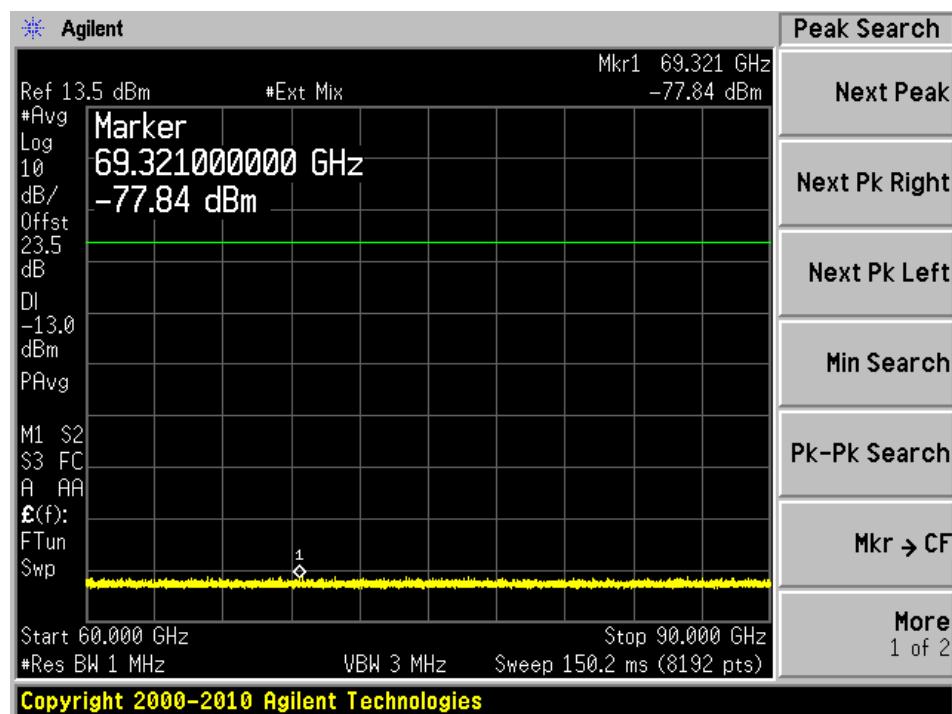
1GHz – 40 GHz



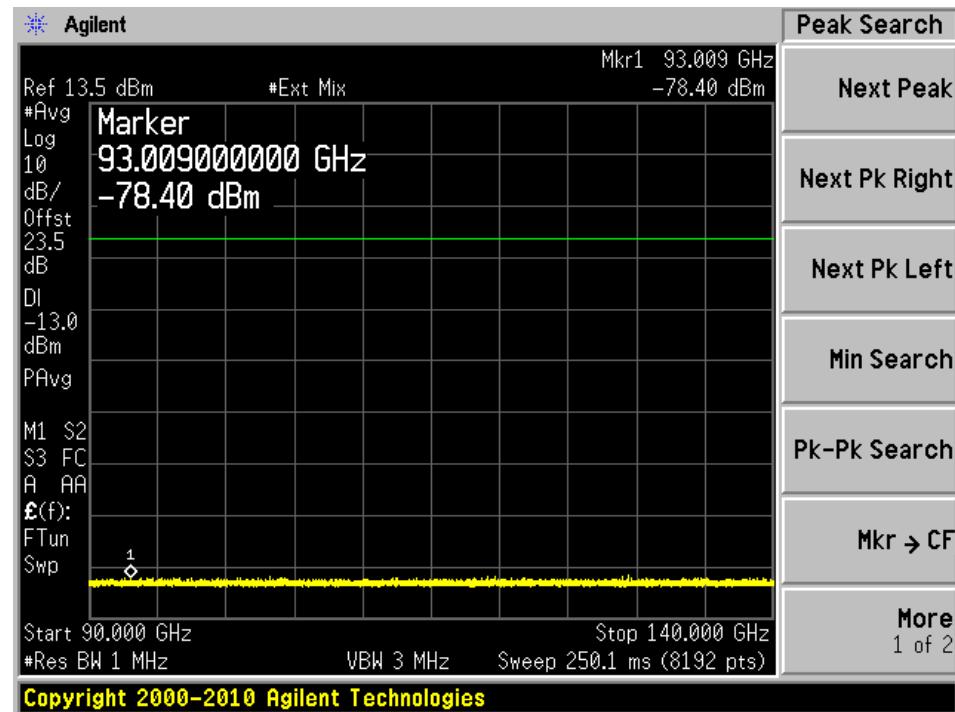
40 GHz – 60 GHz



60 GHz – 90 GHz

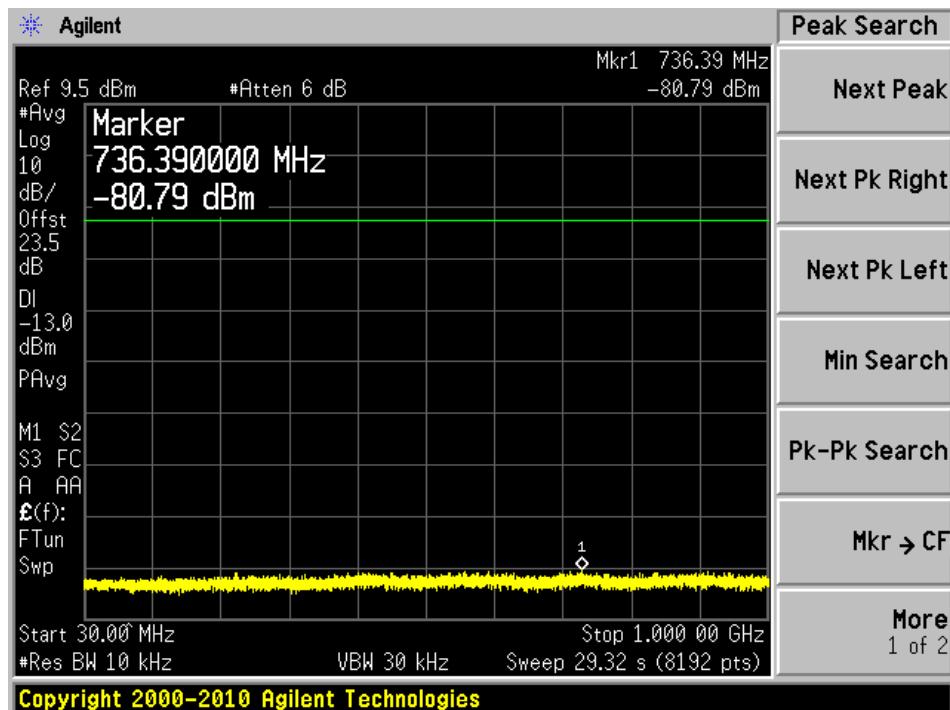


90 GHz – 140 GHz

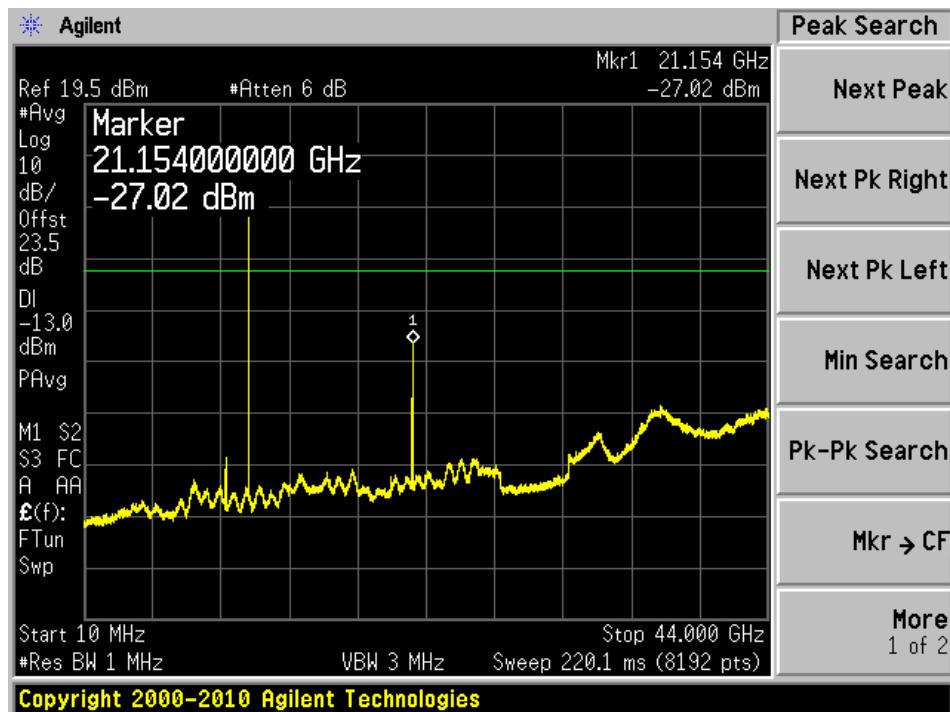


Middle Channel

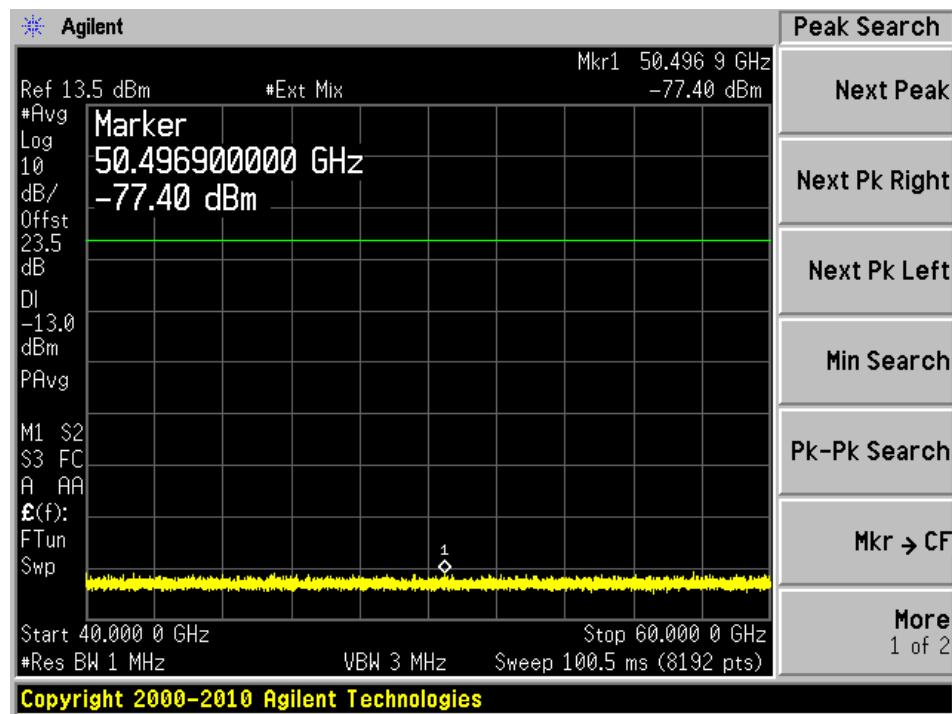
30 MHz – 1 GHz



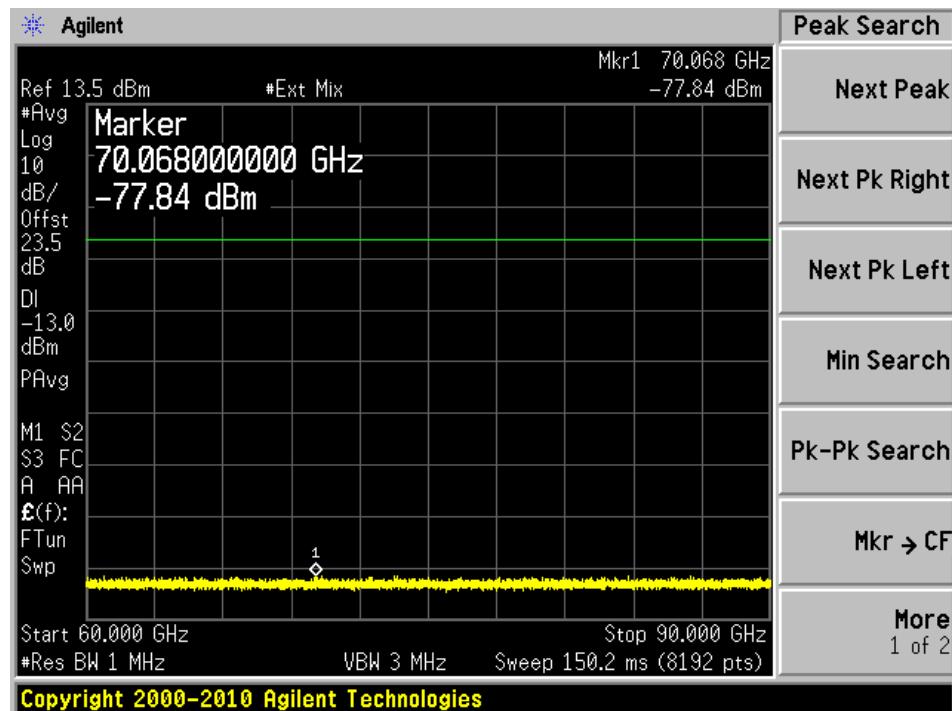
1GHz – 40 GHz



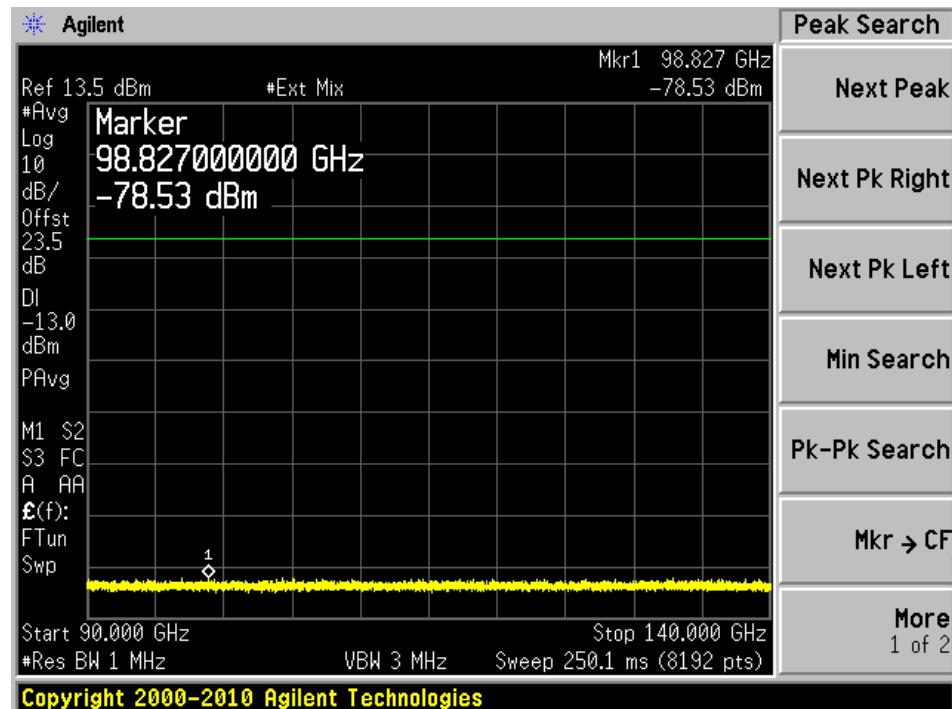
40 GHz – 60 GHz



60 GHz – 90 GHz

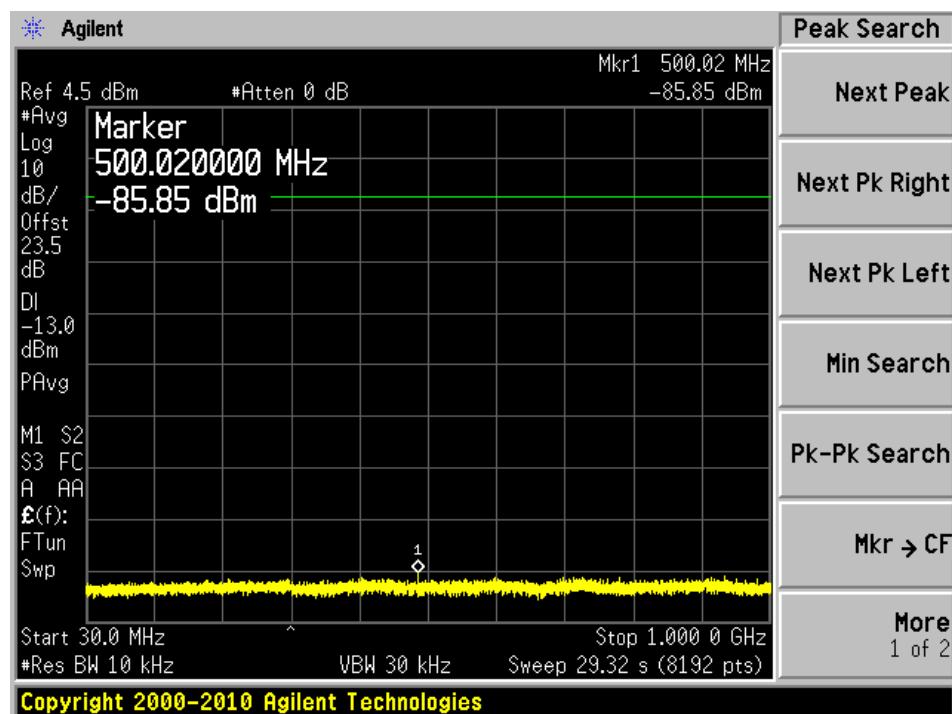


90 GHz – 140 GHz

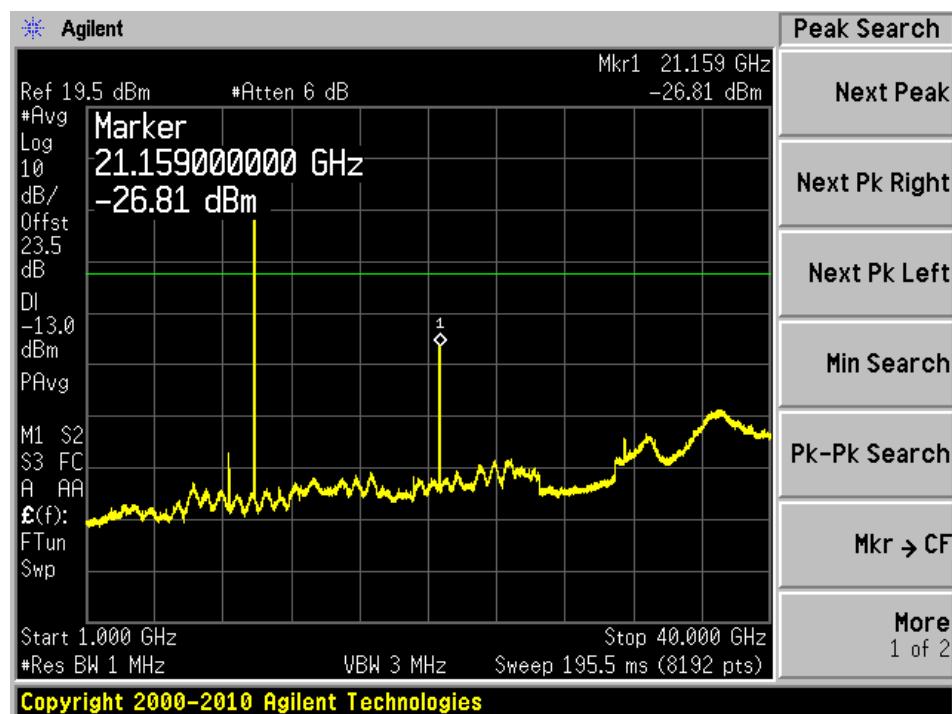


High Channel

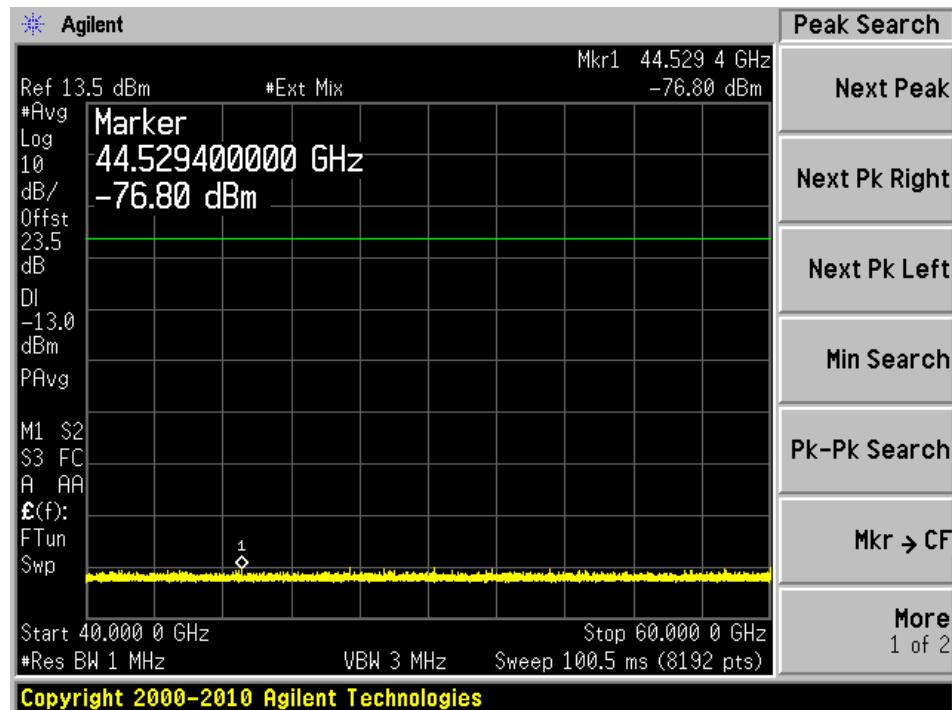
30 MHz – 1 GHz



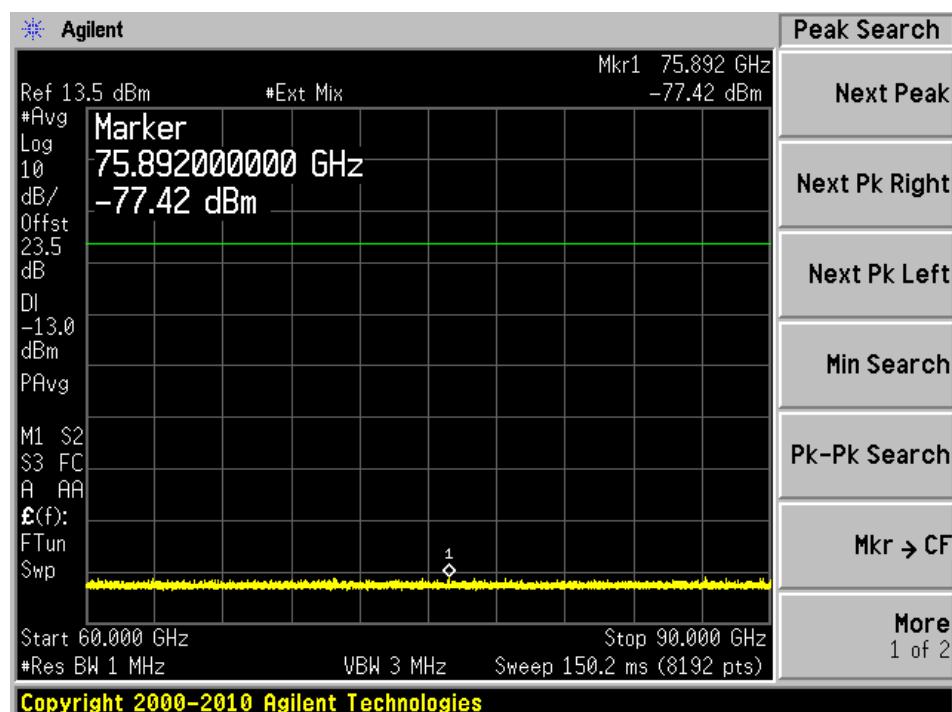
1GHz – 40 GHz



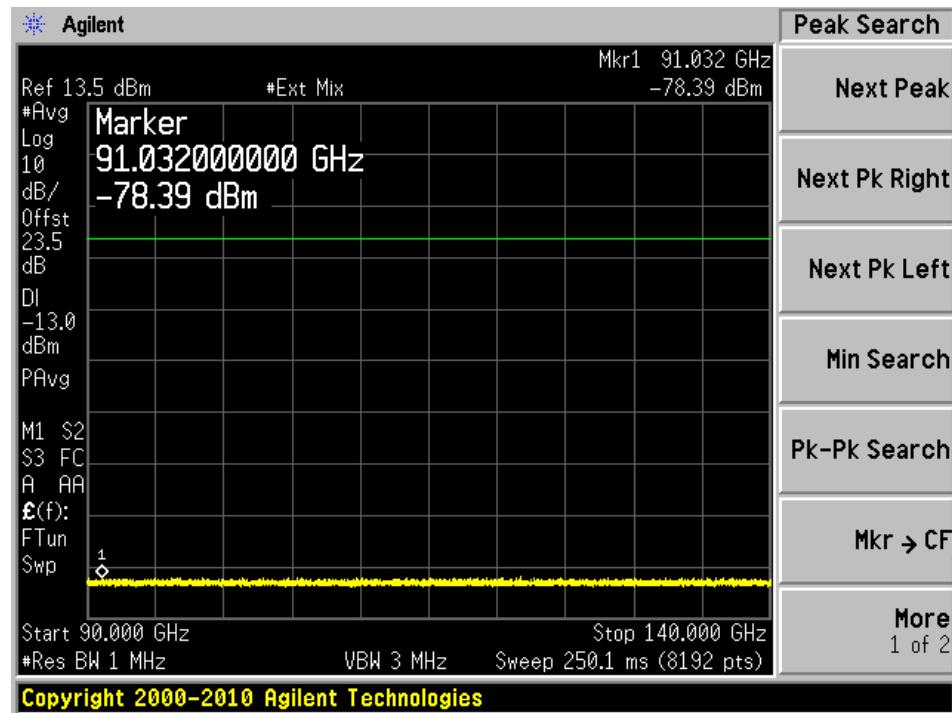
40 GHz – 60 GHz



60 GHz – 90 GHz



90 GHz – 140 GHz



8 FCC §2.1053 & §90.210 – Spurious Radiated Emissions

8.1 Applicable Standard

FCC §2.1053 and FCC §90.210.

Attenuation below carrier of $43+10\log(P)$ dB or -13 dBm.

8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber. The specification used was the FCC §2.1053 and FCC §90.210 limits.

The spacing between the peripherals was 3 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

8.3 Test Procedure

TIA-603 D section 2.2.12

8.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2014-07-24	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2015-03-20	1 year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
Eaton	Antenna, Horn	96001	2617	2014-11-18	1 year
HP	Generator, Signal	83650B	3614A00276	2014-08-06	1 year
Hewlett Packard	Pre Amplifier	8449B OPT H02	3008A01103	2015-03-11	1 year
Wisewave	Amplifier, Low Noise	ALN-33144030-01	11424-01	2015-04-28	2 years
Wisewave	Amplifier, Low Noise	ALN-22093530-01	12263-01	2015-04-28	1 year
WiseWave	Horn Antenna	ARH-4223-02	10555-01	2012-08-09	3 years
Wisewave	Antenna, Horn	ARH-2823-02	10555-01	2012-08-09	3 years

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

8.5 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	52 %
ATM Pressure:	101.89 kPa

The testing was performed by Jerry Tong on 2015-05-08 in 5 m chamber 3.

8.6 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part FCC §2.1053 and FCC §90.210 radiated emissions limits, and had the worst margin of:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel
-36.77	974.8	Horizontal	High

Above 1 GHz:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel
-6.067	20904	Horizontal	High

Please refer to the following tables for specific test result details

8.7 Test Results

Freq. (MHz)	S.A. Amp. (dB μ V/m)	Table Azimuth (Degrees)	Test Ant.		Substitution				Absolute Level (dBm)	Result	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
Low Channel											
360.1	48.69	310	100	V	360.1	-61.91	0	0.09	-62	-13	-49
274.7	53.9	0	100	H	274.7	-57	0	0.05	-57.05	-13	-44.05
668.9	48.5	106	100	V	668.9	-55.5	0	0.16	-55.66	-13	-42.66
225.2	52.55	0	100	H	225.2	-58.45	0	0.08	-58.53	-13	-45.53
5020	59.78	271	150	H	5020	-36.88	10.974	0.98	-26.886	-13	-13.886
14012	49.72	309	150	V	14012	-35.33	11.694	2.93	-26.566	-13	-13.566
20173	51.67	29	157	V	20173	-31.64	14.234	2.92	-20.326	-13	-7.326
20173	47.37	355	150	H	20173	-35.94	14.339	2.92	-24.521	-13	-11.521
Middle Channel											
499	56.4	0	100	V	499	-53.6	0	0.12	-53.72	-13	-40.72
310.6	57.58	0	100	H	310.6	-52.82	0	0.1	-52.92	-13	-39.92
432	51.86	0	100	V	432	-56.74	0	0.1	-56.84	-13	-43.84
274.7	54.28	0	100	H	274.7	-56.52	0	0.1	-56.62	-13	-43.62
5133	56.88	113	150	V	5133	-39.88	10.371	0.98	-30.489	-13	-17.489
5133	60.99	331	150	H	5133	-35.77	10.799	0.98	-25.951	-13	-12.951
20587	48.83	10	150	V	20587	-36.53	14.125	2.76	-25.165	-13	-12.165
20573	47.8	331	150	H	20573	-37.6	14.343	2.29	-25.547	-13	-12.547
High Channel											
448.7	56.98	0	100	V	448.7	-51.82	0	0.11	-51.93	-13	-38.93
974.8	57.63	0	100	H	974.8	-49.57	0	0.2	-49.77	-13	-36.77
325.8	55.78	0	100	V	325.8	-45.25	0	0.1	-45.35	-13	-32.35
950.5	55.14	0	100	H	950.5	-51.46	0	0.2	-51.66	-13	-38.66
5227	58.98	236	150	V	5227	-39.72	10.578	0.99	-30.132	-13	-17.132
5245	61.71	307	150	H	5245	-36.05	10.661	1	-26.389	-13	-13.389
15857	47.59	34	150	H	15857	-35.98	16.375	2.04	-21.645	-13	-8.645
20904	55.37	328	150	H	20904	-29.59	13.143	2.62	-19.067	-13	-6.067

9 FCC §2.1055 & §90.213(a) – Frequency Stability

9.1 Applicable Standard

FCC §2.1055

FCC §90.213 (b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer

9.2 Test Procedure

TIA-603-D, section 2.2.2

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
HP	Generator, Signal	83650B	3614A00276	2014-08-06	1 year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
Eaton	Antenna, Horn	96001	2617	2014-11-18	1 year
Dickson	Chart Recorder, Temperature & Humidity	THDX	8212174	2015-01-16	2 year
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 Year

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

9.4 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Jerry Tong on 2015-05-08 at RF site.

9.5 Test Results

Reference Frequency: EUT Mid Channel (10267.97 MHz) @ 25 °C Limit: ± 100 ppm			
Temperature (°C)	Frequency Stability Results		
	(MHz)	(ppm)	Limit (ppm)
65	10267.9700	0	± 100
55	10267.9700	0	± 100
45	10267.9700	0	± 100
35	10268.0300	5.84	± 100
25	10267.9700	0	± 100
15	10267.8000	-16.56	± 100
5	10267.9000	-6.82	± 100
-5	10268.2000	22.40	± 100
-15	10267.9330	-3.60	± 100
-25	10267.9670	-0.29	± 100
-30	10267.9330	-3.60	± 100