FCC PART 90

TEST REPORT

For

Savari, Inc.

2005 De La Cruz Blvd., Suite 111,

Santa Clara, CA 95050, USA

FCC ID: 2AADT-SAV-RSU2

Report Type:	**Product Type:**
Original Report	Road-Side Unit

Prepared By:	Troy Pandhumsoporn Test Engineer
Report Number:	R1611143-90
Report Date:	2017-10-13
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1611143-90	Original Report	2017-10-13

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of*, Savari, Inc*, and their product model: *RSU2;* FCC ID: 2AADT-SAV-RSU2 or the "EUT" as referred to in this report. The EUT is a Public Safety Road Side Unit with Radio operates in 5860-5920 MHz.

1.2 Mechanical Description of EUT

The EUT measures 22 cm (L), 22 cm (W), 12 cm (H), and weighs 2 kg.

The data gathered are from a production sample provided by the manufacturer, serial number: 01R2111603221000060-0002*, assigned by Client.*

1.3 Objective

This report is prepared on behalf of *Savari, Inc.* in accordance with Part 2, Part 90. The objective is to determine compliance with FCC Part 90.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI TIA-603-D and ASTM E2213-03

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 $\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 Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.03)*** to certify

- For the USA (Federal Communications Commission):
    1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
    2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
    3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
    1 All Scope 1-Licence-Exempt Radio Frequency Devices;
    2 All Scope 2-Licensed Personal Mobile Radio Services;
    3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
    4 All Scope 4-Licensed Maritime & Aviation Radio Services;
    5 All Scope 5-Licensed Fixed Microwave Radio Services
    6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):

1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2

- For the Hong Kong Special Administrative Region:

1 All Radio Equipment, per KHCA 10XX-series Specifications;
2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.

- For Japan:

1 MIC Telecommunication Business Law (Terminal Equipment):
- All Scope A1 - Terminal Equipment for the Purpose of Calls;
- All Scope A2 - Other Terminal Equipment

2 Radio Law (Radio Equipment):
- All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
- All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
- All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
    - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
    - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
    - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
    - Radio & Teleterminal Equipment (R&TTE) Directive 1995/5/EC US -EU EMC & Telecom MRA CAB (NB)
    - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
    - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
    - ENERGY STAR Recognized Test Laboratory – US EPA
    - Telecommunications Certification Body (TCB) – US FCC;
    - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA-603-D and ASTM E2213-03.

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

2.2 EUT Exercise Software

The test utility used was Terminal.

2.3 Special Equipment

Manufacturer	Description	Model
Lenovo	Laptop	T560

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model	Part Number	Calibration Date
N/A	Ethernet cable	N/A	N/A	N/A

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Crystals (MHz)
PC Engines	Computer	ALIX D2D / Rev. 1	0.32768, 14.31818, 25.000, 48.000
dBii, Networks	Wi-Fi Radio	F50-PRO	48.00
Planet Networking & Communication	Passive POE Power Converter	POE-165S	-

2.7 External I/O Cabling List and Details

Cable Descriptions	Length (m)	From	To
AC Power adapter	2.25	AC power	POE Switch
RJ45 Cable	1.5	POE Port	EUT
RJ45 Cable	10	POE Uplink	Laptop

2.8 EUT External Power Supply List and Details

Manufacturer	Description	Model	Serial number
Mean Well	Power Adapter	MDR-60-48	EB24378632
Tycon Systems	POE Power Switch	TP-SW5G-NC	122000194A

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
FCC §2.1091	RF Exposure	Compliant
ASTM E2213-03 §8.9.1 FCC §90.377	Output Power	Compliant
ASTM E2213-03 §8.9.1 FCC §90.379	Transmit Spectrum Mask	Compliant
FCC §2.1049, §90.209	Emission Bandwidth	Compliant
ASTM E2213-03 §8.9.5 FCC §2.1055	Frequency Stability	Compliant
ASTM E2213-03 §8.9.2 FCC §2.1051	Transmit Spurious Emission-Conducted	Compliant
ASTM E2213-03 §8.9.2 FCC §2.1053	Transmit Spurious Emission-Radiated	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

Single Chain MPE Evaluation:

Chain 0

Maximum peak output power at antenna input terminal (dBm):	9.86
Maximum peak output power at antenna input terminal (mW):	9.68
Prediction distance (cm):	20
Prediction frequency (MHz):	5905
Maximum Antenna Gain, typical (dBi):	9
Maximum Antenna Gain (numeric):	7.94
Power density of prediction frequency at 20 cm (mW/cm^2):	0.015
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1

Chain 1

Maximum peak output power at antenna input terminal (dBm):	9.58
Maximum peak output power at antenna input terminal (mW):	9.08
Prediction distance (cm):	20
Prediction frequency (MHz):	5860
Maximum Antenna Gain, typical (dBi):	9
Maximum Antenna Gain (numeric):	7.94
Power density of prediction frequency at 20 cm (mW/cm^2):	0.014
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1

Multi Chains MPE Evaluation:

Chain 0+Chain 1=0.015/1+0.014/1=0.029 < 1.0

Conclusion:

The device compliances with FCC MPE limit at 20 cm distance.

5 ASTM E2213-03 §8.9.1 & §90.377 – RF Output Power

5.1 Applicable Standard

According to ASTM E2213-03 §8.9.1:

Public Safety and Private RSU installations operating in Channels 172, 174, 175, and 176 are used to implement small and medium range operations. RSU installation transmissions in Channels 172,174, and 176 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP. RSU installation transmissions in Channel 175 shall not exceed 10 dBm antenna input power and 23 dBm EIRP. Public Safety RSU installation transmissions in Channel 178 shall not exceed 28.8 dBm antenna input power and 44.8 dBm EIRP. Private RSU installation transmissions in Channel 178 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP.
The DSRC Channels 180, 181, and 182 are used to implement small zone operations. Public Safety and Private RSU installation in these channels shall not exceed 10 dBm antenna input power and 23 dBm EIRP. These installations shall also use an antenna with a minimum 6 dBi gain. Public Safety RSU and OBU operations in Channel 184 shall not exceed 28.8 dBm antenna input power and 40 dBm EIRP. Private RSU operations in Channel 184 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP.

5.2 Test Procedure

According to TIA-603-D

5.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
ETS- Lingerin	Power Sensor	7002-006	160097	2016-12-05	2 years

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:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Frank Wang from 2017-06-09 at RF site.

5.5 Test Results

Channel #	Frequency (MHz)	Conducted Output Power (dBm)		Antenna Gain (dBi)	Conducted Output Power Limit (dBm)	E.I.R.P Chain 0 (dBm)	E.I.R.P Chain 1 (dBm)	E.I.R.P Limit (dBm)
		Chain 0	Chain 1					
172	5860	8.87	9.58	9	28.8	17.87	18.58	33
174	5870	8.99	9.55	9	28.8	17.99	18.55	33
175	5875	9.45	9.58	9	10	18.45	18.58	23
176	5880	9.03	9.13	9	28.8	18.03	18.13	33
178	5890	9.05	9.21	9	28.8	18.05	18.21	44.8
180	5900	8.26	9.38	9	10	17.26	18.38	23
181	5905	9.86	9.51	9	10	18.86	18.51	23
182	5910	8.68	9.00	9	10	17.68	18	23
184	5920	8.95	8.98	9	28.8	17.95	17.98	40

6 ASTM E2213-03 §8.9.2 - Transmit Spectrum Mask

6.1 Applicable Standard

TABLE 9 DSRC Device Classes and Transmit Power Levels[A]

Device Class	Maximum Device Output Power, dBm
A	0
B	10
C	20
D	28.8 or more

[A] From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

TABLE 10 DSRC Spectrum Mask[A]

NOTE—Reduction in Power Spectral Density, dBr.

Class	± 4.5-MHz Offset	± 5.0-MHz Offset	± 5.5-MHz Offset	± 10-MHz Offset	± 15-MHz Offset
Class A	0	-10	-20	-28	-40
Class B	0	-16	-20	-28	-40
Class C	0	-26	-32	-40	-50
Class D	0	-35	-45	-55	-65

[A] From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

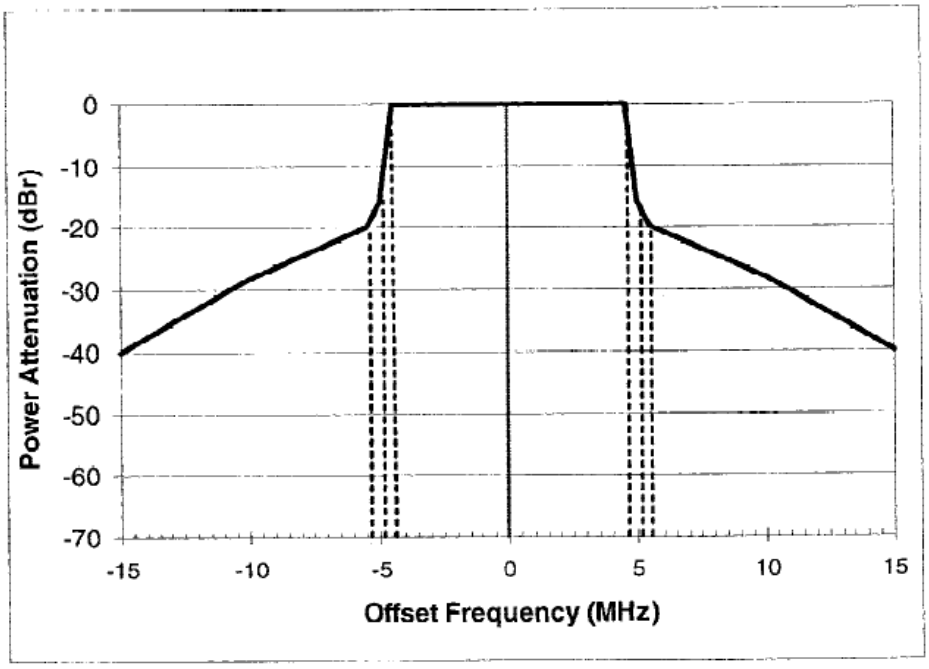


FIG. 13 Class B Transmit Spectrum Mask

6.2 Test Procedure

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by 55 + 10log(*P*) dB, where *P* is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

6.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2017-04-20	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:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

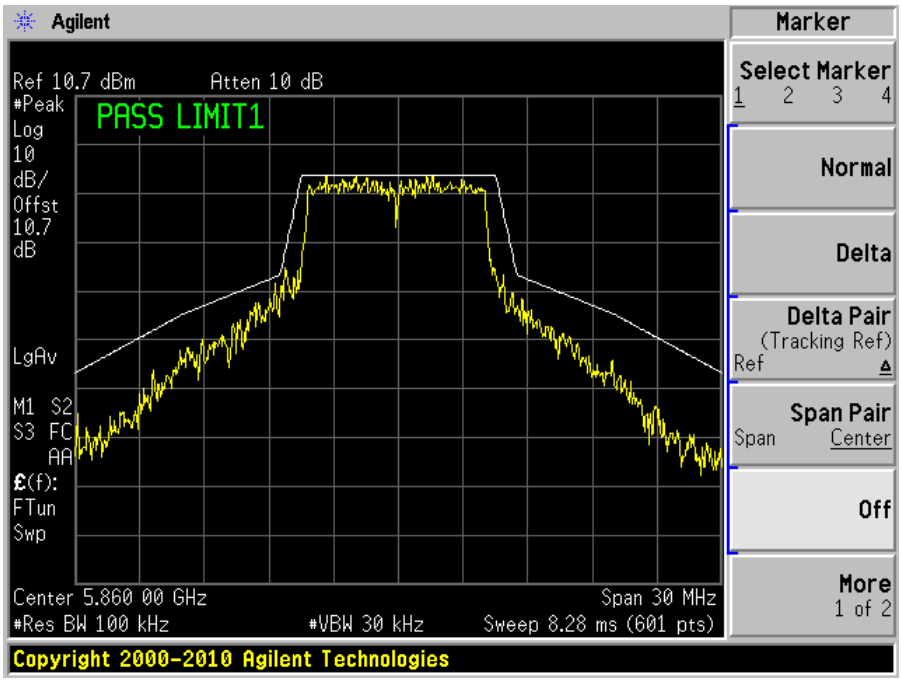
The testing was performed by Frank Wang from 2017-06-09 at RF site.

6.5 Test Results

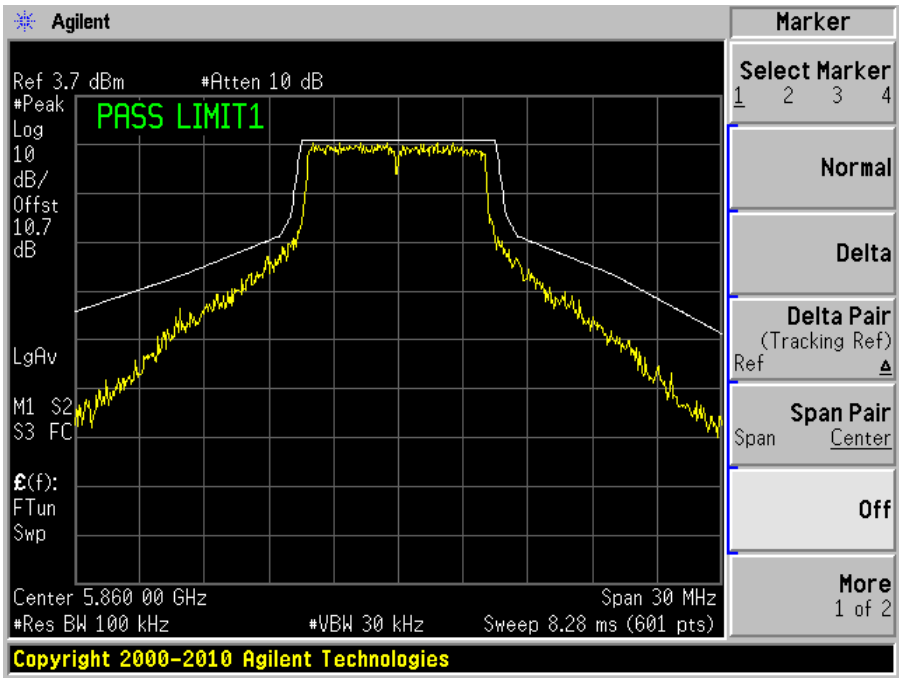
Class B Mask has been utilized.

Please refer to the following plots for the test result

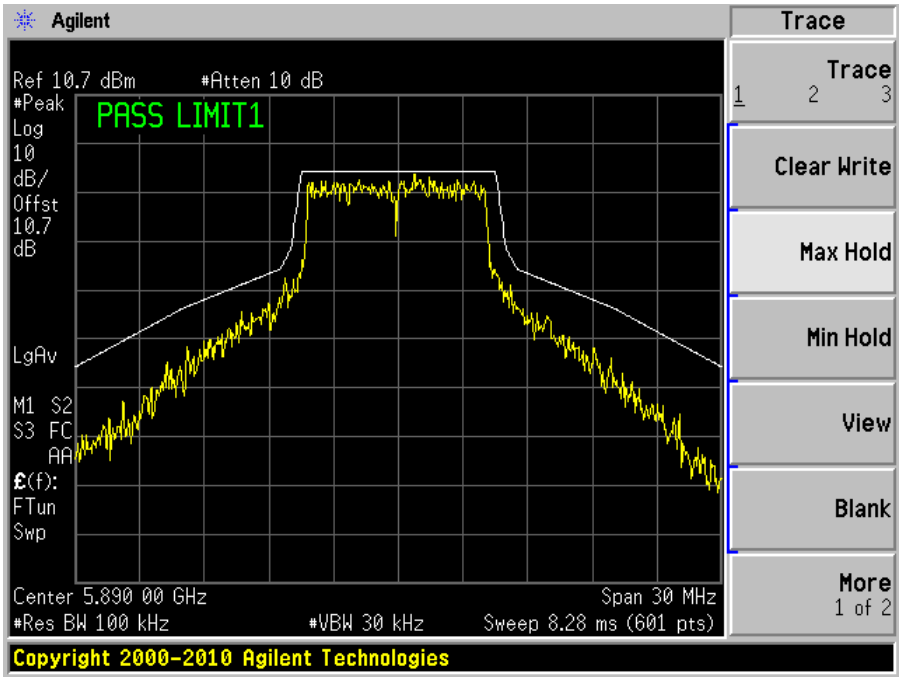
Low Channel, 5860 MHz, Chain 0



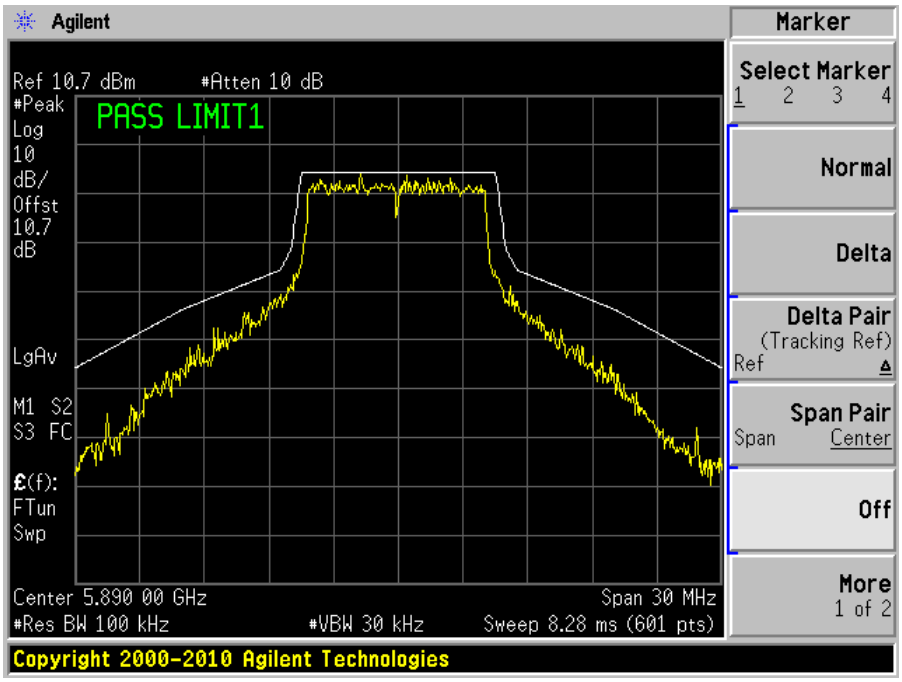
Low Channel, 5860 MHz, Chain 1



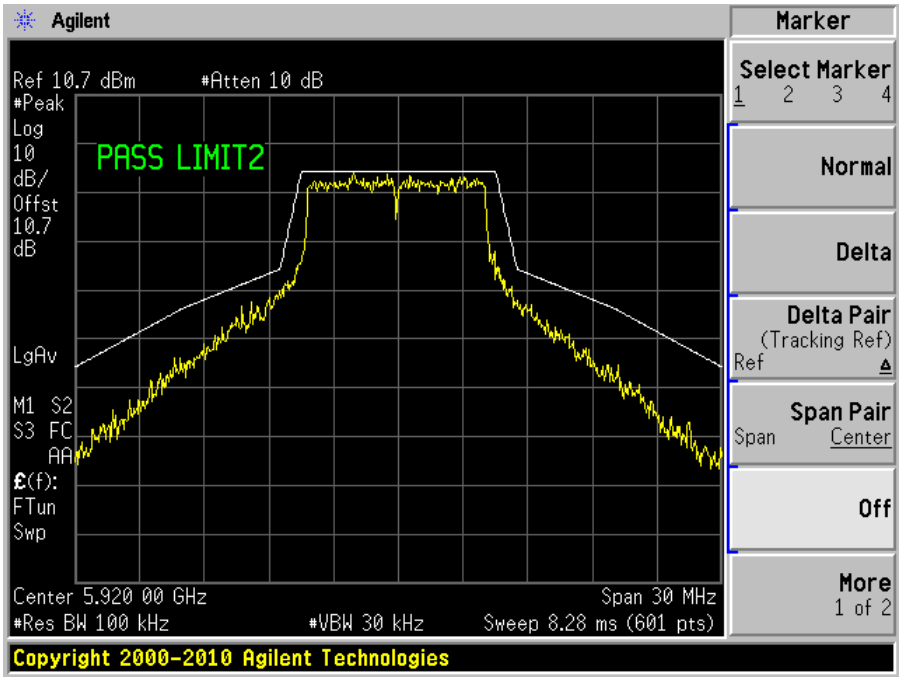
Middle Channel, 5890 MHz, Chain 0



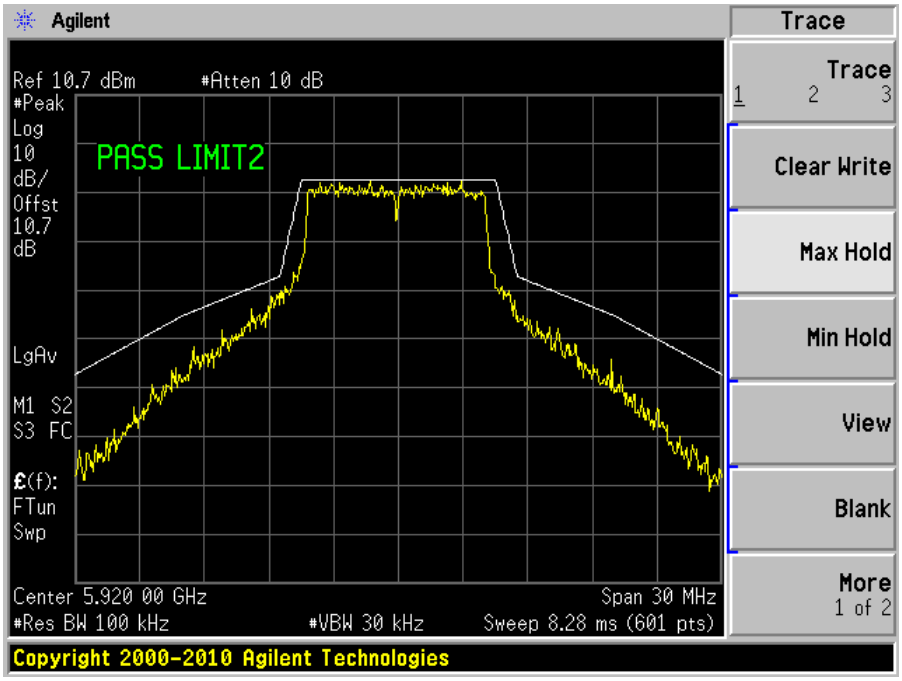
Middle Channel, 5890 MHz, Chain 1



High Channel, 5920 MHz, Chain 0



High Channel, 5920 MHz, Chain 1



7 FCC §2.1049 - Emission Bandwidth

7.1 Applicable Standard

FCC §2.1049

7.2 Test Procedure

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold my produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between two recorded frequencies is the occupied bandwidth.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2017-04-20	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:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

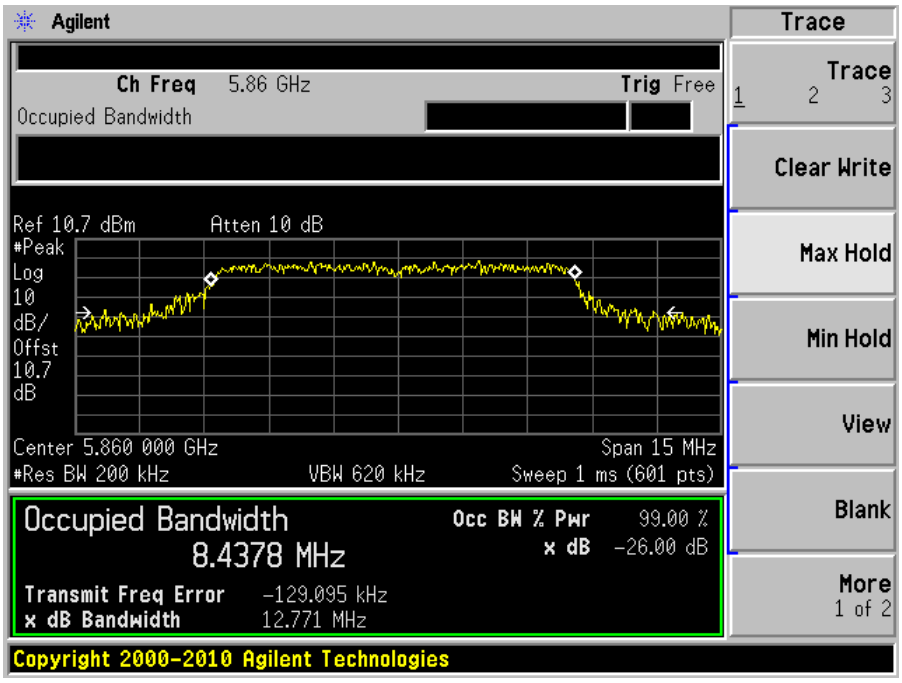
The testing was performed by Frank Wang from 2017-06-09 at RF site.

7.5 Test Results

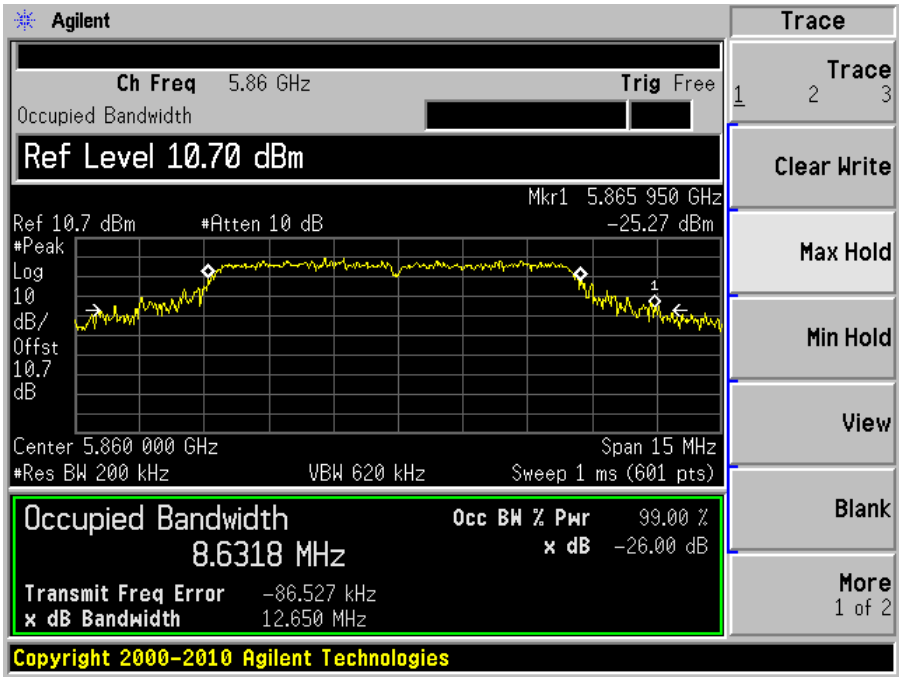
Channel	Frequency (MHz)	99%OBW (MHz) Chain 1	99% OBW (MHz) Chain 2
Low	5860	8.4378	8.6318
Middle	5890	8.4391	8.6144
High	5920	8.8444	8.4871

Please refer to the following plots for the test results

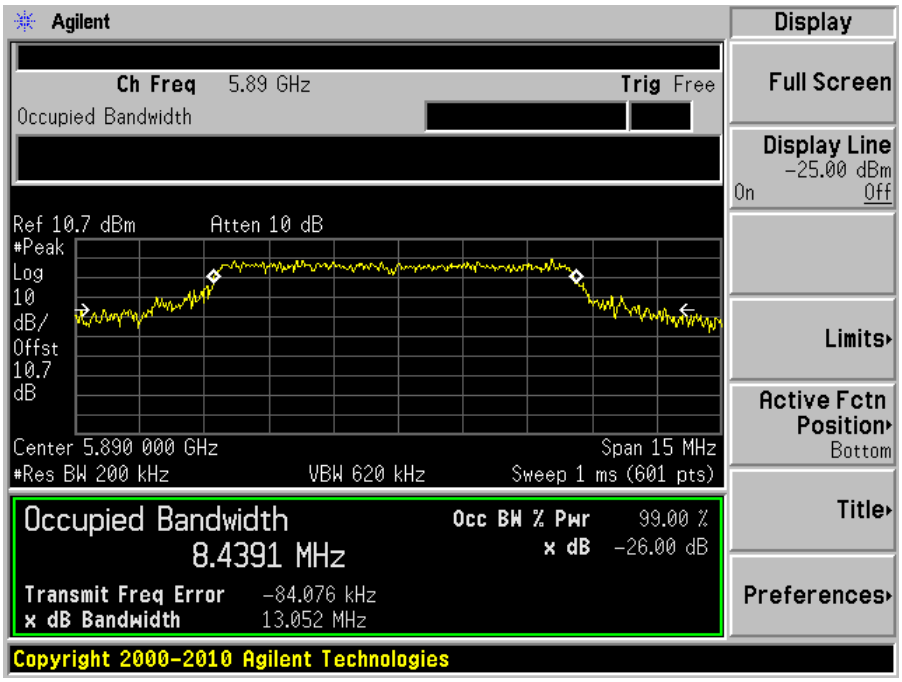
Low Channel, 5860 MHz, Chain 0



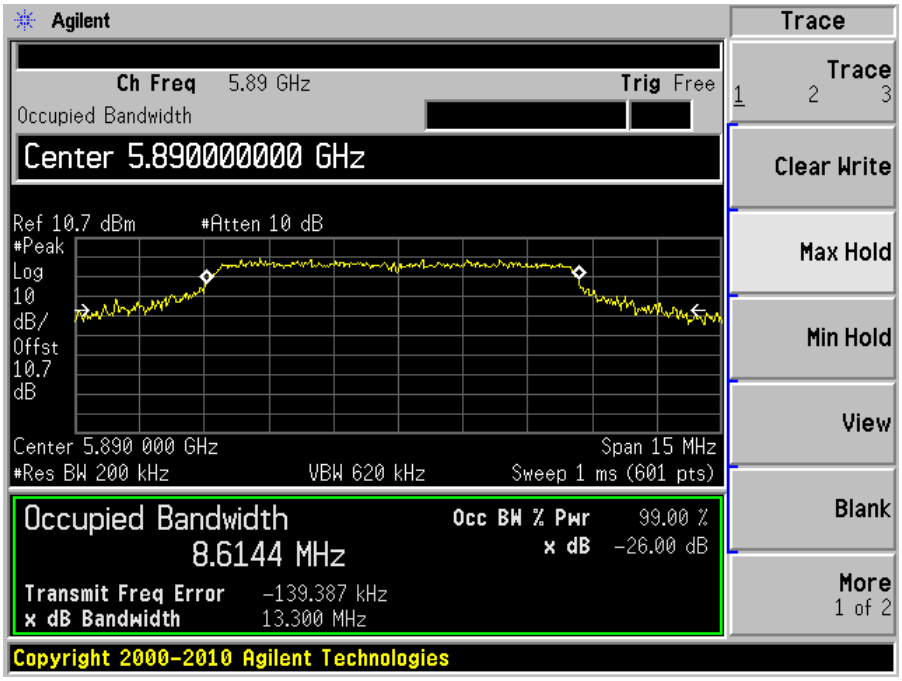
Low Channel, 5860 MHz, Chain 1



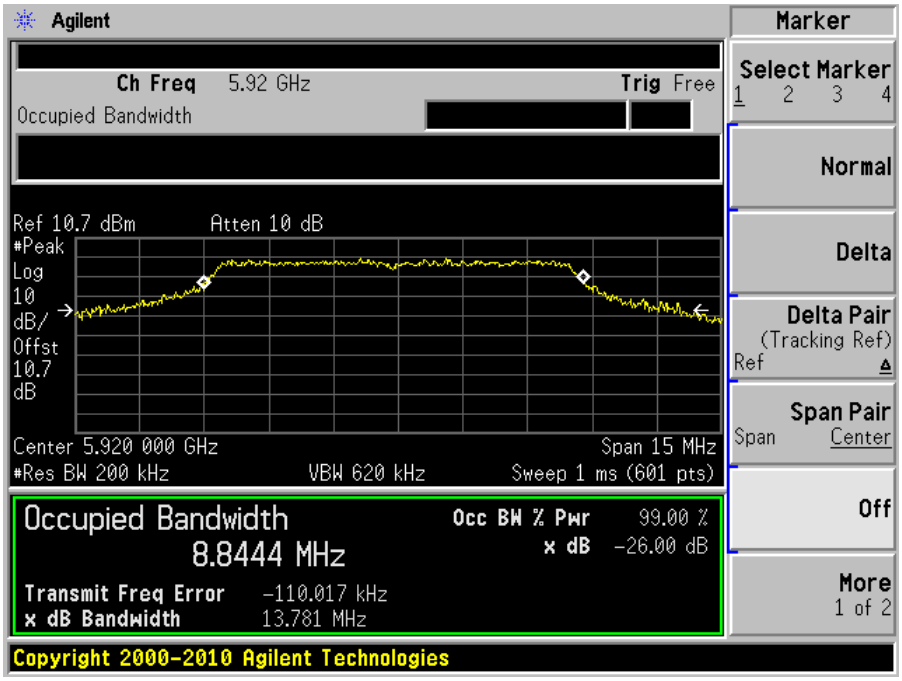
Middle Channel, 5890 MHz, Chain 0



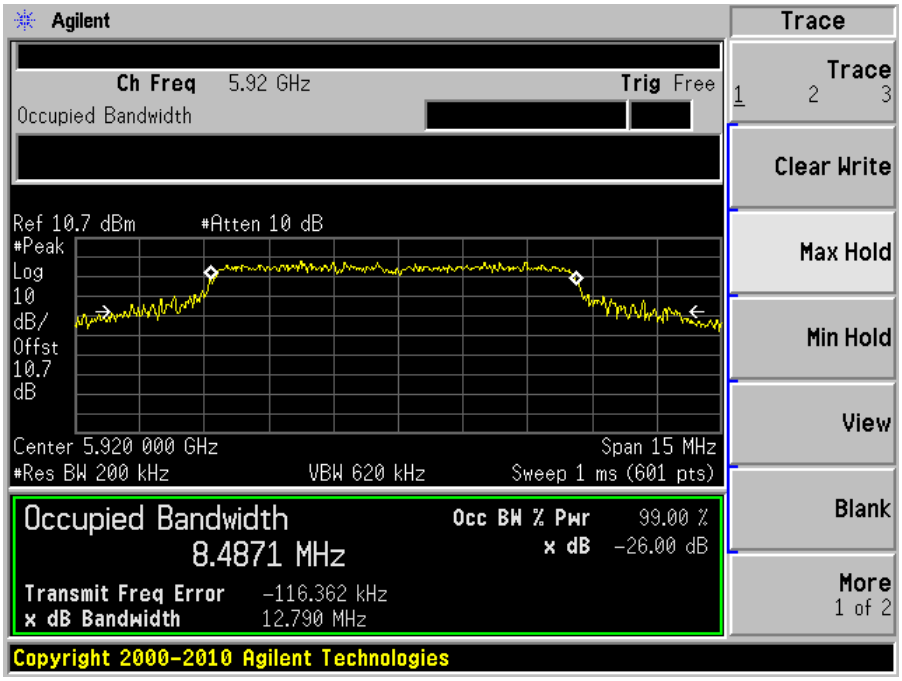
Middle Channel, 5890 MHz, Chain 1



High Channel, 5920 MHz, Chain 0



High Channel, 5920 MHz, Chain 1



8 ASTM E2213-03 §8.9.4 & FCC §2.1055 - Frequency Tolerance

8.1 Applicable Standard

According to FCC §2.1055 and ASTM E2213-03 §8.9.4

8.2 Measurement Procedure

According to ANSI/TIA-D 2010 section 2.2.2, the carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The measurement method is as following:

- Operate the equipment in standby conditions for 15 minutes before proceeding.
- Record the carrier frequency of the transmitter as MCF MHz.
- Calculate the ppm frequency error by the following:

$$\text{Ppm error} = ((\text{MCF}/\text{ACF}) - 1) * 10^6$$

Where

MCF is the Measured Carrier Frequency in MHz
ACF is the Assigned Carrier Frequency in MHz

- The value recorded above is the carrier frequency stability.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2017-04-20	1 year
Tenney	Temperature Chamber	TUJR	27445-06	2016-09-20	13 Months
BK PRECISION	DC Power Supply	E3	N/A	N/A	N/A
Fluke	DMM True-RMS	179	78490059	2016-07-11	1 Year

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

8.4 Test Environmental Conditions

Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Frank Wang from 2017-06-16 at RF site.

8.5 Test Results

Low Channel, 5860 MHz

Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Result (ppm)	Limit (ppm)
-30	48	5859.953	-8.02	± 10
-20	48	5860.011	1.88	± 10
-10	48	5860.013	2.22	± 10
0	48	5860.0035	0.6	± 10
10	48	5859.9685	-5.37	± 10
20	40.8	5859.968	-5.46	± 10
20	48	5859.9475	-8.96	± 10
20	55.2	5859.9575	-7.25	± 10
30	48	5859.974	-4.44	± 10
40	48	5859.9665	-5.71	± 10
50	48	5860.028	0.48	± 10

Middle Channel, 5890 MHz

Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Result (ppm)	Limit (ppm)
-30	48	5889.994	-1.02	± 10
-20	48	5889.957	-7.3	± 10
-10	48	5890.011	1.87	± 10
0	48	5889.985	-2.54	± 10
10	48	5889.961	-6.62	± 10
20	40.8	5889.953	-7.98	± 10
20	48	5889.943	-9.68	± 10
20	55.2	5889.9475	-8.91	± 10
30	48	5890.0075	1.27	± 10
40	48	5889.9735	-4.5	± 10
50	48	5889.9905	-1.61	± 10

High Channel, 5920 MHz

Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Result (ppm)	Limit (ppm)
-30	48	5920.0035	0.59	± 10
-20	48	5919.953	-7.94	± 10
-10	48	5919.9735	-4.476	± 10
0	48	5920.0335	5.66	± 10
10	48	5920.036	6.08	± 10
20	40.8	5920.015	2.53	± 10
20	48	5919.9415	-9.88	± 10
20	55.2	5920.043	7.26	± 10
30	48	5919.97	-5.07	± 10
40	48	5919.983	-2.87	± 10
50	48	5919.9515	-8.19	± 10

Test is based on Chain 1, which is the worst case.

9 ASTM E2213-03 §8.9.2 & FCC §2.1051 - Conducted Spurious Emission

9.1 Applicable Standard

According to ASTM EN2213-03 §8.9.2:

8.9.2.2 The transmitted spectral mask for class A, B, C, and D devices are shown in Figs. 12-15. In addition, all DSRC site installations shall limit the EIRP in the transmitted spectrum to −25 dBm or less in the 100 kHz at the channel edges and the band edges. Additional filtering that supplements the filtering provided by the transmitter may be needed for some antenna/transmitter combinations.

9.2 Measurement Procedure

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by 55 + 10log(*P*) dB, where *P* is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2017-04-20	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

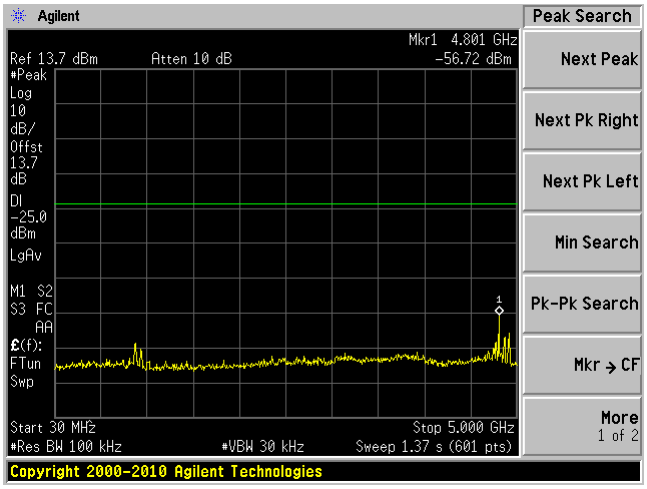
Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Frank Wang from 2017-06-16 at RF site.

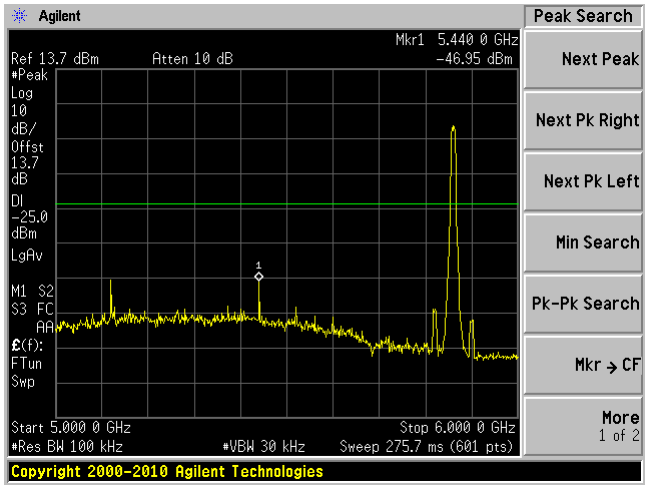
9.5 Test Results

Please refer tot eh following plots.

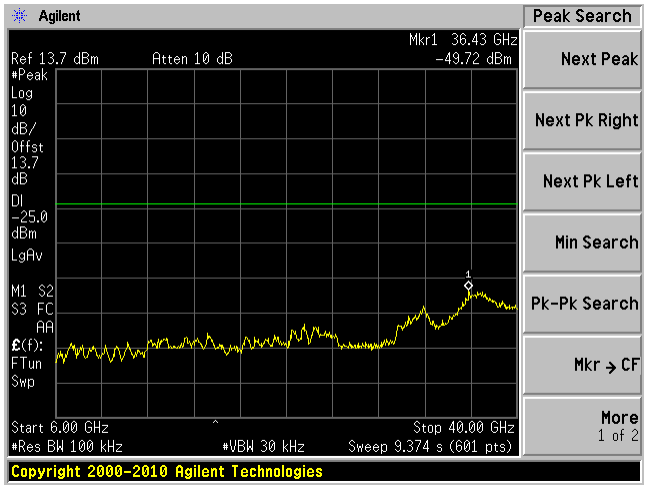
Low Channel 5860 MHz Chain 0, 30MHz – 5GHz



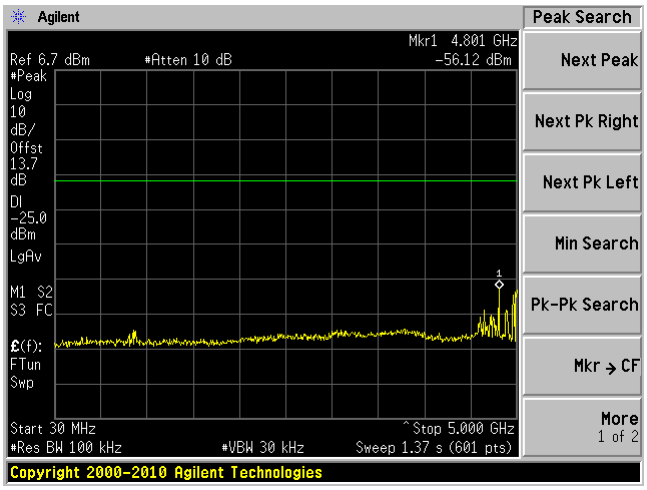
Low Channel 5860 MHz Chain 0, 5GHz – 6GHz



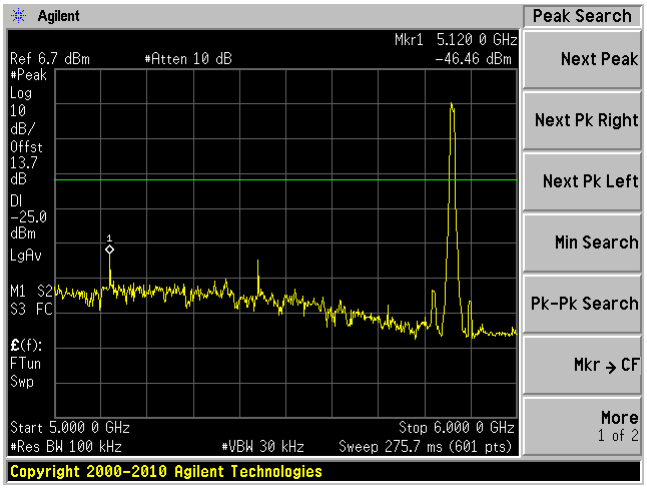
Low Channel 5860 MHz Chain 0, 6 GHz – 40GHz



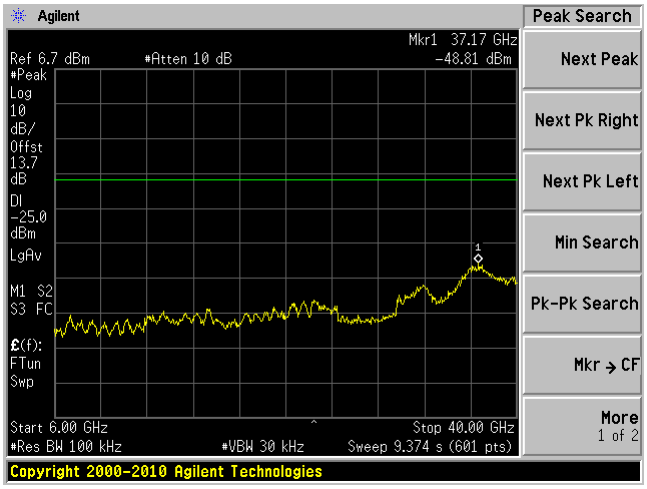
Low Channel 5860 MHz Chain 1, 30MHz – 5GHz



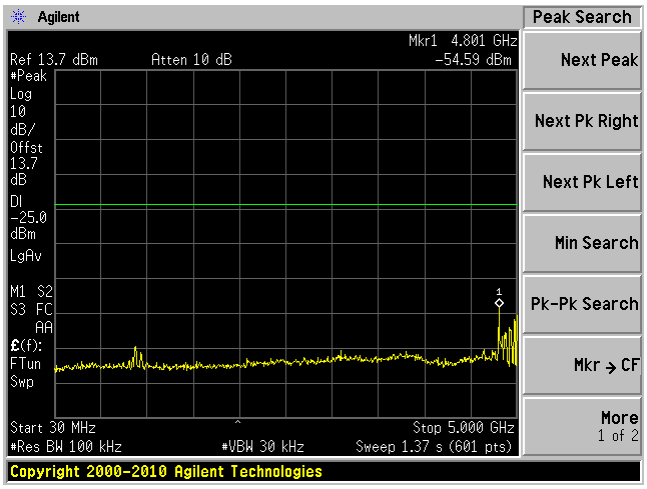
Low Channel 5860 MHz Chain 1, 5 GHz – 6GHz



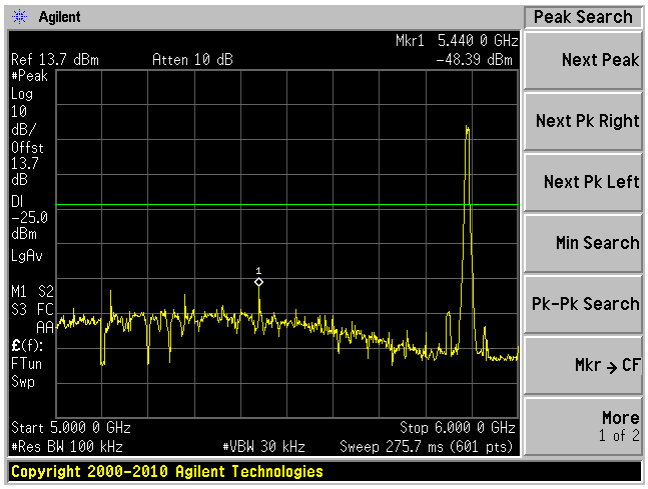
Low Channel 5860 MHz Chain 1, 6GHz – 40GHz



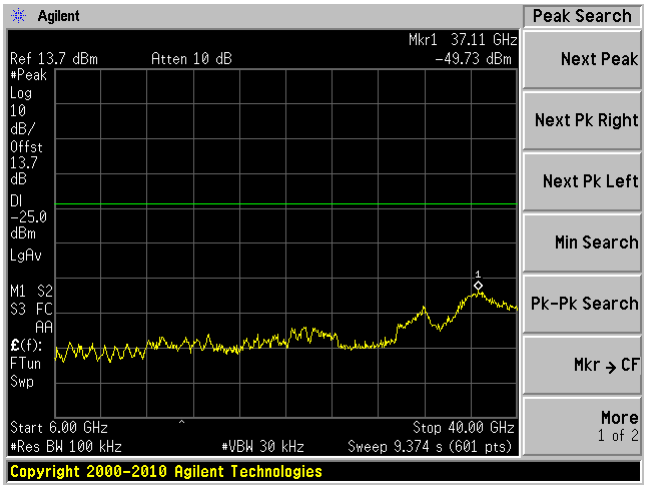
Middle Channel 5890 MHz Chain 0, 30MHz – 5GHz



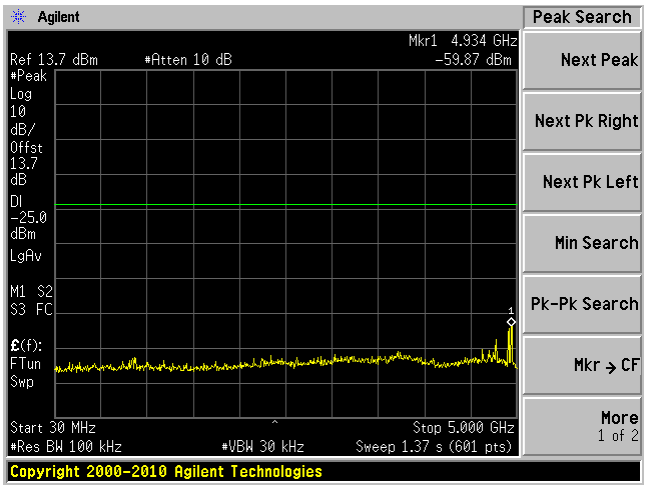
Middle Channel 5890 MHz Chain 0, 5GHz – 6GHz



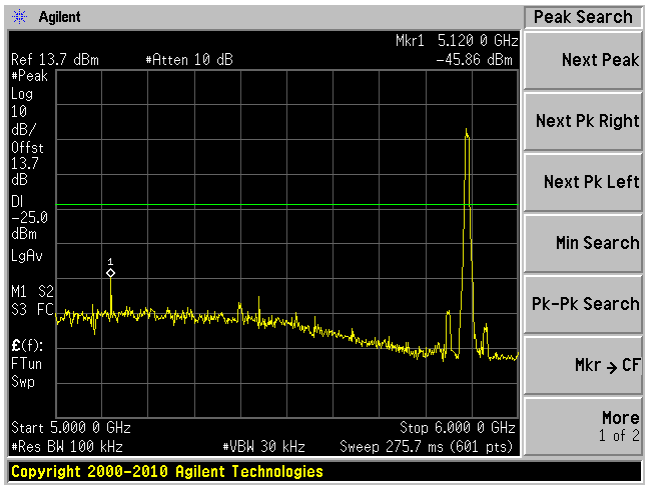
Middle Channel 5890 MHz Chain 0, 6MHz – 40GHz



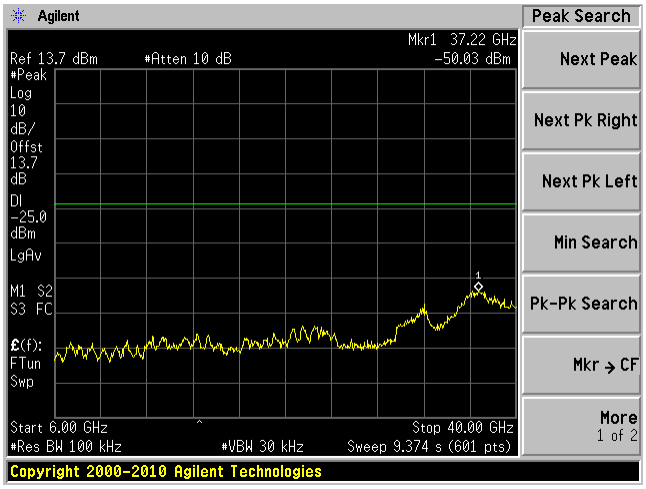
Middle Channel 5890 MHz Chain 1, 30MHz – 5GHz



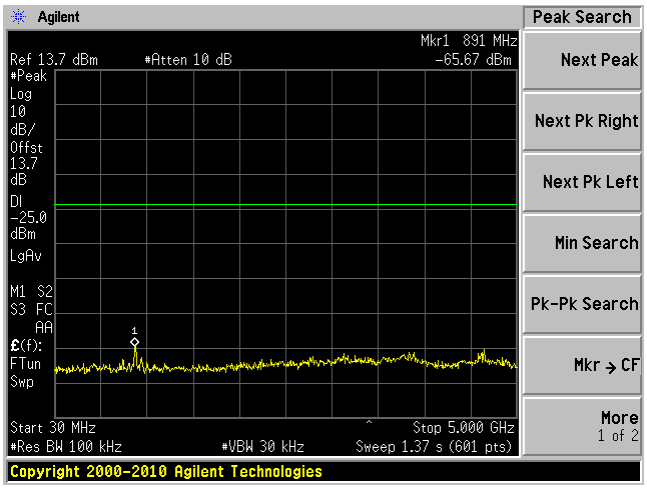
Middle Channel 5890 MHz Chain 1, 5GHz – 6GHz



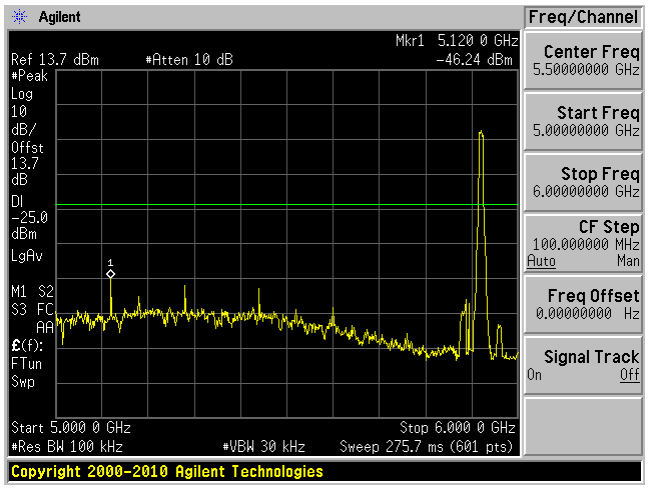
Middle Channel 5890 MHz Chain 1, 6GHz – 40GHz



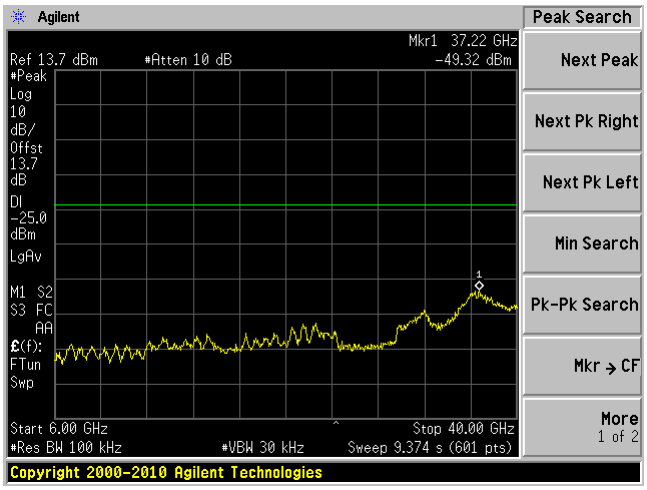
High Channel 5920 MHz Chain 0, 30MHz – 5GHz



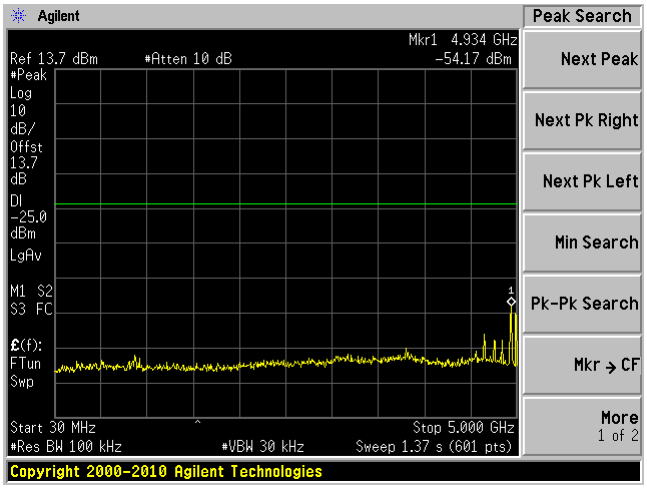
High Channel 5920 MHz Chain 0, 5GHz – 6GHz



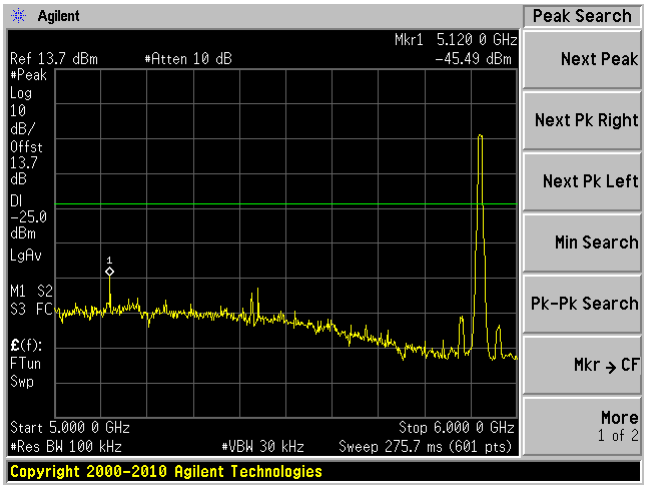
High Channel 5920 MHz Chain 0, 6 GHz – 40GHz



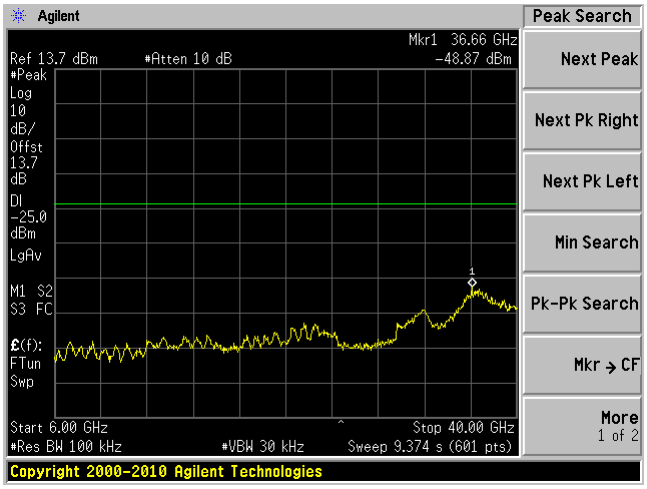
High Channel 5920 MHz Chain 1, 30MHz – 5GHz



High Channel 5920 MHz Chain 1, 5GHz – 6GHz



High Channel 5920 MHz Chain 1, 6GHz – 40GHz



10 ASTM E2213-03 §8.9.2 & FCC §2.1053 - Field Strength of Spurious Emission

10.1 Applicable Standard

According to ASTM EN2213-03 8.9.2:

8.9.2.2 The transmitted spectral mask for class A, B, C, and D devices are shown in Figs. 12-15. In addition, all DSRC site installations shall limit the EIRP in the transmitted spectrum to −25 dBm or less in the 100 kHz at the channel edges and the band edges. Additional filtering that supplements the filtering provided by the transmitter may be needed for some antenna/transmitter combinations.

10.2 Measurement Procedure

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by 55 + 10log(P) dB, where P is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	27 months
Agilent	Amplifier, Pre	8447D	2944A10187	2017-03-13	1 year
Agilent	Spectrum Analyzer	E4446A	US44300386	2017-04-20	1 year
EMCO	Horn Antenna	3315	9511-4627	2016-01-28	2 year
A.R.A.	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 years
Agilent	Amplifier, Pre	8447D	2944A06639	2016-06-28	1 year
HP	Generator, Signal	8648C	3847M00143	2016-12-21	1 year
COM-POWER	Antenna, Dipole	AD-100	721033DB1/ 2/3/4	2017-02-13	2 year

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

10.4 Test Environmental Conditions

Temperature:	22-26° C
Relative Humidity:	42-46 %
ATM Pressure:	101-102 kPa

The testing was performed by Frank Wang from 2017-06-12 at 5 meter chamber 3.

10.5 Test Results

Note: Both chains are transmitting simultaneously at the same channel for testing which is the worst case.

Low Channel Frequency: 5860 MHz

Freq. (MHz)	S.A. Amp. (dBμV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (m)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
60.22	56.51	105	300	V	60.22	-52.68	0	0.076	-52.756	-25	-27.76
60.2	49.05	0	300	H	60.2	-59.12	0	0.076	-59.196	-25	-34.20
87.43	50.82	175	100	V	87.43	-54.85	0	0.076	-54.926	-25	-29.93
87.45	50.77	151	210	H	87.45	-60.43	0	0.076	-60.506	-25	-35.51
192	43.02	109	100	V	192	-60.18	0	0.076	-60.256	-25	-35.26
192.02	45.45	194	150	H	192.02	-57.71	0	0.076	-57.786	-25	-32.79
1965	54	300	150	V	1965	-54.16	8.207	0.335	-46.288	-25	-21.29
1964	53.89	0	180	H	1964	-52.96	8.207	0.335	-45.088	-25	-20.09
2142	48.33	0	100	V	2142	-57.11	9.041	1.06	-49.129	-25	-24.13
2129	53.37	78	300	H	2129	-52.14	9.041	1.06	-44.159	-25	-19.16

Middle Channel Frequency: 5890 MHz

Freq. (MHz)	S.A. Amp. (dBμV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (m)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
36.43	53.11	0	100	V	36.43	-42.9	0	0.076	-42.976	-25	-17.98
60.2	48.01	0	300	H	60.2	-60.16	0	0.076	-60.236	-25	-35.24
77.2	48.26	175	100	V	77.2	-57.41	0	0.076	-57.486	-25	-32.49
81.2	51.59	0	216	H	81.2	-59.61	0	0.076	-59.686	-25	-34.69
192.02	43.16	0	120	V	192.02	-60.04	0	0.076	-60.116	-25	-35.12
192	43.98	185	150	H	192	-59.18	0	0.076	-59.256	-25	-34.26
1965	53.21	0	100	V	1965	-54.95	8.207	0.335	-47.078	-25	-22.078
1965	52.68	108	100	H	1965	-54.17	8.207	0.335	-46.298	-25	-21.298
2124	55.09	0	100	V	2124	-50.35	9.041	1.06	-42.369	-25	-17.369
2126	53.35	0	150	H	2126	-52.16	9.041	1.06	-44.179	-25	-19.179

High Channel Frequency: 5920 MHz

Freq. (MHz)	S.A. Amp. (dBμV)	Table Azimuth Degrees	Test Antenna		Substitution				Absolute Level (dBm)	FCC	
			Height (m)	Polar (H/ V)	S.G Freq. (MHz)	S.G Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
37.7	48.05	0	212	V	37.7	-47.96	0	0.076	-48.036	-25	-23.04
60.22	49.55	0	300	H	60.22	-58.62	0	0.076	-58.696	-25	-33.70
87.18	51.03	162	100	V	87.18	-54.64	0	0.076	-54.716	-25	-29.72
81.5	50.12	0	112	H	81.5	-61.08	0	0.076	-61.156	-25	-36.16
192	45.01	0	120	V	192	-58.19	0	0.076	-58.266	-25	-33.27
192	44.24	0	112	H	192	-58.92	0	0.076	-58.996	-25	-34.00
1965	50.4	0	141	V	1965	-62.87	8.207	0.335	-54.998	-25	-30.00
1965	49.2	0	300	H	1965	-64.07	8.207	0.335	-56.198	-25	-31.20
2122	53.56	0	100	V	2122	-47.45	9.041	1.06	-39.469	-25	-14.47
2122	52.43	0	100	H	2122	-53.08	9.041	1.06	-45.099	-25	-20.10